

City of San Diego

CONTRACTOR'S NAME: PARADIGM MECHANICAL
ADDRESS: 6550 FEDERAL BLVD., LEMON GROVE, CA 91945
TELEPHONE NO.: 619-453-4562 FAX NO.: 619-456-4754
CITY CONTACT: Eleida Felix Yackel, Contract Specialist, Email: EFelixYackel@sandiego.gov
Phone No. (619) 533-3449, Fax No. (619) 533-3633
C.Goodrich/R.Taleghani/egz

CONTRACT DOCUMENTS

ORIGINAL



FOR

RANCHO PENASQUITOS LIBRARY HVAC

VOLUME 1 OF 2

BID NO.: L-15-1222-DBB-2
SAP NO. (WBS/IO/CC): B-10051
CLIENT DEPARTMENT: 1713
COUNCIL DISTRICT: 5
PROJECT TYPE: BT

THIS CONTRACT IS SUBJECT TO THE FOLLOWING:

- THE CITY'S SUBCONTRACTING PARTICIPATION REQUIREMENTS FOR SLBE PROGRAM.
- COMPETITION RESTRICTED TO: SLBE-ELBE or ELBE FIRMS ONLY .
- PREVAILING WAGE RATES: STATE FEDERAL
- APPRENTICESHIP.

BID DUE DATE:

**1:30 PM
FEBRUARY 11, 2015
CITY OF SAN DIEGO
PUBLIC WORKS CONTRACTS
1010 SECOND AVENUE, 14th FLOOR, MS 614C
SAN DIEGO, CA 92101**

ENGINEER OF WORK

The engineering Specifications and Special Provisions contained herein have been prepared by or under the direction of the following Registered Engineer/Architect:



1) Registered Engineer/Architect

12/2/2014

Date

Seal:





2) For City Engineer

12/4/14

Date

Seal

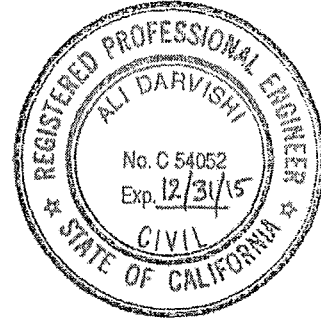


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CITY OF SAN DIEGO, CALIFORNIA

NOTICE INVITING BIDS

1. **LIMITED COMPETITION:** This contract may only be bid by the Contractors on the City's approved SLBE-ELBE Construction Contractors List in accordance with the designation stated on the cover page hereof. For information regarding the SLBE-ELBE Construction Program and registration visit the City's web site: <http://www.sandiego.gov>.
2. **RECEIPT AND OPENING OF BIDS:** Bids will be received at the Public Works Contracts at the location, time, and date shown on the cover of these specifications for performing work on **Rancho Penasquitos Library HVAC** (Project).
3. **SUMMARY OF WORK:** The Work involves furnishing all labor, materials, equipment, services, and other incidental works and appurtenances for the construction of the Project as described in ATTACHMENT A.
4. **BIDS ARE PUBLIC RECORDS:** Upon receipt by the City, Bids shall become public records subject to public disclosure. It is the responsibility of the respondent to clearly identify any confidential, proprietary, trade secret or otherwise legally privileged information contained within the Bid. General references to sections of the California Public Records Act (PRA) will not suffice. If the Contractor does not provide applicable case law that clearly establishes that the requested information is exempt from the disclosure requirements of the PRA, the City shall be free to release the information when required in accordance with the PRA, pursuant to any other applicable law, or by order of any court or government agency, and the Contractor will hold the City harmless for release of this information.
5. **SUBCONTRACTING PARTICIPATION PERCENTAGES:**
 - 5.1. The City has incorporated voluntary subcontractor participation percentage to enhance competition and maximize subcontracting opportunities as follows.
 - 5.2. The following voluntary subcontractor participation percentage for DBE, DVBE, WBE, MBE, SLBE, and ELBE certified Subcontractors shall apply to this contract:

Total voluntary subcontractor participation percentage for this project is 8.4%.
 - 5.3. For additional Equal Opportunity Contracting Program requirements, see Attachment C.
6. **PRE-BID MEETING:**
 - 6.1. There will be a Pre-Bid Meeting to discuss the scope of the Project, bidding requirements, pre-qualification process, and Equal Opportunity Contracting Program requirements and reporting procedures in the Public Works Contracts, Conference Room at 1010 Second Avenue, 14th Floor, San Diego, CA 92101 at **10:00 AM, on JANUARY 20, 2015.**

6.2. The Pre-Bid Meeting has been designated as MANDATORY. All potential bidders are required to attend. Bid will be declared **non-responsive** if the Bidder fails to attend the Pre-Bid Meeting when specified to be mandatory. Attendance at the Pre-Bid Meeting will be evidenced by the representative's signature on **the attendance roster**. It shall be the responsibility of the Bidder's representative to complete and sign the attendance roster. **No Bidder will be admitted after the specified start time of the mandatory Pre-Bid Meeting.**

6.3. To request a copy of the agenda on an alternative format, or to request a sign language or oral interpreter for this meeting, call the Public Works Contracts at (619) 533-3450 at least 5 Working Days prior to the Pre-Bid Meeting to ensure availability.

7. CONTRACTOR REGISTRATION AND ELECTRONIC REPORTING SYSTEM:

7.1. Prior to the Award of the Contract or each Task Order, you and your Subcontractors and Suppliers must register with the City's web-based vendor registration and bid management system, BidsOnline™ hosted by PlanetBids System. For additional information go to:

<http://www.sandiego.gov/purchasing/bids-contracts/vendorreg.shtml>.

7.2. The City may not award the contract until registration of all subcontractors and suppliers is complete. In the event this requirement is not met within the time frame specified in the Notice of Intent to Award letter, the City reserves the right to rescind the Notice of Award / Intent to Award and to make the award to the next responsive and responsible bidder / proposer.

8. PRE-BID SITE VISIT: The Pre-Bid Site Visit has been designated as **MANDATORY**. The prospective Bidders are **required** to visit the Work Site with the Engineer. The purpose of the Site visit is to acquaint Bidders with the Site conditions. To request a sign language or oral interpreter for this visit, call the Public Works Contracts at (619) 533-3450 at least 5 Working Days prior to the meeting to ensure availability. A Pre-Bid Site Visit is offered when the details are provided as follows:

Time: 11:30 a.m. immediately following the Mandatory Pre-Bid Meeting.

Date: JANUARY 20, 2015

Location: 13330 Salmon River Rd, San Diego, CA 92129

9. JOINT VENTURE CONTRACTORS: Provide a copy of the Joint Venture agreement and the Joint Venture license to the City within 10 Working Days after receiving the Contract forms. See 2-1.1.2, "Joint Venture Contractors" in The WHITEBOOK for details.

10. PREVAILING WAGE RATES: Pursuant to San Diego Municipal Code section 22.3019, construction, alteration, demolition, repair and maintenance work performed under this Contract is subject to State prevailing wage laws. For construction work performed under this Contract cumulatively exceeding \$25,000 and for alteration, demolition, repair and maintenance work performed under this Contract cumulatively exceeding \$15,000, the Contractor and its subcontractors shall comply with State prevailing wage laws including, but not limited to, the requirements listed below.

- 10.1. Compliance with Prevailing Wage Requirements.** Pursuant to sections 1720 through 1861 of the California Labor Code, the Contractor and its subcontractors shall ensure that all workers who perform work under this Contract are paid not less than the prevailing rate of per diem wages as determined by the Director of the California Department of Industrial Relations (DIR). This includes work performed during the design and preconstruction phases of construction including, but not limited to, inspection and land surveying work.
- 10.2.** Copies of such prevailing rate of per diem wages are on file at the City and are available for inspection to any interested party on request. Copies of the prevailing rate of per diem wages also may be found at <http://www.dir.ca.gov/OPRL/DPreWageDetermination.htm>. Contractor and its subcontractors shall post a copy of the prevailing rate of per diem wages determination at each job site and shall make them available to any interested party upon request.
- 10.3.** The wage rates determined by the DIR refer to expiration dates. If the published wage rate does not refer to a predetermined wage rate to be paid after the expiration date, then the published rate of wage shall be in effect for the life of this Contract. If the published wage rate refers to a predetermined wage rate to become effective upon expiration of the published wage rate and the predetermined wage rate is on file with the DIR, such predetermined wage rate shall become effective on the date following the expiration date and shall apply to this Contract in the same manner as if it had been published in said publication. If the predetermined wage rate refers to one or more additional expiration dates with additional predetermined wage rates, which expiration dates occur during the life of this Contract, each successive predetermined wage rate shall apply to this Contract on the date following the expiration date of the previous wage rate. If the last of such predetermined wage rates expires during the life of this Contract, such wage rate shall apply to the balance of the Contract.
- 10.4. Penalties for Violations.** Contractor and its subcontractors shall comply with California Labor Code section 1775 in the event a worker is paid less than the prevailing wage rate for the work or craft in which the worker is employed.
- 10.5. Payroll Records.** Contractor and its subcontractors shall comply with California Labor Code section 1776, which generally requires keeping accurate payroll records, verifying and certifying payroll records, and making them available for inspection. Contractor shall require its subcontractors to also comply with section 1776. Contractor and its subcontractors shall submit weekly certified payroll records online via the City's web-based Labor Compliance Program. Contractor is responsible for ensuring its subcontractors submit certified payroll records to the City.
- 10.6. Apprentices.** Contractor and its subcontractors shall comply with California Labor Code sections 1777.5, 1777.6 and 1777.7 concerning the employment and wages of apprentices. Contractor shall be held responsible for the compliance of their subcontractors with sections 1777.5, 1777.6 and 1777.7.
- 10.7. Working Hours.** Contractor and subcontractors shall comply with California Labor Code sections 1810 through 1815, including but not limited to: (i) restrict working hours on public works contracts to eight hours a day and forty hours a week, unless all hours worked in excess of 8 hours per day are compensated at not less than 1½ times the basic rate of pay;

and (ii) specify penalties to be imposed on design professionals and subcontractors of \$25 per worker per day for each day the worker works more than 8 hours per day and 40 hours per week in violation of California Labor Code sections 1810 through 1815.

10.8. Required Provisions for Subcontracts. Contractor shall include at a minimum a copy of the following provisions in any contract they enter into with a subcontractor: California Labor Code sections 1771, 1775, 1776, 1777.5, 1810, 1813, 1815, 1860 and 1861.

10.9. Labor Code Section 1861 Certification. Contractor in accordance with California Labor Code section 3700 is required to secure the payment of compensation of its employees and by signing this Contract, Contractor certifies that "I am aware of the provisions of Section 3700 of the California Labor Code which require every employer to be insured against liability for workers' compensation or to undertake self-insurance in accordance with the provisions of that code, and I will comply with such provisions before commencing the performance of the work of this Contract."

10.10. Labor Compliance Program. The City has its own Labor Compliance Program as authorized by the DIR. The City will withhold contract payments when payroll records are delinquent or deemed inadequate by the City or other governmental entity, or it has been established after an investigation by the City or other governmental entity that underpayment(s) have occurred.

11. BIDDERS MUST REGISTER WITH THE CALIFORNIA DEPARTMENT OF INDUSTRIAL RELATIONS (DIR): Pursuant to Labor Code section 1725.5 (with limited exceptions under Labor Code section 1771.1(a)):

11.1. No contractor or subcontractor may be listed on a bid proposal for a public works project submitted on or after March 1, 2015 unless registered with the Department of Industrial Relations.

11.2. No contractor or subcontractor may be awarded a contract for public work on a public works project awarded on or after April 1, 2015 unless registered with the Department of Industrial

11.3. This project is subject to compliance monitoring and enforcement by the Department of Industrial Relations.

12. INSURANCE REQUIREMENTS:

12.1. All certificates of insurance and endorsements required by the contract are to be provided upon issuance of the City's Notice of Intent to Award letter.

12.2. Refer to sections 7-3, "LIABILITY INSURANCE", and 7-4, "WORKERS' COMPENSATION INSURANCE" of the Supplementary Special Provisions (SSP) for the insurance requirements which must be met.

13. PREQUALIFICATION OF CONTRACTORS:

13.1. Contractors submitting Bid must be pre-qualified for the total amount proposed, inclusive of all alternate items prior to the date of submittal. Bids from contractors who have not been pre-qualified as applicable and Bids that exceed the maximum

dollar amount at which contractors are pre-qualified will be deemed **non-responsive** and ineligible for award. Complete information and prequalification questionnaires are available at:

<http://www.sandiego.gov/cip/bidopps/prequalification.shtml>

13.2. The completed questionnaire, financial statement, and bond letter or a copy of the contractor's SLBE-ELBE certification and bond letter, must be submitted no later than 2 weeks prior to the bid opening to the Public Works Contracts, Prequalification Program, 1010 Second Avenue, 14th Floor, San Diego, CA 92101. For additional information or the answer to questions about the prequalification program, contact David Stucky at 619-533-3474 or dstucky@sandiego.gov.

14. REFERENCE STANDARDS: Except as otherwise noted or specified, the Work shall be completed in accordance with the following standards:

| Title | Edition | Document Number |
|---|---------|-----------------|
| Standard Specifications for Public Works Construction ("The GREENBOOK") | 2012 | PITS070112-01 |
| City of San Diego Standard Specifications for Public Works Construction ("The WHITEBOOK")* | 2012 | PITS070112-02 |
| City of San Diego Standard Drawings* | 2012 | PITS070112-03 |
| Caltrans Standard Specifications | 2010 | PITS070112-04 |
| Caltrans Standard Plans | 2010 | PITS070112-05 |
| California MUTCD | 2012 | PITS070112-06 |
| City Standard Drawings - Updates Approved For Use (when specified)* | Varies | Varies |
| Standard Federal Equal Employment Opportunity Construction Contract Specifications and the Equal Opportunity Clause Dated 09-11-84 | 1984 | 769023 |
| California Building Code | 2010 | |
| California Code of Regulations Title 24 | 2010 | |
| NOTE: *Available online under Engineering Documents and References at: http://www.sandiego.gov/publicworks/edocref/index.shtml | | |

15. CITY'S RESPONSES AND ADDENDA: The City at its option, may respond to any or all questions submitted in writing, via letter, or FAX in the form of an addendum. No oral comment shall be of any force or effect with respect to this solicitation. The changes to the Contract Documents through addendum are made effective as though originally issued with the Bid. The Bidders shall acknowledge the receipt of Addenda on the form provided for this purpose in the Bid.

16. **CITY'S RIGHTS RESERVED:** The City reserves the right to cancel the Notice Inviting Bids at any time, and further reserves the right to reject submitted Bids, without giving any reason for such action, at its sole discretion and without liability. Costs incurred by the Bidder(s) as a result of preparing Bids under the Notice Inviting Bids shall be the sole responsibility of each bidder. The Notice Inviting Bids creates or imposes no obligation upon the City to enter a contract.
17. **CONTRACT PRICING FORMAT:** This solicitation is for a Lump Sum contract with Unit Price provisions as set forth in the Bid Proposal Form(s), Volume 2.
18. **SUBMITTAL OF "OR EQUAL" ITEMS:** See Section 4-1.6, "Trade Names or Equals" in The WHITEBOOK and as amended in the SSP.
19. **AWARD PROCESS:**
 - 19.1. The Award of this contract is contingent upon the Contractor's compliance with all conditions precedent to Award.
 - 19.2. Upon acceptance of a Bid, the City will prepare contract documents for execution within approximately 21 days of the date of the Bid opening and award the Contract approximately within 7 days of receipt of properly executed Contract, bonds, and insurance documents.
 - 19.3. This contract will be deemed executed, and effective, only upon the signing of the Contract by the Mayor or designee of the City.
20. **SUBCONTRACT LIMITATIONS:** The Bidder's attention is directed to Standard Specifications for Public Works Construction, Section 2-3, "SUBCONTRACTS" in The GREENBOOK and as amended in the SSP which requires the Contractor to self-perform not less than the specified amount. Failure to comply with this requirement shall render the Bid **non-responsive** and ineligible for award.
21. **AVAILABILITY OF PLANS AND SPECIFICATIONS:** Contract Documents may be obtained by visiting the City's website: <http://www.sandiego.gov/cip/>. Plans and Specifications for this contract are also available for review in the office of the City Clerk or Public Works Contracts.
22. **SUBMISSION OF QUESTIONS:**
 - 22.1. The Director (or designee), of the Public Works Department is the officer responsible for opening, examining, and evaluating the competitive Bids submitted to the City for the acquisition, construction and completion of any public improvement except when otherwise set forth in these documents. All questions related to this solicitation shall be submitted to:

Public Works Contracts
1010 Second Avenue, 14th Floor
San Diego, California, 92101
Attention: [Contract Specialist listed on the front cover hereof]

OR:

Email address of the Contract Specialist listed on the front cover hereof.

- 22.2. Questions received less than 14 days prior to the date for opening of Bids may not be considered.
 - 22.3. Clarifications deemed by the City to be material shall be issued by Addenda and uploaded to the City's online bidding service.
 - 22.4. Only questions answered by formal written addenda will be binding. Oral and other interpretations or clarifications will be without legal effect. It is the Bidder's responsibility to become informed of any Addenda that have been issued and to include all such information in its Bid.
23. **ELIGIBLE BIDDERS:** No person, firm, or corporation shall be allowed to make, file, or be interested in **more** than one (1) Bid for the same work unless alternate Bids are called for. A person, firm or corporation who has submitted a sub-proposal to a Bidder, or who has quoted prices on materials to a Bidder, is not hereby disqualified from submitting a sub-proposal or quoting prices to other Bidders or from submitting a Bid in its own behalf. Any Bidder who submits more than one bid will result in the rejection of all bids submitted.
24. **SAN DIEGO BUSINESS TAX CERTIFICATE:** The Contractor and Subcontractors, not already having a City of San Diego Business Tax Certificate for the work contemplated shall secure the appropriate certificate from the City Treasurer, Civic Center Plaza, first floor and submit to the Contract Specialist upon request or as specified in the Contract Documents. Tax Identification numbers for both the Bidder and the listed Subcontractors must be submitted on the City provided forms with the Notice Inviting Bids and Contract forms.
25. **PROPOSAL FORMS:** Bid shall be made only upon the Bidding Documents i.e., Proposal form attached to and forming a part of the specifications. The signature of each person signing shall be in longhand.
- 25.1. Bidder shall complete and submit all pages in the "Bidding Document" Section (see Volume 2) as their Bid per the schedule given under "Required Documents Schedule," (see Volume 1). Bidder is requested to retain for their reference other portions of the Contract Documents that are not required to be submitted with the Bid. The entire specifications for the bid package do not need to be submitted with the bid.
 - 25.2. The City may require any Bidder to furnish a statement of experience, financial responsibility, technical ability, equipment, and references.
 - 25.3. Bids and certain other forms and documents as specified in the Volume 2 of 2 of the Contract Documents shall be enclosed in a sealed envelope and shall bear the title of the work and name of the Bidder and the appropriate State Contractors License designation which the Bidder holds.
 - 25.4. Bids may be withdrawn by the Bidder prior to, but not after, the time fixed for opening of Bids.
26. **BIDDER'S GUARANTEE OF GOOD FAITH (BID SECURITY):**
- 26.1. With the exception of the contracts valued \$5,000 or less, JOC and Design-Build contracts, and contracts subject to the Small and Local Business Program of \$250,000 or less e.g., ELBE contracts, each Bidder shall accompany its Bid with

either a cashier's check upon some responsible bank, or a check upon such bank properly certified or an approved corporate surety bond payable to the City of San Diego, for an amount of not less than 10% of the aggregate sum of the Bid, which check or bond, and the monies represented thereby shall be held by the City as a guarantee that the Bidder, if awarded the contract, will in good faith enter into such contract and furnish the required final bonds.

- 26.2. The Bidder agrees that in case of Bidder's refusal or failure to execute this contract and give required final bonds, the money represented by a cashier's or certified check shall remain the property of the City, and if the Bidder shall fail to execute this contract, the Surety agrees that it will pay to the City damages which the City may suffer by reason of such failure, not exceeding the sum of 10% of the amount of the Bid.
- 26.3. A Bid received without the specified bid security will be rejected as being **non-responsive**.

27. AWARD OF CONTRACT OR REJECTION OF BIDS:

- 27.1. This contract may be awarded to the lowest responsible and reliable Bidder.
- 27.2. Bidders shall complete the entire Bid schedule (also referred to as "schedule of prices" or Proposal form). Incomplete price schedules will be rejected as being non-responsive.
- 27.3. The City reserves the right to reject any or all Bids, and to waive any informality or technicality in Bids received and any requirements of these specifications as to bidding procedure.
- 27.4. Bidders will not be released on account of their errors of judgment. Bidders may be released only upon receipt by the City from the Bidder within 3 Working Days, excluding Saturdays, Sundays, and state holidays, after the opening of Bids, of written notice which includes proof of honest, credible, clerical error of material nature, free from fraud or fraudulent intent, and of evidence that reasonable care was observed in the preparation of the Bid.
- 27.5. A non-selected Bidder may protest award of the Contract to the selected Bidder by submitting a written "Notice of Intent to Protest" including supporting documentation which shall be received by Public Works Contracts no later than 10 days after the City's announcement of the selected Bidder or no later than 10 days from the date that the City issues notice of designation of a Bidder as non-responsive in accordance with San Diego Municipal Code Chapter 2, § 22.3029, "Protests of Contract Award."
- 27.6. The City of San Diego will not discriminate with regard to race, religious creed, color, national origin, ancestry, physical handicap, marital status, sex or age, in the award of contracts.
- 27.7. Each Bid package properly executed as required by these specifications shall constitute a firm offer, which may be accepted by the City within the time specified in the Proposal.

27.8. The City reserves the right to evaluate all Bids and determine the lowest Bidder on the basis of any proposed alternates, additive items or options, at its discretion that will be disclosed in the Volume 2 of 2.

28. BID RESULTS:

28.1. The Bid opening by the City shall constitute the public announcement of the Apparent Low Bidder. In the event that the Apparent Low Bidder is subsequently deemed non-responsive or non-responsible, a public announcement will be posted in the City's web page <http://www.sandiego.gov/cip/index.shtml>, with the name of the newly designated Apparent Low Bidder.

28.2. To obtain Bid results, either attend Bid opening, review the results on the City's web site, or provide a self-addressed, stamped envelope, referencing Bid number, and Bid tabulation will be mailed to you upon verification of extensions. Bid results cannot be given over the telephone.

29. THE CONTRACT:

29.1. The Bidder to whom award is made shall execute a written contract with the City of San Diego and furnish good and approved bonds and insurance certificates specified by the City within 14 days after receipt by Bidder of a form of contract for execution unless an extension of time is granted to the Bidder in writing.

29.2. If the Bidder takes longer than 14 days to fulfill these requirements, then the additional time taken shall be added to the Bid guarantee. The Contract shall be made in the form adopted by the City, which includes the provision that no claim or suit whatsoever shall be made or brought by Contractor against any officer, agent, or employee of the City for or on account of anything done or omitted to be done in connection with this contract, nor shall any such officer, agent, or employee be liable hereunder.

29.3. If the Bidder to whom the award is made fails to enter into the contract as herein provided, the award may be annulled and the Bidder's Guarantee of Good Faith will be subject to forfeiture. An award may be made to the next lowest responsible and reliable Bidder who shall fulfill every stipulation embraced herein as if it were the party to whom the first award was made.

29.4. Pursuant to the San Diego City Charter section 94, the City may only award a public works contract to the lowest responsible and reliable Bidder. The City will require the Apparent Low Bidder to (i) submit information to determine the Bidder's responsibility and reliability, (ii) execute the Contract in form provided by the City, and (iii) furnish good and approved bonds and insurance certificates specified by the City within 14 Days, unless otherwise approved by the City, in writing after the Bidder receives notification from the City, designating the Bidder as the Apparent Low Bidder and formally requesting the above mentioned items.

29.5. The award of the Contract is contingent upon the satisfactory completion of the above mentioned items and becomes effective upon the signing of the Contract by the Mayor or designee. If the Apparent Low Bidder does not execute the Contract or submit required documents and information, the City may award the Contract to the

next lowest responsible and reliable Bidder who shall fulfill every condition precedent to award. A corporation designated as the Apparent Low Bidder shall furnish evidence of its corporate existence and evidence that the officer signing the Contract and bond for the corporation is duly authorized to do so.

- 30. EXAMINATION OF PLANS, SPECIFICATIONS, AND SITE OF WORK:** The Bidder shall examine carefully the Project Site, the Plans and Specifications, other materials as described in the Special Provisions, Section 2-7, and the proposal forms (e.g., Bidding Documents). The submission of a Bid shall be conclusive evidence that the Bidder has investigated and is satisfied as to the conditions to be encountered, as to the character, quality, and scope of Work, the quantities of materials to be furnished, and as to the requirements of the Bidding Documents Proposal, Plans, and Specifications.
- 31. CITY STANDARD PROVISIONS:** This contract is subject to the following standard provisions. See The WHITEBOOK for details.
- 31.1.** The City of San Diego Resolution No. R-277952 adopted on May 20, 1991 for a Drug-Free Workplace.
 - 31.2.** The City of San Diego Resolution No. R-282153 adopted on June 14, 1993 related to the Americans with Disabilities Act.
 - 31.3.** The City of San Diego Municipal Code §22.3004 for Pledge of Compliance.
 - 31.4.** The City of San Diego's Labor Compliance Program and the State of California Labor Code §§1771.5(b) and 1776.
 - 31.5.** Sections 1777.5, 1777.6, and 1777.7 of the State of California Labor Code concerning the employment of apprentices by contractors and subcontractors performing public works contracts.
 - 31.6.** The City's Equal Benefits Ordinance (EBO), Chapter 2, Article 2, Division 43 of The San Diego Municipal Code (SDMC).
 - 31.7.** The City's Information Security Policy (ISP) as defined in the City's Administrative Regulation 90.63.
- 32. PRE-AWARD ACTIVITIES:**
- 32.1.** The selected contractor by the City to execute a contract for this Work shall provide the information required within the time specified in "Required Documents," of this bid package. Failure to provide the information within the time specified may result in the Bid being rejected as **non-responsive**.
 - 32.2.** If the Bid is rejected as non-responsive, the selected contractor by the City to execute a contract for this Work shall forfeit the required Bid. The decision that the selected contractor by the City to execute a contract for this Work is non-responsive for failure to provide the information required within the time specified shall be at the sole discretion of the City.

33. REQUIRED DOCUMENT SCHEDULE:

33.1. The Bidder's attention is directed to the City's Municipal Code §22.0807(e), (3)-(5) for important information regarding grounds for debarment for failure to submit required documentation.

33.2. The specified Equal Opportunity Contracting Program (EOCP) forms are available for download from the City's web site at:

<http://www.sandiego.gov/eoc/forms/index.shtml>

| ITEM | WHEN DUE | FROM | DOCUMENT TO BE SUBMITTED |
|------|--|---------------------|--|
| 1. | BID SUBMITTAL DATE/TIME | ALL BIDDERS | Bid |
| 2. | BID SUBMITTAL DATE/TIME | ALL BIDDERS | Bid Bond |
| 3. | BID SUBMITTAL DATE/TIME | ALL BIDDERS | Non-collusion Affidavit to be Executed By Bidder and Submitted with Bid under 23 USC 112 and PCC 7106 |
| 4. | BID SUBMITTAL DATE/TIME | ALL BIDDERS | Contractors Certification of Pending Actions |
| 5. | BID SUBMITTAL DATE/TIME | ALL BIDDERS | Equal Benefits Ordinance Certification of Compliance |
| 6. | BID SUBMITTAL DATE/TIME | ALL BIDDERS | Form AA35 - List of Subcontractors |
| 7. | BID SUBMITTAL DATE/TIME | ALL BIDDERS | Form AA40 - Named Equipment/Material Supplier List |
| 8. | WITHIN 10 WORKING DAYS AFTER RECEIPT BY BIDDER OF CONTRACT FORMS | APPARENT LOW BIDDER | Names of the principal individual owners of the Apparent Low Bidder |
| 9. | WITHIN 10 WORKING DAYS AFTER RECEIPT BY BIDDER OF CONTRACT FORMS | APPARENT LOW BIDDER | If the Contractor is a Joint Venture: <ul style="list-style-type: none"> • Joint Venture Agreement • Joint Venture License |
| 10. | WITHIN 10 WORKING DAYS AFTER RECEIPT BY BIDDER OF CONTRACT FORMS | APPARENT LOW BIDDER | Form BB05 - Work Force Report |
| 11. | WITHIN 10 WORKING DAYS AFTER RECEIPT BY BIDDER OF CONTRACT FORMS | APPARENT LOW BIDDER | Contract Forms - Agreement |
| 12. | WITHIN 10 WORKING DAYS AFTER RECEIPT BY BIDDER OF CONTRACT FORMS | APPARENT LOW BIDDER | Contract Forms - Payment and Performance Bond |

| ITEM | WHEN DUE | FROM | DOCUMENT TO BE SUBMITTED |
|-------------|--|------------------------|--|
| 13. | WITHIN 10 WORKING DAYS AFTER RECEIPT BY BIDDER OF CONTRACT FORMS | APPARENT LOW BIDDER | Certificates of Insurance and Endorsements |
| 14. | WITHIN 10 WORKING DAYS AFTER RECEIPT BY BIDDER OF CONTRACT FORMS | APPARENT LOW BIDDER | Contractor Certification - Drug-Free Workplace |
| 15. | WITHIN 10 WORKING DAYS AFTER RECEIPT BY BIDDER OF CONTRACT FORMS | APPARENT LOW BIDDER | Contractor Certification - American with Disabilities Act |
| 16. | WITHIN 10 WORKING DAYS AFTER RECEIPT BY BIDDER OF CONTRACT FORMS | APPARENT LOW BIDDER | Contractors Standards - Pledge of Compliance |

**CONTRACT FORMS
AGREEMENT**

CONTRACT FORMS

CONSTRUCTION CONTRACT

This contract is made and entered into between THE CITY OF SAN DIEGO, a municipal corporation, herein called "City", and Paradigm Mechanical Corp. herein called "Contractor" for construction of **Rancho Penasquitos Library HVAC**, Bid No. **L-15-1222-DBB-2**; in the amount of Three Hundred Twenty-Nine Thousand Nine Hundred Thirty-Seven Dollars and Zero Cents(\$329,937.00), which is comprised of the Base Bid only.

IN CONSIDERATION of the payments to be made hereunder and the mutual undertakings of the parties hereto, City and Contractor agree as follows:

1. The following are incorporated into this contract as though fully set forth herein:
 - (a) The attached Faithful Performance and Payment Bonds.
 - (b) The attached Proposal included in the Bid documents by the Contractor.
 - (c) Reference Standards listed in the Notice Inviting Bids and the Supplementary Special Provisions (SSP).
 - (d) That certain documents entitled **Rancho Penasquitos Library HVAC** on file in the office of the Public Works Department as Document No. **B-10051** as well as all matters referenced therein.
2. The Contractor shall perform and be bound by all the terms and conditions of this contract and in strict conformity therewith shall perform and complete in a good and workmanlike manner **Rancho Penasquitos Library HVAC**, Bid Number **L-15-1222-DBB-2**, San Diego, California.
3. For such performances, the City shall pay to Contractor the amounts set forth at the times and in the manner and with such additions or deductions as are provided for in this contract, and the Contractor shall accept such payment in full satisfaction of all claims incident to such performances.
4. No claim or suit whatsoever shall be made or brought by Contractor against any officer, agent, or employee of the City for or on account of anything done or omitted to be done in connection with this contract, nor shall any such officer, agent, or employee be liable hereunder.
5. This contract is effective as of the date that the Mayor or designee signs the agreement.

CONTRACT FORMS (continued)

IN WITNESS WHEREOF, this Agreement is signed by the City of San Diego, acting by and through its Mayor or designee, pursuant to Municipal Code §22.3102(d) authorizing such execution.

THE CITY OF SAN DIEGO

APPROVED AS TO FORM AND LEGALITY

Jan I. Goldsmith, City Attorney

By 

By 

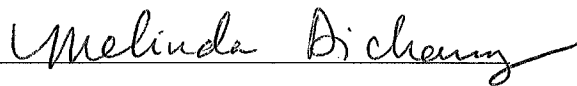
Print Name: Stephen Samara
Principal Contract Specialist (Acting), Public Works

Print Name: Pedro De Lara, Jr.
Deputy City Attorney

Date: 3/12/15

Date: 3/13/15

CONTRACTOR

By 

Print Name: Melinda Dicherry

Title: President

Date: February 23, 2015

City of San Diego License No.: _____

State Contractor's License No.: 947497

CONTRACT FORMS
ATTACHMENTS

Issued in Triplicate

**CONTRACT FORMS ATTACHMENTS
PERFORMANCE BOND AND LABOR AND MATERIALMEN'S BOND**

FAITHFUL PERFORMANCE BOND AND LABOR AND MATERIALMEN'S BOND:

Paradigm Mechanical Corp., a corporation, as principal, and Philadelphia Indemnity Insurance Company, a corporation authorized to do business in the State of California, as Surety, hereby obligate themselves, their successors and assigns, jointly and severally, to The City of San Diego a municipal corporation in the sum of Three Hundred Twenty-Nine Thousand Nine Hundred Thirty-Seven Dollars and Zero Cents(\$329,937.00) for the faithful performance of the annexed contract, and in the sum of Three Hundred Twenty-Nine Thousand Nine Hundred Thirty-Seven Dollars and Zero Cents(\$329,937.00) for the benefit of laborers and materialmen designated below.

Conditions:

If the Principal shall faithfully perform the annexed contract **Rancho Penasquitos Library HVAC**, Bid Number **L-15-1222-DBB-2**, San Diego, California then the obligation herein with respect to a faithful performance shall be void; otherwise it shall remain in full force.

If the Principal shall promptly pay all persons, firms and corporations furnishing materials for or performing labor in the execution of this contract, and shall pay all amounts due under the California Unemployment Insurance Act then the obligation herein with respect to laborers and materialmen shall be void; otherwise it shall remain in full force.

The obligation herein with respect to laborers and materialmen shall inure to the benefit of all persons, firms and corporations entitled to file claims under the provisions of Chapter 3 of Division 5 of Title I of the Government Code of the State of California or under the provisions of Section 3082 et seq. of the Civil Code of the State of California.

Changes in the terms of the annexed contract or specifications accompanying same or referred to therein shall not affect the Surety's obligation on this bond, and the Surety hereby waives notice of same.

CONTRACT FORMS ATTACHMENTS (continued)
PERFORMANCE BOND AND LABOR AND MATERIALMEN'S BOND

The Surety shall pay reasonable attorney's fees should suit be brought to enforce the provisions of this bond.

Dated February 25, 2015

Approved as to Form and Legality

Paradigm Mechanical Corporation
Principal

By Melinda Dicharry
Melinda Dicharry, President
Printed Name of Person Signing for Principal

Jan I. Goldsmith, City Attorney

By Jan I. Goldsmith
Deputy City Attorney

Philadelphia Indemnity Insurance Company
Surety

By Anne Wright
Anne Wright Attorney-in-fact

Approved:

By Stephen Samara

251 South Lake Avenue, Ste. 360
Local Address of Surety

Pasadena, CA 91101
Local Address (City, State) of Surety

Print Name: Stephen Samara
Principal Contract Specialist (Acting), Public Works

626-639-1323
Local Telephone No. of Surety

Premium \$ 5,949.00

Bond No. PB 115111 00204

CALIFORNIA ALL-PURPOSE ACKNOWLEDGMENT

A notary public or other officer completing this certificate verifies only the identity of the individual who signed the document to which this certificate is attached, and not the truthfulness, accuracy, or validity of that document.

STATE OF CALIFORNIA

County of San Diego }

On February 25, 2015 before me, Dana L. Michaelis, Notary Public,
Date Insert Name of Notary exactly as it appears on the official seal

personally appeared Anne Wright

Name(s) of Signer(s)

who proved to me on the basis of satisfactory evidence to be the person(s) whose name(s) is/are subscribed to the within instrument and acknowledged to me that he/she/they executed the same in his/her/their authorized capacity(ies), and that by his/her/their signature(s) on the instrument the person(s), or the entity upon behalf of which the person(s) acted, executed the instrument.

I certify under PENALTY OF PERJURY under the laws of the State of California that the foregoing paragraph is true and correct.

Witness my hand and official seal.

Signature Dana L. Michaelis
Signature of Notary Public Dana L. Michaelis



Place Notary Seal Above

OPTIONAL

Though the information below is not required by law, it may prove valuable to persons relying on the document and could prevent fraudulent removal and reattachment of the form to another document.

Description of Attached Document

Title or Type of Document: _____

Document Date: _____ Number of Pages: _____

Signer(s) Other Than Named Above: _____

Capacity(ies) Claimed by Signer(s)

Signer's Name: _____

- Individual
- Corporate Officer — Title(s): _____
- Partner Limited General
- Attorney in Fact
- Trustee
- Guardian or Conservator
- Other: _____

**RIGHT THUMBPRINT
OF SIGNER**

Top of thumb here

Signer Is Representing:

Signer's Name: _____

- Individual
- Corporate Officer — Title(s): _____
- Partner Limited General
- Attorney in Fact
- Trustee
- Guardian or Conservator
- Other: _____

**RIGHT THUMBPRINT
OF SIGNER**

Top of thumb here

Signer Is Representing:

PHILADELPHIA INDEMNITY INSURANCE COMPANY
231 St. Asaph's Rd., Suite 100
Bala Cynwyd, PA 19004-0950

Power of Attorney

KNOW ALL PERSONS BY THESE PRESENTS: that PHILADELPHIA INDEMNITY INSURANCE COMPANY (the Company), a corporation organized and existing under the laws of the Commonwealth of Pennsylvania, does hereby constitute and appoint: CYNDI BEILMAN, ANNE WRIGHT AND DANA MICHAELIS OF SURETY ASSOCIATES OF SOUTHERN CALIFORNIA INSURANCE SERVICES

Its true and lawful Attorney(s) in fact with full authority to execute on its behalf bonds, undertakings, recognizances and other contracts of indemnity and writings obligatory in the nature thereof, issued in the course of its business and to bind the Company thereby, in an amount not to exceed \$25,000,000.00

This Power of Attorney is granted and is signed and sealed by facsimile under and by the authority of the following Resolution adopted by the Board of Directors of PHILADELPHIA INDEMNITY INSURANCE COMPANY at a meeting duly called the 1st day of July, 2011.

RESOLVED: That the Board of Directors hereby authorizes the President or any Vice President of the Company to: (1) Appoint Attorney(s) in Fact and authorize the Attorney(s) in Fact to execute on behalf of the Company bonds and undertakings, contracts of indemnity and other writings obligatory in the nature thereof and to attach the seal of the Company thereto; and (2) to remove, at any time, any such Attorney-in-Fact and revoke the authority given. And, be it

FURTHER RESOLVED: That the signatures of such officers and the seal of the Company may be affixed to any such Power of Attorney or certificate relating thereto by facsimile, and any such Power of Attorney so executed and certified by facsimile signatures and facsimile seal shall be valid and binding upon the Company in the future with the respect to any bond or undertaking to which it is attached.

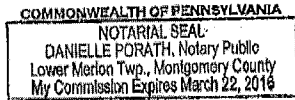
IN TESTIMONY WHEREOF, PHILADELPHIA INDEMNITY INSURANCE COMPANY HAS CAUSED THIS INSTRUMENT TO BE SIGNED AND ITS CORPORATE SEAL TO BE AFFIXED BY ITS AUTHORIZED OFFICE THIS 7TH DAY OF FEBRUARY 2013.



(Seal)

Robert D. O'Leary Jr., President & CEO
Philadelphia Indemnity Insurance Company

On this 7th day of February 2013, before me came the individual who executed the preceding instrument, to me personally known, and being by me duly sworn said that he is the therein described and authorized officer of the PHILADELPHIA INDEMNITY INSURANCE COMPANY; that the seal affixed to said instrument is the Corporate seal of said Company; that the said Corporate Seal and his signature were duly affixed.



(Notary Seal)

Notary Public:

residing at:

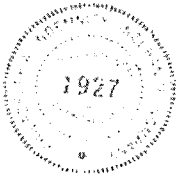
Bala Cynwyd, PA

My commission expires:

March 22, 2016

I, Craig P. Keller, Executive Vice President, Chief Financial Officer and Secretary of PHILADELPHIA INDEMNITY INSURANCE COMPANY, do hereby certify that the foregoing resolution of the Board of Directors and this Power of Attorney issued pursuant thereto are true and correct and are still in full force and effect. I do further certify that Robert D. O'Leary Jr., who executed the Power of Attorney as President, was on the date of execution of the attached Power of Attorney the duly elected President of PHILADELPHIA INDEMNITY INSURANCE COMPANY,

In Testimony Whereof I have subscribed my name and affixed the facsimile seal of each Company this 25th day of February, 20 15.



Craig P. Keller, Executive Vice President, Chief Financial Officer & Secretary
PHILADELPHIA INDEMNITY INSURANCE COMPANY

CONTRACT FORMS ATTACHMENTS (continued)
PERFORMANCE BOND AND LABOR AND MATERIALMEN'S BOND

The Surety shall pay reasonable attorney's fees should suit be brought to enforce the provisions of this bond.

Dated _____

Approved as to Form and Legality

Principal

By _____

Printed Name of Person Signing for Principal

Jan I. Goldsmith, City Attorney

By _____
Deputy City Attorney

Surety

By _____
Attorney-in-fact

Approved:

Local Address of Surety

By _____
Mayor or Designee

Local Address (City, State) of Surety

Local Telephone No. of Surety

Premium \$ _____

Bond No. _____

CONTRACTOR CERTIFICATION

DRUG-FREE WORKPLACE

PROJECT TITLE: Rancho Penasquitos Library HVAC

I hereby certify that I am familiar with the requirements of San Diego City Council Policy No. 100-17 regarding Drug-Free Workplace as outlined in the WHITEBOOK, Section 7-13.3, "Drug-Free Workplace", of the project specifications, and that;

Paradigm Mechanical Corp.

(Name under which business is conducted)

has in place a drug-free workplace program that complies with said policy. I further certify that each subcontract agreement for this project contains language which indicates the subcontractor's agreement to abide by the provisions of subdivisions a) through c) of the policy as outlined.

Signed Melinda Dicharry

Printed Name Melinda Dicharry

Title President

CONTRACTOR CERTIFICATION

AMERICAN WITH DISABILITIES ACT (ADA) COMPLIANCE CERTIFICATION

PROJECT TITLE: Rancho Penasquitos Library HVAC

I hereby certify that I am familiar with the requirements of San Diego City Council Policy No. 100-4 regarding the American With Disabilities Act (ADA) outlined in the WHITEBOOK, Section 7-13.2, "American With Disabilities Act", of the project specifications, and that;

Paradigm Mechanical Corp.
(Name under which business is conducted)

has in place a workplace program that complies with said policy. I further certify that each subcontract agreement for this project contains language which indicates the subcontractor's agreement to abide by the provisions of the policy as outlined.

Signed Melinda Dicharry

Printed Name Melinda Dicharry

Title President

CONTRACTOR CERTIFICATION

CONTRACTOR STANDARDS – PLEDGE OF COMPLIANCE

PROJECT TITLE: Rancho Penasquitos Library HVAC

I declare under penalty of perjury that I am authorized to make this certification on behalf of Paradigm Mechanical Corp., as Contractor, that I am familiar with the requirements of City of San Diego Municipal Code § 22.3224 regarding Contractor Standards as outlined in the WHITEBOOK, Section 7-13.4, ("Contractor Standards"), of the project specifications, and that Contractor has complied with those requirements.

I further certify that each of the Contractor's subcontractors whose subcontracts are greater than \$50,000 in value has completed a Pledge of Compliance attesting under penalty of perjury of having complied with City of San Diego Municipal Code § 22.3224.

Dated this 23 Day of February, 2015.

Signed Melinda Dicharry

Printed Name Melinda Dicharry

Title President

AFFIDAVIT OF DISPOSAL

WHEREAS, on the _____ DAY OF _____, the undersigned entered into and executed a contract with the City of San Diego, a municipal corporation, for:

Rancho Penasquitos Library HVAC
(Name of Project)

as particularly described in said contract and identified as Bid No. **L-15-1222-DBB-2**; SAP No. (WBS/IO/CC) **B-10051**; and **WHEREAS**, the specification of said contract requires the Contractor to affirm that "all brush, trash, debris, and surplus materials resulting from this project have been disposed of in a legal manner"; and **WHEREAS**, said contract has been completed and all surplus materials disposed of:

NOW, THEREFORE, in consideration of the final payment by the City of San Diego to said Contractor under the terms of said contract, the undersigned Contractor, does hereby affirm that all surplus materials as described in said contract have been disposed of at the following location(s)

and that they have been disposed of according to all applicable laws and regulations.

Dated this _____ DAY OF _____, _____.

Contractor
by

ATTEST:

State of _____
County of _____

On this _____ DAY OF _____, 2_____, before the undersigned, a Notary Public in and for said County and State, duly commissioned and sworn, personally appeared _____ known to me to be the _____ Contractor named in the foregoing Release, and whose name is subscribed thereto, and acknowledged to me that said Contractor executed the said Release.

Notary Public in and for said County and State

ATTACHMENTS

ATTACHMENT A
SCOPE OF WORK

SCOPE OF WORK

1. **SCOPE OF WORK:** Replace existing HVAC Units and provide new units.
 - 1.1. The Work shall be performed in accordance with:
 - 1.1.1. The Notice Inviting Bids inclusive and Plans numbered **37862-01-D** through **37862-21-D** inclusive.
2. **CONSTRUCTION COST:** The City's estimated construction cost for this contract is **\$382,000.00**.
3. **LOCATION OF WORK:** The location of the Work is as follows:

13330 Salmon River Road, San Diego, CA 92129. See Appendix E for Location Map.
4. **CONTRACT TIME:** The Contract Time for completion of the Work shall be **80 Working Days**.
5. **CONTRACTOR'S LICENSE CLASSIFICATION:** In accordance with the provisions of California Law, the Contractor shall possess valid appropriate license(s) at the time that the Bid is submitted. Failure to possess the specified license(s) shall render the Bid as **non-responsive** and shall act as a bar to award of the Contract to any Bidder not possessing required license(s) at the time of Bid.
 - 5.1. The City has determined the following licensing classification for this contract:
 - CLASS C20

The completion of Work shall include the approval of the sequence of operation and the commissioning of the HVAC Systems by the independent (3rd party) Commissioning Authority. The Commissioning Authority shall assess the Work at the walk through and final commissioning. The Contractor shall be available to assist the commissioning agent during functional testing. The warranty period for the Work shall start after all the HVAC units are completely operational per Commissioning Authority and if the work can provide continuous service of 7 working days and approved by the Resident Engineer and signed off by the Commissioning Authority. If the Work is not able to maintain continuous service for 7 working days, the start of warranty shall be the beginning date of the 7 working days of subsequent continuous service approved by the City and signed off by the Commissioning Authority.

ATTACHMENT B
INTENTIONALLY LEFT BLANK

ATTACHMENT C
EQUAL OPPORTUNITY CONTRACTING PROGRAM

EQUAL OPPORTUNITY CONTRACTING PROGRAM

1. To The WHITEBOOK, Chapter 10, Sections D and E, DELETE each in its entirety, and SUBSTITUTE with the following:

D. CITY'S EQUAL OPPORTUNITY COMMITMENT.

1. Nondiscrimination in Contracting Ordinance.

1. The Contractor, Subcontractors and Suppliers shall comply with requirements of the City's Nondiscrimination in Contracting Ordinance, San Diego Municipal Code §§22.3501 through 22.3517.

The Contractor shall not discriminate on the basis of race, gender, religion, national origin, ethnicity, sexual orientation, age, or disability in the solicitation, selection, hiring, or treatment of subcontractors, vendors, or suppliers. The Contractor shall provide equal opportunity for subcontractors to participate in subcontracting opportunities. The Contractor understands and agrees that violation of this clause shall be considered a material breach of the contract and may result in contract termination, debarment, or other sanctions.

The Contractor shall include the foregoing clause in all contracts between the Contractor and Subcontractors and Suppliers.

2. Disclosure of Discrimination Complaints. As part of its Bid or Proposal, the Bidder shall provide to the City a list of all instances within the past 10 years where a complaint was filed or pending against Bidder in a legal or administrative proceeding alleging that Bidder discriminated against its employees, subcontractors, vendors, or suppliers, and a description of the status or resolution of that complaint, including any remedial action taken.
3. Upon the City's request, the Contractor agrees to provide to the City, within 60 days, a truthful and complete list of the names of all Subcontractors and Suppliers that the Contractor has used in the past 5 years on any of its contracts that were undertaken within San Diego County, including the total dollar amount paid by the Contractor for each subcontract or supply contract.
4. The Contractor further agrees to fully cooperate in any investigation conducted by the City pursuant to the City's Nondiscrimination in Contracting Ordinance, Municipal Code §§22.3501 through 22.3517. The Contractor understands and agrees that violation of this clause shall be considered a material breach of the Contract and may result in remedies being ordered against the Contractor up to and including contract termination, debarment and other sanctions for violation of the provisions of the Nondiscrimination in Contracting Ordinance. The Contractor further understands and agrees that the procedures, remedies and sanctions provided for in the Nondiscrimination in Contracting Ordinance apply only to violations of the Ordinance.

E. EQUAL EMPLOYMENT OPPORTUNITY OUTREACH PROGRAM.

1. The Contractor, Subcontractors and Suppliers shall comply with the City's Equal Employment Opportunity Outreach Program, San Diego Municipal Code §§22.2701 through 22.2707.

The Contractor shall not discriminate against any employee or applicant for employment on any basis prohibited by law. Contractor shall provide equal opportunity in all employment practices. Prime Contractor shall ensure their subcontractors comply with this program. Nothing in this section shall be interpreted to hold a prime contractor liable for any discriminatory practice of its subcontractors.

The Contractor shall include the foregoing clause in all contracts between the Contractor and Subcontractors and Suppliers.

2. If the Contract is competitively solicited, the selected Bidder shall submit a Work Force Report (Form BB05), within 10 Working Days after receipt by the Bidder of Contract forms to the City for approval as specified in the Notice of Intent to Award letter from the City.
3. If a Work Force Report is submitted, and the City determines there are under-representations when compared to County Labor Force Availability data, the selected Bidder shall submit an Equal Employment Opportunity Plan.
4. If the selected Bidder submits an Equal Employment Opportunity Plan, it shall include the following assurances:
 1. The Contractor shall maintain a working environment free of discrimination, harassment, intimidation and coercion at all sites and in all facilities at which the Contractor's employees are assigned to work.
 2. The Contractor reviews its EEO Policy, at least annually, with all on-site supervisors involved in employment decisions.
 3. The Contractor disseminates and reviews its EEO Policy with all employees at least once a year, posts the policy statement and EEO posters on all company bulletin boards and job sites, and documents every dissemination, review and posting with a written record to identify the time, place, employees present, subject matter, and disposition of meetings.
 4. The Contractor reviews, at least annually, all supervisors' adherence to and performance under the EEO Policy and maintains written documentation of these reviews.
 5. The Contractor discusses its EEO Policy Statement with subcontractors with whom it anticipates doing business, includes the EEO Policy Statement in its subcontracts, and provides such documentation to the City upon request.

6. The Contractor documents and maintains a record of all bid solicitations and outreach efforts to and from subcontractors, contractor associations and other business associations.
7. The Contractor disseminates its EEO Policy externally through various media, including the media of people of color and women, in advertisements to recruit, maintains files documenting these efforts, and provides copies of these advertisements to the City upon request.
8. The Contractor disseminates its EEO Policy to union and community organizations.
9. The Contractor provides immediate written notification to the City when any union referral process has impeded the Contractor's efforts to maintain its EEO Policy.
10. The Contractor maintains a current list of recruitment sources, including those outreaching to people of color and women, and provides written notification of employment opportunities to these recruitment sources with a record of the organizations' responses.
11. The Contractor maintains a current file of names, addresses and phone numbers of each walk-in applicant, including people of color and women, and referrals from unions, recruitment sources, or community organizations with a description of the employment action taken.
12. The Contractor encourages all present employees, including people of color and women employees, to recruit others.
13. The Contractor maintains all employment selection process information with records of all tests and other selection criteria.
14. The Contractor develops and maintains documentation for on-the-job training opportunities, participates in training programs, or both for all of its employees, including people of color and women, and establishes apprenticeship, trainee, and upgrade programs relevant to the Contractor's employment needs.
15. The Contractor conducts, at least annually, an inventory and evaluation of all employees for promotional opportunities and encourages all employees to seek and prepare appropriately for such opportunities.
16. The Contractor ensures the company's working environment and activities are non-segregated except for providing separate or single-user toilets and necessary changing facilities to assure privacy between the sexes.

ATTACHMENT D
INTENTIONALLY LEFT BLANK

ATTACHMENT E
SUPPLEMENTARY SPECIAL PROVISIONS

SUPPLEMENTARY SPECIAL PROVISIONS

The following Supplementary Special Provisions (SSP) modifies the following documents:

- 1) Standard Specifications for Public Works Construction (The GREENBOOK) currently in effect.
 - 2) The City of San Diego Standard Specifications for Public Works Construction (The WHITEBOOK).
-

SECTION 1 – TERMS, DEFINITIONS, ABBREVIATIONS, UNITS OF MEASURE, AND SYMBOLS

1-2 TERMS AND DEFINITIONS.

Normal Working Hours. To the City Supplement, ADD the following:

The Normal Working Hours are 7:00 AM to 3:30 PM.

SECTION 2 - SCOPE AND CONTROL OF WORK

2-3.2 Self Performance. DELETE in its entirety and SUBSTITUTE with the following:

1. You must perform, with your own organization, Contract work amounting to at least 50% of the base bid alone or base bid and any additive or deductive alternate(s) that together when added or deducted form the basis of award.

2-5.3.1 General. To the City Supplement, ADD the following

7. For products for which an AML is available, products listed in the AML shall be used. A submittal review will be conducted for products not identified on an AML on a case-by-case basis when:
 - a) The product type or category is not in the AML.
 - b) The AML does not list at least two available manufacturers of the product.
 - c) The material or manufacturer listed in the AML is no longer available. Documentation to substantiate the product is no longer available or in production is required as part of the submittal.

In the case of conducting a submittal review when required by the Plans or Special Provisions, or when requested by the Engineer, all submittals shall be accompanied by the City's submittal form.

The Product Submittal Form is available for download at:

<http://www.sandiego.gov/publicworks/edocref/index.shtml>

2-14.2 Integration of the Work with Separate Contractors. To the City Supplement, ADD the following:

The list of Separate Contractors includes:

1. Asbestos Contractor
2. Rancho Penasquitos Library Roof Replacement
3. Commissioning Agency

2-14.3 Coordination. To the City Supplement, ADD the following:

Other adjacent City project is scheduled for construction for the same time period in the vicinity of Rancho Penasquitos Library. See Appendix "F." for approximate location. Coordinate the Work with the adjacent project(s) as listed below:

- a) Rancho Penasquitos Library Roof Replacement, Coselyn Goodrich, 619-533-4633

SECTION 4 - CONTROL OF MATERIALS

4-1.3.6 Preapproved Materials. To the City Supplement, ADD the following:

3. You shall submit in writing a list of all products to be incorporated in the Work that are on the AML.

ADD:

4-1.3.7 Testing Under the Direction of the Engineer. When a bid item for Testing under the direction of the Engineer is provided, the Contractor must employ and pay for the services of a qualified third party independent laboratory to perform the required testing. The Contractor will be reimbursed for the cost of testing under this bid item.

4-1.6 Trade Names or Equals. ADD the following:

You must submit your list of proposed substitutions for "an equal" ("or equal") item(s) **no less than 15 Working Days prior to Bid due date/** and on the City's Product Submittal Form available at:

<http://www.sandiego.gov/publicworks/edocref/index.shtml>

SECTION 7 - RESPONSIBILITIES OF THE CONTRACTOR

7-3 **LIABILITY INSURANCE.** DELETE in its entirety and SUBSTITUTE with the following:

The insurance provisions herein must not be construed to limit your indemnity obligations contained in the Contract.

7-3.1 **Policies and Procedures.**

1. You must procure the insurance described below, at its sole cost and expense, to provide coverage against claims for loss including injuries to persons or damage to property, which may arise out of or in connection with the performance of the Work by you, your agents, representatives, officers, employees or Subcontractors.
2. Insurance coverage for property damage resulting from your operations is on a replacement cost valuation. The market value will not be accepted.
3. You must maintain this insurance for the duration of this contract and at all times thereafter when you are correcting, removing, or replacing Work in accordance with this contract. Your liabilities under the Contract, e.g., your indemnity obligations, is not deemed limited to the insurance coverage required by this contract.
4. Payment for insurance is included in the various items of Work as bid by you, and except as specifically agreed to by the City in writing, you are not entitled to any additional payment. Do not begin any work under this contract until you have provided and the City has approved all required insurance.
5. Policies of insurance must provide that the City is entitled to 30 days (10 days for cancellation due to non-payment of premium) prior written notice of cancellation or non-renewal of the policy. Maintenance of specified insurance coverage is a material element of the Contract. Your failure to maintain or renew coverage or to provide evidence of renewal during the term of the Contract may be treated by the City as a material breach of the Contract.

7-3.2 **Types of Insurance.**

7-3.2.1 **Commercial General Liability Insurance.**

1. Commercial General Liability Insurance must be written on the current version of the ISO Occurrence form CG 00 01 07 98 or an equivalent form providing coverage at least as broad.
2. The policy must cover liability arising from premises and operations, XCU (explosions, underground, and collapse), independent contractors, products/completed operations, personal injury and advertising injury, bodily injury, property damage, and liability assumed under an insured's contract (including the tort liability of another assumed in a business contract).

3. There must be no endorsement or modification limiting the scope of coverage for either “insured vs. insured” claims or contractual liability. You must maintain the same or equivalent insurance for at least 10 years following completion of the Work.
4. All costs of defense must be outside the policy limits. Policy coverage must be in liability limits of not less than the following:

| <u>General Annual Aggregate Limit</u> | <u>Limits of Liability</u> |
|---|----------------------------|
| Other than Products/Completed Operations | \$2,000,000 |
| Products/Completed Operations Aggregate Limit | \$2,000,000 |
| Personal Injury Limit | \$1,000,000 |
| Each Occurrence | \$1,000,000 |

7-3.2.2 Commercial Automobile Liability Insurance.

1. You must provide a policy or policies of Commercial Automobile Liability Insurance written on the current version of the ISO form CA 00 01 12 90 or later version or equivalent form providing coverage at least as broad in the amount of \$1,000,000 combined single limit per accident, covering bodily injury and property damage for owned, non-owned, and hired automobiles (“Any Auto”).
2. All costs of defense must be outside the limits of the policy.

7-3.3 Rating Requirements. Except for the State Compensation Insurance Fund, all insurance required by this contract as described herein must be carried only by responsible insurance companies with a rating of, or equivalent to, at least “A-, VI” by A.M. Best Company, that are authorized by the California Insurance Commissioner to do business in the State, and that have been approved by the City.

7-3.3.1 Non-Admitted Carriers. The City will accept insurance provided by non-admitted, “surplus lines” carriers only if the carrier is authorized to do business in the State and is included on the List of Approved Surplus Lines Insurers (LASLI list).

All policies of insurance carried by non-admitted carriers must be subject to all of the requirements for policies of insurance provided by admitted carriers described herein.

7-3.4 Evidence of Insurance. Furnish to the City documents e.g., certificates of insurance and endorsements evidencing the insurance required herein, and furnish renewal documentation prior to expiration of this insurance. Each required document must be signed by the insurer or a person authorized by the insurer to bind coverage on its behalf. We reserve the right to require complete, certified copies of all insurance policies required herein.

7-3.5 Policy Endorsements.

7-3.5.1 Commercial General Liability Insurance.

7-3.5.1.1 Additional Insured.

- a) You must provide at your expense policy endorsement written on the current version of the ISO Occurrence form CG 20 10 11 85 or an equivalent form providing coverage at least as broad.
- b) To the fullest extent allowed by law e.g., California Insurance Code §11580.04, the policy must be endorsed to include the City and its respective elected officials, officers, employees, agents, and representatives as additional insured.
- c) The additional insured coverage for projects for which the Engineer's Estimate is \$1,000,000 or more must include liability arising out of: (a) Ongoing operations performed by you or on your behalf, (b) your products, (c) your work, e.g., your completed operations performed by you or on your behalf, or (d) premises owned, leased, controlled, or used by you.
- d) The additional insured coverage for projects for which the Engineer's Estimate is less than \$1,000,000 must include liability arising out of: (a) Ongoing operations performed by you or on your behalf, (b) your products, or (c) premises owned, leased, controlled, or used by you.

7-3.5.1.2 Primary and Non-Contributory Coverage. The policy must be endorsed to provide that the coverage with respect to operations, including the completed operations, if appropriate, of the Named Insured is primary to any insurance or self-insurance of the City and its elected officials, officers, employees, agents and representatives. Further, it must provide that any insurance maintained by the City and its elected officials, officers, employees, agents and representatives must be in excess of your insurance and must not contribute to it.

7-3.5.1.3 Project General Aggregate Limit. The policy or policies must be endorsed to provide a Designated Construction Project General Aggregate Limit that will apply only to the Work. Only claims payments which arise from the Work must reduce the Designated Construction Project General Aggregate Limit. The Designated Construction Project General Aggregate Limit must be in addition to the aggregate limit provided for the products-completed operations hazard.

7-3.5.2 Commercial Automobile Liability Insurance.

7-3.5.2.1 Additional Insured. Unless the policy or policies of Commercial Auto Liability Insurance are written on an ISO form CA 00 01 12 90 or a later version of this form or equivalent form providing coverage at least as broad, the policy must be endorsed to include the City and its respective elected officials, officers, employees, agents, and representatives as additional insured, with respect to liability arising out of automobiles owned, leased, hired or borrowed by you or on your behalf. This endorsement is limited to the obligations permitted by California Insurance Code §11580.04.

7-3.6 Deductibles and Self-Insured Retentions. You must pay for all deductibles and self-insured retentions. You must disclose deductibles and self-insured retentions to the City at the time the evidence of insurance is provided.

7-3.7 Reservation of Rights. The City reserves the right, from time to time, to review your insurance coverage, limits, deductibles and self-insured retentions to determine if they are acceptable to the City. The City will reimburse you, without overhead,

profit, or any other markup, for the cost of additional premium for any coverage requested by the Engineer but not required by this contract.

7-3.8 Notice of Changes to Insurance. You must notify the City 30 days prior to any material change to the policies of insurance provided under this contract.

7-3.9 Excess Insurance. Policies providing excess coverage must follow the form of the primary policy or policies e.g., all endorsements.

7-4 WORKERS' COMPENSATION INSURANCE. DELETE in its entirety and SUBSTITUTE with the following:

7-4.1 Workers' Compensation Insurance and Employers Liability Insurance.

1. In accordance with the provisions of §3700 of the California Labor Code, you must provide at your expense Workers' Compensation Insurance and Employers Liability Insurance to protect you against all claims under applicable state workers compensation laws. The City, its elected officials, and employees will not be responsible for any claims in law or equity occasioned by your failure to comply with the requirements of this section.

2. Limits for this insurance must be not less than the following:

| <u>Workers' Compensation</u> | <u>Statutory Employers Liability</u> |
|------------------------------|--------------------------------------|
| Bodily Injury by Accident | \$1,000,000 each accident |
| Bodily Injury by Disease | \$1,000,000 each employee |
| Bodily Injury by Disease | \$1,000,000 policy limit |

3. By signing and returning the Contract you certify that you are aware of the provisions of §3700 of the Labor Code which require every employer to be insured against liability for worker's compensation or to undertake self-insurance in accordance with the provisions of that code and you must comply with such provisions before commencing the Work as required by §1861 of the California Labor Code.

7-4.1.1 Waiver of Subrogation. The policy or policies must be endorsed to provide that the insurer will waive all rights of subrogation against the City, and its respective elected officials, officers, employees, agents, and representatives for losses paid under the terms of the policy or policies and which arise from work performed by the Named Insured for the City.

7-10.5.3 Steel Plate Covers. Table 7-10.5.3(A), REVISE the plate thickness for 5'-3" trench width to read 1 3/4".

7-15 INDEMNIFICATION AND HOLD HARMLESS AGREEMENT. To the City Supplement, fourth paragraph, last sentence, DELETE in its entirety and SUBSTITUTE with the following:

Your duty to indemnify and hold harmless does not include any claims or liability arising from the established active or sole negligence, or willful misconduct of the City, its officers, or employees.

7-16 **COMMUNITY LIAISON.** To the City Supplement, DELETE in its entirety and SUSBTITUTE with the following:

ADD:

7-16 **COMMUNITY OUTREACH.**

7-16.1 **General.**

1. To ensure consistency with the City's community outreach plan for the project, the City will work with the Contractor to inform the public (which includes, but is not limited to, property owners, renters, homeowners, business owners, recreational users, and other community members and stakeholders) of construction impacts. Efforts by the Contractor to mitigate construction impacts by communicating with the public require close coordination and cooperation with the City.
2. The Contractor will perform the community outreach activities required throughout the Contract Time.
3. The Contractor shall closely coordinate the Work with the businesses, institutions, residents and property owners impacted by the Project. Example duties of the Contractor include notification to the businesses, institutions and residents of the commencement of construction activities not less than 5 days in advance, coordination of access for vehicular and pedestrian traffic to businesses, institutions and residences impacted by the Project, reporting of Contractor activities at all Project progress meetings scheduled by the Engineer, attendance to the Project Pre-construction Meeting, attendance at 2 community meetings, response to community questions and complaints related to Contractor activities, and written documentation including logging in all inquiries and complaints received into the City's Public Contact Log located on the City's SDSHare site:

<http://sdshare/forums/ecp/PITS/picr/Lists/Public%20Contact%20Log/AllItems.aspx>

4. The Contractor shall execute the Information Security Policy Acknowledgement Form - For Non-City Employees within 15 days of the award of the Contract if:
 - a) The contact information for the Contractor is made available on any outreach materials or;
 - b) The Contractor will be the primary point of contact to resolve project related inquiries and complaints.
5. Electronic Communication.

All inquiries and complaints will be logged in to the City's SDSHare site within 24 hours of receipt of inquiries and complaints.

Any updates or a resolution of inquiries, and complaints shall be documented in the City's SDSShare site within 24 hours.

Copies of email communications shall be saved on to the City's SDSShare site as individually as an Outlook Message Format (*.msg).

All graphics, photos, and other electronic files associated with the inquiries and or complaints shall be saved into the individual record.

6. **When specified**, present your Exclusive Community Liaison to the Engineer, in writing, within 15 days of the award of the Contract.

7-16.2 Submittals.

1. The Contractor shall submit to the Resident Engineer, for review and approval, all drafts of letters, notices, postcards, door hangers, signs, mailing lists, proposed addresses for hand-delivery, and any other notices and letters that are to be mailed and or distributed to the public.
 - a. Prior to distributing or mailing, the Contractor shall submit final drafts of letters, notices, postcards, door hangers, signs, and any other notices and letters to the Resident Engineer for final review and approval.
 - b. After distributing or mailing, the Contractor shall submit verification of delivery and any copies of returned notices to the Resident Engineer.
2. The Contractor will use the City's SDSShare site to identify and summarize communications (via phone, in person, and email) with the public the within 24 hours of receipt, even if the Contractor's response to the individual is still incomplete. The Contractor will upload to the City's SDSShare site copies of all written, electronic, and verbal communications and conversations with the public.

7-16.3 Public Notice by Contractor.

1. Furnish and distribute public notices in the form of door hangers using the City's format to all occupants and/or property owners along streets where Work is to be performed at least 5 days before starting the Work as directed by the Resident Engineer.
2. For all Work on private property, contact each owner and occupant individually a minimum of 15 days prior to the Work. If the Work has been delayed, re-notify owners and occupants of the new Work schedule, as directed by the Resident Engineer.

7-16.4 Quality Assurance.

1. During the course of community outreach, the Contractor shall ensure the character of all persons that conduct community outreach (distributing door hangers, attending community meetings, interacting with the public, etc.), on behalf of the Contractor:

- a. Have the ability to speak and comprehend English and/or Spanish, as appropriate for the community or public they are informing,
- b. Possess and display easily verifiable and readable personal identification that identifies the person as an employee of the Contractor,
- c. Have the interpersonal skills to effectively, professionally, and tactfully represent the project, Contractor, and City to the public.

7-16.5 Communications with the Public.

1. The Contractor shall provide updates on construction impacts to the Resident Engineer. The Contractor shall notify the Resident Engineer in advance about time-sensitive construction impacts and may be required to distribute construction impact notices to the public on short notice.
2. The Contractor shall incorporate community outreach activities related to construction impacts in the baseline schedule and update the Resident Engineer with each week's submittal of the Three-Week Look Ahead Schedule.
3. At the request of the Resident Engineer, the Contractor shall attend and participate in project briefings at community meetings.
4. The Contractor shall coordinate with the Resident Engineer on all responses and actions taken to address public inquiries and complaints within 24-hours that they are received.

7-16.6 Communications with Media.

1. The City may allow members of the media access to its construction site(s) on a case-by-case basis only.
2. Occasionally, members of the media may show up at construction sites, uninvited. Members of the media (including, but not limited to newspaper, magazine, radio, television, bloggers, and videographers) do not have the legal right to be in the construction site without the City's permission.
3. In the event media representatives arrive near or on the construction site(s), the Contractor shall keep them off the site(s), in a courteous and professional manner, until a Public Information Officer is available to meet them at an approved location.
4. The Contractor shall report all members of the media visits to the Resident Engineer as quickly as possible, so that the City's Public Information Officer can meet with the members of the media at the construction site(s).
5. If the City allows members of the media to access a construction site, the Contractor shall allow the City to escort the media representatives while they are on the construction site and shall ensure their safety.

6. The Contractor shall require media representatives to sign in and out of the Site Visitor Log and to use Personal Protective Equipment.
7. The Contractor has a right to speak to members of the media about its company and its role on the project. All other questions shall be referred to the City.

7-16.7

Exclusive Community Liaison Services. If directed to conduct Exclusive Community Liaison Services, the Contractor shall retain an Exclusive Community Liaison for the Project whose sole responsibilities will be as follows:

1. Develop a contact list of community, tenants, property owners, and agencies with a stake in the project.
2. Notify businesses, institutions, property owners, and residents of the commencement of construction activities and utility service interruptions not less than 5 days in advance.
3. Coordinate access for vehicular and pedestrian traffic to businesses, institutions and residences impacted by the Project.
4. Prepare and present of materials in coordination with the Resident Engineer (the City's standards and guidelines for the communication materials are available for review by Bidders by sending a request to the Contract Specialist).
5. Respond to community questions and complaints related to Contractor activities.
6. Write, edit, update, or produce brochures, pamphlets and news releases.
7. Provide standard telephone inquiries and e-mail responses:
 - a) Respond to telephone calls and e-mails from the public.
 - b) Record calls and e-mails on the City's SDSshare site.
8. Report Exclusive Community Liaison activities at all progress meetings scheduled by the Resident Engineer.
9. Attendance at pre-construction, community and stakeholders meetings.

7-16.7.1

Exclusive Community Liaison Work Plan. The Work plan for the Exclusive Community Liaison shall address the items of Work specified in these specifications. Present your Exclusive Community Liaison and submit your exclusive community outreach plan (in writing) **as specified** within 15 days of the Award of the Contract.

7-16.8

Payment. The Payment for the community outreach and public notices is included in the various Bid items. The payment for exclusive community liaison is in the bid item for "Exclusive Community Liaison Services".

7-20

ELECTRONIC COMMUNICATION. ADD the following:

Virtual Project Manager will be used on this contract.

SECTION 9 - MEASUREMENT AND PAYMENT

9-3.2.5 Withholding of Payment. To the City Supplement, item i), DELETE in its entirety and SUBSTITUTE with the following:

- i) Your failure to comply with 7-2.3, "PAYROLL RECORDS" and 2-16, "CONTRACTOR REGISTRATION AND ELECTRONIC REPORTING SYSTEM."

ADD:

9-3.7 Compensation Adjustments for Price Index Fluctuations. This Contract is subject to the provisions of The WHITEBOOK for Compensation Adjustments for Price Index Fluctuations for the paving asphalt.

SECTION 707 – RESOURCE DISCOVERIES

ADD:

707-1.1 Environmental Document. The City of San Diego Environmental Analysis Section (EAS) of the Development Services Department has prepared a **Notice of Exemption** for **Rancho Penasquitos Library HVAC**, as referenced in the Contract Appendix. You must comply with all requirements of the **Notice of Exemption** as set forth in the Contract Appendix A.

Compliance with the City's environmental document is included in the various Bid items, unless a bid item has been provided.

SECTION 708 – ASBESTOS MATERIALS

708-5 FRIABLE ASBESTOS. To the City Supplement, ADD the following:

Asbestos to be removed by others. See Appendix G for the Asbestos and Lead Report

END OF SUPPLEMENTARY SPECIAL PROVISIONS (SSP)

TECHNICALS

**RANCHO PENASQUITOS LIBRARY HVAC
Technical Specifications**

DIVISION 01 - GENERAL REQUIREMENTS

017823 OPERATING AND MAINTENANCE DATA

DIVISION 02 - EXISTING CONDITIONS

024115 ELECTRICAL DEMOLITION

DIVISION 03 - CONCRETE

031534 POST INSTALLED CONCRETE ANCHORS - NORMAL CONFIDENCE

DIVISION 07 - THERMAL & MOISTURE PROTECTION

078400 FIRESTOPPING

DIVISION 22 - PLUMBING

220000 PLUMBING, GENERAL PURPOSE

DIVISION 23 - HEATING, VENTILATING, AND AIR CONDITIONING

230000 AIR SUPPLY, DISTRIBUTION, VENTILATION, AND EXHAUST SYSTEMS

230800.00 10 COMMISSIONING OF HVAC SYSTEMS

CC - EF - 1-5 Exhaust Fan

CC - RTU 1-8 Gas-Electric

FPT - EF - 1-5 Exhaust Fan

FPT - RTU 1-8 Gas-Electric

230923 N DIRECT DIGITAL CONTROL SYSTEM SPECIFICATION

DIVISION 26 - ELECTRICAL

260519 LOW VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES

260526 GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS

260529 HANGERS AND SUPPORTS FOR ELECTRICAL SYSTEMS

260533 RACEWAYS AND BOXES FOR ELECTRICAL SYSTEMS

260553 IDENTIFICATION FOR ELECTRICAL SYSTEMS

260813 ELECTRICAL ACCEPTANCE TESTING

262726 WIRING DEVICES

262816 ENCLOSED SWITCHES AND CIRCUIT BREAKERS

DIVISION 28 - ELECTRONIC SAFETY & SECURITY

283100 FIRE DETECTION AND ALARM SYSTEM (CONVENTIONAL)

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TECHNICALS - TABLE OF CONTENTS

Rancho Penasquitos Library HVAC

Appendix E – Technicals

Volume 1 of 2 (Rev. Dec. 2014)

DIVISION 01 - GENERAL REQUIREMENTS

SECTION 01 78 23 - OPERATION AND MAINTENANCE DATA

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PART 2 - PRODUCTS

PART 3 - EXECUTION

-- End of Section Table of Contents --

SECTION 01 78 23 - OPERATION AND MAINTENANCE DATA

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

ASTM INTERNATIONAL (ASTM)

ASTM E1971 (2005; R 2011) Stewardship for the Cleaning of Commercial and Institutional Buildings

1.2 SUBMISSION OF OPERATION AND MAINTENANCE DATA

Submit Operation and Maintenance (O&M) Data specifically applicable to this contract and a complete and concise depiction of the provided equipment, product, or system, stressing and enhancing the importance of system interactions, troubleshooting, and long-term preventative maintenance and operation. The subcontractors must compile and prepare data and deliver to the Contractor prior to the training of Government personnel.

The Contractor must compile and prepare aggregate O&M data including clarifying and updating the original sequences of operation to as-built conditions. Organize and present information in sufficient detail to clearly explain O&M requirements at the system, equipment, component, and subassembly level. Include an index preceding each submittal.

1.2.1 Package Quality

Documents must be fully legible.

Poor quality copies and material with hole punches obliterating the text or drawings will not be accepted.

1.2.2 Package Content

Data package content shall be as shown in the paragraph titled "Schedule of Operation and Maintenance Data Packages." Comply with the data package requirements specified in the individual technical sections, including the content of the packages and addressing each product, component, and system designated for data package submission, except as follows. Commissioned items with a specified data package requirement in the individual technical sections must use Data Package.

1.2.3 Changes to Submittals

Manufacturer-originated changes or revisions to submitted data must be furnished by the Contractor if a component of an item is so affected subsequent to acceptance of the O&M Data.

Submit changes, additions, or revisions required by the Contracting Officer for final acceptance of submitted data within 30 calendar days of the notification of this change requirement.

1.2.4 Review and Approval

The Independent Commissioning Authority (CA) must review the commissioned systems and equipment submittals for completeness and applicability. The CA must verify that the systems and equipment provided meet the requirements of the Contract documents and design intent, particularly as they relate to functionality, energy performance, water performance, maintainability, sustainability, system cost, indoor environmental quality, and local environmental impacts. The CA must communicate deficiencies to the Contracting Officer. Upon a successful review of the corrections, the CA must recommend approval and acceptance of these O&M manuals to the Contracting Officer. This work is in addition to the normal review procedures for O&M data.

1.2.5 O&M Database

Develop a database from the O&M manuals that contains the information required to start a preventative maintenance program.

1.3 TYPES OF INFORMATION REQUIRED IN O&M DATA PACKAGES

1.3.1 Operating Instructions

Include specific instructions, procedures, and illustrations for the following phases of operation for the installed model and features of each system:

1.3.1.1 Safety Precautions

List personnel hazards and equipment or product safety precautions for all operating conditions.

1.3.1.2 Operator Prestart

Include procedures required to install, set up, and prepare each system for use.

1.3.1.3 Startup, Shutdown, and Post-Shutdown Procedures

Provide narrative description for Startup, Shutdown and Post-shutdown operating procedures including the control sequence for each procedure.

1.3.1.4 Normal Operations

Provide narrative description of Normal Operating Procedures.

Include Control Diagrams with data to explain operation and control of systems and specific equipment.

1.3.1.5 Emergency Operations

Include Emergency Procedures for equipment malfunctions to permit a short period of continued operation or to shut down the equipment to prevent further damage to systems and equipment.

Include Emergency Shutdown Instructions for fire, explosion, spills, or other foreseeable contingencies.

Provide guidance and procedures for emergency operation of all utility systems including required valve positions, valve locations and zones or portions of systems controlled.

1.3.1.6 Operator Service Requirements

Include instructions for services to be performed by the operator such as lubrication, adjustment, inspection, and recording gage readings.

1.3.1.7 Environmental Conditions

Include a list of Environmental Conditions (temperature, humidity, and other relevant data) that are best suited for the operation of each product, component or system. Describe conditions under which the item equipment should not be allowed to run.

