EL MONTE UNION HIGH SCHOOL DISTRICT



BIDDING DOCUMENTS FOR THE EL MONTE UNION HIGH SCHOOL DISTRICT FOR

BID NO. 2023-24(B2) PURCHASE OF HVAC EQUIPMENT FOR ARROYO HIGH SCHOOL REBID

LOCATED AT Arroyo High School 4921 Cedar Ave., El Monte, CA 91732

Contact Person: Margarita Sanchez, Director of Purchasing Phone: (626) 444-9005 Ext. 9855 Email: <u>Purcasing@emuhsd.org</u>

1 st Publication Date:	August 11, 2023
2 nd Publication Date:	August 17, 2023
Pre-Bid RFI Deadline:	August 23, 2023 at 10:00 a.m.
Last Day to Post Addenda:	August 24, 2023 at 10:00 a.m.
Bid Due Date:	August 29, 2023 at 10:00 a.m.
Digital Did Submissions Vie Vender Begistry Only	https://vrapp.vendorregistry.com/Vendor/Register/Index/el-monte-
Digital Bid Submissions via vendor Registry Only:	union-high-school-dist-ca-vendor-registration
Board Approval Date:	September 6, 2023
Equipment Delivery Date No Later Than:	June 1, 2024

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NOTICE CALLING FOR BIDS

District: El Monte Union High School District

August 29, 2023 - 10:00 AM

Place of Bid Receipt: Via EMAIL ONLY to purchasing@emuhsd.org

Project: Bid No. 2023-24(B2) Purchase of HVAC Equipment for Arroyo High School Rebid

NOTICE IS HEREBY GIVEN that the El Monte Union High School District, County of Los Angeles, California, hereafter referred to as "District," acting by and through its Governing Board, will receive up to, but not later than, the above stated bid deadline, sealed bids at the location identified above, for the award of a contract for the above Project.

Sealed bids shall be made on the Bid Proposal Form furnished by the District and included with the Bid Documents. Envelopes shall bear on the outside, the bid number and closing date and time. It is the bidders' sole responsibility to ensure their bids are received at the location specified in this Notice, no later than the date and time specified. Any bids received after the scheduled closing time for receipt of bids will be returned to the bidder unopened. Bids shall be opened and publicly read.

Bid Documents will be available at a no charge, via download, on the District's website at www.emuhsd.org/bids.

All questions about the meaning or intent of the Bid Documents are to be directed in writing (typed or legibly printed) to the District, using the Pre-Bid Request for Information (RFI) included in the Bid Documents, via email only to <u>purchasing@emuhsd.org</u> no later than 10:00 a.m. on August 23, 2023.

The District Board of Trustees reserves the right to reject any and all bids. No bidder may withdraw their bid for a period of ninety (90) calendar days after the date set for the opening of bids. Refer to the formal Bid Documents and specifications for additional information, terms, and conditions.

EL MONTE UNION HIGH SCHOOL DISTRICT

San Gabriel Valley Tribune Published: August 11, 2023 & August 17, 2023

INSTRUCTIONS TO BIDDERS <u>AND</u> <u>GENERAL CONDITIONS</u>

Bidders shall follow the instructions in this Bid Document, and shall submit all documents, forms, and information required for consideration of a bid.

El Monte Union High School District ("District") will evaluate information submitted by the apparent low bidder and, if incomplete or unsatisfactory to District, bidder's bid may be rejected at the sole discretion of District.

DEFINITION(S) -

- 1. Contract, Contract Documents: The Contract consists exclusively of the documents evidencing the agreement of the District and awarded bidder, identified as the Contract Documents. The Contract Documents consist of the following documents:
 - 1. Notice Calling for Bids
 - 2. Instructions to Bidders
 - 3. Bid Proposal Form
 - 4. Bid Bond, if/as applicable to the bid
 - 5. Site Visit Certification, if a site visit was required
 - 6. Non-Collusion Affidavit
 - 7. Notice of Intent to Award
 - 8. Notice to Proceed, as applicable to the bid
 - 9. Agreement and/or Contract, includes collectively all Bid Documents, including post-bid. Both terms may be used interchangeably.
 - 10. Purchase Order
 - 11. Purchase Order Change Order
 - 12. Performance Bond, if/as applicable to the bid
 - 13. Payment Bond, if/as applicable to the bid
 - 14. General Conditions
 - 15. Special Conditions
 - 16. Criminal Background Investigation/Fingerprinting Certification, as applicable to the bid
 - 17. Any and all Plans, Technical Specifications, and Drawings
 - 18. Any and all Addenda to any of the above documents
 - 19. Any and all change orders or written modifications to the above documents if approved by the District
 - 20. Any and all Bid and/or Project Documents published by the District for bidding purposes. Both terms may be used interchangeably.

END OF DEFINITION(S)

- 1. <u>**BID DEADLINE**</u> District will receive bids from bidders no later than 10:00 AM (PST) August 29, 2023, via digital submission through Vendor Registry.
- 2. <u>**BID SUBMITTAL**</u> The District has partnered with Vendor Registry to manage its vendor registration and bidding process. Prospective Bidders shall register their company and submit their bids on Vendor Registry via the following link:

https://vrapp.vendorregistry.com/Vendor/Register/Index/el-monte-union-high-school-dist-ca-vendor-registration.

Registration is free and a condition for submitting a bid.

No bid shall be considered by the District after the scheduled closing time for receipt of bids.

Bidders must submit bids on the Bid Proposal Form and include all other required District forms and information. Bids not submitted on the District's required forms shall be deemed non-responsive and shall not be considered. All blanks on the Bid Proposal Form must be appropriately completed. Additional sheets required to fully respond to requested information are permissible.

It is the bidders' sole responsibility to ensure their bids are received as specified above, no later than the date and time specified above. Any bids received after the scheduled closing time for receipt of bids will not be accepted.

No oral, telephone, or emailed bids, or modifications to District forms will be considered.

3. **<u>BID OPENING</u>** - Bids shall be opened and publicly read via Google Meet virtual meeting as follows:

Virtually: Via the following link, meet.google.com/fgv-mrdr-nod

Join by Phone: (US) +1 575-394-8366 PIN: 449 069 074#

4. <u>**PREPARATION OF BIDS**</u> – Bids shall be submitted on the Bid Proposal Form only. Bidders are requested to enter their firm name where designated on all forms. **All bids must be signed by a responsible officer or employee fully authorized to bind the organization to the terms and conditions herein.** Obligations assumed by such signature must be fulfilled.

District reserves the right in its sole discretion to reject any bid as non-responsive as a result of any error or omission in the bid. **Bidders must complete and submit all of the following documents with the Bid Proposal Form:**

1. Non-Collusion Affidavit

- 5. <u>MODIFICATIONS</u> Changes in or additions to the Bid Proposal Form, alternate bids, or any other modifications of the Bid Proposal Form which are not specifically called for in the Bid Documents may result in the District's rejection of the bid as not being responsive to the invitation to bid.
- 6. <u>ERRORS OR CORRECTIONS</u> No erasures permitted. Mistakes may be crossed out and corrections inserted adjacent to the line but must be initialed in ink by the person signing the bid. In the event of inconsistency between

words and figures or numerals in the bid, words shall control figures and numerals. Bids are to be verified before submission as they cannot be corrected, altered or withdrawn after being opened, or specified withdrawal time period has elapsed. If the District determines that any bid is unintelligible, illegible, or ambiguous, the District may reject such bid as not being responsive. The District reserves the right to reject any bid containing erasures or deletions.

7. **PRICES** – Bid each item separately on the Bid Proposal Form. Prices must be stated in the units specified. Bidders must bid showing unit price and extension (where applicable). In case of error in computations, the unit price shall prevail over extension. Prices should be quoted net.

Pricing shall be inclusive of all and any cost charged to the District, including cost of manufacture, packing, preservations, marking, handling, loading/unloading, delivery, among others, through the agreement period.

Do not include California Sales Tax or Use Taxes in unit prices. The tax will be added and paid for by the District. Prompt payment terms will not influence the award of this bid (except in case of tie bids).

- 8. **EXAMINATION OF BID DOCUMENTS** Before submitting a bid, each bidder shall examine (as applicable) the drawings, read the specifications of the bid, and all other related documents. Bidders shall fully inform themselves of all conditions and all requirements of the bid.
- 9. **INTERPRETATION OF BID DOCUMENTS, PRE-BID REQUESTS FOR INFORMATION, AND** <u>ADDENDA</u> – All questions about the meaning or intent of the Bid Documents are to be directed in writing (typed or legibly printed) to the District, using the Pre-Bid Request for Information (RFI) included in the Bid Documents, via email only to Margarita Sanchez, Director of Purchasing at <u>purchasing@emuhsd.org</u>. Interpretations or clarifications considered necessary by the District in response to such questions will be issued in writing by Addenda and posted on the District's webpage at <u>www.emuhsd.org/bids</u>. Questions received after 10:00 a.m. on July 23, 2023 may not be answered. Only questions answered by formal written District issued Addenda will be binding. Oral and other interpretations or clarifications will be without legal effect.

Addenda may also be issued to modify other parts of the Bid Documents as deemed advisable by the District.

If Bidders are interested in receiving updates about this project via email, please email Margarita Sanchez, Director of Purchasing at <u>purchasing@emuhsd.org</u> to request to be added to the bidders list on this project.

Each bidder must acknowledge each Addendum issued by the District in its proposal on the Bid Proposal Form by number or its bid shall be considered non-responsive. Each Addendum shall be part of the Contract Documents. A complete listing of Addenda may be secured from the District.

Failure to request information, interpretation, or clarification, of any portion of the Bid Documents pursuant to the foregoing is a waiver of any discrepancy, defect, or conflict therein.

10. WITHDRAWAL OF BIDS -

- 1. Prior to Scheduled Closing Time Any person may withdraw their bid personally or by written request at any time prior to the scheduled closing time for receipt of bids.
- 2. After Scheduled Closing Time Pursuant to Public Contract Code Section 5101, a bidder shall not be relieved of the bid unless by consent of the District nor shall any changes be made in the bid because of mistake or error. The bidder shall have five (5) working days from the date of the bid to notify the District in writing and specify in the notice how the mistake(s) occurred. Bidder's written notification to the District

must be signed by a responsible officer or employee fully authorized to bind the organization. The bidder must establish the following criteria in the notice:

- 1. A mistake was made.
- 2. Written Notice was given to the District within five (5) working days from the date of the bid opening.
- 3. The mistake was made in filling out the bid and not due to error in judgment or to carelessness in reading the Bid Documents in the entirety.

If the District deems it is for its best interest, it may, on refusal or failure of the successful bidder to execute the Agreement, the District has the option to award the contract to the next lowest responsive bidder.

No bidder may withdraw any bid for a period of **ninety (90)** calendar days **after** the date set for the opening of bids.

11. **BRANDS** – Brand names and/or specifications are given for descriptive purposes to indicate the quality, utility and capabilities desired by the District; the specifications are not intended to restrict competition. It shall be understood that bidder is bidding on the items specified unless bidder states specifically in the bid that the brand, make or item proposed is not as requested. Alternate brands, which are different from those specified, shall be considered for award provided that the same quality, utility and capabilities as those specified are available as determined solely by the District.

Throughout the Contract Documents, whenever equipment, material, or supply, is designated, product, thing, or service by specific brand name shall be considered to be followed by the words "or equal" whether written or not.

The Bid Proposal Form includes the brand/manufacturer's name and model/catalog number for each item listed. If the brand/manufacturer's name differs from the listed equipment, bidder is to attach the equipment/product specifications. Failure to comply with the requirements of this paragraph shall cause the bid to be considered non-responsive.

12. <u>SUBSTITUTIONS AND SAMPLES</u> – All items bid must conform to the specifications set forth in these bid documents. The District reserves the right to reject all bids that do not conform to the specifications. When bidding on brands other than those specified, the bidder must state on the bid the brand, quality, model number, or other trade designation on each item bid other than "as specified" and attach the equipment/product specifications.

Complete descriptive cut sheets, technical data, and information describing any alternate brands offered must be submitted with the bid.

District reserves the right to evaluate by demonstration, any alternate offer, to determine if alternate offer meets specifications. Suitability and valuation of "equals" rests in the sole discretion of the District.

Where samples are requested they must be furnished free of any charges to the District. Any sample or evaluation equipment submitted must be clearly marked in such a manner that the marking is fixed, so that the identification of the sample and/or evaluation equipment is assured. Such markings shall state (1) name of bidder, (2) number of bid, and (3) item number. Samples will be returned at bidder's expense provided a request accompanies the samples and provided further that samples are not destroyed by tests.

- 13. <u>**REFERENCES**</u> Bidders may be requested to furnish as references a list of customers in the general location of the District who have purchased like equipment within a three (3) year period prior to the closing date of this bid. In addition, bidder may be required to provide proof of financial responsibility to the District, if requested.
- 14. <u>**BID EVALUATION**</u> The District specifically reserves the right to evaluate, in its absolute discretion, the total bid of the bidder and to judge the representation of bidder so as to select equipment, materials, supplies, and/or services, which meets the specifications of the District.
- 15. <u>AWARD OF BID</u> The District reserves the right to reject any or all bids, waive irregularities or informalities in any bids or the bidding per Public Contract Code Section 20111(3), add or delete quantities listed on the Bid Proposal Form, and to solely make its selection of items awarded based upon compliance with District specifications by the lowest responsive bidder offering a proposal meeting District specifications. Failure to comply with any of the instructions stated or to provide all required information in the bid may result in rejection of a bid as non-responsive. After the bid opening date, the District will issue its Notice of Intent to Award to the apparent lowest responsive and responsible bidder. Award of bid, if made by the District, will be by action of the Governing Board of Trustees of the El Monte Union High School District and to the lowest responsive and responsible bidder.

The District reserves the right to award each item individually or by groups of line items.

If two (2) or more identical low bids are received from responsive bidders, the District will determine which bid will be accepted by lot pursuant to Public Contract Code Section 20117.

All bids shall remain open, valid and subject to acceptance for **ninety (90)** calendar days after the bid opening.

- 16. **<u>BID PROTEST</u>** Any bidder may file a bid protest. The protest shall be filed in writing with the District's Director of Purchasing not more than five (5) business days after the date of the bid opening. An e-mail address shall be provided and by filing the protest, protesting bidder consents to receipt of e-mail notices for purposes of the protest and protest related questions and protest appeal, if applicable. The protest shall specify the reasons and facts upon which the protest is based and provided that each and all of the following are complied with:
 - 1. The bid protest is in writing;
 - 2. The bid protest is submitted to the District before 4:30 p.m. of the FIFTH (5th) business day following the bid opening; and
 - 3. The written bid protest sets forth, in detail, all grounds for the bid protest, including without limitation all facts, supporting documentation, legal authorities and argument in support of the grounds for the bid protest; any matters not set forth in the written bid protest shall be deemed waived. All factual contentions must be supported by competent, admissible and creditable evidence.

<u>15.1</u> <u>Resolution of Bid Controversy:</u> Once the bid protest is received, the apparent lowest responsible bidder will be notified of the protest and the evidence presented. If appropriate, the apparent low bidder will be given an opportunity to rebut the evidence and present evidence that the apparent low bidder should be allowed to perform the Work. If deemed appropriate by the District, an informal hearing will be held. District will issue a written decision within fifteen (15) calendar days of receipt of the protest, unless factors beyond the District's reasonable control prevent such resolution. The decision on the bid protest will be copied to all parties involved in the protest.

<u>15.2</u> <u>Appeal</u>: If the protesting bidder or the apparent low bidder is not satisfied with the decision, the matter may be appealed to the Chief Business Official, or their designee, within three (3) business days after receipt of the District's written decision on the bid protest. The appeal must be in writing and sent via overnight registered mail

with all accompanying information relied upon for the appeal and an e-mail address from which questions and responses may be provided to:

El Monte Union High School District Attn: Wael Elatar, Chief Business Official 3537 Johnson Ave. El Monte, CA 91731

<u>15.3</u> <u>Appeal Review</u>: The Chief Business Official or their designee shall review the decision on the bid protest from the Director of Purchasing and issue a written response to the appeal, or if appropriate, appoint a Hearing Office to conduct a hearing and issue a written decision. The written decision of the Chief Business Official or the Hearing Officer shall be rendered within fifteen (15) calendar days and shall state the basis for the decision. The decision concerning the appeal will be final and not subject to any further appeals.

<u>15.4</u> Reservation of Rights to Proceed with Project Pending Appeal. The District reserves the right to proceed to award the Project and commence construction pending an Appeal. If there is State Funding or a critical completion deadline, the District may choose to shorten the time limits set forth in this Section if written notice is provided to the protesting party. E-mailed notice with a written confirmation sent by First Class Mail shall be sufficient to constitute written notice. If there is no written response to a written notice shortening time, the District may proceed with the award.

<u>15.5</u> Finality. Failure to comply with this Bid Protest Procedure shall constitute a waiver of the right to protest and shall constitute a failure to exhaust the protesting bidder's administrative remedies.

17. **<u>PAYMENT</u>** – Bidder shall submit invoices to:

El Monte Union High School District - F.M.O.T. Dept. Attention: Sandy Navarro 1003 Durfee Ave. South El Monte, CA 91733

Payments are due net thirty (30) days after the District's acceptance of work or delivery of equipment, materials, supplies, or services, in accordance with an itemized invoice for delivery of goods to the required destination and any supporting documentation required by the District.

Payment shall be made on completed shipments only, and any discounts offered by the bidder must allow for payment after receipt and acceptance of materials/equipment/supplies or correct invoice, whichever is later.

18. <u>**PURCHASE ORDER**</u> – The purchase order is intended to evidence intent to purchase equipment, materials, supplies, and/or services for the scope of products and work under this bid. The terms and conditions of the purchase order shall be included as part of this contract. In case of conflict between the terms and conditions of the Purchase Order and this bid, the terms of this bid shall prevail.

19. <u>DELIVERY AND INSTALLATION</u> –

1. Timely delivery is essential. Actual delivery of the equipment or services shall be coordinated with the District or contractor designated by the District but shall not exceed the required delivery dates (RDD) specified on the Bid Proposal Form for each particular product. The District, as a matter of bid non-responsiveness, shall reject all bids (regardless of price) that fail to indicate ability to deliver the product

within the required time. Give careful attention to any Required Delivery Dates (RDD) included in the Bid Documents. Upon award of bid, supplier shall keep sufficient stocks of product and service material to insure prompt delivery and service schedules. There shall be no minimum quantities required in order for the District to place orders for needed items.

- 2. Bid all items F.O.B. destination, delivered to various sites within the District. If freight is applicable, bidder shall prepay and add by specifying freight as a non-taxable line item, unless otherwise directed by the District. This shall include relocation and/or removal during the course of the Contract for existing or trade-in equipment being replaced; exceptions may be mutually agreed to.
- 3. Prior to delivery, all equipment shall be tested and integrated at the bidder's facility. All items found to be faulty shall be replaced prior to delivery, installation, and acceptance by the District.
- 4. There are no District designated receiving and offload staging area at site buildings, other than the District Warehouse.
- 20. **INSPECTION AND ACCEPTANCE** All items provided under this bid shall meet or exceed the bid specifications. Inspection and acceptance of all items shall be at destination. Items found to be defective or not in accordance with the bid specifications shall be promptly replaced by the bidder at no cost to the District. Failure to replace said items, in the timeframe required by the District, shall be considered sufficient cause for default action under the DEFAULT provision of this bid and/or resulting Agreement.

21. <u>SAFETY AND LEGAL REQUIREMENTS</u> –

- 1. All materials, equipment and supplies referred to in this bid shall be in full compliance with the safety specifications and requirements of the Division of Industrial Safety of the State of California, the minimum standards of O.S.H.A. and all other laws, regulations, and ordinances applicable hereto.
- 2. All electrical, radio and electric equipment, materials, supplies and accessories called for in the specifications must bear the seal of approval of the Underwriter's Lab., Inc. Where seals of approval are not visibly identifiable, a signed statement of such approval shall be furnished to the District, if so requested.
- 3. Motor driven or shock hazard machinery and appliances must have a three-wire cord (grounded) and threeprong plug. If the item is double-insulated and so certified by Underwriter Labs, grounding is not necessary.
- 4. Material Safety Data Sheets ("MSDS") must be provided to the District upon receipt of a purchase order with applicable items. The District shall provide direction for submittal of MSDS.

21. WARRANTIES AND SERVICE -

Bidders shall honor all warrantees provided by the manufacturers represented in the bid. Bidders are to provide a statement of warranty, minimum one (1) year parts and labor or manufacturer's warranty terms if greater, for all items bid and information on the availability of parts, both during warranty and upon warranty expiration. Include location, hours, phone number, and key contacts. Bidder shall guarantee all equipment to be free of defects in workmanship. Should any problem develop during the warranty period due to defective materials or faulty workmanship, awarded bidder shall furnish all labor, materials, time, and transportation to correct the problem without cost to the District. The District shall be furnished with all appropriate guarantees or warranties.

All service must be on-site with response time to be no longer than twenty-four 24 hours (8 business hours) after the call for service was received. EXCEPTIONS TO THIS ARTICLE MUST BE IN WRITING AND ATTACHED TO THE BID PROPOSAL FORM.

El Monte Union High School District	
Bid No. 2023-24(B2) Purchase of HVAC Equipment for Arroyo High School REBID	

All service shall be performed by fully factory trained and qualified technicians.

Where applicable, all merchandise must be warranted to be in compliance with California energy, conservation, environmental, educational, and products liability standards.

Refer to the Special Conditions Section of the Bid Documents for any warranty and/or service article having precedence over this article.

- 22. <u>STANDARD COMMERCIAL USE (Products Only)</u> The vendor, whether manufacturer, supplier, distributor or retailer, hereby certifies that the products offered under this bid have been placed in regular commercial use for a period of at least three (3) years and that adequate spare parts exist in the marketplace for the items sold. Submit all requests for deviations to this clause as an "or equal" deviation.
- 23. <u>**TRAINING**</u> Bidder shall, as required, provide assistance, as needed to District personnel in the methods of installation and use of all components of the equipment and/or system. Additionally, applicable training and various manual requirements may be stipulated within this Bid Document and Bid Proposal Form. The manufacturer's standard operator's manual shall accompany the delivery of all equipment and system(s).

24. **INSURANCE REQUIREMENTS** –

If applicable, the bidder warrants that it shall procure and maintain in full force and effect a policy or policies of insurance in accordance with the following minimum requirements:

- 1. All insurers must be duly licensed and admitted by the State of California
- 2. General Liability Insurance for bodily injury and property damage, including accidental death, in the combined single limit of not less than \$1,000,000 per occurrence and \$2,000,000 aggregate.
- 3. Worker's Compensation insurance in the amount required by law or a signed exemption and Employer's Liability insurance of not less than \$1,000,000
- 4. Automobile Liability insurance per accident for bodily injury and property damage in an amount of not less than \$1,000,000 per occurrence with no annual aggregate limit.
- 5. Certificates of Insurance, reflecting El Monte Union High School District and its Board of Trustees as additional insured under all policies, except Worker's Compensation, must be provided prior to issuance of Purchase Agreement. Additional Insured Endorsements are required and should accompany Certificates of Insurance. Certificate of Insurance shall provide thirty (30) day prior written notice of cancellation.
- 6. Insurance coverage must be in effect for the duration of any work being performed on District property.
- 25. **DAMAGE OF DISTRICT PROPERTY** The Vendor and/or Contractor shall maintain at all times, as required by conditions and progress of work, all necessary safeguards for the protection of employees and the public. In the event of damage caused by any operation associated with the activities of the Vendor and/or Contractor, Vendor and/or Contractor agrees immediately to make all repairs and replacements necessary to the approval of the District, and at no additional cost.

- 26. <u>ASSIGNMENT OF THE CONTRACT</u> No Contract awarded under this bid shall be assigned without the prior written approval of the District.
- 27. <u>CHANGES</u> Any changes in specifications or volume shall be approved only by Purchasing Department personnel, or as authorized by the District.
- 28. <u>CANCELLATION</u> The District reserves the right to cancel this Agreement by thirty (30) days written notice to bidder. Reason for cancellation would include, but not be limited to, failure of vendor to perform in a timely manner or unacceptable quality of service/equipment.
- 29. <u>CANCELLATION FOR INSUFFICIENT OR NON-APPROPRIATED FUNDS</u> The bidder hereby agrees and acknowledges that monies utilized by the District to purchase the items bid is public money appropriated by the State of California or acquired by the District from similar public sources and is subject to variation. The District fully reserves the right to cancel this bid at any time and/or to limit quantities of items due to non-availability or non-appropriation of sufficient funds.
- 30. **DEFAULT** When any contractor or vendor shall fail to deliver any article or service or shall deliver any article or service which does not conform to the specifications and delivery requirements, the District may, at its sole discretion, annul and set aside the contract entered into with said vendor or contractor, either in whole or in part, and make and enter into a new contract for the same items in such manner as seems to the Board of Trustees to be to the best advantage of the District. Any failure for furnishing such articles or services by reason of the failure of the vendor or contractor, as above stated, shall be a liability against such vendor and his sureties. The Board of Trustees reserves the right to cancel any articles or services which the successful bidder may be unable to furnish because of economic conditions, governmental regulations or other similar causes beyond the control of the bidder provided satisfactory proof is furnished to the Board or Trustees, if requested.
- 31. <u>ANTI-DISCRIMINATION</u> It is the policy of El Monte Union High School District Board of Trustees that in connection with all work or services performed. for the District, there be no discrimination against any prospective or active employee engaged in the work because of race, color, ancestry, national origin, religious creed, sex, age or marital status, and therefore, the bidder agrees to comply with applicable Federal and California laws including, but not limited to, the California Fair Employment Practice Act beginning with Labor Code Sections 1410 and 1735. In addition, the bidder agrees to require like compliance by all subcontractors employed by him.
- 32. <u>CONDUCT</u> All equipment, materials, supplies, and services, provided under the bid are to be performed in a good workmanlike manner. Vendor, Supplier, Contractor, Contractor's employees, Subcontractors, Subcontractors' employees, or any person associated with deliveries, installation, or any work associated with this bid shall conduct themselves in a cooperative manner appropriate for a school and/or public site. No verbal or physical contact with neighbors, students, and faculty, profanity, or inappropriate attire or behavior will be permitted. Verbal contact includes, but is not limited to, whistling at or initiating conversation with personnel not associated with the delivery, installation, and/or any work that may be associated with this bid. District may permanently remove non-complying persons from the site/property.
- 33. <u>HOLD HARMLESS PROVISION</u> The vendor shall save, defend, hold harmless and indemnify the District against any and all liability, claim, and costs of whatsoever kind and nature for injury to or death of any person and for loss or damage to any property occurring in connection with or in any way incident to or arising out of the occupancy, use, service, operations, or performance under the terms of this contract, resulting in whole or in part

from the negligent acts or omissions of vendor, its officers, subcontractor, or any employee, agent, or representative of vendor and/or subcontractor.

- 34. <u>PATENTS, ETC.</u> The vendor shall hold the El Monte Union High School District, its officers, agents, servants, and employees harmless and free from liability of any nature or kind on account of use (by publisher, manufacturer, or author) of any copyrighted or non-copyrighted composition, secret process, patented invention, article or appliance furnished or used under this bid.
- 35. <u>VENDOR/CONTRACTOR NOT OFFICER, EMPLOYEE, OR AGENT OF DISTRICT</u> While engaged in carrying out other terms and conditions of the purchase order, the Vendor and/or Contractor is an independent Vendor and/or Contractor, and not an officer, employee, agent, partner, or joint venture of the District.
- 36. <u>**GOVERNING LAW**</u> This contract shall be construed and interpreted according to the laws of the State of California, in a court of competent jurisdiction in the County of Los Angeles.

Each and every provision of law and clause required by law to be inserted in this bid document shall be deemed to be inserted herein and this bid shall be read and enforced as though it were included herein. Bidder is fully responsible for all city, county, state, and/or federal rules and ordinances.

37. <u>TERM OF AGREEMENT, PRICE GUARANTEE, MULTI-YEAR EXTENSIONS</u> – Price increases may be negotiated, in writing, subject to existing local market conditions, and as determined by the Los Angeles Producer Price Index (PPI), but may never exceed five percent (5%), whichever is lower. Accordingly, bidder pricing is the basis for potential price increases for five (5) years from date of award by the Board of Trustees.

In the event of a general price decrease the District reserves the right to revoke the bid award unless the decrease is passed on to the District.

- 38. <u>ADDITIONAL PURCHASE OPTION</u> The District may purchase additional quantities at the prices established in this bid during the term of the Contract.
- 39. <u>**TECHNOLOGY CLAUSE**</u> As technology advances, it is understood that improved or enhanced products may supersede existing products in both price and performance and yet be essentially similar. This request for bids seeks to address the rapid advances in technology by allowing functionally similar or identical products that may be introduced in the future, during the term of this bid, to be included under the general umbrella of compatible product lines and are thus specifically included in this bid document.
- 40. <u>E-COMMERCE (B2B) CLAUSE</u> The advent of electronic commerce (E-Commerce) and the development of Business to Business (B2B) internet sites have created both opportunities and potential issues for public entities. As the originator and author of this bid document, the El Monte Union High School District authorizes qualified firms to list the products represented in the final award of this bid on internet sites, subject to the approval of the awarded vendor.

END OF INSTRUCTIONS TO BIDDERS AND GENERAL CONDITIONS

SPECIAL CONDITIONS

- 1. **EQUIPMENT SPATIAL AND WEIGHT REQUIREMENTS** Bids submitted to the District as an "or equal" must fully meet the spatial and weight requirements of the products and model numbers specified in the Bid Documents. HVAC equipment must fit measurements of building platforms for designated District site(s). The products and model numbers specified in the Bid Documents meet spatial and weight requirements for District building platforms.
- 2. **DELIVERY EQUIPMENT AND OFFLOAD** Delivery may include offload of ordered equipment from delivery truck, to be performed by vendor with its own equipment, at the District designated delivery location. **Individual District orders will include this requirement if/as applicable.**
- 3. <u>"INITIAL" ORDER DELIVERY LOCATION</u> Delivery of selected equipment and related components shall be made to the following District site. Offload and offload equipment are not required for the <u>initial</u> order, to be coordinated with District.

Site:

Arroyo High School 4921 Cedar Ave. El Monte, CA 91732

4. **REQUIRED DELIVERY DATE(S) FOR <u>INITIAL</u> ORDER/LOCATION AS SPECIFIED IN SPECIAL CONDITIONS:**

Delivery Date:No later than June 1, 2024

5. LIST OF EQUIPMENT:

EMUSD Arroyo HS Modernization - HVAC Equipment List						
Tag	Equipment Type	Manufacturer	Model	Capacity/Size	Quantity	Notes
Kitchen Bu	ilding					
MAU-K-1	Makeup Air Unit	CaptiveAire	CASRTU3-E.154-18-20T	4025 cfm/203 Mbh cooling	1	
KEF-K-1	Exhaust Fan	CaptiveAire	DU240HFA	4025 cfm/1.75" SP	1	
H-1	Kitchen Hood	CaptiveAire	6624 ND-2	11.5' long/1725 cfm	1	Provide an Ansul fire
H-2	Kitchen Hood	CaptiveAire	6024 ND-2	11.5' long/2300 cfm	1	serve the two hoods.
Gymnasiur	n Building					
AHU-R-1	Air Handling Unit - Split System	Trane	CSAA025	12,000 cfm/487 Mbh cooling	1	
AHU-R-2	Air Handling Unit - Split System	Trane	CSAA012	5800 cfm/242 Mbh cooling	1	
AHU-R-3	Air Handling Unit - Split System	Trane	CSAA025	12,000 cfm/487 Mbh cooling	1	
AHU-R-4	Air Handling Unit - Split System	Trane	CSAA012	5800 cfm/242 Mbh cooling	1	
CU-R-1	Condensing Unit	Trane Mitsubishi	TUHYP3604BN40A	360 Mbh cooling	1	
CU-R-2	Condensing Unit	Trane Mitsubishi	TUHYP1924BN40A	192 Mbh cooling	1	
CU-R-3	Condensing Unit	Trane Mitsubishi	TUHYP3604BN40A	360 Mbh cooling	1	
CU-R-4	Condensing Unit	Trane Mitsubishi	TUHYP1924BN40A	192 Mbh cooling	1	
SG-1	Supply Air Grille	Titus	300RS	48x8/1600 cfm	24	
RG-1	Return Air Grille	Titus	350RS	38x30/5200 cfm	12	

El Monte Union High School District	Page 15
Bid No. 2023-24(B2) Purchase of HVAC Equipment for Arroyo High School REBID	5

6. WARRANTIES AND SERVICE –

- 1. Rooftop Units: Warranty period shall begin on the date of start-up, not from the date of manufacture on the unit nameplate.
- 2. Compressors: Five (5) years replacement.
- 3. Heat Exchangers: Ten (10) years.
- All Other Equipment and Parts Not Listed: Bidders are to provide a statement of warranty, with a minimum one (1) year parts and labor, or manufacturer's warranty terms if greater, for all items bid. Warranty shall begin on the date the equipment is placed into service by the District. Additionally, include information on the availability of parts, both during warranty and upon warranty expiration, by providing location, hours, phone number, and key contacts. Vendors shall guarantee all equipment to be free of defects in workmanship. Should any problems develop during the warranty period due to defective equipment and/or materials or faulty workmanship, vendor shall furnish all labor, materials, time, and transportation to correct the problem without cost to the District.
- 7. **<u>REBATES/INCENTIVES</u>** Bidder to inform District of any and all rebate/incentive opportunities available through the Southern California Edison Company, Southern California Gas Company, manufacturers, or any other sources for all items bid.

END OF SPECIAL CONDITIONS

BID PROPOSAL FORM

To: Governing Board of the El Monte Union High School District ("District")

From:		11.			
(Prope	er Company Name of Bi	(dder)			
Receipt and ac	ceptance of the following	ng Addenda is hereby ac	knowledged:		
No.	No.	No.	No.	No.	

The undersigned declares that the Bid Documents including, without limitation, the Notice to Bidders and the Instructions to Bidders have been read and agrees to furnish and deliver such equipment, materials, supplies, and/or services, at the unit prices herein stated and in accordance with the attached specifications, terms and conditions of the Contract Documents for:

Bid No.: 2023-24(B2) Purchase of HVAC Equipment for Arroyo High School REBID

				UNIT	UNIT PRICE	FYTENDED
ITEM	QUANTITY	UOM	PRODUCT DESCRIPTION	PRICE	SHIPPING	PRICE
			MAU-K-1			
			Makeup Air Unit			
			CaptiveAire			
1	1	EA	Model: CASRTU3-E.154-18-20T	\$	\$	\$
			KEF-K-1			
			Exhaust Fan			
			CaptiveAire			
2	1	EA	Model: DU240HFA	\$	\$	\$
			H-1			
			Kitchen Hood			
			CaptiveAire			
3	1	EA	Model: 6624 ND-2	\$	\$	\$
			H-2			
			Kitchen Hood			
			CaptiveAire			
4	1	EA	Model: 6024 ND-2	\$	\$	\$
			AHU-R-1			
			Air Handling Unit - Split System			
			Trane			
5	1	EA	Model: CSAA025	\$	\$	\$
			AHU-R-2			
			Air Handling Unit - Split System			
			Trane			
6	1	EA	Model: CSAA012	\$	\$	\$
			AHU-R-3			
			Air Handling Unit - Split System			
7	1	EA	Trane	\$	\$	\$
El Monte	e Union High Scho	ol Distric	t			Раде 17

Bid No. 2023-24(B2) Purchase of HVAC Equipment for Arroyo High School REBID

			Model: CSAA025			
			AHU-R-4			
			Air Handling Unit - Split System			
			Trane			
8	1	EA	Model: CSAA012	\$	\$	\$
			CU-R-1			
			Condensing Unit			
			Trane Mitsubishi			
9	1	EA	Model: TUHYP3604BN40A	\$	\$	\$
			CU-R-2			
			Condensing Unit			
			Trane Mitsubishi			
10	1	EA	Model: TUHYP1924BN40A	\$	\$	\$
			CU-R-3			
			Condensing Unit			
			Trane Mitsubishi			
11	1	EA	Model: TUHYP3604BN40A	\$	\$	\$
			CU-R-4			
			Condensing Unit			
			Trane Mitsubishi			
12	1	EA	Model: TUHYP1924BN40A	\$	\$	\$
			SG-1			
			Supply Air Grille			
			Titus		+	
13	24	EA	Model: 300RS	\$	\$	\$
			RG-1			
			Return Air Grille			
	10		Titus	ф.	ф.	ф.
14	12	EA	Model: 350RS	\$	\$	\$
15	1	LOT		0/	0/	0/
15	1	LOI	Percentage(s) Discount Off	%	%0	%
			Complete Product Line Catalog /			
			List Price for products not included			
			on this Bid Proposal Form.			
			Attach additional priving sheat(s)			
			Attach additional pricing sheet(s)			
			Identify attachments with District			
			Bid and Item Number Company			
			Name authorized representative			
			signature and date			
1	1	1	I Signature and date.	1	1	

Bid Form Continued on Next Page

BID FORM SUMMARY

roun runnge menung smppme	g: \$		-
Tax (10%) (must be shown separately)	\$		-
Other Cost:	\$		-
Please specify "Other Cost" if any:			
Grand Total:	\$		-
Delivery Date:		Payment Terms:	
		(minimum is	Net 50, state any prompt payment discount)
perjury:	isar r or m, ar c	ti uc and correct and a	
Authorized (Manual) Signature:			1 V
Authorized (Manual) Signature: Printed Name of Authorized Signer:			
Authorized (Manual) Signature: Printed Name of Authorized Signer: Date:			1 V
Authorized (Manual) Signature:Printed Name of Authorized Signer:Date:Bidder Company Name:			
Authorized (Manual) Signature:			
Authorized (Manual) Signature:	State		7in
Authorized (Manual) Signature:	State		Zip

BIDDER CHECKLIST

REMEMBER TO COMPLETE AND SUBMIT:

- ✓ Bid Proposal Form with ORIGINAL AUTHORIZED SIGNATURE
- ✓ Non-Collusion Affidavit

SUBMITTALS REQUIRED BY SUCCESSFUL BIDDER UPON RECIEPT OF NOTICE OF INTENT TO AWARD AND FORTY-EIGHT (48) HOURS PRIOR TO AWARD BY DISTRICT BOARD OF TRUSTEES, IF/AS APPLICABLE:

- ✓ Certificates of Insurance, if/as applicable to the bid
- ✓ Criminal Background Check and Fingerprinting Certification, if/as applicable to the bid

END OF BID PROPOSAL FORM

EXHIBIT "A"

MISCELLANEOUS FORMS

PRE-BID REQUEST FOR INFORMATION FORM

Submit Pre-Bid Request for Information Form, via EMAIL to:

Margarita Sanchez, Director of Purchasing at purchasing@emuhsd.org

Project Information:

Bid / Title: Bid No. 2023-24(B1) Purchase of HVAC Equipment for Arroyo High School

Pre-Bid RFI No: _____

SUBJECT:

DESCRIPTION OF PROBLEM / CLARIFICATION / INFORMATION REQUIRED

Reference: Instructions to Bidders/General Conditions, Special Conditions and/or Specifications(s):_____

Drawing No. : _____

Submitted by:	Date Submitted	:
Bidder:(Name of Compan	y) Contact:	(Print or type Name)
Street Address:	Phone No.:	
City, State, Zip:	Email:	
El Monte Union High School District Bid No. 2023-24(B2) Purchase of HVAC Eq	uipment for Arroyo High School REBID	Page 22

NON-COLLUSION AFFIDAVIT Public Contract Code Section 7106

TO BE EXECUTED BY BIDDER AND SUBMITTED WITH BID

STATE OF CALIFORNIA)
) ss.
COUNTY OF)

	be	eing first duly sworn deposes and
says that he or she is	of	, the
Bidder 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 g	enuine and not collusive or sham	; that the Bidder has not directly
or indirectly induced or solicited any other bidder to put in a false o	r 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 f	from bidding; that the Bidder has
not in any manner, directly or indirectly, sought by agreement, com	munication, or conference with a	anyone to fix the Bid price of the
Bidder or any other bidder, or to fix any overhead, profit, or cost ele	ement of the Bid price, or of that	t of any other bidder, or to secure
any advantage against the District of anyone interested in the propos	ed Contract; that all statements c	contained in the bid are true; and,
further, that the Bidder has not, directly or indirectly, submitted the	ir Bid price or any breakdown th	nereof, or the contents thereof, or
divulged information or data relative thereto, or paid, and will not p	ay, any fee to any corporation, r	partnership, company association,
organization, bid depository, or to any member or agent thereof to ef	fectuate a collusive or sham bid.	

I certify and declare under penalty of perjury under the laws of the State of California that all the foregoing information in this Non-Collusion Affidavit is true and correct.

Date:	
Proper Name of Bidder:	
Signature:	
Print Name:	
Title:	

(ATTACH NOTARIAL ACKNOWLEDGMENT FOR THE ABOVE SIGNATURE)

END OF DOCUMENT

<u>EXHIBIT "B"</u> <u>RESPONSE TO REQUESTS FOR INFORMATION</u> <u>FROM PREVIOUS BID – BID NO. 2023-24(B1)</u>

HMC Architects

El Monte USD

Arroyo HS Modernization (HVAC only) Pre-Bid RFI #336-1008-100 DSA #03-123-169

REQUEST FOR INFORMATION LOG

7/19/2023

RFI No.	RFI Date	HMC Receipt Date	Received From	Due Date	Description	Discipline	Notes/Comments/Response
1	07/14/23	07/14/23	Allison Mechanical, Inc.	7/17/23	 Warranties and Service : General Condition #21, Special Conditions #5 1. When are the units expected to be installed and started-up? 2. Please clarify more on the (1) year labor warranty. Since this is an equipment only bid, we are not installing the units. Are you wanting the awarded bidder to provide labor for service calls to diagnose possible warranty issues and install the warranty parts? 	Mech	 The units are expected to be installed in the summer of 2024 and the work will need to be complete by September 2024. The warranties should be as described in the different specification sections. See sections 23 09 23/1.05, 23 80 00/1.06 and 23 81 29/1.5.
2	07/14/23	07/14/23	Allison Mechanical, Inc.	7/17/23	 Training : General Conditions #23 1. Please clarify more on the Training Requirement per General Condition # 23. How many hours should we include in our bid for training assistance and will it be onsite training or over the phone? 2. Please confirm that the training is only for the Equipment Listed on the Bid Form, Item # 1 -14. 	Mech	 Training shall be as described in section 23 05 00/1.08 and other division 23 sections. Training applies to the equipment and to the controls systems as described in section 23 09 23/1.06.
3	07/14/23	07/14/23	Allison Mechanical, Inc.	7/17/23	Exhibit D - Specifications 1. Please clarify what Specifications Sections in Exhibit D apply to this bid. For example, Specification Section 23 01 30 HVAC Air Duct Cleaning is included in this bid. Are we to provide a cost for duct cleaning?	Mech	1. All sections apply. Duct cleaning shall be provided for only the small amount of existing supply air duct to be reused at the kitchen. All of the other ductwork at the kitchen, and all of the ductwork at the gym is to be newly installed.
4	07/14/23	07/14/23	Allison Mechanical, Inc.	7/17/23	Required Delivery Date : General Conditions #18, Special Conditions #4 Trane is stating that the AHU units will not arrive before the November 30, 2023 required date. As of today the Estimated Lead Times from date order is placed is ranging 32-36 weeks. Can the delivery due date be extended.	Mech	Delivery will not be required until the summer of 2024, so that should provide sufficient time for the equipment to be ordered and shipped.
5	07/11/23	07/11/23	RLH Fire Protection	7/17/23	Can you clarify if this project is needing fire sprinkler or fire alarm?	Arch	Building K and Building R does not have fire sprinklers. Fire alarm is part of the project scope.

EXHIBIT "C" LIST OF EQUIPMENT

EMUSD Arroyo HS Modernization - HVAC Equipment List									
Тад	Equipment Type	Manufacturer	Model	Capacity/Size	Quantity	Notes			
Kitchen B	Kitchen Building								
MAU-K-1	Makeup Air Unit	CaptiveAire	CASRTU3-E.154-18-20T	4025 cfm/203 Mbh cooling	1	1			
KEF-K-1	Exhaust Fan	CaptiveAire	DU240HFA	4025 cfm/1.75" SP	1	1			
H-1	Kitchen Hood	CaptiveAire	6624 ND-2	11.5' long/1725 cfm	1	1 Provide an Ansul fire protection			
H-2	Kitchen Hood	CaptiveAire	6024 ND-2	11.5' long/2300 cfm	1	1 system to serve the two hoods.			
Gymnasiu	m Building								
AHU-R-1	Air Handling Unit - Split System	Trane	CSAA025	12,000 cfm/487 Mbh cooling	1	1			
AHU-R-2	Air Handling Unit - Split System	Trane	CSAA012	5800 cfm/242 Mbh cooling	1	1			
AHU-R-3	Air Handling Unit - Split System	Trane	CSAA025	12,000 cfm/487 Mbh cooling	1	1			
AHU-R-4	Air Handling Unit - Split System	Trane	CSAA012	5800 cfm/242 Mbh cooling	1	1			
CU-R-1	Condensing Unit	Trane Mitsubishi	TUHYP3604BN40A	360 Mbh cooling	1	1			
CU-R-2	Condensing Unit	Trane Mitsubishi	TUHYP1924BN40A	192 Mbh cooling	1	1			
CU-R-3	Condensing Unit	Trane Mitsubishi	TUHYP3604BN40A	360 Mbh cooling	1	1			
CU-R-4	Condensing Unit	Trane Mitsubishi	TUHYP1924BN40A	192 Mbh cooling	1	1			
SG-1	Supply Air Grille	Titus	300RS	48x8/1600 cfm	24	4			
RG-1	Return Air Grille	Titus	350RS	38x30/5200 cfm	12	2			

EXHIBIT "D" SPECIFICATIONS EQUIPMENT, MATERIALS, SUPPLIES, SERVICES

SECTION 23 01 30 - HVAC AIR DUCT CLEANING

PART 1 - GENERAL

1.01 SUMMARY

- A. Section Includes:
 - 1. This Section includes cleaning of the following existing air duct systems:
 - a. Supply system.
 - b. Return system.
 - c. Exhaust and Transfer system.

B. Related Requirements:

- a. Division 01 General Requirements.
- b. Section 23 30 00 Air Distribution.
- c. Section 23 07 00 HVAC Insulation
- d. NADCA Standard ACR.
- e. NADCA General Specification for the Cleaning & Restoration of Commercial HVAC System.
- f. UL181 Standard for Factory-Made Air Ducts and Air Connectors.

1.02 DEFINITIONS

- A. ACR: Assessment, Cleaning, and Restoration of HVAC Systems.
- B. ASCS: Air systems cleaning specialist.
- C. HEPA: High Efficiency Particulate Arrestance.
- D. HVAC: Heating, Ventilation and Air Conditioning.
- E. NADCA: National Air Duct Cleaners Association.
- F. OEHS: Office of Environmental Health & Safety.

Budlong 3361-008-000

- G. SDS: Safety Data Sheet.
- H. SMACNA: Sheet Metal and Air Conditioning Contractors' National Association.
- I. UL: Underwriters Laboratories.

1.03 SUBMITTALS

- A. Qualification Data for ASCS as indicated on NADCA General Specification.
- B. Strategies and Procedures Plan before starting the work.
- C. Cleanliness Verification Report at the project completion.

1.04 QUALITY ASSURANCE

- A. ASCS Qualifications:
 - 1. Certification: Employ an ASCS certified by NADCA on a full-time basis.
 - 2. Supervisor Qualifications: Certified as an ASCS by NADCA.
- B. UL Compliance: Comply with UL 181 "Standard for Factory-Made Air Ducts and Air Connectors" requirement.
- C. Cleaning Conference: Conduct conference at Project site. Review methods and procedures related to HVAC air-distribution system cleaning including, but not limited to, review of the cleaning strategies and procedures plan.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.01 EXAMINATION

- A. Examine HVAC air-distribution equipment systems to determine appropriate methods, tools, and equipment required for performance of the Work.
- B. Perform "Project Assessment and Recommendation" according to current NADCA ACR Standard.
- C. Prepare written report listing conditions detrimental to performance of the Work.
- D. Proceed with work only after unsatisfactory conditions have been corrected, and OAR's approval has been obtained.



3.02 PREPARATION

- A. Prepare a written plan that includes strategies and step-by-step procedures. At a minimum, include the following:
 - 1. Supervisor contact information.
 - 2. Work schedule including location, times, and impact on occupied areas.
 - 3. Methods and materials planned for each HVAC component type.
 - 4. Required support from other trades.
 - 5. Equipment and material storage requirements.
 - 6. Exhaust equipment setup locations.
- B. Use the existing service openings, as required for proper cleaning, at various points of the HVAC system for physical and mechanical entry and for inspection. Refer to Construction Documents for quantities.
- C. Comply with current NADCA ACR Standard, "Guidelines for Constructing Service Openings in HVAC Systems" Section.
- 3.03 CLEANING
 - A. Comply with current NADCA ACR Standard Requirement.
 - B. Do not use any chemicals in the process of cleaning unless there is a significant reason. Using any kind of chemicals is subject to the OAR's approval. Prior to the application of any chemical, ASCS is required to submit SDS document of proposed cleaning materials to OAR in order to obtain product approval from OEHS. Do not apply any material unsafe for hard metal surfaces.
 - C. Systems and Components to be Cleaned by a qualified ASCS:
 - 1. Air devices for supply and return air.
 - 2. Ductwork:
 - a. Supply-air ducts, including turning vanes and reheat coils, to the airhandling unit.
 - b. Return-air ducts to the air-handling unit.
 - c. Exhaust-air and Transfer-air ducts.



- D. Perform cleaning before air balancing or mark the position of manual volume dampers and air-directional mechanical devices inside the system prior to cleaning. Restore them to their marked position on completion of cleaning.
- E. Use duct-mounted access doors, as required, for physical and mechanical entry and for inspection.
 - 1. Install additional duct-mounting access doors to comply with duct cleaning standards. Comply with requirements in Section 23 30 00 "Air Distribution" for additional duct-mounting access doors.
 - 2. Disconnect and reconnect flexible ducts as needed for cleaning and inspection. Replace damaged and deteriorated flexible ducts. Comply with requirements in Section 23 30 00 "Air Distribution" for flexible ducts.
 - 3. Disconnect and reconnect flexible connectors as needed for cleaning and inspection. Replace damaged and deteriorated flexible connectors Comply with requirements in Section 23 30 00 "Air Distribution" for flexible connectors.
 - 4. Replace damaged fusible links on fire and smoke dampers. Replacement fusible links shall be same rating as those being replaced. Comply with requirements in Section 23 30 00 "Air Distribution" for fusible links.
 - 5. Remove and reinstall ceiling components to gain access for duct cleaning. Clean ceiling components after they have been removed and replaced.
- F. Particulate Collection and Odor Control:
 - 1. Where venting vacuuming system inside building, use HEPA filtration with 99.97 percent collection efficiency for 0.3-micron size or greater particles.
 - 2. When venting vacuuming system outside building, use filtration to contain debris removed from the HVAC system and locate exhaust down wind and away from air intakes and other points of entry into building.
- G. Clean the following metal-duct system components by removing visible surface contaminants and deposits:
 - 1. Air outlets and inlets: registers, grilles, and diffusers.
 - 2. Supply, return, and exhaust fans including fan housings, plenums (except ceiling supply and return plenums), scrolls, blades or vanes, shafts, baffles, dampers, and drive assemblies.
 - 3. Air-handling-unit internal surfaces and components including mixing box, coil section, air wash systems, spray eliminators, condensate drain pans, humidifiers and dehumidifiers, filters and filter sections, and condensate collectors and drains.



HVAC AIR DUCT CLEANING 23 01 30-4

- 4. Coils and related components.
- 5. Return-air ducts, dampers, and actuators, except in ceiling plenums and mechanical room.
- 6. Supply-air ducts, dampers, actuators, and turning vanes.
- 7. Dedicated exhaust and ventilation components.
- H. Mechanical Cleaning Methodology:
 - 1. Source-Removal Cleaning Methods: The HVAC system shall be cleaned using source-removal mechanical cleaning methods designed to extract contaminants from within the HVAC system and to safely remove these contaminants from the facility. No cleaning method, or combination of methods, shall be used that could potentially damage components of the HVAC system or negatively alter the integrity of the system.
 - a. Use continuously operating vacuum-collection devices to keep each section being cleaned under negative pressure.
 - b. Cleaning methods that require mechanical agitation devices to dislodge debris that is adhered to interior surfaces of HVAC system components shall be equipped to safely remove these devices. Cleaning methods shall not damage the integrity of HVAC system components or damage porous surface materials such as duct and plenum liners.
 - 2. Cleaning Mineral-Fiber Insulation Components:
 - a. Fibrous-glass thermal or acoustical insulation elements present in equipment or ductwork shall be thoroughly cleaned with HEPA vacuuming equipment while the HVAC system is under constant negative pressure and shall not be permitted to get wet according to current NADCA ACR Standard. Replace fibrous-glass duct liner that is damaged, deteriorated, or delaminated or that has friable material, mold, or fungus growth.
 - b. Cleaning methods used shall not cause damage to fibrous-glass components and will render the system capable of passing the HVAC System Cleanliness Tests, refer to current NADCA ACR Standard.
 - c. Fibrous materials that become wet shall be discarded and replaced inkind.
 - 3. Clean coils and coil drain pans according to current NADCA ACR Standard. Keep drain pan operational. Rinse coils with clean water to remove latent residues and cleaning materials; comb and straighten fins.



HVAC AIR DUCT CLEANING 23 01 30-5

- 4. Provide operative drainage system for wash-down procedures.
- 5. Biocidal Agents and Coatings: Apply Biocidal agents and coatings if active fungal growth is reasonably suspected or where unacceptable levels of fungal contamination have been verified. Apply Biocidal agents and coatings according to manufacturer's written recommendations and OEHS registration listing after the removal of surface deposits and debris.
 - a. When used, Biocidal treatments and coatings shall be applied after the system is rendered clean.
 - b. Apply Biocidal agents and coatings directly onto surfaces of interior ductwork.
 - c. Sanitizing agent products shall be registered by the OEHS as specifically intended for use in HVAC systems and ductwork.
- 6. Debris removed from the HVAC system shall be disposed of according to applicable Federal, state, and local requirements.
- I. Cleanliness Verification:
 - 1. Verify cleanliness according to current NADCA ACR Standard, "Verification of HVAC System Cleanliness" Section.
 - 2. Verify cleanliness after mechanical cleaning and before application of treatment, including biocidal agents and protective coatings.
 - 3. Perform visual inspection for cleanliness. If no contaminants are evident through visual inspection, the HVAC system shall be considered clean. If visible contaminants are evident through visual inspection, those portions of the system where contaminants are visible shall be re-cleaned and re-inspected.
 - 4. Additional Verification:
 - a. Perform surface comparison testing or NADCA vacuum test.
 - b. Conduct NADCA vacuum gravimetric test analysis for nonporous surfaces.
 - 5. Prepare a written cleanliness verification report. At a minimum, include the following:
 - a. Written documentation of the success of the cleaning.
 - b. Site inspection reports, initialed by supervisor, including notation on areas of inspection, as verified through visual inspection.



- c. Surface comparison test results if required.
- d. Gravimetric analysis (nonporous surfaces only).
- e. System areas found to be damaged.

3.04 CONNECTIONS

- A. Reconnect ducts to fans and air-handling units with existing flexible connectors after cleaning ducts and flexible connectors. Replace existing damaged and deteriorated flexible connectors.
- B. For fans developing static pressures of 5-inch w.g. and higher, cover replacement flexible connectors with loaded vinyl sheet held in place with metal straps.
- C. Reconnect terminal units to supply ducts with existing flexible ducts or replace damaged and deteriorated existing flexible ducts with maximum 12-inch lengths of new flexible duct.
- D. Reconnect diffusers to low-pressure ducts with existing flexible ducts or replace damaged and deteriorated existing flexible ducts with maximum 60-inch lengths of flexible duct clamped or strapped in place.
- E. Reconnect existing and new flexible ducts to metal ducts. Comply with requirements in Section 23 30 00 "Air Distribution" for flexible ducts.

3.05 RESTORATION

- A. Restore and repair HVAC air-distribution equipment, ducts, plenums, and components according to current NADCA ACR Standard, "Restoration and Repair of Mechanical Systems" Section.
- B. Restore service openings capable of future reopening. Comply with requirements in Section 23 30 00 "Air Distribution" Include location of service openings in Project closeout report.
- C. Replace fibrous-glass materials that cannot be restored by cleaning or resurfacing. Comply with requirements in Section 23 30 00 "Air Distribution".
- D. Replace damaged insulation according to Section 23 07 00 "HVAC Insulation".
- E. Ensure that closures do not hinder or alter airflow.
- F. New closure materials, including insulation, shall match opened materials and shall have removable closure panels fitted with gaskets and fasteners.
- G. Reseal fibrous-glass ducts. Comply with requirements in Section 23 3000 "Air Distribution".



3.06 FIELD QUALITY CONTROL

- A. Gravimetric Analysis: Sections of metal-duct system, chosen randomly by OAR may be tested for cleanliness according to NADCA vacuum test gravimetric analysis.
 - 1. If analysis determines that levels of debris are equal to or lower than suitable levels, system shall have passed cleanliness verification.
 - 2. If analysis determines that levels of debris exceed suitable levels, system cleanliness verification will have failed and metal-duct system shall be recleaned and re-verified with no additional cost to OWNER.
- B. Verification of Coil Cleaning: Cleaning shall restore coil pressure drop to within 10 percent of pressure drop measured when coil was first installed. If original pressure drop is not known, coil will be considered clean only if it is free of foreign matter and chemical residue, based on thorough visual inspection.
- C. Report results of tests in writing.

END OF SECTION


SECTION 23 05 00 - COMMON WORK RESULTS FOR HVAC

PART 1 – GENERAL

1.01 SUMMARY

- A. Section Includes:
 - 1. This Section provides the basic mechanical requirements that apply to the Work of Division 23.
- B. Related Requirements:
 - 1. Division 01: General Requirements.
 - 2. Division 26: Electrical.

