REQUEST FOR PROPOSALS
RFP #17-05
TOWN OF CUTLER BAY
CUTLER BAY TOWN CENTER
HVAC EQUIPMENT AND CONTROLS REPLACEMENT AND MAINTENANCE SERVICES

BID DUE DATE & TIME:

TBD

TBD

"MANDATORY" PRE-BID MEETING DATE & TIME:

TBD

TBD

REQUEST FOR PROPOSALS
RFP #17-05
TOWN OF CUTLER BAY
CUTLER BAY TOWN CENTER
HVAC EQUIPMENT AND CONTROLS REPLACEMENT AND MAINTENANCE SERVICES

The Town of Cutler Bay is requesting proposals from qualified firms to provide for the Cutler Bay Town Center HVAC EQUIPMENT AND CONTROLS REPLACEMENT AND MAINTENANCE SERVICES. **Interested contractors should visit the Town's website at www.cutlerbay-fl.gov to obtain the Request for Proposal package. Packages may also be picked up at the following location, during normal business hours.**

Town of Cutler Bay
10720 Caribbean Blvd., Suite 105
Cutler Bay, FL 33189

Sealed submittals including one (1) original and four (4) copies plus a CD of the submittals must be received no later than **TBD** on **TBD** and be clearly marked on the outside, **"RFP #17-05 Cutler Bay Town Center HVAC EQUIPMENT AND CONTROLS REPLACEMENT AND MAINTENANCE SERVICES", to Debra E. Eastman, Interim Town Clerk, Town of Cutler Bay, 10720 Caribbean Blvd., Suite 105, Cutler Bay, Florida, 33189.**

The Town will conduct a "**Mandatory" Pre-RFP Response Meeting on TBD at TBD Town Hall Council Chamber (10720 Caribbean Blvd., Suite 115, Cutler Bay FL 33189)**

Late Submittals and facsimile submissions will not be considered. The proposer shall bear all costs associated with the preparation and submission of the proposal.

Pursuant to Town Code, public notice is hereby given that a "Cone of Silence" is imposed concerning the Town's competitive purchasing process, which generally prohibits communications concerning the RFP from the time of advertisement of the RFP until such time as the Town Manager makes a written recommendation to the Town Council concerning the competitive purchase transaction. Please see the detailed specifications for the public solicitation for services for a statement fully disclosing the requirements of the "Cone of Silence".

Pursuant to Ordinance 06-11; Town Code Chapter 8A; Section 7.6 of the Town Charter, vendors of the Town are required to disclose any campaign contributions to the Town Clerk, and each vendor must do so prior to and as a condition of the award of any Town contract to the vendor. Please see the detailed specifications of this solicitation for further details.

The Town of Cutler Bay reserves the right to accept or reject and/or all proposals or parts of proposals, to workshop or negotiate any and all proposals, to waive irregularities, and to request re-proposals on the required materials or services, or take any other such actions that may be deemed in the best interest of the Town.

Rafael G. Casals
Town Manager

SECTION 1
TOWN OF CUTLER BAY
CUTLER BAY TOWN CENTER
HVAC EQUIPMENT AND CONTROLS REPLACEMENT AND MAINTENANCE SERVICES
RFP #17-05

INTRODUCTION

The Town of Cutler Bay (the "Town"), a municipality located in Miami-Dade County, Florida, desires to receive proposals for the selection of a contractor to provide the Cutler Bay Town Center HVAC EQUIPMENT AND CONTROLS REPLACEMENT AND MAINTENANCE SERVICES, located at 10720 Caribbean Blvd., Cutler Bay, Florida 33189.

The Town intends to execute an agreement with a selected Contractor to provide such services.

1. SCHEDULE OF EVENTS

No	Event	Date*	Time* (EST)
1	Advertisement/ Distribution of RFP & Cone of Silence Begins	TBD	TBD
2	**"Mandatory" Pre-RFP Response Meeting** 10720 Caribbean Blvd., Suite 115 Cutler Bay, Florida 33189	**TBD**	**TBD**
3	Deadline to Submit Questions	TBD	TBD
4	Deadline for Town Responses to Questions	TBD	TBD
5	**Deadline to Submit RFP-Response**	**TBD**	**TBD**
6	Evaluation of Proposals	TBD thru TBD	TBD thru TBD
7	Selection Committee Evaluation Meeting	TBD	TBD
8	Announcement of Selected Contractors/Cone of Silence Ends	TBD	TBD

*The Town reserves the right to change the scheduled dates and time.

1.1 DEFINED TERMS

Terms used in these Instructions to Proposers are defined and have the meaning assigned to them. The term "Proposer" means one who submits a proposal directly to the Town as distinct from a Sub-Contractor, who submits a proposal to the Proposer. The term "Successful Proposer" means the best, qualified, responsible and responsive Proposer to whom the Town (on the basis of Town's evaluation as hereinafter provided) makes an award. The term "Town" refers to the Town of Cutler Bay, a municipal corporation of the State of Florida. The term "Contractor" shall mean the individual(s) or firm to whom the award is made or also referred to as the Successful Proposer. The term "Contractor Administrator" shall mean the Town Manager or his designee.

2. GENERAL

The following instructions are given for the purpose of guiding Proposers in properly preparing their proposals. These instructions have equal force and weight with other portions of the specifications and strict compliance is required with all the provisions contained herein.

3. PROPOSAL REQUIREMENTS

3.1 Scope of Services Proposed

Clearly describe how contractor will perform the scope of services proposed including a work plan including an explanation of methodology to be followed to perform the services required of this proposal.

3.2 Proposer Qualifications

This section of the proposal should give a description of the proposer, including the size, range of activities, and number of years of relative experience with large accounts. Particular emphasis should be given as to how the firm-wide experience and expertise in this type of project will be brought to bear on the proposed project. This section must also identify the contact person and telephone number.

3.3 Proposal Package

All proposals shall be submitted on the Town provided Proposal Package forms. Failure to do so may cause the proposal to be rejected. All blanks on the proposal forms must be completed. For further information as to the Instructions to Proposers or the Proposal Package contact Debra E. Eastman, Interim Town Clerk at (305) 234-4262 or Email: deastman@cutlerbay-fl.gov.

3.4 Acknowledgment of Agreement Terms

An acknowledgement of the acceptance of the terms of the Agreement should be included as a part of Proposal. Any exceptions to terms of this Agreement should be included in the exceptions section of the Proposal.

4. "MANDATORY" PRE-RFP MEETING AND SITE INSPECTION

All Proposers or their representatives are required to attend a Mandatory Pre-RFP Response Meeting on **TBD at TBD**, Town Hall Council Chamber, 10720 Caribbean Blvd., Suite 115, Cutler Bay, Florida. This

information session presents an opportunity for the Proposers to clarify any concerns regarding the proposal requirements. Questions regarding the site and specifications will be answered, and Proposers will be able to familiarize themselves with conditions that may affect the proposal prices.

All Proposers shall be held responsible at this time to fully investigate the scope of work to be undertaken based on the Special Conditions and Proposal Detail Requirements included.

5. SUBMISSION OF PROPOSAL

One (1) original and four (4) copies plus a CD of the Proposal shall be submitted no later than **TBD at TBD** to the Office of the Town Clerk, Town Hall, 10720 Caribbean Blvd., Suite 105, Florida 33189, in a sealed envelope which must be plainly marked on the outside:

Cutler Bay Town Center HVAC Equipment and Controls Replacement and Maintenance Services
RFP #17-05
Town of Cutler Bay
Office of the Town Clerk
10720 Caribbean Blvd., Suite# 105
Cutler Bay, Florida 33189

Proposals will be publicly opened and read. All Proposers and their representative are invited to be present.

Proposals shall be typed or printed in ink. Use of erasable ink is **not** permitted. All blanks on the proposal form(s) must be completed. Names must be typed or printed below the signature. Facsimile proposals will **not** be accepted.

It shall be the sole responsibility of the Proposer to ensure that the sealed proposal is submitted by the time and date specified. Any proposal received after the appointed time, whether by mail or otherwise, shall **not** be accepted under any circumstances. Such proposals will be returned to the vendor unopened. Any uncertainty regarding the time a proposal is received shall be resolved against the Proposer.

Only one (1) proposal from any individual, firm, partnership, or corporation, under the same or different names, will be considered. If the Town determines that any Proposer has interest in more than one (1) proposal for work contemplated; all proposals in which such a Proposer is interested will be rejected. Proposer by submitting this proposal certifies that this proposal is made without previous understanding, agreement or connection with any person, firm or corporation making a proposal for the same material, supplies, equipment or services and is in all respects, fair and without collusion of fraud.

6. POINT OF CONTACT

Any inquiries concerning clarifications of solicitation or for additional information shall be submitted in writing to Debra E. Eastman – Interim Town Clerk, Email: deastman@cutlerbay-fl.gov on or before **TBD at TBD**. The Town shall **not** be responsible for oral interpretations given by any Town employee or its representative.

7. EVALUATION METHOD AND CRITERIA

Proposals will be evaluated in accordance with weighted criteria listed below:

	Maximum Points
Scope of Services / Plan	20
Proposer Qualifications	20
References (Relevant experience)	10
Cost	50
Total	100

These weighted criteria are provided to assist the Proposers in the allocation of their time and efforts during the submission process. The criteria also guide the Selection Committee during the short-listing and final ranking of Proposers by establishing a general frame work for those deliberations.

Short listed proposals may be selected for an interview prior to a recommendation being presented to the Town Council. As the best interest of the Town may require, the right is reserved to reject any and all proposals or waive any minor irregularity or technicality in proposals received. The Town will determine which Proposers are "responsible and responsive".

8. DESCRIPTION OF EVALUATION CRITERIA (S):

SCOPE OF SERVICES (20 POINTS): Each proposer will be evaluated on their approach on how the scope of services will be met and the operational plan. A work plan including an explanation of methodology to be followed to perform the services required in the proposal. Information regarding the level of staff to be assigned to contract must also be included.

PROPOSER QUALIFICATION (20 POINTS): Each proposer shall give a description of the firm, including the size, range of activities, and the number of years with relative experience with governmental accounts. Particular emphasis should be given as to how the firm-wide experience and expertise in this type of project will be brought to bear on the proposed project. The firm should also submit proof of insurance as a part of the qualifications portion of their proposal.

REFERENCES (Relevant Experience) (10 POINTS): As part of the proposal evaluation process, the Town will conduct an investigation of references, including a record check or consumer affairs complaints. Proposer's submission of a proposal constitutes acknowledgment of the process and consent to investigate. The Town is the sole judge in determining Proposers qualifications.

COST (50 POINTS): Each proposer shall provide a lump sum cost.

The Town as part of their evaluation may perform an inspection of the Proposer's facilities. The Selection Committee, Town Manager, or his designee as part of their evaluation may perform this inspection. The Selection Committee may perform a second pre-award inspection of the Successful Proposer's facilities and any technical advisors they deem necessary, prior to the award of a Contract.

The term facilities as used in this Solicitation shall include, but shall not be limited to, all properties operated by the Proposer, all equipment used in the performance of business by the Proposer, and/or any other evidence, tangible or intangible, that the Town may deem necessary to substantiate the technical and other qualifications, and the abilities of the Proposer to perform the Services.

The inspection may include, but not be limited to, appearance and cleanliness of facilities, appearance and cleanliness of equipment. Additionally, the Town reserves the right to perform such inspections on the

Successful Proposer as often as it deems necessary, to ensure proper performance of the proposed Contract.

The Town may require short-listed Proposer's to perform an oral presentation in support of their Proposal or to exhibit or otherwise demonstrate the information contained therein. This presentation or demonstration may be performed before the Selection Committee or the Town Manager. If required, Proposers will be notified in writing prior to the date of such a presentation.

9. CLARIFICATION AND ADDENDUM(S)

If any person contemplating submitting a proposal under this RFP is in doubt as to the true meaning of the specifications or other documents or any part thereof, the proposer must submit to the Town of Cutler Bay, Town Clerk on or before **TBD at TBD**, and a request for clarification via fax (305) 234-4251 or Email: deastman@cutlerbay-fl.gov. All such requests for clarification must be made in writing and the person submitting the request will be responsible for its timely delivery.

Any interpretation of the RFP, if made, will be made only by Addendum duly issued by the Town of Cutler Bay, Town Clerk. A copy of such Addendum will be posted on the Town's website under RFP's. However, it is the bidder's responsibility to ensure that it has received and reviewed all addenda prior to submitting the bid and the Town shall not be responsible for failure to send addenda to bidders receiving the RFP. Proposers should acknowledge receipt of all addenda in the space designated on the proposal form. In the event of conflict with the original Contract Documents, addenda shall govern all other Contract Documents to the extent specified. Subsequent addenda shall govern over prior addendum only to the extent specified.

10. ACCEPTANCE OR REJECTION OF PROPOSALS

All proposals submitted shall be valid for a period of sixty (60) calendar days from the day of the proposal opening. However, any proposal may be withdrawn up until the time set for proposal opening. Any proposals not so withdrawn shall upon opening, constitute an irrevocable offer for goods and services until accepted by the Town Council's Award.

Reasonable efforts will be made to either award the Contract(s) or reject all proposals within sixty (60) calendar days after proposal opening date. A Proposer may not withdraw his proposal before the expiration of sixty (60) days from the date of proposal opening. A Proposer may withdraw his proposal after the expiration of sixty (60) days from the date of proposal opening by delivering written notice of withdrawal to the Town Manager's Office prior to award of contract by the Town of Cutler Bay Council.

The Town of Cutler Bay reserves the right to accept or reject any and/or all proposals or parts of proposals, to waive any informality, irregularities, or technicalities, to re-advertise for proposals, or take any other actions that may be deemed to be in the best interests of the Town. The Town also reserves the right to award the Contract on a split order basis, group by group, or item by item, or such combination as will best serve the interests of the Town, unless otherwise stated. The Town also reserves the right to waive minor variations to the specifications (interpretation of such to be made by the applicable department personnel). Final determination and award of contract(s) shall be made by the Town Council. In addition, each proposer agrees to waive any claim it has or may have against the Town and the respective employees, arising out of or in connection with the administration, evaluation, or recommendation of any proposal.

11. BID BOND

Each Proposal must be accompanied by a Bid Bond or Cashier's Check, in an amount no less than five percent (5%) of the proposal **total** amount. All Bid Bonds shall be valid for a period of at least ninety (90) days from the proposal submission date. The Bid Bonds for all unsuccessful Proposals shall be returned after the 90 day period. The purpose of the bid bond is to ensure that proposals are honored and that they remain valid for the required period. Accordingly, bid bonds are subject to forfeiture any time proposers refuse to honor their proposals for at least 45 days after proposal opening.

12. AWARD OF CONTRACT

Once the proposals are opened, a Selection Committee will evaluate the proposals and a recommendation will then be presented to the Town Manager.

It is the Town's intent to award the contract to one (1) Proposer.

The Contract will be awarded only to a responsible Proposer licensed, and qualified by experience to do the work specified. The Proposer shall submit, prior to award of Contract, satisfactory evidence of his experience in similar work and that he is fully prepared with the necessary organization, capital, and equipment to complete the scope of work. Proposer shall be insured, licensed and certified by all applicable local, county and state agencies.

The Proposer warrants to the Town that it is not insolvent, it is not in bankruptcy proceedings or receivership, nor is it engaged in or threatened with any litigation, arbitration or other legal or administrative proceedings or investigations of any kind which would have an adverse effect on its ability to perform its obligations under the Contract.

This signed proposal is considered an offer on the part of the Proposer, which offer shall be considered accepted upon approval by the Town Council. Within five (5) business days after receiving Notice of Award the Successful Proposer shall submit a revised Certificate of Insurance naming the Town of Cutler Bay as additional insured for all liability policies.

The award is subject to the provisions of Chapter 112, Florida Statutes. Proposers must disclose with their proposal, the name of any officer, director, partner, proprietor, associate or agent who is also a public officer or employee of the Town or any of its agencies. Further, all Proposers must disclose the name of any public officer or employee of the Town who owns, directly or indirectly, an interest of five percent (5%) or more in the Officer's firm or any of its branches or affiliate companies.

13. CONTRACT PERIOD

The Contract will become effective on the date it is executed by both parties. The Contractor shall obtain Substantial Completion of the Bid Base Proposal within ten (10) Days of the Notice to Proceed being issued by the Town. After the Town's completes its inspection under Article IV, Contractor must obtain Final Completion within five (5) Days of the Town's inspection.

The initial Contract period for POST HVAC INSTALLATION MAINTENANCE (YEAR 1) and PREVENTATIVE MAINTENANCE BID (YEARS 2 THRU 5) shall be for five (5) years with an option to renew annually not to exceed a maximum of four (4) years subject to appropriation of funds for the budget year applicable. At its sole discretion, the Town shall have an option to renew this Agreement upon the same terms and conditions for up to four (4) additional years (the "Option"). This Option may be

exercised at the sole discretion of the Town Manager. Such extension shall be effective upon receipt of a written notice from the Town Manager to the Contractor received no later than 30 days prior to the date of termination.

14. PERMITS, FEES AND NOTICES

The Successful Proposer shall at his own expense obtain all necessary permits, pay all licenses, fees and taxes, required to comply with all local ordinances, state and federal laws, rules and regulations applicable to business to be carried on under this Contract.

All county, state or federal fees and permits shall be applied for and paid by the Proposer as necessary. Proposer must provide Town with copy(s) of valid licensing by state/county agency for this type of work. The permit fees will be invoiced separately as a direct cost on each "approved" Work Order, issued by Town staff. Town will reimburse for the direct cost of permits.

It is the Proposers responsibility to have and maintain appropriate Certificate(s) of Competency and submit state registration (if required) for the work to be performed and valid for the jurisdiction in which the work is to be performed for all persons (including subcontractors) working on the project for whom a Certificate of Competency is required.

15. NEGOTIATIONS

The Town reserves the right to enter into Contract negotiations with the selected Proposer. If the Town and the selected Proposer cannot negotiate a successful contract, the Town may terminate such negotiations and begin negotiations with the next selected Proposer, reject all proposals or re-advertise the contract. No Proposer shall have any rights against the Town arising from such negotiations.

16. LAWS/ORDINANCES

The Proposer shall observe and comply with all federal, state, local and municipal laws, ordinances, rules and regulations that would apply to this Contract. Failure to familiarize himself/herself with applicable laws will in no way relieve him/her from responsibility.

17. ERRORS AND OMISSIONS

The Town is not required to accept any request by any Proposer to correct errors or omissions in any calculations or price, after proposal is submitted. Proposals which are incomplete, unbalanced, conditional or obscure or which contain additions not called for, erasures, alterations, or irregularities of any kind or which do not comply with the request for proposals and Instructions to Proposers may be rejected at the option of the Town. The Town does, however, have the option to waive technicalities and request further information or clarification.

18. WARRANTIES OF USAGE

No warranty is given or implied by the Town as to any components listed in this Request for Proposals and are considered to be estimates for the purpose of information only. The Town reserves the right to accept all or any part of the proposal and to increase or decrease locations of Proposers proposal to meet additional or reduced requirements of the Town.

19. ASSIGNMENT

Neither party to the Contract shall assign the Contract or subcontract it as a whole without the written consent of the other, nor shall the Contractor assign any monies due or to become due to him, without the previous written consent of the Town Manager or his designee.

20. COLLUSION

The Proposer certifies that its proposal is made without previous understanding, agreement, or connection either with any previous firms or corporations offering a proposal for the same items, or with the Town. The Proposer also certifies that its proposal is in all respects fair, without outside control, collusion, fraud, or otherwise illegal action.

21. CONE OF SILENCE

Notwithstanding any other provision of these specifications, the provisions of Town "Cone of Silence" are applicable to this transaction. The entirety of these provisions can be found in the Town's Purchasing Ordinance, Town Ordinance 06-22. The "Cone of Silence," as used herein, means a prohibition on any communication regarding a particular Request for Proposal ("RFP"), Request for Qualification ("RFQ") or bid, between:

- A potential vendor, service provider, proposer, bidder, lobbyist, or consultant; and
- The Town Council, Town's professional staff including, but not limited to, the Town Manager and his or her staff, any member of the Town's selection or evaluation committee.

The Cone of Silence shall be imposed upon each RFQ, RFP and bid after the advertisement of said RFQ, RFP, or bid. The Cone of Silence shall terminate at the beginning of the Town Council meeting at which time the Town Manager makes his or her written recommendation to the Town Council. However, if the Town Council refers the Manager's recommendation back to the Manager or staff for further review, the Cone of Silence shall be re-imposed until the meeting at which the Manager's subsequent recommendation is before the Town Council.

The Cone of Silence shall not apply to:

1) oral communications at pre-bid conferences;
2) oral presentations before selection or evaluation committees;
3) public presentations made to the Town Council during any duly noticed public meeting;
4) communication in writing at any time with any Town employee, unless specifically prohibited by the applicable RFQ, RFP or bid documents. The bidder or proposer shall file a copy of any written communication with the Town Clerk. The Town Clerk shall make copies available to any person upon request;
5) communications regarding a particular RFQ, RFP or bid between a potential vendor, service provider, proposer, bidder, lobbyist or consultant and the Town's Purchasing Agent or Town employee designated responsible for administering the procurement process for such RFQ, RFP or bid, provided the communication is limited strictly to matters of process or procedure already contained in the corresponding solicitation document;
6) communications with the Town Attorney and his or her staff;
7) duly noticed site visits to determine the competency of proposers regarding a particular bid

during the time period between the opening of bids and the time the Town Manager makes his or her written recommendation;

8) any emergency procurement of goods or services pursuant to Town Code;
9) responses to the Town's request for clarification or additional information;
10) contract negotiations during any duly noticed public meeting;
11) communications to enable Town staff to seek and obtain industry comment or perform market research, provided all communications related thereto between a potential vendor, service provider, proposer, bidder, lobbyist, or consultant and any member of the Town's professional staff including, but not limited to, the Town Manager and his or her staff are in writing or are made at a duly noticed public meeting.

Please contact the Town Attorney at (305) 854-0800 for any questions concerning the Cone of Silence compliance.

Violation of the Cone of Silence by a particular bidder or proposer shall render any RFQ award, RFP award or bid award to said bidder or proposer voidable by the Town Council and/or Town Manager.

22. CAMPAIGN FINANCE RESTRICTIONS ON VENDORS

Pursuant to Ordinance 06-11; Town Code Chapter 8A; Section 7.6 of the Town Charter, vendors of the Town are required to disclose any campaign contributions to the Town Clerk, and each vendor must do so prior to and as a condition of the award of any Town contract to the vendor.

22.1 VENDORS' CAMPAIGN CONTRIBUTION DISCLOSURE

1. General Requirements:

(A) Any vendor required to disclose campaign contributions pursuant to the Charter of the Town of Cutler Bay, as may be amended, shall file a written disclosure with the Town Clerk, stating all contributions made that were accepted by an elected official, the official to whom they were made and the date they were made. The Town Clerk may develop a form to be used by vendors for such disclosure.
(B) The disclosure shall be filed prior to and as a condition of the award of any Town contract to the Vendor.
(C) The Town Clerk shall inform the Council of any disclosures which were made in relation to any items before the Council prior to the hearing on the item or prior to the award of the contract.
(D) If an existing vendor makes a contribution the vendor must report the same to the clerk within ten (10) days of its acceptance or prior to being awarded any additional contract or renewal, whichever occurs first.
(E) The Town Clerk shall file a quarterly report with the Council, which lists all the vendor disclosures in the quarter.

2. Disqualification

(A) As per Section 7.6 of the Town Charter, if a Vendor of products or services who directly or through a member of the person's immediate family or through a political action committee or through any other person makes a campaign contribution to a Town candidate and fails to disclose it then he/she/it shall be barred from selling any product or service to the town for a period of two years following the swearing in of the subject elected official.

23. LOBBYIST REGISTRATION

Proposers must also comply with all Town Charter sections and Code Provisions that pertain to lobbyists, including Section 7.6 of the Town Charter and implementing ordinance(s), including Sec. 2-11(s) of the Town Code and Ordinance 07-02. Please contact the Town Clerk at (305) 234-4262 for additional information. Proposers shall complete a "Lobbyist Registration for Oral Presentation" form and all persons listed thereon shall be considered to be registered only for the purposes of the oral presentation, if any. Lobbyists are required to register and pay applicable fees prior to engaging in any other lobbying activity.

24. PUBLIC RECORDS LAW

a. Contractor agrees to keep and maintain public records in Contractor's possession or control in connection with Contractor's performance under this Agreement. Contractor additionally agrees to comply specifically with the provisions of Section 119.0701, Florida Statutes. Contractor shall ensure that public records that are exempt or confidential and exempt from public records disclosure requirements are not disclosed, except as authorized by law, for the duration of the Agreement, and following completion of the Agreement until the records are transferred to the Town.
b. Upon request from the Town's custodian of public records, Contractor shall provide the Town with a copy of the requested records or allow the records to be inspected or copied within a reasonable time at a cost that does not exceed the cost provided by Chapter 119, Florida Statutes, or as otherwise provided by law.
c. Unless otherwise provided by law, any and all records, including but not limited to reports, surveys, and other data and documents provided or created in connection with this Agreement are and shall remain the property of the Town.
d. Upon completion of this Agreement or in the event of termination by either party, any and all public records relating to the Agreement in the possession of the Contractor shall be delivered by the Contractor to the Town Manager, at no cost to the Town, within seven (7) days. All such records stored electronically by Contractor shall be delivered to the Town in a format that is compatible with the Town's information technology systems. Once the public records have been delivered upon completion or termination of this Agreement, the Contractor shall destroy any and all duplicate public records that are exempt or confidential and exempt from public records disclosure requirements.
e. Any compensation due to Contractor shall be withheld until all records are received as provided herein.
f. Contractor's failure or refusal to comply with the provisions of this section shall result in the immediate termination of this Agreement by the Town.

Section 119.0701(2)(a), Florida Statutes

IF THE CONTRACTOR HAS QUESTIONS REGARDING THE APPLICATION OF CHAPTER 119, FLORIDA STATUTES, TO THE CONTRACTOR'S DUTY TO PROVIDE PUBLIC RECORDS RELATING TO THIS CONTRACT, CONTACT THE CUSTODIAN OF PUBLIC RECORDS.

Custodian of Records:	**Debra E. Eastman, Interim Town Clerk**
Mailing address:	**10720 Caribbean Boulevard, Suite 105 Cutler Bay, FL 33189**
Telephone number:	**(305) 234-4262**
Email:	**deastman@cutlerbay-fl.gov**

END OF SECTION

SECTION 2
TOWN OF CUTLER BAY
CUTLER BAY TOWN CENTER
HVAC EQUIPMENT AND CONTROLS REPLACEMENT AND MAINTENANCE SERVICES
RFP #17-05

SPECIAL CONDITIONS

1. INSURANCE REQUIREMENTS

Throughout the term of this Contract, Successful Proposer and/or any and all subcontractors or anyone directly or indirectly employed by either of them shall maintain in force at their own expense, insurance as follows:

1.1 WORKERS' COMPENSATION

Statutory Limits of coverage to apply for all employees in compliance with all applicable State of Florida and federal laws. The policy must include Employers Liability with a limit of $500,000 each accident.

1.2 GENERAL LIABILITY

Commercial General Liability insurance with limits not less than $2,000,000 each occurrence combined single limit for Bodily Injury and Property Damage including coverage for contractual liability, personal injury, broad form property damage, products and completed operations. This policy of insurance shall be written in an "occurrence" based format.

1.3 AUTOMOBILE LIABILITY

Comprehensive or Business Automobile Liability insurance with limits not less than $1,000,000 each occurrence combined single limit for Bodily Injury and Property Damage including coverage's for owned, hired, and non-owned vehicles and/or equipment as applicable. This policy of insurance shall be written in an "occurrence" based format.

1.4 GENERAL

Should any of the required insurance be provided under a form of coverage that includes a general annual aggregate limit and provides that claims investigation or legal defense costs be included in such general annual aggregate limit, such general annual aggregate limit shall be double the occurrence limits specified above.

Should any required insurance lapse during the Contract term, requests for payments originating after such lapse shall not be processed until the Town receives satisfactory evidence of reinstated coverage as required by this Contract, effective as of the lapse date. If insurance is not reinstated, Town may, at their sole option terminate this Agreement effective on the date of such lapse of insurance.

Liability policies shall be endorsed to provide the following:

a) Name as additional insured the Town of Cutler Bay and its Officers, Agents, Employees and Council Members.

b) That such insurance is primary to any other insurance available to the additional insured with respect to claims covered under the policy and that insurance applies separately to each insured against whom claims are made or suit is brought, but the inclusion of more than one insured shall not operate to increase the insurer's limit of liability.

All policies shall be endorsed to provide thirty (30) days prior written notice of cancellation, non-renewal or reduction in coverage or limits to:

Town of Cutler Bay
Attention: Town Clerk's Office
10720 Caribbean Blvd., Suite# 105
Cutler Bay, Florida 33189

The issuing agency shall include full name, address and telephone number in each insurance certificate issued.

Certificates of Insurance, in form and evidencing all required insurance and endorsements, shall be submitted with the Proposers Proposal Package. If Proposer is Successful Proposer, then prior to commencement of Contract, Proposer must submit revised Certificate of Insurance naming the Town of Cutler Bay as additional insured for all liability policies.

1.5 INSURANCE COMPANY AND AGENT

All insurance policies herein required of the Successful Proposer shall be written by a company with a A.M. Best rating of AB or better that is duly authorized and licensed to do business in the State of Florida and shall be executed by agents, thereof that are duly licensed as agents in said state.

2. SAFETY

The Successful Proposer shall be solely and completely responsible for conditions of the job site, including safety of all persons (including employees) and property during performance of the work. This requirement shall apply continuously and not be limited to normal working hours. Job site safety provisions shall conform to U.S. Department of Labor (OSHA) standards and all other applicable federal, state, county, and local laws, ordinances, codes, and regulations. The Successful Proposer's failure to thoroughly familiarize himself with the aforementioned safety provisions shall not relieve him from compliance with the obligations and penalties set forth therein.

The Town reserves the right, but is not obligated to make safety inspections at any time the Successful Proposer is on Town property and to ensure safety rules are not being violated.

To the extent applicable, the Successful Proposer must also comply with Chapter 487, Florida Statutes. Any items which are delivered from an Agreement resulting from this Proposal must be accompanied by a Material Safety Data Sheets (MSDS). The MSDS sheets must be maintained by the user agency and consist of written, electronic, or printed material concerning an agricultural pesticide that sets forth the following information:

a) The chemical name and the common name of the agricultural pesticide.

b) The hazards or other risks in the use of the agricultural pesticide, including:

1. The potential for fire, explosions, corrosiveness, and reactivity.

2. The known acute health effects and chronic health effects of exposure to the agricultural pesticide, including those medical conditions that are generally recognized as being aggravated by exposure to the agricultural pesticide.

3. The primary routes of entry and symptoms of overexposure.

a) The proper handling practices, necessary personal protective equipment, and other proper or necessary safety precautions in circumstances that involve the use of or exposure to the agricultural pesticide, including appropriate emergency treatment in case of overexposure.

b) The emergency procedures for spills, fire, disposal, and first aid.

c) A description of the known specific potential health risks posed by the agricultural pesticide, which is written in lay terms and is intended to alert any person who reads the information.

d) The year and month, if available, that the information was compiled and the name, address, and emergency telephone number of the manufacturer responsible for preparing the information.

2.1 OCCUPATIONAL HEALTH AND SAFETY

In compliance with Chapter 442, Florida Statutes, any items included in the latest edition of "Florida Substance List" which are delivered from a Contract resulting from this Proposal must be accompanied by a Material Safety Data Sheets (MSDS) The MSDS sheets must be maintained by the user agency and must include the following information:

a) The chemical name and the common name of the toxic substance.

b) The hazards or other risks in the use of the toxic substance, including:

1. The potential for fire, explosion, corrosiveness, and reactivity;

2. The known acute and chronic health effects of risks from exposure, including the medical conditions which are generally recognized as being aggravated by exposure to the toxic substance; and

3. The primary routes of entry and symptoms of overexposure.

c) The proper precautions, handling practices, necessary personal protective equipment, and other safety precautions in the use of or exposure to the toxic substances, including appropriate emergency treatment in case of overexposure.

d) The emergency procedure for spill, fire, disposal, and first aid.

e) A description in lay terms of the known specific potential health risks posed by the toxic substances intended to alert any person reading this information.

f) The year and month, if available, that the information was compiled and the name, address, and the emergency telephone number of the manufacturer responsible for preparing the information.

ALL TOXIC SUBSTANCES MUST BE LABELED FOR IDENTIFICATION IN ACCORDANCE WITH OSHA STANDARDS.

3. CARE AND SAFETY

The Contractor shall exercise the greatest of caution and care in servicing each site so as not to be or create a hazard which may affect the health, safety and welfare of users of the site or those surrounding, abutting or passing, and so as not to cause or inflict damage to any portion of the site and the area abutting and surrounding. The Contractor shall be responsible for all damages to persons and/or property occurring in the course of or resulting from his work, and shall be responsible for all repair, restoration, replacement and/or restitution for said damages at the Contractor's sole expense.

4. DAMAGES, VANDALISM AND THEFT

In the event the Contractor discovers or is made aware of damages, vandalism or theft at a site specified herein, the Contractor, shall immediately notify the Town of same, and shall file a police report of the occurrence.

5. SUB-CONTRACTORS

5.1 Sub-Contractors Terms

The Contractor agrees to bind specifically every sub-contractor to the applicable terms and conditions of the Contract Documents for the benefit of the Town.

5.2 Sub-Contractors Agreement

Written approval by the Town Manager or his designee will be required, prior to hiring any subcontractor. All work performed for the Contractor by a sub-contractor shall be pursuant to an appropriate agreement between the Contractor and the Sub-contractor.

6. PUBLIC ENTITY CRIMES STATEMENT

A person or affiliate who has been placed on the convicted vendor list following a conviction for a public entity crime may not submit a bid on a contract to provide any goods or services to a public entity, may not submit a proposal on a contract with a public entity for the construction or repair of a public building or public work, may not submit proposals on leases of real property to a public entity, may not be awarded or perform work as a Contractor, supplier, subcontractor, or consultant under a contract with any public entity and may not transact business with any public entity in excess of the threshold amount provided in Section 287.017, for CATEGORY TWO for a period of 36 months from the date of being placed on the convicted vendor list.

7. DRUG-FREE WORKPLACE PROGRAMS

Preference shall be given to businesses with Drug-Free Workplace programs. Whenever two or more proposals which are equal with respect to price, quality and service are received by the Town for the procurement of commodities or contractual services, a proposal received from a business that completes the attached Drug-Free Workplace form certifying that it is a Drug-Free Workplace shall be given preference in the award process.

8. PERFORMANCE BOND

Simultaneous with the delivery of the executed contract to the Town, the Contractor shall furnish to the Town an executed performance bond in the amount equal to one hundred percent (100%) of the Proposal Cost Bid Form, as security for the faithful performance of the contract and for the payment of all persons performing labor and/or furnishing materials in connection therewith. It shall be submitted on forms provided. The condition of this obligation is such that, if the Contractor shall promptly and faithfully perform said contract, make payments to all claimants for all labor and material used or reasonably required for use in the performance of the contract, and shall fully indemnify and save harmless the owner for all costs and damages he may suffer by reason of failure so to do, then this obligation shall be null and void; otherwise it shall remain in full force and effect.

9. INSPECTION, DIRECTION, AND PAYMENT

9.1 Direction

The work will be conducted under the general direction of the Town Manager or his designee, and is subject to inspection by his appointed inspectors to insure compliance with the terms of the Contract. No inspector is authorized to change any provision of the specifications without written authorization of the Town Manager or his designee nor shall the presence of an inspector relieve the Contractor from any requirements of the Contract.

9.2 Payment

Contractor shall submit invoices on or about the first of each month for work completed in the previous month under provision of this Contract. Invoices will be verified by checking them against any Evaluation Report forms that were approved for payment during the time period being invoiced. The Town shall pay the Contractor pursuant to the Florida Prompt Payment Act.

END OF SECTION

SECTION 3
TOWN OF CUTLER BAY
CUTLER BAY TOWN CENTER
HVAC EQUIPMENT AND CONTROLS REPLACEMENT AND MAINTENANCE SERVICES
RFP #17-05

GENERAL CONDITIONS

INSPECTION OF SITE

Contractor shall inspect the site and its equipment before bidding in order to verify all field conditions and to be completely familiar with all phases of the work herein specified. All work shall be performed in a good workmanlike manner and shall comply with all Occupation Safety & Health Administration (OSHA) standards and applicable National, State, Town and local codes and ordinances of agencies having jurisdiction.

STATE AND LOCAL SALES TAX AND FILING FEES

The Contractor shall attain and pay for all Federal, State, and Local Taxes and filing fees.

OPERATIONS PERFORMED OR SERVICES PROVIDED

Contractor hereby agrees to defend, indemnify, and hold harmless the Owners and their Representatives from and against any and all liability, loss, damage, claim or action, to the extent permissible by Law, arising out of the operations performed or services provided by the contractor under the contract.

AWARD OF CONTRACT

Award of contract will be made to the lowest and responsive qualified bidder.

SUBSTITUTIONS

In the event the bidder proposes to furnish substitution for a product/service specified, this information shall be identified in writing, including full technical description, catalog cut and sample as appropriate, submitted with the bid. The Owners and or their Representatives reserve the right to request a representative sample of the item(s) quoted, either prior to bid award or before shipment is made. The determination of equality shall be made by the Owners and or their Representatives. Any costs involved in product testing or other evaluation to determine equality shall be borne by the bidder. If the sample or other technical description is not in accordance with the specification or otherwise deemed not to be an equal to that specified, the Owners and or their Representatives may reject the bid, or, if award has been made, cancel the contract at the expense of the bidder.

PRICE(S)

The price(s) submitted on the Proposal Cost Bid Form must include all delivery and installation charges and applicable sales and use tax, unless otherwise required by the Owners.

PAYMENT

Payment will be made by the Owners or their Representatives only upon presentation of correctly itemized invoice. Payments of any claim shall not preclude the Owners and or their Representatives from making claim for adjustment on any item found not to have been in accordance with the general conditions and specific requirements of the contract. The Owners or their Representatives may withhold ten (10) percent of the total contract value as retainage for correction of punch list items.

GUARANTEE

Contract shall provide a one (1) year guarantee against defects in materials or work upon completion of installation, as applicable. Any materials or work which is or becomes defective during the guarantee period shall be replaced by the contractor with the understanding that all replacements shall carry the same guarantee as the original equipment. Such replacement shall be made immediately upon receiving notification form the Owners and or their Representatives.

END OF SECTION

SECTION 4
TOWN OF CUTLER BAY
CUTLER BAY TOWN CENTER
HVAC EQUIPMENT AND CONTROLS REPLACEMENT AND MAINTENANCE SERVICES
RFP #17-05

BID DOCUMENTS

REFERENCES

Bidder shall submit with bid four references for work of the same general character as that specified herein.

Contractor to furnish the names of four references of similar projects:

1. _____
   Name of Property Contact Telephone

2. _____
   Name of Property Contact Telephone

3. _____
   Name of Property Contact Telephone

4. _____
   Name of Property Contact Telephone

_____
Company Name Date

_____
Name of Bidder Title

_____
Signature of Bidder

EXCEPTIONS TO BID REQUIREMENTS

Bidder shall provide any exceptions to the specific requirements stated in this bid document; if none, so state:

Company Name Date

Name of Bidder Title

Signature of Bidder

SECTION 5
TOWN OF CUTLER BAY
CUTLER BAY TOWN CENTER
HVAC EQUIPMENT AND CONTROLS REPLACEMENT AND MAINTENANCE SERVICES
RFP #17-05

TECHNICAL BID INFORMATION

DEFINITIONS OF TERMS

- OWNERS REPRESENTATIVES: as used herein, refers to the Manager acting on the Owners behalf.
- CONTRACT or CONTRACT DOCUMENTS: as used herein, consists of the Agreements, Bidding Information, Conditions of Contract, and Specifications including any Alternates or Addenda issued during the bidding period.
- CONTRACTOR: as used herein, refers to any persons, partners, firm or corporation having a contract with the Owner to furnish labor and materials for the execution of the work herein described.
- SUBCONTRACTOR: as used herein, refers to any persons, partners, firm or corporation having a contract with the Contractor to furnish labor and materials for the execution of the work herein described.
- Words in the singular shall include the plural whenever applicable or the context so indicates.
- All terms in these specifications have the definition given in the latest Florida Building Code 5th Edition (2014) Manuals, HVAC Supplements, and Federal, State, and Local codes and laws.

GENERAL DATA

The work shall be performed and completed in a good, first class, and workmanlike manner and to the owners satisfaction and all work and material required for such performance and completion shall strictly conform to the work data. Anything called for on drawings and not mentioned in specifications, or vice versa, and any work or material necessary to and usually included in the completed finished work shall, together with all such incidental services and processes as are usual and proper in the performance of such work, be furnished by contractor as a part of the work without any extra charge as though the same were specified in the work data.

Contractor, at its expense, shall promptly prepare and furnish to the owners for its approval, any required shop drawings, specifications, as required herein or in the work data and such other usual, proper, and necessary working drawings for the work as may be required from time to time by the owners, but the owners written approval thereof shall be obtained by contractor before the work called for therein is executed and all such models shall be made by artists approved in writing by the owners. Each specification or shop drawing furnished by contractor shall be marked for identification as the owners may direct.

The owners approval of any such specification, working drawing, template, pattern, or model shall not relieve the contractor from responsibility (a) for deviations or omissions from any of the work as otherwise called for by the

work data unless, prior to owner's said approval, contractor shall have called such deviation or omission to owners attention in writing, or (b) for any errors in specifications and working drawings furnished by the Engineer. Contractor shall promptly furnish to the owners such number of copies of said specifications and working drawings as the owners may order for its own use or that of any architect, engineer, or any other contractor engaged in performance of any related work. The owners will furnish contractor such number of copies of the work data prepared by the owners or any architect or engineer as contractor shall require but contractor shall pay to the owners the cost to owner of any copies in excess of two.

Drawings and details to larger scales shall take precedence over those at smaller scales. Contractor shall, in no case, "scale" drawings, but shall work from figured dimensions and all measurements shall be verified at the premises and any failure of the work to fit in place shall be remedied by contractor at its expense.

Where inconsistencies exist in the work data, necessary measurements are missing, work or material called for by the work data is incorrect or impossible of execution, figures fail to check or owner or any architect or engineer shall fail to supply sufficient or clear information to enable contractor to proceed with a part of the work, contractor shall immediately notify the owners and their representatives in writing thereof and conform to owners written directions with respect to the work or material affected thereby lack of information. Failure to understand any of the work data, ignorance of the contents thereof, will not excuse contractor for improper or inferior design, workmanship or material, or for any delay in performing the work, or as a justification for any claim of Contractor for additional compensation.

Contractor, without additional compensation, (a)at owners request, at any time and either verbally or in writing as the owners directs, will report to the owners on the progress of the Work, including the preparation and delivery of material, and (b) will attend meetings of such places and at such times as the owners shall request for the purpose of reporting to the owners on the progress of the work and/or discussion of its relation to the progress of any other work being performed in or for the premises.

SCOPE OF WORK

The project consists of replacing existing custom built Direct Expansion (DX) air handling unit and controls with new chilled water system. Replace existing controls with new Direct Digital Control (DDC), retrofit new DDC control to approximately 135 Variable Air Volume (VAV) Boxes and provide power to 36 VAV boxes with electric heater. Replace 6 VAV boxes with new. Revise and update smoke control system.

The existing DX air handling unit is located in the mechanical penthouse, and two 80 tons condensing units located just outside of the penthouse will be demolished. The existing smoke control fans and louvers will be demolished and replace with new.

The existing supply/return air fire rated mechanical shaft will be extended from penthouse floor to roof structure and sealed to create a means for return air/smoke evacuation air path.

The new equipment are mounted on new structural beams supported from existing structural column.

New systems are as follow.

- New 160 tons air cooled, magnetic bearing packaged chiller and pumping system.
- Replace penthouse unit with new 56,000 CFM, chilled water roof mounted air handling unit

- New 500 gallons chilled water buffer tank
- Replace six (6) VAV boxes (mainly located and served the corridor area)
- Replace toilet exhaust fan EF-1
- Replace vestibule stair 1 exhaust fan EF-2
- Replace stair 1 pressurization fan SF-1
- New vestibule pressurization fan SF-2
- New stair 2 pressurization fan SPF-2
- Replace emergency smoke exhaust fan EEF-1
- Replace elevator pressurization fan EPF-1

ADDITIONAL SPECIFICATIONS

- It is intended that the contract includes all labor and material to accomplish a complete installation in every respect. Bidders are cautioned to familiarize themselves with existing conditions on the premises and to include all incidental work that might occur during the job. After the contract has been signed there will be no extra charges allowed for any labor or material necessary to complete the work whether exactly described in these specifications herein or not, as long as such work, labor and material are required in order to obtain the desired effect and results.

- Any discrepancies or ambiguities found in the specifications shall be reported to the Owners Representative prior to bid for resolution.

- **Information and Drawings**: Any drawings, measurements, or information included with the bidding material shall be for the convenience of the bidders. Completed responsibility for detailed dimensions lies with the Contractor. In the execution of the work on the job, the Contractor is to verify all dimensions with the actual conditions. Where the work of the HVAC Contractor is to join another trade, the shop drawings shall show the actual dimensions and the method of joining the work of the two trades.

- **Codes and Ordinances**: All the work covered by these specifications is to be done in full accordance with the Federal, State and Local Codes, Ordinances and Florida Building Code and Authority Having Jurisdiction (AHJ) as are in effect at the time of the execution of the contract. All of the requirements of the Governmental Authorities are to be fulfilled by the Contractor and its subcontractors.

    a) Bidders should act promptly and allow sufficient time for a reply to reach them before the submission of their bids. Any required interpretation will be in the form of an addendum to the specifications which will be forwarded to all bidders by the Owners Representative.

    b) If the bidder desires to furnish any item different from that specifically mentioned in the specifications, they shall notify the Owners Representative of their intentions prior to the submission of their bid and shall supply the Owners Representative with information, data, pictures, cuts, designs, etc. of the materials he desires to furnish so as to enable the Owners Representative to decide whether or not the article intended to be furnished by the bidder is, in fact, the equal of that specified. Any deviation from the specifications shall be stated by the bidder as an exception to the specifications in a transmittal letter submitted together with, and as a part of, their respective bid.

SPECIAL TERMS AND CONDITIONS

Article I.

Contract Term: The Contract will become effective on the date it is executed by both parties. The Contractor shall obtain Substantial Completion of the Bid Base Proposal within ten (10) Days of the Notice to Proceed being issued by the Town. After the Town's completes its inspection under Article IV, Contractor must obtain Final Completion within five (5) Days of the Town's inspection.

The initial Contract period for POST HVAC INSTALLATION MAINTENANCE (YEAR 1) and PREVENTATIVE MAINTENANCE BID (YEARS 2 THRU 5) shall be for five (5) years with an option to renew annually not to exceed a maximum of four (4) years subject to appropriation of funds for the budget year applicable. At its sole discretion, the Town shall have an option to renew this Agreement upon the same terms and conditions for up to four (4) additional years (the "Option"). This Option may be exercised at the sole discretion of the Town Manager. Such extension shall be effective upon receipt of a written notice from the Town Manager to the Contractor received no later than 30 days prior to the date of termination.

Article II.

Liquidated Damages: The Town may establish liquidated damages on the Notice to Proceed.

The Contractor is obligated and guarantees to obtain Substantial and Final Completions of the Project within the timeframes established in the Contract or any approved extension of time the Contractor may be granted by the Town. In the event of a delay in completion beyond the date established in the Contract Documents, the Contractor must pay to the Town for each and every calendar day of unexcused delay, the sum of two hundred fifty ($250.00) dollars, which is hereby agreed upon not as a penalty but as liquidated damages. The Contractor will be notified of any exceptions. The total amount of liquidated damages will not exceed the value of the Contract.

The Town has the right to deduct liquidated damages assessments from any payment due or which may thereafter become due to the Contractor under any contract the Contractor has with the Town. In case the amount available under contracts the Contractor has with the Town is less than the amount of liquidated damages due the Town, the Contractor must pay the difference upon demand by the Town. Should the Contractor fail to compensate the Town for any liquidated damages, the Town will consider this as a form of indebtedness and may deny any future Work under the Contract or any other Town contract until such indebtedness is paid in full to the Town.

The Town will notify the Contractor in writing that it is incurring liquidated damages.

Article III.

Warranty: Contractor warrants to the Town that all materials and equipment furnished under the Contract will be new unless otherwise specified and that all of the Work will be of good quality, free from faults and defects and in conformance with the Contract Documents. All Work not conforming to these requirements, including substitutions not properly approved and authorized, may be considered defective. If required by the Project Manager the Contractor must furnish satisfactory evidence as to the kind and quality

of materials and equipment. This warranty is not limited by any other provisions within the Contract Documents.

All Work must have a one (1) year warranty on labor from the date of acceptance of the Work by the Town under a Work Order. Contractor must provide a minimum written warranty of one (1) year on all equipment, parts, or material unless the manufacturer provides a longer warranty. Where the manufacturer of the equipment, parts, or material provides a warranty greater than one (1) year or the time frame stipulated then the manufacturer's warranty term will take precedence. Contractor will be required to provide the Project Manager a copy of the manufacturer's warranty prior to the Town issuing final payment. Manufacturer's warranties will become effective upon Final Completion of the Project.

All material and equipment furnished must be fully guaranteed by the Contractor against factory defects and workmanship. At no expense to the Town, the Contractor will correct any and all apparent and latent defects that may occur within the manufacturer's standard warranty. The Contract Documents may supersede the manufacturer's standard warranty.

Should the Contractor fail to perform any required warranty work the Town, at its sole discretion, may have the work performed by others, and deduct such costs from any monies due the Contractor from the Town. Where such funds are not available, the Town will bill the Contractor and Contractor will reimburse the Town within thirty (30) calendar days. The Town may take any necessary and appropriate action provided under this Contract or with law to collect such payment due the Town.

Article IV.

Substantial Completion, Punchlist & Final Completion: The Work will be substantially complete when the Project Manager, in the reasonable exercise of his/her discretion determines that the Work is complete and there are no material or substantial variations from the Contract and the Work is fit for its intended purpose. Upon Substantial Completion, the Project Manager and the Contractor will sign the Substantial Completion Inspection Form. The signing of this form does not relieve the Contractor from its obligation to complete the Project.

When the Contractor believes that the Work is substantially complete, the Contractor must request in writing that the Project Manager or Consultant inspect the Work to determine if Substantial Completion has been achieved. Where the Work requires the Contractor to obtain a Certificate of Completion, no request for Substantial Completion inspection is to be submitted until the Contractor has obtained the Certificate(s) of Completion. The Project Manager or Consultant will schedule the date and time for any inspection and notify the Contractor and any other parties deemed necessary. During this inspection, the Project Substantial Completion Inspection Form will be completed as necessary. Any remaining Work must be identified on this form and it will be known as Punch List Work. The Punch List must be signed by the Project Manager and the Contractor confirming that the Punch List contains the item(s) necessary to complete the Work. The failure or refusal of the Contractor to sign the Project Substantial Completion Inspection Form or Punch List will not relieve the Contractor from complying with the findings of the Project Substantial Completion Inspection and completing the Project to the satisfaction of the Town.

The Project Manager or Consultant, and the Contractor will agree on the time reasonably required to complete all remaining Work included in the Punch List.

Upon Substantial Completion and the receipt and acceptance of any required documentation, including warranty documents, the Project Manager will determine that a Project has achieved Final Completion and authorize final payment.

The acceptance of final payment will constitute a waiver of all claims by Contractor, except those previously made in strict accordance with the provisions of the Contract and identified by Contractor as unsettled at the time of the application for final payment.

Article V.

Acceptance and Final Payment: Upon receipt of written notice from Contractor that the Work is ready for final inspection and acceptance, Project Manager will, within ten (10) calendar days, make an inspection thereof. If the Project Manager finds the Work acceptable, the requisite documents have been submitted and the requirements of the Contract fully satisfied, and all conditions of the permits and regulatory agencies have been met, a Final Certificate for Payment will be issued by Project Manager, stating that the requirements of the Contract have been performed and the Work is ready for acceptance under the terms and conditions thereof.

Before issuance of the Final Certificate for Payment, Contractor must deliver to the Project Manager a final release of all liens arising out of the Contract, receipts in full in lieu thereof; an affidavit certifying that all suppliers and subcontractors have been paid in full and that all other indebtedness connected with the Work has been paid, and a consent of the surety to final payment; the final corrected as-built drawings; operations and maintenance data, and the final bill of materials, if required, and payment application. Contractor must deliver the written Contractor's and all Manufacturer's warranties prior to issuance of the final invoice.

If, after the Work has been substantially completed, full completion thereof is materially delayed through no fault of Contractor, and Project Manager so certifies, Town will, upon such certification of Consultant, and without terminating the Contract, make payment of the balance due for that portion of the Work fully completed and accepted. Such payment will be made under the terms and conditions governing final payment, except that it will not constitute a waiver of claims.

The acceptance of final payment will constitute a waiver of all claims by Contractor, except those previously made in strict accordance with the provisions of the Contract and identified by Contractor as unsettled at the time of the application for final payment.

Article VI.

Prices: All prices quoted in a Bidder's Submittal shall remain firm and fixed, unless amended in writing by the Town.

Article VII.

Performance Standards: All work shall be performed in strict accordance with manufacturer requirements, and applicable standards for equipment, repairs and indoor air quality established by, including but not limited to, the following firms: American Society of Heating, Refrigerating, and Air-Conditioning Engineers (ASHRAE); Environmental Protection Agency (EPA); Heating, Air-Conditioning & Refrigeration Distributors International (HARDI); and all applicable codes.

Installation: All installation projects shall include all necessary equipment and supplies and be completed only by manufacturer qualified personnel. Where material and supplies are required that are outside the scope of the items included in the RFP, the Procurement Manager or designee shall negotiate pricing with the selected contractor. Written approval of project proposal is required prior to the commencement of work.

Article VIII.

Maintenance Plan: Included on the Bid Form, Bidder shall provide a quote for a maintenance plan for all HVAC Equipment installed under this Contract and any HVAC Equipment existing to remain.

Maintenance Plan Term: The maintenance plan must have an initial term of four (4) years to commence after the initial factory one (1) year warranty expires with four options to renew for an additional one (1) year each. The term shall begin on the date final acceptance of HVAC Equipment installation completion.

Furnish all labor necessary to inspect, install replacement parts and service the subject equipment to maintain it in good operating condition. Equipment replacement parts and material are not included in the monthly maintenance fee. Parts and materials will be reimbursed separately, upon approval by Town staff as a pass thru cost, unless parts are under warranty. The contractor will be responsible to obtain all of the required Permits, from the Town's Building & Zoning Department. The permit fees will be invoiced separately as a direct cost on each "approved" Work Order, issued by Town staff. Town will reimburse for the direct cost of permits.

Regularly inspect all HVAC related equipment at a minimal twelve **(12)** times a year, not less than once a month, and on each inspection perform all services per inspection checklist. Provide a written detailed report of any findings, as a result of the regular inspection and the report must be signed by Town staff.

Furnish the Town with a copy of the Inspection Report indicating what repairs, if any, were necessary resulting from each inspection. PROVIDE EMERGENCY SERVICE as needed between inspections during normal working hours at no extra charge.

Provide the Town with Instructions in the operation of equipment to provide for greatest operating efficiency.

HVAC EQUIPMENT: All HVAC equipment as follow, but not limited to:

- Air cooled chiller and ancillary devices
- Air Handling Unit (AHU)

- Direct Digital Control System
- Chilled water pumps
- Exhaust fans
- Pressurization fans
- Smoke control fans
- Variable air volume boxes
- Variable Frequency drive
- Ductless split unit
- Motorized dampers

SERVICE HOURS

This agreement shall include service calls made during normal working hours, between 7:00 a.m. and 6:00 p.m., Monday through Friday, weekends and observed Town Center holidays excluded. Emergency service will be available at other times at an additional cost. All overtime labor will be charged at a rate that is negotiated with the Town staff.