1.3.2 Preventive Maintenance

Include the following information for preventive and scheduled maintenance to minimize corrective maintenance and repair for the installed model and features of each system.

Include potential environmental and indoor air quality impacts of recommended maintenance procedures and materials.

1.3.2.1 Lubrication Data

Include preventative maintenance lubrication data, in addition to instructions for lubrication provided under paragraph titled "Operator Service Requirements":

- a. A table showing recommended lubricants for specific temperature ranges and applications.
- b. Charts with a schematic diagram of the equipment showing lubrication points, recommended types and grades of lubricants, and capacities.
- c. A Lubrication Schedule showing service interval frequency.

1.3.2.2 Preventive Maintenance Plan and Schedule

Include manufacturer's schedule for routine preventive maintenance, inspections, tests and adjustments required to ensure proper and economical operation and to minimize corrective maintenance. Provide manufacturer's projection of preventive maintenance work-hours on a daily, weekly, monthly, and annual basis including craft requirements by type of craft. For periodic calibrations, provide manufacturer's specified frequency and procedures for each separate operation.

1.3.2.3 Cleaning Recommendations

Provide environmentally preferable cleaning recommendations in accordance with ASTM E1971.

1.3.3 Corrective Maintenance (Repair)

Include manufacturer's recommended procedures and instructions for correcting problems and making repairs for the installed model and features of each system. Include potential environmental and indoor air quality impacts of recommended maintenance procedures and materials.

1.3.3.1 Troubleshooting Guides and Diagnostic Techniques

Include step-by-step procedures to promptly isolate the cause of typical malfunctions. Describe clearly why the checkout is performed and what conditions are to be sought. Identify tests or inspections and test equipment required to determine whether parts and equipment may be reused or require replacement.

1.3.3.2 Wiring Diagrams and Control Diagrams

Wiring diagrams and control diagrams shall be point-to-point drawings of wiring and control circuits including factory-field interfaces.

Provide a complete and accurate depiction of the actual job specific wiring and control work.

On diagrams, number electrical and electronic wiring and pneumatic control tubing and the terminals for each type, identically to actual installation configuration and numbering.

1.3.3.3 Maintenance and Repair Procedures

Include instructions and a list of tools required to repair or restore the product or equipment to proper condition or operating standards.

1.3.3.4 Removal and Replacement Instructions

Include step-by-step procedures and a list required tools and supplies for removal, replacement, disassembly, and assembly of components, assemblies, subassemblies, accessories, and attachments.

Provide tolerances, dimensions, settings and adjustments required. Instructions shall include a combination of text and illustrations.

1.3.3.5 Spare Parts and Supply Lists

Include lists of spare parts and supplies required for maintenance and repair to ensure continued service or operation without unreasonable delays.

Special consideration is required for facilities at remote locations.

List spare parts and supplies that have a long lead-time to obtain.

1.3.4 Corrective Maintenance Work-Hours

Include manufacturer's projection of corrective maintenance work-hours including requirements by type of craft.

Corrective maintenance that requires completion or participation of the equipment manufacturer shall be identified and tabulated separately.

1.3.5 Appendices

Provide information required below and information not specified in the preceding paragraphs but pertinent to the maintenance or operation of the product or equipment.

Include the following:

1.3.5.1 Product Submittal Data

Provide a copy of all SD-03 Product Data submittals required in the applicable technical sections.

1.3.5.2 Manufacturer's Instructions

Provide a copy of all SD-08 Manufacturer's Instructions submittals required in the applicable technical sections.

1.3.5.3 O&M Submittal Data

Provide a copy of all SD-10 Operation and Maintenance Data submittals required in the applicable technical sections.

1.3.5.4 Parts Identification

Provide identification and coverage for all parts of each component, assembly, subassembly, and accessory of the end items subject to replacement. Include special hardware requirements, such as requirement to use high-strength bolts and nuts. Identify parts by make, model, serial number, and source of supply to allow reordering without further identification.

Provide clear and legible illustrations, drawings, and exploded views to enable easy identification of the items. When illustrations omit the part numbers and description, both the illustrations and separate listing shall show the index, reference, or key number that will cross-reference the illustrated part to the listed part. Parts shown in the listings shall be grouped by components, assemblies, and subassemblies in accordance with the manufacturer's standard practice. Parts data may cover more than one model or series of equipment, components, assemblies, subassemblies, attachments, or accessories, such as typically shown in a master parts catalog

1.3.5.5 Warranty Information

List and explain the various warranties and clearly identify the servicing and technical precautions prescribed by the manufacturers or contract documents in order to keep warranties in force.

Include warranty information for primary components such as the compressor of air conditioning system.

1.3.5.6 Personnel Training Requirements

Provide information available from the manufacturers that is needed for use in training designated personnel to properly operate and maintain the equipment and systems.

1.3.5.7 Testing Equipment and Special Tool Information

Include information on test equipment required to perform specified tests and on special tools needed for the operation, maintenance, and repair of components.

1.3.5.8 Testing and Performance Data

Include completed prefunctional checklists, functional performance test forms, and monitoring reports.

Include recommended schedule for retesting and blank test forms.

1.3.5.9 Contractor Information

Provide a list that includes the name, address, and telephone number of the General Contractor and each Subcontractor who installed the product or equipment, or system.

For each item, also provide the name address and telephone number of the manufacturer's representative and service organization that can provide replacements most convenient to the project site.

Provide the name, address, and telephone number of the product, equipment, and system manufacturers.

1.4 TYPES OF INFORMATION REQUIRED IN CONTROLS O&M DATA PACKAGES

Include Data Package and the following for control systems:

- a. Narrative description on how to perform and apply all functions, features, modes, and other operations, including unoccupied operation, seasonal changeover, manual operation, and alarms. Include detailed technical manual for programming and customizing control loops and algorithms.
- b. Full as-built sequence of operations.
- c. Copies of all checkout tests and calibrations performed by the Contractor (not Cx tests).
- d. Full points list.

A listing of rooms shall be provided with the following information for each room:

- (1) Floor
- (2) Room number
- (3) Room name
- (4) Air handler unit ID
- (5) Reference drawing number
- (6) Minimum cfm
- (7) Maximum cfm

- e. Full print out of all schedules and set points after testing and acceptance of the system.
- f. Full as-built print out of software program.
- g. Marking of all system sensors and thermostats on the as-built floor plan and mechanical drawings with their control system designations.

1.5 SCHEDULE OF OPERATION AND MAINTENANCE DATA PACKAGES

Furnish the O&M data packages specified in individual technical sections. The required information for each O&M data package is as follows:

1.5.1 Data Package

- a. Safety precautions
- b. Operator prestart
- c. Startup, shutdown, and post-shutdown procedures
- d. Normal operations
- e. Emergency operations
- f. Environmental conditions
- g. Lubrication data
- h. Preventive maintenance plan and schedule
- i. Cleaning recommendations
- j. Troubleshooting guides and diagnostic techniques
- k. Wiring diagrams and control diagrams
- l. Maintenance and repair procedures
- m. Removal and replacement instructions
- n. Spare parts and supply list
- o. Product submittal data
- p. O&M submittal data
- q. Parts identification
- r. Warranty information
- s. Testing equipment and special tool information

t. Testing and performance data

u. Contractor information

PART 2 PRODUCTS Not Used

PART 3 EXECUTION Not Used

-- End of Section --

SECTION 02 4115 - ELECTRICAL DEMOLITION

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. REMOVAL OF EXISTING ELECTRICAL EQUIPMENT, WIRING, AND CONDUIT IN AREAS TO BE REMODELED; REMOVAL OF DESIGNATED CONSTRUCTION; DISMANTLING, CUTTING AND ALTERATIONS FOR COMPLETION OF THE WORK.
- B. DISPOSAL OF MATERIALS.
- C. STORAGE OF REMOVED MATERIALS.
- D. IDENTIFICATION OF UTILITIES.
- E. REMOVAL OF SALVAGED ITEMS.
- F. PROTECTION OF ITEMS TO REMAIN AS INDICATED ON DRAWINGS.
- G. RELOCATE EXISTING ELECTRICAL EQUIPMENT TO ACCOMMODATE CONSTRUCTION.

1.2 SUBMITTALS

- 1. NONE.

1.3 REGULATORY REQUIREMENTS

- A. CONFORM TO REQUIREMENTS OF THE *NATIONAL ELECTRICAL CODE (NEC)*, OSHA, NFPA 70E – *STANDARD FOR ELECTRICAL SAFETY IN THE WORKPLACE*.
- B. EACH PERSON PERFORMING ELECTRICAL DEMOLITION SHALL BE A “QUALIFIED PERSON” AS DEFINED BY NFPA 70E AND THE NEC.
- C. THE FOLLOWING PUBLICATIONS FORM A PART OF THIS SPECIFICATION TO THE EXTENT REFERENCED.
 - 1. ENVIRONMENTAL PROTECTION AGENCY (EPA).
40 CFR Part 761, *Polychlorinated Biphenyls (PCBs) Manufacturing, Processing, Distribution in Commerce, and Use Prohibitions*.
40 CFR Part 273, *Standards for Universal Waste Management*.
 - 2. U.S. DEPARTMENT OF LABOR, OCCUPATIONAL SAFETY AND HEALTH ADMINISTRATION (OSHA):
29 CFR Part 1910.94 Subpart G, *Occupational Health and Environmental Control*.

3. DEPARTMENT OF TRANSPORTATION (DOT):

49 CFR Part 178, *Regulations for Shipping Container Specifications.*

1.4 COORDINATION

- A. CONDUCT DEMOLITION TO MINIMIZE INTERFERENCE WITH ADJACENT AND OCCUPIED BUILDING AREAS.
- B. COORDINATE AND SEQUENCE DEMOLITION SO AS NOT TO CAUSE SHUTDOWN OF OPERATION OF SURROUNDING AREAS.
- C. SHUT-DOWN PERIODS:
 - 1. ARRANGE TIMING OF ELECTRICAL SHUT-DOWN PERIODS WITH THE OWNER. DO NOT SHUT DOWN ANY UTILITY WITHOUT PRIOR WRITTEN APPROVAL.
 - 2. KEEP SHUT-DOWN PERIOD TO MINIMUM OR USE INTERMITTENT PERIOD AS DIRECTED BY THE OWNER.
 - 3. MAINTAIN LIFE-SAFETY SYSTEMS IN FULL OPERATION IN OCCUPIED FACILITIES, OR PROVIDE NOTICE MINIMUM 3 DAYS IN ADVANCE.
- D. IDENTIFY SALVAGE ITEMS IN COOPERATION WITH THE OWNER.

PART 2 PRODUCTS

2.1 MATERIALS AND EQUIPMENT

- A. PROVIDE MATERIALS AND EQUIPMENT FOR PATCHING AND EXTENDING WORK AS SPECIFIED IN THE INDIVIDUAL SECTIONS.

PART 3 EXECUTION

3.2 EXAMINATION

- A. BEFORE WORK BEGINS ON THE DEMOLITION OR SALVAGE OF ELECTRICAL EQUIPMENT, WIRING, OR SYSTEMS:
 - 1. INSPECT THE SITE TO IDENTIFY ANY HAZARDOUS MATERIALS SUCH AS PCBS, ASBESTOS, LEAD, MERCURY OR OTHER HEAVY METAL, OR TOXIC, FLAMMABLE OR EXPLOSIVE MATERIALS, OR RADIOACTIVE MATERIALS THAT MAY BE HANDLED, DISTURBED OR REMOVED. TYPICAL LOCATIONS OF HAZARDOUS MATERIALS INCLUDE:
 - a. PCBs: Oil-filled transformers; potting material and/or capacitors in lighting ballasts; oil-filled capacitors associated with motors, UPS systems, voltage regulators, power-factor correction equipment

- b. Asbestos: Electrical insulation
 - 2. HAVE THE INSPECTION RESULTS AVAILABLE AT THE WORKSITE, INCLUDING ANY DRAWINGS, PLANS OR SPECIFICATIONS, AS APPROPRIATE, TO SHOW THE LOCATIONS OF ANY HAZARDOUS SUBSTANCES.
 - 3. ENSURE THAT ANY HAZARDOUS MATERIALS FOUND ARE SAFELY CONTAINED OR REMOVED.
 - 4. DURING DEMOLITION WORK, IF HAZARDOUS MATERIALS ARE DISCOVERED THAT WERE NOT IDENTIFIED IN THE INITIAL INSPECTION REQUIRED ABOVE, STOP WORK IN THE AREA AND NOTIFY THE OWNER. DO NOT RESUME WORK IN THE AREA UNTIL DIRECTED BY THE OWNER.
- B. VERIFY WIRING AND EQUIPMENT INDICATED TO BE DEMOLISHED SERVE ONLY ABANDONED FACILITIES.
- C. VERIFY TERMINATION POINTS AND LOCKOUT-TAGOUT DEVICE LOCATIONS FOR SERVICES, CIRCUITS, AND SYSTEMS TO BE DISCONNECTED OR REMOVED.
- D. DEMOLITION DRAWINGS ARE BASED ON CASUAL FIELD OBSERVATION AND/OR EXISTING RECORD DOCUMENTS. REPORT DISCREPANCIES TO THE OWNER BEFORE BEGINNING DEMOLITION WORK.
- E. BEGINNING OF DEMOLITION WORK MEANS SUBCONTRACTOR ACCEPTS EXISTING CONDITIONS.

3.3 PREPARATION

- A. PROTECT EXISTING MATERIALS, APPURTENANCES AND EQUIPMENT WHICH ARE NOT TO BE DEMOLISHED. REPAIR OR REPLACE EXISTING MATERIALS, APPURTENANCES AND EQUIPMENT, BUILDING EXTERIOR AND INTERIOR, AND LANDSCAPING ALTERED OR DAMAGED DURING DEMOLITION WORK TO MATCH EXISTING UNDISTURBED CONDITIONS AT NO ADDITIONAL COST TO THE OWNER.
- B. ERECT, AND MAINTAIN TEMPORARY SAFEGUARDS, INCLUDING WARNING SIGNS AND LIGHTS, BARRICADES, AND SIMILAR MEASURES, FOR PROTECTION OF THE PUBLIC, MAINTENANCE PERSONNEL, SUBCONTRACTOR'S EMPLOYEES, AND EXISTING IMPROVEMENTS TO REMAIN.
- C. MAINTAIN PARKING AREAS, DRIVEWAYS, EXTERIOR WALKWAYS, EXIT PATHS, AND LANDSCAPING IN A CLEAN, UNDISTURBED CONDITION.
- D. COORDINATE UTILITY SERVICE OUTAGES WITH THE OWNER.
 - 1. REQUEST UNDERGROUND UTILITIES TO BE LOCATED AND MARKED WITHIN AND SURROUNDING CONSTRUCTION AREAS.

2. PROTECT UTILITIES INDICATED TO REMAIN, FROM DAMAGE.

E. EXISTING LOW-VOLTAGE ELECTRICAL SERVICE: MAINTAIN EXISTING LOW-VOLTAGE (E.G. 480 V, 208 V) ELECTRICAL SERVICE SYSTEM IN OPERATION UNTIL NEW SERVICE SYSTEM IS COMPLETE AND READY FOR OPERATION. DISABLE SERVICE SYSTEM ONLY TO MAKE SWITCHOVERS AND CONNECTIONS. OBTAIN PERMISSION FROM THE OWNER AT LEAST 3 WORKING DAYS BEFORE PARTIALLY OR COMPLETELY DISABLING SYSTEM. MINIMIZE OUTAGE DURATIONS. IF REQUIRED, MAKE TEMPORARY CONNECTIONS TO MAINTAIN SERVICE IN AREAS ADJACENT TO WORK AREA.

3.4 DEMOLITION AND EXTENSION OF EXISTING ELECTRICAL WORK

A. DEMOLISH, RELOCATE, AND EXTEND EXISTING ELECTRICAL WORK TO INSTALLATIONS TO ACCOMMODATE NEW CONSTRUCTION.

B. ESTABLISH AN ELECTRICALLY SAFE WORK CONDITION IN AREAS WHERE ELECTRICAL WORK IS TO BE REMOVED.

1. DISCONNECT, REMOVE, AND CAP DESIGNATED UTILITY LINES WITHIN DEMOLITION AREAS. MARK LOCATIONS OF DISCONNECTED UTILITIES. IDENTIFY UTILITIES AND INDICATE CAPPING LOCATIONS ON PROJECT RECORD DOCUMENTS.

C. PROTECT AND RETAIN POWER TO EXISTING ACTIVE EQUIPMENT THAT IS TO REMAIN.

1. MAINTAIN ACCESS TO EXISTING ELECTRICAL INSTALLATIONS WHICH REMAIN ACTIVE. MODIFY INSTALLATION OR PROVIDE ACCESS PANEL AS APPROPRIATE.

2. INSTALL TEMPORARY WIRING AND CONNECTIONS TO MAINTAIN EXISTING SYSTEMS IN SERVICE DURING CONSTRUCTION.

D. CAREFULLY REMOVE EQUIPMENT, MATERIALS, OR FIXTURES WHICH ARE TO BE REUSED. STORE AND PROTECT TO PREVENT DAMAGE.

1. DISCONNECT, REMOVE, OR RELOCATE EXISTING ELECTRICAL MATERIAL AND EQUIPMENT INTERFERING WITH NEW INSTALLATION.

E. REMOVE ELECTRICAL FIXTURES, EQUIPMENT, AND RELATED SWITCHES, OUTLETS, CONDUIT AND WIRING WHICH ARE NOT PART OF FINAL PROJECT.

1. REMOVE ITEMS IN AN ORDERLY AND CAREFUL MANNER.

2. REMOVE ABANDONED WIRING TO PANELBOARD CIRCUIT BREAKER OR SOURCE OF SUPPLY.

3. REMOVE EXPOSED ABANDONED RACEWAYS, INCLUDING ABANDONED RACEWAYS ABOVE ACCESSIBLE CEILING FINISHES. CUT RACEWAYS FLUSH WITH WALLS AND FLOORS, SEAL OPENINGS, AND PATCH SURFACES.
 4. DISCONNECT ABANDONED OUTLETS AND REMOVE DEVICES. REMOVE ABANDONED OUTLETS IF CONDUIT SERVICING THEM IS ABANDONED AND REMOVED. PROVIDE BLANK COVER FOR ABANDONED OUTLETS WHICH ARE NOT REMOVED.
 5. REMOVE EXPOSED ABANDONED FASTENERS AND SUPPORTS. CUT EMBEDDED SUPPORT ELEMENTS FLUSH WITH WALLS AND FLOORS.
- F. DISCONNECT AND REMOVE THE FOLLOWING EQUIPMENT, WIRING, AND APPURTENANCES AS LISTED BELOW AND AS INDICATED IN THE DRAWINGS. RACEWAYS TO BE CLEANED AND REUSED WHERE INDICATED IN DRAWINGS.
1. EXHAUST FANS
 - a. EF-1
 - b. EF-2
 - c. EF-3
 - d. EF-4
 - e. EF-5
 - f. EF-7
 2. THERMOSTATS
 3. ROOF TOP UNITS (RTU)
 - a. RTU-1
 - b. RTU-2
 - c. RTU-3
 - d. RTU-4
 - e. RTU-5
 - f. RTU-6
 - g. RTU-7
 - h. RTU-8
 4. FUSED DISCONNECT SWITCHES

- G. PROVIDE PROPER AND PERMANENT SUPPORT TO ADJACENT STRUCTURE FOR ALL RACEWAYS AND EQUIPMENT TO REMAIN.
- H. REPAIR ADJACENT CONSTRUCTION AND FINISHES DAMAGED DURING DEMOLITION AND EXTENSION WORK.
 - 1. PATCH AND SEAL UNUSED EXISTING WALL PENETRATIONS TO MATCH EXISTING CONDITIONS AND TO RESTORE FIRE RATING.
- I. EXTEND EXISTING INSTALLATIONS USING MATERIALS AND METHODS COMPATIBLE WITH EXISTING ELECTRICAL INSTALLATIONS, OR AS SPECIFIED. THIS INCLUDES THE EXTENSION OF THE CIRCUIT FROM THE LAST ACTIVE DEVICE TO THE NEXT DEVICE IN THE SYSTEM TO BE ACTIVATED.
 - 1. RECONNECT EQUIPMENT BEING DISTURBED BY RENOVATION WORK AND REQUIRED FOR CONTINUED SERVICE TO ITS ORIGINAL SOURCE.
- J. INVESTIGATE AND MEASURE THE NATURE AND EXTENT OF UNANTICIPATED ITEMS THAT CONFLICT WITH INTENDED FUNCTION OR DESIGN. SUBMIT WRITTEN REPORT WITH ACCURATE DETAILED INFORMATION TO THE OWNER. WHILE AWAITING INSTRUCTIONS FROM THE OWNER, REARRANGE SELECTIVE DEMOLITION SCHEDULE AS NECESSARY TO CONTINUE OVERALL JOB PROGRESS WITHOUT DELAY.
- K. REMOVE DEMOLISHED MATERIALS AS WORK PROGRESSES.

3.5 EXISTING ELECTRICAL DISTRIBUTION EQUIPMENT

- A. VERIFY AND IDENTIFY LOADS SERVED BY CIRCUITS IN EXISTING ELECTRICAL DISTRIBUTION EQUIPMENT (E.G. SWITCHGEAR, SWITCHBOARDS, MOTOR CONTROL CENTERS, PANELBOARDS) AFFECTED BY THE WORK. WHERE ADDITIONAL CIRCUITS ARE NEEDED, REUSE CIRCUITS AVAILABLE FOR REUSE. INSTALL NEW CIRCUIT BREAKERS AS REQUIRED.
- B. TAG UNUSED CIRCUITS AS SPARE.
- C. WHERE EXISTING CIRCUITS ARE INDICATED TO BE REUSED, USE MEASURING DEVICES TO VERIFY CIRCUITS FEEDING PROJECT AREA ARE NOT IN USE.
- D. REMOVE EXISTING WIRE NO LONGER IN USE FROM DISTRIBUTION EQUIPMENT TO EQUIPMENT.
- E. RE-LABEL CIRCUIT BREAKERS, SWITCHES, AND CONTROLLERS TO INDICATE LOADS SERVED. PROVIDE NEW, UPDATED CIRCUIT DIRECTORIES WHERE MORE THAN THREE CIRCUITS IN A PANELBOARD HAVE BEEN MODIFIED OR REWIRED.

3.6 CLEANING AND REPAIR

- A. CLEAN AND REPAIR EXISTING MATERIALS AND EQUIPMENT WHICH REMAIN OR ARE TO BE REUSED.
- B. ELECTRICAL DISTRIBUTION EQUIPMENT: CLEAN EXPOSED SURFACES AND CHECK TIGHTNESS OF ELECTRICAL CONNECTIONS. REPLACE DAMAGED CIRCUIT BREAKERS AND PROVIDE APPROVED CLOSURE PLATES FOR VACANT POSITIONS.

3.7 DISPOSITION OF MATERIAL AND EQUIPMENT

- A. REMOVE AND PROTECT ITEMS INDICATED ON DRAWINGS TO BE SALVAGED AND DELIVER IN GOOD CONDITION TO THE OWNER.
- B. UNLESS INDICATED OTHERWISE, MATERIAL REMOVED UNDER THIS SUBCONTRACT WHICH IS NOT TO BE SALVAGED OR REUSED IN THE PROJECT SHALL BECOME THE PROPERTY OF THE SUBCONTRACTOR.
- C. UNLESS INDICATED OTHERWISE, IMMEDIATELY REMOVE DEMOLISHED MATERIAL FROM SITE. DO NOT STORE OR PERMIT DEBRIS TO ACCUMULATE AT THE SITE. DISPOSE OF MATERIALS LEGALLY OFF SITE. DO NOT BURN OR BURY MATERIALS ON SITE.
- D. UPON COMPLETION, CLEAN THE ENTIRE AREA OF DEMOLITION RESIDUE SATISFACTORY FOR THE CONTINUATION OF THE WORK. REMOVE TEMPORARY WORK.

3.8 INSTALLATION OF RELOCATED EQUIPMENT

- A. INSTALL RELOCATED MATERIALS AND EQUIPMENT UNDER THE PROVISIONS OF THE APPLICABLE SECTIONS OF THESE SPECIFICATIONS.

END OF SECTION

SECTION 03 1534 – POST INSTALLED CONCRETE ANCHORS – NORMAL CONFIDENCE

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. The technical requirements for purchasing post-installed concrete anchors for Performance Category (PC)-1 and PC-2 structures, systems, and components (SSC). This specification applies to expansion, adhesive, undercut, and screw.
- B. The technical requirements for field installation and inspection of post-installed (PI) anchors (including anchor systems consisting of steel reinforcing bars/dowels and grout) in concrete for PC-1 and 2 SSCs. The inspection requirements of this Section do not apply to non-structural anchors.
- C. Does not cover cast-in-place anchors, design of post-installed anchorage, or purchase of tools or equipment required for installation or testing.

1.2 DEFINITIONS

Definitions of anchors per ACI 355.2 (as amended by ICC AC 193) apply, and all notations are identical to those used in that document and in ACI 318 Appendix D. Where additional terms or notations are used, their definitions are included in this Section.

Non-structural anchors are those that anchor PC-1 mechanical and electrical components with flexible connections between the components and associated distribution system (e.g., ductwork, piping, conduit, etc.), and can be categorized under one of the following conditions:

- 1. Mounted at 4 ft or less above a floor level and weigh 400 lb or less, or
- 2. Weigh 20 lb or less, or
- 3. Weigh 5 lb/ft or less if the component(s) is a distribution system.

1.3 REFERENCES

| | |
|------------|---|
| ACI 355.2 | Qualification of Post-Installed Mechanical Anchors in Concrete |
| ACI 355.4 | Qualification of Post-Installed Adhesive Anchors in Concrete (ACI 355.4) and Commentary |
| ACI 318 | Building Code Requirements for Structural Concrete and Commentary |
| ASTM A 36 | Standard Specification for Carbon Steel |
| ASTM A 193 | Standard Specification for Alloy-Steel Bolting Materials for High-Temperature or High Pressure Service and Other Special Purpose Applications |
| ASTM A 615 | Standard Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement |
| ASTM B633 | Standard Specification for Electrodeposited Coatings of Zinc on Iron and Steel |
| ASTM C 928 | Standard Specification for Packaged, Dry, Rapid-Hardening Cementitious Materials for Concrete Repairs |

| | |
|--------------|---|
| ASTM E488 | Standard Test Methods for Strength of Anchors in Concrete and Masonry Elements |
| ASTM E1512 | Standard Specification for Testing Bond Performance of Bonded Anchors |
| ASTM F 436 | Standard Specification for Hardened Steel Washers |
| DOE-STD-1021 | Natural Phenomena Hazards Performance Categorization Guidelines for Structures, Systems, and Components |
| IBC | International Building Code |

Other ICC Documents

| | |
|----------------|---|
| ICC ES Reports | International Code Council Evaluation Services Reports (ESRs)* |
| ICC ESR-1545 | Hilti HSL-3 Carbon Steel Metric Heavy Duty Concrete Anchors in Concrete (August 2005 or later) |
| ICC ESR-1546 | Hilti HDA Carbon Steel and Stainless Steel Metric Undercut Anchors in Concrete (November 2005 or later) |
| ICC ESR-1917 | Hilti Kwik Bolt TZ Carbon and Stainless Steel Anchors in Concrete (September 2005 or later) |
| ICC ESR-2322 | Hilti HIT-RE 500-SD Adhesive Anchor Systems (November 2007 or later) |
| ICC ESR-3187 | Hilti HIT-HY 200 Adhesive Anchoring System (March 2013 or later) Hilti Kwik HUS-EZ Carbon Steel Screw Anchors for Use in Cracked and Uncracked Concrete (December 2010 or later) |
| ICC ESR-3027 | |
| ICC AC 193 | Acceptance Criteria for Mechanical Anchors in Concrete Elements |
| ICC AC 308 | Acceptance Criteria for Post-installed Adhesive Anchors in Concrete Elements |

* The ESR's Scope must include the specific edition of the IBC applicable to the project.

1.4 SUBMITTALS

A. Verification Documents

The following verification documentation shall be submitted by the supplier for any anchors not in Table 2.1, Approved Anchors:

1. Submit the ICC-ES Evaluation Report (ESR) for each product.
2. Submit technical documentation of the product, including, but not limited to: anchor design strength in shear and tension, minimum spacing and edge distances, anchor dimensions, materials and coatings used, installation instructions, and all required design parameters.
3. Submit shipping, handling, and packaging procedures as described in Para 1.6 below.
4. Submit cleaning and coating documentation for review.
5. Submit quality assurance program to meet requirements of Para 1.5.

6. Certificates of Compliance certifying that the anchors meet the requirements of this specification.

1.5 QUALITY ASSURANCE

- A. All material shall be procured as commercial material. The same quality assurance requirements shall be passed down to any lower tier subcontractor.
- B. The design (and installation) shall be in full compliance with the “Conditions of Use” section of applicable ICC-ESR reports.
- C. The inspection, testing, and documentation requirements for same contained herein are the responsibility of the Subcontractor installing PI anchors.

1.6 PACKAGING, SHIPPING, HANDLING, AND STORAGE

- A. Establish and maintain controls for material handling and storage during fabrication and preparation for shipment to prevent damage and deterioration.
- B. Prior to packaging an item, remove dirt, oil residue, water, metal chips, or other contamination.
- C. If nuts, washers, sleeves and anchors are packaged and shipped unassembled, any components that are damaged during handling, shipping & storage, or that don't fit properly (upon assembly during anchor installation), shall be replaced at no cost to the owner
- D. Bolting of different types and/or different sizes shall be packaged separately.

PART 2 PRODUCTS

- 2.1. Anchor types including nuts and washers: expansion, adhesive, and undercut and their intended Natural Phenomena Hazards (NPH) Performance Category.

**Table 2.1
Approved Anchors**

| Anchor Type | Manufacturer | Product Name | Acceptance Report | NPH Performance Category |
|-------------------|--------------|---------------|-------------------|--------------------------|
| Expansion: | | | | |
| Drop-in | not allowed | n/a | n/a | n/a |
| Heavy-Duty Sleeve | Hilti | HSL-3 | <u>ESR-1545</u> | PC-1 and PC-2 |
| Wedge | Hilti | Kwik Bolt TZ | <u>ESR-1917</u> | PC-1 and PC-2 |
| Adhesive | Hilti | HIT-RE 500-SD | <u>ESR-2322</u> | PC-1 and PC-2 |
| Adhesive | Hilti | HIT-HY 200 | <u>ESR-3187</u> | PC-1 and PC-2 |

| Anchor Type | Manufacturer | Product Name | Acceptance Report | NPH Performance Category |
|-------------|--------------|------------------------|-------------------|----------------------------|
| Screw | Hilti | Kwik HUS-EZ | <u>ESR-3027</u> | PC-1 and PC-2 |
| Undercut | Hilti | HDA | <u>ESR-1546</u> | PC-1 and PC-2 |
| Undercut | Drillco | Maxi-Bolt ¹ | See below | PC-3 and PC-4 ² |

¹For Drillco Maxi-Bolts, -type and flush-mount (coupling-type) are acceptable.

²PC-3 and PC-4 anchors may also be used in lower NPH Performance Category installations.

2.2. SUPPLY ANCHOR PRODUCTS OF THE FOLLOWING TYPES:

- A. Mechanical anchors: undercut, expansion (heavy-duty sleeve, and wedge), and screw anchors.
- B. All material shall be commercial material.
- C. All anchors shall have a current ICC-ES Evaluation Service Report that contains recommended design capacities. Load tests used in the ICC-ES Reports shall be performed in accordance with ICC AC 193 and ASTM E488 for mechanical anchors; AC 308; and ASTM E1512 for adhesive anchors.
- D. Provide carbon steel or stainless steel anchors as specified. Submit documentation of materials used.
- E. Outdoor anchors, or those used in a moist environment, shall be of a material, or possess a protective coating, compliant with the associated Condition of Use in the respective ICC-ES Report.
- F. Anchor head shall be stamped, or otherwise permanently marked, with the total anchor length of a length code that can be related to the total anchor length.
- G. Drypack mortar: Packaged, dry, rapid-hardening concrete or mortar in accordance with ASTM C928; 7-day strength of 4,000 psi.
- H. Concrete reinforcing steel (rebar /dowel): ASTM A 615, grade 60 deformed bars

2.3. TEST AND INSPECTIONS

- A. The bolt supplier is responsible for performing inspections, as necessary to ensure compliance with all material and documentation requirements identified in this Specification. Documentations of inspections will be available to owner if requested.
- B. Materials that are not properly marked, have poor workmanship, are corroded, have defective threads, or are improperly documented shall be rejected.

PART 3 EXECUTION

3.1 INSTALLERS

- A. Implement and document a training and/or qualification program for installers. Installers must be made fully familiar with the manufacturer's installation procedures, additions from the associated ESRs, and additional requirements as noted in this Section (follow most stringent).

3.2 EXAMINATION/SITE VERIFICATION OF CONDITIONS

- A. The use of anchors shall be restricted to the applications and installations defined in the design drawings. Construction aids are exempt from this requirement.
- B. Anchors may only be installed in 14-day or older concrete that has attained its minimum specified design strength.
- C. Anchors may only be installed in sound concrete. Surfaces showing obvious distress by way of porosity, disintegration, carbonation and cracks over 0.02 inches in width and 12 inches or longer and within the distance of the embedment depth shall be reported to the Engineer of Record (EOR) for evaluation.
- D. Anchors must not be drilled into the bottom of precast and post-tensioned T-beam stems. Drilling into the sides of the T-beam stems shall be specifically pre-approved by the EOR. Strand-cutting/nicking is prohibited.

3.3 PREPARATION

- A. Use of a rebar locator or drilling pilot holes is recommended to establish the rebar pattern before drilling in congested areas. Pilot holes shall be drilled with a carbide-tip bit to avoid rebar damage.
- B. For safety, consider drill bits/drills that automatically shut off when the bit hits metal, particularly in older construction for which electrical configuration is not well-documented.
- C. Rebar cutting is only permitted with pre-approval by the EOR. Multi-cutting of the same bar is considered as one cut. Rebar approved to be cut must be shown on as-built drawings at completion of Project.
- D. Rebar will be considered to be cut if:
 - 1. For #4 through #7 – Cuts, nicks, or drill into bar body is greater than 1/16"
 - 2. For #8 and larger – Cuts, nicks, or drill into bar body is greater than 1/8"
- E. When installing anchors through cut rebar, the anchoring mechanism shall be located at least two anchor diameters clear beyond the cut rebar.

3.4 INSTALLATION

- A. Each anchor must be installed in the location, at the spacing, and with the embedment depth and edge distance(s) indicated on the project drawings, and in accordance with, in priority order, 1) this Section, 2) the ESR, 3) the manufacturer's installation instructions.
- B. Drill holes and install anchors in accordance with the ESR.
- C. Clean drilled holes of chips, dust, loose material, and water prior to anchor installation. The hole diameters and depths shall be as those required by the ESR. Verify depth of the concrete member before drilling holes. The embedment depth of the anchor must be in accordance with the ESR and the project drawings. Contact the EOR if these requirements conflict.
- D. Anchors must be installed perpendicular to the concrete surface within a ± 5 degree tolerance. Post-installation verification of this criterion may be satisfied by visual inspection to verify proper seating of the nut and washer. When an anchor is replaced with an anchor of diameter one size larger, maintain the spacing requirements of the original size anchor.
- E. In areas where concrete has been removed, the minimum anchor embedment must be measured from the surface of sound concrete.
- F. Unless otherwise noted on project drawings, use the spacing requirements per the ESR. For an anchor located adjacent to a PC-3 or PC-4 anchor or embedded item, use a spacing equal to the sum of 1.5 times the embedment depth of one anchor plus 1.5 times the embedment depth of the other anchor, unless otherwise approved by the EOR.
- G. Bending and welding of post-installed anchors, except grouted anchors, are not permitted.
- H. The nut thread engagement for the anchors (studs) shall be such that the bolt threads are flush with or project beyond the outside face of the nut when completely installed.
- I. Nuts and washers for anchors that are lost or damaged during installation shall be replaced with manufacturer's specified component or equivalent as pre-approved by the EOR.
- J. Flat washers supplied with anchors shall be used in all cases except where details of the design drawings specify the use of another washer under the nuts. A washer may be trimmed to clear interferences. The trimmed edge shall not be closer than 7/8 of the bolt diameter from the center of the washer (ref. ASTM F436).
- K. Unused adhesive anchors shall be cutoff flush with the surface of the concrete. Unused mechanical anchors shall be driven in and cut-off flush. Cut-off anchors shall be considered an abandoned unrepaired hole for future anchor spacing requirements.
- L. The center-to-center distance between a new hole and an exploratory or unused hole or an abandoned cut-off anchor shall not be less than three times the diameter of the larger hole or 1" of clear concrete between the holes, whichever is greater, unless approved by the

EOR. When exploratory or unused holes are repaired (ref. para. 3.8.A) and the repair material has attained the strength of the surrounding concrete, the center-to-center distance shall not be less than 1.5 times the diameter of the larger hole or 1" of clear concrete between holes, whichever is greater, unless approved by the EOR.

- M. Anchors may be installed in the upper and lower flutes of metal decking, as indicated on project drawings. Edge distance(s), embedment depth, spacing, etc. must be in accordance with the ESR. Contact the EOR if any of these requirements conflict with project drawings. If an installation requires the use of an attachment plate that spans deck ribs then the space between the decking and attachment plate must not be filled with grout or concrete or any other material except that spray-applied fire-resistive materials are permitted.
- N. Exercise care to avoid bending anchors to match baseplate holes, or loosening of anchors by prying sideways after tightening. Also ensure that the cone nut of an undercut anchor does not become loose from the stud during the setting or tensioning operation.
- O. Anchors that must be tensioned (via torque or direct tension) in order to be properly set /installed must not be used with leveling nuts placed under mounting plates (in order to preclude interference with pretensioning of the anchor).
- P. Relocating holes within baseplate: The baseplate with bolts may be relocated no more than 1" in any direction with respect to the attachment principal axis, unless otherwise noted on the engineering drawings.

3.5 INSPECTION

- 1. Visually inspect anchors in order to verify and document that they have been installed in accordance with Articles 3.4 and 3.5 as applicable. Attributes requiring inspection are those shown in Table 3.1 plus any additional attributes imposed by this Section and the EOR. These attributes must be identified in the inspection report documentation.
- 2. If visual inspection reveals that the installed anchor does not meet the requirements of this Section, the anchor shall be relocated as permitted by this Section, or shall be removed and replaced by another anchor, or referred to the EOR for evaluation.

Table 3.1 Required Inspection Attributes

For attribute definitions / details above and beyond footnote contents, refer to ESR, manufacturer's installation instructions, and, where indicated in parenthesis, previous portions of this Section.

| Inspection Attribute | | Wedge and Screw | Heavy Duty Sleeve | Adhesive | Undercut |
|----------------------|--|-----------------|-------------------|----------|----------|
| 1 | Anchor / Anchor system ¹ type / description | ✓ | ✓ | ✓ | ✓ |
| 2 | Anchor / Anchor element dimensions | ✓ | ✓ | ✓ | ✓ |
| 3 | Concrete type (normal- vs. light-weight) ² | ✓ | ✓ | ✓ | ✓ |

| Inspection Attribute | | Wedge and Screw | Heavy Duty Sleeve | Adhesive | Undercut |
|----------------------|---|-----------------|-------------------|----------|----------|
| 4 | Concrete compressive strength ² | ✓ | ✓ | ✓ | ✓ |
| 5 | Concrete thickness ² | ✓ | ✓ | ✓ | ✓ |
| 6 | Anchor spacing(s) | ✓ | ✓ | ✓ | ✓ |
| 7 | Edge distance(s) | ✓ | ✓ | ✓ | ✓ |
| 8 | Adhesive expiration date | | | ✓ | |
| 9 | Drill and/or drill bit type, size, power, etc. ³ | ✓ | ✓ | ✓ | ✓ |
| 10 | Drilled hole cleaning (3.4.D) | ✓ | ✓ | ✓ | ✓ |
| 11 | Drilled hole dimensions | ✓ | ✓ | ✓ | ✓ |
| 12 | Steel deck hole dia. ≤ concrete hole dia. + 1/8" ⁴ | ✓ | | | |
| 13 | Adherence to manufacturer's installation instructions | ✓ | ✓ | ✓ | ✓ |
| 14 | Anchor embedment | ✓ | ✓ | ✓ | ✓ |
| 15 | Minimum installation torque | ✓ | ✓ | | |
| 16 | Maximum installation torque | | | ✓ | ✓ |
| 17 | Anchor perpendicular to concrete (3.4.E) | ✓ | ✓ | ✓ | ✓ |
| 18 | Nut thread engagement (3.4.I) | ✓ | ✓ | ✓ | ✓ |

¹Applies to both anchor element (i.e., steel threaded rod, reinforcing bar / rebar dowel, or insert) AND adhesive material.

²Refer to project drawings if not obvious or somehow otherwise known with certainty.

³Refer to ESR for requirements associated with hole (for anchor / rod / rebar / insert) drilling / coring.

⁴Applies to installation in the soffit of concrete-on-steel-deck assemblies.

NOTE: Attributes 1-9 are visually inspected prior to the start of the anchor installation process, 10-16 are verified during the process, and 17-18 are verified after the process is complete.

3.6 REPAIR/RESTORATION

- A. Repair abandoned holes with material specified in Para 2.2. Anchors installed near an abandoned repaired or unrepaired hole must be located as specified in Para 3.4.N. The repair material shall have strength greater than or equal to that of the surrounding concrete.

When anchors are not installed properly, the following repairs may be undertaken:

1. Remove the defective anchor, redrill hole and install the same diameter anchor if the integrity of surrounding concrete has not been disturbed.
2. For cases where excessive slippage upon torquing is experienced, or usage of the same hole is not possible, fill the existing hole with approved material as specified in Para 2.2 and relocate the anchor location as specified in Para 3.4.N.
3. If breakout of concrete around the anchor occurs during installation, the EOR must develop an appropriate repair. The EOR must be contacted to evaluate the damage and repair method. Local spalling of the concrete around the anchor, up to a maximum depth of 1/4 inch, is not considered a concrete breakout failure.
4. Mislocated anchors may be cut flush with concrete surface, and need not be removed if they do not interfere with subsequent installations.
5. Mislocated anchors or anchors installed for temporary applications may be left in place. Those anchors that must be removed to accommodate other attachments, aesthetics or safety of personnel, may be removed completely, or abandoned in place by cutting off beneath the surface after chipping the concrete 1" minimum, and patching with approved material (Para. 2.2). Mislocated anchors that will be covered by a baseplate or an attachment may be cut off flush with the concrete. In the event that an anchor must be removed from the hole and a new anchor installed, the removal and installation of the new anchor shall be in accordance with the manufacturer's specifications. The wedges of anchors that are "lost" during anchor removal may be abandoned in place. The abandoned hole or removed concrete shall be filled with approved material.
6. Removal of installed anchors for inspection or replacement may be performed using Bolt Extractor manufactured by Drillco Devices Ltd. or an equivalent.

END OF SECTION

SECTION TABLE OF CONTENTS
DIVISION 07 - THERMAL AND MOISTURE PROTECTION
SECTION 07 84 00 - FIRESTOPPING

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced.

The publications are referred to within the text by the basic designation only.

ASTM INTERNATIONAL (ASTM)

| | |
|-------------------|--|
| ASTM E119 | (2012a) Standard Test Methods for Fire Tests of Building Construction and Materials |
| ASTM E1399/E1399M | (1997; E 2013; R 2013) Cyclic Movement and Measuring the Minimum and Maximum Joint Widths of Architectural Joint Systems |
| ASTM E1966 | (2007; R 2011) Fire-Resistive Joint Systems |
| ASTM E2174 | (2010a; E 2011) Standard Practice for On-Site Inspection of Installed Fire Stops |
| ASTM E2307 | (2010) Standard Test Method for Determining Fire Resistance of Perimeter Fire Barrier Systems Using Intermediate-Scale, Multi-story Test Apparatus |
| ASTM E2393 | (2010a) Standard Practice for On-Site Inspection of Installed Fire Resistive Joint Systems and Perimeter Fire Barriers |
| ASTM E699 | (2009) Standard Practice for Evaluation of Agencies Involved in Testing, Quality Assurance, and Evaluating of Building Components |
| ASTM E814 | (2013a) Standard Test Method for Fire Tests of Through-Penetration Fire Stops |
| ASTM E84 | (2013a) Standard Test Method for Surface Burning Characteristics of Building Materials |

INTERNATIONAL CODE COUNCIL (ICC)

| | |
|---------|------------------------------------|
| ICC IBC | (2012) International Building Code |
|---------|------------------------------------|

UNDERWRITERS LABORATORIES (UL)

| | |
|--------------------|---|
| UL 1479 | (2003; Reprint Oct 2012) Fire Tests of Through-Penetration Firestops |
| UL 2079 | (2004; Reprint Dec 2012) Tests for Fire Resistance of Building Joint Systems |
| UL 723 | (2008; Reprint Aug 2013) Test for Surface Burning Characteristics of Building Materials |
| UL Fire Resistance | (2012) Fire Resistance Directory |

1.2 SYSTEM DESCRIPTION

1.2.1 General

Furnish and install tested and listed firestopping systems, combination of materials, or devices to form an effective barrier against the spread of flame, smoke and gases, and maintain the integrity of fire resistance rated walls, partitions, floors, and ceiling-floor assemblies, including through-penetrations and construction joints and gaps.

- a. Through-penetrations include the annular space around pipes, tubes, conduit, wires, cables and vents.
- b. Construction joints include those used to accommodate expansion, contraction, wind, or seismic movement; firestopping material shall not interfere with the required movement of the joint.

Gaps requiring firestopping include gaps between the curtain wall and the floor slab and between the top of the fire-rated walls and the roof or floor deck above and at the intersection of shaft assemblies and adjoining fire resistance rated assemblies.

1.2.2 Sequencing

Coordinate the specified work with other trades.

Apply firestopping materials, at penetrations of pipes and ducts, prior to insulating, unless insulation meets requirements specified for firestopping.

Apply firestopping materials, at building joints and construction gaps, prior to completion of enclosing walls or assemblies.

Cast-in-place firestop devices shall be located and installed in place before concrete placement. Pipe, conduit or cable bundles shall be installed through cast-in-place device after concrete placement but before area is concealed or made inaccessible.

Firestop material shall be inspected and approved prior to final completion and enclosing of any assemblies that may conceal installed firestop.

1.2.3 Submittals Requirements

- a. Submit detail drawings including manufacturer's descriptive data, typical details conforming to UL Fire Resistance or other details certified by another nationally recognized testing laboratory, installation instructions or UL listing details for a firestopping assembly in lieu of fire-test data or report.

For those firestop applications for which no UL tested system is available through a manufacturer, a manufacturer's engineering judgment, derived from similar UL system designs or other tests, shall be submitted for review and approval prior to installation.

Submittal shall indicate the firestopping material to be provided for each type of application.

When more than a total of 5 penetrations and/or construction joints are to receive firestopping, provide drawings that indicate location, "F" "T" and "L" ratings, and type of application.

- b. Submit certificates attesting that firestopping material complies with the specified requirements.

For all intumescent firestop materials used in through penetration systems, manufacturer shall provide certification of compliance with UL 1479.

- c. Submit documentation of training and experience for Installer.
- d. Submit inspection report stating that firestopping work has been inspected and found to be applied according to the manufacturer's recommendations and the specified requirements.

1.3 SUBMITTALS

Submit the following:

SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Firestopping Materials

SD-06 Test Reports

Inspection

SD-07 Certificates

Inspector Qualifications

Firestopping Materials

Installer Qualifications

1.4 QUALITY ASSURANCE

1.4.1 Installer

Engage an experienced Installer who is:

- a. FM Research approved in accordance with FM 4991, operating as a UL Certified Firestop Contractor, or
- b. Certified, licensed, or otherwise qualified by the firestopping manufacturer as having the necessary staff, training, and a minimum of 3 years experience in the installation of manufacturer's products in accordance with specified requirements. A manufacturer's willingness to sell its firestopping products to

the Contractor or to an installer engaged by the Contractor does not in itself confer installer qualifications on the buyer.

The Installer shall have been trained by a direct representative of the manufacturer (not distributor or agent) in the proper selection and installation procedures. The installer shall obtain from the manufacturer written certification of training, and retain proof of certification for duration of firestop installation.

1.4.2 Inspector Qualifications

The inspector shall [meet the criteria contained in ASTM E699 for agencies involved in quality assurance and shall] have a minimum of two years experience in construction field inspections of firestopping systems, products, and assemblies. The inspector shall be completely independent of, and divested from, the installer, the manufacturer, and the supplier of any material or item being inspected.

The inspector shall not be a competitor of the installer, the contractor, the manufacturer, or supplier of any material or item being inspected.

Include in the qualifications submittal a notarized statement assuring compliance with the requirements stated herein.

1.5 DELIVERY, STORAGE, AND HANDLING

Deliver materials in the original unopened packages or containers showing name of the manufacturer and the brand name.

Store materials off the ground, protected from damage and exposure to elements and temperatures in accordance with manufacturer requirements.

Remove damaged or deteriorated materials from the site.

Use materials within their indicated shelf life.

PART 2 PRODUCTS

2.1 FIRESTOPPING MATERIALS

Provide firestopping materials, supplied from a single domestic manufacturer, consisting of commercially manufactured, asbestos-free, nontoxic products FM APP GUIDE approved, or UL listed, for use with applicable construction and penetrating items, complying with the following minimum requirements:

2.1.1 Fire Hazard Classification

Material shall have a flame spread of 25 or less, and a smoke developed rating of 50 or less, when tested in accordance with ASTM E84 or UL 723. Material shall be an approved firestopping material as listed in UL Fire Resistance or by a nationally recognized testing laboratory.

2.1.2 Toxicity

Material shall be nontoxic and carcinogen free to humans at all stages of application or during fire conditions and shall not contain hazardous chemicals or require harmful chemicals to clean material or equipment. Firestop material must be free from Ethylene Glycol, PCB, MEK, or other types of hazardous chemicals.

2.1.3 Fire Resistance Rating

Firestop systems shall be UL Fire Resistance listed or FM APP GUIDE approved with "F" rating at least equal to fire-rating of fire wall or floor in which penetrated openings are to be protected.

Where required, firestop systems shall also have "T" rating at least equal to the fire-rated floor in which the openings are to be protected. The City of San Diego Fire Marshall shall be consulted to determine further requirements.

2.1.3.1 Through-Penetrations Firestopping materials for through-penetrations, as described in paragraph SYSTEM DESCRIPTION, shall provide "F", "T" and "L" fire resistance ratings in accordance with ASTM E814 or UL 1479.

PART 3 EXECUTION

3.1 PREPARATION

Areas to receive firestopping shall be free of dirt, grease, oil, or loose materials which may affect the fitting or fire resistance of the firestopping system.

For cast-in-place firestop devices, formwork or metal deck to receive device prior to concrete placement shall be sound and capable of supporting device.

Prepare surfaces as recommended by the manufacturer.

3.2 INSTALLATION

Completely fill void spaces with firestopping material regardless of geometric configuration, subject to tolerance established by the manufacturer.

Firestopping systems for filling floor voids 100 mm 4 inches or more in any direction shall be capable of supporting the same load as the floor is designed to support or shall be protected by a permanent barrier to prevent loading or traffic in the firestopped area.

Install firestopping in accordance with manufacturer's written instructions. Provide tested and listed firestop systems in the following locations, except in floor slabs on grade:

- a. Penetrations of duct, conduit, tubing, cable and pipe through floors and through fire-resistance rated walls, partitions, and ceiling-floor assemblies.
- b. Penetrations of vertical shafts such as pipe chases, elevator shafts, and utility chutes.
- c. Gaps at the intersection of floor slabs and curtain walls, including inside of hollow curtain walls at the floor slab.

- d. Gaps at perimeter of fire-resistance rated walls and partitions, such as between the top of the walls and the bottom of roof decks.
- e. Construction joints in floors and fire rated walls and partitions.
- f. Other locations where required to maintain fire resistance rating of the construction.

3.2.1 Insulated Pipes and Ducts

Thermal insulation shall be cut and removed where pipes or ducts pass through firestopping, unless insulation meets requirements specified for firestopping.

Replace thermal insulation with a material having equal thermal insulating and firestopping characteristics.

3.2.2 Fire Dampers

Install and firestop fire dampers in accordance with Section 23 00 00 AIR SUPPLY, DISTRIBUTION, VENTILATION, AND EXHAUST SYSTEM.

Firestop installed with fire damper must be tested and approved for use in fire damper system.

Firestop installed with fire damper must be tested and approved for use in fire damper system.

3.2.3 Data and Communication Cabling

Cabling for data and communication applications shall be sealed with re-enterable firestopping [products] [devices] [products and devices as indicated].

3.2.3.1 Re-Enterable Devices

Firestopping devices shall be pre-manufactured modular devices, containing built-in self-sealing intumescent inserts.

Firestopping devices shall allow for cable moves, additions or changes without the need to remove or replace any firestop materials.

Devices must be capable of maintaining the fire resistance rating of the penetrated membrane at 0 percent to 100 percent visual fill of penetrants; while maintaining "L" rating of <10 cfm/sf [measured at ambient temperature and 400* F] at 0 percent to 100 percent visual fill.

3.2.3.2 Re-Sealable Products

Provide firestopping pre-manufactured modular products, containing self-sealing intumescent inserts.

Firestopping products shall allow for cable moves, additions or changes.

Devices shall be capable of maintaining the fire resistance rating of the penetrated membrane at 0 percent to 100 percent visual fill of penetrants.

3.3 INSPECTION

3.3.1 General Requirements

For all projects, [the remainder of][the firestopped areas] shall not be covered or enclosed until inspection is complete and approved by the Contracting Officer. [The inspector shall inspect] [Inspect] the applications initially to ensure adequate preparations (clean surfaces suitable for application, etc.) and periodically during the work to assure that the completed work has been accomplished according to the manufacturer's written instructions and the specified requirements.

Submit written reports indicating locations of and types of penetrations and types of firestopping used at each location; type shall be recorded by UL listed printed numbers.

3.3.2 Inspection Standards

Inspect all firestopping in accordance to ASTM E2393 and ASTM E2174 for firestop inspection, and document inspection results to be submitted.

DIVISION 22 – PLUMBING

SECTION 22 00 00 - PLUMBING, GENERAL PURPOSE

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SECTION 22 00 00 - PLUMBING, GENERAL PURPOSE

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced.

The publications are referred to within the text by the basic designation only.

AIR-CONDITIONING, HEATING AND REFRIGERATION INSTITUTE (AHRI)

AHRI 1010 (2002) Self-Contained, Mechanically Refrigerated Drinking-Water Coolers

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

ANSI Z21.10.1/CSA 4.1 (2009; Addenda 2009) Gas Water Heaters Vol. I, Storage Water Heaters with Input Ratings of 75,000 Btu Per Hour or Less

ANSI Z21.10.3/CSA 4.3 (2004; Addenda A 2007; Addenda B 2008) Gas Water Heaters Vol.III, Storage Water Heaters With Input Ratings Above 75,000 Btu Per Hour, Circulating and Instantaneous

ANSI Z21.22/CSA 4.4 (1999; Addenda A 2000, Addenda B 2001; R 2004) Relief Valves for Hot Water Supply Systems

AMERICAN SOCIETY OF HEATING, REFRIGERATING AND AIR-CONDITIONING ENGINEERS (ASHRAE)

ASHRAE 146 (2006) Method of Testing and Rating Pool Heaters

ASHRAE 90.1 - IP (2010) Energy Standard for Buildings Except Low-Rise Residential Buildings

ASHRAE 90.1 - SI (2007; Supplement 2008; Errata 2009; Errata 2009; INT 1-3 2009; Errata 2010) Energy Standard for Buildings Except Low-Rise Residential Buildings

AMERICAN SOCIETY OF SANITARY ENGINEERING (ASSE)

ASSE 1001 (2008) Performance Requirements for Atmospheric Type Vacuum Breakers (ANSI approved 2009)

ASSE 1003 (2009) Performance Requirements for Water Pressure Reducing Valves for Domestic Water Distribution Systems - (ANSI approved 2010)

ASSE 1005 (1999) Water Heater Drain Valves 3/4 Inch Size

| | |
|-----------|--|
| ASSE 1010 | (2004) Performance Requirements for Water Hammer Arresters (ANSI approved 2004) |
| ASSE 1011 | (2004; Errata 2004) Performance Requirements for Hose Connection Vacuum Breakers (ANSI approved 2004) |
| ASSE 1012 | (2009) Performance Requirements for Backflow Preventer with an Intermediate Atmospheric Vent - (ANSI approved 2009) |
| ASSE 1013 | (2009) Performance Requirements for Reduced Pressure Principle Backflow Preventers and Reduced Pressure Fire Protection Principle Backflow Preventers - (ANSI approved 2010) |
| ASSE 1018 | (2001) Performance Requirements for Trap Seal Primer Valves - Potable Water Supplied (ANSI Approved 2002) |
| ASSE 1019 | (2004; Errata 2005) Performance Requirements for Vacuum Breaker Wall Hydrants, Freeze Resistant, Automatic Draining Type (ANSI Approved 2004) |
| ASSE 1020 | (2004; Errata 2004; Errata 2004) Performance Requirements for Pressure Vacuum Breaker Assembly (ANSI Approved 2004) |
| ASSE 1037 | (1990) Performance Requirements for Pressurized Flushing Devices (Flushometers) for Plumbing Fixtures |

AMERICAN WATER WORKS ASSOCIATION (AWWA)

| | |
|------------|---|
| AWWA 10084 | (2005) Standard Methods for the Examination of Water and Wastewater |
| AWWA B300 | (2010) Hypochlorites |
| AWWA B301 | (2010) Liquid Chlorine |
| AWWA C203 | (2008) Coal-Tar Protective Coatings and Linings for Steel Water Pipelines - Enamel and Tape - Hot-Applied |
| AWWA C606 | (2006) Grooved and Shouldered Joints |
| AWWA C651 | (2005; Errata 2005) Standard for Disinfecting Water Mains |
| AWWA C652 | (2002) Disinfection of Water-Storage Facilities |
| AWWA C700 | (2009) Standard for Cold Water Meters - Displacement Type, Bronze Main Case |

AWWA C701 (2007) Standard for Cold-Water Meters - Turbine Type for Customer Service

AWWA D100 (2005; Errata 2007) Welded Steel Tanks for Water Storage

AMERICAN WELDING SOCIETY (AWS)

AWS A5.8/A5.8M (2004) Specification for Filler Metals for Brazing and Braze Welding

AWS B2.2/B2.2M (2010) Specification for Brazing Procedure and Performance Qualification

ASME INTERNATIONAL (ASME)

ASME A112.1.2 (2004) Standard for Air Gaps in Plumbing Systems (For Plumbing Fixtures and Water-Connected Receptors)

ASME A112.14.1 (2003; R 2008) Backwater Valves

ASME A112.19.1/CSA B45.2 (2008) Enameled Cast Iron and Enameled Steel Plumbing Fixtures

ASME A112.19.17 (2010) Manufactured Safety Vacuum Release Systems (SVRS) for Residential and Commercial Swimming Pool, Spa, Hot Tub, and Wading Pool Suction Systems

ASME A112.19.2/CSA B45.1 (2008; Update 2009) Standard for Vitreous China Plumbing Fixtures and Hydraulic Requirements for Water Closets and Urinals

ASME A112.19.3/CSA B45.4 (2008) Stainless Steel Plumbing Fixtures

ASME A112.19.4M (1994; Supplement 1-1998; Supplement 2-2000; R 2009) Porcelain Enameled Formed Steel Plumbing Fixtures

ASME A112.19.5 (2005) Trim for Water-Closet Bowls, Tanks and Urinals

ASME A112.19.8 (2007; Addenda A 2008; Addenda B 2009) Suction Fittings for Use in Swimming Pools, Wading Pools, Spas, And Hot Tubs

ASME A112.36.2M (1991; R 2008) Cleanouts

ASME A112.6.1M (1997; R 2008) Floor Affixed Supports for Off-the-Floor Plumbing Fixtures for Public Use

ASME A112.6.3 (2001; R 2007) Standard for Floor and Trench Drains

ASME A112.6.4 (2003; R 2008) Roof, Deck and Balcony Drains

ASME B1.20.1 (1983; R 2006) Pipe Threads, General Purpose (Inch)

| | |
|-----------------------|--|
| ASME B16.12 | (2009) Cast Iron Threaded Drainage Fittings |
| ASME B16.15 | (2006) Cast Bronze Alloy Threaded Fittings Classes 125 and 250 |
| ASME B16.18 | (2001; R 2005) Cast Copper Alloy Solder Joint Pressure Fittings |
| ASME B16.21 | (2005) Nonmetallic Flat Gaskets for Pipe Flanges |
| ASME B16.22 | (2001; R 2010) Standard for Wrought Copper and Copper Alloy Solder Joint Pressure Fittings |
| ASME B16.23 | (2002; R 2006) Cast Copper Alloy Solder Joint Drainage Fittings - DWV |
| ASME B16.24 | (2006) Cast Copper Alloy Pipe Flanges and Flanged Fittings: Classes 150, 300, 600, 900, 1500, and 2500 |
| ASME B16.29 | (2007) Wrought Copper and Wrought Copper Alloy Solder Joint Drainage Fittings - DWV |
| ASME B16.3 | (2006) Malleable Iron Threaded Fittings, Classes 150 and 300 |
| ASME B16.34 | (2009) Valves - Flanged, Threaded and Welding End |
| ASME B16.39 | (2009) Standard for Malleable Iron Threaded Pipe Unions; Classes 150, 250, and 300 |
| ASME B16.4 | (2006) Standard for Gray Iron Threaded Fittings; Classes 125 and 250 |
| ASME B16.5 | (2009) Pipe Flanges and Flanged Fittings: NPS 1/2 Through NPS 24 Metric/Inch Standard |
| ASME B31.1 | (2007; Addenda a 2008; Addenda b 2009) Power Piping |
| ASME B31.5 | (2010) Refrigeration Piping and Heat Transfer Components |
| ASME B40.100 | (2005) Pressure Gauges and Gauge Attachments |
| ASME BPVC SEC IX | (2010) BPVC Section IX-Welding and Brazing Qualifications |
| ASME BPVC SEC VIII D1 | (2007; Addenda 2008; Addenda 2009) BPVC Section VIII-Rules for Construction of Pressure Vessels Division 1 |
| ASME CSD-1 | (2009) Control and Safety Devices for Automatically Fired Boilers |

ASTM INTERNATIONAL (ASTM)

| | |
|-------------------|--|
| ASTM A 105/A 105M | (2010) Standard Specification for Carbon Steel Forgings for Piping Applications |
| ASTM A 183 | (2003; R 2009) Standard Specification for Carbon Steel Track Bolts and Nuts |
| ASTM A 193/A 193M | (2010a) Standard Specification for Alloy-Steel and Stainless Steel Bolting Materials for High-Temperature Service and Other Special Purpose Applications |
| ASTM A 47/A 47M | (1999; R 2009) Standard Specification for Ferritic Malleable Iron Castings |
| ASTM A 515/A 515M | (2003; R 2007) Standard Specification for Pressure Vessel Plates, Carbon Steel, for Intermediate- and Higher-Temperature Service |
| ASTM A 516/A 516M | (2010) Standard Specification for Pressure Vessel Plates, Carbon Steel, for Moderate- and Lower-Temperature Service |
| ASTM A 518/A 518M | (1999; R 2008) Standard Specification for Corrosion-Resistant High-Silicon Iron Castings |
| ASTM A 53/A 53M | (2010) Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless |
| ASTM A 536 | (1984; R 2009) Standard Specification for Ductile Iron Castings |
| ASTM A 733 | (2003; R 2009e1) Standard Specification for Welded and Seamless Carbon Steel and Austenitic Stainless Steel Pipe Nipples |
| ASTM A 74 | (2009) Standard Specification for Cast Iron Soil Pipe and Fittings |
| ASTM A 888 | (2009) Standard Specification for Hubless Cast Iron Soil Pipe and Fittings for Sanitary and Storm Drain, Waste, and Vent Piping Applications |
| ASTM B 111/B 111M | (2009) Standard Specification for Copper and Copper-Alloy Seamless Condenser Tubes and Ferrule Stock |
| ASTM B 117 | (2009) Standing Practice for Operating Salt Spray (Fog) Apparatus |
| ASTM B 152/B 152M | (2009) Standard Specification for Copper Sheet, Strip, Plate, and Rolled Bar |
| ASTM B 306 | (2009) Standard Specification for Copper Drainage Tube (DWV) |

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| ASTM B 32 | (2008) Standard Specification for Solder Metal |
| ASTM B 370 | (2009) Standard Specification for Copper Sheet and Strip for Building Construction |
| ASTM B 42 | (2010) Standard Specification for Seamless Copper Pipe, Standard Sizes |
| ASTM B 43 | (2009) Standard Specification for Seamless Red Brass Pipe, Standard Sizes |
| ASTM B 584 | (2009a) Standard Specification for Copper Alloy Sand Castings for General Applications |
| ASTM B 75 | (2002) Standard Specification for Seamless Copper Tube |
| ASTM B 75M | (1999; R 2005) Standard Specification for Seamless Copper Tube (Metric) |
| ASTM B 813 | (2010) Standard Specification for Liquid and Paste Fluxes for Soldering of Copper and Copper Alloy Tube |
| ASTM B 828 | (2002) Standard Practice for Making Capillary Joints by Soldering of Copper and Copper Alloy Tube and Fittings |
| ASTM B 88 | (2009) Standard Specification for Seamless Copper Water Tube |
| ASTM B 88M | (2005) Standard Specification for Seamless Copper Water Tube (Metric) |
| ASTM C 1053 | (2000; R 2010) Standard Specification for Borosilicate Glass Pipe and Fittings for Drain, Waste, and Vent (DWV) Applications |
| ASTM C 564 | (2009a) Standard Specification for Rubber Gaskets for Cast Iron Soil Pipe and Fittings |
| ASTM C 920 | (2010) Standard Specification for Elastomeric Joint Sealants |
| ASTM D 1004 | (2009) Initial Tear Resistance of Plastic Film and Sheeting |
| ASTM D 1248 | (2005) Standard Specification for Polyethylene Plastics Extrusion Materials for Wire and Cable |
| ASTM D 1785 | (2006) Standard Specification for Poly(Vinyl Chloride) (PVC), Plastic Pipe, Schedules 40, 80, and 120 |
| ASTM D 2000 | (2008) Standard Classification System for Rubber Products in Automotive Applications |

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| ASTM D 2235 | (2004) Standard Specification for Solvent Cement for Acrylonitrile-Butadiene-Styrene (ABS) Plastic Pipe and Fittings |
| ASTM D 2239 | (2003) Standard Specification for Polyethylene (PE) Plastic Pipe (SIDR-PR) Based on Controlled Inside Diameter |
| ASTM D 2241 | (2009) Standard Specification for Poly(Vinyl Chloride) (PVC) Pressure-Rated Pipe (SDR Series) |
| ASTM D 2447 | (2003) Standard Specification for Polyethylene (PE) Plastic Pipe, Schedules 40 and 80, Based on Outside Diameter |
| ASTM D 2464 | (2006) Standard Specification for Threaded Poly(Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 80 |
| ASTM D 2466 | (2006) Standard Specification for Poly(Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 40 |
| ASTM D 2467 | (2006) Standard Specification for Poly(Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 80 |
| ASTM D 2564 | (2004; R 2009e1) Standard Specification for Solvent Cements for Poly(Vinyl Chloride) (PVC) Plastic Piping Systems |
| ASTM D 2657 | (2007) Heat Fusion Joining Polyolefin Pipe and Fittings |
| ASTM D 2661 | (2008) Standard Specification for Acrylonitrile-Butadiene-Styrene (ABS) Schedule 40, Plastic Drain, Waste, and Vent Pipe and Fittings |
| ASTM D 2665 | (2009) Standard Specification for Poly(Vinyl Chloride) (PVC) Plastic Drain, Waste, and Vent Pipe and Fittings |
| ASTM D 2672 | (1996a; R 2009) Joints for IPS PVC Pipe Using Solvent Cement |
| ASTM D 2683 | (2010) Standard Specification for Socket-Type Polyethylene Fittings for Outside Diameter-Controlled Polyethylene Pipe and Tubing |
| ASTM D 2737 | (2003) Polyethylene (PE) Plastic Tubing |
| ASTM D 2822 | (2005) Asphalt Roof Cement |
| ASTM D 2846/D 2846M | (2009b) Chlorinated Poly(Vinyl Chloride) (CPVC) Plastic Hot- and Cold-Water Distribution Systems |
| ASTM D 2855 | (1996; R 2010) Standard Practice for Making Solvent-Cemented Joints with Poly(Vinyl Chloride) (PVC) Pipe and Fittings |

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| ASTM D 2996 | (2001; R 2007e1) Filament-Wound "Fiberglass" (Glass-Fiber-Reinforced Thermosetting-Resin) Pipe |
| ASTM D 3035 | (2008) Polyethylene (PE) Plastic Pipe (DR-PR) Based on Controlled Outside Diameter |
| ASTM D 3122 | (1995; R 2009) Solvent Cements for Styrene-Rubber (SR) Plastic Pipe and Fittings |
| ASTM D 3138 | (2004) Solvent Cements for Transition Joints Between Acrylonitrile-Butadiene-Styrene (ABS) and Poly(Vinyl Chloride) (PVC) Non-Pressure Piping Components |
| ASTM D 3139 | (1998; R 2005) Joints for Plastic Pressure Pipes Using Flexible Elastomeric Seals |
| ASTM D 3212 | (2007) Standard Specification for Joints for Drain and Sewer Plastic Pipes Using Flexible Elastomeric Seals |
| ASTM D 3261 | (2010a) Standard Specification for Butt Heat Fusion Polyethylene (PE) Plastic Fittings for Polyethylene (PE) Plastic Pipe and Tubing |
| ASTM D 3311 | (2009a) Drain, Waste, and Vent (DWV) Plastic Fittings Patterns |
| ASTM D 4101 | (2010) Standard Specification for Polypropylene Injection and Extrusion Materials |
| ASTM D 4551 | (1996; R 2008e1) Poly(Vinyl Chloride) (PVC) Plastic Flexible Concealed Water-Containment Membrane |
| ASTM D 638 | (2010) Standard Test Method for Tensile Properties of Plastics |
| ASTM E 1 | (2007) Standard Specification for ASTM Liquid-in-Glass Thermometers |
| ASTM E 96/E 96M | (2005) Standard Test Methods for Water Vapor Transmission of Materials |
| ASTM F 1290 | (1998a; R 2004) Electrofusion Joining Polyolefin Pipe and Fittings |
| ASTM F 1760 | (2001; R 2005e1) Coextruded Poly(Vinyl Chloride) (PVC) Non-Pressure Plastic Pipe Having Reprocessed-Recycled Content |
| ASTM F 2387 | (2004) Standard Specification for Manufactured Safety Vacuum Release Systems (SVRS) for Swimming Pools, Spas, and Hot Tubs |
| ASTM F 2389 | (2010) Standard Specification for Pressure-rated Polypropylene (PP) Piping Systems |

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| ASTM F 409 | (2002; R 2008) Thermoplastic Accessible and Replaceable Plastic Tube and Tubular Fittings |
| ASTM F 437 | (2009) Standard Specification for Threaded Chlorinated Poly(Vinyl Chloride) (CPVC) Plastic Pipe Fittings, Schedule 80 |
| ASTM F 438 | (2009) Standard Specification for Socket-Type Chlorinated Poly(Vinyl Chloride) (CPVC) Plastic Pipe Fittings, Schedule 40 |
| ASTM F 439 | (2009) Standard Specification for Chlorinated Poly(Vinyl Chloride) (CPVC) Plastic Pipe Fittings, Schedule 80 |
| ASTM F 441/F 441M | (2009) Standard Specification for Chlorinated Poly(Vinyl Chloride) (CPVC) Plastic Pipe, Schedules 40 and 80 |
| ASTM F 442/F 442M | (2009) Standard Specification for Chlorinated Poly(Vinyl Chloride) (CPVC) Plastic Pipe (SDR-PR) |
| ASTM F 477 | (2010) Standard Specification for Elastomeric Seals (Gaskets) for Joining Plastic Pipe |
| ASTM F 493 | (2010) Solvent Cements for Chlorinated Poly(Vinyl Chloride) (CPVC) Plastic Pipe and Fittings |
| ASTM F 628 | (2008) Acrylonitrile-Butadiene-Styrene (ABS) Schedule 40 Plastic Drain, Waste, and Vent Pipe with a Cellular Core |
| ASTM F 877 | (2007) Crosslinked Polyethylene (PEX) Plastic Hot- and Cold-Water Distribution Systems |
| ASTM F 891 | (2010) Coextruded Poly (Vinyl Chloride) (PVC) Plastic Pipe with a Cellular Core |

CAST IRON SOIL PIPE INSTITUTE (CISPI)

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| CISPI 301 | (2009) Hubless Cast Iron Soil Pipe and Fittings for Sanitary and Storm Drain, Waste, and Vent Piping Applications |
| CISPI 310 | (2009) Coupling for Use in Connection with Hubless Cast Iron Soil Pipe and Fittings for Sanitary and Storm Drain, Waste, and Vent Piping Applications |

COPPER DEVELOPMENT ASSOCIATION (CDA)

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| CDA A4015 | (1994; R 1995) Copper Tube Handbook |
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INTERNATIONAL ASSOCIATION OF PLUMBING AND MECHANICAL OFFICIALS
(IAPMO)

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| IAPMO PS 117 | (2005) Press Type Or Plain End Rub Gasketed W/ Nail CU & CU Alloy Fittings for Install On CU Tubing |
| IAPMO UPC | (2003) Uniform Plumbing Code |
| IAPMO Z124.1.2 | (2005) Plastic Bathtub and Shower Units |
| IAPMO Z124.8 | (1990) Plastic Bathtub Liners |

INTERNATIONAL CODE COUNCIL (ICC)

| | |
|-----------------|--|
| ICC IPC | (2009) International Plumbing Code |
| ICC/ANSI A117.1 | (2003; Errata 2007) Accessible and Usable Buildings and Facilities |

INTERNATIONAL SAFETY EQUIPMENT ASSOCIATION (ISEA)

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| ANSI/ISEA Z358.1 | (2009) American National Standard for Emergency Eyewash and Shower Equipment |
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MANUFACTURERS STANDARDIZATION SOCIETY OF THE VALVE AND FITTINGS
INDUSTRY (MSS)

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| MSS SP-110 | (2010) Ball Valves Threaded, Socket-Welding, Solder Joint, Grooved and Flared Ends |
| MSS SP-25 | (2008) Standard Marking System for Valves, Fittings, Flanges and Unions |
| MSS SP-44 | (2010) Steel Pipeline Flanges |
| MSS SP-58 | (2009) Pipe Hangers and Supports - Materials, Design and Manufacture, Selection, Application, and Installation |
| MSS SP-67 | (2002a) Butterfly Valves |
| MSS SP-69 | (2003) Pipe Hangers and Supports - Selection and Application (ANSI Approved American National Standard) |
| MSS SP-70 | (2006) Gray Iron Gate Valves, Flanged and Threaded Ends |
| MSS SP-71 | (2005) Gray Iron Swing Check Valves, Flanged and Threaded Ends |
| MSS SP-72 | (2010) Ball Valves with Flanged or Butt-Welding Ends for General Service |

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| MSS SP-73 | (2003) Brazing Joints for Copper and Copper Alloy Pressure Fittings |
| MSS SP-78 | (2005a) Cast Iron Plug Valves, Flanged and Threaded Ends |
| MSS SP-80 | (2008) Bronze Gate, Globe, Angle and Check Valves |
| MSS SP-83 | (2006) Class 3000 Steel Pipe Unions Socket Welding and Threaded |
| MSS SP-85 | (2002) Gray Iron Globe & Angle Valves Flanged and Threaded Ends |

NACE INTERNATIONAL (NACE)

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| NACE SP0169 | (1992; R 2007) Control of External Corrosion on Underground or Submerged Metallic Piping Systems |
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NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

| | |
|------------|---|
| NEMA 250 | (2008) Enclosures for Electrical Equipment (1000 Volts Maximum) |
| NEMA MG 1 | (2009) Motors and Generators |
| NEMA MG 11 | (1977; R 2007) Energy Management Guide for Selection and Use of Single Phase Motors |

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

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| NFPA 31 | (2006; Errata 06-1; Errata 07-2; Errata 10-3) Standard for the Installation of Oil-Burning Equipment |
| NFPA 54 | (2009; TIA 10-3) National Fuel Gas Code |
| NFPA 90A | (2009; Errata 09-1) Standard for the Installation of Air Conditioning and Ventilating Systems |

NSF INTERNATIONAL (NSF)

| | |
|-------------|--|
| NSF/ANSI 14 | (2010) Plastics Piping System Components and Related Materials |
| NSF/ANSI 61 | (2010a) Drinking Water System Components - Health Effects |

PLASTIC PIPE AND FITTINGS ASSOCIATION (PPFA)

| | |
|---------|--|
| PPFA-01 | (2004) Firestopping: Plastic Pipe in Fire Resistive Construction |
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PLUMBING AND DRAINAGE INSTITUTE (PDI)

PDI G 101 (2010) Testing and Rating Procedure for Hydro Mechanical Grease Interceptors with Appendix of Installation and Maintenance

PDI WH 201 (2010) Water Hammer Arresters Standard

SOCIETY OF AUTOMOTIVE ENGINEERS INTERNATIONAL (SAE)

SAE J1508 (2009) Hose Clamp Specifications

U.S. ENVIRONMENTAL PROTECTION AGENCY (EPA)

EPA SM 9223 (2004) Enzyme Substrate Coliform Test

Energy Star (1992; R 2006) Energy Star Energy Efficiency Labeling System

PL 93-523 (1974; A 1999) Safe Drinking Water Act

U.S. GREEN BUILDING COUNCIL (USGBC)

LEED (2002; R 2005) Leadership in Energy and Environmental Design(tm) Green Building Rating System for New Construction (LEED-NC)

U.S. NATIONAL ARCHIVES AND RECORDS ADMINISTRATION (NARA)

10 CFR 430 Energy Conservation Program for Consumer Products

21 CFR 175 Indirect Food Additives: Adhesives and Components of Coatings

40 CFR 50.12 National Primary and Secondary Ambient Air Quality Standards for Lead

PL 109-58 Energy Policy Act of 2005 (EPAAct05) UNDERWRITERS LABORATORIES (UL)

UL 174 (2004; Reprint Apr 2009) Household Electric Storage Tank Water Heaters

UL 1951 (1994; Reprint Jun 2010) Electric Plumbing Accessories

UL 430 (2009) Standard for Waste Disposers

UL 499 (2005; Reprint Nov 2009) Electric Heating Appliances

UL 732 (1995; Reprint Apr 2010) Oil-Fired Storage Tank Water Heaters

1.2 SUBMITTALS

The following shall be submitted:

SD-02 Shop Drawings

Plumbing System;

Detail drawings consisting of schedules, performance charts, instructions, diagrams, and other information to illustrate the requirements and operations of systems that are not covered by the Plumbing Code.