1.02 REGULATORY REQUIREMENTS

- A. Materials, fabrication, equipment, and installation shall comply with industry standards and code requirements. Where manufacturer's recommendations exceed industry standards, the manufacturer's recommendation shall establish the minimum standard. As a minimum, standards from the following organizations shall apply:
 - 1. AMCA Air Movement and Control Association.
 - 2. ANSI American National Standards Institute.
 - 3. ASME American Society of Mechanical Engineers.
 - a. ASME Boiler and Pressure Vessel Code.
 - b. ASME B31 Code for Pressure Piping.
 - 4. AHRI Air-Conditioning, Heating, and Refrigeration Institute.
 - 5. ASHRAE American Society of Heating, Refrigerating and Air-Conditioning Engineers.
 - 6. ASTM American Society for Testing and Materials.
 - a. ASTM A53 Specification for Welded and Seamless Pipe.
 - 7. CSA Canadian Standards Association.
 - 8. FM Global Factory Mutual Global
 - 9. IAPMO International Association of Plumbing and Mechanical Officials.
 - 10. NFPA National Fire Protection Association.
 - 11. OSHA Occupational Safety and Health Administration.
 - 12. SMACNA Sheet Metal and Air Conditioning CONTRACTORs' National Association.



- 13. UL Underwriters Laboratories Inc.
- 14. Intertek (ETL Certification).
- B. Materials, fabrication, equipment, and installation shall comply with federal, state, and local codes including, but not limited to, the following:
 - 1. CBC, California Building Code, and CMC, California Mechanical Code.
 - a. Latest edition as adopted by the City of Canyon Country, the County of Ventura, and the State of California including amendments effective on the Effective Date of the Contract.
 - 2. California Code of Regulations, Title 8, Industrial Relations, Division 1, Chapter 4, Division of Industrial Safety.
 - 3. OSHA Occupational Safety and Health Administration.
 - 4. CDPH California Department of Public Health.
 - 5. SCAQMD South Coast Air Quality Management District.
- C. Specifications or Drawings shall not be construed to permit deviation from the requirements of governing codes unless approval has been obtained from legally constituted authorities having jurisdiction, and the Architect. The Contract Documents may contain more stringent requirements than those legally required.
- D. Permits and Fees: Refer to the General and Supplementary Conditions.

1.03 SUBMITTALS

- A. Provide submittals in accordance with Section 01 33 00: Submittal Procedures and with specific requirements of Division 23 sections, as applicable.
- B. After Architect's approval, the above information shall become the basis for inspecting and testing materials and actual installation procedures performed in the Work.
- C. Shop Drawings: Submit one additional copy when control diagrams having line voltage connections are indicated. Shop Drawings shall be specifically prepared for the Work of this Project. Drawings prepared in accordance with requirements of Section 01 31 13: Project Coordination and Section 01 33 00 may be provided by the Architect to serve as a background for the Shop Drawings. Shop Drawings shall comply with the requirements of Section 01 31 13 and Section 01 33 00 and shall indicate at a minimum:
 - 1. Complete system layout of equipment, components, ductwork, and piping, indicating service clearances, duct and pipe sizes, fitting types and sizes, top or bottom of duct and pipe elevations, distances of ducts, pipes and equipment from building reference points and hanger / support locations. All the above items shall be coordinated on the shop drawings according to the requirements of Section 01 31 13.
 - 2. Schedule and description of equipment, ductwork, piping, fittings, valves, dampers, and controllers.



1.04 PROJECT RECORD DOCUMENTS

- A. Comply with provisions of Section 01 77 00: Contract Closeout.
- B. Project Record Drawings:
 - 1. Provide a complete set of mechanical and control system drawings in AutoCAD and, if available, BIM, complete with external reference drawings, fonts, blocks and plotter pen color/line thickness settings on CD-ROM. Also submit one set of full size reproducible plots on vellum and three sets of prints.
 - 2. Before Contract Completion, deliver corrected and completed prints to the OAR. Delivery of project record documents to the OAR does not relinquish responsibility of furnishing required information omitted from project record documents.
- C. Operation and Maintenance Manuals:
 - Submit operation and maintenance manuals in required form and content. If no revisions are required, furnish one additional copy. If revisions are required, one copy shall be returned with instructions for changes; perform such changes and return manuals. Manuals shall be bound in accordance to Section 01 7700. Deliver manuals to the OAR. Submit an electronic copy of the entire manual in PDF file format.
 - 2. Contents of Manual:
 - a. Title sheet with Project name, including names, addresses and telephone number of CONTRACTOR, installer, and related equipment suppliers.
 - b. Manufacturer's operating instructions including, but not limited to, the following:
 - 1) Identification of components and controls.
 - 2) Pre-start checklist and start-up procedures.
 - 3) Normal operation settings and checklists.
 - 4) Pre-shut down checklist and shut down procedures.
 - 5) Trouble shooting checklist and guidelines.
 - 6) Recommendations for optimum performance.
 - 7) Warnings and safety precautions on improper or hazardous operational procedures or conditions
 - c. Manufacturer's product data and parts and maintenance booklet for each item of equipment furnished under Division 23 that includes the following as a minimum:
 - 1) Manufacturer's model, identification and serial numbers.
 - 2) Exploded view of assembly drawings identifying each component or part with the relevant part number.



- 3) Directory of manufacturer's representatives, service CONTRACTORs and part distributors.
- 4) Maintenance and trouble-shooting instructions, including schedule for preventive maintenance, periodic inspection and cleaning criteria.
- d. Project Record Drawings: Complete set of mechanical and control system drawings in 50 percent reduced print format shall be furnished with the manual. Submit the above record drawings on CD-ROM in AutoCAD and, if available, BIM, complete with external reference drawings, fonts, blocks, and plotter pen color/line thickness settings.
- e. Testing, Adjusting, and Balancing reports: Submit as specified in Section 01 45 25.
- f. South Coast Air Quality Management District (SCAQMD) permits to install and operate boilers, water heaters and other fuel burning equipment and third-party source test reports as required by SCAQMD to allow start-up and operation of equipment.
- g. Los Angeles County industrial waste permits.
- h. Valve directory complete with location, function, size, and model of each valve with reference to the project record drawings.
- i. Equipment and component identification chart complete with location, function, size, and model of each equipment or component with reference to the project record drawings.

1.05 COORDINATION

A. Contract Documents indicate extent and general arrangement of Work under Division 23. CONTRACTOR shall coordinate work in accordance with Section 01 3113 requirements and make adjustments as required to provide maximum headroom, a neat arrangement to keep passageways and openings clear to provide accessibility and provisions for maintenance, and to meet code requirements.

1.06 DELIVERY, STORAGE, AND HANDLING

- A. Delivery and Storage: Deliver materials to Project site in their original unopened containers with labels intact and legible at time of delivery. Store in strict accordance with manufacturer's recommendations.
- B. Do not store plastic pipe or materials in direct sunlight.
- 1.07 PRELIMINARY OPERATION



- A. OAR may require any portion of mechanical Work to be operated before Substantial Completion. Such operation shall be in addition to regular tests, demonstrations and instructions required under the Contract Documents, and shall be performed as required.
- B. Notify the Project Inspector at least 24 hours in advance of lighting or re-lighting pilots.
- 1.08 TRAINING OF OWNER PERSONNEL
 - A. Training of Owner's personnel shall include:
 - 1. A minimum of 8 hours of on-site overview of the overall Mechanical System.
 - 2. Refer to Division 23 sections for specific training on each of the components of the Mechanical System.
 - 3. A minimum of 8 hours of on-site overview identifying location and function of all Control Valves and Actuator assemblies.
 - 4. A minimum of 40 hours of (in classroom) software training for a minimum of 20 OWNER personnel on EMS/BMS if such systems are utilized in the project. Training shall be conducted at control CONTRACTOR training facility with computer setup for each person attending.
 - B. Contract shall include the cost of training Owner operation and maintenance personnel in operating, adjusting, maintenance, trouble-shooting, and Project site repair of each component, equipment, or system provided under this Contract.
 - C. Operational and maintenance training shall be conducted on the Project site, unless indicated otherwise.
 - D. Upon completion of Owner training, a completion certificate indicating the nature of the training and a description of the systems, complete with equipment and component lists shall be issued to each trainee. The certificate should be issued in duplicate with one copy retained by OAR.
 - E. An attendance sheet with the names and signatures of all participants attending the training shall be submitted to the OAR and kept as part of the project documents.

1.09 GUARANTEES AND DAMAGE RESPONSIBILITY

A. Sound of water flowing in piping shall not be transmitted to building structure. Operation of mechanical system shall not produce operational sounds that can be heard outside of rooms enclosing apparatus or equipment.

PART 2 – PRODUCTS



2.01 MATERIALS AND EQUIPMENT

- A. Unless otherwise specified, materials and equipment shall be new, in good and clean condition. Equipment, materials, and components shall be of the make; type and model number noted on Drawings or specified. Pieces of equipment of the same type shall be by the same manufacturer.
- B. Whenever an item is listed by a single proprietary name, with or without model number and type, it shall be for purpose of design only, to indicate characteristics and quality desired. Proprietary designation listed on Drawings, or listed first in Specifications, is used as a basis for design to establish a standard for quality and performance and space requirements.
- C. HVAC equipment products from different manufacturers are never identical. Equipment approved as being equal is interpreted as being equivalent in capacity, performance and quality. The dimensions, weight, configuration and utility requirements could be quite different from the equipment used as the basis of design. Due to these differences, additional coordination and adjustments by the CONTRACTOR are required. For the equipment to be deemed truly equal, the additional coordination and adjustments by the CONTRACTOR should not incur any additional cost to the Owner and any additional labor to the design team.
- D. Equipment and materials indicated or required to be installed outdoors shall be of the type that is designed, manufactured, listed or approved by authorities having jurisdiction for outdoor installation by being resistant to the adverse effects of weather. All the additional protective measures against outdoor weather required by the manufacturers' installation instructions and prevalent practice shall be provided.
- E. For substitution of materials or products, refer to the General Conditions.

PART 3 – EXECUTION

- 3.01 GENERAL INSTALLATION REQUIREMENTS
 - A. CONTRACTOR shall arrange for a preconstruction meeting with IOR prior to the installation of refrigerant piping to discuss installation and testing requirement.

3.02 SERVICE INTERRUPTIONS, OFF-SITE, GAS AND WATER

- A. Schedule Work so there shall be no service interruptions of existing systems or systems during normal hours of operation of affected systems and facilities.
- B. When service interruptions are mandatory, arrange in advance with the OAR as to time and date of such interruptions.
- C. Systems, which are interrupted, shall be returned back into operation in such manner that they will function as originally intended.



3.03 CUTTING, NOTCHING, AND BACKING

- A. Conform to California Building Code, Title 24, Part 2, for notches and bored holes in wood and for pipes and sleeves embedded in concrete and for cuts in steel, as detailed on structural Drawings.
- B. Where pipes or ducts pass through or are located within one inch of any construction element, install a resilient pad, 1/2 inch thick minimum, to prevent contact.
- C. Furnish all necessary provisions for recesses, chases, and accesses and provide blocking and backing as necessary for proper reception and installation of mechanical Work.

3.04 LOCATION OF PIPING AND EQUIPMENT

- A. Location of piping, apparatus and equipment as indicated on Drawings is approximate and shall be altered to avoid obstructions, preserve headroom, and provide free and clear openings and passageways.
- B. Trenches parallel to footings shall not be closer than 18 inches to the face of footings and shall not be below a plane having a downward slope of 2 horizontal to one vertical, from a line 9 inches above bottom of footing.
- C. Pipe in tunnels shall be installed close to one side of tunnel to provide maximum space for passage. Pipe shall not be installed through crawl hole unless otherwise specified or detailed on Drawings.
- D. Place equipment in locations and spaces indicated, disassemble and/or reassemble equipment as required by Project conditions.

3.05 VALVE AND SPECIALTY APPLICATIONS

- A. Install thermostatic/ electronic expansion valves as close as possible to distributors on evaporators.
 - 1. Secure bulb to clean, straight, horizontal section of suction line using two bulb straps. Do not mount bulb in a trap or at bottom of the line.
 - 2. If external equalizer lines are required, make connection where it will reflect suction-line pressure at bulb location.
- B. Install safety relief valves where required by ASME Boiler and Pressure Vessel Code. Pipe safety-relief-valve discharge line to outside according to ASHRAE 15.
- C. Install moisture/liquid indicators in liquid line near condensing unit.
- D. Install filter dryers in liquid line between compressor and thermostatic expansion valve.
- E. Consult refrigeration equipment manufacturer to determine the need for a receiver.
- F. Install receivers sized to accommodate pump-down charge.
- G. See Evaluations for discussion of flexible connectors.



H. Install flexible connectors at condensing unit.

3.06 PIPING INSTALLATION

- A. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems; indicated locations and arrangements were used to size pipe and calculate friction loss, expansion, pump sizing, and other design considerations. Install piping as indicated unless deviations to layout are approved on Shop Drawings.
- B. Install refrigerant piping according to ASHRAE 15.
- C. Install piping in concealed locations unless otherwise indicated and except in equipment rooms and service areas.
- D. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.
- E. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.
- F. Install piping adjacent to machines to allow service and maintenance.
- G. Install piping free of sags and bends.
- H. Install fittings for changes in direction and branch connections.
- I. Select system components with pressure rating equal to or greater than system operating pressure.
- J. Install piping as short and direct as possible, with a minimum number of joints, elbows, and fittings.
- K. Arrange piping to allow inspection and service of refrigeration equipment. Install valves and specialties in accessible locations to allow for service and inspection. Install access doors or panels as specified in Division 08 Section "Access Panels Frames" if valves or equipment requiring maintenance is concealed behind finished surfaces.
- L. Install refrigerant piping in protective conduit where installed belowground.
- M. Install refrigerant piping in rigid or flexible conduit in locations where exposed to mechanical injury.
- N. Slope refrigerant piping as follows:
 - 1. Install horizontal hot-gas discharge piping with a uniform slope downward away from compressor.
 - 2. Install horizontal suction lines with a uniform slope downward to compressor.
 - 3. Install traps and double risers to entrain oil in vertical runs.
 - 4. Liquid lines may be installed level.
- O. When brazing or soldering nitrogen must be presented and flow in the piping, remove solenoid-valve coils and sight glasses; also remove valve stems, seats, and packing,



and accessible internal parts of refrigerant specialties. Do not apply heat near expansion-valve bulb.

- P. Retain first paragraph and subparagraphs below for steel pipe. Review the cost of steel pipe using these procedures versus the cost of copper piping. Also consider limiting the size of the refrigerant system and its piping to avoid the use of steel pipe.
- Q. Install pipe sleeves at penetrations in exterior walls and floor assemblies.
- R. Seal penetrations through fire and smoke barriers according to Division 07 Section "Penetration Firestopping."
- S. Install piping with adequate clearance between pipe and adjacent walls and hangers or between pipes for insulation installation.
- T. Install sleeves through floors, walls, or ceilings, sized to permit installation of fullthickness insulation.
- U. Seal pipe penetrations through exterior walls according to Division 07 Section "Joint Sealants" for materials and methods.
- V. Identify refrigerant piping and valves according to Division 23 Section "HVAC Identification."
- 3.07 PIPE JOINT CONSTRUCTION
 - A. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.
 - B. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.
 - C. Fill pipe and fittings with an inert gas (nitrogen), during brazing or welding, to prevent scale formation.
 - D. Soldered Joints: Construct joints according to ASTM B 828 or CDA's "Copper Tube Handbook."
 - E. Brazed Joints: Construct joints according to AWS's "Brazing Handbook," Chapter "Pipe and Tube."
 - 1. Use Type BcuP, copper-phosphorus alloy for joining copper socket fittings with copper pipe.
 - 2. Use Type BAg, cadmium-free silver alloy for joining copper with bronze or steel.
 - F. Welded Joints: Construct joints according to AWS D10.12/D10.12M.

3.08 TESTS AND TESTING

A. Tests shall be as required under the applicable sections of Division 23, including this Section.



- B. Tests required by other sections of the Contract Documents include the following:
 - 1. Test and balance of mechanical equipment and systems: Refer to Section 01 4525: Testing, Adjusting, and Balancing for HVAC.
 - 2. Hydrostatic test of boilers: Refer to Section 01 4525: Testing, Adjusting, and Balancing.
 - 3. Test of smoke and fire detectors: Refer to Division 26: Electrical.
- C. Additional tests may be required in the case of products, materials, and equipment if:
 - 1. Submitted items are altered, changed, or cannot be determined as exactly conforming to the Contract Documents.
 - 2. Performance testing and results may also be required on certain items which are as specified, including fan, and pump performance.
- D. Piping Tests:
 - 1. Perform tests required to demonstrate that operation of mechanical systems and their parts are in accordance with Specifications covering each item or system, and furnish materials, instruments and equipment necessary to conduct such tests. Tests shall be performed in presence of the Project Inspector of Record and Owner Authorized Representative. Work shall not be concealed or covered until required results are provided.
 - 2. Pressure gages furnished in testing shall comply with CPC. Air shall be bled from lines requiring hydrostatic or water tests.
 - 3. Systems shall be pressure-tested in accordance with pipe testing schedule below. Pipe test shall indicate no loss in pressure after a minimum duration of 48 hours at test pressures indicated. Where local codes require higher test pressures than specified herein for fire sprinkler systems, local codes shall govern.
 - 4. Fuel gas lines shall be first tested with piping exposed, before backfilling trenches or lathing; second with piping in finished arrangement, backfilled and paved where required, and walls finished.
 - 5. Piping systems could be tested as a unit or in sections, but entire system shall successfully meet requirements specified herein, before final testing by the Project Inspector.
 - 6. Repair of damage to pipes and their appurtenances or to any other structures resulting from or caused by these tests, shall be provided.
 - 7. Refrigerant piping shall be pressure tested by using a calibrated electronic testing equipment.
 - 8. Refrigerant Piping Brazing and Deburring Testing procedures for each building:
 - a. OWNER will randomly select maximum Two installed split systems serving each building for the inspection of proper brazing and deburring of associated refrigerant piping systems. Maximum Two copper fittings within the piping systems shall be randomly selected by OWNER and cut and removed by CONTRACTOR for inspection.



- b. If a sign of oxidation is found on any selected fittings or adjacent piping, then the tested split system piping, and all connected equipment including evaporator and condensing unit with sign of oxidation shall be removed and replaced in entirety by CONTRACTOR at no additional cost to OWNER.
- c. If a burr is found on any selected joint, then the entire tested refrigerant piping system shall be removed and replaced by CONTRACTOR at no additional cost to OWNER.
- d. CONTRACTOR shall repair all tested systems after OWNER's inspection and approval at no additional cost to OWNER.
- e. Inspector of Record shall be present during the replacement of the defective systems and the repair of the tested systems by CONTRACTOR.
- f. If one or more selected split systems fail, then Two additional split systems (not including the ones previously tested) shall be selected for further testing. Selection of additional split systems and retesting will be performed until neither oxidation nor bur is found within the tested systems.
- 9. Pipe Testing Schedule:

System Tested	Test Pressure (psig)	Test With:
Hot water heating system piping and chilled water piping	150	Water
Refrigeration piping	600	Dry nitrogen

- E. Equipment Performance Assurance Tests:
 - 1. Before operating any equipment or systems, a thorough check shall be performed to determine that systems have been flushed and cleaned as required and that equipment has been properly installed, aligned, lubricated, and serviced. Factory instructions shall be checked to verify installations have been completed and recommended lubricants have been installed in bearings, gearboxes, crankcases, and similar equipment. Particular care shall be furnished in lubricating bearings to avoid damage by over-lubrication and blowing out seals. Equipment shall also be checked for damage that may have occurred during shipment, after delivery, or during installation. Damaged equipment, products, and materials shall be replaced or repaired as required.
 - 2. Upon completion of the above, adjust the system settings to within normal operating conditions to prevent the system from being damaged upon start-up.
 - 3. Run-test the equipment after start-up for five consecutive days. Tests shall include operation of heating, ventilating, and air conditioning equipment and systems for a period of not less than two 8 hour periods at 90 percent of the full specified heating and cooling capacities. If equipment passes, install new filters. If equipment fails, it shall be adjusted and retested until system meets all applicable codes.



- 4. Equipment Start-up Reports: For each equipment or system on which start-up is performed, submit 8 copies of start-up report for review by the Architect.
 - a. The start-up report shall include the manufacturer's standard start-up form completed and signed by the start-up technician.
- 5. Provide, maintain, and pay costs for equipment, instruments, and operating personnel as required for specified tests.
- 6. Provide electric energy and fuel required for tests.
- 7. Final adjustment to equipment or systems shall meet specified performance requirements.
- 8. Equipment, systems, or Work deemed defective during testing shall be replaced or corrected as required. Test until satisfactory results are provided.
- F. Specific Coordinated Plan for Test and Balance:
 - 1. Provide a narrative of the operational intent that clearly describes the function and sequence of operation of each component, equipment, or system installed. Instruct designated Owner personnel in the operation of the installed systems.
 - 2. Prior to final test and balance, mechanical equipment and systems shall be operated and tested as indicated in Paragraph 3.04.F above to demonstrate satisfactory overall operation of the installed systems.
 - 3. Immediately before starting tests, air filter media shall be cleaned or renewed. Roll-type filters shall be advanced to provide new clean media. Cleanable type media shall be thoroughly cleaned and re-oiled with new, clean oil as recommended by manufacturer if they are of viscous impingement type. Disposable type filters shall be replaced with new filters. Replaceable media shall be replaced with new media.
 - 4. An accurate means of measuring air flow and temperatures shall be furnished to balance air supply, return, and exhaust systems so uniform temperatures occur in every room and design airflow is obtained through registers, diffusers, and grilles.
 - 5. Systems shall be adjusted to provide airflows indicated including maximum fresh air and maximum return air. Dampers shall be checked for proper settings and operation. Air and water inlet and leaving temperatures at coils shall be checked. Complete operational data including airflows, room temperatures, fan speeds, motor currents, plenum, and duct static pressures shall be tabulated.
 - 6. Welding performed as part of this Division may be subject to radiographic inspections at random in accordance with requirements specified in Section 23 05 13: Basic HVAC Materials and Methods.

3.09 NOISE AND VIBRATION REDUCTION

A. Correct noise or vibration caused by mechanical systems. Provide all necessary adjustments to specified and installed equipment and accessories to reduce noise to the lowest possible level



B. Correct noise or vibration problems caused by failure to install work in accordance with Contract Documents. Include all labor and materials required as a result of such failure. Pay for re-testing of corrected noise or vibration problems by the project acoustical consultant including travel, lodging, test equipment expenses, etc.

3.10 PROTECTION, CARE AND CLEANING

- A. In addition to storage criteria of the General Conditions, and provisions under Section 01 50 00: Construction Facilities and Temporary Controls, the following shall be provided:
 - 1. Provide for the safety and good condition of materials and equipment until Substantial Completion. Protect materials and equipment from damage.
 - 2. Protect installed Work.
 - 3. Replacements: In case of damage, immediately provide repairs and/or replacements as required.
 - 4. Protect covering for bearings, open connections to tanks, pipe coils, pumps, compressors and similar equipment.
 - 5. Interior of ductwork shall be maintained free of dirt, grit, dust, loose insulation, and other foreign materials.
 - 6. Air handling equipment shall not be operated until building is cleaned and air filters are installed.
 - 7. Fixtures, piping, finished brass or bronze, and equipment shall have grease, adhesive, labels, and foreign materials removed. Chromium, nickel plate, polished bronze or brass Work shall be polished. Glass shall be cleaned inside and out.
 - 8. Before initial start-up and again before Substantial Completion, piping shall be drained and flushed to completely remove grease and foreign matter. Pressure regulating assemblies, traps, strainers, boilers, flush valves, and similar items shall be thoroughly cleaned. Tag system with an information tag listing responsible party and date of element, before initial start-up and again before Substantial Completion. Compressed air, oil, and gas piping shall be blown out with oil-free compressed air or inert gas. Refrigerant piping shall be cleaned as specified.

END OF SECTION



SECTION 23 05 13 - BASIC HVAC MATERIALS AND METHODS

PART 1 – GENERAL

1.01 SUMMARY

- A. Section Includes:
 - 1. This Section prescribes basic materials and methods generally common to the Work of Division 23.
- B. Related Requirements:
 - 1. Division 01: General Requirements.
 - 2. Division 07: Thermal and Moisture Protection: Polyvinyl-Chloride Roofing.
 - 3. Division 23: Heating, Ventilating, and Air-Conditioning.
 - 4. Division 26: Electrical.
- 1.02 SUBMITTALS
 - A. Provide in accordance with Division 01, Section 23 05 00 and specific requirements of each section of Division 23.
- 1.03 QUALITY ASSURANCE
 - A. Standards: Comply with applicable national, state, and local codes and standards: ASTM, ASME, and ANSI. Federal Specifications, AWWA, CISPI, NFPA, FM Global, UL, CPC (California Plumbing Code), CMC (California Mechanical Code), CSA.
 - B. Qualifications of Manufacturer: Products used in the Work of this Section shall be produced by manufacturers regularly engaged in manufacture of similar items and with a history of successful production as reviewed by the Architect.
- 1.04 COORDINATION
 - A. Coordinate related Work in accordance with provisions of Section 01 31 13: Project Coordination.
- PART 2 PRODUCTS

2.01 GENERAL



- A. Provide the following products if they are indicated in the Contract Documents or if they are required for the proper installation, function or operation of equipment, systems or components indicated in the Contract Document.
- B. Provide the following products as a complete assembly with required accessories for a complete and functioning entity in compliance with governing codes and applicable standards as specified in Section 23 05 00, manufacturer's instructions or as required.
 - 1. Omission of minor details in the Contract Documents does not waive and/or otherwise relinquish compliance with the above requirements.
- 2.02 MANUFACTURERS AND MATERIALS
 - A. Ball Valves: Bronze, 2 inches and smaller:

BV-1 Class 150, 600 psi, CWP, 2 piece construction reinforced Teflon seats, full port, adjustable packing gland, stainless ball and stem, threaded ends.

Hammond UP-8303A/UP-8305/UP-8513, NIBCO T-685-80-LF/TS-685-66-LF, Milwaukee UPBA400S/450S, or equal.

BV-2 Class 150, 600 psi CWP, 2-piece construction, bronze body, reinforced Teflon seats, adjustable packing gland, (no threaded stem designs allowed), threaded ends.

Hammond UP8301A, NIBCO T-585-70, Milwaukee BA-400, or equal.

Ball Valves in Insulated Piping: Use extended operating handle of non-thermal conducive material, and protective sleeve that allows operation of valve without breaking the vapor seal or disturbing insulation and memory stops that are fully adjustable after insulation is applied. NIBCO Nib-Seal Handle.

- B. Check Valves:
 - 1. Bronze, 2-inch and smaller:

CHV-1 Class 125, 200 CWP swing check, Teflon disc, threaded ends. .

NIBCO T-413-Y, Milwaukee 509-T, Hammond IB-940, or equal.

CHV-2 Class 150, 300 psi, CWP, swing check, bronze, Teflon disc, threaded ends:

Stockham B-321; Crane 11TF, NIBCO T-433, Milwaukee 510-T, Hammond IB-946, or equal.

C. Electronic Flow Readout Meter:



FM-1 Flow meter shall combine the functions and ranges of several gages into a single board range meter. Meter shall function as a compound pressure gage measuring the high side and low side pressure simultaneously and display each reading in sequence. Meter shall be furnished complete with a shut-off, bypass, and blow down valve network installed on a portable meter panel. A carrying case shall be provided with storage for accessories. Meter shall automatically select the proper range, compensate for temperature, and reset itself. Memory function shall store up to 90 sets of pressure and temperature. Pressure reading shall be accurate to plus or minus 2 percent of reading from 0.01 to 150 psi. Temperature readings shall be accurate to plus or minus 0.5 degrees F and plus or minus 1.0 degree F. from minus 65 degrees F to 250 degrees F. The flow metering device shall be Hydrodata Multimeter HDM-250 as manufactured by Shortridge Instruments Inc., or equal, and shall be furnished with pressure gage, portable meter panel and with valve network. carrying case, battery charger, instruction manual and certificate of calibration, two 6 feet long by 1/2 inch OD pressure hoses with quick disconnects, two 8 foot by 1/4 inch OD drain hoses, and a set of adapters.

- D. Gate Valves:
 - 1. Bronze, 2 inches and smaller:

GV-1 Class 125, 200 psi CWP, bronze body and bonnet non-rising stem, inside screw, screw-in bonnet, solid disc, threaded ends:

Hammond IB645, Crane 1701, Milwaukee 105, American 3F, NIBCO T-113, or equal.

GV-2 Same as GV-1, except solder ends:

NIBCO S 113, Milwaukee 115, Hammond IB 647, or equal.

E. Liquid Level Gage:

LLG-1 Refrigerant type, carbon steel with stainless steel trim or all forged steel construction, back-seating standard design. Upper and lower valve furnished with ball check valves; 1/2 inch diameter glass on center. Four 3/16 inch diameter gage glass guard rods or slotted steel guard.

Peneberthy, Henry, Conbraco, or equal.

- F. Piping:
 - 1. Piping shall be continuously and permanently marked with manufacturer's name, type of material, size, pressure rating, and the applicable ASTM, ANSI, UL, or NSF listing. On plastic pipe, date of extrusion must also be marked.
 - 2. Underground non-ferrous pressure pipes shall be installed with proper color tracer wires. Refer to color code provisions in Section 23 0553: HVAC Identification.



- 3. Refer to HVAC Piping: Section 23 20 13 for heating and chilled water piping and fittings.
- G. Pipe Isolators:

PLA-1 Absorption pad shall be not less than 1/2 inch thick, unloaded. Pad shall completely encompass pipe.

Holdrite, LSP, Stoneman, Potter-Roemer, Trisolator, PR-Isolator, or equal.

PLA-2 Plastic cushion to form an insulating liner and eliminate metal to metal contact when securing copper tubes and pipes in air conditioning and refrigeration insulation preventing galvanic erosion. (Acoustical Type for Sound Absorption)

Hydra-Zorb Cushion Clamps, LSP Products Group Acousto Clamp, or equal.

H. Pressure Gage: Aluminum or steel case, minimum 4-1/4 inches dial; pressure type or combination vacuum-pressure type, with provisions for field calibration. Dial indicator to indicate pressure in psi with accuracy to within plus or minus 0.5 percent of maximum dial reading. Furnish gages with restriction screw, size 60, to eliminate vibration impulses. Black case and ring, bourdon tube of seamless copper alloy with brass tip and socket. Three way gage cock, constructed of brass with stuffing box, 1/2 inch couplings, with fixed or movable cap nut to shut off pressure gage.

PG-1 Pressure type, black drawn steel case, 4 ¹/₂-inch glass dial, range approximately twice line pressure.

Marsh Keckley, Trerice, Weksler, Weiss, or equal.

- I. Thermometers
 - 1. Industrial:

T-1 Straight type with fixed or ratable stem, extruded or cast brass or cast aluminum case and brass separable well 6 inches minimum scale, angle or straight type range 30 degrees - 240 degrees F.

Weksler, Trerice, Weiss, Ashcroft, Marshalltown, or equal.

T-2 Round type 3 ¹/₂-inch minimum dial range of 100 between 30 degrees and 155 degrees F, color coded red above 150 degrees F. Brass chrome plated case.

Ashcroft, U.S. Gage, Marsh, Weiss, or equal.

2. Remote:

T-3 Liquid-filled capillary type with bulbs as required for remote and insertion mounting dials of 3 ½-inch minimum diameter, non-ferrous internal parts, external



means for re-calibration, glass or plastic lens and steel or non-ferrous case suitable for wall, duct or panel mounting range 30 degrees to 240 degrees F.

APPLICATION: PROVIDE FOR MEASURING DUCT, PLENUM, AND OTHER AIR TEMPERATURES.

- J. Unions:
 - 1. Unions shall be furnished and installed in accordance with the following requirements (unless flanges are furnished):
 - a. At each threaded or soldered connection to equipment and tanks, except in Freon or fuel gas, piping systems, whether indicated or not.
 - b. Immediately downstream of any threaded connection to each manually operated threaded valve or cock, and each threaded check valve, yard box or access box except those in Freon piping systems, whether indicated or not.
 - c. At each threaded connection to threaded automatic valves (except those in Freon piping systems) such as reducing valves and temperature control valves, whether indicated or not.
 - d. If grooved piping is used, couplings shall serve as unions. Additional unions are not required
 - 2. Unions shall be located so that piping can be easily disconnected for removal of equipment, tank, or valve.

PART 3 – EXECUTION

3.01 EXAMINATION

A. Examine areas and conditions under which Work of this Section shall be performed. Correct conditions detrimental to proper and timely completion of Work. Do not proceed until unsatisfactory conditions have been corrected.

3.02 INSTALLATION

- A. Provide all materials and equipment for the Work. Furnish and install necessary apparatus, parts, materials, and accessories.
- B. Pipe Installation:
 - 1. Install piping parallel to wall and provide an orderly grouping of proper materials and execution.
 - 2. Piping shall clear obstructions, preserve headroom, provide openings and passageways clear, whether indicated or not. Verify the Work of other Divisions to avoid interference.



- 3. If obstructions or the Work of other Divisions prevent installation of piping or equipment as indicated by the Drawings, perform minor deviations as required by the Architect.
- 4. Install piping after excavation or cutting has been performed. Piping shall not be permanently enclosed, furred in, or covered before required inspection and testing is performed.
- 5. Exposed polished or enameled connections from fixtures or equipment shall be installed with no resulting tool marks or threads at fittings. Residue or exposed pipe compound shall be removed from exterior of pipe.
- 6. Piping shall be concealed in chases, partitions, walls, and between floors, unless otherwise directed or specifically noted on Drawings. When penetrating wood studs, joists, and other wood members, provide such members with reinforcement steel straps of Continental Steel & Tube Co., ULINE, Independent Metal Strap, or equal.
- 7. Reduce fitting where any change in pipe size occurs. Bushings shall not be furnished unless specifically reviewed by the Architect, or indicated on Drawings.
- 8. Piping subject to expansion or contraction shall be anchored in a manner, which permits strains to be evenly distributed. Swing joints or expansion loops shall be installed. Seismic restraints shall be installed so as not to interfere with expansion and contraction of piping. Seismic loops required at all building separations.
- 9. Immediately after lines have been installed, openings shall be capped or plugged to prevent entrance of foreign materials. Caps shall be left in place until removal is necessary for completion of installation.
- 10. Couplings shall not be installed except where required pipe runs between other fittings are longer than standard length of type of pipe being installed and except where their installation is specifically reviewed by the Architect.
- 12. Water lines may be installed in same trench with sewer lines, provided bottom of water line is 12 inches minimum above top and to the side of sewer line.
- 14. Changes in pipe sizes shall be furnished with eccentric reducers, flat on top. Offsets to clear obstruction shall not be installed so as to produce air pockets.
- C. Pipe Sleeves and Plates:
 - 1. Provide and install pipe sleeves of Schedule 40 black steel pipe or Schedule 40 PVC plastic pipe in concrete or masonry walls, footings, and concrete floors below grade. Provide and install adjustable submerged deck type sleeves at locations where pipes pass through concrete floors, except



concrete slab floors on grade, and at locations where soil pipe for floor type water closets passes through concrete floors.

FOR FIRE RATED WALL PENETRATIONS FOLLOW THE CALIFORNIA Building Code.

- 2. Sleeves shall provide 1/2 inch clearance around pipes, except plastic pipe shall have 1-inch clearance. Caps of deck type sleeves shall be removed just prior to installation of pipe. Area around sleeves shall be smooth and without high or low spots. Sleeves in walls shall not extend beyond exposed surface of wall. Sleeves in concrete floors and walls shall be securely fastened to forms to prevent movement while concrete is being placed.
- 3. Piping installed on a roof shall clear the roof surface by 10 inches minimum, with or without insulation. Bottom of individual fittings may infringe on 10 inches clear space but not groups of fittings or fittings located within 27 inches of each other.
- 4. Stiles shall be provided to facilitate crossing of piping when parallel piping runs are laterally greater than 12 inches out-to-out, or any pipe is higher than 18 inches, and more than 40 feet long or runs between 2 or more major pieces of equipment or housings greater than 20 feet apart. Stiles shall be not less than 20 inches wide with a minimum tread depth of 10 inches. Where stiles are required, they shall be located so greatest obstructed distance is 30 feet.
- 5. Where pipes pass through waterproofed walls, floors, or floors on grade, sealant with Link-Seal Modular Seals, or equal, between pipe and sleeve to provide a waterproof joint. Where earth is in contact with pipe on both sides of a wall or foundation, the waterproof joint is not required. Commercial rubber compression units may be furnished instead of sealed sleeves if reviewed by the Architect.
- 6. A swing joint, or other required device, shall be furnished and installed in hot water lines with 10 feet of sealant or compression joint to allow for expansion.
- 7. Pipe sleeves shall be provided where pipes intersect footings or foundation walls and sleeve clearances shall provide for footing settlement, but not less than one inch all around pipe.
- D. Welding of Pipe and Qualifications of Welder:
 - 1. Joints above grade or accessible conduit or tunnels in steel piping may be either welded or screwed unless specifically indicated otherwise on Drawings or specified. Joints in below grade steel piping, whether in insulation or not, shall not be welded, unless otherwise indicated.



- 2. Welded joints in pipe shall be continuous around pipe and shall comply with ASME B31: Code for Pressure Piping, unless otherwise specified.
- 3. Each pipe weld shall be stamped with welder's identification mark. Welding shall be performed by welders possessing a valid certificate of qualification for welding carbon steel welding pipe in horizontal position (2G) and horizontal fixed position (5G) in accordance with the requirements of Section IX of the ASME Boiler and Pressure Vessel Code, by an Owner-recognized, DSA approved testing laboratory.
- 4. Before any welder performs welding on the Work, furnish the Project Inspector with a copy of welder's valid qualification papers and obtain verification. Welder qualification is not valid unless it has been issued while welder was performing work for current employer, and has performed type of work described by qualification in the preceding 3 months.

REFERENCE: ASME BOILER AND PRESSURE VESSEL CODE, SECTION VIII, UW-29 TESTS OF WELDERS AND WELDING OPERATORS.

5. Welding performed under these Specifications is subject to special tests and inspections including rigid Ultra Sonic Testing (UT) and radiographic inspection at random, in accordance with Technique for Radiographic Examination of Welded Joints by an Owner recognized, DSA approved testing laboratory.

ASME BOILER AND PRESSURE VESSEL CODE, SECTION VIII, UW-51 RADIOGRAPHIC EXAMINATION OF WELDED JOINTS.

- E. Unacceptable Welds and Repairs to Welding:
 - 1. Welds containing any of the following types of imperfections shall be deemed defective Work:
 - a. Cracks of any type.
 - b. Zones of incomplete (in excess of 1/32 inch) fusion or penetration.
 - c. Elongated slab inclusions longer than 1/4 inch.
 - d. Groups of slag inclusions in welds having an aggregate length greater than thickness of parent metal in a length 12 times the thickness of the parent metal.
 - e. Undercuts greater than 1/32 inch.
 - f. Overlaps, abrupt ridges or valleys.



- 2. When a defective weld is detected by examination as outlined above, two additional welds shall be radiographed at locations selected by the Project Inspector. If the two selected welds demonstrate compliant welding, then the two tested welds shall be deemed to be in compliance. Welding revealed by radiographs to be defective Work shall be removed, repaired, and tested by radiograph.
- 3. If either of the two selected welds demonstrates welding deemed to be defective Work, all welding in that portion of the Work shall be deemed defective Work and either: all welds shall be cutout, prepare new ends for welding and weld to comply with this Specification, or radiograph all welds, removing and repairing only such welding deemed to be defective Work.
- 4. Repair welding shall be performed in a manner in full compliance with ASME B31. The welded joints or repairs shall be spot examined with UT or radiographic tests in accordance with foregoing requirements.

REFERENCE, ASME BOILER AND PRESSURE VESSEL CODE, SECTION VIII, UW-52.

- 5. Owner shall cause to be performed additional random UT and radiographic examinations of welds. Owner shall be responsible for the costs of any UT and radiographic examinations found to be in compliance with specified requirements.
- 6. Installer shall be responsible for the costs of UT and radiographic reexaminations of welds deemed defective Work and not in compliance with this Specification, and shall repair or replace said welds in accordance with specified requirements.
- F. Welding Rods: Submit a written list of materials and proposed type of welding rods for review by the Architect.
- G. Backing Rings: Backing rings may be submitted for installation provided the Product Data is submitted with the material list.
- H. Qualification Tests for Low-pressure Welding:
 - 1. Tests shall be performed on 3-inch standard weight pipe ASTM A53, Grade A, and shall be welded by acetylene and electric arc. Each sample shall consist of two pieces, each 10 inches long, with 30-degree bevel at point weld.
 - 2. Two 20-inch samples shall be performed in the 2G and two 20-inch samples in the 5G positions, with positions defined in Section IX, ASME Boiler and Pressure Vessel Code. Welds shall have the reinforcement ground or machined flush to the surface of the pipe before testing. Samples shall be tested as full section tensile.



- 3. Weld shall develop a load of 90 percent of 50,000 psi, i.e., 45,000 psi or shall develop a fracture in parent metal.
- 4. Each qualified welder shall carry an identification card listing welder's name, date of test, and type of welding tests passed; signed by the welder and the laboratory.
- 5. A valid certificate of qualification issued in compliance with requirements of the ASME Boiler Pressure Vessel Code Section IX shall qualify a welder for issuance of a certificate for low-pressure pipe welding.
- I. Certificates of Qualification for Welding of Unfired Pressure Vessels:
 - 1. Certificates of qualification shall be issued by a laboratory recognized by the Owner in compliance with the requirements of the ASME Boiler Pressure Vessel Code Section IX. Qualifications shall be for both acetylene and arc welding of Schedule 40 ASTM A53, Type B, steel welded or seamless pipe in the Horizontal Position (2G) and the Horizontal Fixed Position (5G) as defined by said code.

NOTE: Certificate described above is not valid unless it has been issued while welder was working for his current employer, and unless welder has performed type of work described by certificate in the preceding three months. Requirements for possession of a valid certificate shall not be waived for welders fabricating unfired pressure vessels when the Specifications require compliance with ASME code or when welding pipe carries working pressures greater than 75 psi and temperatures greater than 250 degrees F.

- J. Pipe Joints and Connections:
 - 1. Pipe and tubing shall be cut per IAPMO Installation Standards. Pipe shall have rough edges or burrs removed so that a smooth and unobstructed flow shall be provided.
 - 2. Threaded Pipe: Joints in piping shall be installed according to the following service schedule:
 - a. Refrigerant and Soap Piping: Litharge and glycerine, or Expando, Gasoila, or equal.
 - b. All other services Furnish sealant, suitable and as reviewed by the Architect.
 - 3. Threads on pipe shall be cut with sharp, clean, unblemished dies and shall conform to ANSI/ASME B1.20.1 for tapered pipe threads.
 - 4. Joint compounds shall be smoothly placed on male thread and not in fittings. Threaded joints shall be installed tight with tongs or wrenches and sealant of any kind is not permitted. Failed joints shall be replaced with new materials.



Installation of thread cement or sealant to repair a leaking joint is not permitted.

- 5. Sharp-toothed Stillson, or similar wrenches, is not permitted for the installation of brass pipe or other piping with similar finished surfaces.
- K. Copper Tubing and Brass Pipe with Threadless Fittings:
 - 1. Silver brazed joints shall be used for attaching fittings to non-ferrous metallic refrigerant piping.
 - 2. Non-pressure gravity fed condensate lines may be soldered with 95/5 solder.
 - 3 Silver brazing alloy, Class BCUP-5. Surfaces to be joined shall be free of oil, grease, and oxides. Socket of fitting and end of pipe shall be thoroughly cleaned with emery cloth and wiped to remove oxides. After cleaning and before assembly or heating, flux shall be installed to each joint surface and spread evenly. Heat shall be applied in accordance with instructions in the Copper Tube Handbook issued by Copper Development Associates. Joints constructed of rough bronze fittings shall be provided as recommended by manufacturer.
 - 4. Do not overheat piping and fittings when installing silver brazing.
 - 5. Joints in non-ferrous piping for services not covered above shall be installed with solder composed of 95/5 tin/antimony, ASTM B32, Grade 5A. Surfaces to be jointed shall be free of oil, grease, and oxides. Sockets of fitting and end of pipe shall be thoroughly cleaned with emery cloth to remove oxides. Solder flux shall be sparingly installed and solder added until joint is completely filled. Do not overheat. Excess solder, while plastic, shall be removed with a small brush in order to provide an uninterrupted fillet completely around joint. Random inspection of joints shall be conducted by Project Inspector to ensure joints are lead-free.
 - 6. Grooved end joints for copper piping shall be assembled in accordance with the latest manufacturer recommendations. Pipe ends shall be clean and free from indentations, projections, and roll marks in the area from pipe end to groove for proper gasket sealing. Grooving tools shall be as manufactured by Victaulic, RIDGID, MAG Tool, or equal.
- L. Ring-Type Pipe: Joints shall be installed in accordance with manufacturer's instructions with grooved couplings, fittings and rubber rings. Couplings and pipe shall be compatible and of the same manufacturer. Rings shall be accurately located and installed by grooves in coupling. Pipe shall be installed with zero deflection unless otherwise specified. Pressure pipe shall be furnished with thrust blocks at each offset point.



- M. Welded Pipe Joints:
 - 1. Joints in welded steel pipelines shall be installed by oxyacetylene or electric arc process. Welding shall be continuous around pipe and provided as specified.
 - 2. Butt welds shall be of the single V-type, with ends of pipe and fittings beveled approximately 37 ½ degrees. Piping shall be aligned before welding is started with the alignment maintained during welding.
 - 3. Welds for flanges and socket fittings shall be of the fillet type with a throat dimension not less than pipe wall thickness.
- N. Grooved End Pipe Joints: Grooved end joints for carbon steel piping shall be assembled in accordance with the latest manufacturer recommendations. Pipe ends shall be clean and free from indentations, projections, and roll marks in the area from pipe end to grove for proper gasket sealing. Grooving tools shall be as manufactured by Victaulic, RIDGID, MAG Tool, or equal.
- O. Joints shall be Vic-Press 304TM, or equal, made with Victaulic Series 'PFT' tools and the appropriate sized jaw. Pipe shall be certified for use with Vic-Press 304TM system, and shall be square cut, properly deburred and cleaned, and marked at the required location to insure full insertion into the fittings and/or couplings.
- P. Valves: Valves shall conform to the following:
 - 1. Piping systems shall be furnished with valves at points indicated on Drawings and specified, arranged to provide complete regulating control of piping system throughout building and the Project site.
 - 2. Valves shall be installed in a neat grouping, so that parts are easily accessible and maintained.
 - 3. Pressure Independent Characterized Control valve type shall be suitable for service on which installed.
 - 4. Valves shall be full size of line in which they are installed, unless otherwise indicated on Drawings or otherwise specified, and shall be one of types specified.
 - 5. Provide chain operators on valves 2-inch and larger located 7 feet or more above the servicing floor level.
 - 6. Valves for similar service shall be of one manufacturer.
 - 7. Except where otherwise specified, valves shall be Belimo, Victaulic, Stockham, Crane, Jenkins, Milwaukee, Hammond, American Valve, NIBCO, Hoffman, or equal.



- 8. Ball valves below grade in yard boxes shall have stainless steel handles.
- 9. Temperature relief valves and combination temperature and pressure relief valves shall be as specified and furnished as set forth in this Section. Discharge pipe from relief valves shall be not less than discharge area of valve or valves it connects, based on discharge area of valves, and shall terminate as indicated and free of any traps. Valves shall be installed at following locations:
 - a. A combination temperature and pressure relief valve or combination of valves on each heating hot water boiler. Temperature sending element shall extend into water inside boiler.
- 10. Manual air vent valve assemblies shall be installed at each high point of hot water space heating and chilled water piping systems. Valves shall discharge through 1/4 inch diameter copper tubing and drain to nearest floor sink. Automatic type air vent valve shall only be installed where specifically indicated. Radiator, convectors, and finned pipe convectors shall be fitted with packless radiator valves, angle or straight pattern. Each convector or radiator installed as part of a space hot water heating system shall be furnished with a manual-type air vent valve.
- Q. Strainers: Strainers shall be installed on each water main (except for fire line) downstream of the meter, above grade, when a pressure regulator assembly is not installed. Main strainer shall be of Y-flange or groove type. On closed loop chilled and heating hot water systems pump systems, a strainer shall be installed at each pump inlet and upstream of each flow control valve assembly. The control valve assembly may include a modulating temperature control valve and a flow-limiting valve, manufactured by Griswold, AutoFlow, Flow Control Industries, Inc., or equal.
- R. Hangers and Supports:
 - 1. Piping shall be securely fastened to building structure by approved iron hangers, supports, guides, anchors, and sway braces to maintain pipe alignment to prevent sagging and to prevent noise or excessive strain on piping due to uncontrolled or seismic movement under operating conditions. Hangers and supports shall conform to Manufacturer's Standardization Society Specification SP-69. Hangers shall be relocated as required to correct unsatisfactory conditions that may become evident when system is placed into operation. Appliances, heat exchangers, storage tanks, and similar equipment shall be securely fastened to structure in accordance with seismic requirements. Outdoor metal hangers and supports shall be hot-dipped galvanized steel, unless otherwise specified.
 - 2. Piping shall not be supported by wire, rope, wood, plumbers' tape, or other non-recognized devices.



- 3. Hangers and supports shall be designed to support weight of pipe, fittings, weight of fluid and weight of pipe insulation, and shall have a minimum factor of safety of 5, based on ultimate tensile strength of material installed.
- 4. Burning or welding of any structural member under load is not permitted. Field welding not specified on Drawings or reviewed Shop Drawings is not permitted without review by Architect and DSA.
- 5. Burning holes in beam flanges or other structural members is not permitted without review by the Architect and DSA.
- 6. Pipe hangers on piping covered with low temperature insulation shall be installed on outside of insulation and not in contact with pipe unless otherwise detailed on Drawings. Insulation shall be protected by 18 gage galvanized steel shield, with a minimum length of 10 inches, installed completely around pipe covering between covering and hanger. Installing hangers directly on pipe and butting adjoining sections of insulation against hanger is permitted provided void and hanger rod are properly insulated and sealed so that no sweating occurs at hangers.
- 7. Hanger rods shall be fastened to structural steel members with suitable beam clamps. Clamps shall be Tolco, Carpenter & Patterson, Fee and Mason, or equal, as follows:
 - a. Tolco I beam, Fig.62 for maximum 1000 lbs.
 - b. Tolco I or WF beam, Fig. 329, for maximum of 1290 lbs.
- 8. Hanger rods shall be fastened to concrete inserts in concrete slabs or beams. Inserts shall be Tolco, Carpenter & Patterson, Fee and Mason, or equal, as follows:
 - a. Tolco Fig.310 for maximum of 600 lbs.
 - b. Tolco Fig. 309 for maximum of 1140 lbs.
- 9. For fastening to wood ceilings, beams, or joists, furnish Anvil Fig. 128R, Anvil Fig. 153, Tolco 78, or equal pipe hanger flange fastened with drive screws. Under wood floors, 3/8 inch hanger rods shall be hung from 2-inch by 2-inch by 1/4 inch angle clips 3-inch long, with two staggered 10d nails, clinched over joist.
- 10. Hanger rod sizes for copper, iron, or steel pipe: 3/8 inch for pipe sizes 1/2 inch through 2-inch, 1/2 inch for pipe sizes 3-inch, 4-inch and 5-inch, 5/8 inch for pipe size 6-inch, and 3/4 inch for 8-inch and 10-inch pipe.
- 11. Turnbuckles, if furnished, shall provide a load carrying capacity equal to that of the pipe hanger with which they are being installed.



- 12. Pipe hangers shall be of same size, or nearest larger manufactured size available, as pipe or tubing on which they are being installed.
- 13. Hangers, clamps, and guides furnished for support of non-metallic pipe shall be padded with 1/8 inch thick rubber, neoprene, or soft resilient cloth.
- 14. Where special pipe-supporting requirements in the Specifications conflict with any standard requirements specified herein, the Specification requirements shall govern.
- 15. Vertical Piping:
 - a. Vertical pipe risers shall be securely supported with riser clamps of recognized type. Risers in reinforced concrete buildings shall be furnished with extension clamps fastened to pipe above each concrete floor slab with extended arms of clamp to rest on slab. Clamps shall be provided with lead or Teflon liners when installed on copper tubing. Clamps shall be plastic-coated when installed on non-ferrous pipe or tubing.
 - b. Copper tubing in sizes 1 ½-inches and larger and steel pipelines passing up through building shall be supported at each floor of building or every 15 feet whichever is less.
 - c. Copper tubing sizes 1 ¼-inch and smaller shall be supported at not intervals not more than 6 feet on center. Special provisions shall be installed for vertical lines subject to expansion and contraction caused by operating temperature differences.
 - d. Vertical cast iron pipelines shall be supported from each floor and at its base. Malleable iron or steel pipe clamps with minimum thickness of 1/4 inch shall be furnished and fastened around pipe for support.
- 16. Horizontal Piping:
 - a. Roof Mounted Piping: Pressure and non-pressure piping shall be supported from channels, stands, clamps, trapezes, rollers, or structures mounted on 100% rubber, UV resistant rooftop supports with reflective strips, Dura-Block, or equal. Roller type supports shall be provided below and above pipe to prevent its dislodgement. Bottom of pipes shall clear the roof surface by 10 inches.
 - At PVC roofing provide walk tread, polyester reinforced, UV resistant, with surface embossment at rooftop supports. Heat welding of walk pads shall only be done by manufacturer certified installers.



- a) Sika-Sarnafil and Carlisle: Walk tread shall be no more than one inch larger than the plan area of the pipe support blocks and adhered to the roof membrane with Sika 1A or Carlisle Universal Single-Ply sealant, as applicable.
- b) Johns Manville: Walk tread shall be installed under the pipe support blocks and adhered to the blocks, if possible, and left loose laid on top of the PVC roof system. Walk-pad shall have a minimum of 4 inches of material past perimeter on all 4 sides of block.
- 2) Built-up roofing: Provide APP granulated modified torch-down at each pipe support block. Torch-down shall extend 2 to 4 inches beyond the edges of the block and adhered by torch application over existing cap sheet membrane. This work shall be performed by a certified roofer.
- b. Piping Mounted to Underside of Roof and Decks and from Structure:
 - 1. Insulated steam and space heating hot water supply and return piping shall be supported with Tolco Figure 4, B-Line Figure B3140, Anvil Figure 212, or equal, steel hangers with welded eye rods to permit hinge movement at point of attachment of hangers. Hinge movement at point of support shall be provided by welded eye linked rods Tolco Figure 101L, B-Line Figure B3211X, Anvil Figure 278X, or equal.
 - Chilled water supply and return piping, condenser water piping, insulated refrigerant piping may be supported with Tolco Figure 1, B-Line Figure B3100, Anvil Figure 260, or equal, hangers with rods, turnbuckles and inserts suitable for above hangers.
- c. Maximum hanger and support spacing shall conform to CPC schedule for horizontal piping installed above grade.
- 17. A hanger or support shall be installed close to the point of change in direction of a pipe run, in either a horizontal or vertical plane.
- 18. When practicable, supports and hangers for cast iron soil pipe shall be installed as close as possible to joints and when hangers or supports are not located within one foot of a branch line fitting, an additional hanger or support shall be installed at fitting.
- 19. In systems where grooved piping is used, couplings shall be provided with angle pattern bolt pads to comply with support and hanging requirements of ANSI/ASME B31.1, ANSI/ASME B31.9, and NFPA Pamphlet 13.



- S. Flashings:
 - 1. Each pipe, duct, or gas-fired equipment vent passing through roof shall be installed with waterproof flashing.
 - 2. Flashing or flanges on pipes, vents, and ducts passing through a tile or slate roof shall be constructed of sheet lead. Flashing for pipes and heater vents passing through a roof shall be 4 pound soft sheet lead. Flashing and flanges for ducts and heater vents passing through exterior walls shall be 22 gage sheet metal. Flanges and flashing shall be installed waterproof at point of connection with pipe or duct. No soldered joints on roof flashings will be allowed.
 - 3. Lead flashing and flanges shall be constructed of 4 pound sheet lead with burned joints. Flange of lead flashing or lead flange on a duct shall extend out onto roof a minimum of 12 inches from pipe or duct. Lead flashing shall extend up the pipe or duct not less than 7 inches.
 - 4. Sheet metal flashing shall be constructed of 24 gage galvanized sheet steel. Flanges on these flashings shall extend out onto roof a minimum of 10 inches from pipe or duct. Flanges on ducts through exterior walls shall extend out from duct a minimum of 2 ½ inches. Flanges on gas-fired equipment singlewall vents shall be of ventilated type. Type B gas vents through a roof shall be furnished with non-ventilated flashing as per NFPA Pamphlet 211.
 - 5. Cast iron, steel, brass, and copper pipe, which terminate less than 18 inches above roof, shall be furnished with a combination counter-flashing and vandal-proof hood for protection against water, birds and foreign matter. Cast iron, steel, brass and copper pipe, which does not terminate within 18 inches of roof, shall be furnished with a counter-flashing sleeve. Pipe, which terminates more than 18 inches above roof, shall be furnished with be furnished with a counter-flashing sleeve. Pipe, which terminates more than 18 inches above roof, shall be furnished with protection against entrance of water, birds, and foreign matter.
 - 6. Counter-flashing and combination counter-flashing sleeves and vandal-proof hoods shall be cast iron, vandal-proof, threaded, sealed or approved gasheated sleeve type. Counter-flashing sleeves on each of these items shall extend down over flashing a minimum of 3/4 inch.
 - 7. Flashing and flanges on ducts shall be installed waterproof at point of connection to the duct by riveting and soldering. Storm collars shall be securely screwed and installed waterproof around appliance vent pipe immediately above flashing.
 - 8. Vent piping above roof shall be furnished with a combination counter-flashing sleeve and vandal-proof hood.