ITEMS TO BE INCLUDED IN THE MONTHLY PREVENTIVE MAINTENANCE FEE AND INSPECTION CYCLE(S):

- Tighten all Electrical connections
- Inspect Contactors and Relays
- Provide and replace pre-filters as needed
- Clean Condensate Pans and Lines
- Check Refrigerant Pressure
- Check Amperes
- Lubricate Bearings per Manufacturer's Recommendations
- Check Temperature Splits
- Check for Vibrations
- Check Operating of Variable Speed Drive
- Check Panels for Tightness
- Check Coils and Blower Wheels for Cleanliness
- Check Compressor Oil Levels
- Inspect for Refrigerant Leaks
- Check Crankcase Heater Operation Abnormalities
- Supply Customer with Service Report
- Check for Proper Outside Air Flow
- Check Compressor Unloaders
- Check for Proper Staging and Capacity Control
- Inspect Motor and Compressor Mounts
- Check refrigerant Air Drier
- Check Pneumatic Compressors

- Check Smoke Exhaust Damper for proper operation
- Check all Fan Belt Drives for proper belt tightness
- Check outside air and return Air Dampers for proper operation and tight closing
- Inspection of all moving parts
- Inspection of all Ductwork, with in-building once a year
- Inspect all Exposed Refrigerant Piping (as needed), Including HEPA Bag Filters
- Inspect Smoke Evacuation System for proper operation
- Conduct Semi-Annual Test, to the Smoke Evacuation System
- Inspect Control Dampers, Including Actuators
- Inspect all Waste Drainage Lines
- Maintain Smoke Evacuation system
- In addition to maintenance to Smoke Evacuation system perform an annual test
- Provide Town's Representative a report listing any other maintenance replacements, not covered in above section

➢ **Exclusions:** Repairs due to losses or damages as a result of fire, water, windstorm, vandalism, theft, riots, civil commotion, inadequate or fluctuating conditions of the electrical utilities, lightning, damages caused by electrolytic action, crane charges, coil cleanings, indoor air quality, Acts of God, strikes, picket lines or anything beyond the normal mechanical maintenance.

ADDITIONAL REQUIREMENTS

➢ **Permits:** The Contractor shall obtain and pay for all municipal and state permits necessary for execution of the HVAC installation. The permit fees will be invoiced separately as a direct cost on each "approved" Work Order, issued by Town staff. Town will reimburse for the direct cost of permits.

➢ **Protection of Work and Property:** The Contractor shall continuously maintain adequate protection of all its work from damage and shall protect the Owners property from injury or loss arising out of this contract. The Contractor shall make good any such damages, injury or loss, except such as may be directly caused by agents or employees of the Owners.

The Contractor shall provide all barricades required to protect open hoist ways or shafts per OSHA regulations. The owner requires that dust not be emitted into the lobby areas, accordingly, protective fire-rated material must be installed as necessary to control airborne dust into tenant and lobby areas.

➢ **Storage of Materials**: Contractor shall confine storage of materials on job site to limits approved by the Owners Representatives and shall not unnecessarily encumber the premises or overload any portion with materials to a greater extent than the structure design load.

➢ **Removal of Equipment and Rubbish**: The Contractor shall remove all rubbish as fast as it accumulates, keeping the building and premises clean during the progress of the work and leave the premises at completion in perfect condition, as far as his work is concerned, to the Owners Representative's complete satisfaction.

- **Cartage, Hoisting, and Equipment Installation**: All HVAC equipment installed under this contract shall be delivered to the job site and hoisted into place by the Contractor.

- **Materials and Workmanship**: All materials and equipment furnished shall be new and the best of their respective kinds. Installation shall be in a neat, accurate, workmanlike manner and be subject to the approval of the Owners Representative. All materials and equipment furnished shall conform to the regulations of the bodies having jurisdiction and installation shall conform to the regulations of the bodies having jurisdiction over such installation. The Contractor shall furnish for approval all samples as directed and material shall be in accordance with approved samples.

- **Construction Phasing**: Building shall remain operational during normal business hours throughout construction. Installation of new HVAC equipment shall be scheduled such that the existing HVAC equipment operation is least impacted during normal business hours. Provide temporary HVAC equipment as necessary if normal business hours is affected. Installation of all new roof mounted HVAC equipment shall be operational and all ductwork shall be brought to the penthouse and ready to connect to existing prior to demolition of existing equipment.

PAINTING AND FINISHES

- All natural metals shall be of the best grade and shall have the grain of belting in the direction of the longest dimension with a fine, brushed or mirror finish. All surfaces shall be perfectly smooth and without waves. Painting of unfinished metal will be of the highest quality enamel and rust resistant paint.

SUBMITTALS

- Prior to the beginning of the work, the Contractor shall submit and have approved copies of layouts (if required by code authorities for filing), shop drawings and standard cuts. The Owners Representative shall pass on the submittals with reasonable promptness and the Contractor shall be responsible to insure that there will be no delay in their work or that of any trade involved.

- It shall be distinctly understood that approval of the drawings and cuts shall be for general arrangement only and does not include measurements and code compliance which are the Contractor's responsibility or approval of variations from the contract documents.

- The Owners Representative will have a kick off meeting with the successful contractor prior to the beginning of the work. The contractor's sales representative and field manager responsible for the job shall be in attendance. The contractor shall provide the following information at this meeting:

    a. Shop drawings as required including fixture drawings

    b. A catalogue of the fixtures being supplied and samples that may be required

    c. A complete installation bar schedule

    d. Insurance certificates if not already submitted

CONTRACTORS WORK FORCE

The Contractor shall keep competent installers at the job site continuously during the work progress. The superintendent and or the Lead Technician shall represent the Contractor and all instructions given to him shall be as binding as if given to the Contractor. If the Lead Technician does not cooperate fully with the Owners Representative he shall be removed from the job upon notification of the owner and replaced with a competent Lead Technician to the owner's satisfaction. If the contractor removes the work force from the site without the expressed written consent of the owner or owners representative they shall be subject to a penalty of $150.00 per day for each day the work force is removed.

CHANGES, CHARGES AND EXTRA WORK

The Owners may at any time make changes in the specifications, plans or drawings, omit work, and require additional work to be performed or require portions of the work to be completed after normal working hours by the Contractor. For such additional work performed hereunder, the Owners shall pay the Contractor on the basis of a mutually agreed formula; Real Cost of the labor (direct and fringes) and material, multiplied by ten percent for burden and 10% for profit. For work which is part of the original specification performed on overtime, payment will be the premium portion only, the straight time will be part of the contractors responsibility. The contractor shall make no additions, changes, alterations or omissions, or perform extra work, except on prior written authorization of the Owners.

PROGRESS OF WORK

- Upon signing of the contract, the Contractor shall submit a complete starting, progress, and completion schedule, including equipment delivery dates, downtime and return to service dates per unit based on the information submitted on the proposal cost bid form.

- The Contractor, monthly, shall submit in writing the following information to the Owners throughout the installation process:

  a) An updated progress schedule, including the equipment delivery times, work completed the previous week and scheduled work to be performed in the following month.

  b) A progress report with submission of payment request, showing the progress being made and the percentage of the job completed and shall certify to Owner that labor and materials listed on the request for payment have been performed and or installed. The form of invoice shall be the standard AIA including a lien waiver for the invoiced values.

DRAWINGS AND DIAGRAMS

- The Contractor shall submit four copies of any shop drawings and details to the Owners Representative for approval. One copy shall be returned to the HVAC contractor by the Owners Representative marked APPROVED, APPROVED AS NOTED, SUBMIT SPECIFIC ITEM, or REVISE, AND RESUBMIT. Drawings marked APPROVED AS NOTED, REJECTED, or REVISE AND RESUBMIT shall be resubmitted for approval no later than 10 working days after the drawings are returned to the contractor.

- At the conclusion of the job, a final set of drawings shall be submitted incorporating all changes which have been made.
- The three complete sets of AS INSTALLED straight-line wiring diagrams. (One set of diagrams shall be reproducible master).
- Two complete parts catalogs for all replaceable parts of the equipment installed.
- Copies of all approved or approved as noted shop drawings shall be retained at the site.

KEYS

Six sets of keys to operate all keyed switches and locks shall be furnished upon completion. Keys shall be properly tagged. All keying shall be arranged with the Owners and or their Representatives.

TOOLS

Any special tools required in the normal maintenance of the equipment installed shall be supplied to the owner by the contractor as part of the specification and installation. The tools shall become the property of the Owner.

PROJECT COMPLETION

The project completion date submitted is extremely important to the award of the project. Should, during the installation, the Owners Representative, at their sole discretion, believe the contractor is failing to maintain a schedule of work which will meet the completion date, the contractor shall, at no cost to the owners, supply whatever manpower or additional time as required completing the project as originally submitted.

REMOVAL OF EXISTING EQUIPMENT

All existing HVAC equipment which is not used in the new installation shall be removed by the Contractor prior to the new equipment installation. All equipment that is not to be retained by the Owner shall become the property of the Contractor and shall be removed, by the Contractor from the premises. The unused material shall be removed as the work progresses as to keep the site clear of debris.

END OF SECTION

SECTION 6
TOWN OF CUTLER BAY
CUTLER BAY TOWN CENTER
HVAC EQUIPMENT AND CONTROLS REPLACEMENT AND MAINTENANCE SERVICES
RFP #17-05

AGREEMENT

THIS AGREEMENT is made this ____ day of _____, 2017 by and between the Town of Cutler Bay, Florida (the "Town") and _____. (the "Contractor").

The parties, for the consideration provided for below, mutually agree as follows:

1.1.1 **SCOPE OF WORK** The Contractor shall furnish all labor, materials, supervision, equipment, supplies, and incidentals required to perform the scope of work as outlined in the Detailed Specifications of this Agreement, attached hereto as Exhibit "A" and "B" (the "Work").

1.2 **COMPENSATION/PAYMENT**

1.2.1 Contractor shall provide the Town with an invoice on a monthly basis within ten (10) days of the end of each month stating the services provided in the preceding month, through the project.

1.2.2 The Town shall make payment on said invoices of approved amounts due, as required under the Florida Prompt Payment Act. No payments shall be due or payable for Work not performed or materials not furnished. If there is a dispute with regard to an invoice, the Town may withhold payment until all requested supporting materials are received from Contractor and the dispute is resolved.

1.2.3 Contractor shall be compensated at the unit prices specified in the Proposal Cost Bid Form, attached hereto as Section 9, based upon the actual Work completed. The total compensation under this Agreement shall not exceed **$**_____(the "Agreement Sum").

1.3 **TERM** The Contract will become effective on the date it is executed by both parties. The Contractor shall obtain Substantial Completion of the Bid Base Proposal within ten (10) Days of the Notice to Proceed being issued by the Town. After the Town's completes its inspection under Article IV, Contractor must obtain Final Completion within five (5) Days of the Town's inspection.

The initial Contract period for POST HVAC INSTALLATION MAINTENANCE (YEAR 1) and PREVENTATIVE MAINTENANCE BID (YEARS 2 THRU 5) shall be for five (5) years with an option to renew annually not to exceed a maximum of four (4) years subject to appropriation of funds for the budget year applicable. At its sole discretion, the Town shall have an option to renew this Agreement upon the same terms and conditions for up to four (4) additional years (the "Option"). This Option may be exercised at the sole discretion of the Town Manager. Such extension shall be effective upon receipt of a written notice from the Town Manager to the Contractor received no later than 30 days prior to the date of termination.

1.4 **PROTECTION OF PROPERTY AND THE PUBLIC** The Contractor shall continuously maintain adequate protection of all his Work from damage and shall protect public and private property from injury or loss arising in connection with this Agreement as follows:

1.4.1 The Contractor shall take all necessary precautions for the safety of employees in the performance of the Work on, about or adjacent to the work sites, and shall comply with all applicable provisions of Federal, State, and local laws, including, but not limited to the requirements of the Occupational Safety and Health Act of 1970, and amendments thereto, and building codes to prevent accidents or injury to persons on, about or adjacent to the work site where the Work is being performed.

1.4.2 The Contractor shall erect and properly maintain at all times, all necessary safeguards, including sufficient lights and danger signals on or near the Work, from sunset to sunrise, suitable railings, barricades, or other hazards or other protective devices about unfinished work, open trenches, embankments, or other hazards and obstructions to traffic; provide all necessary security staff on the Work by day or by night for the safety of the public; and take all necessary precautions to prevent accidents and injuries to persons or property on or near the Work.

1.4.3 The Contractor shall be completely responsible for, and shall replace and make good all loss, injury, or damage to any property (including landscaping, walks, drives, or structures of the Town and of any land adjoining the work site), which may be caused by Contractor. The Contractor shall, at all times while the Work is in progress, use extraordinary care to see that adjacent property, whether real or personal, is not endangered in any way by reason of fire, water, or construction operations, and shall take all necessary or directed steps, to protect the property.

1.4.4 Buildings, sidewalks, fences, shade trees, lawns and all other improvements shall be duly protected from damage by Contractor. Property obstructions, such as sewers, drains, water or gas lines, conduits, railroads, poles, walls, posts, galleries, bridges, manholes, valve boxes, meter boxes, street monuments, etc., shall be carefully protected from injury and shall not be displaced. The Contractor shall give due notice to any department or public service corporation controlling such items as manholes, valve boxes, meter boxes, street monuments, etc., prior to adjusting them to grade and shall be held strictly liable to the affected utility if any such appliances are disturbed, damaged or covered up during the course of the Work.

1.5 **INDEMNIFICATION**-

1.5.1 The parties agree that 1% of the total compensation paid to the Contractor for the performance of this agreement shall represent the specific consideration for the Contractor's indemnification of the Town as set forth in this Section 1.5 and in the Terms and Conditions.

1.5.2 To the fullest extent permitted by Laws and Regulations, Contractor shall indemnify and hold harmless the Town and their consultants, agents and employees from and against any and all claims, damages, losses and expenses, direct, indirect or consequential (including but not limited to fees and charges of attorneys and other professionals and court costs) arising out of or resulting from the performance of the work, provided that any such claim, damage, loss or expense (a) is attributable to bodily injury, sickness, disease or death, or to injury to or destruction of tangible property (other than the work itself) including the loss of use resulting there from and (b) is caused in whole or in part by any willful and wanton or negligent or gross negligent acts or omission of Contractor, any subcontractor, any person or organization directly or indirectly employed by any of them to perform or furnish any of the work or anyone for whose acts any of them may be liable, regardless of whether or not it is caused in part by a party indemnified

hereunder or arises by or is imposed by Law and Regulations regardless of the negligence of any such party.

1.6 **AGREEMENT DOCUMENTS**- The following documents shall, by this reference, be considered part of this Contract:

Instructions to Proposers;
All Addendums;
Contract Agreement;
Proposal;
Detailed Specifications;
Qualification Statement;
Public Entity Crime Form;
Insurance Certificates

1.7 **CONTRACTOR'S EMPLOYEES**-

1.7.1 The Contractor shall at all times have a competent English speaking supervisor on site who thoroughly understands the Work, who shall, as the Contractor's agent, supervise, direct and otherwise conduct the Work. Contractor's employees shall serve the public in a courteous, helpful, and impartial manner.

1.7.2 Contractor's employees shall wear a clean uniform that provides identification of both the Contractor's company and the name of the employee.

1.7.3 Contractor shall, upon receipt of a written request from the Town, immediately exclude any employee of Contractor from providing Work under this Agreement.

1.7.4 The Work contemplated in this Agreement is on public property, accordingly no alcoholic beverages shall be allowed.

1.7.5 All references in this Agreement to the Contractor shall include Contractor's employees or subcontractors, wherever applicable.

1.8 **VEHICLES AND EQUIPMENT** Contractor shall have on hand at all times and in good working order such vehicles, machinery, tools, accessories, and other items necessary to perform the Work under this Agreement.

1.9 **INSURANCE** The Contractor shall secure and maintain throughout the duration of this Agreement, insurance of such type and in such amounts necessary to protect its interest and the interest of the Town against hazards or risks of loss as specified below. The underwriter of such insurance shall be qualified to do business in Florida, be rated AB or better, and have agents upon whom service of process may be made in the State of Florida. The insurance coverage shall be primary insurance with respect to the Town, its officials, employees, agents and volunteers. Any insurance maintained by the Town shall be in excess of the Contractor's insurance and shall not contribute to the Contractor's insurance. The insurance coverage shall include a minimum of:

1.9.1 **Worker's Compensation and Employer's Liability Insurance** Coverage to apply for all employees for statutory limits as required by applicable State and Federal laws. The policy (ies) must include Employer's Liability with minimum limits of $500,000.00 each accident.

1.9.2 **Comprehensive Automobile and Vehicle Liability Insurance** This insurance shall be written in comprehensive form and shall protect the Contractor and the Town against claims for injuries to members of the public and/or damages to property of others arising from the Contractor's use of motor vehicles or any other equipment and shall cover operation with respect to onsite and offsite operations and insurance coverage shall extend to any motor vehicles or other equipment irrespective of whether the same is owned, non-owned, or hired. The limit of liability shall not be less than $1,000,000.00 per occurrence, combined single limit for Bodily Injury Liability and Property Damage Liability. Coverage must be afforded on a form no more restrictive that the latest edition of the Business Automobile Liability Policy, without restrictive endorsement, as filed by the Insurance Services Office.

1.9.3 **Commercial General Liability** This insurance shall be written in comprehensive form and shall protect the Contractor and the Town against claims arising from injuries to members of the public or damage to property of others arising out of any act or omission to act of the Contractor or any of its agents, employees, or subcontractors. The limit of liability shall not be less than $2,000,000.00 per occurrence, combined single limit for Bodily Injury Liability and Property Damage Liability. Coverage must be afforded on a form no more restrictive than the latest edition of the Commercial General Liability Policy, without restrictive endorsements, as filed by the Insurance Services Office, and must include: (1) Premises and/or Operations; (2) Independent contractors and Products and/or completed Operations; (3) Broad Form Property Damage, Personal Injury and a Contractual Liability Endorsement, including any hold harmless and/or indemnification agreement.

1.9.4 **Certificate of Insurance** Contractor shall provide the Town Manager with Certificates of Insurance for all required policies. The Certificates of Insurance shall not only name the types of policy(ies) provided, but also shall refer specifically to this Agreement and shall state that such insurance is as required by this Agreement. The Town reserves the right to require the Contractor to provide a certified copy of such policies, upon written request by the Town. If a policy is due to expire prior to the completion of the services, renewal Certificates of Insurance or policies shall be furnished thirty (30) calendar days prior to the date of their policy expiration. Each policy certificate shall be endorsed with a provision that not less than thirty (30) calendar days' written notice shall be provided to the Town before any policy or coverage is cancelled or restricted. Acceptance of the Certificate(s) is subject to approval of the Town Manager.

1.9.5 **Additional Insured** The Town is to be specifically included as an Additional Insured for the liability of the Town resulting from operations performed by or on behalf of Contractor in performance of this Agreement. Contractor's insurance, including that applicable to the Town as an Additional Insured, shall apply on a primary basis and any other insurance maintained by the Town shall be in excess of and shall not contribute to Contractor's insurance. Contractor's insurance shall contain a severability of interest provision providing that, except with respect to the total limits of liability, the insurance shall apply to each Insured or Additional Insured in the same manner as if separate policies had been issued to each. All deductibles or self-insured retentions must be declared to and be approved by the Town Manager. The Contractor shall be responsible for the payment of any deductible or self-insured retention in the event of any claim.

1.10 **ASSIGNMENT AND AMENDMENT** No assignment by the Contractor of this Agreement or any part of it, or any monies due or to become due, shall be made, nor shall the Contractor hire a subcontractor to perform its duties under this Agreement without prior written approval of the Town. This Agreement may only be amended, by the parties, with the same formalities as this Agreement.

1.11 **TERMINATION**

1.11.1 Either party may terminate this Agreement without cause upon 30 days written notice to the other party.

1.11.2 Upon notice of such termination, the Town shall determine the amounts due to the Contractor for services performed up to the date of termination. The Contractor shall not be entitled to payment of any lost profits or for Work performed after the date of termination.

1.11.3 After receipt of a notice of termination, and except as otherwise directed, the Contractor shall stop all Work under this Agreement, and shall do so on the date specified in the notice of termination.

1.11.4 The Town may terminate this Agreement upon five (5) days written notice if the Contractor defaults on any material term of this Agreement.

1.12 **GOVERNING LAW** The law of the State of Florida shall govern the contract between the Town of Cutler Bay and the successful proposer and any action shall be brought in Miami-Dade County, Florida. In the event of litigation to settle issues arising hereunder, the prevailing party in such litigation shall be entitled to recover against the other party its costs and expenses, including reasonable attorney fees, which shall include any fees and costs attributable to appellate proceedings arising on and of such litigation.

1.13 **PUBLIC RECORDS LAW**

a. Contractor agrees to keep and maintain public records in Contractor's possession or control in connection with Contractor's performance under this Agreement. Contractor additionally agrees to comply specifically with the provisions of Section 119.0701, Florida Statutes. Contractor shall ensure that public records that are exempt or confidential and exempt from public records disclosure requirements are not disclosed, except as authorized by law, for the duration of the Agreement, and following completion of the Agreement until the records are transferred to the Town.
b. Upon request from the Town's custodian of public records, Contractor shall provide the Town with a copy of the requested records or allow the records to be inspected or copied within a reasonable time at a cost that does not exceed the cost provided by Chapter 119, Florida Statutes, or as otherwise provided by law.
c. Unless otherwise provided by law, any and all records, including but not limited to reports, surveys, and other data and documents provided or created in connection with this Agreement are and shall remain the property of the Town.
d. Upon completion of this Agreement or in the event of termination by either party, any and all public records relating to the Agreement in the possession of the Contractor shall be delivered by the Contractor to the Town Manager, at no cost to the Town, within seven (7) days. All such records stored electronically by Contractor shall be delivered to the Town in a format that is compatible with the Town's information technology systems. Once the public records have been delivered upon completion or termination of this Agreement, the Contractor shall destroy any and all duplicate public records that are exempt or confidential and exempt from public records disclosure requirements.
e. Any compensation due to Contractor shall be withheld until all records are received as provided herein.
f. Contractor's failure or refusal to comply with the provisions of this section shall result in the immediate termination of this Agreement by the Town.

Section 119.0701(2)(a), Florida Statutes

IF THE CONTRACTOR HAS QUESTIONS REGARDING THE APPLICATION OF CHAPTER 119, FLORIDA STATUTES, TO THE CONTRACTOR'S DUTY TO PROVIDE PUBLIC

RECORDS RELATING TO THIS CONTRACT, CONTACT THE CUSTODIAN OF PUBLIC RECORDS.

Custodian of Records:	**Debra E. Eastman, Interim Town Clerk**
Mailing address:	**10720 Caribbean Boulevard, Suite 105 Cutler Bay, FL 33189**
Telephone number:	**(305) 234-4262**
Email:	**deastman@cutlerbay-fl.gov**

1.14 **INSPECTION AND AUDIT** During the term of this Agreement and for three (3) years from the date of termination the Contractor shall allow Town representatives access, during reasonable business hours, to Contractor's and, if applicable, subcontractor's records related to this Agreement for the purposes of inspection or audit of such records. If upon audit of such records, the Town determines the Contractor was paid for services not performed, upon receipt of written demand by the Town, the Contractor shall remit such payments to the Town.

1.15 **SEVERABILITY** If a term, provision, covenant, contract or condition of this contract is held to be void, invalid, or unenforceable, the same shall not affect any other portion of this Agreement and the remainder shall be effective as though every term, provision, covenant, contract or condition had not been contained herein.

1.16 **WAIVER OF JURY TRIAL** The parties irrevocably, knowingly agree to waive their rights to a trial by jury in any action to enforce the terms or conditions of this Agreement.

1.17 **COUNTERPARTS** This Agreement may be signed in one or more counterparts, each of which when executed shall be deemed an original and together shall constitute one and the same instrument.

1.18 **INDEPENDENT CONTRACTOR** It is expressly agreed and understood that the Contractor shall be in all respects an independent contractor as to Work, and that Contractor is in no respect an agent, servant or employee of the Town. Accordingly, Contractor shall not attain, nor be entitled to, any rights or benefits of the Town, nor any rights generally afforded classified or unclassified employees.

Contractor further understands that Florida Worker's Compensation benefits available to employees of the Town are not available to Contractor, and agrees to provide worker's compensation insurance for any employee or agent of Contractor rendering services to the Town under this Agreement.

All employees and subcontractors of the Contractor shall be considered to be, at all times, the sole employees or contractors of Contractor, under its sole discretion and not an employee, contractor or agent of the Town.

1.19 **ACCIDENT PREVENTION AND REGULATIONS** Precautions shall be exercised at all times for the protection of persons and property. The Contractor and subcontractors shall conform to all OSHA, Federal, State, County and Town regulations while performing under the terms and conditions of this Agreement. Any fines levied by the above-mentioned authorities, because of inadequacies to comply with these requirements, shall be borne solely by Contractor responsible for same.

1.20 **BACKGROUND CHECKS** The Contractor will be responsible for maintaining current background checks on all employees and subcontractor employees involved in the performance of this Work.

Background checks must be performed prior to the performance of any Work by the employee under this Agreement. Written verification of any background checks must be provided to the Town at the request of the Town Manager.

1.21 **LAWS, RULES & REGULATIONS** Contractor shall be held responsible for any violation of laws, rules, regulations or ordinances affecting in any way the conduct of all persons engaged in or the materials or methods used by him, on the Work. Contractor shall give all notices and comply with all laws, ordinances, rules, regulations and orders of any public authority bearing on the performance of the Work under this Agreement. Contractor shall secure all permits, fees, licenses, and inspections necessary for the execution of the Work, and upon termination of this Agreement for any reason, Contractor shall transfer such permits, if any, and if allowed by law, to the Town.

1.22 **POLICY OF NON-DISCRIMINATION** The Contractor shall comply with all federal, state and local laws and ordinances applicable to the work or payment for work and shall not discriminate on the grounds of race, color, religion, sex, age, marital status, national origin, physical or mental disability in the performance of work under this Agreement.

1.23 **NON-WAIVER** The approval, and/or acceptance of any part of the Work by the Town shall not operate as a waiver by Town of any other terms and conditions of the Agreement.

1.24 **NOTICES** Whenever any party is required to give or deliver any notice to any other party, or desires to do so, such notices shall be sent via certified mail or hand delivery to:

Town:
Town of Cutler Bay
10720 Caribbean Blvd., Suite# 105
Cutler Bay, FL 33189
Attention: Town Clerk

Contractor:
_____
_____
_____

IN WITNESS WHEREOF the parties hereto have executed this agreement on the day and date first above written.

Attest:

TOWN OF CUTLER BAY

By: _____
Debra E. Eastman, Interim Town Clerk

By: _____
Rafael G. Casals – Town Manager

By: _____
Town Attorney

Town Resolution # _____

Signed, sealed and witnessed in the presence of:

CONTRACTOR: _____

By:_____

By: _____

(*) In the event that the Contractor is a corporation, there shall be attached to each counterpart a certified copy of a resolution of the board of the corporation, authorizing the officer who signs the contract to do so in its behalf.

END OF SECTION

SECTION 7
TOWN OF CUTLER BAY
CUTLER BAY TOWN CENTER
HVAC EQUIPMENT AND CONTROLS REPLACEMENT AND MAINTENANCE SERVICES
RFP #17-05

PROPOSAL REQUIREMENTS CHECKLIST

Proposer has attached all documents listed in the checklist as provided and any other pertinent information.

CHECK LIST	FORMS ATTACHED	
Bid Package: One (1) original and Four (4) copies plus a CD	Yes_____	No_____
Proposal Confirmation	Yes_____	No_____
Proposal Cost Bid Form	Yes_____	No_____
Equipment List	Yes_____	No_____
Scope of Services/Plan	Yes_____	No_____
Proposer's Additional Qualifications	Yes_____	No_____
References	Yes_____	No_____
Indemnification Clause	Yes_____	No_____
Non-Collusive Affidavit	Yes_____	No_____
Drug-Free Workplace Form	Yes_____	No_____
Sworn Statement on Public Entity Crimes	Yes _____	No _____
Exception to the Request for Proposals	Yes_____	No_____
Bid Bond	Yes_____	No_____
Performance Bond	Yes _____	No _____
Addendum Acknowledgement Form	Yes _____	No _____
Anti-Kickback Affidavit	Yes _____	No _____
Proof of Insurance	Yes _____	No_____
Contract/Agreement	Yes _____	No _____
Valid Licenses	Yes_____	No_____
MSDS Sheets and Chemical Applications	Yes_____	No_____

SECTION 8
TOWN OF CUTLER BAY
CUTLER BAY TOWN CENTER
HVAC EQUIPMENT AND CONTROLS REPLACEMENT AND MAINTENANCE SERVICES
RFP #17-05

PROPOSAL CONFIRMATION

In accordance with the requirements to provide Cutler Bay Town Center HVAC EQUIPMENT AND CONTROLS REPLACEMENT AND MAINTENANCE SERVICES, RFP #17-05, the undersigned submits the attached proposal.

The Contract will become effective on the date it is executed by both parties. The Contractor shall obtain Substantial Completion of the Bid Base Proposal within ten (10) Days of the Notice to Proceed being issued by the Town. After the Town's completes its inspection under Article IV, Contractor must obtain Final Completion within five (5) Days of the Town's inspection.

The initial Contract period for POST HVAC INSTALLATION MAINTENANCE (YEAR 1) and PREVENTATIVE MAINTENANCE BID (YEARS 2 THRU 5) shall be for five (5) years with an option to renew annually not to exceed a maximum of four (4) years subject to appropriation of funds for the budget year applicable. At its sole discretion, the Town shall have an option to renew this Agreement upon the same terms and conditions for up to four (4) additional years (the "Option"). This Option may be exercised at the sole discretion of the Town Manager. Such extension shall be effective upon receipt of a written notice from the Town Manager to the Contractor received no later than 30 days prior to the date of termination.

Proposer has examined the site and locality where the work is to be performed and is fully aware of the scope of work based on these requirements, the legal requirements (federal, state and local laws, ordinances, rules and regulations) and the conditions affecting cost, progress or performance of the work and has made such independent investigation as Proposer deems necessary.

This proposal is genuine and not made in the interest of or on behalf of any undisclosed person, firm or corporation and is not submitted in conformity with any agreement or rules of any group, association, organization or corporation; Proposer has not directly or indirectly induced or solicited any other Proposer to submit a false or sham proposal; Proposer has not solicited or induced any person; firm or a corporation to refrain from proposing and Proposer has not sought by collusion to obtain for himself any advantage over any other Proposer or over Owner.

The Proposer shall acknowledge this Proposal by signing and completing the spaces provided. I hereby submit this Proposal Package for the Cutler Bay Town Center HVAC EQUIPMENT AND CONTROLS REPLACEMENT AND MAINTENANCE SERVICES, RFP #17-05 to the Town of Cutler Bay with the full understanding of the Request for Proposal, General and Special Conditions and Detail Requirements and the entire Proposal Package.

_____	_____	_____
Proposer's Name	Signature	Date

State of: _____

County of: _____

The foregoing instrument was acknowledged before me this _____ day of _____, 2017,

by _____, who is (who are) personally known to me or who has

produced _____ as identification and who did (did not) take an oath.

_____

Notary Public Signature [SEAL]

_____

Notary Name, Printed, Typed or Stamped

Commission Number: _____ My Commission Expires:_____

END OF SECTION

SECTION 9
TOWN OF CUTLER BAY
CUTLER BAY TOWN CENTER
HVAC EQUIPMENT AND CONTROLS REPLACEMENT AND MAINTENANCE SERVICES
RFP #17-05

PROPOSAL COST BID FORM

BASE BID PROPOSAL

Contractor agrees to provide all labor, materials, equipment, supervision, mobilization, shop drawings, overhead and profit necessary for the Work specified in this solicitation, of the referenced project as specified herein for the lump sum of:

$_____ lump sum

_____Dollars

POST HVAC INSTALLATION MAINTENANCE (YEAR 1)

Contractor shall provide all the labor and materials necessary to perform preventative maintenance during the warranty period for one year after the final acceptance of the HVAC Equipment as specified in Article VIII of the Special Terms and Conditions for the lump sum of:

$_____ per month x 12 months = $_____ lump sum

_____Dollars

PREVENTATIVE MAINTENANCE BID (YEARS 2 THRU 5)

Contractor agrees to provide all labor and materials necessary for the Preventative Maintenance of the referenced project as specified in Article VIII of the Special Terms and Conditions for 48 months commencing on the expiration of the one year warranty maintenance period for the monthly lump sum of:

$_____ per month x 48 months = $_____ lump sum

_____Dollars

OPTION TO EXTEND MAINTENANCE PLAN (YEARS 6 THRU 9)

At its sole discretion, the Town shall have an option to renew this Agreement upon the same terms and conditions for up to four (4) additional years (the "Option") as in years 2 thru 5. This Option may be exercised at the sole discretion of the Town Manager. Such extension shall be effective upon receipt of a written notice from the Town Manager to the Contractor received no later than 30 days prior to the date of termination.

CONTINGENCY ALLOWANCE

Use of the allocation account shall be for unforeseeable conditions, for construction changes and for availability adjustments, if ordered and authorized by the Town. At the closeout of contract, monies remaining in the contingency allowance will be credited to the Owner by change order.

$_____10,000.00_____ lump sum

_____Ten Thousand and No/100_____Dollars

ADDITIONAL INFORMATION

The contractor shall be substantially completed on the project no later than _____ (weeks) after the Notice to Proceed.

Firm's Name: _____

Signature: _____

Printed Name/Title: _____

Town/State/Zip: _____

SSN or Federal ID No.:_____ Telephone No.: _____

Facsimile No.: _____ E-Mail Address: _____

END OF SECTION

SECTION 10
TOWN OF CUTLER BAY
CUTLER BAY TOWN CENTER
HVAC EQUIPMENT AND CONTROLS REPLACEMENT AND MAINTENANCE SERVICES
RFP #17-05

EQUIPMENT LIST
(TYPE, CONDITION, YEAR, ETC.)

List equipment required to perform service:

Note: Additional sheets may be attached if necessary

SECTION 11
TOWN OF CUTLER BAY
CUTLER BAY TOWN CENTER
HVAC EQUIPMENT AND CONTROLS REPLACEMENT AND MAINTENANCE SERVICES
RFP #17-05

SCOPE OF SERVICES / PLAN

Clearly describe the methodology which will be used to perform, including a work plan for the scope of services proposed. Include information as to level of staff to be assigned.

Note: Additional sheets may be attached if necessary.

SECTION 12
TOWN OF CUTLER BAY
CUTLER BAY TOWN CENTER
HVAC EQUIPMENT AND CONTROLS REPLACEMENT AND MAINTENANCE SERVICES
RFP #17-05

PROPOSER'S ADDITIONAL QUALIFICATIONS

This section of the proposal should give a description of the firm, including the size, range of activities, and the number of years with relative experience with large accounts Particular emphasis should be given as to how the firm-wide experience project will be brought to bear on the proposed project.

This section must also identify the contact person and telephone number.

Note: Additional sheets may be attached if necessary.

TOWN OF CUTLER BAY
CUTLER BAY TOWN CENTER
HVAC EQUIPMENT AND CONTROLS REPLACEMENT AND MAINTENANCE SERVICES
RFP #17-05

PROPOSER'S ADDITIONAL QUALIFICATIONS (CONTINUED)

NOTE: This statement of Proposers Qualifications **must** be completely filled out, properly executed and returned as part of your proposal.

1. List the true, exact and proper names of the company, partnership, corporation, trade or fictitious name under which you do business and principals by name and titles:

   Name of Company: _____

   _____

   Address: _____

   Principals: _____ Titles: _____

   _____ _____

   _____ _____

2. a. Are you licensed, as may be required, in the designated area(s) of Miami-Dade County, Florida?

   Yes _____ No_____

   b. List Principals Licensed:

   Name(s): _____ Title: _____

   _____ _____

   Remarks: _____

   _____

3. How long has your company been in business and so licensed? _____

4. If Proposer is an individual or a partnership, answer the following: _____

   a. Date of organization: _____

TOWN OF CUTLER BAY
CUTLER BAY TOWN CENTER
HVAC EQUIPMENT AND CONTROLS REPLACEMENT AND MAINTENANCE SERVICES
RFP #17-05

PROPOSER'S ADDITIONAL QUALIFICATIONS (CONTINUED)

b. Name, address and ownership units of all partners:

_____

_____

_____

_____

c. State whether general or limited partnership: _____

If Proposer is other than an individual, corporation or partnership, describe the organization and give the name and address of principals.

_____

_____

_____

5. If Proposer is operating under a fictitious name, submit evidence of compliance with the Florida Fictitious Name Statute.

6. How many years has your organization been in business under its present business name?

_____

_____

a. Under what other former names has your organization operated?

_____

_____

7. a. Has your company ever failed to complete a bonded obligation or to complete a Contract?

Yes ____ No_____

TOWN OF CUTLER BAY
CUTLER BAY TOWN CENTER
HVAC EQUIPMENT AND CONTROLS REPLACEMENT AND MAINTENANCE SERVICES
RFP #17-05

PROPOSER'S ADDITIONAL QUALIFICATIONS (CONTINUED)

If so, give particulars including circumstances, where and when, name of bonding company, name and address of owner and disposition of matter:

_____

_____

_____

_____

8. a. List the pertinent experience of the key individuals of your organization (continue on insert sheet, if necessary).

_____

_____

_____

b. State the name of the individual(s) and titles that will have personal supervision of the work:

_____

_____

_____

9. List name and title of persons in your company who are authorized to enter into a Contract with the Town of Cutler Bay, Florida for the proposed work should your company be the Successful Proposer.

Name: _____ _____ _____

Title: _____ _____ _____

Phone #: _____ _____ _____

Email: _____ _____ _____

TOWN OF CUTLER BAY
CUTLER BAY TOWN CENTER
HVAC EQUIPMENT AND CONTROLS REPLACEMENT AND MAINTENANCE SERVICES
RFP #17-05

PROPOSER'S ADDITIONAL QUALIFICATIONS (CONTINUED)

The undersigned guarantees the authenticity of the foregoing statements and does hereby authorize and request any person, firm or corporation to furnish any information requested by the Town of Cutler Bay, Florida to verification of the recitals comprising this statement of the Proposers qualifications. **DISCOVERY OF ANY OMISSION OR MISSTATEMENT THAT MATERIALLY AFFECTS THE PROPOSERS QUALIFICATIONS TO PERFORM UNDER THE CONTRACT SHALL CAUSE THE OWNER TO REJECT THE PROPOSAL AND IF AFTER THE AWARD TO CANCEL AND TERMINATE THE AWARD AND/OR CONTRACT.**

Date: _____

_____ _____
Signature Print Name

_____ _____
Company Title

If Corporation (Seal) If Individual or Partnership, two Witnesses are required:

_____ _____
Witness Witness

Respectfully submitted

(CORPORATE SEAL)

_____
Company - Contractor

TOWN OF CUTLER BAY
CUTLER BAY TOWN CENTER
HVAC EQUIPMENT AND CONTROLS REPLACEMENT AND MAINTENANCE SERVICES
RFP #17-05

PROPOSER'S ADDITIONAL QUALIFICATIONS (CONTINUED)

ATTEST:

_____ By _____ (Seal)
Secretary President

_____
Witness

_____
Contractor Signature

END OF SECTION

SECTION 13
TOWN OF CUTLER BAY
CUTLER BAY TOWN CENTER
HVAC EQUIPMENT AND CONTROLS REPLACEMENT AND MAINTENANCE SERVICES
RFP #17-05

REFERENCES

The following is a list of at least four (4) references that Proposer has provided similar service in the past ten (10) years. **Government agency references are preferred**.

1. Name of Firm, Municipality, County or Agency:_____

   Address:_____

   Contact: _____ Title: _____ Telephone :(____)_____

   Location:_____ Scope of Work:_____

   _____

2. Name of Firm, Municipality, County or Agency:_____

   Address:_____

   Contact: _____ Title: _____ Telephone :(____)_____

   Location:_____ Scope of Work:_____

   _____

3. Name of Firm, Municipality, County or Agency:_____

   Address:_____

   Contact: _____ Title: _____ Telephone :(____)_____

   Location:_____ Scope of Work:_____

   _____

4. Name of Firm, Municipality, County or Agency:_____

   Address:_____

   Contact: _____ Title: _____ Telephone :(____)_____

   Location:_____ Scope of Work:_____

   _____

***NOTE*:** Additional references may be attached and provided.

SECTION 14
TOWN OF CUTLER BAY
CUTLER BAY TOWN CENTER
HVAC EQUIPMENT AND CONTROLS REPLACEMENT AND MAINTENANCE SERVICES
RFP #17-05

INDEMNIFICATION CLAUSE

The parties agree that one percent (1%) of the total compensation paid to Contractor for the work of the contract shall constitute specific consideration to Contractor for the indemnification to be provided by the Contractor. The Contractor shall indemnify and hold harmless the Town Council, the Town of Cutler Bay (collectively, the "Town"), and their agents and employees from and against all claims, damages, losses and expenses including attorney's fees arising out of or resulting from the performance of the work provided that any such claim, damage, loss or expense (1) is attributable to bodily injury, sickness, disease or death, or to injury to or destruction of tangible property (other than the work itself) including the loss of use resulting therefrom, and (2) is caused in whole or in part by any negligent act or omission of the Contractor, any subcontractor, anyone directly or indirectly employed by any of them or anyone for whose acts any of them may be liable, regardless of whether or not it is caused in part by a party indemnified hereunder.

In any and all claims against the Town, or any of their agents or employees by any employee of the Contractor, any subcontractor, anyone directly or indirectly employed by any of them or anyone for whose acts any of them may be liable, the indemnification obligation under this Paragraph shall not be limited in any way by any limitation on this amount or type of damages compensation or benefits payable by or for the Contractor or any subcontractor under Worker's Compensation Acts, Disability Benefit Acts or other Employee Benefit Acts. Nothing in this section shall affect the immunities of the Town pursuant to Chapter 768, Florida Statutes.

_____	_____	_____
Proposer's Name	Signature	Date

State of:_____

County of:_____

The foregoing instrument was acknowledged before me this _____ day of _____, 2017, by _____, who is (who are) personally known to me or who has produced _____ as identification and who did (did not) take an oath.

_____
Notary Public Signature [SEAL]

_____
Notary Name, Printed, Typed or Stamped

Commission Number:_____ My Commission Expires:_____

SECTION 15
TOWN OF CUTLER BAY
CUTLER BAY TOWN CENTER
HVAC EQUIPMENT AND CONTROLS REPLACEMENT AND MAINTENANCE SERVICES
RFP #17-05

NON-COLLUSIVE AFFIDAVIT

State of _____ }
} SS:
County of _____ }

_____ being first duly sworn deposes and says that:

a) He/she is the _____, (Owner, Partner, Officer, Representative or Agent) of _____ , the Proposer that has submitted the attached Proposal;
b) He/she is fully informed respecting the preparation and contents of the attached Proposal and of all pertinent circumstances respecting such Proposal;
c) Such Proposal is genuine and is not collusive or a sham Proposal;
d) Neither the said Proposer nor any of its officers, partners, owners, agents, representatives, employees or parties in interest, including this affiant, have in any way colluded, conspired, connived or agreed, directly or indirectly, with any other Proposer, firm, or person to submit a collusive or sham Proposal in connection with the Work for which the attached Proposal has been submitted; or to refrain from proposing in connection with such work; or have in any manner, directly or indirectly, sought by person to fix the price or prices in the attached Proposal or of any other Proposer, or to fix any overhead, profit, or cost elements of the Proposal price or the Proposal price of any other Proposer, or to secure through any collusion, conspiracy, connivance, or unlawful agreement any advantage against (Recipient), or any person interested in the proposed work;
e) The price or prices quoted in the attached Proposal are fair and proper and are not tainted by any collusion, conspiracy, connivance, or unlawful agreement on the part of the Proposer or any other of its agents, representatives, owners, employees or parties in interest, including this affiant.

Signed, sealed and delivered
in the presence of:

_____ By:_____
Witness

_____ _____
Witness (Printed Name)

_____
(Title)

TOWN OF CUTLER BAY
CUTLER BAY TOWN CENTER
HVAC EQUIPMENT AND CONTROLS REPLACEMENT AND MAINTENANCE SERVICES
RFP #17-05

NON-COLLUSIVE AFFIDAVIT (CONTINUED)

ACKNOWLEDGMENT

State of _____)

) SS:

County of _____)

BEFORE ME, the undersigned authority personally appeared _____ to me well known and known by me to be the person described herein and who executed the foregoing Affidavit and acknowledged to and before me that _____ executed said Affidavit for the purpose therein expressed.

WITNESS, my hand and official seal this _____ day of _____, 2017.

My Commission Expires:

_____
Notary Public State of Florida at Large

END OF SECTION

SECTION 16
TOWN OF CUTLER BAY
CUTLER BAY TOWN CENTER
HVAC EQUIPMENT AND CONTROLS REPLACEMENT AND MAINTENANCE SERVICES
RFP #17-05

DRUG-FREE WORKPLACE FORM

The undersigned vendor in accordance with Florida Statute 287.087 hereby certifies that _____ _____does:
(Name of Business)

1) Publish a statement notifying employees that the unlawful manufacture, distribution, dispensing, possession, or use of a controlled substance is prohibited in the workplace and specifying the actions that will be taken against employees for violations of such prohibition.

2) Inform employees about the dangers of drug abuse in the workplace, the business's policy of maintaining a drug-free workplace, any available drug counseling, rehabilitation, and employee assistance programs, and the penalties that may be imposed upon employees for drug abuse violations.

3) Give each employee engaged in providing the commodities or contractual services that are under bid a copy of the statement specified in subsection (1).

4) In the statement specified in subsection (1), notify the employees that, as a condition of working on the commodities or contractual services that are under bid, the employee will abide by the terms of the statement and will notify the employer of any conviction of, or plea of guilty or nolo contendere to, any violation of chapter 893 or of any controlled substance law of the United States or any state, for a violation occurring in the workplace no later than five (5) days after such conviction.

5) Impose a sanction on, or require the satisfactory participation in a drug abuse assistance or rehabilitation program if such is available in the employee's community, by any employee who is so convicted.

6) Make a good faith effort to continue to maintain a drug-free workplace through implementation of this section.

As the person authorized to sign the statement, I certify that this firm complies fully with the above requirements.

_____ _____
Proposer's Signature Date

_____
Print Name

SECTION 17
TOWN OF CUTLER BAY
CUTLER BAY TOWN CENTER
HVAC EQUIPMENT AND CONTROLS REPLACEMENT AND MAINTENANCE SERVICES
RFP #17-05

SWORN STATEMENT ON PUBLIC ENTITY CRIMES SECTION 287.133(3) (a), FLORIDA STATUTES

THIS FORM MUST BE SIGNED AND SWORN TO IN THE PRESENCE OF A NOTARY PUBLIC OR OTHER OFFICIAL AUTHORIZED TO ADMINISTER OATHS.

1. This sworn statement is submitted to the Town of Cutler Bay

by _____
[Print individual's name and title]

for _____
[Print name of entity submitting sworn statement]

whose business address is

_____

_____

and (if applicable) its Federal Employer Identification Number (FEIN) is _____

(If the entity has no FEIN, include the Social Security Number of the individual

signing this sworn statement: _____)

2. I understand that a "public entity crime" as defined in Paragraph 287.133(1)9g), Florida Statutes, means a violation of any state or federal law by a person with respect to and directly related to the transaction of business with any public entity or with an agency or political subdivision of any other state or the United States, including, but not limited to, any bid or contract for goods and services to be provided to any public entity or an agency or political subdivision of any other state or of the United States involving antitrust, fraud, theft, bribery, collusion, racketeering, conspiracy, or material misrepresentation.
3. I understand that "convicted" or "conviction" as defined in Paragraph 287.133(1) (b), Florida Statutes, means a finding of guilt or a conviction or a public entity crime, with or without an adjudication of guilt, in any federal or state trial court of record relating to charges brought by indictment or information after July 1, 1989, as a result of a jury verdict, non-jury trial, or entry of a plea of guilty or nolo contendere.
4. I understand than an "affiliate" as defined in Paragraph 287.133(1) (a), Florida Statutes, means:
   a) A predecessor or successor of a person convicted of a public entity crime; or
   b) An entity under the control of any natural person who is active in the management

of the entity and who has been convicted of a public entity crime. The term "affiliate" includes those officers, directors, executives, partners, shareholders, employees, members, and agents who are active in the management of an affiliate. The ownership by one person of shares constituting a controlling interest in another person, or a pooling of equipment or income among persons when not for fair market value under an arm's length agreement, shall be a prima facie case that one person controls another person. A person who knowingly enters into a joint venture with a person who has been convicted of a public entity crime in Florida during the preceding 36 months shall be considered an affiliate.

5. I understand that a "person" as defined in Paragraph 287.133(1) (e), Florida Statutes, means any natural person or entity organized under the laws of any state or of the United States with the legal power to enter into a binding contract and which bids or applies to bid on contracts for the provision of goods or services let by a public entity, or which otherwise transacts or applies to transact business with a public entity. The term "person" includes those officers, directors, executives, partners, shareholders, employees, members, and agents who are active in the management of an entity.

6. Based on information and belief, the statement that I have marked below is true in relation to the entity submitting this sworn statement. **[Indicate which statement applies.]**

____ Neither the entity submitting this sworn statement, nor any officers, directors, executives, partners, shareholders, employees, members, or agents who are active in the management of the entity, not any affiliate of the entity, has been charged with and convicted of a public entity crime subsequent to July 1, 1989.

____ This entity submitting this sworn statement, or one or more of its officers, directors, executives, partners, shareholders, employees, members, or agents who are active in the management of the entity, or an affiliate of the entity has been charged with and convicted of a public entity crime subsequent to July 1, 1989.

____ the entity submitting this sworn statement, or one or more of its officers, directors, executives, partners, shareholders, employees, members, or agents who are active in the management of the entity or an affiliate of the entity has been charged with and convicted of a public entity crime subsequent to July 1, 1989. However, there has been a subsequent proceeding before a Hearing Officer of the State of Florida, Division of Administrative Hearings and the Final Order entered by the Hearing Officer determined that it was not in the public interest to place the entity submitting this sworn statement on the convicted vendor list. **[Attach a copy of the final order]**

TOWN OF CUTLER BAY
CUTLER BAY TOWN CENTER
HVAC EQUIPMENT AND CONTROLS REPLACEMENT AND MAINTENANCE SERVICES
RFP #17-05

SWORN STATEMENT ON PUBLIC ENTITY CRIMES
SECTION 287.133(3) (a), FLORIDA STATUTES
(CONTINUED)

I UNDERSTAND THAT THE SUBMISSION OF THIS FORM TO THE CONTRACTING OFFICER FOR THE PUBLIC ENTITY IDENTIFIED IN PARAGRAPH 1 ABOVE IS FOR THAT PUBLIC ENTITY ONLY AND, THAT THIS FORM IS VALID THROUGH DECEMBER 31 OF THE CALENDAR YEAR IN WHICH IT IS FILED. I ALSO UNDERSTAND HAT I AM REQUIRED TO INFORM THE PUBLIC ENTITY PRIOR TO ENTERING INTO A CONTRACT IN EXCESS OF THE THRESHOLD AMOUNT PROVIDED IN SECTION 287.017, FLORIDA STATUTES, FOR CATEGORY TWO OF ANY CHANGE IN THE INFORMATION CONTAINED IN THIS FORM.

_____ _____
Proposer's Name Proposer's Signature

Sworn to and subscribed before me this _____ day of _____, 2017.

Personally known _____

OR produced identification _____ Notary Public State of Florida at Large

_____ My commission expires _____
(Type of identification)

_____
(Printed, typed or stamped commissioned
Name notary public)

END OF SECTION

SECTION 18
TOWN OF CUTLER BAY
CUTLER BAY TOWN CENTER
HVAC EQUIPMENT AND CONTROLS REPLACEMENT AND MAINTENANCE SERVICES
RFP #17-05

EXCEPTION TO THE REQUEST FOR PROPOSALS

NOTE: Please note any exceptions to the provisions of the RFP. (Additional sheets may be attached.) However, all alterations or omissions of required information or any change in proposal requirements are done at the risk of the Proposer presenting the proposal and may result in the **rejection** thereof. The Town reserves the right to require strict compliance with the terms of the RFP and to reject any exceptions or alternative proposals.

SECTION 19
TOWN OF CUTLER BAY
CUTLER BAY TOWN CENTER
HVAC EQUIPMENT AND CONTROLS REPLACEMENT AND MAINTENANCE SERVICES
RFP #17-05

BID BOND

KNOW ALL MEN BY THESE PRESENTS, that we, _____

as Principal and Contractor, and _____

Hereinafter called Surety, are held and firmly bound unto Town of Cutler Bay, a political subdivision of the State of Florida, and represented by its Town Manager, in the sum of five (5) percent (%) of the total bid amount of:

_____
(Written Dollar Amount)

dollars **($**_____) lawful money of the United States of America, for the payment of which well and truly to be made, we bind ourselves, our heirs, executors, administrators, successors, and assigns, jointly and severally by these presents.

WHEREAS, the Principal contemplates submitting or has submitted, a bid to the Town of Cutler Bay for the furnishing of all labor, materials (except those to be specifically furnished by the Town), equipment, machinery, tools, apparatus, means of transportation for, and the performance of the work covered in the bid and the detailed Drawings and Specifications, entitled:

CUTLER BAY TOWN CENTER HVAC EQUIPMENT AND CONTROLS REPLACEMENT AND MAINTENANCE SERVICES

TOWN OF CUTLER BAY
CUTLER BAY TOWN CENTER
HVAC EQUIPMENT AND CONTROLS REPLACEMENT AND MAINTENANCE SERVICES
RFP # 17-05

WHEREAS, it was a condition precedent to the submission of said bid that a cashier's check, certified check, or bid bond in the amount of five percent (5%) of the proposal amount be submitted with said bid as a guarantee that the Proposer would, if awarded the Contract, enter into a written Contract with the Town for the performance of said Contract, within ten (10) consecutive calendar days after written notice having been given of the award of the Contract.

NOW, THEREFORE, the conditions of this obligation are such that if the Principal within ten (10) consecutive calendar days after written notice of such acceptance, enters into a written Contract with the Town of Cutler Bay and furnishes the Performance Bond, in an amount equal to one hundred percent of the **annual** base bid amount, satisfactory to the Town, then this obligation shall be void; otherwise the sum herein stated shall be due and payable to the Town of Cutler Bay and the Surety herein agrees to pay said sum immediately upon demand of the Town in good and lawful money of the United States of America, as liquidated damages for failure thereof of said Principal.

IN WITNESS WHEREOF, the said _____

as Principal herein, has caused these presents to be signed in its name by its _____

_____ and attested by its _____

_____under its corporate seal, and the said _____

_____ as Surety herein, has caused these presents to be signed in its name by its

_____

and attested in its name by its _____ under its corporate seal, this _____ day of _____ A.D., 2017.

Signed, sealed and delivered
in the presence of:

_____

_____
As to Principal

_____
As to Surety

PRINCIPAL:_____

BY:_____

NAME:_____

_____
Surety

BY:_____
Attorney-in-Fact
(Power-of-Attorney to be attached)

BY:_____
Resident Agent

END OF SECTION

SECTION 20
TOWN OF CUTLER BAY
CUTLER BAY TOWN CENTER
HVAC EQUIPMENT AND CONTROLS REPLACEMENT AND MAINTENANCE SERVICES
RFP #17-05

PERFORMANCE BOND

KNOW ALL MEN BY THESE PRESIDENTS:

That we, as Principal, hereinafter Called Contractor, and _____**,** as Surety, are bond to the Town of Cutler Bay, Florida, as Obligee, hereinafter called Owner, in the amount of for the payment whereof Contractor and Surety bind themselves, their heirs, executors, administrators, successors and assigns, jointly and severally.

WHEREAS, Contractor has by written agreement entered into a Contract, HVAC EQUIPMENT AND CONTROLS REPLACEMENT AND MAINTENANCE SERVICES, RFP #17-05, awarded via Town of Cutler Bay Resolution # ____ the _____ day of _____, 2017 with Owner for **Cutler Bay Town Center HVAC EQUIPMENT AND CONTROLS REPLACEMENT AND MAINTENANCE SERVICES** in accordance with specifications prepared by the Town of Cutler Bay and made part hereof, and is hereafter referred to as the Contract;

THE CONDITION OF THIS BOND is that if the Contractor:

1. Fully performs the Contract between the Contractor and the Owner for HVAC EQUIPMENT AND CONTROLS REPLACEMENT AND MAINTENANCE SERVICES for Town Facilities, Medians, and Swales ongoing after the date of Contract commencement as specified in the Notice to Award and in the manner prescribed in the Contract; and

2. Indemnifies and pays Owner all losses, damages (specifically including, but not limited to, damages for non-performance and other consequential damages caused by or arising out of the acts, omissions or negligence of Contractor), expenses, costs and attorney's fees and costs, including attorney's fees incurred in appellate proceedings, that Owner sustains because of default by Contractor under the Contract; and

3. Upon notification by the Owner, corrects any and all defective or faulty work or materials.

4. Performs the guarantee of all work and materials furnished under the Contract for the time specified in the Contract, then this Bond is void, otherwise it remains in full force.