Detail drawings for the complete plumbing system including piping layouts and locations of connections; dimensions for roughing-in, foundation, and support points; schematic diagrams and wiring diagrams or connection and interconnection diagrams. Detail drawings shall indicate clearances required for maintenance and operation. Where piping and equipment are to be supported other than as indicated, details shall include loadings and proposed support methods. Mechanical drawing plans, elevations, views, and details, shall be drawn to scale.

SD-03 Product Data

Fixtures; (LEED)

List of installed fixtures with manufacturer, model, and flow rate.

Flush tank water closets Countertop lavatories

Plumbing system

Diagrams, instructions, and other sheets proposed for posting. Manufacturer's recommendations for the installation of bell and spigot and hubless joints for cast iron soil pipe.(If necessary)

SD-06 Test Reports

Tests, Flushing and Disinfection

Test reports in booklet form showing all field tests performed to adjust each component and all field tests performed to prove compliance with the specified performance criteria, completion and testing of the installed system.

Each test report shall indicate the final position of controls.

Test of Backflow Prevention Assemblies;

Certification of proper operation shall be as accomplished in accordance with state regulations by an individual certified by the state to perform such tests.

If no state requirement exists, the Contractor shall have the manufacturer's representative test the device, to ensure the unit is properly installed and performing as intended. The Contractor shall provide written documentation of the tests performed and signed by the individual performing the tests.

SD-07 Certificates

Materials and Equipment

Where equipment is specified to conform to requirements of the ASME Boiler and Pressure Vessel Code, the design, fabrication, and installation shall conform to the code.

Bolts

Written certification by the bolt manufacturer that the bolts furnished comply with the specified requirements.

1.3 STANDARD PRODUCTS

Specified materials and equipment shall be standard products of a manufacturer regularly engaged in the manufacture of such products. Specified equipment shall essentially duplicate equipment that has performed satisfactorily at least two years prior to bid opening. Standard products shall have been in satisfactory commercial or industrial use for 2 years prior to bid opening. The 2-year use shall include applications of equipment and materials under similar circumstances and of similar size. The product shall have been for sale on the commercial market through advertisements, manufacturers' catalogs, or brochures during the 2 year period.

1.3.1 Alternative Qualifications

Products having less than a two-year field service record will be acceptable if a certified record of satisfactory field operation for not less than 6000 hours, exclusive of the manufacturer's factory or laboratory tests, can be shown.

1.3.2 Service Support

The equipment items shall be supported by service organizations.

Submit a certified list of qualified permanent service organizations for support of the equipment which includes their addresses and qualifications. These service organizations shall be reasonably convenient to the equipment installation and able to render satisfactory service to the equipment on a regular and emergency basis during the warranty period of the contract.

1.3.3 Manufacturer's Nameplate

Each item of equipment shall have a nameplate bearing the manufacturer's name, address, model number, and serial number securely affixed in a conspicuous place; the nameplate of the distributing agent will not be acceptable.

1.3.4 Modification of References

In each of the publications referred to herein, consider the advisory provisions to be mandatory, as though the word, "shall" had been substituted for "should" wherever it appears.

Interpret references in these publications to the "authority having jurisdiction", or words of similar meaning, to mean the resident engineer.

1.3.4.1 Definitions

For the International Code Council (ICC) Codes referenced in the contract documents, advisory provisions shall be considered mandatory, the word "should" shall be interpreted as "shall."

Reference to the "code official" shall be interpreted to mean the "Resident Engineer." For leased facilities, references to the "owner" shall be interpreted to mean the "lessor." References to the "permit holder" shall be interpreted to mean the "Contractor."

1.3.4.2 Administrative Interpretations

For ICC Codes referenced in the contract documents, the provisions of Chapter 1, "Administrator," do not apply. References in the ICC Codes to sections of Chapter 1, shall be applied appropriately by the resident engineer as authorized by his administrative cognizance.

1.4 DELIVERY, STORAGE, AND HANDLING

Handle, store, and protect equipment and materials to prevent damage before and during installation in accordance with the manufacturer's recommendations, and as approved by the Contracting Officer. Replace damaged or defective items.

1.5 REGULATORY REQUIREMENTS

Unless otherwise required herein, plumbing work shall be in accordance with ICC IPC.

Energy consuming products and systems shall be in accordance with PL 109-58 and ASHRAE 90.1 - SI ASHRAE 90.1 - IP

1.6 PROJECT/SITE CONDITIONS

The Contractor shall become familiar with details of the work, verify dimensions in the field, and advise the resident engineer of any discrepancy before performing any work.

1.7 INSTRUCTION TO THE PERSONNEL

When specified in other sections, furnish the services of competent instructors to give full instruction to the designated personnel in the adjustment, operation, and maintenance, including pertinent safety requirements, of the specified equipment or system.

Instructors shall be thoroughly familiar with all parts of the installation and shall be trained in operating theory as well as practical operation and maintenance work.

Instruction shall be given during the first regular work week after the equipment or system has been accepted and turned over to the client for regular operation.

The number of man-days (8 hours per day) of instruction furnished shall be as specified in the individual section. When more than 4 man-days of instruction are specified, use approximately half of the time for classroom instruction. Use other time for instruction with the equipment or system.

When significant changes or modifications in the equipment or system are made under the terms of the contract, provide additional instruction to acquaint the operating personnel with the changes or modifications.

1.8 ACCESSIBILITY OF EQUIPMENT

Install all work so that parts requiring periodic inspection, operation, maintenance, and repair are readily accessible. Install concealed valves, expansion joints, controls, dampers, and equipment requiring access, in locations freely accessible through access doors.

PART 2 PRODUCTS

2.1 Materials

Materials for various services shall be in accordance with TABLES I and II.

PVC pipe shall contain a minimum of 25 percent recycled content in accordance with ASTM F 1760.

HDPE pipe shall contain a minimum of 50 percent post-consumer recycled content. Cement pipe shall contain recycled content. Steel pipe shall contain a minimum of 25 percent recycled content, with a minimum of 16 percent post-consumer recycled content. Pipe schedules shall be selected based on service requirements. Pipe fittings shall be compatible with the applicable pipe materials. Plastic pipe, fittings, and solvent cement shall meet NSF/ANSI 14 and shall be NSF listed for the service intended. Plastic pipe, fittings, and solvent cement used for potable hot and cold water service shall bear the NSF seal "NSF-PW." Polypropylene pipe and fittings shall conform to dimensional requirements of Schedule 40, Iron Pipe size and shall comply with NSF/ANSI 14, NSF/ANSI 61 and ASTM F 2389.

Polypropylene piping that will be exposed to UV light shall be provided with a Factory applied UV resistant coating.

Pipe threads (except dry seal) shall conform to ASME B1.20.1.

Grooved pipe couplings and fittings shall be from the same manufacturer. Material or equipment containing lead shall not be used in any potable water system. In line devices such as water meters, building valves, check valves, meter stops, valves, fittings and back flow preventers shall comply with PL 93-523 and NSF/ANSI 61, Section 8. End point devices such as drinking water fountains, lavatory faucets, kitchen and bar faucets, residential ice makers, supply stops and end point control valves used to dispense water for drinking must meet the requirements of NSF/ANSI 61, Section 9. Hubless cast-iron soil pipe shall not be installed underground, under concrete floor slabs, or in crawl spaces below kitchen floors. Plastic pipe shall not be installed in air plenums. Plastic pipe shall not be installed in a pressure piping system in buildings greater than three stories including any basement levels.

2.1.1 Pipe Joint Materials

Grooved pipe and hubless cast-iron soil pipe shall not be used underground. Solder containing lead shall not be used with copper pipe. Cast iron soil pipe and fittings shall be marked with the collective trademark of the Cast Iron Soil Institute. Joints and gasket materials shall conform to the following:

- a. Coupling for Cast-Iron Pipe: for hub and spigot type ASTM A 74, AWWA C606.
For hubless type: CISPI 310
- b. Coupling for Steel Pipe: AWWA C606.
- c. Couplings for Grooved Pipe: Ductile Iron ASTM A 536 (Grade 65-45-12), Malleable Iron ASTM A 47/A 47M, Grade 32510 or Copper ASTM A 536.
- d. Flange Gaskets: Gaskets shall be made of non-asbestos material in accordance with ASME B16.21. Gaskets shall be flat, 1/16 inch thick, and contain Aramid fibers bonded with Styrene Butadiene Rubber (SBR) or Nitro Butadiene Rubber (NBR). Gaskets shall be the full face or self centering flat ring type. Gaskets used for hydrocarbon service shall be bonded with NBR.
- e. Brazing Material: Brazing material shall conform to AWS A5.8/A5.8M, BCuP-5.
- f. Brazing Flux: Flux shall be in paste or liquid form appropriate for use with brazing material. Flux shall be as follows: lead-free; have a 100 percent flushable residue; contain slightly acidic reagents; contain potassium borides; and contain fluorides.
- g. Solder Material: Solder metal shall conform to ASTM B 32.
- h. Solder Flux: Flux shall be liquid form, non-corrosive, and conform to ASTM B 813, Standard Test 1.
- i. PTFE Tape: PTFE Tape, for use with Threaded Metal or Plastic Pipe.
- j. Rubber Gaskets for Cast-Iron Soil-Pipe and Fittings (hub and spigot type and hubless type): ASTM C 564.
- k. Rubber Gaskets for Grooved Pipe: ASTM D 2000, maximum temperature 230 degrees F.
- l. Flexible Elastomeric Seals: ASTM D 3139, ASTM D 3212 or ASTM F 477.
- m. Bolts and Nuts for Grooved Pipe Couplings: Heat-treated carbon steel, ASTM A 183.
- n. Solvent Cement for Transition Joints between ABS and PVC Nonpressure Piping Components: ASTM D 3138.
- o. Plastic Solvent Cement for ABS Plastic Pipe: ASTM D 2235.
- p. Plastic Solvent Cement for PVC Plastic Pipe: ASTM D 2564 and ASTM D 2855.
- q. Plastic Solvent Cement for CPVC Plastic Pipe: ASTM F 493.

- r. Flanged fittings including flanges, bolts, nuts, bolt patterns, etc., shall be in accordance with ASME B16.5 class 150 and shall have the manufacturer's trademark affixed in accordance with MSS SP-25.

Flange material shall conform to ASTM A 105/A 105M.

Blind flange material shall conform to ASTM A 516/A 516M cold service and ASTM A 515/A 515M for hot service.

Bolts shall be high strength or intermediate strength with material conforming to ASTM A 193/A 193M.

- s. Plastic Solvent Cement for Styrene Rubber Plastic Pipe: ASTM D 3122.
- t. Press fittings for Copper Pipe and Tube: Copper press fittings shall conform to the material and sizing requirements of ASME B16.18 or ASME B16.22 and performance criteria of IAPMO PS 117. Sealing elements for copper press fittings shall be EPDM, FKM or HNBR.

Sealing elements shall be factory installed or an alternative supplied fitting manufacturer. Sealing element shall be selected based on manufacturer's approved application guidelines.

- u. Copper tubing shall conform to ASTM B 88M ASTM B 88, Type K, L or M.
- v. Heat-fusion joints for polypropylene piping: ASTM F 2389.

2.1.2 Miscellaneous Materials

Miscellaneous materials shall conform to the following:

- a. Water Hammer Arrester: PDI WH 201.
- b. Copper, Sheet and Strip for Building Construction: ASTM B 370.
- c. Asphalt Roof Cement: ASTM D 2822.
- d. Hose Clamps: SAE J1508.
- e. Supports for Off-The-Floor Plumbing Fixtures: ASME A112.6.1M.
- f. Metallic Cleanouts: ASME A112.36.2M.
- g. Plumbing Fixture Setting Compound: A preformed flexible ring seal molded from hydrocarbon wax material.

The seal material shall be nonvolatile nonasphaltic and contain germicide and provide watertight, gastight, odorproof and verminproof properties.
- h. Coal-Tar Protective Coatings and Linings for Steel Water Pipelines: AWWA C203.
- i. Hypochlorites: AWWA B300.

- j. Liquid Chlorine: AWWA B301.
- k. Gauges - Pressure and Vacuum Indicating Dial Type - Elastic Element: ASME B40.100.
- l. Thermometers: ASTM E 1. Mercury shall not be used in thermometers.

2.2 PIPE HANGERS, INSERTS, AND SUPPORTS

Pipe hangers, inserts, and supports shall conform to MSS SP-58 and MSS SP-69.

2.3 VALVES

Valves shall be provided on supplies to equipment and fixtures.

Valves 2-1/2 inches and smaller shall be bronze with threaded bodies for pipe and solder-type connections for tubing. Valves 3 inches and larger shall have flanged iron bodies and bronze trim. Pressure ratings shall be based upon the application. Grooved end valves may be provided if the manufacturer certifies that the valves meet the performance requirements of applicable MSS standard. Valves shall conform to the following standards:

| Description | Standard |
|---|---------------------|
| Butterfly Valves | MSS SP-67 |
| Cast-Iron Gate Valves, Flanged and Threaded Ends | MSS SP-70 |
| Cast-Iron Swing Check Valves, Flanged and Threaded Ends | MSS SP-71 |
| Ball Valves with Flanged Butt-Welding Ends for General Service | MSS SP-72 |
| Ball Valves Threaded, Socket-Welding, Solder Joint, Grooved and Flared Ends | MSS SP-110 |
| Cast-Iron Plug Valves, Flanged and Threaded Ends | MSS SP-78 |
| Bronze Gate, Globe, Angle, and Check Valves | MSS SP-80 |
| Steel Valves, Socket Welding and Threaded Ends | ASME B16.34 |
| Cast-Iron Globe and Angle Valves, Flanged and Threaded Ends | MSS SP-85 |
| Backwater Valves | ASME A112.14.1 |
| Vacuum Relief Valves | ANSI Z21.22/CSA 4.4 |
| Water Pressure Reducing Valves | ASSE 1003 |
| Water Heater Drain Valves | ASSE 1005 |

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| Trap Seal Primer Valves | ASSE 1018 |
| Temperature and Pressure Relief Valves | ANSI Z21.22/CSA 4.4 for Hot Water Supply Systems |
| Temperature and Pressure Relief Valves | ASME CSD-1 for Automatically Fired Hot Water Boilers Safety Code No., Part CW, Article 5 |

2.3.1 Wall Faucets

Wall faucets with vacuum-breaker backflow preventer shall be brass with 3/4 inch male inlet threads, hexagon shoulder, and 3/4 inch hose connection. Faucet handle shall be securely attached to stem.

2.4 FIXTURES

Fixtures shall be water conservation type, in accordance with ICC IPC. Fixtures for use by the physically handicapped shall be in accordance with ICC/ANSI A117.1.

ASME A112.19.3/CSA B45.4 302 stainless steel or Vitreous China, nonabsorbent, hard-burned, and vitrified throughout the body shall be provided.

Porcelain enameled ware shall have specially selected, clear white, acid-resisting enamel coating evenly applied on surfaces. No fixture will be accepted that shows cracks, crazes, blisters, thin spots, or other flaws. Fixtures shall be equipped with appurtenances such as traps, faucets, stop valves, and drain fittings. Each fixture and piece of equipment requiring connections to the drainage system, except grease interceptors, shall be equipped with a trap. Brass expansion or toggle bolts capped with acorn nuts shall be provided for supports, and polished chromium-plated pipe, valves, and fittings shall be provided where exposed to view. Fixtures with the supply discharge below the rim shall be equipped with backflow preventers.

Internal parts of flush tank valves, shower mixing valves, shower head face plates, pop-up stoppers of lavatory waste drains, and pop-up stoppers and overflow tees and shoes of bathtub waste drains may contain acetal resin, fluorocarbon, nylon, acrylonitrile-butadiene-styrene (ABS) or other plastic material, if the material has provided satisfactory service under actual commercial or industrial operating conditions for not less than 2 years or shall be copper alloy with all visible surfaces chrome plated. Plastic in contact with hot water shall be suitable for 180 degrees F water temperature.

2.4.1 Flush Tank Water Closets

ASME A112.19.2/CSA B45.1, white vitreous china, siphon jet, round bowl, pressure assisted, floor-mounted, floor outlet.

Top of toilet seat height above floor shall be 14 to 15 inches, except 17 to 19 inches for wheelchair water closets.

[Nonfloat swing type flush tank valves are not acceptable.]

[Gravity tank type water closets are not permitted.]

Provide wax bowl ring including plastic sleeve. Provide a dual-flush toilet with a second flushing option that shall not exceed 1.1 gallons per flush.

Provide white solid plastic round closed-front seat with cover.

2.4.2 Countertop Lavatories

ASME A112.19.2/CSA B45.1, white vitreous china, minimum dimensions of 17 inches wide by 14 inches front to rear, with supply openings for use with top mounted centerset faucets. Furnish template and mounting kit by lavatory manufacturer. Water flow rate shall not exceed 2.2 gpm when measured at a flowing water pressure of 60 psi. Mount counter with the top surface 34 inches above floor and with 29 inches minimum clearance from bottom of the counter face to floor. Lavatory shall be installed 8-1/8" minimum from front edge.

2.4.3 Shower Faucets

Provide single control pressure equalizing shower faucets with body mounted from behind the wall with threaded connections. Provide ball joint self-cleaning shower heads.

Provide shower heads which deliver a maximum of 2.2 GPM at 80 PSI per Energy Star requirements. Provide separate globe valves or angle valves with union connections in each supply to faucet.

Provide shower valve with ball type control handle.

ADA type showers shall comply ADA requirements.

2.5 DRAINS

2.5.1 Floor Drains

Floor drains shall consist of a galvanized body, integral seepage pan, and adjustable perforated or slotted chromium-plated bronze, nickel-bronze, or nickel-brass strainer, consisting of grate and threaded collar.

Floor drains shall be cast iron except where metallic waterproofing membrane is installed. Drains shall be of double drainage pattern for embedding in the floor construction. The seepage pan shall have weep holes or channels for drainage to the drainpipe. The strainer shall be adjustable to floor thickness. A clamping device for attaching flashing or waterproofing membrane to the seepage pan without damaging the flashing or waterproofing membrane shall be provided when required. Drains shall be provided with threaded connection. Between the drain outlet and waste pipe, a neoprene rubber gasket conforming to ASTM C 564 may be installed, provided that the drain is specifically designed for the rubber gasket compression type joint. Floor and shower drains shall conform to ASME A112.6.3. Provide drain with trap primer connection, trap primer, and connection piping. Primer shall meet ASSE 1018.

2.6 TRAPS

Unless otherwise specified, traps shall be plastic per ASTM F 409 or copper-alloy adjustable tube type with slip joint inlet and swivel. Traps shall be with a cleanout. Provide traps with removable access panels for easy clean-out at sinks and lavatories. Tubes shall be copper alloy with walls not less than 0.032 inch thick within commercial tolerances, except on the outside of bends where the thickness may be reduced slightly in manufacture by usual commercial methods. Inlets shall have rubber washer and copper alloy nuts for slip joints above the discharge level. Swivel joints shall be below the discharge level and shall be of metal-to-metal or metal-to-plastic type as required for the application. Nuts shall have flats for wrench grip. Outlets shall have internal pipe thread, except that when required for the application, the outlets shall have sockets for solder-joint connections. The depth of the water seal shall be not less than 2 inches. The interior diameter shall be not more than 1/8 inch over or under the nominal size, and interior surfaces shall be reasonably smooth throughout. A copper alloy "P" trap assembly consisting of an adjustable "P" trap and threaded trap wall nipple with cast brass wall flange shall be provided for lavatories. The assembly shall be a standard manufactured unit and may have a rubber-gasketed swivel joint.

2.7 MISCELLANEOUS PIPING ITEMS

2.7.1 Escutcheon Plates

Provide one piece or split hinge metal plates for piping entering floors, walls, and ceilings in exposed spaces. Provide chromium-plated on copper alloy plates or polished stainless steel finish in finished spaces. Provide paint finish on plates in unfinished spaces.

2.7.2 Pipe Sleeves

Provide where piping passes entirely through walls, ceilings, roofs, and floors.

Sleeves are not required where drain, waste, and vent (DWV) piping passes through concrete floor slabs located on grade, except where penetrating a membrane waterproof floor.

2.7.2.1 Sleeves in Masonry and Concrete

Provide steel pipe sleeves or schedule 40 PVC plastic pipe sleeves. Sleeves are not required where drain, waste, and vent (DWV) piping passes through concrete floor slabs located on grade. Core drilling of masonry and concrete may be provided in lieu of pipe sleeves when cavities in the core-drilled hole are completely grouted smooth.

2.7.2.2 Sleeves Not in Masonry and Concrete

Provide 26 gage galvanized steel sheet or PVC plastic pipe sleeves.

2.7.3 Pipe Hangers (Supports)

Provide MSS SP-58 and MSS SP-69, Type 1 with adjustable type steel support rods, except as specified or indicated otherwise.

Attach to steel joists with Type 19 or 23 clamps and retaining straps.

Attach to Steel W or S beams with Type 21, 28, 29, or 30 clamps.

Attach to steel angles and vertical web steel channels with Type 20 clamp with beam clamp channel adapter. Attach to horizontal web steel channel and wood with drilled hole on centerline and double nut and washer. Attach to concrete with Type 18 insert or drilled expansion anchor. Provide Type 40 insulation protection shield for insulated piping.

2.7.4 Nameplates

Provide 0.125 inch thick melamine laminated plastic nameplates, black matte finish with white center core, for equipment, gages, thermometers, and valves; valves in supplies to faucets will not require nameplates. Accurately align lettering and engrave minimum of 0.25 inch high normal block lettering into the white core. Minimum size of nameplates shall be 1.0 by 2.5 inches. Key nameplates to a chart and schedule for each system. Frame charts and schedules under glass and place where directed near each system. Furnish two copies of each chart and schedule.

PART 3 EXECUTION

3.1 GENERAL INSTALLATION REQUIREMENTS

Piping located in air plenums shall conform to NFPA 90A requirements. Piping located in shafts that constitute air ducts or that enclose air ducts shall be noncombustible in accordance with NFPA 90A.

Installation of plastic pipe where in compliance with NFPA may be installed in accordance with PPFA-01. The plumbing system shall be installed complete with necessary fixtures, fittings, traps, valves, and accessories.

Water and drainage piping shall be extended 5 feet outside the building, unless otherwise indicated. A gate valve and drain shall be installed on the water service line inside the building approximately 6 inches above the floor from point of entry. Piping shall be connected to the exterior service lines or capped or plugged if the exterior service is not in place. Sewer and water pipes shall be laid in separate trenches, except when otherwise shown. Exterior underground utilities shall be at least 12 inches below the finish grade or as indicated on the drawings. If trenches are closed or the pipes are otherwise covered before being connected to the service lines, the location of the end of each plumbing utility shall be marked with a stake or other acceptable means. Valves shall be installed with control no lower than the valve body.

3.1.1 Water Pipe, Fittings, and Connections

3.1.1.1 Utilities

The piping shall be extended to fixtures, outlets, and equipment.

The hot-water and cold-water piping system shall be arranged and installed to permit draining.

The supply line to each item of equipment or fixture, except faucets, flush valves, or other control valves which are supplied with integral stops, shall be equipped with a shutoff valve to

enable isolation of the item for repair and maintenance without interfering with operation of other equipment or fixtures.

Supply piping to fixtures, faucets, hydrants, shower heads, and flushing devices shall be anchored to prevent movement.

3.1.1.2 Cutting and Repairing

The work shall be carefully laid out in advance, and unnecessary cutting of construction shall be avoided.

Damage to building, piping, wiring, or equipment as a result of cutting shall be repaired by mechanics skilled in the trade involved.

3.1.1.3 Protection of Fixtures, Materials, and Equipment

Pipe openings shall be closed with caps or plugs during installation. Fixtures and equipment shall be tightly covered and protected against dirt, water, chemicals, and mechanical injury. Upon completion of the work, the fixtures, materials, and equipment shall be thoroughly cleaned, adjusted, and operated. Safety guards shall be provided for exposed rotating equipment.

3.1.1.4 Mains, Branches, and Runouts

Piping shall be installed as indicated.

Pipe shall be accurately cut and worked into place without springing or forcing.

Structural portions of the building shall not be weakened. Aboveground piping shall run parallel with the lines of the building, unless otherwise indicated. Branch pipes from service lines may be taken from top, bottom, or side of main, using crossover fittings required by structural or installation conditions.

Supply pipes, valves, and fittings shall be kept a sufficient distance from other work and other services to permit not less than 1/2 inch between finished covering on the different services. Bare and insulated water lines shall not bear directly against building structural elements so as to transmit sound to the structure or to prevent flexible movement of the lines. Water pipe shall not be buried in or under floors unless specifically indicated or approved. Changes in pipe sizes shall be made with reducing fittings. Use of bushings will not be permitted except for use in situations in which standard factory fabricated components are furnished to accommodate specific accepted installation practice. Change in direction shall be made with fittings, except that bending of pipe 4 inches and smaller will be permitted, provided a pipe bender is used and wide sweep bends are formed. The center-line radius of bends shall be not less than six diameters of the pipe. Bent pipe showing kinks, wrinkles, flattening, or other malformations will not be acceptable.

3.1.1.5 Pipe Drains

Pipe drains indicated shall consist of 3/4 inch hose bibb with renewable seat and gate valve ahead of hose bibb. At other low points, 3/4 inch brass plugs or caps shall be provided. Disconnection of the supply piping at the fixture is an acceptable drain.

3.1.1.6 Thrust Restraint

Plugs, caps, tees, valves and bends deflecting 11.25 degrees or more, either vertically or horizontally, in waterlines 4 inches in diameter or larger shall be provided with thrust blocks, where indicated, to prevent movement.

Thrust blocking shall be concrete of a mix not leaner than: 1 cement, 2-1/2 sand, 5 gravel; and having a compressive strength of not less than 2000 psi after 28 days. Blocking shall be placed between solid ground and the fitting to be anchored. Unless otherwise indicated or directed, the base and thrust bearing sides of the thrust block shall be poured against undisturbed earth. The side of the thrust block not subject to thrust shall be poured against forms.

The area of bearing will be as shown. Blocking shall be placed so that the joints of the fitting are accessible for repair. Steel rods and clamps, protected by galvanizing or by coating with bituminous paint, shall be used to anchor vertical down bends into gravity thrust blocks.

3.1.1.7 Water Hammer Arresters

Commercial-type water hammer arresters shall be provided on hot- and cold-water supplies and shall be located as generally indicated, with precise location and sizing to be in accordance with PDI WH 201. Water hammer arresters, where concealed, shall be accessible by means of access doors or removable panels. Commercial-type water hammer arresters shall conform to ASSE 1010.

Vertical capped pipe columns will not be permitted.

3.1.2 Joints

Installation of pipe and fittings shall be made in accordance with the manufacturer's recommendations.

Mitering of joints for elbows and notching of straight runs of pipe for tees will not be permitted. Joints shall be made up with fittings of compatible material and made for the specific purpose intended.

3.1.2.1 Threaded

Threaded joints shall have American Standard taper pipe threads conforming to ASME B1.20.1.

Only male pipe threads shall be coated with graphite or with an approved graphite compound, or with an inert filler and oil, or shall have a polytetrafluoroethylene tape applied.

3.1.2.2 Mechanical Couplings

Mechanical couplings may be used in conjunction with grooved pipe for aboveground, ferrous or non-ferrous, domestic hot and cold water systems, in lieu of unions, brazed, soldered, welded, flanged, or threaded joints.

Mechanical couplings are permitted in accessible locations including behind access plates. Flexible grooved joints will not be permitted, except as vibration isolators adjacent to mechanical equipment.

Rigid grooved joints shall incorporate an angle bolt pad design which maintains metal-to-metal contact with equal amount of pad offset of housings upon installation to ensure positive rigid clamping of the pipe.

Designs which can only clamp on the bottom of the groove or which utilize gripping teeth or jaws, or which use misaligned housing bolt holes, or which require a torque wrench or torque specifications will not be permitted.

Rigid grooved pipe couplings shall be for use with grooved end pipes, fittings, valves and strainers.

Rigid couplings shall be designed for not less than 125 psi service and appropriate for static head plus the pumping head, and shall provide a watertight joint.

Grooved fittings and couplings, and grooving tools shall be provided from the same manufacturer.

Segmentally welded elbows shall not be used. Grooves shall be prepared in accordance with the coupling manufacturer's latest published standards.

Grooving shall be performed by qualified grooving operators having demonstrated proper grooving procedures in accordance with the tool manufacturer's recommendations.

The resident engineer shall be notified 24 hours in advance of test to demonstrate operator's capability, and the test shall be performed at the work site, if practical, or at a site agreed upon.

The operator shall demonstrate the ability to properly adjust the grooving tool, groove the pipe, and to verify the groove dimensions in accordance with the coupling manufacturer's specifications.

3.1.2.3 Unions and Flanges

Unions, flanges and mechanical couplings shall not be concealed in walls, ceilings, or partitions.

Unions shall be used on pipe sizes 2-1/2 inches and smaller; flanges shall be used on pipe sizes 3 inches and larger.

3.1.2.4 Cast Iron Soil, Waste and Vent Pipe

Bell and spigot compression and hubless gasketed clamp joints for soil, waste and vent piping shall be installed per the manufacturer's recommendations.

3.1.2.5 Copper Tube and Pipe

- a. Brazed. Brazed joints shall be made in conformance with AWS B2.2/B2.2M, MSS SP-73, and CDA A4015 with flux and are acceptable for all pipe sizes.

Copper to copper joints shall include the use of copper-phosphorus or copper-phosphorus-silver brazing metal without flux.

Brazing of dissimilar metals (copper to bronze or brass) shall include the use of flux with either a copper-phosphorus, copper-phosphorus-silver or a silver brazing filler metal.

b. Soldered.

Soldered joints shall be made with flux and are only acceptable for piping 2 inches and smaller.

Soldered joints shall conform to ASME B31.5 and CDA A4015. Soldered joints shall not be used in compressed air piping between the air compressor and the receiver.

c. Copper Tube Extracted Joint.

Mechanically extracted joints shall be made in accordance with ICC IPC.

d. Press connection. Copper press connections shall be made in **strict** accordance with the manufacturer's installation instructions for manufactured rated size.

The joints shall be pressed using the tool(s) approved by the manufacturer **of that joint**.

Minimum distance between fittings shall be in accordance with the manufacturer's requirements.

3.1.2.6 Plastic Pipe

Acrylonitrile-Butadiene-Styrene (ABS) pipe shall have joints made with solvent cement.

PVC and CPVC pipe shall have joints made with solvent cement elastomeric, threading, (threading of Schedule 80 Pipe is allowed only where required for disconnection and inspection; threading of Schedule 40 Pipe is not allowed), or mated flanged.

3.1.2.7 Corrosive Waste Plastic Pipe

Joints for polyolefin pipe and fittings shall be made by mechanical joint or electrical fusion coil method in accordance with ASTM D 2657 and ASTM F 1290. Joints for filament-wound reinforced thermosetting resin pipe shall be made in accordance with manufacturer's instructions. Unions or flanges shall be used where required for disconnection and inspection.

3.1.2.8 Polypropylene Pipe

Joints for polypropylene pipe and fittings shall be made by heat fusion welding socket-type or butt-fusion type fittings and shall comply with ASTM F 2389.

3.1.3 Dissimilar Pipe Materials

Connections between ferrous and non-ferrous copper water pipe shall be made with dielectric unions or flange waterways.

Dielectric waterways shall have temperature and pressure rating equal to or greater than that specified for the connecting piping. Waterways shall have metal connections on both ends suited to match connecting piping. Dielectric waterways shall be internally lined with an insulator specifically designed to prevent current flow between dissimilar metals. Dielectric flanges shall meet the performance requirements described herein for dielectric waterways.

Connecting joints between plastic and metallic pipe shall be made with transition fitting for the specific purpose.

3.1.4 Corrosion Protection for Buried Pipe and Fittings

Ductile iron, cast iron, and steel pipe, fittings, and joints shall have a protective coating. Additionally, ductile iron, cast iron, and steel pressure pipe shall have a cathodic protection system and joint bonding. Coatings shall be selected, applied, and inspected in accordance with NACE SP0169 and as otherwise specified.

The pipe shall be cleaned and the coating system applied prior to pipe tightness testing. Joints and fittings shall be cleaned and the coating system applied after pipe tightness testing.

For tape coating systems, the tape shall conform to AWWA C203 and shall be applied with a 50 percent overlap.

Primer utilized with tape type coating systems shall be as recommended by the tape manufacturer.

3.1.5 Pipe Sleeves and Flashing

Pipe sleeves shall be furnished and set in their proper and permanent location.

3.1.5.1 Sleeve Requirements

Unless indicated otherwise, provide pipe sleeves meeting the following requirements:

Secure sleeves in position and location during construction. Provide sleeves of sufficient length to pass through entire thickness of walls, ceilings, roofs, and floors. A modular mechanical type sealing assembly may be installed in lieu of a waterproofing clamping flange and caulking and sealing of annular space between pipe and sleeve. The seals shall consist of interlocking synthetic rubber links shaped to continuously fill the annular space between the pipe and sleeve using galvanized steel bolts, nuts, and pressure plates. The links shall be loosely assembled with bolts to form a continuous rubber belt around the pipe with a pressure plate under each bolt head and each nut. After the seal assembly is properly positioned in the sleeve, tightening of the bolt shall cause the rubber sealing elements to expand and provide a watertight seal between the pipe and the sleeve. Each seal assembly shall be sized as recommended by the manufacturer to fit the pipe and sleeve involved.

Sleeves shall not be installed in structural members, except where indicated or approved.

Rectangular and square openings shall be as detailed.

Each sleeve shall extend through its respective floor, or roof, and shall be cut flush with each surface, except for special circumstances. Pipe sleeves passing through floors in wet areas such as mechanical equipment rooms, lavatories, kitchens, and other plumbing fixture areas shall extend a minimum of 4 inches above the finished floor.

Unless otherwise indicated, sleeves shall be of a size to provide a minimum of one inch clearance between bare pipe or insulation and inside of sleeve or between insulation and inside

of sleeve. Sleeves in bearing walls and concrete slab on grade floors shall be steel pipe or cast-iron pipe. Sleeves in nonbearing walls or ceilings may be steel pipe, cast-iron pipe, galvanized sheet metal with lock-type longitudinal seam, or plastic.

Except as otherwise specified, the annular space between pipe and sleeve, or between jacket over insulation and sleeve, shall be sealed as indicated with sealants conforming to ASTM C 920 and with a primer, backstop material and surface preparation. The annular space between pipe and sleeve, between bare insulation and sleeve or between jacket over insulation and sleeve shall not be sealed for interior walls which are not designated as fire rated.

Sleeves through below-grade walls in contact with earth shall be recessed 1/2 inch from wall surfaces on both sides. Annular space between pipe and sleeve shall be filled with backing material and sealants in the joint between the pipe and wall as specified above. Sealant selected for the earth side of the wall shall be compatible with dampproofing/waterproofing materials that are to be applied over the joint sealant.

3.1.5.2 Flashing Requirements

Pipes passing through roof shall be installed through a 16 ounce copper flashing, each within an integral skirt or flange. Flashing shall be suitably formed, and the skirt or flange shall extend not less than 8 inches from the pipe and shall be set over the roof or floor membrane in a solid coating of bituminous cement. The flashing shall extend up the pipe a minimum of 10 inches. For cleanouts, the flashing shall be turned down into the hub and caulked after placing the ferrule. Pipes passing through pitched roofs shall be flashed, using lead or copper flashing, with an adjustable integral flange of adequate size to extend not less than 8 inches from the pipe in all directions and lapped into the roofing to provide a watertight seal. The annular space between the flashing and the bare pipe or between the flashing and the metal-jacket-covered insulation shall be sealed as indicated. Flashing for dry vents shall be turned down into the pipe to form a waterproof joint. Pipes, up to and including 10 inches in diameter, passing through roof or floor waterproofing membrane may be installed through a cast-iron sleeve with caulking recess, anchor lugs, flashing-clamp device, and pressure ring with brass bolts.

Flashing shield shall be fitted into the sleeve clamping device.

Pipes passing through wall waterproofing membrane shall be sleeved as described above.

A waterproofing clamping flange shall be installed.

3.1.5.3 Waterproofing

Waterproofing at floor-mounted water closets shall be accomplished by forming a flashing guard from soft-tempered sheet copper.

The center of the sheet shall be perforated and turned down approximately 1-1/2 inches to fit between the outside diameter of the drainpipe and the inside diameter of the cast-iron or steel pipe sleeve.

The turned-down portion of the flashing guard shall be embedded in sealant to a depth of approximately 1-1/2 inches; then the sealant shall be finished off flush to floor level between the

flashing guard and drainpipe. The flashing guard of sheet copper shall extend not less than 8 inches from the drainpipe and shall be lapped between the floor membrane in a solid coating of bituminous cement. If cast-iron water closet floor flanges are used, the space between the pipe sleeve and drainpipe shall be sealed with sealant and the flashing guard shall be upturned approximately 1-1/2 inches to fit the outside diameter of the drainpipe and the inside diameter of the water closet floor flange. The upturned portion of the sheet fitted into the floor flange shall be sealed.

3.1.5.4 Optional Counterflashing

Instead of turning the flashing down into a dry vent pipe, or caulking and sealing the annular space between the pipe and flashing or metal-jacket-covered insulation and flashing, counterflashing may be accomplished by utilizing the following:

- a. A standard roof coupling for threaded pipe up to 6 inches in diameter.
- b. A tack-welded or banded-metal rain shield around the pipe.

3.1.5.5 Pipe Penetrations of Slab on Grade Floors

Where pipes, fixture drains, floor drains, cleanouts or similar items penetrate slab on grade floors, except at penetrations of floors with waterproofing membrane as specified in paragraphs Flashing Requirements and Waterproofing, a groove 1/4 to 1/2 inch wide by 1/4 to 3/8 inch deep shall be formed around the pipe, fitting or drain.

The groove shall be filled with a sealant.

3.1.5.6 Pipe Penetrations

Provide sealants for all pipe penetrations.

All pipe penetrations shall be sealed to prevent infiltration of air, insects, and vermin.

3.1.6 Fire Seal

Where pipes pass through fire walls, fire-partitions, fire-rated pipe chase walls or floors above grade, a fire seal shall be provided.

3.1.7 Supports

3.1.7.1 General

Hangers used to support piping 2 inches and larger shall be fabricated to permit adequate adjustment after erection while still supporting the load. Pipe guides and anchors shall be installed to keep pipes in accurate alignment, to direct the expansion movement, and to prevent buckling, swaying, and undue strain. Piping subjected to vertical movement when operating temperatures exceed ambient temperatures shall be supported by variable spring hangers and supports or by constant support hangers.

In the support of multiple pipe runs on a common base member, a clip or clamp shall be used where each pipe crosses the base support member.

Spacing of the base support members shall not exceed the hanger and support spacing required for an individual pipe in the multiple pipe run. Threaded sections of rods shall not be formed or bent.

3.1.7.2 Pipe Supports and Structural Bracing, Seismic Requirements

Piping and attached valves shall be supported and braced to resist seismic loads. Structural steel required for reinforcement to properly support piping, headers, and equipment, but not shown, shall be provided.

3.1.7.3 Pipe Hangers, Inserts, and Supports

Installation of pipe hangers, inserts and supports shall conform to MSS SP-58 and MSS SP-69, except as modified herein.

- a. Types 5, 12, and 26 shall not be used.
- b. Type 3 shall not be used on insulated pipe.
- c. Type 18 inserts shall be secured to concrete forms before concrete is placed. Continuous inserts which allow more adjustment may be used if they otherwise meet the requirements for type 18 inserts.
- d. Type 19 and 23 C-clamps shall be torqued per MSS SP-69 and shall have both locknuts and retaining devices furnished by the manufacturer. Field-fabricated C-clamp bodies or retaining devices are not acceptable.
- e. Type 20 attachments used on angles and channels shall be furnished with an added malleable-iron heel plate or adapter.
- f. Type 24 may be used only on trapeze hanger systems or on fabricated frames.
- g. Type 39 saddles shall be used on insulated pipe 4 inches and larger when the temperature of the medium is 60 degrees F or higher. Type 39 saddles shall be welded to the pipe.
- h. Type 40 shields shall:
 - (1) Be used on insulated pipe less than 4 inches.
 - (2) Be used on insulated pipe 4 inches and larger when the temperature of the medium is 60 degrees F or less.
 - (3) Have a high density insert for all pipe sizes. High density inserts shall have a density of 8 pcf or greater.

- i. Horizontal pipe supports shall be spaced as specified in MSS SP-69 and a support shall be installed not over 1 foot from the pipe fitting joint at each change in direction of the piping. Pipe supports shall be spaced not over 5 feet apart at valves. Operating temperatures in determining hanger spacing for PVC or CPVC pipe shall be 120 degrees F for PVC and 180 degrees F for CPVC. Horizontal pipe runs shall include allowances for expansion and contraction.
- j. Vertical pipe shall be supported at each floor, except at slab-on-grade, at intervals of not more than 15 feet nor more than 8 feet from end of risers, and at vent terminations. Vertical pipe risers shall include allowances for expansion and contraction.
- k. Type 35 guides using steel, reinforced polytetrafluoroethylene (PTFE) or graphite slides shall be provided to allow longitudinal pipe movement. Slide materials shall be suitable for the system operating temperatures, atmospheric conditions, and bearing loads encountered. Lateral restraints shall be provided as needed. Where steel slides do not require provisions for lateral restraint the following may be used:
 - (1) On pipe 4 inches and larger when the temperature of the medium is 60 degrees F or higher, a Type 39 saddle, welded to the pipe, may freely rest on a steel plate.
 - (2) On pipe less than 4 inches a Type 40 shield, attached to the pipe or insulation, may freely rest on a steel plate.
 - (3) On pipe 4 inches and larger carrying medium less than 60 degrees F a Type 40 shield, attached to the pipe or insulation, may freely rest on a steel plate.
- l. Pipe hangers on horizontal insulated pipe shall be the size of the outside diameter of the insulation.

The insulation shall be continuous through the hanger on all pipe sizes and applications.
- m. Where there are high system temperatures and welding to piping is not desirable, the type 35 guide shall include a pipe cradle, welded to the guide structure and strapped securely to the pipe.

The pipe shall be separated from the slide material by at least 4 inches or by an amount adequate for the insulation, whichever is greater.
- n. Hangers and supports for plastic pipe shall not compress, distort, cut or abrade the piping, and shall allow free movement of pipe except where otherwise required in the control of expansion/contraction.

3.1.7.4 Structural Attachments

Attachment to building structure concrete and masonry shall be by cast-in concrete inserts, built-in anchors, or masonry anchor devices. Inserts and anchors shall be applied with a safety factor not less than 5. Supports shall not be attached to metal decking. Supports shall not be attached to the underside of concrete filled floor or concrete roof decks unless approved by the resident engineer. Masonry anchors for overhead applications shall be constructed of ferrous materials only.

3.1.8 Pipe Cleanouts

Pipe cleanouts shall be the same size as the pipe except that cleanout plugs larger than 4 inches will not be required. A cleanout installed in connection with cast-iron soil pipe shall consist of a long-sweep 1/4 bend or one or two 1/8 bends extended to the place shown. An extra-heavy cast-brass or cast-iron ferrule with countersunk cast-brass head screw plug shall be caulked into the hub of the fitting and shall be flush with the floor. Cleanouts in connection with other pipe, where indicated, shall be T-pattern, 90-degree branch drainage fittings with cast-brass screw plugs, except plastic plugs shall be installed in plastic pipe. Plugs shall be the same size as the pipe up to and including 4 inches. Cleanout tee branches with screw plug shall be installed at the foot of soil and waste stacks, at the foot of interior downspouts, on each connection to building storm drain where interior downspouts are indicated, and on each building drain outside the building. Cleanout tee branches may be omitted on stacks in single story buildings with slab-on-grade construction or where less than 18 inches of crawl space is provided under the floor. Cleanouts on pipe concealed in partitions shall be provided with chromium plated bronze, nickel bronze, nickel brass or stainless steel flush type access cover plates. Round access covers shall be provided and secured to plugs with securing screw. Square access covers may be provided with matching frames, anchoring lugs and cover screws. Cleanouts in finished walls shall have access covers and frames installed flush with the finished wall. Cleanouts installed in finished floors subject to foot traffic shall be provided with a chrome-plated cast brass, nickel brass, or nickel bronze cover secured to the plug or cover frame and set flush with the finished floor. Heads of fastening screws shall not project above the cover surface. Where cleanouts are provided with adjustable heads, the heads shall be cast iron. Cleanout to grade shall be lacquered cast iron body and round epoxy coated gasketed cover.

3.2 FIXTURES AND FIXTURE TRIMMINGS

Polished chromium-plated pipe, valves, and fittings shall be provided where exposed to view.

Angle stops, straight stops, stops integral with the faucets, or concealed type of lock-shield, and loose-key pattern stops for supplies with threaded, sweat or solvent weld inlets shall be furnished and installed with fixtures.

Where connections between copper tubing and faucets are made by rubber compression fittings, a beading tool shall be used to mechanically deform the tubing above the compression fitting. Exposed traps and supply pipes for fixtures and equipment shall be connected to the rough piping systems at the wall, unless otherwise specified under the item. Floor and wall escutcheons shall be as specified.

Drain lines and hot water lines of fixtures for handicapped personnel shall be insulated and do not require polished chrome finish. Plumbing fixtures and accessories shall be installed within the space shown.

3.2.1 Fixture Connections

Where space limitations prohibit standard fittings in conjunction with the cast-iron floor flange, special short-radius fittings shall be provided. Connections between earthenware fixtures and flanges on soil pipe shall be made gastight and watertight with a closet-setting compound or neoprene gasket and seal.

Use of natural rubber gaskets or putty will not be permitted. Fixtures with outlet flanges shall be set the proper distance from floor or wall to make a first-class joint with the closet-setting compound or gasket and fixture used.

3.2.2 Height of Fixture Rims Above Floor

Lavatories shall be mounted with rim 31 inches above finished floor. Wall-hung drinking fountains and water coolers shall be installed with rim 42 inches above floor. Wall-hung service sinks shall be mounted with rim 28 inches above the floor. Installation of fixtures for use by the physically handicapped shall be in accordance with ICC/ANSI A117.1.

3.3.3 Shower Bath Outfits

The area around the water supply piping to the mixing valves and behind the escutcheon plate shall be made watertight by caulking or gasketing.

3.2.4 Fixture Supports

Fixture supports for off-the-floor lavatories, urinals, water closets, and other fixtures of similar size, design, and use, shall be of the chair-carrier type.

The carrier shall provide the necessary means of mounting the fixture, with a foot or feet to anchor the assembly to the floor slab.

Adjustability shall be provided to locate the fixture at the desired height and in proper relation to the wall.

Support plates, in lieu of chair carrier, shall be fastened to the wall structure only where it is not possible to anchor a floor-mounted chair carrier to the floor slab.

3.2.5 Access Panels

Access panels shall be provided for concealed valves and controls, or any item requiring inspection or maintenance.

Access panels shall be of sufficient size and located so that the concealed items may be serviced, maintained, or replaced.

3.2.6 Traps

Each trap shall be placed as near the fixture as possible, and no fixture shall be double-trapped.

Traps installed on cast-iron soil pipe shall be cast iron. Traps installed on steel pipe or copper tubing shall be recess-drainage pattern, or brass-tube type. Traps installed on plastic pipe may be plastic conforming to ASTM D 3311. Traps for acid-resisting waste shall be of the same material as the pipe.

3.3 IDENTIFICATION SYSTEMS

3.3.1 Identification Tags

Identification tags made of brass, engraved laminated plastic, or engraved anodized aluminum, indicating service and valve number shall be installed on valves, except those valves installed on supplies at plumbing fixtures. Tags shall be 1-3/8 inch minimum diameter, and marking shall be stamped or engraved. Indentations shall be black, for reading clarity. Tags shall be attached to valves with No. 12 AWG, copper wire, chrome-plated beaded chain, or plastic straps designed for that purpose.

3.4 ESCUTCHEONS

Escutcheons shall be provided at finished surfaces where bare or insulated piping, exposed to view, passes through floors, walls, or ceilings, except in boiler, utility, or equipment rooms.

Escutcheons shall be fastened securely to pipe or pipe covering and shall be satin-finish, corrosion-resisting steel, polished chromium-plated zinc alloy, or polished chromium-plated copper alloy. Escutcheons shall be either one-piece or split-pattern, held in place by internal spring tension or setscrew.

3.5 TESTS, FLUSHING AND DISINFECTION

3.5.1 Plumbing System

The following tests shall be performed on the plumbing system in accordance with ICC IPC or IAPMO UPC, except that the drainage and vent system final test shall include the smoke test. The Contractor has the option to perform a peppermint test in lieu of the smoke test. If a peppermint test is chosen, the Contractor must submit a testing procedure to the resident engineer for approval.

- a. Drainage and Vent Systems Test.
The final test shall include a smoke test.
- b. Building Sewers Tests.
- c. Water Supply Systems Tests.

3.5.2 Defective Work

If inspection or test shows defects, such defective work or material shall be replaced or repaired as necessary and inspection and tests shall be repeated. Repairs to piping shall be made with new materials. Caulking of screwed joints or holes will not be acceptable.

3.5.3 System Flushing

3.5.3.1 During Flushing

Before operational tests or disinfection, potable water piping system shall be flushed with [hot] potable water. Sufficient water shall be used to produce a water velocity that is capable of entraining and removing debris in all portions of the piping system. This requires simultaneous operation of all fixtures on a common branch or main in order to produce a flushing velocity of approximately 4 fps through all portions of the piping system. In the event that this is impossible due to size of system, the Contracting Officer (or the designated representative) shall specify the number of fixtures to be operated during flushing. Contractor shall provide adequate personnel to monitor the flushing operation and to ensure that drain lines are unobstructed in order to prevent flooding of the facility. Contractor shall be responsible for any flood damage resulting from flushing of the system. Flushing shall be continued until entrained dirt and other foreign materials have been removed and until discharge water shows no discoloration. All faucets and drinking water fountains, to include any device considered as an end point device by NSF/ANSI 61, Section 9, shall be flushed a minimum of 1 L 0.25 gallons per 24 hour period, ten times over a 14 day period.

3.5.3.2 After Flushing

System shall be drained at low points.

Strainer screens shall be removed, cleaned, and replaced. After flushing and cleaning, systems shall be prepared for testing by immediately filling water piping with clean, fresh potable water. Any stoppage, discoloration, or other damage to the finish, furnishings, or parts of the building due to the Contractor's failure to properly clean the piping system shall be repaired by the Contractor. When the system flushing is complete, the hot-water system shall be adjusted for uniform circulation. Flushing devices and automatic control systems shall be adjusted for proper operation according to manufacturer's instructions. Comply with ASHRAE 90.1 - SI ASHRAE 90.1 - IP for minimum efficiency requirements. Unless more stringent local requirements exist, lead levels shall not exceed limits established by 40 CFR 50.12 Part 141.80(c)(1). The water supply to the building shall be tested separately to ensure that any lead contamination found during potable water system testing is due to work being performed inside the building.

3.5.4 Operational Test

Upon completion of flushing and prior to disinfection procedures, the Contractor shall subject the plumbing system to operating tests to demonstrate satisfactory installation, connections, adjustments, and functional and operational efficiency. Such operating tests shall cover a period of not less than 8 hours for each system and shall include the following information in a report with conclusion as to the adequacy of the system:

- a. Time, date, and duration of test.
- b. Water pressures at the most remote and the highest fixtures.
- c. Operation of each fixture and fixture trim.
- d. Operation of each valve, hydrant, and faucet.
- e. Pump suction and discharge pressures.
- f. Temperature of each domestic hot-water supply.

- g. Operation of each floor and roof drain by flooding with water.
- h. Operation of each vacuum breaker and backflow preventer.
- i. Complete operation of each water pressure booster system, including pump start pressure and stop pressure.
- j. Compressed air readings at each compressor and at each outlet. Each indicating instrument shall be read at 1/2 hour intervals.

The report of the test shall be submitted in quadruplicate.

The Contractor shall furnish instruments, equipment, and personnel required for the tests; the Government will furnish the necessary water and electricity.

3.5.5 Disinfection

After all system components are provided and operational tests are complete, the entire domestic hot- and cold-water distribution system shall be disinfected.

Before introducing disinfecting chlorination material, entire system shall be flushed with potable water until any entrained dirt and other foreign materials have been removed.

Water chlorination procedure shall be in accordance with AWWA C651 and AWWA C652 as modified. The chlorinating material shall be hypochlorites or liquid chlorine. The chlorinating material shall be fed into the water piping system at a constant rate at a concentration of at least 50 parts per million (ppm).

Test the chlorine residual level in the water at 6 hour intervals for a continuous period of 24 hours. If at the end of a 6 hour interval, the chlorine residual has dropped to less than 25 ppm, flush the piping including tanks with potable water, and repeat the above chlorination procedures.

During the chlorination period, each valve and faucet shall be opened and closed several times.

After the second 24 hour period, verify that no less than 25 ppm chlorine residual remains in the treated system. The 24 hour chlorination procedure must be repeated until no less than 25 ppm chlorine residual remains in the treated system.

Upon the specified verification, the system including tanks shall then be flushed with potable water until the residual chlorine level is reduced to less than one part per million. During the flushing period, each valve and faucet shall be opened and closed several times.

Take addition samples of water in disinfected containers, for bacterial examination, at locations specified by the resident engineer Test these samples for total coliform organisms (coliform bacteria, fecal coliform, streptococcal, and other bacteria) in accordance with EPA SM 9223 or AWWA 10084. The testing method used shall be EPA approved for drinking water systems and shall comply with applicable local and state requirements.

Disinfection shall be repeated until bacterial tests indicate the absence of coliform organisms (zero mean coliform density per 100 milliliters) in the samples for at least 2 full days.

The system will not be accepted until satisfactory bacteriological results have been obtained.

3.6 WASTE MANAGEMENT

Place materials defined as hazardous or toxic waste in designated containers.

Return solvent and oil soaked rags for contaminant recovery and laundering or for proper disposal.

Close and seal tightly partly used sealant and adhesive containers and store in protected, well-ventilated, fire-safe area at moderate temperature. Place used sealant and adhesive tubes and containers in areas designated for hazardous waste. Separate copper and ferrous pipe waste in accordance with the Waste Management Plan and place in designated areas for reuse.

3.7 POSTED INSTRUCTIONS

Framed instructions under glass or in laminated plastic, including wiring and control diagrams showing the complete layout of the entire system, shall be posted where directed.

Condensed operating instructions explaining preventive maintenance procedures, methods of checking the system for normal safe operation, and procedures for safely starting and stopping the system shall be prepared in typed form, framed as specified above for the wiring and control diagrams and posted beside the diagrams. The framed instructions shall be posted before acceptance testing of the systems.

3.8 TABLES

TABLE I
PIPE AND FITTING MATERIALS FOR
DRAINAGE, WASTE, AND VENT PIPING SYSTEMS

| Item # | Pipe and Fitting Materials | SERVICE | | | | | |
|--------|---|---------|---|---|---|---|---|
| | | A | B | C | D | E | F |
| 1 | Cast iron soil pipe and fittings, hub and spigot, ASTM A 74 with compression gaskets. Pipe and fittings shall be marked with the CISPI trademark. | X | X | X | X | X | |
| 2 | Cast iron soil pipe and fittings hubless, CISPI 301 and ASTM A 888. Pipe and fittings shall be marked with the CISPI trademark. | | X | X | X | X | |
| 3 | Cast iron drainage fittings, threaded, ASME B16.12 for use with Item 10 | X | | X | X | | |
| 4 | Cast iron screwed fittings (threaded) ASME B16.4 for use with Item 10 | | | | X | X | |
| 5 | Grooved pipe couplings, ferrous and non-ferrous pipe ASTM A 536 and ASTM A 47/A 47M | X | X | | X | X | |
| 6 | Ductile iron grooved joint fittings for ferrous pipe ASTM A 536 and ASTM A 47/A 47M for use with Item 5 | X | X | | X | X | |
| 7 | Bronze sand casting grooved joint pressure fittings for non-ferrous pipe ASTM B 584, for use with Item 5 | X | X | | X | X | |
| 8 | Wrought copper grooved joint pressure fittings for non-ferrous pipe ASTM B 75M ASTM B 75 C12200, ASTM B 152/B 152M, C11000, ASME B16.22 ASME B16.22 for use with Item 5 | X | X | | | | |
| 9 | Malleable-iron threaded fittings, galvanized ASME B16.3 for use with Item 10 | | | | X | X | |
| 10 | Steel pipe, seamless galvanized, ASTM A 53/A 53M, Type S, Grade B | X | | | X | X | |
| 11 | Seamless red brass pipe, ASTM B 43 | | X | X | | | |
| 12 | Bronzed flanged fittings, ASME B16.24 for use | | | | X | X | |

| | | | | | | |
|----------------------|--|-------|-------|----|---|-----|
| with Items 11 and 14 | | | | | | |
| 13 | Cast copper alloy solder joint pressure fittings, ASME B16.18 for use with Item 14 | | | | X | X |
| 14 | Seamless copper pipe, ASTM B 42 | | | | X | |
| 15 | Cast bronze threaded fittings, ASME B16.15 | | | | X | X |
| 16 | Copper drainage tube, (DWV), ASTM B 306 | X* | X | X* | X | X |
| 17 | Wrought copper and wrought alloy solder-joint drainage fittings. ASME B16.29 | X | X | X | X | X |
| 18 | Cast copper alloy solder joint drainage fittings, DWV, ASME B16.23 | X | X | X | X | X |
| 19 | Acrylonitrile-Butadiene-Styrene (ABS) plastic drain, waste, and vent pipe and fittings ASTM D 2661, ASTM F 628 | X | X | X | X | X X |
| 20 | Polyvinyl Chloride plastic drain, waste and vent pipe and fittings, ASTM D 2665, ASTM F 891, (Sch 40) ASTM F 1760 | X | X | X | X | X X |
| 21 | Process glass pipe and fittings, ASTM C 1053 | | | | | X |
| 22 | High-silicon content cast iron pipe and fittings (hub and spigot, and mechanical joint), ASTM A 518/A 518M | | X | | | X X |
| 23 | Polypropylene (PP) waste pipe and fittings, ASTM D 4101 | | | | | X |
| 24 | Filament-wound reinforced thermosetting resin (RTRP) pipe, ASTM D 2996 | | | | | X |
| | SERVICE: | | | | | |
| | A - Underground Building Soil, Waste and | Storm | Drain | | | |
| | B - Aboveground Soil, Waste, Drain In Buildings | | | | | |
| | C - Underground Vent | | | | | |
| | D - Aboveground Vent | | | | | |
| | E - Interior Rainwater Conductors Aboveground | | | | | |
| | F - Corrosive Waste And Vent Above And Belowground | | | | | |
| | * - Hard Temper | | | | | |

TABLE II
PIPE AND FITTING MATERIALS FOR PRESSURE PIPING SYSTEMS

| Item No. | Pipe and Fitting Materials | SERVICE | | | |
|----------|---|---------|-----|-----|------|
| | | A | B | C | D |
| 1 | Malleable-iron threaded fittings, | X | X | X | X |
| | a. Galvanized, ASME B16.3 for use with Item 4a | | | | |
| | b. Same as "a" but not galvanized for use with Item 4b | | | X | |
| 2 | Grooved pipe couplings, ferrous pipe ASTM A 536 and ASTM A 47/A 47M, non-ferrous pipe, ASTM A 536 and ASTM A 47/A 47M, | X | X | X | |
| 3 | Ductile iron grooved joint fittings for ferrous pipe ASTM A 536 and ASTM A 47/A 47M, for use with Item 2 | X | X | X | |
| 4 | Steel pipe: | X | X | X | X |
| | a. Seamless, galvanized, ASTM A 53/A 53M, Type S, Grade B | | | | |
| | b. Seamless, black, ASTM A 53/A 53M, Type S, Grade B | | | X | |
| 5 | Seamless red brass pipe, ASTM B 43 | X | X | | X |
| 6 | Bronze flanged fittings, ASME B16.24 for use with Items 5 and 7 | X | X | | X |
| 7 | Seamless copper pipe, ASTM B 4 | X | X | | X |
| 8 | Seamless copper water tube, ASTM B 88, ASTM B 88M | X** | X** | X** | X*** |
| 9 | Cast bronze threaded fittings, ASME B16.15 for use with Items 5 and 7 | X | X | | X |
| 10 | Wrought copper and bronze solder-joint pressure fittings, ASME B16.22 for use with Items 5, 7 and 8 | X | X | X | X |

| | | | | | |
|----|--|---|---|---|---|
| 11 | Cast copper alloy solder-joint pressure fittings, ASME B16.18 for use with Item 8 | X | X | X | X |
| 12 | Bronze and sand castings grooved joint pressure fittings for non-ferrous pipe ASTM B 584, for use with Item 2 | X | X | X | |
| 13 | Polyethylene (PE) plastic pipe, X Schedules 40 and 80, based on outside diameter ASTM D 2447 | | | | X |
| 14 | Polyethylene (PE) plastic pipe (SDR-PR), based on controlled outside diameter, ASTM D 3035 | X | | | X |
| 15 | Polyethylene (PE) plastic pipe (SIDR-PR), based on controlled inside diameter, ASTM D 2239 | X | | | X |
| 16 | Butt fusion polyethylene (PE) plastic pipe fittings, ASTM D 3261 for use with Items 14, 15, and 16 | X | | | X |
| 17 | Socket-type polyethylene fittings for outside diameter-controlled polyethylene pipe, ASTM D 2683 for use with Item 15 | X | | | X |
| 18 | Polyethylene (PE) plastic tubing, ASTM D 2737 | X | | | X |
| 19 | Chlorinated polyvinyl chloride (CPVC) plastic hot and cold water distribution system, ASTM D 2846/D 2846M | X | X | | X |
| 20 | Chlorinated polyvinyl chloride (CPVC) plastic pipe, Schedule 40 and 80, ASTM F 441/F 441M | X | X | | X |
| 21 | Chlorinated polyvinyl chloride (CPVC) plastic pipe (SDR-PR) ASTM F 442/F 442M | X | X | | X |
| 22 | Threaded chlorinated polyvinyl chloride (chloride CPVC) plastic pipe fittings, Schedule 80, ASTM F 437, for use with Items 20, and 21 | X | X | | X |
| 23 | Socket-type chlorinated polyvinyl chloride (CPVC) plastic pipe fittings, Schedule 40, ASTM F 438 for use with Items 20, 21, and 22 | X | X | | X |

TABLE II
PIPE AND FITTING MATERIALS FOR PRESSURE PIPING SYSTEMS

| Item No. | Pipe and Fitting Materials | SERVICE | | | |
|----------|---|---------|---|---|---|
| | | A | B | C | D |
| 2 4 | Socket-type chlorinated polyvinyl chloride (CPVC) plastic pipe fittings Schedule 80, ASTM F 439 for use with Items 20, 21, and 22 | X | X | | X |
| 2 5 | Polyvinyl chloride (PVC) plastic pipe, Schedules 40, 80, and 120, ASTM D 1785 | X | | | X |
| 2 6 | Polyvinyl chloride (PVC) pressure-rated pipe (SDR Series), ASTM D 2241 | X | | | X |
| 2 7 | Polyvinyl chloride (PVC) plastic pipe fittings, Schedule 40, ASTM D 2466 | X | | | X |
| 2 8 | Socket-type polyvinyl chloride (PVC) plastic pipe fittings, schedule 80, ASTM D 2467 for use with Items 26 and 27 | X | | | X |
| 2 9 | Threaded polyvinyl chloride (PVC) plastic pipe fittings, schedule 80, ASTM D 2464 | X | | | X |
| 3 0 | Joints for IPS PVC pipe using solvent cement, ASTM D 2672 | X | | | X |
| 3 1 | Polypropylene (PP) plastic pipe and fittings; ASTM F 2389 | X | X | | X |
| 3 2 | Steel pipeline flanges, MSS SP-44 | X | X | | |
| 3 3 | Fittings: brass or bronze; ASME B16.15, and ASME B16.18 ASTM B 828 | X | X | | |
| 3 4 | Carbon steel pipe unions, socket-welding and threaded, MSS SP-83 | X | X | X | |
| 3 5 | Malleable-iron threaded pipe unions ASME B16.39 | X | X | | |
| 3 6 | Nipples, pipe threaded ASTM A 733 | X | X | X | |
| 3 7 | Crosslinked Polyethylene (PEX) Plastic Pipe ASTM F 877 | X | X | | X |
| 3 8 | Press Fittings | X | X | | |

A - Cold Water Service Aboveground

B - Hot and Cold Water Distribution 82 degrees C 180 degrees F Maximum

TABLE II
 PIPE AND FITTING MATERIALS FOR PRESSURE PIPING SYSTEMS

| Item No. | Pipe and Fitting Materials | SERVICE | | | |
|----------|--|---------|---|---|---|
| | | A | B | C | D |
| | Aboveground | | | | |
| | C - Compressed Air Lubricated | | | | |
| | D - Cold Water Service Belowground | | | | |
| | Indicated types are minimum wall thicknesses. | | | | |
| | ** - Type L - Hard | | | | |
| | *** - Type K - Hard temper with brazed joints only or type K-soft temper without joints in or under floors | | | | |
| | **** - In or under slab floors only brazed joints | | | | |

-- End of Section --

SECTION TABLE OF CONTENTS

DIVISION 23 - HEATING, VENTILATING, AND AIR CONDITIONING

SECTION 23 00 00 - AIR SUPPLY, DISTRIBUTION, VENTILATION, AND EXHAUST SYSTEMS

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

ACOUSTICAL SOCIETY OF AMERICA (ASA)

ASA S12.51 (2012) Acoustics Determination of Sound Power Levels of Noise Sources using Sound Pressure Precision Method for Reverberation Rooms

AIR CONDITIONING CONTRACTORS OF AMERICA (ACCA)

ACCA Manual 4 (2001) Installation Techniques for Perimeter Heating and Cooling; 11th Edition

AIR MOVEMENT AND CONTROL ASSOCIATION INTERNATIONAL (AMCA)

AMCA 201 (2002; R 2011) Fans and Systems
AMCA 210 (2007) Laboratory Methods of Testing Fans for Aerodynamic Performance Rating
AMCA 220 (2005) Test Methods for Air Curtain Units
AMCA 300 (2008) Reverberant Room Method for Sound Testing of Fans
AMCA 301 (2006; INT 2007) Methods for Calculating Fan Sound Ratings from Laboratory Test Data
AMCA 500-D (2012) Laboratory Methods of Testing Dampers for Rating

AIR-CONDITIONING, HEATING AND REFRIGERATION INSTITUTE (AHRI)

AHRI 260 (2011) Sound Rating of Ducted Air Moving and Conditioning Equipment
AHRI 410 (2001; Addendum 1 2002; Addendum 2 2005; Addendum 3 2011) Forced-Circulation Air-Cooling and Air-Heating Coils
AHRI DCAACP (Online) Directory of Certified Applied Air-Conditioning Products
AHRI Guideline D (1996) Application and Installation of Central Station Air-Handling Units

AMERICAN BEARING MANUFACTURERS ASSOCIATION (ABMA)

ABMA 11 (1990; R 2008) Load Ratings and Fatigue Life for Roller Bearings
ABMA 9 (1990; R 2008) Load Ratings and Fatigue Life for Ball Bearings

AIR SUPPLY, DISTRIBUTION, VENTILATION, AND EXHAUST SYSTEMS

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Appendix E – Technicals

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AMERICAN SOCIETY OF HEATING, REFRIGERATING AND AIR-CONDITIONING
ENGINEERS (ASHRAE)

| | |
|---------------------|---|
| ANSI/ASHRAE 15 & 34 | (2010; Addenda A, B, C, D, E, F, G, H, I, J, K, L, N and O; Errata 2011; INT 1 2012; Errata 2012; Addenda AD, SD, AE and AF 2013) ANSI/ASHRAE Standard 15-Safety Standard for Refrigeration Systems and ANSI/ASHRAE Standard 34-Designation and Safety Classification of Refrigerants |
| ASHRAE 52.2 | (2012) Method of Testing General Ventilation Air-Cleaning Devices for Removal Efficiency by Particle Size |
| ASHRAE 62.1 | (2010; Errata 2011; INT 3 2012; INT 4 2012; INT 5 2013) Ventilation for Acceptable Indoor Air Quality |
| ASHRAE 68 | (1997) Laboratory Method of Testing to Determine the Sound Power In a Duct |
| ASHRAE 70 | (2006; R 2011) Method of Testing for Rating the Performance of Air Outlets and Inlets |
| ASHRAE 84 | (2008) Method of Testing Air-to-Air Heat Exchangers |
| ASHRAE 90.1 - IP | (2010; Errata 1-3 2011; INT 1-12 2011; Addenda A, B, C, G, H, J, K, O, P, S, Y, Z, BZ, CG, CI and DS 2012; Errata 4-8 2012; INT 13-16 2012; Errata 9-10 2013) Energy Standard for Buildings Except Low-Rise Residential Buildings |
| ASHRAE 90.1 - SI | (2010; Errata 1-2 2011; INT 2-12 2011; Addenda A, B, C, G, H, J, K, O, P, S, Y, Z, BZ, CG, CI and DS 2012; Errata 3-9 2012; INT 13-16 2012; Errata 10-11 2013) Energy Standard for Buildings Except Low-Rise Residential Buildings |

INSTITUTE OF ENVIRONMENTAL SCIENCES AND TECHNOLOGY (IEST)

| | |
|----------------|------------------------------|
| IEST RP-CC-001 | (2009) HEPA and ULPA Filters |
|----------------|------------------------------|

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

| | |
|------------|--|
| NEMA ICS 6 | (1993; R 2011) Enclosures |
| NEMA MG 1 | (2011; Errata 2012) Motors and Generators |
| NEMA MG 10 | (2001; R 2007) Energy Management Guide for Selection and Use of Fixed Frequency Medium AC Squirrel-Cage Polyphase Induction Motors |
| NEMA MG 11 | (1977; R 2012) Energy Management Guide for Selection and Use of Single Phase Motors |

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

AIR SUPPLY, DISTRIBUTION, VENTILATION, AND EXHAUST SYSTEMS

Section 23 00 00

| | |
|----------|---|
| NFPA 70 | (2011; Errata 2 2012) National Electrical Code |
| NFPA 701 | (2010) Standard Methods of Fire Tests for Flame Propagation of Textiles and Films |
| NFPA 90A | (2012) Standard for the Installation of Air Conditioning and Ventilating Systems |

SCIENTIFIC CERTIFICATION SYSTEMS (SCS)

| | |
|-----|--|
| SCS | Scientific Certification Systems (SCS)Indoor Advantage |
|-----|--|

SHEET METAL AND AIR CONDITIONING CONTRACTORS' NATIONAL ASSOCIATION (SMACNA)

| | |
|----------------|--|
| SMACNA 1403 | (2008) Accepted Industry Practice for Industrial Duct Construction, 2nd Edition |
| SMACNA 1819 | (2002) Fire, Smoke and Radiation Damper Installation Guide for HVAC Systems, 5th Edition |
| SMACNA 1884 | (2003) Fibrous Glass Duct Construction Standards, 7th Edition |
| SMACNA 1966 | (2005) HVAC Duct Construction Standards Metal and Flexible, 3rd Edition |
| SMACNA 1972 CD | (2012) HVAC Air Duct Leakage Test Manual - 2nd Edition |
| SMACNA 1981 | (2008) Seismic Restraint Manual Guidelines for Mechanical Systems, 3rd Edition |

U.S. DEPARTMENT OF DEFENSE (DOD)

| | |
|--------------|---|
| MIL-STD-101 | (1970; Rev B) Color Code for Pipelines & for Compressed Gas Cylinders |
| UFC 4-010-01 | (2012) DoD Minimum Antiterrorism Standards for Buildings |

U.S. NATIONAL ARCHIVES AND RECORDS ADMINISTRATION (NARA)

| | |
|-----------|-----------------------------------|
| 40 CFR 82 | Protection of Stratospheric Ozone |
|-----------|-----------------------------------|

UNDERWRITERS LABORATORIES (UL)

| | |
|---------|--|
| UL 1995 | (2011) Heating and Cooling Equipment |
| UL 555 | (2006; Reprint May 2012) Standard for Fire Dampers |

| | | |
|--------------------------|--------------------------|--|
| UL 555S | (1999; Reprint May 2012) | Smoke Dampers |
| UL 586 | (2009) | Standard for High-Efficiency Particulate, Air Filter Units |
| UL 6 | (2007; reprint Nov 2010) | Electrical Rigid Metal Conduit-Steel |
| UL 705 | (2004; Reprint Mar 2012) | Standard for Power Ventilators |
| UL 723 | (2008; Reprint Sep 2010) | Test for Surface Burning Characteristics of Building Materials |
| UL 900 | (2004; Reprint Feb 2012) | Standard for Air Filter Units |
| UL 94 | (1996; Reprint Feb 2013) | Standard for Tests for Flammability of Plastic Materials for Parts in Devices and Appliances |
| UL Electrical Constructn | (2012) | Electrical Construction Equipment Directory |
| UL Fire Resistance | (2012) | Fire Resistance Directory |

1.2 SYSTEM DESCRIPTION

Provide roof top units with new disconnects. Furnish transition ductwork, condensate and natural gas piping, fittings, and accessories as required to provide a complete installation. Contractor shall provide TAB after installation is completed. Coordinate the work of the different trades to avoid interference between piping, equipment, structural, and electrical work. Provide complete, in place, all necessary offsets in piping and ductwork, and all fittings, and other components, required to install the work as indicated and specified.

1.2.1 Service Labeling

Label roof top unit, including exhaust fans, electric panels, etc. with labels made of self-sticking, plastic film designed for permanent installation. Labels shall be in accordance with the typical examples below:

| SERVICE | LABEL AND TAG DESIGNATION |
|----------------------|---------------------------|
| Roof Top Unit Number | RTU - [] |
| Exhaust Fan Number | EF - [] |
| Electric Panels | EP - [] |

1.2.2 Color Coding

Color coding of all piping systems shall be in accordance with ASME A13.1 MIL-STD-101.

1.3 SUBMITTALS

Submit the following:

SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Detail Drawings

SD-03 Product Data

Air Handling Units

Diagrams

SD-06 Test Reports

Performance Tests

SD-07 Certificates

Certification

SD-08 Manufacturer's Instructions

Manufacturer's Installation Instructions

Operation and Maintenance Training

SD-10 Operation and Maintenance Data

Operation and Maintenance Manuals

Roof top units

1.4 QUALITY ASSURANCE

Except as otherwise specified, approval of materials and equipment is based on manufacturer's published data.

- a. Where materials and equipment are specified to conform to the standards of the Underwriters Laboratories, the label of or listing with reexamination in UL Bld Mat Dir, and UL 6 is acceptable as sufficient evidence that the items conform to Underwriters Laboratories requirements. In lieu of such label or listing, submit a written certificate from any nationally recognized testing agency, adequately equipped and competent to perform such services, stating that the items have been tested and that the units conform to the specified requirements. Outline methods of testing used by the specified agencies.
- b. Conformance to such agency requirements does not relieve the item from compliance with other requirements of these specifications.

1.4.1 Prevention of Corrosion

Protect metallic materials against corrosion. Manufacturer shall provide standard finish for the equipment enclosures.

1.4.2 Asbestos Prohibition

Do not use asbestos and asbestos-containing products.

1.4.3 Ozone Depleting Substances Used as Refrigerants

Minimize releases of Ozone Depleting Substances (ODS) during repair, maintenance, servicing or disposal of appliances containing ODS's by complying with all applicable sections of 40 CFR 82 Part 82 Subpart F. Any person conducting repair, maintenance, servicing or disposal of appliances owned by NASA shall comply with the following:

- a. Do not knowingly vent or otherwise release into the environment, Class I or Class II substances used as a refrigerant.
- b. Do not open appliances without meeting the requirements of 40 CFR 82 Part 82.156 Subpart F, regarding required practices for evacuation and collection of refrigerant, and 40 CFR 82 Part 82.158 Subpart F, regarding standards of recycling and recovery equipment.
- c. Only persons who comply with 40 CFR 82 Part 82.161 Subpart F, regarding technician certification, can conduct work on appliances containing refrigerant.

In addition, provide copies of all applicable certifications to the

Resident Engineer at least 14 calendar days prior to initiating maintenance, repair, servicing, dismantling or disposal of appliances, including:

- a. Proof of Technician Certification
- b. Proof of Equipment Certification for recovery or recycling equipment.
- c. Proof of availability of certified recovery or recycling equipment.

1.4.4 Use of Ozone Depleting Substances, Other than Refrigerants

The use of Class I or Class II ODS's listed as nonessential in 40 CFR 82 Part 82.66 Subpart C is prohibited. These prohibited materials and uses include:

- a. Any plastic party spray streamer or noise horn which is propelled by a chlorofluorocarbon
- b. Any cleaning fluid for electronic and photographic equipment which contains a chlorofluorocarbon; including liquid packaging, solvent wipes, solvent sprays, and gas sprays.
- c. Any plastic flexible or packaging foam product which is manufactured with or contains a chlorofluorocarbon, including, open cell foam, open cell rigid polyurethane poured foam, closed cell extruded polystyrene sheet foam, closed cell polyethylene foam and closed cell polypropylene foam except for flexible or packaging foam used in coaxial cabling.

- d. Any aerosol product or other pressurized dispenser which contains a chlorofluorocarbon, except for those listed in 40 CFR 82 Part 82.66 Subpart C.

Request a waiver if a facility requirement dictates that a prohibited material is necessary to achieve project goals. Submit the waiver request in writing to the Resident Engineer. The waiver will be evaluated and dispositioned.

1.4.5 Detail Drawings

Submit detail drawings showing equipment layout, including assembly and installation details and electrical connection diagrams; ductwork layout showing the location of all supports and hangers, typical hanger details, gauge reinforcement, reinforcement spacing rigidity classification, and static pressure and seal classifications. Include any information required to demonstrate that the system has been coordinated and functions properly as a unit on the drawings and show equipment relationship to other parts of the work, including clearances required for operation and maintenance. Submit drawings showing bolt-setting information, and foundation bolts prior to concrete foundation construction for all equipment indicated or required to have concrete foundations. Submit function designation of the equipment and any other requirements specified throughout this Section with the shop drawings.

1.4.6 Test Procedures

Submit proposed test procedures and test schedules for the ductwork leak test, and performance tests of systems, at least 2 weeks prior to the start of related testing.

1.5 DELIVERY, STORAGE, AND HANDLING

Protect stored equipment at the jobsite from the weather, humidity and temperature variations, dirt and dust, or other contaminants. Additionally, cap or plug all pipes until installed.