T. Equipment Installation: Install roof or floor mounted equipment on level platforms, housekeeping pads or curbs and provide sound, vibration and seismic control measures per Section 23 05 48, unless indicated otherwise whether indicated on drawings or not.

END OF SECTION



SECTION 23 05 48 - HVAC SOUND, VIBRATION AND SEISMIC CONTROL

PART 1 – GENERAL

1.01 SUMMARY

- A. Section Includes: Reduction or elimination of excessive noise or vibration within building due to operation of equipment, machinery, piping, and ductwork as specified.
 - 1. Vibration isolators.
 - 2. Seismic restraint devices.
 - 3. Duct silencers.
 - 4. Acoustic housings.
 - 5. Lining and enclosing ductwork.
 - 6. Acoustic louvers.
 - 7. Sound attenuation boots at supply, return, exhaust and transfer air inlets, outlets and openings.
 - 8. Flexible ducts, conduits and piping.
- B. Related Requirements:
 - 1. Division 01: General Requirements.
 - 2. Section 01 45 25: Testing, Adjusting, and Balancing for HVAC.
 - 3. Section 23 05 00: Common Work Results for HVAC.
 - 4. Section 23 05 13: Basic HVAC Materials and Methods.
 - 5. Section 23 30 00: Air Distribution.
 - 7. Section 23 38 13: Kitchen Ventilation System.
 - 8. Section 23 80 00: Heating, Ventilating and Air Conditioning Equipment.

1.02 GENERAL REQUIREMENTS

A. Provide vibration isolators to eliminate or reduce the transmission of vibration noise to any part of building and mitigate vibration frequency and load imposed by equipment. Vibration isolators, base frames, inertia bases and seismic restraints shall be of sufficient size, flexibility and load distribution configuration to assure that deflection,



stability and seismic restraint requirements are met without permitting excessive movement when starting. For typical units, no fewer than four isolators shall be provided. Isolators shall be provided to deflect uniformly under operating gravity and equipment thrust loadings to within plus or minus 10 percent of specified deflection values.

- B. Static deflections specified are based on the anticipated equipment characteristics. In the event the equipment proposed by the Contractor has characteristics other than those indicated, particularly the rated rpm, the static deflection shall be re-evaluated and the proper mountings and other devices shall be provided.
- C. Where fabricated vibration isolator units are indicated, furnish manufacturer's standard catalog products with printed loading ratings or certified submittals
- D. Seismic Requirements:
 - 1. Refer to Seismic Restraint Manual: Guidelines for Mechanical Systems, published by SMACNA and approved by DSA, for minimum seismic restraints required on mechanical components design and construction details.
 - 2. Provide seismic restraints for mechanical equipment or components specified. Where equipment is specified with proprietary names, design for seismic restraints is for first proprietary name listed.
 - 3. Provide restraints, bracing and anchorage as required for the mechanical equipment, electrical equipment and components specified in the Contract Documents. Restraints, bracing and anchorage shall be installed to resist the total design earthquake or wind loads in any direction in accordance with CBC and SMACNA guidelines.
 - 4. Provide restraints, bracing, and anchorage for the mechanical equipment and components.
 - 5. For rigidly mounted liquid filled steel pipe, comply with the following:
 - a. Provisions of NFPA Pamphlet 13, section for sway bracing.
 - b. Provisions of NFPA Pamphlet 13, section for earthquake protection.
 - c. Hanger spacing as specified in Section 23 05 13 under Hanger Spacing Schedule.
 - d. SMACNA Seismic Restraint Manual: Guidelines for Mechanical Systems and approval by DSA.
 - 6. For flexibly mounted liquid filled steel pipe, comply with the following:
 - a. Provisions of the California Building Code for flexibly mounted equipment.



- b. Provisions of VISCMA (Vibration Isolation and Seismic Control Manufacturer's Association) Seismic Control Device Installation, Best Practices Manuals.
- c. Installer may provide a DSA or OSHPD approved system such as the SMACNA Seismic Restraint Manual with Addendum No. 1, the Mason Industries Seismic Restraint Guidelines or other proprietary preapproved system.
- 7. For ductwork and other mechanical equipment restraints, comply with SMACNA Seismic Restraint Manual: Guidelines for Seismic Mechanical Systems and obtain approval by DSA.

1.03 SUBMITTALS

- A. Provide in accordance with Division 01.
 - 1. Catalog cuts and data sheets on specific vibration isolators, seismic restraints, and anchors demonstrating compliance with the Specifications.
 - 2. Shop Drawings for each piece of equipment including dimensions, structural member size, support point, vibration, and seismic restraints.
 - 3. Written approval of frame design to be furnished by the equipment manufacturer.
 - 4. Drawings indicating methods for suspension, support, seismic restraints, guides, etc., for piping, ductwork, etcetera.
 - 5. Drawings indicating methods for isolation of pipes, ducts etcetera, piercing slabs, beams, etcetera.
- B. Vibration Test Reports: At completion of installation, submit the following documents. Submission of these documents must be complete before final acceptance of vibration isolation systems is given. Assistance from the vibration isolation equipment Manufacturer may be required.
 - 1. Complete tabulation showing for each vibration isolator:
 - a. Actual static deflection measured at the project.
 - b. Specified minimum static deflection.
 - 2. Report certifying:
 - a. Each piece of operative rotating mechanical equipment does not exceed the specified vibration displacement level.



- b. Each piece of isolated equipment or equipment component (ducts, pipes, conduit, etcetera) is not short-circuited by any means.
- c. Requirements of Part 2 are satisfied for equipment.

1.04 QUALITY ASSURANCE

- A. Standards and Codes: Comply with applicable codes and standards having jurisdiction including, but not limited to:
 - 1. NFPA, Pamphlet 13.
 - 2. ASHRAE Handbook: HVAC Systems and Equipment.
 - 3. SMACNA Seismic Restraint Manual: Guidelines for Mechanical Systems.
 - 4. California Building Code.
 - 5. VISCMA
 - a. Installing Seismic Restraints for Mechanical Equipment.
 - b. Installing Seismic Restraints for Duct and Pipe.
- B. Qualifications of Manufacturer and Installers: Comply with provisions as set forth in Section 23 0500: Common Work Results for HVAC.

PART 2 – PRODUCTS

2.01 GENERAL

- A. Furnish and install vibration dampers, sound isolation pads, flexible connections and similar equipment required to prevent sound of water flowing in pipes, vibration of motors, and motor operated equipment from being transmitted to building structure; and, in case of fans, from being transmitted along ducts. Piping shall be isolated from vibrating equipment by furnishing required flexible connectors.
- B. Pumps and similar motor operated equipment shall be installed on anti-vibration units.
- C. Fans, except curb-mounted roof-type exhaust fans and wall mounted propeller fans, shall be installed with anti-vibration units, whether indicated on Drawings or not. Fans built into air handling units may be furnished with independent anti-vibration mountings or whole unit may be installed on an external vibration isolation system.
- D. Other equipment shall be installed on anti-vibration bases, pads, or hangers, unless specifically noted otherwise on Drawings. Package units, furnished with built in anti-vibration bases, do not require unit bases unless otherwise specified.



- 1. Unless specified otherwise, anti-vibration bases shall be Mason Industries, M.W. Sausse & Co., the VMC Group, or equal, of the Model Number specified or indicated on the drawings. Furnished base including sub-base, shall be manufactured by same company with fan and integral motor base. Seismic restraints may be incorporated into bases or furnished separately.
- 2. Inertia anti-vibration bases shall conform to requirements indicated.
- 3. Unless noted otherwise, furnished anti-vibration bases, including supporting units for inertia bases, shall be of the spring type.
- 4. Selection of bases or supporting units shall be in accordance with manufacturer's recommendations based on following installed minimum effective isolation efficiencies (where not provided with each piece of equipment):

a.	Centrifugal fans, packaged fan and coil units and cooling towers, less than 800 RPM	80 percent
b.	Centrifugal fans over 800 RPM	90 percent
C.	Centrifugal pumps	95 percent
d.	Reciprocating compressors	95 percent

- E. Flexible duct connections shall be provided at inlet and outlets of each fan or HVAC unit, except curb-mounted roof exhaust fans whether indicated on the drawings or not.
- F. Flexible pipe or conduit connections shall be provided at piping and conduit connections to HVAC units, pumps, compressors and other moving (reciprocating or rotating) mechanical or electrical equipment provided under this Section whether indicated on the drawings or not.
- G. Flexible connections for Freon piping shall be seamless flexible metal hoses of type and length recommended by manufacturer and suitable for system operating pressure.
- H. Flexible connections for all other piping shall be flexible metal hose or spool type with flanged ends, unless otherwise specified. Metal hose shall be covered with protective braiding in areas where physical abrasion may occur, or for personnel safety.
- I. Spool types shall be similar to American Rubber Co., Mercer Rubber Co., PROCO Products, Inc., or equal, and hose types shall be similar to DME, Inc., U.S. Flex, Pennflex, Anaconda Flexpipe, Keflex, or equal with any required modifications to meet specified requirements. Flanges shall be furnished with steel retaining rings. Units installed on discharge side of pumps shall be furnished for a suitable working pressure of not less than 100 psig, and those on suction side for working pressures of 50 psig or 30 inches Hg vacuum.
- J. Units installed in cold water lines (less than 125 degrees F) shall furnish a minimum temperature rating of 180 degrees F and those installed in hot water lines (above 125 degrees F) shall be constructed of special heat resistant materials and be furnished for


a minimum temperature rating of 220 degrees F, continuous operation. Units shall be able to withstand a maximum lateral deflection of 3/8 inch. Temperature and pressure ratings shall be molded into body of each spool unit so they are easily identified. Spool types shall be for straight in flow only.

- K. Spool type units shall be furnished with control units comprised of a minimum of two tierods and anchor plates or internal guide sleeves to prevent excessive elongation or misalignment. Rubber washers shall be provided under bolt heads and rubber grommets in bolt holes to prevent any metal to metal contact between bolts and flanges.
- L. Where hose type units are furnished, restraining anchors or braces shall be provided if excessive or undesirable pipe movement occurs when system is operated.

2.02 GENERAL PROPERTIES OF VIBRATION ISOLATORS.

- A. Shall be provided with markings so that, after adjustment, when carrying their load, deflection under load can be verified; thus determining that load is within proper range of device and that correct degree of vibration isolation is being provided according to the design.
- B. Isolators to operate in direct proportion to their load versus deflection curve. Load versus deflection curves shall be furnished by manufacturer and must be linear over a deflection range of 50 percent above design deflection.
- C. Wave motion through isolator shall be reduced to following extent: Isolation above resonant frequency shall follow theoretical prediction based upon an un-dampened single degree of freedom system with a minimum isolation of 50 decibels above 150 cycles per second.
- D. Vibration isolator spring diameters shall be no less than their deflected height. Furnish spring with a 50 percent overload safety factor.
- E. Unless otherwise indicated, equipment installed on vibration bases shall provide a minimum operating clearance of one inch between structural steel base and floor or support base. Provide flexible connectors in piping and flexible conduit in power wiring to minimize transmission of vibration.
- F. Isolators and springs exposed to weather shall be hot-dipped galvanized or powder coated after fabrication and before installation. Hot-dipped zinc coating shall be not less than two ounces per square foot by weight complying with ASTM A123. In addition, provide limit stops to resist wind velocity.
- G. Where indicated, provide structural steel bases with height saving brackets, and minimum of three points of support. Isolators shall be furnished with a method for leveling.
- H. Design isolators and seismic restraints for positive anchorage against uplift and overturning.



I. Provide and install, under this Section of the Specifications, structural steel required to properly support equipment and steel required to support horizontal thrust arrestors.

2.03 ISOLATOR TYPES

- A. Type A: Steel Spring Isolators: Un-housed steel spring isolators, laterally stable and unrestrained. Design springs so that ratio of horizontal to vertical spring (stiffness) constant is between 0.9 and 1.3. Natural frequency of isolator must be 1/3 to 1/4 of driving frequency that is to be controlled. Isolators to provide a minimum additional travel to solid equal to 50 percent of rated deflection. Isolators shall be furnished with built-in leveling bolts complete with sound isolation pads type B. Static deflection as specified.
- B. Type B: Sound Isolation Pad: Provide under each spring isolator a sound isolation pad, utilizing high quality durable neoprene pad material, loaded to 40 psi. Build sound pad up to 2 layers of 1/4 inch thick neoprene material; separate layers with a 16 gage galvanized sheet metal plate. Top layer shall provide a hardness of 40 durometers and the bottom layer shall be 40 durometers. Cold bond sound pads together and to isolator baseplate.
- C. Type C: Neoprene-in-Shear Isolators: Isolator shall be neoprene-in-shear type as recommended by manufacturer. Isolator shall provide a static deflection under rated load at 1/4 inch.
- 2.04 EQUIPMENT FRAMES
 - A. Provide mounting frames and brackets to carry load of equipment without causing mechanical distortion or stress to the equipment.
 - B. Type A Frame: Wide flange members, rigidized structural steel frame with brackets. Maximum allowable deflection at any point on load frame relative to unloaded frame shall be 0.005 inch. Members to be constructed of wide flange beams, with a depth of not less than 1/10 of length of span between isolators. Frame shall be M.W. Sausse & Co. type RMSB-W, as basis of design, or Mason Industries, Caldyn, or equal.
 - C. Type B Frame: Channel members, rigidized structural steel frame with brackets. Frame to be constructed of channel steel with section depth equal to 1/10th length of longest structural member. Frame shall be M.W. Sausse & Co. type RMSB-C, as basis of design, or Mason Industries, Caldyn, or equal.
 - D. Type C Frame: Steel gusset or bracket welded or bolted directly to machine frame in order to accommodate isolator. Frame shall be M.W. Sausse & Co. type RMSG, as basis of design, or Mason Industries, Caldyn, or equal.
 - E. Type D Frame: Fabricated of rectangular channel steel forms for floating foundations to be filled with concrete on the Project site. Channel depth to be a minimum of 1/12th of longest dimension, but in no case less than 6 inches. Form shall include 1/2 inch reinforcing bars installed each way in a layer 1 ½ inches above bottom and drilled steel members with sleeves mounted below holes to receive equipment anchor bolts. Weight



of concrete and frame shall be two times or more than the weight of the unit it supports. Frame shall be M.W. Sausse & Co. type RMSBI, as basis of design, or Mason Industries, Caldyn, or equal.

2.05 MATERIALS AND CONSTRUCTION

- A. Duct Silencers: Provide factory fabricated duct silencers of tubular or rectangular type, for low or medium velocity service, with arrangements, sizes, and capacities as indicated on the Drawings.
 - 1. Construction:
 - Fabricate silencers of galvanized steel with casing seams sealed or a. welded to be airtight at a pressure differential of 8 inches water gage between inside and outside of unit, and stiffen or brace as necessary to prevent structural failure or deformation at same condition, or audible vibration during normal operation. Outer casings of rectangular silencer modules shall be made of 22 gage galvanized steel in accordance with ASHRAE Guide of recommended construction for high-pressure rectangular ductwork. Seams shall be lock formed and mastic filled. Outer casings of tubular silencers shall be made of galvanized steel in 18 to 22 gage. Internal acoustic elements of rectangular silencers shall incorporate integral die formed entry and exit to minimize pressure drop and self-noise. Interior partitions for rectangular silencers shall be fabricated of not less than 26 gage galvanized perforated steel. Interior construction of tubular silencers shall be compatible with the outside casings.
 - b. Filler material shall comply with the following:
 - 1) Fire Safety Standards: NFPA 90A and NFPA 90B.
 - 2) Temperature: ASTM C411.
 - 3) Air velocity: ASTM C1071, UL 181.
 - 4) Fire Hazard Classification: ASTM E84, UL 723-Class 1, NFPA 255.
 - 5) Corrosion Resistance: ASTM C739, C665.
 - 6) Fungi Resistance: ASTM G21.
 - 7) Water Vapor Sorption: ASTM C1104, less than 1 percent by weight.
 - 8) Formaldehyde, Phenolic Resins or other Volatile Organic Compounds: 0 percent.



- c. Airtight construction shall be provided by furnishing a duct sealing compound installed on the Project site. Silencers shall not fail structurally when subjected to a differential air pressure of 8 inches w.g. inside to outside of casing.
- 2. Acoustic Performance: Silencer ratings shall be determined in a duct-toreverberant room test facility, which provides for airflow in both directions through the test silencer in accordance with ASTM Standard E477. The test facility shall be accredited by the National Voluntary Laboratory Accredited Program for the ASTM E477 test standard. Data from a non-accredited laboratory is not permitted. The test set-up and procedure shall eliminate effects due to end reflection, directivity, flanking transmission, standing waves, and test chamber sound absorption. Acoustic ratings shall include dynamic insertion loss (DIL) and self-noise (SN) power levels both for forward flow (air and noise in same direction) and reverse flow (air and noise in opposite directions). Data shall be for test silencers no smaller than the following cross-sections:

Rectangular, inches - 24 by 24, 24 by 30, or 24 by 36 Tubular, inches - 12, 24, 36, and 48

- a. Noise reduction values (dynamic insertion loss) in decibels reference 10-12 watts, shall not be less than (of the model, size and length) indicated on Drawings.
- b. Self generated noise in decibels reference 10 to 12 watts, shall not be more than of the model, size and length indicated on Drawings.
- 3. Aerodynamic performance: Airflow measurements shall be performed in accordance with ASTM specification E477 and applicable portions of ASME, Air Movement and Control Association (AMCA), and Air Diffusion Council (ADC) airflow test codes. Tests shall be reported on the identical units for which acoustic data is presented. Air pressure drops shall not exceed those (of the model, size and length) indicated on Drawings.
- 4. Certification: With submittals, provide certified test data on dynamic insertion loss, self-noise power levels, and aerodynamic performance for reverse and forward flow test conditions. Test data shall be for a standard product. Rating tests shall be conducted in the same facility, shall utilize the same silencer, and shall be open to inspection if required by the Architect.
- 5. Rectangular silencers shall be Industrial Acoustics Company of the model number indicated on the drawing, as basis of design, or Vibro-Acoustics, Dynasonics, SEMCO Silentair, TranSonics, Inc., or equal.
- B. Duct Liner: As indicated in Section 23 07 00: HVAC Insulation.
- C. Flexible Ducts: As indicated in Section 23 07 00: HVAC Insulation.



PART 3 - EXECUTION

3.01 INSTALLATION

- A. Provide isolators, flexible pipe connectors, flexible electrical conduit and flexible duct connectors at all moving mechanical system components to prevent transmission of vibration noise to any part of building whether indicated on the drawings or not.
- B. Install isolators to suit imposed load and the vibration frequency to be absorbed. Isolator units shall furnish adequate strength and flexibility to exhibit proper resiliency under machine load and impact without permitting excessive movement when starting.
- C. Where commercial vibration isolator and seismic restraint units are specified, furnish manufacturer's standard catalog products with printed loading ratings, or provide substantiating calculations.
- D. Install vibration isolators and seismic restraints in accordance with manufacturer's printed installation instructions.
- E. Where equipment is belt driven and motor is not installed on equipment, install motor and driven equipment on unitized support, and install entire support isolators. Unitized support to be provided with adjustable slide rails sized for motor weight and frequency. Support shall be Mason Industries type WF, M.W. Sausse & Co., type RMSF, Caldyn, or equal.
- F. Do not install any equipment, piping, conduit, ductwork, etc., that makes rigid contact with building or its structural members, unless reviewed by the Architect.
 - 1. Coordinate Work with other trades to avoid rigid contact with building.
 - 2. Correct, before installation, any conflict with other Work that would result in solid contact to equipment or piping due to inadequate space.
 - 3. Obtain inspection from the Project Inspector for concealed Work before enclosure.
 - 4. Notify manufacturer before installation of vibration isolation devices so that manufacturer may instruct and demonstrate technique for proper installation.
- G. The furnishing or installation of vibration isolators must not cause any change of position or alignment of equipment, ductwork, or piping, resulting in stresses in piping or ductwork, connections, or misalignment of shafts or bearings. Equipment, piping, and ductwork shall be maintained in a rigid position during installation. Load shall not be transferred to isolator until installation is complete and under full operational load.
- H. Air Compressors, Water Chillers, Pumps, Boilers with Integral Combustion Fans and Miscellaneous Equipment, mounted on roof or raised floors: Install each unit with its motor on a vibration isolated base utilizing type B frames, except where a type D frame is indicated on Drawings. Install steel support frame furnished by equipment



manufacturer, utilizing equipment anchor bolt templates and isolator height saving brackets. Provide springs as specified for type "A" isolator; static deflection shall be a minimum of 2 inches.

I. Fans (2000 rpm or higher) Air Compressors and Miscellaneous Equipment, mounted on grade: As specified for grade mounted boilers except furnish type C isolators.

PROVIDE HOUSEKEEPING PAD DETAILS ON DRAWINGS.

- J. Boilers mounted on grade: Install each unit on concrete housekeeping pad with sound isolation pad designed for applicable equipment loading. Unit shall be fastened to housekeeping pad to prevent any movement.
- K. Air Handling, Air Conditioning Units, Floor Mounted Fans, and Cabinet-Installed Fans: Install entire casing including filters, mixing box, fan section, coil sections, etc., on a continuous, integral, structural steel base, as indicated. Furnish type A, B, or C frames, reinforced as necessary to prevent distortion of frame. Furnish isolator type A; static deflection shall be a minimum of I ½ inches.
- L. Suspended Fans and Air Conditioning Unit Fan Coils and Unit Ventilators: Suspend each integral unit from overhead structure on steel spring and elastomer hanger isolators. Support deflection under rated load of 3/8 inch. Provide spring static deflection as follows:

Fan RPM	Min. Deflection
200 – 400	3 inches
400 – 700	2 inches
Above 700	1 inche s

- M. Pipe Isolation: Where indicated and as required, furnish and support each pipe from an isolator. Isolator for the first five support locations away from vibrating equipment shall have the same deflection as the equipment isolators. After that, isolators shall be a neoprene-in-shear type of size as recommended by manufacturer; except where indicated on Drawings, pipe hanger rod shall be furnished with a steel spring isolator and elastomeric element, with lower rod capable of 30 degrees total misalignment without contact on spring housing.
- N. Seismic Restraints: Floor or pad mounted equipment that do not require vibration isolators, shall be bolted to floor or other support. Floor mounted equipment with vibration isolators shall be provided with lateral and vertical restraining devices on all sides of base to restrict displacement of equipment. On all sides of suspended equipment, provide bracing for rigid supports and provide aircraft cable restraints for resiliently supported equipment.
- O. Ductwork, duct acoustical lining, manual volume dampers and flexible ducts: Do not reduce length of duct runs, duct acoustical lining, manual volume dampers and flexible ducts for economy.



- P. Installation of flexible ducts at air inlets and outlets: Do not attach flexible ducts directly to air inlets and outlets unless a straight, smooth and uniform air flow can be achieved with sufficient space to make an elbow with a radius of at least three times the diameter of the duct. If sufficient space is not available to make such an elbow, provide a rigid elbow or a lined plenum.
- Q. Placement of Air Devices: Do not relocate air devices without the Architect's approval.

3.02 EXAMINATION

A. Arrange for the services of a certified representative of isolation manufacturer to visit the Project site for inspecting installation of devices. In the event the isolators do not meet specified requirements perform necessary revisions. Submit a written report to the Architect, signed by above representative, indicating all devices are properly installed and are operating as specified or required by isolation manufacturer.

END OF SECTION



SECTION 23 05 53 - HVAC IDENTIFICATION

PART 1 – GENERAL

1.01 SUMMARY

- A. Section Includes: Marking and identification required on mechanical piping systems, ducts, controls, valves, apparatus, etcetera.
- B. Related Requirements:
 - 1. Division 01: General Requirements.
 - 2. Section 23 05 13: Basic HVAC Materials and Methods.
 - 3. Section 23 09 00: HVAC Instrumentation and Controls.
 - 4. Section 23 30 00: Air Distribution.
 - 5. Section 23 80 00: Heating, Ventilating and Air Conditioning Equipment.

1.02 SUBMITTALS

- A. Submit in accordance with Division 01 and Section 23 05 00: Common Work Results for HVAC.
- B. Submit product data and installation instructions for each item specified.
- C. Submit Samples of materials.
- 1.03 QUALITY ASSURANCE
 - A. Comply with provisions of:
 - 1. Section 23 05 00: Common Work Results for HVAC.
 - 2. ANSI/ASME A13.1: Scheme for the Identification of Piping Systems.
 - 3. APWA: Uniform Color Code.

Or

4. IAPMO: Uniform Plumbing Code (UPC).

PART 2 – PRODUCTS

2.01 MATERIALS

Budlong

3361-008-000

A. General: Piping systems, controls, valves, apparatus, etc., except those that are installed in inaccessible locations in partitions, walls, and floors, shall be permanently identified.

2.02 VALVES

- A. Furnish prepared chart or diagram for each piping system, indicating by identifying letter or model number of each valve in the system, its location, and function.
- B. Install charts in aluminum frame with clear glass front and secure on wall where designated by the Project Inspector.
- C. Bind copies of each chart in operating instructions manual.
- D. Provide each valve with a brass, aluminum, or plastic disc, not less than 1-1/4 inches diameter bearing engraved numbers corresponding to those indicated on chart. Fasten discs to valve with No. 14 brass wire.
- E. Provide an additional tag for safety valves and other valves that could be hazardous to safety and health of occupants. Distinguish these tags from regular valve tags by color (such as yellow with black letters, and marked "Danger"); submit Sample tag to the Architect for review.

2.03 INSTRUMENTS AND CONTROLS

- A. Identify panel-mounted instruments and controls with engraved bakelite nameplates permanently affixed to panel boards.
- B. Identify alarm indicating devices and alarm reset devices by nameplates.
- C. Identify damper motors and automatic valves, flow switches, pressure switches, etc., with embossed aluminum or plastic tape affixed to controller, indicating service and setting.

2.04 EQUIPMENT

A. Identify each major piece of equipment with engraved bakelite nameplates permanently affixed to the equipment, indicating the room numbers it services, Equipment identification designation shall be the same to its designation indicated on the "As-Built Drawings". Room numbers in the nameplates shall correspond to the final room numbers.

2.05 ABOVE GRADE PIPE IDENTIFICATION

- A. Identify pipes by means of colored labels with directional flow arrows and identification of the pipe content, in conformance to ANSI/ASME A13.1 or the UPC.
- B. Materials: Precoiled acrylic plastic with clear polyester coating, all-temperature, selfadhering, as manufactured by Brady, Brimar Industries, Seton, Stranco, Inc., or equal.



HVAC IDENTIFICATION 23 05 53-2

C. Size:

Outside Diameter of Pipe or Insulation	Length of Color Field	Size of Letter
³ ⁄ ₄ to 1 ¹ ⁄ ₄ -inch	8-inch	½-inch
1 ½ to 2-inch	8-inch	¾-inch
2 1/2 to 6-inch	12-inch	1 ¼-inch"
8 to 10-inch	24-inch	2 ½-inch"
over 10-inch	32-inch	3 ½-inch

- D. Colors: As indicated in schedule.
- E. Locations:
 - 1. On accessible piping, whether insulated or not (including mechanical rooms, attic and ceiling spaces); except that labels shall be omitted from piping where contained material is obvious due to its connection to fixtures (such as faucets, water closets, etc.).
 - 2. Near each valve and branch connection in such accessible piping.
 - 3. At each pipe passage through wall or floor.
 - 4. At not more than 20 feet spacing on straight pipe run between bands required in 2 and 3 above.
 - 5. At each change in direction.
- F. Application: Install on clean surfaces free of dust, grease, oil, or any material that will prevent proper adhesion. Replace non-adhering or curling labels with new labels, as required by the Project Inspector.
- G. Schedule:

Content of Pipe	Legend	Background Color	Lettering Color
Refrigeration supply	Refrigeration supply	Yellow	Black
Refrigeration return	Refrigeration return	Yellow	Black
Air conditioning condensation drain	A/C condensate drain	Green	White



2.06 UNDERGROUND PIPE

- A. Detectable Marking Tape:
 - 1. Provide and install detectable marking tape along buried piping. Tape shall be specifically manufactured for marking and locating underground utilities with electronic equipment. Tape shall be acid and alkali resistant, and manufactured with integral wires or foil backing, encased with protective cladding. Tape shall be a minimum of two inches in width.
 - 2. Manufacturer: Reef Industries, Inc., Advantage Brands, Inc., Northtown Company, Mutual Industries, Inc., or equal.
 - 3. Detectable marking tape shall be color-coded per APWA Color Code:
 - a. Yellow: Steam.
 - b. Blue: Water.
 - c. Red: Electric power lines, cables, conduit and lighting cables. By Division 26.
 - d. Orange: Communication, alarm or signal cables. By Divisions 26 and 27.
- B. Tracer Wire:
 - 1. Solid copper wire type THWN, 12 AWG gage, with heat and moisture resistant insulation.

2.07 IDENTIFICATION OF AIR CONDITIONING EQUIPMENT

- A. Provide identification markers to locate air conditioning equipment above T-bar ceilings. Install 3/4 inch to one inch diameter colored self-adhesive dots to T-bar ceiling grid indicating point of access. The following identification markers shall be recorded on the project record documents:
 - 1. Fire Damper and Combination Fire/Smoke Fire Damper: Red.
 - 2. Manual Volume Dampers, Relief Dampers, Motorized Volume Dampers: Blue.
 - a. Supply air: Full dot.
 - b. Return air: Half dot.
 - 3. Fan coil unit: Green.
 - 4. Filter Location if separate from fan coil: Yellow.



PART 3 - EXECUTION

3.01 INSTALLATION

- A. Correct detrimental conditions prior to commencing the Work of this Section. Install markers and identification tags as specified with materials and installation procedures recommended by manufacturer.
- B. Place tracer wire on top of non-metal utility lines allowing some slack. Do not wrap tracer wire around pipe. Fasten tracer wire in place at approximately 10 feet on centers with non-metal ties.
- C. Install underground detectable pipe marking tape continuously buried 8 to 10 inches above the buried utility pipe. Wrap tape on pipe risers up to a height of 12 inches above grade.

3.02 CLEANUP

A. Remove rubbish, debris, and waste materials and legally dispose of off the Project site.

END OF SECTION



SECTION 23 07 00 - HVAC INSULATION

PART 1 – GENERAL

1.01 SUMMARY

- A. Section Includes:
 - 1. Condensate drain piping from air conditioning equipment.
 - 2. Refrigerant piping.
 - 3. Supply and return air ducts for heating and cooling systems air ducts.
- B. Related Requirements:
 - 1. Division 01: General Requirements.
 - 2. Section 23 05 00: Common Work Results for HVAC.
 - 3. Section 23 05 13: Basic HVAC Materials and Methods.
 - 4. Section 23 05 53: Mechanical Identification.
 - 5. Section 23 30 00: Air Distribution.
 - 6. Section 23 80 00: Heating, Ventilating and Air Conditioning Equipment.

1.02 REFERENCES

- A. American Society for Testing and Materials International (ASTM):
 - 1. ASTM C167 Standard Test Methods for Thickness and Density of Blanket or Batt Thermal Insulations.
 - 2. ASTM C209 Standard Test Methods for Cellulosic Fiber Insulating Board.
 - 3. ASTM C302 Standard Test Method for Density and Dimensions of Preformed Pipe-Covering-Type Thermal Insulation.
 - 4. ASTM C411 Standard Test Method for Hot-Surface Performance of High-Temperature Thermal Insulation.
 - 5. ASTM C518 Standard Test Method for Steady-State Thermal Transmission Properties by Means of the Heat Flow Meter Apparatus.
 - 6. ASTM C533 Standard Specification for Calcium Silicate Block and Pipe Thermal Insulation.

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- 7. ASTM C534 Standard Specification for Preformed Flexible Elastomeric Cellular Thermal Insulation in Sheet and Tubular Form.
- 8. ASTM C547 Standard Specification for Mineral Fiber Pipe Insulation.
- 9. ASTM D5116 Standard Guide for Small-Scale Environmental Chamber Determinations of Organic Emissions from Indoor Materials/Products.
- 10. ASTM E84 Standard Test Method for Surface Burning Characteristics of Building Materials.
- 11. ASTM E96 Standard Test Methods for Water Vapor Transmission of Materials.
- 12. ASTM G21 Standard Practice for Determining Resistance of Synthetic Polymeric Materials to Fungi.
- 13. ASTM G22 Standard Practice for Determining Resistance of Plastics to Bacteria.
- B. Underwriters Laboratories Inc.:
 - 1. UL 181 Standard for Factory-Made Air Ducts and Air Connectors.
 - 2. UL 723 Standard for Test for Surface Burning Characteristics of Building Materials.
- C. National Fire Protection Association:
 - 1. NFPA 90A Standard for the Installation of Air-Conditioning and Ventilating Systems .
 - 2. NFPA 90B Standard for the Installation of Warm Air Heating and Air-Conditioning Systems.
 - 3. NFPA 255 Standard Method of Test of Surface Burning Characteristics of Building Materials.

1.03 SUBMITTALS

- A. Submit in accordance with Division 01 and Section 23 05 00: Common Work Results for HVAC.
 - 1. Complete material list of items to be furnished and installed under this Section.
 - 2. Manufacturer's specifications and other data required demonstrating compliance with the specified requirements.



- 3. Shop Drawings, catalog cuts and manufacturer's data indicating insulation, jacketing, adhesives, and coating. Insulating materials shall be certified by manufacturer to comply with the California quality standards for insulating materials.
- 4. Display sample cutaway sections.
- 5. Manufacturer's recommended method of installation procedures, which will become part of this Section.
- 1.04 QUALITY ASSURANCE
 - A. Qualifications of Manufacturer and Installer, Materials, Fabrication, Execution, and Standard of Quality: Comply with provisions stated under Section 23 05 00: Common Work Results for HVAC and Section 23 05 13: Basic HVAC Materials and Methods.
 - B. Test Ratings:
 - Comply with provisions stated under Section 23 05 00 and 23 05 13 with emphasis on ASTM E84, NFPA 255, or UL 723. ASTM C167, ASTM C302, UL label or listing of satisfactory test results from the National Institute of Standards and Technology, or a satisfactory certified test report from an acceptable testing laboratory. Approval by the State Fire Marshal is required.
 - 2. Furnish labels, legibly printed with the name of the manufacturer or listings indicate that fire hazard ratings do not exceed those specified for materials proposed for installation. Flame spread index of not more than 25 and smoke developed rating not exceeding 50.
 - 3. Tests shall be performed on each item individually when insulation, vapor barrier covering, wrapping materials, or adhesives are installed separately at the Project site.
 - 4. Test insulation, vapor barrier covering, wrapping materials and adhesives as an assembly when they are factory composite systems.
 - C. Regulatory Requirements: Insulation furnished and installed under this Section shall conform to the requirements of the California Building Code Parts 4, Mechanical Code, Part 5, Plumbing Code and Part 6, Energy Code.
 - D. All chemically based products such as sealers, primers, fillers, adhesives, etc. shall meet the California air quality regulations.

1.05 PRODUCT HANDLING

A. Protection, Replacement, Delivery and Storage: Comply with provisions stated under Sections 23 05 00: Common Work Results for HVAC and 23 05 13: Basic HVAC Materials and Methods.

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PART 2 – PRODUCTS

2.01 MATERIALS

- A. General:
 - 1. Piping insulating material shall be fire resistant, non-corrosive, shall not break, settle, sag, pack or disintegrate under vibration, nor absorb more than 1 percent moisture by weight.
 - 2. Piping insulating material shall be furnished with thickness indicated in Table 1, unless otherwise noted on the drawings, and shall furnish thermal resistance in the range of R-4.0 to 4.6 in accordance with inch at 75 degrees F. For any other value of R, insulation thickness shall be calculated accordingly and submitted for review.
 - 3. Asbestos in any quantity in insulating material is not permitted.
 - 4. Provide insulation materials, adhesives, coatings, sealants, fitting covers, and other accessories with a fire hazard rating not to exceed 25 for flame spread, 25 for fuel contributed and 50 for smoke developed, except for materials listed as follows:
 - a. Nylon anchors for installing insulation to ducts or equipment.
 - b. Treated wood blocks.
 - 5. Flame-proofing treatments subject to moisture damage are not permitted.

TABLE 1 - MINIMUM PIPING INSULATION THICKNESS (1)

Insulation Thickness Required (in inches)

Space Heating Systems (Steam, Steam Condensate and Hot Water)

Piping System Type	Temp. Range (degrees F)	Run- outs up to 2 (2)	1 and less	1.25 to 2	2.5 to 4
Refrigerant	Below 40	1.0	1.0	1.5	1.5
Condensate Drain	¹ / ₂ -inch Minimum insulation thickness.	0.5	0.5	0.5	0.5
From Air Conditioning Equipment:	Insulate condensate drain lines within building, in room, inside walls and above ceilings.	0.5	0.5	0.5	0.5

NOTES:

- (1) For piping exposed to ambient temperatures, increase thickness by 0.5 inch.
- (2) Run-outs to individual terminal units, not exceeding 12 feet in length.
- B. Lagging Adhesives: Shall be nonflammable and fire-resistant and shall have a maximum flame spread index of 25 and a maximum smoke developed index of 50 when tested in accordance with ASTM E84. Insulation finished with canvas shall be provided with laps adhered in accordance to manufacturer's recommendation. A finish coat of same material shall be applied to entire outer surface of lagging cloth at coverage specified by manufacturer.
- C. Canvas Jackets: Furnish 6 ounce in accordance with square foot minimum, 48 by 48 thread count canvas jacketing.
- D. Insulation Jackets:
 - 1. Exterior insulation exposed to weather shall be weatherproofed with Childers aluminum jacketing as basis of design, or Pabco, RPR, or equal. Jacketing shall be manufactured from 1100, 3105 or 5010 aluminum alloy with 3/16-inch corrugations. Smooth or embossed jackets may be permitted in special situations to match an existing installation. Jacketing shall be furnished with an integrally bonded moisture barrier over entire surface in contact with insulation. A minimum thickness of 0.016 aluminum jacketing is to be provided on ducts and piping. A minimum thickness of 0.020 shall be provided on tanks, equipment, and heat exchangers.
 - 2. Insulated elbows, of 90 degrees and 45 degrees, with a nominal iron pipe size of ½-inch to 8-inch shall be provided with Childers aluminum Ell-Jacs insulation covers as basis of design, or Pabco, RPR, or equal, manufactured from 1100 aluminum alloy of 0.024-inch thickness. Insulated elbows with a nominal pipe size of 10 inches to 18 inches shall be provided with Childers 4-piece aluminum Ell-Jacs as basis of design, or Pabco, RPR, or equal.
 - 3. Tees, Flanges, and Valve Insulation in Conjunction with Aluminum Jacketing: Furnish Childers Aluminum Special Fabrications Insulation Covers as manufactured by Childers Products Company, Pabco, RPR, or equal.
- E. Adhesives: Adhesives shall be water based, UL Classified, meet the requirements of NFPA 90A and NFPA 90B, have been tested according to relevant ASTM requirements, and be acceptable to the State Fire Marshal. Name, type and method of installation shall be submitted for review.
- F. Valve and Fitting Cover: When installed in conjunction with PVC jacketing, furnish Zeston 25/50 rated polyvinyl chloride fitting covers as manufactured by Johns Manville, Knauf Insulation, Speedline, or equal.

2.02 PIPING SYSTEM INSULATION

- A. General: Insulate chilled water supply and return piping and refrigerant piping.
- B. Materials:
 - 1. Classes of Insulation:
 - a. Class A: Expanded polystyrene pipe insulation, self-extinguishing type, either molded or extruded; Dow Chemical Co. STYROFOAM, ITW Insulation Systems XPS PIB, Foam-Control EPS, or equal.
 - b. Class B: Glass fiber molded pipe insulation ASTM C547. Pipe insulation shall be one piece, preformed, and provide a minimum R factor of 4 at 75 degrees F mean temperature. Insulation shall be faced with all-purpose fire-retardant vapor barrier jacket. Pipe insulation shall be Johns Manville Micro-Lok, CertainTeed Snap-On, Owens Corning FIBERGLAS SSL II-ASJ, or equal.
 - c. Class C: Expanded (foamed) urethane (polyurethane) or polyisocyanurate pipe insulation of self-extinguishing type molded or fabricated, Dyplast Products, LLC ISO-C1/2.0, ITW Trymer, Specialty Products & Insulation Co. Polyisocyanurate Pipe Insulation, Armacell Armalok, or equal.
 - d. Class D: Foamed plastic pipe insulation, self-extinguishing type, ASTM C534 Type 1 - tubular. Pipe insulation shall be one-piece preformed, flexible tubing type and provide a maximum K factor of 0.28 at 75 degrees F mean temperature. Pipe insulation shall be Armacell Armaflex, Aeroflex Aerocel, Rubatex INSUL-TUBE 180, or equal.
 - 2. Locations and Class of Insulation Required: For thickness required, refer to Table 1 of this Section.

<u>SERVICE</u>	LOCATION	CLASS OF INSULATION
Condensate drains from air conditioning equipment	Indoors at all locations including above ceilings and between stud walls	D
Refrigerant suction	All locations except	D
Liquid line as required	underground	
All other piping,	All locations	A, B, C
except underground	except underground	

TABLE 3 – SERVICE, LOCATION AND CLASS OF INSULATION REQUIRED

3. Adhesives:



- a. Polystyrene adhesives: Synthetic rubber and resin adhesives specifically designed to adhere extruded and expanded rigid polystyrene and urethane insulation to themselves and to other porous and non-porous substrates.
- b. Vapor barrier laps and penetrations: Furnish protective coating and lagging adhesive on butt joints of foil-faced vapor barriers, and where pins and staples puncture facings.

2.03 DUCTWORK AND PLENUM INSULATION

- A. General: Insulate ductwork and plenums with not less than the amount of insulation tabulated in Table 4, unless noted otherwise on the drawings. Insulation may be omitted under the following conditions:
 - 1. Exposed return air ductwork in conditioned space.
 - 2. Return air ductwork between wall studs inside an interior wall.

Duct Location	Insulation Type
Exposed interior round and oval supply air ductwork located at Gyms and MPR Stages	DW-1
Exposed interior rectangular supply air ductwork located at Gyms and MPR Stages	L-1
Exterior locations of Health Units and Clinics	DW-2
Exterior locations other than Health Units and Clinics	L-2
In walls, within floor/ ceiling spaces	F-1 or L-1 See note 3
Hot and cold plenums	F-2, DW-1 or L-2 See note 3
Attics, Garages, and Crawl Spaces, within unconditioned space or in basement	F-3 or L-2 See note 3

TABLE 4 - INSULATION OF DUCTS AND PLENUM

- B. Insulation Types:
 - 1. DW-1: 1-inch thick insulation sandwiched inside double-wall type ducts and fittings.
 - 2. DW-2: 2-inch thick insulation sandwiched inside double-wall type ducts and fittings. Duct joints shall be waterproofed.
 - 3. F-1: 1¹/₂-inch blanket fiberglass, factory-laminated with all-service jacket vapor barrier.

- 4. F-2: 2-inch blanket fiberglass, factory-laminated with all-service jacket vapor barrier.
- 5. F-3: 3-inch blanket fiberglass, factory-laminated with all-service jacket vapor barrier.
- 6. L-1: 1¹/₂-inch Internal duct lining.
- 7. L-2: 2-inch Internal duct lining.
- C. Notes:
 - 1. Minimum insulation provided shall be as required by the current California Mechanical Code Title 24 for the most restrictive condition.
 - 2. Refer to the materials indicated in this section for external insulation & Internal Lining.
 - 3. External insulation shall be replaced with internal duct lining (of equivalent thermal resistance value unless noted otherwise) where indicated on the drawings or specified elsewhere for sound attenuation.
 - 4. Provide internal duct lining (1 ¹/₂-inch unless noted otherwise) where indicated on the drawings or specified elsewhere for sound attenuation.
 - 5. All exterior insulated ductworks shall be water proofed at joints, seams and duct penetrations.
- D. Materials:
 - 1. Fire-Resistive Insulation Materials and Coatings: Submit State Fire Marshal pre-approved materials only.
 - 2. Adhesives: See Paragraph 2.01.E for applicable products.
 - 3. External Insulation: Provide glass fiber blankets that are factory-laminated with Foil Reinforced Kraft (FRK) vapor barrier facing; Johns Manville Microlite, Owens-Corning SOFTR Duct Wrap, Knauf Insulation Friendly Feel Duct Wrap, or equal. Provide a minimum installed R value as required by the CEC Building Energy Efficiency Standards; but not less than scheduled on Table 5:

TABLE 5

INSULATION OF DUCTS AND PLENUM INSTALLED

THERMAL RESISTANCE "R" VALUES

Туре	Labeled Thickness (in inches)	Installed R Value (hr.ft².°F/Btu)	
F-1	1 1⁄2	4.2	

F-2	2	5.6
F-3	3	8.3
DW-1	1	4.2
DW-2	2	5.6
L1	1 ½	6.0
L2	2	8.0

- 4. Internal Lining: Internal Lining shall be of the type that inhibits the growth of mold, mildew and fungi and shall not contain harmful VOC's or contain glass fiber. Approved Material:
 - a. Polyester Duct Liner:
 - Polyester duct liner shall be an engineered nonwoven, thermally bonded Polyester with a smooth and durable FSK facing.
 - 2) Polyester duct liner must be able to withstand a constant internal temperature up to 250°F must be compliant with Greenguard Environmental Institute and contain zero VOCs per ASTM D5116. Liner must comply with all applicable standards including ASTM E84, ASTM C411, ASTM C518, ASTM G21, NFPA 90A and 90B, and UL 181.
 - 3) Approved Manufacturer: Ductmate Industries "PolyArmor" duct liner or approved equal.
 - b. Elastomeric duct liner:
 - Closed-cell, sponge- or expanded-rubber materials. Elastomeric liner must be able to withstand a constant internal temperature up to 300°F and must comply with all applicable standards including ASTM E84, ASTM E96, ASTM C209, ASTM C534 - Type II sheet materials, ASTM C411, ASTM C518, ASTM G21, ASTM G22, NFPA 90A and 90B, and UL 181.
 - 2) Approved Manufacturer: Armacell LLC "AP Armaflex FS" duct liner or approved equal.
 - c. Duct liner must be attached per manufacturer's requirements using a non-flammable, low VOC water-based adhesive. When applicable, apply a non-flammable, low VOC water-based lagging adhesive to the exposed leading edge of the insulation. Install fasteners per SMACNA HVAC Duct Liner installation instructions.

d. Duct liner must be installed per SMACNA Manual, "HVAC Duct Construction Standards, Metal and Flexible," Third Edition unless otherwise specified.

PART 3 – EXECUTION

3.01 INSTALLATION

- A. Except as specified herein, install material in accordance with recommendations of manufacturer. Do not install insulation materials until tests specified in other sections are completed. Remove foreign material such as rust, scale, or dirt. Surfaces shall be clean and dry. Maintain insulation clean and dry at all times.
- B. On cold surfaces where a vapor barrier must be provided and maintained, insulation shall be installed with a continuous, unbroken moisture and vapor seal. Hangers, supports, anchors, or other projections that are fastened to cold surfaces shall be insulated and vapor sealed to prevent condensation.
- C. Surface finishes shall be extended in such a manner as to protect raw edges, ends, and surfaces of insulation.
- D. Pipe or duct insulation shall be continuous through walls, ceiling or floor openings, or sleeves; except where fire-stop or fire-safing materials are required.
- E. Metal shields shall be installed between hangers or supports and the piping insulation. Rigid insulation inserts shall be installed between the pipe and the insulation shields. Inserts shall be of equal thickness to adjacent insulation and shall be vapor sealed accordingly.
- F. Insulation shall not be installed in the following locations unless otherwise noted:
 - 1. On vacuum return lines less than 50 feet long.
 - 2. On unions, flanged connections or valve handles.
 - 3. Over edges of any manhole, clean-out hole, clean-out plug, access door or opening to a fire damper, so as to restrict opening or identification of access.
 - 4. Over any label or stamp indicating make, approval, rating, inspection, or similar data, unless provision is made for identification and access to label or stamp.

3.02 INSTALLATION OF PIPING SYSTEM INSULATION

- A. General: Chilled water supply and return piping, refrigerant piping and condensate drain lines, after having been tested, shall be cleaned and insulated.
- B. Application: Insulation on chilled water lines, refrigerant suction lines and liquid lines, if indicated, and air conditioner interior drain lines shall be jacketed with fire-

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resistant vapor barrier of laminated aluminum foil consisting of 2 plies with glassyarn reinforcing. Jacket joints shall be lapped and sealed with an approved adhesive. Insulation shall be secured with aluminum bands not less than 0.005inch thick by ³/₄-inches wide, spaced not over 12-inch on centers, or as recommended by manufacturer.

- 1. Longitudinal Seams: Butt hinged sections of covering tightly together and seal down jacket flap with adhesive, or with factory-applied, self-sealing lap with pressure-sensitive sealer protected with release paper.
- 2. End Joints: Wrap joint with a 3-inch wide (minimum) self-sealing tape.
- 3. Fittings and Valves: Fittings and valves shall be covered with same material of same thickness as pipe insulation, sealed with an approved, vapor-sealing tape or compound and covered with Johns Manville Zeston polyvinyl-chloride cover, Knauf Insulation Proto PVC Fitting Cover, Speedline Polyco Smoke Safe, or equal.
- 4. Pipe hangers shall be insulated or attached to pipe by an insulating insert, butted between adjoining insulation sections.
- C. Additional Jackets:
 - 1. Exposed Indoor Insulation: Cover with 26 gage galvanized sheet metal jacket to 8 feet above floors, except in mechanical equipment rooms and accessible pipe tunnels.
 - 2. Exposed Outdoor Insulation: In addition to canvas or fiberglass cloth cover, provide 0.016-inch thick aluminum jacket with 1-inch wide aluminum bands and seals. Install appropriate jackets on valves and fittings.

3.03 INSTALLATION OF DUCTWORK AND PLENUM INSULATION

- A. External Covering:
 - 1. Before installing duct insulation, sheet metal ducts shall be clean, dry, and tightly sealed at joints and seams, inspected pressure tested, and accepted by OAR/ Inspector.
 - 2. Duct exterior insulation shall be firmly wrapped around ductwork with joints lapped a minimum of 2-inch. Insulation shall be securely fastened with 18 gage copper-lined steel wire, or 16 gage soft-annealed galvanized wire spaced approximately 12-inch on centers and at loose ends, presenting a neat and workmanlike appearance. Where duct width is such that wiring will not fasten insulation firmly against duct an adhesive shall be furnished to fasten insulation to duct with wiring being installed at ends of insulation segment.



- 3. Insulation on ductwork transporting conditioned air, both supply and return, and outside air intake ducts when pre-conditioned, shall be furnished with a factory-applied, fire-resistant vapor barrier.
- 4. Exposed Ducts or Plenum:
 - a. Install insulation to ducts or plenum furnished with butt joints, without voids and with adhesive over entire surface of duct. Cover insulation with canvas jacket, fastened tightly to insulation with lagging adhesive. Install 2 finish coats of undiluted adhesive.
 - b. When installing jacket, finished covering shall be even and level, without humps, with constant diameters on round ducts maintained.
- B. Interior insulation lining:
 - 1. Dimensions of ducts indicated are net inside dimensions and must include thickness of duct liners to obtain the required duct size.
 - 2. Install insulation in square turns, where required, to cover interior surfaces before duct turns are installed.
 - 3. Install lining material during fabrication of duct with sealed face only exposed to air stream.
 - 4. Interior insulation in ducts or plenums shall not have exposed edges. Edges open to entering or leaving air streams shall be covered, secured in place and sealed with approved duct liner edge sealers.
 - 5. Insulation shall be fastened to sheet metal with an approved fire-retardant adhesive, with minimum 90 percent coverage and edges firmly adhered.
 - 6. Mechanical fasteners shall supplement the adhesive on top sections of ducts more than 12-inch wide and on sides of ducts more than 24-inch high and shall be spaced on 16-inch centers maximum. Fastener posts shall be cut off approximately ¼-inch from metal disc.

3.04 CLEANUP

- A. Remove rubbish, debris, and waste materials and legally dispose of off the Project site.
- 3.05 PROTECTION
 - A. Protect the Work of this Section until Substantial Completion.

END OF SECTION

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SECTION 23 08 00 - HVAC SYSTEMS COMMISSIONING

PART 1 – GENERAL

1.01 SUMMARY

- A. Section Includes:
 - 1. General requirements for Commissioning (Cx) of HVAC systems and equipment including installation, start-up, testing, documentation, and training according to the Construction Documents.
 - 2. Standard procedures for the execution of commissioning work shall be in conformance with Division 01, Section 01 91 13: General Commissioning Requirements. Coordinate work with the Commissioning Services Provider (CxSP).
- B. Related Requirements:
 - 1. Division 01: General Requirements.
 - 2. Section 01 45 23: Testing and Inspection.
 - 3. Section 01 45 25: Testing, Adjusting, and Balancing for HVAC.
 - 4. Section 01 79 00: Maintenance and Operations Staff Demonstration and Training.
 - 5. Section 01 91 13: General Commissioning Requirements.
 - 6. Section 23 05 00: Common Work Results for HVAC.
 - 7. Section 23 30 00: Air Distribution.
 - 8. Section 23 38 13: Kitchen Ventilation System.
 - 9. Section 23 80 00: Heating, Ventilating and Air Conditioning Equipment.
 - 10. Section 26 05 00: Common Work Results for Electrical.
 - 11. Section 26 05 13: Basic Electrical Materials and Methods.
 - 12. Section 26 05 19: Low Voltage Wires (600 Volt AC).
 - 13. Section 26 05 26: Grounding and Bonding.
 - 14. Section 28 31 49: Carbon Monoxide Detection and Alarm Systems.
 - 15. Section 26 05 86: Motors and Drives.
 - 16. Section 26 08 00: Electrical Systems Commissioning.
 - 17. Section 26 29 13: Adjustable Frequency Drives.
 - 18. Project Commissioning Plan (CxP).

1.02 REFERENCES



- A. Applicable codes, standards, and references: inspections and tests shall be in accordance with the following applicable codes and standards:
 - 1. InterNational Electrical Testing Association NETA.
 - 2. National Electrical Manufacturers Association NEMA.
 - 3. American Society for Testing and Materials ASTM.
 - 4. Institute of Electrical and Electronics Engineers IEEE.
 - 5. American National Standards Institute ANSI.
 - 6. National Electrical Safety Code NESC.
 - 7. California Building Code CBC.
 - 8. California Electrical Code CEC.
 - 9. California Mechanical Code CMC.
 - 10. Insulated Cables Engineers Association ICEA.
 - 11. Occupational Safety and Health Administration OSHA.
 - 12. National Institute of Standards and Technology NIST.
 - 13. National Fire Protection Association NFPA.
 - American Society of Heating and Air-Conditioning Engineers ASHRAE (The HVAC Commissioning Process, ASHRAE Guideline).
 - 15. Associated Air Balance Council AABC (National Standards for Total System Balance).

1.03 SUBMITTALS

- A. Submittals package shall include the following:
 - 1. Commissioning required submittals in accordance with Division 01 Specification Sections.
 - 2. Copy of the Architect's reviewed and accepted submittals to the CxSP via the OAR.
 - 3. List of team members who will represent the Contractor in the Prefunctional Equipment Checks (PEC) and Functional Performance Tests (FPT), at least six weeks prior to the start of Pre-functional Equipment Checks.
 - 4. Detailed manufacturer installation and start-up, operating, troubleshooting and maintenance procedures, a copy of full details of Owner-contracted tests, full factory testing reports, if any, and Warranty information, including responsibilities of Owner to keep Warranty in force clearly defined.
 - 5. Installation and checklist documentation shipped with equipment and field checklist forms to be used by factory or field technicians.



6. Detailed manufacturer's recommended procedures and schedules for PECs, supplemented by Contractor's specific procedures, and FPTs, at least four weeks prior to the start of PEC.

1.04 MEETINGS, SEQUENCING AND SCHEDULING

- A. Meetings: Attend the Cx meetings as required under Section 01 91 13 and Cx Plan.
- B. Sequencing and Scheduling: The work described in this Section shall begin only after work required in related Divisions 23 and 26 Sections has been successfully completed and tests, inspection reports, and Operation and Maintenance manuals required have been submitted and accepted. The start-up and PEC shall be completed and submitted to the Owner at least two weeks prior to beginning FPT.
 - 1. Coordinate HVAC work with the work of other trades prior to scheduling of any Cx procedures.
 - 2. Coordinate the completion of HVAC testing, inspection, and calibration prior to start of Cx activities.
- 1.05 QUALITY CONTROL
 - A. Comply with Division 01 quality control specifications.
 - B. Incorporate manufacturer's recommended Cx procedures for the systems and equipment to be commissioned under this Section.
 - C. Comply with Section 01 45 25: Testing, Adjusting, and Balancing for HVAC.
- 1.06 EQUIPMENT AND SYSTEMS TO BE COMMISIONED
 - A. Split Systems.
 - B. Make Up Air Units, with gas fired heat and evaporative cooling.
 - C. Fan Coil Units.
 - D. Variable Volume and Temperature System.
 - E. Exhaust Fans.
 - F. Ventilators.
 - G. Water Heaters, Gas and Electric.
 - H. Air Conditioning Units.

PART 2 – PRODUCTS

- 2.01 TEST EQUIPMENT
 - A. Equipment to be utilized in the commissioning process shall meet the following requirements:



- 1. Provide test equipment as necessary for the testing of the equipment and systems to be commissioned.
- 2. Provide testing equipment and accessories that are free of defects and certified for use.
- 3. Provide testing equipment with current calibration labels as per NIST Standards.
- 4. Equipment shall be calibrated on the manufacturer's recommended intervals with calibration tags affixed to the instrument. In the absence of calibration tags, calibration documentation shall be submitted to the CxSP at least thirty days prior to use; this documentation shall include description and serial number of instrument and calibration data and date.
- 5. Testing equipment shall be maintained in good operating condition for the duration of the project.