Whenever Contractor shall be, and declared by Owner to be, in default under the Contract, the Owner having performed obligations thereunder, the Surety may promptly remedy the default, or shall promptly:

TOWN OF CUTLER BAY
CUTLER BAY TOWN CENTER
HVAC EQUIPMENT AND CONTROLS REPLACEMENT AND MAINTENANCE SERVICES
RFP #17-05

PERFORMANCE BOND (CONTINUED)

4.1. Complete the Contract in accordance with its terms and conditions; or

4.2 Obtain a proposal or proposals for completing the Contract in accordance with its terms and conditions, and upon determination by Surety of the best, lowest, qualified, responsible and responsive Proposer, or, if the Owner elects, upon determination by the Owner and Surety jointly of the best, lowest, qualified, responsible and responsive Proposer, arrange for a Contract between such Proposer and Owner, and make available as work progresses (even though there should be a default or a succession of defaults under the Contract or Contracts of completion arranged under this paragraph) sufficient funds to pay the cost of completion less the balance of the Contract price; but not exceeding, including other costs and damages for which the Surety may be liable hereunder, the amount set forth in the first paragraph hereof. The term "balance of the Contract Price," as used in this paragraph, shall mean the total amount payable by Owner to Contractor under the Contract and any amendments thereto, less the amount properly paid by Owner to Contractor.

No right of action shall accrue on this Bond to or for the use of any person or corporation other than the Owner named herein.

The Surety hereby waives notice of and agrees that any changes in or under the Contract Documents and compliance or noncompliance with any formalities connected with the Contract or the changes do not affect Surety's obligation under this Bond.

Signed and sealed this _____ day of _____, 2017.

WITNESSES:

_____
(Name of Corporation)

_____
Secretary

By:_____
(Signature and Title)

[CORPORATE SEAL]

_____
(Type Name and Title signed above)

TOWN OF CUTLER BAY
CUTLER BAY TOWN CENTER
HVAC EQUIPMENT AND CONTROLS REPLACEMENT AND MAINTENANCE SERVICES
RFP #17-05

PERFORMANCE BOND (CONTINUED)

IN THE PRESENCE OF:

INSURANCE COMPANY

_____
Witness

By:_____
Agent and Attorney-in-Fact

Address: _____
(Street)

_____
(City/State/Zip Code)

Telephone No.:_____

END OF SECTION

SECTION 21
TOWN OF CUTLER BAY
CUTLER BAY TOWN CENTER
HVAC EQUIPMENT AND CONTROLS REPLACEMENT AND MAINTENANCE SERVICES
RFP #17-05

ADDENDUM ACKNOWLEDGEMENT FORM

Addendum #	Date Received

Proposer: _____
(Company Name)

_____
(Signature)

_____
(Printed Name & Title)

END OF SECTION

SECTION 22
TOWN OF CUTLER BAY
CUTLER BAY TOWN CENTER
HVAC EQUIPMENT AND CONTROLS REPLACEMENT AND MAINTENANCE SERVICES
RFP #17-05

ANTI-KICKBACK AFFIDAVIT

STATE OF FLORIDA }
} SS:
COUNTY OF MIAMI-DADE }

I, the undersigned, hereby duly sworn, depose and say that no portion of the sum herein bid will be paid to any employees of the Town of Cutler Bay, its elected officials, and _____ or its design consultants, as a commission, kickback, reward or gift, directly or indirectly by me or any member of my firm or by an officer of the corporation.

By:_____

Title:_____

Sworn and subscribed before this

_____ day of_____, 2017

_____
Notary Public, State of Florida

_____
(Printed Name)

My commission expires: _____

END OF SECTION

SECTION 23
TOWN OF CUTLER BAY
CUTLER BAY TOWN CENTER
HVAC EQUIPMENT AND CONTROLS REPLACEMENT AND MAINTENANCE SERVICES
RFP #17-05

ALLOWANCES

PART 1 SCOPE OF WORK

1.01 DEFINITION

Included in the contract sum is an allocation account for unforeseen conditions, quantity adjustments, and additional work that the Town may deem necessary if ordered and authorized by the Town through the issuance of a "Work Order".

1.02 ALLOWANCE ACCOUNT

Monies in the allocation account will be used only on issuance of "Work Orders", approved by the Town Manager or his designee.

1.03 SELECTION OF PRODUCTS UNDER ALLOWANCES

Town Manager or his designee duties:

1. Consult with the Contractor in consideration of products and supplier or installers or changes in quantities of contract items.

2. Make selection in consultation with the contractor, designating:

    a. Product, model and/or class of materials.
    b. Accessories and attachments.
    c. Supplier and installer as applicable.
    d. Cost to Contractor, delivered to the site or installed, as applicable.
    e. Warranties
    f. Quantities

3. Transmit Town's decision to the Contractor.

4. Prepare change orders.

Contractor's Duties:

1. Assist Town Manager or his designee in determining qualified suppliers, quantities or subcontractor.

2. Obtain proposals from a minimum of three (3) suppliers and/or subcontractors when requested by Town Manager or his designee.

3. Make appropriate recommendations for consideration of the Town Manager or his designee.

4. Notify Town Manager or his designee promptly of:

   a. Any reasonable objections Contractor may have against any supplier, or party under consideration for installation.

   b. Any effect on the construction schedule anticipated by selection under consideration.

1.04 CONTRACTOR RESPONSIBILITY FOR PURCHASE, DELIVERY AND INSTALLATION

A. On notification of selection, execute purchase agreement with designated suppliers and/or subcontractors.

B. Arrange for and process shop drawings, product data and samples, as required.

C. Make all arrangements for delivery.

D. Upon delivery, promptly inspect products for damage or defects.

E. Submit claims for transportation damage.

F. Install and finish products in compliance with requirements of referenced specification sections, including restoration.

PART 2 EXECUTION

2.01 MEASURE AND PAYMENT

A. The cost shall include a fixed amount per the Bid Form.

B. Use of the allocation account shall be for unforeseeable conditions, for construction changes and for availability adjustments, if ordered and authorized by the Town. At the closeout of contract, monies remaining in the contingency allowance will be credited to the Owner by change order.

C. The fixed amount will be **$ 10,000** and will be added to the proposer's base bid price.

END OF SECTION

TOWN OF CUTLER BAY
CUTLER BAY TOWN CENTER
HVAC EQUIPMENT AND CONTROLS REPLACEMENT AND MAINTENANCE SERVICES
RFP #17-05

EXHIBIT "A"

PROJECT PLANS

Reserved for Exhibit "A"

ELECTRICAL SYMBOL LEGEND

BASIC MATERIALS

SYMBOL	DESCRIPTION
S_a	SINGLE POLE SWITCH (SUBSCRIPT INDICATES ITEM CONTROLLED)
S_3	THREE-WAY SWITCH
S_4	FOUR-WAY SWITCH
S_{WP}	SINGLE POLE SWITCH WITH WEATHERPROOF COVER
S_{WPL}	SINGLE POLE SWITCH WITH WEATHERPROOF LOCKING COVER
S_{OSab}	WALL MOUNTED DUAL TECHNOLOGY OCCUPANCY SENSOR SWITCH, DUAL RELAY
S_{OS}	WALL MOUNTED DUAL TECHNOLOGY OCCUPANCY SENSOR SWITCH
S_K	SINGLE POLE KEY SWITCH
DS	DAYLIGHT SENSOR CEILING MOUNTED
DS	DAYLIGHT SENSOR WALL MOUNTED
	WALL MOUNTED OCCUPANCY SENSOR
	CEILING MOUNTED OCCUPANCY SENSOR
S_L	SINGLE POLE SWITCH WITH SECURITY LOCKING KEY
S_{LV}	LOW VOLTAGE SWITCH
S_F	FAN SWITCH
S_M	MANUAL MOTOR STARTER WITH OVERLOAD HEATERS
S_{MP}	MANUAL MOTOR STARTER WITH OVERLOAD HEATERS AND PILOT LIGHT
S_D	DIMMER SWITCH (1500 WATTS UNLESS OTHERWISE INDICATED)
	DUPLEX RECEPTACLE H = HOSPITAL GRADE TV = TV RECEPTACLE MOUNTED ADJACENT TO TV OUTLET T= TAMPERPROOF IG = ISOLATED GROUND
	SINGLE RECEPTACLE
	PEDESTAL MOUNTED RECEPTACLE
	FLOOR OUTLET BOX AND DUPLEX RECEPTACLE WITH APPROPRIATE FLANGE.
	FLOOR OUTLET BOX WITH TWO DUPLEX RECEPTACLES AND ONE COMBINATION W/ VOICE/DATA OUTLET
	DUPLEX RECEPTACLE WITH EACH HALF ON SEPARATE CIRCUIT (BREAKER SHALL BE TWO POLE WITH COMMON TRIP)
	DUPLEX RECEPTACLE MOUNTED ABOVE COUNTER
	DUPLEX SAFETY RECEPTACLE MOUNT COVERPLATES WITH SPANNER HEAD SCREWS
	DUPLEX RECEPTACLE WITH TOP HALF SWITCHED
EWC	SIMPLEX RECEPTACLE (EWC DENOTES ELECTRIC WATER COOLER. COORDINATE WITH EWC INSTALLER FOR MOUNTING HEIGHT)
WP	GFI RECEPTACLE. WP DENOTES WEATHER RESISTANT RECEPTACLE IN WEATHERPROOF ENCLOSURE.
	GFI RECEPTACLE MOUNTED ABOVE COUNTER
	TWO DUPLEX RECEPTACLES WITH COMMON COVER
	TWO DUPLEX RECEPTACLES WITH COMMON COVER MOUNTED ABOVE COUNTER
IG	ISOLATED GROUND DUPLEX RECEPTACLE, (ORANGE DEVICE)
	DUPLEX RECEPTACLE NOTE: TICK MARKS SHOWN ON ANY DEVICE REPRESENTS RECEPTACLE CONNECTED TO THE EMERGENCY CIRCUIT (RED DEVICE) TYPICAL FOR ANY DEVICE IN LEGEND
C	CLOCK RECEPTACLE
	SPECIAL PURPOSE RECEPTACLE, RATING AS NOTED
	PHOTOCELL, MOUNTED ON ROOF FACING NORTH
	GROUND BAR
	PLUG-IN STRIP WITH RECEPTACLES, 18" O.C. UNLESS OTHERWISE INDICATED
J	JUNCTION BOX WALL MOUNTED
J	JUNCTION BOX CEILING MOUNTED
	CONDUIT SEAL-OFF FITTINGS
SS C3	SURGE SUPRESSOR C3 = SERVICE ENTRANCE DEVICE B3 = DISTRIBUTION BOARD DEVICE A3 = PANELBOARD DEVICE
ST	SHUNT-TRIP BUTTON - FLUSH MOUNTED UNLESS OTHERWISE NOTED NEMA 3R FOR EXTERIOR LOCATIONS
	MOTOR CONNECTION
MD	MOTORIZED DAMPER CONNECTION
VFD	VARIABLE FREQUENCY DRIVE
DDC	DIRECT DIGITAL CONTROL PANEL

BASIC MATERIALS CONT.

SYMBOL	DESCRIPTION
T	TRANSFORMER
	AUTOMATIC TRANSFER SWITCH
30AR NF	NON-FUSED DISCONNECT SWITCH, SIZE AS NOTED NF DENOTES NON-FUSED
30AR 20AF	FUSED DISCONNECT AR DENOTES AMP RATING OF SWITCH AF DENOTES AMP FUSE SIZE
MCP SIZE, 3003, 3R	COMBINATION MAGNETIC MOTOR STARTER, SIZE AS NOTED # OF POLES 3 POLE UNLESS OTHERWISE NOTED ENCLOSURE NEMA 1 UNLESS NOTED NEMA STARTER SIZE
	BRANCH CIRCUIT PANELBOARD, UNDER 250 VOLTS, SURFACE MOUNTED
	BRANCH CIRCUIT PANELBOARD, UNDER 250 VOLTS, FLUSH MOUNTED
	BRANCH CIRCUIT PANELBOARD, OVER 250 VOLTS, SURFACE MOUNTED
	BRANCH CIRCUIT PANELBOARD, OVER 250 VOLTS, FLUSH MOUNTED
	BRANCH CIRCUIT CONDUIT CONCEALED ABOVE CEILING OR IN WALL. CONDUIT SHALL INCLUDE PHASE, NEUTRAL AND GROUND CONDUCTORS AS REQUIRED FOR CIRCUITS (UNLESS OTHERWISE NOTED).
	BRANCH CIRCUIT CONDUIT CONCEALED IN SLAB, UNDERGROUND OR UNDER FLOOR.
	BRANCH CIRCUIT CONDUIT EXPOSED
	GROUND OR GROUND ROD AS NOTED
EQ	EQUIPMENT BRANCH CONDUIT
UP	CONDUIT TURNING UP
DN	CONDUIT TURNING DOWN
	CONDUIT STUB
	CONDUIT CONTINUED
	FLEXIBLE CONDUIT
	EXISTING TO BE REMOVED
	EXISTING TO REMAIN
	EXISTING AFFECTED BY THIS PROJECT
	FUTURE
	NEW

FIRE ALARM/DETECTION SYSTEM

SYMBOL	DESCRIPTION
F	MANUAL PULL STATION
	CEILING SMOKE DETECTOR, PHOTO-ELECTRIC TYPE UNLESS OTHERWISE NOTED E = ELEVATOR WITH RECALL CONTACTS I = IONIZATION
	DUCT SMOKE DETECTOR R = RETURN S = SUPPLY
R	SUPERVISED CONTROL RELAY
R	DUCT SMOKE REMOTE ALARM INDICATING LAMP, W/ TEST SWITCH, WALL MOUNTED 72" AFF
RT	REMOTE FIRE ALARM WITH TEST SWITCH
F XXCD	COMBINATION SPEAKER/STROBE WALL MOUNTED CD = CANDELA RATING
S	SPEAKER ONLY WALL MOUNTED
FS	COMBINATION SPEAKER/STROBE CEILING MOUNTED CD = CANDELA RATING
SS	SPEAKER ONLY CEILING MOUNTED
F XXCD	FIRE ALARM STROBE CEILING MOUNTED CD = CANDELA RATING
F	FIRE ALARM STROBE, WALL MOUNTED
P	FIREMAN'S PHONE JACK
TS	SPRINKLER TAMPER SWITCH CONNECTION
FS	SPRINKLER WATERFLOW SWITCH CONNECTION
	ELECTROMAGNETIC DOOR HOLD OPEN DEVICE
H	CEILING HEAT DETECTOR 135° UNLESS OTHERWISE INDICATED
FACP	FIRE ALARM CONTROL PANEL
FATC	FIRE ALARM TERMINAL CABINET
FAAP	FIRE ALARM ANNUNCIATOR PANEL - FLUSH MOUNTED
F	FIRE ALARM SYSTEM CONDUIT AND WIRING
E	FIREMAN'S ELEVATOR WARNING LIGHT

LIGHTING

	FLUORESCENT STRIP FIXTURE
A	FIXTURE DESIGNATION
2 a	FLUORESCENT FIXTURE LOWER CASE LETTER INDICATES CONTROL CIRCUIT SWITCH LEG CIRCUIT NUMBER
	FLUORESCENT FIXTURE DIAGONAL SHADING DENOTES LIGHT FIXTURE CONNECTED TO EMERGENCY CIRCUIT OR WITH BATTERY PACK
	FLUORESCENT WALL MOUNTED FIXTURE WITH WALL OUTLET BOX
	HID, FLUORESCENT, OR LED FIXTURE
	FLUORESCENT, OR LED WALL WASHER.
	EXIT LIGHT FIXTURE, DIRECTION ARROWS AS SHOWN (SHADED QUADRANT INDICATES FACE(S) OF FIXTURE)
	WALL MOUNTED EXIT LIGHT FIXTURE
	EXTERIOR LIGHT FIXTURE WITH ARMS AS SHOWN ON DRAWINGS
	TRACK WITH TRACK LIGHT FIXTURE (TRIANGLES INDICATE QUANTITY OF LIGHT FIXTURES)
	BATTERY PACK WITH TWIN HEADS

SPECIAL LIGHTING NOTES:

1. ALL LIGHTING CIRCUITS SHALL BE PROVIDED WITH A DEDICATED NEUTRAL.

LIGHTNING PROTECTION SYSTEM

CI	CLASS I MAIN CONDUCTOR CABLE
CII	CLASS II MAIN CONDUCTOR CABLE
	TEE SPLICE
	BONDING PLATE
	PIPE CLAMP FOR PLUMBING VENT THRU ROOF.
	AIR TERMINATION DEVICE
	GROUND TERMINAL
	BONDING CONDUCTOR
DN	DOWN CONDUCTOR
G	COUNTERPOISE CONDUCTOR
P	PARAPET MOUNTED AIR TERMINAL
F	FLAT ROOF MOUNTED OR MECHANICAL
DN	THRU-ROOF CONDUCTOR

NOTE: SOME SYMBOLS SHOWN ON THIS LEGEND MAY NOT PERTAIN TO THIS PROJECT.

GENERAL NOTES:

1. RECEPTACLES SHALL BE LOCATED 18 INCHES ABOVE FINISHED FLOOR TO CENTER LINE OF DEVICE, UNLESS OTHERWISE NOTED. ABOVE COUNTER RECEPTACLES SHALL BE MOUNTED 6" ABOVE BACK SPLASH TO CENTERLINE OF DEVICE.
2. EQUIPMENT SHALL BE OF MATERIALS SUITABLE FOR AND RATED FOR THE ENVIRONMENT IN WHICH THEY ARE TO BE INSTALLED.
3. WORKING CLEARANCES FOR ELECTRICAL EQUIPMENT SHALL BE IN COMPLIANCE WITH NEC 110.
4. THE EXCLUSIVELY DEDICATED SPACE EXTENDING FROM FLOOR TO STRUCTURAL CEILING WITH A WIDTH AND DEPTH OF THE PANELBOARD OR SWITCHBOARD MUST BE CLEAR OF ALL PIPING, DUCTS, EQUIPMENT FOREIGN TO THE ELECTRICAL EQUIPMENT OR ARCHITECTURAL APPURTENANCES IN
5. ACCORDANCE WITH NEC 408.
6. ALL DEVICES SHALL BE MOUNTED VERTICAL, UNLESS OTHERWISE NOTED.
7. ALL RECEPTACLES SHALL BE MOUNTED SUCH THAT THE GROUND PIN IS MOUNTED DOWN.
8. ALL WIRE SHALL BE SIZED AS SHOWN ON THE DRAWINGS. IF NO SIZE IS SHOWN, THEN WIRE SHALL BE SIZED FOLLOWING "BRANCH CIRCUIT WIRING SCHEDULE" TABLE ON SHEET E300. 277 V BRANCH CIRCUIT HOME-RUNS OVER 140 FEET IN LENGTH SHALL BE #10 AWG.
9. FINAL CONNECTIONS TO TRANSFORMERS, AHU'S, AND PUMPS SHALL BE WITH LIQUIDTIGHT, FLEXIBLE METAL CONDUIT.
10. PROVIDE POLYOLEFIN JET-LINE #232 IN EACH EMPTY CONDUIT WITH ENGRAVED METAL TAG INDICATING CONDUIT DESIGNATION.
11. ALL CONDUCTORS IN CABINETS MUST BE CAREFULLY FORMED AND HARNESSED SO THAT EACH CONDUCTOR DROPS OFF DIRECTLY OPPOSITE TO TERMINAL.
12. MINIMUM RACEWAY SIZE SHALL BE 3/4".
13. COMPRESSION TYPE FITTINGS SHALL BE USED FOR EMT.
14. ARC FLASH DANGERWARNIG LABELS SHALL BE APPLIED TO SWITCHBOARD, PANELBOARDS, AND EQUIPMENT CONTROLLERS PER NEC ARTICLE 110.76.
15. FIRE PROTECTION PIPING SHALL NOT BE USED FOR GROUNDING.
16. PROVIDE PANEL-CIRCUIT IDENTIFICATION ON INSIDE OF LIGHT SWITCH FACEPLATES, RECEPTACLE FACEPLATES AND JUNCTION BOX COVERS.
17. NO PVC CONDUIT MAY BE USED INSIDE OF BUILDING.
18. ALL NEW AND EXISTING PANELS AFFECTED BY THIS PROJECT SHALL BE PROVIDED WITH A NEW TYPE WRITTEN DIRECTORY.

ELECTRICAL DRAWING INDEX

ENGINEERING
FOR ARCHITECTURE
5757 Blue Lagoon Drive, Suite 400
Mimai, Florida 33126
PH: 305.266.6553
Fax: 350.266.6695
www.tlc-engineers.com
COA 15

CUTLER BAY TOWN CENTER HVAC EQUIPMENT AND CONTROLS

10720 Caribbean Blvd. Cutler Bay, Florida 33189

Revisions:

No.	Date	Description

Seal

Manuel Mollinedo, P.E.
Florida License # 63096

MANUEL MOLLINEDO LICENSE No. 63096 STATE OF FLORIDA PROFESSIONAL ENGINEER
OCT 14 2016

100% CD SUBMITTAL

Project No.:	Project Number
Issue Date:	Issue Date
Drawn By:	Author
Approved By:	Approver
Scale:	12" = 1'-0"

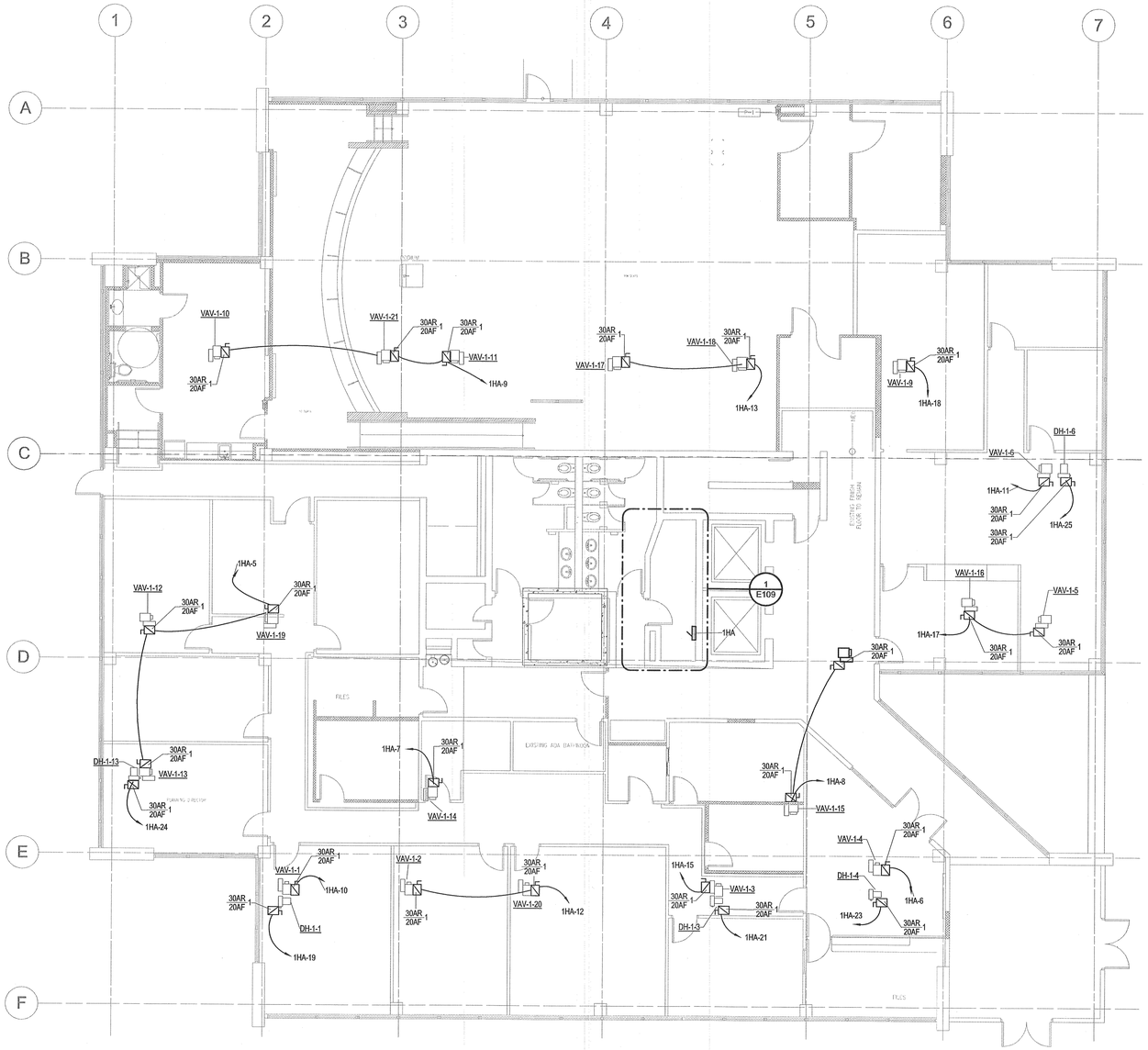
Drawing Title:

ELECTRICAL LEGEND, GENERAL NOTES, & SHEET INDEX

Drawing No.:

E000

C:\Revit 2016 Local Models\616018_MEP_R16_barbara.rodriguez.rvt
10/14/2016 2:38:49 PM



1 E101 N — ELECTRICAL LEVEL 1 FLOOR PLAN
1/8" = 1'-0"

GENERAL NOTES: (VALID FOR ALL SHEETS).

SOME EXISTING VAV'S SHALL BE REPLACED AND OTHER VAV'S SHALL BE PROVIDED WITH NEW HEATERS. REFER TO MECHANICAL DRAWINGS FOR EXACT LOCATION AND DETAILS.

ALL VAV'S SHALL BE AT 277V, SINGLE PHASE.

VAV'S WITH HEATERS SHALL BE CONNECTED TO A DEDICATED BRANCH CIRCUIT.

VAV'S WITHOUT HEATERS MAY SHARE THE BRANCH CIRCUIT. NO MORE THAN 4 VAV'S SHALL BE CONNECTED TO SAME BRTNACH CIRCUIT.

USE WIRE #12 AWG THWN IN 3/4" C TO CONNECTE VAV'S TO PANELBOARD.

FOR BRANCH CIRCUIT LONGER THAN 140 FEET INCREASE THE WIRES TO NEXT SIZE.

PROVIDE EQUIPMENT GROUNDING CONDUCTOR IN EVERY BRANCH CIRCUIT SIZED AS PER NEC 250.122.

ENGINEERING
FOR ARCHITECTURE
5757 Blue Lagoon Drive, Suite 400
Miami, Florida 33126
PH: 305.266.6553
Fax: 350.266.6695
www.tlc-engineers.com
COA 15

CUTLER BAY TOWN CENTER HVAC EQUIPMENT AND CONTROLS

10720 Caribbean Blvd. Cutler Bay, Florida 33189

Revisions:

No.	Date	Description

Seal

Manuel Mollinedo, P.E.
Florida License # 63096

MANUEL MOLLINEDO LICENSE No. 63096 STATE OF FLORIDA PROFESSIONAL ENGINEER
DEC 1 9 2016

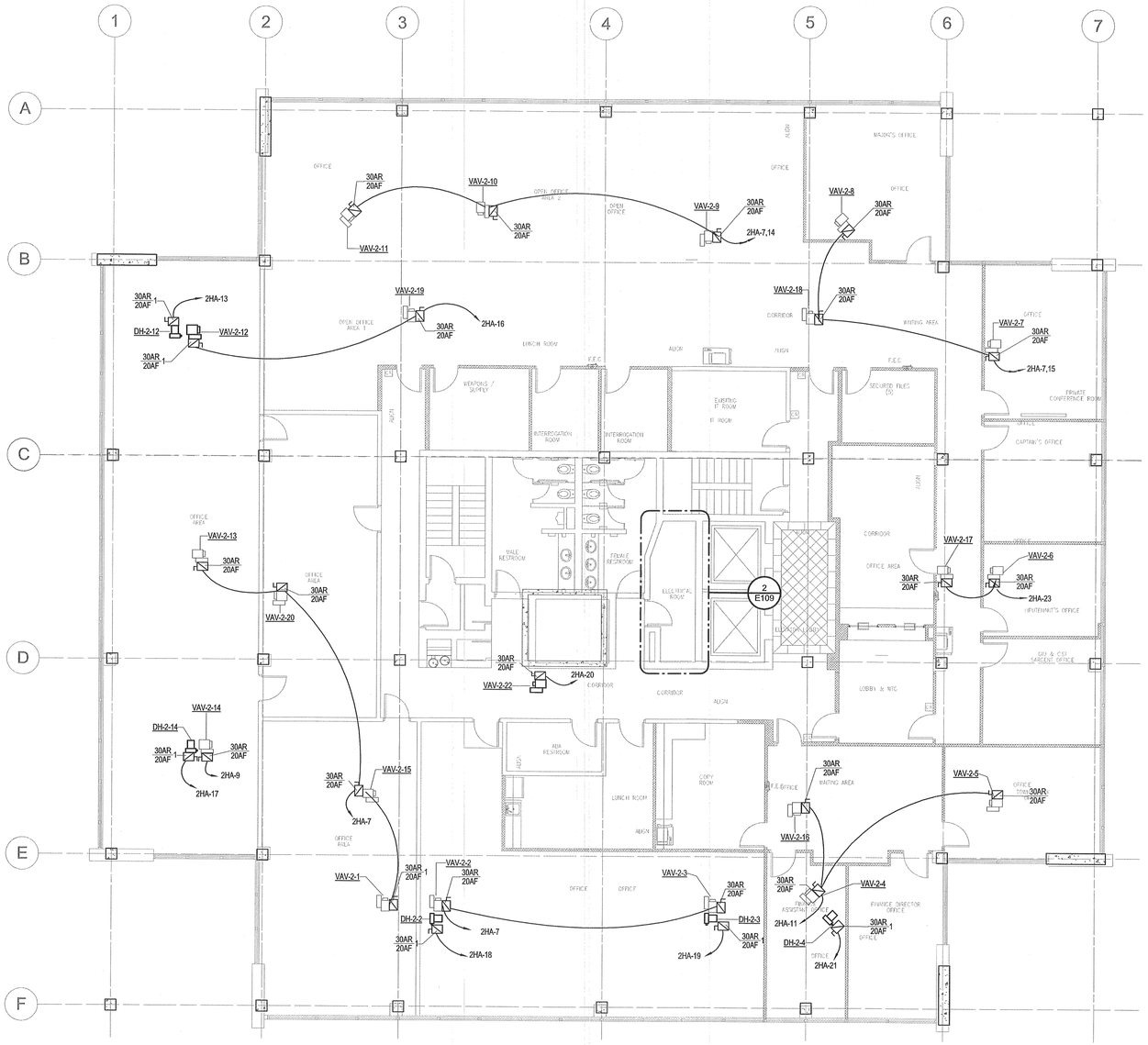
100% CD SUBMITTAL

Project No.: Project Number
Issue Date: Issue Date
Drawn By: Author
Approved By: Approver
Scale: 1/8" = 1'-0"

Drawing Title:
ELECTRICAL LEVEL 1 FLOOR PLAN

Drawing No.:
E101

C:\Revit 2016 Local Models\616018_MEP_R16_barbara.rodriguez.rvt
12/2/2016 2:38:51 PM



1 E102 N

ELECTRICAL LEVEL 2 FLOOR PLAN

1/8" = 1'-0"

ENGINEERING
FOR ARCHITECTURE
5757 Blue Lagoon Drive, Suite 400
Miami, Florida 33126
PH: 305.266.6553
Fax: 350.266.6695
www.tlc-engineers.com
COA 15

CUTLER BAY TOWN CENTER HVAC
EQUIPMENT AND CONTROLS

10720 Caribbean Blvd. Cutler Bay, Florida 33189

Revisions:

No.	Date	Description

Seal

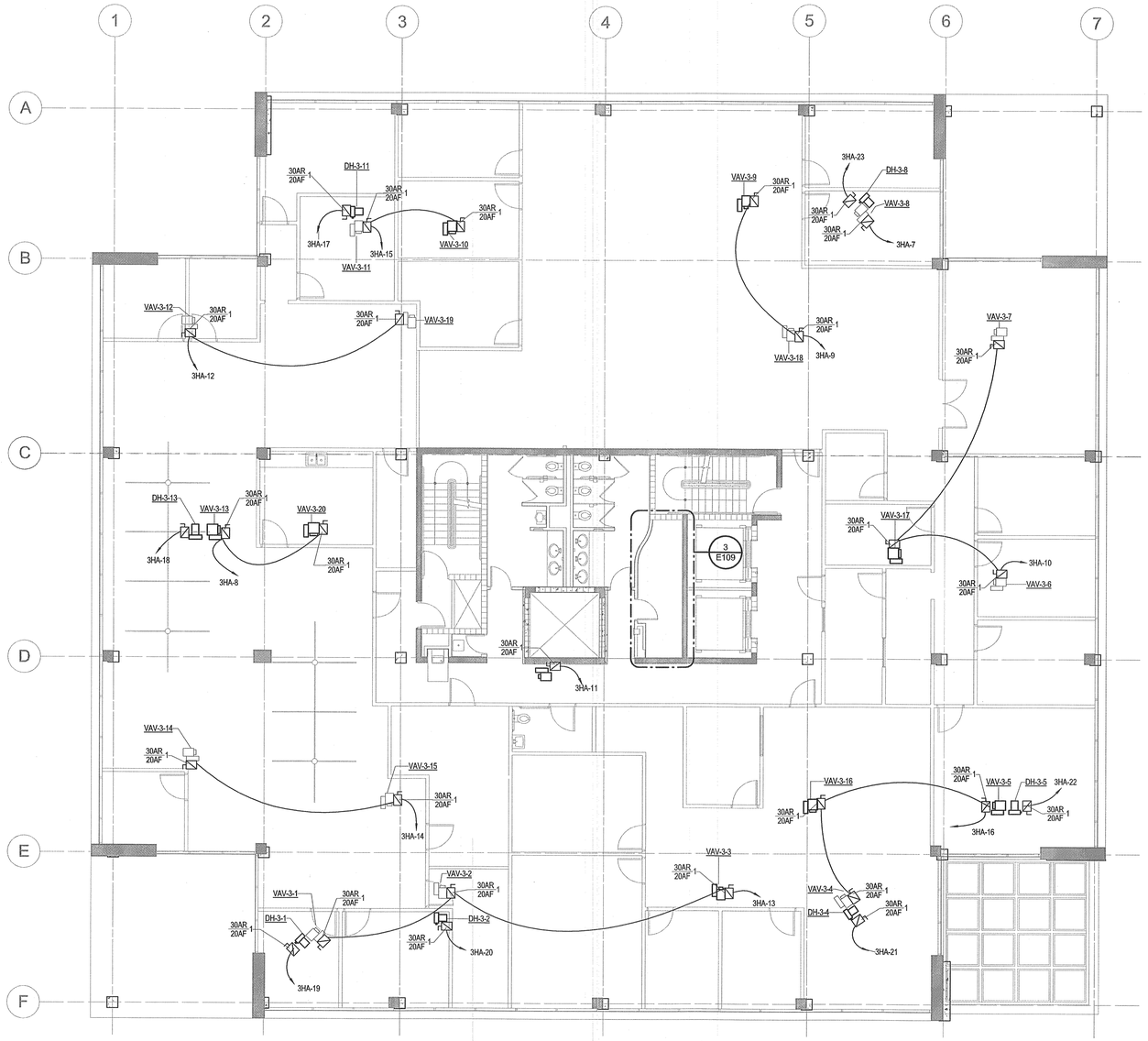
Manuel Mollinedo, P.E.
Florida License # 63096

MANUEL MOLLINEDO LICENSE No. 63096 STATE OF FLORIDA PROFESSIONAL ENGINEER
06/12/2016

100% CD SUBMITTAL

Project No.: Project Number
Issue Date: Issue Date
Drawn By: Author
Approved By: Approver
Scale: 1/8" = 1'-0"
Drawing Title: ELECTRICAL LEVEL 2 FLOOR PLAN
Drawing No.: E102

C:\Revit 2016 Local Models\816018_MEP_R16_barbara.rodriguez.rvt
2/6/2016 2:38:54 PM



1 / E103 N — ELECTRICAL LEVEL 3 FLOOR PLAN

1/8" = 1'-0"

TLC ENGINEERING FOR ARCHITECTURE
5757 Blue Lagoon Drive, Suite 400
Miami, Florida 33126
PH: 305.266.6553
Fax: 350.266.6695
www.tlc-engineers.com
COA 15

CUTLER BAY TOWN CENTER HVAC EQUIPMENT AND CONTROLS

10720 Caribbean Blvd. Cutler Bay, Florida 33189

Revisions:

No.	Date	Description

Seal

Manuel Mollinedo, P.E.
Florida License # 63096

MANUEL MOLLINEDO LICENSE No. 63096 STATE OF FLORIDA PROFESSIONAL ENGINEER
OCT 12 2016

Project No.: Project Number
Issue Date: Issue Date

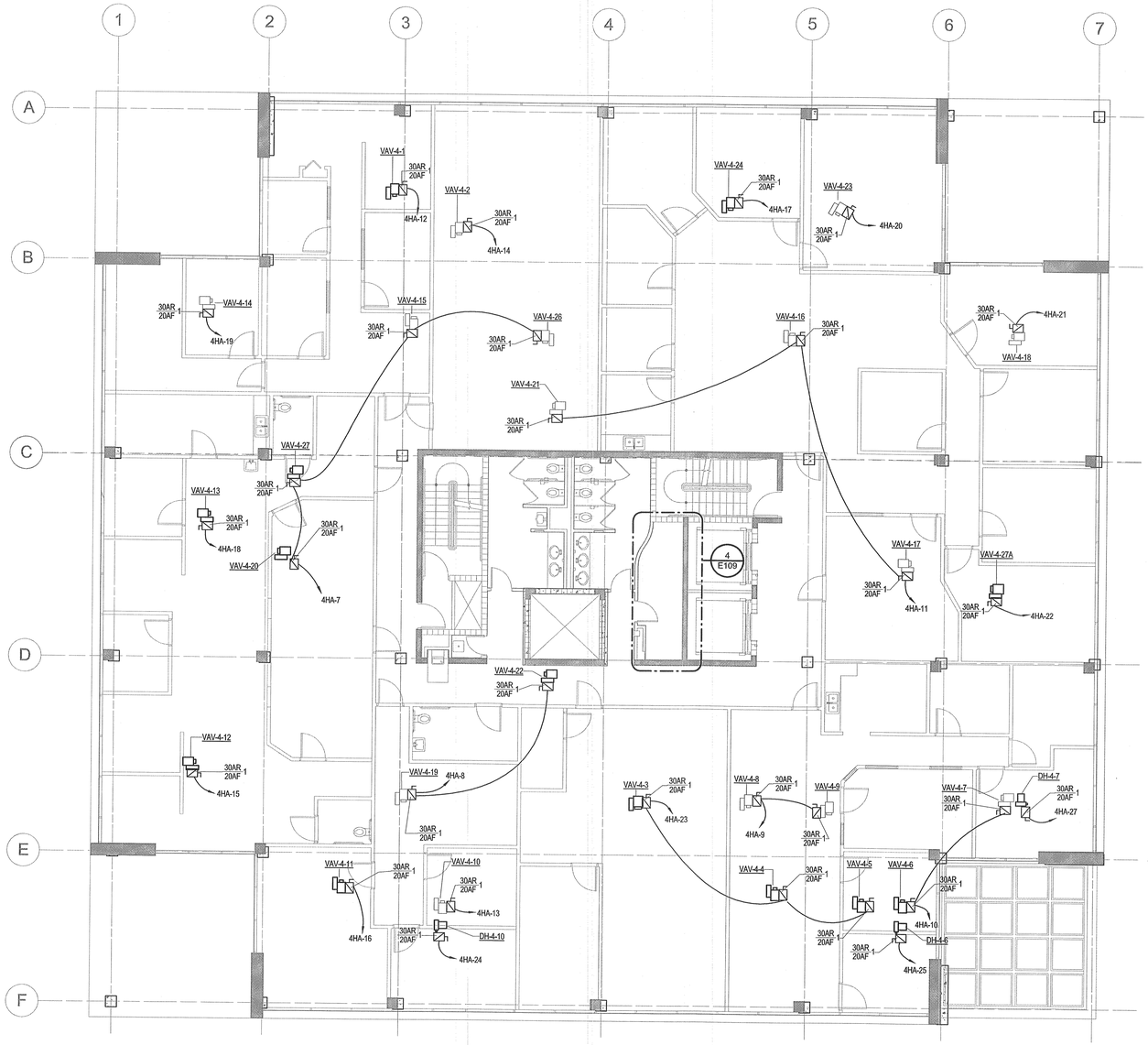
Drawn By: Author
Approved By: Approver
Scale: 1/8" = 1'-0"

Drawing Title:
ELECTRICAL LEVEL 3 FLOOR PLAN

Drawing No.:
E103

100% CD SUBMITTAL

C:\Revit 2016 Local Models\616018_MEP_R16_barbara.rodriguez.rvt
10/12/2016 2:38:57 PM



1 E104 N

ELECTRICAL LEVEL 4 FLOOR PLAN

1/8" = 1'-0"

ENGINEERING
FOR ARCHITECTURE
5757 Blue Lagoon Drive, Suite 400
Miami, Florida 33126
PH: 305.266.6553
Fax: 350.266.6695
www.tlc-engineers.com
COA 15

CUTLER BAY TOWN CENTER HVAC EQUIPMENT AND CONTROLS

10720 Caribbean Blvd. Cutler Bay, Florida 33189

Revisions:

No.	Date	Description

Seal

Manuel Mollinedo, P.E.
Florida License # 63096

MANUEL MOLLINEDO LICENSE No. 63096 STATE OF FLORIDA PROFESSIONAL ENGINEER
OCT 12 2016

100% CD SUBMITTAL

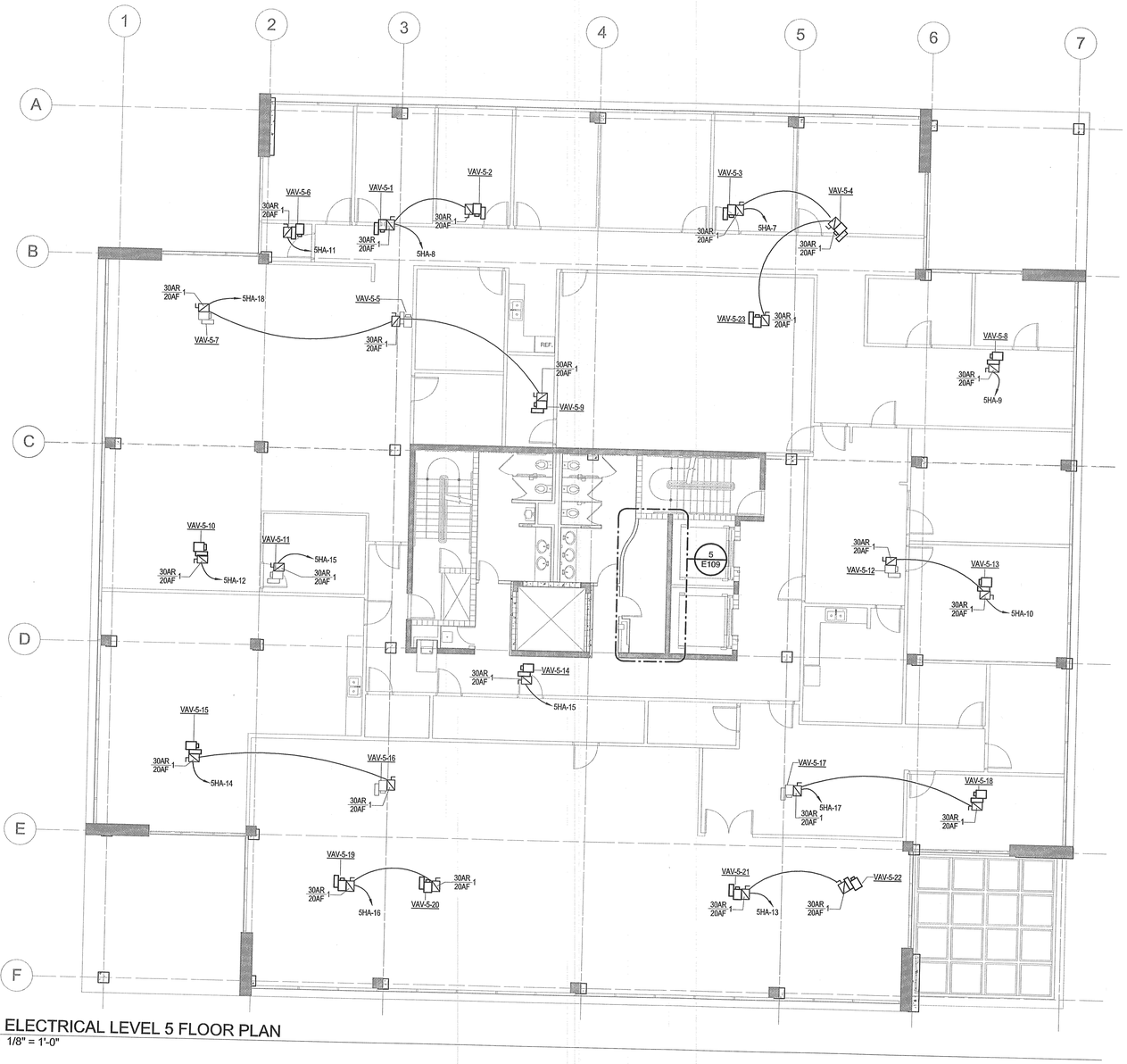
Project No.: Project Number
Issue Date: Issue Date

Drawn By: Author
Approved By: Approver
Scale: 1/8" = 1'-0"

Drawing Title:
ELECTRICAL LEVEL 4 FLOOR PLAN

Drawing No.:
E104

C:\Revit 2016 Local Models\616018_MEP_R16_barbara.rodriguez.rvt
2/2/2016 2:38:59 PM



1 E105 N

ELECTRICAL LEVEL 5 FLOOR PLAN

1/8" = 1'-0"

ENGINEERING
FOR ARCHITECTURE
5757 Blue Lagoon Drive, Suite 400
Miami, Florida 33126
PH: 305.266.6553
Fax: 350.266.6695
www.tlc-engineers.com
COA 15

CUTLER BAY TOWN CENTER HVAC
EQUIPMENT AND CONTROLS

10720 Caribbean Blvd. Cutler Bay, Florida 33189

Revisions:

No.	Date	Description

Seal

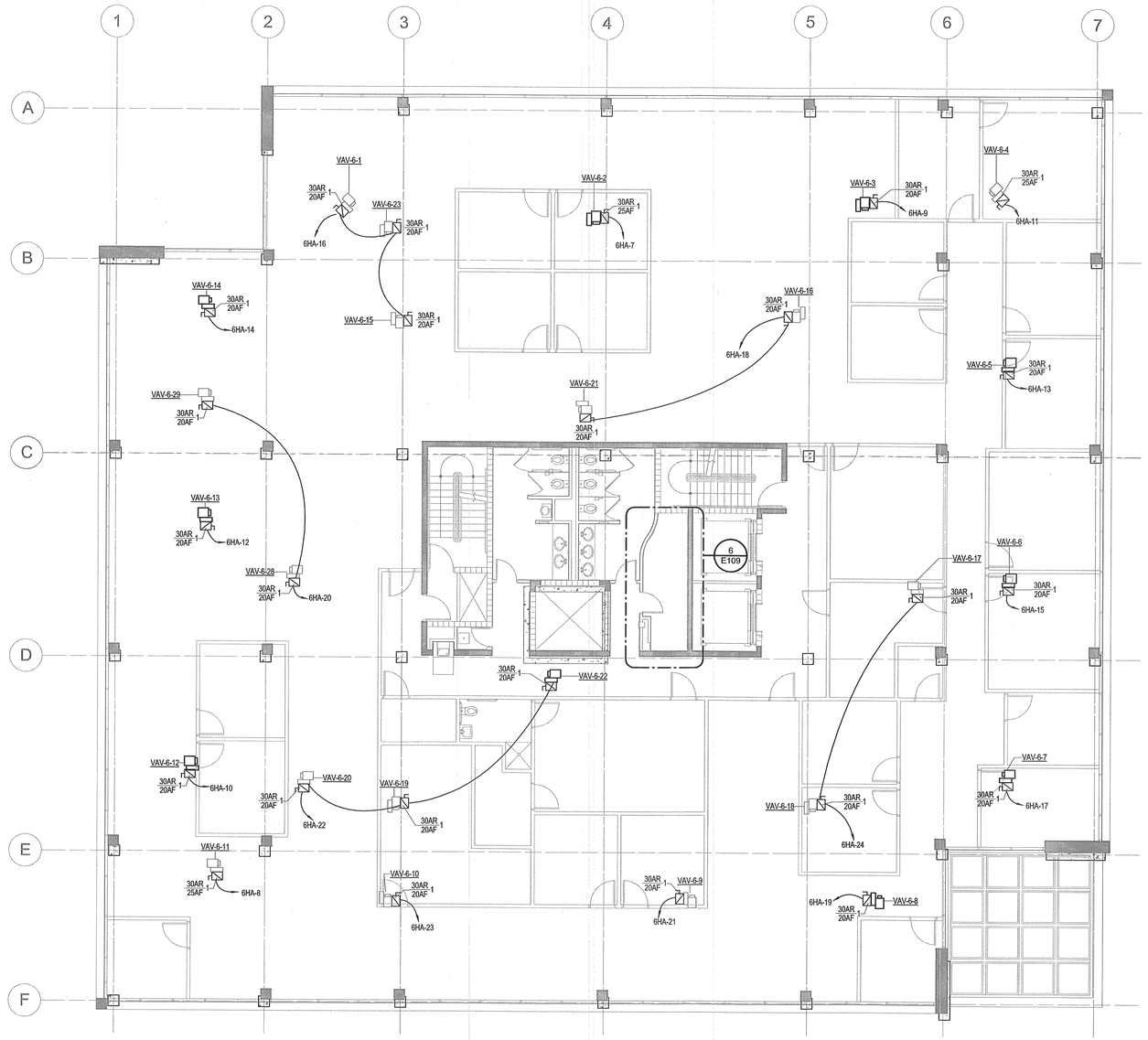
Manuel Mollinedo, P.E.
Florida License # 63096

MANUEL MOLLINEDO LICENSE No. 63096 STATE OF FLORIDA PROFESSIONAL ENGINEER
NOT VALID WITHOUT SIGNATURE AND ORIGINAL RAISED SEAL

100% CD SUBMITTAL

Project No.: Project Number
Issue Date: Issue Date
Drawn By: Author
Approved By: Approver
Scale: 1/8" = 1'-0"
Drawing Title: ELECTRICAL LEVEL 5 FLOOR PLAN
Drawing No.: E105

C:\Revit 2016 Local Models\616018_MEP_R16_barbara.rodriguez.rvt
10/12/2016 2:38:02 PM



1 E106 ELECTRICAL LEVEL 6 FLOOR PLAN

1/8" = 1'-0"

ENGINEERING
FOR ARCHITECTURE
5757 Blue Lagoon Drive, Suite 400
Miami, Florida 33126
PH: 305.266.6553
Fax: 350.266.6695
www.tlc-engineers.com
COA 15

CUTLER BAY TOWN CENTER HVAC EQUIPMENT AND CONTROLS

10720 Caribbean Blvd. Cutler Bay, Florida 33189

Revisions:

No.	Date	Description

Seal

Manuel Mollinedo, P.E.
Florida License # 63096

MANUEL MOLLINEDO LICENSE NO. 63096 STATE OF FLORIDA PROFESSIONAL ENGINEER

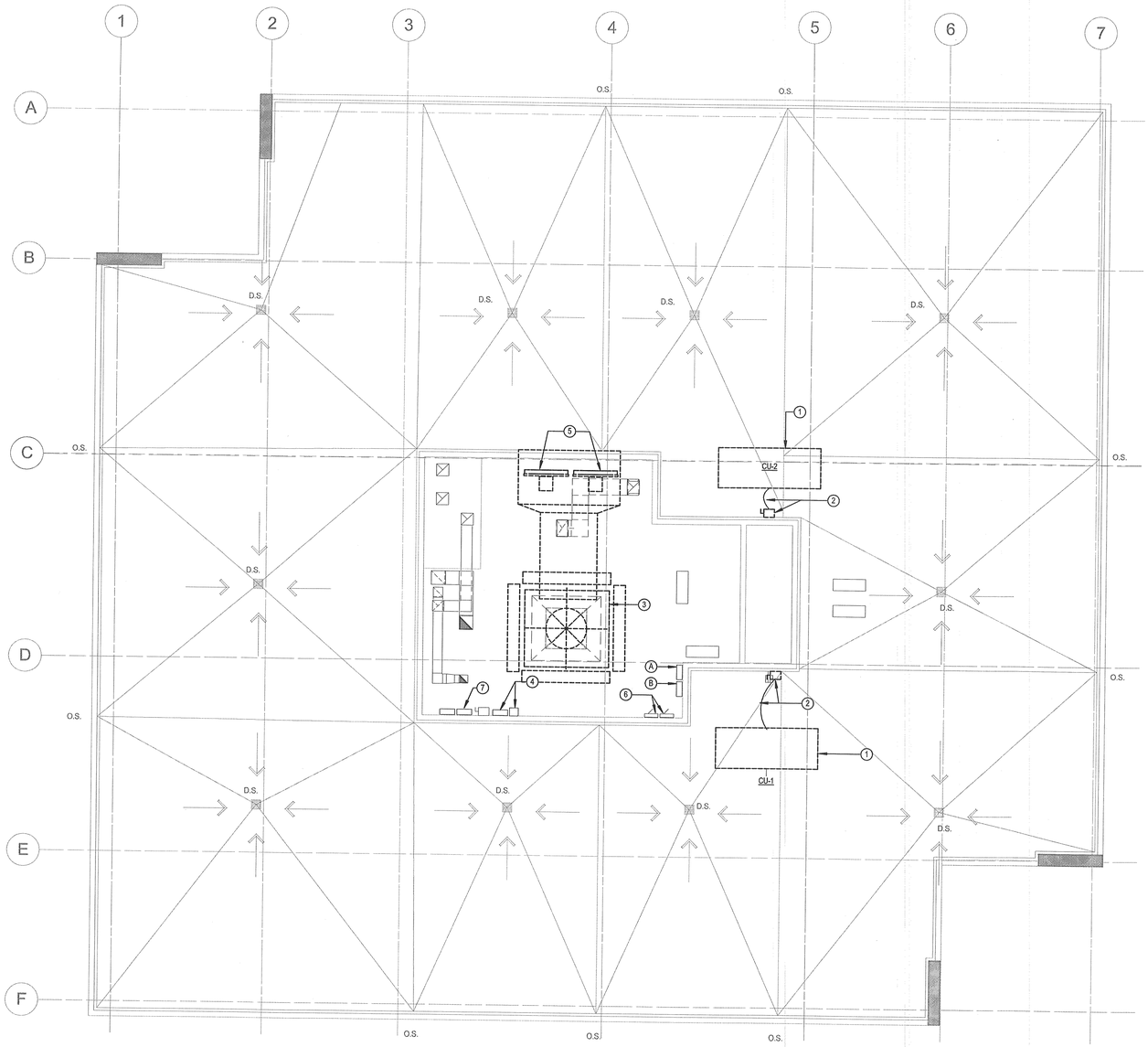
100% CD SUBMITTAL

Project No.: Project Number
Issue Date: Issue Date
Drawn By: Author
Approved By: Approver
Scale: 1/8" = 1'-0"

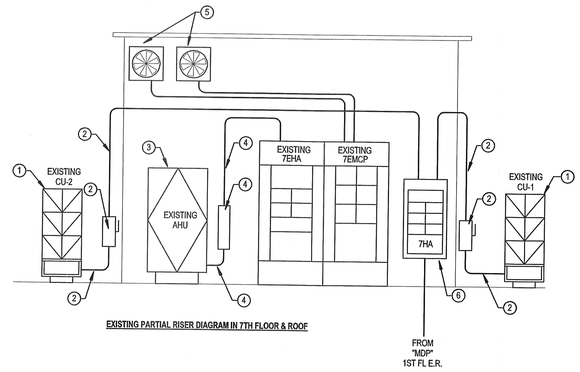
Drawing Title:
ELECTRICAL LEVEL 6 FLOOR PLAN

Drawing No.:
E106

C:\Revit 2016 Local Models\61608_MEP_R16_barbara.rodriguez.rvt
2/7/2016 2:39:04 PM



1 E107 N POWER DEMO ROOF PLAN
1/8" = 1'-0"



EXISTING PARTIAL RISER DIAGRAM IN 7TH FLOOR & ROOF

DEMOLITION NOTES:

1. EXISTING CU'S TO BE DEMOLISHED.
2. DEMOLISH THE EXISTING FEEDERS (WIRES, CONDUITS AND DISCONNECTS) ALL THE WAY BACK TO PANEL "7HA", TURN OFF THE CIRCUIT BREAKER AND LABEL AS "SPARE".
3. EXISTING AHU TO BE DEMOLISHED. REMOVE EXISTING DUCT SMOKE DETECTORS AND PRESERVE TO BE REUSED. VERIFY THE FIRE ALARM SYSTEM REMAINS OPERATIVE DURING ALL DEMOLITION PHASES.
4. REMOVE EXISTING BFD AND J-BOX PART OF THE FEEDERS TO EXISTING AHU. DEMOLISH FEEDER CIRCUIT (WIRES, CONDUITS, J-BOXES) ALL THE WAY BACK TO PANEL "7EHA". TURN OFF THE CIRCUIT DISCONNECT, REMOVE THE FUSES AND LABEL AS "SPARE".
5. EXISTING EF-6 AND EF-7 TO BE DEMOLISHED. DEMOLISH FEEDER CIRCUIT (WIRES, CONDUITS, J-BOXES) ALL THE WAY BACK TO PANEL SOURCE AND LABEL ASSOCIATED CIRCUIT BREAKER AS SPARE.
6. EXISTING PANEL "7HA" TO BE REMOVED AND REPLACED. TURN OFF AND LOCK IN OFF POSITION THE CIRCUIT BREAKER IN PANEL "MDP" (1ST FLOOR ELECTRICAL ROOM) CURRENTLY FEEEDING PANEL "7HA". REMOVE EXISTING PANELBOARD, IDENTIFY, TAG, AND PRESERVE EXISTING FEEDERS CURRENTLY POWERING PANEL "7HA" TO BE REUSED. IDENTIFY, TAG, AND PRESERVE EXISTING BRANCH CIRCUIT CONNECTED TO PANEL "7HA" TO BE REUSED.
7. EXISTING PANEL "7EHA" TO BE REPLACED. IDENTIFY, TAG, AND PRESERVE ALL EXISTING BRANCH CIRCUIT AND FEEDER WIRES. PROVIDE NEW PANELBOARD AS SPECIFIED IN PNALE SCHEDULE (SHEET E303) WITH IDENTICAL CHARACTERISTICS AS EXISTING BUT WITH 30 SPACES.