PART 2 PRODUCTS

2.1 STANDARD PRODUCTS

Provide components and equipment that are "standard products" of a manufacturer regularly engaged in the manufacturing of products that are of a similar material, design and workmanship. "Standard products" is defined as being in satisfactory commercial or industrial use for 2 years before bid opening, including applications of components and equipment under similar circumstances and of similar size, satisfactorily completed by a product that is sold on the commercial market through advertisements, manufacturers' catalogs, or brochures. Products having less than a 2-year field service record are acceptable if a certified record of satisfactory field operation, for not less than 6000 hours exclusive of the manufacturer's factory tests, can be shown. Provide equipment items that are supported by a service organization.

2.2 IDENTIFICATION PLATES

In addition to standard manufacturer's identification plates, provide engraved laminated phenolic identification plates for each piece of mechanical equipment. Identification plates are to designate the function of the equipment. Submit designation with the shop drawings. Identification plates shall be three layers, black-white-black, engraved to show white letters on black background.

Letters shall be upper case. Identification plates 1-1/2-inches high and smaller shall be 1/16-inch thick, with engraved lettering 1/8-inch high; identification plates larger than 1-1/2-inches high shall be 1/8-inch thick, with engraved lettering of suitable height. Identification plates 1-1/2-inches high and larger shall have beveled edges. Install identification plates using a compatible adhesive.

2.4 EQUIPMENT GUARDS AND ACCESS

Fully enclose or guard belts, pulleys, chains, gears, couplings, projecting setscrews, keys, and other rotating parts exposed to personnel contact according to OSHA requirements. Properly guard or cover with insulation of a type specified, high temperature equipment and piping exposed to contact by personnel or where it creates a potential fire hazard.

2.5 ELECTRICAL WORK

- a. Provide motors, controllers, integral disconnects, contactors, and controls with their respective pieces of equipment, except controllers indicated as part of motor control centers. Provide electrical equipment, including motors and wiring, as specified in Section 26 20 00 INTERIOR DISTRIBUTION SYSTEM. Provide manual or automatic control and protective or signal devices required for the operation specified and control wiring required for controls and devices specified, but not shown. For packaged equipment, include manufacturer provided controllers with the required monitors and timed restart.
- b. Provide motors in accordance with NEMA MG 1 and of sufficient size to drive the load at the specified capacity without exceeding the nameplate rating of the motor. Provide motors rated for continuous duty with the enclosure specified.
- c. Where two-speed or variable-speed motors are indicated, solid-state variable-speed controllers are allowed to accomplish the same function.

2.6 ANCHOR BOLTS

Provide anchor bolts for equipment placed on concrete equipment pads or on concrete slabs. Bolts to be of the size and number recommended by the equipment manufacturer and located by means of suitable templates. Installation of anchor bolts shall not degrade the surrounding concrete.

2.7 SEISMIC ANCHORAGE

Anchor equipment in accordance with applicable seismic criteria for the area and as defined in SMACNA 1981

2.8 PAINTING

Paint equipment units in accordance with approved equipment manufacturer's standards unless specified otherwise. Field retouch only if approved.

2.9 INDOOR AIR QUALITY

Provide equipment and components that comply with the requirements of ASHRAE 62.1 unless more stringent requirements are specified herein.

2.10.0 AIR SYSTEMS EQUIPMENT

2.10.1 Fans

Test and rate fans according to AMCA 210. Calculate system effect on air moving devices in accordance with AMCA 201 where installed ductwork differs from that indicated on drawings. Install air moving devices to minimize fan system effect. Where system effect is unavoidable, determine the most effective way to accommodate the inefficiencies caused by system effect on the installed air moving device. Provide standard AMCA arrangement, rotation, and discharge as indicated. Provide power ventilators that conform to UL 705 and have a UL label.

2.10.1.1 Centrifugal Fans

Provide fully enclosed, single-width single-inlet, or double-width double-inlet centrifugal fans, with AMCA Pressure Class I, II, or III as required or indicated for the design system pressure.

2.10.1.2 In-Line Centrifugal Fans

Provide in-line fans with centrifugal backward inclined blades, stationary discharge conversion vanes, internal and external belt guards, and adjustable motor mounts. Mount fans in a welded tubular casing. Provide a fan that axially flows the air in and out. Streamline inlets with conversion vanes to eliminate turbulence and provide smooth discharge air flow. Enclose and isolate fan bearings and drive shafts from the air stream. Provide precision, self aligning ball or roller type fan bearings that are sealed against dust and dirt and are permanently lubricated. Provide L50 rated bearing life at not less than 200,000 hours as defined by ABMA 9 and ABMA 11. Provide motors enclosure.

2.10.1.3 Centrifugal Type Power Roof exhaust fans

Provide direct driven centrifugal type fans with backward inclined, non-overloading wheel. Provide hinged or removable and weatherproof motor compartment housing, constructed of heavy gauge aluminum. Provide fans with birdscreen, disconnect switch, gravity dampers. Provide dripproof type motor enclosure.

2.10.1.4 Ceiling Exhaust Fans

Provide centrifugal type, direct driven suspended cabinet-type ceiling exhaust fans. Provide fans with acoustically insulated housing. Provide chatter-proof backdraft damper. Provide egg-crate design or louver design integral face grille. Mount fan motors on vibration isolators. Furnish unit with mounting flange for hanging unit from above. Provide U.L. listed fans.

2.10.2 Coils

Provide fin-and-tube type coils constructed of seamless copper tubes and **Aluminum** copper fins mechanically bonded or soldered to the tubes.

2.10.3 Air Filters

Unit shall be provided with a draw-through filter section. The filter section shall be supplied complete with the filter rack as an integral part of the unit.

Pre-Filters: MERV 8, pleated, panel filters shall be provided. Filters shall be constructed of 100% synthetic material that does not support microbial growth. Filters shall be of a metal-free construction to reduce its impact when land filled.

2.11 Roof top Air handling units

2.11.1 Factory-Fabricated Air Handling Units

Provide single-zone draw-through type units as indicated. Units shall include fans, coils, airtight insulated casing, prefilters, adjustable V-belt drives, access sections where indicated, mixing box. Provide vibration isolators as indicated. Physical dimensions of each air handling unit shall be suitable to fit space allotted to the unit with the capacity indicated. **Provide air handling unit that is rated in accordance with AHRI 340/360 and AHRI certified for cooling.**

2.11.1.1 Casings

All cabinet insulation, except floor panels, shall be a nominal ½” thick, 1 lb. density with neoprene coating on airside.

Finished surface is to withstand a minimum 500-hour salt spray test in accordance with ASTM B117 standard for salt spray resistance.

The unit base shall overhang the roof curb for positive water runoff and shall have a formed recess that seats on the roof curb gasket to provide a positive, weather tight seal.

2.11.1.2 Heating and Cooling Coils

Provide coils as specified in paragraph AIR SYSTEMS EQUIPMENT.

2.11.1.3 Air Filters

Provide air filters as specified in paragraph AIR SYSTEMS EQUIPMENT for types and thickness indicated.

2.11.1.4 Fans

Provide fans as specified in paragraph AIR SYSTEMS EQUIPMENT.

2.12 FACTORY PAINTING

Factory paint new equipment, which are not of galvanized construction.

Factory painting that has been damaged prior to acceptance by the Resident Engineer shall be field painted in compliance with the requirements of paragraph FIELD PAINTING OF MECHANICAL EQUIPMENT.

2.13 SUPPLEMENTAL COMPONENTS/SERVICES

2.13.1 Condensate Drain Lines

Provide and install condensate drainage for each item of equipment that generates condensate in accordance with Section 22 00 00 PLUMBING, GENERAL PURPOSE. Provide "U" trap for condensate drain piping. Provide minimum of ¾" inch copper piping for condensate drain.

2.13.2 Controls

The requirements for controls are specified in Section 23 09 23 DIRECT DIGITAL CONTROL SYSTEM SPECIFICATION.

PART 3 EXECUTION

3.1 EXAMINATION

After becoming familiar with all details of the work, verify all dimensions in the field, and advise the Resident Engineer of any discrepancy before performing the work.

3.2 INSTALLATION

Install materials and equipment in accordance with the requirements of the contract drawings and approved manufacturer's installation instructions. Accomplish installation by workers skilled in this type of work. Perform installation so that there is no degradation of the designed fire ratings of walls, partitions, ceilings, and floors.

3.2.1 Condensate Drain Lines

Provide water seals in the condensate drain from all units. Provide a depth of each seal of 2 inches plus the number of inches, measured in water gauge, of the total static pressure rating of the unit to which the drain is connected. Provide water seals that are constructed of 2 tees and an appropriate U-bend with the open end of each tee plugged. Provide pipe cap or plug cleanouts where indicated. Connect drains indicated to connect to the sanitary waste system using an indirect waste fitting.

3.2.2 Equipment and Installation

Provide frames and supports for tanks, compressors, pumps, valves, air handling units, fans, coils, dampers, and other similar items requiring supports.

3.2.3 Flexible Duct

Install pre-insulated flexible duct at transition between new unit and exiting supply and return main duct in ceiling space in accordance with the latest printed instructions of the manufacturer to ensure a vapor tight joint. Provide hangers, when required to suspend the duct, of the type recommended by the duct manufacturer and set at the intervals recommended.

3.3 EQUIPMENT PADS

Provide equipment pads to the dimensions shown or, if not shown, to conform to the shape of each piece of equipment served with a minimum 3-inch margin around the equipment and supports. Allow equipment bases and foundations, when constructed of concrete or grout, to cure a minimum of 14 calendar days before being loaded.

3.4 CLEANING

Thoroughly clean surfaces of piping and equipment that have become covered with dirt, plaster, or other material during handling and construction before such surfaces are prepared for final finish painting or are enclosed within the building structure. Before final acceptance, clean mechanical equipment, including piping, ducting, and fixtures, and free from dirt, grease, and finger marks. When the work area is in an occupied space such as office, laboratory or warehouse protect all furniture and equipment from dirt and debris. Incorporate housekeeping for field construction work which leaves all furniture and equipment in the affected area free of construction generated dust and debris; and, all floor surfaces vacuum-swept clean.

3.5 PENETRATIONS

Provide sleeves and prepared openings for duct mains, branches, and other penetrating items, and install during the construction of the surface to be penetrated. Cut sleeves flush with each surface. Place sleeves for round duct 15 inches and smaller. Build framed, prepared openings for round duct larger than 15 inches and square, rectangular or oval ducts. Sleeves and framed openings are also required where grilles, registers, and diffusers are installed at the openings. Provide one inch clearance between penetrating and penetrated surfaces except at grilles, registers, and diffusers. Pack spaces between sleeve or opening and duct or duct insulation with mineral fiber conforming with ASTM C553, Type 1, Class B-2.

- a. Sleeves: Fabricate sleeves, except as otherwise specified or indicated, from 20 gauge thick mill galvanized sheet metal. Where sleeves are installed in bearing walls or partitions, provide black steel pipe conforming with ASTM A53/A53M, Schedule 20.
- b. Framed Prepared Openings: Fabricate framed prepared openings from 20 gauge galvanized steel, unless otherwise indicated.
- c. Closure Collars: Provide closure collars of a minimum 4 inches wide, unless otherwise indicated, for exposed ducts and items on each side of penetrated surface, except where equipment is installed.

Install collar tight against the surface and fit snugly around the duct or insulation. Grind sharp edges smooth to prevent damage to penetrating surface. Fabricate collars for round ducts 15 inches in diameter or less from 20 gauge galvanized steel. Fabricate collars for square and rectangular ducts, or round ducts with minimum dimension over 15 inches from 18 gauge galvanized steel. Fabricate collars for square and rectangular ducts with a maximum side of 15 inches or less from 20 gauge galvanized steel. Install collars with fasteners a maximum of 6 inches on center. Attach to collars a minimum of 4 fasteners where the opening is 12 inches in diameter or less, and a minimum of 8 fasteners where the opening is 20 inches in diameter or less.

3.6 TESTING, ADJUSTING, AND BALANCING

Begin testing, adjusting, and balancing only when the air supply and distribution, including controls, has been completed, with the exception of performance tests.

One or more of the applicable AABC (Associated Air Balance Council), NEBB (National Environmental Balance Bureau) or SMACNA (Sheet Metal and Air-Conditioning Contractors National Association) publications, supplemented by ASHRAE Hand book "HVAC Applications"

Chapter 36 shall be the basis for procedures and reports.

Provide commissioning documentation in accordance with the requirements of Section 23 08 00 – Commissioning of HVAC Systems for all inspection, start up, and contractor testing required by System Readiness Checklist provided by the Commissioning Agent.

3.7 OPERATION AND MAINTENANCE

3.4.1 Operation and Maintenance Manuals

Submit six manuals at least 2 weeks prior to field training. Submit data complying with the requirements specified in Section 01 78 23 OPERATION AND MAINTENANCE DATA. Submit Data Package 3 for the items/units listed under SD-10 Operation and Maintenance Data

3.4.2 Operation And Maintenance Training

Conduct a training course for the members of the operating staff as designated by the Resident Engineer. Conduct field instruction that covers all of the items contained in the Operation and Maintenance Manuals as well as demonstrations of routine maintenance operations. Submit the proposed On-site Training schedule concurrently with the Operation and Maintenance Manuals and at least 14 days prior to conducting the training course.

-- End of Section --

SECTION 23 0800.00 10 - COMMISSIONING OF HVAC SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This section includes commissioning process requirements for HVAC&R systems, assemblies, and equipment.

1.3 DESCRIPTION

- A. Commissioning: Commissioning is a quality-oriented process for achieving, verifying, and documenting that the performance of facilities, systems, and assemblies meet defined objectives and criteria. The Commissioning process begins at project inception (during the pre-design phase) and continues through the life of the facility. The commissioning process includes specific tasks to be conducted during each phase in order to verify that design, construction, and training meets the owner's project requirements.
- B. Commissioning Team: The members of the commissioning team consist of the contracted commissioning agent (CxA), the owner's representative/construction manager (CM), the general contractor (GC), the architect and design engineers, the mechanical contractor (MC), the electrical contractor (EC), the testing and balancing (TAB) contractor, the control contractor (CC), the facility operating staff, and any other installing subcontractors or suppliers of equipment. The contracted commissioning agent is hired by the owner directly. The CxA directs and coordinates the project commissioning activities and the reports to the owner. All team members work together to fulfill their contracted responsibilities and meet the objectives of the contract documents.

Commissioning shall:

1. Verify that applicable equipment and systems are installed according to the contract documents, manufacturer's recommendations, and industry accepted minimum standards and that they receive adequate operational checkout by installing contractors.
2. Verify and document proper performance of equipment and systems.
3. Verify that O&M documentation left on site is complete.
4. Witness that the owner's operating personnel are adequately trained.

The commissioning process does not take away from or reduce the responsibility of the system designers or installing contractors to provide a finished and fully functioning product.

1.4 COMMISSIONING FIRM

- A. The Commissioning Firm shall report to and be hired directly by the client / owner.
- B. These Commissioning Services are to assist the prime contractor in performing the quality oversight for which it is responsible. The Commissioning Firm shall be a 1st tier hire to the owner / client and shall be financially and corporately independent of all other subcontractors.

1.5 SUBMITTALS

- A. The owners commissioning firm will submit a complete project specific commissioning plan after contract award.
- B. The contractor will provide the following:
 - 1. Certificates of readiness
 - 2. Certificates of completion of installation, prestart, and startup activities.
 - 3. O&M manuals
 - 4. Test reports
- C. The contractor will provide the following control drawings submittals:
 - 1. The control drawings shall have a key to all abbreviations.
 - 2. The control drawings shall contain graphic schematic depictions of the systems and each component.
 - 3. The schematics will include the system and component layout of any equipment that the control system monitors, enables or controls, even if the equipment is primarily controlled by packaged or integral controls.
 - 4. Provide a full points list with at least the following included for each point:
 - a. Controlled system
 - b. Point abbreviation
 - c. Point description
 - d. Display unit
 - e. Control point or set point (Yes / No)
 - f. Monitoring point (Yes / No)
 - g. Intermediate point (Yes / No)
 - h. Calculated point (Yes / No)

1.6 QUALITY ASSURANCE

- A. Test Equipment Calibration Requirements: Contractors will comply with test manufacturer's calibration procedures and intervals. Recalibrate test instruments immediately after instruments have been repaired resulting from being dropped or damaged. Affix calibration tags to test instruments. Furnish calibration records to CxA upon request.

1.7 COORDINATION

- A. The Commissioning Firm will provide coordination and scheduling for the commissioning activities. The Commissioning Firm will not be responsible for coordination or scheduling of the Equipment start-up, Controls or TAB activities.

PART 2 - PRODUCTS

2.1 TEST EQUIPMENT

- A. All standard testing equipment required to perform startup, initial checkout and functional performance testing shall be provided by the Contractor for the equipment being tested. For example, the mechanical contractor of Division 23 shall ultimately be responsible for all standard testing equipment for the HVAC&R system and controls system in Division 23, except for equipment specific to and used by TAB in their testing responsibilities.
- B. Special equipment, tools and instruments (specific to a piece of equipment and only available from vendor) required for testing shall be included in the base bid price to the Owner and left on site, except for stand-alone data logging equipment that may be used by the CxA.
- C. Proprietary test equipment and software required by any equipment manufacturer for programming and/or start-up, whether specified or not, shall be provided by the manufacturer of the equipment. Manufacturer shall provide the test equipment, demonstrate its use, and assist in the commissioning process as needed. Proprietary test equipment (and software) shall become the property of the Owner upon completion of the commissioning process.
- D. Data logging equipment and software required to test equipment will be provided by the CxA, but shall not become the property of the Owner.
- E. All testing equipment shall be of sufficient quality and accuracy to test and/or measure system performance with the tolerances specified in the Specifications. If not otherwise noted, the following minimum requirements apply: Temperature sensors and digital thermometers shall have a certified calibration within the past year to accuracy of 0.5°F and a resolution of + or - 0.1°F. Pressure sensors shall have an accuracy of + or - 2.0% of the value range being measured (not full range of meter) and have been calibrated within the last year.

PART 3 - EXECUTION

3.1 GENERAL DOCUMENTATION REQUIREMENTS

- A. With assistance from the installing contractors, the CxA will prepare Pre-Functional Checklists for all commissioned components, equipment, and systems
- B. **Red-lined Drawings:**
 - 1. The contractor will verify all equipment, systems, instrumentation, wiring and components are shown correctly on red-lined drawings.
 - 2. Preliminary red-lined drawings must be made available to the Commissioning Team for use prior to the start of Functional Performance Testing.

3. Changes, as a result of Functional Testing, must be incorporated into the final as-built drawings, which will be created from the red-lined drawings.
4. The contracted party, as defined in the Contract Documents will create the as-built drawings.

C. Operation and Maintenance Data:

1. Contractor will provide a copy of O&M literature within 45 days of each submittal acceptance for use during the commissioning process for all commissioned equipment and systems.
2. The CxA will review the O&M literature once for conformance to project requirements.
3. The CxA will receive a copy of the final approved O&M literature once corrections have been made by the Contractor.

D. Demonstration and Training:

1. Contractor will provide demonstration and training as required by the specifications.
2. A complete training plan and schedule must be submitted by the contractor to the CxA four weeks (4) prior to any training.
3. A training agenda for each training session must be submitted to the CxA one (1) week prior the training session.
4. The CxA shall be notified at least 72 hours in advance of scheduled tests so that testing may be observed by the CxA and Owner's representative. A copy of the test record shall be provided to the CxA, Owner, and Architect.
5. The Contractor shall engage a Factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain specific equipment.
6. Train Owner's maintenance personnel on procedures and schedules for starting and stopping, trouble shooting, servicing, and maintaining equipment.
7. Review data in O&M Manuals.

E. Systems manual requirements:

1. The Systems Manual is intended to be a usable information resource containing all of the information related to the systems, assemblies, and Commissioning Process in one place with indexes and cross references.
2. The GC shall include final approved versions of the following information for the Systems Manual:
 - a. As-Built System Schematics

- b. Verified Record Drawings
 - c. Test Results (not otherwise included in Cx Record)
 - d. Periodic Maintenance Information for computer maintenance management system
 - e. Recommendations for recalibration frequency of sensors and actuators
 - f. A list of contractors, subcontractors, suppliers, architects, and engineers involved in the project along with their contact information
 - g. Training Records, Information on training provided, attendees list, and any on-going training
- 3. This information shall be organized and arranged by building system, such as fire alarm, chilled water, heating hot water, etc.
 - 4. Information should be provided in an electronic version to the extent possible. Legible, scanned images are acceptable for non-electronic documentation to facilitate this deliverable.

3.2 CONTRACTOR'S RESPONSIBILITIES

- A. Mechanical, Controls and TAB Contractors. The commissioning responsibilities applicable to each of the mechanical, controls and TAB contractors of Division 23 are as follows (all references apply to commissioned equipment only):
- B. Perform commissioning tests at the direction of the CxA.
- C. Attend construction phase controls coordination meetings.
- D. Attend testing, adjusting, and balancing review and coordination meetings.
- E. Participate in HVAC&R systems, assemblies, equipment, and component maintenance orientation and inspection as directed by the CxA.
- F. Provide information requested by the CxA for final commissioning documentation.
- G. Include requirements for submittal data, operation and maintenance data, and training in each purchase order or sub-contract written.
- H. Prepare preliminary schedule for Mechanical system orientations and inspections, operation and maintenance manual submissions, training sessions, pipe and duct system testing, flushing and cleaning, equipment start-up, testing and balancing and task completion for owner. Distribute preliminary schedule to commissioning team members.
- I. Update schedule as required throughout the construction period.
- J. During the startup and initial checkout process, execute the related portions of the prefunctional checklists for all commissioned equipment.
- K. Assist the CxA in all verification and functional performance tests.

- L. 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.
- M. Gather operation and maintenance literature on all equipment, and assemble in binders as required by the specifications. Submit to CxA (45) days after submittal acceptance.
- N. Coordinate with the CxA to provide (48) hour advance notice so that the witnessing of equipment and system start-up and testing can begin.
- O. Notify the CxA a minimum of (2) weeks in advance of the time for start of the testing and balancing work. Attend the initial testing and balancing meeting for review of the official testing and balancing procedures.
- P. Participate in, and schedule vendors and contractors to participate in the training sessions.
- Q. Provide written notification to the CM/GC and CxA Authority that the following work has been completed in accordance with the contract documents, and that the equipment, systems, and sub-system are operating as required.
 - 1. HVAC&R equipment including all fans, air handling units, ductwork, dampers, terminals, and all other equipment furnished under this Division.
 - 2. Fire stopping in the fire rated construction, including fire and smoke damper installation, caulking, gasketing and sealing of smoke barriers.
 - 3. Fire detection and smoke detection devices furnished under other divisions of the specification.
- R. Provide a complete set of red-lined drawings to the CxA prior to the start of Functional Performance Testing.
- S. Test, Adjust and Balance Contractor
 - 1. Attend initial commissioning coordination meeting scheduled by the Commissioning Authority.
 - 2. Submit the site specific testing and balancing plan 90 days before commencement of TAB work to the CxA and AE for review and acceptance.
 - 3. Attend the testing and balancing review meeting scheduled by the CxA. Be prepared to discuss the procedures that shall be followed in testing, adjusting, and balancing the HVAC&R system.
 - 4. At the completion of the testing and balancing work, and the submittal of the final testing and balancing report, notify the HVAC&R contractor and the CM/GC.
 - 5. At the completion of testing and balancing work, and the submittal of the final testing and balancing report, notify the HVAC&R Contractor and the CM/GC.

- 6. Participate in verification of the testing and balancing report, which will consist of repeating measurements contained in the testing and balancing reports. Assist in diagnostic purposes when directed.
- T. Provide training of the Owner's operating staff using expert qualified personnel, as specified.
- U. Equipment Suppliers
 - 1. Provide all requested submittal data, including detailed start-up procedures and specific responsibilities of the Owner, to keep warranties in force.
 - 2. Assist in equipment testing per agreements with contractors.
 - 3. Provide information requested by CxA regarding equipment sequence of operation and testing procedures.

3.3 OWNER'S RESPONSIBILITIES

- A. Facilitate the coordination of the commissioning work by the CxA, and, with the GC and CxA, ensure that commissioning activities are being scheduled into the master schedule.
- B. Furnish a copy of all construction documents, addenda, change orders and approved submittals and shop drawings related to commissioned equipment to the CxA.
- C. Review and approve the performance test procedures submitted by the CxA, prior to testing.
- D. Review commissioning progress and deficiency reports.
- E. Sign-off (final approval) on individual commissioning tests as completed and passing. Recommend completion of the commissioning process to the Project Manager.
- F. Assign operation and maintenance personnel and schedule them to participate in commissioning team activities as required.

3.4 DESIGN PROFESSIONAL'S RESPONSIBILITIES

- A. Perform normal submittal review, construction observation, as-built drawing preparation, etc., as contracted. One site observation should be completed just prior to system startup.
- B. Provide any design narrative and sequences documentation requested by the CxA. The designers shall assist (along with the contractors) in clarifying the operation and control of commissioned equipment in areas where the specifications, control drawings or equipment documentation is not sufficient for writing detailed testing procedures.
- C. Attend commissioning scoping meetings and other selected commissioning team meetings.
- D. Participate in the resolution of system deficiencies identified during commissioning, according to the contract documents.

- E. Prepare and submit the final as-built design intent and operating parameters documentation for inclusion in the O&M manuals. Review and approve the O&M manuals.
- F. From the contractor's red-line drawings, edit and update one-line diagrams developed as part of the design narrative documentation and those provided by the vendor as shop drawings for the chilled and hot water, condenser water, domestic water, steam and condensate systems; supply, return and exhaust air systems and emergency power system.
- G. Provide a presentation at one of the training sessions for the owner's personnel.
- H. Review and approve the construction checklists for major pieces of equipment for sufficiency prior to their use.
- I. Review and approve the performance test procedure forms for major pieces of equipment for sufficiency prior to their use.
- J. Witness testing of selected pieces of equipment and systems

3.5 CxA'S RESPONSIBILITIES

- A. The contractors will provide all tools or the use of tools to start, check-out and test equipment and systems, except for specified testing with portable data-loggers, which shall be supplied and installed by the CxA.
- B. The CxA will verify the execution of commissioning process activities using random sampling. The sampling rate may vary from 1 to 100 percent. Verification will include, but is not limited to, equipment submittals, construction checklists, training, operating and maintenance data, tests, and test reports to verify compliance with the OPR. When a random sample does not meet the requirement, CxA will report the failure in the "Issues Log."
 - 1. Coordinates and directs the commissioning activities in a logical, sequential and efficient manner using consistent protocols and forms, centralized documentation, clear and regular communications and consultations with all necessary parties, frequently updated timelines and schedules and technical expertise.
 - 2. Coordinate the commissioning work and, with the GC and owner/CM, help integrate commissioning activities into the master schedule.
 - 3. Revise the Construction Phase Commissioning Plan as necessary.
 - 4. Plan and conduct a commissioning scoping meeting and other commissioning meetings.
 - 5. Request and review additional information required to perform commissioning tasks, including O&M materials, contractor startup and checkout procedures.
 - 6. Before startup, gather and review the current control sequences and interlocks and work with contractors and design engineers until sufficient clarity has been obtained, in writing, to be able to write detailed testing procedures.

7. Review and approve normal contractor submittals applicable to systems being commissioned for compliance with commissioning needs, concurrent with the A/E reviews.
8. Write and distribute construction checklists. Prepare and maintain completed construction checklist log.
9. Perform site visits, as necessary, to observe component and system installations. Attend selected planning and job-site meetings to obtain information on construction progress. Review construction-meeting minutes for revisions/substitutions relating to the commissioning process. Assist in resolving any discrepancies.
10. Witness all or part of the HVAC piping test and flushing procedure, sufficient to be confident that proper procedures were followed. Document this testing and include the documentation in O&M manuals. Notify owner/CM of any deficiencies in results or procedures.
11. Witness all or part of any ductwork testing and cleaning procedures, sufficient to be confident that proper procedures were followed. Document this testing and include the documentation in O&M manuals. Notify owner's project manager of any deficiencies in results or procedures.
12. Approve construction checklist completion by selected site observation and spot checking.
13. Recommend approval of systems startup by reviewing startup reports and by selected site observation.
14. Review TAB execution plan.
15. Oversee sufficient testing of the control system and approve it to be used for TAB, before TAB is executed.
16. Recommend approval of air and water systems balancing by spot testing, by reviewing completed reports and by selected site observation.
17. With necessary assistance and review from installing contractors, write the performance test procedures for equipment and systems, including energy management control system trending, stand-alone data logger monitoring or manual performance testing. Submit to CM for review, and for approval if required.
18. Analyze any performance trend logs and monitoring data to verify performance.
19. Coordinate, witness, and recommend approval of manual performance tests performed by installing contractors. Coordinate retesting as necessary until satisfactory performance is achieved
20. Maintain a master Issues Log and a separate testing record. Provide the owner/ CM with written progress reports and test results with recommended actions.

21. Review equipment warranties to ensure that the owner's responsibilities are clearly defined.
22. Review training plan and materials, attend all or part of the training of the owner's operating personnel.
23. Compile and maintain a commissioning record and building systems book(s).
24. Review the preparation of the O&M manuals.
25. Provide a final commissioning report (as described in this section).

3.6 TESTING PREPARATION

- A. Certify in writing to the CxA that HVAC&R systems, subsystems, and equipment have been installed, calibrated, and started and are operating according to the Contract Documents.
- B. Certify in writing to the CxA that HVAC&R 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. Certify in writing that testing, adjusting, and balancing procedures have been completed and that testing, adjusting, and balancing reports have been submitted, discrepancies corrected, and corrective work approved.
- D. Place 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).
- E. Inspect and verify the position of each device and interlock identified on checklists.
- F. Check safety cutouts, alarms, and interlocks with smoke control and life-safety systems during each mode of operation.
- G. Testing Instrumentation: Install measuring instruments and logging devices to record test data as directed by the CxA.

3.7 TESTING, ADJUSTING AND BALANCING VERIFICATION

- A. Prior to performance of Testing, Adjusting and Balancing work, provide copies of reports, sample forms, checklists, and certificates to the CxA.
- B. Notify the CxA at least ten (10) days in advance of testing and balancing Work, and provide access for the CxA to witness testing and balancing Work.
- C. Provide technicians, instrumentation, and tools to verify testing and balancing of HVAC&R systems at the direction of the CxA.
 1. The CxA will notify testing and balancing subcontractor ten (10) days in advance of the date of field verification. Notice will not include data points to be verified.

2. The testing and balancing subcontractor shall use the same instruments (by model and serial number) that were used when original data were collected.
3. Failure of an item includes, other than sound, a deviation of more than 10 percent. Failure of more than 10 percent of selected items shall result in rejection of final testing, adjusting, and balancing report. For sound pressure readings, a deviation of 3 dB shall result in rejection of final testing. Variations in background noise must be considered.
4. Remedy the deficiency and notify the CxA so verification of failed portions can be performed.

3.8 GENERAL TESTING REQUIREMENTS

- A. Provide technicians, instrumentation, and tools to perform commissioning test at the direction of the CxA.
- B. Scope of HVAC&R testing shall include entire HVAC&R installation, from central equipment for heat generation and refrigeration through distribution systems to each conditioned space. Testing shall include measuring capacities and effectiveness of operational and control functions.
- C. 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.
- D. The CxA along with the HVAC&R contractor, testing and balancing Subcontractor, and HVAC&R Instrumentation and Control Subcontractor shall prepare detailed testing plans, procedures, and checklists for HVAC&R systems, subsystems, and equipment.
- E. Tests will be performed using design conditions whenever possible.
- F. Simulated conditions may need to be imposed using an artificial load when it is not practical to test under design conditions. Before simulating conditions, calibrate testing instruments. Provide equipment to simulate loads. Set simulated conditions as directed by the CxA and document simulated conditions and methods of simulation. After tests, return settings to normal operating conditions.
- G. The CxA may direct that set points be altered when simulating conditions is not practical.
- H. The CxA may direct that sensor values be altered with a signal generator when design or simulating conditions and altering set points are not practical.
- I. If tests cannot be completed because of a deficiency outside the scope of the HVAC&R system, document the deficiency and report it to the Owner. After deficiencies are resolved, reschedule tests.
- J. If the testing plan indicates specific seasonal testing, complete appropriate initial performance tests and documentation and schedule seasonal tests.

3.9 HVAC&R SYSTEMS, SUBSYSTEMS, AND EQUIPMENT TESTING PROCEDURES

- A. **Equipment Testing and Acceptance Procedures:** Testing requirements are specified in individual Division 15 / 23 sections. Provide submittals, test data, inspector record, and certifications to the CxA.
- B. **HVAC&R Instrumentation and Control System Testing:** Field testing plans and testing requirements are specified in *Division 15 / 23 Sections "Instrumentation and Control for HVAC" and "Sequence of Operations for HVAC Controls."* Assist the CxA with preparation of testing plans.
- C. **HVAC&R Distribution System Testing:** Provide technicians, instrumentation, tools, and equipment to test performance of air, steam, and hydronic distribution systems; special exhaust; and other distribution systems, including HVAC&R terminal equipment and unitary equipment.
- D. The work included in the commissioning process involves a complete and thorough evaluation of the operation and performance of all components, systems and sub-systems. The following equipment and systems where they exist shall be evaluated:
 - 1. **Building Automation System**
 - 2. **Ductwork**
 - 3. **Exhaust Fans**
 - 4. **Packaged Units**
 - 5. **Testing, Adjusting and Balancing**

3.10 DEFICIENCIES/NON-CONFORMANCE, COST OF RETESTING, FAILURE DUE TO MANUFACTURER DEFECT

- A. Additional testing due to system failures during 1st system tests will be discussed and mutually understood and agreed upon between the general contractor, sub-contractors and the Commissioning Firm.

3.11 APPROVAL

- A. The Commissioning Firm will provide signatory approval of the installed systems after the commissioning testing, or document the discrepancies and provide details to the owner / client as to responsibility and expected corrections. The Commissioning Firm will retest any deficiencies found until completion. Excessive retests will invoke section 3.10.

3.12 OPERATION AND MAINTENANCE MANUALS

- A. The Operation and Maintenance Manuals shall conform to Contract Documents requirements as stated in the contract documents.
- B. An updated as-built version of the control drawings and sequences of operation shall be included in the final controls O&M manual submittal.

3.13 TRAINING OF OWNER PERSONNEL

- A. Refer to the contract documents for requirements pertaining to training.
- B. **Mechanical Contractor.** The mechanical contractor shall have the following training responsibilities:
 - 1. Provide the CxA with a training plan two weeks before the planned training.
 - 2. Provide designated Owner personnel with comprehensive orientation and training in the understanding of the systems and the operation and maintenance of each piece of HVAC equipment including, but not limited to, all HVAC equipment (ex. pumps, heat exchangers, chillers, heat rejection equipment, air conditioning units, air handling units, fans, terminal units, controls and water treatment systems, etc.)
 - 3. Training shall normally start with classroom sessions followed by hands-on training on each piece of equipment, which shall illustrate the various modes of operation, including startup, shutdown, fire/smoke alarm, power failure, etc.
 - 4. During any demonstration, should the system fail to perform in accordance with the requirements of the O&M manual or sequence of operations, the system will be repaired or adjusted as necessary and the demonstration repeated.
 - 5. The appropriate trade or manufacturer's representative shall provide the instructions on each major piece of equipment. This person may be the start-up technician for the piece of equipment, the installing contractor or manufacturer's representative. Practical building operating expertise as well as in-depth knowledge of all modes of operation of the specific piece of equipment is required. More than one party may be required to execute the training.
 - 6. The controls contractor shall attend sessions other than the controls training, as requested, to discuss the interaction of the controls system as it relates to the equipment being discussed.
 - 7. The training sessions shall follow the outline in the Table of Contents of the operation and maintenance manual and illustrate whenever possible the use of the O&M manuals for reference.
 - 8. Training shall include:
 - a. Use of the printed installation, operation and maintenance instruction material included in the O&M manuals.
 - b. A review of the written O&M instructions emphasizing safe and proper operating requirements, preventative maintenance, special tools needed and spare parts inventory suggestions. The training shall include start-up, operation in all modes possible, shut-down, seasonal changeover and any emergency procedures.
 - c. Discussion of relevant health and safety issues and concerns.
 - d. Discussion of warranties and guarantees.
 - e. Common troubleshooting problems and solutions.

- f. Explanatory information included in the O&M manuals and the location of all plans and manuals in the facility.
 - g. Discussion of any peculiarities of equipment installation or operation.
 - h. The format and training agenda in The HVAC Commissioning Process, ASHRAE Guideline 1-2007, is recommended.
9. Hands-on training shall include start-up, operation in all modes possible, including manual, shut-down and any emergency procedures and preventative maintenance for all pieces of equipment.
 10. The mechanical contractor shall fully explain and demonstrate the operation, function and overrides of any local packaged controls, not controlled by the central control system.
 11. Training shall occur after functional testing is complete, unless approved otherwise by the Owner.
- C. **Controls Contractor.** The controls contractor shall have the following training responsibilities:
1. Provide the CxA and AE with a training plan four weeks before the planned training.
 2. The controls contractor shall provide designated Owner personnel training on the control system in this facility. The intent is to clearly and completely instruct the Owner on all the capabilities of the control system.
 3. Training manuals. The standard operating manual for the system and any special training manuals will be provided for each trainee, with three extra copies left for the O&M manuals. In addition, copies of the system technical manual will be demonstrated during training and three copies submitted with the O&M manuals. Manuals shall include detailed description of the subject matter for each session. The manuals will cover all control sequences and have a definitions section that fully describes all relevant words used in the manuals and in all software displays. Manuals will be approved by the CxA and AE. Copies of audiovisuals shall be delivered to the Owner.
 4. The trainings will be tailored to the needs and skill-level of the trainees.
 5. The trainers will be knowledgeable on the system and its use in buildings. For the on-site sessions, the most qualified trainer(s) will be used. The Owner shall approve the instructor prior to scheduling the training.
 6. During any demonstration, should the system fail to perform in accordance with the requirements of the O&M manual or sequence of operations, the system will be repaired or adjusted as necessary and the demonstration repeated.
 7. The controls contractor shall attend sessions other than the controls training, as requested, to discuss the interaction of the controls system as it relates to the equipment being discussed.
 8. There shall be three (2) training sessions:
 - a. Training I. Control System. The first training shall consist of 4 hours of actual training. This training may be held on-site or in the supplier's facility. If held off-site, the training may occur prior to final completion of the system installation. Upon completion, each student, using appropriate documentation,

should be able to perform elementary operations and describe general hardware architecture and functionality of the system.

- b. Training II. Building Systems. The second session shall be held on-site for a period of 4 hours of actual hands-on training after the completion of system commissioning. The session shall include instruction on:
 - 1) Specific hardware configuration of installed systems in this building and specific instruction for operating the installed system, including HVAC systems, lighting controls and any interface with security and communication systems.
 - 2) Security levels, alarms, system start-up, shut-down, power outage and restart routines, changing set points 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.
 - 3) All trending and monitoring features (values, change of state, totalization, etc.), including setting up, executing, downloading, viewing both tabular and graphically and printing trends. Trainees will actually set-up trends in the presence of the trainer.
 - 4) Every screen shall be completely discussed, allowing time for questions.
 - 5) Use of keypad or plug-in laptop computer at the zone level.
 - 6) Use of remote access to the system via phone lines or networks.
 - 7) Setting up and changing an air terminal unit controller.
 - 8) Graphics generation
 - 9) Point database entry and modifications
 - 10) Understanding DDC field panel operating programming (when applicable)

D. **TAB.** The TAB contractor shall have the following training responsibilities:

1. TAB shall meet for 4 hours with facility staff after completion of TAB and instruct them on the following:
 - a. Go over the final TAB report, explaining the layout and meanings of each data type.
 - b. Discuss any outstanding deficient items in control, ducting or design that may affect the proper delivery of air or water.
 - c. Identify and discuss any terminal units, duct runs, diffusers, coils, fans and pumps that are close to or are not meeting their design capacity.
 - d. Discuss any temporary settings and steps to finalize them for any areas that are not finished.
 - e. Other salient information that may be useful for facility operations, relative to TAB.

END OF SECTION 23 08 00

Construction Checklist

GENERAL EXHAUST FAN

CC # x EF- 1 thru 5

The above equipment and systems integral to them are complete and ready for functional testing. The checklist items are complete and have been checked off only by parties having direct knowledge of the event, as marked below, respective to each responsible contractor. This construction checklist is submitted for approval, subject to an attached list of outstanding items yet to be completed. A Statement of Correction will be submitted upon completion of any outstanding areas. None of the outstanding items preclude safe and reliable functional tests being performed.

- ✓ Documentation complete as per contract documents for given trade : _____
- ✓ Equipment Approved by Engineer of Record : _____
- ✓ Equipment Installed matches the submittals : _____

| | | | |
|-----------------------|------|---------------------|------|
| Mechanical Contractor | Date | Controls Contractor | Date |
| Construction QC | Date | TAB Contractor | Date |

- This checklist does not take the place of the manufacturer's recommended checkout /startup procedures, etc.
- Items that do not apply shall be noted with the reasons on this form (N/A = not applicable, BO = by others).
- Operation and Maintenance Manuals and or Training are under project closeout procedures and acceptance.
- Equipment Warranties, etc are provided under project closeout documentation.
- Contractor's assigned responsibility for sections of the checklist shall be responsible to see that items by their sub-contractors are completed and checked off.

| | |
|---------------------|------|
| Commissioning Agent | Date |
|---------------------|------|

This filled-out CC has been reviewed and approved with the exceptions noted on the following pages.

| Equipment Information | | | |
|-----------------------|--|-----------------------------------|--|
| Manufacturer | | Motor Power (hp) | |
| Model Number | | Airflow Capacity (cfm) | |
| Serial Number | | Static Pressure Rating (in. w.g.) | |
| Voltage / Phase | | Exhaust Fan Configuration | |

Requested documentation submitted

| Document | Submitted | Notes |
|--|-----------|-------|
| Manufacturer's submittals | | |
| Performance data (fan curves, coil data, etc.) | | |
| Installation and startup manual and plan | | |
| Sequences and control strategies | | |
| O&M manuals | | |

All required documentation has been submitted per contract documents : _____

Installation Checks

| Inspection Item | Checked | Notes |
|---|---------|-------|
| General Installation | | |
| Permanent labels affixed | | |
| Casing: no dents, leaks, door gaskets installed | | |
| Mountings checked and shipping bolts removed | | |
| Vibration isolators installed | | |
| Equipment guards installed | | |
| Pulleys aligned, tension correct | | |
| Plenums clear of debris | | |
| Fans rotate freely | | |
| Fire and balance dampers installed | | |
| Back-draft dampers installed and operate freely | | |
| Duct system complete | | |
| Air leakage in ductwork | | |
| Electrical and Controls | | |
| Power wiring installed properly | | |
| All electrical components grounded properly | | |
| Control wiring and control system hooked up | | |

| Inspection Item | Checked | Notes |
|--|---------|-------|
| Sensors calibrated | | |
| Control system interlocks hooked up and functional | | |
| Operational Checks | | |
| Fan rotation correct | | |
| Electrical interlocks | | |
| Unusual vibrations and/or noise | | |
| Full load running amperage | | |
| Voltage check +/- 5% | | |
| Disconnect switch properly operates | | |
| 24 hours of operation, recheck belt and alignment | | |

Construction Checklist

AIR-HANDLING UNIT – CV GAS-ELECTRIC

CC # x RTU-1 thru RTU-8

The above equipment and systems integral to them are complete and ready for functional testing. The checklist items are complete and have been checked off only by parties having direct knowledge of the event, as marked below, respective to each responsible contractor. This construction checklist is submitted for approval, subject to an attached list of outstanding items yet to be completed. A Statement of Correction will be submitted upon completion of any outstanding areas. None of the outstanding items preclude safe and reliable functional tests being performed.

- ✓ Documentation complete as per contract documents for given trade : _____
- ✓ Equipment Approved by Engineer of Record : _____
- ✓ Equipment Installed matches the submittals : _____

| | | | |
|------------------------------|-------------|----------------------------|-------------|
| | | | |
| Mechanical Contractor | Date | Controls Contractor | Date |
| | | | |
| Construction QC | Date | TAB Contractor | Date |

- This checklist does not take the place of the manufacturer's recommended checkout /startup procedures, etc.
- Items that do not apply shall be noted with the reasons on this form (N/A = not applicable, BO = by others).
- Operation and Maintenance Manuals and or Training are under project closeout procedures and acceptance.
- Equipment Warranties, etc are provided under project closeout documentation.
- Contractor's assigned responsibility for sections of the checklist shall be responsible to see that items by their sub-contractors are completed and checked off.

| | |
|----------------------------|-------------|
| | |
| Commissioning Agent | Date |

This filled-out CC has been reviewed and approved with the exceptions noted on the following pages.

| Equipment Information | | | |
|-----------------------|--|-----------------------------------|--|
| Manufacturer | | Airflow Capacity (cfm) | |
| Model Number | | Static Pressure Rating (in. w.g.) | |
| Serial Number | | Cooling Capacity (MBH) | |
| Voltage / Phase | | Heating Capacity (MBH) | |
| Motor Power (hp) | | Area(s) Served | |

Components Included

| Component | Included |
|--------------|----------|
| Supply Fan | |
| Filter(s) | |
| Cooling Coil | |
| Furnace | |

Requested documentation submitted

| Document | Submitted | Notes |
|--|-----------|-------|
| Manufacturer's submittals | | |
| Performance data (fan curves, coil data, etc.) | | |
| Installation and startup manual and plan | | |
| Sequences and control strategies | | |
| O&M manuals | | |
| Factory test results | | |
| Warranty certificate | | |

All required documentation has been submitted per contract documents : _____

Installation Checks

| Inspection Item | Checked | Notes |
|---|---------|-------|
| General Installation | | |
| Cabinet and general installation. | | |
| Permanent labels affixed. | | |
| Casing condition good (no dents or leaks with door gaskets installed). | | |
| Access doors close tightly with no leaks. | | |
| Connection between duct and unit tight and in good condition. | | |
| Vibration isolation equipment installed & released from shipping locks. | | |
| Maintenance access acceptable for unit and components. | | |

| Inspection Item | Checked | Notes |
|---|---------|-------|
| Thermal insulation properly installed and according to specification. | | |
| Instrumentation installed according to specification (thermometers, pressure gages, flow meters, etc.). | | |
| Clean up of equipment completed per contract documents. | | |
| Filters installed. Replacement type and efficiency identification affixed to housing. Construction filters removed. | | |

| Unit Appurtenances | | |
|--|--|--|
| No leaking apparent around refrigerant fittings. | | |
| All coils are clean and fins are in good condition. | | |
| All condensate drain pans clean and slope to drain per spec. | | |
| P-Trap installed per specifications. | | |
| OSAT, SAT, sensors properly located and secure (related OSAT sensor shielded). | | |
| Refrigerant piping in good condition and suction insulated. | | |
| P/T plugs and isolation valves installed per drawings. | | |
| Fans and Dampers | | |
| Supply fan and motor alignment correct. | | |
| Supply fan belt in proper tension and in good condition. | | |
| Supply fan protective shrouds for belts in place and secure. | | |
| Supply fan area clean. | | |
| Supply fan and motor properly lubricated. | | |
| Compressor and Condenser | | |
| Refrigerant sight glass clear of bubbles. | | |
| Moisture indicator shows no moisture. | | |
| Correct oil level (check sight glass during operation). | | |
| Compressors and piping were leak tested, as required. | | |
| Crankcase heater on when unit is off. | | |

| Inspection Item | Checked | Notes |
|---|---------|-------|
| Condenser coils clean and in good condition. | | |
| Adequate clearance for airflow around condenser. | | |
| Electrical and Controls | | |
| Pilot lights are functioning. | | |
| Power disconnects in place and labeled. | | |
| All electric connections tight. | | |
| Proper grounding installed for components and unit. | | |
| Safeties in place and operable. | | |
| Current overload heaters installed and correct size. | | |
| Auxiliary heaters installed. | | |
| Sensors calibrated. | | |
| All building control system interlocks hooked up with packaged controls and functional. | | |
| Fire and smoke detectors in place. | | |
| Enthalpy control and sensor properly installed (if economizer installed). | | |
| Related thermostats are installed. | | |
| Related building automation system points are installed. | | |
| All control devices, pneumatic tubing and wiring complete. | | |
| Operational Checks | | |
| Supply fan rotation correct. | | |
| Supply fan has no unusual noise or vibration. | | |
| All dampers fully stroke without binding and spans calibrated and BAS reading site verified. | | |
| Valves stroke fully and easily and spanning is calibrated. | | |
| Valves verified to not be leaking through coils when closed at normal operating pressure. | | |
| Specified point-to-point checks have been completed and documentation record submitted for this system. | | |

Notes and Comments

Functional Performance Test

GENERAL EXHAUST FAN

FPT # x EF- 1 thru 5

The above equipment and systems integral to them are complete and ready for functional testing. The checklist items are complete and have been checked off only by parties having direct knowledge of the event, as marked below, respective to each responsible contractor. This FPT is submitted for approval, subject to an attached list of outstanding items yet to be completed. A Statement of Correction will be submitted upon completion of any outstanding areas. None of the outstanding items preclude safe and reliable functional tests being performed.

✓ Documentation complete as per contract documents for given trade : _____

| | | | |
|------------------------------|-------------|----------------------------|-------------|
| | | | |
| Mechanical Contractor | Date | Controls Contractor | Date |
| | | | |
| Construction QC | Date | TAB Contractor | Date |

- This checklist does not take the place of the manufacturer's recommended checkout /startup procedures, etc.
- Items that do not apply shall be noted with the reasons on this form (N/A = not applicable, BO = by others).
- Operation and Maintenance Manuals and or Training are under project closeout procedures and acceptance.
- Equipment Warranties, etc are provided under project closeout documentation.
- Contractor's assigned responsibility for sections of the checklist shall be responsible to see that items by their sub-contractors are completed and checked off.

| | |
|----------------------------|-------------|
| | |
| Commissioning Agent | Date |

This filled-out FPT has been reviewed and approved with the exceptions noted on the following pages.

| Equipment Information | | | |
|-----------------------|--|-----------------------------------|--|
| Manufacturer | | Motor Power (hp) | |
| Model Number | | Airflow Capacity (cfm) | |
| Serial Number | | Static Pressure Rating (in. w.g.) | |
| Voltage / Phase | | Exhaust Fan Configuration | |

Requested documentation submitted

| Document | Submitted | Notes |
|---|-----------|-------|
| Equipment approved per submittals | | |
| Installation manuals on file | | |
| O&M manuals | | |
| Record as-built drawings on file | | |
| Approved Sequence of Operations on file | | |

All required documentation has been submitted per contract documents : _____

Equipment Control Type

| Exhaust Fan | Control Type |
|---------------------|--------------|
| Thermostat | |
| Standard Switch | |
| Time-of-Day | |
| Equipment Interlock | |
| Other means | |

Thermostat Controlled Exhaust Fan Testing Procedures and Record

| Test # | Test Procedure | Response / Result | Result / Yes / No / N/A | Comment Reference Number |
|--------|--|---|-------------------------|--------------------------|
| 1 | Record temperature set-point prior to test changes. | _____ °F controls drawings or plans. | _____ °F | |
| 2 | Sensor or thermostat in proper location. | Not on exterior wall or near heat generating equipment. | ___ Verified | |
| 3 | Measure and record temperature at thermostat. Lower zone temperature set-point to 5°F less than the measured temperature. | The fan should start. | ___ Verified | |
| 4 | Raise zone temperature set-point to 5°F greater than the measured temperature. | The fan should stop. | ___ Verified | |
| 5 | Reset set-points to starting values and record any notes. | Sequence shall be verified. | ___ Verified | |

Manually Controlled Exhaust Fan Testing Procedures and Record

| Test # | Test Procedure | Response / Result | Result / Yes / No / N/A | Comment Reference Number |
|--------|--|--|-------------------------|--------------------------|
| 1 | Manual switch located properly. | Near a door or within reasonable access. | ___ Verified | |
| 2 | Turn fan OFF at the switch. | Fan shall be off. | ___ Verified | |
| 3 | Turn fan ON at the switch. | Fan shall be on. | ___ Verified | |
| 4 | Any operational problems shall be noted. | Sequence verified. | ___ Verified | |

Time-of-Day Controlled Exhaust Fan Testing Procedures and Record

| Test # | Test Procedure | Response / Result | Result / Yes / No / N/A | Comment Reference Number |
|--------|---|--|--|--------------------------|
| 1 | Record programmed start and stop times. | <u>Specifications or Plan Drawings</u> _____ Mon _____ Tues _____ Wed _____ Thu _____ Fri _____ Sat _____ Sun | <u>BAS</u> _____ Mon _____ Tues _____ Wed _____ Thu _____ Fri _____ Sat _____ Sun | |
| 2 | Start and stop schedule reasonable. | Does not start more than (1) hour before nor it does not end more than (1) hour after occupied schedule. | ___ Verified | |
| 3 | Set fan to be ON in BAS schedule. | The fan should start. | ___ Verified | |
| 4 | Set fan to be OFF in BAS schedule. | The fan should stop. | ___ Verified | |
| 5 | Reset set-points to starting values and record any notes. | Sequence shall be verified. | ___ Verified | |

Equipment Interlocked Exhaust Fan Testing Procedures and Record

| Test # | Test Procedure | Response / Result | Result / Yes / No / N/A | Comment Reference Number |
|--------|---|--|---|--------------------------|
| 1 | Equipment name or ID of controlling equipment. | <u>Specifications or Plan Drawings</u> _____ | <u>BAS</u> _____ | |
| 2 | With interlocked equipment ON, should exhaust fan be ON or OFF? | <u>Specifications or Plan Drawings</u> _____ | <u>BAS</u> _____ | |
| 3 | Start test with exhaust fan ON. Switch status of interlocked equipment. | The fan should stop. | ___ Verified | |
| 4 | Again, switch the status of the interlocked equipment. | The fan should start. | ___ Verified | |
| 5 | Command the static pressure set-point to be 1-inch above the current static pressure. | The fan VFD should increase in speed. | ___ Verified | |
| 6 | Command the static pressure to be 1-inch above the static pressure set-point | If bypass damper/valve exists, the bypass shall open. | ___ Verified | |
| | | The fan VFD modulates to maintain airflow or velocity set-point. | ___ Verified ___ airflow ___ velocity | |

| Test # | Test Procedure | Response / Result | Result / Yes / No / N/A | Comment Reference Number |
|--------|---|--|---|--------------------------|
| 7 | Command the static pressure set-point to be 1-inch below the current static pressure. | The fan VFD should decrease in speed. | ___ Verified | |
| 8 | Command the static pressure to be 1-inch below the static pressure set-point | If bypass damper/valve exists, the bypass shall close. | ___ Verified | |
| | | The fan VFD modulates to maintain airflow or velocity set-point. | ___ Verified ___ airflow ___ velocity | |
| 9 | Reset set-points to starting values and record any notes. | Sequence shall be verified. | ___ Verified | |

Exhaust Fan Controlled by Other Means Testing Procedures and Record

| Test # | Test Procedure | Response / Result |
|--------|---|-------------------|
| 1 | Describe the control sequence as designed, either from specifications or plan drawings. | |
| 2 | Describe testing procedure to follow. | |

Functional Performance Test

AIR-HANDLING UNIT – CV GAS-ELECTRIC

FPT # x RTU-1 thru RTU-8

The above equipment and systems integral to them are complete and ready for functional testing. The checklist items are complete and have been checked off only by parties having direct knowledge of the event, as marked below, respective to each responsible contractor. This FPT is submitted for approval, subject to an attached list of outstanding items yet to be completed. A Statement of Correction will be submitted upon completion of any outstanding areas. None of the outstanding items preclude safe and reliable functional tests being performed.

✓ Documentation complete as per contract documents for given trade : _____

| | | | |
|------------------------------|-------------|----------------------------|-------------|
| | | | |
| Mechanical Contractor | Date | Controls Contractor | Date |
| | | | |
| Construction QC | Date | TAB Contractor | Date |

- This checklist does not take the place of the manufacturer's recommended checkout /startup procedures, etc.
- Items that do not apply shall be noted with the reasons on this form (N/A = not applicable, BO = by others).
- Operation and Maintenance Manuals and or Training are under project closeout procedures and acceptance.
- Equipment Warranties, etc are provided under project closeout documentation.
- Contractor's assigned responsibility for sections of the checklist shall be responsible to see that items by their sub-contractors are completed and checked off.

Commissioning Agent Date

This filled-out FPT has been reviewed and approved with the exceptions noted on the following pages.

| Equipment Information | | | |
|-----------------------|--|-----------------------------------|--|
| Manufacturer | | Airflow Capacity (cfm) | |
| Model Number | | Static Pressure Rating (in. w.g.) | |
| Serial Number | | Cooling Capacity (MBH) | |
| Voltage / Phase | | Heating Capacity (MBH) | |
| Motor Power (hp) | | Area(s) Served | |

Requested documentation submitted

| Document | Submitted | Notes |
|---|-----------|-------|
| Equipment approved per submittals | | |
| Installation manuals on file | | |
| O&M manuals | | |
| Record as-built drawings on file | | |
| Approved Sequence of Operations on file | | |

All required documentation has been submitted per contract documents : _____

Testing Procedures and Record

| Test # | Test Procedure | Response / Result | Result / Yes / No / N/A | Comment Reference Number |
|--------|--|---|-------------------------|--------------------------|
| 1 | Turn the unit OFF. | Unit shall be OFF. | ___ Verified | |
| 2 | Enable the stand-alone thermostat to the fan in the ON position. | Fan should start. | ___ Verified | |
| 3 | Disable the fan from the stand-alone thermostat. | Fan should stop. | ___ Verified | |
| 4 | Enable gas heating from the stand-alone thermostat. | Induced draft blower motor shall start and main gas ignition shall begin. | ___ Verified | |
| 5 | Indoor fan motor shall experience a time delay. | Indoor fan starts when combustion box reaches proper temperature. | ___ Verified | |

| Test # | Test Procedure | Response / Result | Result / Yes / No / N/A | Comment Reference Number |
|--------|---|--|-------------------------|--------------------------|
| 6 | Disable gas heating from the indoor stand-alone thermostat. | Main gas valve and induced draft blower shall shut down. | ___ Verified | |
| 7 | Indoor fan motor shall experience a time delay. | Indoor fan motor shall run for a specified amount of time and shut off. | ___ Verified | |
| 8 | Enable cooling from the indoor stand-alone thermostat. | Compressor, condenser fan motor and indoor fan motor shall start. | ___ Verified | |
| 9 | Disable cooling from the indoor stand-alone thermostat. | Compressor, condenser fan motor and indoor fan motor shall shut down. | ___ Verified | |
| 10 | Economizer (powered exhaust enabled) first stage cooling. | Economizer damper actuates open and powered exhaust motor starts. | ___ Verified | |
| 11 | Economizer (powered exhaust enabled) cycle ends. | Economizer damper actuates back to minimum ventilation and powered exhaust motor shuts down. | ___ Verified | |
| 12 | Filters are installed. | Filters installed per specifications and plan drawings. | ___ Verified | |
| 13 | Reset set-points to starting values and record any notes. | Sequence shall be verified. | ___ Verified | |

Notes and Comments

SECTION 23 09 23-N - DIRECT DIGITAL CONTROL SYSTEM SPECIFICATION

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by the basic designation only.

AIR MOVEMENT AND CONTROL ASSOCIATION, INC. (AMCA)

AMCA 500 (1991) Louvers, Dampers and Shutters

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

ANSI B16.18 (1984; R 1994) Cast Copper Alloy Solder Joint Pressure Fittings

ANSI C12.10 (1987) Electromechanical Watt-hour Meters

ANSI C57.13 (1978; R 1987) Instrument Transformers

AMERICAN SOCIETY OF HEATING, REFRIGERATING, AND AIR-CONDITIONING
ENGINEERS, INC. (ASHRAE)

ASHRAE 3 (1996) Reducing Emission of Fully Halogenated Chlorofluorocarbon (CFC)
Refrigerants in Refrigeration and Air-Conditioning Equipment and Applications

AMERICAN SOCIETY OF MECHANICAL ENGINEERS (ASME)

ASME/ANSI B16.5 (1996) Pipe Flanges and Flanged Fittings

ASME/ANSI B16.34 (1996) Valves - Flanged, Threaded, and Welding End

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A 126 (1995) Gray Iron Castings for Valves, Flanges, and Pipe Fittings

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 70 (1998) National Electrical Code

NFPA 90A (1996) Installation of Air Conditioning and Ventilating Systems

SHEET METAL & AIR CONDITIONING CONTRACTORS NATIONAL ASSOCIATION, INC.
(SMACNA)

SMACNA DCS(1985) HVAC Duct Construction Standards - Metal and Flexible

SMACNA HVACTAB (1993) HVAC Systems Testing, Adjusting and Balancing

UNDERWRITERS LABORATORIES INC. (UL)

- UL 506 (1994; R 1997, Bul. 1997) Specialty Transformers
- UL 555S (1996) Leakage Rated Dampers for Use in Smoke Control Systems
- UL 1449 (1996) Transient Voltage Surge Suppressors

1.2 DEFINITIONS

1.2.1 Extended Application and Data Servers (ADXs)

Server class computers that manages the collection, presentation, and long-term storage of trend data, event messages, operator transactions, graphic displays and system configuration data. The ADX servers communicate with the Building Network Controllers on the network. In addition, the user interface of the ADX servers provides system navigation, viewing of graphic displays, comprehensive alarm management, trend analysis and summary reporting capabilities.

1.2.2 Building Level Network

The communication network within a building that connects Digital Controllers and Field Equipment Controllers to a Building Network Controller. The Building Level Network utilizes existing Ethernet, Carrier Comfort Network (CCN), and RS-485 that connects Digital Controllers to a Building Network Controller in a daisy-chain configuration.

1.2.3 Building Network Controller

A microprocessor-based device that is connected to and supervises Digital Controllers and Field Equipment Control Devices over a Building Level Network. The Building Network Controller provides monitoring, control, alarm and event management, data exchange, trending, scheduling and data storage of the ancillary controllers associated with it. The Building Network Controller also has interfaces for communicating with Portable Workstation Laptop Computers as well communicating with the ADX servers via the network.

1.2.4 Device

Any control system component, usually a sensor, switch, relay, or actuator, that provides an input or receives an output from a Digital Controller.

1.2.5 Digital Controller

A microprocessor based electronic controller, with integral programming logic and digital and analog input/output capability to perform closed loop control functions in a stand-alone capacity.

a. Universal Programmable Controller

A Digital Controller that processes analog, digital, and software inputs through user-defined programming logic (via multi-purpose programmable function modules, software implemented Programmable Logic Controller (PLC) modules, time schedule modules, optimal start/stop modules, etc) to produce required outputs and operating parameters.

b. Application Specific Controller (ASC)

A Digital Controller that processes analog, digital, and software inputs through pre-defined programming logic in the firmware of the controller to produce required outputs and operating parameters.

c. Network Communication Capable Thermostat

An equipment-specific Digital Controller with an internal programmable time clock that provides the functionality of a thermostat as well as processing analog, digital, and software inputs through pre-defined programming logic in the firmware of the controller to produce required outputs and operating parameters.

1.2.6 Direct Digital Control (DDC)

Digital Controllers performing control logic. The controller directly senses physical values, makes control decisions based on internal programs, and provides output control signals that directly operate devices such as relays, valve and damper actuators, variable frequency drives, etc.

1.2.7 DDC System

A building level network of Digital Controllers and Field Equipment Control Device that communicate with a Building Network Controller. The DDC system includes the sensors, actuators, relays, software, programming, graphic displays “graphics”, system database and any other component, parameters, and attributes of the devices used in measuring inputs or controlling outputs. The DDC system may also include a local desktop Operator Workstation or a Portable Workstation Laptop Computer.

1.2.8 Distributed Control

Controllers located near the equipment being controlled, with physical input and output points that allows distributed processing at each standalone Digital Controller. Individual system or equipment control is not split between controllers, and the failure of any single Digital Controller does not cause any other Digital Controller to fail. See also “Stand-Alone Control”.

1.2.9 Dynamic Control

A process that optimizes operation of HVAC systems (air handling units, converters, chillers, and boilers) by increasing and decreasing setpoints or starting and stopping equipment in response to heating and cooling needs of downstream equipment. A requirement of dynamic control is knowing the heating/cooling demand status of downstream equipment, therefore dynamic control requires Digital Controllers be connected in a communications network.

1.2.10 Field Equipment Control Device

A microprocessor-based electronic controller (such as a Variable Frequency Drive, Chiller Controller, or Lighting Controller), designed to control a specific piece of equipment (such as a motor, chiller, or lighting system) that can communicate directly on the Building Level Network.

1.2.11 Firmware

Firmware is software programmed into read only memory (ROM) and erasable programmable read only memory (EPROM) chips. Software may not be changed without physically altering the chip.

1.2.12 Graphic Displays (Graphics)

Graphical schematic displays on an operator workstation of the hardware and software points on a DDC system. Graphic displays give a visual representation of HVAC systems that allow the operational status to be monitored and controlled.

1.2.13 Hand-Held Terminal

A portable device which can be connected directly to a communications port on a Digital Controller through which the Digital Controller can be interrogated and, in some cases, programmed.

1.2.14 Input/Output (I/O)

Physical inputs and outputs to and from a Digital Controller including analog inputs (AI), digital inputs (DI), analog outputs (AO), and digital outputs (DO). Inputs are from analog sensors (such as temperature, pressure, flow, humidity) and digital sensors (such as motor status, flow switches, switch position, and pulse output devices). Outputs operate modulating and on/off control devices. The term also encompasses software, or "virtual" I/O in a digital controller. (In regards to I/O, throughout this document, the terms software and virtual will be used interchangeably.) Software/Virtual points typically reside within the programming of the Digital Controller or the Building Network Controller and typically are used as set points or to provide the status or run time of a device for use in the execution of a control loop or program logic.

1.2.15 Internet Protocol (IP, TCP/IP, UDP/IP)

A protocol for communication between computers, used as a standard for transmitting data over networks and as the basis for standard Internet protocols, the most common use is the World Wide Web. At the lowest level, it is based on Internet Protocol (IP), a method for conveying and routing packets of information over various LAN media. Two other protocols are User Datagram Protocol (UDP) and Transmission Control Protocol (TCP). UDP conveys information to well-known "sockets" without confirmation of receipt. TCP establishes "sessions", which have end-to-end confirmation and guaranteed sequence of delivery.

1.2.16 I/O Expansion Unit

An I/O expansion unit provides local additional point capacity to a Digital Controller within the Digital Controller enclosure.

1.2.17 IP Address

A numeric identifier for a computer or Building Network Controller on a TCP/IP network. Networks using the TCP/IP protocol route messages based on the IP address of the destination. The format of an IP address is a 32-bit numeric address written as four numbers separated by periods. Each number can be zero to 255. For example, 1.160.10.240 could be an IP address.

1.2.18 IP Subnet

Internet protocol (IP) identifies individual devices with a 32-bit number divided into four groups from 0 to 255. Devices are often grouped and share some portion of this number. For example, one device has IP address 209.185.47.68 and another device has IP address 209.185.47.82. These two devices share Class C subnet 209.185.47.

1.2.19 DDC Communications Protocols

In order to achieve the maximum savings, benefits and permit sharing of global information making it possible to apply network-wide control strategies (such as peak demand limiting, coordinated alarm gathering and response, remote monitoring, and remote programming of building network controllers and digital controllers), the various components must be able to seamlessly communicate. The new expanded system utilizes Transmission Control Protocol/Internet Protocol (TCP/IP) and Hypertext Transfer Protocol (HTTP) to communicate with Building Network Controllers via Ethernet. Similar, the CCN Network is extended to enable the Owner to utilize existing software and hardware for programming the Digital Controllers and monitoring/controlling devices.

1.2.20 Local Area Network (LAN)

A communication network that spans a finite geographic area and uses the same basic communication technology throughout.

1.2.21 Microprocessor

A microprocessor refers to the central processing unit (CPU) that contains all the registers and logic circuitry that make it possible for Digital Controllers to do computing.

1.2.22 Operator Workstation (OWS)

A desktop computer that allows the hardware and software I/Os of the DDC system to be viewed in both a text based and graphic format. The Operator Workstation is equipped with software that allows setup and collection of trends, as well as allowing the storage, creation, modification and downloading of Building Network Controller and Digital Controller programming.

1.2.23 Optimum Start/Stop

Optimum Start/Stop utilizes prediction software to determine the minimum time of HVAC system operation needed to satisfy space environmental requirements at the start of the occupied cycle, and determine the earliest time for stopping equipment at the day's end without exceeding space environmental requirements.

1.2.24 Peer-to-Peer

A network of Digital Controllers that act independently as equals and communicate with each other to pass information which facilitate control.

1.2.25 PID

PID refers to proportional, integral, and derivative control; the three types of actions that are used in controlling modulating equipment to maintain a set point.

1.2.26 Point Name

A standard name that is assigned to any software or hardware I/O.

1.2.27 Portable Workstation Laptop Computer

A laptop computer that allows the hardware and software I/Os of the DDC system to be viewed in both a text based and graphic format by direct connection to the Building Network Controller or Digital Controller. The Portable Workstation Laptop Computer is equipped with software that allows setup and collection of trends, creation of graphic displays, as well as allowing the storage, creation, modification and downloading of Building Network Controller and Digital Controller programming.

1.2.28 Stand-Alone Control

The ability of a Digital Controller being to perform required climate control, and energy management functions without connection to another Digital Controller or central site computer. Digital Controller requirements for stand-alone control are a time clock, a microprocessor, microchip resident control programs, PID control, a communications port for interfacing with and programming the controller, firmware for interrogation and programming, and I/O for sensing and effecting control of its control environment.

1.2.29 Wide Area Network (WAN)

A communication network that spans a relatively large geographic area or two or more geographically disparate areas. Typically, a WAN consists of two or more local-area networks (LANs) to form a single network.

1.3 DDC SYSTEM PROJECT DESCRIPTION

- a. Provide a DDC system to maintain stable temperature control and all other conditions as indicated. The end-to-end accuracy of the system, including temperature sensor error, wiring error, A/D conversion, and display, shall be 1 deg F for space, duct, and outside air temperatures, 3% for relative humidity; 2% of range for pressure; and 3% of range for flow.

1.3.1 SYSTEM INTERFACE

- a. Description: Operator Interface Via Web Browser

The control system shall be as shown and consist of a high-speed, peer-to-peer network of DDC controllers and a stand alone Web Server. The stand alone Web server shall be a compact device capable of routing peer to peer communications of devices on the RS-485 network to an Ethernet LAN. The Web Server shall be capable of storing all system device definitions within the Web server and shall not require an external system manager, computer, or controller to define or access system control devices. The Web Server will allow users to interface with the network via dynamic color graphics served over the Intranet or Internet via a standard Web Browser. The

Web server shall be capable of tabular and graphic displays of mechanical systems, building floor plans, or control devices depicted by point-and-click graphics.

b. Operator Interface

Furnish one compact i-Vu Web server interface as shown on the system drawings. Operators shall be able to access all necessary operational information in the system via personal computer utilizing standard Web browser software. Computer and Web browsing software shall not be furnished under this section. The Web server shall reside on the same Peer-to-Peer network as the Building Controllers.

Web Server shall connect via Ethernet to a LAN and be able to serve up controller information to simultaneous operators connected via the Ethernet or telephone with standard Web Browsers. Each standard browser connected to server shall be able to access all system information.

c. Web Server Hardware:

Furnish one compact i-Vu Web server router with ethernet port for operator computer access. The web server shall have an integrated RS-485 port for connection to the peer to peer controller network. The web server shall not require a permanent keyboard or monitor, however shall have an integrated terminal port for connecting a terminal and keyboard during installation and configuration. The Web server shall allow file transfer of files from another system for use as graphics backgrounds or custom displays.

d. Web Browser Interaction

1. The Web server shall be capable of providing the operator, at a Web Browser, with both tabular or graphical pages of controller data. An operator with the proper password level shall be able to change setpoint and occupancy schedules or override points and remove overrides. Dynamic objects shall include analog and binary values, dynamic text, static text, and animation files. Graphics shall have the ability to show animation by shifting image files based on the status of the object.
2. Custom Graphics: Custom graphic files may be created with the use of a graphics generation package. Graphics may be downloaded to the Web server to use as graphical backgrounds for Dynamic data sent to a Web browser.
3. Graphics Library: Furnish a library of standard HVAC equipment graphics such as chillers, boilers, air handlers, terminals, fan coils, and unit ventilators. The library shall be furnished in a file format compatible with the graphics generation package program. Upon connection to the controls system the Web Server shall have the capability to learn the controls system and automatically present default web pages for each controller found.
4. Alarms. An operator shall be able to access a tabular listing of the systems most recent alarm messages from a standard Web browser. This listing shall allow the operator to manage the alarms and acknowledge, print, delete and hyperlink to trouble areas.

5. Display Information. An operator shall have the capability to perform setup of the Web Server from a standard Web browser. Setup shall include learning new controllers that are added to the controls system, setting the time in controllers and changing the display units of the data presented between Metric and Imperial units.
- e. Performance Standards: System shall conform to the following minimum standards over network connections.
1. Graphic Display. A graphic with 20 dynamic points shall display with current data within 10 sec.
 2. Graphic Refresh. A graphic with 20 dynamic points shall update with current data within 10 sec. and shall automatically refresh every 15 sec.
 3. Configuration and Tuning Screens. Screens used for configuring, calibrating, or tuning points, PID loops, and similar control logic shall automatically refresh within 10 sec.
 4. Object Command. Devices shall react to command of a binary object within 2 sec. Devices shall begin reacting to command of an analog object within 2 sec.
 5. Alarm Response Time. An object that goes into alarm shall be annunciated at the web browser within 15 sec.

1.3.2 ROOFTOP CONTROLLERS

- b. A Factory Installed Building Level Network Controller (BLC) shall be provided to integrate control of the new Roof Top Units. The BLC shall communicate with the smart controller integral with the RTUs using the existing CCN network.
- c. The controller integral to each RTU shall provide all the following data/control points:
- Cooling Capacity
 - Heating Capacity
 - Occupancy
 - Occupancy Mode
 - Emergency Override Mode
 - Discharge Air Temperature
 - Return Air Temperature
 - Space Temperature
 - Outdoor Air Temperature
 - Discharge Fan Status
 - Suction Pressure
 - Condensing Temperature
 - Discharge Fan Capacity
 - Effective Cooling Enable Setpoint
 - Occupied Cooling Setpoint
 - Unoccupied Cooling Setpoint
 - Effective Cooling Discharge Setpoint

- Discharge Air Cooling Setpoint
- Outdoor Air Damper Position Feedback
- Effective Minimum Outdoor Damper Position Setpoint
- Outdoor Air Damper Minimum Position
- Minimum Outdoor Airflow Damper Position
- Effective Heating Discharge Setpoint
- Discharge Air Heating Setpoint
- Occupancy Scheduler Input

d. The controller integral to each RTU shall provide the following Alarms:

- Smoke Alarm
- Discharge Air Temperature Sensor Failure
- Outdoor Air Temperature Sensor Failure
- Space Temperature Sensor Failure
- Duct Pressure High Limit
- High Return Air Temperature
- High Discharge Air Temperature
- Low Discharge Air Temperature
- Fan Failure
- Heat Failure
- Economizer/Outdoor Air Damper Stuck Failure
- Airflow Switch Alarm
- Dirty Filter Alarm
- Low Airflow Alarm
- Circuit High Pressure Alarm (per circuit)
- Circuit Low Pressure/Frost Alarm (per circuit)
- Compressor Motor Protection Alarm (per compressor)

e. Powered Exhaust Fan control for shall be provided from the stand alone integrated powered exhaust controller. This control shall allow for modulating fan speed operation to control room static pressure.

f. All points shall be proven to work end-to-end from a Portable Workstation Laptop Computer directly connected to the Building Network Controller and shall be proven by interrogating and/or overriding each Input / Output channel during the Performance Verification Test (PVT). The database for the DDC System shall be created using the latest revision of the System Configuration Tools (SCT) software available at the time construction begins.

g. Software and Hardware naming shall be in accordance with naming conventions established by the Owner and shall be compatible with existing DDC naming conventions.

h. All Digital Controllers and Field Equipment Control Devices shall communicate using CCN. The building level controller shall have the ability to communicate to higher level computer using BACnet/IP or shall have the ability to communicate directly using the Internet to remotely located computers using Internet Explorer 8 (or newer).

- i. All application software necessary to control the system shall be provided. Complete and Integrated hardware and software shall be ready to completely control the DDC system.
- j. DDC System shall be secure from outside intervention or monitoring using built in protection software. Only authorized personnel shall have access to the DDC system.

1.4 PROJECT SEQUENCE OF WORK

The control system work for this project shall proceed in the following order:

- a. Schedule and participate in a Pre-Controls meeting with the building Owner.
- b. Submit Contractor's Qualifications, Manufacturer's Product Specification Data, and Shop Drawings as specified under the paragraph "Submittals."
 - a. Receive QC and Owner approval on the above submittals.
- c. Submit Pre-field Test Plan for Contractor use during the Contractor Field Test.
 - a. Receive QC and Owner approval on the above submittals.
- d. Perform the control system installation work, including all field check-outs and tuning.
- e. Create the Contractor Field Test Report from the field checkout sheets, tuning documentation and trend data.
- f. When applicable, Provide support to TAB personnel as specified under the paragraph "TEST AND BALANCE SUPPORT."
- g. Submit SD-04, Contractor Field Test Report.
 - a. Receive QC and Owner approval on the above submittals
- h. Submit Pre-field Test Plan for Contractor use during the Performance Verification Test.
 - a. Receive QC and Owner approval on the above submittals.
- i. Submit Certificate of Test Readiness.
 - a. Receive QC and Owner approval of the Certificate of Test Readiness and then schedule the Performance Verification Test.
- j. Conduct the Performance Verification Test with the Owner, (the graphics portion of the test may be run in parallel or subsequent to the rest of the test) and record any deficiencies in the performance of the system or deviations from the design in a Performance Verification Test (PVT) Punch List.
- k. Schedule and participate in the Performance Verification Test Review meeting to discuss Punch List items and determine a time line of when they will be corrected.
- l. Correct all items and issues on the PVT Punch List.

- m. Submit SD-05, Performance Verification Test Report.
- n. Submit, Final Shop Drawings for review.
 - a. Receive QC and Owner approval on the above submittals.
- o. Schedule and participate in a PVT Punch List back-check with the Owner and affix laminated copies of the Final Shop Drawings to the Digital Controller and Building Controller panels as specified under paragraph "Laminated Final Shop Drawings".
- p. Controls System Operator's Manual specified under the paragraph "Control System Operator's Manuals and VFD Service Manuals".
 - a. Receive QC and Owner approval on the above submittal.
- q. Training Documentation specified under the paragraph "INSTRUCTION TO OWNER PERSONNEL" and "VFD Service Support". Submit at least 30 days before training.
 - a. Receive QC and Owner approval on the above submittal.
- r. Perform Opposite Season Test if required.
- s. Schedule Training.
- t. Conduct the Phase I Training and VFD on-site/hands-on training.
- u. Conduct the Phase II Training.
- v. Submit SD-09 Project Closeout Documentation.
 - a. Receive QC and Owner approval on the above submittal.