PART 3 – EXECUTION

3.01 COMMISSIONING PROCESS REQUIREMENTS

- A. Work to be performed prior to commissioning:
 - 1. Complete phases of the work so the system(s) can be started, tested, adjusted, balanced, and otherwise commissioned.
 - 2. If modifications or corrections to the installed system(s) are required to bring the system(s) to acceptance levels due to Contractor's incorrect installation or defective materials, such modifications shall be made at no additional cost to the Owner.
 - 3. Normal start-up services required to bring each system into full operational state:
 - a. Testing, motor rotation check, control sequences of operation, full and part load performance.
 - b. Commissioning shall not start until each system is complete and start-up has been performed.
- B. Pre-Commissioning responsibilities:
 - 1. Inspection, calibration and testing of the equipment required to commission the following systems:
 - a. HVAC System(s).
- C. Commissioning Process Requirements:
 - 1. Refer to Section 01 91 13: General Commissioning Requirements and related Sections for information on meetings, start-up plans, Pre-Functional and FPT, operations and maintenance data, training requirements, and other Cx activities.

3.02 PREPARATION



- A. Provide certified HVAC technicians as required, with tools and equipment necessary to perform Cx activities specified.
- B. Provide certified testing agency personnel and equipment factory representatives as require in the Cx plan and other related Sections.
- C. Verify that work required in this Section and in Section 01 91 13 is complete prior to starting of FPT.
- D. Verify that complete operational manuals have been reviewed and accepted by the CxSP as specified before starting FPT.

3.03 TESTING

- A. Testing procedures shall include the following minimum information:
 - 1. Test number.
 - 2. Equipment used for the test, with manufacturer and model number and date of last calibration.
 - 3. Date and time of the test.
 - 4. Indication of whether the record is for a first test or retest following correction of a problem or issue.
 - 5. Identification of the system, subsystem, assembly, or equipment.
 - 6. Conditions under which the test was conducted, including (as applicable); ambient conditions, set points, override conditions, status, and operating conditions that impact the results of the test.
 - 7. Systems and assemblies test results and performance and compliance with contract requirements.
 - 8. Issue number, if any, generated as the result of the test.
 - 9. Name(s) and signature(s) of witnesses and the person(s) performing the test.
- B. Contractor shall participate and perform Cx related testing requirements as specified.
- C. General Requirements for Mechanical, Controls, and Testing and Balance:
 - 1. Construction and Acceptance Phases:
 - a. Provide assistance to CxSP in preparing FPT procedures specified. Sample test forms are included in the project Cx Plan.
 - b. Develop full startup and initial checkout plan using manufacturer's start-up procedures and Cx checklists for commissioned equipment. Submit to CxSP for review and approval prior to startup.
 - c. During startup and initial checkout process, execute mechanicalrelated portions of PEC for the equipment and systems to be commissioned.



- d. Perform and clearly document completed startup and system operational checkout procedure. Providing four copies of the results to the Owner.
- e. Resolve any open punch list items before FPT. Air testing and balance shall be completed with discrepancies and problems remedied before FPT of respective air -related systems.
- f. Provide skilled technicians to execute starting of equipment and to execute PFT. Ensure that technicians are available and present during agreed upon schedules and for sufficient duration to complete necessary tests, adjustments, and solutions to identified problems.
- g. Maintain a log of events and issues of tests and related Cx activities. Submit handwritten reports of discrepancies, deficient or uncompleted work by others, contract interpretation requests, and lists of completed tests as specified.
- h. Correct open issues and re-test as needed to prove compliance with system operational standards.
- i. Prepare Operation and Maintenance Manuals and provide training for the Owner maintenance personnel and end-users per Section 01 79 00.
- j. Coordinate with equipment manufacturers to determine specific requirements to maintain validity of Warranty and notify the Owner.
- k. Execute simulated seasonal FPT, witnessed by the Owner and the CxSP, as specified. Document results and perform corrections as needed for system acceptance and make necessary adjustments to Maintenance and Operations Manuals and Record Drawings.

3.04 SENSOR CALIBRATION

- A. Field-installed temperature, relative humidity, CO₂, pressure sensors, pressure gages, and actuators (dampers and valves) shall be calibrated using the methods described below. Calibration procedures shall be documented during execution of the Start-up and the PEC. Alternate methods may be used, if approved by the CxSP.
- B. Test instruments shall have had a NIST certified calibration within the last 12 months. Sensors installed in the unit at the factory with provided calibration certification need not be field calibrated.
- C. Sensors:
 - 1. Verify that sensor locations are appropriate and away from causes of erratic operation.
 - 2. Verify that sensors with shielded cable are grounded only at one end.



- 3. For sensor pairs that determine a temperature difference, make sure they are reading within 0.2 degrees F of each other.
- 4. For sensor pairs that determine a pressure difference, make sure they are reading within 2 percent of each other.
- 5. Calibration: Put the equipment in operation. Make a reading with a calibrated test instrument within six inches of the site sensor. Verify that the sensor reading (via the permanent thermostat or gage) is within the tolerance listed in the table below of the instrument-measured value. If not, calibrate or replace sensor.
- 6. Tolerances:

<u>Sensor</u>	Required Tolerance (+/-)
AHU wet bulb or dew point	2.0 degrees F
Outside air, space air, duct air temps	0.4 degrees F
Watt-hour, voltage, and amperage	1 percent of design
Pressures, air, water and gas	3 percent of sensor range (inc. design value)
Flow rates, air	10 percent of sensor range (inc. design value)
Flow rates, natural gas	5 percent of sensor range (inc. design value)
Relative humidity	4 percent
CO ₂ monitor	100 ppm
Sound level	5 db - Type 1 meter (Per Calibrator Mfg.)
Domestic Hot Water Temperature	1.5 degrees F
Domestic Hot Water Pressures Water and Gas	3 percent of sensor range (inc. design value)



Flow Rates, Domestic Water 4 percent of sensor range (inc. design value)

Flow Rates

5 percent of sensor range (inc. design value)

3.05 ADJUSTING

- A. Perform work required to rectify installations not meeting contract requirements at no additional cost to the Owner.
- B. Corrective work shall be completed in a timely manner to permit completion of the Cx process.
- C. If systems' Cx deadline, as defined in the Project Schedule, goes beyond the scheduled completion without resolution of the problem(s), the Owner reserves the right to obtain supplementary services or equipment to resolve the problem.
- 3.06 TRAINING
 - A. Provide training plan for systems to be commissioned as required in applicable Division 23 specification sections and Section 01 79 00.

END OF SECTION



SECTION 23 08 13 - ENVIRONMENTAL CONTROLS AND ENERGY MANAGEMENT SYSTEMS COMMISSIONING

PART 1 – GENERAL

1.01 SUMMARY

- A. Section Includes:
 - 1. General requirements for the Commissioning (Cx) of the Environmental Controls and Energy Management System (ECEMS), and interfacing with other systems such as, lighting controls and HVAC systems interconnection, including installation, start-up, testing and documentation according to Construction Documents and Commissioning Plan (CxP).
 - 2. Standard procedures for the execution of commissioning work shall be in conformance with Division 01, Section 01 91 13: General Commissioning Requirements. Coordinate work with the Commissioning Services Provider (CxSP).
- B. Related Requirements:
 - 1. Division 01: General Requirements.
 - 2. Section 01 45 23: Testing and Inspection.
 - 3. Section 01 77 00: Contract Closeout.
 - 4. Section 01 79 00: Maintenance and Operations Staff Demonstration and Training.
 - 5. Section 01 91 13: General Commissioning Requirements.
 - 6. Section 23 05 00: Common Work Results for HVAC.
 - 7. Section 23 05 13: Basic HVAC Materials and Methods.
 - 8. Section 23 08 00: HVAC Systems Commissioning.
 - 9. Section 23 09 00: Instrumentation and Controls.
 - 10. Section 23 09 23: Environmental Controls and Energy Management Systems.
 - 11. Section 23 30 00: Air Distribution.
 - 12. Section 23 38 18: Kitchen Ventilation System.
 - 13. Section 23 80 00: Heating, Ventilating and Air Conditioning Equipment.
 - 14. Section 26 05 00: Common Work Results for Electrical.
 - 15. Section 26 05 13: Basic Electrical Materials and Methods.
 - 16. Section 26 05 19: Low Voltage Wires (600 Volt AC).
 - 17. Section 26 05 26: Grounding and Bonding.
 - 18. Section 26 05 86: Motors and Drives.

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- 19. Section 26 08 00: Electrical Systems Commissioning.
- 20. Section 26 24 19: Motor Control Centers and Motor Control Devices.
- 21. Section 26 29 13: Adjustable Frequency Drives.
- 22. Project Commissioning Plan.

1.02 REFERENCES

- A. The latest version of applicable codes, standards, and references: Inspections and tests shall be in accordance with the following applicable codes and standards, except as provided otherwise herein:
 - 1. National Electrical Manufacturers Association NEMA.
 - 2. American Society for Testing and Materials ASTM.
 - 3. American National Standards Institute ANSI.
 - 4. California Electrical Code CEC.
 - 5. Occupational Safety and Health Administration OSHA.
 - 6. National Institute of Standards and Technology NIST.
 - 7. American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE). – Building Management and Energy Management Systems Commissioning, ASHRAE Guideline.
 - 8. California Building Code CBC.
 - 9. California Mechanical Code CMC.
 - 10. InterNational Electrical Testing Association (NETA) Acceptance Testing.

1.03 SUBMITTALS

- A. Submittals shall include the following:
 - 1. Required Cx submittals in accordance with Division 01 Specifications.
 - 2. Copy of the Architect's reviewed and accepted submittals to the CxSP via the OAR.
 - 3. List of team members who will represent the CONTRACTOR in the Prefunctional and Functional Performance Testing, at least two weeks prior to the start of Pre-functional Equipment Checks.
 - 4. Detailed manufacturer installation and start-up, operating, troubleshooting and maintenance procedures, checklist documentation and field checklist forms to be used by factory or field technicians, and a copy of full details of OWNER-contracted tests, full factory testing reports, if any, and Warranty information, including responsibilities of OWNER to keep Warranty in force, clearly defined.
 - 5. Detailed manufacturer's recommended procedures and schedules for Pre-functional Equipment Checks, supplemented by CONTRACTOR's



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specific procedures, and Functional Performance Tests, at least four weeks prior to the start of Pre-functional Performance Tests.

- 6. System logic documentation and sequence of operations for review and approval.
- 7. Provide Level 1 passwords.
- 8. After facility's commission is complete, submit completed Pre-functional Equipment Checklists and Functional Performance Test checklists organized by system and by subsystem. Bind information in a single package. The results of failed tests shall be included along with a description of the corrective actions taken.

1.04 MEETINGS, SEQUENCING AND SCHEDULING

- A. Meetings: Attend Cx meetings as required under Section 01 91 13, any other related Sections and the CxP.
- B. Sequencing and Scheduling: The work described in this Section shall begin only after work required in related Division 23 and 26 Sections have been successfully completed, and tests, inspection reports and Operation & Maintenance manuals required have been submitted and reviewed. The start-up and Pre-functional Equipment Checklists shall be completed and submitted to the OWNER's Authorized Representative (OAR) prior to the Functional Performance Tests.
 - 1. Coordinate electrical work with the work of other trades prior to scheduling of any Cx procedures.
 - 2. Coordinate the completion of electrical testing, inspection, and calibration prior to start of Cx activities.
 - 3. Cx activities shall be scheduled in accordance with project's Section 01 91 13 and Cx plan.
- 1.05 QUALITY CONTROL
 - A. Comply with OWNER's Quality Control Specifications.
 - B. Incorporate manufacturer's recommended Cx procedures for the systems and equipment to be commissioned under this Section.
 - C. Typical quality control procedures include but are not limited to the following:
 - 1. Attend CxSP progress and coordination meetings.
 - 2. Establish trend logs of system schedules as required in Section 23 09 23.
 - 3. Demonstrate system operation and compliance with contract documents.
 - 4. Manipulate systems and equipment to facilitate testing.
 - 5. Provide instrumentation necessary for verification and performance testing.
 - D. Provide ECEMS technician(s) to work at the direction of the CxSP for software optimization assistance for a minimum of 8 hours. Refer to Part 3 for a description of the software optimization.

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- E. Compensation for Retesting: Compensate OWNER for site time necessitated by incompleteness of systems or equipment at time of Functional Performance Testing (FPT). Testing failures, which require on-site time for retesting, will be considered actual damages to the OWNER. Parties under contract with the OWNER who are affected by the retesting shall be included in the contract modification.
- F. Allow sufficient time before final commissioning dates to complete electrical testing, inspection, and calibration to avoid delays in the commissioning process.
- G. During the commissioning activities, provide labor and materials to make corrections when required, without undue delay.

1.06 COORDINATION

- A. Coordinate the completion of electrical testing, inspection, programming and calibration prior to start of commissioning activities.
- B. Coordinate factory field-testing per the requirements of this Section.
- C. Coordinate commissioning efforts with CxSP prior to commencing any activities.

PART 2 – PRODUCTS

2.01 TEST EQUIPMENT

- A. Equipment to be used in the commissioning process shall meet the following requirements.
 - 1. Provide test equipment as necessary for start-up and commissioning of the EMS system.
 - 2. Provide testing equipment and accessories that are free of defects and are certified for use.
 - 3. Provide testing equipment with current calibration labels as per NIST Standards; Equipment shall be calibrated on the manufacturer's recommended intervals with calibration tags affixed to the instrument. In the absence of calibration tags, calibration documentation shall be submitted to the CxSP at least thirty days prior to use; this documentation shall include description and serial number of instrument and calibration date and time.
 - 4. Testing equipment shall be maintained in good operating condition for the duration of the project.
 - 5. Testing equipment shall be UL Listed.
- B. Instrumentation required to verify readings and test the system and equipment performance shall be provided by the CONTRACTOR and made available to CxSP. Generally, no testing equipment will be required beyond that required to perform CONTRACTOR's work under contract documents.

2.02 TESTING AND AIR BALANCING AND COMMISSIONING

A. Provide a portable operator's terminal or hand-held device to facilitate testing, adjusting, and calibration of controls. This device shall support functions and

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allow querying and editing of parameters required for proper calibration and start up.

B. Connections shall be provided local to the device being calibrated. For instance, for VAV boxes, connection of the operator's terminal shall be either at the sensor or at the terminal box. Otherwise, a wireless system shall be provided to facilitate this local functionality.

PART 3 – EXECUTION

3.01 COMMISSIONING PROCESS REQUIREMENTS

- A. Work prior to commissioning:
 - 1. Complete phases of the work so the system(s) can be started, tested, adjusted, balanced, and otherwise commissioned.
 - 2. If contractual modifications are required to bring the system(s) to acceptance levels, such modifications shall be made at no additional cost to the OWNER.
 - 3. Normal start-up services required to bring each system into full operational state:
 - a. Testing, motor rotation check, control sequences of operation, full and part load performance.
 - b. Commissioning will not start until each system is complete and start-up has been performed.
- B. Pre-Commissioning responsibilities:
 - 1. Inspection, calibration and testing of the equipment required to commission the following systems:
 - a. Environmental Controls and Energy Management Systems.
 - b. Interface and connections of EMS system with lighting controls, electric utility meter, gas meter, photo voltaic system, or as otherwise indicated in contract documents.
- C. Commissioning Process Requirements:
 - 1. Refer to Section 01 91 13: General Commissioning Requirements and related Sections for information on meetings, start-up plans, Functional Performance Testing (FPT), operations and maintenance data, training requirements, and other Commissioning activities.

3.02 PREPARATION

- A. Provide certified EMS technicians as required, with tools and equipment necessary to perform Cx activities specified.
- B. Provide certified testing agency personnel and equipment factory representatives as required in the Cx plan and other related Sections.

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- C. Verify that work required in this Section and in Section 01 91 13 is complete prior to starting of FPT.
- D. Verify that complete operational manuals have been reviewed and accepted by the CxSP as specified before starting FPT.

3.03 START-UP, TESTING, ADJUSTING, AND CALIBRATION

- A. Work or systems installed shall be fully functioning prior to Demonstration and Acceptance Phase. Start, test, adjust, and calibrate work as described below:
 - 1. Inspect the installation of devices. Review the manufacturer's installation instructions and validate that the device is installed in accordance with them.
 - 2. Verify proper electrical voltages and amperages and verify that circuits are free from faults.
 - 3. Verify integrity/safety of electrical connections.
 - 4. For AHUs that use a throttled outside air damper position when minimum outside air is required, mark the minimum outside air damper position.
 - 5. Coordinate with testing and air balance (TAB) subCONTRACTOR to obtain, Cx and fine-tune control settings that are determined from balancing procedures. Record the following control settings as obtained from TAB CONTRACTOR, and note any TAB deficiencies in the ECEMS Start-up report:
 - a. Optimum duct static pressure setpoints for VAV air handling units.
 - b. Minimum outside air damper settings for air handling units.
 - c. Optimum differential pressure setpoints for variable speed pumping systems.
 - d. Calibration parameters for flow control devices such as VAV boxes and flow measuring stations.
 - 6. Test, calibrate, and set digital and analog sensing and actuating devices. Test equipment shall be 50 percent more accurate that the filed device over the same range. Calibrate each instrumentation device by making a comparison between the ECEMS display and the reading at the device. (e.g., if field device is plus or minus 0.5 percent accurate, test equipment shall be plus or minus 0.25 percent accurate over the same range). Record the measured value and displayed value for each device in the ECEMS start-up report.
 - 7. Check and set zero and span adjustments for transducers and transmitters.
 - 8. Dampers and Valves:
 - a. Check for adequate installation including free travel throughout range and adequate seal.

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- b. Where loops are sequenced, check for proper control with overlap.
- 9. Actuators:
 - a. Check to ensure that device seals tightly when the appropriate signal is applied to the operator.
 - b. Check for appropriate fail position, and that the stroke and range is as required.
- 10. Check each digital control point by making a comparison between the control command at the central command unit and the status of the controlled device. Check each digital input point by making a comparison of the state of the sensing device and the ECEMS display. Record the results for each devise in the ECEMS start-up report.
- 11. For outputs to reset other manufacturer's devices (for example, VSDs) and for feedback from them, calibrate ranges to establish proper parameters. Coordinate with representative of the respective manufacturer and obtain their approval of the installation.
- 12. Verify proper sequences by using the checklists to record results and submit with ECEMS start-up report. Verify proper sequence and operation of specified functions.
- 13. Verify that safety devices trip at appropriate conditions. Adjust setpoints accordingly.
- 14. Tune control loops to obtain the fastest stable response without hunting, offset or overshoot. Record tuning parameters and response test results for each control loop in the ECEMS start-up report. Except from a startup, maximum allowable variance from setpoint for controlled variables under normal load fluctuations shall be as follows. Within 3 minutes of any upset (for which the system has the capability to respond) in the control loop, tolerances shall be maintained (exceptions noted):
 - a. Duct air temperature: plus or minus 1-degree F.
 - b. Space temperature: plus or minus 2-degrees F.
 - c. Hot water temperature: plus or minus 3-degrees F
 - d. Duct pressure: plus or minus 0.25 inches w.g.
 - e. Water pressure: plus or minus 1 psid.
 - f. Air flow control: plus or minus 5 percent of setpoint velocity.
 - g. Space pressurization: plus or minus 0.05 inches w.g.
- 15. For interface and DDC control panels:



- a. Ensure devices are properly installed with adequate clearance for maintenance and with clear labels in accordance with the record drawings.
- b. Ensure that terminations are safe, secure and labeled in accordance with the record drawings.
- c. Check power supplies for proper voltage ranges and loading.
- d. Ensure that wiring and tubing are run in a neat and workman-like manner, either bound or enclosed in trough.
- e. Check for adequate signal strength on communication networks.
- f. Check for standalone performance of controllers by disconnecting the controller from the LAN. Verify that the controlling LAN reconfigures as specified in the event of a LAN disconnection.
- g. Ensure that outputs and devices fail to their proper positions/states.
- h. Ensure that buffered or volatile information is held through power outage.
- i. With system and communications operating normally, sample and record update/annunciation times for critical alarms fed from the panel to the Operator Interface.
- j. Check for adequate grounding of DDC panels and devices.
- 16. Operator Interfaces:
 - a. Verify that elements on the graphics are functional and are properly bound to physical devices or virtual points, and that hot links or page jumps are functional and logical.
 - b. Output specified ECEMS reports for review and approval.
 - c. Verify that the alarm printing and logging is functional and per requirements.
 - d. Verify that trends are archiving to disk and provide a sample to the CxSP and OWNER for review.
 - e. Verify that e-mail alarm annunciation is functional.
 - f. Verify that functionality of remote operator interfaces.
 - g. Verify that required third party software applications required with the bid are installed and are functional.
 - h. Verify proper interface with fire alarm, lighting control system, photo voltaic system, gas and electrical meters.
- B. Submit start-up test report: Report shall be completed, submitted, and reviewed prior to Substantial Completion.

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3.04 SENSOR CHECKOUT AND CALIBRATION

- A. General Checkout: Verify that sensor locations are appropriate and are away from causes of erratic operation. Verify that sensor with shielded cable are grounded only at one end.
- B. Calibration: Calibrate sensors using one of the following procedures:
 - 1. Sensors Without Transmitters Standard Application: Make a reading with a calibrated test instrument within 6 inches of the site sensor at various points across the range. Verify that the sensor reading (via the permanent thermostat, gage, or ECEMS) is within the tolerances specified for the sensor. Where sensors are subject to wide variations in the sensed variable, calibrate sensor within the highest and lowest 20 percent for the expected range.
- C. Sensor Tolerance: Sensors shall be within the tolerances specified for the device.
- 3.05 COIL VALVE LEAK CHECK
 - A. Verify proper close off of the valves. Ensure that valve seats properly by simulating the maximum anticipated pressure difference across the circuit. Calibrate air temperature sensor on each side of coil to be within 0.5 degrees F of each other. Via the Operator Interface, command the valve to close. Energize fans. After five minutes observe air temperature difference across coil. If a temperature difference is indicated, and the piping surface temperature entering the coil is within 3 degrees F of the water supply temperature, leakage is probably occurring. If it appears that it is occurring, close the isolation valve to the coil to ensure the conditions change. If they do, this validates that the valve is not closing. Remedy the condition by adjusting the stroke and range, increasing the actuator size/torque, replacing the seat, or replacing the valve as applicable.

3.06 VALVE STROKE SETUP AND CHECK

- A. For valve and actuator positions check, verify the actual position against the ECEMS display.
- B. Set pumps to normal operating mode. Command valve closed, verify that valve is closed, and adjust output zero signal as required. Command valve open, verify position is full open and adjust output signal as required. Command the valve to various few intermediate positions. If actual valve position does not reasonably correspond, replace actuator.

3.07 ECEMS DEMONSTRATION

A. Demonstrate the operation of the ECEMS hardware, software, and related components and systems to the satisfaction of the CxSP and OWNER. Schedule the demonstration with the OWNER's representative two weeks in advance. Demonstration shall not be scheduled until hardware and software submittals and the start-up test report are reviewed. If the work fails to be

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demonstrated to conform with contract specifications, so as to require scheduling of additional site visits by the CxSP and OWNER's representative for redemonstration, reimburse OWNER for reasonable local costs of subsequent CxSP site visits as detailed elsewhere in these specifications.

- B. Supply personnel and equipment for the demonstration, including, but not limited to, instruments, ladders, etcetera. Contractor-supplied personnel shall be competent with and knowledgeable of project-specific hardware, software, and the HVAC systems. Training documentation and submittals shall be at the job site.
- C. Demonstration shall typically involve small representative samples of systems and equipment randomly selected by the OWNER and CxSP.
- D. The system shall be demonstrated following the same procedures used in the start-up test by using the Commissioning checklist. Demonstration shall include, but not necessarily be limed to, the following:
 - 1. Demonstrate that required software is installed on ECEMS workstations. Demonstrate that graphic screens, alarms, trends, and reports are installed as submitted. Demonstrate directory structure and file system matches that submitted.
 - 2. Demonstrate that points specified and shown can be interrogated or commanded (as applicable) from workstations, as specified, in less than the maximum response time.
 - 3. Demonstrate correct calibration of input/output devices using the same methods specified for the start-up tests. A maximum of 10 percent of I/O points shall be selected at random by the CxSP or OWNER for demonstration. Upon failure of any device to meet the specified end-to-end accuracy, an additional 10 percent of I/O points shall be selected at random by CxSP for demonstration. This process shall be repeated until 100 percent of randomly selected I/O points have been demonstrated to meet specified end-to-end accuracy.
 - 4. Demonstrate that DDC and other software programs exist at respective field panels. The DDC programming and point database shall be as submitted.
 - 5. Demonstrate that DDC programs accomplish the specified sequences of operation including failure sequences.
 - 6. Demonstrate that the panels automatically recover from power failure, as specified. Demonstrate alarms as specified.
 - 7. Demonstrate that the stand-alone operation of panels meets the requirements of these Specifications. Demonstrate that the panels' response to LAN communication failures meets the requirements of these Specifications.
 - 8. Identify access to equipment selected by CxSP or by the OWNER. Demonstrate that access is sufficient to perform required maintenance.

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- 9. Demonstrate that required trend graphs and trend logs are set up per the requirements. Provide a sample of the data archive. Indicate the file names and locations.
- E. ECEMS demonstration shall be completed and prior to Substantial Completion.
- F. Tests successfully completed during the demonstration will be recorded as passed for the Functional Performance Testing (FPT) and will not have to be retested.

3.08 RESOLUTION OF DEFICIENCIES

- A. Maladjustments, misapplied equipment, or deficient CONTRACTOR's performance may result in additional work being required for Cx acceptance.
 - 1. Perform work required to correct the installations not meeting contract requirements at no additional cost to the OWNER.
- B. Corrective work shall be completed in a timely manner to permit completion of the Cx process.
 - 1. Refer to Article 3.07 above, Section 01 91 13, and Cx plan for retesting requirements necessary to achieve required system performance.
 - 2. If the system's Cx deadline, as defined in the CxP, goes beyond the scheduled completion of Cx without resolution of the problem, the OWNER reserves the right to obtain supplementary services or equipment to resolve the problem.

3.09 ECEMS ACCEPTANCE PERIOD

- A. After approval of the ECEMS demonstration and prior to contract close-out acceptance phase shall commence. Acceptance period shall not be scheduled until HVAC systems are in operation and have been accepted, required cleaning and lubrication has been completed (i.e., filters changed, piping flushed, strainers cleaned, and the like), and Testing and Balancing report has been submitted and reviewed. Acceptance Period and its approval will be performed on a system-by-system basis if mutually agreed upon by the CONTRACTOR and the OWNER.
- B. Operational Test: At the beginning of the Acceptance Phase, the system shall operate properly for two weeks without malfunction, without alarm caused by control action or device failure, and with smooth and stable control of systems and equipment in conformance with these specifications. At the end of the two weeks, forward the trend logs to the CxSP for review and acceptance. CxSP shall determine is the system is ready for Functional Performance Testing (FPT) and document any problems requiring CONTRACTOR attention.
 - 1. If the systems are not ready for Functional Performance Testing (FPT), correct problems and provide notification to the OWNER's representative that problems have been corrected. The acceptance period shall be restarted at the mutually scheduled time for an additional one-week period. This process shall be repeated until CxSP issues notice that the ECEMS is ready for Functional Performance Testing (FPT).
- C. During the acceptance period, maintain a hard copy log of alarms generated by the ECEMS. For each alarm received, diagnose the cause of the alarm, and list

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on the log for each alarm the diagnosed cause of the alarm, and the corrective action taken.

3.10 TREND LOGS

A. Configure and analyze trends required under Section 23 09 23.

3.11 TREND GRAPHS

- A. Trend graphs as specified in Section 23 09 23 shall generally be used during the acceptance phase to facilitate and document testing. Prepare controller and workstation software to display graphical format trends during the acceptance period. Trend graphs shall demonstrate compliance with contract documents.
- B. Each graph shall be clearly labeled wit HVAC subsystem title, date, and times.

3.12 WARRANTY PHASE

A. Trending: Throughout the Warranty phase, trend logs shall be maintained as required for the acceptance period. Forward archive trend logs to the CxSP and OWNER for review. CxSP or OWNER will review these and notify CONTRACTOR of Warranty work required.

3.13 SOFTWARE OPTIMIZATION ASSISTANCE

- A. Provide the services of an ECEMS technician at the project site to be at the disposal of the CxSP and OWNER. The technician is to make changes, enhancements, and additions to control unit or workstation software that has been identified by the CxSP or OWNER during the Construction and Commissioning of the project and that are beyond the specified contract requirements. The cost for this service to include a total of 40 hour will be included with the bid. Request for assistance shall be for contiguous or non-contiguous 8-hour days, unless otherwise mutually agreed upon by the CONTRACTOR, CxSP, and OAR. The OWNER Authorized Representative (OAR) shall notify CONTRACTOR two days in advance of each day of requested assistance.
 - B. The ECEMS technician provided shall be trained in the programming and operation of the controller and workstation software. If the ECEMS technician provided cannot perform every software task requested by the CxSP or OWNER in a timely fashion, provide additional qualified personnel at the project site as requested by the CxSP or OWNER.

END OF SECTION

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SECTION 23 09 23 - ENVIRONMENTAL CONTROLS AND ENERGY MANAGEMENT SYSTEMS

PART 1 – GENERAL

1.01 SUMMARY

- A. Section Includes: Environmental controls and energy management systems, including equipment, materials, installation, start-up, testing, documentation and training according to construction documents. The project drawings establish the scope of HVAC controls work in conjunction with the scope of work indicated in Section 23 0900: HVAC Instrumentation and Controls. This Section complements the requirements of Section 23 0900, and construction drawings for controls and system communications.
- B. Related Requirements:
 - 1. Division 01: General Requirements.
 - 2. Section 01 45 23: Testing and Inspection.
 - 3. Section 01 79 00: Maintenance and Operations Staff Demonstration and Training.
 - 4. Section 01 91 13: General Commissioning Requirements.
 - 5. Section 21 13 13: Fire-Suppression Sprinkler Systems.
 - 6. Section 23 05 00: Common Work Results for HVAC.
 - 7. Section 23 05 13: Basic HVAC Materials and Methods.
 - 8. Section 23 08 00: HVAC Systems Commissioning.
 - 9. Section 23 08 13: Environmental Controls and Energy Management Systems Commissioning.
 - 10. Section 23 30 00: Air Distribution.
 - 11. Section 23 38 13: Kitchen Ventilation System.
 - 12. Section 23 80 00: Heating, Ventilating and Air Conditioning Equipment.

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- 13. Section 26 05 00: Common Work Results for Electrical.
- 14. Section 26 05 13: Basic Electrical Materials and Methods.
- 15. Section 26 05 19: Low-Voltage Wires (600 Volt AC).
- 16. Section 26 05 26: Grounding and Bonding.
- 17. Section 26 09 23: Lighting Control Systems.
- 18. Section 28 31 49: Carbon Monoxide Detection and Alarm Systems.
- 19. Section 27 01 26: Test and Acceptance Requirements for Structured Cabling
- 20. Section 27 10 13: Structured Cabling (Existing Site)
- 21. Section 28 31 49: Carbon Monoxide Detection and Alarm Systems.
- 22. Project Commissioning Plan (CxP).

1.02 REFERENCES

- A. The latest version of applicable codes, standards, and references. Inspections and tests shall be in accordance with the following applicable codes and standards, except as provided otherwise herein.
 - 1. International Electrical Testing Association NETA.
 - 2. National Electrical Manufacturers Association NEMA.
 - 3. American Society for Testing and Materials ASTM.
 - 4. Institute of Electrical and Electronics Engineers IEEE.
 - 5. American National Standards Institute ANSI.
 - 6. National Electrical Safety Code NESC.
 - 7. California Building Code CBC.
 - 8. California Electrical Code CEC.
 - 9. California Mechanical Code CMC.
 - 10. Insulated Cables Engineers Association ICEA.
 - 11. Occupational Safety and Health Administration OSHA.

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- 12. National Institute of Standards and Technology NIST.
- 13. National Fire Protection Association NFPA.
- 14. American Society of Heating, Refrigerating, and Air-Conditioning Engineers ASHRAE (The HVAC Commissioning Process, ASHRAE Guideline).
- 15. International Building Code IBC.
- 16. International Mechanical Code IMC.
- 17. InterNational Electrical Testing Association (NETA) Acceptance Testing.

1.03 SUBMITTALS

- A. Provide in accordance with Division 01 and Section 23 0500: Common Work Results for HVAC.
- B. Shop Drawings shall include but not limited to:
 - 1. Cover page with legend, common notes, symbol schedule, and drawing index.
 - 2. Complete point to point environmental controls and energy management network communication diagram(s) for Direct Digital Controls (DDC) of each system:
 - a. Identify all components.
 - b. Indicate conduit and wire characteristics, sizes and quantities.
 - c. Provide bill of materials.
 - 3. Floor plans showing control panels and intercommunication wiring.
 - a. Show system(s) interface connections.
 - 4. Valve Schedules where required.
 - 5. Operations and Maintenance Manuals.
 - 6. As-built submittal drawings.
 - 7. Installation Instructions of each control device.
 - 8. PC Workstation.

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- 9. Software flow diagram of each unique system sequence of operation.
- 10. Software licenses and electronic keys.
- 11. Supplemental local or factory training schedule for post warranty support.
- 12. A complete list of recommended spare parts with pricing for the OWNER's use in keeping the environmental control system downtime to a minimum.
- 13. Composite CD-ROM with AutoCAD drawings in a ".dwg" format.

1.04 QUALITY CONTROL

- A. CONTRACTOR shall have adequate experience installing systems of similar size and complexity with the control product line proposed for this project.
 - 1. Qualifications of Installer: Minimum five years experience installing products and systems of similar scope and complexity.
 - 2. Installer shall submit certification from the equipment manufacturer indicating that installer is an authorized representative of the equipment manufacturer and is trained on network applications.
 - 3. Installer shall maintain a fully equipped service organization capable of furnishing repair service to the equipment and shall maintain a spare set of major parts for the system at all times.
 - 4. Installer shall furnish a letter from manufacturer of equipment certifying equipment has been installed according to factory standards and that system is operating properly.
 - 5. CONTRACTOR shall have participated in the commissioning of a minimum of 10 projects of similar magnitude to those needed for this project.
 - 6. System startup and testing shall be performed under the direct observation of the Project Inspector and OAR.
- B. Materials and equipment installed shall be new.
- C. System installation shall not begin until Shop Drawings are submitted and reviewed by the Architect or Engineer of Record.
- D. Components for Direct Digital Control (DDC) shall comply with ASHRAE standards.
- E. The installer shall provide the system components required by code and for the life safety of the service personnel.



- F. System shall be able to interface with open protocol BACnet systems.
- G. Provide all ancillary components for the system to perform the required sequence of operations. Install, test and adjust the system accordingly.
- H. System components shall operate per industry standards. The standards shall be as defined by ASHRAE, SMACNA, AABC, NEBB, TABB, and the literature of the manufacturers listed in this Section.
- I. Provide field engineering tools including software and hardware needed for programing and/or modifying system controller and devices.

1.05 WARRANTY

- A. Components, system hardware and software, and parts and labor shall be guaranteed against defects in materials, fabrication, and execution for three years from date of system acceptance. Provide labor and materials to repair, reprogram, or replace defective components at no charge to the OWNER during the warranty period.
- B. Provide a list of applicable warranties for equipment and components, this list shall include warranty information, names, addresses, telephone numbers, and procedures for filing a claim and obtaining warranty services.
- C. CONTRACTOR shall respond to OWNER's request for warranty service within four hours of initial call to schedule a mutually agreeable time for service. Submit records of the nature of the call, the work performed, and the parts replaced or service rendered.

1.06 TRAINING

- A. Provide a competent instructor who is factory trained and has comprehensive knowledge of system components and operations to provide full instructions to designated personnel in the system operation, maintenance, and programming. Training shall be specifically oriented to installed equipment and systems.
 - 1. Provide four hours of onsite OWNER familiarization and training for the installed system. Training shall include system overview, time schedules, override commands, emergency operation, and programming and report generation. OWNER employees attending this training session shall be provided with the following documentation:
 - a. As-built drawings of System layouts and point to point connection diagrams.
 - b. System components cut sheets.

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- c. Operations and maintenance data.
- 2. Programmer and maintenance training shall include database entry; trend logs application programs, diagnostic routines, reporting, failure recovery and calibration.
 - a. Provide 24 hours of training as follows:
 - 1) Training session shall accommodate a minimum of 20 persons and be facilitated at CONTRACTOR's training facility, which should be no more than 50 miles from the Project Site.
 - a) Training shall be delivered in 6 hours per session increments.
 - b) Obtain OWNER's approval for training locations exceeding 50 miles. In such cases, the CONTRACTOR shall be responsible for transportation expenses.
 - c) CONTRACTOR shall provide training computers for all attendees. Computers shall be ready for live training sessions.
 - 2) Training shall cover instruction, theory, and expose the trainees to system's features, components, architecture, operations, programming, report generation, communications, and any other pertinent information required for the operations and maintenance of the system.
 - 3) Each training session shall have an itemized agenda covering all aspects of the training to be covered in the sessions. CONTRACTOR shall obtain agendas approval from OWNER and Commissioning Agent.
 - 3) Instructor(s) shall give the trainees the opportunity to practice on simulated and actual (installed) systems.
 - 4) The training session shall cover, but not be limited to the following instruction modules or sessions:
 - a) System Architecture:
 - (1) System layout and components interrelations and hierarchical structure.
 - (2) Controllers interfacing and functions.

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- (3) Server functionality and data management, error messages, and alarm conditions.
- (4) Connectivity and communication losses.

(5) Replacement procedures for system components.

- b) User Operations:
 - (1) Familiarization and navigation with the EMS operating System.
 - (2) Window panes, menus, navigation buttons, alarm response windows, system passwords and accessibility features and options, monitoring and managing data points (inputs, outputs, numeric values, time and date, strings).
 - (3) Views: Provide sufficient information as to train staff on how and where to access programs, functions, adjust or alter diagnostic points and related data, override messages, reports and actions taken.
- c) Trending: Setting trend(s) intervals, accessing data trends and history logs for diagnosis points or groups, and reporting. Working with trended data graphical displays, including but not limited to hiding points, setting display types and colors, viewing and setting scales.
- d) Graphics: Standard symbols and color codes, graphics customization, how and where to access and manage the system with the graphic displays, including changing points and values, using HOA switches and viewing results, mapping to or with other graphic sources and functions, including groups, navigation, sequence of operations, and displays and reports.
- e) Alarms: Reading and interpreting alarms, acknowledging and silencing alarms, routing and setting priorities, viewing and responding e-mailed and paged alarms.



PART 2 – PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

A. Environmental controls and energy management systems shall be approved products of Carrier i-Vu.

2.02 SYSTEM ARCHITECTURE

- A. The system shall be capable of providing a peer-to-peer network of distributed standalone DDC controllers that meet ANSI/ASHRAE Standard 135 for open protocol communications.
- B. A maximum of 32 controllers shall be connected to any one MS/TP bus. Minimum Speed of 38kb and can support 127 devices per COM port. Provide a minimum of 2 ports.
 - 1. Provide a Building Automation System (BAS) that consists of Network Server/Controllers (NSCs), a family of Standalone Digital Control Units (SDCUs), Administration and Programming Workstations (APWs), and Webbased Operator Workstations (WOWs). The BAS shall provide control, alarm detection, scheduling, reporting and information management for the entire facility, WEB enable capabilities, and Wide Area Network (WAN).
 - 2. The Enterprise Level BAS shall consist of an Enterprise Server, which enables multiple NSCs (including all graphics, alarms, schedules, trends, programming, and configuration) to be accessible from a single Workstation simultaneously for operations and engineering tasks. The Enterprise Level BAS shall be able to host up to 250 servers, or NSCs, beneath it.
 - 3. For Enterprise and robust reporting capability outside of the trend chart and listing ability of the Workstation, a Reports Server shall be provided and installed on a Microsoft Windows based computer. The Reports Server can be installed on the same computer as the Enterprise Server.
 - 4. The system shall be a top-level 100/1000bT Ethernet network that utilizes BACnet/IP with IP field Controllers.
 - a. A sub-network of SDCUs using the BACnet MS/TP protocol shall connect the local, and stand-alone controllers with Ethernet-level Network Server Controllers/IP Routers.
 - 5. The system shall match the existing LonWorks IP, and/or Modbus TCP protocol.



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- a. Integration to existing Modbus RTU/ASCII (and J-bus), Modbus TCP, LonTalk FTT-10A, and Web Services shall be native to the NSCs. There shall not be a need to provide multiple NSCs or additional software to allow all three protocols to be natively supported.
- b. A sub-network of SDCUs using LonTalk FTT-10A, and/or Modbus RTU protocol shall connect the local, stand-alone controllers with Ethernet-level Network Server Controllers/IP Routers.
- C. Only systems that use HTML 5 structured language are allowed.
- D. The supplied computer software shall employ object-oriented technology (OOT) for representation of data and control devices within the system. For each global, system or unitary controller, provide a PICS document showing the installed device's compliance level. Minimum compliance is Level 3 with the ability to support data read and write functionality.
- E. Maximum acceptable response time from any alarm occurrence (at the point of origin) to the point of annunciation shall not exceed three seconds for network connected controllers or user interfaces.
 - 1. For each system point, alarms can be created based on high/low limits or in comparison to other point values.
 - 2. There is no limit to the number of alarms that can be created or stored in system hardware for any point, up to the system capacity.
 - 3. System shall generate configured alarms from single or multiple system conditions.
 - 4. Alarms will be generated from an evaluation of the alarm condition, and presented to the user in a fully configurable order, by priority, time, and category,
 - a. Alarm views shall be presented to the user upon logging into the system WorkStation and/or Webstation.
 - 5. Program the alarm management system to create and report alarm events history; the alarm events history data base shall provide the option to select alarm cause and action notes associated with an alarm event. The alarm management system shall also generate checklists for operators' use when utilizing a suggested mode of troubleshooting.



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- 6. Provide alarm event history for a feature use to permit assigning of events for resolution to OWNER staff. The system shall notify the user and assigned resolution personnel.
- 7. Alarms shall be capable of being routed to any BACnet workstation that conforms to the B-OWS device profile and uses the BACnet/IP protocol.
- F. The system shall be able to interface with subsystems that utilize ANSI/CEA-709.1: Control Network Protocol Specification.

2.03 EMS SERVER AND USER INTERFACE WORKSTATION

- A. EMS Server: The EMS Server shall include a tower or rack mounted server with an Intel Xeon E5 2600 processor, 8 Gb RAM, RAID 1 configuration with two hot swap 2TB 7200 RPM SATA drive, DVDRW drive, keyboard, mouse, 27 inch LCD color display and the latest version of Microsoft Windows Server operating system software. The workstation shall connect to the network through an internal 1Gbps Ethernet interface card.
 - 1. Software licensing shall be provided for local or remote unlimited simultaneous users of the system, unlimited future point expansion, user graphical display generation and non-vendor controllers. Licenses and electronic keys shall be included with the M&O manuals for project acceptance. Conditional Licenses will not be acceptable.
 - 2. The system shall be programmed to email selected alarms to designated response personnel.
 - a. The ability to utilize email paging of alarms shall be a standard feature of the operating system's mail application interface (MAPI). No special software and no email client software must be running in order for the system to distribute emails.
 - b. The email notification shall be able to be sent to an individual user or a user group.
 - c. The NSC shall support the use of Web Services based on open standards, such as SOAP and REST. Use incoming third-party data (temperature forecast, energy cost) over the Web to determine site modes, scheduling, and programming.
 - 3. Web-based operation shall be supported directly by the NSCs and shall not require additional software.



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- 4. The supplied system shall incorporate the ability to access all data using HTML5 enabled browsers without requiring proprietary operator interface and configuration programs.
- 5. Programming of SDCUs shall be capable of being done either off-line or online from any operator workstation. All information shall be available in graphic or text displays stored at the NSC. Graphic displays shall feature animation effects to enhance the presentation of the data, to alert operators of problems, and to facilitate location of information throughout the DDC system. All operator functions shall be selectable through a mouse.
- 6. Programming in the NSC shall be either in graphical block format or lineprogramming format or both.
- 7. Programming of the NSC shall be available offline from system prior to deployment into the field. All engineering tasks shall be possible, except the viewing of live tasks or values.
- 8. The programmer's environment shall include access to a superset of the same programming language supported in the SDCUs.
- 9. Provided NSC devices shall support both script programming language as well as the graphical function block programming language. For both languages, the programmer will be able to configure application software for custom program development, and write global control programs. Both languages will have debugging capabilities in their editors.
- 10. The system shall be able to save custom programs as libraries for reuse throughout the system. A wizard tool shall be available for loading programs from a library file in the program editor.
- 11. The system shall be capable providing views of graphical programming in live and real-time from Workstation(s).
- 12. The system shall be capable of creating 'binding templates' allowing the user to bind multiple points to multiple objects all at once.
- 13. Automatic detecting zone that may be excessively driving the reset logic and generate an alarm.
- 14. Readily allow operator removal of zones from reset algorithm.
- 15. Applications shall be able to be assigned different priorities and cycle times for a prioritized execution of different function.



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- 16. The provided system shall be able to create objects that allow common objects such as power meters, VFD drives, etc. to be integrated into the system with simple import actions without the need of complicated programming or configuration setups.
- 17. The BAS workstation software shall allow the creation of a custom, browserstyle interface linked to the user when logging into any workstation. Additionally, it shall be possible to create customized workspaces that can be assigned to user groups. This interface shall support the creation of "hotspots" that the user may link to view/edit any object in the system or run any object editor or configuration tool contained in the software. Furthermore, this interface shall be able to be configured to become a user's "PC Desktop" – with all the links that a user needs to run other applications. This, along with the Windows user security capabilities, shall enable a system administrator to setup workstation accounts that not only limit the capabilities of the user within the BAS software, but may also limit what a user can do on the PC and/or LAN/WAN. This might be used to ensure, for example, that the user of an alarm monitoring workstation is unable to shut down the active alarm viewer and/or unable to load software onto the PC.
- 18. The workstation software shall automatically log and timestamp every operation that a user performs at a workstation, from logging on and off a workstation to changing a point value, modifying a program, enabling/disabling an object, viewing a graphic display, running a report, modifying a schedule, etc.
- 19. Provide a Web Server to automatically convert system displays on the workstation to an Internet page. Internet page shall be readable from standard PC browsers. Acceptable browsers shall be latest version of internet explorer, Chrome, or Firefox. No additional plug-ins, programs, software, hardware, etc. shall be needed to access the Internet page. The server shall be a separate device to provide security protection for the building system from outside hackers.
 - a. Coordinate individual system components IP addresses, switch port assignments, security settings such as but not limited to SNMP alarm delivery, HTTPS/SSL settings, VLAN assignment and authorized IP address ranges with the OWNER's Information Technology Division. Coordination activities with ITD shall be executed through the OAR.
 - b. Provide IP address label on the interior of each cabinet door or equipment.
 - c. The system shall support the ability to notify school or OWNER designated personnel by SMS or Email messages, utilizing the



OWNER's mail server when problems or situations that require immediate attention arise.

- 20. Operator Workstation shall display data associated with the project as called out on drawings or object type list supplied. Graphic files shall be created using digital, full color photographs of system installation, AutoCAD or Visio drawing files of field installation drawings and wiring diagrams from as-built drawings. Operator's workstation shall display data using three-dimensional graphic representations of mechanical equipment. System shall be capable of displaying graphic files, text, trend data and dynamic object data together on each display screen with animation of equipment operation.
- 21. Controllers shall be programmed using graphical software tools that allow connection of function blocks for visual sequencing of control logic. Function blocks shall display real time data and be animated to show status of data inputs and outputs when in real time operation. Animation shall also show change of status on logic devices and countdown of timer devices in a graphical format.
- 22. Operator Tracking Log shall record operator changes to the system for future review. This shall include, but not be limited to setpoint changes, time schedule overrides, alarm limits, etc.
- 23. The system shall be equipped with a battery back-up source capable of providing 30 minutes of operation (computer and monitor) in the absence of normal power, to allow for an orderly shutdown and data back-up.
- B. EMS Workstation: The EMS Workstation shall be an enterprise level tower with an Intel Core[™] i7 or better processor, 16GB of RAM, 256 GB solid state drive, DVD drive, keyboard, mouse, 27 inch LCD color display and the latest version of Microsoft Windows professional operating system software. The workstation shall connect to the network through an internal 1Gbps Ethernet interface card.

2.04 GLOBAL CONTROLLER

- A. Building controllers shall incorporate the functions of a 3-way BACnet router. Controller shall route BACnet messages between the high-speed LAN (Ethernet 100MHz), master slave token passing (MS/TP) LANs, a point-to-point (PTP/RS-232) connection and telephone modem.
- B. Provide global control strategies for the system based on information from any point objects in the system. Programming shall be object-oriented using graphical control function blocks. Global strategies shall include, but not limited to unit scheduling, electrical demand limiting, optimized start-stop of equipment, central plan reset control, etc.



- C. Battery shall retain static RAM memory and real-time clock functions for a minimum of 1.5 years (cumulative). Battery shall provide up to five minutes of powerless operation for orderly shutdown and data backup.
- D. Each building controller shall support a minimum of 250 BACnet Schedule Objects and 250 BACnet Calendar Objects.
- E. Each building controller shall log a minimum 1,000 trend logs. Any point object in the system (real or calculated) may be logged. Sample time interval shall be adjustable at the operator's workstation. Building controller shall periodically upload trended data to networked operator's workstation for long term archiving if desired. Archived data shall be available for use in third-party spreadsheet or database programs.
- F. Alarms may be generated within the system for any object change of value or state either real or calculated. This includes events such as analog object value changes, binary object state changes and various controller communication failures. Each alarm may be automatically dialed out to a telephone pager or emailed to any Internet PC computer.
- G. Provide a 1.5 KVA UPS with battery back-up capability to provide a minimum of 30 minutes of operation (computer and monitor) for orderly shutdown and data backup. Make connections and test the system for proper operation in the presence of the Project Inspector.
- H. The global controller shall be equipped with ADR demand limiting capacity interface.
 - 1. The system shall include 5 DI for interfacing to local utility ADR program. The 5 DI shall be located in a 24 X 24 X 6 NEMA 12 cabinet mounted in the MDF or IDF room. Upon closer of each DI the control system shall raise or lower (depend on system mode) global room temperature set point 1 degree (user adjustable).
 - 2. The system shall also include a demand-limiting program that utilizes data from site utility meter. Features indicated below shall be available via a switchable graphical user interface in all operating stations:
 - a. Shed/Restore equipment in digital format shall include 5 data input points for interface to future ADR web appliance located in an MDF/IDF room. System server shall accept ADR command from utility service via web interface, and shall include at least 5 priority levels of equipment shedding. Load shedding on a given priority level shall include two methods. In one the loads shall be shed and restored in a "first-off/first-on" mode and in the other; the loads shall be shed/restored in a linear fashion.



- b. Adjust operator selected control setpoints in analog format based on energy usage when compared to shed and restore settings.
- c. Shedding may be implemented independently on each and every zone or piece of equipment connected to the system.
- d. Status of every load shed shall be capable of being displayed on every operator terminal connected to the system. Statuses shall be displayed along with the English description of each load.
- 2.05 APPLICATION (system and unitary) DDC CONTROLLERS.
 - A. Application controllers shall include universal inputs with 10-bit resolution that accept 3K and 10K thermistors, 0 to 10VDC, 0 to 5 VDC, 4 to 20 mA and dry contact signals. Any input on a controller may be either analog or digital with a minimum of three inputs that accept pulses. Controller shall include support and modifiable programming for interface to intelligent room sensor with digital display, and set point adjustment and override button. Controller shall include binary and analog outputs on board. Analog outputs shall be switch selectable as either 0–10VDC or 0–20mA. Software shall include scaling features for analog outputs. Application controller shall include a supply voltage to power external sensors.
 - B. Program sequences shall be stored in EEPROM or flash memory. No batteries shall be needed to retain logic program. Controller shall execute program sequences 10 times per second and be capable of multiple PID loops for control of multiple devices. Calculations shall be completed using floating-point math. Programming of application controller shall be completely modifiable in the field over the installed BACnet LANs or remotely via modem interface.
 - C. CONTRACTOR shall provide a laminated wiring diagram for each control panel. Locate diagrams on interior side of control panel's doors.

2.06 TEMPERATURE SENSORS

- A. Temperature sensors shall be 10K ohm thermistor factory-calibrated to within 0.5 degrees F, totally interchangeable with housings appropriate for the application.
- B. Wall sensors shall be installed 48 inches above finished floor. Duct sensors to be installed such that the sensing element is in the main air stream. Immersion sensors to be installed in wells filled with thermal compound. Outside air sensors shall be installed away from exhaust or relief vents, not in an outside air intake and in a location that is in the shade most of the day.
- C. Intelligent room sensors shall be equipped with digital display, set point adjustment and override button. Smart room temperature sensor/thermostat shall incorporate PIR motion sensor, temperature display, set point adjustment and override button.



Acceptable Manufacturers: Schneider Electric SE8600 series, Viconics VT8600 series, Sigler 8600 series or equal.

D. Room thermostat shall be BACnet capable, Acceptable manufacturers: Schneider Electric SE8600 series, Viconics VT8600 series, Sigler VT8600 series or equal.

2.07 CARBON DIOXIDE (CO₂) SENSORS

- A. Sensors shall be wall mounted at a height of approximately 4 feet. Locate sensors adjacent to room thermostat.
- B. Sensors are not permitted on marker boards, between shelving, in recesses or above heat producing equipment.
- C. Sensors shall be furnished with a display window that provides continuous monitoring and sensor status readings, and with tamperproof cover.
- D. Sensors shall be gold plated for long-calibration stability, be factory calibrated and certified for a minimum of five years.
- E. CO₂ sensors shall be BACnet capable, acceptable manufacturers: Honeywell C7232A, Telaire Ventostat Wall Mount, Johnson Control CD-WRD-00-0, or equal.

2.08 WINDOWS AND DOOR SENSOR

A. Provide windows and door switches at every operable window and in controlled spaces. Each switch shall be connected to a DI point on the DDC controller. Each switch shall be wired independently. Wiring multiple switches in series shall not be acceptable. Acceptable Manufacturers: Illumra E3-MDCCP or equal.

2.09 HUMIDITY SENSORS

- A. The humidity sensor shall be a solid-state device that is factory calibrated to provide a linear output with an accuracy of 3.0 percent from 0 to 90 percent RH. A metal fabric filter shall protect the humidity-sensing element.
- B. Duct humidity sensors shall utilize a sampling tube enclosure that is accessible for maintenance personnel.
- C. Room and duct sensors shall incorporate a temperature sensor in the same enclosure when required.

2.10 PRESSURE SENSORS

A. Differential and pressure sensors shall have a tensioned stainless-steel diaphragm to form a variable capacitor that produces a linear output with an accuracy of 1.0



percent of full scale. The unit shall be able to withstand 10 PSIG over pressurization.

- B. Differential pressure switches shall utilize a diaphragm operated snap-acting switch with a setpoint range of 0.05 to 2.0 inches WC.
- C. Steam pressure sensors shall be mounted on a pigtail siphon with manual shutoff ball valve.

2.11 CARBON DIOXIDE (CO₂) SENSORS

- A. Carbon dioxide concentration levels shall be sensed by non-dispersive infrared technology. A corrosion-free sensing chamber shall be used for accurate, stable CO₂ sensing. An LCD shall display sensed CO₂ concentration.
- B. Sensor shall be gold plated and have a range of 0-2000 PPM at +/- 5 percent accuracy for long-term calibration stability. Both analog and binary relay output circuits shall be available on the sensor. An automatic background calibration algorithm shall reduce required maintenance.
- C. Acceptable Manufacturers: Telaire, Honeywell, Johnson Controls, or equal.

2.12 ELECTRONIC VALVES

- A. Control Valves ½ inch to 2-inch shall be characterized stainless steel ball valves with actuators sized to close off against twice the maximum fluid pressure. Valve body shall be NPT screwed for 2-way or 3-way application. A push button release shall be provided for manual operation.
- B. Control Valves 2 ½-inch and larger shall be butterfly type with actuators sized to close off against twice the maximum fluid pressure. Valve body shall be flanged for 2-way or 3-way application. Contacts shall be provided to mechanically indicate the full open and full closed position of the valve.
- C. Steam Valves shall be globe valves suitable for 35-PSI inlet steam service. Valve bodies shall be NPT screwed or flanged with spring-return normally closed valve actuators.
- D. Valve control shall be accomplish with 2-10 VDC. All valve shall provide feedback signal to EMS/BMS for monitoring on GUI.
- E. Acceptable Manufacturers: Belimo, Honeywell, Johnson Controls, Schneider Electric or equal.
- 2.13 DAMPER ACTUATORS

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- A. Electric damper actuators (including VAV box actuators) shall be direct shaft mounted and use a V-bolt and toothed V-clamp. The actuator mounting arrangement and spring return feature shall permit normally open or normally closed positions of the damper as required.
- B. Actuators shall be sized for 200 percent of the design torque requirements.
- C. Damper actuators shall incorporate a release mechanism to manually position the damper for maintenance or emergency override.
- D. Damper Actuators located outdoors shall have a clear plastic weather shield specifically designed for the application.
- E. Damper motor control shall be with 2-10 VDC
- F. Acceptable Manufacturers: Belimo, Honeywell, Johnson Controls, Schneider Electric, or equal.
- 2.14 CURRENT SWITCH
 - A. Current sensing switch shall be self-powered with solid-state circuitry and a dry contact output. A multi-turn setpoint adjustment shall set the trip point status. An LED shall indicate the on or off status.

2.15 CONTROL RELAY

A. The relay shall be contained in a plenum rated NEMA 12 enclosure with a ³/₄" NPT conduit fitting. Coil voltage shall be 24 or 120 VAC with a contact rating of 10A. An LED on the enclosure cover shall indicate the relay is energized.

2.16 POWER SUPPLIES

Power supplies and panel assemblies shall be UL or NRTL listed.

2.17 ENCLOSURES

- A. Controllers, power supplies and relays shall be mounted in Hoffman A-LP NEMA 12 enclosures or equal when located in an indoor environment.
- B. Enclosures for outdoor applications shall be metal NEMA 4, Hoffman A-ALP, A-BLP or equal, and be mounted on the north exposure of the controlled unit.
- C. Enclosures shall have hinged, locking doors with common keying (CAT-60) for control panel on the Project Site.