ENGINEERING
FOR ARCHITECTURE
5757 Blue Lagoon Drive, Suite 400
Mimai, Florida 33126
PH: 305.266.6553
Fax: 350.266.6695
www.tlc-engineers.com
COA 15

CUTLER BAY TOWN CENTER HVAC EQUIPMENT AND CONTROLS

10720 Caribbean Blvd. Cutler Bay, Florida 33189

Revisions:

No.	Date	Description

Seal

Manuel Mollinedo, P.E.
Florida License # 63096

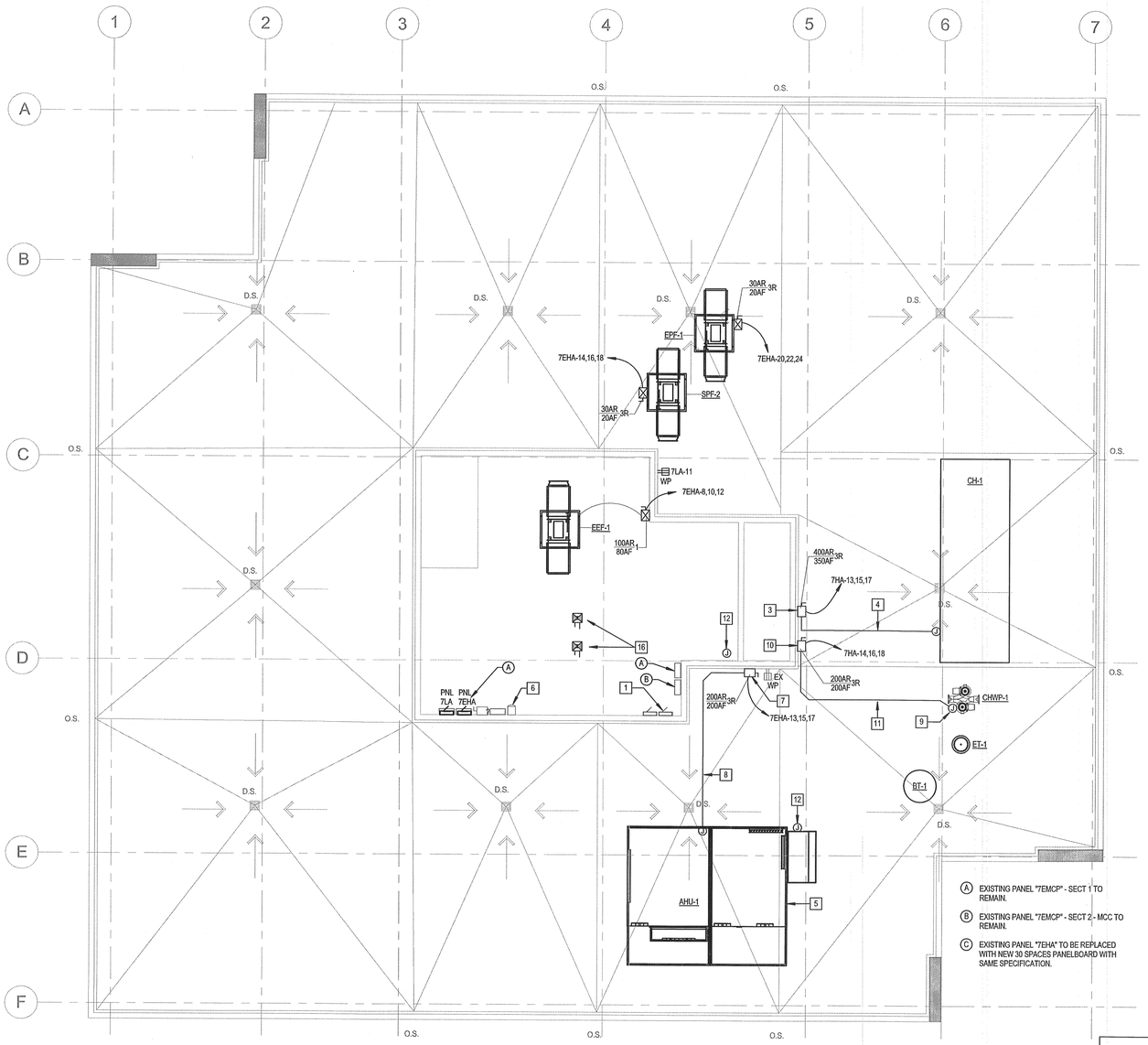
MANUEL MOLLINEDO LICENSE No. 63096 STATE OF FLORIDA PROFESSIONAL ENGINEER 12-2016

100% CD SUBMITTAL

Project No.: Project Number
Issue Date: Issue Date
Drawn By: Author
Approved By: Approver
Scale: 1/8" = 1'-0"

Drawing Title:
DEMO - ROOF PLAN

Drawing No.:
E107



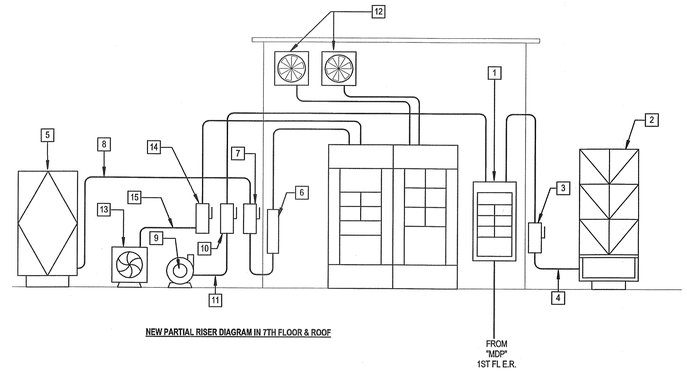
Ⓐ EXISTING PANEL "7EMCP" - SECT 1 TO REMAIN.

Ⓑ EXISTING PANEL "7EMCP" - SECT 2 - MCC TO REMAIN.

Ⓒ EXISTING PANEL "7EHA" TO BE REPLACED WITH NEW 30 SPACES PANELBOARD WITH SAME SPECIFICATION.

1/E108 ELECTRICAL ROOF PLAN

1/8" = 1'-0"



NEW PARTIAL RISER DIAGRAM IN 7TH FLOOR & ROOF

NEW WORK NOTES:

1. INSTALL NEW "7HA" PANELBOARD. CONNECT EXISTING FEEDERS COMING FROM PANEL "MDP" AND PRESERVED DURING DEMOLITION PHASE. CONNECT ALSO THE BRANCH CIRCUITS PRESERVED DURING DEMOLITION PHASE TAKING CARE THAT ARE CONNECTED IN SAME CIRCUIT THEY WERE BEFORE DEMOLITION. REFER TO SHEET E303 FOR NEW PANEL "7HA" LAYOUT.
2. NEW AIR COOLED CHILLER. PROVIDE POWER AS INDICATED. REFER TO PANEL SCHEDULE.
3. NEW 400A HEAVY DUTY SAFETY SWITCH, NEMA 3R, 480V, 3 POLE, SOLID NEUTRAL. PROVIDE (3) 300A RK5 FUSES. LABEL DISCONNECT HOUSING AS REQUIRED BY NEC 110.22
4. (3) #350 KCM THWN + (1) #4 AWG THWN (G) IN 2 1/2" C. INSTALL AS PER NEC 300 - 352. PROVIDE FLEXIBLE CONDUIT SECTION 3 FEET BEFORE TO REACH THE AIR COOLED CHILLER EQUIPMENT.
5. NEW AHU, PROVIDE POWER AS INDICATED. REFER TO PANEL SCHEDULE.
- 5a. INSTALL DUCT SMOKE DETECTORS REMOVED AND PRESERVED DURING DEMOLITION PHASE. INSTALL IN SUPPLY AND RETURN DUCTS, FOLLOW NFPA-72 NFOR QUANTITY AND EXACT LOCATION. PRESERVED DUCT SMOKE DETECTORS SHALL BE TESTED BEFORE TO INSTALL TO VERIFY THEY ARE FULLY OPERATIVE AND REPLACE IF NECESSARY. THE FIRE ALARM SYSTEM SHALL BE RECERTIFIED UPON THE COMPLETION OF ELECTRICAL WORKS.
6. NEW VFD (PROVIDED BY MECHANICAL CONTRACTOR) TO DRIVE THE AHU.
7. NEW HEAVY DUTY SAFETY SWITCH 400A, 480V, 3 POLE, NEMA 3R, WITH EARLY BREAK AUXILIARY CONTACT TO PREVENT VFD DOWNTIME FROM OUT OF SEQUENCE SHUTDOWNS (HUBBELL SERIE HBLDS-VFD); REFER TO DETAIL FOR CONNECTION. PROVIDE (3) 225 A RK5 FUSES. LABEL DISCONNECT HOUSING TO MEET NEC 110.22.
8. (3) #4/0 AWG THWN + (1) # 4 AWG THWN (G) IN 2" C. INSTALL AS PER NEC 300 - 352. PROVIDE FLEXIBLE CONDUIT SECTION 3 FEET BEFORE TO REACH THE AHU.
9. NEW CHWP PUMP - 7.5 HP, 480V.
10. NEW HEAVY DUTY SAFETY SWITCH 30A, 480V, 3 POLE, NEMA 3R. PROVIDE (3) 15A RK5 FUSES, LABEL DISCONNECT HOUSING AS REQUIRED BY NEC 110.22. COORDINATE WITH MECHANICAL / CONTROL CONTRACTOR FOR STARTING METHOD AND CONTROL DEVICES TO BE INCLUDED IN THE CIRCUIT.
11. (3) #10 AWG THWN + (1) #10 AWG THWN(G) IN 3/4"C. INSTALL AS PER NEC 300 - 352. PROVIDE FLEXIBLE CONDUIT SECTION 3 FEET BEFORE TO REACH THE CHWP PUMP.
12. POWER CONNECTION TO MOTORIZED DAMPER. COORDINATE WITH THE MECHANICAL CONTRACTOR.
13. NOT USED.
14. NEW HEAVY DUTY SAFETY SWITCH, 100A, 3 POLE, 480V RATED, NEMA 3R ENCLOSURE. PROVIDE (3) 80A RK5 FUSES. LABEL DISCONNECT HOUSING AS REQUIRE BY NEC 110.22. COORDINATE WITH MECHANICAL / CONTROL CONTRACTOR FOR SATRTING METHOD AND CONTROL DEVICES TO BE INCLUDED IN THE CIRCUIT.
15. (3) #4 AWG THWN + (1) #8 AWG THWN(G) IN 1" C. INSTALL AS PER NEC 300 - 352. PROVIDE FLEXIBLE CONDUIT SECTION 3 FEET BEFORE TO REACH THE SEF-1 FAN.
16. PROVIDE NEW DUCT SMOKE DETECTORS COMPATIBLE WITH EXISTING FIRE ALARM SYSTEM AND LOCATED AS PER NFPA 72 17.7.5.5. FIRE ALARM SYSTEM SHALL BE RECERTIFIED.

100% CD SUBMITTAL

ENGINEERING
FOR ARCHITECTURE
5757 Blue Lagoon Drive, Suite 400
Mimai, Florida 33126
PH: 305.266.6553
Fax: 350.266.6695
www.tlc-engineers.com
COA 15

CUTLER BAY TOWN CENTER HVAC EQUIPMENT AND CONTROLS

10720 Caribbean Blvd. Cutler Bay, Florida 33189

Revisions:

No.	Date	Description

Seal

Manuel Mollinedo, P.E.
Florida License # 63096

Project No.: Project Number
Issue Date: Issue Date
Drawn By: Author
Approved By: Approver
Scale: 1/8" = 1'-0"

Drawing Title:

PROPOSED ROOF PLAN

Drawing No.:

E108

C:\Revit 2016 Local Models\616018_MEP_R16_barbara.rodriguez.rvt

12/12/2016 2:39:09 PM

Branch Panel: 6LA

Location:
Supply From:
Mounting: Surface
Enclosure: Type 1

Volts: 120/208 Wye
Phases: 3
Wires: 4

A.I.C. Rating:
Mains Type: MCB
Mains Rating: 225 A
MCB Rating: 225 A
Neutral Rating: 100.00%

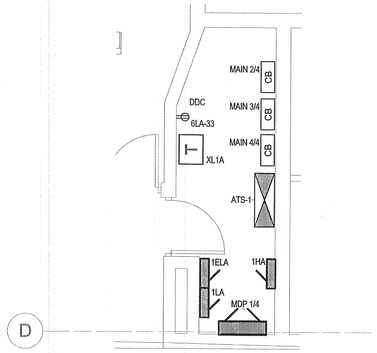
Notes:

CKT	Circuit Description	Note	Trip	Pole	A	B	C	Pole	Trip	Note	Circuit Description	CKT
1	EXISTING CIRCUIT		20 A	1	1.0 kVA	1.0 kVA		1	0 A		EXISTING CIRCUIT	2
3	EXISTING CIRCUIT		20 A	1		1.0 kVA	1.0 kVA	1	20 A		EXISTING CIRCUIT	4
5	EXISTING CIRCUIT		20 A	1			1.0 kVA	1.0 kVA	1	20 A		EXISTING CIRCUIT	6
7	EXISTING CIRCUIT		20 A	1	1.0 kVA	1.0 kVA			1	20 A		EXISTING CIRCUIT	8
9	EXISTING CIRCUIT		20 A	1		1.0 kVA	1.0 kVA		1	20 A		EXISTING CIRCUIT	10
11	EXISTING CIRCUIT		20 A	1			1.0 kVA	1.0 kVA	1	20 A		EXISTING CIRCUIT	12
13	EXISTING CIRCUIT		20 A	1	1.0 kVA	1.0 kVA			1	20 A		EXISTING CIRCUIT	14
15	EXISTING CIRCUIT		20 A	1		1.0 kVA	1.0 kVA		1	20 A		EXISTING CIRCUIT	16
17	EXISTING CIRCUIT		20 A	1			1.0 kVA	1.0 kVA	1	20 A		EXISTING CIRCUIT	18
19	EXISTING CIRCUIT		20 A	1	1.0 kVA	1.0 kVA			1	20 A		EXISTING CIRCUIT	20
21	EXISTING CIRCUIT		20 A	1		1.0 kVA	1.0 kVA		1	20 A		EXISTING CIRCUIT	22
23	EXISTING CIRCUIT		20 A	1			1.0 kVA	1.0 kVA	1	20 A		EXISTING CIRCUIT	24
25	EXISTING CIRCUIT		20 A	1	1.0 kVA	1.0 kVA			1	20 A		EXISTING CIRCUIT	26
27	DDC 6TH FLOOR		20 A	1		0.5 kVA	1.0 kVA		1	20 A		EXISTING CIRCUIT	28
29	DDC 5TH FLOOR		20 A	1			0.5 kVA	0.2 kVA	1	20 A		DDC 4TH FLOOR	30
31	DDC 3RD FLOOR		20 A	1	0.5 kVA	0.5 kVA			1	20 A		DDC 2ND FLOOR	32
33	DDC 1ST FLOOR		20 A	1		0.5 kVA	0.5 kVA		1	20 A		Other	34
35													36
37					0.0 kVA								38
39	MAIN CIRCUIT BREAKER		100 A	3		0.0 kVA							40
41							0.0 kVA						42
	Total Load:				11.0 kVA	10.5 kVA	8.7 kVA						
	Total Amps:				94 A	90 A	73 A						

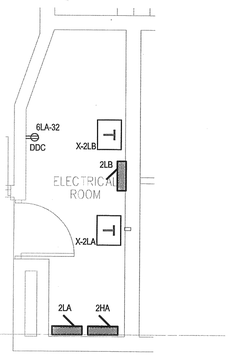
Load Classification	Connected Load	Demand Factor	Estimated Demand
Other	0.5 kVA	100.00%	0.5 kVA
Receptacle	2.7 kVA	100.00%	2.7 kVA

Panel Totals	
Total Conn. Load:	30.2 kVA
Total Est. Demand:	30.20 kVA
Total Conn. Current:	84 A
Total Est. Demand Current:	84 A

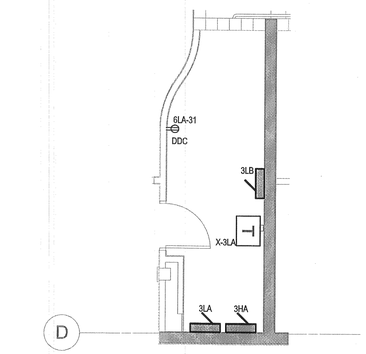
Notes:



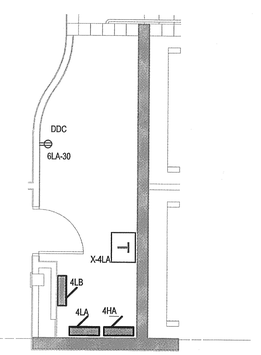
3 N E109 LEVEL 1 - ELECTRICAL ROOM
1/4" = 1'-0"



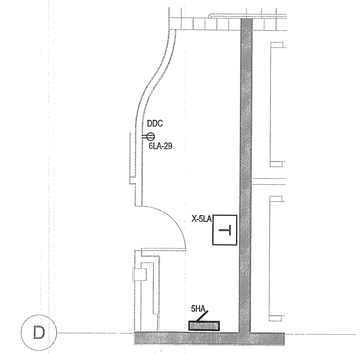
2 N E109 LEVEL 2 - ELECTRICAL ROOM
1/4" = 1'-0"



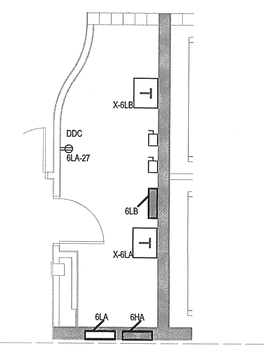
3 N E109 LEVEL 3 - ELECTRICAL ROOM
1/4" = 1'-0"



4 N E109 LEVEL 4 - ELECTRICAL ROOM
1/4" = 1'-0"



5 N E109 LEVEL 5 - ELECTRICAL ROOM
1/4" = 1'-0"



6 N E109 LEVEL 6 - ELECTRICAL ROOM
1/4" = 1'-0"

ENGINEERING
FOR ARCHITECTURE
5757 Blue Lagoon Drive, Suite 400
Miami, Florida 33126
PH: 305.266.6553
Fax: 350.266.6695
www.tlc-engineers.com
COA 15

CUTLER BAY TOWN CENTER HVAC EQUIPMENT AND CONTROLS

10720 Caribbean Blvd. Cutler Bay, Florida 33189

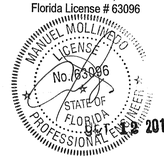
100% CD SUBMITTAL

Revisions:

No.	Date	Description

Seal

Manuel Mollinedo, P.E.
Florida License # 63096

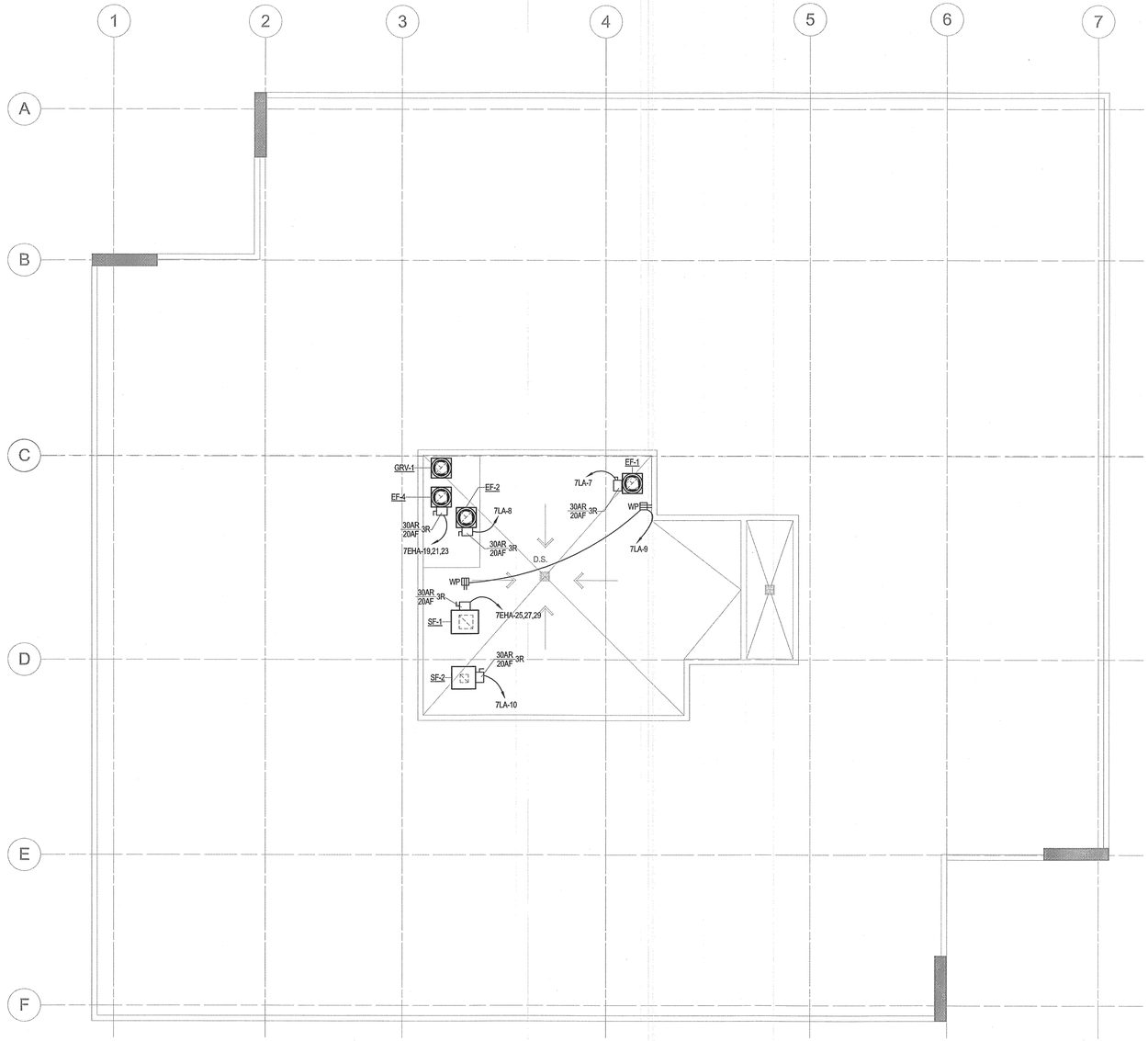


DATE: 1.2. 2016.

Project No.: Project Number
Issue Date: Issue Date
Drawn By: Author
Approved By: Approver
Scale: 1/4" = 1'-0"

Drawing Title:
ENLARGED ELECTRICAL ROOMS

Drawing No.:
E109



1 E110 N ELECTRICAL PENTHOUSER ROOF PLAN
1/8" = 1'-0"

ENGINEERING
FOR ARCHITECTURE
5757 Blue Lagoon Drive, Suite 400
Miami, Florida 33126
PH: 305.266.6553
Fax: 350.266.6695
www.tlc-engineers.com
COA 15

CUTLER BAY TOWN CENTER HVAC EQUIPMENT AND CONTROLS

10720 Caribbean Blvd. Cutler Bay, Florida 33189

Revisions:

No.	Date	Description

Seal

Manuel Mollinedo, P.E.
Florida License # 63096

100% CD SUBMITTAL

Project No.:	Project Number
Issue Date:	Issue Date
Drawn By:	Author
Approved By:	Approver
Scale:	1/8" = 1'-0"

Drawing Title:
ELECTRICAL PENTHOUSER ROOF PLAN

Drawing No.:
E110

C:\Revit 2016 Local Models\616016_MEP_R16_barbara.rodriguez.rvt
12/16/2016 2:39:15 PM

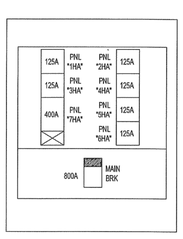
TOWN OF CUTLER BAY
10720 CARIBBEAN BLVD STE 105
ACC NUMBER: 52196-01266

DEMAND [KW] PER MONTH

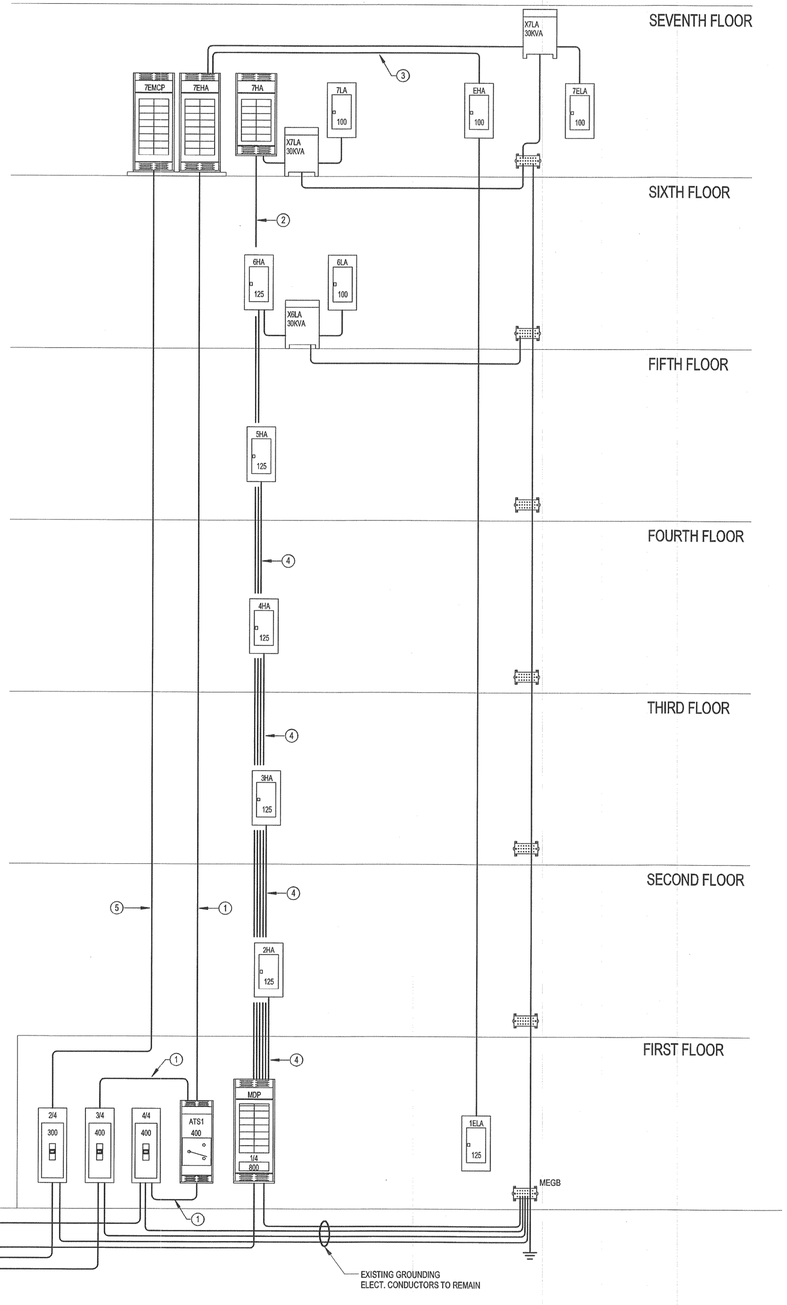
No	YEAR	FROM		TO		DEMAND [KW]
1	2015	JUNE	16	JULY	16	224
2	2015	JULY	16	AUG	17	226
3	2015	AUG	17	SEP	16	230
4	2015	SEP	16	OCT	15	224
5	2015	OCT	15	NOV	13	220
6	2015	NOV	13	DEC	15	218
7	2015	DEC	15	JAN	15	215
8	2016	JAN	15	FEB	15	213
9	2016	FEB	15	MAR	16	213
10	2016	MAR	16	APR	15	221
11	2016	APR	15	MAY	16	221
12	2016	MAY	16	JUN	15	228
13	2016	JUNE	15	JULY	18	231

MAX DEMAND IN A YEAR = 231 KW X 1.25 S.F. = 388.75 KW
388.75 KW @ 480v, 3Ø = 467.5 AMPS

MDFR NOTE: EMERGENCY GENERATOR IN COMPLIANCE WITH NFPA 110.



PANEL "MDP" LAYOUT
(FOR INFO ONLY)



1 E300 PARTIAL ELECTRICAL RISER DIAGRAM
N 6" = 1'-0"

KEYED NOTES:

1. EXISTING 2 SETS: EACH SET = (4) #3/0 AWG THWN + (1) #3 AWG THWN (G) IN 3"C.
1a. SERVICE ENTRANCE CONDUCTORS: EXISTING (4) # 600KCM THWN IN 4" PVC-UG TOTAL AMPACITY = 420 A.
2. EXISTING (4) #500 KCM THWN + (1) # 3 AWG THWN (G) IN 3-1/2" C.
3. EXISTING (4) #1 AWG THWN + (1) # 6 AWG THWN (G) IN 1-1/4" C.
4. EXISTING (4) #1 AWG THWN + (1) #6 AWG THWN (G) IN 1-1/4"C.
5. EXISTING (4) #400 KCM THWN + (1) #4 AWG THWN (G) IN 3"C.
5a. SERVICE ENTRANCE CONDUCTORS: EXISTING (4) #400 KCM THWN IN 4" PVC-UG TOTAL AMPACITY = 335 A.
6. EXISTING SERVICE ENTRANCE CONDUCTORS (SIZE NO VERIFIED).
7. EXISTING FEEDERS TO REMIAN (SIZE NO VERIFIED).

NOTE ON PARTIAL RISER DIAGRAM:

THE PARTIAL RISER DIAGRAM SHOWN ON THIS PLANS IS ESSENTIALLY THAT: A PARTIAL RISER DIAGRAM, AND WAS OBTAINED FROM THE INTEGRATION OF SEVERAL OTHER PARTIAL RISER DIAGRAMS TAKEN FROM OTHER REMODELING PROJECTS OF DIFFERENT AREAS OF THE BUILDING.

THE ORIGINAL WHOLE RISER DIAGRAM WAS NOT AVAILABLE DURING THE DESIGN PHASE OF THIS PROJECT. SITE VISIT AND WALK-THRU WERE PERFORMED AND THE INFORMATION GATHERED IS INCLUDED ON THIS PARTIAL RISER DIAGRAM.

NO ALL PANELS NEITHER DISCONNECTS COULD BE OPENED TO VERIFY CABLE SIZES OR CIRCUIT DIRECTORY.

PANELS, DISCONNECTS, TRANSFORMERS, AND OTHER ELECTRICAL EQUIPMENT NOT PART OF THIS SCOPE OF WORK ARE NOT SHOWN ON THIS PARTIAL RISER DIAGRAM.

ELECTRICAL CONTRACTOR SHALL VERIFY EVERY BRANCH CIRCUIT TO BE REUSED OR INSTALLED BEFORE TO PROCEED WITH CONNECTION.

BRANCH CIRCUIT WIRING SCHEDULE

BREAKER SIZE	THHN/THWN CONDUCTOR	GROUND	CONDUIT
20A	12	12	3/4"
30A	10	10	3/4"
35A	8	10	3/4"
40A	8	10	3/4"
45A	6	10	3/4"
50A	6	10	3/4"
60A	6	10	3/4"
80A	3	8	1"

NOTE:
1. PROVIDE A CONDUCTOR PER BREAKER POLE. THESE ARE THE MINIMUM SIZES REQUIRED FOR EACH CIRCUIT. CONTRACTOR TO MAKE ALL THE NECESSARY FIELD ADJUSTMENTS TO COMPENSATE FOR VOLTAGE DROP.
2. ALL 120V, 20A BRANCH CIRCUITS OVER 80'-0" IN LENGTH SHALL BE #10 AWG CU. CONDUCTORS MINIMUM TO ACCOMMODATE VOLTAGE DROP. WHERE A CONFLICT EXISTS BETWEEN THIS REQUIREMENT AND CONDUCTOR SIZES INDICATED ELSEWHERE IN THE CONTRACT DOCUMENTS, THIS REQUIREMENT SHALL TAKE PRECEDENCE.
3. IN GENERAL, VOLTAGE DROP FOR ANY BRANCH CIRCUIT SHALL NOT EXCEED 3%. VOLTAGE DROP FOR ANY FEEDER SHALL NOT EXCEED 2%. WHERE VOLTAGE DROP EXCEEDS THESE REQUIREMENTS, THE CONTRACTOR SHALL INCREASE THE SIZE OF THE CONDUCTORS AND RACEWAY AS REQUIRED.

ENTIRE SHEET HAS BEEN REVISED

ENGINEERING
FOR ARCHITECTURE
5757 Blue Lagoon Drive, Suite 400
Miami, Florida 33126
PH: 305.266.6553
Fax: 350.266.6695
www.tlc-engineers.com
COA 15

CUTLER BAY TOWN CENTER HVAC EQUIPMENT AND CONTROLS

10720 Caribbean Blvd. Cutler Bay, Florida 33189

Revisions:

No.	Date	Description
1	11-16-16	Building Dept. Comments

Seal

Manuel Mollinedo, P.E.
Florida License # 63096

100% CD SUBMITTAL

Project No.: Project Number
Issue Date: Issue Date
Drawn By: Author
Approved By: Approver
Scale: As indicated

Drawing Title:
ELECTRICAL RISER DIAGRAMS

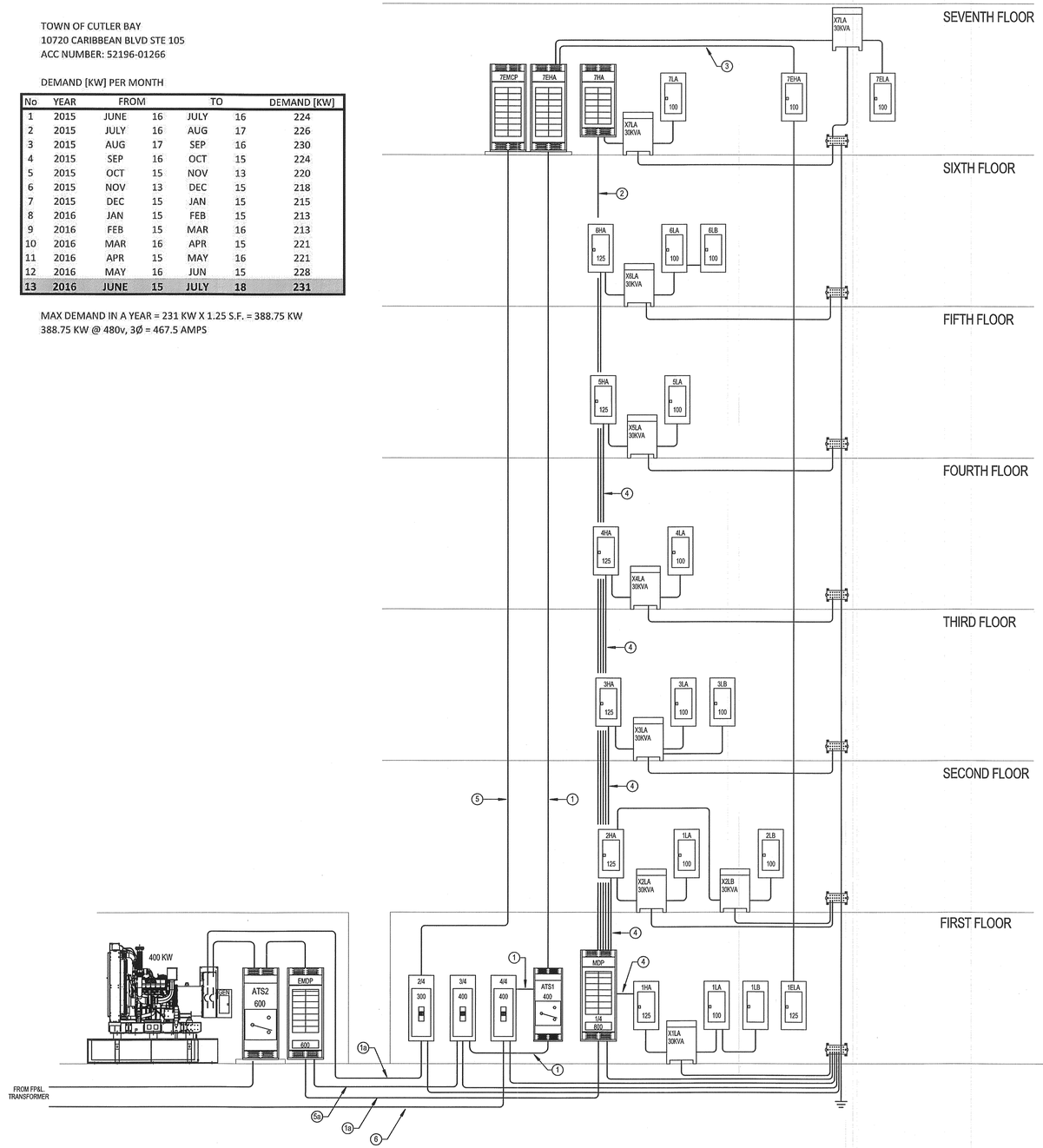
Drawing No.:
E300

TOWN OF CUTLER BAY
10720 CARIBBEAN BLVD STE 105
ACC NUMBER: 52196-01266

DEMAND [KW] PER MONTH

No	YEAR	FROM		TO		DEMAND [KW]
1	2015	JUNE	16	JULY	16	224
2	2015	JULY	16	AUG	17	226
3	2015	AUG	17	SEP	16	230
4	2015	SEP	16	OCT	15	224
5	2015	OCT	15	NOV	13	220
6	2015	NOV	13	DEC	15	218
7	2015	DEC	15	JAN	15	215
8	2016	JAN	15	FEB	15	213
9	2016	FEB	15	MAR	16	213
10	2016	MAR	16	APR	15	221
11	2016	APR	15	MAY	16	221
12	2016	MAY	16	JUN	15	228
13	2016	JUNE	15	JULY	18	231

MAX DEMAND IN A YEAR = 231 KW X 1.25 S.F. = 388.75 KW
388.75 KW @ 480v, 3Ø = 467.5 AMPS



1 E300 PARTIAL ELECTRICAL RISER DIAGRAM
6" = 1'-0"

KEYED NOTES:

1. EXISTING 2 SETS: EACH SET = (4) #3/0 AWG THWN + (1) #3 AWG THWN (G) IN 3"C.
1a. SERVICE ENTRANCE CONDUCTORS: EXISTING (4) # 600KCM THWN IN 4" PVC-UG TOTAL AMPACITY = 420 A.
2. EXISTING (4) #500 KCM THWN + (1) # 3 AWG THWN (G) IN 3-1/2" C.
3. EXISTING (4) #1 AWG THWN + (1) # 6 AWG THWN (G) IN 1-1/4" C.
4. EXISTING (4) #1 AWG THWN + (1) #6 AWG THWN (G) IN 1-1/4"C.
5. EXISTING (4) #400 KCM THWN + (1) #4 AWG THWN (G) IN 3"C.
5a. SERVICE ENTRANCE CONDUCTORS: EXISTING (4) #400 KCM THWN IN 4" PVC-UG TOTAL AMPACITY = 335 A.

BRANCH CIRCUIT WIRING SCHEDULE

BREAKER SIZE	THHN/THWN CONDUCTOR	GROUND	CONDUIT
20A	12	12	3/4"
30A	10	10	3/4"
35A	8	10	3/4"
40A	8	10	3/4"
45A	6	10	3/4"
50A	6	10	3/4"
60A	6	10	3/4"
80A	3	8	1"

NOTE:
1. PROVIDE A CONDUCTOR PER BREAKER POLE. THESE ARE THE MINIMUM SIZES REQUIRED FOR EACH CIRCUIT. CONTRACTOR TO MAKE ALL THE NECESSARY FIELD ADJUSTMENTS TO COMPENSATE FOR VOLTAGE DROP.
2. ALL 120V, 20A BRANCH CIRCUITS OVER 80'-0" IN LENGTH SHALL BE #10 AWG CU. CONDUCTORS MINIMUM TO ACCOMMODATE VOLTAGE DROP. WHERE A CONFLICT EXISTS BETWEEN THIS REQUIREMENT AND CONDUCTOR SIZES INDICATED ELSEWHERE IN THE CONTRACT DOCUMENTS, THIS REQUIREMENT SHALL TAKE PRECEDENCE.
3. IN GENERAL, VOLTAGE DROP FOR ANY BRANCH CIRCUIT SHALL NOT EXCEED 3%. VOLTAGE DROP FOR ANY FEEDER SHALL NOT EXCEED 2%. WHERE VOLTAGE DROP EXCEEDS THESE REQUIREMENTS, THE CONTRACTOR SHALL INCREASE THE SIZE OF THE CONDUCTORS AND RACEWAY AS REQUIRED.

ENGINEERING
FOR ARCHITECTURE
5757 Blue Lagoon Drive, Suite 400
Mimai, Florida 33126
PH: 305.266.6553
Fax: 350.266.6695
www.tlc-engineers.com
COA 15

CUTLER BAY TOWN CENTER HVAC EQUIPMENT AND CONTROLS

10720 Caribbean Blvd. Cutler Bay, Florida 33189

Revisions:

No.	Date	Description

Seal
Manuel Mollinedo, P.E.
Florida License # 63096

MANUEL MOLLINEDO LICENSE No. 63096 STATE OF FLORIDA PROFESSIONAL ENGINEER
OCT 12 2016

100% CD SUBMITTAL

Project No.: Project Number
Issue Date: Issue Date
Drawn By: Author
Approved By: Approver
Scale: As indicated

Drawing Title: ELECTRICAL RISER DIAGRAMS

Drawing No.: E300

C:\Revit 2016 Local Models\616018_MEP_R16_barbara.rodriguez.rvt
10/12/2016 2:39:17 PM

Branch Panel: 1HA

Location: | **Volts:** 480/277 Wye | **A.I.C. Rating:**
Supply From: | **Phases:** 3 | **Mains Type:** MLO
Mounting: Surface | **Wires:** 4 | **Mains Rating:** 400 A
Enclosure: Type 1 | **MCB Rating:**
Neutral Rating: 100.00%

Notes:

CKT	Circuit Description	Note	Trip	Pole	A	B	C	Pole	Trip	Note	Circuit Description	CKT
1	EXIST.LIGHTS CIRCUIT		20 A	1	3.2 kVA	4.0 kVA		1	20 A		EXIST. LIGHTS CIRCUIT	2
3	EXIST. LIGHTS CIRCUIT		20 A	1			3.3 kVA	4.0 kVA	1	20 A		EXIST. LIGHTS COMMON AREAS	4
5	VAV-1-13, VAV -1-12, VAV-1-19		20 A	1				2.4 kVA	0.8 kVA	1	20 A		VAV-1-4	6
7	VAV-1-14, VAV-1-22		20 A	1	0.8 kVA	1.6 kVA				1	20 A		VAV-1-15, VAV-X-X	8
9	VAV-1-11, VAV-1-0, VAV-1-21		20 A	1			2.4 kVA	3.0 kVA		1	20 A		VAV-1-1	10
11	VAV-1-6		20 A	1					0.8 kVA	1.6 kVA	1	20 A		VAV-1-2, VAV-1-20	12
13	VAV-1-18, VAV-1-19		20 A	1	1.6 kVA	0.0 kVA					1	20 A			14
15	VAV-1-3		20 A	1			0.8 kVA	0.0 kVA			1	20 A			16
17	VAV-1-5, VAV-1-16		20 A	1					1.6 kVA	0.8 kVA	1	20 A		VAV-1-9,	18
19	DH-1-1		20 A	1	3.0 kVA	0.0 kVA					1	20 A			20
21	DH-1-3		20 A	1			3.0 kVA	0.0 kVA			1	20 A			22
23	DH-1-4		20 A	1				3.0 kVA	3.0 kVA	1	20 A		DH-1-13	24
25	DH-1-6		20 A	1	3.0 kVA	7.0 kVA									26
27			20 A	1			0.0 kVA	7.0 kVA		3	50 A		EXIST. TRANSFORMER X-L1A	28
29									7.0 kVA						30
31															32
33															34
35															36
37															38
39															40
41															42
			Total Load:		24.2 kVA		23.5 kVA		21.0 kVA						
			Total Amps:		89 A		86 A		76 A						

Load Classification	Connected Load	Demand Factor	Estimated Demand	Panel Totals	
HVAC	33.2 kVA	102.26%	34.0 kVA		
Other	21.0 kVA	100.00%	21.0 kVA	Total Conn. Load:	68.7 kVA
				Total Est. Demand:	69.45 kVA
				Total Conn. Current:	83 A
				Total Est. Demand Current:	84 A

Notes:

Branch Panel: 2HA

Location: | **Volts:** 480/277 Wye | **A.I.C. Rating:**
Supply From: | **Phases:** 3 | **Mains Type:** MCB
Mounting: Surface | **Wires:** 4 | **Mains Rating:** 225 A
Enclosure: Type 1 | **MCB Rating:** 225 A
Neutral Rating: 100.00%

Notes:

CKT	Circuit Description	Note	Trip	Pole	A	B	C	Pole	Trip	Note	Circuit Description	CKT
1	EXIST. LIGHTS CIRCUIT		20 A	1	0.5 kVA	0.4 kVA		1	20 A		EXIST. LIGHTS CIRCUIT	2
3	EXIST. LIGHTS CIRCUIT		20 A	1			0.6 kVA	0.7 kVA	1	20 A		EXIST. LIGHTS COMMON AREAS	4
5	EXIST. LIGHTS CIRCUIT		20 A	1					0.3 kVA	0.0 kVA	1	20 A		SPARE	6
7	VAV-2-1, VAV-2-2, VAV-2-15, VAV-2-1		20 A	1	8.0 kVA	0.0 kVA					1	20 A		SPARE	8
9	VAV-2-14		20 A	1			0.8 kVA	0.0 kVA			1	20 A		SPARE	10
11	VAV-2-3, VAV-2-4, VAV-2-16		20 A	1					4.6 kVA	0.0 kVA	1	20 A		VAV-2-X	12
13	DH-2-12		20 A	1	3.0 kVA	1.6 kVA					1	20 A		VAV-2-10, VAV-2-11, VAV-2-19	14
15	VAV-2-8, VAV-2-9, VAV-2-18		20 A	1			0.8 kVA	3.8 kVA			1	20 A		VAV-2-12	16
17	DH-2-14		20 A	1					3.0 kVA	3.0 kVA	1	20 A		DH-2-2	18
19	DH-2-3		20 A	1	3.0 kVA	0.8 kVA					1	20 A		VAV-2-5, VAV-2-13, VAV-2-22	20
21	DH-2-4		20 A	1			3.0 kVA								22
23	VAV-2-6, VAV-2-7, VAV-2-17		20 A	1				0.8 kVA							24
25						7.0 kVA									26
27								7.0 kVA			3	50 A		EXIST. TRANSFORMER X-2LA	28
29									7.0 kVA						30
			Total Load:		24.3 kVA		16.7 kVA		18.7 kVA						
			Total Amps:		89 A		60 A		69 A						

Load Classification	Connected Load	Demand Factor	Estimated Demand	Panel Totals	
HVAC	36.2 kVA	102.07%	37.0 kVA		
Other	21.0 kVA	100.00%	21.0 kVA	Total Conn. Load:	59.7 kVA
				Total Est. Demand:	60.45 kVA
				Total Conn. Current:	72 A
				Total Est. Demand Current:	73 A

Notes:

Branch Panel: 3HA

Location: | **Volts:** 480/277 Wye | **A.I.C. Rating:**
Supply From: | **Phases:** 3 | **Mains Type:** MLO
Mounting: Surface | **Wires:** 4 | **Mains Rating:** 225 A
Enclosure: Type 1 | **MCB Rating:**
Neutral Rating: 100.00%

Notes:

CKT	Circuit Description	Note	Trip	Pole	A	B	C	Pole	Trip	Note	Circuit Description	CKT
1	EXIST. LIGHT CIRCUIT		20 A	1	1.0 kVA	0.7 kVA		1	20 A		EXIST. LIGHT CIRCUIT	2
3	EXIST. LIGHT CIRCUIT		20 A	1			1.2 kVA	0.5 kVA	1	20 A		EXIST. LIGHT CIRCUIT	4
5	EXIST. LIGHT CICUIT		20 A	1					0.4 kVA	0.6 kVA	1	20 A		EXIST. LIGHT CIRCUIT	6
7	VAV-3-8		20 A	1	0.8 kVA	3.8 kVA					1	20 A		VAV-3-13, VAV-3-20	8
9	VAV-3-9, VAV-3-18		20 A	1			1.6 kVA	2.4 kVA			1	20 A		VAV-3-7, VAV-3-10, VAV-3-17	10
11	VAV-3-22		20 A	1					0.8 kVA	1.6 kVA	1	20 A		VAV-3-12, VAV-3-19	12
13	VAV-3-1, VAV-3-2, VAV-3-3		20 A	1	4.6 kVA	1.6 kVA					1	20 A		VAV-3-14, VAV-3-15	14
15	VAV-3-10, VAV-3-11		20 A	1			3.8 kVA	4.6 kVA			1	20 A		VAV-3-4, VAV-3-5, VAV-3-16	16
17	DH-3-11		20 A	1					3.0 kVA	3.0 kVA	1	20 A		DH-3-13	18
19	DH-3-1		20 A	1	3.0 kVA	3.0 kVA					1	20 A		DH-3-2	20
21	DH-3-4		20 A	1			3.0 kVA	3.0 kVA			1	20 A		DH-3-5	22
23	DH-3-8		20 A	1					3.0 kVA						24
25						7.0 kVA									26
27								7.0 kVA			3	60 A		EXIST. TRANSFORMER X-3LA	28
29										7.0 kVA					30
			Total Load:		25.5 kVA		27.1 kVA		19.4 kVA						
			Total Amps:		95 A		101 A		70 A						

Load Classification	Connected Load	Demand Factor	Estimated Demand	Panel Totals	
HVAC	46.6 kVA	101.61%	47.4 kVA		
Other	21.0 kVA	100.00%	21.0 kVA	Total Conn. Load:	72.0 kVA
				Total Est. Demand:	72.78 kVA
				Total Conn. Current:	87 A
				Total Est. Demand Current:	88 A

Notes:

Branch Panel: 4HA

Location: | **Volts:** 480/277 Wye | **A.I.C. Rating:**
Supply From: | **Phases:** 3 | **Mains Type:** MLO
Mounting: Surface | **Wires:** 4 | **Mains Rating:** 225 A
Enclosure: Type 1 | **MCB Rating:**
Neutral Rating: 100.00%

Notes:

CKT	Circuit Description	Note	Trip	Pole	A	B	C	Pole	Trip	Note	Circuit Description	CKT
1	EXIST. LIGHT CIRCUIT		20 A	1	0.3 kVA	0.0 kVA		1	20 A		EXIST. LIGHT CIRCUIT	2
3	EXIST. LIGHT CIRCUIT		20 A	1			0.5 kVA	0.6 kVA	1	20 A		EXIST. LIGHT CIRCUIT	4
5	EXIST. LIGHT CIRCUIT		20 A	1					0.3 kVA	0.6 kVA	1	20 A		EXIST. LIGHT CIRCUIT	6
7	VAV-4-26, VAV-4-15, VAV-4-27, VAV-4-20		20 A	1	3.2 kVA	3.8 kVA					1	20 A		VAV.-4-19, VAV-4-22	8
9	VAV-4-4, VAV-4-9, VAV-4-8,		20 A	1			1.6 kVA	1.6 kVA			1	20 A		VAV-4-6, VAV-4-7	10
11	VAV-4-17, VAV-4-16, VAV-4-21		20 A	1					2.4 kVA	3.0 kVA	1	20 A		VAV-4-1	12
13	VAV-4-10		20 A	1	3.0 kVA	3.0 kVA					1	20 A		VAV-4-2	14
15	VAV-4-12		20 A	1			3.0 kVA	3.0 kVA			1	20 A		VAV-4-11	16
17	VAV-4-12		20 A	1					3.0 kVA	3.0 kVA	1	20 A		VAV-4-13	18
19	VAV-4-14		20 A	1	3.0 kVA	3.0 kVA					1	20 A		VAV-4-23	20
21	VAV-4-18		20 A	1			3.0 kVA	3.5 kVA			1	20 A		VAV-4-27A	22
23	VAV-4-3, VAV-4-4, VAV-4-5		20 A	1					4.7 kVA	3.0 kVA	1	20 A		DH-4-10	24
25	DH-4-6		20 A	1	3.0 kVA	7.0 kVA									26
27	DH-4-7		20 A	1			3.0 kVA	7.0 kVA		3	60 A		EXIST. TRANSFORMER X-4LA	28
29									7.0 kVA						30
			Total Load:		29.3 kVA		26.8 kVA		27.0 kVA						
			Total Amps:		106 A		97 A		97 A						

Load Classification	Connected Load	Demand Factor	Estimated Demand	Panel Totals	
HVAC	59.8 kVA	101.46%	60.7 kVA		
Other	21.0 kVA	100.00%	21.0 kVA	Total Conn. Load:	83.1 kVA
				Total Est. Demand:	83.97 kVA
				Total Conn. Current:	100 A
				Total Est. Demand Current:	101 A

Notes:

Branch Panel: 5HA

Location: | **Volts:** 480/277 Wye | **A.I.C. Rating:**
Supply From: | **Phases:** 3 | **Mains Type:** MLO
Mounting: Surface | **Wires:** 4 | **Mains Rating:** 225 A
Enclosure: Type 1 | **MCB Rating:**
Neutral Rating: 100.00%

Notes:

CKT	Circuit Description	Note	Trip	Pole	A	B	C	Pole	Trip	Note	Circuit Description	CKT
1	EXIST. LIGHT CIRCUIT		20 A	1	0.5 kVA	0.6 kVA		1	20 A		EXIST. LIGHT CIRCUIT	2
3	EXIST. LIGHT CIRCUIT		20 A	1			0.5 kVA	0.8 kVA	1	20 A		EXIST. LIGHT CIRCUIT	4
5	EXIST. LIGHT CIRCUIT		20 A	1					0.5 kVA	0.6 kVA	1	20 A		EXIST. LIGHT CIRCUIT	6
7	VAV-5-3, VAV-5-4		20 A	1	2.4 kVA	1.6 kVA					1	20 A		VAV-5-1, VAV-5-2	8
9	VAV-5-8		20 A	1			3.0 kVA	4.3 kVA			1	20 A		VAV-5-12, VAV-5-13	10
11	VAV-5-6		20 A	1					3.0 kVA	3.5 kVA	1	20 A		VAV-5-10	12
13	VAV-5-21, VAV-5-22		20 A	1	1.6 kVA	1.6 kVA					1	20 A		VAV-5-15, VAV-5-16	14
15	VAV-5-11, VAV-5-14		20 A	1			1.6 kVA	1.6 kVA			1	20 A		VAV-5-19, VAV-5-20	16
17	VAV-5-17, VAV-5-18		20 A	1					1.6 kVA	2.4 kVA	1	20 A		VAV-5-5, VAV-5-7, VAV-5-9	18
19															20
21															22
23															24
25						7.0 kVA									26
27								7.0 kVA			3	50 A		EXIST TRANSFORMER X-5LA	28
29									7.0 kVA						30
			Total Load:		15.3 kVA		18.8 kVA		18.6 kVA						
			Total Amps:		55 A		70 A		69 A						

Load Classification	Connected Load	Demand Factor	Estimated Demand	Panel Totals	
HVAC	28.2 kVA	103.10%	29.1 kVA		
Other	21.0 kVA	100.00%	21.0 kVA	Total Conn. Load:	52.7 kVA
				Total Est. Demand:	53.53 kVA
				Total Conn. Current:	63 A
				Total Est. Demand Current:	64 A

Notes:

Branch Panel: 6HA

Location: | **Volts:** 480/277 Wye | **A.I.C. Rating:**
Supply From: | **Phases:** 3 | **Mains Type:** MLO
Mounting: Surface | **Wires:** 4 | **Mains Rating:** 225 A
Enclosure: Type 1 | **MCB Rating:**
Neutral Rating: 100.00%

Notes:

CKT	Circuit Description	Note	Trip	Pole	A	B	C	Pole	Trip	Note	Circuit Description	CKT
1	EXISTING LIGHT CIRCUIT		20 A	1	0.3 kVA	0.6 kVA		1	20 A		EXISTING LIGHT CIRCUIT	2
3	EXISTING LIGHT CIRCUIT		20 A	1			0.5 kVA	0.4 kVA				EXISTING LIGHT CIRCUIT	4
5	EXISTING LIGHT CIRCUIT		20 A	1					0.7 kVA	0.5 kVA	1	20 A		EXISTING LIGHT CIRCUIT	6
7	VAV-6-2		25 A	1	4.5 kVA	5.0 kVA					1	25 A		VAV-6-11	8
9	VAV-6-3		20 A	1			4.0 kVA	3.5 kVA			1	20 A		VAV-6-12	10
11	VAV-6-4		25 A	1					5.0 kVA	3.5 kVA	1	20 A		VAV-6-13	12
13	VAV-6-5		20 A	1	3.5 kVA	3.5 kVA					1	20 A		VAV-6-14	14
15	VAV-6-6		20 A	1			3.5 kVA	2.4 kVA			1	20 A		VAV-6-1, VAV-6-15, VAV-6-23	16
17	VAV-6-7		20 A	1					3.5 kVA	1.6 kVA	1	20 A		VAV-6-16, VAV-6-21	18
19	VAV-6-8		20 A	1	3.5 kVA	1.6 kVA					1	20 A		VAV-6-28, VAV-6-29	20
21	VAV-6-9		20 A	1			4.0 kVA	2.4 kVA			1	20 A		VAV-6-19, VAV-6-20, VAV-6-22	22
23	VAV-6-10		20 A	1					4.0 kVA	1.6 kVA	1	20 A		VAV-6-17, VAV-6-18	24
25					0.0 kVA	7.0 kVA									26
27	SPARE		20 A	3			0.0 kVA	7.0 kVA			3	60 A		EXISTING TRANSFORMER X-6LA	28
29									0.0 kVA	7.0 kVA					30
			Total Load:		29.5 kVA		27.7 kVA		27.4 kVA						
			Total Amps:		107 A		100 A		99 A						

Load Classification	Connected Load	Demand Factor	Estimated Demand	Panel Totals	
HVAC	60.6 kVA	102.06%	61.9 kVA		
Other	21.0 kVA	100.00%	21.0 kVA	Total Conn. Load:	84.6 kVA
				Total Est. Demand:	85.85 kVA
				Total Conn. Current:	102 A
				Total Est. Demand Current:	103 A

Notes:

TLC ENGINEERING FOR ARCHITECTURE
5757 Blue Lagoon Drive, Suite 400
Miami, Florida 33126
PH: 305.266.6553
Fax: 350.266.6695
www.tlc-engineers.com
COA 15

CUTLER BAY TOWN CENTER HVAC EQUIPMENT AND CONTROLS

10720 Caribbean Blvd. Cutler Bay, Florida 33189

Revisions:

No.	Date	Description

Seal

Manuel Mollinedo, P.E.
Florida License # 63096

100% CD SUBMITTAL

Project No.: Project Number
Issue Date: Issue Date
Drawn By: Author
Approved By: Approver
Scale:

Drawing Title: ELECTRICAL SCHEDULES

Drawing No.: E302

C:\Revit 2016 Local Models\616018_MEP_R16_barbara.rodriguez.rvt
10/12/2016 2:39:22 PM

PANELBOARD NAME:	PANEL"7HA" (EXISTING)	45,000 RMS SYMMETRICAL A.I.C.	
PANELBOARD TYPE:	MAIN LUGS ONLY	SURFACE MOUNTED, NEMA 1 ENCLOSURE	
PANEL LOCATION:	ROOF ELECT ROOM	480Y/277 VOLTS, 3 PHASE, 4 WIRE, 60 Hz	400 AMP FRAME
SUPPLIED FROM:	MDP		

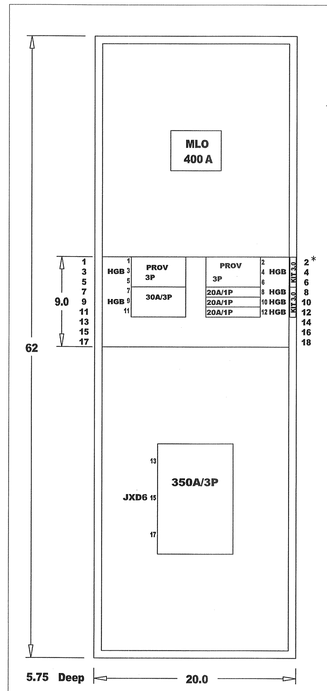
CKT NO.	TRIP AMPS	NO. POLES	WIRE / GND / COND	LOAD SERVED	LOAD VA	Ø	LOAD VA	LOAD SERVED	WIRE / GND / COND	NO. POLES	TRIP AMPS	CKT NO.
1	20	1	2#12 , #12 GND, 1/2" C	EXIST.CIRCUIT TO REMAIN	1500	A	2000	EXIST XFMR 7LA TO REMAIN	3#10 , #10 GND, 3/4" C	3	30	2
3	20	1	2#12 , #12 GND, 1/2" C	EXIST.CIRCUIT TO REMAIN	1500	B	2000					
5	20	1	2#12 , #12 GND, 1/2" C	EXIST.CIRCUIT TO REMAIN	1500	C	2000					
7		3		SPACE		A		SPACE		3		8
						B						
						C						
13	200	3	3#3/0 , #6 GND, 2" C	EXIST.CU #1 (DEMOLISH)	23960	A	23960	EXITING CU#2 (DEMOLISH)	3#3/0 , #6 GND, 2" C	3	200	14
					23960	B	23960					
					23960	C	23960					

TOTAL CONNECTED LOAD = 154.3 kVA X 100% DEMAND FACTOR = 154.3 kVA ESTIMATED DEMAND LOAD
PHASE BALANCE (KVA) - A: 51.4 , B: 51.4 , C: 51.4 DESIGN LOAD = 186 AMPERES, TOTAL LOAD WITH EXPANSION = 186 AMPERES

PANELBOARD NAME:	REPLACED PANEL"7HA"	45,000 RMS SYMMETRICAL A.I.C.	
PANELBOARD TYPE:	MAIN LUGS ONLY	SURFACE MOUNTED, NEMA 1 ENCLOSURE	
PANEL LOCATION:	ROOF ELECT ROOM	480Y/277 VOLTS, 3 PHASE, 4 WIRE, 60 Hz	400 AMP FRAME
SUPPLIED FROM:	MDP		

CKT NO.	TRIP AMPS	NO. POLES	WIRE / GND / COND	LOAD SERVED	LOAD VA	Ø	LOAD VA	LOAD SERVED	WIRE / GND / COND	NO. POLES	TRIP AMPS	CKT NO.
1	20	1	2#12 , #12 GND, 1/2" C	EXISTING CIRCUIT	1000	A	2000	EXISTING XFMR 7LA	3#10 , #10 GND, 3/4" C	3	30	2
3	20	1	2#12 , #12 GND, 1/2" C	EXISTING CIRCUIT	1000	B	2000					
5	20	1	2#12 , #12 GND, 1/2" C	EXISTING CIRCUIT	1000	C	2000					
7		3		SPACE		A		SPACE		3		8
						B						
						C						
13	350	3	3#500 , #4 GND, 3" C	NEW CHILLER	58751	A	3048	NEW CHWP (7.5 HP)	3#10 , #10 GND, 3/4" C	3	20	14
					58751	B	3048					
					58751	C	3048					

TOTAL CONNECTED LOAD = 194.4 kVA X 100% DEMAND FACTOR = 194.4 kVA ESTIMATED DEMAND LOAD
PHASE BALANCE (KVA) - A: 64.8 , B: 64.8 , C: 64.8 DESIGN LOAD = 234 AMPERES, TOTAL LOAD WITH EXPANSION = 234 AMPERES



PANELBOARD NOTES

SECTION	:1 OF 1
PANEL TYPE	:P2
CATALOG NUMBER	:P2E18ML400ATS
ENCLOSURE	:1 Indoor
SYSTEM VOLTAGE	:480Y/277 3Ø 4W Wye AC
IR RATING	:35 K AIC
MAIN BUS	:400 A
BUS MATERIAL	:Aluminum Tin
FEED	:Top
MOUNTING	:Surface
SE LABEL	:No
SERIES RATED	:No
CONDUIT AREA	:N/A

*INDICATES POSITIONING NUMBERS TO HELP WITH THE MANUAL PLACEMENT OF BREAKERS ON THE MECHANICAL VIEW

PANELBOARD COMPONENTS

Main :
1 - 400A MAIN LUG
1-(1)4/0-600Kcmil

Branches :
2 - 3P-HGB - PROV
1 - 30A /3P-HGB
3 - 20A /1P-HGB
1 - 350A /3P-JXD6

Options :
1-Card Holder-Std Plastic Sleeve
1-NP Location - Trim
1-Certification - UL
1-Std Al/Cu Gnd Connector

NEW PANEL "7HA" LAYOUT: PANEL SHALL BE SIEMENS CAT NO. P2E18ML400ATS.
NO SUSTITUTION IS ALLOWED.

PANELBOARD NAME:	PANEL"7EHA" (EXISTING)	45,000 RMS SYMMETRICAL A.I.C.	
PANELBOARD TYPE:	MAIN LUGS ONLY	SURFACE MOUNTED, NEMA 1 ENCLOSURE	
PANEL LOCATION:	ROOF ELECT ROOM	480Y/277 VOLTS, 3 PHASE, 4 WIRE, 60 Hz	400 AMP FRAME
SUPPLIED FROM:	ATS 1		

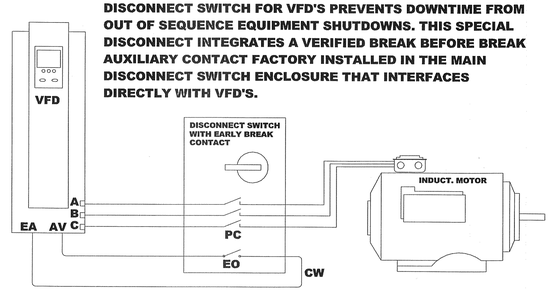
CKT NO.	TRIP AMPS	NO. POLES	WIRE / GND / COND	LOAD SERVED	LOAD VA	Ø	LOAD VA	LOAD SERVED	WIRE / GND / COND	NO. POLES	TRIP AMPS	CKT NO.
1	40	3	4#8 , #10 GND, 1 1/2" C	EXIST.XFMR 7ELA	4000	A	6000	PANEL EHA	4#6 , #10 GND, 1" C	3	60	2
					4000	B	6000					
					4000	C	6000					
7	100	3	3#2 , #8 GND, 2" C	EXIST. ELEVATOR MACHINE	18844	A		SPACE		3		8
					18844	B						
					18844	C						
13	200	3	3#3/0 , #6 GND, 3" C	EXIST. AHU (75 HP)	26600	A		SPACE		3		14
					26600	B						
					26600	C						

TOTAL CONNECTED LOAD = 166.3 kVA X 100% DEMAND FACTOR = 166.3 kVA ESTIMATED DEMAND LOAD
PHASE BALANCE (KVA) - A: 55.4 , B: 55.4 , C: 55.4 DESIGN LOAD = 200 AMPERES, TOTAL LOAD WITH EXPANSION = 200 AMPERES

PANELBOARD NAME:	PANEL"7EHA" (EXIST. AFTER WORKS)	45,000 RMS SYMMETRICAL A.I.C.	
PANELBOARD TYPE:	MAIN LUGS ONLY	SURFACE MOUNTED, NEMA 1 ENCLOSURE	
PANEL LOCATION:	ROOF ELECT ROOM	480Y/277 VOLTS, 3 PHASE, 4 WIRE, 60 Hz	400 AMP FRAME
SUPPLIED FROM:	ATS 1		

CKT NO.	TRIP AMPS	NO. POLES	WIRE / GND / COND	LOAD SERVED	LOAD VA	Ø	LOAD VA	LOAD SERVED	WIRE / GND / COND	NO. POLES	TRIP AMPS	CKT NO.
1	40	3	4#8 , #10 GND, 1 1/2" C	EXIST. XFMR "7ELA"	4000	A	6000	EXIST. PANEL" EHA"	4#6 , #10 GND, 1" C	3	60	2
					4000	B	6000					
					4000	C	6000					
7	100	3	3#2 , #8 GND, 2" C	EXIST. ELEVATOR MACHINE	18844	A	5820	NEW EEF-1 (15 HP)	3#4 , #8 GND, 1" C	3	80	8
					18844	B	5820					
					18844	C	5820					
13	200	3	3#3/0 , #6 GND, 3" C	NEW AHU (75P)	25495	A	443	NEW SPF-2 (3/4 HP)	3#10 , #10 GND, 3/4" C	3	20	14
					25495	B	443					
					25495	C	443					
19	20	3	3#10 , #10 GND, 3/4" C	NEW EF-3	443	A	831	NEW EPF-1 (1.5 HP)	3#10 , #10 GND, 3/4" C	3	20	20
					443	B	831					
					443	C	831					
25	20	3	3#10 , #10 GND, 3/4" C	NEW SF-1	443	A						
					443	B						
					443	C						

TOTAL CONNECTED LOAD = 187 kVA X 100% DEMAND FACTOR = 187 kVA ESTIMATED DEMAND LOAD
PHASE BALANCE (KVA) - A: 62.3 , B: 62.3 , C: 62.3 DESIGN LOAD = 225 AMPERES, TOTAL LOAD WITH EXPANSION = 225 AMPERES



DISCONNECT SWITCH FOR VFD'S PREVENTS DOWNTIME FROM OUT OF SEQUENCE EQUIPMENT SHUTDOWNS. THIS SPECIAL DISCONNECT INTEGRATES A VERIFIED BREAK BEFORE BREAK AUXILIARY CONTACT FACTORY INSTALLED IN THE MAIN DISCONNECT SWITCH ENCLOSURE THAT INTERFACES DIRECTLY WITH VFD'S.

A,B,C: HOT WIRES POWER (3 PHASES).
AV: AUXILIARY DC VOLTAGE = 24VDC.
EA: VDF ENABLE INPUT
E0: NORMALLY OPEN EARLY BREAK AUXILIARY CONTACTS
EARLY BREAK CONTACTS OPEN 15 DEGREES EARLY THAN MAIN CONTACTS
CW: CONTROL WIRES: 2#16 AWG THWN IN SEPARATE CONDUIT.

ENGINEERING
FOR ARCHITECTURE
5757 Blue Lagoon Drive, Suite 400
Miami, Florida 33126
PH: 305.266.6553
Fax: 350.266.6695
www.tlc-engineers.com
COA 15

CUTLER BAY TOWN CENTER HVAC
EQUIPMENT AND CONTROLS

10720 Caribbean Blvd. Cutler Bay, Florida 33189

Revisions:

No.	Date	Description

Seal

Manuel Mollinedo, P.E.
Florida License # 63096

MANUEL MOLLINEDO LICENSE No. 63096 STATE OF FLORIDA PROFESSIONAL ENGINEER
OCT. 13 2016

100% CD SUBMITTAL

Project No.: Project Number
Issue Date: Issue Date
Drawn By: Author
Approved By: Approver
Scale: As indicated
Drawing Title: PANEL SCHEDULES

Drawing No.: E303

BUILDING PERMIT CATEGORIES

CATEGORY	DESCRIPTION	PERMIT TYPE
BUILDING		
01	GENERAL BUILDING—COMMERCIAL	MBLD
02	SUB—GENERAL BUILDING—RESIDENTIAL	MBLD
08	CANVAS AWNING	MBLD
10	COMMUNICATION TOWER	MBLD
15	DEMOLITION	MBLD
29	METAL AWNING & STORM SHUTTER	MBLD
48	SCREEN ENCLOSURES	MBLD
55	SWIMMING POOL	MBLD
56	TENNIS COURTS (SURFACE PAVING)	MBLD
86	TRAILER TIE DOWN	MBLD
88	WALK-IN COOLER	MBLD
91	MARINAS	MBLD
92	LOW SLOPE APPLICATIONS (GRAVEL, SMOOTH MODIFIED, SINGLE PLY)	MBLD
95	SHINGLES (ASPHALT, FIBERGLASS)	MBLD
96	SHINGLES (METAL ROOFS/WOOD SHINGLES & SHAKE)	MBLD
97	STAGE 2 VAPOR RECOVERY SYSTEM	MBLD
99	SOIL IMPROVEMENT	MBLD
0100	BULK STORAGE PROPANE TANK	MBLD
0101	REMOVABLE STORM PANELS	MBLD
0107	TILE ROOF	MBLD
0110	WATER MAIN	MBLD
0111	SITE PLAN	MBLD
0112	INDOOR EVENT/EXHIBIT	MBLD
ELECTRICAL		
04	FIRE ALARM SPECIALTY	MELE
16	SPECIALTY WIRING	MELE
38	GENERATORS	MELE
LPGX		
01	LIQUEFIED PETROLEUM GAS	MLPG
02	MISCELLANEOUS	MLPG
04	LIQUEFIED PETROL. GAS/STATE	MLPG
MECHANICAL		
09	ABOVE/BELOW GROUND TANKS/PUMPS & POLLUTANT STORAGE SYSTEM	MMEC
38	COMMERCIAL HOODS	MMEC
43	FIRE CHEMICAL	MMEC
46	SPRAY BOOTHS	MMEC
48	SMOKE CONTROL	MMEC
52	RESIDENTIAL ELEVATOR	MMEC
FIRE		
32	FIRE SPRINKLER	FIRE

MIAMI-DADE COUNTY

DEPARTMENT OF REGULATORY AND ECONOMIC RESOURCES

http://www.miamidade.gov/building/home.asp

2/7/2017 2:38:52 PM

Tracking #	Process #	Permit #
3617005533	M2017005533	2017023185

THIS COPY OF PLANS MUST BE AVAILABLE ON BUILDING SITE OR AN INSPECTION WILL NOT BE MADE.			
Review	**Disposition**	**Reviewer**	**Date**
WASA	N	Nancy Cobb	2/3/2017 11:51:38 AM
FIRE	A	Odon F Diaz	2/3/2017 1:13:14 PM
DERM	A	Jose Debasa	2/3/2017 8:12:28 AM
PWIF	N	Marielena Gonzalez	2/2/2017 4:19:22 PM

Disclaimer.

Subject to compliance with all Federal, State, and County Laws, rules and regulations. Miami-Dade County assumes no responsibility for accuracy of or results of these plans.

NOTICE: In addition to the requirements of this permit, there may be additional restrictions applicable to the property that may be found in the public records of this county, and there may be additional permits required from other governmental entities such as water management districts, state agencies or federal agencies.

Stamp Name	Trade	Disposition	Stamp Description
Approved	FIRE	A	Approved
Reference Only	FIRE	R	Reference only.

HVAC SYMBOL LEGEND

SYMBOL	DESCRIPTION
	-CEILING DIFFUSER, ROUND NECK (CEILING DIFFUSERS ARE 4-WAY THROW UNO)
	-ROUND DIFFUSER
	-CEILING RETURN
	-CEILING EXHAUST
	-CEILING DIFFUSER, RECTANGULAR OR SQUARE NECK (CEILING DIFFUSERS ARE 4-WAY THROW UNO)
	-SUPPLY REGISTER OR GRILLE (VERTICAL MOUNT, SIDEWALL)
	-RETURN/EXHAUST REGISTER OR GRILLE (VERTICAL MOUNT, SIDEWALL)
1	-REVISION REFERENCE
1 / M-1	-DETAIL REFERENCE: TOP-DETAIL#, BOTTOM-DRAWING# SHOWN ON
T	-THERMOSTAT/TEMPERATURE SENSOR
H	-HUMIDISTAT/HUMIDITY SENSOR
SD	-DUCT SMOKE DETECTOR
	-CONNECT TO EXISTING
	-DEMOLISH TO POINT INDICATED
M	-MOTORIZED CONTROL DAMPER
TS	-TEMPERATURE SENSOR
P	-PRESSURE SENSOR
BD	-BACKDRAFT DAMPER
N	-NEUTRAL RELATIVE PRESSURE
+	-POSITIVE RELATIVE PRESSURE
-	-NEGATIVE RELATIVE PRESSURE
1	-SHEET NOTE CALLOUT
1	-SHEET NOTE CALLOUT
1	-SHEET NOTE CALLOUT
	-CEILING MOUNTED ACCESS DOOR
	-SQUARE THROAT ELBOW W/TURNING VANES
	-RADIUS ELBOW
	-RECTANGULAR/ROUND BRANCH TAKE-OFF OR ROUND/ROUND BRANCH TAKE-OFF
	-EXHAUST DUCT UP THROUGH SLAB W/ FAN ON ROOF ABOVE
	-EXHAUST FAN ON ROOF W/ DUCT DOWN THROUGH ROOF

SYMBOL	DESCRIPTION
	-FIRE DAMPER (WITH ACCESS PANEL)
	-FIRE & SMOKE DAMPER (WITH ACCESS PANEL)
	-EXISTING FIRE DAMPER TO REMAIN
	-EXISTING FIRE & SMOKE DAMPER TO REMAIN
SA-1	-SOUND ATTENUATOR
M	-MOTOR OPERATED CONTROL DAMPER (MOD)
FM	-AIR FLOW MEASURING STATION
	-MANUAL BALANCING DAMPER
	-DOOR GRILLE
	-UNDERCUT DOOR
	-ACCESS DOORS, VERTICAL OR HORIZONTAL
	-STAINLESS STEEL DUCTWORK
	-FLEXIBLE CONNECTION
12x8ø	-FLAT OVAL DUCT
24x12	-NEW DUCTWORK, FIRST DIMENSION IS SIDE SHOWN
24x12	-EXISTING DUCTWORK TO REMAIN
24x12	-EXISTING DUCTWORK TO BE REMOVED
24x12 DOWN / UP W/IN FLOOR	-DUCT ELBOW, POSITIVE PRESSURE (SUPPLY), FIRST DIMENSION INDICATES SIDE TO WHICH ARROW IS POINTING
	-DUCT ELBOW, EXHAUST
	-DUCT ELBOW, NEGATIVE PRESSURE, RETURN
	-DUCT ELBOW UP THROUGH ROOF OR SLAB ABOVE
	-RECTANGULAR DUCT SECTION UP, POSITIVE PRESSURE, SUPPLY OR OUTSIDE AIR
	-RECTANGULAR DUCT SECTION UP, NEGATIVE PRESSURE, RETURN
	-RECTANGULAR DUCT SECTION UP, EXHAUST
	-ROUND DUCT SECTION UP
	-FLAT OVAL DUCT SECTION UP

SYMBOL	DESCRIPTION
	-TERMINAL UNIT, VARIABLE/CONSTANT AIR VOLUME WITH ELECTRIC HEAT
	-TERMINAL UNIT, VARIABLE/CONSTANT AIR VOLUME WITH ELECTRIC HEAT
	-TERMINAL UNIT, VARIABLE/CONSTANT AIR VOLUME, FAN POWERED
	-TERMINAL UNIT, VARIABLE/CONSTANT AIR VOLUME, FAN POWERED, WITH ELECTRIC HEAT
	-ELECTRIC DUCT HEATER (W/ PANEL CLEARANCE)
	-HYDRONIC REHEAT COIL
	-INLINE CENTRIFUGAL FAN
	-PACKAGED TERMINAL AIR CONDITIONER (PTAC)
UP DN	-CHANGE OF ELEVATION
	-FLEXIBLE DUCT
	-TRANSITION, CONCENTRIC
	-TRANSITION, ECCENTRIC
10x8 8ø	-TRANSITION, SQUARE TO ROUND
	-SQUARE THROAT TEE
12x8	-RAD/US TEE
	-RECTANGLE-TO-ROUND TAKE-OFF
	-STANDARD BRANCH TAKE-OFF
	-SPIN-IN TAKE-OFF

HVAC PIPING SYMBOL LEGEND

SYMBOL	DESCRIPTION
CWS	-CONDENSER WATER SUPPLY
CWR	-CONDENSER WATER RETURN
CHWS	-CHILLED WATER SUPPLY
CHWR	-CHILLED WATER RETURN
CD	-CONDENSATE
CR	-CONDENSATE RETURN
PC	-PUMPED CONDENSATE
HWR	-HOT WATER RETURN
HWS	-HOT WATER SUPPLY
HPS	-HIGH PRESSURE STEAM SUPPLY
MPS	-MEDIUM PRESSURE STEAM SUPPLY
LPS	-LOW PRESSURE STEAM SUPPLY
HPR	-HIGH PRESSURE STEAM RETURN
MPR	-MEDIUM PRESSURE STEAM RETURN
LPR	-LOW PRESSURE STEAM RETURN
RL	-REFRIGERANT LIQUID
RS	-REFRIGERANT SUCTION
	-TEE, OUTLET DOWN
	-TEE, OUTLET UP
D D	-45° PIPE RISE (R) / DROP (D)
	-PIPE ANCHORS
	-CONCENTRIC REDUCER
	-ECCENTRIC REDUCER

SYMBOL	DESCRIPTION
	-FLOW DIRECTION
	-GATE VALVE
	-BALL VALVE
	-CALIBRATING BALANCING VALVE
	-BUTTERFLY VALVE
	-GAS COCK
	-UNION
	-STRAINER
	-CONTROL VALVE
	-SOLENOID VALVE
	-PSI REG.
	-CHECK VALVE
	-FLOW SWITCH
	-SLOPE DIRECTION (DOWN)
	-FLEX CONNECTION
	-O.S.&Y. GATE VALVE
	-STEAM TRAP
	-THREE-WAY CONTROL VALVE
	-THERMOMETER

SYMBOL	DESCRIPTION
EQUIP.	- P-TRAP
	-TWO-WAY CHECK VALVE
MV	-MANUAL VENT
	-PRESSURE GAUGE
	-RELIEF VALVE
FM	-FLOW METER
M	-WATER METER
	-INLINE PUMP
C	-INLINE PUMP
	-VALVE ON RISER
	-CAP
	-CONNECTION, BOTTOM
	-CONNECTION, TOP
	-COUPLING
	-ELBOW, 90°
	-ELBOW, 45°
	-ELBOW, TURNED DOWN
	-ELBOW, TURNED UP

NOTE: SOME SYMBOLS SHOWN ON THIS LEGEND MAY NOT PERTAIN TO THIS PROJECT

HVAC ABBREVIATIONS

SYMBOL	DESCRIPTION
AFD	-ADJUSTABLE FREQUENCY DRIVE
AFF	-ABOVE FINISHED FLOOR
AFR	-ABOVE FINISHED ROOF
AHU	-AIR HANDLING UNIT
AP	-ACCESS PANEL
BOP	-BOTTOM OF PIPE
BHP	-BRAKE HORSEPOWER
BTU	-BRITISH THERMAL UNIT
℄	-CENTER LINE
∱	-CFM (CUBIC FEET PER MINUTE)
CD	-CEILING DIFFUSER
CT	-COOLING TOWER
CV	-CONSTANT AIR VOLUME
ΔP	-CHANGE IN PRESSURE
ΔT	-CHANGE IN TEMPERATURE
CFM	-CUBIC FEET PER MINUTE
CU	-CONDENSING UNIT
DDC	-DIRECT DIGITAL CONTROLS
DN	-DOWN
EAT	-ENTERING AIR TEMPERATURE
ESP	-EXTERNAL STATIC PRESSURE
EWT	-ENTERING WATER TEMPERATURE
FCU	-FAN COIL UNIT
FD	-FIRE DAMPER
FF	-FINAL FILTERS
FLA	-FULL LOAD AMPS
FPM	-FEET PER MINUTE
GPM	-GALLONS PER MINUTE
KW	-KILOWATT
LAT	-LEAVING AIR TEMPERATURE
LWT	-LEAVING WATER TEMPERATURE
LD	-LINEAR DIFFUSER
MBH	-THOUSAND BTUs PER HOUR
MCA	-MINIMUM CIRCUIT AMPS
MOCP	-MAXIMUM OVER CURRENT PROTECTION
MOD	-MOTOR OPERATED CONTROL DAMPER (MOD)
NC	-NORMALLY CLOSED
NO	-NORMALLY OPEN
NTS	-NOT TO SCALE
OA	-OUTSIDE AIR
OAL	-OUTSIDE AIR LOUVER
PRV	-PRESSURE REDUCING VALVE
PRS	-PRESSURE REDUCING STATION
PSI	-POUNDS PER SQUARE INCH
PSIG	-PSI GAUGE
PTAC	-PACKAGED TERMINAL AIR CONDITIONER
PVC	-POLYVINYL CHLORIDE PIPE
RA	-RETURN AIR
RHC	-REHEAT COIL
RHP	-ROOFTOP HEAT PUMP
RPM	-REVOLUTIONS PER MINUTE
RS/L	-REFRIGERANT SUCTION & LIQUID LINES
RTU	-ROOFTOP AIR HANDLING UNIT
SA	-SUPPLY AIR
SP	-STATIC PRESSURE
TSP	-TOTAL STATIC PRESSURE
UNO	-UNLESS NOTED OTHERWISE
V/PH	-VOLTS/PHASE
VAV	-VARIABLE AIR VOLUME
VFD	-VARIABLE FREQUENCY DRIVE

HVAC EQUIPMENT TAGS

TAG: A 200 CFM — -AIR DISTRIBUTION DEVICE

AHU NUMBER: AHU-1 — -AIR HANDLING UNIT

AHU NUMBER / COIL NUMBER: RHC-1-1 — -REHEAT COIL

VARIABLE/CONSTANT AIR VOLUME TERMINAL UNITS

TERMINAL UNIT TYPE:
- VTU - VARIABLE TERMINAL UNIT
- CTU - CONSTANT TERMINAL UNIT
- PTU - PARALLEL TERMINAL UNIT
- STU - SERIES TERMINAL UNIT

AHU NUMBER / TERMINAL NUMBER: VTU-1-1

SCOPE OF WORK

1. REPLACE EXISTING DIRECT EXPANSION (DX) AIR HANDLING SYSTEM (HVAC) EQUIPMENT AND CONTROLS WITH NEW AIR COOLED CHILLER AND AIR HANDLING UNIT. RETROFIT NEW DDC CONTROLS TO APPROXIMATELY 135 VARIABLE AIR VOLUME (VAV) BOXES AND VERIFY ALL POWER CONNECTION TO VAV BOXES'S ELECTRIC HEATER. IF NOT, PROVIDE DESIGN TO PROVIDE POWER TO THE HEATER.
2. PROVIDE STUDY OF THE EXISTING SMOKE CONTROL SYSTEM AND EQUIPMENT OPERATION. AND PROVIDE NEW CONCEPT OF DESIGN FOR SMOKE CONTROL WITH HIGHER EFFICIENCY EQUIPMENT.

HVAC GENERAL NOTES

1. CONNECTION TO EQUIPMENT SHALL BE VERIFIED WITH MANUFACTURER'S CERTIFIED DRAWINGS. TRANSITIONS TO ALL EQUIPMENT SHALL BE VERIFIED AND PROVIDED FOR EQUIPMENT FURNISHED.
2. DIMENSIONS SHALL BE FIELD-VERIFIED AND COORDINATED PRIOR TO PROCUREMENT OR FABRICATION. COORDINATE THE WORK WITH OTHER TRADES INVOLVED. FIELD MODIFICATIONS SUCH AS OFFSETS IN PIPING OR DUCTWORK (INCLUDING DIVIDED DUCTWORK) NEEDED DUE TO OBSTRUCTIONS OR INTERFERENCES SHALL BE PROVIDED AT NO ADDITIONAL COST. FOR PROJECTS INVOLVING RENOVATION, COORDINATE NEW WORK WITH EXISTING ELEMENTS SUCH AS THE BUILDING STRUCTURE AND ARCHITECTURAL FEATURES, SPRINKLER PIPING, LIGHTS, PLUMBING, AND ELECTRICAL CONDUIT.
3. DUCT CONSTRUCTION SHALL BE IN ACCORDANCE WITH THE LATEST EDITION OF THE SMACNA HVAC DUCT CONSTRUCTION STANDARD.
4. SEE SPECIFICATIONS FOR GAUGES, THICKNESS, BRACING, REQUIREMENTS, ETC., OF DUCTWORK.
5. PROVIDE AIR TURNING VANES IN ALL 90 DEGREE RECTANGULAR DUCT ELBOWS.
6. DUCT SIZES AND ALL OPENINGS THROUGH BUILDING CONSTRUCTION SHALL SUIT EQUIPMENT FURNISHED.
7. COORDINATE DIFFUSER, GRILLE AND REGISTER LOCATIONS WITH ARCHITECTURAL REFLECTED CEILING PLANS AND EQUIPMENT OF ALL TRADES.
8. LOCATE THERMOSTATS, TEMPERATURE SENSORS, HUMIDISTAT, AND HUMIDITY SENSORS AT 48" ABOVE FINISHED FLOOR UNLESS NOTED OTHERWISE. COORDINATE LOCATIONS WITH OTHER EQUIPMENT, FURNITURE, AND DOOR SWINGS.
9. ALL EQUIPMENT, DUCTWORK, ETC., SHALL BE SUPPORTED AS DETAILED AND/OR SPECIFIED. PROVIDE ADDITIONAL SUPPORTS AS REQUIRED TO PROVIDE A VIBRATION-FREE, RIGID INSTALLATION.
10. ALL DUCT SIZES SHOWN ARE INSIDE CLEAR DIMENSIONS.
11. DAMPERS AND INSIDES OF DUCTS VISIBLE THROUGH GRILLES, REGISTERS AND DIFFUSERS SHALL BE PAINTED FLAT BLACK.
12. REFER TO TYPICAL DETAILS FOR PIPING AND INSTALLATION OF EQUIPMENT.
13. TRAPPED CONDENSATE DRAINS FROM ALL MECHANICAL EQUIPMENT SHALL BE PROVIDED FOR PROPER DRAINAGE TO SUIT EQUIPMENT FURNISHED.
14. ACCESS PANELS IN DUCTWORK AND CEILINGS SHALL BE PROVIDED WHERE REQUIRED FOR OPERATION, BALANCING OR MAINTENANCE OF ALL MECHANICAL EQUIPMENT.
15. ALL DUCTWORK AND PIPING IS SHOWN SCHEMATICALLY. PROVIDE ALL TRANSITIONS, TURNING VANES, ELBOWS, FITTINGS, ETC., TO ALLOW SMOOTH FLOWS. ALL SPLIT DUCT FITTINGS SHALL TRANSITION TO FULL SIZE OF THE SUM OF BOTH BRANCHES, UPSTREAM OF SPLIT.
16. PROVIDE CONCRETE HOUSEKEEPING PAD UNDER ALL FLOOR-MOUNTED EQUIPMENT. REFER TO SPECIFICATIONS FOR DETAILED REQUIREMENTS.
17. VERIFY FINISH WITH ARCHITECT PRIOR TO PURCHASING GRILLES, REGISTERS, DIFFUSERS, LOUVERS AND OTHER AIR DISTRIBUTION DEVICES.
18. PROVIDE FLEXIBLE DUCT CONNECTIONS ON ALL DUCTWORK CONNECTING TO EACH FAN, AIR HANDLING UNITS, AND FAN COIL UNITS.
19. PROVIDE TRANSITIONS AT DIFFUSER NECKS AS REQUIRED TO MATCH SIZES OF FLEX DUCTS TO BE CONNECTED.
20. INTERRUPTIONS TO EXISTING SERVICES SHALL BE SCHEDULED FOR TIMES OTHER THAN NORMAL OPERATING HOURS (SUCH AS NIGHTS AND WEEKENDS). SUCH INTERRUPTIONS TO SERVICES SHALL NOT BE MADE WITHOUT THE PRIOR WRITTEN CONSENT OF THE OWNER'S REPRESENTATIVE AND PROPER COORDINATION WITH OTHER TRADES. PRE-WORK SHALL BE PERFORMED TO MAKE THE SHUTDOWN PERIOD AS BRIEF AS POSSIBLE.
21. ALL EQUIPMENT, DUCTWORK, ETC., TO BE REMOVED SHALL REMAIN PROPERTY OF THE OWNER OR DISPOSED OF LEGALLY, AS DIRECTED BY OWNER.
22. MAINTAIN CLEARANCE OF A MINIMUM OF 6" BETWEEN DUCTWORK, PIPING, EQUIPMENT, ETC., AND ALL FIRE RATED AND FIRE/SMOKE RATED PARTITIONS, TO ALLOW FOR INSPECTIONS OF RATED WALLS.
23. LOCATE ALL OUTSIDE AIR INTAKES A MINIMUM OF 10' CLEAR FROM ALL PLUMBING VENTS AND EXHAUST AIR DISCHARGE LOCATIONS.
24. DUCT RUNOUTS TO DIFFUSERS SHALL MATCH THE SIZE OF THE DIFFUSER NECK.
25. WATER PRESSURE DROPS THROUGH COIL CONTROL VALVES SHALL NOT EXCEED 5 PSI.
26. UNLESS OTHERWISE NOTED, ALL EQUIPMENT AND VALVE DRAINS SHALL BE INDEPENDENTLY PIPED FULL SIZE TO THE NEAREST PLUMBING DRAIN.
27. SLEEVE AND SEAL ALL PIPING PENETRATIONS THROUGH BUILDING PARTITIONS. PROVIDE MANUAL AIR VENTS AT ALL HIGH POINTS IN CHILLED WATER AND HOT WATER PIPING.
28. PIPING, DUCTWORK, LEAK PROTECTION APPARATUS, OR OTHER EQUIPMENT FOREIGN TO ELECTRICAL SWITCHBOARDS, PANELBOARDS, DISTRIBUTION BOARDS, OR MOTOR CONTROL CENTERS SHALL NOT BE INSTALLED WITHIN THE REQUIRED SPACE FOR WORKING CLEARANCES OR DEDICATED SPACES OF THE ELECTRICAL EQUIPMENT, EXTENDING IN FRONT OF AND FROM FLOOR TO STRUCTURAL CEILING WITH A WIDTH AND DEPTH OF THE ELECTRICAL EQUIPMENT IN ACCORDANCE WITH NEC-110.26.
29. CONTRACTOR SHALL PROVIDE START UP SHEETS FOR PROPOSED MECHANICAL EQUIPMENT.
30. PROVIDE (3) THREE COPIES OF RECORD DRAWINGS OF DUCTWORK AND PIPING INSTALLATION AND (2) BOUND SETS OF OPERATION AND MAINTENANCE MANUALS FOR ALL EQUIPMENT TO OWNER UPON COMPLETION OF THE PROJECT.
31. ALL EQUIPMENT AND CONSTRUCTION MATERIALS SHALL BE SUBMITTED TO ARCHITECT PRIOR TO USE ON PROJECT FOR REVIEW BY APPROPRIATE DESIGN PROFESSIONAL.
32. A MINIMUM OF THREE WEEKS SHALL BE PROVIDED FOR REVIEW PROCESS, AND SUBMISSION AND WORK SCHEDULE SHALL BE SET ACCORDINGLY.
33. TESTING AND BALANCING OF ALL AIR HANDLING EQUIPMENT SHALL BE PERFORMED BY AN AABC OR NEBB CERTIFIED BALANCING CONTRACTOR, AND AIR BALANCING REPORTS SHALL BE SUBMITTED TO ARCHITECT FOR REVIEW, PRIOR TO AHCA FINAL INSPECTION.

HVAC PHASING NOTES

1. BUILDING SHALL REMAIN OPERATIONAL DURING NORMAL BUSINESS HOURS THROUGHOUT CONSTRUCTION.
2. INSTALLATION OF NEW AHU, CHILLER AND PUMP PACKAGED SHALL BE OPERATIONAL AND ALL NEW DUCTWORK SHALL BE BROUGHT INTO THE PENTHOUSE AND READY TO BE CONNECTED TO THE EXISTING DUCTWORK PRIOR TO DEMOLITION OF EXISTING EQUIPMENT.

HVAC DRAWING INDEX

ENGINEERING
FOR ARCHITECTURE
5757 Blue Lagoon Drive, Suite 400
Miami, Florida 33126
PH: 305.266.6553
Fax: 350.266.6695
www.tlc-engineers.com
COA 15

CUTLER BAY TOWN CENTER HVAC EQUIPMENT AND CONTROLS

10720 Caribbean Blvd. Cutler Bay, Florida 33189

Revisions:

No.	Date	Description

Seal

Chi S. Lui, P.E.
Florida License # 61748

CHI S. LUI LICENSE No. 61748 STATE OF FLORIDA PROFESSIONAL ENGINEER

100% CD SUBMITTAL

Project No.: Project Number
Issue Date: Issue Date
Drawn By: Author
Approved By: Approver
Scale: 12" = 1'-0"

Drawing Title: MECHANICAL LEGEND, GENERAL NOTES, & SHEET INDEX

Drawing No.: M000

C:\Revit 2016 Local Models\616018_MEP_R16_shay.cdonnell.rvt
2/3/2017 9:53:43 PM

GENERAL NOTES:

- MECHANICAL EQUIPMENT IS SHOWN AT APPROXIMATE LOCATIONS. INFORMATION INDICATED ON THE DRAWINGS IS BASED ON AVAILABLE AS-BUILT RECORDS AND LIMITED VISUAL OBSERVATION OF THE SITE. FIELD VERIFICATION DOES NOT INCLUDE DUCTWORK LAYOUT AND ROUTING OF DUCT, WHICH MAY DEVIATE FROM ACTUAL FIELD CONDITIONS.
- PRIOR TO STARTING WORK, CONTRACTOR SHALL BE RESPONSIBLE FOR VERIFYING FIELD CONDITION OF ALL MECHANICAL SYSTEM INVOLVED IN THE AREA OF SCOPE OF WORK AND REPORT DEFICIENCIES. CONTRACTOR SHALL BE RESPONSIBLE FOR RESOLVING ANY CONFLICTS OR DISCREPANCIES AND ADJUSTMENTS OR REPLACEMENT AS NECESSARY PRIOR TO STARTING NEW WORK.
- ALL DEMO WORK SHALL BE PERFORMED DURING THE TIME SCHEDULE ALLOWED BY LANDLORD.
- ALL EQUIPMENT REMOVED FROM THE SPACE IS THE PROPERTY OF THE LANDLORD. CONTRACTOR SHALL DISPOSE OF AS AUTHORIZED BY LANDLORD.

FOR MECHANICAL EQUIPMENT DEMOLITION AND DETAILS GO TO CORRESPONDING ENLARGE DEMO PLANS.

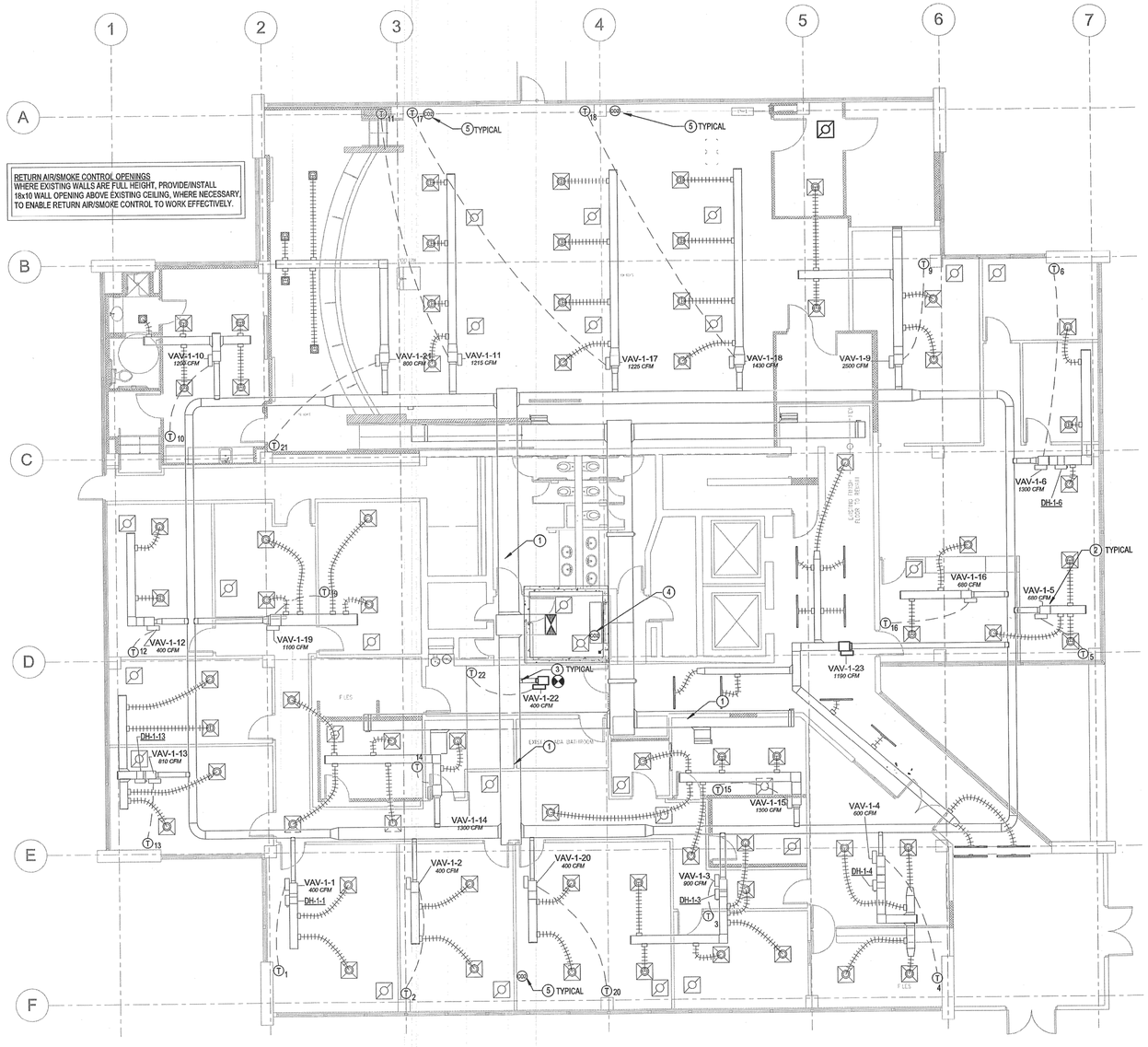
PRIOR TO STARTING ANY WORK, A TEST AND BALANCE ON ALL AIR DISTRIBUTION DEVICES SHALL BE PREFORMED AND A REPORT SHALL BE PRODUCED AND PRESENTED TO ENGINEER OF RECORD FOR REVIEW AND COMMENT.

DEMOLITION KEY NOTES:

1. EXISTING S/A AND R/A DUCTWORK ASSOCIATED WITH AHU-1 SHALL REMAIN AS IS. THE DRAWING SHALL BE CONSIDERED FOR REFERENCE ONLY. EXISTING AHU/CU'S AND STAND AT ROOF SHALL BE REMOVED.
2. REMOVE EXISTING THERMOSTAT TO EACH VAV .
3. EXISTING SUPPLY DIFFUSER AND RETURN GRILLE SHALL REMAIN AS IS. CONTRACTOR SHALL BE RESPONSIBLE TO VERIFY CONDITION AND REPORT ANY DEFICIENCIES.
4. EXISTING HEATER AT VAV AND DUCT WORK FOR ALL VAV UNIT APPLICABLE SHALL BE REMAIN AS IS. REFER TO VAV SCHEDULE FOR REFERENCE. CONTRACTOR SHALL BE RESPONSIBLE TO VERIFY AT FIELD CONDITION OF EXISTING AND REPAIR OR REPLACE AS NECESSARY TO ACCOMMODATE NEW CONTROLS, AND CONNECTIONS.

NEW WORK NOTES:

1. EXISTING S/A, R/A DUCTWORK ASSOCIATED WITH AHU-1 SHALL REMAIN AS IS. CONTRACTOR SHALL BE RESPONSIBLE FOR VERIFYING ROUTING, SIZE AND CONDITION OF EXISTING DUCT WORK. THIS DRAWING SHALL BE CONSIDERED FOR REFERENCE ONLY.
2. PROVIDE NEW DDC CONTROLS FOR ALL VAV UNITS AND CONNECT THEM TO NEW MANAGEMENT BUILDING SYSTEM. REFER TO SHEET M401 AND M402 FOR NEW CONTROL DIAGRAM.
3. REPLACE NEW VAV AT POINT INDICATED. CONTRACTOR SHALL BE RESPONSIBLE FOR VERIFYING ROUTING, SIZE AND CONDITION OF EXISTING DUCT WORK FOR NEW VAV UNITS CONNECTION AND REPORT ANY DEFICIENCY. PROVIDE NEW SUPPLY AIR DUCT WORK CONNECTED TO EXISTING. CONTRACTOR SHALL SEAL THE DUCTWORK AND RESTORE THE ORIGINAL CONDITION, WHEREVER WORK IS PERFORMED.
4. CONTRACTOR SHALL CONNECT NEW CO2 SENSOR AT MAIN RETURN DUCT WORK. CONTRACTOR SHALL SEAL THE DUCTWORK AND RESTORE THE ORIGINAL CONDITION, WHEREVER WORK IS PERFORMED. REFER TO CONTROL DRAWINGS M401 AND M402 FOR SEQUENCE.
5. PROVIDE NEW CO2 SENSOR ASSOCIATED WITH AREAS OF MAXIMA OCCUPANCY AND CONNECTED TO BMS SYSTEM. REFER TO CONTROL DRAWINGS M401 AND M402 FOR SEQUENCE.



1 / M101 MECHANICAL LEVEL 1 FLOOR PLAN
1/8" = 1'-0"

MDFR NOTE: CO DETECTION SYSTEM TO COMPLY WITH NFPA 720 (2012 EDITION).

ENGINEERING
FOR ARCHITECTURE
5757 Blue Lagoon Drive, Suite 400
Mimai, Florida 33126
PH: 305.266.6553
Fax: 350.266.6695
www.tlc-engineers.com
COA 15

CUTLER BAY TOWN CENTER HVAC EQUIPMENT AND CONTROLS

10720 Caribbean Blvd. Cutler Bay, Florida 33189

Revisions:

No.	Date	Description

Seal

Chi S. Lui, P.E.
Florida License # 61748

CHI S. LUI LICENSE No. 61748 STATE OF FLORIDA PROFESSIONAL ENGINEER

100% CD SUBMITTAL

Project No.: Project Number
Issue Date: Issue Date
Drawn By: Author
Approved By: Approver
Scale: 1/8" = 1'-0"

Drawing Title: MECHANICAL LEVEL 1 FLOOR PLAN

Drawing No.: M101

C:\Revit 2016 Local Models\616018_MEP_R16_shay.odonnell.rvt
10/20/2016 3:02:48 PM

GENERAL NOTES:

- MECHANICAL EQUIPMENT IS SHOWN AT APPROXIMATE LOCATIONS. INFORMATION INDICATED ON THE DRAWINGS IS BASED ON AVAILABLE AS-BUILT RECORDS AND LIMITED VISUAL OBSERVATION OF THE SITE. FIELD VERIFICATION DOES NOT INCLUDE DUCTWORK LAYOUT AND ROUTING OF DUCT, WHICH MAY DEVIATE FROM ACTUAL FIELD CONDITIONS.
- PRIOR TO STARTING WORK, CONTRACTOR SHALL BE RESPONSIBLE FOR VERIFYING FIELD CONDITION OF ALL MECHANICAL SYSTEM INVOLVED IN THE AREA OF SCOPE OF WORK AND REPORT DEFICIENCIES. CONTRACTOR SHALL BE RESPONSIBLE FOR RESOLVING ANY CONFLICTS OR DISCREPANCIES AND ADJUSTMENTS OR REPLACEMENT AS NECESSARY PRIOR TO STARTING NEW WORK.
- ALL DEMO WORK SHALL BE PERFORMED DURING THE TIME SCHEDULE ALLOWED BY LANDLORD.
- ALL EQUIPMENT REMOVED FROM THE SPACE IS THE PROPERTY OF THE LANDLORD. CONTRACTOR SHALL DISPOSE OF AS AUTHORIZED BY LANDLORD.

FOR MECHANICAL EQUIPMENT DEMOLITION AND DETAILS GO TO CORRESPONDING ENLARGE DEMO PLANS.