1.5 SUBMITTALS

Submit detailed and annotated manufacturer's data, drawings, and specification sheets for each item, that clearly show compliance with the project specifications.

- a. Submittals:
See GREENBOOK and 2012 City Supplement, Section 2-5.3 for Shop Drawings and Submittals.
- b. Substitutions:
See GREENBOOK and 2012 City Supplement, Section 4-1.6 for Substitutions.

1.5.1 Contractors' Qualifications

Submit documentation demonstrating compliance with the requirements specified under the paragraph, 'Contractor's Qualifications'.

1.5.2 Manufacturer's Product Specification Data

Submit Manufacturers' Product Specification Data sheets for every product that is to be installed in the DDC system to show compliance of the product with the design drawings and the specifications. If information on multiple products is provided on the Manufacturers' Product Specification Data sheets, highlight the specific product (or products) of relevance, and indicate the specification paragraph number that the item is in compliance with. Submit sufficient manufacturers' information to allow verification of compliance by the Owner. Equipment and software, for which Manufacturers' Product Specification Data shall be submitted, should include but not be limited to the following:

- a. DDC hardware
 - i. Digital Controllers
 - ii. Building Network Controller
 - iii. Field Equipment Control Devices
 - iv. LAN devices including media converters, routers, hubs, bridges, and switches
- b. DDC Programming Software
 - i. Programming software for Digital Controllers
 - ii. Programming software for Building Network Controllers
 - iii. Software for creating Graphics
 - iv. Software used on Internet based workstations & laptops
- c. Input devices
 - i. Temperature Sensors
 - ii. Flow Sensors/Switches
 - iii. Current Sensors/switches
 - iv. Damper & Valve position
- d. Output Devices
 - i. Damper and Valve actuators
 - ii. Control Relays/motor starter contactors
 - iii. VFD Commands
- e. Surge and transient protection
 - i. Power line conditioners
 - ii. Network surge protectors

- f. Operator Workstation Software
- g. Portable Workstation Laptop computer Software
- h. Hand-held terminal
- i. Smoke detectors
- j. Variable Frequency Drives

Any piece of equipment to be installed as part of the DDC system shall have a data sheet provided. For each submitted Manufacturers' Product Specification Data sheet, highlight in a reproducible form each unique piece of equipment and reference each item to the relevant specification paragraph number. Submit sufficient manufacturers' information to allow verification of compliance by the owner.

1.5.3 Shop Drawings

- a. Control System Drawing Title Sheet
- b. Building Level Network Communication Architecture Schematic
- c. Control System Schematics
- d. Control System Components List
- e. Table of I/O Points
- f. HVAC Equipment Electrical Ladder Diagrams
- g. Component Wiring Diagrams (Shop Drawing)
- h. Terminal Strip Diagrams (Shop Drawing)
- i. AC Power Table (Shop Drawing)
- j. Floor Plan Hardware Location Drawings

Show all information in the descriptions listed below on the drawings. Due are to be developed during the design stage and presented for review by Owner. Drawings labeled as (Shop Drawings) may be submitted after 100% Design Review is accomplished. Obtain the signature of the Owner prior to commencement of the control system installation work.

1.5.3.1 Control System Drawing Title Sheet

Provide a title sheet for the control system drawing set. Include the project title, project location, contract number, the controls contractor preparing the drawings, an index of the control drawings in the set and a legend of the symbols and abbreviations used throughout the control systems drawings

1.5.3.2 Building Level Network Communication Architecture Schematic

Provide a schematic showing the architecture of the DDC system's entire Building Level Network, including the locations in the building (with room numbers) of all Digital Controllers, Field Equipment Control Devices (such as VFDs, factory chiller control panels, etc.), Building Network Controllers, Operator Workstation, and LAN devices including media converters, routers, hubs, bridges, and switches. In addition, provide notation on the schematic of the addressing of the Digital Controllers, Expansion Modules, Field Equipment Control Devices LON and RS/485 communications links, and the IP Addressing of the Building Network Controllers.

1.5.3.3 Control System Schematics

Provide a control system schematic for each Digital Controller and Building Network Controllers. Typical schematics for multiple pieces of exactly identical equipment with exactly identical sequences of operation are allowed unless otherwise requested in design or contract criteria. For similar pieces of equipment where a typical schematic is to be submitted, if the sequence of operation is the same, but there is only a slight deviation in the quantity or type of I/Os, indicate on the drawing the points that deviate from the standard and what digital controller(s)/piece(s) of equipment the deviation is applicable to. Include the following:

- a. Location of each input and output device
- b. Flow diagram for each piece of HVAC equipment
- c. Point *Name* for each control system component, such as SA-T for a Supply Air Temperature sensor.
- d. Setpoints, with differential or proportional band values
- e. Written sequence of operation for the HVAC equipment
- f. Valve and Damper Schedules, with normal (power fail) position

1.5.3.4 Control System Components List

Also known as a Bill of Materials, provide a complete list of control system components installed on this project. Include for each controller and device: control system schematic name, control system schematic designation, device description, manufacturer, and manufacturer part number. For sensors, include point name, sensor range, and operating limits. For valves, include body style, Cv, design flow rate, pressure drop, valve characteristic (linear or equal percentage), and pipe connection size. For actuators, include point name, spring return, modulating or two-position action, normal (power fail) position, nominal control signal operating range (0-10 volts DC or 4-20 milliamps), and operating limits.

1.5.3.5 Table of I/O Points

Also known as a Point Schedule, provide for each input and output point physically connected to a digital controller: point name, point description, point type (Analog Output (AO), Analog Input (AI), Digital Output (DO), or Digital Input (DI)), point sensor range, point actuator range, point address, and point connection terminal number, the controller address, controller

type, controller location (with room number), and the associated Control System Schematic drawing. Typical schedules for multiple pieces of exactly identical equipment with exactly identical sequences of operation are allowed unless otherwise requested in design or contract criteria. For similar pieces of equipment where a typical schematic is to be submitted, if there is only a slight deviation in the quantity or type of I/Os, indicate on the schedule the points that deviate from the standard and what digital controller(s)/piece(s) of equipment the deviation is applicable to.

1.5.3.6 HVAC Equipment Electrical Ladder Diagrams

Provide HVAC equipment electrical ladder diagrams. Indicate required electrical interlocks, including voltages and currents.

1.5.3.7 Component Wiring Diagrams

Provide a wiring diagram for each type of input device and each type of output device. Diagram shall show how the device is wired and powered; showing typical connections at the Digital Controller and each power supply, as well as at the device itself. Show for all field connected devices, including, but not limited to, control relays, motor starters, electric or electronic actuators, and temperature, pressure, flow, and proof sensors and transmitters.

1.5.3.8 Terminal Strip Diagrams

Provide a diagram of each terminal strip, including Digital Controller terminal strips, terminal strip location, termination numbers and the associated point names.

1.5.3.9 AC Power Table

Provide a table listing each controller and the circuit breaker number, panel box number, and physical location of each controller's source of AC power.

1.5.3.10 Floor Plan Hardware Location Drawings

Provide architectural floor plan drawings indicating the physical location of the Building Network Controller, Digital controllers, [NETWORK repeaters], NETWORK bus wiring paths, outside air temperature sensor, room sensors/thermostats, [duct static/differential pressure sensors], and each building network and digital controller's source of AC power. (i.e. transformer locations). In addition, indicate the electrical panel location and circuit breaker number providing power to the building network and Digital Controllers.

1.5.4 Contractor Field Test Report

Provide a Contractor Field Test Report showing results of the testing in accordance with paragraph 'Contractor's Field Testing'. Documentation shall consist of calibration of sensors, expected/actual response of sensors, actuators, and controllers, trend logs/graphs proving control loop stability and accuracy, as well as proper execution of temperature control programs (sequence of operation), and proper operation of equipment interlocks.

1.5.5 Performance Verification Test Report

At the conclusion of the execution of the Performance Verification Test, a report documenting the results of the testing shall be provided in accordance with paragraph 3.3.5 'Performance Verification Test (PVT)'.

1.5.6 Final Shop Drawings

Provide a complete set of Final Shop Drawings, also known as 'As-built' drawings that incorporate all information, details, or data (such as the Building Network Controller IP address) that may not have been available to be documented on the SD-03 submittals. Also incorporate any changes, modifications, or revisions from the SD-03 submittals that occurred in the installation of the controls system so that the final shop drawings reflect an accurate as-built condition of the controls system. Permanently affix a complete set of laminated Final Shop drawings in each Building Network Controller cabinet. In addition, for each Digital Controller, permanently affix laminated copies of the Control System Schematic, Control System Component List, Table of I/O Points, Component Wiring Diagrams, & AC power table associated with the controller, in the Digital Controller cabinet.

1.5.7 Operations and Maintenance Manuals

Provide six copies of the Operations and Maintenance Manual for the DDC system in printed and CD format. Provide printed manuals in sturdy 3-ring binders with a title sheet on the outside of each binder indicating the project title, project location, contract number, and the prime, mechanical and controls contractor's names, address', and telephone numbers. Each binder shall include a table of contents and tabbed dividers, with all material neatly organized. The manual contents shall be specifically applicable to the project, written to reflect actual project conditions, and shall provide a complete and concise depiction of the installed work. Provide information in detail to clearly explain all user operation requirements at each level of the HVAC and control system. The manuals shall include the following parts:

- a. PART 1. DDC and HVAC Systems Operator's Manual
- b. PART 2. DDC Manufacturer's Hardware and Software Manuals
- c. PART 3. VFD Manufacturer's Service Manual

1.5.7.1 PART 1- DDC and HVAC Systems Operator's Manual

This manual is designed to document the design, installation, and operation of the HVAC systems and the associated DDC system. Construct this manual with a minimum of the following 7 sections. Use tabs to divide each section.

- a. Section 1 Description of HVAC Systems: Provide a listing and description of each HVAC system component and their associated Digital Controllers.
- b. Section 2 Mechanical Design Drawings: Provide a set of the project's final mechanical design drawings, which incorporate all changes, modifications, or revisions that occurred in the installation of the HVAC systems, such that the drawings reflect an accurate 'As-built' condition of the HVAC systems.

- c. Section 3 Controls Drawings: Provide a set of final shop drawings that incorporate all changes, modifications or revisions that occurred during the installation of the controls system. The final shop drawings shall reflect an accurate 'As-built' condition of the controls system as specified in Paragraph "SD-06 Final Shop Drawings".
- d. Section 4 Performance Verification Test Report: Provide a copy of the approved Performance Verification Test Report.
- e. Section 5 Test, Adjust, and Balance Report: Provide a copy of the approved Test, Adjust, and Balance Report.
- f. Section 6 Control Equipment Cut Sheets: Provide cut sheets of all controller hardware and accessories. Include temperature versus resistance charts for temperature sensors, and calibration charts for pressure transducers.
- g. Section 7 Backup of Control Program: Provide a soft copy of the control programs on CD ROM.

1.5.7.2 PART 2-DDC Manufacturer's Hardware and Software Manuals

Provide the following manuals. Use tabs to divide each section.

- a. Section 1 Installation and Technical Manuals for all Digital Controller and Field Equipment Controller hardware.
- b. Section 2 Operators Manuals for all Digital Controllers
- c. Section 3 Operators Manuals for Building Network Controller
- d. Section 4 Programming Manuals for all Digital Controllers
- e. Section 5 Programming Manuals for Building Network Controller
- f. Section 6 Installation and Technical Manuals for the Operator Workstation.
- g. Section 7 Programming Manuals for the Operator Workstation software.

1.5.7.3 PART 3-VFD Manufacturer's Service Manual

Provide a complete set of the VFD manufacturer's Operators Manuals that specifically cite the data and control words formats. Also included shall be any VFD communication interfaces to the DDC.

1.5.8 Training Documentation

Submit schedule, syllabus, and training materials in accordance with the paragraph 'Training'.

1.5.9 Project Closeout Documentation

Provide administrative and closeout submittals:

- a. Training course documentation

- b. Service organization
- c. Contractor certification

1.5.9.1 Training Course Documentation

Training course documentation shall include a manual for each trainee plus two additional copies and two copies of audiovisual training aids, if used. Documentation shall include an agenda, defined objectives for each lesson and detailed description of the subject matter of each lesson.

1.5.9.2 Service Organization

Qualified service organization list, within 50 miles of the jobsite, that shall include the names and telephone numbers of organizations qualified to service the HVAC control systems.

1.5.9.3 Contractor Certification

Provide certification that the installation of the control system is complete and the technical requirements of this section have been met.

1.6 QUALITY ASSURANCE

1.6.1 Standard Products

- a. Provide material and equipment that are standard products of manufacturers regularly engaged in the manufacturing of such product, using similar materials, design and workmanship. The standard products shall have been in commercial or industrial use for 2 years prior to bid opening, unless otherwise approved by the City. The 2-year use shall include applications of similarly sized equipment and materials used under similar circumstances. The 2-year experience must be satisfactorily completed by a product which has been sold on the commercial market through advertisements, manufacturers' catalogs, or brochures.
- b. Provide materials and equipment that are manufacturer's products currently in production, and supported by a local service organization.

1.6.2 Storage

Stored products shall be protected from the weather, humidity and temperature variations, dirt and dust, and other contaminants, within the storage condition limits published by the equipment manufacturer.

1.6.3 Verification of Dimensions

The contractor shall become familiar with all details of the work, shall verify all dimensions in the field, and shall advise the Contracting Officer of any discrepancy before performing the work.

1.6.4 Drawings

Because of the small scale of the drawings, it is not possible to indicate all offsets, fittings, and accessories that may be required. The Contractor shall carefully investigate the mechanical,

electrical, and finish conditions that could affect the work to be performed, and shall furnish all work necessary to meet such conditions.

1.6.5 Contractor's Qualifications

- a. The Contractor or subcontractor that will perform the work, with whom the Contractor has a firm contractual agreement, shall have completed at least three DDC systems installations of the same type and design specified, that have successfully operated the required sequence of operation for at least one year.
- b. The programmer responsible for programming the Digital Controllers shall have a minimum of 2 years experience programming Digital Controllers, of the same manufacturer, for HVAC systems.

1.6.6 Support

Certified local technical support shall exist within 50 miles of the site.

PART 2 PRODUCTS

2.1 DDC SYSTEM

In addition to the scope of work shown on the drawings, the scope of work shall include the following:

- a. Provide a DDC system as a distributed control system that is totally integrated with the existing DDC system. Provide and install an appropriate quantity and type of Building Network Controller(s) to supervise the associated Digital Controllers. Provide a LAN connection between the new Building Network Controller(s) and the Ethernet switch (located in the building telecom room) and establish communication with all operator workstations and laptop interfaces including internet connections.
- b. Provide the quantity and type of Digital Controllers and Field Equipment Control Devices indicated on the mechanical design drawings, that will perform the required climate control, energy management, and alarm functions. The quantity of controllers shall be no less than the number shown on design drawings. The DDC system shall consist of Digital Controllers and Field Equipment Control Devices communicating via communications networks that allows the sharing of common data amongst the Digital Controllers and Field Equipment Control Devices, as well as communication with the Building Network Controller(s) and Operator Workstation.
- c. Provide an operator programmable system with all of the necessary programming to perform closed-loop, modulating control that will execute the sequences of operations indicated on the mechanical design drawings, for all of the building's HVAC equipment. Provide a database/interface in both a text based format and graphic display format for viewing the operation of the DDC system. The database shall be created using the latest revision of software available at the time construction begins.
- d. Provide a Portable Workstation Laptop Computer for connecting to the Building Network Controller. The Portable Workstation Laptop Computer shall be provided

with both a text based and graphic display interface of the DDC system. The Portable Workstation Laptop Computer shall be able to create and collect trends; monitor alarms; and allow overrides, set point and parameter changes. In addition, the Portable Workstation Laptop Computer shall be able to create graphics; and download, u. All software provided shall also be compatible with the existing DDC systems and software upload, and modify the programs in the Building Network Controller and Digital Controllers.

2.1.1 DIGITAL CONTROLLERS

2.1.1.1 Factory Installed and Integrated Unit Controllers shall contain:

1. Four button detailed English scrolling marquee display.
2. CCN (Carrier Comfort Network) capable.
3. Unit control with standard suction pressure transducers and condensing temperature thermistors.
4. Shall provide a 5_F temperature difference between cooling and heating set points to meet ASHRAE 90.1 Energy Standard.
5. Shall provide and display a current alarm list and an alarm history list.
6. Service run test capability.
7. Shall accept input from a CO2 sensor (both indoor and outdoor).
8. Configurable alarm light shall be provided which activates when certain types of alarms occur.
9. Compressor minimum run time (3 minutes) and minimum off time (5 minutes) are provided.
10. Service diagnostic mode.
11. Economizer control.
12. Control multi capacity stages
13. Unit shall be complete with self-contained low voltage control circuit.
14. Unit shall have 0_F low ambient cooling operation.

2.1.2 Distributed Control

Apply Digital Controllers in a distributed control manner. Provide repeaters on the communication link per manufactures instructions.

2.1.3 I/O Point Limitation

Total number of I/O hardware points connected to a single stand-alone Digital Controller shall not exceed 64. I/O expansion units are not permitted unless all the required type of I/Os are exhausted on the digital controller. Place I/O expansion units in the same Controller Cabinet as the Digital Controller it is associated with. Multiplexing of I/O is not permitted.

2.1.4 Environmental Operating Limits

Provide Digital Controllers that operate in environmental conditions between 32 and 120 degrees F. Controllers shall be suitable for, and placed in protective enclosures suitable for the environment (temperature, humidity, dust, and vibration) where they are located.

2.1.5 Stand-Alone Control

Provide stand-alone Digital Controllers. All I/O points specified in the mechanical design drawings for a single piece of equipment or system (such as a chiller plant or boiler plant) shall be integral to one controller and its associated I/O expansion units. Control of a single piece of equipment or system shall not be split between two controllers. Failure of any single controller shall not cause a failure with any other controllers.

2.1.6 Internal Clock

Provide an internal clock for the Building Network Controller, accurate within 2 seconds per day. The Building Network Controller shall have its clock backed up by a battery or capacitor with sufficient capacity to maintain clock operation for a minimum of 72 hours during a line power outage. When connectivity of the Building Network Controller has been established, automatic synchronization of the clock will be made from an operator-designated point of reference. The system shall automatically adjust for daylight savings time.

2.1.7 Memory

- a. Provide sufficient memory for each Digital Controller and Building Network Controller to support required control, communication, trend, alarm, and messaging functions.
- b. Memory Protection: Programs residing in memory shall be protected either by using EEPROM or by an uninterruptible power source (battery or uninterruptible power supply (UPS)). The backup power source shall have sufficient capacity to maintain volatile memory in event of an AC power failure. Where the uninterruptible power source is rechargeable (a rechargeable battery), provide sufficient capacity for a minimum of seventy-two hours back up. Trend and alarm history collected during normal operation shall not be lost during power outages less than 72 hours long. The rechargeable power source shall be constantly charged by charging circuitry while the controller is operating under normal line power. If a non-rechargeable power source is used, the non-rechargeable power source shall be capable of providing a backup power supply for not less than a two years period. Batteries shall be designed to allow replacement without soldering.

2.1.8 Immunity to Power Fluctuations and Noise

Controllers shall operate at 90% to 110% nominal voltage rating. Protect against electrical noise of 5 to 120Hz and from keyed radios up to 5 watts at 3 ft.

2.1.9 Wiring Terminations

Use screw terminal wiring terminations for all controllers. Provision of field removable modular terminal strips is required for all controllers, except controllers integral to terminal units (like VAV controllers with an integral damper actuator) or Network Communication Capable Thermostats, unless specified otherwise.

2.1.10 Input and Output Interface

Shorting an input or output point to itself, to another point, or to ground shall cause no controller damage. Input or output point contact with sources up to 24 volts AC or DC for any duration shall cause no controller damage. Provide hard-wired input and output interface for all controllers as follows:

2.1.10.1 Inputs

Provide input function integral to the direct digital controller. Provide input type as required by the DDC design.

- a. Analog Inputs: Allowable input types are 4 to 20 mA signals, or 0-10 VDC signals. Direct RTD inputs must have appropriate conversion curves stored in controller software or firmware. Analog to digital (A/D) conversion shall be a minimum of 10-bit resolution.
- b. Space Temperature Sensors shall be 5,000 or 10,000 ohm thermistor with wall plate adapter and blank cover assembly. The sensor shall include an integral occupancy override button. Space Temperature Sensors shall include space temperature adjustment slides where shown on the plans. The Space Temperature Sensors shall be mounted approximately 48" above the floor.
- c. Digital Inputs: Digital inputs shall sense open/close, on/off, or other two state indications.
- d. Pulse Accumulation Inputs: Pulse accumulation inputs shall conform to the binary input requirements and accumulate a minimum of 2 pulses per second for Application Specific Controllers, and up to 10 pulses per second for Universal Programmable Controllers.

2.1.10.2 Outputs

Provide output function integral to the direct digital controller. Provide output type as required by the DDC design.

- a. Analog Outputs: Provide controllers with a minimum output resolution of 8 bits. Analog Outputs shall send modulating 0-10 VDC or 4 to 20 MA signals to control output devices. Feedback shall be integral to the output function.

- b. Digital Outputs: Binary outputs shall send a pulsed low-voltage signal for pulse-width-modulation control, or provide a maintained open-closed position for on-off control. Provide contact closure with contacts rated at a minimum of 1 ampere at 24 volts. For HVAC equipment, provide for manual overrides, either with three-position (hand-off-auto) override switches and status lights, or with an adjacent operator display and interface.
- c. Tri-State Outputs: Tri-State outputs (floating point control outputs) are strictly prohibited.

2.1.11 PID Control

Provide controllers with proportional, proportional plus integral, and proportional plus integral plus derivative control capability. Application Specific Controllers and Network Communication Capable Thermostat controllers are not required to have the derivative component.

2.1.12 Communications Ports

- a. Controller-to-Controller Communications Ports: Digital Controllers shall be equipped with a communication port that allows the controllers to be connected in a daisy chained to form a Building Level Network. Building Network Controllers shall have a communication port for connectivity to the Building Level Network. The Building Level Network shall permit sharing of common data amongst the Digital Controllers. Minimum baud rate for the Building Level Network shall be 9600 Baud per second. Communication ports shall be provided including required hardware and software for all Controllers installed on the following pieces of equipment:

Single Zone Air Handling Units

The controls contractor shall provide, install and establish communications between the communication ports of all Digital Controllers, Field Equipment Control Devices, and the Building Network Controller

- b. Digital Controller On-Site Interface Ports: Provide a communications port for each Digital Controller that allows direct connection of a computer or hand held terminal through which the controller may be fully interrogated. Controller access may also be by Internet.
- c. Building level controllers shall use Transmission Control Protocol/Internet Protocol (TCP/IP) and Hypertext Transfer Protocol (HTTP) to communicate with Building Network Controllers via the various communication links. Provide a communications port on the Building Network Controller, that when connected to the Ethernet switch will provide communications, or when connected to a Portable Workstation Laptop Computer will allow every controller in the direct digital control system to be fully interrogated and programmed. When the Building Network Controller is connected the following operations shall be available: creation, modification, downloading and uploading control programs; creation and modification of graphics and program data base; and creating and collecting of trend reports, status reports, messages, and alarms.

- d. Whenever available as an OEM standard option, provide Field Equipment Control Devices with a communication port that allows the controllers to be connected to the Building Level Network in a daisy chained manner. Typical Field Equipment Control Devices equipped with communication ports include, but are not limited to, boilers, chillers, lighting control panels, and variable frequency motor drives.

2.1.13 Controller Cabinets

Controls shall be factory installed and integrated into the associated HVAC Units.

2.1.13.1 Main Power Switch

Provide every power transformer or DC Power Supply with a fused main power switch or circuit breaker for isolation from AC power.. The switch shall be protected from tampering by being located within the Controller Cabinet.

2.1.14 Wire & Conduit Routing

Contractor shall utilize the existing conduit system to the maximum extent feasible.

Contractor shall route new thermostat wiring using the present routing for the pneumatic tubing. This will minimize exposure to Asbestos which is present.

Contractor shall route new CCN, CAT-5 Ethernet, and Power cabling as required to power the Extended DDC system

2.2 DDC SOFTWARE

Software resides in the Digital Controllers and performs control sequences.

Provide a complete, clear, and concise written sequence of operation for the HVAC equipment. Include all conventional control operations, time event operations, energy management functions (night setback, reset schedules, optimum start, enthalpy economizer control); demand limiting, safeties, and emergency conditions. Put the sequence of operation on the design drawings, not in the specifications.

2.2.1 Programming

Provide Factory engineered programs and software configuration to execute the sequence of operation indicated in the DDC design. Provide all programming and tools to configure and program all controllers. Provide programming routines in simple, easy-to-follow logic with detailed text comments describing what the logic does and how it corresponds to the project's written sequence of operation.

- a. Graphic-based programming shall use a library of function blocks made from pre-programmed code objects designed for direct digital control. Function blocks or objects shall be assembled with interconnecting lines, depicting the control sequence in a flowchart. Graphic programs shall be viewable in real time showing present values and logical results from each function block or objects. Graphical HAND-AUTO-OFF icons shall be provided to control all active equipment.

- b. Menu-based programming shall be done by entering parameters, definitions, conditions, requirements, and constraints.
- d. For line-by-line and text-based programming, declare variable types (local, global, real, integer, etc.) at the beginning of the program. Use descriptive comments frequently to describe the programming.
- e. Provide a means for detecting program errors and testing software strategies with a program compiler and/or digital simulation tool prior to downloading programming into the Digital Controllers.

2.2.1.1 Optimum Start/Stop Program

This program shall start and stop equipment as specified for the scheduled start-stop program, but shall include a sliding schedule based on indoor and outdoor air conditions. The program shall take into account the thermal characteristics of the structure, and indoor and outdoor air conditions, using prediction software to determine the minimum time of HVAC system operation needed to satisfy space environmental requirements at the start of the occupied cycle, and determine the earliest time for stopping equipment at the day's end without exceeding space environmental requirements.

- a. Program Inputs
 - (1) Day of week/holiday.
 - (2) Time of day.
 - (3) Cooling or heating mode of operation.
 - (4) Equipment status.
 - (5) Cooling and heating building occupancy schedules.
 - (6) Space temperature(s).
 - (7) Building heating constant (operator adjustable and automatically optimized).
 - (8) Building cooling constant (operator adjustable and automatically optimized).
 - (9) OA temperature.
 - (10) Required space temperature at occupancy (heating).
 - (11) Required space temperature at occupancy (cooling).
 - (12) Equipment constraints.
 - (13) Cooling and heating high-low alarm limits.

b. Program Outputs:

(1) Start/stop signal.

2.2.1.2 Electrical Power Demand Limiting

The EMS shall be able to receive commands from the existing City SEMMS system via BACnet/IP. The EMS shall monitor and limit the electrical demand at individual installations using a demand minimization program and a time of day demand limiting program. The demand minimization program shall be activated manually by an operator who will be advised when a utility wide peak is expected, as well as the duration of the peak period. The time of day demand limiting program shall be active at all times in accordance with the re-established seasonal schedules and peak demand limits. The time of day demand limiting program shall use installation electric utility meters and predict an electrical peak demand. When the predicted demand exceeds a preset value, the demand limiting programs shall change equipment operating set points and shed loads on a pre-scheduled step basis to reduce the connected load before the actual electrical demand peak exceeds the target peak demand value.

2.2.1.3 Economizer Program

The software shall reduce the HVAC system cooling requirements when weather conditions allow the use of outside air for cooling. Ambient air conditions shall be monitored by the DDC through the outside air temperature (OA-T) sensor and the outside enthalpy (OA-E) sensor. The economizer program shall be inhibited if the enthalpy of the outside air exceeds an operator selectable value or the enthalpy of the return air. When outside air conditions are favorable for economizer operation, based on a comparison of the enthalpy of the outside air to the enthalpy of the return air], the Digital Controller shall enable economizer operation. When the economizer operation is enabled, the OA, return air, and exhaust air dampers shall be positioned to maintain the required temperature. When economizer operation is disabled; the OA dampers, return air dampers, and relief air dampers shall be positioned to provide minimum required OA.

a. Program Input

- (1) Changeover conditions.
- (2) OA dry bulb temperature.
- (3) Return/Space dry bulb temperature.
- (4) Maximum allowable OA air dry bulb temperature.
- (5) OA enthalpy and RA enthalpy
- (6) OA Damper position feedback

b. Program Output: Damper actuator/cooling control signal.

2.2.1.4 Ventilation-Recirculation Program

The software shall reduce the HVAC system thermal load for two modes of operation as follows:

a. Ventilation mode:

In this mode, the system shall pre-cool the space prior to building occupancy. When the outside air temperature is lower than the space temperature, the outside air damper and exhaust air damper shall open to their maximum positions and the return air damper shall close to its minimum position.

b. Recirculation mode:

In this mode, the system shall preheat the space prior to building occupancy. When the outside air temperature is lower than the space temperature, the outside air damper and the exhaust air damper shall close to their minimum positions and, the return air damper shall open to its maximum position.

The outside air damper and the exhaust air damper shall be closed at all other times during unoccupied periods, except for economizer operation during day/night setback periods. For systems without mechanical cooling, this program shall, in addition to the above requirements, act as an economizer. The EMS shall modulate the outside, return, and exhaust air dampers to maintain the required mixed air temperature setpoint. When this program is released, the outside and exhaust air dampers shall return to their minimum positions, and the return air damper shall return to its maximum position.

c. Program Inputs

- (1) Day of week.
- (2) Time of day.
- (3) Cooling or heating mode of operation.
- (4) Equipment status.
- (5) Cooling and heating occupancy schedules.
- (6) OA dry bulb temperature.
- (7) Space temperature.
- (8) Equipment constraints.

d. Program Output: Damper actuator control signal.

2.2.1.11 Timed Local Override for Temporary Occupancy Program

Thermostats and wall mounted temperature sensors shall have a means for a temporary manual override of the program schedule, with automatic program restoration after the scheduled interval. Interval shall be adjustable, at an initial interval of one hour. Provide programming for a timed local override of the program schedule of each HVAC system via its system designated temporary occupancy pushbutton (either a standalone pushbutton that is labeled as to its function or a pushbutton integral to a thermostat or wall mounted temperature sensor), with automatic program restoration after a user defined time interval. Timed local overrides

are to be disabled during occupancy periods. For systems such variable air volume systems, the timed local override shall not only enable the VAV box for the zone in which the button was pushed, but shall also enable all other associated pieces of equipment (the air handler, chiller, boiler, etc.) allowing the zone to be conditioned to the normal occupied set points.

2.2.2 Database Modification

All setpoints, software points, writeable object properties, and all other programming parameters needed to comply with the project specification shall be adjustable regardless of programming methods used to create the applications. Database modification shall be accomplished through a network connected OWS, local OWS, Portable workstation laptop computer, hand held terminal, or through a keypad integral to the controller. When the control program is of the line-by-line type, or block programming language, database parameters shall require assignment of variable names so parameters can be changed without modifying the programming. The following shall be modifiable in this way:

- a. Setpoints
- b. Dead band limits and spans
- c. Reset schedules
- d. Switchover points
- e. PID gains and time between control output changes
- f. Time
- g. Timed local override time
- h. Occupancy schedules
- i. Holidays
- j. Alarm points, alarm limits, and alarm messages
- k. Point definition database
- l. Point enable, disable, and override
- m. Trend points, trend intervals, trend reports
- n. Analog input default values
- o. Passwords
- p. Communications parameters including network and telephone communications setups

2.2.3 Short Cycling Prevention

Where equipment is started and stopped or opened and closed in response to some analog input such as temperature, or pressure, include a differential or an appropriate minimum off time delay for the control loop to prevent short cycling of equipment.

2.2.4 Motor and Flow Status Delay

Provide an adjustable delay between when a motor is commanded on or off and when the control program looks to the motor or flow status input for confirmation of successful execution of the command.

2.2.5 Runtime Accumulation

Provide resettable run time accumulation for each Binary Output connected to mechanical loads greater than 1HP, electrical loads greater than 10KW, or wherever else specified.

2.2.6 Time Programs

Provide programming to automatically adjust for leap years, allow operator time adjustments, and make daylight savings time and standard time adjustments.

2.2.7 Scheduling

- a. Each control output point shall be schedulable and its operation based on time of day, day of week, and day of year. Output points may be associated into groups. Each group may be associated with a different schedule. Changing the schedule of a group shall change the schedule of each point in the group. Points may be added to and deleted from groups. Groups may be created and deleted by the operator.
- b. Provide capability that will allow current schedules to be viewed and modified in a seven-day week format. When control program does not automatically compute holidays, provide capability to allow holiday schedules to be entered one full year at a time.

2.2.8 Point Override

I/O and virtual points shall be able to accept overrides in the software and be commanded to any valid value from a hand held terminal, through a keypad integral to a Digital Controller, any OWS, or a Portable Workstation Laptop Computer connected to the Building Network Controller or direct connected to a Digital Controller. When documented, exceptions to these requirements are allowed for life, machine, and process safeties.

2.2.9 Alarming

I/O points and virtual points shall be alarmable. Alarms may be enabled and disabled for every point. Alarm limits shall be adjustable on analog points. Building Network Controllers connected to the network shall download alarms and alarm messages to the data servers when an alarm occurs. Otherwise alarms will be stored at the Building Network Controller until connected to a Portable Workstation Laptop Computer and retrieved. When a Building Network Controller is not connected to the network, and the memory on the Building Network Controller becomes full, the most recent data shall overwrite the oldest data. Provide alarming

in accordance with the point schedule, sequence of operation, and any other notation in the design drawings. At a minimum the following conditions shall generate alarms including alarms defined in prior section of this document:

- a. Motor is commanded on or off but the motor status input indicates no change
- b. Room temperature or pressure strays outside selectable limits
- c. An analog input takes a value indicating sensor failure
- d. A module is "dead" to the LAN
- e. A power outage occurs
- f. Damper is commanded open or closed but the limit switch status or positional status has not changed
- g. Hand-Off-Auto switch has been placed in the Hand or Off position
- h. Smoke detectors sense smoke condition; fire alarms
- i. Filter differential pressure
- j. Supply fan high limit switch
- k. Tank levels outside limits
- l. Equipment safeties (chiller, boiler, VFD, etc.)
- m. Emergency shutoff switch (Demand Limit Step 3)

2.2.10 Messages

Messages shall be operator defined and assigned to alarm points. Messages shall be sent via email or text message.

2.2.11 Trending

DDC system shall have the capability to trend I/O and virtual points. Points may be associated into groups. A trend report may be set up for each group. The period between logging consecutive trend values shall range from one minute to 60 minutes at a minimum. Trend data type shall be selectable as either averages over the logging period or instantaneous values at the time of logging. The minimum number of consecutive trend values stored at one time shall be 100 per variable. When trend memory is full, the most recent data shall overwrite the oldest data. Trend data shall be capable of being uploaded to computer. Trend data shall be available on a real time basis; trend data shall appear either numerically or graphically on a connected computer's screen as the data is being processed from the DDC system data environment. Trend reports shall be capable of being uploaded to computer disc and archived.

2.2.12 Status Display

Current status of I/O and virtual points shall be displayed on command. Points shall be associated into functional groups, such as all the I/O and virtual points associated with control of a single air handling unit, and displayed as a group, so the status of a single mechanical system can be readily checked. A group shall be selectable from a menu of groups having meaningful names; such as AHU-4, Second Floor, Chiller System, and other such names.

2.2.13 Diagnostics

Each controller shall perform self-diagnostic routines and provide messages to an operator when errors are detected. DDC system shall be capable of recognizing a non-responsive module on a LAN. The remaining, responsive modules on a LAN shall not operate in a degraded mode.

2.2.14 Power Loss

In event of a power outage, each controller shall assume a disabled status and outputs shall go to a user definable state. Upon restoration of power, DDC system shall perform an orderly restart, with sequencing of outputs, and restoration of control.

2.2.15 Program Transfer

Every Digital Controller in the DDC system shall be capable of being downloaded and uploaded to through the Building Network Controller.

2.2.16 Password Protection

Provide at least three levels of password protection to the DDC system permitting different levels of access to the system.

2.3 WORKSTATION

2.3.1 Workstation Software

Workstation software shall be recommended and supported by the DDC system manufacturer and configured to operate according to the DDC system manufacturer's specifications. Workstation software shall be resident in the workstation computer. Workstation software shall permit monitoring, modification, and troubleshooting of the DDC system. Workstation software shall permit modification of the controller database and control programs for any Building Network Controller or Digital Controller on the network. Operations shall be menu selected. Menu selections shall be made with a mouse.

- a. Menu System: Menu system shall allow an operator to select a particular function or access a particular screen through successive menu penetration.
- b. Controller Data Base Modification: The workstation software shall be an interface for performing capabilities specified in paragraph entitled "DDC Software" and available through direct connection of a computer to a digital controller. Database modification shall require only that an operator "fill in the blank" for that parameter on a screen

requesting the information in plain language. Database modifications shall be automatically downloaded to the appropriate controllers at operator request.

- c. Program modification: For systems using a line-by-line programming language, provide an off-line text editor, similar to a BASIC program editor, permitting modification of controller resident control programs, For systems using block or object programming languages provide a capability for linking blocks/objects together to create new programs or modify existing programs. Program modifications shall be automatically downloaded to the appropriate controllers at operator request.

2.4 GRAPHIC DISPLAY (GRAPHICS) SOFTWARE

Provide web-based Graphic Displays (Graphics) viewable on browsers compatible with MS Internet Explorer 8.X or greater using an industry-standard file format such as HTML, BMP, JPEG, or GIF.

The intent of graphics software is to provide an ergonomic interface to the DDC system that encourages effective and efficient interaction with the system. Graphics software shall provide graphical representation of the building, the buildings mechanical systems, and the DDC system. The current value and point name of every I/O point (physical and virtual) shall be shown on at least one graphic and in its appropriate physical location relative to building and mechanical systems.

Provide graphics that closely follow the style of the control drawings in representing mechanical systems, sensors, controlled devices, and point names

- a. Graphic Title: Provide graphics with an identifying title visible when the graphic is being viewed and include building number with either location description for floor plans or system description.
- b. Dynamic Update: When the workstation is on-line with the control system, point data shall update dynamically on the graphic images.
- c. Graphic Penetration: Provide graphic penetration when the capability exists. For systems without graphic penetration, provide menu penetration for selection of individual graphics to give the same hierarchical affect provided by graphic penetration.
- d. Graphic Types: Graphic-based software shall have graphics of the building exterior, building section, floor plans, and mechanical systems. Provide the following graphics.
 - (1) Base Graphic: Show building on digital photograph of base with active pushpin link
 - (2) Building Summary Graphic: Show stacked floors for multi-level or multi-sectioned floor plans with appropriate section and floor name for each area.
 - (3) Roof/Floor Plan Graphics: Provide roof graphic and a single graphic for each floor, unless the graphic will contain more information than can reasonably be shown on a single graphic. Each heating or cooling zone within a floor plan shall have a zone name and/or room number and its current temperature displayed

within the zone outline. Show each controlled variable in the zone. Show locations of thermostats and physical equipment and location of Building Network Controller. Graphics shall display active key plan and north directional arrows. Provide visual indication for each point that is in alarm.

(4) Mechanical System Graphics: Provide three-dimensional drawings to symbolize mechanical equipment; do not use line drawings. Show controlled or sensed mechanical equipment. Each graphic shall consist of a single mechanical system; examples are a graphic for an air handling unit, a graphic for a VAV box, a graphic for a heating water system, and a graphic for a chiller system. Exception would be for an exhaust fan interlocked to an air handling unit where exhaust fan shall be displayed on the air handling unit graphic. Place sensors and controlled devices associated with mechanical equipment in their appropriate locations. Place point name and point value adjacent to sensor or controlled device. Provide visual indication of each point in alarm. Condition, such as zone temperature, associated with the mechanical system shall be shown on the graphic. Point values shall update dynamically on the graphic. Link buttons shall be provided to access associated system graphics such as applicable legends. Access to the sequence of operation text shall be via Adobe Acrobat .pdf file format.

(5) Miscellaneous Summary Graphics: Provide summary tables as overview of equipment statuses or systems' critical temperatures or to simplify representation of data for common system types. Examples are multi-zone dampers.

e. Graphic Editing: The full capabilities as afforded by the graphics software package shall be included for operator editing of graphics. Graphics may be created, deleted, and modified, and text added. Provide capability to store graphic symbols in a symbol directory and incorporate these symbols into graphics. A minimum of sixteen colors shall be available though for human engineering purposes the amount of colors shall be limited to 5 colors per screen.

f. Dynamic Point Editing: Provide full editing capability for deleting, adding, and modifying dynamic points on graphics.

g. Trending: Trend data shall be displayed graphically, with control variable and process variable plotted as functions of time on the same chart. Graphic display of trend data shall be a capability internal to the workstation software and not a capability resulting from download of trend data into a third-party spreadsheet program such as Excel, unless such transfer is automatic and transparent to the operator, and the third-party software is included with the workstation software package. At the operator's discretion trend data shall be plotted real time.

2.5 SENSORS AND INPUT HARDWARE

2.5.1 Resistance Temperature Detectors (RTDs)

Field Installed sensors shall be provided by unit manufacturer to assure compatibility with factory installed controls.

- a. Wiring:
 - (1) Provide 20 gage twisted and shielded pair cable for direct connected RTDs.
 - (2) Provide 20 gage twisted and shielded pair cable for RTDs using 4 to 20 milliampere transmitters.
- b. Transmitters: Provide 4 to 20 milliampere transmitters for RTDs where:
 - (1) Digital Controllers do not support direct connection of RTDs to controllers; and
 - (2) Digital Controllers do not meet temperature resolution requirement of 0.25 degree F.

2.5.2 Transmitters

Provide transmitters with 4 to 20 mA or 0 to 10 VDC output linearly scaled to the temperature, pressure, or flow range being sensed. Transmitter shall be matched to the sensor, factory calibrated, and sealed. Total error shall not exceed 0.1 percent of 20 milliampere (0.02 milliampere) at any point across the 4 to 20-ma span. Supply voltage shall be 24 volts ac or dc. Transmitters shall have non-interactive offset and span adjustments. For temperature sensing, transmitter stability shall not exceed 0.05 degrees C a year.

2.5.2.1 Spans and Ranges

Transmitter spans or ranges shall be the following and shall be suitable for the application:

- a. Temperature:
 - (1) 50 degrees F span: Room, chilled water, cooling coil discharge air, return air sensors
 - (2) 100 degrees F span: Outside air, hot water, heating coil discharge air, mixed air sensors
 - (3) 200 degrees F span: High temperature hot water, heating hot water, chilled/hot water system sensors.
- b. Pressure:
 - (1) - 0.25 to 0.25 inches water differential range: Room static pressure
 - (2) 0 to 5 inches water differential range: Duct static pressure
 - (3) 0 to 50 PSI differential: Water differential pressure
 - (4) 0 to 2.5 inches water differential range: Filter differential pressure

2.5.2.2 Relative Humidity Transmitters

Provide transmitters with an accuracy equal to plus or minus 3 percent from 0 to 90% scale, and less than one percent drift per year. Sensing elements shall be the polymer type.

2.5.2.3 Pressure Transmitters

Provide integral pressure transducer and transmitter. Output of pressure instrument shall be a 0 – 10 VDC signal proportional to the pressure span. Span shall be as specified. Accuracy shall be 1.0 percent. Linearity shall be 0.1 percent. Supply voltage shall be 24 V dc. Transmitter shall meet specified requirements.

2.5.3 Current Transducers

Provide current transducers to monitor the amperage of each motor or compressor. For chillers with multiple compressors provide a current transducer at the incoming power to the chiller unless otherwise specified. Current Sense Relays shall be used on motors of 3 HP or less.

2.5.4. Timed Local Override for Temporary Occupancy

Provide every HVAC system (unless otherwise noted) with a momentary contact temporary occupancy timers (either a standalone pushbutton that is labeled as to its function or a pushbutton integral to a thermostat or wall mounted temperature sensor) with override time set in controller software. Provide to override DDC time of day program and activate occupancy program for assigned units. Upon expiration of override time, the control system shall return to time-of-day program. Time interval for the length of operation shall be software adjustable and shall expire unless reset.

2.5.8 Occupancy Sensors/Timers

Occupancy Timers shall be provided that are identical to those presently used. New timers shall be installed in existing locations.

2.6 OUTPUT HARDWARE

Show all control dampers on the control drawings. Indicate the blade configuration (parallel or opposed-blade), the actuator normal position, and whether it's two-position or modulating. Provide damper position feedback to indicate the damper status/position.

2.6.1 Dampers

Damper already exist on the HVAC units.

2.6.3 Actuators

Provide electric motor type spring return actuators on all control dampers and all control valves (so that, in the event of power failure, actuators shall fail safe in either the normally open or normally closed position as specified) except terminal VAV units, convectors, and unit heaters; unless indicated otherwise. Provide a minimum of one actuator for each damper.

Show on drawings the normal position of each actuator without power or control signal. Select normal position considering power loss, freezing, moisture damage, and smoke or fire transmission. Indicate power return actuators where necessary for actuator timing and process requirements. Indicate spring return for actuators where normal position, but not timing, is important. Spring return closed is often desirable for steam valves and outside air intake dampers. Whenever possible provide electric actuators for reduced maintenance, quality control, and DDC integration. However, pneumatic actuators may be preferable in unusual circumstances like explosion-proof areas. Existing pneumatic actuators may also have to remain in retrofits where costs prevent actuator replacement.

2.6.3.1 Electric Actuators

Provide direct drive electric actuators for all valve and damper control applications. Where pneumatics exists, replace at central and zone levels and where possible, remove all associated pneumatic piping. Otherwise, remove pneumatic piping as far back as possible (either to the nearest wall that the tubing is running through or against, or no less than 5 feet back from the device that the tubing was connected to) and permanently plug the pneumatic tubing. When operated at rated voltage, each actuator shall be capable of delivering the torque required for continuous uniform movement of the valve or damper and shall have internal end switches to limit travel, or shall withstand continuous stalling without damage. Actuators shall be quiet operating and function properly with range of 85 to 110 percent of line voltage. Provide gears of steel or copper alloy. Fiber or reinforced nylon gears may be used for torques less than 16 inch pounds. Provide hardened steel running shafts in sleeve bearing of copper alloy, hardened steel, nylon, or ball bearing. Provide proportioning actuators capable of stopping at all points in the cycle and starting in either direction, from any point. Actuators shall be equipped with a switch for reversing direction, and a button to disengage the clutch to allow manual adjustments. Provide the actuator with a hand crank for manual adjustments, as applicable. Equip valve actuators with a force-limiting device such as spring yield so that, when in a relaxed position, device shall maintain a pressure on valve disc equivalent to system pressure at valve. Provide a power return operation adjustable up to 4 minutes with sufficient reserve power to fully stroke the valve once and hold in the desired FAIL SAFE position. Provide reversible shaded pole, split capacitor, synchronous, or stepper type electric motors. Each actuator shall have distinct markings indicating the full-open and full-closed position, and the points in-between.

2.6.4 Hand-Off-Automatic (HOA) Switches

Hand-Off-Automatic (HOA) switch shall be rated for a minimum of 600 VAC, 5 A. Dual auxiliary contacts shall be provided for the automatic position to provide sensing at the controller. Auxiliary contacts shall be rated at least 120 VAC, 1 A.

2.6.5 Output Switches

2.6.5.1 Control Relays

Field installed and DDC panel relays shall be double pole, double throw (DPDT), UL listed, with contacts rated to the application, indicator light, and enclosed in a dustproof enclosure. The indicator light shall be lit when coil is energized and is off when coil is not energized. Relays shall be socket type, plug into a fixed base, and be replaceable without need of tools or removing wiring.

2.6.5.2 Motor Starter Contactor

IEC form factor Contactors shall be used to control power to motors. These devices shall be DIN rail mount, have multiple poles that depend upon the application such as single phase versus three phase contactor, shall be controlled via the DDC using 24 VAC Coils, shall be rated for the inductive loading such as ½ hp vs. 5 hp motors and shall have suitable terminations for the incoming power and outgoing power wire sizes

2.7 ELECTRICAL POWER AND DISTRIBUTION

Provide a source of 120 volts , 60 Hz, single phase, two wire with ground to step down to 24 VAC which shall be used to power any new DDC equipment that is not able to be powered from existing sources.

Devices shall be UL listed or FM approved. Power output to all new DDC equipment shall be 24 VAC and it shall be provided from the nearest existing power sources to the maximum extent feasible.

2.7.1 Transformers

Transformers shall conform to UL 506. Provide power to the primary side of the transformer from a dedicated circuit breaker. Add a new breaker if required at the nearest electrical panel with available spare capacity. Transformers for Digital Controllers shall be fed from the nearest distribution panel board or motor control center, using circuits provided for the purpose. Provide a fuse cutout on the secondary side of the transformer. Transformers shall be fused or current limiting and rated at 125% power consumption.

2.7.2 Surge Protection

Provide each Building network Controller and Digital Controller with surge and transient power protection. Surge and transient protection shall consist of the following devices, installed externally to the controllers.

2.7.2.1 Power Line Surge Protection

Surge suppressors shall be installed on all incoming AC power. Surge suppressor shall be rated by UL 1449, and have clamping voltage ratings below the following levels:

- a. Normal Mode (Line to Neutral): 350 Volts
- b. Common Mode (Line to Ground): 350 Volts

2.7.2.2 Telephone and Communication Line Surge Protection

Telephone and Communication Lines shall be protected from surges. Metal oxide varistor (MOV) protection, rated for the application, shall be installed at the equipment. Additional protection, gas tubes rated for the application, shall be installed within 3 feet of the building cable entrance or within 3 feet of the telephone company's network interface.

2.7.2.3 Sensor and Control Wiring Surge Protection

Controllers shall have sensor and control wiring surge protection with optical isolation, metal oxide varistors (MOV), or silicon avalanche devices. Fuses are not permitted for surge protection.

2.7.3 Wiring

Provide complete electric wiring for DDC System, including wiring to transformer primaries. Control circuit conductors which run in the same conduit as power circuit conductors shall have the same insulation level as power circuit conductors. Circuits operating at more than 100 Volts shall be in accordance with Section 26 27 26, "Wiring Devices." Circuits operating at 100 Volts or less shall be defined as low voltage and shall be run in rigid or flexible conduit, metallic tubing, metal raceways or wire trays, armored cable, or multi-conductor cable for outdoor usage.

For indoor use provide circuit and wiring protection as required by NFPA 70. Aluminum-sheathed cable or aluminum conduit may be used but shall not be buried in concrete. Protect exposed wiring from abuse and damage.

2.7.3.1 AC Control Wiring

- a. Control wiring for 24 V circuits shall be insulated copper 18 AWG minimum and shall be rated for 300 VAC service.
- b. Wiring for 120 V shall be 14 AWG minimum and shall be rated for 600 V service.

2.7.3.2 Analog Signal Wiring

Analog signal wiring for analog inputs and analog outputs shall be 20 AWG single or multiple twisted pair. Each cable shall be 100 percent shielded, and have 20 AWG drain wire. Exception is direct connect RTD wiring which shall be a single 20 AWG minimum-twisted pair, 100 percent shielded, and with 20 AWG drain wire. Each wire shall have insulation rated to 300 V ac. Cables shall have an overall aluminum-polyester or tinned-copper (cable-shield tape), overall 20 AWG tinned copper cable drain wire, and overall cable insulation rated to 300 V ac. Install analog signal wiring in conduit separate from AC power circuits.

2.7.3.3 Digital Signal Wiring

Digital signal wiring for digital inputs and digital outputs shall be 18 AWG single twisted pair. Each cable shall be 100 percent shielded with 20 AWG drain wire. Each wire shall have insulation rated to 300 V ac. Cables shall have an overall aluminum-polyester or tinned-copper (cable-shield tape), overall 20 AWG tinned copper cable drain wire, and overall cable insulation rated to 300 V ac. Install digital signal wiring in conduit separate from AC power circuits.

2.8 FIRE PROTECTION DEVICES

Provide smoke detectors in return and supply air ducts on downstream side of filters in accordance with NFPA 90A, except as otherwise indicated. Provide UL listed or FM approved detectors for duct installation.

2.8.1 Smoke Detectors

Provide duct smoke detectors in HVAC ducts in accordance with NFPA 72 and NFPA 90A, except as indicated otherwise. Smoke detector interlocks shall be hardwired to the MCC or thru the unit's internal packaged control board for direct shutdown. Each smoke detector shall be monitored and an alarm shall be generated upon detection of smoke. Provide UL listed or FM approved detectors, designed specifically for duct installation. Provide smoke detectors as follows:

- a. Provide duct-mounted supply air smoke detectors for each air-handling system with supply air capacity equal to or greater than 2000 cfm. Locate the detector downstream of the supply air fan, before the first branch connection.
- b. Provide duct-mounted return air smoke detectors for each air-handling system serving more than one story, and where the total return air capacity is equal to or greater than 15,000 cfm. Provide a detector at each story's return duct main, before its connection to the common return air duct. Also provide a detector at the return air inlet connection to the air handler, before any fresh air or recirculation connection.

2.8.2 Smoke Dampers and Combination Smoke/Fire Damper

Smoke damper and actuator assembly as required in accordance with NFPA 90A shall meet the Class II leakage requirements of UL 555S. Dampers shall be factory fabricated from galvanized steel or stainless steel with lubricated bearing, linkage, and seals to withstand temperatures from minus 20 to plus 250 degrees F. Provide seals that can be easily replaced. Combination smoke/fire dampers shall have UL 1.5 hour rating and shall be equipped with electric/thermal link which closes damper at 165 degrees F and then automatically resets after normal temperature is restored by cycling damper operator. Equip dampers with pneumatic or electric operators which close smoke dampers tightly when activated.

2.9 VARIABLE FREQUENCY DRIVES

Existing variable frequency drives (VFDs) as indicated on the system architecture drawing. The existing VFDs shall be modified to accept a RS=485/Modbus communication link. This may require addition of extra communications equipment to the VFDs.

2.9.1 VFD Quality Assurance

2.9.2 VFD Features

Existing VFDs have the following features:

- a. A local operator control keypad capable of:
 - (1) Remote/Local operator selection with password access.
 - (2) Run/Stop and manual speed commands.
 - (3) All programming functions.
 - (4) Scrolling through all display functions.

- b. Digital display capable of indicating:
 - (1) VFD status.
 - (2) Frequency.
 - (3) Motor RPM.
 - (4) Phase current.
 - (5) Fault diagnostics in descriptive text.
 - (6) All programmed parameters.
- c. Standard PI loop controller with input terminal for controlled variable and parameter settings.
- d. User interface terminals for remote control of VFD speed, speed feedback, and an isolated form C SPDT relay, which energizes on a drive fault condition.
- e. An isolated form C SPDT auxiliary relay which energizes on a run command.
- f. A metal NEMA 1 enclosure for indoors, NEMA 4 with heater for outdoors.
- g. An adjustable carrier frequency with 16 KHz minimum upper limit.
- h. A built in or external line reactor with 3% minimum impedance to protect the VFDs DC buss capacitors and rectifier section diode
- i. Communications Port that is compatible with the installed network gateway equipment (RS-485 or MODBUS). This port shall be able to control all VFD internal parameters and shall read all VFD internal data including alarms and status as well as operating parameters.

2.9.3 Programmable Parameters

Existing VFDs include the following operator programmable parameters:

- a. Upper and lower limit frequency.
- b. Acceleration and Deceleration rate.
- c. Variable torque volts per Hertz curve.
- d. Starting voltage level.
- e. Starting frequency level.
- f. Display speed scaling.
- g. Enable/disable auto-restart feature.

- h. Enable/disable soft stall feature.
- i. Motor overload level.
- j. Motor stall level.
- k. Jump frequency and hysteresis band.
- l. PWM carrier frequency.

2.9.4 Protective Features

VFDs already exist.

2.9.5 Minimum Operating Conditions

VFDs already exist.

2.9.6 Additional Features

Provide VFDs with the following additional features:

- a. communication interface port compatible with new digital controller protocol to include RS422/485 or MODBUS interface card with application software allowing monitoring and/or control of the VFD from an attached computer.

PART 3 EXECUTION

3.1 INSTALLATION

Prior to commencement of installation, the Contractor shall schedule meeting with the Owner to finalize controls design submittal for approval and ensure that the System Names and Point Names to be used in the DDC system database are in accordance with the Owner overall requirements. Contractor shall: Perform installation under supervision of competent technicians regularly employed in the installation of DDC systems. Provide components for a complete and operational DDC system.

3.1.1 Building Network Controller

Communication interfaces shall be provided for the Building Network Controller, to allow connectivity to via the closest local Switch. The Building Network Controller shall be located within 300 feet of the Ethernet switch. The Contractor shall provide, install, and establish communications between the Building Network Controller and the Internet servers, including the provision of Ethernet Standard Category 5 cables between the Building Network Controller and the designated termination at the Ethernet Switch. Successful communication of the DDC system with the Internet based system shall be demonstrated.

3.1.2 Digital Controllers

- a. Do not divide control of a single mechanical system such as an air handling unit, boiler, chiller, or terminal equipment between two or more controllers. A single controller shall

manage control functions for a single mechanical system. It is permissible, however, to manage more than one mechanical system with a single controller.

- b. No multiplexing of points is allowed.
- c. Universal Programmable Controllers shall be specified for all boiler and chiller controllers regardless of the required point capacity.
- d. Controllers shall have I/O function as spare capacity to the maximum extend feasible. The panel I/O functions shall be furnished complete, with no changes or additions necessary to support implementation of spare functions. Output relays associated with digital signals shall be considered part of the I/O function, whether physically mounted in the enclosure or separately mounted. Implementation of spare points shall necessitate only providing the additional field sensor or control, field wiring including connection to the system, and point definition assignment by the operator. The panel shall contain all necessary I/O functions to connect to field sensors and control panels. I/O function operation shall be fully supervised to detect I/O function failures.

3.1.3 Nameplates and Wire Tags

- a. All HVAC equipment, controller cabinets (including Field Equipment Controller cabinets), sensors, control devices, relays, etc. are to be labeled with a minimum of 3” wide by 1” high WHITE laminated plastic nameplates with BLACK lettering and a minimum of 1/4” high engraved, capitalized block lettering, backed with double-sided adhesive. Laminated plastic shall be 1/8” thick with black center core.
- b. Each nameplate shall identify the system and object name as applicable. HVAC equipment, controller cabinets, and Field Equipment Controller cabinets, shall be labeled using the system name of the HVAC system it is associated with. All physical I/O equipment devices (sensors, control devices, relays etc.) shall be labeled using the object name of the I/O it is associated with All physical I/O equipment devices (sensors, control devices, relays, etc.) not located within 5 feet of the associated HVAC equipment (such as supply air static pressure sensors, differential pressure sensors, relays, etc) shall be labeled with both the system and object names. Nameplates shall be placed on or near the physical I/O equipment device, and shall be placed in a visible location to aid in locating the device. Plastic nameplates for controllers and devices above the ceiling shall be mounted in a visible location (T-bar, wall adjacent to ceiling, etc.), as such, controllers in enclosures located above drop ceilings will require two nameplates. Prior approval is required for alternative methods of nameplate mounting.
- c. All Control wiring shall be labeled at both terminations utilizing printed labels with the object name of the physical I/O equipment device it is associated with, or the function it provides (24V AC, Network Comm., etc.). All controllers shall be properly labeled with the system name, and controller address, utilizing printed labels. The flip down cover on Universal programmable controllers shall be labeled with a printed list of the I/Os associated with the controller. All thermostats and space temperature sensors shall be labeled with both the system and object names, and if applicable, the system name of the primary system by which it is served (such as thermostats associated with VAV boxes where multiple air handlers serve the building). Handwritten labels are strictly prohibited.

3.1.4 Wiring Criteria

The Contractor shall install control wiring as required to meet the project specifications, the National Electrical Code, the National Electrical Safety Code, and all state and local codes. Unless specifically noted otherwise on the plans, the Owner requires the least expensive wiring installation that meets these specifications and codes within the following guidelines:

- a. In mechanical rooms and un-finished interior rooms, the wiring shall be run in EMT in exposed areas, unless noted otherwise.
- b. Under slab, in dirt or direct buried underground, schedule 40 PVC shall be used.
- c. Where subject to foot traffic or when cabling is run along roof surface, rigid conduit with threaded fittings shall be used.
- d. Whenever low voltage control cable is utilized without conduit, the low voltage control cable shall be plenum rated. Plenum rated cable shall be hung with bridle rings as required to prevent drooping. Laying of plenum rated cable on ceiling tiles for support shall be prohibited. Squeeze type connectors shall be utilized where plenum rated cable enters equipment enclosures. Use of plenum rated cable in areas where induction is anticipated such as near lighting ballasts, is not acceptable. In areas where induction producing devices are located, control wiring shall be run in conduit.
- e. Whenever EMT conduit is attached to a vibrating surface indoors, a short run of flexible conduit shall be utilized.
- f. Whenever EMT or rigid conduit is attached to a vibrating surface outdoors, a short run of flexible seal tight conduit shall be utilized.
- g. Compression type fittings shall be utilized with EMT. The use of setscrews shall not be permitted.
- h. Weather proof compression type fittings shall be utilized with EMT subject to damp or wet locations. The use of setscrews shall not be permitted.
- i. Power wiring (120 Volt, 60 Hz or 480 Volt) inside of the buildings shall be run in EMT.
- j. Power wiring (120 Volt, 60 Hz or 480 Volt) exposed outdoors shall be run in rigid conduit.
- k. Rigid or flexible conduit shall be terminated at all sensors and output devices.
- l. Fill ratio of conduit shall not exceed 40%.
- m. Plenum rated cable shall be suspended and properly secured and shall not have contact with ceiling tiles.
- n. Not used.

- o. Grounding: Ground controllers and cabinets to earth ground. Ground controller to a ground in accordance with Section 26 05 26, "Grounding and Bonding for Electrical Systems." Grounding of the green ac ground wire, at the breaker panel, alone is not adequate. Run metal conduit from controller panels to adequate building grounds. Ground sensor drain wire shields at controller end.
- p. Contractor is responsible for correcting all associated ground loop problems.

Note: Use existing communication wiring in inaccessible areas only. All control wiring shall be new including low voltage power. Do not run control wiring, Ethernet cable, or CCN bus wiring in the same conduit with low voltage or high voltage wiring (voltage above 30VAC).

3.1.5 Temperature Sensors

Provide temperature sensors in locations to sense the appropriate condition. Provide sensor where they are easy to access and service without special tools. Calibrate sensors to accuracy specified. In no case will sensors designed for one application be installed for another application.

3.1.5.1 Room Temperature Sensors

Provide on interior walls to sense average room temperature conditions. Avoid locations that may cover the sensor by office furniture or where accurate room conditions may not be registered (near heat generating equipment). Room temperature sensors should not be mounted on exterior walls when other locations are available. Mount centerline of sensor at 5 feet above finished floor. Cut and patch or provide plate as required. Sensor shall be isolated from drafts due to wall penetrations.

3.1.5.2 Duct Temperature Sensors

- a. Provide sensors in ductwork in general locations as indicated. Select specific sensor location within duct to accurately sense appropriate air temperatures. Do not locate sensors in dead air spaces or positions obstructed by ducts or equipment. Install gaskets between the sensor housing and duct wall. Seal duct and insulation penetrations.
- b. Provide duct-averaging sensors to be used where stratification is likely to occur, typically for larger air ducts or in the mixing section of air handlers equipped with an economizer.
- c. String duct-averaging sensors between two rigid supports in a serpentine position to sense average conditions. Thermally isolate temperature-sensing elements from supports. Provide duct access doors to averaging sensors.
- d. Locate freeze protection sensors in appropriate locations to sense lowest temperatures, to avoid potential problems with air stratification.

3.1.5.3 Immersion Temperature Sensors

Provide thermo-wells for sensors measuring temperatures in liquid applications or pressure vessels. Locate wells to sense continuous flow conditions. Do not install wells using extension couplings. Where piping diameters are smaller than the length of the wells, provide wells in piping at elbows to effect proper flow across entire area of well. Wells shall not

restrict flow area to less than 70 percent of pipe area. Increase piping size as required to avoid restriction. Provide thermo-wells with thermal transmission material within the well to speed the response of temperature measurement. Provide wells with sealing nuts to contain the thermal transmission material.

3.1.5.4 Outside Air Temperature Sensors

Provide outside air temperature sensor on north side of the building, away from exhaust hoods, air intakes and other areas that may affect temperature readings. Provide sunshields to protect outside air sensor from direct sunlight.

3.1.6 Damper Actuators

Actuators shall not be mounted in the air stream.

3.1.7 Thermometers

Not used.

3.1.8 Pressure Sensors

3.1.8.1 Differential Pressure

- a. General: Install pressure-sensing tips in locations to sense appropriate pressure conditions.
- b. Duct Static Pressure Sensing: Locate duct static pressure tip approximately two-thirds of distance from supply fan to end of duct with the greatest pressure drop.
- c. Pumping Proof with Differential Pressure Switches: Install high-pressure side between pump discharge and check valve.
- d. Filter differential Pressure Sensing: Install differential pressure sensors (analog) for tracking build-up and for the purposes of filter replacement.

3.2 ADJUSTMENTS

Calibrate all sensors, instrumentation, and controls and verify the specified accuracy using test equipment with accuracies in compliance with NIST standards. Adjust controls and equipment to maintain conditions indicated, to perform functions indicated, and to operate in the sequence specified.

3.3 FIELD QUALITY CONTROL

3.3.1 General

- a. Demonstrate compliance of the heating, ventilating, and air conditioning control system with the contract documents. Furnish personnel, equipment, instrumentation, and supplies necessary to perform calibration and site testing. Ensure that tests are performed by competent employees of the DDC system installer or the DDC system manufacturer regularly employed in the testing and calibration of DDC systems.

- b. Testing will include the Contractor Field Tests and the Performance Verification Tests. Contractor Field Tests shall demonstrate proper calibration of input and output devices, and the operation of specific equipment. Performance Verification Tests shall ensure proper execution of the sequence of operation and proper tuning of control loops.
- c. Obtain approval of the plan for each phase of testing before beginning that phase of testing. Give the owner written notification of planned testing at least 45 days prior to test. Notification shall be accompanied by the proposed test procedures. In no case will the Contractor be allowed to start testing without written Owner approval of test procedures. The test procedures shall consist of detailed instructions for complete testing to prove performance of the heating, ventilating and air-conditioning system and digital control system. Test procedures shall include tests outlined in the following paragraphs.
- d. Before scheduling the Performance Verification Test, furnish the Contractor Field Test documentation and written certification to the Owner that the installed system has been calibrated, tested, and is ready for the performance verification test. Contractor shall schedule meeting with the Owner to review all documentation and test procedures. Do not start the performance verification test prior to meeting and receiving written permission from the Owner.
- e. Tests are subject to oversight and approval by the Owner. The testing shall not be run during scheduled seasonal off-periods of heating and cooling systems.

3.3.2 Test Reporting for Contractor Field Testing and Performance Verification Tests

- a. Document all tests with detailed test results. Explain in detail the nature of each failure and corrective action taken.
- b. During and after completion of the Contractor Field Tests, and again after the Performance Verification Tests, identify, determine causes, replace, repair or calibrate equipment that fails to meet the specification, and deliver a written report to the Owner.
- c. Provide a written report containing test documentation after the Contractor Field Tests and again after the Performance Verification Tests. Convene a test review meeting at the job site to present the results to the Owner. As part of this test review meeting, demonstrate by performing all portions of the field tests or performance verification test that each failure has been corrected. Based on the report and test review meeting, the Owner will determine either the restart point or successful completion of testing. Do not commence retesting until after receipt of written notification by the Owner. At the conclusion of retesting, assessment will be repeated.
- d. Any and all points selected by the Owner shall be proven to work end-to-end during PVT.

3.3.3 Contractor's Field Testing

- a. Testing, Adjusting, and Commissioning: After the Contractor has received written approval of the shop drawings and as specified, the Contractor will be authorized to proceed with the installation of the system equipment, hardware, and software. Once the installation has been completed, the Contractor shall test, adjust and commission each control loop and system; and shall verify proper operation of each item in the

sequences of operation, including hardware and software. The Contractor shall calibrate field equipment, including control devices, adjust control parameters and logic (virtual) points including control loop set points, gain constants, and constraints, and verify data communications before the system is placed on-line. The Contractor shall calibrate each instrumentation device connected to the DDC system by making a comparison between the reading at the device and the display at the Workstation, using a standard at least twice as accurate as the device to be calibrated. The Contractor shall check each control point within the DDC system by making a comparison between the control command at the Workstation and field-controlled device. I/O function calibration checks shall include before and after calibration readings (deviation of reading from actual value as measured by a known calibration standard). Contractor shall utilize analog test instruments with calibration traceable to the National Institute of Standards and Technology, and shall provide calibration documentation as a part of the report. Analog test instrumentation shall be at least twice as accurate as the device being calibrated. For each analog and digital point being controlled by the DDC system, the Contractor shall command each point and verify its proper operation, and the proper operation of connected equipment such as fans, valves, and dampers. Where practicable, create the field conditions for change of state for digital inputs and verify proper reporting at the control system interface. The contractor shall deliver trend logs/graphs of all points showing to the Owner that stable control has been achieved. Points on common HVAC systems shall be trended simultaneously. One log shall be provided showing concurrent samples taken once a minute for a total of 4 hours. One log shall be provided showing concurrent samples taken once every 15 minutes, for a total of 48 hours. The Contractor shall verify operation of systems in the specified failure modes upon DDC system failure or loss of power, and verify that systems return to DDC system control automatically upon a resumption of DDC system operation or return of power. The Contractor shall deliver a report describing results of functional tests, diagnostics, and calibration including written certification to the Owner that the installed complete system has been calibrated, tested, and is ready to begin the PVT. The report shall include certification. The report shall also include a copy of the approved PVT Procedure.

- b. System Inspection: Observe the HVAC system in its shutdown condition. Check dampers and valves for proper normal positions. Document each position for the test report.
- c. Calibration Accuracy and Operation of Input Test: Verify correct calibration and operation of input instruments. For each sensor and transmitter, including those for temperature, pressure, relative humidity, and dew point inputs, record the reading at the sensor or transmitter location using calibrated test equipment. Record the output reading provided by that sensor or transmitter. Document each of these locations and output readings for the performance verification test report. The test equipment shall have been calibrated within one year of the date of use in the field. Test equipment calibration shall be traceable to the measurement standards of the National Institute of Standards and Technology.
- d. Operation of Outputs Test: Check the operation of each output to verify correct operation. Command digital outputs on and off. Command analog outputs to minimum range, such as 4 mA, and maximum range, such as 20 mA, measure and record commanded and actual output values. Document each command and result for the test report.

- e. Actuator Range Adjustment Test: With the digital controller, apply a control signal to each actuator and verify that the actuator operates properly from its normal position to full range of stroke position. Record actual spring ranges and normal positions for all modulating control valves and dampers. Include documentation in the test report.
- f. Digital Controller Startup and Memory Test: Demonstrate that programming is not lost after a power failure, and Digital Controllers automatically resume proper control after a power failure.
- g. Application Software Operation Test: Test compliance of the application software for:
 - (i) The ability to demonstrate seamless communications with the existing Internet based Server, location to be determined, as well as direct connect via the Building Network Controller in the facility where the work is being accomplished.
 - (ii) Editing Control programs: Demonstrate the ability to edit the control program off line.
 - (iii) Reporting of alarm conditions: Cause alarm conditions for each alarm, and ensure that workstations receive the alarms.
 - (iv) Reporting trend and status reports: Demonstrate ability of software to receive and save trend and status reports.

3.3.3.1 Contractor Field Test Report

The contractor shall prepare a report including all pertinent data described above with the content and annotations as described below. Four (4) complete copies will be submitted for approval.

- a. Tab 1 - Engineering Review Checklists: Engineering Review Checklists shall be provided and shall list all Clarifications (including contract negotiated clarifications), Existing Conditions or deficiencies (ECRs), Requests for Information (RFIs) and Field Change Orders (FCOPs) pertaining to the individual building. Hardcopies of all RFIs with responses to be provided with the checklist sheet.
- b. Tab 2 & 3 - Redline Drawings: Contractor's Redline Drawings shall be marked up copies of approved drawings. Redline A/E Design Drawings shall also be provided with updated panel locations, thermostat locations, and wire runs. Tabs shall separate A/E Design (Tab 2) and Contractor's (Tab 3) drawings. Both Contractor's and A/E Design Redline Drawings shall include all changes made during construction such as but not limited to panel and thermostat locations, occupancy time schedules, sequences of operation, or changes to controller/device type and will show these changes on all drawings that apply. References to directions given shall be noted (RFI) with all changes. Redline Drawings shall be legible and show description and date of revision and preparer's name.

- c. Tab 4 - Graphic Templates: Include hardcopies of graphic templates for each primary system with sample copies of typical graphics for systems that are repeated. Include floor plan graphics templates and any summary or legend graphics templates that are required.
- d. Tab 5 - Checkouts: Checkouts shall be provided for each system installed and/or networked. Checkouts shall be arranged by systems and shall include all hardware points of that system. States defined on I/O points shall be the engineering units for that point.
- e. Tab 6 - Calibration Certificates: Current Calibration Certificates shall be provided for all instruments used for calibration for the particular Building.
- f. Tab 7 - Software: Provide softcopies of all database and programming data. They shall be in a separate electronic folder labeled "Software Files". Provide a Hardcopy of the expanded software tree showing all building systems. Provide printouts of the I/O summary for all primary systems with sample copies of typical systems that are repeated (e.g. VAV Boxes, Fan Coil Units, etc.).
- g. Trends: Softcopies of Trends shall be provided for each system installed and/or networked. Trends shall be provided in Microsoft Excel format and show data in tabular and graphical form. Trends for every system shall include all hardware points and any software points that relate to Sequence of Operations. Actual setpoints (in addition to RM-TSET) shall be provided. Trends shall be provided in two separate electronic files. One file will show data over at least a 48hour period in 15 minute intervals. The second file shall show data over at least four hours in one-minute intervals. Trends for each file for all systems shall be accumulated at concurrent time periods.

If more than a single worksheet is required to show all points of a system, control and monitoring points that correspond to each other shall be provided on the same worksheet

During the one minute trending, the technician will manipulate inputs and setpoints to show control actions that verify all items in the sequence of operation. The technician will describe in detail what inputs or setpoints were changed in a note on the far right side cell in the system's trend worksheet. The cell used for the description will correspond to the time the change was made.

NOTE: All electronic data shall be provided on a single, inscribed/labeled CD in a pouch oriented so that the CD does not fall out of the CFT Book.

3.3.4 Test, Adjust, and Balance Support

The controls contractor shall coordinate with and provide on-site support to the test, adjust, and balance (TAB) personnel when applicable. This support shall include:

- a. On-site operation and manipulation of the control system during the testing and balancing.
- b. Control set point adjustments for balancing all relevant mechanical systems.
- c. Tuning control loops with set points and adjustments determined by the TAB personnel.

3.3.5 Performance Verification Test (PVT)

- a. The Contractor shall demonstrate that the completed DDC system complies with the contract requirements. Using approved test procedures, all physical and functional requirements of the project including communication requirements shall be demonstrated and shown. Contractor shall verify that each control function operates as described in the sequence of operation. The PVT as specified shall not be started until after receipt by the Contractor of written permission by the Owner, based on the Contractor's written report including certification of successful completion of Contractor Field Testing as specified, and upon successful completion of training as specified. Upon successful completion of the PVT, the Contractor shall deliver test reports and other documentation as specified to the Owner.
- b. The performance verification tests shall include verification that the control system maintains setpoints, that the system recovers properly following a power loss, that control loops are tuned, that sensors are calibrated, that the LON, RS-485/MODBUS, Ethernet communications are established and controllers are programmed to execute the sequences of operations, as required by the contract. Conduct the performance verification test during one week of continuous HVAC and DDC systems operation and before final acceptance of work.
- c. Demonstrate functionality of the new DDC system including graphics on the Contractor's portable workstation laptop computer and the Internet based computer (location to be determined) including functionality of temperature control, status points, and positions of dampers and valves. The Contractor shall provide the graphic templates on the Owner provided, Internet based, portable or fixed workstation during the test for this purpose.
- d. Demonstrate the functionality of the sequence of operations for randomly selected systems utilizing the graphics, testing as individual systems, or included in the sampling of multiple typical systems. In some cases, because of the type of controllers, it may be necessary to use non graphic means of control to directly access the programs to manipulate the data to demonstrate control.
- e. Panel Checkouts by the Owner shall be performed on all installed systems. The Contractor need only be present during Panel checkouts of systems included in the testing samples.
- f. When dealing with typical systems such as air handling units, etc., the Owner will select a random sample for testing, in the quantities tested shown in the table below. In the CFT report, the Contractor shall apply the table below to the systems on the project, and provide a list of the quantities of typical systems and the quantities of samples to be tested during the PVT.

| Quantity of Typical Units | Units to be sampled |
|---------------------------|---------------------|
| 1 | 1 |
| 2-5 | 2 |
| 6-10 | 3 |

As a part of the sample unit checkout verification testing by the Contractor, the Contractor shall demonstrate calibration compliance for calibrated points, and all outputs shall be verified.

Recalibration of sensors and adjustments of outputs during the test will only be allowed at the discretion of the Owner Representative. If a large amount of sensors and / or outputs prove to be out of calibration during testing, the Owner Representative may require more samples on additional systems, or may choose to suspend the testing.

3.4 TRAINING

Provide a training course schedule, syllabus, and training materials 14 days prior to the start of training. Furnish a qualified instructor to conduct training courses for designated personnel in the maintenance and operation of the HVAC and DDC system. Orient training to the specific system being installed under this contract. Use operation and maintenance manual as the primary instructional aid in contractor provided activity personnel training. Base training on the Operations and Maintenance manuals and a DDC training manual. Manuals shall be delivered for each trainee with two additional sets delivered for archiving at the project site. Training manuals shall include an agenda, defined objectives and a detailed description of the subject matter for each lesson. Furnish audio-visual equipment and all other training materials and supplies. A training day is defined as 8 hours of classroom or lab instruction, including two 15-minute breaks and excluding lunchtime, Monday through Friday, during the daytime shift in effect at the training facility. For guidance, the Contractor should assume the attendees will have a high school education and are familiar with HVAC systems. Provide a minimum of one training day.

3.5 COMMISSIONING

The Contractor shall be responsible for commissioning the DDC system as specified in the commissioning sections of 230800 or as provided by Independent (3rd Party) Commissioning Authority.