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D. Enclosures shall have permanently affixed to the door an engraved nametag identifying the equipment served. The nametag shall be a minimum 1 inch by 3-inch with ½ inch lettering.

PART 3 – EXECUTION

3.01 CONTROLS INSTALLATION

- A. Wiring methods for control system shall be as defined in the Division 26 specifications. Wire types shall conform to manufacturers' recommendations.
- B. Mount control panels adjacent to associated equipment on vibration-free walls or freestanding angle iron supports. One cabinet may accommodate more than one system in same equipment room. Control panel assemblies must be UL listed.
- C. Provide software and hardware required to provide controls and monitoring of diagnostic points indicated in specification Section 23 8000.
- D. Coordinate with Division 26 electrical installer so that "Hand/Off/Auto" selector switches are installed to override automatic interlock controls when switch is in the "Hand" position. Safety shutdown interlock wiring shall disable the equipment regardless of the position of the H-O-A switch.

3.02 ROOM SENSORS INSTALLATION

A. Room sensors shall be wall mounted at a 48-inch height above finished floor. Room sensors are not permitted on outside walls, at chalkboards, between shelving, in recesses or above heat producing equipment. Coordinate with Division 26 for sensor or thermostat mounting adjacent to light switches.

3.03 COORDINATION

- A. Coordinate the work with other aspects of mechanical, electrical, fire-life safety and security systems, controls, and photo voltaic systems to obtain a complete and operating system in accordance with the contract documents.
- B. Meet with the OAR and school principal and other school staff to determine when each zone or building will be occupied, and to determine programming and scheduling of the heating, ventilating and air conditioning equipment.
- C. CONTRACTOR shall contact OAR to coordinate for timely availability of VPN access point(s) form OWNER's Information Technology Division.

3.04 DDC CONTROL SYSTEM ADJUSTMENTS

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A. Make adjustments under operating conditions to provide sequence of operation for each control system per design intent. If required operating conditions cannot be obtained prior to completion date of the contract due to outdoor seasonal temperatures, return to the job site when requested by the OWNER and re-adjust control system when outdoor temperatures will permit proper operating conditions. Start re-adjustment within seven calendar days after notification.

3.05 PERFORMANCE AND ACCEPTANCE:

- A. Test and calibrate each device including but not limited to the following for proper operation, connection, signal value or response.
 - 1. Building Controllers.
 - 2. Custom Application Controllers.
 - 3. Application Specific Controllers.
 - 4. Input / Output Devices. (Sensors, actuators and monitoring devices)
 - 5. Operator Interfaces.
- B. Verify that systems are standalone and operable upon network failure.
- C. Verify that systems return to normal operation automatically upon resumption of network operation or return of power.
- D. Test each system for functions of the required control sequence of operation either by normal control operation or forced operation as required. Log and submit results.
- E. Test the network for connectivity, data transmission rates, input/output responses, and other appropriate parameters Failure modes, including network failure, individual control system failure, and power outages, shall be simulated and responses logged, with any effects on network operation noted and corrected.
- F. Test each preprogrammed time and holiday schedule.
- G. Commissioning requirements of Divisions 01, 23, and 26 apply to this Section.
- H. Schedule of Responsibilities: Refer to Appendix A. The schedule identifies the responsibilities of the CONTRACTOR for the installation of the environmental controls and energy management system. Deviations and clarifications of this schedule only if allowed by the OAR, provided trade CONTRACTOR coordination and schedule requirements are met. Submit a record copy of the Schedule of Responsibilities to the OAR at the commencement of this Section's Work.

3.06 WIRING AND INFRASTRUCTURE

A. Provide necessary wiring, terminations, connections and conduit infrastructure for the complete system as indicated in the construction documents.

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- B. Exterior cables whether above or below ground level shall be rated for exterior applications. When entering a building provide a code sized pull box with necessary hardware to transition exterior rated cables to interior applications.
- C. Underground EMS cables are permitted to be installed with lighting control wiring in underground applications. Provide innerduct to separate EMS cables from lighting control system cables.
- D. Provide both labeling and record documentation for all EMS system cabling. A cable management schedule and diagram shall be provided at each system panel or cabinet, in addition to a complete cabling diagram to be provided at the head end equipment location.
 - 1. The cable management spread file shall include the following:
 - a. Cable Schedule.
 - b. Cable Test Forms.
 - c. Cable Label sequence and nomenclature.
 - d. Network chart.
 - 2. Cable numbering shall be based on a defined format which readily identifies cable type, and allows maintenance technicians to determine originating and terminating locations.
 - 3. Present the data in an Excel spreadsheet that will operate on the latest Windows platform. Information shall be presented in paper and electronic formats.
 - 4. A copy of the cable schedule in a transparent plastic sleeve shall be affixed in the interior side of the front door of each network cabinet or cables convergence hub points.

3.07 DATA LOGGING REQUIREMENTS

- A. The system must be capable of storing the system's collected and diagnosis data for a minimum of seven days.
- B. Program the system for a standard seven day schedule including holydays.

3.08 CLEANUP

- A. Remove rubbish, debris and waste materials and legally dispose of off Project Site.
- 3.09 PROTECTION
 - A. Protect Work of this Section until Substantial Completion.

END OF SECTION

ENVIRONMENTAL CONTROLS AND

ENERGY MANAGEMENT SYSTEMS 23 09 23-21

Budlong 3361-008-000



ENVIRONMENTAL CONTROLS AND

APPENDIX A

SCHEDULE OF RESPONSIBILITIES

	ITEM	FURNIS	INSTAL	POWE	CONTRO
		Н	L	R	L
		BY	BY	BY	WIRING
1	Magnetic Motor Starters:				BY
- 1	Automatic controlled with or without HOA switches	F	F	F	
	b Manually controlled	F	F	F	N/A
	c. Manually controlled furnished as factory wired unit	M	M	Ē	Ĕ
	equipment				
	d. Special duty type (part winding, multi-speed, etc.)	М	See Note	E	See Note
	e. Adjustable frequency drives with or without manual	DDC	Ē	Е	
	bypass.				Soo Noto
	f. Domestic booster pump. Motor Controls	М	М	Е	
2	Line voltage contactors.	E	E	E	DDC
3	Control relay transformers (other than starters).	DDC	DDC	E	DDC
4	Control and Instrumentation panels	DDC	NI	E	DDC
5	Automatic control valves, automatic dampers and	DDC	М	E	DDC
	damper operators, solenoid valves, insertion				
~	temperature and pressure sensors including wells	000			000
6	towers fans and air bandling units and other	DDC	DDC	E	DDC
	miscellaneous mechanical equipment.				
7	Duct Smoke Detectors	E	М	E	E
8	Dampers				
	a. Control Dampers	М	М	N/A	DDC
	b. Smoke Dampers and Combination Fire/Smoke	М	М	E	E
	Dampers				
9	Airflow Stations with transmitter.	M	M	E	DDC
10	Air terminal devices (I.e., VAV and fan powered boxes).	M	M	E	DDC
11	Intelligent Devices and Control Units provided with	М	М	E	NI
	packaged mechanical equipment such as: Large VAV				
12	Intelligent Devices and Control Units not provided by			E	
12	lequipment manufacturer such as Air handling units		DDC	Ŀ	DDC
	Heat pumps, AC units (small < 20 tons), Air terminal				
	units (VAV boxes)				
13	Intelligent Devices and Control Units provided with	E	E	E	DDC
	electrical systems such as: Occupancy / motion sensors,				
	Multiplexing Control Units Door Entry Control Units				
14	Gateways for proprietary non-BACnet equipment	М	М	F	DDC
15	Communications network devices such as Routers	DDC	DDC	DDC	DDC
	Bridges and Repeaters.				220
Abbreviations					



DD C	DDC CONTRACTOR (controls CONTRACTOR)
Μ	Mechanical CONTRACTOR
E	Electrical CONTRACTOR
N/A	Not Applicable

Notes:

- 1. Magnetic motor starters (special duty type) shall be set in place under electrical division except when part of factory wired equipment, in which case they shall be set in place under mechanical division.
- 2. Where a remote motor disconnect is required in addition to the one provided integral to a Variable Frequency Drive (VFD), controls CONTRACTOR shall provide the necessary control interlock between the disconnects.



ENVIRONMENTAL CONTROLS AND

SECTION 23 30 00 - AIR DISTRIBUTION

PART 1 – GENERAL

1.01 SUMMARY

- A. Section Includes: Ductwork and appurtenances required for a complete air transmission and distribution system for the heating, ventilating, and air conditioning systems indicated on Drawings and as specified.
- B. Related Requirements:
 - 1. Division 01: General Requirements.
 - 2. Section 09 90 00: Painting and Coating.
 - 3. Section 23 05 00: Common Work Results for HVAC.
 - 4. Section 23 08 00: HVAC Systems Commissioning.
 - 5. Section 23 05 13: Basic HVAC Materials and Methods.
 - 6. Section 23 05 48: HVAC Sound, Vibration and Seismic Control.
 - 7. Section 23 07 00: HVAC Insulation.
 - 8. Section 23 09 00: HVAC Instrumentation and Controls.
 - 9. Section 23 09 23: Environmental Control and Energy Management Systems.
 - 10. Section 23 38 13: Kitchen Ventilation System.
 - 11. Section 23 80 00: Heating, Ventilating and Air Conditioning Equipment.

1.02 SUBMITTALS

- A. Provide in accordance with Division 01 and Section 23 05 00: Common Work Results for HVAC.
- B. Manufacturer's Data:
 - 1. Complete list of items to be furnished and installed under this Section. Material lists that do not require performance data shall include manufacturer names, types and model numbers.



- 2. Manufacturer's specifications and other data required to demonstrate compliance with specified requirements.
- 3. Literature shall include descriptions of equipment, types, models, sizes, capacity tables or curves marked to indicate performance characteristics, electrical requirements, options selected, space requirements, including allowances for servicing, and other data. Data shall include name and address of nearest service and maintenance organization that regularly stocks repair parts. Listings of items that function as parts of an integrated system shall be furnished at one time.
- 4. Submit complete acoustical test reports showing that proposed products have been tested in accordance with latest editions of relevant ASHRAE and AHRI Standards (ANSI/ASHRAE Standard 70 for air inlets and outlets; ANSI/ASHRAE Standard 130 and AHRI 880 for terminal units) and will be suitable for operation in Project spaces with specified maximum noise criteria (NC) requirements. The results of all testing shall be certified by an independent testing agency and submitted to the ARCHITECT for approval. The submittal shall include a complete description of the test conditions, methods and procedures.
- 5. Submittals shall include a tabulation of proposed products, identification of Project spaces where proposed products are to be installed, maximum allowable NC for all Project spaces, and product NC (at specific design air volume) for all Project spaces.
- 6. Shop Drawings: Shop Drawings indicating methods of installation of equipment and materials, sizes and gages of ducts, and details of supports. Items to be covered shall include but not be limited to following:
 - a. Layout of ductwork and equipment drawn to scale to establish that equipment will fit into allotted spaces with clearance for installation and maintenance. Indicate proposed details for attachment, anchoring to, and hanging from structural framing of building. Indicate vibration isolation units, foundations, supports, and openings for passage of pipes and ducts.
 - b. Drawings indicating locations and sizes of sleeves and prepared openings for pipes and ducts.
 - c. Typical details of supports for equipment and ductwork.

1.03 QUALITY ASSURANCE

A. Installer's and Manufacturer's Qualifications: Comply with provisions stated under Section 23 05 00: Common Work Results for HVAC.



B. Sound power level measurements and Manufacturers' NC value calculations shall be conducted in complete accordance with the latest version of ANSI/ASHRAE Standards 70 and 130 and AHRI 880.

1.04 DELIVERY, STORAGE AND HANDLING

- A. Comply with provisions stated in Section 23 05 00: Common Work Results for HVAC.
- B. Ensure ducts are clean and free of dirt, dust, moisture, oils and other contaminants that can lead to poor air quality. Cover openings of ductwork with a self-adhering protective film. Film shall not leave a residue on metal after removal, and shall be highly resistant to tears and punctures.

1.05 COORDINATION

- A. Coordinate activities in accordance with provisions of Section 23 05 00: Common Work Results for HVAC.
- PART 2 PRODUCTS
- 2.01 GENERAL
 - A. Unless otherwise noted, provisions, including amendments thereto, of the latest edition of the HVAC Duct Construction Standards of Sheet Metal and Air Conditioning Contractor's National Association (SMACNA) and the California Mechanical Code (CMC), are hereby made part of this Section.
 - B. Rectangular, round and flat oval ducts shall be manufactured and installed in accordance with requirements of the latest edition of the HVAC Duct Construction Standards Metal and Flexible of SMACNA.
 - C. Sheet metal ducts shall be fabricated from galvanized steel, aluminum or stainless steel.
 - D. Galvanized steel ducts shall be fabricated of galvanized steel sheet, lock forming grade, conforming to ASTM A653 and A924.
 - E. Galvanized steel ducts gage thickness and permissible joints and seams of ductwork shall conform to requirements of the latest edition of the HVAC Duct Construction Standards Metal and Flexible of SMACNA and the CMC unless noted otherwise on the drawings. The more stringent requirements shall prevail.
 - F. Button punch snap-lock seams, using Lockformer or equal, shall be permitted only in concealed areas using 20 and 22 gage galvanized steel ducts with screws added at the ends. Button punch snap-lock is not permitted for aluminum or duct lighter than 22 gage.



- G. Ducts shall be reinforced in accordance with the latest edition of the SMACNA HVAC Duct Construction Standards: Cross-broken Duct: Duct sizes 19 inches wide and larger which have more than 10 square feet of unbraced panel shall be beaded or cross-broken. This requirement is applicable to 20 gage or less thickness and 3 inches w.g. or less pressure. For details, refer to SMACNA manual.
- H. Round and Oval Galvanized Steel and Aluminum Ducts:
 - 1. Round Spiral Ducts and Fittings: Fabricated from galvanized sheet steel shall be machine-formed spiral pipe with sealed spiral locking joints. Fittings shall be furnished with continuous corrosion-resistant welds. Provide gages of ducts and fittings recommended by manufacturer.
 - 2. Details of seams and transverse joints for round duct and fittings shall conform to SMACNA standards.
 - 3. Flat oval ducts shall be provided as indicated on the Drawings. Reference standard details in SMACNA manual.
 - 4. Minimum duct wall thickness, and permissible joints and seams of ductwork for flat oval duct construction shall conform to requirements in the latest edition of the HVAC Duct Construction Standards Metal and Flexible of SMACNA and the CMC. The more stringent requirements shall prevail.
 - 5. These provisions apply for ducts furnished for indoor comfort heating, ventilating and air conditioning service only.
- I. Flexible Ducts
 - Flexible duct shall be non-metallic, insulated for conditioned air supply and return. The flexible ducts shall be factory fabricated with exterior reinforced laminated vapor barrier, 1 ½-inch thick fiber glass insulation (K = 0.25 at 75 degrees F), encapsulated zinc-coated spring steel wire helix and impervious, smooth, non-perforated interior vinyl liner and factory fabricated steel connection collars. For the composite assembly, including insulation and vapor barrier, comply with NFPA Standard 90A or 90B and tested in accordance with UL Standard, UL 181. Non-insulated metallic ducts shall be provided for exhaust only.
 - 2. Methods of installations, standards for joining and attaching, and supporting flexible duct shall conform to applicable provisions of SMACNA manual.
 - 3. Specifications herein shall not supersede installation requirements by flexible duct manufacturer if those are more stringent.
- J. Aluminum Ducts:


- 1. Material for aluminum duct shall be of 3003-H14 alloy aluminum sheets, with such designation embossed or stenciled on each sheet. Minimum tensile strength shall be 19,000 psi.
- 2. Aluminum duct thickness and permissible joint and seams shall conform to requirements of the latest edition of the HVAC Duct Construction Standards-Metal and Flexible of SMACNA, and CMC.
- 3. Aluminum ductwork shall be furnished to transport moisture-laden air from shower rooms, shower drying rooms, dishwashers and discharge ducts from evaporative condenser and cooling towers.
- 4. Unless otherwise noted, follow SMACNA Duct Construction Details for steel construction standards as indicated for unreinforced duct, reinforced duct, or cross-broken duct.
- 5. Button punch snap-lock seams on aluminum ducts are not permitted.
- K. Stainless Steel Duct:
 - 1. Materials for stainless steel duct shall be stainless steel conforming to ASTM A167 and A480.
 - 2. Stainless steel ducts shall be provided as required and indicated on the Drawings.
 - 3. Fume hood exhaust shall be stainless steel Type 304.
 - 4. Kitchen exhaust duct system shall be stainless steel Type 304.
 - 5. Stainless steel ducts shall be constructed with welded joints except for connections to equipment which shall be flanged joints with gaskets.
 - 6. Entire stainless steel duct systems shall comply with current CMC requirements for product conveying ducts except where the requirements of this Section are more stringent.
- L. Fittings and Other Construction Details: Details of fittings such as elbows, turning vanes, branch take-off and connections, duct access doors, connections for grilles, registers and ceiling diffusers, flexible connector at fan, etcetera, shall conform to applicable provisions of this Section or SMACNA manual.
- M. Duct Seam and Joint Sealant: Provide sealant for metal ducts at duct joints which are defined as transverse joints between duct sections including girth joints, branch and sub-branch intersections, duct collar tap-ins, fitting subsections, louver and air terminal connections, access doors and frames, and abutments to building structure. Also provide the same at duct seams which are defined as longitudinal joint between



duct sections. Spiral lock seams in factory fabricated round or oval ducts are excluded.

- 1. Sealant for low-pressure ducts shall be: Design Polymerics DP1010 or DP1020, Childers CP-145A/CP-146 Chil-Flex, Foster's 32-19 Duct-Fas, Miracle-Kingco Glenkote Seal-Flex, Ductmate Industries PROseal or FIBERseal, or equal.
- 2. Provide sealing material for medium-pressure ducts as described in the SMACNA manual for those pressures.
- 3. Sealant materials shall comply with the flame spread and smoke developed rating of current CMC when tested in accordance with ASTM E84.
- 4. Sealant for exposed to weather ducts shall pass the Weather Resistance Test per ASTM G154 at 2000 hours QUV.
- N. Restrictions:
 - 1. Zinc-coated steel duct shall not be installed for ductwork transporting moistureladen air. Flexible duct may only be furnished where specifically indicated on Drawings. Aluminum ducts shall not be installed for internal pressures above 2 inches of water.
 - 2. Fiberglass duct is not permitted as a substitute for sheet metal duct.

2.02 DAMPERS

- A. Manually Operated Volume Control Dampers:
 - 1. VD-1, Rectangular: Multi-blade type, opposed blade operation, 16 gage galvanized steel blades; center pivoted on 3/8 inch diameter steel trunnions; interlocking edges; dampers shall be in own angle frame, full duct size as indicated on Drawings; frame of minimum 16 gage steel channel construction. Provide with damper operator and axles positively locked to blade. Ruskin MD35, Pottorff MD-42, Greenheck MBD-15 or equal.
 - 2. VD-2, Round: Frame shall be constructed of not less than 20 gage galvanized steel, blades of not less than 20 gage galvanized steel channel construction with factory neoprene seals, ½ inch diameter axle shafts and locking hand quadrant. Ruskin MDRS25, Greenheck MBDR-50, or equal.
 - 3. VD-3, Oval: Frame shall be constructed of not less than 14 gage galvanized steel channels with factory blade seals of not less than 12 gage galvanized steel with not less than 1⁄2 inch diameter axle shafts. Provide Ruskin standard construction for frame, blade and axle size, thickness and material variation. Provide adjustable locking hand quadrant. Ruskin CDO25, or equal.
- B. Motorized Volume Control Dampers:



- 1. MVD-1, Rectangular: Multi-blade type opposed blade operation, 16 gage minimum steel channel frame construction; 16 gage galvanized steel blades center pivoted on ½ inch diameter steel trunnions. Interlocking edges. Dampers shall be in own angle frame. Full duct size as indicated on the Drawings. Provide with matching two position motorized actuator with linkages, 24VAC by Belimo, Honeywell, Invensys, or equal. Ruskin CD35, Pottorff CD-42, Greenheck VCD Series, or equal.
- 2. MVD-2, Round: Butterfly type constructed with minimum 20 gage galvanized steel frame with steel angle reinforcement on above 20-inch diameter. Blade shall be 14 gage minimum thickness. Neoprene seal to ensure air tightness in closed position. Furnish with matching two position motorized actuator with linkage 24 VAC by Belimo, Honeywell, Invensys, or equal. Ruskin CDRS25, American Warming and Ventilating (AMV) VC-25, Air Balance, Inc. AC530, or equal.
- 3. Electronic Damper Actuators: Belimo, Honeywell, Invensys, or equal.
 - a. Sized for torque required for damper seal at load conditions.
 - b. Coupling: V-bolt dual nut clamp with a V-shaped toothed cradle. Aluminum clamps or set screws are not acceptable.
 - c. Overload Protection: Microprocessor or an electronic based motor controller providing burnout protection if stalled before full rotation is reached. Actuator shall be electronically cut off at full open to eliminate noise generation with the holding noise level to be inaudible.
 - d. Power Requirements: As indicated on Drawings.
 - e. Actuator Timing: Shall meet 15 seconds.
 - f. Temperature Rating: Actuator shall have a UL 555S listing by damper manufacturer for 350 F.
 - g. Auxiliary Switches: Provide for signaling, fan control, and position indications.
- C. Automatic Fire Dampers:
 - 1. FD, Fire Dampers: Shall conform to requirements of and be listed by State of California Fire Marshal and NFPA 90A. Dampers shall provide airflow resistance not to exceed 0.05 inch water gage static pressure at 900 fpm or 0.25 inch water gage at 2,000 fpm. Dampers shall be installed in required steel sleeve at each penetration of a rated partition.
 - a. Vertical-mounted fire dampers: Fire damper shall be curtain type with blades removed from the air stream to allow for maximum free area. Dampers will be provided in factory sleeves as tested and listed by



manufacturer. Dampers shall be rated for 1 ½ hours for installation in one or 2-hour partitions. Provide UL listed fusible links of adequate size and temperature rating. Dampers will be installed according to the manufacturer's recommended installation instructions provided with units. Provide suitable access for inspection and servicing of each damper. Pottorff VFD-10/VFD-10D Series, Ruskin IBD/DIBD Series, Greenheck FD/DFD Series, or equal.

- b. Ceiling fire dampers: Ceiling fire dampers shall be butterfly type with ceramic material to minimize heat radiation. Dampers shall be rated for one hour and shall be furnished as a part of an integral sleeve ceiling box that will accept air distribution, have a UL listed and pre-mounted hanger tabs. Dampers shall be installed according to the manufacturers recommended installation instructions. Pottorff CFD-15 Series, Ruskin CFD Series, Greenheck CRD-1 Series/CRD-2, or equal.
- Combination fire and smoke dampers: Combination fire and smoke C. dampers shall be louver bladed type. Units shall be tested and listed under UL 555 and UL 555S. Rating 1 1/2 hours for installation in one or 2-hour partitions. The seals shall be non-degradable steel to steel. Leakage shall not exceed 15 cfm/sg. ft. at one inch w.g. and shall be tested at 850 degrees F. Dampers shall be capable of being remotely controlled and reset for pressurization and smoke evacuation. Firereleasing device shall be UL 33 listed melting fusible links. Dampers shall be provided in sleeves with pre-mounted non-stall motor actuators and dual-position indicators for remote annunciation, if required. The complete assembly shall be factory cycled and tested prior to shipment. Provide suitable access for inspection and servicing of each damper. Pottorff FSD-141 with non-stall motor, Ruskin FSD37 or FSD60 with electric fuse link Model EFL 200, with electric non-stall motor, Greenheck FSD Series, with non-stall motor, or equal.
- 2. Electronic Damper Actuators: Refer to Sub-paragraph 2.04.B.3.
- D. Relief Dampers: Parallel multi-blade, counter balanced type with adjustable counter weights. Constructed of 20 gage galvanized sheet steel or extruded aluminum with solid stops all around. Bearings shall be dust proof, ball bearings. Damper shall open on a positive pressure of 0.01 inch within space and close to a backdraft. Interlocking edges shall prevent dust infiltration when closed. Air Balance, Inc., Pottorff, Ruskin, Metal Form Manufacturing Co. Inc., or equal.
- E. Duct Access Panels: Provide factory fabricated access panels in ducts where required for servicing fire or smoke dampers, and at other locations as specified in this Section. Units shall consist of removable panel, gasketed and pressure sealed by controlled spring tension locks. Construct unit, including interior parts, of same material as duct. Units shall be constructed to be suitable for installation in systems of up to 5 inches water gage static pressure.



2.03 AIR DISTRIBUTION DEVICES

- A. General:
 - 1. Grilles, registers, diffusers and appurtenances shall conform to requirements specified herein and shall be of type and sizes as specified and indicated on Drawings. Performance shall be in accordance with ANSI/ASHRAE Standard 70 including airflow velocity, pressure, temperature, and sound measurements.
 - 2. Sponge neoprene, rubber, vinyl or felt border gaskets shall be provided for surface-mounted registers, grilles or diffusers.
 - 3. The noise generating characteristics of all specified grilles, registers, and diffusers shall be tested to, and comply with, all requirements of this specification. Representative samples shall be subjected to tests in accordance with applicable standards and procedures in order to demonstrate such compliance. A special test for this project is not required if the manufacturer has previous certified test results that can be made applicable to this project. Maximum Sound Levels of diffusers, grilles and registers shall be as follows:

Administrative office area:	NC 30
Classrooms:	NC 20
Libraries and other noise sensitive areas:	NC 25
Gymnasiums, cafeterias, lockers areas:	NC 30

- 4. Provide suitable frame types to match the ceiling types as specified or indicated on the Architectural Drawings.
- 5. Ceiling diffusers shall be provided with equalizing grids.
- 6. Ceiling mounted grilles, registers and diffusers shall be provided with a factory applied, baked enamel, dull finish, bone white to match acoustical ceiling tile.
- 7. Grilles or registers mounted on painted walls or other surfaces shall be furnished with a baked prime coat and finish painted in accordance with Section 09 9000: Painting and Coating.
- 8. Do not provide opposed blade dampers at diffusers and registers to balance the airflow, as they tend to create noise. Provide a manual volume damper at each branch take-off and also at branch duct to each diffuser and register upstream of the flexible duct connections. Air throw patterns shall be as indicated on the drawings.
- 9. Diffusers, registers and grilles indicated or scheduled on the drawings to comply with special requirements shall take precedence over the standard items specified.
- B. Ceiling Diffusers Round, Square, Rectangular:



- 1. CD-1 For non-classroom areas of less than 10 feet ceiling height only. Units shall be square or rectangular modular core type as indicated on the drawings. Anemostat QC Series, Krueger Model 1240, Price SMCD Series, Titus MCD Series, or equal.
- 2. CD-2 For typical classrooms. Units shall be square plaque type. Anemostat PG Series, Krueger Model PLQ, Price SPD Series, Titus OMNI Series, or equal. The horizontal air discharge pattern shall be 360-degree radial type with factory installed blank-offs for three way, two way corner, two way opposite, or one way discharge pattern.
- 3. CD-3 For non-classroom areas of higher than 10 feet ceiling height. Units shall be square or rectangular louver faced type. Anemostat D Series, Krueger Model SH, Price SMD/AMD Series, Titus TDC/TDC-AA Series, or equal.
- 4. CD-4: Units shall be round, adjustable pattern, and surface-mounted type. Anemostat C-27, Krueger RM Series, Price RCDE Series, Titus TMR Series, or equal.
- 5. CD-5: Units shall be adjustable linear slot type. Anemostat SLAD Series, Krueger Model 1900, Price AS Series, Titus FL Series, or equal.
- C. Grilles Return, Exhaust, Ceiling, Square, Rectangular:
 - GR-1 Acoustical Tile on Plaster Ceiling: Return and exhaust grilles shall be single deflection type with horizontal fixed face bars set at straight or 45 degree angle, ¹/₂ inch spacing and flush and flanged for surface mounting. Anemostat S3HD Series, Kruger Model S80/S85, Price 500/600 Series, Titus 350/355 Series, or equal.
 - GR-2 Prefabricated Acoustical Tile Ceiling with Inverted Exposed T-Bars: Return and exhaust grilles shall be with single deflection horizontal fixed face bars, set at straight or 45 degree angle, ½ inch spacing and flush, lay-in panel type with nominal overall dimension of 24-inch by 24-inch. Anemostat Type SAC3L Series, Krueger Model S80/S85, Price 500/600 Series, Titus 350/355 Series, or equal.
- D. Registers, Supply, Return, Wall:
 - WR-1: Sidewall supply register shall be double deflecting type with loose keyoperated opposed blade volume control. Anemostat S2 Series, Krueger Model 80/880, Price 500/600 Series, Titus 300 Series, or equal.
 - 2. WR-2: Sidewall return register shall be single deflecting type with horizontal fixed face bars set at 45 degree angle flush and flanged for surface mounting and complete with loose key-operated opposed blade volume



control. Anemostat S3 Series, Krueger Model S80/S85, Price 500/600 Series, Titus 350/355 Series, or equal.

2.04 SOUND ATTENUATING EQUIPMENT - DUCT SILENCERS

A. Provide factory fabricated duct silencers of tubular or rectangular type, for high or low velocity service, with arrangements, sizes and capacities as indicated on Drawings. Construct silencers of galvanized steel with casing seams sealed or welded to be airtight at a pressure differential of 8 inches water gage between inside and outside of unit, and stiffen or brace as required to prevent structural failure or deformation at same condition, or audible vibration during normal operation. Filler material shall comply with the following:

Fire Safety Standards:	NFPA 90A and 90B	
Temperature:	ASTM C411	
Air velocity:	ASTM C1071, UL 181	
Fire Hazard Classification:	ASTM E84, UL 723-Class 1, NFPA 255	
Corrosion Resistance:	ASTM C739, C665	
Fungi Resistance:	ASTM G21	
Water Vapor Sorption:	ASTM C1104, less than 1 percent by weight	
Formaldehyde, Phenoloc Resins or other Volatile Organic compounds: 0 percent.		

- B. Select and provide silencers from acoustical and aerodynamic rating tables based on actual test readings or interpolated values of such readings obtained from tests made by recognized independent laboratories. Tests shall be in accordance with ASTM E477.
- C. Select and provide silencers for air pressure drops not exceeding those indicated on Drawings, and of types, sizes and models for which noise reduction values, dynamic insertion loss, in decibels reference 10 to 12 watts, are not less than indicated on Drawings.

2.05 ZONE TEMPERATURE CONTROL DEVICES

- A. Variable Air Volume Control Terminals:
 - 1. VAV-1: AHRI 880 certified, single duct, pressure independent, variable air volume control terminal with reheat coil, sound attenuators, multi-point flow sensor, electric actuators and electronic direct digital controls. The controllers shall comply with Section 23 0923: Environmental Control and Energy Management Systems. The coils shall be copper tubes with copper fins. Casings shall be 22 gage galvanized steel lined with minimum ½ inch, 1.5 pound density, foil faced insulation that complies with NFPA 90A and UL 181.

Anemostat, Krueger, Price, or equal.

2.06 SMOKE DETECTORS



A. Refer to Section 28 31 00: Fire Detection and Alarm.

PART 3 – EXECUTION

3.01 EXAMINATION

A. Examine areas and conditions under which Work of this Section will be performed. Correct conditions detrimental to proper and timely completion of Work. Do not proceed until unsatisfactory conditions have been corrected.

3.02 DUCTWORK

- A. Construct ductwork according to details of fabrication and methods of support, as indicated in the SMACNA manuals and CMC, unless specified or indicated otherwise in this Section or on Drawings. In event of conflict, the most stringent requirement shall be provided.
- B. Unless otherwise required, construct ducts to conform accurately to dimensions indicated and to be straight and smooth on inside, with joints neatly finished.
- C. Duct dimensions indicated are net inside dimensions.
- D. Where aluminum is welded, provide a minimum thickness of 16 gage, and use gas inert tungsten process of welding.
- E. Anchor ducts to building structural slab, framing and roof decking and detail method of anchoring and fastening if not indicated on Drawings. Supports shall be seismically constructed as required by the latest edition of the SMACNA guidelines.
- F. Construct and install ducts to be completely free from vibration under operating conditions.
- G. Indicate on layout drawing, required for suspended ductwork, location of supports, loads imposed on each fastening or anchor, typical details for anchorage, and details for special anchorage for supports attached to metal roof decking.
- H. Attach supports only to building structural framing members and concrete slabs.
- I. Where supports are required between structural framing members, detail and install suitable intermediate metal framing.
- J. Ducts transporting air-conditioned or heated supply air shall be insulated in accordance with requirements of Section 23 0700: HVAC Insulation.
 - 1. Ducts exposed to weather shall be prefabricated double wall type from HVAC equipment through building envelope.



- K. Ferrous angles and structural members and joining collars specified for construction and support of ductwork and plenums shall be primed with one heavy coat of required asphaltic aluminum paint before installation or fabrication. Metal surfaces shall be thoroughly cleaned before installation of paint. Galvanizing may be provided instead of painting. Installed duct hanger rods concealed in furred ceilings and walls are not required to be primed or painted.
- L. Broken places in galvanized coating shall be acid washed and then completely soldered over or painted with galvanizing paint.

3.03 DUCT CONSTRUCTION

- A. Minimum ductwork gages, joints, reinforcing, and bracing of ductwork shall conform to SMACNA and CMC. The most stringent standards shall prevail. Additional bracing shall be provided to prevent objectionable panel vibration.
- B. Button punch snap-lock seams, using Lock-former or equal, shall be permitted only in non-accessible areas using 20 and 22 gage galvanized steel ducts with screws added at the ends. Button punch snap-lock is not permitted for aluminum or duct lighter than 22 gage.
- C. Provide longitudinal seams of the grooved snap lock, or Pittsburg and standing, sealed spiral or continuously welded.
- D. Ferrous angles and structural members and joining collars specified for the construction and support of ductwork and plenums shall be primed with one heavy coat of asphalt aluminum paint before installation or fabrication. The metal surface shall be thoroughly cleaned before application of the paint. Galvanizing may be provided instead of painting. Installed duct hanger rods concealed in furred ceilings and walls is not required to be primed or painted.
- E. Broken places in galvanized coating shall be acid washed and then completely soldered over or painted with galvanizing paint.
- F. S-type or drive-slip type girths or longitudinal seams shall not be furnished for ductwork installed outdoors or mounted on roofs.
- G. Broken places in galvanized coating shall be acid washed and then completely soldered over or painted with galvanizing paint.

3.04 DUCT ELBOWS AND TURNING VANES

A. Duct elbows, including supply, exhaust, and return, shall be provided with a centerline radius of 1.5 times duct width parallel to radius whenever possible; centerline radius shall not be less than width of duct parallel to radius.



- B. Where space does not permit above radius, or where square elbows are indicated on Drawings, turning vanes shall be installed whether indicated on Drawings or not.
- C. Turning vanes shall conform to SMACNA and CMC.

3.05 DUCT JOINTS AND SEAMS

- A. Conditioned air supply ducts shall be furnished with joints and seams sealed, welded for air tightness, except spiral seam factory machine formed duct components. Spiral seam is exempted. Joints between slip-fit components may be assembled with all seams and joint connections fastened with screws.
- B. Other ducts shall be furnished with joints and seams sealed by using sealant, taping, soldering, or welding. Ducts for grease hood exhaust shall be furnished with grease-tight welding or brazing on external surface for joints and seams. Fiberglass ducts shall be provided with a thermally activated closure system, Johns Manville Fortifiber Therm-Lock with Automatic Bond Indicator dots, or equal.
- C. S-slip or drive-slip type girths or longitudinal seams are not permitted on exterior or exposed rooftop mounted ductwork.
- D. Caulking, taping, or other joint or seam treatment shall be provided in accordance with recognized standards.
- E. Seams around fan, coil housing and plenums shall be sealed with gaskets or sealing compound to provide an airtight assembly.
- F. Stainless steel ductwork connected to range hoods and fume hoods shall be provided with grease-tight, gas tight welded seams, and shall be constructed and installed so that grease or other material cannot become pocketed in any portion thereof, and system shall slope downward toward hood not less than 1/4 inch per lineal foot. Gasketed flanged joints with sealing compound shall be used only at fan and fume hood connections.
- G. Alternative duct connectors such as Ductmate Industries, Mez Industries, or equal may be used if the following conditions are met:
 - 1. One of the specifically listed connectors is submitted and approved by the ARCHITECT and OAR.
 - 2. The correct size connector, application, and gage of material conform to SMACNA Standards.
 - 3. The connector is installed per manufacturer's specifications.

3.06 DUCT TRANSITION



A. Slopes in sides of transition pieces shall be no greater than 1 to 5. Abrupt changes or offsets in duct system are not permitted, except when reviewed by the ARCHITECT.

3.07 DUCT TEST HOLES

A. Holes in ducts and plenums shall be provided for pilot or static tubes for obtaining air measurements to balance or check air systems. Holes shall be covered with neoprene gasketed sheet metal cover or plugged with a fitted neoprene plug chained to duct.

3.08 SOUND ATTENUATING EQUIPMENT

A. Install sound attenuators where required and indicated on Drawings. Refer to manufacturer's instructions for required installation.

3.09 FLEXIBLE CONNECTIONS

A. At points where sheet metal connections are installed to fans or air handling units, or where ducts of dissimilar metals are connected, a flexible connection of commercial grade, Duro Dyne Durolon, Ventfabrics Ventglas, Ductmate Industries Proflex, or equal, non-combustible material shall be installed and securely fastened by zinc-coated steel clinch-type bands or a flange type connection. Inlet and outlet openings shall be axially in-line, maximum deviation of centerline shall be less than 5 percent of diameter or shortest dimension of a rectangular inlet of fan or air handling unit, with system at rest. Duct end of connection shall be seismically restrained if more than 4 feet from last support.

3.10 AIR TERMINAL DEVICES

- A. General: Install supply devices after ducts, plenums, and casings have been cleaned and blown free of small particles, as specified. Devices shall be aligned to be parallel to ceiling construction or walls and ceiling surfaces, and shall be pulled tightly to compress gaskets and to fit neatly against surfaces.
- B. Diffusers: Support surface mounted ceiling diffusers from angles or channels resting on and fastened to ceiling construction. Do not support from ducts. Install lay-in diffusers on T-bar ceilings with hanger wires from each corner and not supported by ceiling structure. Provide sheet metal adaptor box above each diffuser to allow space for volume controller with round collars for connection to round ducts where indicated on Drawings. Fasten duct-mounted diffusers to duct collars.
- C. Registers and Grilles:
 - 1. Install wall supply registers at least 6 inches below ceiling, unless otherwise indicated. Locate return and exhaust registers 6 inches below ceiling unless otherwise indicated.



- 2. Support ceiling diffuser type inlets, registers, and grilles as required above for ceiling diffusers.
- 3. Fasten wall mounted and duct mounted registers and grilles to flanges of duct collars.

3.11 DAMPERS

- A. Manually operated dampers, gravity dampers, fire dampers, and motor operated dampers shall be furnished and installed as specified and indicated. Upon completion of installation, dampers shall be checked, lubricated, and adjusted so that they operate freely, without binding. Dampers shall be of standard commercial manufacture, complete with damper frame. Where painting is required, they shall be shop finished unless otherwise noted.
 - 1. Provide and install manual volume dampers per SMACNA standards to allow balancing per AABC, NEBB or TABB Procedures and Standards whether indicated on the drawings or not.
 - 2. Balancing dampers shall be installed in main supply ducts from fan discharge plenums, where two or more ducts are connected to each plenum, although such balancing dampers may not be indicated. Each zone shall be provided with a manual volume damper. Sheet metal screws shall be installed through handles and into ducts to lock damper in place after test and balance.
 - 3. Each supply, return, and exhaust branch shall be provided with manual volume dampers.
 - 4. Do not provide opposed blade dampers at air inlets and outlets.
 - 5. Each supply, return, and exhaust inlet or outlet shall be provided with a manual volume damper. This damper shall be a minimum of 5 feet upstream of the air outlet and inlets. An acoustic flexible duct should be provided between the outlet and inlet and the damper for concealed ducts.
 - 6. Dampers installed in accessible locations shall be provided with locking and indicating quadrants. Ventfabrics Ventlok, Duro Dyne, Young Regulator Co., or equal.
 - 7. Dampers installed in ductwork in furred ceiling spaces or in roof spaces with less than 30 inches of clearance below beams, joists, or other construction, and where access panels are not provided shall be furnished with damper rods extended below ceiling and terminated with a concealed damper regulation. Ventfabrics Ventlok, Young Regulator Co., Duro Dyne, or equal.
 - 8. Dampers not identified as splitter, extractor, or butterfly dampers shall be of multi-louver type arranged for opposed blade operation. Damper shall be same



dimension as adjoining duct and be tight closing. Blades shall not be greater than 9 inches. Dampers shall be not less than 18 gage steel.

- 9. Motor operated dampers shall be furnished by temperature control manufacturer as part of temperature control equipment and shall conform to requirements of Section 23 0900: HVAC Instrumentation and Controls.
- 10. Dampers shall be provided with accessible operating mechanisms. Where operators are exposed in finished portions of building, operators shall be chromium-plated with exposed edges rounded. Splitter dampers are not permitted unless specified and reviewed by the ARCHITECT.
- 11. Dampers shall not be installed in combustion air ducts.
- 12. Access panels shall be installed for access at each damper's operating mechanism.

3.12 FIRE AND SMOKE DAMPERS

- A. Fire dampers or combination fire and smoke dampers shall be installed and accessible at duct penetrations of rated walls and partitions and as required by State Fire Marshal and NFPA 90A, 92A, 92B, and 101.
- B. Fire dampers shall be sized, and adjoining duct enlarged, to assure full size air passage of connecting ductwork.
- C. Install smoke dampers as indicated on Drawings and as required in ducts penetrating smoke isolation separations.
- D. Fire dampers or combination fire and smoke dampers shall be electrically actuated, power open-fail close type, UL 555 and UL 555S classified for 1-1/2 hours.
- E. Provide a service disconnect switch for each and every combination smoke and fire damper.

3.13 DETECTORS

- A. Smoke detectors shall be installed in accordance with requirements of the California Mechanical Code.
- B. Smoke detectors shall be installed in systems of over 2000 CFM capacity to detect presence of smoke and automatically shut down air handling units or fans unless it has been verified with the electrical installer that Exception 1 to CMC 609.0: Automatic Shutoffs, regarding automatic shutdown of systems with total coverage smoke detection systems is applied.
- C. Smoke detectors shall be installed in supply system downstream of filters.



3.14 BACKDRAFT DAMPERS

A. Backdraft dampers shall be installed at locations indicated in accordance with the State of California Building Energy Efficiency Standards, Title 24, CCR.

3.15 DUCT SLEEVES AND PREPARED OPENINGS

- A. Furnish duct sleeves for 15-inch diameter ducts or less passing through floors, walls, ceilings, or roof and install during construction of the floor, wall, ceiling, or roof. Install round ducts larger than 15 inches diameter and square and rectangular ducts passing through floors, walls, ceilings or roof through prepared openings. Provide duct sleeves and prepared openings for duct mains and duct branches.
- B. Provide one inch clearance between duct and sleeve or between insulation and sleeves for insulated ducts, except at grilles, registers and diffusers.
- C. Provide prepared openings for round ducts larger than 15 inches in diameter and for square and rectangular ducts with one inch clearance between duct and openings or between insulation and opening for insulated ducts, except at grilles, registers and diffusers.
- D. Provide closure collar of galvanized sheet metal not less than 4 inches wide unless otherwise indicated on Drawings on each side of walls or floors where sleeves or prepared openings are provided except where grilles or diffusers are installed. Install collar tight against surface. Fit sharp edges of collar installed around insulated duct to preclude tearing or puncturing insulation covering vapor barrier. Fabricate collars from round ducts in steel. Provide not less than 4 nails to attach collar where openings are 12 inches in diameter or less and not less than 8 nails where openings are 20 inches in diameter or less.
- E. Pack space between sleeve or opening and duct or duct insulation with commercial grade packing yarn.

3.16 FLEXIBLE DUCT RUNOUTS

A. Runouts from branches, risers or mains to air terminal units and outlets may be preinsulated, factory fabricated flexible ducts complying with NFPA 90A. Flexible ductwork shall not exceed 7 feet in length. When required to suspend flexible ducts, furnish hangers of type recommended by manufacturers of pre-insulated flexible duct and install at intervals recommended. Method of attachment to other components of air distribution system for a vapor-tight joint shall be in accordance with printed instructions of flexible duct manufacturer. Bend radius shall be 1-1/2 times diameter of duct, measured from centerline. Bends greater than 90-degree angle are not permitted. Non-metallic flexible duct shall be permitted only in T-bar suspended ceilings.

3.17 DUCT HANGERS AND SUPPORTS



- A. Exposed or easily accessible ductwork: All exposed ducts shall be supported by allthread Rod as a single hanger and or a trapeze support for rectangular duct work in accordance with requirements of the latest edition of the HVAC Duct Construction Standards – Metal and Flexible of SMACNA.
- B. Non-accessible ductwork: Non-exposed and hidden from sight during regular school operations ductwork, rigid round, rectangular, and flat oval metal ducts, shall be installed with support systems conforming to SMACNA Standards.
- C. Where ducts are installed one above the other, they shall be individually supported on a trapeze of steel angles with 3/8 inch supporting steel rods securely fastened to overhead construction. A minimum distance of 3 inches shall be maintained between ducts wherever possible, but in no event shall distance be less than 2 inches. Minimum sizes of steel angles shall be 1 ½-inch by 1 ½-inch by 1/8 inch for duct sizes through 60 inches in greatest dimension, 2-inch by 2-inch by 1/8 inch for duct sizes 61 inches through 84 inches, 2-inch by 2-inch by 3/16 inch for duct sizes 85 inches through 96 inches, and 2-inch by 2-inch by 1/4 inch for duct sizes over 97 inches.
- D. Ducts six square feet area and greater and or minimum 28" round or greater shall be seismically restrained. Refer to Section 23 0548: HVAC Sound, Vibration and Seismic Control.
- E. Hangers shall not be supported by, or fastened to, non-structural members including blocking. Toggle or Molly type bolts are not permitted.
- F. Vertical ducts shall be supported with suitable angles on each side of each duct located at each floor and at intervals not to exceed 8 feet. Angles shall be sized and installed according to SMACNA Standards for required span so that they will be rigid, without bending or sagging.
- G. Roof-mounted ductwork shall be installed a minimum 12 inches above roof and shall be supported by galvanized welded pipe, one on each side, fastened to roof structure, flashed and sealed to roof membrane. Install supports at each turn, unit connections, and each penetration, and space at maximum 6 feet off-center in general. Pitch pockets are not allowed.

3.18 ACCESS PLATES AND DOORS

- A. Access plates and doors shall be furnished and installed where stops, valves, fire dampers, fusible links, coils, damper operating mechanism, control equipment, lubrication fittings, air filters, air handling equipment and similar items normally requiring adjustment or servicing are installed in concealed spaces.
- B. Access plates and doors shall be located to permit convenient access to equipment sized to permit removal of equipment for servicing. Access plates shall be no less than 12-inch by 12-inch in clear opening. Proper servicing of equipment requires adequate access for maintenance personnel. Access doors shall not be less than 24-inches by 24-inch, unless otherwise detailed. Two or more valves shall not be located in same



access area unless sufficient clearance is provided for operation, servicing and removal of each valve.

- C. Openings in ducts or plenums whose longer dimension does not exceed 12 inches may be covered by a plate of same material as duct, gasketed and fastened to duct or plenum with sheet metal screws.
- D. Access plates in floors shall not be less than 8-inch by 8-inch and shall be carborundum surface brass with cast brass frames anchored into concrete. Access plates in tile walls shall be chromium plated brass and polished. Serrated plates furnished as part of a clean-out assembly are permitted in floors instead of a separate plate.
- E. Access plates and doors in walls and ceilings of finished rooms and in locations normally accessible to students shall be furnished with continuous piano hinges, unless otherwise specified, and a special flush type spring-loaded latch requiring an Allen wrench to operate. Access devices shall be installed after plastering in plaster ground openings.
- F. Access panels or doors penetrating one-hour fire resistive ceilings shall meet code requirements for such openings.
- G. Access panels shall be fire-rated; Milcor, or equal. Access doors shall be as required for installation in openings penetrating one-hour fire resistive ceilings. Access doors shall be furnished with a flush, key-operated cylinder lock, furnished with two keys each, instead of Allen headlock for non-rated ceilings.
- H. Access panels that are part of an integrated ceiling are specified in Section 09 8433: Cementitious Wood Fiber Acoustical Units. Identification markers shall be affixed to adjacent supports, under this portion of Work, to indicate location and type of mechanical device to be serviced.
- I. Access panels installed in ducts or plenums located in heater or equipment rooms containing gas-fired equipment shall be furnished with heavy-duty spring closing hinges and refrigerator door type catches unless otherwise required. When these panels are intended for maintenance personnel access, catches shall be operable from both interior and exterior.
- J. Other access panels, except those specified above, shall be furnished with suitable hinges and one or more sash fasteners.
- K. Panels located in ducts and plenums shall be installed with gaskets made of synthetic rubber, felt, or similar material to provide an airtight installation. Panels shall be constructed and reinforced to prevent vibration.
- L. Label the words "FIRE DAMPERS" on panels over fire dampers and words "DO NOT OPEN - HEATER IS OPERATING" on panels located in heater or equipment rooms. Letters shall be approximately 3 inches high, if space is available.



- M. Furnish a key to operate latch access plates, one for each access plate, but not to exceed five keys for any one Project.
- N. Access plates and panels shall be furnished with manufacturer's name or trademark and model number cast or stamped thereon, or upon a label permanently affixed thereon.
- O. Provide duct through roof flashing as detailed in the SMACNA standards or as indicated on Drawings.
- P. Refer to SMACNA for access plate and door construction.

3.19 CLEANUP

A. Remove rubbish, debris and waste materials and legally dispose off the Project site.

3.20 PROTECTION

A. Protect the Work of this Section until Substantial Completion.

END OF SECTION



SECTION 23 38 13 - KITCHEN VENTILATION SYSTEM

PART 1 – GENERAL

1.01 SUMMARY

- A. Section Includes: Kitchen ventilation system. Including, but are not limited to:
 - 1. Make-up Air Unit with Heating and Cooling.
 - 2. Exhaust Fan.
 - 3. Ductwork and Appurtenances.
 - 4. Controls.
- B. Related Requirements:
 - 1. Division 01: General Requirements.
 - 2. Division 26: Electrical.
 - 3. Section 22 1000: Plumbing.
 - 4. Section 23 0500: Common Work Results for HVAC.
 - 5. Section 23 0513: Basic HVAC Materials and Methods.
 - 6. Section 23 0548: HVAC Sound, Vibration and Seismic Control.
 - 7. Section 23 3000: Air Distribution.
 - 8. Section 23 8000: Heating, Ventilating and Air Conditioning Equipment.
- 1.02 SYSTEM DESCRIPTION
 - A. Kitchen ventilation system shall provide heating, ventilating and cooling to prevent extreme temperatures in the kitchen. Kitchen temperature shall be controlled by room thermostat. Supply air fan shall automatically shut off when kitchen fire alarm is activated.

1.03 SUBMITTALS

- A. Provide in accordance with Division 01 and Section 23 0500: Common Work Results for HVAC.
- B. Manufacturer's Data:



- 1. Complete list of items to be furnished and installed under this Section.
- 2. Manufacturer's specifications and other data required to demonstrate compliance with specified requirements, three sets of operation and maintenance manuals, and service, parts list, and installation instructions.
- C. Shop Drawings:
 - 1. Submit Shop Drawings and layout drawings of complete kitchen ventilation system, including, but not limited to, dimensioned location of exhaust hood, exhaust fan, heating, ventilating, cooling, make-up air unit, and ductwork.
 - 2. Provide Drawings for the kitchen ventilation system in accordance with requirements of NFPA 96.
- D. Closeout Submittals: Submit Project Record Documents and Operations and Maintenance Manuals in accordance with Section 23 0500: Common Work Results for HVAC.
- 1.04 QUALITY ASSURANCE
 - A. Standards: Kitchen ventilation system fabrication and installation shall comply with NFPA 96 standards, applicable provisions of Section 23 0500: Common Work Results for HVAC, and the California Mechanical Code (CMC).
 - B. Qualifications of Manufacturers: Products used in the Work of this Section shall be produced by manufacturers regularly engaged in manufacture of similar items and with a minimum of 5-year history of successful production.
 - C. Qualification of Installers: Provide adequate number of skilled workmen, thoroughly trained and experienced in necessary crafts, and completely familiar with specified requirements and methods needed for proper performance of the Work of this Section.

1.05 INSTRUCTIONS

- A. Prior to Substantial Completion, provide a 2 hour instruction period on system and equipment operation and maintenance procedure before or during completion test, in compliance with Section 23 0500: Common Work Results for HVAC, to designated Owner personnel. Coordinate and arrange for instruction period.
- B. Instructions shall be provided by an individual who has been thoroughly trained and experienced to demonstrate proper operation and maintenance procedure of particular system and equipment.
- 1.06 PRODUCT HANDLING
 - A. Comply with provisions stated under Section 23 0500: Common Work Results for HVAC.
- 1.07 COORDINATION



A. Coordinate activities in accordance with provisions of Section 01 3113: Project Coordination.

PART 2 – PRODUCTS

2.01 KITCHEN HOOD DUCTWORK

- A. Make-up air supply and exhaust duct connections for kitchen hood shall be furnished in parallel configuration only. Exhaust duct shall have a minimum velocity of 1,500 fpm and a maximum velocity of 2,100 fpm. Exhaust duct shall be constructed of stainless steel Type 304, 18 gage minimum with welded joints. Make-up supply ductwork shall be constructed of stainless steel Type 304, 18 gage minimum with welded joints. Make-up supply ductwork shall be constructed of stainless steel Type 304, 18 gage minimum with welded joints. Make-up supply ductwork shall be constructed of stainless steel Type 304, 18 gage minimum with welded joints on parallel duct arrangement. Duct installation shall conform to NFPA 96. Exhaust duct connecting collars shall be of heat expansion type. Field weld exhaust duct to mating flange at canopy, in accordance with CMC requirements. Factory fabricated ductwork, when approved, shall be furnished by duct manufacturer and shall be UL listed as grease duct for restaurant cooking appliances.
- B. Clean-outs and other openings: Refer to CMC requirements.
- C. Duct enclosure: Refer to CMC requirements.
- D. Prevention of grease accumulation: Refer to CMC requirements.
- E. Other requirements of CMC and Section 23 3000: Air Distribution.
- 2.02 KITCHEN HOOD EXHAUST FANS (KEF)
 - A. Exhaust fan shall be roof-mounted, upblast, direct-drive type, complete with centrifugal backward inclined blades, UL listed for removal of smoke and grease laden air. Unit shall be rated for continuous service at 300 degrees F conforming to UL 762 and shall be rated in accordance with ANSI/AMCA 210. Unit shall be compatible for installation with kitchen hood specified. Utility type fans may be furnished where building configuration does not permit the installation of upblast roof exhausters.
 - B. Unit shall be Captiveaire, Loren Cook Company, Greenheck, or Supreme Fan, or equal.
- 2.03 KITCHEN MAKE-UP AIR UNIT (MAU)
 - A. Make-up air unit shall be roof mounted type factory built-up assembled and wired in accordance with NFPA 70: NEC and ETL listed to ANSI Z83.8 and CSA 2.6 standards as a package. The energy usage shall be designed to meet ANSI/ASHRAE Standard 90.1
 - B. The unit shall be Captiveaire, or equal, and shall be furnished with the following:
 - 1. Plenum fan, permanently lubricated bearings, direct drive. Motor and blower shall be rubber in shear vibration isolated.



- 2. Disposable media type air filters 2 inches thick of MERV 13 efficiency, shall be provided in the air stream, unless indicated otherwise in the drawings.
- 3. Outside air shall enter unit through an outside air hood with moisture elimination louvers and bird screen or evaporative cooler with 1" pre-filter unless otherwise indicated on the Drawings.
- 4. Cabinet shall have through-the-base utility knockouts. Control service compartment doors shall be hinged. Blower door hardware shall be heavy duty stainless. Control and burner door hardware shall be heavy duty external hardware. Unit cabinet shall be supplied with double wall steel construction with factory installed 1 ½ pound density insulation. R value of insulation shall be 3.8 or greater. Insulation with foil backing is not acceptable. The packaged system shall have a pre-coat RAL 1001 white paint finish. Finish shall be a minimum 60 gloss on G90 galvanized steel. Painted metal shall pass 1,000 hour salt spray test per ASTM B117. Unit shall be designed with heavy 16 gage pre-painted steel rail perimeter base. Base shall feature provisions for corner lifting, with lifting strap holes to facilitate handling and installation.
- 5. Cooling of outside air shall be provided by DX cooling.
 - a. For cooling, unit shall be provided with a DX split system. Manufacturer shall provide a factory-installed cooling coil in a cabinet. Manufacturer shall also provide an integral condensing unit section for DX cooling. Unit shall use non-ozone depleting R-410a refrigerant. Units 7.5 tons and above shall have dual circuits with independent scroll compressors. Dual circuits shall have independent liquid line receivers.
 - 1) Evaporator coils:
 - a) Aluminum plate fins mechanically bonded to enhanced copper tubes with joints brazed.
 - b) Tube sheet openings shall be belled to prevent tube wear.
 - c) Evaporator coil shall be of full-face active design.
 - d) Dual circuit models shall have face-split type evaporator coil.
 - 2) Condenser coils Type A, B or C are acceptable.
 - a) Type A: Copper-tube, aluminum-fin coil, with liquid subcooler. Internally enhanced 3/8 inch OD seamless copper tubing mechanically bonded to aluminum fins.
 - b) Type B: Spine Fin[™] condenser coil shall be continuously wrapped, corrosion resistant aluminum



with minimum brazed joints. This coil is 3/8 inch OD seamless aluminum tubing glued to a continuous aluminum fin. Coils are lab tested to withstand 2,000 pounds of pressure per square inch. The outdoor coil provides low airflow resistance and efficient heat transfer. The coil is protected on four sides by louvered panels.