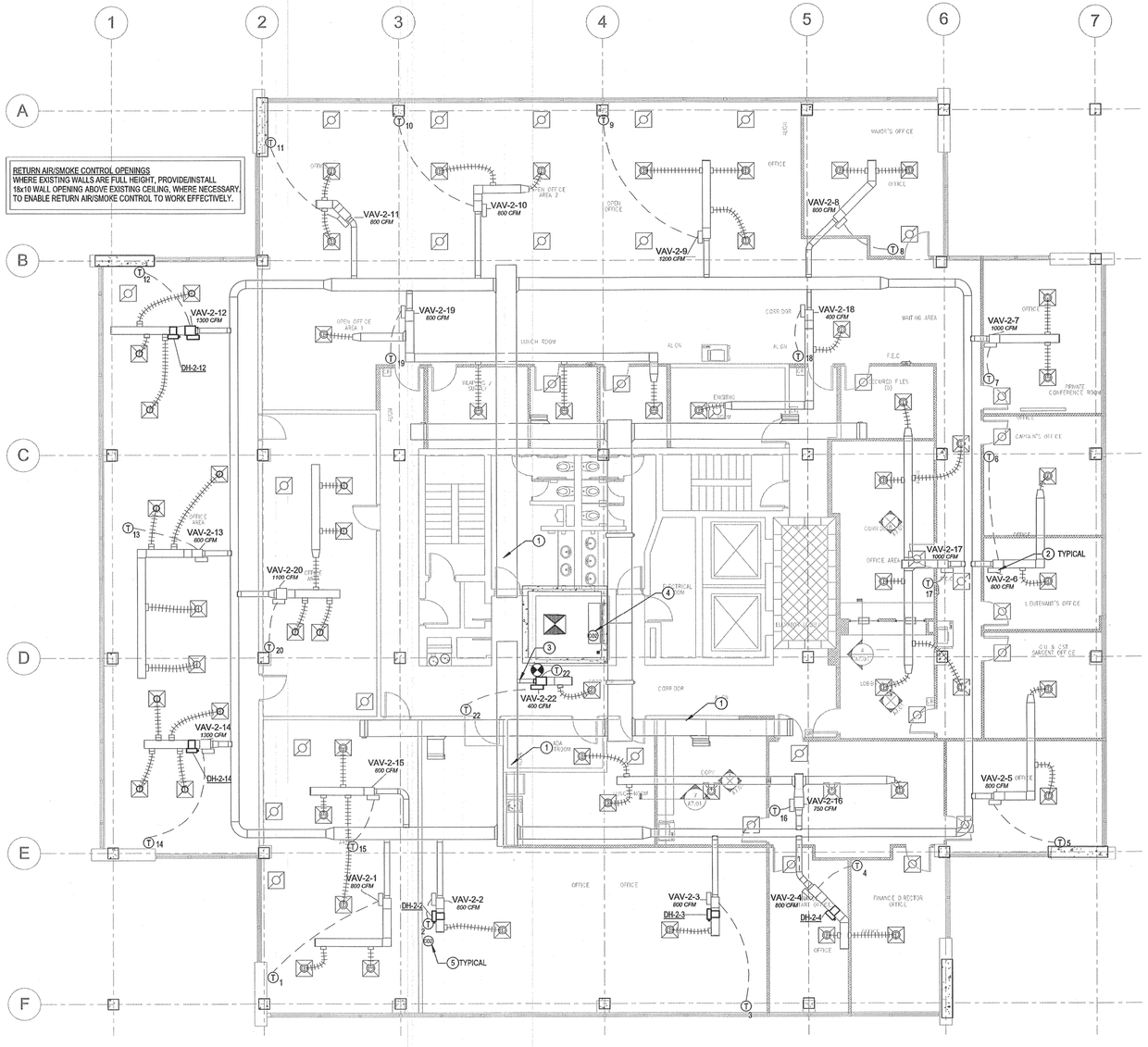
PRIOR TO STARTING ANY WORK, A TEST AND BALANCE ON ALL AIR DISTRIBUTION DEVICES SHALL BE PREFORMED AND A REPORT SHALL BE PRODUCED AND PRESENTED TO ENGINEER OF RECORD FOR REVIEW AND COMMENT.

DEMOLITION KEY NOTES:

1. EXISTING S/A AND R/A DUCTWORK ASSOCIATED WITH AHU-1 SHALL REMAIN AS IS. THE DRAWING SHALL BE CONSIDERED FOR REFERENCE ONLY. EXISTING AHU/CU'S AND STAND AT ROOF SHALL BE REMOVED.
2. REMOVE EXISTING THERMOSTAT TO EACH VAV .
3. EXISTING SUPPLY DIFFUSER AND RETURN GRILLE SHALL REMAIN AS IS. CONTRACTOR SHALL BE RESPONSIBLE TO VERIFY CONDITION AND REPORT ANY DEFICIENCIES.
4. EXISTING HEATER AT VAV AND DUCT WORK FOR ALL VAV UNIT APPLICABLE SHALL BE REMAIN AS IS. REFER TO VAV SCHEDULE FOR REFERENCE. CONTRACTOR SHALL BE RESPONSIBLE TO VERIFY AT FIELD CONDITION OF EXISTING AND REPAIR OR REPLACE AS NECESSARY TO ACCOMMODATE NEW CONTROLS, AND CONNECTIONS.

NEW WORK NOTES:

1. EXISTING S/A, R/A DUCTWORK ASSOCIATED WITH AHU-1 SHALL REMAIN AS IS. CONTRACTOR SHALL BE RESPONSIBLE FOR VERIFYING ROUTING, SIZE AND CONDITION OF EXISTING DUCT WORK. THIS DRAWING SHALL BE CONSIDERED FOR REFERENCE ONLY.
2. PROVIDE NEW DDC CONTROLS FOR ALL VAV UNITS AND CONNECT THEM TO NEW MANAGEMENT BUILDING SYSTEM. REFER TO SHEET M401 AND M402 FOR NEW CONTROL DIAGRAM.
3. REPLACE NEW VAV AT POINT INDICATED. CONTRACTOR SHALL BE RESPONSIBLE FOR VERIFYING ROUTING, SIZE AND CONDITION OF EXISTING DUCT WORK FOR NEW VAV UNITS CONNECTION AND REPORT ANY DEFICIENCY. PROVIDE NEW SUPPLY AIR DUCT WORK CONNECTED TO EXISTING. CONTRACTOR SHALL SEAL THE DUCTWORK AND RESTORE THE ORIGINAL CONDITION, WHEREVER WORK IS PERFORMED.
4. CONTRACTOR SHALL CONNECT NEW CO2 SENSOR AT MAIN RETURN DUCT WORK. CONTRACTOR SHALL SEAL THE DUCTWORK AND RESTORE THE ORIGINAL CONDITION, WHEREVER WORK IS PERFORMED. REFER TO CONTROL DRAWINGS M401 AND M402 FOR SEQUENCE.
5. PROVIDE NEW CO2 SENSOR ASSOCIATED WITH AREAS OF MAXIMA OCCUPANCY AND CONNECTED TO BMS SYSTEM. REFER TO CONTROL DRAWINGS M401 AND M402 FOR SEQUENCE.



1 M102 MECHANICAL LEVEL 2 FLOOR PLAN
1/8" = 1'-0"

MDFR NOTE: CO DETECTION SYSTEM TO COMPLY WITH NFPA 720 (2012 EDITION).

ENGINEERING FOR ARCHITECTURE
5757 Blue Lagoon Drive, Suite 400
Miami, Florida 33126
PH: 305.266.6553
Fax: 350.266.6695
www.tlc-engineers.com
COA 15

CUTLER BAY TOWN CENTER HVAC EQUIPMENT AND CONTROLS

10720 Caribbean Blvd. Cutler Bay, Florida 33189

Revisions:

No.	Date	Description

Seal

Chi S. Lui, P.E.
Florida License # 61748

CHI S. LUI LICENSE # 61748 STATE OF FLORIDA PROFESSIONAL ENGINEER

Project No.: Project Number
Issue Date: Issue Date
Drawn By: Author
Approved By: Approver
Scale: 1/8" = 1'-0"

Drawing Title: MECHANICAL LEVEL 2 FLOOR PLAN

Drawing No.: M102

100% CD SUBMITTAL

C:\Revit 2016 Local Models\616018_MEP_R16_shay.odonnell.rvt
2/7/2017 2:38:53 PM

GENERAL NOTES:

- MECHANICAL EQUIPMENT IS SHOWN AT APPROXIMATE LOCATIONS. INFORMATION INDICATED ON THE DRAWINGS IS BASED ON AVAILABLE AS-BUILT RECORDS AND LIMITED VISUAL OBSERVATION OF THE SITE. FIELD VERIFICATION DOES NOT INCLUDE DUCTWORK LAYOUT AND ROUTING OF DUCT, WHICH MAY DEVIATE FROM ACTUAL FIELD CONDITIONS.
- PRIOR TO STARTING WORK, CONTRACTOR SHALL BE RESPONSIBLE FOR VERIFYING FIELD CONDITION OF ALL MECHANICAL SYSTEM INVOLVED IN THE AREA OF SCOPE OF WORK AND REPORT DEFICIENCIES. CONTRACTOR SHALL BE RESPONSIBLE FOR RESOLVING ANY CONFLICTS OR DISCREPANCIES AND ADJUSTMENTS OR REPLACEMENT AS NECESSARY PRIOR TO STARTING NEW WORK.
- ALL DEMO WORK SHALL BE PERFORMED DURING THE TIME SCHEDULE ALLOWED BY LANDLORD.
- ALL EQUIPMENT REMOVED FROM THE SPACE IS THE PROPERTY OF THE LANDLORD. CONTRACTOR SHALL DISPOSE OF AS AUTHORIZED BY LANDLORD.

FOR MECHANICAL EQUIPMENT DEMOLITION AND DETAILS GO TO CORRESPONDING ENLARGE DEMO PLANS.

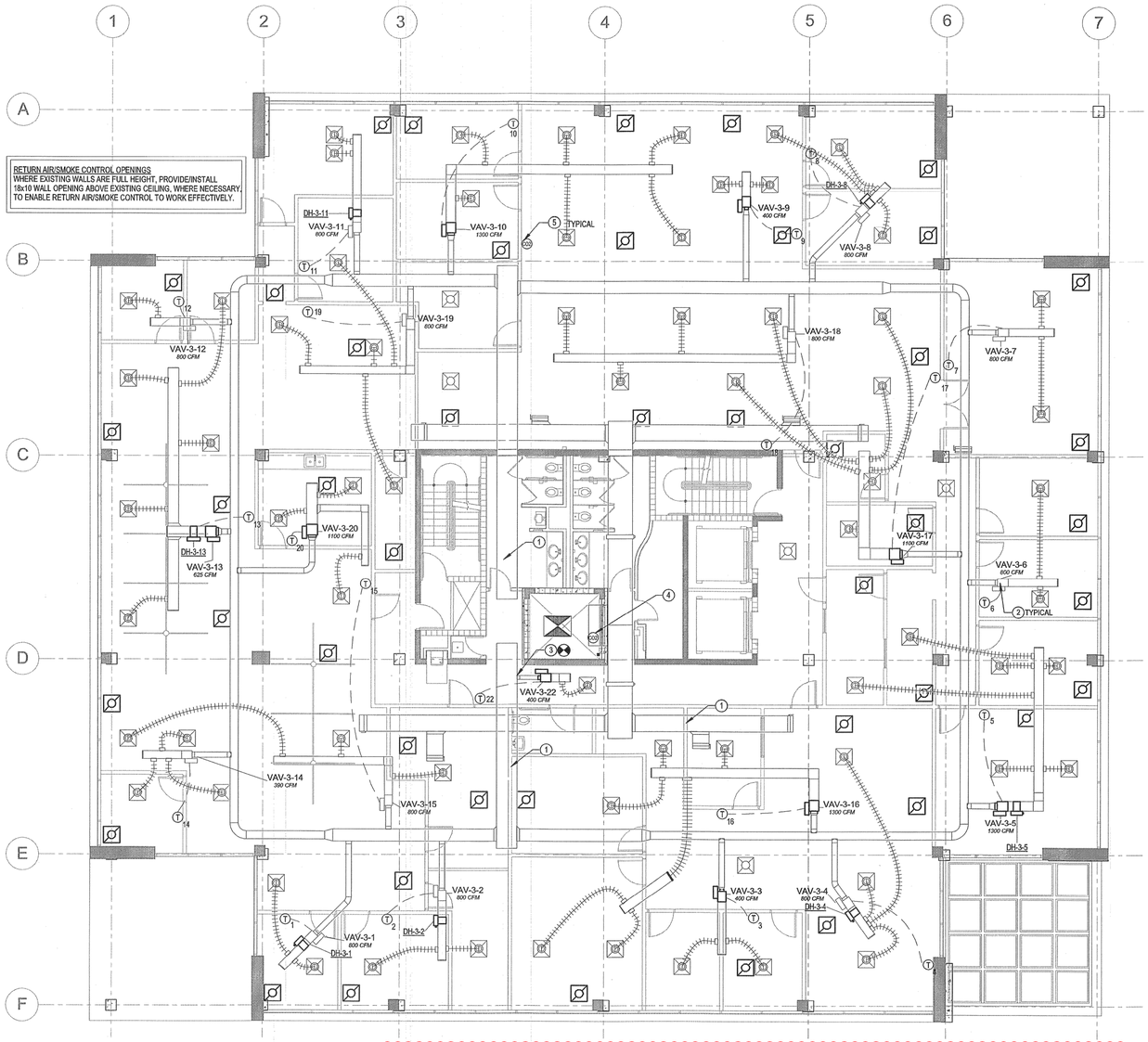
PRIOR TO STARTING ANY WORK, A TEST AND BALANCE ON ALL AIR DISTRIBUTION DEVICES SHALL BE PREFORMED AND A REPORT SHALL BE PRODUCED AND PRESENTED TO ENGINEER OF RECORD FOR REVIEW AND COMMENT.

DEMOLITION KEY NOTES:

1. EXISTING S/A AND R/A DUCTWORK ASSOCIATED WITH AHU-1 SHALL REMAIN AS IS. THE DRAWING SHALL BE CONSIDERED FOR REFERENCE ONLY. EXISTING AHU/CU'S AND STAND AT ROOF SHALL BE REMOVED.
2. REMOVE EXISTING THERMOSTAT TO EACH VAV .
3. EXISTING SUPPLY DIFFUSER AND RETURN GRILLE SHALL REMAIN AS IS. CONTRACTOR SHALL BE RESPONSIBLE TO VERIFY CONDITION AND REPORT ANY DEFICIENCIES.
4. EXISTING HEATER AT VAV AND DUCT WORK FOR ALL VAV UNIT APPLICABLE SHALL BE REMAIN AS IS. REFER TO VAV SCHEDULE FOR REFERENCE. CONTRACTOR SHALL BE RESPONSIBLE TO VERIFY AT FIELD CONDITION OF EXISTING AND REPAIR OR REPLACE AS NECESSARY TO ACCOMMODATE NEW CONTROLS, AND CONNECTIONS.

NEW WORK NOTES:

1. EXISTING S/A, R/A DUCTWORK ASSOCIATED WITH AHU-1 SHALL REMAIN AS IS. CONTRACTOR SHALL BE RESPONSIBLE FOR VERIFYING ROUTING, SIZE AND CONDITION OF EXISTING DUCT WORK. THIS DRAWING SHALL BE CONSIDERED FOR REFERENCE ONLY.
2. PROVIDE NEW DDC CONTROLS FOR ALL VAV UNITS AND CONNECT THEM TO NEW MANAGEMENT BUILDING SYSTEM. REFER TO SHEET M401 AND M402 FOR NEW CONTROL DIAGRAM.
3. REPLACE NEW VAV AT POINT INDICATED. CONTRACTOR SHALL BE RESPONSIBLE FOR VERIFYING ROUTING, SIZE AND CONDITION OF EXISTING DUCT WORK FOR NEW VAV UNITS CONNECTION AND REPORT ANY DEFICIENCY. PROVIDE NEW SUPPLY AIR DUCT WORK CONNECTED TO EXISTING. CONTRACTOR SHALL SEAL THE DUCTWORK AND RESTORE THE ORIGINAL CONDITION, WHEREVER WORK IS PERFORMED.
4. CONTRACTOR SHALL CONNECT NEW CO2 SENSOR AT MAIN RETURN DUCT WORK. CONTRACTOR SHALL SEAL THE DUCTWORK AND RESTORE THE ORIGINAL CONDITION, WHEREVER WORK IS PERFORMED. REFER TO CONTROL DRAWINGS M401 AND M402 FOR SEQUENCE.
5. PROVIDE NEW CO2 SENSOR ASSOCIATED WITH AREAS OF MAXIMA OCCUPANCY AND CONNECTED TO BMS SYSTEM. REFER TO CONTROL DRAWINGS M401 AND M402 FOR SEQUENCE.



1 / M103 MECHANICAL LEVEL 3 FLOOR PLAN
1/8" = 1'-0"

MDFR NOTE: CO DETECTION SYSTEM TO COMPLY WITH NFPA 720 (2012 EDITION).

ENGINEERING
FOR ARCHITECTURE
5757 Blue Lagoon Drive, Suite 400
Miami, Florida 33126
PH: 305.266.6553
Fax: 350.266.6695
www.tlc-engineers.com
COA 15

CUTLER BAY TOWN CENTER HVAC EQUIPMENT AND CONTROLS

10720 Caribbean Blvd. Cutler Bay, Florida 33189

Revisions:

No.	Date	Description

Seal

Chi S. Lui, P.E.
Florida License # 61748

CHI S. LUI LICENSE No. 61748 STATE OF FLORIDA PROFESSIONAL ENGINEER

Project No.: Project Number
Issue Date: Issue Date
Drawn By: Author
Approved By: Approver
Scale: 1/8" = 1'-0"

Drawing Title:
MECHANICAL LEVEL 3 FLOOR PLAN

Drawing No.:
M103

100% CD SUBMITTAL

C:\Revit 2016 Local Models\616018_MEP_R16_shay.odonnell.rvt

GENERAL NOTES:

- MECHANICAL EQUIPMENT IS SHOWN AT APPROXIMATE LOCATIONS. INFORMATION INDICATED ON THE DRAWINGS IS BASED ON AVAILABLE AS-BUILT RECORDS AND LIMITED VISUAL OBSERVATION OF THE SITE. FIELD VERIFICATION DOES NOT INCLUDE DUCTWORK LAYOUT AND ROUTING OF DUCT, WHICH MAY DEVIATE FROM ACTUAL FIELD CONDITIONS.
- PRIOR TO STARTING WORK, CONTRACTOR SHALL BE RESPONSIBLE FOR VERIFYING FIELD CONDITION OF ALL MECHANICAL SYSTEM INVOLVED IN THE AREA OF SCOPE OF WORK AND REPORT DEFICIENCIES. CONTRACTOR SHALL BE RESPONSIBLE FOR RESOLVING ANY CONFLICTS OR DISCREPANCIES AND ADJUSTMENTS OR REPLACEMENT AS NECESSARY PRIOR TO STARTING NEW WORK.
- ALL DEMO WORK SHALL BE PERFORMED DURING THE TIME SCHEDULE ALLOWED BY LANDLORD.
- ALL EQUIPMENT REMOVED FROM THE SPACE IS THE PROPERTY OF THE LANDLORD. CONTRACTOR SHALL DISPOSE OF AS AUTHORIZED BY LANDLORD.

FOR MECHANICAL EQUIPMENT DEMOLITION AND DETAILS GO TO CORRESPONDING ENLARGE DEMO PLANS.

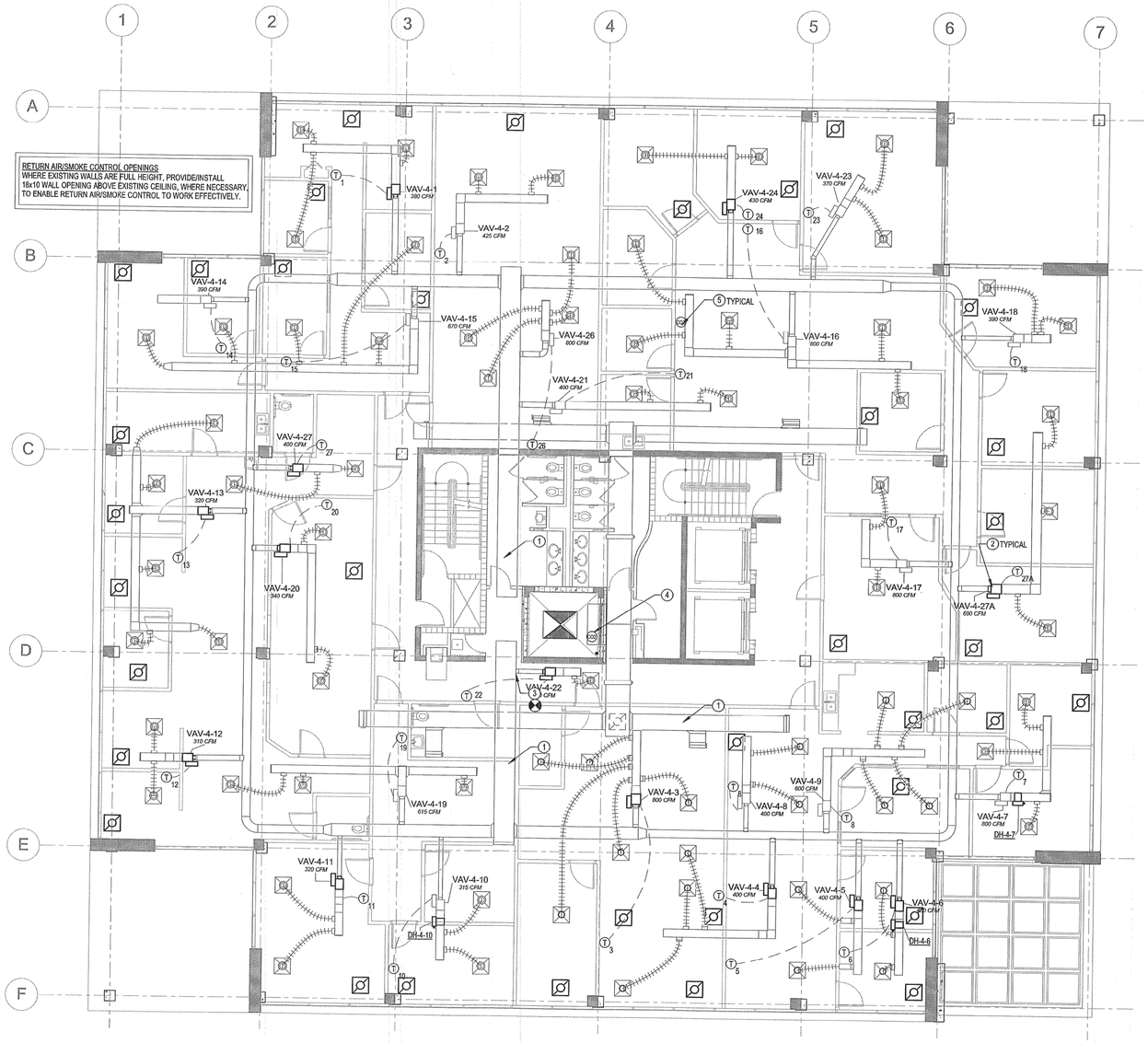
PRIOR TO STARTING ANY WORK, A TEST AND BALANCE ON ALL AIR DISTRIBUTION DEVICES SHALL BE PREFORMED AND A REPORT SHALL BE PRODUCED AND PRESENTED TO ENGINEER OF RECORD FOR REVIEW AND COMMENT.

DEMOLITION KEY NOTES:

1. EXISTING S/A AND R/A DUCTWORK ASSOCIATED WITH AHU-1 SHALL REMAIN AS IS. THE DRAWING SHALL BE CONSIDERED FOR REFERENCE ONLY. EXISTING AHU/CU'S AND STAND AT ROOF SHALL BE REMOVED.
2. REMOVE EXISTING THERMOSTAT TO EACH VAV .
3. EXISTING SUPPLY DIFFUSER AND RETURN GRILLE SHALL REMAIN AS IS. CONTRACTOR SHALL BE RESPONSIBLE TO VERIFY CONDITION AND REPORT ANY DEFICIENCIES.
4. EXISTING HEATER AT VAV AND DUCT WORK FOR ALL VAV UINT APPLICABLE SHALL BE REMAIN AS IS. REFER TO VAV SCHEDULE FOR REFERENCE. CONTRACTOR SHALL BE RESPONSIBLE TO VERIFY AT FIELD CONDITION OF EXISTING AND REPAIR OR REPLACE AS NECESSARY TO ACCOMMODATE NEW CONTROLS, AND CONNECTIONS.

NEW WORK NOTES:

1. EXISTING S/A, R/A DUCTWORK ASSOCIATED WITH AHU-1 SHALL REMAIN AS IS. CONTRACTOR SHALL BE RESPONSIBLE FOR VERIFYING ROUTING, SIZE AND CONDITION OF EXISTING DUCT WORK. THIS DRAWING SHALL BE CONSIDERED FOR REFERENCE ONLY.
2. PROVIDE NEW DDC CONTROLS FOR ALL VAV UNITS AND CONNECT THEM TO NEW MANAGEMENT BUILDING SYSTEM. REFER TO SHEET M401 AND M402 FOR NEW CONTROL DIAGRAM.
3. REPLACE NEW VAV AT POINT INDICATED. CONTRACTOR SHALL BE RESPONSIBLE FOR VERIFYING ROUTING, SIZE AND CONDITION OF EXISTING DUCT WORK FOR NEW VAV UNITS CONNECTION AND REPORT ANY DEFICIENCY. PROVIDE NEW SUPPLY AIR DUCT WORK CONNECTED TO EXISTING. CONTRACTOR SHALL SEAL THE DUCTWORK AND RESTORE THE ORIGINAL CONDITION, WHEREVER WORK IS PERFORMED.
4. CONTRACTOR SHALL CONNECT NEW CO2 SENSOR AT MAIN RETURN DUCT WORK. CONTRACTOR SHALL SEAL THE DUCTWORK AND RESTORE THE ORIGINAL CONDITION, WHEREVER WORK IS PERFORMED. REFER TO CONTROL DRAWINGS M401 AND M402 FOR SEQUENCE.
5. PROVIDE NEW CO2 SENSOR ASSOCIATED WITH AREAS OF MAXIMA OCCUPANCY AND CONNECTED TO BMS SYSTEM. REFER TO CONTROL DRAWINGS M401 AND M402 FOR SEQUENCE.



1 / M104 N — MECHANICAL LEVEL 4 FLOOR PLAN
1/8" = 1'-0"

MDFR NOTE: CO DETECTION SYSTEM TO COMPLY WITH NFPA 720 (2012 EDITION).

ENGINEERING
FOR ARCHITECTURE
5757 Blue Lagoon Drive, Suite 400
Miami, Florida 33126
PH: 305.266.6553
Fax: 350.266.6695
www.tlc-engineers.com
COA 15

CUTLER BAY TOWN CENTER HVAC EQUIPMENT AND CONTROLS

10720 Caribbean Blvd. Cutler Bay, Florida 33189

Revisions:

No.	Date	Description

Seal

Chi S. Lui, P.E.
Florida License # 61748

CHI S. LUI LICENSE No. 61748 STATE OF FLORIDA PROFESSIONAL ENGINEER

100% CD SUBMITTAL

Project No.:	Project Number
Issue Date:	Issue Date
Drawn By:	Author
Approved By:	Approver
Scale:	1/8" = 1'-0"

Drawing Title:
MECHANICAL LEVEL 4 FLOOR PLAN

Drawing No.:
M104

C:\Revit 2016 Local Models\616018_MEP_R16_shay.odonnell.rvt
1/26/2016 1:15:04 PM

GENERAL NOTES:

- MECHANICAL EQUIPMENT IS SHOWN AT APPROXIMATE LOCATIONS. INFORMATION INDICATED ON THE DRAWINGS IS BASED ON AVAILABLE AS-BUILT RECORDS AND LIMITED VISUAL OBSERVATION OF THE SITE. FIELD VERIFICATION DOES NOT INCLUDE DUCTWORK LAYOUT AND ROUTING OF DUCT, WHICH MAY DEVIATE FROM ACTUAL FIELD CONDITIONS.
- PRIOR TO STARTING WORK, CONTRACTOR SHALL BE RESPONSIBLE FOR VERIFYING FIELD CONDITION OF ALL MECHANICAL SYSTEM INVOLVED IN THE AREA OF SCOPE OF WORK AND REPORT DEFICIENCIES. CONTRACTOR SHALL BE RESPONSIBLE FOR RESOLVING ANY CONFLICTS OR DISCREPANCIES AND ADJUSTMENTS OR REPLACEMENT AS NECESSARY PRIOR TO STARTING NEW WORK.
- ALL DEMO WORK SHALL BE PERFORMED DURING THE TIME SCHEDULE ALLOWED BY LANDLORD.
- ALL EQUIPMENT REMOVED FROM THE SPACE IS THE PROPERTY OF THE LANDLORD. CONTRACTOR SHALL DISPOSE OF AS AUTHORIZED BY LANDLORD.

FOR MECHANICAL EQUIPMENT DEMOLITION AND DETAILS GO TO CORRESPONDING ENLARGE DEMO PLANS.

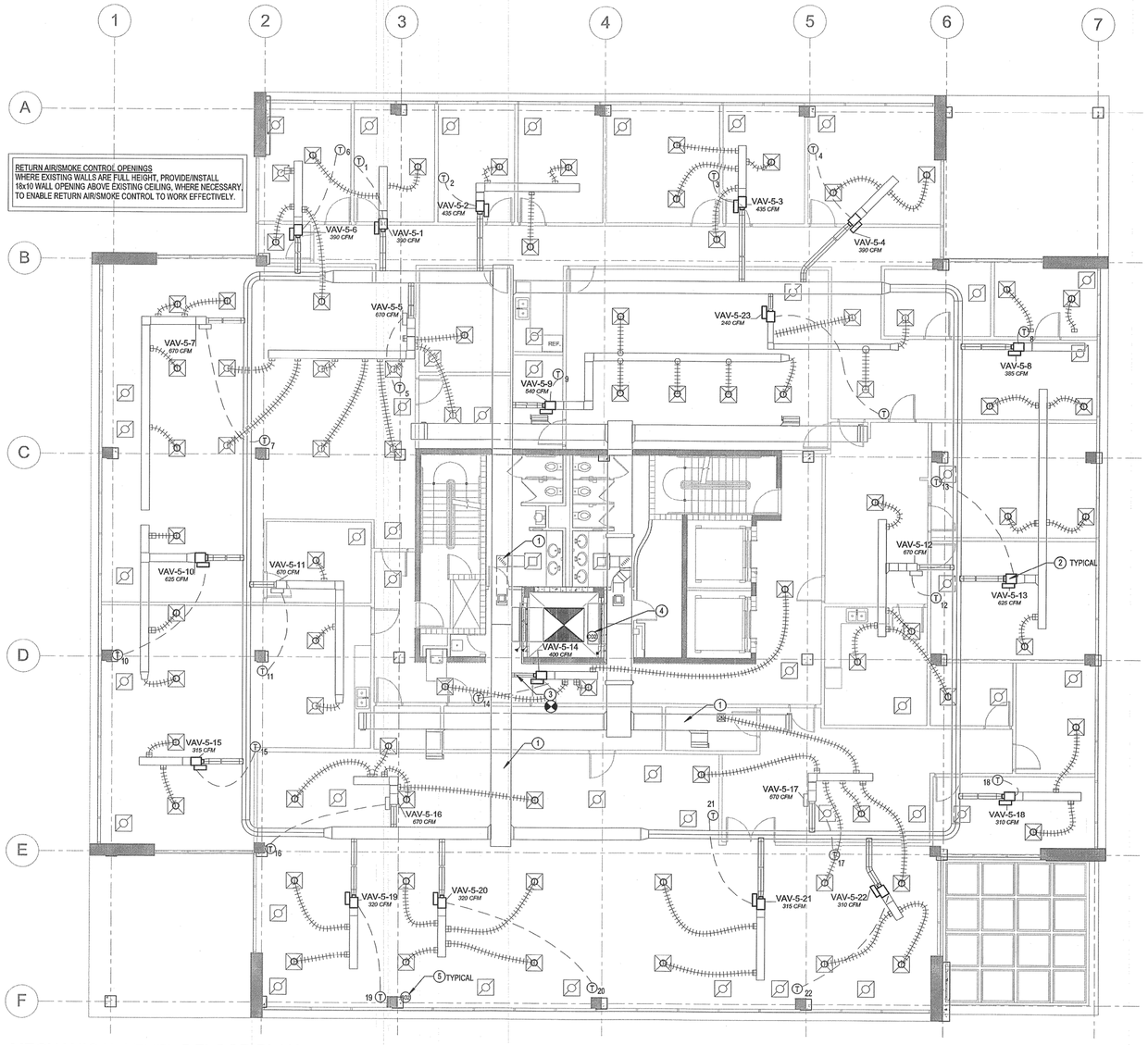
PRIOR TO STARTING ANY WORK, A TEST AND BALANCE ON ALL AIR DISTRIBUTION DEVICES SHALL BE PREFORMED AND A REPORT SHALL BE PRODUCED AND PRESENTED TO ENGINEER OF RECORD FOR REVIEW AND COMMENT.

DEMOLITION KEY NOTES:

1. EXISTING S/A AND R/A DUCTWORK ASSOCIATED WITH AHU-1 SHALL REMAIN AS IS. THE DRAWING SHALL BE CONSIDERED FOR REFERENCE ONLY. EXISTING AHU/CU'S AND STAND AT ROOF SHALL BE REMOVED.
2. REMOVE EXISTING THERMOSTAT TO EACH VAV .
3. EXISTING SUPPLY DIFFUSER AND RETURN GRILLE SHALL REMAIN AS IS. CONTRACTOR SHALL BE RESPONSIBLE TO VERIFY CONDITION AND REPORT ANY DEFICIENCIES.
4. EXISTING HEATER AT VAV AND DUCT WORK FOR ALL VAV UNIT APPLICABLE SHALL BE REMAIN AS IS. REFER TO VAV SCHEDULE FOR REFERENCE. CONTRACTOR SHALL BE RESPONSIBLE TO VERIFY AT FIELD CONDITION OF EXISTING AND REPAIR OR REPLACE AS NECESSARY TO ACCOMMODATE NEW CONTROLS, AND CONNECTIONS.

NEW WORK NOTES:

1. EXISTING S/A, R/A DUCTWORK ASSOCIATED WITH AHU-1 SHALL REMAIN AS IS. CONTRACTOR SHALL BE RESPONSIBLE FOR VERIFYING ROUTING, SIZE AND CONDITION OF EXISTING DUCT WORK. THIS DRAWING SHALL BE CONSIDERED FOR REFERENCE ONLY.
2. PROVIDE NEW DDC CONTROLS FOR ALL VAV UNITS AND CONNECT THEM TO NEW MANAGEMENT BUILDING SYSTEM. REFER TO SHEET M401 AND M402 FOR NEW CONTROL DIAGRAM.
3. REPLACE NEW VAV AT POINT INDICATED. CONTRACTOR SHALL BE RESPONSIBLE FOR VERIFYING ROUTING, SIZE AND CONDITION OF EXISTING DUCT WORK FOR NEW VAV UNITS CONNECTION AND REPORT ANY DEFICIENCY. PROVIDE NEW SUPPLY AIR DUCT WORK CONNECTED TO EXISTING. CONTRACTOR SHALL SEAL THE DUCTWORK AND RESTORE THE ORIGINAL CONDITION, WHEREVER WORK IS PERFORMED.
4. CONTRACTOR SHALL CONNECT NEW CO2 SENSOR AT MAIN RETURN DUCT WORK. CONTRACTOR SHALL SEAL THE DUCTWORK AND RESTORE THE ORIGINAL CONDITION, WHEREVER WORK IS PERFORMED. REFER TO CONTROL DRAWINGS M401 AND M402 FOR SEQUENCE.
5. PROVIDE NEW CO2 SENSOR ASSOCIATED WITH AREAS OF MAXIMA OCCUPANCY AND CONNECTED TO BMS SYSTEM. REFER TO CONTROL DRAWINGS M401 AND M402 FOR SEQUENCE.



1 / M105 MECHANICAL LEVEL 5 FLOOR PLAN
1/8" = 1'-0"

MDFR NOTE: CO DETECTION SYSTEM TO COMPLY WITH NFPA 720 (2012 EDITION).

ENGINEERING
FOR ARCHITECTURE
5757 Blue Lagoon Drive, Suite 400
Miami, Florida 33126
PH: 305.266.6553
Fax: 350.266.6695
www.tlc-engineers.com
COA 15

CUTLER BAY TOWN CENTER HVAC EQUIPMENT AND CONTROLS

10720 Caribbean Blvd. Cutler Bay, Florida 33189

Revisions:

No.	Date	Description

Seal

Chi S. Lui, P.E.
Florida License # 61748

CHI S. LUI LICENSE No. 61748 STATE OF FLORIDA PROFESSIONAL ENGINEER

Project No.:	Project Number
Issue Date:	Issue Date
Drawn By:	Author
Approved By:	Approver
Scale:	1/8" = 1'-0"

Drawing Title:
MECHANICAL LEVEL 5 FLOOR PLAN

Drawing No.:
M105

100% CD SUBMITTAL

C:\Revit 2016 Local Models\616016_MEP_R16_shay.odonnell.rvt
2/7/2017 1:15:09 PM

GENERAL NOTES:

- MECHANICAL EQUIPMENT IS SHOWN AT APPROXIMATE LOCATIONS. INFORMATION INDICATED ON THE DRAWINGS IS BASED ON AVAILABLE AS-BUILT RECORDS AND LIMITED VISUAL OBSERVATION OF THE SITE. FIELD VERIFICATION DOES NOT INCLUDE DUCTWORK LAYOUT AND ROUTING OF DUCT, WHICH MAY DEVIATE FROM ACTUAL FIELD CONDITIONS.
- PRIOR TO STARTING WORK, CONTRACTOR SHALL BE RESPONSIBLE FOR VERIFYING FIELD CONDITION OF ALL MECHANICAL SYSTEM INVOLVED IN THE AREA OF SCOPE OF WORK AND REPORT DEFICIENCIES. CONTRACTOR SHALL BE RESPONSIBLE FOR RESOLVING ANY CONFLICTS OR DISCREPANCIES AND ADJUSTMENTS OR REPLACEMENT AS NECESSARY PRIOR TO STARTING NEW WORK.
- ALL DEMO WORK SHALL BE PERFORMED DURING THE TIME SCHEDULE ALLOWED BY LANDLORD.
- ALL EQUIPMENT REMOVED FROM THE SPACE IS THE PROPERTY OF THE LANDLORD. CONTRACTOR SHALL DISPOSE OF AS AUTHORIZED BY LANDLORD.

FOR MECHANICAL EQUIPMENT DEMOLITION AND DETAILS GO TO CORRESPONDING ENLARGE DEMO PLANS.

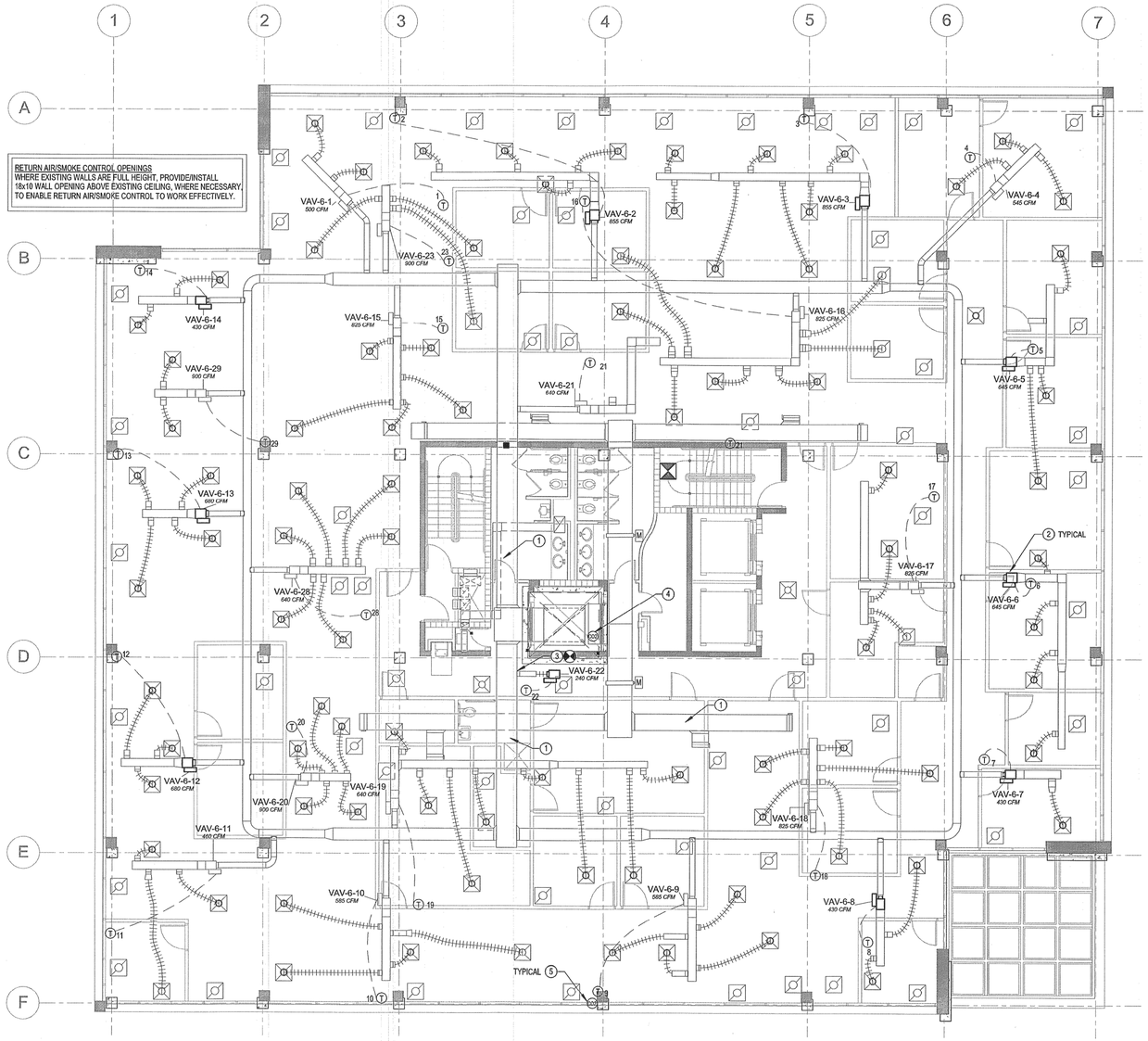
PRIOR TO STARTING ANY WORK, A TEST AND BALANCE ON ALL AIR DISTRIBUTION DEVICES SHALL BE PREFORMED AND A REPORT SHALL BE PRODUCED AND PRESENTED TO ENGINEER OF RECORD FOR REVIEW AND COMMENT.

DEMOLITION KEY NOTES:

1. EXISTING S/A AND R/A DUCTWORK ASSOCIATED WITH AHU-1 SHALL REMAIN AS IS. THE DRAWING SHALL BE CONSIDERED FOR REFERENCE ONLY. EXISTING AHUCUS AND STAND AT ROOF SHALL BE REMOVED.
2. REMOVE EXISTING THERMOSTAT TO EACH VAV .
3. EXISTING SUPPLY DIFFUSER AND RETURN GRILLE SHALL REMAIN AS IS. CONTRACTOR SHALL BE RESPONSIBLE TO VERIFY CONDITION AND REPORT ANY DEFICIENCIES.
4. EXISTING HEATER AT VAV AND DUCT WORK FOR ALL VAV UNIT APPLICABLE SHALL BE REMAIN AS IS. REFER TO VAV SCHEDULE FOR REFERENCE. CONTRACTOR SHALL BE RESPONSIBLE TO VERIFY AT FIELD CONDITION OF EXISTING AND REPAIR OR REPLACE AS NECESSARY TO ACCOMMODATE NEW CONTROLS, AND CONNECTIONS.

NEW WORK NOTES:

1. EXISTING S/A, R/A DUCTWORK ASSOCIATED WITH AHU-1 SHALL REMAIN AS IS. CONTRACTOR SHALL BE RESPONSIBLE FOR VERIFYING ROUTING, SIZE AND CONDITION OF EXISTING DUCT WORK. THIS DRAWING SHALL BE CONSIDERED FOR REFERENCE ONLY.
2. PROVIDE NEW DDC CONTROLS FOR ALL VAV UNITS AND CONNECT THEM TO NEW MANAGEMENT BUILDING SYSTEM. REFER TO SHEET M401 AND M402 FOR NEW CONTROL DIAGRAM.
3. REPLACE NEW VAV AT POINT INDICATED. CONTRACTOR SHALL BE RESPONSIBLE FOR VERIFYING ROUTING, SIZE AND CONDITION OF EXISTING DUCT WORK FOR NEW VAV UNITS CONNECTION AND REPORT ANY DEFICIENCY. PROVIDE NEW SUPPLY AIR DUCT WORK CONNECTED TO EXISTING. CONTRACTOR SHALL SEAL THE DUCTWORK AND RESTORE THE ORIGINAL CONDITION, WHEREVER WORK IS PERFORMED.
4. CONTRACTOR SHALL CONNECT NEW CO2 SENSOR AT MAIN RETURN DUCT WORK. CONTRACTOR SHALL SEAL THE DUCTWORK AND RESTORE THE ORIGINAL CONDITION, WHEREVER WORK IS PERFORMED. REFER TO CONTROL DRAWINGS M401 AND M402 FOR SEQUENCE.
5. PROVIDE NEW CO2 SENSOR ASSOCIATED WITH AREAS OF MAXIMA OCCUPANCY AND CONNECTED TO BMS SYSTEM. REFER TO CONTROL DRAWINGS M401 AND M402 FOR SEQUENCE.



1 / M106 MECHANICAL LEVEL 6 FLOOR PLAN
1/8" = 1'-0"

MDFR NOTE: CO DETECTION SYSTEM TO COMPLY WITH NFPA 720 (2012 EDITION).

ENGINEERING
FOR ARCHITECTURE
5757 Blue Lagoon Drive, Suite 400
Miami, Florida 33126
PH: 305.266.6553
Fax: 350.266.6695
www.tlc-engineers.com
COA 15

CUTLER BAY TOWN CENTER HVAC EQUIPMENT AND CONTROLS

10720 Caribbean Blvd. Cutler Bay, Florida 33189

Revisions:

No.	Date	Description

Seal

Chi S. Lui, P.E.
Florida License # 61748

CHI S. LUI LICENSE No. 61748 STATE OF FLORIDA PROFESSIONAL ENGINEER

Project No.: Project Number
Issue Date: Issue Date
Drawn By: Author
Approved By: Approver
Scale: 1/8" = 1'-0"

Drawing Title: MECHANICAL LEVEL 6 FLOOR PLAN

Drawing No.: M106

100% CD SUBMITTAL

C:\Revit 2016 Local Models\616018_MEP_R16_shay.odonnell.rvt

GENERAL NOTES:

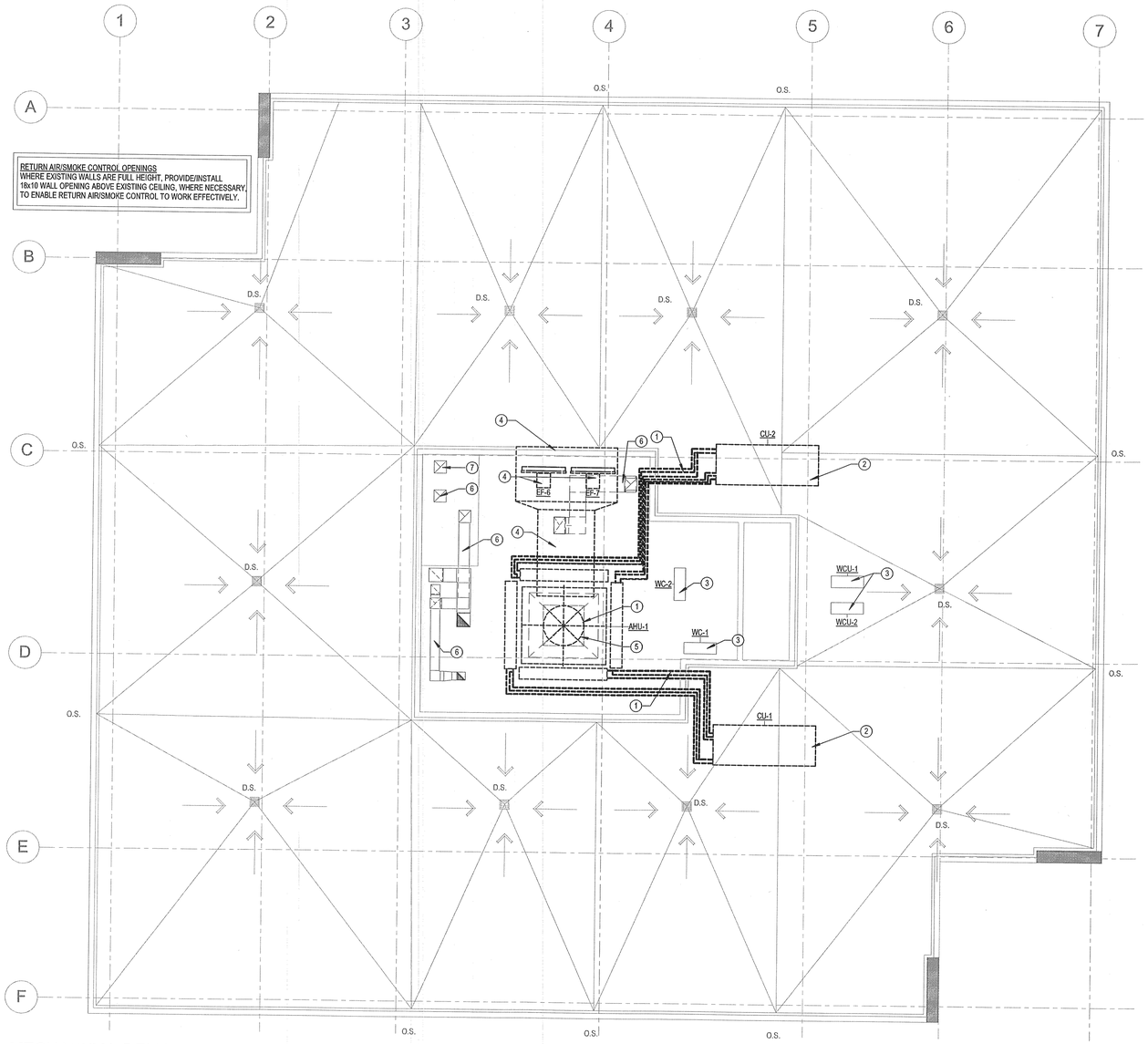
- MECHANICAL EQUIPMENT IS SHOWN AT APPROXIMATE LOCATIONS. INFORMATION INDICATED ON THE DRAWINGS IS BASED ON AVAILABLE AS-BUILT RECORDS AND LIMITED VISUAL OBSERVATION OF THE SITE. FIELD VERIFICATION DOES NOT INCLUDE DUCTWORK LAYOUT AND ROUTING OF DUCT, WHICH MAY DEVIATE FROM ACTUAL FIELD CONDITIONS.
- PRIOR TO STARTING WORK, CONTRACTOR SHALL BE RESPONSIBLE FOR VERIFYING FIELD CONDITION OF ALL MECHANICAL SYSTEM INVOLVED IN THE AREA OF SCOPE OF WORK AND REPORT DEFICIENCIES. CONTRACTOR SHALL BE RESPONSIBLE FOR RESOLVING ANY CONFLICTS OR DISCREPANCIES AND ADJUSTMENTS OR REPLACEMENT AS NECESSARY PRIOR TO STARTING NEW WORK.
- ALL DEMO WORK SHALL BE PERFORMED DURING THE TIME SCHEDULE ALLOWED BY LANDLORD.
- ALL EQUIPMENT REMOVED FROM THE SPACE IS THE PROPERTY OF THE LANDLORD. CONTRACTOR SHALL DISPOSE OF AS AUTHORIZED BY LANDLORD.

FOR MECHANICAL EQUIPMENT DEMOLITION AND DETAILS GO TO CORRESPONDING ENLARGE DEMO PLANS.

PRIOR TO STARTING ANY WORK, A TEST AND BALANCE ON ALL AIR DISTRIBUTION DEVICES SHALL BE PREFORMED AND A REPORT SHALL BE PRODUCED AND PRESENTED TO ENGINEER OF RECORD FOR REVIEW AND COMMENT.

KEY DEMOLITION NOTES:

1. REMOVE EXISTING AIR HANDLING AND CORRESPONDED APPURTENANCE MOUNTED AT MECHANICAL ROOM. REFER TO ELECTRICAL DRAWINGS FOR DISCONNECTING POWER. REMOVE CONDENSATE DRAIN AND ALL REFRIGERANT PIPE ASSOCIATED WITH THE UNIT.
2. EXISTING CU-1 AND CU-2 SHALL BE REMOVED.
3. EXISTING WC-1,2 AND WCU-1,2 SHALL BE REMAIN.
4. REMOVE EXISTING SMOKE EXHAUST DUCT WORK, AND CORRESPONDED APPURTENANCE. ASSOCIATED FANS EF-6 AND EF-8 SHALL BE REMOVED. REFER TO ELECTRICAL DRAWINGS FOR DISCONNECTING POWER. EXISTING EXHAUST LOUVER SHALL BE DEMOLISHED AND SEAL TO ACCOMMODATED NEW EEF-1 INSTALLATION.
5. REMAIN EXISTING S/A DUCT WORK CONNECTION FROM AHU TO POINT INDICATED.
6. EXISTING E/A AND S/A DUCTWORK ASSOCIATED WITH EF-1,2,4, AND SF-1,2 SHALL REMAIN AS IS. CONTRACTOR SHALL RESPONSIBLE TO VERIFY CONDITION OF EXISTING EXHAUST/SUPPLY DUCT WORK AND REPORT ANY DEFICIENCY. THE DRAWING SHALL BE CONSIDERED FOR REFERENCE ONLY. EXISTING EF'S AND SF'S AT ROOF SHALL BE REMOVED.
7. EXISTING DUCT WORK ASSOCIATED WITH EF-3 SHALL BE DEMOLISHED.



1 / M107 N — MECHANICAL DEMO ROOF PLAN
1/8" = 1'-0"

C:\Revit 2016 Local Models\616018_MEP_R16_shay.odonnell.rvt

Miami Dade County Department of Regulatory And Economic Resources - Job Copy
3617005§33 - 2/7/2017 2:38:52 PM
M107-01262017.PDF
Examiner Date Time Stamp Disp. Trade Stamp Name
Odon F Diaz 2/3/2017 1:03:25 PM FIRE Reference Only

ENGINEERING
FOR ARCHITECTURE
5757 Blue Lagoon Drive, Suite 400
Miami, Florida 33126
PH: 305.266.6553
Fax: 350.266.6695
www.tlc-engineers.com
COA 15

CUTLER BAY TOWN CENTER HVAC EQUIPMENT AND CONTROLS

10720 Caribbean Blvd. Cutler Bay, Florida 33189

Revisions:

No.	Date	Description

Seal

Chi S. Lui, P.E.
Florida License # 61748

CHI S. LUI LICENSE No. 61748 STATE OF FLORIDA PROFESSIONAL ENGINEER

100% CD SUBMITTAL

Project No.: Project Number
Issue Date: Issue Date
Drawn By: Author
Approved By: Approver
Scale: 1/8" = 1'-0"

Drawing Title:
MECHANICAL PENTHOUSE/ROOF SLAB DEMO ROOF PLAN

Drawing No.:
M107

GENERAL NOTES:

- MECHANICAL EQUIPMENT IS SHOWN AT APPROXIMATE LOCATIONS. INFORMATION INDICATED ON THE DRAWINGS IS BASED ON AVAILABLE AS-BUILT RECORDS AND LIMITED VISUAL OBSERVATION OF THE SITE. FIELD VERIFICATION DOES NOT INCLUDE DUCTWORK LAYOUT AND ROUTING OF DUCT, WHICH MAY DEVIATE FROM ACTUAL FIELD CONDITIONS.
- PRIOR TO STARTING WORK, CONTRACTOR SHALL BE RESPONSIBLE FOR VERIFYING FIELD CONDITION OF ALL MECHANICAL SYSTEM INVOLVED IN THE AREA OF SCOPE OF WORK AND REPORT DEFICIENCIES. CONTRACTOR SHALL BE RESPONSIBLE FOR RESOLVING ANY CONFLICTS OR DISCREPANCIES AND ADJUSTMENTS OR REPLACEMENT AS NECESSARY PRIOR TO STARTING NEW WORK.
- ALL DEMO WORK SHALL BE PERFORMED DURING THE TIME SCHEDULE ALLOWED BY LANDLORD.
- ALL EQUIPMENT REMOVED FROM THE SPACE IS THE PROPERTY OF THE LANDLORD. CONTRACTOR SHALL DISPOSE OF AS AUTHORIZED BY LANDLORD.