-- End of Section --

SECTION 26 0519 - LOW VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Building wire (600 V)
- B. Wire and cable connectors
- C. Insulating tape and tubing
- D. Wire pulling lubricant

1.2 QUALITY ASSURANCE

- A. Comply with the *National Electrical Code* (NEC) for components and installation.
- B. Provide products that are listed and labeled by a Nationally Recognized Testing Laboratory (NRTL) for the application and environment in which installed.

1.3 SUBMITTALS

- A. Submit the following:
 - 1. Catalog Data.

1.4 RECEIVING, STORING AND PROTECTING

- A. Receive, store, and protect, and handle products according to NECA 1, *Standard Practices for Good Workmanship in Electrical Construction*.

PART 2 PRODUCTS

2.1 PRODUCT OPTIONS AND SUBSTITUTIONS

- A. Prior approval of alternate products is required for substitutions.

2.2 BUILDING WIRE

- A. Provide NRTL-listed building wire as shown on the Drawings with the following characteristics:
 - 1. Description: Single conductor 600 V insulated wire.
 - 2. Conductor:
 - a. 98% conductivity, annealed, uncoated copper, ASTM B 3 *Standard Specification for Soft or Annealed Copper Wire*, solid or stranded as specified in Part 3 of this Section.

3. Insulation: The following types, rated 600 volts:
 - a. 3 AWG and smaller, Type THHN/THWN-2 per UL Standard 83, "Thermoplastic-Insulated Wires and Cables."
 - b. 2 AWG and larger, Type XHHW per UL Standard 44, "Thermoset-Insulated Wires and Cables."

B. Color code conductors as follows:

1. Use colored insulation for color coding conductors 6 AWG and smaller.
2. Use water and oil resistant colored plastic adhesive tape, 3/4 inch minimum width, for color coding conductor 4 AWG and larger. Manufacturer: 3M "Scotch 35"
3. Provide black conductor insulation where colored tape is used for color coding.
4. Use the following color codes for AC power system conductors:

| | | | |
|-------------------------------|-----------|-----------|----------------------|
| System Voltage: Conductor: | 480Y/277V | 208Y/120V | 120/240V |
| Phase A: | Brown | Black | Black |
| Phase B: | Orange | Red | Red |
| Phase C: | Yellow | Blue | --- |
| Grounded (Neutral): | Gray | White | White White/Blue* |
| Equipment Grounding: | Green | Green | Green |
| Switched: | Purple | Pink | Blue |

* Provide grounded conductor insulation with colored stripe when installed in any raceway, box, or enclosure with wiring of another system voltage.

5. Provide color code for control conductors as indicated on equipment or control system manufacturer's drawings.

2.3 WIRING CONNECTORS

- A. For splices and taps on copper wire, sizes 20 to 12 AWG solid and 16 to 14 AWG stranded, use push-on, insulated, spring type connectors, rated 600 V and 105 °C that are NRTL-listed to UL 486C *Splicing Wire Connectors* and provide a means of visual inspection of the connection. Manufacturer: IDEAL "In-Sure."
- B. For splices and taps on copper wire, sizes 8 AWG and smaller, use insulated, spring type connectors, rated 600 volts and 105 °C that are NRTL-listed to UL 486C, *Splicing Wire Connectors*. Manufacturer: 3M "Scotchlok."
- C. For splices and taps on copper wire, sizes 6 AWG through 1 AWG, use the following materials:

1. Tin-plated copper split-bolt connectors that meet the requirements in UL 486A-486B, *Wire Connectors*; provide with matching 600-volt snap-on insulating cover. Manufacturer: FCI Burndy "Type KSA" with "Type SC" insulating cover.
 2. Multi-tap connectors that meet the requirements of UL 486A-466B that have two or more range-taking mechanical lugs and matching 600-volt insulated cover. Manufacturers: Burndy "POLYTAP" or "UNITAP", IlSCO "Type PCT", Blackburn "AMT".
- D. For copper wire, sizes 1/0 AWG and larger, use UL 486A-486B listed circumferential or hexagonal crimp compression terminals, splices, or adapters.
1. Provide compression terminals and splices made from electro-tin plated seamless copper tubing and marked with wire size, die index / color code, and number / locations of crimps. Manufacturers: FCI Burndy Types "YA", "YA-L", "YA-L-NT", "YS", and "YC-C." Thomas & Betts "Color-Keyed."
 2. Provide straight and offset compression adapters made from electro-tin plated aluminum, NRTL listed for use on copper conductors, and marked with wire size, die index / color code, and number / locations of crimps. Each adapter shall include a 600 V, 90 degree C rated insulating cover. Manufacturer: FCI Burndy Types "AYP" and "AYPO."
 3. Range-taking, die-less, or indenter-applied terminals are not acceptable.
- E. For control wiring use nylon insulated crimp-on terminals with insulation grip that meet the requirements of UL 486A-486B. Manufacturer: 3M "Scotchlok MNG," Thomas & Betts "Sta-Kon."
1. Use ring tongue terminals for nutted studs.
 2. Use flanged fork terminals for barrier terminal blocks.
 3. Use pin terminals or ferrules for DIN type terminal blocks.
- F. Insulation-piercing type connectors are not acceptable for power or control wiring.

2.4 INSULATING TAPE AND TUBING

- A. For making re-enterable tape-insulated splices and connections, provide varnished cambric electrical insulating tape made of cotton cambric fabric that is oil primed and coated with electrical insulating varnish. Manufacturer: 3M "Scotch 2510" (no adhesive) and Scotch 2520" (pressure-sensitive adhesive).
- B. Insulate taped splices and connections using ethylene propylene rubber (EPR) tape that meets the requirements of UL 510 - *Polyvinyl Chloride, Polyethylene, and Rubber Insulating Tape* and is rated for 90 °C continuous operation and 130 °C short-term overload service. Manufacturer: 3M "Scotch 130C"

- C. For the outer covering of tape-insulated splices and connections use vinyl plastic tape that meets the requirements of UL 510 - *Polyvinyl Chloride, Polyethylene, and Rubber Insulating Tape* and has the following characteristics:
 - 1. 8.5 mil minimum thickness,
 - 2. ASTM D-3005, "Standard Specification for Low-Temperature Resistant Vinyl Chloride Plastic Pressure-Sensitive Electrical Insulating Tape – Type 1."
 - 3. Rated 600 volts and 105 °C, suitable for indoor and outdoor applications.
 - 4. Retains flexibility, adhesion, and applicable at temperature ranges from 0 through 100 °F without loss of physical or electrical properties.
 - 5. Resistant to abrasion, moisture, alkalis, acid, corrosion, and sunlight.
 - 6. Manufacturer: 3M "Scotch Super 88"
- D. Provide heat shrinkable tubing that meets the requirements of UL 486D – *Sealed Wire Connector Systems* and has the following characteristics:
 - 1. Rated 600 volts
 - 2. Factory applied adhesive/sealant
 - 3. Split resistant
 - 4. Manufacturer: 3M "ITCSN"
- E. Use motor lead splicing kits to insulate and seal connections to leads for motors rated 480V and less. Manufacturer: 3M "5300 Series"

2.5 WIRE PULLING LUBRICANT

- A. Provide NRTL-listed wire pulling lubricant that is compatible with the conductor insulation or jacket, has a maximum coefficient of dynamic friction of 0.25, and leaves no flammable residue. For cold weather installations, provide wire pulling lubricant suitable for conduit temperature.
- B. Compatibility with conductor insulation shall be determined in accordance with IEEE Std 1210, *Standard Tests for Determining Compatibility of Cable-Pulling Lubricants with Wire and Cable*.
- C. Manufacturer:
 - 1. Polywater "Lubricant J."

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify interior of building has been protected from weather.
- B. Verify that work of other trades likely to damage wire and cable is completed.
- C. Verify raceway installation is complete and supported.
- D. Verify that field measurements are as shown on Drawings.
- E. Wire and cable routing shown on Drawings is approximate unless dimensioned.
 - 1. Route wire and cable as required meeting project conditions.
 - 2. Where cable routing is not shown, and destination only is indicated, determine exact routing and lengths required to meet Project conditions.

3.2 PREPARATION

- A. Examine raceways and building finishes that are to receive wires and cables for compliance with installation tolerances and other conditions. Do not proceed with installation until unsatisfactory conditions have been corrected.
- B. Completely and thoroughly swab raceway before installing wire.

3.3 EXISTING WORK

- A. Remove abandoned wire and cable, including abandoned wire and cable above accessible ceiling finishes. Patch surfaces where removed cables pass through building finishes.
- B. Disconnect abandoned circuits and remove circuit wire and cable. Remove abandoned boxes when wire and cable servicing boxes are abandoned and removed. Install blank cover for abandoned boxes not removed.
- C. Provide access to existing wiring connections remaining active and requiring access. Modify installation or install access panel.
- D. Extend existing circuits using materials and methods as specified.

3.4 BUILDING WIRE INSTALLATION

- A. Install building wire according to, the NEC, the requirements in this Section, and the following NECA installation standards as applicable:
 - 1. NECA 1 *Standard for Good Workmanship in Electrical Construction* (ANSI).
- B. Do not damage conductor, insulation, or jacket by excessive installation pulling tension or sidewall bearing pressure.
 - 1. Calculate expected cable pulling tension and sidewall bearing pressures for each set of conductors being pulled into a conduit run where any of the following

combinations of bends and raceway length is exceeded between accessible pull points:

- a. 4 equivalent 90-degree bends and 10 feet of raceway.
 - b. 3 equivalent 90-degree bends and 40 feet of raceway.
 - c. 2 equivalent 90-degree bends and 80 feet of raceway.
 - d. 1 equivalent 90-degree bend and 150 feet of raceway.
 - e. Straight pull with more than 250 feet of raceway.
2. For cable pulling tension and sidewall bearing pressure calculations use formulas and factors described in IEEE Std 422, *IEEE Guide for the Design and Installation of Cable Systems in Power Generating Stations*.
 3. Obtain recommended maximum conductor or cable pulling tension and sidewall bearing pressure values from the manufacturer, or use the following maximum allowable values:
 - a. Maximum sidewall bearing pressure: 500 lb/ft.
 - b. Maximum tension, pulling directly on conductor: 0.008 lb/cmil
 - c. Maximum tension, pulling on basket grip over insulation jacket: 2000 lb, not to exceed 0.008 lb/cmil of conductor.
- C. Use solid copper conductors for power circuits 10 AWG and smaller except use stranded conductors in flexible conduits.
 - D. Use stranded conductors for power circuits 8 AWG and larger.
 - E. Use copper conductors not smaller than 12 AWG for power and lighting branch circuits.
 - F. Use stranded copper conductors not smaller than 14 AWG for 120V control circuits.
 - G. Use minimum 10 AWG copper conductors from panelboard to first outlet for 20-ampere, 120-volt branch circuits longer than 75 feet; use larger conductors as indicated on the Drawings.
 - H. Use minimum 10 AWG copper conductors from panelboard to first outlet for 20-ampere, 277-volt branch circuits longer than 150 feet; use larger conductors as indicated on the Drawings.

3.5 CONNECTOR INSTALLATION

- A. Install conductors in terminals, splices, adapters, and connectors in accordance with the manufacturer's instructions. Have the manufacturer's installation instructions available at the construction site.

- B. Make splices, taps, and terminations to carry full ampacity of conductors with no perceptible temperature rise above the conductor temperature.
- C. Do not nick conductors when removing insulation.
- D. Do not cut conductor strands to fit into connectors, splices, adapters, or terminals.
- E. Make connections using clean connection surfaces. Wire brush conductors immediately before installing lugs, terminals, splices, or adapters.
- F. Connect conductors 1/0 AWG and larger using compression terminals at the locations described below where there is adequate wire bending space to accommodate compression terminals. Select compression terminals suitable for the conductor sizes, materials, and termination point configurations. Install compression terminals using the manufacturer's recommended dies and minimum 12-ton force compression tools.
 - 1. Circuit breakers with frame size greater than 100 amperes that are NRTL listed for with compression terminals. Use compression adapters where the circuit breaker is not listed for compression terminals.
 - 2. Safety switches and fused switches rated more than 100 amperes.
 - 3. Switchboards, panelboards, and similar service and distribution equipment.
 - 4. Utilization equipment connections that are NRTL listed for with compression terminals.
- G. Install copper conductors, 1/0 AWG and larger, connected using mechanical lugs, in the locations or conditions described below.
 - 1. Connection points not NRTL-listed for either compression terminals or compression adapters.
 - 2. Where there is insufficient wire bending space to accommodate either compression terminals or compression adapters.
 - 3. 100 ampere frame circuit breakers.
 - 4. 30, 60, and 100 ampere safety switches.
- H. Terminate power conductors smaller than 1/0 AWG using mechanical lugs.
- I. Terminate control conductors using crimp-on terminals or ferrules. Do not place stranded conductors directly under terminal screws. Install terminals or ferrules on conductors using ratchet-type compression tools.
- J. Connect outlets and components to wiring and to ground as indicated and instructed by manufacturer. Tighten connectors and terminals, including screws and bolts, according to equipment manufacturer's published torque-tightening values for equipment connectors. Where manufacturer's torque requirements are not indicated,

tighten connectors and terminals according to tightening torques specified in UL Standard 486A-486B.

3.6 INSULATING TAPE AND TUBING INSTALLATION

- A. Install insulating tape and tubing in accordance with the manufacturer's instructions. Have the manufacturer's installation instructions available at the construction site.
- B. Insulate splices and taps of irregular shapes with manufactured insulating covers or insulating tape built up to not less than 150 percent of insulation rating of conductor.
 - 1. Apply varnished cambric tape over connections where re-entry is likely, such as motor lead connections.
 - 2. Use rubber insulating tape in half-lapped layers to develop the basic insulation over splices and taps.
 - 3. Use vinyl plastic tape in half-lapped layers to provide the outer protective covering over splices and taps.
- C. Insulate cylinder shaped splices and taps, connector barrels and adapter barrels using heat shrinkable insulating tubing, insulating covers manufactured for the connector, or tape insulation as described above.

3.7 IDENTIFICATION

- A. Identify wire and cable under provisions of Section 26 0553, Identification for Electrical Systems.
- B. Identify each conductor with its circuit number or other designation indicated on Drawings.
- C. Apply color coding tape on conductors at each termination, splice, junction, and pull box.
- D. Post conductor color code on each panelboard, switchboard, switchgear assembly, motor control center, dry-type transformer, safety switch, and separate motor controller. Use type-written, adhesive-backed labels

3.8 FIELD QUALITY CONTROL

- A. Observe conductors and cables during the installation process.
 - 1. Reject and replace entire reels, rolls, or boxes containing conductors or cables with material or manufacturing defects.
 - 2. Reject and replace cable or conductor segments that have been kinked, dented, or otherwise damaged during handling or installation.

- B. After installation of wires and cables and before electrical circuit is energized, show product capability and compliance with requirements and verify by documented inspections and tests.
- C. Perform the following inspections:
 - 1. Inspect conductors and cables for:
 - a. Freedom from material defect or physical damage,
 - b. Correct conductor size, material, and insulation type,
 - c. Correct color coding and identification.
 - 2. Inspect connections for:
 - a. Correct connector size and type according to the Specifications,
 - b. The use of the correct compression dies and the correct number of crimps on compression connectors in accordance with the connector manufacturer's instructions.
- D. Perform the following tests:
 - 1. Before connecting conductors to equipment, use a megohm meter in a 1-minute test to verify the insulation integrity of each service conductor, feeder conductor, critical system branch circuit conductor, and critical system control conductor with respect to ground and other conductors in the same raceway.
 - a. Use 1000-volts dc to test conductors rated 600 volts.
 - b. Conductors with insulation resistances over 50 megohms are acceptable.
 - c. Conductors with insulation resistances less than 2 megohms are defective.
 - d. If the conductor insulation resistance is between 50 megohms and 2 megohms notify owner and investigate the conductor installation.
 - 2. After connecting conductors to equipment, test continuity and correct connection of each power circuit conductor and each control circuit conductor.
 - 3. Measure and record the tightness of not less than 10% of each size and type of mechanical or bolted connection using a calibrated torque wrench or torque screwdriver.
 - a. Compare measured torque with torque recommended by the connector manufacturer or UL Standard 486A-486B.
 - b. If any connection is found to be less than 90% of the recommended torque, notify the owner and re-torque all bolted connections on the Project.

- E. Remove and replace defective, incorrect, or improperly installed conductors and connectors. Re-inspect and re-test replacement conductors and connectors.
- F. Refer to Section 26 0813, Electrical Acceptance Testing for other inspections and tests that are required before conductors may be energized.

END OF SECTION

SECTION 26 0526 - GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. CIRCUIT AND SYSTEM GROUNDING
- B. ENCLOSURE AND EQUIPMENT GROUNDING SYSTEM

1.2 SUBMITTALS

- A. SUBMIT THE FOLLOWING:
 - 1. Catalog Data: Submit catalog data for grounding conductors, grounding clamps, grounding bushings, grounding bars, exothermic weld materials, and compression grounding connector materials.

1.3 REGULATORY REQUIREMENTS

- A. COMPLY WITH THE NATIONAL ELECTRICAL CODE (NEC) FOR COMPONENTS AND INSTALLATION.
- B. PROVIDE PRODUCTS THAT ARE LISTED AND LABELED BY A NATIONALLY RECOGNIZED TESTING LABORATORY (NRTL) FOR THE APPLICATION AND ENVIRONMENT IN WHICH INSTALLED.

1.4 RECEIVING, STORING AND PROTECTING

- A. RECEIVE, STORE, AND PROTECT, AND HANDLE PRODUCTS ACCORDING TO NECA 1 STANDARD PRACTICES FOR GOOD WORKMANSHIP IN ELECTRICAL CONSTRUCTION.

PART 2 PRODUCTS

2.1 PRODUCT OPTIONS AND SUBSTITUTIONS

- A. PRIOR APPROVAL OF ALTERNATE PRODUCTS IS REQUIRED FOR SUBSTITUTIONS.

2.2 GROUND ELECTRODE CABLE

- A. PROVIDE BARE STRANDED, SOFT TEMPER COPPER CABLE THAT CONFORMS TO ASTM B8 STANDARD SPECIFICATION FOR CONCENTRIC-LAY STRANDED COPPER CONDUCTORS.

2.3 EQUIPMENT GROUNDING CONDUCTORS

- A. PROVIDE NRTL-LISTED THHN/THWN INSULATED COPPER WIRE.

- B. USE SOLID GROUNDING CONDUCTORS 10 AWG AND SMALLER WHERE NOT SUBJECT TO VIBRATION OR REPEATED FLEXING.
- C. USE STRANDED GROUNDING CONDUCTORS FOR 8 AWG AND LARGER.
- D. USE STRANDED GROUNDING CONDUCTORS WHERE SUBJECT TO VIBRATION OR REPEATED FLEXING. USE STRANDED GROUNDING CONDUCTORS IN FLEXIBLE CONDUIT AT MOTOR CONNECTIONS.
- E. COLOR CODE GROUNDING CONDUCTORS AS FOLLOWS:
 - 1. Equipment ground:
 - a. Conductors 6 AWG and smaller: Green colored insulation.
 - b. Conductors 4 AWG and larger: Green colored insulation or black colored insulation with 3/4 inch wide band of water and oil-resistant green plastic adhesive tape.

2.4 PIPE GROUNDING CONNECTORS

- A. PROVIDE NRTL-LISTED COPPER-ALLOY CONNECTORS FOR MAKING CABLE TO PIPE CONNECTIONS.
- B. MANUFACTURER: O-Z/GEDNEY "ABG" OR "CG" OR APPROVED EQUAL.

2.5 CONDUIT GROUNDING BUSHINGS

- A. PROVIDE NRTL-LISTED, GALVANIZED MALLEABLE IRON, 150 C RATED INSULATED THROAT GROUNDING BUSHINGS WITH LAY-IN TYPE GROUND CABLE LUGS.
- B. MANUFACTURERS: O-Z/GEDNEY TYPE "BLG" OR APPROVED EQUAL.

2.6 EXOTHERMIC WELD GROUNDING CONNECTIONS

- A. PROVIDE MOLDS AND WELDING MATERIAL FOR MAKING EXOTHERMIC WELD CONNECTIONS.
- B. IN INTERIOR LOCATIONS AND IN VAULTS, USE LOW SMOKE EMISSION TYPE WELDING MATERIAL.
- C. MATCH MOLD AND WELD MATERIAL TO MATERIAL TYPES, SHAPES AND SIZES TO BE JOINED.
- D. MANUFACTURER: ERICO CADWELD OR APPROVED EQUAL.

2.7 COMPRESSION GROUNDING CONNECTIONS

- A. PROVIDE WROUGHT COPPER CONNECTORS, TERMINALS, TAPS, AND SPLICES FOR MAKING IRREVERSIBLE COMPRESSION GROUNDING CONNECTIONS.

- B. FURNISH NRTL-LISTED GROUNDING CONNECTORS THAT ARE SUITABLE FOR DIRECT BURIAL AND HAVE BEEN TESTED SUCCESSFULLY ACCORDING TO THE REQUIREMENTS OF IEEE STD. 837 IEEE STANDARD FOR QUALIFYING PERMANENT CONNECTIONS USED IN SUBSTATION GROUNDING.
- C. PROVIDE CONNECTOR MANUFACTURER'S HYDRAULIC COMPRESSION TOOLS AND DIES THAT MATCH THE CONNECTORS.
- D. MATCH CONNECTOR AND DIE SIZE TO MATERIAL SHAPES AND CONDUCTOR SIZES TO BE JOINED.
- E. USE TWO-HOLE HEAVY-DUTY COMPRESSION LUGS FOR BOLTED CONNECTIONS TO GROUND BARS, GROUND PLATES, AND EQUIPMENT GROUND PADS.
- F. MANUFACTURER: BURNDY "HYGROUND" OR APPROVED EQUAL.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify that work of other trades likely to damage grounding and bonding material has been completed.
- B. Verify that field measurements are as shown on Drawings.
- C. Electrode locations and grounding cable routing shown on Drawings are approximate unless dimensioned.
 1. Install electrodes and route cable as required meeting project conditions.
 2. Where electrode location or cable routing is not shown, and destination only is indicated, determine exact locations, routing, and lengths required to meet project conditions.

3.2 PREPARATION

- A. Examine equipment and building finishes that are to receive grounding and bonding material for compliance with installation tolerances and other conditions. Do not proceed with installation until unsatisfactory conditions have been corrected.

3.3 EXISTING WORK

- A. Remove exposed abandoned grounding and bonding material, including that abandoned above accessible ceiling finishes. Patch surfaces where grounding and bonding materials are removed.
- B. Disconnect abandoned grounding and bonding systems and remove.

- C. Provide access to existing grounding and bonding connections remaining active and requiring access. Modify installation or install access panel.
- D. Extend existing grounding and bonding systems using materials and methods specified.

3.4 GENERAL

- A. Comply with the requirements of the NEC, this Section and the Drawings.
- B. INSTALL GROUNDING AND BONDING MATERIAL ACCORDING TO MANUFACTURER'S INSTRUCTIONS. HAVE THE MANUFACTURER'S INSTALLATION INSTRUCTIONS AVAILABLE AT THE CONSTRUCTION SITE.
- C. Use the following connection methods unless otherwise specified or indicated on the Drawings:
 - 1. Use exothermic weld grounding connections for underground or concealed connections of dissimilar materials.
 - 2. Use exothermic weld or compression grounding connections for underground or concealed connections of like materials.
 - 3. Use exothermic weld, compression, or bolted grounding connections for accessible connections.
 - 4. Make bolted connections using bolts, nuts, flat washers, and toothed lock washers suitable for the connector and the installation environment; acceptable materials include high strength silicon bronze and 18-8 alloy stainless steel.
 - 5. Make irreversible bolted connections using 18-8 alloy stainless steel tamper-resistant bolts and tamper-resistant nuts along with flat washers, and toothed lock washers. Tamper-resistant nuts and bolts must resist loosening with common tools; acceptable tamper-resistant fasteners include penta-head, break-away, and oval designs.
- D. Tighten grounding and bonding connectors and terminals, including screws and bolts, in accordance with manufacturer's published torque tightening values for connectors and bolts. Where manufacturer's torquing requirements are not indicated, tighten connections to comply with torque tightening values specified in UL 486A and UL 486B. Use a calibrated torque wrench.
- E. Use hydraulic compression tools to provide the correct circumferential pressure for compression connectors. Follow connector manufacturer's installation instructions and use tools and dies recommended by the manufacturer of the connectors. Provide embossing die code or other standard method to make a visible indication that a connector has been adequately compressed.

- F. Install exothermic welds in accordance with manufacturer's instructions and recommendations. Welds that are puffed up or that show convex surfaces indicating improper cleaning are not acceptable.
- G. Make connections in such a manner as to minimize possibility of galvanic action or electrolysis. Select connectors, connection hardware, conductors, and connection methods so metals in direct contact will be galvanically compatible.
 - 1. Use electroplated or hot-tin-coated materials to assure high conductivity and make contact points closer in order of galvanic series.
 - 2. Make connections with clean bare metal at points of contact.
 - 3. Make aluminum to steel connections with stainless steel separators and mechanical clamps.
 - 4. Make aluminum to galvanized steel connections with tin-plated copper jumpers and mechanical clamps.
 - 5. Coat and seal connections involving dissimilar metals with inert material to prevent future penetration of moisture to contact surfaces.
- H. Comply with requirements in Section 26 0529, Hangers and Supports for Electrical Systems.

3.5 CIRCUIT AND SYSTEM GROUNDING

- A. Connect the service entrance equipment ground bus to the main electrode ground bar; use ground cable as indicated on the Drawings, or not smaller than the grounding electrode conductor required by the NEC and not smaller than 4 AWG.
- B. In the service entrance equipment, connect the neutral bus to the ground bus using a bonding jumper not smaller than the grounding electrode conductor required by the NEC; do not use a bonding screw for this purpose. Make no other neutral-to-ground connections on the load side of the service entrance disconnect.
- C. Separately Derived Systems:
 - 1. Connect ground bus of first disconnecting means for separately derived systems (e.g. dry type transformers, power distribution units, generators, and uninterruptible power supplies) in the vicinity of the main electrical equipment room to the main electrode ground bar; use grounding conductor sized as shown on the Drawings or as required by the NEC.
 - 2. Connect ground bus of first disconnecting means for separately derived systems that are remote from the main electrical room to the nearest effectively grounded building structural steel column and the nearest effectively grounded metal water pipe; use grounding conductor sized as shown on the Drawings or as required by the NEC. Make connections at accessible locations.

3. Connect ground bus of first disconnecting means for separately derived systems that are remote from the main electrical room to an extension of the main electrode ground bar if there is neither a nearby effectively grounded building structural steel column nor an effectively grounded metal water pipe; use grounding conductor sized as shown on the Drawings or as required by the NEC.
4. At the first system overcurrent device or disconnecting means, connect the neutral bus to the ground bus using a bonding jumper sized as required by the NEC; do not use a bonding screw for this purpose. Make no other neutral-to-ground connections on the load side of the separately derived system disconnect.

3.6 ENCLOSURE AND EQUIPMENT GROUNDING

- A. Provide permanent and effective equipment, enclosure, and raceway grounding in accordance with NEC requirements and as further specified or shown on the Drawings.
- B. Provide an equipment ground bar, separate from any neutral bar, in all switchboards, panelboards, transformers, starters, disconnect switches, cabinets, etc., for grounding the enclosure and for connecting other equipment and raceway ground conductors. Make connections to the ground bar using mechanical lugs or compression lugs.
- C. Make connections and couplings on metallic conduit systems wrench tight.
- D. Bonding Bushings:
 1. Install bonding bushings on metallic conduit containing circuits rated 100 amperes and higher.
 2. Install bonding bushings on metallic conduits entering enclosures through concentric, eccentric or oversize knockouts.
 3. Install bonding bushings on metallic conduits that terminate to a metallic enclosure without effective electrical connection such as locknuts or threaded bushings.
 4. Bond conduit bonding bushing lug to the equipment ground bar or ground lug in switchgear, panelboards, transformers, motor control centers, starters, disconnect switches, cabinets, etc. Size bonding jumpers in accordance with the NEC.
- E. Provide an insulated equipment grounding conductor for each feeder and branch circuit.
 1. Install the grounding conductor within the common conduit or raceway with the related phase and neutral conductors and connect to the grounding terminal or grounding bus in each box or cabinet.
 2. Size equipment ground conductor in accordance with the NEC or as shown on the Drawings.

- F. In each 15 or 20 ampere branch circuit outlet box and junction box, install a green colored washer head grounding screw with a 12 AWG equipment grounding conductor pigtail.
- G. Connect receptacle grounding terminals to the equipment ground system using minimum 12 AWG equipment grounding conductor. Do not use a "self-grounding" receptacle strap as the only equipment grounding path.

3.7 FIELD QUALITY CONTROL

- A. General: Perform on-site verification, certification and acceptance testing of the grounding installation during construction. Verification and testing will be witnessed by owner.
- B. Before work is concealed verify and certify that the following grounding installations have been made correctly:
 - 1. All underground grounding installations.
- C. Acceptance Testing.
 - 1. Perform ground-impedance measurements using the "fall-of-potential" method in accordance with IEEE 81 Guide for Measuring Earth Resistivity, Ground Impedance and Earth Surface Potentials of a Grounding System. Use instrumentation specifically designed for ground impedance testing. Provide sufficient spacing of test electrodes so that the plotted curves flatten in the 62% area of the distance between the item under test and the current electrode. When sufficient spacing of electrodes is impractical for the "fall-of-potential" method, perform ground-impedance measurements using either the "intersecting curves method" or the "slope method", referenced in IEEE Std. 81. Investigate and correct ground resistances that exceed the following values:
 - a. Service rated 50 kVA or less: as required by the NEC
 - b. Service rated more than 50 kVA but less than 2500 kVA: 5 Ohms
 - c. Service rated 2500 kVA or greater: 1 Ohm
 - 2. Test equipment ground resistances for the following items. Measure resistance between the equipment item and the Main Ground Electrode Ground Bar. Use the "two-point method" of IEEE Std. 81. Investigate and correct equipment ground resistances that exceed 0.5 ohm.
 - a. Transformers
 - b. Switchboards
 - c. Panelboards
 - d. Motors larger than 1 HP

- D. Prepare test reports, certified by the testing organization, of the ground resistance at each test location. Include observations of weather and other phenomena that may affect test results. Describe any measures taken to improve test results.

END OF SECTION

SECTION 26 0529 - HANGERS AND SUPPORTS FOR ELECTRICAL SYSTEMS

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Furnish and install, hangers, supports, anchors, concrete bases, and other positive fastenings for non-structural electrical components such that gravity loads are safely transferred to the structure.

1.2 QUALITY ASSURANCE

- A. Furnish and install hangers and supports that conform to the requirements of the following codes and standards:
 - 1. NFPA 70, *National Electric Code* (NEC)
 - 2. IBC, *International Building Code*
 - 3. NECA 1, *Standard Practices for Good Workmanship in Electrical Contracting*
 - 4. Metal Framing Manufacturers Association
 - a. MFMA-4, *Metal Framing Standards Publication*
 - b. MFMA-102, *Guidelines for the Use of Metal Framing*
- B. Where a Nationally Recognized Testing Laboratory (NRTL) has requirements for such products, provide products that are NRTL listed and labeled for the application, installation condition, and the environment in which installed.

1.3 SUBMITTALS

- A. Submit the following:
 - 1. Catalog Data: Submit catalog data for each type of product specified. Include information substantiating equivalent corrosion resistance to zinc coated steel of alternative treatment, finish, or inherent material characteristic.
 - 2. Test reports: Submit ICC Evaluation Service, Inc evaluation report for each post-installed concrete or masonry anchor product showing that it complies with the current edition of the IBC and the intended conditions of use.

1.4 RECEIVING, STORING AND PROTECTING

- A. Receive, store, and protect, and handle products according to NECA 1.

PART 2 PRODUCTS

2.1 SUBSTITUTIONS

- A. Prior approval of alternate products is required for substitutions.

2.2 COATINGS AND MATERIALS

- A. Furnish products for use indoors protected with zinc coating or with treatment of equivalent corrosion resistance using approved alternative treatment, finish, or inherent material characteristic.
- B. Furnish products for use outdoors or in damp or corrosive indoor locations with hot-dip galvanized coating or with treatment of equivalent corrosion resistance using approved alternative treatment, finish, or material such as stainless steel with inherent corrosion resistant characteristics.

2.3 RACEWAY SUPPORTING DEVICES

- A. Furnish supports as described below for the installation of raceway systems.
- B. Use pressed steel, single bolt hangers to support individual RGS, IMC or EMT conduits from threaded rods or beam clamps. Manufacturer: Steel City "6H Series" or approved equal.
- C. For individual runs of EMT up to 1-inch trade size above accessible ceilings, use spring steel conduit clips with positive snap closure. Manufacturer: ERICO CADDY "M Series" or approved equal.
- D. Use malleable iron conduit clamps to secure individual RGS, IMC or EMT conduit runs across, parallel, or perpendicular to beams, channels and angle supports. Manufacturer: Steel City "RC, EC, and PC Series" or approved equal.
- E. Use two-piece carbon steel riser clamps for individual vertical conduits passing through floors. Manufacturer: Kindorf "C-210 Series" or approved equal.
- F. Use snap-on type one-hole steel straps to secure individual conduits up to 2-inch trade size to flat, dry interior surfaces. Manufacturer: T&B "1210 Series" for RGS and IMC and "4100 Series" for EMT or approved equal.
- G. Use one-hole malleable iron straps to secure individual conduits up to 4-inch trade size to flat, dry interior surfaces. Manufacturer: T&B "1275 Series" or approved equal.
- H. Use one-hole malleable iron straps and conduit spacers to secure individual conduits to flat exterior or damp flat interior surfaces. Manufacturer: T&B "1275 Series" straps with 1350 Series" spacers or approved equal.
- I. Support multiple parallel horizontal conduits with trapeze hangers fabricated from framing channel materials specified below.

2.4 OUTLET BOX SUPPORTING DEVICES

- A. Furnish pre-fabricated sheet steel brackets to support outlet boxes from metal studs in dry-wall construction.
- B. Single outlet boxes: Provide brackets that are inset to allow for dry-wall ring and have a far-side support leg. Manufacturer: ERICO CADDY “H Series” or “MEB1” attached with “SMS8” low-profile self-tapping screws.
- C. Multiple outlet boxes: Provide brackets that are inset to allow for dry-wall rings and span from stud to stud. Manufacturer: ERICO CADDY “RBS Series” attached with “SMS8” low-profile self-tapping screws

2.5 HANGER RODS

- A. Furnish mild steel rods that conform to ASTM A 307, *Standard Specification for Carbon Steel Bolts and Studs, 60 000 PSI Tensile Strength*.
- B. Furnish rods that are threaded on both ends, threaded on one end, or continuous threaded with UNC (coarse) thread pitch.

2.6 FASTENERS

- A. Pre-set Concrete Inserts
 - 1. Furnish pre-set concrete inserts as shown on the Drawings.
 - 2. Manufacturers:
 - a. Continuous inserts for wood forms: B-Line “B22I-12” or longer.
 - b. Spot inserts for wood forms or metal decks: B-Line “B2500” with “N2500” nut, “B2501”
- B. Post-installed Concrete Anchors
 - 1. Furnish post-installed concrete anchors as shown on the Drawings.
 - 2. Each post-installed anchor shall have an ICC-ES evaluation report stating that the product is compliant with the current edition of the IBC and the intended conditions of use.
 - 3. For applications in outdoor, damp, or corrosive locations furnish stainless steel post installed anchors.
 - 4. Furnish post-installed expansion, adhesive, and undercut anchors specified in Section 03 1534 Post Installed Concrete Anchor Purchase – Normal Confidence.
 - 5. Powder-actuated threaded studs: Use zinc-plated carbon steel or stainless steel suitable for the intended service:

- a. 1/4-20 threaded stud: Manufacturer: Hilti X-W6 or approved equal.
- b. 3/8-16 threaded stud: Manufacturer: Hilti W10 or approved equal.
- 6. Concrete and masonry screw anchors: Heat-treated carbon steel. Manufacturer: Simpson Strong-Tie "Titen HD" or approved equal.
- C. Beam Clamps: NRTL-listed, or compliant with Federal Specification WW-H-171E, or compliant with Manufacturers' Standardization Society SP-69 and SP-58 or approved equal.
- D. Hollow Wall Anchors: All steel-spring head type toggle bolts.

2.7 FRAMING CHANNEL SYSTEMS

- A. Furnish U-channel framing systems that conform to MFMA-4 and are fabricated using minimum 12-gage steel, with 9/16-inch-diameter holes, from 1-1/2 to 1-7/8 inches on center, in the surface opposite the "U" opening.
- B. Furnish fittings and accessories that mate and match with U-channel and are of the same manufacturer. Use two-piece, single bolt type conduit straps on U-channel supports.
- C. Manufacturers: Unistrut, B-Line, Superstrut or approved equal.

2.8 FABRICATED SUPPORTING DEVICES

- A. Furnish shop- or field-fabricated supports or manufactured supports assembled from U-channel components.
- B. Furnish steel brackets fabricated from angles, channels, and other standard structural shapes. Connect with welds and machine bolts to form rigid supports.

PART 3 EXECUTION

3.1 GENERAL

- A. Install hangers and supports according to the NEC, IBC, NECA 1, the requirements in this Section, and specific supporting requirements in other Sections.
- B. Conform to manufacturer's instructions and recommendations for selection and installation of hangers and supports.
- C. Do not use wire or perforated strap for permanent supports.
- D. Install flexible sections in electrical conduits and raceways where they cross expansion joints and where they connect to equipment with seismic controls or vibration isolators. Refer to Section 26 0533 - Raceways and Boxes for Electrical Systems.
- E. Do not support conduits, boxes, raceways, etc. from ceiling suspension wires.

3.2 EXAMINATION

- A. Examine surfaces to receive hangers and supports for compliance with installation tolerances and other conditions affecting performance of the system. Do not proceed with installation until unsatisfactory conditions have been corrected.

3.3 FASTENERS

- A. Pre-set inserts: Install pre-set inserts for anchoring to reinforced concrete slabs, sides of reinforced concrete beams, and reinforced concrete walls.
- B. Post-installed concrete expansion anchors: Installation and Testing and the product's ICC-ES report conditions of use.
- C. Masonry screw anchors: Use in accordance with NECA 1 and the product's ICC-ES report conditions of use.
- D. Powder-actuated threaded studs:
 - 1. Use only to fasten individual conduits 2-1/2 inches trade size and smaller.
 - 2. Install in accordance with the product's ICC-ES report conditions of use and the manufacturer's instructions using recommended tools and loads.
 - 3. Use only in uncracked concrete or concrete masonry units.
 - 4. Install to provide embedment as indicated on the Drawings.
- E. Hollow wall anchors: Use toggle bolts in accordance with NECA 1.
- F. Use wood screws for fastening to wood construction.
- G. Use beam clamps or machine bolts, nuts, and washers for fastening to metal.
- H. The use of lead-cinch drop in anchors is not allowed.
- I. Torque threaded fasteners as recommended by the manufacturer's instructions.

3.4 RACEWAY SUPPORTS.

- A. Install individual and multiple (trapeze) raceway hangers and riser clamps as necessary to support raceways. Provide U-bolts, clamps, attachments, and other hardware necessary for hanger assembly and for securing hanger rods and conduits.
- B. Support three or more parallel runs of horizontal raceways together on trapeze hangers.
- C. Support individual horizontal raceways by separate pipe hangers.
- D. Do not support conduits from ceiling suspension wires.

3.5 BOXES AND CABINETS

- A. Support sheet metal boxes directly from the building structure, or by approved brackets or bar hangers, as shown on the Drawings or as required. Where bar hangers are used, attach the bar to structure on opposite sides of the box.
- B. In open overhead spaces, cast boxes threaded to raceways need not be supported separately except where used for fixture support.
- C. Install surface-mounted cabinets and panelboards as shown on the Drawings or as required.

3.6 FRAMING CHANNEL SYSTEMS

- A. Select and install framing channel systems in accordance with MFMA-103.
- B. Use framing channel to support electrical equipment that is mounted free of walls.
- C. Use framing channel to support equipment mounted on walls that do not have sufficient strength to resist pull-out or wallowing out of equipment mounting bolts.

3.7 CONCRETE BASES

- A. Install a reinforced concrete base for each piece of floor-mounted electrical equipment.
 - 1. Form concrete equipment bases using framing lumber with form release compounds.
 - 2. Construct concrete bases as shown on the Drawings and not less than 3.5 inches high and not less than 4 inches larger in both directions than the supported equipment.
 - 3. Place pre-set anchors, conduits, and sleeves using the equipment manufacturer's installation template or instructions. Install post-installed anchors in accordance with FASTENERS article above.
 - 4. Place concrete and provide a steel trowel finish on top; chamfer top edges and corners.
- B. Cure concrete not less than seven days before installing equipment.

3.8 PAINTING

- A. Paint hangers and supports to match finish of adjacent surfaces.

END OF SECTION

SECTION 26 0533 - RACEWAYS AND BOXES FOR ELECTRICAL SYSTEMS

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Conduits and fittings
- B. Outlet boxes
- C. Pull and junction boxes
- D. Wireway

1.2 SUBMITTALS

- A. Submit the following:
 - 1. Catalog Data: Submit catalog data describing floor boxes. Include data substantiating that materials comply with specified requirements.
 - 2. Catalog Data: Submit catalog data describing surface metal raceway. Include data substantiating that materials comply with specified requirements.
 - 3. Catalog Data: Submit catalog data describing wireway. Include data substantiating that materials comply with specified requirements.

1.3 QUALITY ASSURANCE

- A. Comply with the *National Electrical Code* (NEC) for components and installation.
- B. Provide products that are listed and labeled by a Nationally Recognized Testing Laboratory (NRTL) for the application, installation condition, and the environment in which installed.

1.4 RECEIVING, STORING, AND PROTECTING

- A. Receive, store, and protect, and handle products according to NECA 1 – *Standard Practices for Good Workmanship in Electrical Construction*.

PART 2 PRODUCTS

2.1 PRODUCT OPTIONS AND SUBSTITUTIONS

- A. Prior approval of alternate products is required for substitutions.

2.2 COATINGS

- A. Provide products with zinc coating or with treatment of equivalent corrosion resistance using approved alternative treatment, finish, or inherent material characteristic that is suitable for the environment in which the product will be installed and used.

2.3 RIGID METAL CONDUIT AND FITTINGS (RMC)

- A. Furnish rigid metal conduit (RMC) that meets the requirements of UL6 – *Rigid Metal Electrical Conduit*, NEMA C80.1 – *Electrical Rigid Steel Conduit (ERSC)*.
- B. Furnish zinc-plated, threaded, malleable iron fittings and conduit bodies that meet the requirements of UL514B and ANSI/NEMA FB1.

2.4 PLASTIC-COATED STEEL CONDUIT AND FITTINGS

- A. Furnish PVC exterior coated, urethane interior coated, RMC or IMC that meets the requirements of NEMA RN 1 – *PVC Externally Coated Galvanized Rigid Steel Conduit and Intermediate Metal Conduit*.
- B. Use factory-fabricated elbows.
- C. Furnish 40 mils PVC exterior coated, urethane interior coated, zinc-plated, threaded, malleable iron fittings and conduit bodies meeting the requirements of UL514B – *Fittings for Conduit and Outlet Boxes* and NEMA RN 1 PVC.

2.5 RIGID NON-METALLIC CONDUIT AND FITTINGS (RNC)

- A. Furnish rigid non-metallic conduit (RNC) that conforms to UL651 – *Schedule 40 and 80 Rigid PVC Conduit*, NEMA TC 2 – *Electrical Plastic Tubing and Conduit*.
- B. Furnish non-metallic, solvent-welded socket fittings that meet the requirements of UL514C – *Non-Metallic Fittings for Conduit and Outlet Boxes*, and NEMA TC 3 – *PVC Fittings for Use with Rigid PVC Conduit and Tubing*.

2.6 ELECTRICAL METALLIC TUBING AND FITTINGS (EMT)

- A. Furnish galvanized electrical metallic tubing (EMT) that conforms to UL797 – *Electrical Metallic Tubing*, NEMA C80.3 – *Steel Electrical Metallic Tubing (EMT)*.
- B. Furnish compression or set-screw type fittings that meet the requirements of UL514B – *Fittings for Conduit and Outlet Boxes*, and ANSI/NEMA FB1 – *Fittings, Cast Metal Boxes, and Conduit Bodies for Conduit and Cable Assemblies*. Furnish insulated throat connectors.

2.7 FLEXIBLE METAL CONDUIT AND FITTINGS

- A. Furnish galvanized steel flexible metal conduit that meets the requirements of UL1 – *Flexible Metal Electrical Conduit*.
- B. Furnish zinc-plated malleable iron fittings that meet the requirements of UL514B – *Fittings for Conduit and Outlet Boxes*, and ANSI/NEMA FB1 – *Fittings, Cast Metal Boxes, and Conduit Bodies for Conduit and Cable Assemblies*. Furnish insulated throat connectors.

2.8 LIQUID-TIGHT FLEXIBLE METAL CONDUIT AND FITTINGS

- A. Furnish liquid-tight flexible metal conduit that meets the requirements of UL360 – *Liquid-Tight Flexible Steel Conduit, Electrical*.
- B. Furnish zinc-plated malleable iron or zinc-plated steel liquid-tight fittings that meet the requirements of UL514B – *Fittings for Conduit and Outlet Boxes*, and ANSI/NEMA FB1 – *Fittings, Cast Metal Boxes, and Conduit Bodies for Conduit and Cable Assemblies*. Furnish insulated throat connectors.

2.9 INSULATING BUSHINGS

- A. Provide NRTL listed insulating bushings with 105 °C rated insulation.
- B. Manufacturer: O-Z/Gedney, Type IB or approved equal.

2.10 GROUNDING BUSHINGS

- A. Provide NRTL listed, galvanized malleable iron, 150 °C rated insulated throat grounding bushings with lay-in type ground cable lugs.
- B. Manufacturer: O-Z/Gedney, Type BLG or approved equal.

2.11 EXPANSION FITTINGS

- A. Furnish NRTL listed expansion fittings with hot dipped galvanized malleable iron body, factory installed packing and a bonding jumper.
- B. Manufacturer: O-Z/Gedney, Type AX, TX or EXE with Type BJ bonding jumper or approved equal.

2.12 SEALING FITTINGS

- A. Furnish zinc-plated, malleable iron sealing fittings that meet the requirements of UL886 *Outlet Boxes and Fittings for Use in Hazardous Locations*.
- B. Select each sealing fitting so the cross-sectional area of conductors passing through the seal is not more than 25 percent of the cross-sectional area of a rigid metal conduit of the same trade size unless the fitting is specifically identified for a higher percentage of fill.
- C. Provide sealing compound specifically listed for use with the sealing fitting.
- D. Manufacturer: Crouse-Hinds Type EYS, EYSX, EYD or approved equal.

2.13 CORROSION PROTECTION TAPE

- A. Furnish pressure-sensitive, 10 mil thick. PVC based tape for corrosion protection of metal conduit and fittings.
- B. Manufacturer: 3M, Type 50 or approved equal.

2.14 WIREWAY

- A. Provide NRTL listed, raintight type wireway with covers, elbows, tees, hangers, and fittings required for a complete system.
- B. Manufacturer: Square D "Square-Duct" or approved equal.

2.15 OUTLET BOXES

- A. Provide outlet boxes selected for specific installations using the guidance in NEMA OS 3, *Selection and Installation Guidelines for Electrical Outlet Boxes*, and the requirements of this Section.
- B. For dry locations provide galvanized steel outlet boxes that comply with UL Standard 514-A – *Metallic Outlet Boxes* and ANSI/NEMA OS1 – *Sheet-Steel Outlet Boxes, Device Boxes, Covers, and Box Supports*.
 - 1. For luminaire outlets use 4 inch x 1-1/2 inch deep octagonal boxes with fixture stud attachment as required to support luminaires.
 - 2. For flush outlets in stud walls or above-grade cast-in-place concrete walls use 4 inch square x 1-1/2 inch deep boxes; provide deeper boxes or multiple gang boxes as required to fit devices. Provide raised device covers that match the thickness of the wallboard and the number of devices. Provide supplemental box supports to prevent movement of the box.
 - 3. For flush outlets in above-grade masonry walls use masonry boxes with conduit knockouts. Provide boxes with depth suitable for the masonry unit size. Provide multiple gang boxes as required by the number of devices.
 - 4. For surface outlet boxes in EMT raceway systems, use 4 inch x 2-1/8 inch deep square boxes. Provide deeper boxes or multiple gang boxes as required to fit devices. Provide square surface covers that match the installed device and have not less than two holes for securing the device to the cover.
- C. For damp or wet locations and for surface-mounted RMC or IMC raceway systems, provide outlet boxes that comply with UL Standard 498 and 514, ANSI/NEMA FB1.
 - 1. For lighting fixture outlets use 4 inch x 2-1/16 inch deep round cast malleable iron boxes with threaded hubs.
 - 2. For flush or surface wall-mounted outlets, use 4-11/16 square, 2-11/16 inch deep cast malleable iron boxes with threaded hubs. Provide multiple gang boxes as required to fit devices. Provide gasketed cast malleable iron or cast copper-free aluminum covers that match the installed device and have not less than two holes for securing the device to the cover.

2.16 PULL AND JUNCTION BOXES

- A. For dry locations in clean, non-contamination environments use galvanized sheet steel pull and junction boxes that comply with UL Standard 50 Type 1 and the NEC as to

size and construction. Use boxes not less than 4 inches square x 1-1/2 inches deep with screw-secured covers. Provide larger boxes as required by the number and size of conduits and conductors.

- B. For dry locations in dusty or possible contamination (e.g. beryllium, explosives, or uranium) environments use galvanized steel pull and junction boxes that comply with UL Standard 50 Type 12 and the NEC as to size and construction. Use boxes not less than 6 inches square x 4 inches deep with gasketed covers. Provide larger boxes as required by the number and size of conduits and conductors.
- C. For damp or wet, non-corrosive locations, in conduit runs up to 3/4 inch trade size, provide 4-11/16 inches square, 2-11/16 inches deep cast malleable iron pull and junction boxes with threaded hubs and gasketed cast malleable iron or cast copper-free aluminum covers.
- D. For damp or wet, non-corrosive locations, in conduit runs 1 inch trade size and larger, provide galvanized sheet-steel pull and junction boxes and covers that comply with UL 50 Type 3R.
- E. For damp or wet, non-corrosive locations that are subject to hose-directed water, provide pull and junction boxes and covers that comply with UL 50 Type 4.
- F. For in-ground, non-metallic, open-bottom handholes provide products that are NRTL-listed to ANSI/SCTE 77 – *Specification for Underground Enclosure Integrity*.
 - 1. Material: Polymer concrete.
 - 2. Minimum ANSI/SCTE 77 load rating:
 - a. Located in sidewalks: Tier 8.
 - b. Located in driveways, parking lots, and off-roadway locations: Tier 15.
 - 3. Size: Up to 30” x 48”
 - 4. Cover: Non-skid cover with stainless steel cover bolts.
 - 5. Identification: Permanent mark or logo on cover prominently identifying the function of the enclosure in accordance with NEC requirements.
 - 6. Manufacturer: Quazite “Style PC, PG, or PT” or approved equal.
- G. Provide connection points for equipment grounding conductors in each box.

PART 3 EXECUTION

3.1 EXISTING WORK

- A. Remove all exposed abandoned raceways, including abandoned raceways above accessible ceiling finishes, to the point that non-removable building construction (e.g.

concrete or masonry) covers the raceway. Cut raceways flush with non-removable building construction.

- B. Disconnect abandoned outlets and remove devices. Remove abandoned outlets when raceway is abandoned and removed. Install blank cover for abandoned outlets not removed.
- C. Cap, plug, or seal remaining raceway openings to restore the original fire rating of floors, walls, and ceilings after electrical demolition. Patch surfaces to match existing.
- D. Maintain access to existing boxes and other installations remaining active and requiring access. Modify installation or provide access panel.
- E. Extend existing raceway and box installations using materials and methods compatible with existing electrical installations.
- F. Clean and repair existing raceway and boxes to remain or to be reinstalled.

3.2 EXAMINATION

- A. Examine surfaces to receive raceways and boxes for compliance with installation tolerances and other conditions affecting performance of the raceway system. Do not proceed with installation until unsatisfactory conditions have been corrected.

3.3 GENERAL

- A. Install complete systems of raceways and boxes for wiring systems.
- B. Install raceways and boxes according to NECA 1 – *Standard Practices for Good Workmanship in Electrical Construction*, NECA 101 – *Standard for Installing Steel Conduits (Rigid, IMC, EMT)*, NECA 111 – *Standard for Installing Nonmetallic Raceways (RNC, ENT, LFNC)*, the NEC, the manufacturer's instructions, and requirements in this Section.
- C. Raceway termination points and box locations shown on the Drawings are in approximate locations unless dimensioned. Verify locations before rough-in.
- D. Raceway routing is shown on the Drawings in approximate locations unless dimensioned. Coordinate routing with structure and with work of other trades. Route as required for a complete wiring system.
- E. Ground and bond raceways and boxes as required in Section 26 0526 – *Grounding and Bonding for Electrical Systems*.
- F. Support raceways and boxes in accordance with the requirements the National Electrical Code, Section 26 0529 – *Hangers and Supports for Electrical Systems*.
- G. Identify raceways and boxes as required in Section 26 0553 – *Identification for Electrical Systems*.

- H. Arrange raceway and boxes to maintain headroom and present neat appearance.
- I. Install knockout closures in unused openings in boxes or raceways.

3.4 CONDUIT INSTALLATION

- A. For low-voltage wiring systems (less than 1000 volts) use conduit materials according to the NEC and the following:
 - 1. Outdoors - underground:
 - a. Direct buried: Use RNC, plastic-coated RMC, tape-wrapped RMC, or tape-wrapped IMC. Do not use RNC where subject to physical damage. Install with 24 inches minimum cover from top of conduit to finished grade or top of paving.
 - b. Concrete encased: Use RNC, plastic-coated RMC, RMC, or IMC for concrete encased underground work. Install with 24 inches minimum cover from top of encasement to finished grade or paving.
 - 2. Outdoors - exposed: Use RMC or IMC.
 - 3. Outdoor corrosive locations (including cooling towers): Use plastic-coated RMC and fittings.
 - 4. Outdoors - concealed: Use RMC or IMC for concealed outdoor work. Do not use bare RMC or IMC in direct contact with earth. EMT may be used for concealed outdoor work where not in contact with earth, not encased in concrete, and where not exposed to deteriorating agents.
 - 5. Indoors – exposed outside of designated electrical rooms or telecommunications rooms:
 - a. Exposed to severe physical damage during or after installation: Use RMC or IMC.
 - b. Exposed to moisture: Use RMC or IMC.
 - c. Exposed to corrosives: Use plastic-coated RMC and fittings.
 - d. Not exposed to deteriorating agents, and not subject to severe physical damage during or after installation: Use RMC, IMC, or EMT.
 - 6. Indoors – concealed:
 - a. Within drywall partitions and above false ceilings: Use RMC or EMT.
 - b. Within masonry or cast-in-place concrete walls or floors: Use RMC.
 - c. Direct-buried under building floor slabs on grade: Use RNC, plastic-coated RMC, or tape-wrapped RMC. Locate top of conduits not less than 12 inches

below the bottom of the concrete slab. Install warning tape approximately 6 inches above the conduits; install multiple warning tapes above parallel conduit runs wider than 18 inches.

- d. Concrete encased under building floor slabs on grade: Use RNC, plastic-coated RMC, or RMC. Locate top of concrete encasement not less than 12 inches below the bottom of the concrete slab. Install warning tape approximately 6 inches above the concrete encasement; install multiple warning tapes above concrete encasements wider than 24 inches.
7. Install flexible conduit sections where raceways cross expansion joints or seismic joints, where they are attached to parts of the structure with a potential for differential seismic displacement, and where they connect to equipment with designed anchors (seismic controls) or vibration isolators. Refer to Section 26 0529 – *Hangers and Supports for Electrical Systems*.
- a. For raceway systems from 1/2 through 1-1/4 inches, install a minimum of 2 feet of flexible conduit, maximum length as determined by the NEC.
 - b. For raceway systems from 1-1/2 through 2 inches, install a minimum of 3 feet of flexible conduit, maximum length as determined by the NEC.
 - c. For raceway systems larger than 2 inches, install a minimum of 4 feet of flexible conduit, maximum length as determined by the NEC.
 - d. Arrange the flexible conduit sections to accommodate 4 inches of movement in all directions,
 - e. Use liquidtight flexible metal conduit outdoors, in wet, damp, or corrosive indoor locations, and in mechanical rooms. Use flexible metal conduit in dry indoor locations.
 - f. Install pull boxes as required to comply with the limits on conduit bends and distance between pull points in the CONDUIT INSTALLATION article of this Section; count each flexible conduit section described in this article as not less than a 90-degree bend.
8. Connection to vibrating equipment (including transformers and hydraulic, pneumatic, or electric solenoid or motor-driven equipment) - Use a minimum of 24 inches; maximum length as determined by the NEC:
- a. Outdoors: Use liquidtight flexible metal conduit.
 - b. In mechanical rooms: Use liquidtight flexible metal conduit.
 - c. Wet, damp, or corrosive indoor locations: Use liquidtight flexible metal conduit.
 - d. Dry indoor locations: Use flexible metal conduit.

9. Connections to luminaires: Use 3/8 inch flexible metal conduit or metal-clad cable in 6 foot maximum lengths for tap conductors to luminaires above suspended ceilings.
- B. Use 3/4-inch or larger conduit to enclose multiple conductors larger than 12 AWG.
- C. Conceal conduits, unless otherwise indicated on the Drawings, with finished walls, floors and ceilings. Unless otherwise indicated on the Drawings, install concealed conduits with a minimum of bends in the shortest practical distance considering the type of building construction and obstructions.
- D. Position parallel underground conduits with not less than 7-1/2 inches center-to-center separation.
- E. Install expansion fittings where embedded conduits cross building expansion joints.
- F. Use conduit hubs to fasten conduit to boxes in damp and wet locations.
- G. Use sealing locknuts, hubs, or similar water-resistant fittings on conduits entering the top of switchgear, switchboards, motor control centers, panelboards, cabinets, pull boxes, and similar enclosures that are exposed in structures with automatic fire sprinkler systems.
- H. Install insulating bushings or connectors with an insulated throat to protect conductors or cables at conduit terminations.
- I. Install conduits with the following limits of bends and distance between pull points:
 1. Less than 50 ft, follow the NEC.
 2. 50 ft to 100 ft, a maximum of 3 equivalent 90 degree bends.
 3. 100 ft to 150 ft, a maximum of 2 equivalent 90 degree bends.
 4. 150 ft to 200 ft, a maximum of with 1 equivalent 90 degree bend.
 5. Over 200 ft, a straight run with no bend.
- J. Stub-Up Connections:
 1. Extend conduits through concrete floor for connection to freestanding equipment with an adjustable top or coupling threaded inside for plugs, and set flush with the finished floor or equipment pad.
 2. Extend conductors to equipment with rigid steel conduit; flexible metal conduit may be used 6 inches above the floor.
 3. Where equipment connections are not made under this Subcontract, install threaded insert plugs set flush with the floor.

- K. Join nonmetallic conduit using cement as recommended by manufacturer. Wipe nonmetallic conduits dry and clean before joining. Apply full even coat of cement to entire area inserted in fitting. Allow joint to cure for 20 minutes, minimum.
- L. Install plastic-coated RMC and fittings according to the NEC and manufacturer's instructions. Use only fittings approved for use with that material. Patch all nicks and scrapes in PVC coating after installing conduits.
- M. Do not use RNC 90 degree elbows larger than 2 inch trade size; use plastic-coated RMC, tape-wrapped RMC, or tape-wrapped IMC for 2-1/2 inch trade size and larger 90 degree elbows.
- N. Maintain the following minimum clearances between conduit and surfaces with temperatures exceeding 104 degrees F (40 degrees C):
 - 1. 6 inches at perpendicular crossings.
 - 2. 12 inches between parallel runs.
- O. Avoid moisture traps in conduit system; provide junction boxes with drain fitting at low points in conduit system.
- P. Install corrosion protection tape on metal conduits and fittings in contact with soil using half-lapped wrappings.
- Q. Install grounding bushings at the following locations:
 - 1. At every entry to enclosures on metallic conduits containing circuits rated 100 amperes and higher.
 - 2. On metallic conduits entering enclosures through concentric, eccentric or oversize knockouts.
 - 3. On metallic conduits that terminate to a metallic enclosure without effective electrical connection such as locknuts or threaded bushings.
- R. Install conduit measuring tape in empty raceways. Leave not less than 12 inches of slack at each end of the tape. Secure each end of tape.

3.5 CONCRETE ENCASEMENT

- A. Concrete-encase underground low-voltage (less than 1000 volts) electrical service and feeder conduits outside the perimeter of the building foundation.
- B. Concrete-encase underground electrical branch circuit, communications, and alarm conduits as indicated on the Drawings.
- C. Provide not less than 3 inches of concrete coverage on all sides of conduits.

3.6 FIRESTOPPING

- A. Install an NRTL approved firestop system at each electrical penetration in a fire-rated wall, floor, or partition.
- B. At least 2 days prior to firestopping installation, notify the owner so that arrangements can be made for inspection during installation.

3.7 OUTLET BOX INSTALLATION

- A. Install outlet boxes with centers at the following heights unless noted otherwise on the Drawings:
 - 1. Receptacle, telephone and data outlets:
 - a. Common Areas: 18 inches above finished floor.
- B. Where the Drawings show outlets as adjacent, align outlet boxes with each other and group them symmetrically.
- C. Orient boxes to accommodate wiring devices oriented as specified in Section 26 2726, Wiring Devices.
- D. Install a multi-gang box where more than one device is mounted together. Do not use sectional type boxes.
- E. Install box with plaster ring for single or multiple device outlets.
- F. Use flush mounted outlet boxes in finished areas.
 - 1. Install flush outlet boxes and fittings in walls and ceilings so that front edge is flush with the finished surface. Repair broken wall or ceiling surfaces so no gaps or open spaces exceed 1/8 inch at the edge of boxes or fittings.
 - 2. Locate flush mounting box in masonry wall to require cutting of masonry unit corner only. Coordinate masonry cutting to achieve neat opening.
 - 3. Do not install flush mounting boxes back-to-back in walls; install with minimum 6 inches separation. Install with minimum 24 inches separation in acoustic rated walls.
 - 4. Secure flush mounting boxes to interior wall and partition studs. Accurately position to allow for surface finish thickness.
 - 5. Install stamped steel bridges to fasten multiple flush mounting outlet boxes between studs.
 - 6. Install flush mounting box without damaging wall insulation or reducing its effectiveness.

- G. Install adjustable steel channel fasteners for hung ceiling outlet box.
- H. Do not fasten boxes to ceiling support wires or other piping systems.
- I. Support boxes independently of conduit.
- J. Install partitions in boxes as follows:
 1. Between 277 volt devices
 2. Between 277 volt light switches devices and 120 volt devices.
 3. Between either 120 volt or 277 volt devices and low voltage control switches.
- K. Install a blank cover plate on each outlet box in which no device is installed.

3.8 PULL AND JUNCTION BOX INSTALLATION

- A. Install pull and junction boxes as shown on the Drawings and as required for splices, taps, wire pulling, and compliance with regulatory requirements.
- B. Install pull boxes as required to comply with limits on conduit bends and distance between pull points in the CONDUIT INSTALLATION article of this Section.
- C. Install indoor pull and junction boxes in accessible locations above accessible ceilings and in unfinished spaces. Position boxes so covers can be removed. Place boxes to maintain headroom.

3.9 WIREWAY INSTALLATION

- A. Install wireways at locations indicated on the Drawings.
- B. Mount plumb and level.

3.10 ADJUSTING

- A. Adjust flush-mounted outlets to make front flush with finished floor, wall, or ceiling material.
- B. Install knockout closures in unused openings in boxes.

3.11 CLEANING

- A. Clean interior of boxes to remove dust, debris, and other material.
- B. Repair damage to galvanized finishes with zinc-rich paint recommended by manufacturer.
- C. Repair damage to paint finishes with matching touch-up coating recommended by the manufacturer.

3.12 FIELD QUALITY CONTROL

- A. Provide final protection and maintain conditions to ensure that coatings and finishes are without damage or deterioration at final inspection.

END OF SECTION

SECTION 26 0553 - IDENTIFICATION FOR ELECTRICAL SYSTEMS

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. COMPONENT IDENTIFICATION TAGS.
- B. EQUIPMENT NAMEPLATES.
- C. OUTLET LABELS.
- D. WIRE MARKERS.
- E. VOLTAGE MARKERS.
- F. WARNING SIGNS.
- G. WORKING SPACE MARKERS.

1.2 SUBMITTALS

- A. SUBMIT THE FOLLOWING:
 - 1. CATALOG DATA: SUBMIT MANUFACTURER'S CATALOG LITERATURE FOR EACH PRODUCT.
 - 2. SUBMIT ELECTRICAL IDENTIFICATION SCHEDULE INCLUDING LIST OF WORDING, SYMBOLS, LETTER SIZE, COLOR CODING, TAG NUMBER, LOCATION, AND FUNCTION.
 - 3. MANUFACTURER'S INSTALLATION INSTRUCTIONS: SUBMIT INSTALLATION INSTRUCTIONS, INDICATING SPECIAL PROCEDURES AND INSTALLATION REQUIREMENTS.

1.3 REGULATORY REQUIREMENTS

- A. CONFORM TO REQUIREMENTS OF THE NATIONAL ELECTRICAL CODE (NEC), NFPA 70E, AND OSHA.
- B. CONFORM TO APPLICABLE REQUIREMENTS OF THE FOLLOWING ANSI STANDARDS:
 - 1. Z535.1 SAFETY COLOR CODE.
 - 2. Z535.2 ENVIRONMENTAL AND FACILITY SAFETY SIGNS.
 - 3. Z535.3 CRITERIA FOR SAFETY SYMBOLS AND LABELS.
 - 4. Z535.4 PRODUCT SAFETY SIGNS AND LABELS.

5. Z535.5 SAFETY TAGS AND BARRICADE TAPES (FOR TEMPORARY HAZARDS).

1.4 COORDINATION

- A. COORDINATE IDENTIFICATION NAMES, ABBREVIATIONS, COLORS, AND OTHER FEATURES WITH REQUIREMENTS IN THE SUBCONTRACT DOCUMENTS, SHOP DRAWINGS, AND MANUFACTURER'S WIRING DIAGRAMS, WITH THOSE REQUIRED BY CODES, STANDARDS, AND 29 CFR 1910.145. USE CONSISTENT DESIGNATIONS THROUGHOUT PROJECT.

PART 2 PRODUCTS

2.1 PRODUCT OPTIONS AND SUBSTITUTIONS

- A. PRIOR APPROVAL OF ALTERNATE PRODUCTS IS REQUIRED FOR SUBSTITUTIONS.

2.2 COMPONENT IDENTIFICATION TAGS

- A. FURNISH COMPONENT IDENTIFICATION TAGS AS SPECIFIED BELOW AND IDENTIFIED ON THE DRAWINGS TO IDENTIFY ELECTRICAL EQUIPMENT USING THE SYSTEM DESIGNATION, AND EQUIPMENT IDENTIFICATION.
- B. PROVIDE COMPONENT IDENTIFICATION TAGS WITH BLACK LETTERS ON YELLOW BACKGROUND WITH 2 INCHES BY 3 INCHES DIMENSIONS.
- C. PROVIDE MINIMUM 48 POINT SIZE LETTERING.
- D. PROVIDE TAGS MADE OF ONE OF THE FOLLOWING MATERIALS:
1. TYPE 1 (INDOOR APPLICATIONS ONLY):
 - a. Laminated plastic adhesive tape with machine printed letters.
 - b. Manufacturer: Brother, Seton, Brady or approved equal.
 2. TYPE 2:
 - a. Two-ply plastic nameplate with letters engraved through yellow surface showing black core.
 - b. Provide UV stabilized material for outdoor applications.
 - c. Manufacturer: Seton Nameplate Corp or approved equal.

2.3 EQUIPMENT NAMEPLATES

A. FURNISH EQUIPMENT NAMEPLATES AS SPECIFIED BELOW AND IDENTIFIED ON THE DRAWINGS TO INDICATE THE FOLLOWING INFORMATION:

1. CATEGORY I NAMEPLATES:

- a. Served by nameplates: circuit directory information including circuit number, equipment identification, and location of equipment serving the item, plus the voltage, number of phases, and number of wires.
- b. Serves nameplates: circuit directory information including circuit number, equipment identification, and location of equipment served, plus the voltage, number of phases, and number of wires.

B. PROVIDE NAMEPLATES MADE OF ONE OF THE FOLLOWING MATERIALS:

1. TYPE 1 (INDOOR APPLICATIONS ONLY):

- a. Laminated plastic adhesive tape with machine printed letters.
- b. Manufacturer: Brother, Seton, Brady or approved equal.

2. TYPE 2:

- a. Two-ply plates with letters engraved through surface color showing core color.
- b. Use UV stabilized material for outdoor applications.
- c. Manufacturer: Seton Nameplate Corp or approved equal.

C. PROVIDE 10 POINT MINIMUM SIZE LETTERING.

D. PROVIDE COLORS AS FOLLOWS:

1. CATEGORY I NAMEPLATES: WHITE OR BLACK LETTERS ON BLUE BACKGROUND.

E. DIMENSIONS SHALL BE AS FOLLOWS:

1. CATEGORY I NAMEPLATES: 1 INCH BY 2 1/2 INCH MINIMUM.

2.4 OUTLET LABELS

A. FURNISH A TYPEWRITTEN OR MACHINE PRINTED LABEL FOR EACH SWITCH AND RECEPTACLE OUTLET INDICATING CIRCUIT NUMBER, PANELBOARD, AND VOLTAGE.

- B. PROVIDE LABELS OF THE FOLLOWING MATERIALS:
 - 1. LAMINATED PLASTIC ADHESIVE TAPE WITH MACHINE PRINTED LETTERS.
 - 2. MANUFACTURER: BROTHER, SETON, BRADY OR APPROVED EQUAL.
- C. PROVIDE BLACK, 10 POINT MINIMUM SIZE LETTERING ON A WHITE BACKGROUND.

2.5 WIRE MARKERS

- A. PROVIDE WIRE MARKERS FOR POWER, CONTROL, INSTRUMENTATION, ALARM, AND COMMUNICATION CIRCUIT WIRES.
- B. FURNISH SPLIT SLEEVE, HEAT-SHRINKABLE SLEEVE, OR SELF-LAMINATING ADHESIVE WIRE MARKERS.
- C. LOCATE A WIRE MARKER ON EACH CONDUCTOR AT SWITCHGEAR, PANELBOARDS, PULL BOXES, OUTLET AND JUNCTION BOXES, AND EACH LOAD CONNECTION.
- D. PROVIDE TYPEWRITTEN LETTERING ON WIRE MARKERS AS FOLLOWS:
 - 1. POWER AND LIGHTING CIRCUITS: AS-BUILT BRANCH CIRCUIT OR FEEDER CIRCUIT NUMBER.
 - 2. CONTROL CIRCUITS: AS-BUILT CONTROL WIRE NUMBER INDICATED ON SCHEMATIC AND INTERCONNECTION DIAGRAMS OR EQUIPMENT MANUFACTURER'S WIRING DIAGRAMS.
- E. MANUFACTURER: LEM PRODUCTS, INC., BRADY, PANDUIT OR APPROVED EQUAL.

2.6 VOLTAGE MARKERS

- A. FURNISH VOLTAGE MARKERS FOR TRANSFORMERS, SWITCHGEAR, PANELBOARDS, STARTERS, MOTOR CONTROL CENTERS, SAFETY SWITCHES, PULL BOXES, CABINETS, AND CONDUITS.
- B. PROVIDE FLEXIBLE PRESSURE SENSITIVE VINYL MARKERS WITH MINIMUM 1 INCH X 4 INCHES ORANGE BACKGROUND AND BLACK LETTERS.
- C. PROVIDE VOLTAGE MARKERS WITH LETTERING INDICATING THE HIGHEST VOLTAGE PRESENT:
 - 1. 208Y/120 VOLT SYSTEM: 208 VOLTS

2. 120/240 AND 240 VOLT SYSTEM: 240 VOLTS
 3. 480Y/277 AND 480 VOLT SYSTEM: 480 VOLTS
- D. MANUFACTURER: ELECTROMARK, LEM PRODUCTS, INC OR APPROVED EQUAL.

2.7 WIRING SYSTEM COLOR CODE LABELS

- A. In buildings with more than one voltage system, provide wiring system color code labels on each panelboard, switchboard, switchgear, and motor control center.
- B. Provide labels with black, 10-point minimum size lettering on a white background.
- C. Provide information on labels as follows:

| |
|---|
| <p>THIS BUILDING HAS MULTIPLE WIRNG SYSTEMS: 480Y/277V: BROWN, ORANGE, YELLOW, GREY 208Y/120V: BLACK, RED, BLUE, WHITE</p> |
|---|

- D. Provide labels of the following materials:
1. OUTDOOR LABELS SHALL BE SUITABLE FOR A HIGH-UV ENVIRONMENT.
 2. PROVIDE MACHINE-PRODUCED CUSTOM LABELS PRINTED USING A THERMAL TRANSFER PROCESS:
 - a. Use polyester label stock that is NRTL-recognized to UL969, *Marking and Labeling Systems*, and has a high adhesion adhesive back.
 - b. Use printing ribbon recommended by the label stock manufacturer.
 3. USE A SUITABLE LABEL-PRINTING MACHINE TO GENERATE LABELS.
 4. MANUFACTURER: BROTHER, SETON, BRADY OR APPROVED EQUAL.

2.8 WORKING SPACE FLOOR MARKING

- A. PROVIDE BLACK PAINT AND WHITE PAINT TO MARK THE NEC-REQUIRED WORKING SPACE ON THE FLOOR AT ELECTRICAL EQUIPMENT THAT IS LIKELY TO REQUIRE EXAMINATION, ADJUSTMENT, SERVICING, OR MAINTENANCE WHILE ENERGIZED.

2.9 WORKING SPACE LABELS

- A. PROVIDE LABELS INDICATING REQUIRED WORKING CLEARANCE AT ELECTRICAL EQUIPMENT THAT IS LIKELY TO REQUIRE EXAMINATION, ADJUSTMENT, SERVICING, OR MAINTENANCE WHILE ENERGIZED AND

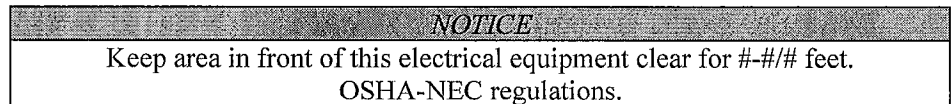
IT IS IMPRACTICAL MARK THE NEC-REQUIRED WORKING SPACE ON THE FLOOR

B. MATERIAL:

1. USE POLYESTER LABEL STOCK THAT IS NRTL-RECOGNIZED TO UL969, *MARKING AND LABELING SYSTEMS*, AND HAS A HIGH ADHESION ADHESIVE BACK.
2. USE PRINTING RIBBON RECOMMENDED BY THE LABEL STOCK MANUFACTURER.
3. USE A SUITABLE THERMAL TRANSFER PROCESS LABEL-PRINTING MACHINE TO GENERATE LABELS AND ENTER THE APPLICATION-SPECIFIC INFORMATION
4. OUTDOOR LABELS SHALL BE SUITABLE FOR A HIGH-UV ENVIRONMENT.

C. MINIMUM DIMENSIONS: 3-1/2 X 1-1/4 INCHES.

D. USE THE FOLLOWING LABEL DESIGN:



1. SIGNAL WORD: "NOTICE" IN 24 POINT MINIMUM WHITE ITALIC LETTERS ON SAFETY BLUE PANEL.
2. WORD MESSAGE: 16 POINT MINIMUM BLACK OR SAFETY BLUE LETTERS ON WHITE BACKGROUND.
 - a. Word message for 120/240-volt and 208Y/120-volt equipment: "Keep area in front of this electrical equipment clear for 3 feet. OSHA-NEC regulations."
 - b. Word message for 480-volt and 480Y/277-volt equipment with exposed live parts on one side of the working space and no live parts on the other side of the working space: "Keep area in front of this electrical equipment clear for 3-1/2 feet. OSHA-NEC regulations."
 - c. Word message for 480-volt and 480Y/277-volt equipment with exposed live parts on both sides of the working space: "Keep area in front of this electrical equipment clear for 4 feet. OSHA-NEC regulations."

E. MANUFACTURER: BROTHER, SETON, BRADY OR APPROVED EQUAL.

PART 3 EXECUTION

3.1 EXISTING WORK

- A. INSTALL IDENTIFICATION ON EXISTING EQUIPMENT TO REMAIN IN ACCORDANCE WITH THIS SECTION.
- B. INSTALL IDENTIFICATION ON UNMARKED EXISTING EQUIPMENT
- C. REPLACE LOST NAMEPLATES.

3.2 EXAMINATION

- A. EXAMINE SURFACES TO RECEIVE IDENTIFICATION PRODUCTS FOR COMPLIANCE WITH INSTALLATION TOLERANCES AND OTHER CONDITIONS AFFECTING PERFORMANCE OF THE IDENTIFICATION PRODUCTS. DO NOT PROCEED WITH INSTALLATION UNTIL UNSATISFACTORY CONDITIONS HAVE BEEN CORRECTED.

3.3 INSTALLATION - GENERAL

- A. WHERE IDENTIFICATION IS TO BE APPLIED TO SURFACES THAT REQUIRE FINISH, INSTALL IDENTIFICATION AFTER COMPLETION OF FINISH WORK.
- B. INSTALL LABELS WHERE INDICATED AND AT LOCATIONS FOR BEST CONVENIENCE OF VIEWING WITHOUT INTERFERENCE WITH OPERATION AND MAINTENANCE OF EQUIPMENT.
 - 1. COORDINATE INSTALLATION OF IDENTIFYING DEVICES WITH LOCATION OF ACCESS PANELS AND DOORS.
 - 2. INSTALL IDENTIFYING DEVICES BEFORE INSTALLING ACOUSTICAL CEILINGS AND SIMILAR CONCEALMENT.
- C. INSTALL ELECTRICAL IDENTIFICATION PRODUCTS ONLY WHEN AMBIENT TEMPERATURE AND HUMIDITY CONDITIONS FOR ADHESIVE ARE WITHIN RANGE RECOMMENDED BY MANUFACTURER.
- D. CLEAN SURFACE WHERE ELECTRICAL IDENTIFICATION PRODUCT IS TO BE PLACED.
- E. USE MANUFACTURER'S RECOMMENDED ADHESIVE FOR ENGRAVED TAGS AND NAMEPLATES.
- F. PLACE ELECTRICAL IDENTIFICATION PRODUCTS CENTERED AND PARALLEL TO EQUIPMENT LINES.
- G. POSITION NAMEPLATES SO THEY CAN BE READ FROM FLOOR OR GROUND.