- c) Type-C: Coil shall be air-cooled Micro-Channel heat exchanger technology (MCHX) and shall have a series of flat tubes containing a series of multiple, parallel flow microchannels layered between the refrigerant manifolds. Coils shall consist of a two-pass arrangement. Coil construction shall consist of aluminum alloys for fins, tubes, and manifolds in combination with a factory applied corrosion-resistant coating.
- C. Unit shall be supplied from factory with EPAct compliant premium efficiency ODP blower motor and factory installed VFD.
- D. Unit shall be provided with a remote control panel that will provide the control functions that are indicated on the drawings including but not limited to the following:
 - a. Thermostat for space temperature control.
 - b. Fan on/off and speed indicator lights.
 - c. Manual on/off switch.
- E. Make up air unit shall be provided with an automatic cut-off through a field furnished detector in the event of fire.
- F. Electrical wiring, components and connections including electrical grounding shall be made in accordance with the National Electrical Code (NFPA 70). A separate line voltage supply shall be run directly from the main panel to a fused disconnect switch, at the unit, and then making connection to leads in the unit junction box. External wiring shall be made within approved conduit and shall have a minimum temperature rise rating of 60 degrees C. The unit shall be electrically grounded in accordance with the National Electrical Code (NFPA 70) when installed if an external source is utilized. Units shall be equipped with a 24 volt control transformer; protective air proving switch; resiliently isolated venter motor and a high temperature limit control. Operation shall be controlled through an integrated circuit board. The circuit board shall monitor heater operation and have LED diagnostic lights to identify abnormalities in control functions.

PART 3 – EXECUTION

3.01 EXAMINATION



- A. Examine areas and conditions under which Work of this Section will be performed. Correct conditions detrimental to proper and timely completion of Work. Do not proceed until unsatisfactory conditions have been corrected.
- 3.02 INSTALLATION
 - A. Kitchen ventilation system shall be installed in accordance with manufacturer's instructions and shall comply with NFPA 96 and CMC.
 - B. Exterior surfaces of roof-mounted equipment shall be weatherproofed.
- 3.03 COMPLETION TEST
 - A. Project Inspector shall be notified 48 hours in advance of testing. Notify fire authorities and test components of system and sequence of operation in presence of and for observation of the Project Inspector and fire inspectors.
- 3.04 CLEANUP
 - A. Remove rubbish, debris and waste materials and legally dispose of off the Project site.
- 3.05 PROTECTION
 - A. Protect the Work of this Section until Substantial Completion.

END OF SECTION



SECTION 23 70 00 - AIR HANDLING UNITS

PART 1 – GENERAL

- 1.01 SUMMARY
 - A. Section Includes:
 - 1. Indoor air handling units.
 - B. Related Requirements:
 - 1. Division 01: General Requirements.
 - 2. Section 23 0500: Common Work Results for HVAC.
 - 3. Section 23 0513: Basic HVAC Materials and Methods.
 - 4. Section 23 0548: HVAC Sound, Vibration and Seismic Control.
 - 5. Section 23 0700: HVAC Insulation.
 - 6. Section 23 0900: HVAC Instrumentation and Controls.
 - 7. Section 23 8000: Heating, Ventilating and Air Conditioning Equipment.

1.02 REFERENCES

- A. Air Movement and Control Association International, Inc. (AMCA):
 - 1. AMCA 211 Certified Ratings Program Product Rating Manual for Fan Air Performance.
 - 2. AMCA 300 Reverberant Room Method for Sound Testing of Fans.
 - 3. AMCA 301 Methods for Calculating Fan Sound Ratings from Laboratory Test Data.
- B. Air-Conditioning, Heating, and Refrigeration Institute (AHRI):
 - 1. AHRI 410 Forced Circulation Air-Cooling and Air-Heating Coils.
- C. American Society for Testing and Materials International (ASTM):
 - 1. ASTM B117 Standard Practice for Operating Salt Spray (Fog) Apparatus.
 - 2. ASTM D2247 Standard Practice for Testing Water Resistance of Coatings in 100 Percent Relative Humidity.



- 3. ASTM E84 Standard Test Method for Surface Burning Characteristics of Building Materials.
- D. National Fire Protection Association (NFPA):
 - 1. NFPA 90A Standard for the Installation of Air-Conditioning and Ventilating Systems.
- E. Underwriters Laboratories, Inc. (UL):
 - 1. UL 181 Standard for Factory-Made Air Ducts and Air Connectors.
 - 2. UL 723 Standard for Test for Surface Burning Characteristics of Building Materials.
 - 3. UL 1995 Heating and Cooling Equipment.
- F. Underwriters Laboratories of Canada (ULC):
 - 1. CAN/ULC-S102.2 Standard Method of Test for Surface Burning Characteristics of Flooring, Floor Coverings, and Miscellaneous Materials and Assemblies.
- G. American Society of Heating, Refrigerating, and Air-Conditioning Engineers (ASHRAE):
 - 1. ASHRAE Standard 62.1 Ventilation for Acceptable Indoor Air Quality.
- H. National Electrical Manufacturers Association (NEMA):
 - 1. NEMA MG 1, Table 12-10: NEMA Threshold Full-Load Nominal Efficiency Values for Energy-Efficient Motors.
- 1.03 SUBMITTALS
 - A. Comply with provisions of Division 01 and Section 23 05 00: Common Work Results for HVAC.
 - B. Manufacturer's Data:
 - 1. Complete materials list of items proposed to be furnished and installed under this Section. Materials lists, which do not require performance data, shall include manufacturer's name, type, and model number for indicated installation.
 - 2. Manufacturer's specifications and other data required to demonstrate compliance with specified requirements. Literature shall include descriptions of equipment, types, models and sizes proposed, capacity tables or curves marked to indicate performance characteristics, electrical requirements, options selected, space requirements and other data



necessary to ensure compliance with requirements of this Specification and performances indicated on Drawings.

- 3. Provide data of filter media, filter performance data, filter assembly, and filter frames.
- C. Shop Drawings indicating methods of installation of equipment and materials, and details of supporting structures for items indicated. Items to be submitted shall include but not be limited to the following:
 - 1. Layout Drawings of Equipment: Include plans, elevations, and sections, of proposed equipment drawn to scale, to establish which equipment shall fit in allotted spaces with clearance for installation and maintenance. Indicate proposed details for attachment. Indicate vibration isolation units, foundations, supports, and openings for passage of pipes and ducts.
 - 2. Electrical interlock or control diagrams for electrically controlled components furnishing more than one automatic or manual control devices, which are not indicated on Drawings.
- D. Manufacturer's Recommended Installation Procedures: Manufacturer's recommended installation procedures, when reviewed by the Architect shall become basis for inspecting actual installation procedures provided.
- E. Acoustical Test Report: Submit complete acoustical test reports showing that proposed products have been tested in accordance with latest versions of AMCA Standard 300, Reverberant Room Method for Sound Testing of Fans, and AMCA Standard 301, Methods for Calculating Fan Sound Ratings from Laboratory Test Data.
- F. Submit test certification stating compliance with the maximum requirement of 1 percent cabinet leakage of the specified airflow.
- G. Operations and Maintenance Data: Include instructions for lubrication, filter replacement, motor and drive replacement, spare parts list and wiring diagrams.
- 1.04 QUALITY ASSURANCE
 - A. Qualifications of Manufacturers and Installers: Comply with provisions in Section 23 05 00: Common Work Results for HVAC.
 - B. Sound Level Measurements and Calculations:
 - 1. Sound power level measurements and calculations shall be made in complete accordance with latest version of AMCA Standard 300, Methods for Calculating Fan Sound Ratings from Laboratory Test Data, and AMCA Standard 301, Methods for Calculating Fan Sound Ratings from Laboratory Test Data.
 - 2. The results of all testing shall be certified by independent testing agency or an AMCA-approved testing laboratory and submitted to architect for



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approval. The submittal shall include a complete description of test conditions, methods and procedures, including specific installation type used for measurements, as detailed in AMCA 300.

- 3. Maximum Allowable Sound Power Levels: Maximum allowable sound power levels for supply discharge, return intake, and casing radiated noise shall not exceed values given in schedule below as indicated on drawings with equipment operating at design airflow and static pressure conditions.
- C. Factory Leak Testing: Manufacturer shall provide a factory leak test on units at design total static pressure across the cabinet exterior walls. Cabinet leakage shall not exceed 1 percent of specified airflow on the operating side of the unit. All panels shall be sealed with closed cell gasketing material. A written test report shall be prepared by the manufacturer and submitted to the Architect.

1.05 PROJECT RECORD DOCUMENTS

A. Provide Owner instructions on equipment operation and maintenance procedures, as indicated in Section 23 05 00: Common Work Results for HVAC.

1.06 PRODUCT HANDLING

A. Protection, Replacements, Delivery and Storage: Comply with provisions stated under Section 23 05 00: Common Work Results for HVAC.

PART 2 – PRODUCTS

2.01 CUSTOM INDOOR CENTRAL STATION AIR HANDLING UNIT:

- A. General:
 - 1. Central station air-handling unit specially designed, fabricated and factory tested for the capacity, configuration, arrangement and components as indicated on Drawings.
 - 2. Units shall be UL or ETL approved to ensure compliance with electrical codes.
 - 3. Unit shall be serviceable through service clearances indicated on drawings.
 - 4. Unit dimensions shall not exceed dimensions indicated on drawings.
- B. Base Frame: Provide a full perimeter welded base frame capable of mounting to a curb and supporting unit during shipment, installation, and operation. Base frame shall be manufactured with structural steel tubing or C-Channel support members. Formed metal base rails with bolted or screwed support members are not acceptable. Base and unit frame shall be painted with a gray phenolic, corrosion inhibitive primer. Base rails shall be fitted with lifting lugs at corner of



unit or section (if demounted). Base rail shall overhang curb to facilitate water run-off and protection of curb-to-base connection from water intrusion. Base shall include a formed pocket that seats on roof curb gasketing to provide a positive, weather-tight seal.

- C. Base: The base shall include 2-inch foam insulation or a 4-inch thick fiberglass insulated "double bottom" floor with minimum 20 gage G-90 galvanized outer and 14 gage G-90 galvanized inner walk-on surface. Subfloor is not required with 2-inch foam insulation unless the underfloor is being used as a return air plenum. All floor seams shall be sealed for an airtight unit. Where access is provided to unit interior, floor openings shall be covered with walk on steel safety grating. Single wall floors with glued and pined insulation are not acceptable. Base frame shall be attached to unit at factory.
- D. Casing:
 - 1. Sections of unit shall be of same construction and finish except for interior panels that are specified differently for individual sections.
 - 2. Exterior Panels: Exterior panels including cooling coil sections shall be minimum 2-inch thick formed 16 gage galvanized steel. Provide necessary support to limit casing deflection to 1/200 of narrowest panel dimension. If panels cannot meet this deflection, add additional internal reinforcing. Panel seams shall be fully welded or sealed for an airtight unit. Leakage rates shall be less than 1 percent at design static pressure. The exterior panel finish shall have a polyurethene paint system that is designed for long term corrosion resistance meeting or exceeding ASTM B117, Salt Spray Resistance, at 95 degrees F, 1,000 hrs. and ASTM D2247, Humidity Resistance, at 95 degrees F, 1,000 hrs. The color shall be sterling gray.
 - 3. Interior Panels: Casing shall be of double wall construction with 20 gage interior galvanized steel liner in all sections and 22 gage galvanized steel perforated liner in all fan sections.
 - 4. Insulation: Casing shall have 2-inch minimum thickness foam injected R-13 insulation.
 - 5. Thermal Breaks: Casing construction downstream of the cooling coil shall consist of thermal break panels to prevent condensation from accumulating on outer walls
 - 6. Access doors shall be of double wall construction and shall be installed on stainless steel hinges for outward opening applications. Multiple handles of no more than four, shall be provided to assure positive closure. Handles shall be zinc alloy or glass reinforced nylon and rated to meet 500 hour salt-spray requirements. Doors shall be furnished with 2 seals with an atmospheric break between two seals to ensure zero negative pressure. The outer seal shall shield water from inner seal. Doors shall open outward for negative pressure and inward for positive



pressure applications. Operating pressure of unit shall ensure that door compresses gasket seal. Doors shall open against system pressure. Provide ETL, UL, and CAL/OSHA approved tool operated safety latch on all fan section access doors. Access doors downstream of the cooling coil shall be thermal break.

- 7. Floors shall be double wall. Insulation shall be capped to isolate floor insulation from both airstream and from potential water damage.
- 8. Units shall be provided with exterior paint.
- 9. Unit shall provide an integral base which is capable of curb, platform or pad mounting and supporting unit during shipment, installation, and operation.
- E. Fan Section:
 - 1. General: Fan section shall be furnished with a structural steel base for integral mounting of fan assembly and casing panels. Fan scroll, wheel, shaft, bearings, drives, and motor shall be installed on a structural steel base frame assembly isolated from outer casing with factory-installed, spring isolators of deflection indicated on drawings. This base frame assembly shall be seismically braced. Flexible connectors shall be provided between fans and stationary part of unit. Wiring shall be in flexible conduit. Comply with Section 23 0548: HVAC Sound, Vibration and Seismic Control. Hinged access door, as specified above, shall be provided on both sides of unit.
 - Fans: Each unit shall be furnished with one or more supply fans as required. Fans shall be double-width, double-inlet type with backward curved airfoil blades or shall be single width, single inlet, ARR. 1 or ARR. 4 plug type fans with backward curved airfoil blades as indicated on equipment schedule. Fans shall be AMCA Class II rated.
 - 3. Fan Bearings: Bearings shall be selected for a minimum L10 life (200,000 hours) at maximum horsepower and operating speed for classification. Bearings shall have same bore, type and manufacturer. Rigid support for inlet bearing must be removable for access to wheel.
 - 4. Fan Wheels: Fan wheels shall be painted with zinc chromate primer and an enamel finish coat, unless constructed of aluminum. Fan wheels shall be keyed to shaft and shall be designed for continuous operation at maximum rated fan speed and motor horsepower. Fan wheels and shafts shall be selected to operate at 25 percent below first critical speed, and shall be statically and dynamically balanced as an assembly at factory.
 - 5. Fan shafts: Fan shafts shall be solid steel, turned, ground, polished, and coated with rust-preventive oil. Access doors shall be provided so fan shaft may be removed without removal of casing panels and to facilitate air balancing of system.



- 6. Fan Motor: The motor shall be installed within fan section casing on adjustable slide rails. Motor shall be open drip-proof, NEMA Design B with size and electrical characteristics as indicated on equipment schedule. Motors shall be mounted on a horizontal flat surface and shall not be supported by fan or its structural members. Each motor shall be tested to IEEE Standard 112, test method B, and NEMA MG 1 Article 12.58.2 and 12.59 Table 12-10 and bear a factory certification run test label to verify compliance. Motors shall be premium efficiency, inverter duty, with minimum 90 percent efficiency for motors greater than 3 horsepower.
- 7. Fan Drives: Fan drive shall be designed for a minimum 1.3 service factor, shall be constant-speed variable pitch for motors 15 hp or less, and shall be constant-speed fixed-pitch for 20 hp and larger. Drives shall be factory mounted, with belts aligned and tensioned.
- 8. Fan Sound Ratings: Fans shall be AMCA 211 rated for performance and AMCA 300 and 301 rated for sound.
- 9. Accessories: The fan section shall be furnished with double pane glass viewport with safety wire reinforcement, field wired service light with safety cage and extended lubrication lines to unit exterior for fan motor and fan bearings
- F. Coil Section:
 - 1. General: Coil sections shall be fabricated of insulated galvanized steel panels. Coils shall be easily removable from side of units. Where 2 or more coils are installed in a coil bank, 304 stainless steel intermediate drain pans that extend a minimum of 6 inches from coil face shall be provided and condensate shall be piped to bottom drain pan. The bottom coil shall not serve as a drain path for upper coil. Main drain pan shall be insulated double-wall 304 stainless steel, sloped toward drain fitting. Drain fitting shall be flush with bottom pan for side discharge, FPT 304 stainless steel connection and shall comply with ASHRAE Standard 62 recommendations. A maximum of one drain shall be furnished for each cooling coil section. Moisture shall not carry over past coil.
 - 2. Coil Test and Standards: Coils shall be leak tested at 450 psig air pressure while submerged in water. Coil performance shall be certified in accordance with AHRI Standard 410. Coils shall be furnished with galvanized steel casing as standard.
 - 3. Coil Tubes: Tube wall thickness shall not be less than 0.02 inch. Tube diameter with 0.025 inch brazed return bends on water and refrigerant coils. Tubes shall be 5/8 inch OD to ensure high thermal performance with lower total flow and reduced pumping requirements. Intermediate tube support shall be provided for coils over 44-inch fin length with an additional support every 42 inches.



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- a. Coil options shall be furnished with aluminum fin construction.
- G. Filter Section:
 - 1. General: Each filter section shall be designed and constructed to house specific type of filter indicated on equipment schedule. Provide filters of type indicated on schedule. A double-walled hinged access door, as specified above, shall be provided on side of section. Internal blank-offs shall be provided to prevent air bypass around filters.
 - 2. Filter tracks in flat or cartridge filter sections: Filter tracks in flat or cartridge filter sections shall be upstream loaded Type 8 constructed from galvanized steel to ensure rigidity and tight tolerances. Tracks must be field adjustable without tools and designed to accept standard-size filters with one inch, 2-inch, or 4-inch widths.
 - 3. Filter tracks in angle filter sections: Filter tracks in angle filter sections shall be constructed from galvanized steel to ensure rigidity and tight tolerances. Angle filter sections shall be designed to hold 2-inch filters of standard sizes, arranged in horizontal V-formation.
 - 4. Each filter bank shall be provided with a Dwyer Series 2000 Magnehelic Differential Pressure Gage, or equal.
 - 6. Mixing boxes or Economizer Section: Combination exhaust mixing boxes and filter-mixing boxes shall be furnished with opposed blades, interconnecting outside-air and return-air low leak dampers. Mixing boxes and filter-mixing boxes shall be furnished with a double-walled hinged access door as specified. Floors of 16 gage galvanized steel shall be furnished for mixing boxes to protect insulation during installation and servicing of damper actuators. Non-ducted outside air intakes shall include stationary louvers to reduce opportunity for rain or snow to enter unit.
- H. Damper Section:
 - 1. Face and bypass sections shall be furnished with opposed-acting damper blades in face damper and opposed bypass damper. Blades shall be double-skin airfoil type.
 - 2. Damper blades shall be extruded aluminum, housed in a galvanized steel frame and mechanically fastened to a hex axle rod rotating in stainless steel bearings. Dampers shall be sectionalized to limit blade length to no more than 48 inches so as to minimize blade warpage. Replaceable neoprene blade seals are to be provided to insure tight closure.
 - 3. Dampers shall be rated for maximum leakage rate per square foot of 7 cf. at 1.0 inch wg. Optional premium dampers shall be available for maximum leakage rate per square foot of 5 cfm at 1.0 inch wg. Damper



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blades shall be double-skin extruded aluminum airfoil type with stainless steel jam seals.

- I. Plenum Sections:
 - 1. General: Inlet, discharge, access, and plenum sections shall be installed where indicated on Drawings and shall be as specified on equipment schedule.
 - 2. Inlet section: Inlet section shall be provided with extruded aluminum stationary louvers. Louvers shall be drainable type with built in downspouts and furnished with birdscreen. Blades shall be vertical and housed inside an aluminum frame and mounted to unit exterior. Louvers shall be painted to match unit exterior.
 - 3. Access sections: Access sections shall be provided by a double-walled hinged door, as specified above and 16 gage galvanized steel floors to protect insulation.
 - 4. Downblast discharge section: Downblast discharge section, which provides an opening through roof, shall be furnished with a grating over duct opening of sufficient size and strength to support a minimum of 300 pounds.
 - 5. Diffuser sections: Diffuser sections shall consist of casings as specified with an integral perforated aluminum plate installed on discharge side of supply fan to ensure even and uniform air distribution over adjacent downstream component. Not required on plug fan applications.
 - a. Blow-thru coil sections shall be provided with diffuser as an integral part of coil section and shall not extend length of standard section.
 - b. Diffuser sections shall be available and required if a filter section is directly following fan.
 - c. Unit panels shall be constructed of 16 gage galvanized steel.
 - d. A hinged access door shall be provided down-stream of mixer if specified. It shall be full height, insulated double-wall, with full perimeter gasketing.
 - e. Unit shall mix two or more air streams of different temperatures to within a range of six degrees F standard deviation of theoretical mixed-air temperature and shall provide a more uniform air velocity contour entering a downstream filter or coil bank.
- J. Sound Attenuators: Sound attenuators as specified in Section 23 0548 shall be provided as an integral part of unit when specified or indicated on drawings.



- K. Electrical: Provide electrical and automatic control devices that are listed below and on drawings:
 - 1. The units shall be factory pre-wired for a single point electrical power connection for both power and control circuits. Manufacturer shall provide a factory furnished and wired step down transformer with a fused disconnect for 120 Volt service.
 - 2. Provide a main disconnect for each unit.
 - 3. Each fan motor shall be wired to a non-fusible disconnect.
 - 4. The unit shall be equipped with vapor proof light fixtures with guard.
 - 5. Lights shall be controlled by one light switch mounted adjacent to supply air fan access door. Lights shall be provided in each accessible section.
 - 6. Furnish a 120 Volt duplex convenience outlet on exterior of unit. Locate outlet next to fan section access door.
 - 7. A separate Variable Frequency Drive and three contactor bypass is required for each motor in unit including factory mounting and wired to motor. Danfoss, ABB, Toshiba, or equal.
 - 8. VFDs shall be recessed or surface mounted as shown on the drawings.
- L. Acoustical Performance Requirements: The sound generating characteristics of air handling and multi-zone units shall be tested to, and comply with, all requirements of this specification. Representative samples shall be subjected to tests in accordance with applicable standards and procedures in order to demonstrate such compliance. A special test for this project is not required if manufacturer has previous certified test results that can be made applicable to this project.
- M. Manufacturer: Trane, or equal.

PART 3 – EXECUTION

3.01 GENERAL

- A. Examine areas under which Work of this Section will be performed. Correct conditions detrimental to proper and timely completion of Work. Do not proceed until unsatisfactory conditions have been corrected.
- 3.02 EQUIPMENT FOUNDATIONS
 - A. Equipment foundations shall be of sufficient size and weight, and of proper design to preclude shifting of equipment under operating conditions, or under any abnormal conditions imposed upon equipment.



B. Foundations shall meet requirements of equipment manufacturer and, when required by the Architect, obtain from equipment manufacturer, approval of foundation design and construction for equipment to be installed. Equipment vibration shall be maintained within design limits, and shall be dampened and isolated. Isolators shall be bolted to a steel member so as to be readily removable.

3.03 EQUIPMENT INSTALLATION

- A. Equipment Installation: Equipment installation shall be in strict accordance with these Specifications, and installation instructions of manufacturers. Equipment installed on concrete foundations shall be grouted before piping is installed. Piping shall be installed in such a manner as not to place a strain on any of the equipment. Flanged joints shall be adequately extended before installation.
 - 1. Install equipment in a neat and skillful manner, properly aligned, leveled, and adjusted for satisfactory operation.
 - 2. Install so connecting and disconnecting of piping and accessories can be readily accomplished, parts are readily accessible for inspection, service and repair. Space shall be provided to readily remove filters, coils, and fan wheels.

3.04 NOISE AND VIBRATION

- A. Operation of Equipment: Mechanical equipment and piping systems shall operate without exceeding specified noise and/or vibration levels.
- B. Corrective Measures: If specified noise and/or vibration levels are exceeded, provide necessary changes to reduce noise and/or vibration levels to within specified levels.
- 3.05 FIELD TESTS AND INSPECTION
 - A. General: Perform field inspections, field tests, and trial operations as specified in Section 23 0500: Common Work Results for HVAC. Provide labor, equipment and incidentals required for testing. The Project Inspector will witness field tests and trial operations as specified in Section 23 0500: Common Work Results for HVAC.
 - B. Equipment and Material: Equipment and material certified as being successfully tested by manufacturer, in accordance with referenced Specifications and standards, will not require re-testing before installation. Equipment and materials not tested at the place of manufacture will be tested before or after installation, as applicable or necessary, to determine compliance with reference Specifications and standards.
 - C. Start-Up and Operational Test: System shall be started up and initially operated with components operating. During this test, filters shall be periodically cleaned until no further accumulation of foreign material occurs. Adjust safety and automatic control instruments as required to provide proper operation and control sequence. Refer to Section 23 0500: Common Work Results for HVAC.



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- D. Extent of Field Tests: After installation and before completion, Work of this Section shall be subjected to required field tests, including those specified here and in Section 23 0500: Common Work Results for HVAC.
- E. Operation and Maintenance Data: Provide required operation and maintenance data as specified in Section 23 0500: Common Work Results for HVAC.
- 3.06 PROTECTION
 - A. Protect the Work of this Section until Substantial Completion.
- 3.07 CLEANUP
 - A. Remove rubbish, debris, and waste materials and legally dispose of off the Project site.

END OF SECTION



SECTION 23 80 00 - HEATING, VENTILATING AND AIR CONDITIONING EQUIPMENT

PART 1 – GENERAL

1.01 SUMMARY

- A. Section Includes: Air conditioning and air handling equipment including but not limited to:
 - 1. Fans.
 - 2. Package Roof Top Air Conditioning Units.
- B. Related Requirements:
 - 1. Division 01: General Requirements.
 - 2. Section 07 60 00: Flashing and Sheet Metal.
 - 3. Section 22 10 00: Plumbing.
 - 4. Section 23 05 00: Common Work Results for HVAC.
 - 5. Section 23 05 13: Basic HVAC Materials and Methods.
 - 6. Section 23 05 48: HVAC Sound, Vibration and Seismic Control.
 - 7. Section 23 09 00: HVAC Instrumentation and Controls.
 - 8. Section 23 09 23: Environmental Control and Energy Management System.
 - 9. Section 23 30 00: Air Distribution.

1.02 DESIGN REQUIREMENTS

A. Work of this Section is based on HVAC equipment units indicated as Basis of Design in Part 2 of this Section. Products from different HVAC equipment manufacturers listed are never identical, although equivalent in capacity, performance and quality. In the cases where dimensions, weight, configuration and utility requirements differ from the products used as a basis of design, the Contractor, at no additional cost to the Owner, shall coordinate and submit, for Architect review, revisions to the design.

1.03 SUBMITTALS

A. Provide in accordance with Division 01 and Section 23 05 00: Common Work Results for HVAC.

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- B. For products listed that are not the basis of design, submit the following in addition to above requirements:
 - 1. Title 24 Calculations: Replace HVAC unit values in calculation files provided by the Architect and submit for review.

1.04 QUALITY ASSURANCE

A. Provide submittals in accordance with Section 23 05 00: Common Work Results for HVAC.

1.05 PROJECT RECORD DOCUMENTS

A. Provide Owner instructions on equipment operation and maintenance procedures, as indicated in Section 23 05 00: Common Work Results for HVAC.

1.06 WARRANTY

- A. Compressors shall be provided with manufacturer's five year warranty, replacement only.
- B. Manufacturer shall warrant parts, except heat exchangers, for a period of five years.
- C. Heat exchangers shall be provided with manufacturer's ten year warranty, replacement only.

PART 2 – PRODUCTS

2.01 EQUIPMENT

A. Capacities of air conditioning equipment indicated on Drawings are net capacities actually required. Standard catalog ratings shall be adjusted to actual Project site environmental conditions.

2.02 ROOF MOUNTED POWER EXHAUST VENTILATORS

- A. RMEV-1
 - 1. Manufacturer:

GREENHECK	LOREN COOK
GB Series	ACEB



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- 2. Spun aluminum, roof mounted, belt driven, downblast centrifugal exhaust ventilator, with components as indicated and specified. Sizes, performances, and accessories shall be as indicated on equipment schedules on Drawings. Provide required accessories for proper operation and balancing of fans in accordance with design intent and sequence of operation.
- Certification: Fan shall be listed by Underwriters Laboratories Inc (UL 705). Fan shall bear AMCA Certified Ratings Seals for Fan Sound and Air Performance.
- 4. Housing: The fan shall be of bolted and welded construction utilizing The spun aluminum structural corrosion resistant fasteners. components shall be constructed of minimum 18 gage Aluminum, bolted to a rigid aluminum support structure. The aluminum base shall have continuously welded curb cap corners for maximum leak protection. The discharge baffle shall have a rolled bead for added strength. A two piece top cap shall have stainless steel, or galvanized quick release latches to provide access into motor compartment without use of tools, or screws. An integral conduit chase shall be provided through curb cap and into motor compartment to facilitate wiring connections. The motor, bearings and drives shall be mounted on a minimum 16 gage steel power assembly, isolated from unit structure with rubber vibration isolators. These components shall be enclosed in a weather-tight compartment, separated from exhaust airstream. Lifting lugs shall be provided to help prevent damage from improper lifting. Unit shall bear an engraved aluminum nameplate.
- 5. Wheel: Wheel shall be centrifugal backward inclined, constructed of 100 percent aluminum, including a precision machined cast aluminum hub. Wheel inlet shall overlap an aerodynamic aluminum inlet cone to provide maximum performance and efficiency. Wheel shall be balanced in accordance with AMCA Standard 204, Balance Quality and Vibration Levels for Fans.
- 6. Motor: Motor shall be heavy-duty ECM type with permanently lubricated sealed ball bearings and furnished at specified voltage, phase, and enclosure.
- 7. Bearing: Bearings shall be designed and individually tested specifically for use in air handling applications. Construction shall be heavy duty regreasable ball type in a cast iron pillow block housing selected for a minimum L50 life in excess of 200,000 hours at maximum cataloged operating speed.
- 8. Belts and Drives: Belts shall be oil and heat resistant, non-static type. Drives shall be precision-machined cast iron type, or heavy gauge

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galvanized steel, keyed and securely attached to wheel and motor shafts. Drives shall be sized for 150 percent of installed motor horsepower. The variable pitch motor drive must be factory set to specified fan RPM.

- B. RMEV-2:
 - 1. Manufacturer:

GREENHECK	LOREN COOK
G Series	ACED

- 2. Spun aluminum, roof mounted, direct driven, downblast centrifugal exhaust ventilator, with components as indicated and specified. Sizes, performances, and accessories shall be as indicated on equipment schedules on Drawings. Also, provide accessories for proper operation and balancing of fans in accordance with design intent and sequence of operation.
- Certification: Fan shall be listed by Underwriters Laboratories Inc. (UL 705). Fan shall bear AMCA Certified Ratings Seals for Fan Sound and Air Performance.
- 4. Housing: The fan shall be of bolted and welded construction utilizing corrosion resistant fasteners. The spun aluminum structural components shall be constructed of minimum 18 gage Aluminum, bolted to a rigid aluminum support structure. The aluminum base shall have continuously welded curb cap corners for maximum leak protection. The discharge baffle shall have a rolled bead for added strength. An integral conduit chase shall be provided through curb cap and into motor compartment to facilitate wiring connections. The motor shall be enclosed in a weather-tight compartment, separated from exhaust airstream. Unit shall bear an engraved aluminum nameplate.
- 5. Wheel: Wheel shall be centrifugal backward inclined, constructed of 100 percent aluminum, including a precision machined cast aluminum hub. An aerodynamic aluminum inlet cone shall be provided for maximum performance and efficiency. Wheel shall be balanced in accordance with AMCA Standard 204, Balance Quality and Vibration Levels for Fans.
- 6. Motor: Motor shall be heavy-duty ECM type with permanently lubricated sealed bearings and furnished at specified voltage, phase, and enclosure.
- C. RMEV-3:

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1. Manufacturer:

GREENHECK	LOREN COOK
CUBE Series	ACRUB

- 2. Spun aluminum, roof mounted, belt driven, upblast centrifugal exhaust ventilator, with components as indicated and specified. Sizes, performances, and accessories shall be as indicated on equipment schedules on Drawings. Also, provide accessories for proper operation and balancing of fans in accordance with design intent and sequence of operation.
- 3. Certification: Fan shall be listed by Underwriters Laboratories Inc. (UL 705). Fan shall bear AMCA Certified Ratings Seals for Fan Sound and Air Performance.
- 4 Housing: The fan shall be of bolted and welded construction utilizing corrosion resistant fasteners. The spun aluminum structural components shall be constructed of minimum 18 gage Aluminum, bolted to a rigid aluminum support structure. The aluminum base shall have a one piece inlet spinning and continuously welded curb cap corners for maximum leak protection. The windband shall have a rolled bead for added strength. A two piece top cap shall have stainless steel, or galvanized quick release latches to provide access into motor compartment without use of tools, or screws. An integral conduit chase shall be provided into motor compartment to facilitate wiring connections. The motor, bearings and drives shall be mounted on a minimum 16 gage steel power assembly, isolated from unit structure with rubber vibration isolators. These components shall be enclosed in a weather-tight compartment, separated from exhaust airstream. Lifting lugs shall be provided to help prevent damage from improper lifting. Unit shall bear an engraved aluminum nameplate.
- 5. Wheel: Wheel shall be centrifugal backward inclined, constructed of 100 percent aluminum, including a precision machined cast aluminum hub. Wheel inlet shall overlap an aerodynamic aluminum inlet cone to provide maximum performance and efficiency. Wheel shall be balanced in accordance with AMCA Standard 204, Balance Quality and Vibration Levels for Fans.
- 6. Motor: Motor shall be heavy-duty ECM type with permanently lubricated sealed ball bearings and furnished at specified voltage, phase, and enclosure.
- 7. Bearing: Bearings shall be designed and individually tested specifically for use in air handling applications. Construction shall be heavy-duty regreasable ball type in a cast iron pillow block housing selected for a

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minimum L50 life in excess of 200,000 hours at maximum cataloged operating speed.

- 8. Belts and Drives: Belts shall be oil and heat resistant, non-static type. Drives shall be precision machined cast iron, or galvanized steel type, keyed and securely attached to wheel and motor shafts. Drives shall be sized for 150 percent of installed motor horsepower. The variable pitch motor drive must be factory set to specified fan RPM.
- D. RMEV-4:
 - 1. Manufacturer:

GREENHECK	LOREN COOK
CUE Series	ACRUD

- 2. Spun aluminum, roof mounted, direct driven, upblast centrifugal exhaust ventilator, with components as indicated and specified. Sizes, performances, and accessories shall be as indicated on equipment schedules on Drawings. Also, provide accessories for proper operation and balancing of fans in accordance with design intent and sequence of operation.
- Certification: Fan shall be listed by Underwriters Laboratories Inc. (UL 705). Fan shall bear AMCA Certified Ratings Seals for Fan Sound and Air Performance.
- 4. Housing: Fan shall be of bolted and welded construction utilizing corrosion resistant fasteners. The spun aluminum structural components shall be constructed of minimum 18 gage Aluminum, bolted to a rigid aluminum support structure. The aluminum base shall have a one piece inlet spinning and continuously welded curb cap corners for maximum leak protection. The windband shall have a rolled bead for added strength. An integral conduit chase shall be provided into motor compartment to facilitate wiring connections. The motor shall be enclosed in a weather-tight compartment, separated from exhaust airstream. Unit shall bear an engraved aluminum nameplate.
- 5. Wheel: Wheel shall be centrifugal backward inclined, constructed of 100 percent aluminum, including a precision machined cast aluminum hub. An aerodynamic aluminum inlet cone shall be provided for maximum performance and efficiency. Wheel shall be balanced in accordance with AMCA Standard 204, Balance Quality and Vibration Levels for Fans.





6. Motor: Motor shall be heavy-duty ECM type with permanently lubricated sealed bearings and furnished at specified voltage, phase, and enclosure.

2.03 FILTERS

Budlong

3361-008-000

- A. Air filter media shall be minimum 2-inch thick, MERV 13 Class 2, 100% synthetic, high capacity, pleated, disposable type, with support grid and enclosing frame, continuously laminated on a supporting moisture resistant beverage board type frame that conforms to the configuration of the pleats. Media shall be glued to the frame along all four sides and glued horizontally & diagonally to grill members on both sides. The media shall be unaffected by water and humidity, be non-toxic, non-allergenic, and shall not support the growth of any fungi or bacteria. Filter shall have rigid outer frame that will not bend or distort under normal usage. Filter shall be UL 900 listed, Class 2.
- B. Filter media shall provide an average efficiency as specified on drawings per ASHRAE Standard 52.2.
- C. Initial resistance of air filters shall not exceed following limits for each efficiency level at face velocities indicated. Lower resistance requirements, if indicated on drawings shall have precedence.

85 percent (MERV 13)	0.30 inch water gage at 500 feet per minute
95 percent (MERV 14)	0.38 inch water gage at 500 feet per minute

- D. Use standard size Filter Medias only.
- E. Media support shall be a welded wire grid or a rigid frame with an effective open area of not less than 96 percent.
 - 1. Media support shall be bonded to filter media to eliminate possibility of media oscillation and media pull-away.
 - 2. Media support grid shall be formed in such a manner that it effectively forms a radial pleat design, providing total use of filter media.
- F. Enclosing frame shall be bonded to air entering and air exit side of each pleat, to ensure pleat stability. Inside periphery of enclosing frame shall be bonded to filter pack, thus eliminating possibility of air bypass.
- G. Holding frames shall be factory fabricated of 16 gage galvanized steel, or equivalent and shall be furnished with gaskets and spring type positive sealing fasteners. Fasteners shall be capable of being attached or removed without use of tools.
- H. Manufacturers: Camfil Farr, Koch, or AAF.
- 2.04 LOUVERS, AIR CONDITIONING (use in conjunction with relief damper)

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- A. Standard steel louvers shall be furnished complete with frames, blades, finish and construction details per Drawings and manufacturer's recommendations.
- B. Louvers shall be furnished with horizontal blades, 2 inches deep for air through wall installation in conjunction with gravity relief damper for backdraft protection that will open at 0.01-inch wc room static pressure as indicated on Drawings. Blades shall be 16-gage steel, spaced at 1 7/8-inch at 30 degrees angle, and with baked epoxy coating. Panel size shall be as indicated but not less than 24 inches width by 18 inches in height.

PART 3 – EXECUTION

- 1.01 GENERAL
 - A. Examine areas under which Work of this Section will be performed. Correct conditions detrimental to proper and timely completion of Work. Do not proceed until unsatisfactory conditions have been corrected.
- 1.02 EQUIPMENT FOUNDATIONS
 - A. Provide foundations (housekeeping pads, level platforms or curbs) for mechanical equipment whether indicated on drawings or not. Equipment foundations shall be of sufficient size and weight, and of proper design to preclude shifting of equipment under operating conditions, or under abnormal conditions imposed upon equipment.
 - B. Provide foundations (housekeeping pads, level platforms or curbs) for mechanical equipment whether indicated on drawings or not. Foundations shall meet requirements of equipment manufacturer and, when required by Architect, obtain from equipment manufacturer, approval of foundation design and construction, for equipment to be installed. Equipment vibration shall be maintained within design limits, and shall be dampened and isolated. Isolators shall be bolted to a structural member so as to be readily removable.

1.03 EQUIPMENT DESIGN AND INSTALLATION

- A. Uniformity: Unless otherwise specified, equipment of same type or classification shall be product of same manufacturer.
- B. Application: Only provide equipment as reviewed by Architect.
- C. Equipment Installation: Equipment installation shall be in strict accordance with these Specifications, and installation instructions of manufacturers. Equipment installed on concrete foundations shall be grouted before piping is installed. Piping shall be installed in such a manner as not to place a strain on equipment. Flanged joints shall be adequately extended before installation. Piping shall be graded, anchored, guided and supported, without low pockets.

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- 1. Install equipment in a neat and skillful manner, properly aligned, leveled, and adjusted for satisfactory operation.
- 2. Install so connecting and disconnecting of piping and accessories can be readily accomplished, parts are readily accessible for inspection, service and repair. Space shall be provided to readily remove filters, coils, compressors and fan wheels. Access doors shall be hinged with cam lock door handles.
- 3. Provide flexible connections for duct, pipe and conduit connections at moving equipment.

1.04 ROOF-TOP EQUIPMENT MOUNTING

- A. Downflow Packaged Units: Install unit on a prefabricated mounting frame or curb secured directly to roof. Follow manufacturers recommended installation manuals. Submit Shop Drawings for review by Architect.
- B. Horizontal Flow Packaged Units: Install unit on platform or prefabricated mounting frame or curb secured directly to roof designed to suit roof conditions and requirements of provided unit. Submit Shop Drawings for review by Architect.

1.05 REFRIGERANT PIPING INSTALATION

- A. Unless otherwise indicated, main liquid and suction lines from condensing unit to Indoor coil shall be of sizes specified by manufacturer.
- B. Refrigeration piping shall be refrigeration grade copper tubing, type L hard-drawn. In instances where refrigeration lines are installed in an inaccessible location and must be snaked through conduit or a trench, that portion of tubing required to complete connections through conduit or trench may be soft drawn. Maintain entire system clean and dry during installation. Pipe shall be sealed until installed.
- C. Refrigeration piping, both hard and soft-drawn, shall be straight and free from kinks, restrictions and horizontal runs shall be sloped towards compressor one inch to 10 feet wherever possible. Vapor line oil traps shall be installed on bottom of vertical risers and inverted oil trap shall be installed on top of vertical risers.
- D. Joints shall be installed with Sil-Fos 15, Silvaloy 15, or equal.
- E. Flare nuts required on suction lines shall be of short forged or frost-proof type. Other fittings shall be standard sweat-soldered type. Ells and return bends shall be long radius type. Install leak lock material.
- F. Refrigeration Piping: Joints shall be silver brazed and tested according to the section 23 0500 "Common Work Results for HVAC". Construct joints according to AWS's "Brazing Handbook," "Pipe and Tube" Chapter. Field fabricated lines shall be thoroughly deburred, flushed and cleaned before connection. Bleed nitrogen through





lines during silver brazing, maintain Nitrogen flow rate of 1.75 cubic feet per minute or more using a pressure regulator. Cap and seal lines when not completed and connected to equipment.

- 1. Brazing or Debrazing shall always be conducted with nitrogen purging through the refrigeration system.
- 2. Arrange a refrigerant piping pre-installation conference between Contractor, Architect, IOR, and OAR to review and confirm installation method.
- 3. Do not charge refrigerant through the split system prior to testing procedure by contractor and acceptance by Owner.
- G. Sleeve penetrations of floors, walls and ceiling to allow for free motion of piping. Provide 24 gage galvanized iron pipe and chrome-plated escutcheon plates. Pack annular space between pipe and sleeve with incombustible material such as fiberglass and seal each end with mastic to provide a waterproof seal.
- H. Install insulated couplings at points of connection between dissimilar metals for cathodic protection. Insulate copper tubing from ferrous materials and hangers with 2-inch thickness of 3-inch wide strip, 10 mil polyvinyl tape wrapped around pipe.
- I. Support piping by iron hangers and supports. Hydra-Zorb cushion clamps, LSP Products Group Acousto Clamp, or equal, on non-insulated piping, and Klo-Shure coupling clamp on insulated piping, or equal.
- J. Provide saddles to protect pipe insulation.
- K. Provide connections of copper, copper plated steel, steel, and brass pipe and tubing with Harris Products Group Safety-Silv 56, Lucas-Milhoupt, Inc., or equal, complying with ANSI/AWS A5.8 and NSF 51.
- L. Insulate refrigerant suction lines.
- M. On split systems, insulate both vapor and liquid lines. For insulation materials, refer to Section 23 07 00: HVAC Insulation.

1.06 NOISE AND VIBRATION

- A. Operation of Equipment: Mechanical equipment and piping systems shall operate without exceeding specified noise and/or vibration levels.
- B. Corrective Measures: If specified noise and/or vibration levels are exceeded, provide necessary changes to reduce noise and/or vibration levels to within specified levels.
- 1.07 FIELD TESTS AND INSPECTION

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- A. General: Perform field inspections, field tests, and trial operations as specified in Section 23 05 00: Common Work Results for HVAC. Provide labor, equipment and incidentals required for testing. The Project Inspector will witness field tests and trial operations as specified in Section 23 05 00: Common Work Results for HVAC.
- B. Equipment and Material: Equipment and material certified as being successfully tested by manufacturer, in accordance with referenced Specifications and standards, will not require re-testing before installation. Equipment and materials not tested at place of manufacture will be tested before or after installation, as applicable or necessary, to determine compliance with reference Specifications and standards.
- C. Start-Up and Operational Test: System shall be started up and initially operated with components operating. During this test, various strainers or filters shall be periodically cleaned until no further accumulation of foreign material occurs. Adjust safety and automatic control instruments as required to provide proper operation and control sequence. Refer to Section 23 05 00: Common Work Results for HVAC.
- D. Extent of Field Tests: After installation and before completion, Work of this Section shall be subjected to required field tests, including those specified here and in Section 23 05 00: Common Work Results for HVAC.
- E. Operation and Maintenance Data: Provide required operation and maintenance data as specified in Section 23 05 00: Common Work Results for HVAC.
- 1.08 CLEANUP
 - A. Remove rubbish, debris and waste materials and legally dispose of off Project site.
- 1.09 PROTECTION
 - A. Protect Work of this Section until Substantial Completion.
- 3.10 STANDARDS AND CERTIFICATIONS
 - A. All units must be:
 - 1. ETL certified duct furnace(s) which conform to the latest ANSI standards for efficiency and safe performance.
 - 2. ETL or UL certified for electrical safety in compliance with UL 1995 safety standard for heating, ventilation and cooling equipment
 - 3. Compliant with FM (Factory Mutual) requirements
 - B. Fuel Types
 - 1. Rooftop unit will be suitable for operation with natural gas.

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3.11 FUEL TYPES

A. Rooftop unit will be suitable for operation with natural gas.

3.12 MECHANICAL ARRANGEMENT

- A. Rooftop unit will consist of a furnace section consisting of a single furnace. The firing rate of each furnace will not exceed 400 MBh and will contain its own heat exchanger, flue collector, venting, burners, safety and ignition controls.
- B. Rooftop unit will consist of a blower section containing supply blower(s) and blower motor. The blower motor will be interlocked electrically and disengage the blower motor and control circuit upon opening the service panel.
- C. Rooftop unit will consist of an electrical cabinet that is isolated from the air stream with a non-removable access panel interior to the outer service panel. Provision for component mounting, wire routing, and high voltage isolation
- D. Rooftop unit will be provided with outside air opposed blade damper(s).
- E. Rooftop unit will consist of a filter section to accommodate 2" MERV 13 filter and be of a design for minimal pressure drop.

3.13 ELECTRICAL SYSTEMS

- A. All electrical components and fixtures will carry UL or ETL and/or CSA listing certification and//or recognition.
- B. All wire will be rated to meet or exceed electrical requirements for voltage, ampacity, dielectric strength of sheathing and temperature rating per location.
- C. Standard control relays will be socket mounted with terminal block connections.
- D. All high voltage wiring will be enclosed in flexible metallic sheathed BX cable and include an identifying marker corresponding to the wiring diagram.

3.14 MOUNTING

A. Rooftop unit will be mounted on metal rails with down rolled outer edges with lifting and anchor holes and be suitable for clab or curb mounting.

3.15 STANDARD SAFETY PROVISIONS

A. Rooftop unit will be provided with a low voltage circuit breaker rated for 150% of the unit's normal 24-volt operating load.

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- B. An access interlock switch will be installed in the blower compartment and will disengage the blower upon removing the service panel. An override or cheat switch will be incorporated into the interlock switch for serviceability.
- C. Each duct furnace will be provided with a primary limit switch, 24V high temperature limit switch and a (redundant) combination gas valve.
- D. Rooftop units will contain a reverse air flow interlock switch. The normally closed switch when activated will cause gas valve to close.
- E. A drafter prove switch will be installed in all power vented units and disengage gas flow if for any reason the drafter has failed to operate.
- F. Warning labels will be visible in accessible areas of the rooftop where unsafe conditions could occur.

3.16 BURNERS

- A. Burners will be die formed with stamped porting and stainless-steel port protectors to prevent scale or foreign matter from obstructing the burner ports. Burner construction will consist of corrosion resistant aluminized steel.
- B. Burners must be individually removable for ease of cleaning and servicing. The entire burner assembly must be easily removable with a slide-out drawer design. The pilot must be accessible through a pilot access panel without removing the burner assembly.

3.17 HEAT EXCHANGER

A. The heat exchanger construction will consist of 20-gauge 409 stainless steel tubes and 20-gauge headers.

3.18 VENTING SYSTEM

- A. The flue collector construction will consist of corrosion resistant aluminized steel.
- B. Rooftop will be provided with power venting. Outside air for combustion and products of combustion will have individual air inlet and discharge grilles located in the upper section of the furnace service panel. A drafter prove switch will be installed and its normally open contacts wired in series with the main gas valve.

3.19 CABINETRY

A. Cabinetry will be die-formed, 20-gauge corrosion resistant ZAM (Zinc, Aluminum and Magnesium) steel with acrylic finish coat.

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- B. Hinged access doors will be provided by the manufacturer on the blower and filter cabinet doors. Doors will be double wall construction and incorporate dual quick opening tool-less latches. Door stops will be included to prevent against closure while open.
- C. Blower/filter sections will be insulated with fire resistant, environmentally safe, odorless, one inch fiber material. It will be matte faced.

3.20 DAMPERS

A. Dampers will be of the opposed blade type. Constructed of galvanized steel with neoprene nylon bushings. Blades to be mechanically interlocked.

3.21 FILTER RACK

- A. Filter rack will be constructed of galvanized steel with access through the side service panel.
- 3.22 INTAKE HOOD
 - A. Intake hood will be constructed of galvanized steel and include a bird screen.

3.23 SUPPLY BLOWER

A. Supply blower will be belt drive, forward curved, centrifugal type blower assembly, statically and dynamically balanced with double inlet. The blower well will be fixed on a shaft, supported with super quiet rubber cartridges for vibration isolation, and ball bearing.

3.24 BLOWER MOTOR

- A. Motor will be single speed, ball bearing drive, permanently lubricated, EPACT compliant, standard NEMA frame size and service factory, with resilient base and Class B windings.
- B. Motor will be of the voltage and horsepower as scheduled.
- C. Motor wiring will be enclosed in flexible metallic sheathed BX conduit.
- D. Motor will be activated through a magnetic starter with IEC overload protection.

3.25 GAS AND IGNITION SYSTEM

A. A solid-state ignition control system which ignites the pilot by spark during each cycle of operation will be provided. When a pilot flame is proven, the main burner valve will open to allow gas flow to the burners. Pilot and burners must be extinguished during the off cycle.

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B. Rooftop units will be provided with a gas valve suitable for NEC Class 2 use, for a maximum inlet of 0.5 psi (14" W.C.) on natural gas. The 24-volt combination automatic gas valve must include a main operating valve, pilot safety valve, pressure regulator, manual main and pilot shutoff valve and adjustable pilot valve.

3.26 GAS CONTROLS

A. Single stage unit will be provided with one stage of heat. Ignition is the full rate of the furnace(s) rated input.

3.27 DAMPER MOTOR

- A. Damper motor will be two positions with spring return. Motor will operate at 24 volts.
- B. Motor and control wiring will be harnessed with terminal block connections. Wire will have a temperature rating of at least 105C outside of the duct furnace.

3.28 DAMPER CONTROL

A. Two position spring return motor with outside air damper will be provided. The motor will power the outside air damper full open when the units is on and full closed with the unit is off.

3.29 ACCESSORIES

- A. Rooftop unit will be provided with an airflow prove switch to verify airflow through the unit. The switch will be a Dwyer 1910-0 pressure switch suitable for duct mounting with a range of 0.15-0.50" W.C.
- PART 4 EXECUTION
- 4.01 EXAMINATION
 - A. Contractor shall verify that roof is ready to receive work.
 - B. Contractor shall verify that proper power supply is available.

4.02 INSTALLATION

- A. Contractor shall install in accordance with manufacturer's instructions.
- B. Mount units on factory-built roof mounting frame providing watertight enclosure to protect ductwork and utility services. Install roof mounting curb level.

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END OF SECTION

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SECTION 23 81 29 - VARIABLE REFRIGERANT FLOW HVAC SYSTEMS

PART 1 - GENERAL

1.01 SUMMARY

- A. Section Includes: Split-system air-conditioning and heat pump units consisting of separate evaporator-fan and compressor-condenser components.
- B. Related Requirements:
 - 1. Division 01 General Requirements.
 - 2. Section 23 05 00 Common Work Results for HVAC.
 - 3. Section 23 05 48 Vibration and Seismic Controls for HVAC.
 - 4. Division 26 Electrical.

1.02 REFERENCES

- A. American Society of Heating, Refrigerating and Air Conditioning Engineers (ASHRAE):
- B. ANSI/ASHRAE 62.1 Ventilation for Acceptable Indoor Air Quality.
- C. ANSI/ASHRAE/IES Standard 90.1 Energy Standard for Buildings Except Low-Rise Residential Buildings.
- D. ASTM International:
 - 1. ASTM B117 Standard Practice for Operating Salt Spray (Fog) Apparatus.
 - 2. ASTM B280 Standard Specification for Seamless Copper Tube for Air Conditioning and Refrigeration Field Service.
 - 3. ASTM D1418 Standard Practice for Rubber and Rubber Latices-Nomenclature.
- E. International Organization for Standardization (ISO):
 - 1. ISO3745 Standard Acoustics -- Determination of sound power levels and sound energy levels of noise sources using sound pressure --Precision methods for anechoic rooms and hemi-anechoic rooms.



1.03 SUBMITTALS

- A. Provide in accordance with Division 01, General Requirements, and Section 23 0500, Common Work Results for HVAC.
- B. Product Data: Submit performance data in terms of capacities, outlet velocities, static pressures, sound power characteristics, motor requirements, and electrical characteristics.
 - 1. Complete materials list of items proposed to be furnished and installed under this Section. Materials lists, which do not require performance data, shall include manufacturer's name, type, and model number for indicated installation.
 - 2. Manufacturer's specifications and other data required to demonstrate compliance with specified requirements. Literature shall include descriptions of equipment, types, models and sizes proposed, performance data in terms of capacities, outlet velocities, static pressures, sound power characteristics, motor requirements, electrical requirements, options selected, space requirements and other data necessary to ensure compliance with requirements of this Specification and performances indicated on Drawings.
- C. Shop Drawings indicating methods of installation of equipment and materials, and details of supporting structures for items indicated. Items to be submitted shall include but not be limited to the following:
 - 1. Layout Drawings of Equipment: Include plans, elevations, and sections, of proposed equipment drawn to scale, to establish which equipment shall fit in allotted spaces with clearance for installation and maintenance. Indicate proposed details for attachment. Indicate vibration isolation units, foundations, supports, and openings for passage of pipes and ducts.
 - 2. Electrical interlock or control diagrams for electrically controlled components furnishing more than one automatic or manual control devices, which are not indicated on Drawings.
- D. Manufacturer's installation instructions.
- 1.04 QUALITY ASSURANCE
- A. Qualifications of Manufacturers and Installers: Comply with provisions in Section 23 0500: Common Work Results for HVAC.
- B. Installers shall be certified by VRF manufacturer and have a minimum of 3 VRF projects of comparable size and complexity.



1.5 WARRANTY

- A. Manufacturer shall warrant all parts for a period of ten (10) years from date of Substantial Completion.
- 1.6 TRAINING
- A. Training for OWNER Staff off-site by the VRF manufacturer.
 - 1. Training sessions shall not exceed 8 hours per day.
 - 2. Training session shall accommodate a minimum of 20 personnel and be facilitated at a location no more than 50 miles from OWNER's location.
 - 3. Training sessions shall provide manufacturer's required hours of training for the staff to be factory certified to be able to maintain, repair and service the equipment.
 - 4. Training shall provide specifications, drawings, cut sheets manuals, computers/laptops and other supportive documents and materials required for training and certifications.
 - 5. At the conclusion of training, the manufacturer shall provide certification for each attendee acknowledging their attendance and knowledge for maintenance, service and repair of the system.
 - 6. Training and certification shall include all components of VRF system requiring maintenance, service and repair but not limited to condensing units, branch controller boxes, fan coils, leak detection, controls piping and trouble shooting.
 - 7. Training shall include hands-on training, demonstrating replacing and reprogramming of components in order to restore to full operational condition and shall not be limited to presentation materials only.
 - 8. OWNER's employees attending this training session shall be provided with the following documentation:
 - a. System layout and Installation Checklist.
 - b. System controls and EMS interface and Operation and Maintenance Instruction.
 - c. Component isolation technics.
 - d. Refrigerant and oil management and replacement.
 - e. Unit component diagnostic system and points.



- Β. Training for OWNER's staff on-site: The training sessions shall not exceed four hours per day and shall be conducted by the VRF manufacturer's technical staff regarding overall Maintenance and Operation of the entire VRF system. On-site training shall allocate sufficient hours for the staff to have a good understanding of the system, components and maintenance, service and repair requirements. All supporting documents, manuals, cut sheets, spare parts shall be provided as required to maintain and service the system. The training shall consist of, but not be limited to the following:
 - 1. System layout and Operation and Maintenance Manuals.
 - 2. Trouble shooting and diagnostic protocol.
 - 3. Leak detection/prevention strategy.
 - 4. Routine Maintenance requirements.
 - 5. System isolation points, installation checklist, system controls and EMS interface, refrigerant and oil management and verification of all component locations.
- C. For additional training requirements refer to Sections 23 0500, Common Work Results for HVAC and 23 0800, HVAC Systems Commissioning.

PART 2 - PRODUCTS

- 2.01 MANUFACTURERS
- Α. Equipment listed on this Section shall be manufactured by: LG, Daikin, Mitsubishi and Samsung.
 - 1. Basis of Design: Samsung
- Β. Capacities of the equipment indicated on the drawings are net capacities.
- 2.02 **IN-CEILING CASSETTE DUCTLESS UNITS**
- Α. General
 - 1. Unit shall be factory assembled, wired, piped and run tested.
 - 2. Unit shall be designed to be installed for indoor application.
 - 3. Unit shall be designed for mounting in the finished ceiling.
 - 4. Unit shall be capable to be installed with heat pump or heat recovery or cooling VRF system.