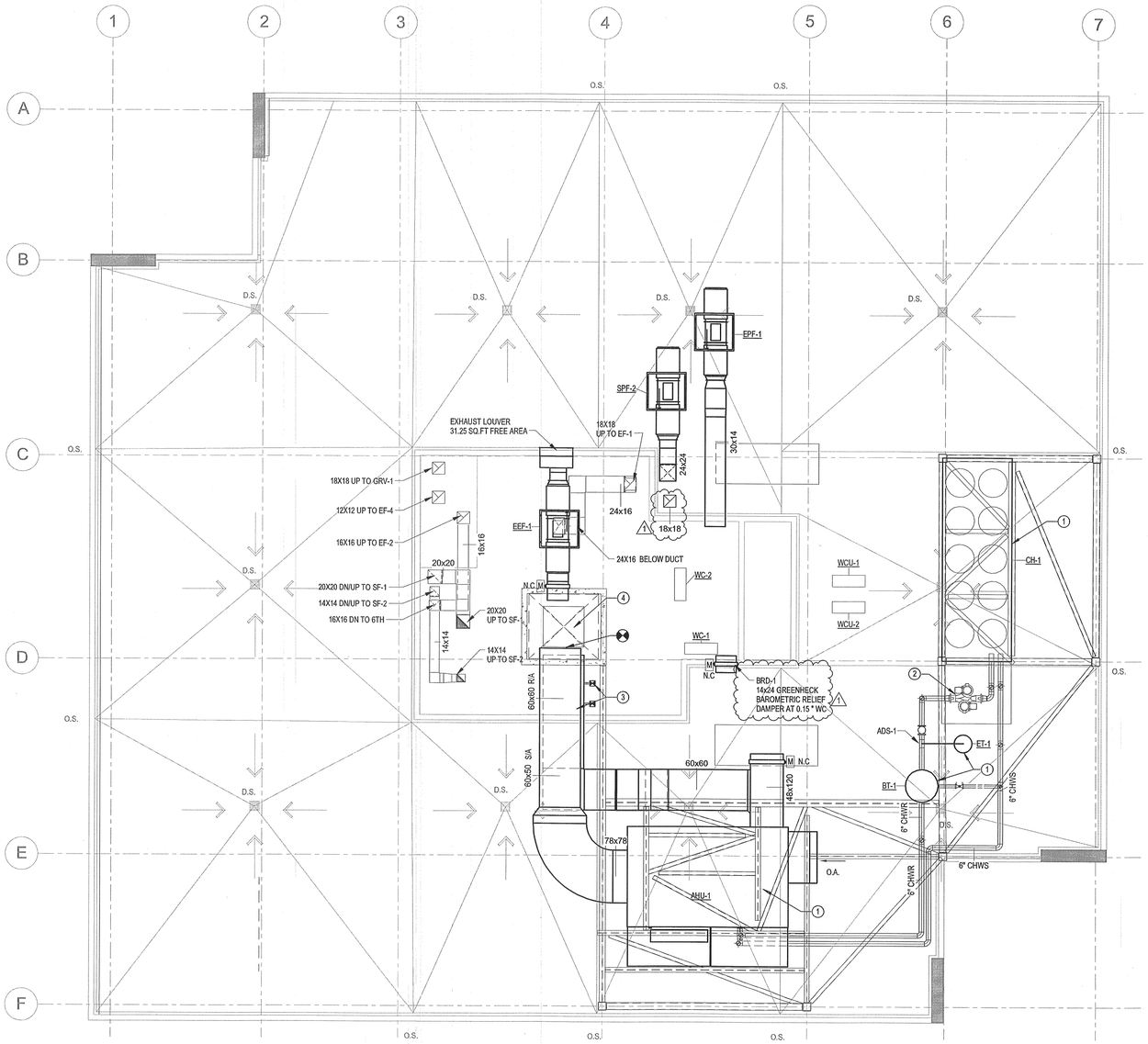
FOR MECHANICAL EQUIPMENT DEMOLITION AND DETAILS GO TO CORRESPONDING ENLARGE DEMO PLANS.

PRIOR TO STARTING ANY WORK, A TEST AND BALANCE ON ALL AIR DISTRIBUTION DEVICES SHALL BE PREFORMED AND A REPORT SHALL BE PRODUCED AND PRESENTED TO ENGINEER OF RECORD FOR REVIEW AND COMMENT.

NEW WORK NOTES:

1. PROVIDE NEW AHU-1 AND CH-1 AT ROOF. ALL ANCILLARY DEVICES AND CHILLER WATER BUFFER TANK. CONTRACTOR SHALL COORDINATE WITH DIV26 FOR ELECTRICAL REQUIREMENTS. CONTRACTOR SHALL BE RESPONSIBLE TO SEAL AND WATERPROOF THE ROOF AS NECESSARY.
2. PROVIDE NEW PUMPS CONNECTION. CONTRACTOR TO INSTALL BASED ON FIELD CONDITIONS. REFER TO DETAILS.
3. CONTRACTOR SHALL BE RESPONSIBLE FOR VERIFYING CONDITION OF EXISTING SMOKE DETECTOR AND REPAIR OR REPLACE AS NECESSARY TO ACCOMMODATE NEW AHU'S CONNECTION IN ACCORDANCE WITH REQUIREMENTS. IF SMOKE DETECTOR IS REPLACED, RECERTIFICATION TO TAKE PLACE AFTER COMPLETION.
4. EXISTING S/A DUCTWORK ASSOCIATED WITH AHU'S SHALL REMAIN AS IS. THIS DRAWING SHALL BE CONSIDERED FOR REFERENCE ONLY.

   PROVIDE NEW SUPPLY SMOKE CONTROL FAN, ASSOCIATED WITH EXISTING SYSTEM. REFER TO SEQUENCE OF OPERATION FOR SMOKE CONTROL. REFER TO M-401, M402.



1 / M108 MECHANICAL ROOF PLAN
1/8" = 1'-0"

ENGINEERING
FOR ARCHITECTURE
5757 Blue Lagoon Drive, Suite 400
Miami, Florida 33126
PH: 305.266.6553
Fax: 350.266.6695
www.tlc-engineers.com
COA 15

CUTLER BAY TOWN CENTER HVAC EQUIPMENT AND CONTROLS

10720 Caribbean Blvd. Cutler Bay, Florida 33189

Revisions:

No.	Date	Description
1	11-16-16	Building Dept. Comments

Seal

Chi S. Lui, P.E.
Florida License # 61748

CHI S. LUI LICENSE NO. 61748 STATE OF FLORIDA PROFESSIONAL ENGINEER

100% CD SUBMITTAL

Project No.:	Project Number
Issue Date:	Issue Date
Drawn By:	Author
Approved By:	Approver
Scale:	1/8" = 1'-0"

Drawing Title:
MECHANICAL PENTHOUSE/ROOF SLAB ROOF/ PLAN

Drawing No.:
M108

GENERAL NOTES:

- MECHANICAL EQUIPMENT IS SHOWN AT APPROXIMATE LOCATIONS. INFORMATION INDICATED ON THE DRAWINGS IS BASED ON AVAILABLE AS-BUILT RECORDS AND LIMITED VISUAL OBSERVATION OF THE SITE. FIELD VERIFICATION DOES NOT INCLUDE DUCTWORK LAYOUT AND ROUTING OF DUCT, WHICH MAY DEVIATE FROM ACTUAL FIELD CONDITIONS.
- PRIOR TO STARTING WORK, CONTRACTOR SHALL BE RESPONSIBLE FOR VERIFYING FIELD CONDITION OF ALL MECHANICAL SYSTEM INVOLVED IN THE AREA OF SCOPE OF WORK AND REPORT DEFICIENCIES. CONTRACTOR SHALL BE RESPONSIBLE FOR RESOLVING ANY CONFLICTS OR DISCREPANCIES AND ADJUSTMENTS OR REPLACEMENT AS NECESSARY PRIOR TO STARTING NEW WORK.
- ALL DEMO WORK SHALL BE PERFORMED DURING THE TIME SCHEDULE ALLOWED BY LANDLORD.
- ALL EQUIPMENT REMOVED FROM THE SPACE IS THE PROPERTY OF THE LANDLORD. CONTRACTOR SHALL DISPOSE OF AS AUTHORIZED BY LANDLORD.

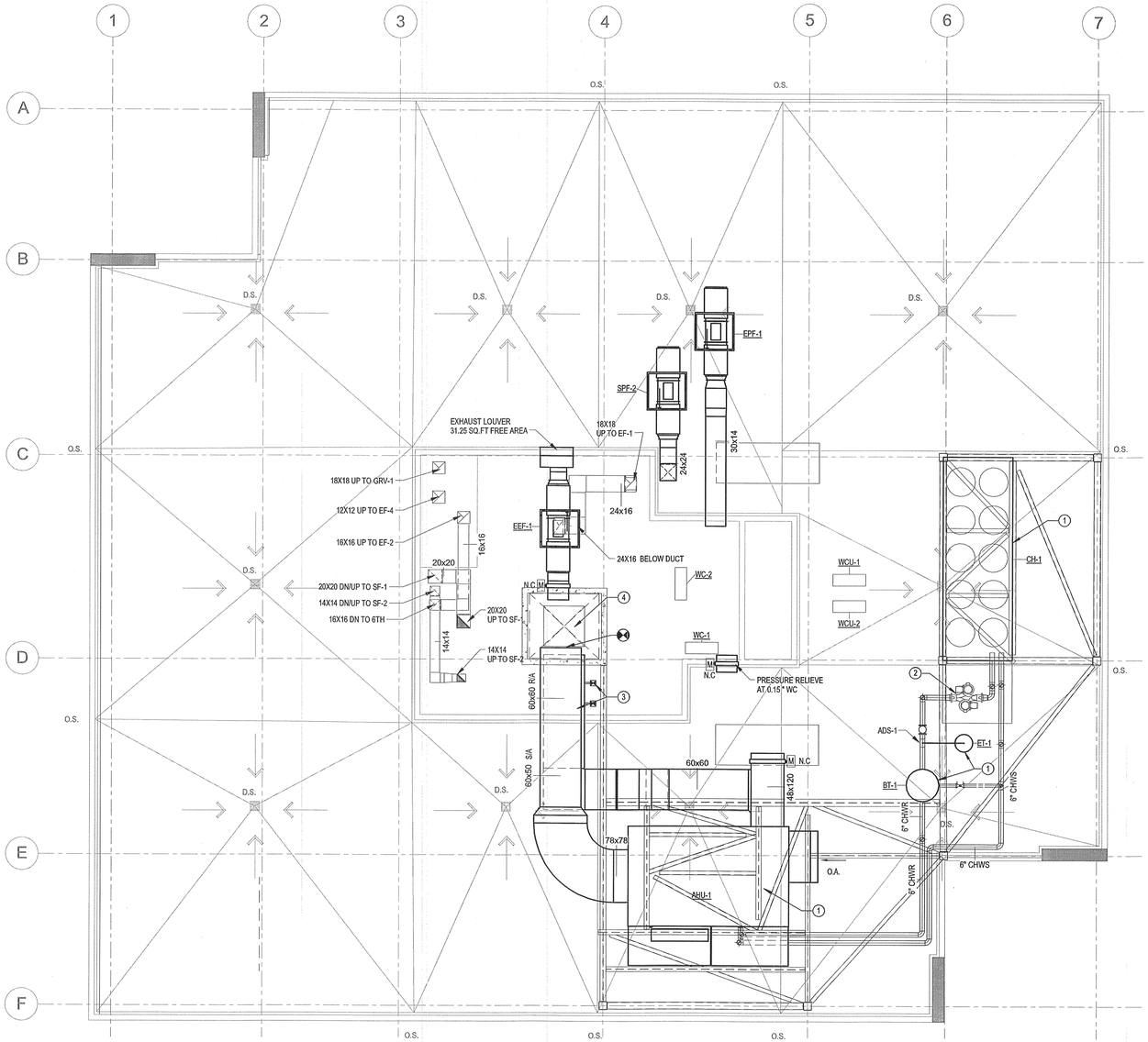
FOR MECHANICAL EQUIPMENT DEMOLITION AND DETAILS GO TO CORRESPONDING ENLARGE DEMO PLANS.

PRIOR TO STARTING ANY WORK, A TEST AND BALANCE ON ALL AIR DISTRIBUTION DEVICES SHALL BE PREFORMED AND A REPORT SHALL BE PRODUCED AND PRESENTED TO ENGINEER OF RECORD FOR REVIEW AND COMMENT.

NEW WORK NOTES:

1. PROVIDE NEW AHU-1 AND CH-1 AT ROOF, ALL ANCILLARY DEVICES AND CHILLER WATER BUFFER TANK. CONTRACTOR SHALL COORDINATE WITH DIV26 FOR ELECTRICAL REQUIREMENTS. CONTRACTOR SHALL BE RESPONSIBLE TO SEAL AND WATERPROOF THE ROOF AS NECESSARY.
2. PROVIDE NEW PUMPS CONNECTION. CONTRACTOR TO INSTALL BASED ON FIELD CONDITIONS. REFER TO DETAILS.
3. CONTRACTOR SHALL BE RESPONSIBLE FOR VERIFYING CONDITION OF EXISTING SMOKE DETECTOR AND REPAIR OR REPLACE AS NECESSARY TO ACCOMMODATE NEW AHU'S CONNECTION IN ACCORDANCE WITH REQUIREMENTS. IF SMOKE DETECTOR IS REPLACED, RECERTIFICATION TO TAKE PLACE AFTER COMPLETION.
4. EXISTING S/A DUCTWORK ASSOCIATED WITH AHU'S SHALL REMAIN AS IS. THIS DRAWING SHALL BE CONSIDERED FOR REFERENCE ONLY.

   PROVIDE NEW SUPPLY SMOKE CONTROL FAN, ASSOCIATED WITH EXISTING SYSTEM. REFER TO SEQUENCE OF OPERATION FOR SMOKE CONTROL. REFER TO M-401, M402.



1 / M108 MECHANICAL ROOF PLAN
1/8" = 1'-0"

N

ENGINEERING
FOR ARCHITECTURE
5757 Blue Lagoon Drive, Suite 400
Mimai, Florida 33126
PH: 305.266.6553
Fax: 350.266.6695
www.tlc-engineers.com
COA 15

CUTLER BAY TOWN CENTER HVAC EQUIPMENT AND CONTROLS

10720 Caribbean Blvd. Cutler Bay, Florida 33189

Revisions:

No.	Date	Description

Seal

Chi S. Lui, P.E.
Florida License # 61748

CHI S. LUI LICENSE NO. 61748 STATE OF FLORIDA PROFESSIONAL ENGINEER

100% CD SUBMITTAL

Project No.:	Project Number
Issue Date:	Issue Date
Drawn By:	Author
Approved By:	Approver
Scale:	1/8" = 1'-0"

Drawing Title:

MECHANICAL PENTHOUSE/ROOF SLAB ROOF/ PLAN

Drawing No.:

M108

C:\Revit 2016 Local Models\616018_MEP_R16_dhay.cdonnell.rvt

GENERAL NOTES:

- MECHANICAL EQUIPMENT IS SHOWN AT APPROXIMATE LOCATIONS. INFORMATION INDICATED ON THE DRAWINGS IS BASED ON AVAILABLE AS-BUILT RECORDS AND LIMITED VISUAL OBSERVATION OF THE SITE, FIELD VERIFICATION DOES NOT INCLUDE DUCTWORK LAYOUT AND ROUTING OF DUCT, WHICH MAY DEVIATE FROM ACTUAL FIELD CONDITIONS.
- PRIOR TO STARTING WORK, CONTRACTOR SHALL BE RESPONSIBLE FOR VERIFYING FIELD CONDITION OF ALL MECHANICAL SYSTEM INVOLVED IN THE AREA OF SCOPE OF WORK AND REPORT DEFICIENCIES. CONTRACTOR SHALL BE RESPONSIBLE FOR RESOLVING ANY CONFLICTS OR DISCREPANCIES AND ADJUSTMENTS OR REPLACEMENT AS NECESSARY PRIOR TO STARTING NEW WORK.
- ALL DEMO WORK SHALL BE PERFORMED DURING THE TIME SCHEDULE ALLOWED BY LANDLORD.
- ALL EQUIPMENT REMOVED FROM THE SPACE IS THE PROPERTY OF THE LANDLORD. CONTRACTOR SHALL DISPOSE OF AS AUTHORIZED BY LANDLORD.

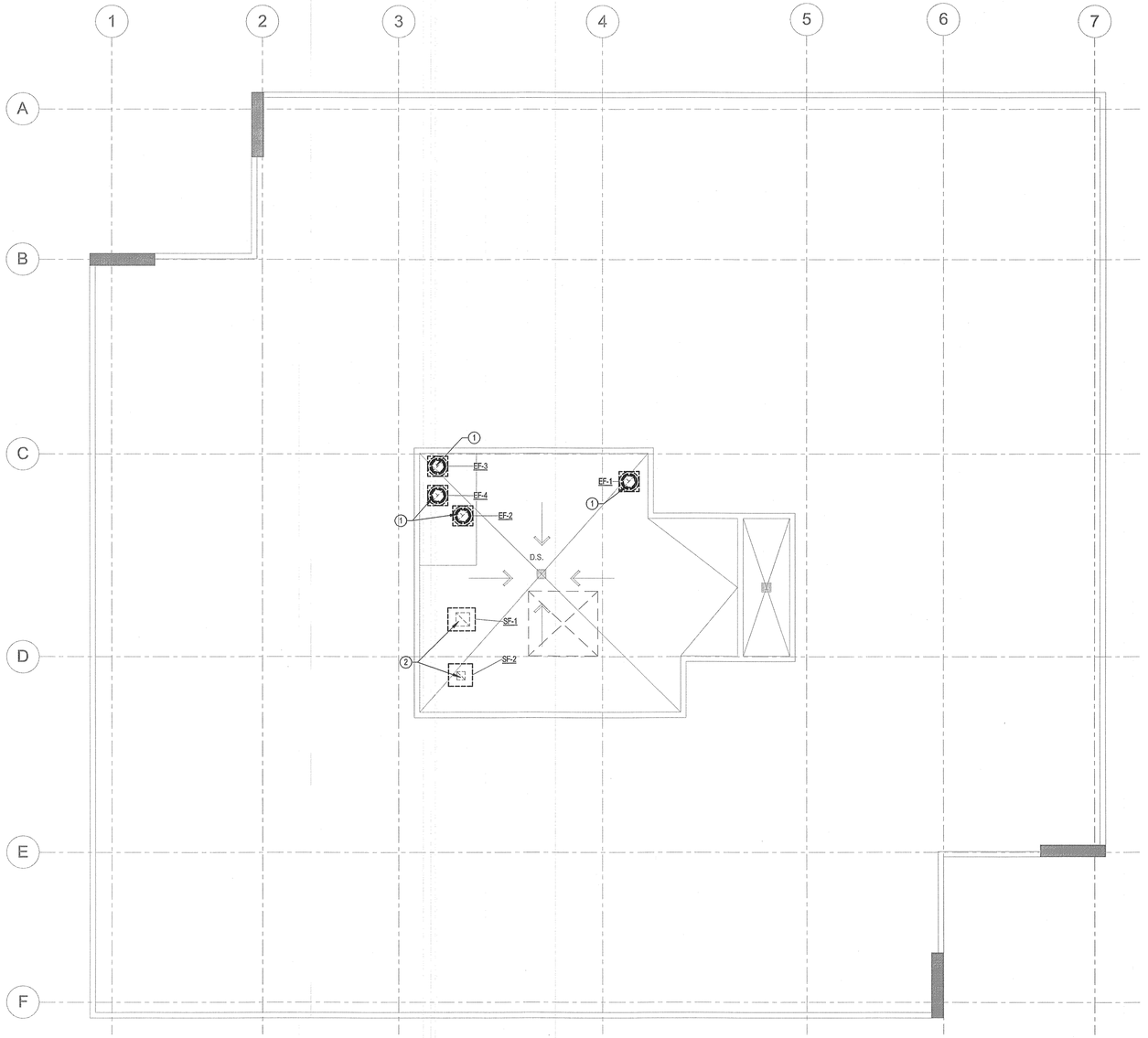
FOR MECHANICAL EQUIPMENT DEMOLITION AND DETAILS GO TO CORRESPONDING ENLARGE DEMO PLANS.

PRIOR TO STARTING ANY WORK, A TEST AND BALANCE ON ALL AIR DISTRIBUTION DEVICES SHALL BE PREFORMED AND A REPORT SHALL BE PRODUCED AND PRESENTED TO ENGINEER OF RECORD FOR REVIEW AND COMMENT.

KEY DEMOLITION NOTES:

(1) REMOVE EXISTING EF'S AND CORRESPONDED APPURTENANCE. REFER TO ELECTRICAL DRAWINGS FOR DISCONNECTING POWER.

(2) REMOVE EXISTING SF'S, AND CORRESPONDED APPURTENANCE. REFER TO ELECTRICAL DRAWINGS FOR DISCONNECTING POWER.



1 / M109 MECHANICAL PENTHOUSE DEMO ROOF PLAN
N.T.S.

N

ENGINEERING
FOR ARCHITECTURE
5757 Blue Lagoon Drive, Suite 400
Mimai, Florida 33126
PH: 305.266.6553
Fax: 350.266.6695
www.tlc-engineers.com
COA 15

CUTLER BAY TOWN CENTER HVAC EQUIPMENT AND CONTROLS

10720 Caribbean Blvd. Cutler Bay, Florida 33189

Revisions:

No.	Date	Description

Seal

Chi S. Lui, P.E.
Florida License # 61748

CHI S. LU LICENSE NO. 61748 STATE OF FLORIDA PROFESSIONAL ENGINEER

Project No.: Project Number
Issue Date: Issue Date

Drawn By: Author
Approved By: Approver
Scale: 1/8" = 1'-0"

Drawing Title:
MECHANICAL PENTHOUSE DEMO ROOF PLAN

Drawing No.:
M109

100% CD SUBMITTAL

C:\Revit 2016 Local Models\616018_MEP_R16_shay.odonnell.rvt
1/26/2016 1:15:21 PM

GENERAL NOTES:

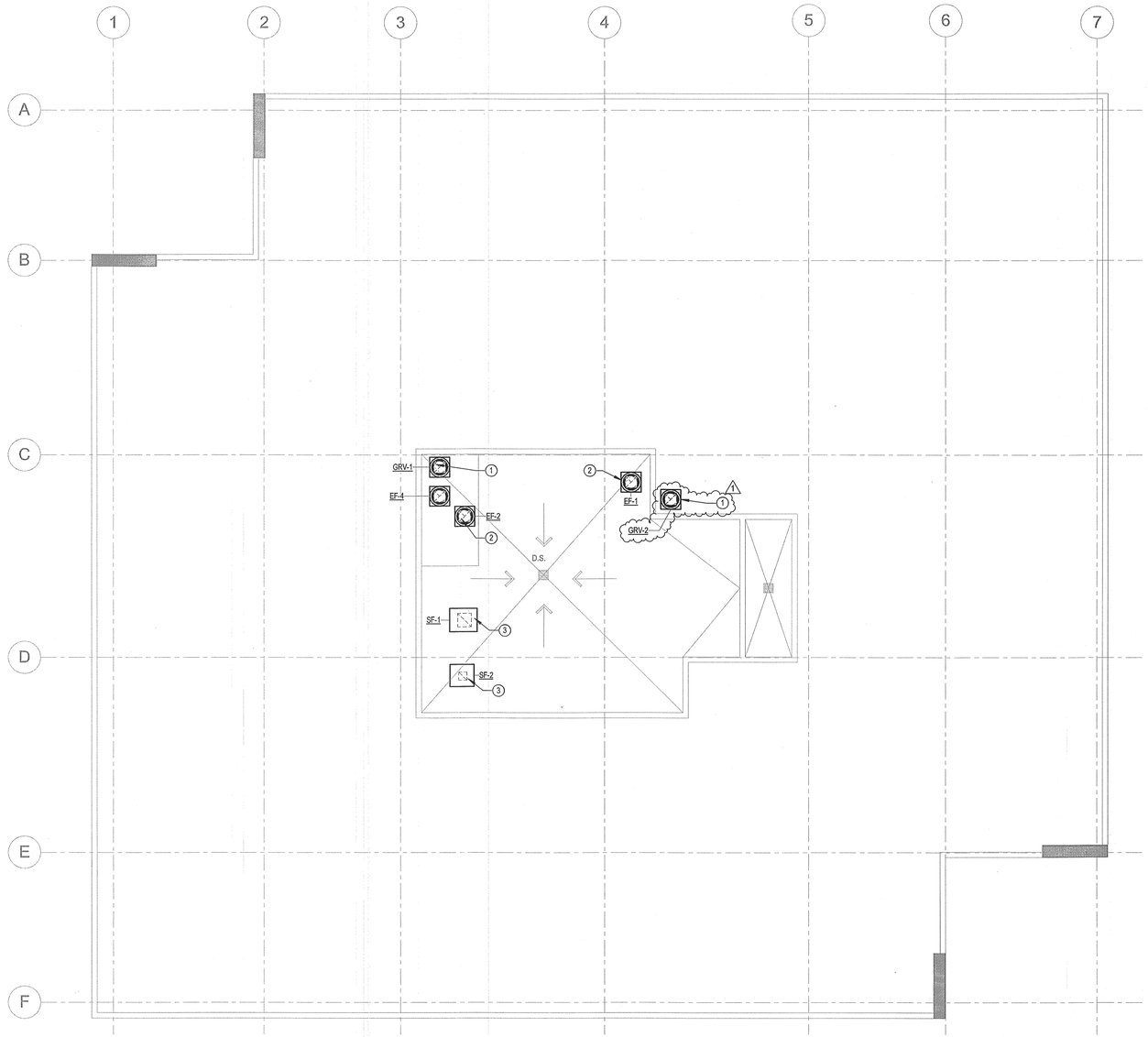
- MECHANICAL EQUIPMENT IS SHOWN AT APPROXIMATE LOCATIONS. INFORMATION INDICATED ON THE DRAWINGS IS BASED ON AVAILABLE AS-BUILT RECORDS AND LIMITED VISUAL OBSERVATION OF THE SITE. FIELD VERIFICATION DOES NOT INCLUDE DUCTWORK LAYOUT AND ROUTING OF DUCT, WHICH MAY DEVIATE FROM ACTUAL FIELD CONDITIONS.
- PRIOR TO STARTING WORK, CONTRACTOR SHALL BE RESPONSIBLE FOR VERIFYING FIELD CONDITION OF ALL MECHANICAL SYSTEM INVOLVED IN THE AREA OF SCOPE OF WORK AND REPORT DEFICIENCIES. CONTRACTOR SHALL BE RESPONSIBLE FOR RESOLVING ANY CONFLICTS OR DISCREPANCIES AND ADJUSTMENTS OR REPLACEMENT AS NECESSARY PRIOR TO STARTING NEW WORK.
- ALL DEMO WORK SHALL BE PERFORMED DURING THE TIME SCHEDULE ALLOWED BY LANDLORD.
- ALL EQUIPMENT REMOVED FROM THE SPACE IS THE PROPERTY OF THE LANDLORD. CONTRACTOR SHALL DISPOSE OF AS AUTHORIZED BY LANDLORD.

FOR MECHANICAL EQUIPMENT DEMOLITION AND DETAILS GO TO CORRESPONDING ENLARGE DEMO PLANS.

PRIOR TO STARTING ANY WORK, A TEST AND BALANCE ON ALL AIR DISTRIBUTION DEVICES SHALL BE PREFORMED AND A REPORT SHALL BE PRODUCED AND PRESENTED TO ENGINEER OF RECORD FOR REVIEW AND COMMENT.

NEW WORK NOTES:

1. PROVIDE NEW GRV-1 & 2 FOR RELIEF AIR AT STAIRS 1 & 2. CONTRACTOR SHALL BE RESPONSIBLE TO SEAL AND WATERPROOF THE ROOF AS NECESSARY TO ACCOMMODATED THE NEW ROOF CURB. (1)
2. PROVIDE EF'S INSTALLATION. CONTRACTOR TO INSTALL BASED ON FIELD CONDITIONS. REFER TO DETAILS. CONTRACTOR SHALL BE RESPONSIBLE FOR VERIFYING CONDITION OF EXISTING ROOF CURB AND REUSED OR PROVIDE NEW AS NECESSARY. CONTRACTOR SHALL COORDINATE WITH DIV26 FOR ELECTRICAL REQUIREMENTS. CONTRACTOR SHALL BE RESPONSIBLE TO SEAL AND WATERPROOF THE ROOF AS NECESSARY.
3. PROVIDE SF'S INSTALLATION. CONTRACTOR TO INSTALL BASED ON FIELD CONDITIONS. REFER TO DETAILS. CONTRACTOR SHALL BE RESPONSIBLE FOR VERIFYING CONDITION OF EXISTING ROOF CURB AND REUSED OR PROVIDE NEW AS NECESSARY. CONTRACTOR SHALL COORDINATE WITH DIV26 FOR ELECTRICAL REQUIREMENTS. CONTRACTOR SHALL BE RESPONSIBLE TO SEAL AND WATERPROOF THE ROOF AS NECESSARY.



1 / M110 N — MECHANICAL PENTHOUSER ROOF PLAN
N.T.S.

ENGINEERING
FOR ARCHITECTURE
5757 Blue Lagoon Drive, Suite 400
Mimai, Florida 33126
PH: 305.266.6553
Fax: 350.266.6695
www.tlc-engineers.com
COA 15

CUTLER BAY TOWN CENTER HVAC EQUIPMENT AND CONTROLS

10720 Caribbean Blvd. Cutler Bay, Florida 33189

Revisions:

No.	Date	Description
1	11-16-16	Building Dept. Comments

Seal

Chi S. Lui, P.E.
Florida License # 61748

Project No.: Project Number
Issue Date: Issue Date

Drawn By: Author
Approved By: Approver
Scale: 1/8" = 1'-0"

Drawing Title:
MECHANICAL PENTHOUSE ROOF/ PLAN

Drawing No.:
M110

100% CD SUBMITTAL

GENERAL NOTES:

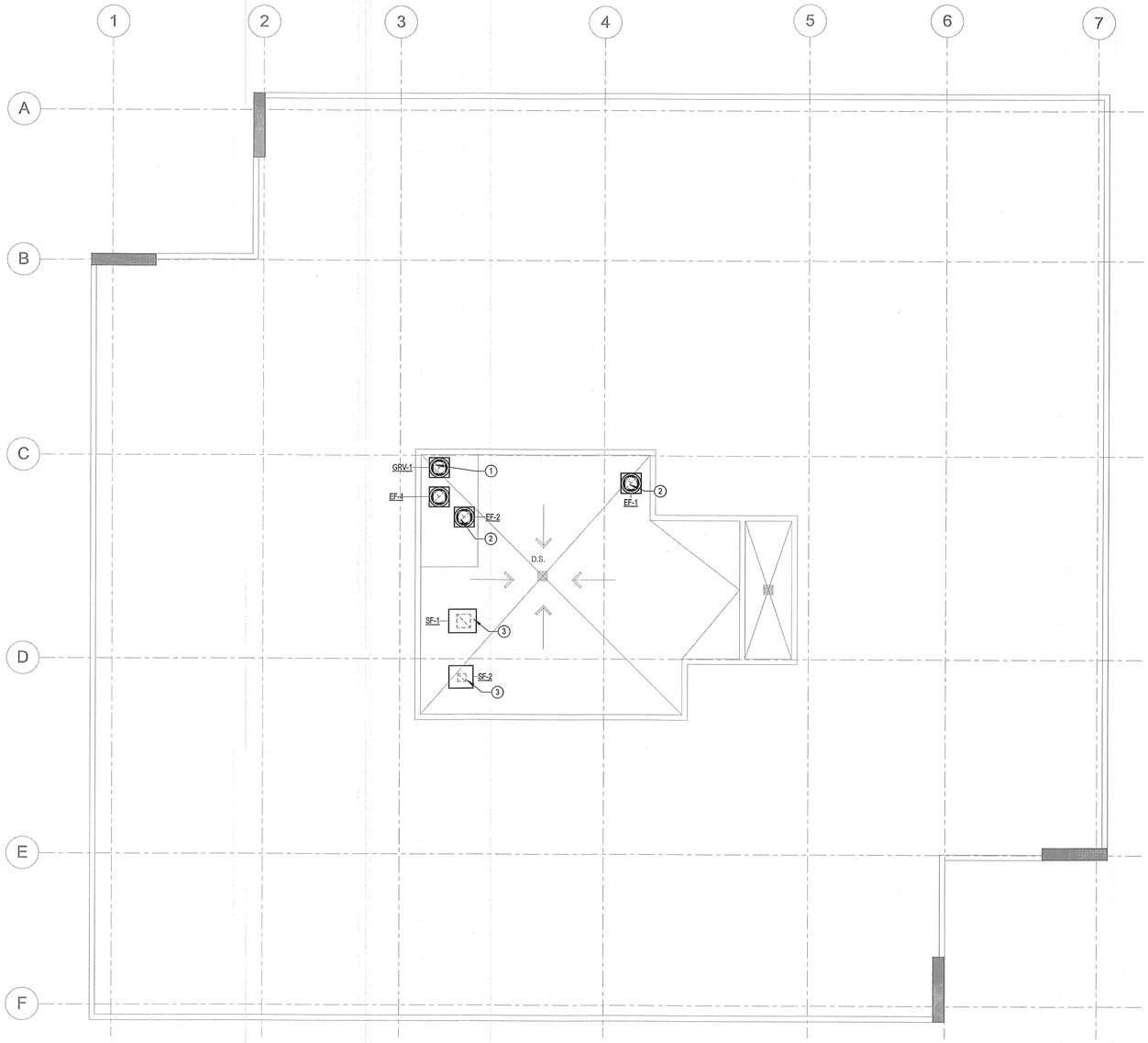
- MECHANICAL EQUIPMENT IS SHOWN AT APPROXIMATE LOCATIONS. INFORMATION INDICATED ON THE DRAWINGS IS BASED ON AVAILABLE AS-BUILT RECORDS AND LIMITED VISUAL OBSERVATION OF THE SITE. FIELD VERIFICATION DOES NOT INCLUDE DUCTWORK LAYOUT AND ROUTING OF DUCT, WHICH MAY DEVIATE FROM ACTUAL FIELD CONDITIONS.
- PRIOR TO STARTING WORK, CONTRACTOR SHALL BE RESPONSIBLE FOR VERIFYING FIELD CONDITION OF ALL MECHANICAL SYSTEM INVOLVED IN THE AREA OF SCOPE OF WORK AND REPORT DEFICIENCIES. CONTRACTOR SHALL BE RESPONSIBLE FOR RESOLVING ANY CONFLICTS OR DISCREPANCIES AND ADJUSTMENTS OR REPLACEMENT AS NECESSARY PRIOR TO STARTING NEW WORK.
- ALL DEMO WORK SHALL BE PERFORMED DURING THE TIME SCHEDULE ALLOWED BY LANDLORD.
- ALL EQUIPMENT REMOVED FROM THE SPACE IS THE PROPERTY OF THE LANDLORD. CONTRACTOR SHALL DISPOSE OF AS AUTHORIZED BY LANDLORD.

FOR MECHANICAL EQUIPMENT DEMOLITION AND DETAILS GO TO CORRESPONDING ENLARGE DEMO PLANS.

PRIOR TO STARTING ANY WORK, A TEST AND BALANCE ON ALL AIR DISTRIBUTION DEVICES SHALL BE PREFORMED AND A REPORT SHALL BE PRODUCED AND PRESENTED TO ENGINEER OF RECORD FOR REVIEW AND COMMENT.

NEW WORK NOTES:

1. PROVIDE NEW GRV-1 FOR RELIEVE AIR AT STAIR. CONTRACTOR SHALL BE RESPONSIBLE TO SEAL AND WATERPROOF THE ROOF AS NECESSARY TO ACCOMMODATED THE NEW ROOF CURB.
2. PROVIDE EF'S INSTALLATION. CONTRACTOR TO INSTALL BASED ON FIELD CONDITIONS. REFER TO DETAILS. CONTRACTOR SHALL BE RESPONSIBLE FOR VERIFYING CONDITION OF EXISTING ROOF CURB AND REUSED OR PROVIDE NEW AS NECESSARY. CONTRACTOR SHALL COORDINATE WITH DIV26 FOR ELECTRICAL REQUIREMENTS. CONTRACTOR SHALL BE RESPONSIBLE TO SEAL AND WATERPROOF THE ROOF AS NECESSARY.
3. PROVIDE SF'S INSTALLATION. CONTRACTOR TO INSTALL BASED ON FIELD CONDITIONS. REFER TO DETAILS. CONTRACTOR SHALL BE RESPONSIBLE FOR VERIFYING CONDITION OF EXISTING ROOF CURB AND REUSED OR PROVIDE NEW AS NECESSARY. CONTRACTOR SHALL COORDINATE WITH DIV26 FOR ELECTRICAL REQUIREMENTS. CONTRACTOR SHALL BE RESPONSIBLE TO SEAL AND WATERPROOF THE ROOF AS NECESSARY.



1 / M110 MECHANICAL PENTHOUSER ROOF PLAN
N.T.S.

ENGINEERING
FOR ARCHITECTURE
5757 Blue Lagoon Drive, Suite 400
Miami, Florida 33126
PH: 305.266.6553
Fax: 350.266.6695
www.tlc-engineers.com
COA 15

CUTLER BAY TOWN CENTER HVAC EQUIPMENT AND CONTROLS

10720 Caribbean Blvd. Cutler Bay, Florida 33189

Revisions:

No.	Date	Description

Seal

Chi S. Lui, P.E.
Florida License # 61748

CHI S. LUI
No. 61748
STATE OF FLORIDA
PROFESSIONAL ENGINEER

100% CD SUBMITTAL

Project No.:	Project Number
Issue Date:	Issue Date
Drawn By:	Author
Approved By:	Approver
Scale:	1/8" = 1'-0"

Drawing Title:
MECHANICAL PENTHOUSE ROOF/ PLAN

Drawing No.:
M110

C:\Revit 2016 Local Models\61601R_MEP_R16_dhay.rvt 2/7/2016 1:15:22 PM

AIR HANDLING UNIT SCHEDULE

PLAN MARK	UNIT TYPE	AREA SERVING	MODEL	FAN DATA								COOLING COIL										ELECTRICAL DATA				REMARKS	DIMENSIONS L x W x H (IN.)	WEIGHT (lbs.)
				CFM NORMAL MODE	O.A.	EXT. STATIC (IN W.G.)	FILTERS	MOTOR DATA			VFD	TOTAL MBH	SENSIBLE MBH	EAT F°		LAT F°		MAX. FACE VEL. FPM	MIN. ROWS	EWT F°	LWT F°	WATER FLOW GPM	WPD	ELECTRIC HEATER						
								HP	RPM	VOLT / PHASE				DB	WB	DB	WB			DB	DB			MBH	MIN. # STEPS	VOLTS	PHASE			
AHU-1	HORIZONTAL	BUILDING	SOLUTION INDOOR 120X180	56,000	11,300	3.5	MERV 13	75	1800	480/3	YES	1945.4	1412.7	80	67	56.7	55.6	559	4/11	44	56	321.5	4.1	-	-	460	3	1,2,3,4,5,6,7	189X180X120	12278

NOTES:
1. BASIS OF DESIGN: JOHNSON CONTROL.
2. PROVIDE FACTORY INSTALLED BELT DRIVEN BLOWER MOTOR.
3. PROVIDE FACTORY INSTALLED MERV 13 FILTER RACK.
4. PROVIDE FACTORY INSTALLED NON CORROSIVE DRAIN PAN.
5. PROVIDE FACTORY INSTALLED MOTOR CONTROL BOX AND OVERLOAD PROTECTION.
6. PROVIDE 4 ROW COOLING COIL.
7. PROVIDE 3-WAY CONTROL VALVE.

TABLE 4-1
RECTANGULAR DUCT HANGERS MINIMUM SIZE

MAXIMUM HALF OF DUCT PERIMETER	PAIR AT 10 FT SPACING		PAIR AT 8 FT SPACING		PAIR AT 5 FT SPACING		PAIR AT 4 FT SPACING	
	STRAP	WIRE/ ROD	STRAP	WIRE/ ROD	STRAP	WIRE/ ROD	STRAP	WIRE/ ROD
P/2 = 30"	1"x 22 GA.	10 GA. (.135")	1"x 22 GA.	10 GA. (.135")	1"x 22 GA.	12 GA. (.106")	1"x 22 GA.	12 GA. (.106")
P/2 = 72"	1"x 18 GA.	3/8"	1"x 20 GA.	1/4"	1"x 22 GA.	1/4"	1"x 22 GA.	1/4"
P/2 = 96"	1"x 16 GA.	3/8"	1"x 18 GA.	3/8"	1"x 20 GA.	3/8"	1"x 22 GA.	1/4"
P/2 = 120"	1\" x 16 GA	1/2"	1"x 16 GA.	3/8"	1"x 18 GA.	3/8"	1"x 20 GA.	1/4"
P/2 = 168"	1\" x 16 GA	1/2"	1\" x 16 GA	1/2"	1"x 16 GA.	3/8"	1"x 18 GA.	3/8"
P/2 = 192"	NOT GIVEN	1/2"	1\" x 16 GA	1/2"	1"x 16 GA.	3/8"	1"x 16 GA.	3/8"
P/2 = 193" UP	SPECIAL ANALYSIS REQUIRED							

WHEN STRAPS ARE LAP JOINED
USE THESE MINIMUM FASTENERS:

1"x 18, 20, 22 GA.-TWO #10 OR ONE 1/4" BOLT
1"x 16 GA.-TWO 1/4" DIA.
1 1/2"x 16 GA. -TWO 3/8" DIA.
PLACE FASTENERS IN SERIES, NOT SIDE BY SIDE.

SINGLE HANGER MAXIMUM ALLOWABLE LOAD	
STRAP	WIRE OR ROD (DIA.)
1"x 22 GA.-260 LBS. 1"x 20 GA.-320 LBS. 1"x 18 GA.-420 LBS. 1"x 16 GA.-700 LBS. 1 1/2"x 16 GA. -1100 LBS.	0.016"-.80 LBS. 0.135"- 120 LBS. 0.162"- 160 LBS. 1/4"- 270 LBS. 3/8"- 680 LBS. 1/2"- 1250 LBS. 5/8"- 2000 LBS. 3/4"- 3000 LBS.

NOTES
1. DIMENSIONS OTHER THAN GAGE ARE IN INCHES.
2. TABLES ALLOW FOR DUCT WEIGHT, 1 LB./SF INSULATION WEIGHT AND NORMAL REINFORCEMENT AND TRAPEZE WEIGHT, BUT NO EXTERNAL LOADS.
3. FOR CUSTOM DESIGN OF HANGERS, DESIGNERS MAY CONSULT SMACNA'S RECTANGULAR INDUSTRIAL DUCT STANDARDS, THE AISI COLD FORMED STEEL DESIGN MANUAL AND THE AISC STEEL CONSTRUCTION MANUAL.
4. STRAPS ARE GALVANIZED STEEL; OTHER MATERIALS ARE UNCOATED STEEL.
5. ALLOWABLE LOADS FOR P/2 ASSUME THAT DUCTS ARE 16 GA. MAXIMUM, EXCEPT THAT WHEN MAXIMUM DUCT DIMENSION (W) IS OVER 60" THEN P/2 MAXIMUM IS 1.25W.
6. FOR UPPER ATTACHMENTS REFER TO SMACNA DUCT STANDARDS - SECOND EDITION: FIG. 4-2
7. FOR LOWER ATTACHMENTS REFER TO SMACNA DUCT STANDARDS - SECOND EDITION: FIG. 4-4
8. FOR TRAPEZE SIZES REFER TO SMACNA DUCT STANDARDS - SECOND EDITION: TABLE 4-3 AND FIG. 4-5.
9. 12, 10, OR 8 GA. WIRE IS STEEL OF BLACK ANNEALED, BRIGHT BASIC, OR GALVANIZED TYPE.

TABLE 4-2
MINIMUM HANGER SIZES FOR ROUND DUCT

DIA.	MAXIMUM SPACING	WIRE/ DIA.	ROD	STRAP
10" DN. 250 MM DN	12' 3.7 M	ONE 12 GA. ONE 2.75 MM	1/4" 6.4 MM	1"x 22 GA. 25.4 x 0.85 MM
11-18"	12'	TWO 12 GA. OR ONE 8 GA.	1/4"	1"x 22 GA.
460 MM	3.7 M	ONE 4.27 MM	6.4 MM	25.4 x 0.85 MM
19-24" 610 MM	12' 3.7 M	TWO 10 GA. TWO 3.51 MM	1/4" 6.4 MM	1"x 22 GA. 25.4 x 0.85 MM
25-36" 900 MM	12' 3.7 M	TWO 8 GA. TWO 2.7 MM	3/8" 9.5 MM	1"x 20 GA. 25.4 x 0.85 MM
37-50" 1270 MM	12' 3.7 M		TWO 3/8" TWO 9.5 MM	TWO 1"x 20 GA. (2) 25.4 x 1.00 MM
51-60" 1520 MM	12' 3.7 M		TWO 3/8" TWO 9.5 MM	TWO 1"x 18 GA. (2) 25.4 x 1.31 MM
61-84" 2130 MM	12' 3.7 M		TWO 3/8" TWO 9.5 MM	TWO 1"x 16 GA. (2) 25.4 x 1.61 MM

NOTES

1. STRAPS ARE GALVANIZED STEEL; RODS ARE UNCOATED OR GALVANIZED STEEL; WIRE IS BLACK ANNEALED, BRIGHT BASIC, OR GALVANIZED STEEL. ALL ARE ALTERNATIVES.
2. REFER TO SMACNA DUCT STANDARDS - SECOND EDITION: FIG. 4-4 FOR LOWER SUPPORTS.
3. REFER TO SMACNA DUCT STANDARDS - SECOND EDITION: FIG. 4-2 AND 4-3 FOR UPPER ATTACHMENTS.
4. TABLE ALLOWS FOR CONVENTIONAL WALL THICKNESS, AND JOINT SYSTEMS PLUS ONE LB/SF INSULATION WEIGHT. IF HEAVIER DUCTS ARE TO BE INSTALLED, ADJUST HANGER SIZES TO BE WITHIN THEIR LOAD LIMITS; REFER TO SMACNA DUCT STANDARDS SECOND EDITION ALLOWABLE LOADS WITH TABLE 4-1. HANGER SPACING MAY BE ADJUSTED BY SPECIAL ANALYSIS.
5. DESIGNERS: FOR INDUSTRIAL GRADE SUPPORTS, INCLUDING SADDLES, SINGLE LOAD TRAPEZE LOADS, LONGER SPANS AND FLANGE JOINT LOADS, SEE SMACNA'S ROUND INDUSTRIAL DUCT CONSTRUCTION STANDARDS.
6. REFER TO SMACNA DUCT STANDARDS - SECOND EDITION: FIGS.3-9 AND 3-10 FOR FLEXIBLE DUCT SUPPORTS.

HVAC DESIGN REQUIRES:

	YES	NO
DUCT SMOKE DETECTOR	✓	
FIRE DAMPER(S)	✓	
SMOKE DAMPER(S)	✓	
FIRE RATED ENCLOSURE	✓	
FIRE RATED ROOF/ FLOOR CEILING ASSEMBLY	✓	
FIRE STOPPING	✓	
SMOKE CONTROL	✓	

AIR CONDITIONING DESIGN SCHEDULE

DESIGN AREA	SUMMER DESIGN				WINTER DESIGN		
	OUTSIDE		INSIDE		OUTSIDE	INSIDE	
	DB	WB	DB	% RH	DB	DB	% RH
MIAMI	91	78	75	50	46	68	50

SCHEDULE OF OUTSIDE AIR PER ASHRAE STD. 62.1-2014

SYSTEM	AREA SERVED	SPACE	ASHRAE 62.1 O.A REQUIRED	AREA SERVED (SQ. FT.)	OCCUPANCY	O.A REQUIRED	MAX. OA. PROVIDED
AHU-1	OFFICE 1ST FLOOR	OFFICE	5 CFM/PERS-0.06CFM/SQFT	12,181	626	3861	4700
	OFFICE 2ND FLOOR	OFFICE	5 CFM/PERS-0.06CFM/SQFT	11,826	61	1015	1300
	OFFICE 3RD FLOOR	OFFICE	5 CFM/PERS-0.06CFM/SQFT	11,328	57	965	1300
	OFFICE 4TH FLOOR	OFFICE	5 CFM/PERS-0.06CFM/SQFT	11,328	57	965	1300
	OFFICE 5TH FLOOR	OFFICE	5 CFM/PERS-0.06CFM/SQFT	11,365	58	967	1300
	CORRIDOR	CORRIDOR	0.06CFM/SQFT	12,075	61	1030	1400
						TOTAL	11300

CHILLER SCHEDULE

UNIT NO.	TONS	MFGR & MODEL NO.	EVAPORATOR (WATER)					CONDENSER (AIR)				EVAP. PRESS. DROP	COMP. No.	FULL LOAD EFFIC.	ELECTRICAL							OPERATING WEIGHT LBS	EFFICIENCY RATING
			EWT	LWT	GPM	MIN GPM	NO OF PASSES	EAT	No FANS	TOTAL HEAT REJECTION MBH	TOTAL FAN KW	FT. H_2O	KW(EACH)	KW/tonR	VOLTS	PH	AMPS	HZ	MCA	MCOP	REFRIGERANT		kW/TON R COMPRESSOR
CH-1	160	SMARDT AD054.2BG06.F2AEHA	58°	46°	318.2	144.5	2	95°	8	2515.10	16.8	8.26	2/67.8	0.953	460	3	212	60	236	329	HFC 134a	--	0.848 0.345

NOTES:
1. BASIS OF DESIGN IS SMARDT INC.
2. SINGLE POINT OF CONNECTION. INDIVIDUAL BREAKER OR FUSED DISCONNECT PER COMPRESSOR.
3. NEMA 3R CONTROL ENCLOSURES - OUTDOOR USE.

PUMP SCHEDULE

UNIT NO.	LOCATION	PURPOSE	MANUFACTURER	MODEL NO.	TYPE	FRAME	GPM	HEAD FT H2O	PUMP RPM	HP	VOLTS/PH/HZ	IMPELLER DIAMETER (INCHES)	DESIGN EFFICIENCY %	REMARKS
CHWP-1	ROOF	CHILLED WATER	ARMSTRONG	SERIES 4302-0408-07.5 4X4X8	VERTICAL IN LINE DUAL ARM	--	318.5	50	1800	7.5	460/3/60	--	70.00	

NOTES:
1. ALL PUMP WILL HAVE FACTORY INTEGRATED VARIABLE FREQUENCY DRIVES NEMA 4X. AND MOTOR ENCLOSURE TEFC.
2. ALL VFD'S WILL HAVE BACNECT COMMUNICATION PROTOCOL.
3. ALL VFD'S SHALL BE CAPABLE OF ON SCREEN DISPLAY OF FLOW HEAD BASED ON SENSORLESS DATA.
4. ALL PUMPS TO HAVE SENSORLESS CONTROL BUILT-IN WITHIN THE VFD'S.

AIR AND DIRT ELIMINATION SYSTEM SCHEDULE

PLAN MARK	SYSTEM	LOCATION	MANUFACTURER	MODEL NO.	CONN. SIZE INCH	FLOW GPM	MAX P.D. FT. WG	DRAIN SIZE INCH	MINIMUM DIMENSIONS (HxDxLF)INCH	MIN. VOL. GALS	WEIGHT LBS	REMARKS
ADS-1	CHILLED WATER	CHILLER PLANT	SPIROTHERM	VSR600	6	318.5	2.0	1	--"x20"x37.5"	117	986	1,2,3,4,5,6,7,8

REMARKS:
1. PROVIDE COALESCENT TYPE SEPARATORS. CENTRIFUGAL TYPE NOT ACCEPTED.
2. VESSEL SHALL BE RATED FOR 150# WORKING PRESSURE AND BE FURNISHED WITH CLASS 150 STEEL WELDE-NECK RAISED-FACE FLANGES.
3. UNIT SHALL INCLUDE AN INTERNAL SPIROTUBE COPPER BUNDLE FILLING THE ENTIRE VESSEL.
4. VESSEL WITH LOOSE OR PARTIALLY FILLED INTERNAL MEDIA NOT ACCEPTABLE.
5. UNIT SHALL REMOVE 100% OF FREE AN ENTRAINED AIR AND 99.6% OF DISSOLVED AIR TESTED BY INDEPENDENT LAB.
6. UNIT SHALL REMOVE 80% OF 30 MICRON PARTICLES IN 100 CIRCULATIONS. UNIT CAPABLE OF 5 MICRON PARTICLES SIZE REMOVAL.
7. PROVIDE INTEGRAL FULL PORT FLOAT ACTUATED BRASS VENTING MECHANISM.
8. PROVIDE AUTOMATIC BLOWDOWN VALVE WITH TIMER CONTROL.

EXPANSION TANK SCHEDULE

PLAN MARK	SYSTEM	LOCATION	MANUFACTURER	MODEL NO.	TYPE	MOUNT	SYSTEM TEMP.		INITIAL PRESS. PSIG	CONN. SIZE INCH	TANK VOLUME GAL.	TANK ACCEPT. GAL.	SHPNG. WEIGHT LBS	REMARKS
							MIN.	MAX.						
ET-1	CHILL WATER	CHILLER PLANT	ARMSTRONG	85	BLADDER	VERTICAL	42	80	12	1	50	211	90	1,2,3,4,5,6

NOTES:
1. PROVIDE VERTICAL EXPANSION TANK WITH HEAVY DUTY BUTYL DIAPHRAGM.
2. VESSEL SHALL BE ASME SECTION VIII DIV. 1 STAMPED FOR 125#WORKING PRESSURE.
3. PROVIDE PRE-CHARGED TANK.
4. PROVIDE TANK WITH BASE AND LIFTING RINGS.
5. PROVIDE NPT SYSTEM TOP CONNECTION.
6. PROVIDE STANDARD AIR CHARGING VALVE (STANDARD TIRE VALVE) WITH CAP.

GRAVITY RELIEF VENTILATOR SCHEDULE

PLAN MARK	MANUFACTURER	MANUFACTURER MODEL	EQUIPMENT SERVING	SIZE (IN.)	ACTUAL VOLUME (CFM)	THROAT AREA (FT2)
GRV-1&2	GREENHECK	FGR	STAIRS #1	18x18	940	2.25

NOTES:
1. PROVIDE 18" HIGH ROOF CURB.
2. PROVIDE ALUMINUM BIRDSCREEN.
3. HURRICANE RATED CONSTRUCTION.
4. GRAVITY RELIEF WITH COUNTER WEIGHT BACKDRAFT DAMPER 0.05 IN. WG. INSIDE CURB.

BAROMETRIC RELIEF DAMPER SCHEDULE

PLAN MARK	MANUFACTURER	MANUFACTURER MODEL	EQUIPMENT SERVING	SIZE (IN.)	ACTUAL VOLUME (CFM)	THROAT AREA (FT2)
BRD-1	GREENHECK	BR-30	ELEVATORS	14x24	1,000	2.16

NOTES:
1. VERTICALLY MOUNTED DAMPER.
2. PROVIDE ALUMINUM BIRDSCREEN.
3. HURRICANE RATED CONSTRUCTION.
4. PROVIDE/INSTALL WEATHER HOOD.

ENGINEERING
FOR ARCHITECTURE
5757 Blue Lagoon Drive, Suite 400
Miami, Florida 33126
PH: 305.266.6553
Fax: 350.266.6695
www.tlc-engineers.com
COA 15

CUTLER BAY TOWN CENTER HVAC EQUIPMENT AND CONTROLS

10720 Caribbean Blvd. Cutler Bay, Florida 33189

Revisions:

No.	Date	Description
1	11-16-16	Building Dept. Comments

Seal

Chi S. Lui, P.E.
Florida License # 61748

CHI S. LUI LICENSE No. 61748 STATE OF FLORIDA PROFESSIONAL ENGINEER

100% CD SUBMITTAL

Project No.: Project Number
Issue Date: Issue Date
Drawn By: Author
Approved By: Approver
Scale: 12" = 1'-0"

Drawing Title: MECHANICAL SCHEDULES

Drawing No.: M301

AIR HANDLING UNIT SCHEDULE

PLAN MARK	UNIT TYPE	AREA SERVING	MODEL	FAN DATA								COOLING COIL										ELECTRICAL DATA				REMARKS	DIMENSIONS L x W x H (IN.)	WEIGHT (lbs.)
				CFM NORMAL MODE	O.A.	EXT. STATIC (IN W.G.)	FILTERS	MOTOR DATA			VFD	TOTAL MBH	SENSIBLE MBH	EAT F°		LAT F°		MAX. FACE VEL. FPM	MIN. ROWS	EWT F°	LWT F°	WATER FLOW GPM	WPD	ELECTRIC HEATER						
								HP	RPM	VOLT / PHASE				DB	WB	DB	WB			DB	DB			MBH	MIN. # STEPS	VOLTS	PHASE			
AHU-1	HORIZONTAL	BUILDING	SOLUTION INDOOR 120X180	56,000	11,300	3.5	MERV 13	75	1800	480/3	YES	1945.4	1412.7	80	67	56.7	55.6	559	4/11	44	56	321.5	4.1	-	-	460	3	1,2,3,4,5,6,7	189X180X120	12278

NOTES:
1. BASIS OF DESIGN: JOHNSON CONTROL.
2. PROVIDE FACTORY INSTALLED BELT DRIVEN BLOWER MOTOR.
3. PROVIDE FACTORY INSTALLED MERV 13 FILTER RACK.
4. PROVIDE FACTORY INSTALLED NON CORROSIVE DRAIN PAN.
5. PROVIDE FACTORY INSTALLED MOTOR CONTROL BOX AND OVERLOAD PROTECTION.
6. PROVIDE 4 ROW COOLING COIL.
7. PROVIDE 3-WAY CONTROL VALVE.