3.4 OUTLET LABELS

- A. INSTALL OUTLET LABEL ON OUTSIDE OF DEVICE COVER FOR EACH RECEPTACLE OUTLET AND LIGHT SWITCH.

3.5 WIRE MARKERS

- A. INSTALL WIRE MARKERS ON POWER, CONTROL AND COMMUNICATION CONDUCTORS AT EACH APPEARANCE IN LOCATIONS SUCH AS PULL BOXES, OUTLET BOXES, JUNCTION BOXES, PANELBOARDS, SWITCHGEAR, MOTOR CONTROL CENTERS, CONTROLLERS, SAFETY SWITCHES, ENCLOSED CIRCUIT BREAKERS, AND LOAD CONNECTIONS.
- B. POSITION MARKERS SO THEY CAN BE READ FROM THE FRONT OF THE ENCLOSURE.

3.6 VOLTAGE MARKERS

- A. INSTALL VOLTAGE MARKERS AT THE FOLLOWING LOCATIONS AND POSITION MARKERS SO THEY CAN BE READ FROM FLOOR OR GROUND:
 - 1. FRONT AND REAR OF EACH FREE-STANDING LOW- VOLTAGE SWITCHGEAR OR SWITCHBOARD SECTION.
 - 2. FRONT OF EACH LOW-VOLTAGE TRANSFORMER, PANELBOARD, INDUSTRIAL CONTROL PANEL, MOTOR CONTROL CENTER, ENCLOSED CIRCUIT BREAKER, SAFETY SWITCH, AND MOTOR CONTROLLER ENCLOSURE, INCLUDING THOSE FURNISHED WITH MECHANICAL EQUIPMENT.
 - 3. COVER OF EACH PULL BOX CONTAINING LOW-VOLTAGE CONDUCTORS.
 - 4. EACH 2 INCH AND LARGER CONDUIT LONGER THAN 6 FEET; SPACE MARKERS NOT MORE THAN 20 FEET ON CENTER.

3.7 WORKING SPACE FLOOR MARKERS

- A. INSTALL FLOOR MARKING PAINT ON THE FLOOR AT THE LOCATIONS LISTED BELOW TO INDICATE THE WORKING SPACE REQUIRED BY THE NEC.
 - 1. FRONT AND REAR OF EACH FREE-STANDING LOW-VOLTAGE SWITCHBOARD SECTION.
 - 2. FRONT OF EACH LOW-VOLTAGE TRANSFORMER, SWITCHBOARD, PANELBOARD, INDUSTRIAL CONTROL PANEL, ENCLOSED CIRCUIT BREAKER, SAFETY SWITCH, AND MOTOR CONTROLLER ENCLOSURE INCLUDING THOSE FURNISHED WITH MECHANICAL EQUIPMENT.

3. ANY OTHER EQUIPMENT LIKELY TO REQUIRE EXAMINATION, ADJUSTMENT, SERVICING, OR MAINTENANCE WHILE ENERGIZED.
- B. DIMENSIONS OF WORKING SPACE AREA SHALL BE AS FOLLOWS:
1. WIDTH: THE GREATER OF THE WIDTH OF THE EQUIPMENT OR 30 INCHES.
 2. DEPTH:
 - a. 120/240-volt and 208Y/120-volt equipment: 3 feet
 - b. 480-volt and 480Y/277-volt equipment with exposed live parts on one side of the working space and no live parts on the other side of the working space: 3-1/2 feet.
 - c. 480-volt and 480Y/277-volt equipment with exposed live parts on both sides of the working space: 4 feet.
- C. THOROUGHLY PREPARE FLOOR SURFACE TO RECEIVE PAINT.
- D. PAINT THE NEC-REQUIRED WORKING SPACE AREA WITH ALTERNATING 3 TO 6 INCH WIDE BLACK AND WHITE DIAGONAL STRIPES.

3.8 WORKING SPACE LABELS

- A. INSTALL WORKING SPACE LABELS AT THE FOLLOWING LOCATIONS ONLY IN CASES WHERE IT IS IMPRACTICAL TO MARK THE NEC-REQUIRED WORKING SPACE ON THE FLOOR (E.G. CARPETED AREAS).
1. FRONT OF EACH LOW-VOLTAGE OR SWITCHBOARD SECTION AND REAR OF EACH FREESTANDING LOW-VOLTAGE SWITCHGEAR OR SWITCHBOARD SECTION.
 2. FRONT OF EACH METER ENCLOSURE, LOW-VOLTAGE TRANSFORMER, PANELBOARD, INDUSTRIAL CONTROL PANEL, MOTOR CONTROL CENTER, ENCLOSED CIRCUIT BREAKER, SAFETY SWITCH, AND MOTOR CONTROLLER ENCLOSURE, INCLUDING THOSE FURNISHED WITH MECHANICAL EQUIPMENT.
 3. ANY OTHER EQUIPMENT LIKELY TO REQUIRE EXAMINATION, ADJUSTMENT, SERVICING, OR MAINTENANCE WHILE ENERGIZED.
- B. POSITION LABELS SO THEY CAN BE READ FROM FLOOR OR GROUND:

END OF SECTION

SECTION 26 0813 - ELECTRICAL ACCEPTANCE TESTING

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. PROVIDE THE SERVICES OF A QUALIFIED ELECTRICAL TESTING AGENCY (ETA) TO PERFORM THE FUNCTIONS DESCRIBED BELOW:
1. ACCEPTANCE TESTS, INSPECTIONS, AND SYSTEM FUNCTION TESTS OF CERTAIN ELECTRICAL SYSTEMS, EQUIPMENT, COMPONENTS, AND MATERIAL (SSCS) INSTALLED UNDER THE SCOPE OF THIS PROJECT; REFER TO PART 3 OF THIS SECTION.
 2. SYSTEM FUNCTION TESTS AFTER COMPLETION OF ACCEPTANCE TESTS ON CERTAIN ELECTRICAL SSCS INSTALLED UNDER THE SCOPE OF THIS PROJECT.
 3. THE FOLLOWING POWER SYSTEM STUDIES BASED ON THE INSTALLED ELECTRICAL SSCS:
 - a. Arc-flash hazard analysis

1.2 REGULATORY REQUIREMENTS

- A. MAKE INSPECTIONS AND TESTS IN ACCORDANCE WITH THE FOLLOWING CODES AND STANDARDS:
1. INTERNATIONAL ELECTRICAL TESTING ASSOCIATION - NETA ATS-2009, ACCEPTANCE TESTING SPECIFICATIONS (ANSI). NETA ATS FORMS A PART OF THIS SPECIFICATION TO THE EXTENT REFERENCED.
 2. NATIONAL FIRE PROTECTION ASSOCIATION – NFPA
 - a. NFPA 70: *National Electrical Code* (ANSI) (NEC)
 - b. NFPA 70B: *Recommended Practice for Electrical Equipment Maintenance* (ANSI)
 - c. NFPA 70E: *Standard for Electrical Safety in the Workplace* (ANSI).
 3. INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS - IEEE
 - a. IEEE Std 399: *IEEE Recommended Practice for Industrial and Commercial Power Systems Analysis*
 - b. IEEE Std 1584: *IEEE Guide for Performing Arc-Flash Hazard Calculations*

1.3 QUALITY ASSURANCE

- A. THE ETA SHALL BE AN INDEPENDENT TESTING ORGANIZATION WHICH SHALL FUNCTION AS AN UNBIASED TESTING AUTHORITY, PROFESSIONALLY INDEPENDENT OF THE MANUFACTURERS, SUPPLIERS, AND INSTALLERS OF THE EQUIPMENT OR SYSTEMS TO BE EVALUATED.
- B. THE ETA SHALL BE REGULARLY ENGAGED IN THE TESTING OF ELECTRICAL EQUIPMENT DEVICES, INSTALLATIONS, AND SYSTEMS.
- C. THE ETA SHALL HAVE A DOCUMENTED QUALITY ASSURANCE PROGRAM, DOCUMENTED INSPECTION AND TEST AND PROCEDURES, AND A DOCUMENTED ELECTRICAL SAFETY PROGRAM.
- D. THE ETA SHALL HAVE SUCCESSFULLY COMPLETED NOT LESS THAN THREE ACCEPTANCE TESTING, INSPECTION AND CALIBRATION PROJECTS OF SIMILAR SCOPE TO THIS PROJECT.
- E. THE ETA SHALL HAVE A CALIBRATION PROGRAM, AND TEST INSTRUMENTS USED SHALL BE CALIBRATED IN ACCORDANCE WITH NETA ATS.
- F. EACH ETA TECHNICIAN PERFORMING TESTING, INSPECTION, CALIBRATION, AND ADJUSTMENTS SHALL BE A "QUALIFIED PERSON" AS DEFINED BY NFPA 70E AND THE NEC.
 - 1. TECHNICIANS PERFORMING THESE ELECTRICAL TESTS AND INSPECTIONS SHALL BE TRAINED AND EXPERIENCED CONCERNING THE APPARATUS AND SYSTEMS BEING EVALUATED.
 - 2. TECHNICIANS SHALL BE CAPABLE OF CONDUCTING THE TESTS IN A SAFE MANNER WITH COMPLETE KNOWLEDGE OF THE HAZARDS INVOLVED AND THE APPROPRIATE SAFETY-RELATED WORK PRACTICES.
 - 3. TECHNICIANS SHALL BE QUALIFIED TO EVALUATE THE TEST DATA AND MAKE A JUDGMENT ON THE SERVICEABILITY OF THE SPECIFIC EQUIPMENT.
- G. TESTING, INSPECTION, CALIBRATION, AND ADJUSTMENTS SHALL BE PERFORMED OR SUPERVISED ON THE PROJECT SITE BY AN ETA EMPLOYEE WITH THE FOLLOWING MINIMUM QUALIFICATIONS:
 - 1. A MINIMUM OF 3 YEARS' EXPERIENCE INSPECTING, TESTING, AND CALIBRATING ELECTRICAL DISTRIBUTION AND GENERATION EQUIPMENT, SYSTEMS, AND DEVICES, AND
 - 2. ONE OF THE FOLLOWING CERTIFICATIONS/REGISTRATIONS:

- a. An engineering technician certified to at least Level III in accordance with ANSI/NETA ETT *Standard for Certification of Electrical Testing Technicians* (ANSI), or
- b. An engineering technician certified to at least the NICET ET-grade in Electrical Testing Engineering Technology, or

1.4 SUBMITTALS

A. SUBMIT THE FOLLOWING:

- 1. CERTIFICATIONS: SUBMIT NAME AND QUALIFICATIONS OF THE ETA.
- 2. CERTIFICATIONS: SUBMIT QUALITY ASSURANCE PROGRAM OF THE ETA.
- 3. CERTIFICATIONS: SUBMIT INSTRUMENT CALIBRATION PROGRAM OF THE ETA.
- 4. CERTIFICATIONS: SUBMIT ELECTRICAL SAFETY PROGRAM OF THE ETA.
- 5. CERTIFICATIONS: SUBMIT NAME AND QUALIFICATIONS OF THE LEAD ENGINEER OR ENGINEERING TECHNICIAN PERFORMING THE REQUIRED TESTING SERVICES. INCLUDE A LIST OF THREE COMPARABLE JOBS PERFORMED BY THE INDIVIDUAL WITH SPECIFIC NAMES AND TELEPHONE NUMBERS FOR REFERENCE.
- 6. CALCULATIONS: SUBMIT CERTIFIED COPIES OF POWER SYSTEM STUDIES LISTED BELOW. CALCULATIONS SHALL INCLUDE CERTIFICATION OF COMPLIANCE WITH SPECIFIED REQUIREMENTS, IDENTIFY DEFICIENCIES, AND RECOMMEND CORRECTIVE ACTION WHEN APPROPRIATE. TYPE AND NEATLY BIND CALCULATIONS TO FORM A PART OF THE FINAL RECORD. SUBMIT POWER SYSTEM STUDIES IN PAPER FORMAT AND ALSO IN ELECTRONIC FORMAT TRANSMITTED ON A CD-ROM.
 - a. Arc-flash hazard analysis

1.5 COORDINATION

- A. SCHEDULE THE PROJECT TO ALLOW ADEQUATE TIME FOR ELECTRICAL ACCEPTANCE TESTING BEFORE EQUIPMENT OR SYSTEM IS ENERGIZED.
 - 1. NOTIFY THE ETA WHEN EQUIPMENT BECOMES AVAILABLE FOR STUDIES.
- B. NOTIFY THE RESIDENT ENGINEER AT LEAST 14 DAYS IN ADVANCE SCHEDULED ACCEPTANCE TESTS, INSPECTIONS, AND SYSTEM FUNCTION TESTS.

1. NOTIFY THE RESIDENT ENGINEER AGAIN APPROXIMATELY 24 HOURS BEFORE START OF TESTING.

PART 2 PRODUCTS - Not Applicable

PART 3 EXECUTION

3.1 GENERAL

- A. PERFORM THE INSTALLATION INSULATION-RESISTANCE, CONTINUITY, AND ROTATION TESTS FOR ELECTRICAL SSCS DESCRIBED IN EACH SECTION OF THESE SPECIFICATIONS BEFORE, AND IN ADDITION TO, TESTS PERFORMED BY THE ETA THAT ARE SPECIFIED IN THIS SECTION.
- B. SUPPLY SUITABLE AND STABLE ELECTRICAL POWER, ADEQUATE LIGHTING, AND HEATING OR VENTILATION AS REQUIRED AT EACH TEST SITE FOR THE ETA TO PERFORM THE SPECIFIED ACCEPTANCE TESTING.
- C. SUPPLY ONE SET OF THE FOLLOWING TO ETA PRIOR TO THE PERFORMANCE OF ANY FINAL TESTING:
 1. COMPLETE SET OF ELECTRICAL DRAWINGS, SPECIFICATIONS, AND ANY PERTINENT CHANGE ORDERS
 2. APPROVED CONSTRUCTION SUBMITTAL DOCUMENTS FOR MATERIAL AND EQUIPMENT
 3. SITE SPECIFIC HAZARD NOTIFICATION AND SAFETY TRAINING.
 4. OTHER INFORMATION NECESSARY FOR A SAFE AND ACCURATE TEST AND INSPECTION OF THE SYSTEM.

3.2 POWER SYSTEM STUDIES

- A. THE ETA SHALL PROVIDE POWER SYSTEM STUDIES DESCRIBED BELOW BASED ON THE INSTALLED ELECTRICAL DISTRIBUTION SYSTEM AND EQUIPMENT IN ACCORDANCE WITH PROCEDURES DESCRIBED IN NETA-ATS AND THE REFERENCED CODES AND STANDARDS.
 1. INCLUDE IN THE STUDY THE EFFECT OF ALL PORTIONS OF THE ELECTRICAL DISTRIBUTION SYSTEM INCLUDING ALTERNATE SOURCES OF POWER.
 2. ADDRESS NORMAL SYSTEM OPERATING CONFIGURATION PLUS ANY PLAUSIBLE ALTERNATE CONFIGURATIONS AND OPERATIONS THAT COULD RESULT IN MAXIMUM FAULT CONDITION.
- B. ARC-FLASH HAZARD ANALYSIS. PERFORM ARC-FLASH HAZARD ANALYSIS AND SHOCK HAZARD ANALYSES BASED ON THE FINAL SHORT-CIRCUIT STUDY AND THE FINAL COORDINATION STUDY. USE PROCEDURES OUTLINED IN IEEE STD 1584 AND NFPA 70E. PROVIDE THE

FOLLOWING INFORMATION IN TABULAR FORM FOR THE ARC-FLASH WARNING LABELS DESCRIBED IN SECTION 26 0553, *IDENTIFICATION FOR ELECTRICAL SYSTEMS*:

1. FLASH HAZARD BOUNDARY (INCHES) CALCULATED IN ACCORDANCE WITH IEEE STD 1584 OR NFPA 70E.
2. ARC-FLASH INCIDENT ENERGY (CAL/CM²) CALCULATED IN ACCORDANCE WITH IEEE STD 1584 OR NFPA 70E.
3. WORKING DISTANCE (INCHES) SELECTED FROM IEEE STD 1584 OR NFPA 70E (ANNEX D) BASED ON EQUIPMENT TYPE.
4. HAZARD/RISK CATEGORY NUMBER FROM NFPA 70E TABLE 130.7(C)(9) FOR OPERATIONS WITH DOORS CLOSED AND COVERS ON
5. SYSTEM PHASE-TO-PHASE VOLTAGE
6. CONDITION THAT EXPOSES WORKER TO ELECTRICAL SHOCK HAZARD
7. LIMITED APPROACH BOUNDARY FROM NFPA 70E TABLE 130.2(C) BASED ON NOMINAL SYSTEM PHASE-TO-PHASE VOLTAGE.
8. RESTRICTED APPROACH BOUNDARY FROM NFPA 70E TABLE 130.2(C) BASED ON NOMINAL SYSTEM PHASE-TO-PHASE VOLTAGE.
9. PROHIBITED APPROACH BOUNDARY FROM NFPA 70E TABLE 130.2(C) BASED ON NOMINAL SYSTEM PHASE-TO-PHASE VOLTAGE.
10. CLASS FOR INSULATING GLOVES BASED ON SYSTEM VOLTAGE (E.G. CLASS 00 FOR UP TO 500 VOLTS).
11. VOLTAGE RATING FOR INSULATED OR INSULATING TOOLS BASED ON SYSTEM VOLTAGE (E.G. 1000 VOLTS).
12. EQUIPMENT ID CODE BASED ON DRAWINGS AND INCLUDING TA NUMBER, BUILDING NUMBER, AND SYSTEM IDENTIFIER.
13. DATE THAT HAZARD ANALYSIS WAS PERFORMED.
14. "SERVED FROM" CIRCUIT DIRECTORY INFORMATION INCLUDING THE SERVING EQUIPMENT ID CODE, LOCATION (E.G. ROOM NUMBER), CIRCUIT NUMBER, AND CIRCUIT VOLTAGE/PHASES/WIRES.
15. IF APPLICABLE, "SERVES" CIRCUIT DIRECTORY INFORMATION INCLUDING THE SERVED EQUIPMENT ID CODE, LOCATION (E.G. ROOM NUMBER), CIRCUIT NUMBER, AND CIRCUIT VOLTAGE/PHASES/WIRES.

3.3 TEST REPORT

A. THE ETA SHALL INCLUDE THE FOLLOWING INFORMATION IN THE FINAL TEST REPORT:

1. SUMMARY OF PROJECT.
2. DESCRIPTION OF EQUIPMENT INSPECTED AND TESTED.
3. DESCRIPTION OF INSPECTIONS.
4. DATA RECORD RESULTING FROM EACH INSPECTION.
5. POWER SYSTEM STUDIES.
6. ANALYSIS AND IDENTIFICATION OF DEFICIENCIES, AND RECOMMENDATIONS FOR CORRECTIVE ACTION.

3.4 FIELD QUALITY CONTROL

- A. REPORT TO THE RESIDENT ENGINEER, WITHIN THREE WORKING DAYS, ANY SSC OR CONSTRUCTION THAT IS FOUND DEFECTIVE BASED ON INSPECTIONS BY THE ETA.
- B. WITHIN 15 DAYS OF DIRECTION FROM THE RESIDENT ENGINEER, REWORK, REPAIR OR REPLACE ANY SSC OR CONSTRUCTION THAT IS FOUND DEFECTIVE BASED ON ACCEPTANCE TESTS OR INSPECTIONS.
- C. THE ETA SHALL RETEST ANY SSC OR CONSTRUCTION THAT DID NOT PASS ACCEPTANCE TESTS OR INSPECTIONS.

END OF SECTION

SECTION 26 2726 - WIRING DEVICES

PART 1 GENERAL

1.1 SUMMARY

A. SECTION INCLUDES

1. Receptacles
2. Snap switches
3. Wall plates
4. Multi-outlet assemblies

1.2 SUBMITTALS

A. SUBMIT THE FOLLOWING:

1. Product Data

1.3 QUALITY ASSURANCE

A. COMPLY WITH THE *NATIONAL ELECTRICAL CODE* (NEC).

B. FURNISH PRODUCTS LISTED AND LABELED BY A NATIONALLY RECOGNIZED TESTING LABORATORY (NRTL) FOR THE APPLICATION, INSTALLATION CONDITION, AND THE ENVIRONMENTS IN WHICH INSTALLED.

C. MANUFACTURERS OF PRODUCTS ADDRESSED IN THIS SECTION SHALL MAINTAIN AN ISO 9001 CERTIFICATION.

1.4 RECEIVING, STORING, AND PROTECTING

A. RECEIVE, STORE, AND PROTECT, AND HANDLE PRODUCTS ACCORDING TO NECA 1, *STANDARD PRACTICES FOR GOOD WORKMANSHIP IN ELECTRICAL CONSTRUCTION*.

PART 2 PRODUCTS

2.1 PRODUCT OPTIONS AND SUBSTITUTIONS

A. PRIOR APPROVAL OF ALTERNATE PRODUCTS IS REQUIRED FOR SUBSTITUTIONS.

2.2 RECEPTACLES

A. PROVIDE BACK AND SIDE WIRED, SCREW PRESSURE TERMINAL, STRAIGHT-BLADE AND LOCKING TYPE, RECEPTACLES AS INDICATED ON

THE DRAWINGS. RECEPTACLES SHALL MEET THE PERFORMANCE AND DESIGN REQUIREMENTS OF FEDERAL SPECIFICATION WC596 AND UL STANDARD 498, *ELECTRICAL ATTACHMENT PLUGS AND RECEPTACLES*. RECEPTACLE CONFIGURATIONS SHALL BE IN ACCORDANCE WITH NEMA WD 6.

- B. FOR 120 VOLT CONVENIENCE RECEPTACLES CONNECTED TO GENERAL PURPOSE BRANCH CIRCUITS PROVIDE STRAIGHT-BLADE NEMA 5-15R, 15 AMPERES, 125 VOLTS, GROUNDING DUPLEX RECEPTACLES. RECEPTACLE MOUNTING STRAP, GROUND TERMINAL, AND GROUND CONTACTS SHALL BE FORMED FROM ONE PIECE OF BRASS ALLOY. MANUFACTURER: HUBBELL "HBL5262" OR APPROVED EQUAL.
- C. FOR 120 VOLT RECEPTACLES CONNECTED TO INDIVIDUAL BRANCH CIRCUITS PROVIDE STRAIGHT-BLADE NEMA 5-20R, 20 AMPERES, 125 VOLTS, GROUNDING DUPLEX RECEPTACLES. RECEPTACLE MOUNTING STRAP, GROUND TERMINAL, AND GROUND CONTACTS SHALL BE FORMED FROM ONE PIECE OF BRASS ALLOY. MANUFACTURER: HUBBELL "HBL5362" OR APPROVED EQUAL.
- D. FOR GROUND FAULT CIRCUIT INTERRUPTER (GFCI) RECEPTACLES PROVIDE STRAIGHT-BLADE NEMA 5-15R, 15 AMPERES, 125 VOLTS, GROUNDING, "FEED THROUGH" TYPE, SELF-TESTING GFCI, DUPLEX RECEPTACLE THAT MEET THE REQUIREMENTS OF UL STANDARD 943, *GROUND FAULT CIRCUIT INTERRUPTERS*. PROVIDE UNITS THAT CAN BE INSTALLED IN A 2-3/4-INCH DEEP OUTLET BOX WITHOUT AN ADAPTER. MANUFACTURER: HUBBELL "GFR5252ST." OR APPROVED EQUAL.
- E. FOR GROUND FAULT CIRCUIT INTERRUPTER (GFCI) RECEPTACLES CONNECTED TO INDIVIDUAL BRANCH CIRCUITS PROVIDE STRAIGHT-BLADE NEMA 5-20R, 20 AMPERES, 125 VOLTS, GROUNDING, "FEED THROUGH" TYPE, SELF-TESTING GFCI, DUPLEX RECEPTACLE THAT MEET THE REQUIREMENTS OF UL STANDARD 943, *GROUND FAULT CIRCUIT INTERRUPTERS*. PROVIDE UNITS THAT CAN BE INSTALLED IN A 2-3/4-INCH DEEP OUTLET BOX WITHOUT AN ADAPTER. MANUFACTURER: HUBBELL "GFR5352ST." OR APPROVED EQUAL.
- F. PROVIDE STRAIGHT-BLADE AND TWIST LOCK RECEPTACLES FOR SPECIAL APPLICATIONS AS INDICATED ON THE DRAWINGS.

2.3 RECEPTACLES, INDUSTRIAL HEAVY DUTY

- A. FOR NRTL LISTED EQUIPMENT FURNISHED WITH CORDS AND ATTACHMENT PLUGS CONFIGURED TO THE CURRENT EDITION OF NEMA WD 6, PROVIDE THE CORRESPONDING RECEPTACLES. PROVIDE RECEPTACLES THAT MEET THE PERFORMANCE AND DESIGN REQUIREMENTS OF FEDERAL SPECIFICATION WC596 AND UL STANDARD 498, *ELECTRICAL ATTACHMENT PLUGS AND RECEPTACLES*. FOR EQUIPMENT NOT FURNISHED WITH CORDS AND ATTACHMENT PLUGS

CONFORMING TO NEMA WD 6, PROVIDE RECEPTACLES AND MATCHING PLUGS AS SPECIFIED BELOW.

- B. FOR 20, 30, 60, AND 100 AMPERE HEAVY DUTY RECEPTACLE OUTLETS LOCATED IN DRY, DAMP, OR WET LOCATIONS PROVIDE PIN AND SLEEVE TYPE RECEPTACLES THAT ARE COLOR CODED AND UNIQUELY CONFIGURED TO THE PARTICULAR CIRCUIT VOLTAGE AND CURRENT RATING.
- C. PIN AND SLEEVE RECEPTACLES SHALL BE NRTL LISTED TO UL STANDARD 1682, *PLUGS, RECEPTACLES, AND CABLE CONNECTORS OF THE PIN AND SLEEVE TYPE* AND UL CLASSIFIED TO IEC STANDARDS 309-1 AND 309-2, *PLUGS, SOCKET OUTLETS, AND COUPLERS FOR INDUSTRIAL PURPOSES*, AND SERIES II RATED FOR VOLTAGES AND SERVICES.
- D. PROVIDE A BACK BOX SUITABLE FOR EACH PARTICULAR RECEPTACLE DEVICE AND INSTALLATION LOCATION.
- E. WHERE INDICATED ON THE DRAWINGS PROVIDE 20, 30, 60, AND 100 AMPERE PIN AND SLEEVE RECEPTACLES WITH SAFETY INTERLOCKS THAT WILL PREVENT MAKING OR BREAKING THE RECEPTACLE CONNECTION UNDER LOAD.
- F. FOR EACH RECEPTACLE PROVIDE A MATCHING PLUG.
- G. MANUFACTURER: PASS & SEYMOUR "IEC 309 INDUSTRIAL PRODUCTS" OR APPROVED EQUAL.

2.4 SNAP SWITCHES

- A. PROVIDE SINGLE POLE, DOUBLE POLE, THREE-WAY, FOUR-WAY AND ILLUMINATED HANDLE SNAP SWITCHES AS INDICATED ON THE DRAWINGS.
- B. SWITCHES SHALL BE RATED 20 AMPERES, 120-277 VOLTS AC, BACK AND SIDE WIRED, SCREW PRESSURE TERMINAL, QUIET TYPE AC SWITCH WITH YOKE GROUNDING SCREW. SWITCHES SHALL MEET THE PERFORMANCE AND DESIGN REQUIREMENTS OF UL STANDARD 20, *GENERAL USE SNAP SWITCHES*, AND FEDERAL SPECIFICATION WS896.
- C. MANUFACTURER: HUBBELL "HBL1220" SERIES OR APPROVED EQUAL.

2.5 WALL PLATES

- A. FOR FLUSH MOUNTED INTERIOR RECEPTACLES AND WALL SWITCHES, PROVIDE 0.032 INCH THICK (MINIMUM) BRUSHED 302/304 ALLOY STAINLESS STEEL SMOOTH WALL PLATES THAT MEET THE REQUIREMENTS OF FEDERAL SPECIFICATION WP-455A. MANUFACTURER: HUBBELL "S" SERIES OR APPROVED EQUAL.

- B. FOR SURFACE MOUNTED INTERIOR RECEPTACLES AND SWITCHES, FURNISH GALVANIZED STEEL 4 INCH SQUARE RAISED SURFACE COVERS. RECEPTACLES INSTALLED IN RAISED COVERS SHALL BE SECURED BY MORE THAN ONE SCREW. MANUFACTURER: RACO "800" SERIES OR APPROVED EQUAL.
- C. FOR GFCI RECEPTACLES IN DAMP LOCATIONS PROVIDE WEATHERPROOF, CAST ALUMINUM, HINGED, SELF-CLOSING DEVICE COVERS. MANUFACTURER: HUBBELL "WP26" OR "WPFS26" OR APPROVED EQUAL.
- D. FOR GFCI RECEPTACLES IN WET LOCATIONS PROVIDE CAST ALUMINUM, HINGED, SELF-CLOSING DEVICE COVERS THAT ARE WEATHERPROOF WHETHER OR NOT THE ATTACHMENT PLUG CAP IS INSERTED. MANUFACTURER: HUBBELL "WP26M" OR "WP26MH" OR APPROVED EQUAL.
- E. PROVIDE SINGLE, MULTI-GANG, AND COMBINATION TYPE WALL PLATES THAT MATE AND MATCH WITH CORRESPONDING WIRING DEVICES.
- F. USE METAL PLATE-SECURING SCREWS TO MATCH PLATE FINISH.

PART 3 EXECUTION

3.1 PREPARATION

- A. VERIFY OUTLET BOXES ARE INSTALLED AT PROPER LOCATIONS AND HEIGHTS.
- B. VERIFY WALL OPENINGS ARE NEATLY CUT AND WILL BE COMPLETELY COVERED BY WALL PLATES.
- C. VERIFY BRANCH CIRCUIT WIRING INSTALLATION IS COMPLETED, TESTED, AND READY FOR CONNECTION TO WIRING DEVICES.
- D. CLEAN DEBRIS FROM OUTLET BOXES BEFORE INSTALLING DEVICES.

3.2 INSTALLATION

- A. INSTALL PRODUCTS FOLLOWING MANUFACTURER'S INSTRUCTIONS. HAVE THE MANUFACTURER'S INSTALLATION INSTRUCTIONS AVAILABLE AT THE CONSTRUCTION SITE.
- B. INSTALL DEVICES PLUMB, LEVEL, AND SECURE.
- C. EXCEPT AS OTHERWISE INDICATED ON THE DRAWINGS, MOUNT DEVICES FLUSH, WITH LONG DIMENSION VERTICAL, AND GROUNDING POINT OF RECEPTACLES ON TOP. GROUP ADJACENT SWITCHES AND RECEPTACLES UNDER SINGLE, MULTI-GANG WALL PLATES.

- D. DO NOT USE THE DUPLEX/SPLIT-WIRE BREAK-OFF TABS IN RECEPTACLES AS CIRCUIT CONDUCTORS FOR CONNECTING DOWNSTREAM DEVICES.
- E. COVER DEVICES AND ASSEMBLIES DURING PAINTING.
- F. INSTALL WALL PLATES ON SWITCH, RECEPTACLE, AND BLANK OUTLETS AFTER PAINTING IS COMPLETE.
- G. INSTALL GALVANIZED STEEL PLATES ON OUTLET BOXES AND JUNCTION BOXES IN UNFINISHED AREAS, ABOVE ACCESSIBLE CEILINGS, AND ON SURFACE MOUNTED OUTLETS.

3.3 GROUNDING

- A. CONNECT WIRING DEVICE GROUNDING TERMINAL TO BRANCH CIRCUIT EQUIPMENT GROUNDING CONDUCTOR.
- B. CONNECT ISOLATED GROUND RECEPTACLE GROUNDING TERMINAL TO THE ISOLATED GROUNDING CONDUCTOR.

3.4 IDENTIFICATION

- A. Identify wiring devices with circuit number as required in Section 26 0553, Identification for Electrical Systems.

3.5 FIELD QUALITY CONTROL

- A. INSPECT EACH WIRING DEVICE FOR DEFECTS BEFORE INSTALLING.
- B. OPERATE EACH OPERABLE DEVICE AT LEAST SIX TIMES WITH CIRCUIT ENERGIZED; VERIFY PROPER OPERATION.
- C. TEST 15 AND 20 AMPERE RECEPTACLES FOR PROPER POLARITY AND GROUND CONTINUITY USING AN NRTL LISTED TEST DEVICE THAT IMPRESSES A MOMENTARY CURRENT OF AT LEAST 15 AMPERES ON THE BRANCH CIRCUIT CONDUCTORS AND EQUIPMENT GROUNDING PATH.
- D. TEST GROUND-FAULT CIRCUIT INTERRUPTER RECEPTACLE OPERATION WITH BOTH LOCAL AND REMOTE FAULT SIMULATIONS ACCORDING TO MANUFACTURER RECOMMENDATIONS.
 - 1. Verify that GFCI will trip at 5 ± 1 mA current
 - 2. Verify that GFCI does not trip at less than 1.8 mA current.
- E. REPLACE DAMAGED OR DEFECTIVE WIRING DEVICES.

3.6 CLEANING AND ADJUSTING

- A. CLEAN DEVICES AND WALL PLATES. REPLACE STAINED OR IMPROPERLY PAINTED WALL PLATES OR DEVICES.
- B. ADJUST DEVICES AND WALL PLATES TO BE FLUSH AND LEVEL.

END OF SECTION

SECTION 26 2816 - ENCLOSED SWITCHES AND CIRCUIT BREAKERS

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Safety switches
- B. Fuses
- C. Enclosed circuit breakers

1.2 SUBMITTALS

- A. Submit the following in accordance with project submittal procedures:
 - 1. Product Data: Submit manufacturer's technical data for each type of safety switch and enclosed circuit breaker, including data proving that materials comply with specified requirements. Provide catalog sheets showing voltage and current ratings, short circuit ratings, dimensions, and enclosure details.
 - 2. Installation Instructions: Indicate application conditions and limitations of use stipulated by Product testing agency specified under Regulatory Requirements. Include instructions for storage, handling, protection, examination, preparation, installation, and starting of Product.

1.3 QUALITY ASSURANCE

- A. Comply with the *National Electrical Code* (NEC) for components and installation.
- B. Provide safety switches and circuit breakers that are listed and labeled by a Nationally Recognized Testing Laboratory (NRTL) for the application, installation condition, and the environment in which installed.
- C. Comply with the following standards as applicable:
 - 1. NEMA AB 3 – *Molded Case Circuit Breakers and Their Application*
 - 2. NEMA FU 1 *Low Voltage Cartridge Fuses*
 - 3. NEMA KS 1 - *Enclosed and Miscellaneous Distribution Equipment Switches (600 Volts Maximum)*
 - 4. UL 50 - *Enclosures for Electrical Equipment.*
 - 5. UL 489 – *Molded Case Circuit Breakers, Molded Case Switches, and Circuit Breaker Enclosures*

1.4 RECEIVING, STORING AND PROTECTING

- A. Receive, inspect, handle, and store safety switches and enclosed circuit breakers according to the manufacturer's written instructions and NECA 1 *Standard Practices for Good Workmanship in Electrical Construction* (ANSI).

1.5 SERVICE CONDITIONS

- A. Provide safety switches and enclosed circuit breakers that will perform satisfactorily in the following service conditions:
 - 1. Maximum ambient temperature of 104 °F.
 - 2. 24-hour average temperature not exceeding 86 °F.
 - 3. Maximum solar heat gain: 110 W/sq.ft.
 - 4. International Building Code / ASCE 7 seismic criteria:
 - a. Seismic Design Category = D
 - b. S_{DS} = spectral acceleration, short period = 0.75g
 - c. S_{D1} = spectral acceleration, 1-second period = 0.64g
 - d. a_p = component amplification factor = 2.5
 - e. R_p = component response modification factor = 6.0

1.6 EXTRA MATERIALS

- A. Provide one spray can of touch-up paint that matches finish of switches and enclosed circuit breakers finish.
- B. Provide a spare set of three fuses of each type and size installed in fused safety switches.

PART 2 PRODUCTS

2.1 PRODUCT OPTIONS AND SUBSTITUTIONS

- A. Prior approval of alternate products is required for substitutions.

2.2 SAFETY SWITCHES

- A. Provide NRTL-listed, NEMA KS 1 Type HD safety switches with ratings and number of poles as indicated on the Drawings or as required by the NEC.
- B. Safety switches used as service equipment shall be NRTL labeled for the application.

- C. Enclosure type shall be in accordance with NEMA KS 1 and as required by the conditions of installation and use.
- D. Fusible safety switches shall have rejection clips for NEMA FU 1, Class R fuses. Provide fuse pullers in 30, 60, and 100 ampere fusible safety switches.
- E. Each safety switch shall have an equipment ground bar.
- F. Furnish a neutral bar for each safety switch used on a circuit that includes a grounded “neutral” conductor.
- G. Each safety switch shall have a factory-installed cover-mounted viewing window positioned over the blades to allow visual verification of ON-OFF status.
- H. Provide auxiliary electrical interlock switches with safety switches as indicated on the Drawings or as required by the application.
- I. Each safety switch shall have provisions for padlocking in the OFF position.
- J. Manufacturer: Square D “Class 3110” or approved equal.

2.3 FUSES

- A. Provide NRTL-listed, NEMA FU 1 Class R fuses for fusible safety switches as indicated on the Drawings, required by the NEC, or required by the manufacturer of served equipment.
- B. Size fuses in accordance with NEC requirements based upon load supplied.
- C. Provide a cabinet for spare fuses.
- D. Manufacturer: Bussman “LPN-RK_SP” (250 V), “LPS-RK_SP” (600 V), and “SFC-FUSE-CAB” or approved equal.

2.4 ENCLOSED CIRCUIT BREAKERS

- A. Provide, enclosed molded-case circuit breakers with ratings as indicated on the Drawings or as required by the NEC.
- B. Enclosed molded-case circuit breakers shall be NRTL-listed to UL 489.
- C. Multi-pole circuit breakers used on 480-volt or 480Y/277-volt systems shall be 600 V rated.
- D. Enclosed circuit breakers used as service equipment shall be NRTL labeled for the application.

- E. Enclosure type shall be in accordance with UL-50 and as required by the conditions of installation and use.
- F. Each enclosed circuit breaker shall have an equipment ground bar.
- G. Furnish a neutral bar for each enclosed circuit breaker used on a circuit that includes a grounded “neutral” conductor.
- H. Enclosed circuit breakers rated 100 amperes and larger shall be suitable for use with crimp-on compression lugs.
- I. Each enclosed circuit breaker shall have a permanently-installed provision for padlocking in the OFF position.
 - 1. Furnish handle lock-off device that will accept a 1/4-inch padlock shackle.
 - 2. Securely attach the device to the circuit breaker case; the attachment shall not depend on a friction fit or the presence of the enclosure front for the handle lock-off device to remain in place and be functional.
- J. Manufacturer: Square D “Class 610” enclosure with F, K, L, or M frame circuit breaker or approved equal.

PART 3 EXECUTION

3.1 EXISTING WORK

- A. Disconnect and remove each abandoned safety switch and enclosed circuit breaker.
- B. Maintain access to each existing safety switch and enclosed circuit breaker that is to remain active.
- C. Clean, repair, and test existing safety switches and enclosed circuit breakers to remain or be reinstalled for the project per the Field Quality Control paragraphs of this Section.

3.2 EXAMINATION

- A. Examine surfaces to receive safety switches and enclosed circuit breakers for compliance with installation tolerances and other conditions affecting performance of the product. Do not proceed with installation until unsatisfactory conditions have been corrected.

3.3 INSTALLATION

- A. Install safety switches and enclosed circuit breakers where indicated on the Drawings and according to manufacturer's instructions, NECA 1, and the *NEC*. Have the manufacturer’s installation instructions available at the construction site.

- B. Install each safety switch and enclosed circuit breaker so the interlock bypass will be accessible.
- C. Provide supports and seismic anchorage in accordance with the manufacturer's installation instructions and Section 26 0529, Hangers and Supports for Electrical Systems.
- D. Ground and bond safety switches and enclosed circuit breakers as required in Section 26 0526, Grounding and Bonding for Electrical Systems.
- E. Install conduits as required in Section 26 0533, Raceways and Boxes for Electrical Systems.
- F. Install conductors as required in Section 26 0519, Low Voltage Electrical Power Conductors and Cables.
 - 1. Use compression type lugs to connect all service, feeder, and branch circuit cables to enclosed circuit breakers rated greater than 100 amperes.
 - 2. Tighten electrical connectors and terminals to the manufacturer's published torque-tightening values. Where manufacturer's torque values are not indicated, use those specified in UL 486A.
- G. Install fuses in fusible safety switches as indicated on the Drawings or as required to match installed motor or load characteristics. Apply adhesive tag on inside door of each fused switch indicating NEMA fuse class and size installed.

3.4 IDENTIFICATION

- A. Identify safety switches and enclosed circuit breakers and install warning signs and arc-flash warning labels as required in Section 26 0553, Identification for Electrical Systems.
- B. Provide permanent indication of trip rating of each enclosed circuit breaker or fuses installed in each enclosed switch that will be visible without opening cover and exposing energized conductors.
- C. Mark floor in front of safety switches and enclosed circuit breakers to show NEC required working space according to Section 26 0553, Identification for Electrical Systems.

3.5 FIELD QUALITY CONTROL

- A. Clean interior and exterior of safety switches and enclosed circuit breakers.
- B. Verify that ratings for safety switches and enclosed circuit breakers match values indicated on the Drawings.

- C. Verify proper torque of accessible bus connections and mechanical fasteners after installing safety switches and enclosed circuit breakers.
- D. After completing installation, cleaning, and testing, touch up scratches and mars on finish to match original finish.

END OF SECTION

SECTION 28 31 00 - FIRE DETECTION AND ALARM SYSTEM (CONVENTIONAL)

PART 1 - GENERAL

3.14 GENERAL REQUIREMENTS/SCOPE

- A. Provide a complete and operable fire detection and alarm system as specified herein and as shown on the drawings. The system shall comprise all necessary component parts as described in Part 2 to provide the functions and facilities described in Part 3, and obtain the required approvals. The fire alarm control panel (FACP) is existing to remain.
- B. The entire system shall conform to Titles 8, 19, and 24; California Code of Regulations, including all referenced standards. All equipment shall be UL Listed, FM-approved, and currently listed by the California State Fire Marshal.
- C. Scope: At the minimum, the project shall include the following:
 - 1. FACP is to remain as indicated on the drawings.
 - 2. Provide duct-mounted smoke detectors as specified herein and as indicated on the drawings.
 - 3. Provide duct-mounted smoke detectors in the main supply-air duct(s) to effect shutdown of each air handler rated at supplying more than 2000 CFM. Provide duct-mounted smoke detectors to actuate smoke/fire dampers as shown on the drawings.

3.15 CLARIFICATION

- A. Where this section references Fire Marshal involvement, the Contractor's contact with the Fire Marshal shall be via the Owner's Representative. All documents and other materials shall be submitted to the Owner's Representative.
- B. Whenever the term "system" is used herein without additional modification, it shall be taken to mean the fire detection and alarm system. The system shall be as defined in Section 204(c), Title 19, California Code of Regulations. It shall not be construed as including auxiliary circuits such as those associated with elevator recall, elevator machine electrical power disconnection, fan and smoke control system controls/devices, magnetic door hold-open release relays, and/or automatic-closing doors.
- C. Unless otherwise specified, all system circuits (including, but not limited to initiating device, notification appliance, and relay circuits) shall be considered to start and end at the FACP.
- D. The existing fire alarm system shall be maintained in a fully-operational status throughout the installation of the new equipment, except as specifically required (e.g., for installation of modules within the FACP, connection of new equipment to the system, etc.). Any modifications to the system shall be made in the presence of, or with the prior knowledge and approval of the Owner's fire alarm technician. It shall be the responsibility of the Contractor to ensure that the Police Department has been notified in advance of any planned or potential change in the status of the system; any fines assessed by the San Diego Fire Department for

false alarms due to the failure of the Contractor to so notify the Police Department shall be the sole responsibility of the Contractor.

3.16 MANUFACTURERS

- A. Equipment shall be manufactured by Edwards This is a necessary item, that is only available from the listed source, or it is required to match existing facility standards, and no other product shall be furnished.
- B. All major equipment (including, but not limited to initiating devices, notification appliances, and control elements) shall be the product of the manufacturer of the FACP.

3.17 SYSTEM CONTRACTOR QUALIFICATIONS

- A. The system specified herein and as described on the drawings (including but not limited to materials, design, installation and testing) shall be provided by a single contractor, identified hereafter as the system contractor, qualified as described below. There shall be no further subdivision of this work.

EXCEPTION: THE SYSTEM CONTRACTOR MAY SUBCONTRACT THE PROVIDING OF CONDUIT, TERMINAL CABINETS, AND/OR WIRING TO A C-10 CONTRACTOR QUALIFIED AS PER 1.4.B AND 1.4.C. THE SYSTEM CONTRACTOR SHALL REMAIN RESPONSIBLE FOR COMPLIANCE WITH THIS SPECIFICATION AND THE DRAWINGS.

- B. The system contractor shall hold a current California C-10 contractor's license, and shall have held this license, under the currently-licensed business name, for a period of not less than five years as of the date of bidding the job.
- C. The system contractor shall demonstrate satisfactory installations of comparable systems over a period of not less than five years immediately preceding the date of bidding this job, including references.
- D. The system contractor shall be a factory-authorized distributor of the manufacturer of the specified FACP, and shall have been so continuously for a period of not less than five years as of the date of bidding the job. Additionally, the system contractor shall employ design personnel and installation technicians who have been factory-trained on the specified FACP.
- E. The system contractor shall prove the ability to provide emergency restoration service within 12 hours by factory-certified personnel.
- F. The system contractor shall be capable of providing drawings in AutoCAD[®], Release 14 (or higher), format.

3.18 RELATED WORK

- A. Firestopping; Section 07 84 00
- B. Mechanical (HVAC); Division 23
- C. Electrical; Division 26 (General; Conductors; Conduit and Raceway)

FIRE DETECTION AND ALARM SYSTEM (CONVENTIONAL)

Section 28 31 00

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Attachment E - Technicals

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NOTE: THESE SECTIONS ARE REFERENCED FOR COORDINATION REQUIREMENTS BETWEEN FIRE ALARM CONDUIT AND OTHER CONDUIT AND FOR METHODS OF INSTALLATION SHALL COMPLY WITH DIVISION 26. IN THE EVENT OF CONFLICT BETWEEN THIS AND ANY OTHER SECTION, THIS SECTION SHALL TAKE PRECEDENCE.

3.19 SUBMITTALS

- A. Approval from the Owner's Representative and Fire Marshal must be obtained for all components of the system submittal (including but not limited to: system contractor qualifications, material data sheets, and shop drawings). Submittals having any content which is incomplete or unclear will be returned without review or approval. If all components of the system submittal have not been approved due to Contractor's incompleteness or errors, the Owner shall have the right to require the Contractor to cancel the system contractor's contract and to engage the services of a substitute system contractor at Contractor's expense.

NOTE: FIRE MARSHAL APPROVAL OF SUBMITTALS IS FOR PERMISSION TO PROCEED AND DOES NOT AUTHORIZE DESIGN, PRODUCTS, OR INSTALLATION NOT CONFORMING TO REFERENCED CODES AND STANDARDS AND THIS SPECIFICATION. ALTERNATES REQUIRE SPECIFIC APPROVAL BY THE FIRE MARSHAL.

- B. Submit evidence of the system contractor's current California C-10 contractor's license and list of comparable installations required by 1.4 herein.
- C. Submit catalog data sheets for all materials. Submit factory installation manuals/sheets for each component to be installed in the system. Data sheets/factory installation manuals/sheets are required for all system components, including but not limited to: initiating devices, cabinets, enclosures, conduit, wiring conductors, and relays. All equipment drawing alarm or supervisory current shall have documentation of the current draw highlighted in the submittal information. Submittals shall include State Fire Marshal Listing Sheets, including listing number with annual update and expiration date, for every system component. Submittals will be automatically rejected if complete listing information does not accompany submittal. Submit one original copy of the latest edition of the operation, maintenance, and installation manual(s) (whichever exist) for each FACP submitted.
- D. Submit shop drawings.
1. After approval of the above materials submittal, submit installation shop drawings, prepared by a designer who has been factory-trained on the specified FACP. Working drawings shall be submitted in complete sets (partial submissions will not be accepted). Working drawings shall include, at a minimum:
 - a. A title sheet, which includes a sheet index, a scaled site plan, an initiating device zone chart, a notification appliance zone chart, a combination parts list/symbol legend, and an annunciator zone schedule.
 - b. Standby power battery calculation(s) for devices added to existing system.
 - c. A complete riser diagram.

- d. Complete point-to-point wiring schematics.
 - e. A proposed conduit layout diagram, indicating the size and specific wires in each segment of conduit, the location of each piece and device (including identification of the initiating device/notification appliance circuit to which each is connected), the address of each addressable device, the location of all partitions, with specific identification of all fire walls, and the name and occupancy classification of each area or room.
- E. Operation and Maintenance Manuals: Submit two (2) manuals, each of which shall include all instructions necessary for operation and required maintenance of the system, complete circuit diagrams, wiring and termination schedule for each circuit entering and on leaving each piece of equipment, schematic diagrams of each major component, including a replacement parts list with part numbers, name, and telephone number of local supplier. Include any portions of the material list and shop drawings which are not included in the foregoing.
- F. Certification: Furnish written certification from the system supplier that the system is in compliance with all applicable code requirements.
- G. As-builts: Submit a total of three (3) sets of final as-built drawings, which shall be sufficiently complete as to facilitate trouble shooting and repair of the system, as follows: two (2) sets shall be blue-line (or equal) reproduction copies, and one (1) set shall be on an MS-DOS-formatted CD-ROM in AutoCAD[®], Release 14 (or higher) .DWG format with no X-Refs. In particular, the drawings shall identify every change of wiring/conduit direction accomplished by other than bending, including, but not limited to: junction boxes, pull boxes, LBs, LLs, LRs, entrance Ls, etc. Final approvals are subject to receipt of acceptable as-built drawings. Submittal of a single blue-line (or equal) reproduction draft copy for review prior to the final submission is encouraged.

3.20 COORDINATION

- A. The Contractor shall be specifically responsible for ensuring that no system components (including but not limited to: conduit, wire, terminal cabinets, junction boxes and/or device boxes) shall be installed prior to their having been detailed on approved shop drawings. The Contractor shall be specifically responsible for ensuring that coordination between the system work and the fire protection system work takes place to ensure full awareness of the location of all fire protection system components (including, but not limited to control valves, flow switches and tamper switches) requiring connection to the system. Further, the Contractor shall be specifically responsible for ensuring that coordination between the system work and other work takes place to ensure full awareness of the location of all components/devices requiring connection to the system (including, but not limited to: fan and smoke control system controls/devices, magnetic door hold-open release relays, and automatic-closing doors).

PART 4 - PRODUCTS

- A. All materials and equipment installed as part of this work shall be new, and the manufacturer's current model.

2.1 GENERAL

- B. The Contractor shall furnish and install a complete supervised system consisting of one FACP (existing), initiating devices, relay modules, metallic conduit, boxes, wiring, and other components as required for a functional system.

4.2 FIRE ALARM CONTROL PANEL

- A. The fire alarm control panel is manufactured by Edwards and is existing.
- B. Each initiating device and notification appliance zone shall include power-limited circuits, individual supervisory and alarm functions and shall be so arranged that a fault condition in any circuit shall not affect the specified operation of any other circuits, and so that a fire alarm signal takes precedence over any other signal. Zone functions shall be modular, plug-in devices with no more than two circuits per module (not more than four circuits per module with integral disconnect switches). There shall be one supervised zone circuit for each annunciation point. The unit shall include the following module types:
 - 1. Initiating Device Circuit (IDC) Module: Each initiating zone shall consist of a Style D (Class A) circuit and shall accommodate at least 30 smoke detectors and any quantity of shorting type contact devices, intermixed as desired. Upon operation of any device on the circuit, the system shall latch in alarm, unless otherwise directed in this Specification. Each circuit shall include alarm and trouble lamps. Automatic devices shall be on separate zones independent of manual station zones.
 - 2. Supplementary Relay Module: These modules shall be provided for the control of external devices where dry contacts are required for interfacing.
- C. Power Supplies: Each power supply shall be 120 VAC, single phase, of UL Listed capacity to operate the system fully loaded. Supply shall be reduced to 24 VDC for operation of the system. Power supplies shall be supervised for, and shall initiate a trouble signal in the FACP in case of any of the following conditions: loss of AC power, low battery voltage, and absence of battery.

NOTE: THE ABOVE REQUIREMENTS APPLY EQUALLY TO ANY SUPPLEMENTARY AND/OR AUXILIARY POWER SUPPLIES DETERMINED NECESSARY TO FULLY POWER THE SYSTEM, AS WELL AS TO THE ANNUNCIATOR POWER SUPPLY.

- D. The FACP shall have the capacity to be zoned in accordance with 3.2.A.7.

4.3 MANUAL FIRE ALARM STATIONS

- A. Manual fire alarm stations are existing to remain

4.4 SMOKE DETECTORS

- A. Photoelectric Smoke Detectors are existing to remain
- B. Duct smoke detectors shall provide full cross-sectional sampling of the duct, and be listed for operation at a minimum airflow of 100 feet per minute. Auxiliary alarm dry contacts shall be

provided. Duct smoke detectors shall be provided and connected to the system in the work of this section. Duct smoke detectors shall be installed and connected to the fan control system, or to smoke/fire dampers, in the work of Division 15.

4.5 "Not Used"

4.6 "Not Used"

4.7 "Not Used"

4.8 "Not Used"

4.9 "Not Used"

4.10 NOTIFICATION APPLIANCES

- A. Audible/Visual Notification Appliances are existing to remain

4.11 BATTERIES

- A. Batteries shall be rated for the capacity to operate the system in a full supervisory mode with AC power removed for 24 hours followed by operation of all notification appliances for 5 minutes. Batteries shall be lead-calcium, sealed, maintenance-free type.

NOTES:

1. **THE CALCULATIONS DONE TO DETERMINE THE SIZE BATTERIES NECESSARY TO MEET THIS REQUIREMENT SHOULD BE ACCOMPLISHED IN ACCORDANCE WITH THE RECOMMENDATIONS OF THE BATTERY MANUFACTURER WITH REGARD TO THE EFFECTS OF APPLYING A HIGH-CURRENT LOAD AFTER A LONG PERIOD OF LOW-CURRENT LOAD. REGARDLESS OF THE METHOD USED FOR THE CALCULATIONS, AND/OR THE BATTERY SIZE(S) SHOWN ON APPROVED SHOP DRAWINGS, THE SYSTEM CONTRACTOR IS RESPONSIBLE FOR PROVIDING BATTERIES WITH THE CAPACITY REQUIRED TO SUCCESSFULLY DEMONSTRATE COMPLIANCE WITH THIS REQUIREMENT.**
2. **THE ABOVE REQUIREMENTS APPLY EQUALLY TO ANY BATTERIES ASSOCIATED WITH SUPPLEMENTARY AND/OR AUXILIARY POWER SUPPLIES DETERMINED NECESSARY TO FULLY POWER THE SYSTEM, AS WELL AS TO THE ANNUNCIATOR POWER SUPPLY.**

4.12 BATTERY CABINETS

- A. Each battery cabinet shall be a separate, locking cabinet manufactured for the purpose.

PART 5 - EXECUTION

5.1 INSTALLATION

NOTE: ALL MATERIALS AND EQUIPMENT SHALL BE INSTALLED IN STRICT COMPLIANCE WITH THE MANUFACTURER'S RECOMMENDATIONS AND/OR INSTALLATION INSTRUCTIONS.

- A. Locate and install conduit, devices, equipment, and accessories as specified. FACPs shall be located in approved electrical rooms.
1. All conduit, devices, and equipment shall be attached to walls and ceiling/floor assemblies and shall be held firmly in place. Smoke detectors shall not be supported solely by suspended ceilings. Fasteners and supports shall be adequate to support the required load.
 2. All equipment and devices installed in exterior or other locations exposed to the outside environment shall be approved and UL Listed for such application, or shall be installed in a NEMA 4X enclosure. All conduit, fittings and hardware shall be corrosion resistant rigid type.
 3. All modules (e.g., monitor modules, control modules, signal modules, and isolator modules) shall be installed within an FATC.

EXCEPTION: MINIATURE MONITOR MODULES MAY BE INSTALLED WITHIN INTERIOR OR WEATHERPROOF EXTERIOR MANUAL FIRE ALARM STATION BACKBOXES.

4. Provide a lockdown clip for each circuit breaker supplying power to system components. Circuit breakers shall be permanently and clearly identified at the circuit breaker panel by red marking and shall be identified as FIRE ALARM CIRCUIT. Additionally, the location and designation of the circuit breaker panel, and the circuit breaker number(s) shall be permanently and clearly identified at the powered system component.
 5. Penetrations of fire-rated construction shall be firestopped using an approved, listed through-penetration firestop system (see Section 07 84 00).
 6. Install duct detectors on the vertical sides of ducts only.
- B. System wiring shall conform to the following requirements:
1. All wire shall be new.
 2. Minimum wire size shall be No. 12 AWG (No. 14 AWG permitted for IDC and NAC wiring not exceeding 25 VDC), type THWN, 600 volt, solid copper. Wire size shall be increased as required to maintain voltage and current capacity. Voltage drop shall not exceed manufacturer's listing for NACs, but shall in no case exceed 10 percent.
 3. All system circuits (including, but not limited to initiating device, notification appliance, power, and relay circuits) shall be run above-grade and/or overhead (i.e., there shall be no system circuit wiring in or below floor slabs).

EXCEPTION: VISUAL ANNUNCIATOR CIRCUIT WIRING AND POST INDICATOR VALVE TAMPER SWITCH CIRCUIT WIRING.

4. Wiring shall be continuous from field devices and to the FACP. Splicing (whether in terminal boxes, junction boxes, device boxes, or below-grade) shall not be permitted. Parallel branches ("T" taps) are not permitted regardless of the method of supervision employed.

EXCEPTION: DEVICES AVAILABLE ONLY WITH "PIG-TAIL" CONNECTIONS SHALL BE CONNECTED TO THE CIRCUIT WIRING USING APPROVED INSULATED WIRE NUTS.

5. Only those wires directly serving a duct detector shall be routed through its housing.
- C. Conduit shall be provided and configured to conform to the following requirements:
1. All wiring shall be in metal conduit, concealed in interior locations. Minimum conduit size shall be 0.75-inch. EMT conduit shall be used in all above-ground locations, except that rigid steel conduit (PVC-coated where indicated below) shall be used in the following locations:
 - a. Where required by code.
 - b. In electrical, mechanical, and machine rooms.
 - c. Where exposed to weather (PVC-coated).
 - d. Where exposed and below 7 feet 6 inches above finished floor.
EXCEPTION: IN OCCUPIED OR FINISHED SPACES.
 - e. Where exposed to physical damage.
 - f. In corrosive areas (PVC-coated).
 - g. In damp or wet locations (PVC-coated).
 2. All system wiring shall be installed in conduit independent of all other electrical circuits.
 3. All styles of Class A circuits (initiating device circuits and notification appliance circuits) shall be wired without parallel branches, with return conductors separate (i.e., in separate conduit) from outgoing conductors, and are to start at and return to the main FATC. Conduit containing outgoing conductors shall be physically separated from conduit containing return conductors by not less than 12 inches horizontally; there is no separation requirement for vertical conduit.

EXCEPTIONS:

1. **CONDUIT CONTAINING OUTGOING CONDUCTORS AND CONDUIT CONTAINING RETURN CONDUCTORS SEPARATED**

BY A WALL OF NOT LESS THAN ONE-HOUR FIRE-RESISTIVE CONSTRUCTION MAY BE SPACED CLOSER.

2. **OUTGOING AND RETURN CONDUCTORS MAY BE ROUTED THROUGH THE SAME CONDUIT FOR A DISTANCE OF NOT MORE THAN 10 FEET TO AN INITIATING DEVICE, NOTIFICATION APPLIANCE, OR CONTROL UNIT ENCLOSURE.**
4. Initiating device circuits and notification appliance circuits shall each be installed in separate conduit from one another. No circuit shall pass through a device mounting box, J-box, pull-box, or any other component of any other circuit.

EXCEPTION: FOR RISERS CONNECTING FLOOR FATCs, INITIATING DEVICE CIRCUITS AND NOTIFICATION APPLIANCE CIRCUITS MAY BE INSTALLED IN THE SAME CONDUIT.

5. Maximum conduit fill shall be 75 percent of that permitted by the California Electrical Code.
6. All system conduit shall be externally identified with 2-inch wide bands at maximum 5-foot intervals, but at least in each space, by permanent red paint or tape suitable for the purpose. All junction box covers shall be externally identified by permanent red paint suitable for the purpose.

NOTES:

1. **WHERE SYSTEM CONDUIT IDENTIFICATION IS UNAMBIGUOUS, THE FIRE MARSHAL MAY PERMIT INCREASED SPACING, UP TO A MAXIMUM OF 20-FOOT INTERVALS.**
 2. **CONDUIT CONTAINING AUXILIARY CIRCUIT WIRING AS DEFINED IN 1.2.B ARE NOT TO BE SO IDENTIFIED.**
 7. Conduit shall be arranged such that only those wires directly serving a duct detector are routed through its housing.
 8. Conduit shall not penetrate shaft walls nor be routed within shafts unless serving system components located within the shaft. Where a system component is located within a shaft, wiring to it shall be by means of a single conduit as permitted by Exception 2 to 3.1.D.2.
- D. Initiating Device Circuits (IDCs) and initiating devices shall be installed to comply with NFPA 72 and the following requirements:
1. Provide wiring and connections to devices (such as, but not limited to: duct smoke detectors; electrically-actuated smoke dampers; and roll-down fire door releasing devices) installed by other work.

2. Smoke or heat detectors located within concealed spaces (e.g., duct detectors located above the ceiling, in interstitial spaces, etc.) or in other areas not readily accessible (e.g., installed on roof-mounted air handling equipment, above 8 feet A.F.F., etc.) shall be provided with readily-accessible remote alarm LED/test stations located in an approved location. Smoke or heat detectors located within normally-locked rooms/spaces shall be provided with readily-visible remote alarm LEDs located in an approved location outside the normally-locked room/space.

NOTE: REMOTE ALARM LED/TEST STATIONS CONNECTED TO DUCT DETECTORS FOR CLOSURE OF SMOKE/FIRE DAMPERS IN CORRIDOR WALLS REQUIRED TO BE OF FIRE-RESISTIVE CONSTRUCTION SHALL BE INSTALLED IN THE CORRIDOR, REGARDLESS OF WHICH SIDE OF THE WALL THE DETECTOR IS ACTUALLY LOCATED ON.

3. Duct smoke detectors shall be installed in accordance with the manufacturer's written installation instructions, especially those portions having to do with required air differential pressure (see 3.6.D.12). Detectors failing the air pressure differential testing shall be relocated as necessary to permit passing the test.
4. If use of the FACP alarm verification capability requires that the initiating device circuits be arranged in any special manner, they shall be so arranged.

5.2 GENERAL SYSTEM OPERATION

A. Basic Performance:

1. "Not Used"
2. Initiation device circuits shall be Style D (Class A).
3. Notification appliance circuits shall be Style Z (Class A).
4. Digitized electronic signals shall employ check digits or multiple polling.
5. "Not Used"
6. Alarm signals arriving at the FACP shall not be lost following a power failure (or outage) until the alarm signal is processed and recorded.
7. The system shall be zoned as follows:
 - a. Duct smoke detection for shutdown of air handling units: by controlled air handling unit.
8. Resetting of all devices shall be a single operation accomplished at the FACP.
9. Silencing of an alarm shall not prevent subsequent zones from initiating and indicating an alarm in a non-interfering manner.

NOTE: DURING CONSTRUCTION, THE CONTRACTOR SHALL ENSURE THAT THE SYSTEM CONTRACTOR COORDINATE REQUIREMENTS

WITH THE FIRE MARSHAL TO PROVIDE A SYSTEM FULLY-COMPLIANT WITH THIS SPECIFICATION.

- B. The system shall be installed and wired with all necessary equipment, wiring, conduit, and hardware to perform all designated functions. Activation of any alarm initiating device shall perform, as a minimum, the following:
1. The System (Fire) Alarm LED shall flash.
 2. A local piezo-electric signal in the FACP shall sound.
 3. The 80-character LCD display shall indicate all information associated with the fire alarm condition, including the type of alarm point and its location within the protected premises.
 4. Activate all notification appliances throughout the building. Unless otherwise approved in advance by the Fire Marshal, all audible notification appliances and visual notification appliances throughout the building shall be synchronized.
 5. All system output programs assigned via control-by-event equations to be activated by the particular point in alarm shall be executed, and the associated system outputs (notification appliances and/or relays) shall be activated.
 6. Cause annunciation by zone at the annunciator.
 7. Transmit an alarm condition to the Fire Alarm Monitoring Station.
 8. Continue the alarm condition until manually reset.
 9. Release all door holders in the building.
 10. Operate building location strobe/annunciator lights (provided with non-coded power) until manually reset (not silenceable).
 11. All alarms originating from smoke detectors (including duct detectors) shall undergo alarm verification (maximum delay: 60 seconds) prior to initiating a general alarm condition.
- C. Activation of any system trouble or supervisory condition shall be indicated audibly and visually at the FACP and annunciator panel and shall transmit a trouble signal to the Fire Alarm Monitoring Station. Trouble in one zone shall not interfere with the operation of the remaining zones.
- D. Activation of a duct smoke detector for closure of a smoke/fire damper shall initiate the closure of the associated damper, as well as initiating an alarm at the FACP.
- E. Operation of the SIGNAL (ALARM) SILENCE switch at the FACP shall deactivate all alarm notification appliances (both audible and visual, except for the building location strobe lights). Activation of an alarm initiating device on any other IDC zone than that associated with the original alarm shall cause them to be reactivated.

- F. Activation of a smoke or heat detector with an associated remote alarm LED shall result in illumination of the alarm LED.

5.3 IDENTIFICATION

- A. Provide identification of equipment and materials.

5.4 GROUNDING

- A. All metallic conduit, cabinets, junction boxes, and exposed non-current-carrying metal parts shall be permanently grounded. A separate No. 10 AWG conductor shall connect a grounding bus bar located in the main FATC to building ground. The bus bar shall be provided with a minimum of five tubular, pressure type screw terminals sized for No. 18 AWG through No. 10 AWG wire. The ground wire for the FACP and the main FATC shall be grounded via the bus bar.

5.5 DOCUMENTATION

- A. Copies of complete as-built installation wiring documentation, internal FACP schematics, and maintenance manuals are to be submitted prior to final acceptance.

5.6 SYSTEM ACCEPTANCE TESTING

- A. Prior to acceptance testing of the system, it shall be tested and adjusted by the contractor under the supervision of a factory-trained engineer or technician authorized by the manufacturer of the fire alarm equipment to technically supervise and participate during all of the adjustments and tests for the system.
- B. When the system is complete and operating normally in all respects, the Contractor shall furnish necessary equipment and personnel to perform acceptance testing, as described herein. Acceptance testing shall be accomplished in the presence of the Fire Marshal and the Owner's Representative, and at the direction of the Fire Marshal. The purpose of the testing is to ensure that all equipment and devices are installed in an approved manner and are performing as specified. Any deficiencies found must be rectified and the system retested.
- C. The system contractor shall provide not less than two persons, at least one of whom shall have been personally involved in the installation of the system, and at least one of whom shall have been personally involved in the programming/start-up of the system. In addition, the system contractor shall provide not less than three units of two-way communication equipment capable of communicating between any two points within the building. Finally, the system contractor shall have available for, and to be retained by the Fire Marshal a preliminary set of as-built drawings, and at least one copy of the operation manual for the FACP.
- D. Testing will include, but not be limited to the following:
 - 1. Before energizing the cables and wires, check for correct connections and test for short circuits, ground faults, continuity, and insulation.
 - 2. Open initiating device circuits and verify that the trouble signal actuates.

3. "Not Used"
4. Open and short notification appliance circuits and verify that trouble signal actuates.
5. Ground all circuits and verify response of trouble signals.
6. Check presence and audibility of all notification appliances.
7. Each of the alarm conditions that the system is required to detect shall be introduced on the system. Verify the proper receipt and the proper processing of the signal at the FACP and the correct activation of the control points.
8. With the air handling unit turned on, and all filters and dampers in place, measure the air differential pressure on all duct smoke detectors which use sampling tubes.
9. When any defects are detected, make repairs or install replacement components, and repeat the tests as required.
10. When all other tests have been completed to the satisfaction of the Owner's Representative, the system shall be continuously operated on battery power for a period not less than 24 hours, immediately followed by a period not less than 5 minutes during which all notification appliances shall operate continuously. The test shall be considered to have been successfully accomplished if all notification appliances operate as specified throughout the 5-minute period.

5.7 INSTRUCTION

- A. The Contractor shall provide the services of a system manufacturer's trained and authorized engineer/technician for providing instruction and training to Owner's personnel in the operation, maintenance and repair of the complete system. The instruction and training shall be held at the Owner's premises or at an authorized training facility in two sessions of 8 hours each, and shall be provided at no additional cost. "Hands-on" demonstrations of the operation of all system components and the entire system including program changes and functions shall be provided.
- B. A typewritten "Sequence of Operation" shall be provided.

END OF SECTION

SUPPLEMENTARY SPECIAL PROVISIONS

APPENDICES

APPENDIX A
NOTICE OF EXEMPTION

NOTICE OF EXEMPTION

TO: X RECORDER/COUNTY CLERK
P.O. BOX 1750, MS A-33
1600 PACIFIC HWY, ROOM 260
SAN DIEGO, CA 92101-2422

FROM: CITY OF SAN DIEGO
DEVELOPMENT SERVICES DEPARTMENT
1222 FIRST AVENUE, MS 501
SAN DIEGO, CA 92101

OFFICE OF PLANNING AND RESEARCH
1400 TENTH STREET, ROOM 121
SACRAMENTO, CA 95814

PROJECT No.: N/A PROJECT TITLE: RANCHO PENASQUITOS LIBRARY AND ROOF REPLACEMENT

PROJECT LOCATION-SPECIFIC: 13330 Salmon River Road within the Rancho Penasquitos Community Planning Area.

PROJECT LOCATION-CITY/COUNTY: San Diego/San Diego

DESCRIPTION OF NATURE, PURPOSE, AND BENEFICIARIES OF PROJECT: The project would consist of the replacement of the Heating, Ventilation and Air Conditioning (HVAC) unit and an approximate 20,650 square-foot roof on the City-owned Rancho Penasquitos Branch Library.

NAME OF PUBLIC AGENCY APPROVING PROJECT: City of San Diego

Name of Person or Agency Carrying Out Project:

Julian Espinoza, Associate Engineer (619) 533-4384
Engineering and Capital Projects Department, City of San Diego
600 B Street, San Diego CA 92101

EXEMPT STATUS: (CHECK ONE)

- MINISTERIAL (SEC. 21080(b)(1); 15268);
- DECLARED EMERGENCY (SEC. 21080(b)(3); 15269(a));
- EMERGENCY PROJECT (SEC. 21080(b)(4); 15269(b)(c))
- CATEGORICAL EXEMPTION; 15301, "EXISTING FACILITIES" / 15302 (Replacement + Reconstruction)
- STATUTORY EXEMPTIONS;

REASONS WHY PROJECT IS EXEMPT: The project qualifies for the Existing Facilities categorical exemption due to the limited scope of repair and replacement work and due to the fact that the project would not trigger any exceptions to the exemption.

LEAD AGENCY CONTACT PERSON: Marc Cass

TELEPHONE: (619) 533-6678

IF FILED BY APPLICANT:

- 1. ATTACH CERTIFIED DOCUMENT OF EXEMPTION FINDING.
- 2. HAS A NOTICE OF EXEMPTION BEEN FILED BY THE PUBLIC AGENCY APPROVING THE PROJECT?
 YES NO

IT IS HEREBY CERTIFIED THAT THE CITY OF SAN DIEGO HAS DETERMINED THE ABOVE ACTIVITY TO BE EXEMPT FROM CEQA

Marc Cass
SIGNATURE/TITLE

4/14/10
DATE

CHECK ONE:

- SIGNED BY LEAD AGENCY
- SIGNED BY APPLICANT

DATE RECEIVED FOR FILING WITH COUNTY CLERK OR OPR:

Revised April 12, 2010mjh

APPENDIX B
FIRE HYDRANT METER PROGRAM

| | | |
|---|--------------------------------|---|
| CITY OF SAN DIEGO CALIFORNIA DEPARTMENT INSTRUCTIONS | NUMBER DI 55.27 | DEPARTMENT Water Department |
| SUBJECT FIRE HYDRANT METER PROGRAM (FORMERLY: CONSTRUCTION METER PROGRAM) | PAGE 1 OF 10 | EFFECTIVE DATE October 15, 2002 |
| | SUPERSEDES DI 55.27 | DATED April 21, 2000 |

1. **PURPOSE**

- 1.1 To establish a Departmental policy and procedure for issuance, proper usage and charges for fire hydrant meters.

2. **AUTHORITY**

- 2.1 All authorities and references shall be current versions and revisions.
- 2.2 San Diego Municipal Code (NC) Chapter VI, Article 7, Sections 67.14 and 67.15
- 2.3 Code of Federal Regulations, Safe Drinking Water Act of 1986
- 2.4 California Code of Regulations, Titles 17 and 22
- 2.5 California State Penal Code, Section 498B.0
- 2.6 State of California Water Code, Section 110, 500-6, and 520-23
- 2.7 Water Department Director

Reference

- 2.8 State of California Guidance Manual for Cross Connection Programs
- 2.9 American Water Works Association Manual M-14, Recommended Practice for Backflow Prevention
- 2.10 American Water Works Association Standards for Water Meters
- 2.11 U.S.C. Foundation for Cross Connection Control and Hydraulic Research Manual

3. **DEFINITIONS**

- 3.1 **Fire Hydrant Meter:** A portable water meter which is connected to a fire hydrant for the purpose of temporary use. (These meters are sometimes referred to as Construction Meters.)

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3.2 **Temporary Water Use:** Water provided to the customer for no longer than twelve (12) months.

3.3 **Backflow Preventor:** A Reduced Pressure Principal Assembly connected to the outlet side of a Fire Hydrant Meter.

4. **POLICY**

4.1 The Water Department shall collect a deposit from every customer requiring a fire hydrant meter and appurtenances prior to providing the meter and appurtenances (see Section 7.1 regarding the Fees and Deposit Schedule). The deposit is refundable upon the termination of use and return of equipment and appurtenances in good working condition.

4.2 Fire hydrant meters will have a 2 ½" swivel connection between the meter and fire hydrant. The meter shall not be connected to the 4" port on the hydrant. All Fire Hydrant Meters issued shall have a Reduced Pressure Principle Assembly (RP) as part of the installation. Spanner wrenches are the only tool allowed to turn on water at the fire hydrant.

4.3 The use of private hydrant meters on City hydrants is prohibited, with exceptions as noted below. All private fire hydrant meters are to be phased out of the City of San Diego. All customers who wish to continue to use their own fire hydrant meters must adhere to the following conditions:

a. Meters shall meet all City specifications and American Water Works Association (AWWA) standards.

b. Customers currently using private fire hydrant meters in the City of San Diego water system will be allowed to continue using the meter under the following conditions:

1. The customer must submit a current certificate of accuracy and calibration results for private meters and private backflows annually to the City of San Diego, Water Department, Meter Shop.

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2. The meter must be properly identifiable with a clearly labeled serial number on the body of the fire hydrant meter. The serial number shall be plainly stamped on the register lid and the main casing. Serial numbers shall be visible from the top of the meter casing and the numbers shall be stamped on the top of the inlet casing flange.
3. All meters shall be locked to the fire hydrant by the Water Department, Meter Section (see Section 4.7).
4. All meters shall be read by the Water Department, Meter Section (see Section 4.7).
5. All meters shall be relocated by the Water Department, Meter Section (see Section 4.7).
6. These meters shall be tested on the anniversary of the original test date and proof of testing will be submitted to the Water Department, Meter Shop, on a yearly basis. If not tested, the meter will not be allowed for use in the City of San Diego.
7. All private fire hydrant meters shall have backflow devices attached when installed.
8. The customer must maintain and repair their own private meters and private backflows.
9. The customer must provide current test and calibration results to the Water Department, Meter Shop after any repairs.
10. When private meters are damaged beyond repair, these private meters will be replaced by City owned fire hydrant meters.

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11. When a private meter malfunctions, the customer will be notified and the meter will be removed by the City and returned to the customer for repairs. Testing and calibration results shall be given to the City prior to any re-installation.
 12. The register shall be hermetically sealed straight reading and shall be readable from the inlet side. Registration shall be in hundred cubic feet.
 13. The outlet shall have a 2 ½ "National Standards Tested (NST) fire hydrant male coupling.
 14. Private fire hydrant meters shall not be transferable from one contracting company to another (i.e. if a company goes out of business or is bought out by another company).
- 4.4 All fire hydrant meters and appurtenances shall be installed, relocated and removed by the City of San Diego, Water Department. All City owned fire hydrant meters and appurtenances shall be maintained by the City of San Diego, Water Department, Meter Services.
- 4.5 If any fire hydrant meter is used in violation of this Department Instruction, the violation will be reported to the Code Compliance Section for investigation and appropriate action. Any customer using a fire hydrant meter in violation of the requirements set forth above is subject to fines or penalties pursuant to the Municipal Code, Section 67.15 and Section 67.37.
- 4.6 **Conditions and Processes for Issuance of a Fire Hydrant Meter**
- Process for Issuance
- a. Fire hydrant meters shall only be used for the following purposes:
 1. Temporary irrigation purposes not to exceed one year.

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2. Construction and maintenance related activities (see Tab 2).
 - b. No customer inside or outside the boundaries of the City of San Diego Water Department shall resell any portion of the water delivered through a fire hydrant by the City of San Diego Water Department.
 - c. The City of San Diego allows for the issuance of a temporary fire hydrant meter for a period not to exceed 12 months (365 days). An extension can only be granted in writing from the Water Department Director for up to 90 additional days. A written request for an extension by the consumer must be submitted at least 30 days prior to the 12 month period ending. No extension shall be granted to any customer with a delinquent account with the Water Department. No further extensions shall be granted.
 - d. Any customer requesting the issuance of a fire hydrant meter shall file an application with the Meter Section. The customer must complete a "Fire Hydrant Meter Application" (Tab 1) which includes the name of the company, the party responsible for payment, Social Security number and/or California ID, requested location of the meter (a detailed map signifying an exact location), local contact person, local phone number, a contractor's license (or a business license), description of specific water use, duration of use at the site and full name and address of the person responsible for payment.
 - e. At the time of the application the customer will pay their fees according to the schedule set forth in the Rate Book of Fees and Charges, located in the City Clerk's Office. All fees must be paid by check, money order or cashiers check, made payable to the City Treasurer. Cash will not be accepted.
 - f. No fire hydrant meters shall be furnished or relocated for any customer with a delinquent account with the Water Department.
 - g. After the fees have been paid and an account has been created, the

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meter shall be installed within 48 hours (by the second business day). For an additional fee, at overtime rates, meters can be installed within 24 hours (within one business day).