- B. Unit Cabinet:
 - 1. Cabinet shall be constructed of zinc-coated steel.
 - 2. Fully insulated discharge and inlet grilles shall be attractively styled, highimpact non-metallic material.
 - 3. The inlet grille shall have hinges and can be opened to obtain access to the cleanable filters, indoor fan motor and control box.
- C. Fan Assembly:
 - 1. Fan shall be centrifugal direct-drive blower type with air intake in the center of the unit and discharge at the perimeter. Automatic, motor-driven vertical air sweep shall be provided standard. Automatic motor-driven louvers shall be provided standard and shall be adjustable for 2, 3 or 4-way discharge.
 - 2. Air sweep operation shall provide three user selectable modes.
- D. Coil:
 - Coil shall be copper tube with aluminum fins and galvanized steel tube sheets. Fins shall be bonded to the tubes by mechanical expansion and specially coated for enhanced wet-ability. A drip pan under the coil shall have a factory installed condensate pump and drain connection for hose attachment to remove condensate. A replaceable element in the condensate disposal system provides antibacterial protection.
- E. Motors:
 - 1. Motors shall be totally enclosed, permanently lubricated ball bearing with inherent overload protection. Fan motors shall be inverter controlled variable speed.
- F. Microprocessor Control:
 - 1. Unit shall have a factory installed microprocessor controller capable of performing functions necessary to operate the system.
 - 2. Unit shall be able to communicate with other indoor units and the outdoor unit using a field supplied minimum of 18 AWG, 2 core, stranded and shielded communication cable.
 - 3. Unit controls shall operate the indoor unit using one of the five operating modes:
 - a. Auto changeover (Heat Recovery System only).
 - b. Heating.



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- c. Cooling.
- d. Dry.
- e. Fan only.
- G. Filters:
 - 1. Unit shall have factory-supplied resin net (cleanable) type filters. The return air filter material shall have the following characteristics:
 - a. Odorless
 - b. Temperature resistant to 185°F
 - c. Humidity resistant up to 95% RH
 - d. MERV 8 or Better
- H. Electrical: Unit shall be capable of operating within voltage limits of +/- 10% of the rated voltage.
- I. Controls: Unit shall use controls provided by the manufacturer to perform all functions necessary to operate the system effectively and efficiently and communicate with the outdoor unit over an RS485 daisy chain.
- 2.03 EVAPORATOR-FAN UNIT (HORIZONTAL DUCTED HIGH STATIC)
- A. General
 - 1. Unit shall be factory assembled, wired, piped and run tested.
 - 2. Unit shall be designed to be installed for indoor application.
 - 3. Unit shall be designed to mount fully concealed above the finished ceiling.
 - 4. Supply air shall be flanged for field installed ductwork that shall not exceed the external static pressure limitation of the unit.
 - 5. Unit shall be capable to be installed with heat pump or heat recovery or cooling VRF system.
- B. Casing/Panel:
 - 1. Unit case shall be manufactured using galvanized steel plate.
 - 2. Cold surfaces of the unit shall be covered internally with a coated polystyrene insulating material.



- 3. Cold surfaces of the unit shall have internal insulation.
- 4. External insulation shall be plenum rated and conform to ASTM D1418.
- 5. Unit shall be provided with hanger brackets designed to support the unit weight on four corners.
- 6. Hanger brackets shall have pre-punched holes designed to accept field supplied, all thread rod hangers.
- C. Cabinet Assembly:
 - 1. Unit shall be equipped with factory installed temperature thermistors for:
 - a. Return air.
 - b. Refrigerant entering coil.
 - c. Refrigerant leaving coil.
 - 2. Unit shall have a factory assembled, piped and wired electronic expansion valve (EEV) for refrigerant control.
 - 3. Unit shall have a built-in control panel to communicate with other indoor units and to the outdoor unit.
 - 4. Unit shall have the following functions as standard:
 - a. Self-diagnostic function.
 - b. Auto restart function.
 - c. Auto changeover function (Heat Recovery system only).
 - d. Auto operation function.
 - e. Forced operation.
 - f. Dual thermistor control.
 - g. External static pressure (ESP) control.
- D. Fan Assembly:
 - 1. Unit shall have direct driven fan(s).
 - 2. Fan shall be made of high strength resin.
 - 3. The fans shall be mounted on a common shaft.



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- 4. Fan motor shall be Brushless Digitally controlled (BLDC) with permanently lubricated and sealed ball bearings.
- 5. Fan/motor assembly shall be mounted on vibration attenuating rubber grommets.
- 6. Fan speed shall be controlled using microprocessor based direct digitally controlled algorithm.
- 7. In cooling mode, the indoor fan shall have the following settings: Low, Med, High and Auto.
- 8. In heating mode, the indoor fan shall have the following settings: Low, Med, High and Auto.
- 9. The Auto fan setting shall adjust the fan speed to most effectively achieve the set-point.
- 10. Each of the settings can be field adjusted from the factory setting (RPM/ESP).
- 11. Unit shall be designed for high speed air volume against an external static pressure of up to 1.0" water gauge.
- E. Coil Assembly:
 - 1. Unit shall have a factory built coil comprised of aluminum fins mechanically bonded on copper tubing.
 - 2. Unit shall have minimum of two rows of coils.
 - 3. Unit shall have a factory supplied condensate drain pan below the coil.
 - 4. Where indicated, horizontal unit shall be installed and wired condensate drain pump capable of providing minimum 27.5 inch lift from bottom surface of the unit.
 - 5. Vertical unit shall be designed for gravity drain.
 - 6. Unit drain pan shall be provided with a secondary drain port/plug allowing pan to be drained for service.
 - 7. Drain pump shall have a safety switch to shut off the unit if condensate rises too high in the drain pan.
 - 8. Coil shall be factory pressure tested at a minimum of 551 psig.
- F. Microprocessor Control:



- 1. Unit shall have a factory installed microprocessor controller capable of performing functions necessary to operate the system.
- 2. Unit shall be able to communicate with other indoor units and the outdoor unit using a field supplied minimum of 18 AWG, 2 core, stranded and shielded communication cable.
- 3. Unit controls shall operate the indoor unit using one of the five operating modes:
 - a. Auto changeover (Heat Recovery System only).
 - b. Heating.
 - c. Cooling.
 - d. Dry.
 - e. Fan only.
- G. Electrical: Unit shall be capable of operating within voltage limits of +/- 10% of the rated voltage.
- H. Controls: Unit shall use controls provided by the manufacturer to perform all functions necessary to operate the system effectively and efficiently and communicate with the outdoor unit over an RS485 daisy chain.
- 2.04 AIR-COOLED, COMPRESSOR-CONDENSER UNIT, HEAT RECOVERY OR HEAT PUMP
- A. General:
 - 1. Each system shall consist of one, two or three air source outdoor unit frame.
 - 2. Dual and triple frame configurations shall be field piped together using manufacturer's designed and supplied Y-branch kit in conjunction with field provided interconnecting pipe to form a common refrigerant circuit.
 - 3. Refrigerant circuit configuration for Heat Recovery System.
 - a. Refrigerant circuit shall be constructed using field provided copper piped together with manufacturer supplied Heat Recovery unit(s) ,Ybranches or Header fittings, connected to (ducted, non-ducted or combination thereof) single/multiple indoor units to effectively and efficiently control the simultaneous heating and cooling operation of the VRF system.



- b. Refrigerant pipe, y-branch, header kit, elbows and isolation ball valves shall be individually insulated with no air gaps. Joints shall be glued and sealed.
- 4. Factory installed microprocessor controls in the outdoor unit(s), HR unit(s), and indoor unit(s) shall perform functions to efficiently operate the VRF system and communicate in a daisy chain configuration between each other. Communications and cabling shall conform to RS485 standard.
- 5. Unit shall be shipped from the factory fully assembled including internal refrigerant piping, compressor, contacts, relay(s), power and communications wiring necessary.
- 6. Refrigeration circuit shall have the following components:
 - a. Refrigerant strainer(s).
 - b. Check valve(s).
 - c. Oil separator.
 - d. Accumulator.
 - e. 4-way reversing valve.
 - f. Vapor injection valve.
 - g. Variable path valve.
 - h. Oil Level sensor.
 - i. Electronic expansion valve(s).
 - j. Sub-cooler.
 - k. High and low side Schrader valve service ports with caps, or service valves.
- B. Unit Cabinet:
 - 1. Outdoor unit cabinet shall be made of 20 gauge galvanized steel with an enamel finish.
 - 2. Outdoor unit cabinet finish shall be tested in accordance with ASTM B117 salt spray test procedure.
 - 3. Front panels of outdoor units shall be removable type for access to internal components.



- C. Fan:
 - 1. 6 ton cabinets shall be equipped with one direct drive variable speed propeller fan with Brushless Digitally Controlled (BLDC) motor with a vertical air discharge.
 - 2. 8 to 14 ton cabinets shall be equipped with two direct drive variable speed propeller fan(s) with BLDC motor(s) with a vertical air discharge.
 - 3. Fan(s) motor shall be equipped with permanently lubricated bearings.
 - 4. Fan motor shall be variable speed with a maximum operating speed of 1050 RPM.
 - 5. Fan shall have a raised guard to help prevent contact with moving parts.
 - 6. Cabinet shall have option to change the discharge air direction from vertical to horizontal using optional factory provided air guides.
- D. Condenser Coil:
 - 1. Outdoor units shall have a factory built coil comprised of aluminum fins mechanically bonded on copper tubing.
 - 2. Copper tubes shall have inner groves.
 - 3. Aluminum fins shall have factory applied corrosion resistant material.
 - 4. Hydrophilic Coil coating shall be tested in accordance with ASTM B117 salt spray test procedure.
 - 5. Outdoor unit coil shall be tested to a pressure of 551 psig.
 - 6. Cabinet shall have a coil guard.
- E. Compressor:
 - 1. Units shall be equipped with two or three inverter driven twin rotary compressors.
 - 2. Inverter driven, twin rotary compressors shall be capable of operating in a frequency range from 15 Hz to 150 Hz with control in 0.5 Hz increments.
 - 3. Compressor(s) shall be equipped with a 60 Watt crankcase heater.
 - 4. Compressor shall use a factory charge of Polyvinyl Ether (PVE) oil.
 - 5. Compressor bearing(s) shall have Teflon[™] coating.



- 6. Compressor(s) shall be protected with:
 - a. High Pressure switch.
 - b. Over-current /under current protection.
 - c. Phase failure.
 - d. Phase reversal.
 - e. Standard, non-inverter driven compressors shall not be permitted.
- F. Oil Management: System shall have an oil management system as recommended by manufacturer.
- G. Refrigerant Management:
 - 1. System shall have advanced refrigerant control functions that optimize operating efficiency at all ambient operating conditions. Advanced refrigerant control functions shall include:
 - a. Accumulator shall be equipped with controls that vary the amount of refrigerant charge being circulated based on operating mode.
 - b. Outdoor unit coil shall be equipped with controls that maximizes heat transfer. Controls shall vary the coil circuiting between parallel and series configurations and be able to change flow direction in response to multiple refrigerant monitoring parameters and operating conditions.
 - c. Compressors shall be equipped with an intermediary port that introduces additional refrigerant to the compression chamber based on multiple refrigerant system monitoring parameters. This feature increases heating capacity at low ambient conditions.
- H. Sensors: Each single cabinet shall have:
 - 1. Suction temperature sensor.
 - 2. Discharge temperature sensor.
 - 3. High Pressure sensor.
 - 4. Low Pressure sensor.
 - 5. Outdoor temperature sensor.
 - 6. Outdoor unit heat exchanger temperature sensor.

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2.05 BAS INTERFACE GATEWAY

- A. Provide BTL certified BACnet Gateway allowing complete open protocol, 2 way communication between VRF system and various brands of BAS over BACnet/IP.
- B. An embedded web server shall be incorporated to facilitate troubleshooting and remote diagnostics or serve as an alternative method for manual system control whenever the BAS is offline.
- C. Interface shall be capable of controlling and monitoring up to 256 indoor units with the following functions:
 - 1. Unit Run/stop.
 - 2. Zone Controller Permit/Prohibit.
 - 3. Operation Mode Cool/Dry/Fan/Auto/Heat.
 - 4. Fan Speed Low/Medium/High/Auto.
 - 5. Temperature Setpoint with upper and lower limits.
 - 6. Room Temperature.
- D. Module shall require 120V power.
- 2.06 DIAGNOSTIC TOOL
- A. Provide an electronic diagnostic tool that can be connected to the VRF controls system at any unit location to provide, via a laptop computer, detailed information about the system and its components.
- 2.07 REFRIGERANT PIPING
- A. See Section 23 23 00, for refrigerant piping.

PART 3 - EXECUTION

- 3.01 INSTALLATION
- A. Install evaporator-fan components using manufacturer's standard mounting devices securely fastened to building structure.
- B. Install ground-mounted, compressor-condenser components on a 4-inch-thick, unless otherwise indicated on the drawings, reinforced concrete base. Base shall be a minimum of 4 inches larger on each side than the unit. Concrete, reinforcement, and



formwork, shall be as specified in Sections 03 1000, Concrete Forming and Accessories, Section 03 2000, Concrete Reinforcing, and Section 03 3000 Cast-in-Place Concrete. Coordinate anchor location and installation with concrete base.

- C. Install compressor-condenser components on restrained, spring isolators with a minimum static deflection of 1 inch. Refer to Section 23 0548, HVAC Sound, Vibration and Seismic Control. Fasten equipment and isolators with removable, cadmium-plated fasteners.
- 3.02 FIELD INSTALLED REFRIGERANT PIPING
- A. Connect ACR tubing to component's quick-connect fittings. Install tubing to allow access to unit.
- B. Install piping adjacent to unit to allow service and maintenance.
- C. Piping shall be copper with joints brazed with 15% silver, silphos brazing rod, with nitrogen flowing through pipe while brazing.
- D. Elbows shall be of the long radius type.
- E. Liquid and vapor piping shall be insulated with ³/₄" thick closed cell rubberized insulation.
- F. Piping shall be secured to structure with straps, taking care to ensure that the refrigerant piping does not contact the structure and that the insulation is not torn.
- G. All copper piping shall be brazed while purging air with dry nitrogen gas.
- H. Initial leak test shall be performed per the manufacturer's installation guide, with dry nitrogen gas on all field installed piping simultaneously, to not less than 500 psi.
- I. Piping shall be evacuated with a triple-evacuation process, breaking with dry nitrogen between steps, to 4000 microns, 1500 microns, and finally <500 microns. Perform rise test of <500 microns for at least one hour.
- 3.03 FIELD QUALITY CONTROL
- A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust field-assembled components and equipment installation, including connections, and to assist in field testing. Report results in writing.
- B. Leak Test: After installation:
 - 1. Pressure test the system with Nitrogen for (24) hours at 550 PSIG. Repair any leaks and retest until no leaks exists.



- 2. Vacuum test the complete system at 500 microns for (24) hours.
- 3. A factory authorized technician shall verify the teak tests were completed before charging the system.
- C. Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation. Remove malfunctioning units, replace with new components, and retest.
- D. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
- 3.04 CLEAN UP
- A. Remove rubbish, debris and waste materials and legally dispose of off the Project site.
- 3.05 PROTECTION
- A. Protect the Work of this section until Substantial Completion.

END OF SECTION



EXHIBIT "E" DRAWINGS

- 8-1/2x11 BOOK SPECIFICATIONS SHALL FORM PA WORK.
- ALL DUCTWORK AND CEILING PENETRATION SHA COORDINATED WITH EXISTING STRUCTURAL JOIS PROVIDE OFFSETS IN PIPES AND DUCTS TO AVOI BEAMS AND JOISTS UNLESS INDICATED ON STRU DRAWINGS.
- MAINTAIN CLEAR ACCESS TO SERVICE EQUIPME ACCESSORIES REQUIRING SERVICE, VISUAL INSF HAND OPERATION. WHERE INDICATED OR REQUI ACCESS PANELS OF THE TYPE SELECTED TO SUI WHICH INSTALLED.
- ALL WORK SHALL BE DONE IN ACCORDANCE WIT APPLICABLE CODES AND REGULATIONS PER CAL OTHER AUTHORITIES HAVING JURISDICTION.
- THE MECHANICAL DRAWINGS ARE DIAGRAMMAT NOT BE SCALED EXISTING CONDITIONS AND MAK TO DIMENSIONS AS NECESSARY TO COMPLETE
- CONTRACTOR SHALL OBTAIN ALL NECESSARY PE SHALL ARRANGE FOR ALL INSPECTIONS AS REQU
- CONTRACTOR SHALL THOROUGHLY EXAMINE PRI OBSERVE ALL CONDITIONS AND CIRCUMSTANCES THE WORK SHALL BE PERFORMED. NO ALLOWAN MADE FOR ERRORS OR NEGLIGENCE IN THIS RES
- THE CONTRACTOR'S ATTENTION IS DIRECTED TO IMPORTANCE OF PROPER SCHEDULING AND PHA WORK SO AS TO CAUSE MINIMUM DISTURBANCE ACTIVITIES IN THE OTHER FLOORS AND AREAS W OCCUPIED THROUGHOUT THE DURATION OF THE CONTRACTOR'S WORK SCHEDULE SHALL BE SUB APPROVED BY OAR.
- CONTRACTOR SHALL PERFORM WORK ONLY AFT GATHERING OF EXACT FIELD DIMENSIONS OF THI STRUCTURE AND CEILINGS ETC. WHICH MAY AFFI INSTALLATION OF THE NEW SYSTEMS.
- 10. OTHER CONTRACTOR SHALL FULLY COORDINATE OTHER TRADES TO ASSURE ALL WORK CAN BE P INSTALLED WITHOUT INTERFERENCE OR DELAY.
- 11. CLEAN UP ALL WASTE AND DEBRIS AT THE END C WORKING DAY AND AT THE COMPLETE OF THE JC
- 12. PRIOR TO STARTING WORK, SUBMIT SHOP DRAW MECHANICAL EQUIPMENT & DUCTWORK PER SPE
- 13. EXACT LOCATIONS OF ALL CEILING DIFFUSERS, GRILLES SHALL BE COORDINATED WITH LIGHTING DIFFUSERS SHALL HAVE A MINIMUM OF 36" FROM DEVICES.
- 14. CONTRACTOR SHALL MOUNT AND CONNECT EACH EQUIPMENT AS SHOWN ON PLAN
- 15. ALL OPENINGS IN WALLS, CEILINGS, AND FLOORS FROM DUCT DEMOLITION SHALL BE CLOSED AND MATCH THE SURROUNDING.
- 16. COORDINATE WITH PLUMBING TO PROVIDE CONE LINES FOR ALL COOLING COILS.
- 17. ALL SUPPLY & RETURN DUCTWORK SHALL BE INS TITLE-24 REQUIREMENTS.
- 18. PROVIDE VOLUME DAMPERS AT EACH BRANCH T MAIN SUPPLY RETURN, AND EXHAUST DUCT SERV DEVICE.
- 19. WHEN REMOVING EXISTING DUCTWORK, GRILLE AND SEAL (WEATHER TIGHT IF NECESSARY) ALL REFER TO ARCHITECTURAL DRAWINGS FOR DET
- 20. ALL EQUIPMENT WITH MOVING PARTS SHALL BE FLEXIBLE DUCT AND PIPE CONNECTIONS.
- 21. CONTRACTOR SHALL VERIFY ALL CLEARANCES A SPACE FOR DUCTWORK PRIOR TO ORDERING ANI FABRICATING MATERIAL
- 22. EXACT LOCATIONS OF ALL CEILING DIFFUSERS, GRILLES SHALL BE COORDINATED WITH LIGHTING SHALL BE USED ONLY FOR GENERAL DUCT ROU DISTRIBUTION. ACCESS DOORS SHALL BE PROVID DAMPERS, AUTOMATIC DAMPERS, MANUAL DAMP BYPASS DAMPERS.

GENERAL		ES		TITLE 24 NO
RT OF THIS	23.	NOTE THE CRITICAL SPACE AVAILABLE ABOVE CEILINGS. PROVIDE TRANSITION PIECES AT CROSSOVERS, UNDER	1.	ALL THERMOSTATS SHALL HAVE AND COOLING, CAPABLE OF AD
ALL BE STS AND BEAMS. ID CUTTING OF JCTURAL		DUCTS WITHIN SPACE AVAILABLE, PROVIDING EQUIVALENT DUCT SIZE TO THE DIMENSION SHOWN. COORDINATE CLOSELY WITH OTHER SECTIONS TO REDUCE NECESSITY OF TRANSITIONS TO A MINIMUM. NO ADDITIONAL COSTS	2.	ALL EQUIPMENT DESIGNED TO I SECURELY FIXED IN PLACE IN A REQUIREMENTS.
NT AND OTHER PECTION OR IRED, PROVIDE	24.	WILL BE PAID FOR ANY REQUIRED TRANSITIONS OR OTHER SPECIAL CHANGE SHAPE PIECES. UPON COMPLETION OF WORK, THE CONTRACTOR SHALL HAVE ALL AIR SYSTEMS BALANCED TO INDICATED AIR	3.	REQUIRED ROUTINE MAINTENAL STATED AND INCORPORATED O PERMANENT WEATHERPROOF I TO CROSS-REFERENCING THE I MAINTENANCE ACTION IS DESC
	25	FLOW QUANTITIES BY A CERTIFIED AABC BALANCING CONTRACTOR. PROVIDE POST-CONSTRUCTION AIR BALANCE REPORT.	4.	AIR-HANDLING DUCT SYSTEMS INSTALLED, SEALED, AND INSUL
LIFORNIA AND	23.	EXCEED 5'-0" FEET.		OR SMACNA GUIDELINES AS A M
IC AND SHOULD (E ADJUSTMENTS	26.	ALL EXISTING DUCT INSULATION SHALL BE THOROUGHLY PATCHED PRIOR TO STARTUP OF EXISTING EQUIPMENT.	5.	ALL EQUIPMENT SHALL CONFOR ACCORDANCE WITH THE APPLIC REQUIREMENTS FOR SUCH DEV
THE WORK. ERMITS AND	27.	ALL OPENINGS IN WALLS, CEILINGS, AND FLOORS RESULTING FROM DUCT DEMOLITION SHALL BE CLOSED AND FINISHED TO MATCH THE SURROUNDING.		AGENCY.
UIRED. EMISES AND S UNDER WHICH	28.	RUNNING ALL DUCTWORK AND PIPING AS HIGH AS POSSIBLE UNLESS OTHERWISE NOTED. PIPING SHALL BE ABOVE DUCTWORK.	6.	ALL EQUIPMENT SHALL BE LABE SPACES SERVED. (SEE SCHEDU
NCES WILL BE SPECT.	29.	REPAIR CEILING AND WALL SURFACES AFTER INSTALLATION AND INSPECTION OF NEW MECHANICAL		CODE STAI
D THE ASING OF THE TO THE VHICH REMAIN		DUCTWORK, FANS, ETC. ARE INSTALLED. PAINT OR INSTALL NEW TILE TO MATCH EXISTING CONDITION AND SURROUNDINGS, VERIFY WITH ARCHITECT. PATCH AND/OR REPAIR ROOF SYSTEM IF ANY DEMOLITION WORK FOR	<u>CC</u> 24	ONSTRUCTION SHALL COMPLY WITH CALIFORNIA CODE OF REGULATIO
E CONTRACT. THE BMITTED TO AND	30.	MECHANICAL SYSTEM AFFECTED THE ROOF. CONTRACTOR SHALL PROVIDE "YOUNG" REGULATORS IN	PA PA PA	RT 1 2022 CALIFORNIA BUILDING S ⁻ RT 2 2022 CALIFORNIA BUILDING CO RT 3 2022 CALIFORNIA ELECTRICAL
TER THE IE BUILDING FECT THE		LIEU OF VOLUME DAMPERS IN HARD CEILING AREAS AT EACH BRANCH TAKE-OFF FROM MAIN SUPPLY, RETURN AND EXHAUST DUCT SERVING EACH AIR DEVICE. ALL MANUAL VOLUME DAMPERS MAY NOT BE SHOWN ON PLANS. PROVIDE AS STATED.	PA PA PA PA PA	RT 4 2022 CALIFORNIA MECHANICA RT 5 2022 CALIFORNIA PLUMBING (RT 6 2022 CALIFORNIA ENERGY CO RT 7 CURRENTLY VACANT RT 8 2022 CALIFORNIA HISTORICAL
E ALL WORK WITH PROPERLY	31.	THE SEISMIC ANCHORAGE OF MECHANICAL AND ELECTRICAL EQUIPMENT SHALL CONFORM TO C.C.R TITLE 24, OF SECTION 16 AND 16A CBC-2022 AND ASCE 7-10. A COPY OF THE GUIDELINES PUBLISHED BY SMACNA SHALL	PA PA PA PA	RT 9 2022 CALIFORNIA FIRE CODE (RT 10 2022 CALIFORNIA EXISTING E RT 11 2022 CALIFORNIA GREEN BU RT 12 2022 CALIFORNIA REFERENC
OB.	00	SITE AT ALL TIMES.	20 CH	A TIAL LIST OF APPLICABLE STAND 13 CALIFORNIA BUILDING CODE (FC IAPTERS 35 AND 45.
VINGS FOR ALL ECIFICATIONS. REGISTERS, AND G. CEILING MANY FIRE ALARM	32.	ANY EQUIPMENT, DUCTWORK, OR PIPING INSTALLED MORE THAN 1 FT FROM THE LOCATION SHOWN ON THE RAWINGS SHALL BE CLEARLY DOCUMENTED ON THE FIELD. CONTRACTOR SHALL PROVIDE AS-BUILT DRAWINGS THAT CLEARLY SHOW THE LOCATION OF THE THE EQUIPMENT BEFORE THAN COMPLETION OF THE PROJECT. ALL EXPENSE RELATING TO VERIFY THE AS-BUILT DRAWINGS BY THE DISTRICT OR ITS REPRESENTATIVE(S) DUE TO	NF 20 NF NF NF NF	PA 13, AUTOMATIC SPRINKLER SYS 22 EDITION PA 14, STANDPIPE SYSTEMS (CALIF PA 17, DRY CHEMICAL EXTINGUISH PA 17A, WET CHEMICAL SYSTEMS PA 20, STATIONARY PUMPS 2022 EI PA 24, PRIVATE FIRE MAINS (CALIF
	33	THE CONTRACTOR HAS THE OPTION TO CHANGE DUCT TO		DITION OTE: SEE UL STANDARD 1971 FOR "
FINISHED TO	00.	ROUND AS LONG AS INTERIOR ASPECT RATIO IS MAINTAINED, AND SPACE ALLOWS.	NF ED	PA 30, FIRE DOOR AND OTHER OFE PA 253, CRITICAL RADIANT FLUX OF DITION
DENSATE DRAIN	34.	RECORD PLANS "AS BUILTS" - THROUGHOUT CONSTRUCTION, THE CONTRACTOR SHALL MAINTAIN A CLEAN, UNDAMAGED SET OF PRINTS OF DRAWINGS AND	RE 35	FERENCE CODE SECTION FOR NFF 04.1
SULATED PER		SHOP DRAWINGS ON SITE. RED LINE THE SET TO SHOW THE ACTUAL INSTALLATION WHERE THE INSTALLATION VARIES SUBSTANTIALLY FROM THE WORK AS ORIGINALLY		
AKE-OFF FROM VING EACH AIR		SHOWN. FOR CLOSE OUT, THE CONTRACTOR SHALL INCORPORATE THE CHANGES IN AUTOCAD FORMAT INTO THE APPROPRIATE ORIGINAL DRAWINGS. SIMPLE	1.	COORDINATE WITH LIFE SAFET
S, ETC., PATCH WALL OPENINGS. AILS.	35.	SHOP DRAWINGS, RFC'S OR RFI'S ARE NOT ACCEPTABLE.		INTERCONNECTING OF HVAC EO FIRE ALARM SYSTEM FOR SHUT FIRE ALARM SYSTEM.
PROVIDED WITH		INSIDE DIMENSIONS) AND REPRESENT THE FREE OR UNOBSTRUCTED AREA REQUIRED ON THE INSIDE OF THE DUCT.	2.	ALL BUILDINGS ARE PROVIDED DETECTORS IN EACH ROOM INT SYSTEM.
AND AVAILABLE ND/OR REGISTERS, AND G. DRAWINGS	36.	DUCT LINERS AND ALL OTHER AIRSTREAM SURFACES, EXCEPT SHEET METAL SURFACES AND METAL FASTENERS, SHALL BE RESISTANT TO MOLDE GROWTH IN ACCORDANCE WITH STANDARDIZED TEST METHOD, SUCH AS THE MOLD GROWTH AND HUMIDITY TEST IN UL 181, ASTM C 1338 OR ASTM D3273	3.	AREA TYPE SMOKE DETECTORS ELECTRICAL DRAWINGS FOR DE SYSTEM. THE FIRE ALARM SYST UNITS AS DESCRIBED IN NOTE IN DRAWINGS FOR LOCATION OF A
FING AND AIR DED ON ALL FIRE PERS, AND	37.	PROVIDE MANUAL VOLUME DAMPERS AT ALL BRANCH DUCTWORK SERVING SUPPLY, OUTSIDE, RETURN AND		DETECTORS.
	38.	EXHAUST REGISTERS. CONTRACTOR TO MAINTAIN DAILY PROTECTIVE SEAL OF DUCT OPENINGS.		

OTES

'E A DEADBAND BETWEEN HEATING JUSTMENT UP TO 10°F.

BE FIXED IN POSITION SHALL BE CCORDANCE WITH SEISMIC

NCE ACTION SHALL BE CLEARLY ON A READILY ACCESSIBLE LABEL. THE LABEL MAY BE LIMITED MAINTENANCE MANUAL IF SUCH RIBED THEREIN FOR THE LABELED

SHALL BE CONSTRUCTED, LATED AS PROVIDED IN THE RM MECHANICAL CODE CHAPTER 6 MINIMUM

RM TO AND BE CERTIFIED IN CABLE STANDARDS AND THE /ICES GIVEN IN THE PLANS AND THE LOCAL ENFORCEMENT

BELED AS TO FUNCTION AND ULE)

NDARDS

H THE FOLLOWING PARTS OF TITLE DNS (CCR):

STANDARDS ADMINISTRATIVE CODE ODE (CBC) VOLUME 1 AND 2 L CODE (CEC) AL CODE (CMC)

CODE (CPC) DDE (CEC)

BUILDING CODE

(CFC) BUILDING CODE IILDING STANDARDS CODE

CED STANDARDS

OR SFM) REFERENCED STANDARDS

STEMS (CALIFORNIA AMENDED)

FORNIA AMENDED) 2022 EDITION IING SYSTEM 2013 EDITION 2013 EDITION DITION

ORNIA AMENDED) 2022 EDITION DE (CALIFORNIA AMENDED) 2013

'VISUAL DEVICES") ENING PROTECTIVES 2022 EDITION F FLOOR COVERING SYSTEMS 2015

GUISHING SYSTEMS 2015 EDITION PA STANDARDS-2001 CBC (SFM)

ONTROL NOTES

Y CONTRACTOR FOR THE QUIPMENT WITH THE BUILDING F DOWN UPON A SIGNAL FROM THE

WITH AREA TYPE SMOKE TERLOCKED WITH THE FIRE ALARM

S WILL BE INSTALLED (REFER TO ETAIL). TO SIGNAL THE FIRE ALARM TEM SHALL SHUT DOWN THE AH NO. 1. REFER TO THE ELECTRICAL ALL AREA TYPE SMOKE

MEP COMPONENT ANCHORAGE NOTE

MEP COMPONENT ANCHORAGE NOTE ALL MECHANICAL, PLUMBING, AND ELECTRICAL COMPONENTS SHALL BE ANCHORED AND INSTALLED PER DETAILS ON THE DSA APPROVED CONSTRUCTION DOCUMENTS. THE FOLLOWING COMPONENTS SHALL BE ANCHORED OR BRACED TO MEET THE FORCE AND DISPLACEMENT REQUIREMENTS PRESCRIBED IN THE 2022 CBC. SECTIONS 1617A.1.18 THROUGH 1617A.1.26 AND ASCE 7-16 CHAPTER 13, 26 AND 30.

ALL PERMANENT EQUIPMENT AND COMPONENTS.

- TEMPORARY OR MOVABLE EQUIPMENT THAT IS PERMANENTLY ATTACHED (E.G. HARD WIRED) TO THE BUILDING UTILITY SERVICES SUCH AS ELECTRICITY, GAS, OR WATER. PERMANENTLY ATTACHED SHALL INCLUDE ALL ELECTRICAL CONNECTIONS EXCEPT PLUGS FOR 110/220 VOLT RECEPTACLES HAVING A FLEXIBLE CABLE.
- TEMPORARY, MOVABLE OR MOBILE EQUIPMENT WHICH IS HEAVIER THAN 400 POUNDS OR HAS A CENTER MASS LOCATED 4 FEET OR MORE ABOVE THE ADJACENT FLOOR OR ROOF LEVEL THAT DIRECTLY SUPPORT THE COMPONENT IS REQUIRED TO BE RESTRAINED IN A MANNER APPROVED BY DSA.

THE FOLLOWING MECHANICAL AND ELECTRICAL COMPONENTS SHALL BE POSITIVELY ATTACHED TO THE STRUCTURE, BUT NEED NOT DEMONSTRATE DESIGN COMPLIANCE WITH THE REFERENCES NOTED ABOVE. THESE COMPONENTS SHALL HAVE FLEXIBLE CONNECTIONS PROVIDED BETWEEN THE COMPONENT AND ASSOCIATED DUCTWORK, PIPING. AND CONDUIT. FLEXIBLE CONNECTIONS MUST ALLOW MOVEMENT IN BOTH TRANSVERSE AND LONGITUDINAL DIRECTIONS.

- COMPONENTS WEIGHING LESS THAN 400 POUNDS AND HAVE A CENTER OF MASS LOCATED 4 FEET OR LESS ABOVE ADJACENT FLOOR OR ROOF LEVEL THAT DIRECTLY SUPPORT THE COMPONENT.
- COMPONENTS WEIGHING LESS THAN 20 POUNDS, OR IN THE CASE OF DISTRIBUTED SYSTEMS, LESS THAN 5 POUNDS PER FOOT, WHICH ARE SUSPENDED FROM THE ROOF OR FLOOR OR HUNG FROM A WALL.

THE ANCHORAGE OF ALL MECHANICAL, ELECTRICAL AND PLUMBING COMPONENTS SHALL BE SUBJECT TO THE APPROVAL OF THE DESIGN PROFESSIONAL IN GENERAL RESPONSIBLE CHARGE OR STRUCTURAL ENGINEER DELEGATED RESPONSIBILITY AND ACCEPTANCE BY DSA. THE PROJECT INSPECTOR WILL VERIFY THAT ALL COMPONENTS AND EQUIPMENT HAVE BEEN ANCHORED IN ACCORDANCE WITH ABOVE REQUIREMENTS.

PIPING, DUCTWORK, ELECTRICAL DISTRIBUTION SYSTEM BRACING NOTE

PIPING, DUCTWORK, AND ELECTRICAL DISTRIBUTION SYSTEMS SHALL BE BRACED TO COMPLY WITH THE FORCES AND DISPLACEMENTS PRESCRIBED IN ASCE 7-16 SECTION 13.3 AS DEFINED IN ASCE 7-16 SECTIONS 13.6.5, 13.6.6, 13.6.7, 13.6.8, AND 2022 CBC, SECTIONS 1617A.1.24, 1617A.1.25 AND 1617A.1.26.

THE METHOD OF SHOWING BRACING AND ATTACHMENTS TO THE STRUCTURE FOR THE IDENTIFIED DISTRIBUTION SYSTEM ARE AS NOTED BELOW. WHEN BRACING AND ATTACHMENTS ARE BASED ON A PRE-APPROVED INSTALLATION GUIDE (E.G., OSHPD OPM FOR 2013 CBC OR LATER), COPIES OF THE BRACING SYSTEM INSTALLATION GUIDE OR MANUAL SHALL BE AVAILABLE ON THE JOBSITE PRIOR TO THE START OF AND DURING THE HANGING AND BRACING OF THE DISTRIBUTION SYSTEMS. THE STRUCTURAL ENGINEER OF RECORD SHALL VERIFY THE ADEQUACY OF THE STRUCTURE TO SUPPORT THE HANGER AND BRACE LOADS.

MECHANICAL PIPING (MP), MECHANICAL DUCTS (MD), PLUMBING PIPING, (PP), ELECTRICAL DISTRIBUTION SYSTEMS (E)

MP MD	PP	E 🕅	-OPTION 1: DETAILED ON THE APPROVED DRAWINGS WITH PROJECT SPECIFIC NOTES AND DETAILS.	
MP X MD X	PP	E 🗌	-OPTION 2: SHALL COMPLY WITH THE APPLICABLE OSHPD PRE-APPROVAL OPM# 0203-13.	

	MECHANICAL SHEET INDEX
Sheet Number	Sheet Name
M001	MECHANICAL FRONT SHEET
M002	MECHANICAL LEGEND AND ABBREVIATIONS
M003	MECHANICAL T-24 FORMS
M101	MECHANICAL 1ST FLOOR - DEMOLITION PLAN - BLDG K
M102	MECHANICAL DEMOLITION ROOF PLAN - BLDG K
M103	MECHANICAL 1ST FLOOR - FLOOR PLAN - BLDG K
M104	MECHANICAL ROOF PLAN - BLDG K
M105	MECHANICAL 1ST FLOOR - DEMOLITION PLAN - BLDG R
M106	MECHANICAL 2ND FLOOR - DEMOLITION PLAN - BLDG R
M107	MECHANICAL 1ST FLOOR - FLOOR PLAN - BLDG R
M108	MECHANICAL 2ND FLOOR - FLOOR PLAN - BLDG R
M501	MECHANICAL DETAILS
M502	MECHANICAL DETAILS
M503	MECHANICAL DETAILS
M504	MECHANICAL DETAILS
M505	MECHANICAL DETAILS
M506	MECHANICAL DETAILS
M507	MECHANICAL DETAILS
M508	MECHANICAL DETAILS
M509	MECHANICAL DETAILS
M601	MECHANICAL SCHEDULES
M602	MECHANICAL SCHEDULES
M701	MECHANICAL CONTROLS
M702	MECHANICAL CONTROLS

MECHANICAL CONTROLS

IM703



3361-008-000

ONTARIO, CA 91764

330E

DESCRIPTION

PRICING SET

KEYNOTES

NOTES

FACILITY:

4921 Cedar Ave El Monte, CA 91732

PROJECT: EMUSD Arroyo HS Modernization

SHEET NAME: **MECHANICAL FRONT SHEET**



DATE: 11/28/22 SHEET



CLIENT PROJ NO: 3361-008-000

DSA SUBMITTAL



DATE

2023-01-11

ΨN

HVAC ABBREVIATIONS

BBREVIATION	DESCRIPTION
AC	AIR CONDITIONING UNIT
AD	ACCESS DOOR
AFF	ABOVE FINISHED FLOOR
AH	AIR HANDLING
BDD	BACK DRAFT DAMPER (WEIGHTED)
BT	BYPASS TIMER
BTU	BRITISH THERMAL UNITS PER HOUR
CC	COOLING COIL
CD	CEILING DIFFUSER
CFM	CUBIC FEET PER MINUTE
CLG	CEILING
CU	CONDENSING UNIT
CV	CONSTANT VOLUME, CONT., CONTINUES
CSFD	COMBINATION FIRE/SMOKE DAMPER
DAL	DISCHARGE AIR LOUVER DECIBELS
DB	DRY BULB TEMPERATURE
DDC	DIRECT DIGITAL CONTROL
DIA	DIAMETER
DN	DOWN
DTR	DOWN THROUGH ROOF
EA	EACH
EAT	ENTERING AIR TEMPERATUR
EF	EXHAUST FAN
EG	EXHAUST GRILLE
EFF	EFFICIENCY
EMS	ENERGY MANAGEMENT SYSTEM
ER	EXHAUST REGISTER
ESP	EXTERNAL STATIC PRESSURE
°F FC FCU FD FLR FLA FLA FPM FT FV	DEGREES, FAHRENHEIT FLEX CONNECTION FAN COIL UNIT FIRE DAMPER FLOOR FULL LOAD AMPS FEET PER MINUTE FEET FACE VELOCITY
HZ	HERTZ
HPU	HEAT PUMP UNIT
HP	HORSE POWER
HW	HOT WATER
HWR	HOT WATER RETURN
HWR	HOT WATER SUPPLY
IN	INCHES
IN.W.C.	INCHES OF WATER COLUMN
IFM	INDOOR FAN MOTOR
LAT	LEAVING AIR TEMPERATURE
LBS	POUNDS
LRA	LOCKED ROTOR AMPS
MAX	MAXIMUM
MBH	ONE THOUSAND BTUH
MCA	MINIMUM CIRCUIT AMPS
MCOP	MAXIMUM CIRCUIT AMPS
MD	MOTORIZED DAMPER
MIN	MINIMUM
MFS	MAXIMUM FUSE SIZE
MVD	MANUAL VOLUME DAMPER
N/A	NOT APPLICABLE
NC	NOISE CRITERIA
NIC	NOT IN CONTRACT
NK	NECK
NO	NUMBER
NTS	NOT TO SCALE
OFM	OUTDOOR FAN MOTOR
OSA	OUTSIDE AIR
OAI	OUTSIDE AIR INTAKE
OAL	OUTSIDE AIR LOUVER
OBD	OPPOSED BLADE DAMPER
RA	RETURN AIR
RAR	RETURN AIR REGISTER
RF	RETURN FAN
RG	RETURN GRILLE
RH	HUMIDITY
RLA	RATED LOAD AMPS
RM	ROOM
RPM	REVOLUTIONS PER MINUTE
RR	RETURN REGISTER
SA	SUPPLY AIR
SF	SUPPLY AIR FAN
SP	STATIC PRESSURE
SPEC	SPECIFICATIONS
SR	SUPPLY REGISTER
TD	TEMPERATURE DIFFERENCE
TEMP	TEMPERATURE
TSTAT	THERMOSTAT
TYP	TYPICAL
TSP	TOTAL STATIC PRESSURE
UH	UNIT HEATER
UNO	UNLESS NOTED OTHERWISE
UTR	UP THROUGH ROOF
V	VOLT
VENT	VENTILATION; VENT
VERT	VERTICAL
VTR	VENT THROUGH ROOF
W/	WITH
W	WATT
WBT	WET BULB TEMPERATURE
WMS	WIRE MESH SCREEN
ZD (ETR) (E) (N) (R) (RL) (RS) (DCV)	ZONE DAMPER EXISTING TO REMAIN EXISTING NEW REMOVE RELOCATED REMOVE & SAVE FOR RELOCATION DEMAND CONTROL VENTILATION (CO2)

	DUCTWORK SYMBOLS	
	SUPPLY DUCT RISER IN PLAN	
	RETURN DUCT RISER IN PLAN	T
	EXHAUST DUCT RISER	
		S
8 ∠ ==	$ \otimes \otimes $	
	$= = \frac{1}{2}$ (L) 1" ACOUSTICALLY LINED DUCTWORK	
<u></u>		
)>		
	SQUARE-THROATED ELBOW W/TURNING VANES	
	RADIUS ELBOW	
NK=	T NK= RADIUS TEE	
,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,	PT CHANGE IN ELEVATION WITH RELATION TO AIR ELOW	
		[S]
, - , 1 , - , 1	TRANSITION ON CENTER	
	RECTANGULAR-TO-ROUND TRANSITION	
	TAKE-OFE TAP TO RECTANGULAR DUCT AND VOLUME DAMPER	
	CONICAL TAP TO RECTANGULAR DUCT AND VOLUME DAMPER	R
		s
	COMBINATION FIRE SMOKE DAMPER (CFSD)	
, ⊥L ' ⊥ , ← FD 4	↓L ⊋ FD	
	FIRE DAMPER (FD)	
۶۶ ^{۲-}	EXISTING DUCTWORK TO REMAIN (DASHED)	
· در		
, , , 		
<u>≮</u> ≦j	ACCESS REQUIRED FOR EQUIPMENT SERVICE	FS
	SIDE WALL REGISTER/GRILLE	FM
	RETURN GRILLE WITH ACOUSTICALLY LINED BOOT	
	CEILING DIFFUSER 3-WAY THROW	
	CEILING DIFFUSER 2-WAY THROW	
	CEILING DIFFUSER 2-WAY THROW	CV
\mathbf{X}	CEILING DIFFUSER 1-WAY THROW	PRV
	RETURN AIR GRILLE	
	EXHAUST GRILLE	
	THERMOSTAT (MAX. 48" A.F.F.)	—⊘— CBV
	CO SENSOR (MAX 48" A E E)	PRV
	BYPASS TIMER (MAX. 48 A.F.F.)	
	FOUIPMENT TAG DESCRIPTION FAU	
D80-1/	ROOM NUMBER D80, UNIT NUMBER 1 DETAIL REFERENCE. DETAIL 1. SHEET NUMBER M-1	
M-1 DL	DOOR LOUVER MIN. 12x12	
DU	DOOR UNDERCUT MAX. 1"	
1 M-1	SECTION REFERENCE, SECTION 1 SHEET M-1	
EQUIP. TYPE	EQUIPMENT REFERENCE, UNIT NUMBER	
	CONSTRUCTION NOTE #1	
<u> </u>	ROOF MOUNTED DUCT SUPPORT	
BD	BACK DRAFT DAMPER	

SEPARATOR FILTER, IN L PUMP SUCT CONTROL VA PRESSURE REDUCING VALVE STATION

PUMP

FLOW CONTROL VALVE CALIBRATED BALANCE VALVE PRESSURE REDUCING VALVE AGENCY APPROVAL:

	- EICW $-$
SHUT-OFF VALVE	— ICW — — DW —
CHECK VALVE, SWING OR LIFT	— D — — COND —
SILENT CHECK VALVE	— V — — CHWS —
STOP CHECK VALVE	— CHWR — — SWS —
ANGLE STOP CHECK VALVE	— SWR — — HWS — — HWR —
BUTTERFLY VALVE	
BALL VALVE SQUARE HEAD COCK	- RL $-$
BALANCING VALVE	— RRV — — RS —
PLUG VALVE (TYPE AS NOTED)	- RHG $--$ CF $-$
PRESSURE REDUCING VALVE	— BFW — — BD —
PRESSURE INDEPENDANT CONTROL VALVE	— CBD —
THREE-WAY AUTOMATIC CONTROL VALVE	>
FLOW CONTROL VALVE	
QUICK OPENING VALVE	
ELECTRIC MOTORIZED VALVE OPERATOR	
PNEUMATIC VALVE OPERATOR	
"Y" TYPE STRAINER	
RELIEF VALVE	
SAFETY VALVE	
AUTOMATIC AIR VENT	
MANUAL AIR VENT	
REFRIGERANT SIGHT GLASS	
VIBRATION ISOLATOR IN HANGER	
TEST PLUG	
THERMOMETER AND WELL	0
PRESSURE GAUGE WITH VALVE	
AQUASTAT	
TEMPERATURE TRANSMITTER	
FLOW SWITCH	,
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	•
SEPARATOR	
PUMP SUCTION DIFFUSER	
CONTROL VALVE STATION	

EXISTING INDUSTRIAL COLD WATER INDUSTRIAL COLD WATER DOMESTIC WATER DRAIN CONDENSATE VENT OR ATMOSPHERIC RELIEF
CHILLED WATER RETURN SECONDARY WATER SUPPLY SECONDARY WATER RETURN HOT WATER SUPPLY HOT WATER RETURN
EXISTING INDUSTRIAL COLD WATER REHEAT WATER RETURN REFRIGERANT LIQUID LINE REFRIGERANT RELIEF VENT REFRIGERANT SUCTION LINE REFRIGERANT HOT GAS
CHEMICAL FEED BOILER FEED WATER BLOW DOWN CONTINUOUS BLOW DOWN NEW PIPING (SOLID)
EXISTING PIPING TO BE REMOVED
NEW PIPE WITH DIRECTION OF FLOW
EXISTING PIPING TO REMAIN (DASHED)
PIPE IN UNDERGROUND CONDUIT PIPE DROP
PIPE RISE PITCH UP IN DIRECTION OF FLOW PITCH DOWN IN DIRECTION OF FLOW
FLANGED CONNECTION CONCENTRIC REDUCER ECCENTRIC REDUCER - FLAT BOTTOM ECCENTRIC REDUCER - FLAT TOP
DEAD END, SCREWED CAP EXPANSION LOOP PIPE EXPANSION JOINT
BALL JOINT PIPE ALIGNMENT GUIDE PIPE ANCHOR GATE VALVE
ANGLE GATE VALVE
GLOBE VALVE
ANGLE GLOBE VALVE
NEEDLE VALVE COCK
DRAIN VALVE
ELBOW TURNED UP ELBOW TURNED DOWN
TEE TURNED UP TEE TURNED DOWN CAP
RISE OR DROP IN PIPE
UNION
PIPE CONTINUES POINT OF CONNECTION
VALVE IN RISER FLOW IN DIRECTION OF ARROW GATE VALVE CHECK VALVE
BUTTERFLY VALVE (FOR SIZES 2 ¹ 2" AND LARGER) AND BALL VALVE (FOR 2" AND SMALLER)

3361-008-000 B546 CONCOURS STREET ISSUE Δ **DESCRIPTION** PRICING SET **KEYNOTES** NOTES

FACILITY:

4921 Cedar Ave El Monte, CA 91732

PROJECT:

SHEET NAME:



DATE: 02/13/23 SHEET:



CLIENT PROJ NO: 3361-008-000

MECHANICAL LEGEND AND ABBREVIATIONS

EMUSD Arroyo HS Modernization



DATE 2023-01-11

| Nonresidential Performance Cor | ompliance Method |
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| Project Name: | | Arroyo High Sch
 | nool Gym - Buil
 | ding R Date Prep | pared: | | 2023-02-14 | B1. PROJECT SUM | IMARY |
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 |
| . General Information | |
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 | | | | | Table B shows wh
permit applicatio | hich building com
on. | nponents are i
 | ncluded in the | performance ca | culation. If indic
 | ated as not i | ncluded, the p | project must show | compliance presci | riptively if wit
 |
| Project Name Run Title | Arroyo High School Gym - Building | g R
 |
 | | | | | | Bu | uilding Compo
 | nents Comply | ng via Performa | nce
 | Performan | ce The f | Building Compo | nents Complying | Prescriptive
 |
| Project Location | 4921 Cedar Avenue |
 |
 | | | | | Envelope (See Ta
Nonres | ible G) | Not Inclu
 | ded Kitch | red Process: Co
ens (see Table J | nmercial
 | Not Include | ed NRCC | criptive compliance
C form listed if with | and should be do
in the scope of th | ocumented c
 |
| City | El Monte | 5
 | Standards Ve
 | ersion | | | | | | Performa
 | nce | |
 | Performan | (i.e. o
ce Indoo | or Lighting (Uncon | ditioned) 140.6 | NRCC-PRF-E
 |
| Zip code
Climate Zone | 91732 | 7
 | Compliance S
Building Orie
 | Software (version) | EnergyPro 9.0 | | | Mechanical (See
Nonres | Table H) | Not Inclu
 | ded | |
 | Not Include | ed Outd | loor Lighting 140.7 | & 170.2(e) | NRCC-LT
 |
| Building Type(s) | Nonresidential | 11
 | Weather File
 | (| LOS-ANGELES-I | USC_STYP20.epw | | Domestic Hot Wa | ater (See | Performa
 | nce Cove | red Process: La | oratory 🛛
 | Performan | ce Sign | Lighting 140.8 &ar | np; 170.2(e) | NRCC-LT
 |
| Project Scope | Existing addition and alteration | 13
 | Number of D
 | welling Units | 0 | | | Table I) Nonres | | Not Inclu Rerforma
 | ded Exha | ust (see Table J) |
 | Not Include | ed | ding Components | Complying with N |
 |
| Scope (ft ²) | ^{23 IN} 15625 | 15
 | Total # of ho
 | tel/motel rooms | 0 | | | Lighting (Indoor
see Table K) Non | Conditioned, —
res | Not Inclu
 | ded ar | levator and esc
d should be do | alator requirem
umented on the
 | ents are man
NRCC form I | datory
listed if Elect | crical Power Distrib | ution 110.11 | NRCC-El
 |
| Area (ft ²) | 0 | 17
 | Fuel Type
 | ries (Habitable | Natural gas | | | Solar Thermal W/ | ater Heating | Performa
 | nce | ipplicable (i.e. c | ompliance will r
 | not be shown
NRCC- | on the
PRF-E.) Com | missioning 120.8 | | NRCC-C
required
 |
| B Floor Area | 15625 | 19
 | Above Grade
 | :) | 1 | | | (See Table 13) | | Not Inclu
 | ded | |
 | | Solar | rand Battery 110.1(|) | NRCC-SA
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(Page 5 of 16) | CERTIFICATE OF
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| 3. TDV ENERGY RESULTS FOR NON- | N-REGULATED COMPONENTS ¹ |
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 | | | | | C4. SOURCE ENER | | RESULTS FOR PI
 | RFORMANCE C | OMPONENTS (An | ual SOURCE Ene
 | rgy Use, kBtu/ | ′ft² /yr) | | |
 |
| Non-Regulated E | Energy Component | Standard Desig
 | n (TDV)
 | Proposed Desi | sign (TDV) | Compliance N | Margin (TDV) ¹ | | r | Omner
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 | | Dron - | d Design (Source) | A |
 |
| ocess | | 41.17
 |
 | 41.17 | | | | Space Heating | Energy (| -omponent
 | | Sta | 4.21
 | CONCE) | Fioposec | 1.08 | | 3.13
 |
| her Ltg | |
 |
 | | | - | | Space Cooling | |
 | | | 7.47
 | | | 5.7 | _ | 1.77
 |
| ocess Motors | I-REGULATED COMPONENTS) |
385.74
 |
 | 372.88 | 38 | 12.86 | (3.3%) | Indoor Fans
Heat Rejection | |
 | | | 3.2
0
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0 | | -0.52
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| otes: This table is not used for l | r Energy Code Compliance. |
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 | | | 1 | | Pumps & Misc. | |
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 | | | | | EFFICIENCY COMP | PLIANCE TOTAL |
 | | | 35.18
 | | | 30.8 | 4. | .38 (12.5%)
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| | |
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 | | | | | Photovoltaics
Batteries | |
 | | | -0.59
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 | | | | | TOTAL COMPLIAN | ICE |
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WATER HEATER EQUIPMENT SUN 01 02 Natural Gas	Image: Nonkesidential compliance Image: Nonkesidential compliance Standard Design (kBtu/ft² / yr) S5.94 Standard Design (kBtu/ft² / yr) S5.94 Image: Solution of Sol	Report Vers Schema Ver MPLIANCE METHOD MPLIANCE METHOD Proposed Design (ki 49.75 49.75 Area (ft²) 1 Area (ft²) 1 Schon ver 1 500'00" east of north 1 500'00" west of south 1 0'00" south of east of south 1 0'00" north of west of south 1 0 0 0 MPLIANCE METHOD 1 0 0 0 0 0 0 0 0 0 0 0 1 0 0 0 1 0 0 0 0 0 0 0 1 0 0 0 0 0 0 0 0 0 0 0 0 0 1 0 0 0 0 1 0 0 0 0 0 0 0 0 0 <t< td=""><td>sion: 2022.0.00 rsion: rev 2022 Btu/ft² / yr) guident of the second of the secon</br></td><td>0 00001 Margin (kBtu, 6.19 3.73 cluding PV)/Total Bu stration Area (ft²) 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0</td><td>Repor</td><td>t Generated: 2023 Margin Pa 11 6. 11 6. 4 Window to Wall I 0 0 0 0 0 0 0 0 0 0 0 0 0</td><td>3-02-14 16:24:53 NRCC-PRF-E (Page 9 of 16) </td><td>¹ Notes: This num ¹ Notes: This num CA Building Energy CERTIFICATE OF Nonresidential GS. 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INDOOR CON CI DECLARATION OF Selections made b and provided to th DUIDING CENTIFICATE OF NONRESIDENTIAL NOTESIDENTIAL CO Selections made b Selections made b CENTIFICATE OF NORESIDENTIAL Selections made b Selections made b</td><td>nber in parenthes nber in parenthes rgy Efficiency Sta Performance Co FACE ASSEMBLY SU 02 FACE ASSEMBLY SU 02 Underground Floor Floor Exterior Wall eed, E - Existing EQUIPMENT (FURI Heat Pump A System A - Altered, E - Existing EQUIPMENT (FURI Heat Pump A System A - Altered, E - Existing EQUIPMENT (FURI Co ITIONED LIGHTIN Co ITIONED LIGHTIN Co DITIONED LIGHTIN Co DITIONED LIGHTIN Co IN IN</td><td>NONRESIDEN mpliance Met JMMARY 03 Area (ft²) 15,625 15,625 11,726 11,726 NORESIDEN mpliance Met 15,625 11,726 NACES, AIR HAN 03 Qty Vir 2 I1,726 NORESIDEN mpliance Met JM Qty Vir 2 IIFICATES OF IN MRCI-ENV-0 NRCI-ENV-0 NRCI-ENV-0 NRCI-ENV-0 NRCI-PLE NRCI-PLE</td><td>IAL PERFORM IAL PERFORM <!--</td--><td>ANCE COMPLIA O ANCE COMPLIA O O Cavity O O Cavity O O O N O O N O O N O O N O O N O O N O O N O O N O O N O O N O O N O O N O O O N O O O N O O O O N O</td><td>n 4, represents Report Versi Schema Versi nCE METHOD innous R-Value rior Exterio A N/A A N/A A 2.93 A A ECONOMIZERS E o6 ating Efficiency Unit COP ating COP A N/A Power COP A NCE METHOD Power L Power L A NCE METHOD A NCE METHOD A NCE METHOD A NCE METHOD A Buildings Buildings Sistems Sistems Sistems</td><td>the Percent E on: 2022.0.00 ion: rev 2022 T 0 0 0 0 0 0 0 0 0 0 0 0 0</td><td>3etter than St 3etter than St 3etter</td><td>tandard.</td><td><pre>>port Generated: . og og og of Assembly La eated slab on gra ntation =None lue =none s0_25In sle felt - 1/8 in. n. cyanurate (unface all Roof Ceiling - 4 - 1/2 in. lb/ft3 - 10 in. find find find find find find find fin</pre></td><td>2023-02-14 NF (Page vyers ide ed) - 1/2 in. or 11 iomizer pe (if ssent) 2023-02-14 in.lor 2023-02-14 NR (Page 0 0 0 0 0 0 0 0 0 0 0 0 0</td></td></t<>	sion: 2022.0.00 rsion: rev 2022 Btu/ft ² / yr) 	0 00001 Margin (kBtu, 6.19 3.73 cluding PV)/Total Bu stration Area (ft ²) 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	Repor	t Generated: 2023 Margin Pa 11 6. 11 6. 4 Window to Wall I 0 0 0 0 0 0 0 0 0 0 0 0 0	3-02-14 16:24:53 NRCC-PRF-E (Page 9 of 16) 	¹ Notes: This num ¹ Notes: This num CA Building Energy CERTIFICATE OF Nonresidential GS. OPAQUE SUR 01 Surface Name Slab On Grade8 R-3 Roof No Attic10 10 Concrete Wall22 ¹ Status: N - New, A - Alte H1. DRY SYSTEM 01 Equipment Name Gymnasium AHU-1/AHU-3 ¹ Status: N - New, A - Alte Gymnasium AHU-1/AHU-3 ¹ Status: N - New, A - Alte CERTIFICATE OF Nonresidential K1. INDOOR CON 01 CERTIFICATE OF Nonresidential K1. INDOOR CON 01 CCupancy Sports Arena Building Energy Sports Arena Sports Arena Sports Arena Building CO CERTIFICATE OF Nonresidential K1. INDOOR CON 01 CCUPANCY Sports Arena Building CO CENTIFICATE OF Nonresidential K4. INDOOR CON CI DECLARATION OF Selections made b and provided to th DUIDING CENTIFICATE OF NONRESIDENTIAL NOTESIDENTIAL CO Selections made b Selections made b CENTIFICATE OF NORESIDENTIAL Selections made b Selections made b	nber in parenthes nber in parenthes rgy Efficiency Sta Performance Co FACE ASSEMBLY SU 02 FACE ASSEMBLY SU 02 Underground Floor Floor Exterior Wall eed, E - Existing EQUIPMENT (FURI Heat Pump A System A - Altered, E - Existing EQUIPMENT (FURI Heat Pump A System A - Altered, E - Existing EQUIPMENT (FURI Co ITIONED LIGHTIN Co ITIONED LIGHTIN Co DITIONED LIGHTIN Co DITIONED LIGHTIN Co IN	NONRESIDEN mpliance Met JMMARY 03 Area (ft²) 15,625 15,625 11,726 11,726 NORESIDEN mpliance Met 15,625 11,726 NACES, AIR HAN 03 Qty Vir 2 I1,726 NORESIDEN mpliance Met JM Qty Vir 2 IIFICATES OF IN MRCI-ENV-0 NRCI-ENV-0 NRCI-ENV-0 NRCI-ENV-0 NRCI-PLE NRCI-PLE	IAL PERFORM IAL PERFORM </td <td>ANCE COMPLIA O ANCE COMPLIA O O Cavity O O Cavity O O O N O O N O O N O O N O O N O O N O O N O O N O O N O O N O O N O O N O O O N O O O N O O O O N O</td> <td>n 4, represents Report Versi Schema Versi nCE METHOD innous R-Value rior Exterio A N/A A N/A A 2.93 A A ECONOMIZERS E o6 ating Efficiency Unit COP ating COP A N/A Power COP A NCE METHOD Power L Power L A NCE METHOD A NCE METHOD A NCE METHOD A NCE METHOD A Buildings Buildings Sistems Sistems Sistems</td> <td>the Percent E on: 2022.0.00 ion: rev 2022 T 0 0 0 0 0 0 0 0 0 0 0 0 0</td> <td>3etter than St 3etter than St 3etter</td> <td>tandard.</td> <td><pre>>port Generated: . og og og of Assembly La eated slab on gra ntation =None lue =none s0_25In sle felt - 1/8 in. n. cyanurate (unface all Roof Ceiling - 4 - 1/2 in. lb/ft3 - 10 in. find find find find find find find fin</pre></td> <td>2023-02-14 NF (Page vyers ide ed) - 1/2 in. or 11 iomizer pe (if ssent) 2023-02-14 in.lor 2023-02-14 NR (Page 0 0 0 0 0 0 0 0 0 0 0 0 0</td>	ANCE COMPLIA O ANCE COMPLIA O O Cavity O O Cavity O O O N O O N O O N O O N O O N O O N O O N O O N O O N O O N O O N O O N O O O N O O O N O O O O N O	n 4, represents Report Versi Schema Versi nCE METHOD innous R-Value rior Exterio A N/A A N/A A 2.93 A A ECONOMIZERS E o6 ating Efficiency Unit COP ating COP A N/A Power COP A NCE METHOD Power L Power L A NCE METHOD A NCE METHOD A NCE METHOD A NCE METHOD A Buildings Buildings Sistems Sistems Sistems	the Percent E on: 2022.0.00 ion: rev 2022 T 0 0 0 0 0 0 0 0 0 0 0 0 0	3etter than St 3etter	tandard.	<pre>>port Generated: . og og og of Assembly La eated slab on gra ntation =None lue =none s0_25In sle felt - 1/8 in. n. cyanurate (unface all Roof Ceiling - 4 - 1/2 in. lb/ft3 - 10 in. find find find find find find find fin</pre>	2023-02-14 NF (Page vyers ide ed) - 1/2 in. or 11 iomizer pe (if ssent) 2023-02-14 in.lor 2023-02-14 NR (Page 0 0 0 0 0 0 0 0 0 0 0 0 0