4.7 Relocation of Existing Fire Hydrant Meters

- a. The customer shall call the Fire Hydrant Meter Hotline (herein referred to as "Hotline"), a minimum of 24 hours in advance, to request the relocation of a meter. A fee will be charged to the existing account, which must be current before a work order is generated for the meter's relocation.
- b. The customer will supply in writing the address where the meter is to be relocated (map page, cross street, etc). The customer must update the original Fire Hydrant Meter Application with any changes as it applies to the new location.
- c. Fire hydrant meters shall be read on a monthly basis. While fire hydrant meters and backflow devices are in service, commodity, base fee and damage charges, if applicable, will be billed to the customer on a monthly basis. If the account becomes delinquent, the meter will be removed.

4.8 Disconnection of Fire Hydrant Meter

- a. After ten (10) months a "Notice of Discontinuation of Service" (Tab 3) will be issued to the site and the address of record to notify the customer of the date of discontinuance of service. An extension can only be granted in writing from the Water Department Director for up to 90 additional days (as stated in Section 4.6C) and a copy of the extension shall be forwarded to the Meter Shop Supervisor. If an extension has not been approved, the meter will be removed after twelve (12) months of use.
- b. Upon completion of the project the customer will notify the Meter Services office via the Hotline to request the removal of the fire hydrant meter and appurtenances. A work order will be generated

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for removal of the meter.

- c. Meter Section staff will remove the meter and backflow prevention assembly and return it to the Meter Shop. Once returned to the Meter Shop the meter and backflow will be tested for accuracy and functionality.
- d. Meter Section Staff will contact and notify Customer Services of the final read and any charges resulting from damages to the meter and backflow or its appurtenance. These charges will be added on the customer's final bill and will be sent to the address of record. Any customer who has an outstanding balance will not receive additional meters.
- e. Outstanding balances due may be deducted from deposits and any balances refunded to the customer. Any outstanding balances will be turned over to the City Treasurer for collection. Outstanding balances may also be transferred to any other existing accounts.

5. **EXCEPTIONS**

- 5.1 Any request for exceptions to this policy shall be presented, in writing, to the Customer Support Deputy Director, or his/her designee for consideration.

6. **MOBILE METER**

- 6.1 Mobile meters will be allowed on a case by case basis. All mobile meters will be protected by an approved backflow assembly and the minimum requirement will be a Reduced Pressure Principal Assembly. The two types of Mobile Meters are vehicle mounted and floating meters. Each style of meters has separate guidelines that shall be followed for the customer to retain service and are described below:

- a) **Vehicle Mounted Meters:** Customer applies for and receives a City owned Fire Hydrant Meter from the Meter Shop. The customer mounts the meter on the vehicle and brings it to the Meter Shop for

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inspection. After installation is approved by the Meter Shop the vehicle and meter shall be brought to the Meter Shop on a monthly basis for meter reading and on a quarterly basis for testing of the backflow assembly. Meters mounted at the owner's expense shall have the one year contract expiration waived and shall have meter or backflow changed if either fails.

b) **Floating Meters:** Floating Meters are meters that are not mounted to a vehicle. **(Note: All floating meters shall have an approved backflow assembly attached.)** The customer shall submit an application and a letter explaining the need for a floating meter to the Meter Shop. The Fire Hydrant Meter Administrator, after a thorough review of the needs of the customer, (i.e. number of jobsites per day, City contract work, lack of mounting area on work vehicle, etc.), may issue a floating meter. At the time of issue, it will be necessary for the customer to complete and sign the "Floating Fire Hydrant Meter Agreement" which states the following:

- 1) The meter will be brought to the Meter Shop at 2797 Caminito Chollas, San Diego on the third week of each month for the monthly read by Meter Shop personnel.
- 2) Every other month the meter will be read and the backflow will be tested. This date will be determined by the start date of the agreement.

If any of the conditions stated above are not met the Meter Shop has the right to cancel the contract for floating meter use and close the account associated with the meter. The Meter Shop will also exercise the right to refuse the issuance of another floating meter to the company in question.

Any Fire Hydrant Meter using reclaimed water shall not be allowed use again with any potable water supply. The customer shall incur the cost of replacing the meter and backflow device in this instance.

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7. FEE AND DEPOSIT SCHEDULES

7.1 **Fees and Deposit Schedules:** The fees and deposits, as listed in the Rate Book of Fees and Charges, on file with the Office of the City Clerk, are based on actual reimbursement of costs of services performed, equipment and materials. These deposits and fees will be amended, as needed, based on actual costs. Deposits, will be refunded at the end of the use of the fire hydrant meter, upon return of equipment in good working condition and all outstanding balances on account are paid. Deposits can also be used to cover outstanding balances.

All fees for equipment, installation, testing, relocation and other costs related to this program are subject to change without prior notification. The Mayor and Council will be notified of any future changes.

8. UNAUTHORIZED USE OF WATER FROM A HYDRANT

8.1 Use of water from any fire hydrant without a properly issued and installed fire hydrant meter is theft of City property. Customers who use water for unauthorized purposes or without a City of San Diego issued meter will be prosecuted.

8.2 If any unauthorized connection, disconnection or relocation of a fire hydrant meter, or other connection device is made by anyone other than authorized Water Department personnel, the person making the connection will be prosecuted for a violation of San Diego Municipal Code, Section 67.15. In the case of a second offense, the customer's fire hydrant meter shall be confiscated and/or the deposit will be forfeited.

8.3 Unauthorized water use shall be billed to the responsible party. Water use charges shall be based on meter readings, or estimates when meter readings are not available.

8.4 In case of unauthorized water use, the customer shall be billed for all applicable charges as if proper authorization for the water use had been obtained, including but not limited to bi-monthly service charges, installation charges and removal charges.

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- 8.5 If damage occurs to Water Department property (i.e. fire hydrant meter, backflow, various appurtenances), the cost of repairs or replacements will be charged to the customer of record (applicant).

**Larry Gardner
Water Department Director**

- Tabs: 1. Fire Hydrant Meter Application
2. Construction & Maintenance Related Activities With No Return To Sewer
3. Notice of Discontinuation of Service

APPENDIX

Administering Division: Customer Support Division

Subject Index: Construction Meters
Fire Hydrant
Fire Hydrant Meter Program
Meters, Floating or Vehicle Mounted
Mobile Meter
Program, Fire Hydrant Meter

Distribution: DI Manual Holders



Application for Fire Hydrant Meter (EXHIBIT A)

(For Office Use Only)

| | |
|--------|------|
| NS REQ | FAC# |
| DATE | BY |

METER SHOP (619) 527-7449

| | |
|------------------|-------------------------|
| Application Date | Requested Install Date: |
|------------------|-------------------------|

Meter Information

| | | |
|--|------|------------------------------|
| Fire Hydrant Location: (Attach Detailed Map//Thomas Bros. Map Location or Construction drawing.) Zip: | T.B. | G.B. (CITY USE) |
| Specific Use of Water: | | |
| Any Return to Sewer or Storm Drain, if so, explain: | | |
| Estimated Duration of Meter Use: | | Check Box if Reclaimed Water |

Company Information

| | | | |
|--|--------|----------------------|------------|
| Company Name: | | | |
| Mailing Address: | | | |
| City: | State: | Zip: | Phone: () |
| *Business license# | | *Contractor license# | |
| A Copy of the Contractor's license OR Business License is required at the time of meter issuance. | | | |
| Name and Title of Billing Agent: <small>(PERSON IN ACCOUNTS PAYABLE)</small> | | | Phone: () |
| Site Contact Name and Title: | | | Phone: () |
| Responsible Party Name: | | | Title: |
| Cal ID# | | | Phone: () |
| Signature: | | Date: | |
| Guarantees Payment of all Charges Resulting from the use of this Meter. Insures that employees of this Organization understand the proper use of Fire Hydrant Meter. | | | |

| | | |
|---|-------------------------|-------|
| Fire Hydrant Meter Removal Request | Requested Removal Date: | |
| Provide Current Meter Location if Different from Above: | | |
| Signature: | Title: | Date: |
| Phone: () | Pager: () | |

| City Meter | Private Meter |
|--|---|
| Contract Acct #: | Deposit Amount: \$ 936.00 Fees Amount: \$ 62.00 |
| Meter Serial # | Meter Size: 05 Meter Make and Style: 6-7 |
| Backflow # | Backflow Size: Backflow Make and Style: |
| Name: Rancho Penasquitos Library HVAC Appendix B - Fire Hydrant Meter Program | Signature: Date: 320 Page |

WATER USES WITHOUT ANTICIPATED CHARGES FOR RETURN TO SEWER

Auto Detailing
Backfilling
Combination Cleaners (Vactors)
Compaction
Concrete Cutters
Construction Trailers
Cross Connection Testing
Dust Control
Flushing Water Mains
Hydro Blasting
Hydro Seeing
Irrigation (for establishing irrigation only; not continuing irrigation)
Mixing Concrete
Mobile Car Washing
Special Events
Street Sweeping
Water Tanks
Water Trucks
Window Washing

Note:

1. If there is any return to sewer or storm drain, then sewer and/or storm drain fees will be charges.

Date

Name of Responsible Party
Company Name and Address
Account Number: _____

Subject: Discontinuation of Fire Hydrant Meter Service

Dear Water Department Customer:

The authorization for use of Fire Hydrant Meter # _____, located at *(Meter Location Address)* ends in 60 days and will be removed on or after *(Date Authorization Expires)*. Extension requests for an additional 90 days must be submitted in writing for consideration 30 days prior to the discontinuation date. If you require an extension, please contact the Water Department, or mail your request for an extension to:

City of San Diego
Water Department
Attention: Meter Services
2797 Caminito Chollas
San Diego, CA 92105-5097

Should you have any questions regarding this matter, please call the Fire Hydrant Hotline at (619) _____ - _____.

Sincerely,

Water Department

APPENDIX C

MATERIALS TYPICALLY ACCEPTED BY CERTIFICATE OF COMPLIANCE

Materials Typically Accepted by Certificate of Compliance

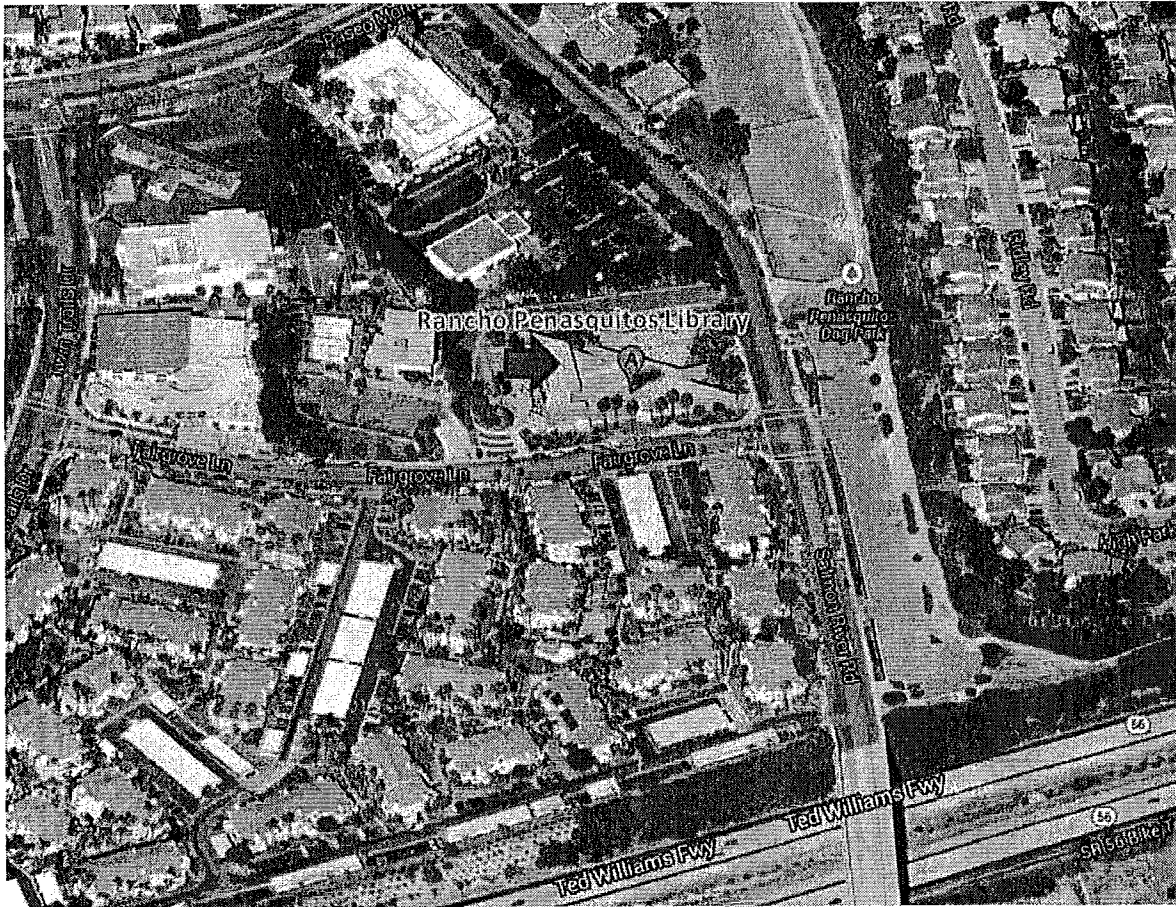
1. Soil amendment
2. Fiber mulch
3. PVC or PE pipe up to 16 inch diameter
4. Stabilizing emulsion
5. Lime
6. Preformed elastomeric joint seal
7. Plain and fabric reinforced elastomeric bearing pads
8. Steel reinforced elastomeric bearing pads
9. Waterstops (Special Condition)
10. Epoxy coated bar reinforcement
11. Plain and reinforcing steel
12. Structural steel
13. Structural timber and lumber
14. Treated timber and lumber
15. Lumber and timber
16. Aluminum pipe and aluminum pipe arch
17. Corrugated steel pipe and corrugated steel pipe arch
18. Structural metal plate pipe arches and pipe arches
19. Perforated steel pipe
20. Aluminum underdrain pipe
21. Aluminum or steel entrance tapers, pipe downdrains, reducers, coupling bands and slip joints
22. Metal target plates
23. Paint (traffic striping)
24. Conductors
25. Painting of electrical equipment
26. Electrical components
27. Engineering fabric
28. Portland Cement
29. PCC admixtures
30. Minor concrete, asphalt
31. Asphalt (oil)
32. Liquid asphalt emulsion
33. Epoxy

APPENDIX D
SAMPLE CITY INVOICE

| City of San Diego, Field Engineering Div., 9485 Aero Drive, SD CA 92123 | | | | | | Contractor's Name: | | | | | |
|---|----------------------------------|------------------------|----------|--------------|---------------|---|--------|---------------|-----------------|----------------|--------|
| Project Name: | | | | | | Contractor's Address: | | | | | |
| SAP No. (WBS/IO/CC) | | | | | | | | | | | |
| City Purchase Order No. | | | | | | Contractor's Phone #: | | | Invoice No. | | |
| Resident Engineer (RE): | | | | | | Contractor's Fax #: | | | Invoice Date: | | |
| RE Phone#: | | RE Fax#: | | | | Contact Name: | | | Billing Period: | | |
| Item # | Item Description | Contract Authorization | | | | Previous Estimate | | This Estimate | | Totals to Date | |
| | | Unit | Qty | Price | Extension | %/QTY | Amount | %/ QTY | Amount | %/ QTY | Amount |
| 1 | 2 Parallel 4" PVC C900 | LF | 1,380 | \$34.00 | \$46,920.00 | | | | | | |
| 2 | 48" Primary Steel Casing | LF | 500 | \$1,000.00 | \$500,000.00 | | | | | | |
| 3 | 2 Parallel 12" Secondary Steel | LF | 1,120 | \$53.00 | \$59,360.00 | | | | | | |
| 4 | Construction and Rehab of PS 49 | LS | 1 | \$150,000.00 | \$150,000.00 | | | | | | |
| 5 | Demo | LS | 1 | \$14,000.00 | \$14,000.00 | | | | | | |
| 6 | Install 6' High Chain Link Fence | LS | 1 | \$5,600.00 | \$5,600.00 | | | | | | |
| 7 | General Site Restoration | LS | 1 | \$3,700.00 | \$3,700.00 | | | | | | |
| 8 | 10" Gravity Sewer | LF | 10 | \$292.00 | \$2,920.00 | | | | | | |
| 9 | 4" Blow Off Valves | EA | 2 | \$9,800.00 | \$19,600.00 | | | | | | |
| 10 | Bonds | LS | 1 | \$16,000.00 | \$16,000.00 | | | | | | |
| 11 | Field Orders | AL | 1 | \$80,000 | \$80,000.00 | | | | | | |
| 11.1 | Field Order 1 | LS | 5,500 | \$1.00 | \$5,500.00 | | | | | | |
| 11.2 | Field Order 2 | LS | 7,500 | \$1.00 | \$7,500.00 | | | | | | |
| 11.3 | Field Order 3 | LS | 10,000 | \$1.00 | \$10,000.00 | | | | | | |
| 11.4 | Field Order 4 | LS | 6,500 | \$1.00 | \$6,500.00 | | | | | | |
| 12 | Certified Payroll | LS | 1 | \$1,400.00 | \$1,400.00 | | | | | | |
| CHANGE ORDERS | | | | | | | | | | | |
| Change Order 1 | | | 4,890 | | | | | | | | |
| Items 1-4 | | | | | \$11,250.00 | | | | | | |
| Item 5-Deduct Bid Item 3 | | LF | 120 | -\$53.00 | (\$6,360.00) | | | | | | |
| Change Order 2 | | | 160,480 | | | | | | | | |
| Items 1-3 | | | | | \$95,000.00 | | | | | | |
| Item 4 Deduct Bid Item 1 | | LF | 380 | -\$340.00 | (\$12,920.00) | | | | | | |
| Item 5-Increase bid Item 9 | | LF | 8 | \$9,800.00 | \$78,400.00 | | | | | | |
| Change Order 3 (Close Out) | | | -121,500 | | | | | | | | |
| Item 1 Deduct Bid Item 3 | | | 53 | -\$500.00 | (\$26,500.00) | | | | | | |
| Item 2 Deduct Bid Item 4 | | LS | -1 | 45,000.00 | (\$45,000.00) | | | | | | |
| Items 3-9 | | | 1 | -\$50,500.00 | (\$50,500.00) | | | | | | |
| SUMMARY | | | | | | | | Total This | \$ - | Total Billed | \$0.00 |
| A. Original Contract Amount | | | | | | Retention and/or Escrow Payment Schedule | | | | | |
| B. Approved Change Order 1 Thru 3 | | | | | | Total Retention Required as of this billing | | | | | |
| C. Total Authorized Amount (A+B) | | | | | | Previous Retention Withheld in PO or in Escrow | | | | | |
| D. Total Billed to Date | | | | | | Add'l Amt to Withhold in PO/Transfer in Escrow: | | | | | |
| E. Less Total Retention (5% of D) | | | | | | Amt to Release to Contractor from PO/Escrow: | | | | | |
| F. Less Total Previous Payments | | | | | | | | | | | |
| G. Payment Due Less Retention | | | | | | Contractor Signature and Date: | | | | | |
| H. Remaining Authorized Amount | | | | | | | | | | | |

APPENDIX E
LOCATION MAP

LOCATION MAP



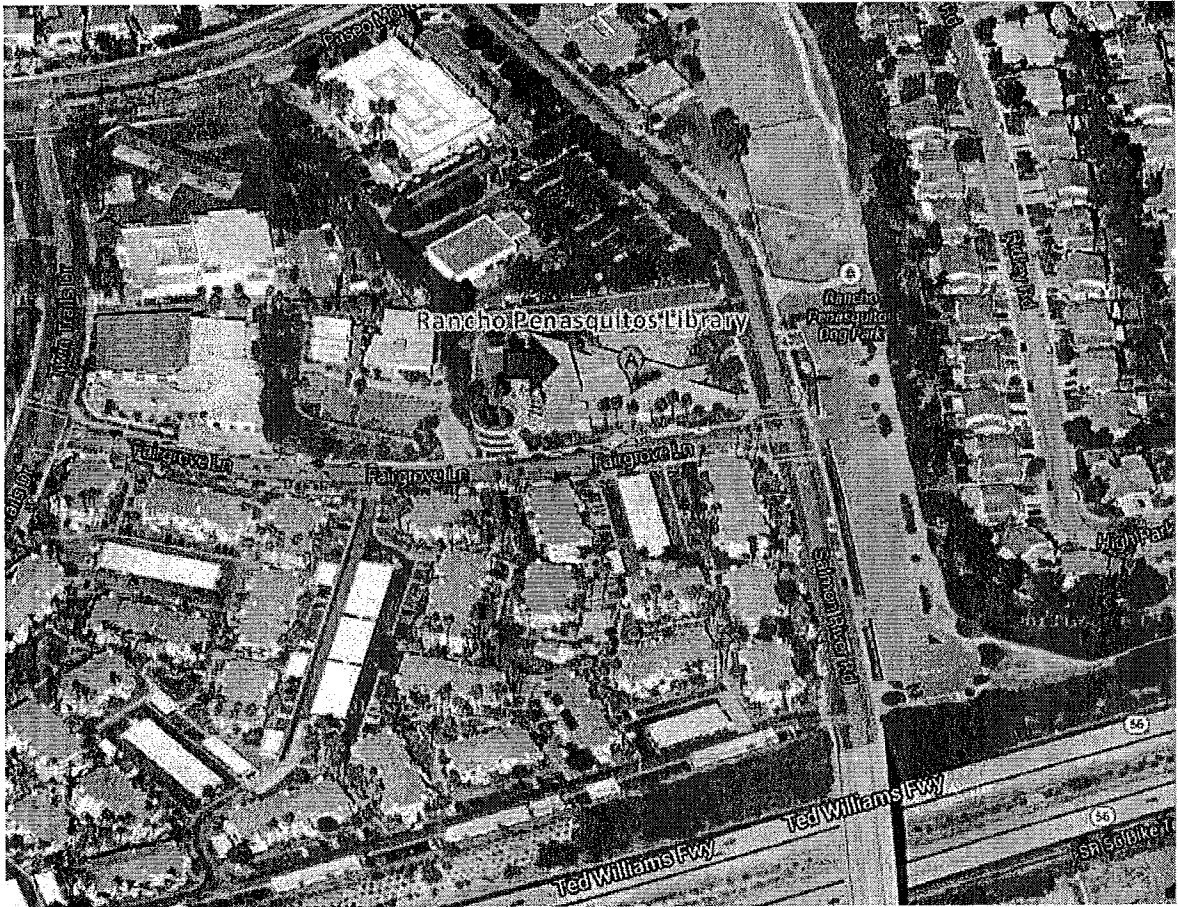
RANCHO PENASQUITOS LIBRARY
13330 Salmon River Rd
San Diego, CA 92129

APPENDIX F

ADJACENT PROJECTS

Rancho Penasquitos Library Roof Replacement

ADJACENT PROJECTS



RANCHO PENASQUITOS LIBRARY ROOF REPLACEMENT

13330 Salmon River Rd
San Diego, CA 92129

APPENDIX G

WORK REQUEST FOR ASBESTOS AND LEAD MANAGEMENT PROGRAM

4165

CITY of SAN DIEGO
WORK REQUEST FOR ASBESTOS & LEAD MANAGEMENT PROGRAM

Department: E&CP Dept#: 545 Division: ABP
Work Requested By: Coselyn Goodrich MS#: 908A Phone/Fax: 619-533-4633
Facility Name/Address: Rancho Penasquitos Library Roof Replacement/ 13330 Salmon River Rd. S.D. CA 92129
Facility #: 009996 Age of Facility: 1991 Plans Attached? YES NO Target Start: 9/1/10
Description of Proposed Work (explain detail of work as well as where in facility):
Complete re-roof work. The existing roof membrane is a multi-ply built-up type with flood coat asphalt and gravel surfacing installed over lightweight insulating concrete.

7-1-10

AUG 19 2010

Have internal order or WBS # opened to ALMP for labor cost. ALMP cost center 211511111; fund 100000; revenue acct 424071. The following accounting #s are for laboratory, abatement, and/or other NPE. Request estimate if needed.

Accounting Numbers: 2113110012 400002 512114 B-10049
Cost Center Fund G/L # WBS/Internal Order

I have the authority to authorize ALMP to bill hourly inspection labor and laboratory expenses to the accounting numbers above for work related to this project.

Signature Coselyn Goodrich Title Associate Engineer Date 8/1/10

Print Name Coselyn Goodrich Div. Analyst Name Alicia Belen

Send completed form to: **ASBESTOS & LEAD MANAGEMENT PROGRAM - 9601 Ridgehaven Court, Suite 310, San Diego, CA 92123 or MS 1103-A or Fax (858)492-5089**

FOR OFFICE USE ONLY

Date Received _____ Inspector Jeff Jaker
Records/Inspection Information No previous sampling results available, roof was inspected & sampled.

Impact on Project Roof field material was negative for asbestos, however roof mastic is positive. Asbestos & Lead Mgmt program will coordinate & monitor abatement of asbestos mastic by an abatement contractor. Please contact Jeff to discuss contract options

[Signature] 9/1/10 [Signature] 9/25/10
ASBESTOS & LEAD PROGRAM INSPECTOR DATE ASBESTOS & LEAD PROGRAM MANAGER DATE

Asbestos & Lead Management Program -- (858) 573-1262 (FAX) (858) 492-5089

ATTACHMENT F
INTENTIONALLY LEFT BLANK

City of San Diego

CITY CONTACT: Eleida Felix Yackel, Contract Specialist, Email: EFelixYackel@sandiego.gov
Phone No. (619) 533-3449, Fax No. (619) 533-3633

ADDENDUM "A"

FOR



RANCHO PENASQUITOS LIBRARY HVAC

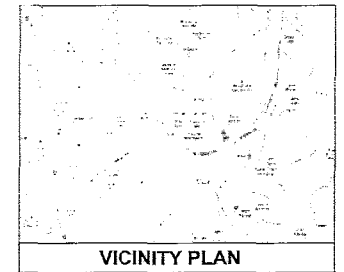
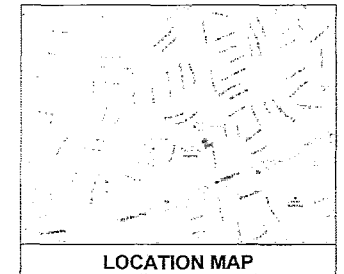
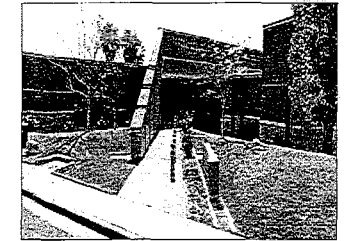
BID NO.: L-15-1222-DBB-2
SAP NO. (WBS/IO/CC).: B-10051
CLIENT DEPARTMENT: 1713
COUNCIL DISTRICT: 5
PROJECT TYPE: BT

BID DUE DATE:

**1:30 PM
FEBRUARY 11, 2015
CITY OF SAN DIEGO
PUBLIC WORKS CONTRACTS
1010 SECOND AVENUE, 14th FLOOR, MS 614C
SAN DIEGO, CA 92101**

RANCHO PENASQUITOS HVAC REPLACEMENT

13330 SALMON RIVER ROAD, SAN DIEGO, CA 92129



| GENERAL NOTES |
|--|
| 1. THE CONTRACTOR SHALL REVIEW EXISTING CONDITIONS ON THE SITE DURING THE BIDDING. THE CONTRACTOR SHALL VERIFY ALL DIMENSIONS PRIOR TO STARTING WORK. |
| 2. THE CONTRACTOR SHALL COORDINATE AND VERIFY SIZES AND LOCATIONS OF MECHANICAL EQUIPMENT AND PIPING. |
| 3. INSULATION MATERIALS SHALL MEET THE CALIFORNIA QUALITY STANDARDS PER SECTION 118 ENERGY EFFICIENCY STANDARDS (E.E.S.) |
| 4. UNLESS OTHERWISE SHOWN OR NOTED, ALL PHASES OF WORK ARE TO CONFORM TO THE MINIMUM STANDARDS OF 2010 CALIFORNIA MECHANICAL CODE AND CALIFORNIA PLUMBING CODE. |
| 5. NOTES AND DETAILS ON THE DRAWINGS SHALL TAKE PRECEDENCE OVER GENERAL NOTES AND TYPICAL DETAILS. |
| 6. THE CONTRACTOR SHALL, AT HIS OWN EXPENSE, DESIGN, CONSTRUCT AND MAINTAIN ALL SAFETY DEVICES AND SHALL BE SOLELY RESPONSIBLE FOR CONFORMING ALL LOCAL, STATE AND FEDERAL SAFETY AND HEALTH STANDARDS, LAWS AND REGULATIONS. |
| 7. PIPES, DUCTS, SLEEVES, OPENINGS, POCKETS, CHASES, BLOCK-OUTS, ETC. SHALL NOT BE PLACED IN SLABS, BEAMS, GIRDERS, COLUMNS, WALLS, FOUNDATIONS UNLESS SPECIFICALLY DETAILED ON THE DRAWINGS. |
| 8. THE CONTRACTOR SHALL BE RESPONSIBLE FOR ALL CUTTING PATCHING OF WALLS, FLOORS AND ROOF, INCLUDING ALL SAW CUTTING AND CORE DRILLING. |
| 9. GOOD HOUSEKEEPING SHALL MAINTAIN AT ALL TIMES. ACCUMULATION OF COMBUSTIBLE WASTE MATERIALS IN THE BUILDING SHALL NOT BE ALLOWED. C.F.C. 902.4/DEPARTMENT POLICY. |
| 10. ALL OMISSIONS AND/OR CONFLICTS BETWEEN THE VARIOUS ELEMENTS OF THE WORKING DRAWINGS AND SPECIFICATIONS SHALL BE BROUGHT TO THE ATTENTION OF THE RESIDENT ENGINEER. WORK SHOULD NOT PROCEED UNTIL A SOLUTION IS GIVEN BY THE RESIDENT ENGINEER. |
| 11. ROOF ACCESS LADDER SHALL COMPLY WITH SECTION 304 CMC. |
| 12. PROVIDE SMOKE DETECTORS IN MAIN SUPPLY AIR DUCTS OF AIR MOVING SYSTEMS EXCEEDING 2000 CFM PER SECTION 608.0 CMC. |
| 13. ALL PIPING AND DUCTWORK SHALL BE INSULATED CONSISTENT WITH THE REQUIREMENTS OF SECTIONS 118, 123, 124 TITLE 24 ENERGY STANDARDS, AND TABLES 6-6A AND 6-6B OF CMC. |
| 14. ALL HVAC SYSTEMS SHALL MEET THE CONTROL REQUIREMENTS PER SECTION 112 AND 122 E.E.S. |
| 15. ALL HVAC EQUIPMENT AND APPLIANCES SHALL MEET THE REQUIREMENTS PER SECTION 111-113, 115, 120-124 TITLE 24 ENERGY STANDARDS. |
| SITE DATA |
| ADDRESS: 13330 SALMON RIVER ROAD, SAN DIEGO, CA 92129 |
| OCCUPANCY CLASSIFICATION: GROUP A-3 |
| TYPE OF CONSTRUCTION: V8 W/SPRINKLERS |

| DRAWING INDEX |
|--|
| G-1 TITLE SHEET |
| M-0.1 MECHANICAL SCHEDULES |
| M-1 MECHANICAL FLOOR PLAN-DEMOLITION |
| M-2 MECHANICAL ROOF PLAN-DEMOLITION |
| M-3 MECHANICAL FLOOR PLAN |
| M-4 MECHANICAL ROOF PLAN |
| M-5 MECHANICAL ZONING PLAN |
| M-6 MECHANICAL DETAILS |
| M-7 MECHANICAL CONTROLS DETAIL |
| M-8 MECHANICAL TITLE 24 |
| E-001 LEGEND, NOTES, AND ABBREVIATION |
| E-101 ELECTRICAL FLOOR PLAN-DEMOLITION |
| E-102 ELECTRICAL ROOF PLAN-DEMOLITION |
| E-201 ELECTRICAL FLOOR PLAN |
| E-202 ELECTRICAL ROOF PLAN |
| E-501 ELECTRICAL DETAILS |
| E-601 ELECTRICAL SINGLE LINE DIAGRAM-E |
| E-602 ELECTRICAL SINGLE LINE DIAGRAM-N |
| E-603 ELECTRICAL PANEL SCHEDULES |
| S-1.1 NOTES AND SUPPORT DETAIL |
| S-2.1 STRUCTURAL FRAMING PLAN |

| APPLICABLE CODES |
|---------------------------------------|
| CBC - 2010 CALIFORNIA BUILDING CODE |
| CPC - 2010 CALIFORNIA PLUMBING CODE |
| CMC - 2010 CALIFORNIA MECHANICAL CODE |
| CEC - 2010 CALIFORNIA ELECTRICAL CODE |
| SAN DIEGO MUNICIPAL CODE 2008 |

| EQUIPMENT TAGS | |
|----------------|--------------------------------|
| | EQUIPMENT ABBREVIATION |
| | EQUIPMENT NUMBER |
| | DIFFUSER TAG |
| | DIFFUSER NECK SIZE (IN INCHES) |
| | CFM |

| DISCIPLINE CODE | ABBREVIATION / SYMBOLS |
|-----------------|----------------------------------|
| G GENERAL | SYMR / ABBREV. DESCRIPTION |
| D DEMOLITION | ////// EXIST. DUCT TO BE REMOVED |
| M MECHANICAL | NEW DUCTWORK |
| E ELECTRICAL | NEW CEILING DIFFUSER |
| S STRUCTURAL | NEW RETURN REGISTER/GRILLE |
| | NEW EXHAUST GRILLE |
| | DIRECTION OF FLOW |
| | PHASE (PH) |
| | FLEXIBLE DUCT |
| | FIRE/SMOKE DAMPER |
| | BACK DRAFT DAMPER |
| | VOLUME CONTROL DAMPER |
| | CONDENSATE DRAIN |
| | CEILING SPACE |
| | DUCTWORK SLOPED DOWN |
| | DOWN THROUGH ROOF |
| | (E) EXISTING |
| | EA EXHAUST AIR |
| | EG EXHAUST GRILLE |
| | (L) LINED DUCTWORK |
| | OBDD OPPOSED BLADE DAMPER |
| | OSA OUTSIDE AIR |
| | RA RETURN AIR |
| | RAG RETURN AIR GRILLE |
| | SA SUPPLY AIR |
| | TYP TYPICAL |
| | G GAS |

| SCOPE OF WORK |
|---|
| REMOVE EIGHT EXISTING ROOF MOUNTED HVAC UNITS, SEVEN EXISTING EXHAUST FANS AND HVAC CONTROL SYSTEM. |
| PROVIDE AND INSTALL EIGHT NEW ROOF MOUNTED HVAC UNITS, FIVE NEW EXHAUST FANS AND NEW HVAC CONTROL SYSTEM. |
| PROVIDE START-UP, TEST & BALANCE OF NEW HVAC & EXHAUST SYSTEMS. |

| SYMR / ABBREV. | DESCRIPTION |
|----------------|----------------------------|
| ////// | EXIST. DUCT TO BE REMOVED |
| --- | NEW DUCTWORK |
| | NEW CEILING DIFFUSER |
| | NEW RETURN REGISTER/GRILLE |
| | NEW EXHAUST GRILLE |
| | DIRECTION OF FLOW |
| | PHASE (PH) |
| | FLEXIBLE DUCT |
| | FIRE/SMOKE DAMPER |
| | BACK DRAFT DAMPER |
| | VOLUME CONTROL DAMPER |
| | CONDENSATE DRAIN |
| | CEILING SPACE |
| | DUCTWORK SLOPED DOWN |
| | DOWN THROUGH ROOF |
| (E) | EXISTING |
| EA | EXHAUST AIR |
| EG | EXHAUST GRILLE |
| (L) | LINED DUCTWORK |
| OBDD | OPPOSED BLADE DAMPER |
| OSA | OUTSIDE AIR |
| RA | RETURN AIR |
| RAG | RETURN AIR GRILLE |
| SA | SUPPLY AIR |
| TYP | TYPICAL |
| G | GAS |

| SYMBOL | ABBREV. | DESCRIPTION |
|--------|---------|-------------------------------|
| | BHP | BRAKE HORSE POWER |
| | BTUH | BRITISH THERMAL UNITS P/ HOUR |
| | CFM | CUBIC FEET PER MIN |
| | F | DEGREE FAHRENHEIT |
| | DB | DRY BULB |
| | EFF | EFFICIENCY |
| | EAT | ENTERING AIR TEMPERATURE |
| | EF | EXHAUST FAN |
| | (E) | EXISTING |
| | ESP | EXTERNAL STATIC PRESSURE |
| | W.C. | INCHES OF WATER COLUMN |
| | LAT | LEAVING AIR TEMPERATURE |
| | MCC | MINIMUM CIRCUIT CAPACITY |
| | RPM | REVOLUTIONS PER MINUTE |
| | RTU | ROOF TOP UNIT |
| | SEER | SEASONAL ENERGY EFFICIENCY |
| | MBH | THOUSAND BTU |
| | V/ø/Hz | VOLTS/PHASE/CYCLES |
| | W | WATTS |
| | WB | WET BULB |
| | | EXHAUST AIR RISE |
| | | RETURN AIR RISE |
| | | SUPPLY AIR RISE |
| | AHU | AIR HANDLING UNIT |
| | MZ | MULTI ZONE |
| | ET | EXPANSION TANK |
| | AS | AIR SEPARATOR |
| | | DEMOLITION |
| | P.O.C. | POINT OF CONNECTION |
| | P.O.D. | POINT OF DISCONNECTION |
| | UNO | UNLESS NOTED OTHERWISE |

I HEREBY DECLARE THAT I AM THE ENGINEER OF WORK FOR THIS PROJECT THAT I HAVE EXERCISED RESPONSIBLE CHARGE OVER THE DESIGN OF THE PROJECT AS DEFINED IN SECTION 6703 OF THE BUSINESS AND PROFESSIONS CODE AND THAT THE DESIGN IS CONSISTENT WITH CURRENT STANDARDS. I UNDERSTAND THAT THE CHECK OF PROJECT DRAWINGS AND SPECIFICATIONS BY THE CITY OF SAN DIEGO IS CONFINED TO A REVIEW ONLY AND DOES NOT RELIEVE ME, AS ENGINEER OF WORK, OF MY RESPONSIBILITIES FOR PROJECT DESIGN.

Simeon Gomez
ENGINEER'S NAME 4/11/2011
DATE

| CONSTRUCTION CHANGE / ADDENDUM |
|---|
| CHANGE DATE AFFECTED OR ADDRES SHEET NUMBERS APPROVAL NO. |
| A 1/28/15 S |

CONSULTANT

SCALE: HORIZONTAL NO SCALE
VERTICAL 70 SCALE

CITY OF SAN DIEGO
PUBLIC WORKS PROJECT

WARNING

IF THIS SEAL DOES NOT READ: I AM ENGINEER OF WORK FOR THIS PROJECT

SPEC. NO. 1222 G-1

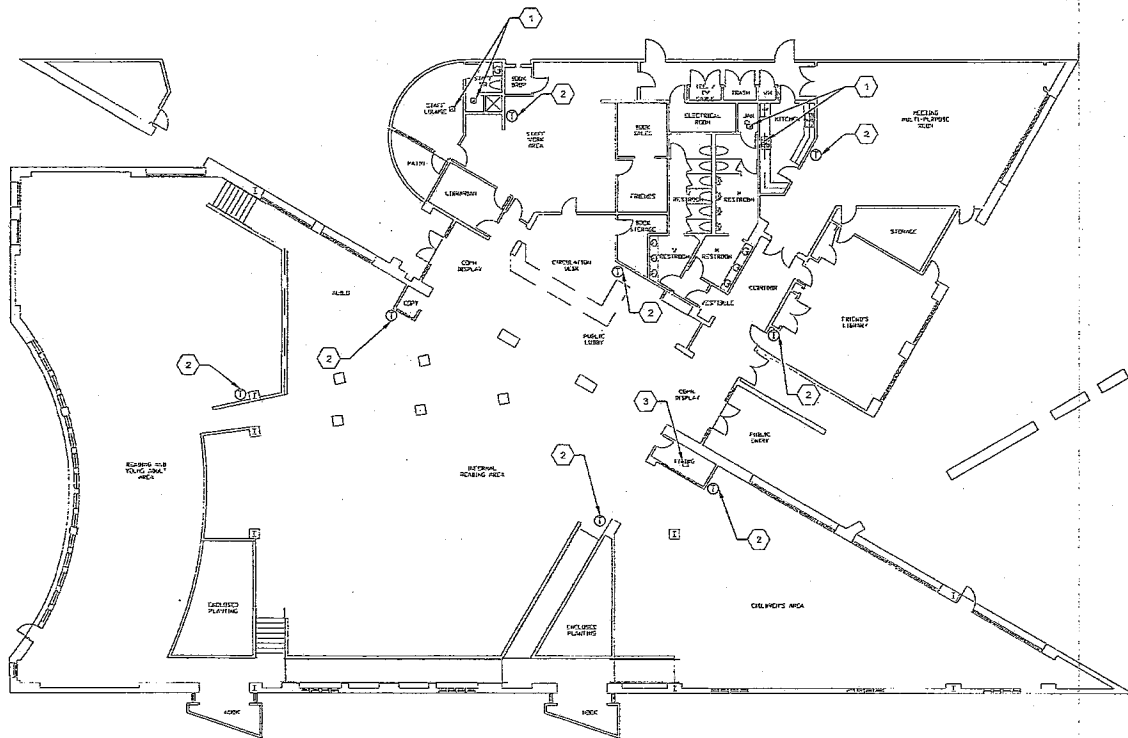
**PLANS FOR THE CONSTRUCTION OF:
RANCHO PENASQUITOS LIBRARY -
HVAC PROJECT**

TITLE SHEET, LEGEND AND NOTES

| | |
|---------------------------------------|-----------------|
| CITY OF SAN DIEGO / PUBLIC WORKS DEPT | W&C PROJECT |
| SHEET 1 OF 21 SHEETS | 8-10051 |
| FOR CITY ENGINEER | 10/14/2014 |
| DESIGNED BY | DATE |
| CHECKED BY | DATE |
| APPROVED BY | DATE |
| CONTRACT NO. | PROJECT MANAGER |
| CONTRACTOR | DATE STARTED |
| INSPECTOR | DATE COMPLETED |

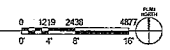
37862-1-D

RANCHO PENASQUITOS LIBRARY - HVAC PROJECT ADDENDUM A



- KEY NOTES**
- 1 - PROVIDE NEW EXHAUST FAN AND CO-ORDINATE WITH ELECTRICAL DRAWINGS FOR POWER SUPPLY.
 - 2 - PROVIDE NEW THERMOSTATS AND CONNECT IT TO THE BUILDING EMS.
- CONTRACTOR SHALL FIELD VERIFY EXISTING CONTROL NETWORK TO MAKE SURE CONTROL WIRING IS INTACT AND REUSABLE.
- ENSURE WIRING FROM EACH THERMOSTAT TO RTU IT SERVES AS WELL AS THERMOSTAT TO THERMOSTAT NETWORK/WIRING CAN BE REUSED.
- IF EXISTING NETWORK SYSTEM CANNOT BE REUSED, CONNECT THE CONTROL WIRING/CONDUITS ON ROOF FROM UNIT TO UNIT. OBTAIN AUTHORIZATION FROM RESIDENT ENGINEER IF CONTROL WIRING IS TO BE DONE ON ROOF PRIOR TO INSTALLATION.
 - 3 - PROVIDE NEW CEILING TILE TO THE OPENING CREATED AFTER REMOVING EXHAUST FAN GRILL. MATCH NEW CEILING TILE WITH THE EXISTING ONE INSIDE THE ROOM.
- PROVIDE 1 1/2" UNDERCUT TO DOOR OF TYPING ROOM (AT PRESENT QUITE STUDY ROOM)

NEW MECHANICAL FLOOR PLAN
3/20' = 1" @ 1/8" RANCHO PENASQUITOS LIBRARY



- GENERAL NOTES**
- 1 - ZONING PLAN IS PROVIDED FOR INFORMATION ONLY
 - 2 - INTERLOCK EF-3 TO RTU-3 AND CONNECT TO THE I-VU CONTROLS SERVER

SPEC. NO. 1222 M-3

**PLANS FOR THE CONSTRUCTION OF:
RANCHO PENASQUITOS LIBRARY -
HVAC PROJECT**

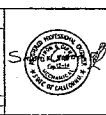
NEW MECHANICAL FLOOR PLAN

| | | |
|----------------------------------|----------------|----------------------------|
| CITY OF SAN DIEGO / PUBLIC WORKS | | SCALE: 8-1/2" X 11" |
| SHEET 5 OF 24 SHEETS | | PROJECT: |
| DATE: 10/14/2014 | | ALL DIVERSITY SECTION HEAD |
| DESCRIPTION | REV. APPROVED | DATE |
| ORIGINAL | ISSN | 11/18/2015 |
| ADDENDUM A | ISSN | 11/18/2015 |
| AS-BUILT | | 10/18/2015 |
| CONTRACTOR | DATE STARTED | 37862-5-D |
| INSPECTOR | DATE COMPLETED | |

CONSULTANT

Case Design
ARCHITECTS & ENGINEERS

SCALE: HORIZONTAL: NO SCALE, VERTICAL: NO SCALE



**CITY OF SAN DIEGO
PUBLIC WORKS PROJECT**




WARNING
IF THIS SEAL BREAKS
REPLACE IMMEDIATELY
WITH A NEW SEAL

ADDENDUM ADDED GENERAL NOTE

RANCHO PENASQUITOS LIBRARY - HVAC PROJECT - ADDENDUM A

2/12/15 ew
valid

City of San Diego

CONTRACTOR'S NAME: PARADIGM MECHANICAL 

ADDRESS: _____

TELEPHONE NO.: _____ FAX NO.: _____

CITY CONTACT: Eleida Felix Yackel, Email: EFelixYackel@sandiego.gov

Phone No. (619) 533-3449, Fax No. (619) 533-3633

C.Goodrich/R.Taleghani/egz

CONTRACT DOCUMENTS



FOR

RANCHO PENASQUITOS LIBRARY HVAC

VOLUME 2 OF 2

BID NO.: L-15-1222-DBB-2

SAP NO. (WBS/IO/CC): B-10051

CLIENT DEPARTMENT: 1713

COUNCIL DISTRICT: 5

PROJECT TYPE: BT

THIS CONTRACT IS SUBJECT TO THE FOLLOWING:

- THE CITY'S SUBCONTRACTING PARTICIPATION REQUIREMENTS FOR SLBE PROGRAM.
- COMPETITION RESTRICTED TO: SLBE-ELBE or ELBE FIRMS ONLY .
- PREVAILING WAGE RATES: STATE FEDERAL
- APPRENTICESHIP.

THIS BIDDING DOCUMENT TO BE SUBMITTED IN ITS ENTIRETY REFER TO VOLUME 1 COVER PAGE FOR TIME, DATE, AND LOCATION

TABLE OF CONTENTS

DESCRIPTION

PAGE NUMBER

Volume 2 - Bidding Documents

The following forms must be completed in their entirety and submitted with the Bid. Include the form(s) even if the information does not apply. Where the information does not apply write in N/A. Failure to include any of the forms may cause the Bid to be deemed **non-responsive**. If you are uncertain or have any questions about any required information, contact the City no later than 14 days prior to Bid due date.

- 1. Bid/Proposal..... 3
- 2. Bid Bond 6
- 3. Non-Collusion Affidavit to be executed by Bidder and Submitted with Bid under 23 USC 112 and PCC 7106 7
- 4. Contractors Certification of Pending Actions 8
- 5. Equal Benefits Ordinance Certification of Compliance..... 9
- 6. Proposal (Bid)..... 10
- 7. Form AA35 - List of Subcontractors 13
- 8. Form AA40 - Named Equipment/Material Supplier List 14

BIDDING DOCUMENTS

PROPOSAL

Bidder's General Information

To the City of San Diego:

Pursuant to "Notice Inviting Bids", specifications, and requirements on file with the City Clerk, and subject to all provisions of the Charter and Ordinances of the City of San Diego and applicable laws and regulations of the United States and the State of California, the undersigned hereby proposes to furnish to the City of San Diego, complete at the prices stated herein, the items or services hereinafter mentioned. The undersigned further warrants that this bid is not made in the interest of, or on behalf of, any undisclosed person, partnership, company, association, organization, or corporation; that the bid is genuine and not collusive or sham; that the bidder has not directly or indirectly induced or solicited any other bidder to put in a false or sham bid, and has not directly or indirectly colluded, conspired, connived, or agreed with any bidder or anyone else to put in a sham bid, or that anyone shall refrain from bidding; that the bidder has not in any manner, directly or indirectly, sought by agreement, communication, or conference with anyone to fix the bid price of the bidder or any other bidder, or to fix any overhead, profit, or cost element of the bid price, or of that of any other bidder, or to secure any advantage against the public body awarding the contract of anyone interested in the proposed contract; that all statements contained in the bid are true; and, further, that the bidder has not, directly or indirectly, submitted his or her bid price or any breakdown thereof, or the contents thereof, or divulged information or data relative thereto, or paid, and will not pay, any fee to any corporation, partnership, company, association, organization, bid depository, or to any member or agent thereof to effectuate a collusive or sham bid.

The undersigned bidder(s) further warrants that bidder(s) has thoroughly examined and understands the entire Contract Documents (plans and specifications) and the Bidding Documents therefore, and that by submitting said Bidding Documents as its bid proposal, bidder(s) acknowledges and is bound by the entire Contract Documents, including any addenda issued thereto, as such Contract Documents incorporated by reference in the Bidding Documents.

IF A SOLE OWNER OR SOLE CONTRACTOR SIGN HERE:

N/A

- (1) Name under which business is conducted _____
- (2) Signature (Given and surname) of proprietor _____
- (3) Place of Business (Street & Number) _____
- (4) City and State _____ Zip Code _____
- (5) Telephone No. _____ Facsimile No. _____
- (6) Email Address _____

IF A PARTNERSHIP, SIGN HERE:

N/A

- (1) Name under which business is conducted _____

BIDDING DOCUMENTS

(2) Name of each member of partnership, indicate character of each partner, general or special (limited):

N/A

(3) Signature (Note: Signature must be made by a general partner)

Full Name and Character of partner

(4) Place of Business (Street & Number) _____

(5) City and State _____ Zip Code _____

(6) Telephone No. _____ Facsimile No. _____

(7) Email Address _____

IF A CORPORATION, SIGN HERE:

(1) Name under which business is conducted Paradigm Mechanical Corp.

(2) Signature, with official title of officer authorized to sign for the corporation:

Melinda Dicharry
(Signature)

Melinda Dicharry
(Printed Name)

President
(Title of Officer)

(Impress Corporate Seal Here)

(3) Incorporated under the laws of the State of California

(4) Place of Business (Street & Number) 6550 Federal Blvd.

(5) City and State Lemon Grove, CA Zip Code 91945

(6) Telephone No. (619) 456-4562 Facsimile No. (619) 456-4754

(7) Email Address melinda@pmcontracting.com

BIDDING DOCUMENTS

THE FOLLOWING SECTIONS MUST BE FILLED IN BY ALL PROPOSERS:

In accordance with the "NOTICE INVITING BIDS", the bidder holds a California State Contractor's license for the following classification(s) to perform the work described in these specifications:

LICENSE CLASSIFICATION B, C20

LICENSE NO. 947497 EXPIRES 5/31/2016

This license classification must also be shown on the front of the bid envelope. Failure to show license classification on the bid envelope may cause return of the bid unopened.

TAX IDENTIFICATION NUMBER (TIN): [REDACTED]

Email Address: melinda@pmccontracting.com

THIS PROPOSAL MUST BE NOTARIZED BELOW:

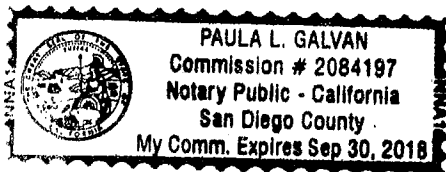
I certify, under penalty of perjury, that the representations made herein regarding my State Contractor's license number, classification and expiration date are true and correct.

Signature Melinda Dichaux Title President

SUBSCRIBED AND SWORN TO BEFORE ME, THIS 11th DAY OF Feb. 2015.

Notary Public in and for the County of San Diego, State of CA

[Signature]
(NOTARIAL SEAL)



BIDDING DOCUMENTS

BID BOND

KNOW ALL MEN BY THESE PRESENTS,

That Paradigm Mechanical Corp. as Principal, and Philadelphia Indemnity Insurance Company as Surety, are held and firmly bound unto The City of San Diego hereinafter called "OWNER," in the sum of **10% OF THE TOTAL BID AMOUNT** for the payment of which sum, well and truly to be made, we bind ourselves, our heirs, executors, administrators, successors, and assigns, jointly and severally, firmly by these presents.

WHEREAS, said Principal has submitted a Bid to said OWNER to perform the WORK required under the bidding schedule(s) of the OWNER's Contract Documents entitled Rancho Penasquitos Library HVAC L-15-1222-DBB-2

NOW THEREFORE, if said Principal is awarded a contract by said OWNER and, within the time and in the manner required in the "Notice Inviting Bids" enters into a written Agreement on the form of agreement bound with said Contract Documents, furnishes the required certificates of insurance, and furnishes the required Performance Bond and Payment Bond, then this obligation shall be null and void, otherwise it shall remain in full force and effect. In the event suit is brought upon this bond by said OWNER and OWNER prevails, said Surety shall pay all costs incurred by said OWNER in such suit, including a reasonable attorney's fee to be fixed by the court.

SIGNED AND SEALED, this 9th day of February, 2015

Paradigm Mechanical Corp. (SEAL) Philadelphia Indemnity Insurance Company (SEAL)
(Principal) (Surety)

By: Melinda Dichauy (Signature) By: Anne Wright (Signature) Anne Wright
Attorney-in-Fact

(SEAL AND NOTARIAL ACKNOWLEDGEMENT OF SURETY)

CALIFORNIA ALL-PURPOSE ACKNOWLEDGMENT

A notary public or other officer completing this certificate verifies only the identity of the individual who signed the document to which this certificate is attached, and not the truthfulness, accuracy, or validity of that document.

STATE OF CALIFORNIA

County of San Diego

On February 9, 2015 before me, Pam Davis, Notary Public,
Date Insert Name of Notary exactly as it appears on the official seal

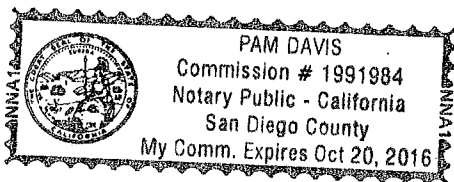
personally appeared Anne Wright
Name(s) of Signer(s)

who proved to me on the basis of satisfactory evidence to be the person(s) whose name(s) is/are subscribed to the within instrument and acknowledged to me that he/she/they executed the same in his/her/their authorized capacity(ies), and that by his/her/their signature(s) on the instrument the person(s), or the entity upon behalf of which the person(s) acted, executed the instrument.

I certify under PENALTY OF PERJURY under the laws of the State of California that the foregoing paragraph is true and correct.

Witness my hand and official seal.

Signature *Pam Davis*
Signature of Notary Public Pam Davis



Place Notary Seal Above

OPTIONAL

Though the information below is not required by law, it may prove valuable to persons relying on the document and could prevent fraudulent removal and reattachment of the form to another document.

Description of Attached Document

Title or Type of Document: _____

Document Date: _____ Number of Pages: _____

Signer(s) Other Than Named Above: _____

Capacity(ies) Claimed by Signer(s)

Signer's Name: _____

- Individual
- Corporate Officer — Title(s): _____
- Partner Limited General
- Attorney in Fact
- Trustee
- Guardian or Conservator
- Other: _____

**RIGHT THUMBPRINT
OF SIGNER**

Top of thumb here

Signer is Representing: _____

Signer's Name: _____

- Individual
- Corporate Officer — Title(s): _____
- Partner Limited General
- Attorney in Fact
- Trustee
- Guardian or Conservator
- Other: _____

**RIGHT THUMBPRINT
OF SIGNER**

Top of thumb here

Signer is Representing: _____

PHILADELPHIA INDEMNITY INSURANCE COMPANY
231 St. Asaph's Rd., Suite 100
Bala Cynwyd, PA 19004-0950

Power of Attorney

KNOW ALL PERSONS BY THESE PRESENTS: that PHILADELPHIA INDEMNITY INSURANCE COMPANY (the Company), a corporation organized and existing under the laws of the Commonwealth of Pennsylvania, does hereby constitute and appoint: CYNDI BEILMAN, ANNE WRIGHT AND DANA MICHAELIS OF SURETY ASSOCIATES OF SOUTHERN CALIFORNIA INSURANCE SERVICES

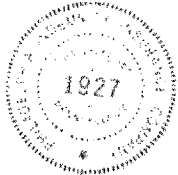
Its true and lawful Attorney(s) in fact with full authority to execute on its behalf bonds, undertakings, recognizances and other contracts of indemnity and writings obligatory in the nature thereof, issued in the course of its business and to bind the Company thereby, in an amount not to exceed \$25,000,000.00

This Power of Attorney is granted and is signed and sealed by facsimile under and by the authority of the following Resolution adopted by the Board of Directors of PHILADELPHIA INDEMNITY INSURANCE COMPANY at a meeting duly called the 1st day of July, 2011.

RESOLVED: That the Board of Directors hereby authorizes the President or any Vice President of the Company to: (1) Appoint Attorney(s) in Fact and authorize the Attorney(s) in Fact to execute on behalf of the Company bonds and undertakings, contracts of indemnity and other writings obligatory in the nature thereof and to attach the seal of the Company thereto; and (2) to remove, at any time, any such Attorney-in-Fact and revoke the authority given. And, be it

FURTHER RESOLVED: That the signatures of such officers and the seal of the Company may be affixed to any such Power of Attorney or certificate relating thereto by facsimile, and any such Power of Attorney so executed and certified by facsimile signatures and facsimile seal shall be valid and binding upon the Company in the future with the respect to any bond or undertaking to which it is attached.

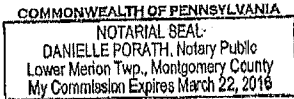
IN TESTIMONY WHEREOF, PHILADELPHIA INDEMNITY INSURANCE COMPANY HAS CAUSED THIS INSTRUMENT TO BE SIGNED AND ITS CORPORATE SEAL TO BE AFFIXED BY ITS AUTHORIZED OFFICE THIS 7TH DAY OF FEBRUARY 2013.



(Seal)

Robert D. O'Leary Jr., President & CEO
Philadelphia Indemnity Insurance Company

On this 7th day of February 2013, before me came the individual who executed the preceding instrument, to me personally known, and being by me duly sworn said that he is the therein described and authorized officer of the PHILADELPHIA INDEMNITY INSURANCE COMPANY; that the seal affixed to said instrument is the Corporate seal of said Company; that the said Corporate Seal and his signature were duly affixed.



(Notary Seal)

Notary Public:

residing at:

Bala Cynwyd, PA

My commission expires:

March 22, 2016

I, Craig P. Keller, Executive Vice President, Chief Financial Officer and Secretary of PHILADELPHIA INDEMNITY INSURANCE COMPANY, do hereby certify that the foregoing resolution of the Board of Directors and this Power of Attorney issued pursuant thereto are true and correct and are still in full force and effect. I do further certify that Robert D. O'Leary Jr., who executed the Power of Attorney as President, was on the date of execution of the attached Power of Attorney the duly elected President of PHILADELPHIA INDEMNITY INSURANCE COMPANY,

In Testimony Whereof I have subscribed my name and affixed the facsimile seal of each Company this 9th day of February, 20 15.



Craig P. Keller, Executive Vice President, Chief Financial Officer & Secretary
PHILADELPHIA INDEMNITY INSURANCE COMPANY

BIDDING DOCUMENTS

NON-COLLUSION AFFIDAVIT TO BE EXECUTED BY BIDDER AND SUBMITTED WITH BID UNDER 23 UNITED STATES CODE 112 AND PUBLIC CONTRACT CODE 7106

State of California)) ss.

County of San Diego)

Melinda Dichamy, being first duly sworn, deposes and says that he or she is President of the party making the foregoing bid that the bid is not made in the interest of, or on behalf of, any undisclosed person, partnership, company, association, organization, or corporation; that the bid is genuine and not collusive or sham; that the bidder has not directly or indirectly induced or solicited any other bidder to put in a false or sham bid, and has not directly or indirectly colluded, conspired, connived, or agreed with any bidder or anyone else to put in a sham bid, or that anyone shall refrain from bidding; that the bidder has not in any manner, directly or indirectly, sought by agreement, communication, or conference with anyone to fix the bid price of the bidder or any other bidder, or to fix any overhead, profit, or cost element of the bid price, or of that of any other bidder, or to secure any advantage against the public body awarding the contract of anyone interested in the proposed contract; that all statements contained in the bid are true; and further, that the bidder has not, directly or indirectly, submitted his or her bid price or any breakdown thereof, or the contents thereof, or divulged information or data relative thereto, or paid, and will not pay, any fee to any corporation, partnership, company association, organization, bid depository, or to any member or agent thereof to effectuate a collusive or sham bid.

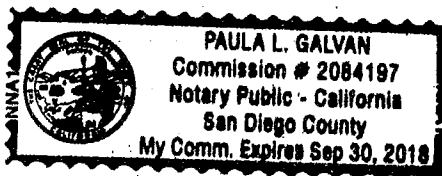
Signed: Melinda Dichamy

Title: President

Subscribed and sworn to before me this 11th day of Feb., 2015

[Signature] Notary Public

(SEAL)



BIDDING DOCUMENTS

CONTRACTORS CERTIFICATION OF PENDING ACTIONS

As part of its bid or proposal (Non-Price Proposal in the case of Design-Build contracts), the Bidder shall provide to the City a list of all instances within the past 10 years where a complaint was filed or pending against the Bidder in a legal or administrative proceeding alleging that Bidder discriminated against its employees, subcontractors, vendors or suppliers, and a description of the status or resolution of that complaint, including any remedial action taken.

CHECK ONE BOX ONLY.

- The undersigned certifies that within the past 10 years the Bidder has NOT been the subject of a complaint or pending action in a legal administrative proceeding alleging that Bidder discriminated against its employees, subcontractors, vendors or suppliers.
- The undersigned certifies that within the past 10 years the Bidder has been the subject of a complaint or pending action in a legal administrative proceeding alleging that Bidder discriminated against its employees, subcontractors, vendors or suppliers. A description of the status or resolution of that complaint, including any remedial action taken and the applicable dates is as follows:

| DATE OF CLAIM | LOCATION | DESCRIPTION OF CLAIM | LITIGATION (Y/N) | STATUS | RESOLUTION/REMEDIAL ACTION TAKEN |
|---------------|----------|----------------------|------------------|--------|----------------------------------|
| | | | | | |
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| | | | | | |
| | | | | | |

Contractor Name: Paradigm Mechanical Corp.

Certified By Melinda Dicharry Title President
Name

Melinda Dicharry Date 2-11-15
Signature

USE ADDITIONAL FORMS AS NECESSARY

BIDDING DOCUMENTS

**EQUAL BENEFITS ORDINANCE
CERTIFICATION OF COMPLIANCE**



For additional information, contact:
CITY OF SAN DIEGO
EQUAL BENEFITS PROGRAM
 202 C Street, MS 9A, San Diego, CA 92101
 Phone (619) 533-3948 Fax (619) 533-3220

COMPANY INFORMATION

| | |
|--|--|
| Company Name: <u>Paradigm Mechanical Corp.</u> | Contact Name: <u>Melinda Dicharry</u> |
| Company Address: <u>6550 Federal Blvd.</u> | Contact Phone: <u>(619) 456-4562</u> |
| <u>Lemon Grove, CA 91945</u> | Contact Email: <u>melinda@pmecontracting.com</u> |

CONTRACT INFORMATION

| | |
|--|-----------------------------|
| Contract Title: <u>Rancho Penasquitos Library HVAC</u> | Start Date: <u>TBD 2015</u> |
| Contract Number (if no number, state location): <u>L-15-1222-DBB-2</u> | End Date: |

SUMMARY OF EQUAL BENEFITS ORDINANCE REQUIREMENTS

The Equal Benefits Ordinance [EBO] requires the City to enter into contracts only with contractors who certify they will provide and maintain equal benefits as defined in SDMC §22.4302 for the duration of the contract. To comply:

- Contractor shall offer equal benefits to employees with spouses and employees with domestic partners.
 - Benefits include health, dental, vision insurance; pension/401(k) plans; bereavement, family, parental leave; discounts, child care; travel/relocation expenses; employee assistance programs; credit union membership; or any other benefit.
 - Any benefit not offer an employee with a spouse, is not required to be offered to an employee with a domestic partner.
- Contractor shall post notice of firm's equal benefits policy in the workplace and notify employees at time of hire and during open enrollment periods.
- Contractor shall allow City access to records, when requested, to confirm compliance with EBO requirements.
- Contractor shall submit *EBO Certification of Compliance*, signed under penalty of perjury, prior to award of contract.

NOTE: This summary is provided for convenience. Full text of the EBO and Rules Implementing the EBO are available at www.sandiego.gov/administration.

CONTRACTOR EQUAL BENEFITS ORDINANCE CERTIFICATION

Please indicate your firm's compliance status with the EBO. The City may request supporting documentation.

- I affirm **compliance** with the EBO because my firm (*contractor must select one reason*):
- Provides equal benefits to spouses and domestic partners.
 - Provides no benefits to spouses or domestic partners.
 - Has no employees.
 - Has collective bargaining agreement(s) in place prior to January 1, 2011, that has not been renewed or expired.
- I request the City's approval to pay affected employees a cash equivalent in lieu of equal benefits and verify my firm made a reasonable effort but is not able to provide equal benefits upon contract award. I agree to notify employees of the availability of a cash equivalent for benefits available to spouses but not domestic partners and to continue to make every reasonable effort to extend all available benefits to domestic partners.

It is unlawful for any contractor to knowingly submit any false information to the City regarding equal benefits or cash equivalent associated with the execution, award, amendment, or administration of any contract. [San Diego Municipal Code §22.4307(a)]

Under penalty of perjury under laws of the State of California, I certify the above information is true and correct. I further certify that my firm understands the requirements of the Equal Benefits Ordinance and will provide and maintain equal benefits for the duration of the contract or pay a cash equivalent if authorized by the City.

| | | |
|------------------------------------|-------------------------|----------------|
| <u>Melinda Dicharry, President</u> | <u>Melinda Dicharry</u> | <u>2-11-15</u> |
| Name/Title of Signatory | Signature | Date |

FOR OFFICIAL CITY USE ONLY

| | | | |
|---------------|--------------|-----------------------------------|---|
| Receipt Date: | EBO Analyst: | <input type="checkbox"/> Approved | <input type="checkbox"/> Not Approved – Reason: |
|---------------|--------------|-----------------------------------|---|

(Rev 02/15/2011)

BIDDING DOCUMENTS

PROPOSAL (BID)

The Bidder agrees to the construction of **Rancho Penasquitos Library HVAC** for the City of San Diego, in accordance with these contract documents for the prices listed below. The Bidder guarantees the Contract Price for a period of 120 days (90 days for federally funded contracts and contracts valued at \$500,000 or less) from the date of Bid opening to Award of the Contract. The duration of the Contract Price guarantee shall be extended by the number of days required for the City to obtain all items necessary to fulfill all conditions precedent e.g., bond and insurance.

| Item | Quantity | Unit | NAICS | Payment Reference | Description | Unit Price | Extension |
|----------------------------------|----------|------|--------|-------------------|---|---------------------------------|----------------------|
| BASE BID | | | | | | | |
| 1. | 1 | LS | 524126 | 2-4.1 | Bonds (Payment and Performance) | | \$ 4,700.00 |
| 2. | 1 | AL | 266220 | 7-5.3 | Building Permit - Type I | | \$10,000.00 |
| 3. | 1 | LS | 236220 | 9-3.1 | Construction of Rancho Penasquitos Library HVAC Project | | \$ 284,776.00 |
| 4. | 1 | AL | | 9-3.5 | Field Orders - Type II | | \$30,000.00 |
| 5. | 1 | LS | 541330 | 701-13.9.5 | Water Pollution Control Program Development | | \$ 275.00 |
| 6. | 1 | LS | 237990 | 701-13.9.5 | Water Pollution Control Program Implementation | | \$ 186.00 |
| ESTIMATED TOTAL BASE BID: | | | | | | | \$ 329,937.00 |

TOTAL BID PRICE FOR BID (Items 1 through 6 inclusive) amount written in words:

Three hundred twenty nine thousand nine hundred thirty seven dollars and zero cents

BIDDING DOCUMENTS

The Bid shall contain an acknowledgment of receipt of all addenda, the numbers of which shall be filled in on the Bid form. If an addendum or addenda has been issued by the City and not noted as being received by the Bidder, this proposal shall be rejected as being **non-responsive**. The following addenda have been received and are acknowledged in this bid: Addendum A

The names of all persons interested in the foregoing proposal as principals are as follows:

Melinda Dicharry & President, Vice President, Secretary & Treasurer

IMPORTANT NOTICE: If Bidder or other interested person is a corporation, state secretary, treasurer, and manager thereof; if a co-partnership, state true name of firm, also names of all individual co-partners composing firm; if Bidder or other interested person is an individual, state first and last names in full.

Bidder: Paradigm Mechanical Corp.

Title: President

Business Address: 6550 Federal Blvd. Lemon Grove, CA 91945

Place of Business: 6550 Federal Blvd. Lemon Grove, CA 91945

Place of Residence: El Cajon, CA

Signature: Melinda Dicharry

BIDDING DOCUMENTS

NOTES:

- A. The City shall determine the low Bid based on the Base Bid alone:
- B. Prices and notations shall be in ink or typewritten. All corrections (which have been initiated by the Bidder using erasures, strike out, line out, or "white-out") shall be typed or written in with ink adjacent thereto, and shall be initialed in ink by the person signing the bid proposal.
- C. Failure to initial all corrections made in the bidding documents may cause the Bid to be rejected as **non-responsive** and ineligible for further consideration.
- D. Blank spaces must be filled in, using figures. Bidder's failure to submit a price for any Bid item that requires the Bidder to submit a price shall render the Bid **non-responsive** and shall be cause for its rejection.
- E. Unit prices shall be entered for all unit price items. Unit prices shall not exceed two (2) decimal places. If the Unit prices entered exceed two (2) decimal places, the City will only use the first two digits after the decimal points without rounding up or down.
- F. All extensions of the unit prices bid will be subject to verification by the City. In the case of inconsistency or conflict between the product of the Quantity x Unit Price and the Extension, the product shall govern.
- G. In the case of inconsistency or conflict, between the sums of the Extensions with the estimated total Bid, the sum of the Extensions shall govern.
- H. Bids shall not contain any recapitulation of the Work. Conditional Bids will be rejected as being **non-responsive**. Alternative proposals will not be considered unless called for.
- I. Subcontractors' License Number must be filled in. Failure to provide the information specified may deem the bidder **non-responsive**.

BIDDING DOCUMENTS

LIST OF SUBCONTRACTORS

In accordance with the requirements provided in the "Subletting and Subcontracting Fair Practices Act", Division 2, Part 1, Chapter 4 of the Public Contract Code, the Bidder shall list below the name and address of each Subcontractor who will perform work, labor, render services or specially fabricates and installs a portion [type] of the work or improvement, in an amount in excess of 0.5% of the Contractor's total Bid. The Bidder shall also list below the portion of the work which will be done by each subcontractor under this Contract. The Contractor shall list only one Subcontractor for each portion of the Work. The **DOLLAR VALUE** of the total Bid to be performed shall be stated for all subcontractors listed. Failure to comply with this requirement shall result in the Bid being rejected as **non-responsive** and ineligible for award. The Bidder's attention is directed to the Special Provisions - General; Paragraph 2-3 Subcontracts, which stipulates the percent of the Work to be performed with the Bidders' own forces. The Bidder shall list all SLBE, ELBE, DBE, DVBE, MBE, WBE, OBE, SDB, WoSB, HUBZone, and SDVOSB Subcontractors that Bidders are seeking recognition towards achieving any mandatory, voluntary, or both subcontracting participation percentages.

Subcontractors' License Number must be filled in. Failure to provide the information specified may deem the bidder **non-responsive**.

| NAME, ADDRESS AND TELEPHONE NUMBER OF SUBCONTRACTOR | CONSTRUCTOR OR DESIGNER | SUBCONTRACTOR LICENSE NUMBER | TYPE OF WORK | DOLLAR VALUE OF SUBCONTRACT (MUST BE FILLED OUT) | MBE, WBE, DBE, DVBE, OBE, ELBE, SLBE, SDB, WoSB, HUBZone, OR SDVOSB | WHERE CERTIFIED Ⓞ | CHECK IF JOINT VENTURE PARTNERSHIP |
|---|-------------------------|------------------------------|------------------|--|---|----------------------|------------------------------------|
| Name: <u>REED ELECTRICAL SERVICES</u> Address: <u>1638 BURROUGHS ST.</u> City: <u>OCEANSIDE</u> State: <u>CA</u> Zip: <u>92054</u> Phone: <u>(760) 822-5349</u> Email: <u>CAMERON'S REEDSERVICESINC.COM</u> | CONSTRUCTOR | 929319 | ELECTRICAL | \$14,777.00 | NONE | N/A | NO |
| Name: <u>PRECISION AIR BALANCE CO INC.</u> Address: <u>1240-H N. JEFFERSON ST.</u> City: <u>ANAHEIM</u> State: <u>CA</u> Zip: <u>92807</u> Phone: <u>(714) 630-3796</u> Email: <u>RAY'S PRECISION AIR BALANCE.COM</u> | CONSTRUCTOR | 633805 | TEST AND BALANCE | \$2,300.00 | WBE SBE | CA/CPUC CA | NO |

Ⓞ As appropriate, Bidder shall identify Subcontractor as one of the following and shall include a valid proof of certification (except for OBE, SLBE and ELBE):

- | | | | |
|---|--------|--|---------|
| Certified Minority Business Enterprise | MBE | Certified Woman Business Enterprise | WBE |
| Certified Disadvantaged Business Enterprise | DBE | Certified Disabled Veteran Business Enterprise | DVBE |
| Other Business Enterprise | OBE | Certified Emerging Local Business Enterprise | ELBE |
| Certified Small Local Business Enterprise | SLBE | Small Disadvantaged Business | SDB |
| Woman-Owned Small Business | WoSB | HUBZone Business | HUBZone |
| Service-Disabled Veteran Owned Small Business | SDVOSB | | |

Ⓞ As appropriate, Bidder shall indicate if Subcontractor is certified by:

- | | | | |
|--|--------|--|----------|
| City of San Diego | CITY | State of California Department of Transportation | CALTRANS |
| California Public Utilities Commission | CPUC | San Diego Regional Minority Supplier Diversity Council | SRMSDC |
| State of California's Department of General Services | CADoGS | City of Los Angeles | LA |
| State of California | CA | U.S. Small Business Administration | SBA |

The Bidder will not receive any subcontracting participation percentages if the Bidder fails to submit the required proof of certification.

D.0517
CP

BIDDING DOCUMENTS

NAMED EQUIPMENT/MATERIAL SUPPLIER LIST

N/A

The Bidder seeking the recognition of equipment, materials, or supplies obtained from Suppliers towards achieving any mandatory, voluntary, or both subcontracting participation percentages shall list the Supplier(s) on the Named Equipment/Material Supplier List. The Named Equipment/Material Supplier List, at a minimum, shall have the name, locations (City) and the **DOLLAR VALUE** of the Suppliers. The Bidder will be credited up to 60% of the amount to be paid to the Suppliers for such materials and supplies unless vendor manufactures or substantially alters materials and supplies in which case 100% will be credited. The Bidder is to indicate (Yes/No) whether listed firm is a supplier or manufacturer. In calculating the subcontractor participation percentages, vendors/suppliers will receive 60% credit of the listed **DOLLAR VALUE**, whereas manufacturers will receive 100% credit. If no indication provided, listed firm will be credited at 60% of the listed dollar value for purposes of calculating the Subcontractor Participation Percentage, Suppliers will receive 60% credit of the listed **DOLLAR VALUE**, whereas manufacturers will receive 100% credit. If no indication provided, listed firm will be credited at 60% of the listed **DOLLAR VALUE** for purposes of calculating the subcontractor participation percentages.

| NAME, ADDRESS AND TELEPHONE NUMBER OF VENDOR/SUPPLIER | MATERIALS OR SUPPLIES | DOLLAR VALUE OF MATERIAL OR SUPPLIES (MUST BE FILLED OUT) | SUPPLIER (Yes/No) | MANUFACTURER (Yes/No) | MBE, WBE, DBE, DVBE, OBE, ELBE, SLBE, SDB, WoSB, HUBZone, OR SDVOSB | WHERE CERTIFIED ② |
|--|-----------------------|---|-------------------|-----------------------|---|-------------------|
| Name: _____ Address: _____ City: _____ State: _____ Zip: _____ Phone: _____ Email: _____ | | | | | | |
| Name: _____ Address: _____ City: _____ State: _____ Zip: _____ Phone: _____ Email: _____ | | | | | | |

① As appropriate, Bidder shall identify Vendor/Supplier as one of the following and shall include a valid proof of certification (except for OBE, SLBE and ELBE):

- | | | | |
|---|--------|--|---------|
| Certified Minority Business Enterprise | MBE | Certified Woman Business Enterprise | WBE |
| Certified Disadvantaged Business Enterprise | DBE | Certified Disabled Veteran Business Enterprise | DVBE |
| Other Business Enterprise | OBE | Certified Emerging Local Business Enterprise | ELBE |
| Certified Small Local Business Enterprise | SLBE | Small Disadvantaged Business | SDB |
| Woman-Owned Small Business | WoSB | HUBZone Business | HUBZone |
| Service-Disabled Veteran Owned Small Business | SDVOSB | | |

② As appropriate, Bidder shall indicate if Vendor/Supplier is certified by:

- | | | | |
|--|--------|--|----------|
| City of San Diego | CITY | State of California Department of Transportation | CALTRANS |
| California Public Utilities Commission | CPUC | San Diego Regional Minority Supplier Diversity Council | SRMSDC |
| State of California's Department of General Services | CADoGS | City of Los Angeles | LA |
| State of California | CA | U.S. Small Business Administration | SBA |

The Bidder will not receive any subcontracting participation percentages if the Bidder fails to submit the required proof of certification.