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RESIDENTIAL PERFORMANCE COMPLIANCE METHOD NRCC-PRF								
ince Method (Page 2 of 2								
ents are included in the performance calculation. If indicated as not included, the project must show compliance prescriptively if within the								
g Components Co	omplying via Performance			Building Components Complying Pr	escriptively			
Performance			Performance	The following building components are ONI	Y eligible for			
Not Included	Covered Process: Commercial Kitchens (see Table J)		Not Included	prescriptive compliance and should be documented on NRCC form listed if within the scope of the permit appl (i.e. compliance will not be shown on the NRCC-PRF-E)				
Performance			Performance	Indoor Lighting (Unconditioned) 140.6 & 170.2(e)	NRCC-LTI-E is required			
Not Included		\boxtimes	Not Included	Outdoor Lighting 140.7 & 170.2(e)	NRCC-LTO-E is required			
Performance	Covered Process: Laboratory		Performance	Sign Lighting 140.8 & 170.2(e)	NRCC-LTS-E is required			
Not Included	Exhaust (see Table J)	\boxtimes	Not Included					
Performance	Electrical power systems, con	nmissi	oning, solar ready,	y, Building Components Complying with Mandatory Measures				
Not Included	elevator and escalator requ and should be documented o annlicable (i.e. compliance	ireme n the will n	nts are mandatory NRCC form listed if at he shown on the	Electrical Power Distribution 110.11	NRCC-ELC-E is required			
Performance			NRCC-PRF-E.)	Commissioning 120.8	NRCC-CXR-E is required			
Not Included				Solarand Battery 110.10	NRCC-SAB-E is required			

	COMPLIES ³					
	Time Depende	Time Dependent Valuaton (TDV)				
	Efficiency ¹ (kBtu/ft ² - yr)	Total ² (kBtu/ft ² - yr)				
Standard Design	360.38	344.57				
Proposed Design	331.71	331.71				
Compliance Margins	28.67	12.86				
	Pass	Pass				

CERTIFICATE OF COMPLIANCE - NONRESIDENTIAL PERFORMANCE COMPLIANCE METHOD

Nonresidential Performance Compliance Method

s - 2022 Nonresidential Compliance Report Version: 2022.0.000 Report Generated: 2023-02-14 16:24:53 CA Building Energy Efficiency Standards - 2022 Nonresidential Compliance Report Version: 2022.0.000 Schema Version: rev 20220601

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CERTIFICATE OF COMPLIANCE - NONRESIDENTIAL PERFORMANCE COMPLIANCE METHOD Nonresidential Performance Compliance Method

AHU-2/AHU-4

¹ Status: N - New, A - Altered, E - Existing

C5. SOURCE ENERGY RESULTS FOR NON-REGULATED COMPONENTS ¹						
Non-Regulated Energy Component	Standard Design (SOURCE)	Proposed Design (SOURC				
Receptacle	3.01	3.01				
Process						
Other Ltg						
Process Motors						
TOTAL (TOTAL COMPLIANCE + NON-REGULATED COMPONENTS)	37.6	33.81				
¹ Notes: This table is not used for Energy Code Compliance.						
C6. 'ABOVE CODE' QUALIFICATIONS						
This project is pursuing CalGreen Tier 1	This project	is pursuing CalGreen Tier 2				

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ance Method			(Page 6 of 16)
LTS FOR PERFORMANCE COMPONE	NTS (Annual SOURCE Energy Use, kBtu	/ft ² /yr)	
	COMPLIES ²		
oonent	Standard Design (SOURCE)	Proposed Design (SOURCE)	Compliance Margin (SOURCE) ¹
	4.21	1.08	3.13
	7.47	5.7	1.77
	3.2	3.72	-0.52
	0	0	0
	0	0	0
	13.27	13.27	0
	7.03	7.03	0
	35.18	30.8	4.38 (12.5%)
	-0.59		-0.59
	0		
	34.59	30.8	3.79 (11%)
llowing the Compliance Margin	in column 4, represents the Percent	Better than Standard.	

IRESIDENTIAL PERFORMANCE COMPLIANCE METHOD NRCC-PRF-E												
iance Me	thod						(Pag	e 10 of 16)				
/IARY												
03 04 05 06 07 08 09								10				
(ft ²)	(r.2) Framing	Framing	Framing	Framing	Framing	Cavity	Continuo	us R-Value	Unite	Value	Description of Assembly Layers	Charlen 1
ea (it)	Туре	R-Value	Interior	Exterior	Onits	value	Description of Assembly Layers	Status				
.5,625	N/A	0	N/A	N/A	F-factor	0.73	Slab Type =Unheated slab on grade Insulation Orientation =None Insulation R-Value =none	E				
.5,625	N/A	0	N/A	2.93	U-factor	0.1608	AsphaltShingles0_25In Vapor permeable felt - 1/8 in. Plywood - 1/2 in. Cellular polyisocyanurate (unfaced) - 1/2 in. R2.9 Air - Cavity - Wall Roof Ceiling - 4 in. or more Gypsum Board - 1/2 in.	E				
.1,726	N/A	0	N/A	N/A	U-factor	0.6289	Concrete - 140 lb/ft3 - 10 in.	E				

S, AIR HANDLING UNITS, HEAT PUMPS, VRF, ECONOMIZERS ETC.)									
03	04	05	06	07	08	09	10	11	12
		Hea	ting			Cooling			
Qty	Total Heating Output (kBtu/h)	Supp Heat Output (kBtu/h)	Efficiency Unit	Efficiency	Total Cooling Output (kBtu/h)	Efficiency Unit	Efficiency	Economizer Type (if present)	Status ¹
2	494.72	0	СОР	3.42	494.72	EER	11.3	Differential Enthalpy	Ν

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CERTIFICATE OF COMPLIANCE - NONRESIDENTIAL PERFORMANCE COMPLIANCE METHOD Nonresidential Performance Compliance Method H1. DRY SYSTEM EQUIPMENT (FURNACES, AIR HANDLING UNITS, HEAT PUMPS, VRF, ECONOMIZERS ETC.) 01 02 03 04 05 06 07 08 09 Heating Cooling Qty Total Supp Heat Heating Output (kBtu/h) Supt Heat Unit Unit Total Cooling Efficiency Output Unit (kBtu/h) Equipment Name Equipment Type Efficiency _____ Exercise Area Package 52 VAV Heat Pump Air AHU-2/AHU-4 System 2 260.38 0 COP 3.74 260.38 EER ¹ Status: N - New, A - Altered, E - Existing H3. NONRESIDENTIAL / COMMON USE AREA FAN SYSTEMS SUMMARY 01 02 03 04 05 06 07 08 09 10
 Name or Item Tag
 Qty
 Design OA CFM
 Supply Fan

 CFM
 CFM
 Power
 Power Units
 Control
 Fan Type
 CFM
 Power
 Gymnasium 2 2666.25 12,000 3 BHP VSD N/A N/A N/A AHU-1/AHU-3 _____ Exercise Area 2 372 5,800 1.7 BHP VSD N/A N/A N/A

CA Building Energy Efficiency Standards - 2022 Nonresidential Compliance Report Version: 2022.0.000

Nonresidential Performance	Compliance Method
M. DECLARATION OF REQUIRED	CERTIFICATES OF ACCEPTANCE
elections made by Documentatic o the building inspector during co https://www.energy.ca.gov/title2	n Author indicate which Certificates of Acceptance must be submitted for the features to be recognized for compliance anstruction and must be completed through an Acceptance Test Technician Certificaiton Provider (ATTCP). For more info 4/2019standards/2019_compliance_documents/Nonresidential_Documents/NRCA/
Building Component	Form/Title
Indoor Lighting	NRCA-LTI-02-A - Occupancy Sensors and Automatic Time Switch Controls.
Indoor Lighting	NRCA-LTI-04-A - Demand Responsive Lighting Controls.
Mechanical	NRCA-MCH-02-A - Outdoor Air must be submitted for all newly installed HVAC units. Note: MCH-02-A car MCH-07-A Supply Fan VFD Acceptance (if applicable) since testing activities overlap
Mechanical	NRCA-MCH-05-A - Air Economizer Controls
Mechanical	NRCA-MCH-06-A Demand Control Ventilation Systems must be submitted for all systems required to emp (refer to) can vary outside ventilation flow rates based on maintaining interior carbon dioxide (CO2) con-
Mechanical	NRCA-MCH-07-A Supply Fan Variable Flow Controls
Mechanical	NRCA-MCH-12-A FDD for Packaged Direct Expansion Units
	NRCA-MCH-21-H Multifamily Envelope
Mechanical	
Mechanical	
Mechanical N. DECLARATION OF REQUIRED C	ERTIFICATES OF VERIFICATION
Mechanical N. DECLARATION OF REQUIRED C ielections made by Documentatic ind provided to the building inspe	ERTIFICATES OF VERIFICATION In Author indicate which Certificates of Verification must be submitted for the features to be recognized for compliance ector during construction and can be found online
Mechanical N. DECLARATION OF REQUIRED C elections made by Documentatio nd provided to the building inspe Building Component	ERTIFICATES OF VERIFICATION n Author indicate which Certificates of Verification must be submitted for the features to be recognized for compliance ector during construction and can be found online Form/Title

CA Building Energy Efficiency Standards - 2022 Nonresidential Compliance Report Version: 2022.0.000

CA Building Energy Efficiency Standards - 2022 Nonresidential Compliance Report Version: 2022.0.000

AGENCY APPROVAL:



CERTIFICATE OF COMPLIANCE - NONRESIDENTIAL PERFORMANCE COMPLIANCE METHOD	NRCC-PRF-E
Nonresidential Performance Compliance Method	(Page 4 of 16)
C2. TDV ENERGY COMPLIANCE RESULTS FOR PERFORMANCE COMPONENTS (Annual TDV Energy Use, kBtu/ft ² - yr)	

	COMPLIES ²		
Energy Component	Standard Design (TDV)	Proposed Design (TDV)	Compliance Margin (TDV) ¹
Space Heating	13.13	8.13	5
Space Cooling	166.87	144.14	22.73
Indoor Fans	47.85	46.91	0.94
Heat Rejection	0	0	0
Pumps & Misc.	0	0	0
Domestic Hot Water	36.86	36.86	0
Indoor Lighting	95.67	95.67	0
Flexibility			
EFFICIENCY COMPLIANCE TOTAL	360.38	331.71	28.67 (8%)
Photovoltaics	-15.81		-15.81
Batteries	0		
TOTAL COMPLIANCE	344.57	331.71	12.86 (3.7%)
¹ Notes: This number in parenthesis following the Compliance Mar	rgin in column 4, represents the Percent	Better than Standard.	÷

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CA Building Energy Efficiency Standards - 2022 Nonresidential Compliance Report Version: 2022.0.000

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	(Page 11 of 16)								
	10		11		12				
		F -1							
Ef	ficiency	ECC T	onomizer Type (if present)		Status ¹				
12.4 Dif			ferential nthalpy	Ν					
	11		12	13					
Fa	in			Status ¹					
	Power U	nits	Contro	I	status-				
	N/A		N/A		N				
	N/A		N/A		Ν				

Nonresidential Performance Complia	nce Method					(Page 8 of 1	
C7. ENERGY USE SUMMARY							
Energy Component	Standard Design Site (MWh)	Proposed Design Site (MWh)	Margin (MWh)	Standard Design Site (MBtu)	Proposed Design Site (MBtu)	Margin (MBtu	
Space Heating		4.1		71.6			
Space Cooling	70.5	55.8	14.7				
Indoor Fans	22	25.2	-3.2				
Heat Rejection							
Pumps & Misc.							
Domestic Hot Water				225.9	225.9	0	
Indoor Lighting	53.5	53.5	0				
Flexibility							
EFFICIENCY TOTAL	146	138.6	7.4	297.5	225.9	71.6	
Photovoltaics	-11.3						
Batteries	0						
ENERGY USE SUBTOTAL	134.7	138.6	-3.9	297.5	225.9	71.6	
Receptacle	23	23	0				
Process							
Other Ltg							
Process Motors							
ENERGY USE TOTAL	157.7	161.6	-3.9	297.5	225.9	71.6	

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CERTIFICATE OF COMP	LIANCE - NONRESIDENTI	AL PERFORMANCE COMPL	IANCE METH	OD				NRCC-PRF-E	
Nonresidential Perform	nance Compliance Meth	od						(Page 12 of 16)	
18. SYSTEM SPECIAL FEAT	URES								
1		2			3		4		
System Name		Equipment Type		Interlocks per 140.4(n) ¹ Other Special Features and			Features and Controls		
Gymnasium AHI	J-1/AHU-3 Pa	ckage SZ VAV Heat Pump A	vir System		N/A	DDC Controls Zone(s) With CO2 Sensor Vent. Cont Optimum Start Differential Enthalpy		C Controls 2 Sensor Vent. Control imum Start ntial Enthalpy	
Exercise Area AHU-2/AHU-4 Pa		ckage SZ VAV Heat Pump A	vir System	N/A		Zone(s) \	Zone(s) With CO2 Sensor Vent. Control Differential Enthalpy		
Undefined Plant1 - SHW		Service Hot Water			N/A	Fix	Fixed Temperature Control		
otes: This table includes c RCC-MCH-E.	ontrols related to the perfo	mance path only. For projects	using the pres	criptive path,	mandatory and prescriptive	controls requiremen	nts are d	ocumented on the	
Yes = interlocks are provia	led, No = interlocks are not	provided, NA means no opera	ble openings.						
19. NONRESIDENTIAL / CO	OMMON USE AREA & HOTI	L/MOTEL VENTILATION							
1	2	3	4		5	6		7	
Zone Name		Mechanical Ventilation					a (sf)	DCV or Occupant Sensor	
Zone Name	Ventilation Function	# of People# of People	Supply C	DA CFM	Exhaust CFM	conditioned Are	u (31)	Controls, or Both	
1-Gymnasium R-07	Sports/Entertainment - Gym, sports arena (play 450 53 area)		533	2.5	0	10665		DCV	
2-Exercise Area R-06	Sports/Entertainment - Gym, sports arena (play area)	49.6	74	4	0	4960		DCV	

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NRCC-PRF-E
(Page 15 of 16)
e. These documents must be provided ormation visit:
n be performed in conjunction with
ploy demand controlled ventilation centration setpoints.
e. These documents must be retained

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CERTI	FICATE OF COMPLIANCE - NONRESIDENTIAL PERFORMANCE COMPLIANC	E METHOD	NRCC-PRF-E		
Nonre	esidential Performance Compliance Method		(Page 16 of 16)		
Docume	entation Author's Declaration Statement				
1. I cer	tify that this Certificate of Compliance documentation is accurate and co	mplete.			
Docum	entation Author Name: Mark Griggs, PE	Documentation Author Signature:	MA N M AN		
Compai	ny: Budlong	Signature Date:	Marin Dugps		
Addres	s: 315 Arden Avenue	CEA/HERS Certification Identificatio	CEA/HERS Certification Identification (if applicable):		
City/Sta	ate/Zip: , Glendale, CA 91203	Phone: 818 638-8780			
Respon	sible Person's Declaration statement				
1. 2. 3. 4. 5. 6.	The information provided on this Certificate of Compliance is true and of I am eligible under Division 3 of the Business and Professions Code to a Compliance (responsible designer) The energy features and performance specifications, materials, compor Certificate of Compliance conform to the requirements of Title 24, Part The building design features or system design features identified on this compliance documents, worksheets, calculations, plans and specification I understand that a registered copy of this Certificate of Compliance sha the enforcement agency for all applicable inspections, and I will take the I understand that a registered copy of this Certificate of Compliance is a complish these regu	sorrect. scorrect. scoret responsibility for the building design of another that the source of the building design of a not part 6 of the California Code of Regul s Certificate of Compliance are consistent w ins submitted to the enforcement agency fo all be made available with the building perm e necessary steps to accomplish this require equired to be included with the documenta irements.	or system design identified on this Certificate of ilding design or system design identified on this lations. /ith the information provided on other applicable or approval with this building permit application. nit(s) issued for the building, and made available to ement. tion the builder provides to the building owner at		
Respon	sible Designer Name:	Responsible Designer Signature:			
Compar	ny: HMC Architects				
Address: 633 West 5th Street		Date Signed:			
City/Sta	ate/Zip: Los Angeles, CA 90071	License #:			
Phone:	213 545-7609	Title:	Scope:		
Responsible Designer Name: Sunil Patel, PE		Responsible Designer Signature:	alit		
Company: Budlong		(600		
Address: 315 Arden Avenue		Date Signed: March 27, 2030			
Auures					
City/Sta	ate/Zip: Glendale, CA 91203	License #: 29448			

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CA Building Energy Efficiency Standards - 2022 Nonresidential Compliance Report Version: 2022.0.000

CA Building Energy Efficiency Standards - 2022 Nonresidential Compliance Report Version: 2022.0.000

NOTES

FACILITY:

4921 Cedar Ave El Monte, CA 91732

PROJECT:

SHEET NAME: **MECHANICAL T-24 FORMS**



DATE: 11/28/22 SHEET:



CLIENT PROJ NO: 3361-008-000

EMUSD Arroyo HS Modernization

1990E





Arroyo HS - Modernization.rvt
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NOTES

ISSUE

 Δ **DESCRIPTION**

PRICING SET

KEYNOTES

KEY PLAN:



4921 Cedar Ave El Monte, CA 91732

PROJECT:

SHEET NAME:

κ



DATE: 12/07/22 SHEET:



PLEASE RECYCLE

1/16" = 1'-0"

TN

PN



CLIENT PROJ NO: 3361-008-000

MECHANICAL 1ST FLOOR - DEMOLITION PLAN - BLDG

EMUSD Arroyo HS Modernization

HMC Architects 3361-008-000 3546 CONCOURS STREET ONTARIO, CA 91764 909 989 9979 / www.hmcarchitects.com C_O



DATE

2023-01-11



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ISSUE

KEYNOTES

KEY PLAN:



4921 Cedar Ave El Monte, CA 91732

PROJECT: EMUSD Arroyo HS Modernization

SHEET NAME:



DATE: 12/07/22 SHEET:

MECHANICAL DEMOLITION ROOF PLAN - OVERALL - BLDG K

PLEASE RECYCLE

1/16" = 1'-0"

TN

PN



CLIENT PROJ NO: 3361-008-000

MECHANICAL DEMOLITION ROOF PLAN - BLDG K

R Budlong An MBE|SBE|DBE|LSBE Firm Glendale|Downtown LA|Camarillo W W W . B U D L O N G . C O M Job No. 22-263 HMC Architects 3361-008-000 3546 CONCOURS STREET ONTARIO, CA 91764 909 989 9979 / www.hmcarchitects.com C_O Δ **DESCRIPTION** DATE PRICING SET 2023-01-11



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PRICING SET

KEYNOTES

	KEF-K-1 (
2	NEW KIT M504 - M
3	(E) SA DL REMAIN.
4	CONNEC ABOVE C
5	NEW CO

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4921 Cedar Ave El Monte, CA 91732

PROJECT:

SHEET NAME:



DATE: 12/07/22 SHEET:



1/16" = 1'-0"

TN

PN



REVIEWING AGENCIES STAMP HERE



2023-01-11

1 16"ø EA DUCT DN TO KITCHEN HOOD AND UP TO KEF-K-1 ON ROOF. KITCHEN HOOD PER DETAILS ON SHEETS - M508. DUCT WORK AND (E) SA GRILLES TO IECT (E) 24x48 SA DUCT TO (E) SA DUCT E CEILING. CONTROL PANEL FOR I-VU EMS SYSTEM. 6 KITCHEN HOOD SWITCH (ENERGIZES MAU-K-1 AND KEF-K-1.

EMUSD Arroyo HS Modernization

MECHANICAL 1ST FLOOR - FLOOR PLAN - BLDG K

DSA SUBMITTAL

M103

CLIENT PROJ NO: 3361-008-000

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PRICING SET

KEY PLAN:



4921 Cedar Ave El Monte, CA 91732

PROJECT:

SHEET NAME:



DATE: 12/07/22 SHEET:

MECHANICAL ROOF PLAN - OVERALL - BLDG K

1/16" = 1'-0" PLEASE RECYCLE

TN

PN



CLIENT PROJ NO: 3361-008-000

MECHANICAL ROOF PLAN - BLDG K

EMUSD Arroyo HS Modernization







DATE 2023-01-11



EXACTLY ONE INCH LONG AT SHEETS ORIGINAL PAGE SI	
	STORA(R-17
	EQUIP. ROU R-05 ELEC R-04
	ENTRY R-01



___1/8" = 1'-0"____ PLEASE RECYCLE





PLEASE RECYCLE





PLEASE RECYCLE









PLEASE RECYCLE





DUCT SUPPORTS PER OPM 0203-13







CLIENT PROJ NO: 3361-008-000

DSA SUBMITTAL

MECHANICAL DETAILS

EMUSD Arroyo HS Modernization

4921 Cedar Ave El Monte, CA 91732

FACILITY:

PROJECT:

SHEET NAME:

DATE: 03/19/23

SHEET

NOTES





1 MAU-K-1 ROOF CURB

AGENCY APPROVAL:

SHEET NAME:

PROJECT:

FACILITY:



DATE: 03/19/23 SHEET:



CLIENT PROJ NO: 3361-008-000

MECHANICAL DETAILS

EMUSD Arroyo HS Modernization

4921 Cedar Ave El Monte, CA 91732

KEYNOTES

ISSUE

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<u>H00I</u>) INFORM	ATION –	<u>J0B#59168</u>	<u>991</u>							
HOOD NO	TAG	MODEL	MANUFACTURER	LE	ENGTH	MAX COOKING TEMP	TYPE	APPLIAN DUTY	ICE	DESIGN CFM/F	EXH CFI
1	H-1 Ovens	6624 ND-2	CAPTIVEAIRE	11′6″		450 DEG	I	MEDIU	м	150	1725
2	H-2	6024 ND-2	6024 ND-2 CAPTIVEAIRE 11' 6" 600 DEG I HEAVY								2300
HOOL) INFORM	ATION									
	-			ŀ	FILTER	2)					1
	TAG	T.	TYPE QTY HEIGHT LENGTH EFFICIENCY @ MICRONS							QTY	
1	H-1 Ovens	CAPTRATE	SOLO FILTER	8	20″	16″	85%	SEE FILI SPEC	ΓER	3	RECI
2	H-2	CAPTRATE	SOLO FILTER	8	20″	16″	85%	SEE FILI SPEC	ΓER	3	REC
HOOL	OPTIONS	S									
	TAG			DF	PTION						
1		FIELD W	RAPPER 18.0)0″	HIGH	FRONT,	LEFT,	RIGHT.			
	H-I Uvens	BALANCE I	DAMPERS.								
2		FIELD W	RAPPER 18.0)0″	HIGH	FRONT,	LEFT,	RIGHT.			
	H-C	BALANCE I)AMPERS.								

<u>SPECIFICATION: CAPTRATE[®] GREASE-STOP[®] SOLO FILTER</u> THE CAPTRATE GREASE-STOP SOLD FILTER IS A SINGLE-STAGE FILTER FEATURING A UNIQUE S-BAFFLE DESIGN IN CONJUNCTION WITH A SLOTTED REAR BAFFLE DESIGN, TO DELIVER EXCEPTIONAL FILTRATION EFFICIENCY. FILTER IS STAINLESS STEEL CONSTRUCTION, AND SIZED TO FIT INTO STANDARD 2-INCH DEEP HOOD CHANNEL(S).





EXHAUST PLENUM RISER(S)

WIRE

GUARD

ND

NΠ

4" | 16" | 1725 | 1235 | -0.423"

4" 16" 2300 1647 -0.753"

LOCATION

LEFT

RIGHT

SIZE

12"×66"×24"

12"×60"×24" TANK FS

DUTY CFM/FT EXH CFM WIDTH LENG HEIGHT DIA CFM VEL SP

LIGHT(S

TYPE

RECESSED ROUND

RECESSED ROUND

FIRE	SYSTI	EM	INFORMATIC	N	
FIRE SYSTEM ND	TAG		TYPE		
1			TANK ES		

ELECTRICAL

MODEL #

DC∨-1111

HOOD CONFIG

ALONE FRONT

ALONE BACK

SIZE

4.0/4.0

ROV

END TO

END

UTILITY CABINET

HOOD

304 SS

100%

304 SS

100%

TYPE

CONSTRUCTION

FIRE	SYSTI	EM	INFORMATIC	N	_
FIRE SYSTEM ND	TAG		TYPE		
1			TANK FS		

SWITCHES

QUANTITY

1 LIGHT

1 FAN

AGENCY **APPROVAL:**



SHEET NAME:



DATE: 03/19/23 SHEET:

PLEASE RECYCLE



CLIENT PROJ NO: 3361-008-000

DSA SUBMITTAL

MECHANICAL DETAILS

EMUSD Arroyo HS Modernization







AGENCY APPROVAL:



CLIENT PROJ NO: 3361-008-000

DSA SUBMITTAL

EMUSD Arroyo HS Modernization





		TAG	PACKA	GE		LOCATI	 DN			CHES				PTION		
	1		DCV-1	111	UTILIT	Y CABIN	IET RIGHT	I SHIF	P LOOSE W/ PREWIRE	1 LIGH	T	:	SMART CE	UNTROLS DC	v	
				·			MBFR			DRAWN BY	SCHEMATIC T	MPE DF	SCRIPTIO	IN OF OPFRA		
	1	59	16991			OB NAME	EL MONTE	'-1111 USD ARROYI] HS 460∨	DATE 5/18/2023	INSTAL DWG NO 3 ECP #1	L Demo modu sens L-1 dist	and Control Ver alate based on sor shipped loo ance exceeds 5	duct temperature. In duct temperature. In se for field installat 50 feet.	for 1 Exhaust NVERTER DUTY Ion.Verify dist	t Fan, 1 3 PHASE tance be
	2	BREAKER	PANEL 1 Respons	TO PR sibility	IMARY Electr	CONTROL rician	PANEL			PANEL TO AC	CESSORY I	ITEMS		CONTROL PANEL	<u>ST 0</u> <u>N1 0</u>	NEUT
	- 1 - 1		R SIZE SHE	JWN IS	: THE MA	PRIMAL	ILOWED Ry control pai 0 H1	NEL	CONTROL PANEL	WIRE DIRECTLY TO	CONTROL BOARD			CONTROL PANEL	KS 0	FIRE C
	5	120 ∨ 15 A	CONTROL F	POWER. JR SHU	DO NO NT TRIP	<u>Ground</u> TWIRE	<u>0 N1</u> <u>0 GND</u>			CAT-5 CONNECTION PLACE END OF L IN EMPTY JACK.	INE PLUG PN: EOL120A EO	L120A [2		EXTERNAL CONTACTOR COI	IL IN	S TERMIN FIRE C
	6	BREAKER 3PH	BREAKER, 1ST HOOD LIG CONTROL POWE	HT BREAK ER. SWITC	CER SHARED CH #1	W/			CONTROL PANEL B1	<u>0</u>	BLACK		L	CONTROL PANEL DRY CONTACT ON/OFF WITH	<u>SFC10</u> <u>SFD10</u> <u>SFC20</u>	
	8	460 ∨ MCA: 9.0 A M⊡CP: 15 A	KEF-1		 SM-1	LINE Ground	<u>L2</u> <u>L3</u> <u>GND</u>		HODD LIGHTS GND 1400 W MAX		GREEN	ROUTER		SUPPLY FAN	SFD2 SPAR	RE CONT IMON TO EN SUPP
	9		WIRE TO VF	D QUICK	CONNECTO	R				WIRE DIRECTLY TO	COMMUNICATION RES 1) DHCP 2)			VFD ANAL⊡G [0-10∨ DUTPUT[]		RE TO V
	10	REAKER PANEL	BREAKEI Respons	R PAN sibility	IEL TO Electr	FANS rician	FANS		WEB	UDP PORT 1444 & 1 DUTBOUND TRAFFIC	445 OPEN FOR ONLY.			CONTROL PANEL	H1 0 I01 0	
	12	BREAKER 3PH 460V					POWER TO		CONTROL PANEL J1 or J2 TO RTU	WIRE DIRECTLY TO DF RTU. SEE CASL	J2 TERMINAL			SWITCH		L ACT
All Christian Availability Development of the second of	13	MDCP: 45A	SUP-2 VIRE DIRECT	— — — — — — — —	SM-2	<u>Ground</u>			CONTROL PANEL TIA					CONTROL PANEL		LY ENE
OCHERE_NAME Description 0 Market of the second state	14 15								TD <u>T1B</u> KITCHEN TEMP SENSOR	WIRE TO CONTROL SENSOR IN ROOM AV SOURCES, DO NOT I ON THE CEILING GR	BOARD. INSTALL WAY FROM HEAT NSTALL SENSOR ND, SEE MANUAL.					DT NEE AS VAL
	16	PRIMARY PA	CONTROI Respons	L PAN sibility	IEL TO Electr	FANS rician	FANS		CONTROL PANEL T2A TO T2B DUCT SENSOR	FACTORY WIRED TE SENSOR. MOUNTED I	MPERATURE N EXHAUST DUCT	HODD 2 RISER 1		R CONTROL PA	esponsibil ANEL	llty
	17	Load Wiring SM-1 WIRF TU		DAD LEG 1 DAD LEG 2 DAD LEG 3		FAN: 01	KEF-1 	A⊧7.2 ⁵ 5.000 JLT⊧460 V	CONTROL PANEL T3A TO T3B DUCT SENSOR		BOARD			CONTROL PANEL SIGNAL FOR BUILDING	J9	
	19	VFD QUICK [CONNECTOR	GNDO	<u>GROUND</u> ST HA∨E NDT SH			WIRE TO DISCONNECT		CONTROL PANEL GAS		TO_GAS_VALVE <u>NEUTRAL</u>		IID	FIRE ALARM PANEL	AL2 WIR BDA CON	RE DIREI ARD. AL1 ADITION.
	20	DCCUPIED DVERRIDE SUP-2				24 VAC	- ⁺ J16-(7) - ⁻ J11-(7)		GAS VALVE	DNLY ENERGIZED	THROUGH LCD SYSTEM ARMED.			CONTROL PANEL SIGNAL FOR BUILDING		
	21	VDC ANALOG DUTPUT SUP-2				RED	_ ⁺ J28-(6) J28-(7)			MAY OR MAY REQUIRED BASED SPECIFIC	Y NOT BE ON JOBSITE ATIONS			ALARM		JUBLE R KE TBC NDITION.
A COS NO STILOSSI DO DEL NAMES DOV-1111 MORE NO COST. NAMES DOV-1111 DO DEL NAMES DOVE NO ANNO DE N	23		ANAL(To At	NALOG I	UI VÜLTAO NPUT DF M	JA B⊡ARD.										
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(1) KITCHEN DETAILS PAGE 3 NO SCALE

AGENCY APPROVAL:









(1) KITCHEN DETAILS PAGE 4 NO SCALE

DATE: 03/23/23 SHEET:



CLIENT PROJ NO: 3361-008-000

DSA SUBMITTAL

EMUSD Arroyo HS Modernization



2023-01-11



REVIEWING AGENCIES STAMP HERE



- NDTES
 FIELD PIPE DROPS AS SHOWN PIPING, ELBOWS, TEES, AND NOZZLES SUPPLIED BY CAS.
 FIELD INSTALLED DROP: FACTORY WILL PROVIDE QTY 2 60IN LONG PIECES OF CHROME PLATED PIPING SHIPPED LOOSE TO BE FIELD-INSTALLED.
 SHIP LOOSE DROP: FACTORY WILL PROVIDE THE EXACT CHROME PIPE LENGTH NEEDED SHIPPED LOOSE TO BE FIELD-INSTALLED.
 RELOCATE NOZZLES IF FLOW PATTERN IS BLOCKED BY SHELVING, SALAMANDERS, ETC.
 OVERLAPPING COVERAGE SHALL NOT BE USED ON ANY APPLIANCE WITH AN OBSTRUCTION.
 IF APPLICABLE, EXTENDED PRE-PIPED DROPS ARE SHIPPED LOOSE.
 FACTORY PIPING EXTENDS A MAXIMUM OF 6" ABOVE THE TOP OF THE HOOD.

- APPLIANCE DIMENSIONS LISTED REPRESENT THE COOKING SURFACE SIZE, NOT THE OVERALL APPLIANCE SIZE.
- THIS FIRE SYSTEM COMPLIES WITH U.L. 300 REQUIREMENTS.
- DL-F NDZZLE PART NUMBER REPLACES 3070-3/8H-10-SS
- J□B #: 5916991. J□B NAME: EL M⊡NTE USD ARR⊡Y□ HS 460∨- EL M⊡NTE, CA 91732.
- SYSTEM SIZE: TANK-SP-3 TOTAL FP REQUIRED: 48. HODD # 1 11' 6.00" LONG × 66" WIDE × 24" HIGH. RISER # 1 SIZE: 16" DIA. HODD # 1 METAL BLOW-DFF CAPS INCLUDED. HODD # 2 11' 6.00" LONG × 60" WIDE × 24" HIGH. RISER # 1 SIZE: 16" DIA. HODD # 2 METAL BLOW-DFF CAPS INCLUDED.

NDTES

- HEAVY-DUTY APPLIANCES (RATED 600°F) WILL REQUIRE AN ADDITIONAL DOWNSTREAM FIRESTAT IN THE EVENT THAT THE DUCTWORK CONTAINS ANY

HORIZONTAL RUNS OVER 25 FT IN LENGTH. - MEDIUM TO LIGHT-DUTY APPLIANCES (RATED 450°F) WILL NOT REQUIRE ANY ADDITIONAL DOWNSTREAM DETECTION.

4 GALLON TANK. PRIMARY ACTUATOR RELEASE. SECONDARY ACTUATOR RELEASE.

<u> LEGEND – FIRE CABINET TANK SYSTEM</u>

- PRESSURE SUPERVISION SWITCH. PRIMARY HOSE ASSEMBLY. SECONDARY HOSE ASSEMBLY.
- REMDTE MANUAL ACTUATION DE∨ICE.

System Designed by Reece McNulty Tank Certified Designer 12/14/21 Certificate











CLIENT PROJ NO: 3361-008-000

DSA SUBMITTAL

DATE: 05/23/23

SHEET:



<u>Fan #2 casrtu3-e,154-18-20t - heater</u>

NDTES:

3

- DO NOT OBSTRUCT OUTSIDE AIR INLET, OUTSIDE AIR COIL 1.
- OR DUTSIDE AIR FAN, DENDTES CORNER WEIGHT,
- ROOF OPENING MUST BE 2" SMALLER THAN CURB DIMENSIONS
- IN BOTH DIRECTIONS.

*NOTE: SUPPLY DUCT MUST BE INSTALLED TO MEET SMACNA STANDARDS. A MINIMUM STRAIGHT DUCT LENGTH MUST BE MAINTAINED DOWNSTREAM OF UNIT DISCHARGE AS OUTLINED IN AMCA PUBLICATION 201. WHEN USING RECTANGULAR DUCTWORK, ELBOWS MUST BE RADIUS THROAT, RADIUS BACK WITH TURNING VANES. FLEXIBLE DUCTWORK AND SQUARE THROAT/SQUARE BACK ELBOWS SHOULD NOT BE USED. ANY TRANSITION AND/OR TURNS IN THE DUCTWORK WILL CAUSE SYSTEM EFFECT. SYSTEM EFFECT WILL DRASTICALLY INCREASE STATIC PRESSURE AND REDUCE AIRFLOW. DO NOT RELY ON UNIT TO SUPPORT DUCT IN ANY WAY, FAILURE TO PROPERLY SIZE DUCTWORK MAY CAUSE SYSTEM EFFECTS AND REDUCE PERFORMANCE OF THE EQUIPMENT. SUGGESTED STRAIGHT DUCT SIZE IS 25" × 14".



UNIT WEIGHT: 2466 LB CURB WEIGHT: 450 LB MOUNTING DETAIL: 1/M503









-89 3/4″-















-FACTORY INSTALLED SAFETY DISCONNECT SWITCH.





AGENCY APPROVAL:

PROJECT:

SHEET NAME: MECHANICAL DETAILS



DATE: 03/23/23 SHEET:



CLIENT PROJ NO: 3361-008-000

DSA SUBMITTAL

EMUSD Arroyo HS Modernization



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			FAN INFORMATION					ELECTRICAL I	NFORMAT	ION				COOLING IN	FORMATI	ION					REHEAT IN	ORMATION		EL	ECTRIC F		MATION		HEAT PUMP INF	ORMATION	
FAN UNI	TAG QT	Y DOAS/RTU MODEL #	MANUFACTURER B	BLOWER		TOTAL	ESP	HP PHASE VOLT	т мса	MOCP	OUTSIDE AIR	MIXED	AIR	LEAVING	AIR	CAI	PACITY	IEER ISMF		CHARGE	CAF	ACITY	MOISTURE - REMOVAL	DSGN.	MAX.	VOLTS A		ENTERING		DISCHARGE	COP
NO					AIR CFM AIR CFM						DB WB	DB	WB	DB WB	DP	TOTAL	SENS.		DB	WB	DESIRED	MAX	RATE	KW S		<u> </u>	RIJE				
2	1	CASRTU3-E.154-18-20T	CAPTIVEAIRE	18P-3	0 4025	4025	0.750	5.00 3 460	42.3A	45A	90.0°F 68.0°F	F 90.0°F 6	68.0°F	50.3°F 50.3°F	50.4°F	202.7 MBH	166.3 MBH	H 18.2 6.0) 70.0°	°F 58.4°F	88.7 MBH	129.6 MBH	33.4 LBS/HR	10	15	460	18.1 8 °F	50.0°F	33.0°F	83.0°F	5.4
1. 2. 3. 4. 5. 6. 7. 8. 9. 10 11 12	NVERTER SCRO DIRECT DRIVE F NTEGRATED MO REFRIGERATIOI EC MOTOR CON ELECTRONIC EX SUCTION LINE A FACTORY COMM AVERAGING INT 2" EXTERIOR D SUPPLY CFM M FULLY MODULA SIDE DISCHAR	OLL COMPRESSOR WITH INTEGRATED PLENUM BLOWER. BELT DRIVEN BLOW ONITORING VIA CELLULAR CONNECTI N PRESSURE MONITORING ON HIGH A NDENSING FANS XPANSION VALVE. TXV NOT ACCEPTA ACCUMULATOR MISSIONING WITH 5 YEAR PARTS WAF FAKE, EVAP AND DISCHARGE TEMPER DUAL-WALL CONSTRUCTION W/ R-13 IN MONITORING INTEGRAL TO UNIT WITH ATING HOT GAS REHEAT CGE/SIDE RETURN	O OIL SENSOR. DIGITAL OR VERS ARE NOT ACCEPTAB ON BY MANUFACTURER ND LOW PRESSURE SIDE (BLE RANTY ATURE SENSORS (DISCHAI ISULATION-MINIMUM 20GA CFM MEASUREMENT INCL	R STAGED BLE OF SYSTE ARGE SEN A EXTERIC LUDED TH	D SCROLL NOT AN AP EM INCLUDED THROU NSOR TO BE FACTOR OR W/ 14GA BASE HROUGH DIGITAL INTH	PROVED EG JGH DIGITA (MOUNTER ERFACE	QUAL L INTERFA	CE NIT)		14. 15. 16. 17. A C	. PROVIDE STANI . COORDINATE C . WEIGHT OF EXI . PROVIDE AUTO AREA DETECTION OF THE FIRE ALA	DARD SIZE 2" CONTROLS WI ISTING UNIT: MATIC SHUTI N). FAN SHALI RM SYSTEM	" MERV 1030 LE DOWN (L BE CC TO THE	13 FILTERS. SSELL SIGLER. 3. DF UNIT PER CM DNNECTED TO B FAN.	IC 608 (DI UILDING	UCT SMOKE I FIRE ALARM	DETECTOR IS SYSTEM. FIR	S NOT REQUIR E ALARM CON	ED AS TH	HE SPACE R SHALL M	HAS FULL CO IAKE FINAL C	OVERAGE ONNECTION									

KITCHEN MAKEUP AIR UNIT (ROOFTOP UNIT)

				E>	KHAUS [.]	T FAN	I SCH	IEDU	LE						
						MO	TOR	ELECTRICAL				WEIGHT			
SYMBOL	MANUFACTURER AND MODEL NO.	LOCATION	AIR FLOW (CFM)	SP (") W.G.	DRIVE	HP	FAN RPM	VOLTS	PHASE	Hz	WEIGHT (LB)	(E) FAN (LB)	MOUNTING DETAIL	REMARKS	
KEF-K-1	CAPTIVEAIRE DU240HFA	KITCHEN ROOF	4025	1.75	DIRECT	5	946	460	3	60	361	926	2/M501	1, 2, 3	

WEIGHT (LB)

UNIT CURB

2466

MOUNTING DETAIL

NOTES

450 1/M503 1,2,3,4,5,6,7,8,9,10,11,12,13,14,15,16,17

NOTES:-

PROVIDE ROOF CURB, DISCONNECT AND HINGED BASE.
 PROVIDE UL762 CERTIFICATION.
 PROVIDE OSHPD SEISMIC CERTIFICATION.

AGENCY APPROVAL:

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EC C	No.
	EXP. Q
	XA
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C	XOF

3361-008-000

ISSUE Δ **DESCRIPTION**

PRICING SET

KEYNOTES

NOTES

FACILITY:

4921 Cedar Ave El Monte, CA 91732

PROJECT: EMUSD Arroyo HS Modernization

SHEET NAME: MECHANICAL SCHEDULES



DATE: 11/28/22 SHEET:



CLIENT PROJ NO: 3361-008-000



2023-01-11



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[
	VRF SPLIT SYSTEM EQUIPMENT SCHEDULE																					
	AIR HANDLING UNIT (INDOOR)																					
ELECTRIC ELECTRIC						LECTRICAL			OPERATING	OPERATING												
SYMBOL	MANUFACTURER AND MODEL NO.	SERVING	CFM	ESP ("W.G.)	TOTAL (HP)	HEATING (TOTAL MBH)	G COOLING 3H) (TOTAL MBH)	SENSIBLE (TOTAL MBH)	DB/WB (°F)	DB/WB (°F)	FILTER (FLAT)	FLA	MCA	MOCP	VOLTS	PHASE	Hz	OSA CFM	SA WEIGHT WEIGHT CFM (N) UNIT (E) UNIT (LB) (LB)	WEIGHT (E) UNIT (LB)	MOUNTING DETAIL	REMARKS
AHU-R-1	TRANE CSAA025	GYMNASIUM R-07	12,000	1.5	(2) 8	475	487	394	86/68	56/55	2" MERV 13	16.79	18.82	25	460	3	60	1200 / 3375	1754	1950	5/M501	SEE NOTES 1, 2, 3, 4, 5, 6, 7, 8
AHU-R-2	TRANE CSAA012	EXERCISE AREA R-06	5,800	1.5	8	225	242	193	86/68	56/55	2" MERV 13	8.66	10.69	15	460	3	60	600 / 1250	1044	1400	5/M501	
AHU-R-3	TRANE CSAA025	GYMNASIUM R-07	12,000	1.5	(2) 8	475	487	394	86/68	56/55	2" MERV 13	16.79	18.82	25	460	3	60	1200 / 3375	1754	1950	5/M501	
AHU-R-4	TRANE CSAA025	EXERCISE AREA R-06	5,800	1.5	8	225	242	193	86/68	56/55	2" MERV 13	8.66	10.69	15	460	3	60	600 / 1250	1044	1400	5/M501	

NOTES:

- AIR HANDLING UNIT SHALL BE MOUNTED ON CONCRETE PAD IN MECHANICAL ROOM.
- PROVIDE STANDARD SIZE 2" THROW AWAY MERV 13 PLEATED FILTERS. SCHEDULE OPERATING WEIGHT INCLUDES ALL ACCESSORIES.
- ALL SPLIT SYSTEMS SHALL USE R-410A REFRIGERANT.
- SHALL BE CONNECTED TO BUILDING FIRE ALARM SYSTEM. FIRE ALARM CONTRACTOR SHALL MAKE FINAL CONNECTION OF THE FIRE ALARM SYSTEM TO THE FAN.

	VRF SPLIT SYSTEM EQUIPMENT SCHEDULE														
	CONDENSING UNIT (OUTDOOR)														
		ELECTRICAL						FRIGER/	ANT						
SYMBOL	MANUFACTURER AND MODEL NO.	MCA(A) (PER MODULE)	MOCP (A) (PER MODULE)	VOLTS	PHASE	Hz	TYPE	LL	SL	OPERATING WEIGHT (LBS) PER MODULE)	ATING HT (LBS) /ODULE)	ER EER	MOUNTING DETAIL	REMARKS	
CU-R-1	CITY MULTI TUHYP3604BN40A	19.0 +19.0+19.0	30+30+30	460	3	60	R410A	-	-	640+640+640	22.4	11.3	3/M501	SEE NOTES 1, 2, 3, 4	
CU-R-2	CITY MULTI TUHYP1924BN40A	15.0 +15.0	20+20	460	3	60	R410A	-	-	616+616	25.0	12.4	3/M501		
CU-R-3	CITY MULTI TUHYP3604BN40A	19.0 +19.0+19.0	30+30+30	460	3	60	R410A	-	-	640+640+640	22.4	11.3	3/M501		
CU-R-4	CITY MULTI TUHYP1924BN40A	15.0 +15.0	20+20	460	3	60	R410A	-	-	616+616	25.0	12.4	3/M501		

NOTES:-



CONDENSING UNIT SHALL BE MOUNTED ON LEVELED PLATFORM ON GRADE SCHEDULE OPERATING WEIGHT INCLUDES ALL ACCESSORIES. 4. ALL SPLIT SYSTEMS SHALL USE R-410A REFRIGERANT.

PROVIDE SUCTION AND LIQUID REFRIGERANT LINES BETWEEN AIR HANDLING UNIT AND CONDENSING UNIT. SIZE PER MANUFACTURER RECOMMENDATIONS.

UNIT CONTROLS TO BE ELECTROMECHANICAL - UNIT MANUFACTURER TO COORDINATE WITH RUSSELL SIGLER FOR CONTROLS. UNIT SHALL USE DEMAND CONTROL VENTILATION (DCV) - LOWER VALUE OF MIN. OSA IS MINIMUM OSA FOR DCV, HIIGHER VALUE IS FOR SPACE AT FULL OCCUPANCY. PROVIDE AUTOMATIC SHUTDOWN OF UNIT PER CMC 608 (DUCT SMOKE DETECTOR IS NOT REQUIRED AS THE SPACE HAS FULL COVERAGE AREA DETECTION). FAN

PROVIDE SUCTION AND LIQUID REFRIGERANT PIPING BETWEEN AIR HANDLING UNIT AND CONDENSING UNIT. SIZE PER MANUFACTURER RECOMMENDATIONS.

AIR DISTRIBUTION SCHEDULE									
CD-X (CFM) SYMBOL	MANUFACTURER AND MODEL NO.	SERVICE	TYPE	NECK SIZE (")	FACE SIZE (")	CFM RANGE	MAX NC	REMARKS	
SG-1	TITUS 300 RS	SUPPLY	DOUBLE DEFLECTION	48x8	50x10	1300 - 1600	30	SEE NOTES	
RG-1	TITUS 350 RS	RETURN	35° DEFLECTION	38x30	40x32	4000 - 5200	30	SEE NOTES 1	

NOTES: 1. IN THE GYM TWO (2) OF THESE GRILLES WILL BE INSTALLED NEXT TO EACH OTHER, CONNECTED BY MULLIONS OR TABS, TO FROM ONE 76" WIDE BY 30" HIGH GRILLE.

AGENCY APPROVAL:



3361-008-000



KEYNOTES

NOTES

FACILITY:

4921 Cedar Ave El Monte, CA 91732

PROJECT: EMUSD Arroyo HS Modernization

SHEET NAME:



DATE: 02/14/23 SHEET:



CLIENT PROJ NO: 3361-008-000

MECHANICAL SCHEDULES





ABBREVIATION	DESCRIPTION
AC	AIR CONDITIONING
ACU	AIR CONDITIONING UNIT
Al	ANALOG INPUT
AO	ANALOG OUTPUT
BI	BINARY INPUT
BO	BINARY OUTPUT
C CHW	COMMON CHILLED WATER
CHWP	CHILLED WATER PUMP
CHWR	CHILLED WATER RETURN
COND	CONDENSER
CW	CONDENSER WATER
CWP	CONDENSER WATER PUMP
CWR CWS	CONDENSER WATER RETORN
DA	DISCHARGE AIR
DI	DIGITAL INPUT
EA	EXHAUST AIR
EF	EXHAUST FAN
EVAP	EVAPORATOR
FCU	FAN COIL UNIT
HOA	HAND/OFF/AUTO
HP HRU	HEAT PUMP HEAT RECOVERY UNIT
HTEX	HEAT EXCHANGER
HW	HOT WATER
HWP	HOT WATER PUMP HOT WATER RETURN
HWS	HOT WATER SUPPLY
MAX	MAXIMUM
MISC	MINIMUM MISCELLANEOUS
NC	NORMALLY CLOSED
NO	
RA	RETURN AIR
RF	RETURN FAN
RH	RELATIVE HUMIDITY
SA	SUPPLY AIR
SF	SUPPLY FAN
SP TEMP	STATIC PRESSURE TEMPERATURE
UH	UNIT HEATER
UV	
VAV VAVTU	VARIABLE AIR VOLUME VARIABLE AIR VOLUME TERMINAL UNIT
VVT	VARIABLE VOLUME & TEMPERATURE
W/	WITH
WSHP	WITHOUT WATER SOURCE HEAT PUMP



1.0 SEQUENCES OF OPERATION

1.1 SEQUENCE OF OPERATION FOR EMUSD ARROYO HS

1.1.1 MAKEUP AIR UNIT CONTROLLER (MAU-K-1)

Indoor Fan The fan shall energize when the kitchen hood switch is engaged. The fan operates at a variable speed to maintain constant supply airflow.

Heating Mode When space temperature is below the heating setpoint, unit shall operate in the heating mode. Unit shall stage available heat stages to satisfy demand in the occupied space.

Cooling Mode When space temperature is above cooling setpoint, unit shall operate in the cooling mode. Unit shall enable available cooling stages to satisfy demand in the occupied space.

Outside Air Damper

Damper shall close when fan is off or during a loss of power. When fan is energized, the damper shall open to 100%.

1.1.2 AHU SPLIT DETAIL (AHU-R-1 THRU AHU-R-4)

Indoor Fan During Occupied periods, fan shall operate continuously. During Unoccupied periods, fan shall operate when the space temperature exceeds the unoccupied heating or cooling setpoints.

Supply Air Temperature Cooling Setpoint The controller will monitor the supply air temperature and will maintain supply air temperature cooling setpoint of 56 °F (adj.) whenever cooling is required.

Supply Air Duct Static Pressure Control

The controller will measure duct static pressure and will modulate the supply fan VFD speed to maintain a duct static pressure setpoint of 1.5 in H2O (adj.). The supply fan VFD speed will not drop below 30 % (adj.).

Economizer Economizer shall close when fan is off or during a loss of power. During occupied hours when fan is energized, the economizer shall open to adjustable minimum position. When outside air temperature is below 71° and occupied space requires cooling, economizer shall open. If economizer air is not sufficient to meet the demand in the occupied space, unit shall enable available mechanical cooling stages to satisfy demand in the occupied space.

3361-008-000 ONTARIO, CA 91764

DESCRIPTION

PRICING SET

KEYNOTES

NOTES

Unit shall monitor space CO2 when the supply fan is energized. When CO2 is above setpoint of 1000 PPM, economizer shall modulate open toward an adjustable maximum CO2 position. As the CO2 level in the space increases above the setpoint, the minimum positions of the dampers will be increased proportionally, until the maximum ventilation setting is reached. As the space CO2 level decreases because of the increase in fresh air, the outdoor-damper will follow the higher demand condition from the DCV mode or

1.1.3 EXHAUST FAN DETAIL (KEF-K-1)

Exhaust Fans KEF-K-1 shall energize when the kitchen hood switch is engaged. Exhaust fan status will be monitored through a current sensing switch. If the current switch does not detect fan status after a start command has been sent to the associated exhaust fan, an alarm will be generated to the i-Vu web server. KEF-K-1 and MAU-K-1 shall be interlocked so energize at the same time.

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PROJECT: EMUSD Arroyo HS Modernization

SHEET NAME: MECHANICAL CONTROLS



DATE: 02/14/23 SHEET:



CLIENT PROJ NO: 3361-008-000

DSA SUBMITTAL





AGENCY APPROVAL:



NOTES

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MECHANICAL CONTROLS