TABLE 4-1
RECTANGULAR DUCT HANGERS MINIMUM SIZE

MAXIMUM HALF OF DUCT PERIMETER	PAIR AT 10 FT SPACING		PAIR AT 8 FT SPACING		PAIR AT 5 FT SPACING		PAIR AT 4 FT SPACING	
	STRAP	WIRE/ ROD	STRAP	WIRE/ ROD	STRAP	WIRE/ ROD	STRAP	WIRE/ ROD
P/2 = 30"	1"x 22 GA.	10 GA. (.135")	1"x 22 GA.	10 GA. (.135")	1"x 22 GA.	12 GA. (.105")	1"x 22 GA.	12 GA. (.105")
P/2 = 72"	1"x 18 GA.	3/8"	1"x 20 GA.	1/4"	1"x 22 GA.	1/4"	1"x 22 GA.	1/4"
P/2 = 96"	1"x 16 GA.	3/8"	1"x 18 GA.	3/8"	1"x 20 GA.	3/8"	1"x 22 GA.	1/4"
P/2 = 120"	1\" x 16 GA	1/2"	1"x 16 GA.	3/8"	1"x 18 GA.	3/8"	1"x 20 GA.	1/4"
P/2 = 168"	1\" x 16 GA	1/2"	1\" x 16 GA	1/2"	1"x 16 GA.	3/8"	1"x 18 GA.	3/8"
P/2 = 192"	NOT GIVEN	1/2"	1\" x 16 GA	1/2"	1"x 16 GA.	3/8"	1"x 16 GA.	3/8"
P/2 = 193" UP	SPECIAL ANALYSIS REQUIRED							

WHEN STRAPS ARE LAP JOINED USE THESE MINIMUM FASTENERS:	SINGLE HANGER MAXIMUM ALLOWABLE LOAD	
	STRAP	WIRE OR ROD (DIA.)
1"x 18, 20, 22 GA.-TWO #10 OR ONE 1/4" BOLT 1"x 16 GA.-TWO 1/4" DIA. 1 1/2"x 16 GA. -TWO 3/8" DIA. PLACE FASTENERS IN SERIES, NOT SIDE BY SIDE.	1"x 22 GA.-260 LBS. 1"x 20 GA.-320 LBS. 1"x 18 GA.-420 LBS. 1"x 16 GA.-700 LBS. 1 1/2"x 16 GA. -1100 LBS.	0.016"-80 LBS. 0.135"- 120 LBS. 0.162"- 160 LBS. 1/4"- 270 LBS. 3/8"- 680 LBS. 1/2"- 1250 LBS. 5/8"- 2000 LBS. 3/4"- 3000 LBS.

NOTES
1. DIMENSIONS OTHER THAN GAGE ARE IN INCHES.
2. TABLES ALLOW FOR DUCT WEIGHT, 1 LB./SF INSULATION WEIGHT AND NORMAL REINFORCEMENT AND TRAPEZE WEIGHT, BUT NO EXTERNAL LOADS.
3. FOR CUSTOM DESIGN OF HANGERS, DESIGNERS MAY CONSULT SMACNA'S RECTANGULAR INDUSTRIAL DUCT STANDARDS, THE AISI COLD FORMED STEEL DESIGN MANUAL AND THE AISC STEEL CONSTRUCTION MANUAL.
4. STRAPS ARE GALVANIZED STEEL; OTHER MATERIALS ARE UNCOATED STEEL.
5. ALLOWABLE LOADS FOR P/2 ASSUME THAT DUCTS ARE 16 GA. MAXIMUM, EXCEPT THAT WHEN MAXIMUM DUCT DIMENSION (W) IS OVER 60" THEN P/2 MAXIMUM IS 1.25W.
6. FOR UPPER ATTACHMENTS REFER TO SMACNA DUCT STANDARDS - SECOND EDITION: FIG. 4-2
7. FOR LOWER ATTACHMENTS REFER TO SMACNA DUCT STANDARDS - SECOND EDITION: FIG. 4-4
8. FOR TRAPEZE SIZES REFER TO SMACNA DUCT STANDARDS - SECOND EDITION: TABLE 4-3 AND FIG. 4-5.
9. 12, 10, OR 8 GA. WIRE IS STEEL OF BLACK ANNEALED, BRIGHT BASIC, OR GALVANIZED TYPE.

TABLE 4-2
MINIMUM HANGER SIZES FOR ROUND DUCT

DIA.	MAXIMUM SPACING	WIRE/ DIA.	ROD	STRAP
10" DN. 250 MM DN	12' 3.7 M	ONE 12 GA. ONE 2.75 MM	1/4" 6.4 MM	1"x 22 GA. 25.4 x 0.85 MM
11-18"	12'	TWO 12 GA. OR ONE 8 GA.	1/4"	1"x 22 GA.
460 MM	3.7 M	ONE 4.27 MM	6.4 MM	25.4 x 0.85 MM
19-24" 610 MM	12' 3.7 M	TWO 10 GA. TWO 3.51 MM	1/4" 6.4 MM	1"x 22 GA. 25.4 x 0.85 MM
25-36" 900 MM	12' 3.7 M	TWO 8 GA. TWO 2.7 MM	3/8" 9.5 MM	1"x 20 GA. 25.4 x 0.85 MM
37-50" 1270 MM	12' 3.7 M		TWO 3/8" TWO 9.5 MM	TWO 1"x 20 GA. (2) 25.4 x 1.00 MM
51-60" 1520 MM	12' 3.7 M		TWO 3/8" TWO 9.5 MM	TWO 1"x 18 GA. (2) 25.4 x 1.31 MM
61-84" 2130 MM	12' 3.7 M		TWO 3/8" TWO 9.5 MM	TWO 1"x 16 GA. (2) 25.4 x 1.61 MM

NOTES

1. STRAPS ARE GALVANIZED STEEL; RODS ARE UNCOATED OR GALVANIZED STEEL; WIRE IS BLACK ANNEALED, BRIGHT BASIC, OR GALVANIZED STEEL. ALL ARE ALTERNATIVES.
2. REFER TO SMACNA DUCT STANDARDS - SECOND EDITION: FIG. 4-4 FOR LOWER SUPPORTS.
3. REFER TO SMACNA DUCT STANDARDS - SECOND EDITION: FIG. 4-2 AND 4-3 FOR UPPER ATTACHMENTS.
4. TABLE ALLOWS FOR CONVENTIONAL WALL THICKNESS, AND JOINT SYSTEMS PLUS ONE LB/SF INSULATION WEIGHT. IF HEAVIER DUCTS ARE TO BE INSTALLED, ADJUST HANGER SIZES TO BE WITHIN THEIR LOAD LIMITS; REFER TO SMACNA DUCT STANDARDS SECOND EDITION ALLOWABLE LOADS WITH TABLE 4-1. HANGER SPACING MAY BE ADJUSTED BY SPECIAL ANALYSIS.
5. DESIGNERS: FOR INDUSTRIAL GRADE SUPPORTS, INCLUDING SADDLES, SINGLE LOAD TRAPEZE LOADS, LONGER SPANS AND FLANGE JOINT LOADS, SEE SMACNA'S ROUND INDUSTRIAL DUCT CONSTRUCTION STANDARDS.
6. REFER TO SMACNA DUCT STANDARDS - SECOND EDITION: FIGS.3-9 AND 3-10 FOR FLEXIBLE DUCT SUPPORTS.

HVAC DESIGN REQUIRES:

	YES	NO
DUCT SMOKE DETECTOR	✓	
FIRE DAMPER(S)	✓	
SMOKE DAMPER(S)	✓	
FIRE RATED ENCLOSURE	✓	
FIRE RATED ROOF/ FLOOR CEILING ASSEMBLY	✓	
FIRE STOPPING	✓	
SMOKE CONTROL	✓	

AIR CONDITIONING DESIGN SCHEDULE

DESIGN AREA	SUMMER DESIGN				WINTER DESIGN		
	OUTSIDE		INSIDE		OUTSIDE	INSIDE	
	DB	WB	DB	% RH	DB	DB	% RH
MIAMI	91	78	75	50	46	68	50

CHILLER SCHEDULE

UNIT NO.	TONS	MFGR & MODEL NO.	EVAPORATOR (WATER)					CONDENSER (AIR)				EVAP. PRESS. DROP	COMP. No.	FULL LOAD EFFIC.	ELECTRICAL							OPERATING WEIGHT LBS	EFFICIENCY RATING
			EWT	LWT	GPM	MIN GPM	NO OF PASSES	EAT	No FANS	TOTAL HEAT REJECTION MBH	TOTAL FAN KW	FT. H2O	KW(EACH)	KW/tonR	VOLTS	PH	AMPS	HZ	MCA	MOCP	REFRIGERANT		kW/TON R COMPRESSOR
CH-1	160	SMARDT AD054.2BG06.F2AEHA	58°	46°	318.2	144.5	2	95°	8	2515.10	16.8	8.26	2/67.8	0.953	460	3	212	60	236	329	HFC 134a	--	0.848 0.345

NOTES:
1. BASIS OF DESIGN IS SMARDT INC.
2. SINGLE POINT OF CONNECTION. INDIVIDUAL BREAKER OR FUSED DISCONNECT PER COMPRESSOR.
3. NEMA 3R CONTROL ENCLOSURES - OUTDOOR USE.

PUMP SCHEDULE

UNIT NO.	LOCATION	PURPOSE	MANUFACTURER	MODEL NO.	TYPE	FRAME	GPM	HEAD FT H2O	PUMP RPM	HP	VOLTS/PH/HZ	IMPELLER DIAMETER (INCHES)	DESIGN EFFICIENCY %	REMARKS
CHWP-1	ROOF	CHILLED WATER	ARMSTRONG	SERIES 4302-0408-07.5 4X4X8	VERTICAL IN LINE DUAL ARM	--	318.5	50	1800	7.5	460/3/60	--	70.00	

NOTES:
1. ALL PUMP WILL HAVE FACTORY INTEGRATED VARIABLE FREQUENCY DRIVES NEMA 4X. AND MOTOR ENCLOSURE TEFC.
2. ALL VFD'S WILL HAVE BACNECT COMMUNICATION PROTOCOL.
3. ALL VFD'S SHALL BE CAPABLE OF ON SCREEN DISPLAY OF FLOW HEAD BASED ON SENSORLESS DATA.
4. ALL PUMPS TO HAVE SENSORLESS CONTROL BUILT-IN WITHIN THE VFD'S.

AIR AND DIRT ELIMINATION SYSTEM SCHEDULE

PLAN MARK	SYSTEM	LOCATION	MANUFACTURER	MODEL NO.	CONN. SIZE INCH	FLOW GPM	MAX P.D. FT. WG	DRAIN SIZE INCH	MINIMUM DIMENSIONS (HxDxLF)INCH	MIN. VOL. GALS	WEIGHT LBS	REMARKS
ADS-1	CHILLED WATER	CHILLER PLANT	SPIROTHERM	VSR600	6	318.5	2.0	1	--"x20"x37.5"	117	986	1,2,3,4,5,6,7,8

REMARKS:
1. PROVIDE COALESCENT TYPE SEPARATORS. CENTRIFUGAL TYPE NOT ACCEPTED.
2. VESSEL SHALL BE RATED FOR 150# WORKING PRESSURE AND BE FURNISHED WITH CLASS 150 STEEL WELDE-NECK RAISED-FACE FLANGES.
3. UNIT SHALL INCLUDE AN INTERNAL SPIROTUBE COPPER BUNDLE FILLING THE ENTIRE VESSEL.
4. VESSEL WITH LOOSE OR PARTIALLY FILLED INTERNAL MEDIA NOT ACCEPTABLE.
5. UNIT SHALL REMOVE 100% OF FREE AN ENTRAINED AIR AND 99.6% OF DISSOLVED AIR TESTED BY INDEPENDENT LAB.
6. UNIT SHALL REMOVE 80% OF 30 MICRON PARTICLES IN 100 CIRCULATIONS. UNIT CAPABLE OF 5 MICRON PARTICLES SIZE REMOVAL.
7. PROVIDE INTEGRAL FULL PORT FLOAT ACTUATED BRASS VENTING MECHANISM.
8. PROVIDE AUTOMATIC BLOWDOWN VALVE WITH TIMER CONTROL.

EXPANSION TANK SCHEDULE

PLAN MARK	SYSTEM	LOCATION	MANUFACTURER	MODEL NO.	TYPE	MOUNT	SYSTEM TEMP.		INITIAL PRESS. PSIG	CONN. SIZE INCH	TANK VOLUME GAL.	TANK ACCEPT. GAL.	SHPNG. WEIGHT LBS	REMARKS
							MIN.	MAX.						
ET-1	CHILL WATER	CHILLER PLANT	ARMSTRONG	85	BLADDER	VERTICAL	42	80	12	1	50	211	90	1,2,3,4,5,6

NOTES:
1. PROVIDE VERTICAL EXPANSION TANK WITH HEAVY DUTY BUTYL DIAPHRAGM.
2. VESSEL SHALL BE ASME SECTION VIII DIV. 1 STAMPED FOR 125#WORKING PRESSURE.
3. PROVIDE PRE-CHARGED TANK.
4. PROVIDE TANK WITH BASE AND LIFTING RINGS.
5. PROVIDE NPT SYSTEM TOP CONNECTION.
6. PROVIDE STANDARD AIR CHARGING VALVE (STANDARD TIRE VALVE) WITH CAP.

BUFFER TANK SCHEDULE

PLAN MARK	SYSTEM	LOCATION	MANUFACTURER	MODEL NO.	TYPE	MOUNT	SYSTEM TEMP.		INITIAL PRESS. PSIG	CONN. SIZE INCH	TANK VOLUME GAL.	TANK ACCEPT. GAL.	SHPNG. WEIGHT LBS	REMARKS
							MIN.	MAX.						
BT-1	CHILL WATER	ROOF	AMERICAN WHEATLEY	--	BUFFER	VERTICAL	42	95	--	--	500	--	--	1,2,3,4,5,6

NOTES:
1. PROVIDE PRE-CHARGED TANK.
2. PROVIDE TANK WITH BASE AND LIFTING RINGS.
3. PROVIDE NPT SYSTEM TOP CONNECTION.
4. PROVIDE STANDARD AIR CHARGING VALVE (STANDARD TIRE VALVE) WITH CAP.

SCHEDULE OF OUTSIDE AIR PER ASHRAE STD. 62.1-2014

SYSTEM	AREA SERVED	SPACE	ASHRAE 62.1 O.A REQUIRED	AREA SERVED (SQ. FT.)	OCCUPANCY	O.A REQUIRED	MAX. OA. PROVIDED
AHU-1	OFFICE 1ST FLOOR	OFFICE	5 CFM/PERS-0.06CFM/SQFT	12,181	626	3861	4700
	OFFICE 2ND FLOOR	OFFICE	5 CFM/PERS-0.06CFM/SQFT	11,826	61	1015	1300
	OFFICE 3RD FLOOR	OFFICE	5 CFM/PERS-0.06CFM/SQFT	11,328	57	965	1300
	OFFICE 4TH FLOOR	OFFICE	5 CFM/PERS-0.06CFM/SQFT	11,328	57	965	1300
	OFFICE 5TH FLOOR	OFFICE	5 CFM/PERS-0.06CFM/SQFT	11,365	58	967	1300
	OFFICE 4TH FLOOR	OFFICE	5 CFM/PERS-0.06CFM/SQFT	12,075	61	1030	1400
						TOTAL	11300

ENGINEERING
FOR ARCHITECTURE
5757 Blue Lagoon Drive, Suite 400
Miami, Florida 33126
PH: 305.266.6553
Fax: 350.266.6695
www.tlc-engineers.com
COA 15

CUTLER BAY TOWN CENTER HVAC EQUIPMENT AND CONTROLS

10720 Caribbean Blvd. Cutler Bay, Florida 33189

Revisions:

No.	Date	Description

Seal

Chi S. Lui, P.E.
Florida License # 61748

CHI S. LUI LICENSE No. 61748 STATE OF FLORIDA PROFESSIONAL ENGINEER

Project No.: Project Number
Issue Date: Issue Date
Drawn By: Author
Approved By: Approver
Scale: 12" = 1'-0"
Drawing Title: MECHANICAL SCHEDULES
Drawing No.: M301

100% CD SUBMITTAL

EXISTING SINGLE DUCT VAV TERMINAL UNIT SCHEDULE (ELECTRIC HEAT)

PLAN MARK	BASIS OF DESIGN MFGR	BASIS OF DESIGN MODEL	INLET SIZE	AIRFLOW COOLING DESIGN (CFM)	AIRFLOW COOLING MINIMUM (CFM)	AIRFLOW HEATING DESIGN (CFM)	MAX AIR PRESS. DROP (IN. WG)	ELECTRIC HEATING COIL DATA TEMP EAT (°F)	TEMP LAT (°F)	KW
VAV-1-1	Titus	DESV	6"	400	200	0	0.15	44	75	0.0
VAV-1-2	Titus	DESV	6"	400	200		0.15	44	75	0.0
VAV-1-3	Titus	DESV	8"	900	270		0.2	44	75	0.0
VAV-1-4	Titus	DESV	6"	600	180		0.2	44	75	0.0
VAV-1-5	Titus	DESV	8"	680	205		0.2	44	75	0.0
VAV-1-6	Titus	DESV	10"	1300	700		0.2	44	75	0.0
VAV-1-9	Titus	DESV	10"	2500	435		0.2	44	75	0.0
VAV-1-10	Titus	DESV	8"	1200	360		0.2	44	75	0.0
VAV-1-11	Titus	DESV	10"	1215	365		0.2	44	75	0.0
VAV-1-12	Titus	DESV	6"	400	200		0.15	44	75	0.0
VAV-1-13	Titus	DESV	8"	810	245		0.2	44	75	0.0
VAV-1-14	Titus	DESV	10"	1300	700		0.2	44	75	0.0
VAV-1-15	Titus	DESV	10"	1300	700		0.2	44	75	0.0
VAV-1-16	Titus	DESV	8"	680	205		0.2	44	75	0.0
VAV-1-17	Titus	DESV	10"	1225	370		0.2	44	75	0.0
VAV-1-18	Titus	DESV	12"	1430	430		0.2	44	75	0.0
VAV-1-19	Titus	DESV	12"	1100	1,100		0.2	44	75	0.0
VAV-1-20	Titus	DESV	6"	400	200		0.15	44	75	0.0
VAV-1-21	Titus	DESV	10"	800	240		0.2	44	75	0.0
VAV-1-22 *	Titus	DESV	6"	400	120		0.15	44	75	0.0
VAV-1-23	Titus	DESV	10"	1190	360		0.2	44	75	0.0
VAV-2-1	Titus	DESV	8"	800	400		0.2	44	75	0.0
VAV-2-2	Titus	DESV	8"	800	400		0.2	44	75	0.0
VAV-2-3	Titus	DESV	8"	800	400		0.2	44	75	0.0
VAV-2-4	Titus	DESV	10"	800	400	0	0.2	44	75	0.0
VAV-2-5	Titus	DESV	8"	800	240		0.2	44	75	0.0
VAV-2-6	Titus	DESV	8"	800	240		0.2	44	75	0.0
VAV-2-7	Titus	DESV	8"	1000	300		0.2	44	75	0.0
VAV-2-8	Titus	DESV	8"	800	240		0.2	44	75	0.0
VAV-2-9	Titus	DESV	8"	1200	360		0.2	44	75	0.0
VAV-2-10	Titus	DESV	8"	800	240		0.2	44	75	0.0
VAV-2-11	Titus	DESV	8"	800	240		0.2	44	75	0.0
VAV-2-12	Titus	DESV	10"	1300	700	0	0.2	44	75	0.0
VAV-2-13	Titus	DESV	8"	800	400		0.2	44	75	0.0
VAV-2-14	Titus	DESV	10"	1300	700	0	0.2	44	75	0.0
VAV-2-15	Titus	DESV	8"	800	400		0.2	44	75	0.0
VAV-2-16	Titus	DESV	10"	750	225		0.2	44	75	0.0
VAV-2-17	Titus	DESV	8"	1000	300		0.2	44	75	0.0
VAV-2-18	Titus	DESV	6"	400	120		0.15	44	75	0.0
VAV-2-19	Titus	DESV	8"	800	240		0.2	44	75	0.0
VAV-2-20	Titus	DESV	12"	1100	1,100		0.2	44	75	0.0
VAV-2-22 *	Titus	DESV	6"	400	120		0.15	44	75	0.0
VAV-3-1	Titus	DESV	8"	800	400	0	0.2	44	75	0.0
VAV-3-2	Titus	DESV	8"	800	400	0	0.2	44	75	0.0
VAV-3-3	Titus	DESV	6"	400	200		0.15	44	75	0.0
VAV-3-4	Titus	DESV	8"	800	400	0	0.2	44	75	0.0
VAV-3-5	Titus	DESV	10"	1300	700	0	0.2	44	75	0.0
VAV-3-6	Titus	DESV	8"	800	400		0.2	44	75	0.0
VAV-3-7	Titus	DESV	8"	800	400		0.2	44	75	0.0
VAV-3-8	Titus	DESV	8"	800	400	0	0.2	44	75	0.0
VAV-3-9	Titus	DESV	6"	400	200		0.15	44	75	0.0
VAV-3-10	Titus	DESV	10"	1300	700		0.2	44	75	0.0
VAV-3-11	Titus	DESV	8"	800	400	0	0.2	44	75	0.0
VAV-3-12	Titus	DESV	8"	800	400		0.2	44	75	0.0
VAV-3-13	Titus	DESV	12"	625	210	0	0.2	44	75	0.0
VAV-3-14	Titus	DESV	8"	390	130		0.2	44	75	0.0
VAV-3-15	Titus	DESV	8"	800	400		0.2	44	75	0.0
VAV-3-16	Titus	DESV	10"	1300	700		0.2	44	75	0.0
VAV-3-17	Titus	DESV	12"	1100	330		0.2	44	75	0.0
VAV-3-18	Titus	DESV	8"	800	400		0.2	44	75	0.0
VAV-3-19	Titus	DESV	8"	800	400		0.2	44	75	0.0
VAV-3-20	Titus	DESV	12"	1100	330		0.2	44	75	0.0
VAV-3-22 *	Titus	DESV	6"	400	120		0.15	44	75	0.0
VAV-4-1	Titus	DESV	6"	390	130	290	0.2	44	75	2.8
VAV-4-2	Titus	DESV	8"	425	125	320	0.2	44	75	3.0
VAV-4-3	Titus	DESV	10"	800	240		0.2	44	75	0.0
VAV-4-4	Titus	DESV	6"	400	200		0.15	44	75	0.0
VAV-4-5	Titus	DESV	6"	400	200		0.15	44	75	0.0
VAV-4-6	Titus	DESV	6"	400	200		0.15	44	75	0.0
VAV-4-7	Titus	DESV	8"	800	400		0.2	44	75	0.0
VAV-4-8	Titus	DESV	6"	400	200		0.15	44	75	0.0
VAV-4-9	Titus	DESV	8"	600	180		0.2	44	75	0.0
VAV-4-10	Titus	DESV	6"	315	105	0	0.15	44	75	0.0
VAV-4-11	Titus	DESV	6"	320	167	290	0.15	44	75	2.8
VAV-4-12	Titus	DESV	6"	310	170	290	0.15	44	75	2.8
VAV-4-13	Titus	DESV	6"	320	170	290	0.15	44	75	2.8
VAV-4-14	Titus	DESV	6"	390	130	320	0.15	44	75	3.0
VAV-4-15	Titus	DESV	8"	670	200		0.2	44	75	0.0
VAV-4-16	Titus	DESV	8"	800	240		0.2	44	75	0.0
VAV-4-17	Titus	DESV	8"	800	240		0.2	44	75	0.0
VAV-4-18	Titus	DESV	6"	390	130	340	0.15	44	75	3.2
VAV-4-19	Titus	DESV	8"	615	185		0.2	44	75	0.0
VAV-4-20	Titus	DESV	8"	340	200		0.15	44	75	0.0
VAV-4-21	Titus	DESV	8"	400	240		0.15	44	75	0.0
VAV-4-22 *	Titus	DESV	6"	400	120		0.15	44	75	0.0
VAV-4-23	Titus	DESV	6"	370	123	290	0.15	44	75	2.8
VAV-4-24	Titus	DESV	7"	430	143	320	0.2	44	75	3.0
VAV-4-26	Titus	DESV	8"	800	240		0.2	44	75	0.0
VAV-4-27	Titus	DESV	6"	400	120		0.15	44	75	0.0
VAV-4-27A	Titus	DESV	9"	690	230	380	0.2	44	75	3.5
VAV-5-1	Titus	DESV	6"	390	130	290	0.15	44	75	2.8
VAV-5-2	Titus	DESV	7"	435	145	320	0.2	44	75	3.0
VAV-5-3	Titus	DESV	7"	435	145	320	0.2	44	75	3.0
VAV-5-4	Titus	DESV	6"	390	130	290	0.15	44	75	2.8
VAV-5-5	Titus	DESV	8"	670	200		0.2	44	75	0.0
VAV-5-6	Titus	DESV	6"	390	130	320	0.15	44	75	3.0
VAV-5-7	Titus	DESV	8"	670	200		0.2	44	75	0.0
VAV-5-8	Titus	DESV	6"	385	120	340	0.15	44	75	3.2
VAV-5-9	Titus	DESV	6"	540	160		0.2	44	75	0.0
VAV-5-10	Titus	DESV	9"	625	200	380	0.2	44	75	3.6
VAV-5-11	Titus	DESV	8"	670	200		0.2	44	75	0.0
VAV-5-12	Titus	DESV	8"	670	200		0.2	44	75	0.0
VAV-5-13	Titus	DESV	9"	625	200	380	0.2	44	75	3.6

EXISTING SINGLE DUCT VAV TERMINAL UNIT SCHEDULE (ELECTRIC HEAT)

PLAN MARK	BASIS OF DESIGN MFGR	BASIS OF DESIGN MODEL	INLET SIZE	AIRFLOW COOLING DESIGN (CFM)	AIRFLOW COOLING MINIMUM (CFM)	AIRFLOW HEATING DESIGN (CFM)	MAX AIR PRESS. DROP (IN. WG)	ELECTRIC HEATING COIL DATA TEMP EAT (°F)	TEMP LAT (°F)	KW
VAV-5-14 *	Titus	DESV	6"	400	120		0.15	44	75	0.0
VAV-5-15	Titus	DESV	6"	315	105	320	0.15	44	75	3.0
VAV-5-16	Titus	DESV	8"	670	200		0.2	44	75	0.0
VAV-5-17	Titus	DESV	8"	670	200		0.2	44	75	0.0
VAV-5-18	Titus	DESV	6"	310	100		0.15	44	75	0.0
VAV-5-19	Titus	DESV	6"	320	100	290	0.15	44	75	2.8
VAV-5-20	Titus	DESV	6"	320	100	290	0.15	44	75	2.8
VAV-5-21	Titus	DESV	6"	315	105	320	0.15	44	75	3.0
VAV-5-22	Titus	DESV	6"	310	100	290	0.15	44	75	2.8
VAV-5-23 *	Titus	DESV	6"	240	80		0.15	44	75	0.0
VAV-6-1	Titus	DESV	8"	500	170		0.2	44	75	0.0
VAV-6-2	Titus	DESV	10"	855	285	460	0.2	44	75	4.4
VAV-6-3	Titus	DESV	10"	855	285	420	0.2	44	75	4.0
VAV-6-4	Titus	DESV	8"	545	180	520	0.2	44	75	5.0
VAV-6-5	Titus	DESV	9"	645	215	380	0.2	44	75	3.6
VAV-6-6	Titus	DESV	9"	645	215	380	0.2	44	75	3.6
VAV-6-7	Titus	DESV	6"	430	130	380	0.2	44	75	3.6
VAV-6-8	Titus	DESV	6"	430	130	380	0.2	44	75	3.6
VAV-6-9	Titus	DESV	6"	585	195	420	0.2	44	75	4.0
VAV-6-10	Titus	DESV	8"	585	195	420	0.2	44	75	4.0
VAV-6-11	Titus	DESV	8"	460	150	500	0.2	44	75	4.8
VAV-6-12	Titus	DESV	9"	680	230	380	0.2	44	75	3.6
VAV-6-13	Titus	DESV	9"	680	205	380	0.2	44	75	3.6
VAV-6-14	Titus	DESV	6"	430	130	380	0.2	44	75	3.6
VAV-6-15	Titus	DESV	8"	825	250		0.2	44	75	0.0
VAV-6-16	Titus	DESV	8"	825	250		0.2	44	75	0.0
VAV-6-17	Titus	DESV	8"	825	250		2	44	75	0.0
VAV-6-18	Titus	DESV	8"	825	250		0.2	44	75	0.0
VAV-6-19	Titus	DESV	8"	640	200		0.2	44	75	0.0
VAV-6-20	Titus	DESV	8"	900	300		0.2	44	75	0.0
VAV-6-21	Titus	DESV	8"	640	200		0.2	44	75	0.0
VAV-6-22 *	Titus	DESV	8"	240	200		0.15	44	75	0.0
VAV-6-23	Titus	DESV	8"	900	300		0.2	44	75	0.0
VAV-6-28	Titus	DESV	8"	640	200		0.2	44	75	0.0
VAV-6-29	Titus	DESV	8"	900	300		0.2	44	75	0.0

LEGEND

* NEW VAV UNITS.

SINGLE DUCT HEATER UNIT SCHEDULE (ELECTRIC HEAT) - EXISTING

PLAN MARK	HEATER TYPE	AIRFLOW (CFM)	ELECTRIC HEATING COIL DATA TEMP EAT (°F)	TEMP LAT (°F)	KW	STEPS	VOLTS / PHASE
DH-1-1	SLIP-IN	400	44	75	3.0	-	277 / 1
DH-1-3	SLIP-IN	400	44	75	3.0	-	277 / 1
DH-1-4	SLIP-IN	600	44	75	3.0	-	277 / 1
DH-1-6	SLIP-IN	1,300	44	75	3.0	-	277 / 1
DH-1-13	SLIP-IN	810	44	75	3.0	-	277 / 1
DH-2-2	SLIP-IN	800	44	75	3.0	-	277 / 1
DH-2-3	SLIP-IN	800	44	75	3.0	-	277 / 1
DH-2-4	SLIP-IN	800	44	75	3.0	-	277 / 1
DH-2-12	SLIP-IN	1,300	44	75	3.0	-	277 / 1
DH-2-14	SLIP-IN	1,300	44	75	3.0	-	277 / 1
DH-3-1	SLIP-IN	800	44	75	3.0	-	277 / 1
DH-3-2	SLIP-IN	800	44	75	3.0	-	277 / 1
DH-3-4	SLIP-IN	800	44	75	3.0	-	277 / 1
DH-3-5	SLIP-IN	1,300	44	75	3.0	-	277 / 1
DH-3-8	SLIP-IN	800	44	75	3.0	-	277 / 1
DH-3-11	SLIP-IN	800	44	75	3.0	-	277 / 1
DH-3-13	SLIP-IN	630	44	75	3.0	-	277 / 1
DH-4-6	SLIP-IN	400	44	75	3.0	-	277 / 1
DH-4-7	SLIP-IN	800	44	75	3.0	-	277 / 1
DH-4-10	SLIP-IN	320	44	75	3.0	-	277 / 1

BUFFER TANK SCHEDULE

PLAN MARK	SYSTEM	LOCATION	MANUFACTURER	MODEL NO.	TYPE	MOUNT	SYSTEM TEMP. MIN.	SYSTEM TEMP. MAX.	INITIAL PRESS. PSIG	CONN. SIZE INCH	TANK VOLUME GAL.	TANK ACCEPT. GAL.	SHPNG. WEIGHT LBS	REMARKS
BT-1	CHILL WATER	ROOF	AMERICAN WHEATLEY	--	BUFFER	VERTICAL	42	95	--	--	500	--	--	1,2,3,4,5,6

NOTES:

1. PROVIDE PRE-CHARGED TANK.
2. PROVIDE TANK WITH BASE AND LIFTING RINGS.
3. PROVIDE NPT SYSTEM TOP CONNECTION.
4. PROVIDE STANDARD AIR CHARGING VALVE (STANDARD TIRE VALVE) WITH CAP.

SUPPLY AND EXHAUST FAN SCHEDULE EXISTING (REPLACEMENT)

PLAN MARK	SERVING	SELECTION BASED ON MANUFACTURER	SELECTION BASED ON MODEL	FAN TYPE	CFM	STATIC PRESSURE	DRIVE TYPE	FAN MOTOR RPM	FAN MOTOR HP	FAN MOTOR VOLT	FAN MOTOR PHASE	EMERGENCY POWER	VFD	WEIGHT (LB.)	ACCESSORIES
EF-1	TOILET EXHAUST	GREENHECK	GB-180-5	CENTRIFUGAL	3180	0.375	BELT DRIVE	1725	1/2	120	1/60	NO	NO	88	1,3,4,5,7
EF-2	EXHAUST VEST STAIR 1	GREENHECK	GB-180-4	CENTRIFUGAL	1575	0.375	BELT DRIVE	1725	1/4	120	1/60	YES	YES	83	1,3,4,5,7,& 23
EF-3	EXHAUST STAIR 1	GREENHECK	GB-141-7	CENTRIFUGAL	2500	0.25	BELT DRIVE	1438	3/4	460	3/60	YES	YES	81	1,3,4,5,7,& 23
SF-1	PRESSURIZATION STAIR 1	GREENHECK	RSF-150	CENTRIFUGAL	3000	0.5	BELT DRIVE	1550	3/4	480	3/60	YES	YES	367	1,7,12,21
SF-2	PRESSURIZATION VEST	GREENHECK	RSF-90	CENTRIFUGAL	1050	0.5	BELT DRIVE	1550	1/4	120	1/60	YES	YES	168	1,7,12,21

1

NOTES:

1. BASIS OF DESIGN: GREENHECK.
2. PROVIDE FACTORY INSTALLED BELT DRIVEN BLOWER MOTOR.

1. BACKDRAFT DAMPER
2. THERMOSTAT
3. BIRDSCREEN
4. ROOF CURB
5. DISCONNECT SWITCH
6. DRAIN
7. EQUIPMENT SUPPORTS
8. INLET SCREEN
9. CURB MOUNT ROOF JACK
10 SPEED CONTROLLER
11. WALL SHUTTER
12. VIBRATION ISOLATORS
13. WALL CAP
14 WALL SHUTTER - MOTORIZED
15. WEATHER COVER
16. 2 SPEED / 1 WINDING
17. FILTERS
18. WALL COLLAR
19. FAN GUARD / SCREEN
20. COMPANION FLANGES
21 INSULATED HOUSING FOR SOUND CONTROL
22. HINGED FRAMES
22. SPARK / EXPLOSION PROOF
23. POWER VENTILATOR APPROVED FOR USE IN SMOKE CONTROL SYSTEM
24. WALL/COLUMN MOUNT BRACKET AND SPEED CONTROLLER
25. INTERLOCKED WITH ASSOCIATED VAV BOX (BOX CONTROLLED BY OCC. SENSOR)

SMOKE CONTROL FAN SCHEDULE

PLAN MARK	MODEL NO.	TYPE	FAN SERVICE	EMERGENCY POWER	CFM	STATIC PRESS.	FAN RPM	MOTOR RPM	MOTOR HP	VOLT/ PHASE	DRIVE TYPE	VFD	WEIGHT (LB.)	ACCESSORIES
SPF-2	TBI-CA-3H18-7	INLINE	STAIR 2 PRESSURIZATION	YES	3000	0.5	1598	1725	3/4	460/3	BELT	YES	95	1,2,3,5,8,12,13,15-26,28,29-33.
EEF-1	TBI-FS-4L36-150	INLINE	EMERGENCY SMOKE EXHAUST	YES	25000	1.25	1490	1725	15	460/3	BELT	YES	400	1,2,3,5,8,9,13,15,22,23,25,27-30,32
EPF-1	TBI-CA-3H24	INLINE	ELEVATOR PRESSURIZATION	YES	7000	0.35	1444	1725	11/2	460/3	BELT	YES	125	1,2,3,5,8,9,13,15,22,23,25,27-30,32

1

NOTES:

1. MODEL NUMBERS AND FAN SELECTION ARE BASED ON GREENHECK

1. PROVIDE MOTOR WITH CLASS F INSULATION
2. PROVIDE EXTENDED MOTOR LEADS
3. PROVIDE HI-PRO Z COATING, CONCRETE GRAY COLOR FOR COMPLETE FAN, CURB AND ATTACHED ACCESSORIES
4. PROVIDE 14" ROOF CURB - ALUMINUM CONSTRUCTION
5. PROVIDE UL/CUL-705 - "POWER VENTILATORS"
6. PROVIDE MOUNTING SUPPORT - ROOF MOUNT
7. PROVIDE INSPECTION DOOR - BOLTED
8. PROVIDE UL EMERGENCY SMOKE(150 C / 300 F FOR 5 HOURS)
9. PROVIDE STEEL BUTTERFLY DAMPER BLADES
10. PROVIDE MAGNETIC DAMPER LATCHES
11. PROVIDE EXTENDED LUBE LINES - NYLON
12. PROVIDE TIE DOWN POINTS (SET OF 4)
13. PROVIDE NEMA PREMIUM EFFICIENT MOTOR - MEETS NEMA TABLE 12-12, TIMES THE MINIMUM REQUIRED NUMBER OF BELTS
14. PROVIDE UL/CUL 762 LISTED - "POWER VENTILATORS FOR RESTAURANT EXHAUST".
15. PROVIDE SWITCH, NEMA-3R, TOGGLE, JUNCTION BOX MOUNTED & WIRED
16. PROVIDE HIGH WIND RATED (+/- 150 PSF RATING)
17. PROVIDE FLORIDA PRODUCT APPROVAL & MIAMI-DADE NOA (ROOF MOUNTED EQUIPMENT)
18. PROVIDE COATED WITH HI-PRO POLYESTER, CONCRETE GRAY FAN, CURB AND ATTACHED ACCESSORIES.
19. PROVIDE STAINLESS STEEL FASTENERS - 300 SERIES
20. PROVIDE DRAIN CONNECTION
21. PROVIDE BIRDSCREEN: ALUMINUM
22. PROVIDE HEAT BAFFLE (ATTACHED)
23. PROVIDE BEARINGS WITH GREASE FITTINGS, L10 LIFE OF 100,000 HRS (L50 AVG. LIFE 500,000 HRS)
24. PROVIDE CLEAN-OUT PORT
25. PROVIDE ALL BELT DRIVES WITH 1.5 TIMES THE MINIMUM REQUIRED NUMBER OF BELTS
26. PROVIDE NEMA-1, TOGGLE, JUNCTION BOX MOUNTED & WIRED SWITCH.
27. PROVIDE GRAVITY OPERATED BACKDRAFT DAMPER COATED.
28. PROVIDE ALUMINUM HOUSING
29. PROVIDE INSULATED HOUSING - 1 IN. THICK: FAN HOUSING, FILTER BOX, MOTOR COVER
30. PROVIDE MOTOR COVER, ALUMINUM
31. PROVIDE SLOPED FILTER BOX, 2 IN. PLEATED FILTERS, MERV 8
32. PROVIDE ISOLATORS & BRACKETS, SPRING HANGING (2 KIT(S): QTY 8, PN: 850346) (SHIPPED LOOSE)
33. PROVIDE CORROSION RESISTANT FASTENERS ALL ROOF MOUNTED EQUIPMENT

ENGINEERING
FOR ARCHITECTURE
5757 Blue Lagoon Drive, Suite 400
Miami, Florida 33126
PH: 305.266.6553
Fax: 305.266.6695
www.tlc-engineers.com
COA 15

CUTLER BAY TOWN CENTER HVAC EQUIPMENT AND CONTROLS

10720 Caribbean Blvd. Cutler Bay, Florida 33189

100% CD SUBMITTAL

Revisions:

No.	Date	Description
1	11-16-16	Building Dept. Comments

Seal

Chi S. Lui, P.E.
Florida License # 61748

CHI S. LUI LICENSE NO. 61748 STATE OF FLORIDA PROFESSIONAL ENGINEER

Project No.: Project Number
Issue Date: Issue Date
Drawn By: Author
Approved By: Approver
Scale: 12" = 1'-0"

Drawing Title: MECHANICAL SCHEDULES

Drawing No.: M302

EXISTING SINGLE DUCT VAV TERMINAL UNIT SCHEDULE (ELECTRIC HEAT)

PLAN MARK	BASIS OF DESIGN MFGR	BASIS OF DESIGN MODEL	INLET SIZE	AIRFLOW COOLING DESIGN (CFM)	AIRFLOW COOLING MINIMUM (CFM)	AIRFLOW HEATING DESIGN (CFM)	MAX AIR PRESS. DROP (IN. WG)	ELECTRIC HEATING COIL DATA TEMP EAT (°F)	TEMP LAT (°F)	KW
VAV-1-1	Titus	DESV	6"	400	200	0	0.15	44	75	0.0
VAV-1-2	Titus	DESV	6"	400	200		0.15	44	75	0.0
VAV-1-3	Titus	DESV	8"	900	270		0.2	44	75	0.0
VAV-1-4	Titus	DESV	6"	600	180		0.2	44	75	0.0
VAV-1-5	Titus	DESV	8"	680	205		0.2	44	75	0.0
VAV-1-6	Titus	DESV	10"	1300	700		0.2	44	75	0.0
VAV-1-9	Titus	DESV	10"	2500	435		0.2	44	75	0.0
VAV-1-10	Titus	DESV	8"	1200	360		0.2	44	75	0.0
VAV-1-11	Titus	DESV	10"	1215	365		0.2	44	75	0.0
VAV-1-12	Titus	DESV	6"	400	200		0.15	44	75	0.0
VAV-1-13	Titus	DESV	8"	810	245		0.2	44	75	0.0
VAV-1-14	Titus	DESV	10"	1300	700		0.2	44	75	0.0
VAV-1-15	Titus	DESV	10"	1300	700		0.2	44	75	0.0
VAV-1-16	Titus	DESV	8"	680	205		0.2	44	75	0.0
VAV-1-17	Titus	DESV	10"	1225	370		0.2	44	75	0.0
VAV-1-18	Titus	DESV	12"	1430	430		0.2	44	75	0.0
VAV-1-19	Titus	DESV	12"	1100	1,100		0.2	44	75	0.0
VAV-1-20	Titus	DESV	6"	400	200		0.15	44	75	0.0
VAV-1-21	Titus	DESV	10"	800	240		0.2	44	75	0.0
VAV-1-22 *	Titus	DESV	6"	400	120		0.15	44	75	0.0
VAV-1-23	Titus	DESV	10"	1190	360		0.2	44	75	0.0
VAV-2-1	Titus	DESV	8"	800	400		0.2	44	75	0.0
VAV-2-2	Titus	DESV	8"	800	400		0.2	44	75	0.0
VAV-2-3	Titus	DESV	8"	800	400		0.2	44	75	0.0
VAV-2-4	Titus	DESV	10"	800	400	0	0.2	44	75	0.0
VAV-2-5	Titus	DESV	8"	800	240		0.2	44	75	0.0
VAV-2-6	Titus	DESV	8"	800	240		0.2	44	75	0.0
VAV-2-7	Titus	DESV	8"	1000	300		0.2	44	75	0.0
VAV-2-8	Titus	DESV	8"	800	240		0.2	44	75	0.0
VAV-2-9	Titus	DESV	8"	1200	360		0.2	44	75	0.0
VAV-2-10	Titus	DESV	8"	800	240		0.2	44	75	0.0
VAV-2-11	Titus	DESV	8"	800	240		0.2	44	75	0.0
VAV-2-12	Titus	DESV	10"	1300	700	0	0.2	44	75	0.0
VAV-2-13	Titus	DESV	8"	800	400		0.2	44	75	0.0
VAV-2-14	Titus	DESV	10"	1300	700	0	0.2	44	75	0.0
VAV-2-15	Titus	DESV	8"	800	400		0.2	44	75	0.0
VAV-2-16	Titus	DESV	10"	750	225		0.2	44	75	0.0
VAV-2-17	Titus	DESV	8"	1000	300		0.2	44	75	0.0
VAV-2-18	Titus	DESV	6"	400	120		0.15	44	75	0.0
VAV-2-19	Titus	DESV	8"	800	240		0.2	44	75	0.0
VAV-2-20	Titus	DESV	12"	1100	1,100		0.2	44	75	0.0
VAV-2-22 *	Titus	DESV	6"	400	120		0.15	44	75	0.0
VAV-3-1	Titus	DESV	8"	800	400	0	0.2	44	75	0.0
VAV-3-2	Titus	DESV	8"	800	400	0	0.2	44	75	0.0
VAV-3-3	Titus	DESV	6"	400	200		0.15	44	75	0.0
VAV-3-4	Titus	DESV	8"	800	400	0	0.2	44	75	0.0
VAV-3-5	Titus	DESV	10"	1300	700	0	0.2	44	75	0.0
VAV-3-6	Titus	DESV	8"	800	400		0.2	44	75	0.0
VAV-3-7	Titus	DESV	8"	800	400		0.2	44	75	0.0
VAV-3-8	Titus	DESV	8"	800	400	0	0.2	44	75	0.0
VAV-3-9	Titus	DESV	6"	400	200		0.15	44	75	0.0
VAV-3-10	Titus	DESV	10"	1300	700		0.2	44	75	0.0
VAV-3-11	Titus	DESV	8"	800	400	0	0.2	44	75	0.0
VAV-3-12	Titus	DESV	8"	800	400		0.2	44	75	0.0
VAV-3-13	Titus	DESV	12"	625	210	0	0.2	44	75	0.0
VAV-3-14	Titus	DESV	8"	390	130		0.2	44	75	0.0
VAV-3-15	Titus	DESV	8"	800	400		0.2	44	75	0.0
VAV-3-16	Titus	DESV	10"	1300	700		0.2	44	75	0.0
VAV-3-17	Titus	DESV	12"	1100	330		0.2	44	75	0.0
VAV-3-18	Titus	DESV	8"	800	400		0.2	44	75	0.0
VAV-3-19	Titus	DESV	8"	800	400		0.2	44	75	0.0
VAV-3-20	Titus	DESV	12"	1100	330		0.2	44	75	0.0
VAV-3-22 *	Titus	DESV	6"	400	120		0.15	44	75	0.0
VAV-4-1	Titus	DESV	6"	380	130	290	0.2	44	75	2.8
VAV-4-2	Titus	DESV	8"	425	125	320	0.2	44	75	3.0
VAV-4-3	Titus	DESV	10"	800	240		0.2	44	75	0.0
VAV-4-4	Titus	DESV	6"	400	200		0.15	44	75	0.0
VAV-4-5	Titus	DESV	6"	400	200		0.15	44	75	0.0
VAV-4-6	Titus	DESV	6"	400	200		0.15	44	75	0.0
VAV-4-7	Titus	DESV	8"	800	400		0.2	44	75	0.0
VAV-4-8	Titus	DESV	6"	400	200		0.15	44	75	0.0
VAV-4-9	Titus	DESV	8"	600	180		0.2	44	75	0.0
VAV-4-10	Titus	DESV	6"	315	105	0	0.15	44	75	0.0
VAV-4-11	Titus	DESV	6"	320	167	290	0.15	44	75	2.8
VAV-4-12	Titus	DESV	6"	310	170	290	0.15	44	75	2.8
VAV-4-13	Titus	DESV	6"	320	170	290	0.15	44	75	2.8
VAV-4-14	Titus	DESV	6"	390	130	320	0.15	44	75	3.0
VAV-4-15	Titus	DESV	8"	670	200		0.2	44	75	0.0
VAV-4-16	Titus	DESV	8"	800	240		0.2	44	75	0.0
VAV-4-17	Titus	DESV	8"	800	240		0.2	44	75	0.0
VAV-4-18	Titus	DESV	6"	390	130	340	0.15	44	75	3.2
VAV-4-19	Titus	DESV	8"	615	185		0.2	44	75	0.0
VAV-4-20	Titus	DESV	8"	340	200		0.15	44	75	0.0
VAV-4-21	Titus	DESV	8"	400	240		0.15	44	75	0.0
VAV-4-22 *	Titus	DESV	6"	400	120		0.15	44	75	0.0
VAV-4-23	Titus	DESV	6"	370	123	290	0.15	44	75	2.8
VAV-4-24	Titus	DESV	7"	430	143	320	0.2	44	75	3.0
VAV-4-26	Titus	DESV	8"	800	240		0.2	44	75	0.0
VAV-4-27	Titus	DESV	6"	400	120		0.15	44	75	0.0
VAV-4-27A	Titus	DESV	9"	690	230	380	0.2	44	75	3.5
VAV-5-1	Titus	DESV	6"	390	130	290	0.15	44	75	2.8
VAV-5-2	Titus	DESV	7"	435	145	320	0.2	44	75	3.0
VAV-5-3	Titus	DESV	7"	435	145	320	0.2	44	75	3.0
VAV-5-4	Titus	DESV	6"	390	130	290	0.15	44	75	2.8
VAV-5-5	Titus	DESV	8"	670	200		0.2	44	75	0.0
VAV-5-6	Titus	DESV	6"	390	130	320	0.15	44	75	3.0
VAV-5-7	Titus	DESV	8"	670	200		0.2	44	75	0.0
VAV-5-8	Titus	DESV	6"	385	120	340	0.15	44	75	3.2
VAV-5-9	Titus	DESV	6"	540	160		0.2	44	75	0.0
VAV-5-10	Titus	DESV	9"	625	200	380	0.2	44	75	3.6
VAV-5-11	Titus	DESV	8"	670	200		0.2	44	75	0.0
VAV-5-12	Titus	DESV	8"	670	200		0.2	44	75	0.0
VAV-5-13	Titus	DESV	9"	625	200	380	0.2	44	75	3.6

EXISTING SINGLE DUCT VAV TERMINAL UNIT SCHEDULE (ELECTRIC HEAT)

PLAN MARK	BASIS OF DESIGN MFGR	BASIS OF DESIGN MODEL	INLET SIZE	AIRFLOW COOLING DESIGN (CFM)	AIRFLOW COOLING MINIMUM (CFM)	AIRFLOW HEATING DESIGN (CFM)	MAX AIR PRESS. DROP (IN. WG)	ELECTRIC HEATING COIL DATA TEMP EAT (°F)	TEMP LAT (°F)	KW
VAV-5-14 *	Titus	DESV	6"	400	120		0.15	44	75	0.0
VAV-5-15	Titus	DESV	6"	315	105	320	0.15	44	75	3.0
VAV-5-16	Titus	DESV	8"	670	200		0.2	44	75	0.0
VAV-5-17	Titus	DESV	8"	670	200		0.2	44	75	0.0
VAV-5-18	Titus	DESV	6"	310	100		0.15	44	75	0.0
VAV-5-19	Titus	DESV	6"	320	100	290	0.15	44	75	2.8
VAV-5-20	Titus	DESV	6"	320	100	290	0.15	44	75	2.8
VAV-5-21	Titus	DESV	6"	315	105	320	0.15	44	75	3.0
VAV-5-22	Titus	DESV	6"	310	100	290	0.15	44	75	2.8
VAV-5-23 *	Titus	DESV	6"	240	80		0.15	44	75	0.0
VAV-6-1	Titus	DESV	8"	500	170		0.2	44	75	0.0
VAV-6-2	Titus	DESV	10"	855	285	460	0.2	44	75	4.4
VAV-6-3	Titus	DESV	10"	855	285	420	0.2	44	75	4.0
VAV-6-4	Titus	DESV	8"	545	180	520	0.2	44	75	5.0
VAV-6-5	Titus	DESV	9"	645	215	380	0.2	44	75	3.6
VAV-6-6	Titus	DESV	9"	645	215	380	0.2	44	75	3.6
VAV-6-7	Titus	DESV	6"	430	130	380	0.2	44	75	3.6
VAV-6-8	Titus	DESV	6"	430	130	380	0.2	44	75	3.6
VAV-6-9	Titus	DESV	6"	585	195	420	0.2	44	75	4.0
VAV-6-10	Titus	DESV	8"	585	195	420	0.2	44	75	4.0
VAV-6-11	Titus	DESV	8"	460	150	500	0.2	44	75	4.8
VAV-6-12	Titus	DESV	9"	680	230	380	0.2	44	75	3.6
VAV-6-13	Titus	DESV	9"	680	205	380	0.2	44	75	3.6
VAV-6-14	Titus	DESV	6"	430	130	380	0.2	44	75	3.6
VAV-6-15	Titus	DESV	8"	825	250		0.2	44	75	0.0
VAV-6-16	Titus	DESV	8"	825	250		0.2	44	75	0.0
VAV-6-17	Titus	DESV	8"	825	250		2	44	75	0.0
VAV-6-18	Titus	DESV	8"	825	250		0.2	44	75	0.0
VAV-6-19	Titus	DESV	8"	640	200		0.2	44	75	0.0
VAV-6-20	Titus	DESV	8"	900	300		0.2	44	75	0.0
VAV-6-21	Titus	DESV	8"	640	200		0.2	44	75	0.0
VAV-6-22 *	Titus	DESV	8"	240	200		0.15	44	75	0.0
VAV-6-23	Titus	DESV	8"	900	300		0.2	44	75	0.0
VAV-6-28	Titus	DESV	8"	640	200		0.2	44	75	0.0
VAV-6-29	Titus	DESV	8"	900	300		0.2	44	75	0.0

LEGEND

* NEW VAV UNITS.

SINGLE DUCT HEATER UNIT SCHEDULE (ELECTRIC HEAT) - EXISTING

PLAN MARK	HEATER TYPE	AIRFLOW (CFM)	ELECTRIC HEATING COIL DATA TEMP EAT (°F)	TEMP LAT (°F)	KW	STEPS	VOLTS / PHASE
DH-1-1	SLIP-IN	400	44	75	3.0	-	277 / 1
DH-1-3	SLIP-IN	400	44	75	3.0	-	277 / 1
DH-1-4	SLIP-IN	600	44	75	3.0	-	277 / 1
DH-1-6	SLIP-IN	1,300	44	75	3.0	-	277 / 1
DH-1-13	SLIP-IN	810	44	75	3.0	-	277 / 1
DH-2-2	SLIP-IN	800	44	75	3.0	-	277 / 1
DH-2-3	SLIP-IN	800	44	75	3.0	-	277 / 1
DH-2-4	SLIP-IN	800	44	75	3.0	-	277 / 1
DH-2-12	SLIP-IN	1,300	44	75	3.0	-	277 / 1
DH-2-14	SLIP-IN	1,300	44	75	3.0	-	277 / 1
DH-3-1	SLIP-IN	800	44	75	3.0	-	277 / 1
DH-3-2	SLIP-IN	800	44	75	3.0	-	277 / 1
DH-3-4	SLIP-IN	800	44	75	3.0	-	277 / 1
DH-3-5	SLIP-IN	1,300	44	75	3.0	-	277 / 1
DH-3-8	SLIP-IN	800	44	75	3.0	-	277 / 1
DH-3-11	SLIP-IN	800	44	75	3.0	-	277 / 1
DH-3-13	SLIP-IN	630	44	75	3.0	-	277 / 1
DH-4-6	SLIP-IN	400	44	75	3.0	-	277 / 1
DH-4-7	SLIP-IN	800	44	75	3.0	-	277 / 1
DH-4-10	SLIP-IN	320	44	75	3.0	-	277 / 1

BUFFER TANK SCHEDULE

PLAN MARK	SYSTEM	LOCATION	MANUFACTURER	MODEL NO.	TYPE	MOUNT	SYSTEM TEMP. MIN.	SYSTEM TEMP. MAX.	INITIAL PRESS. PSIG	CONN. SIZE INCH	TANK VOLUME GAL.	TANK ACCEPT. GAL.	SHPNG. WEIGHT LBS	REMARKS
BT-1	CHILL WATER	ROOF	AMERICAN WHEATLEY	--	BUFFER	VERTICAL	42	95	--	--	500	--	--	1,2,3,4,5,6

NOTES:

1. PROVIDE PRE-CHARGED TANK.
2. PROVIDE TANK WITH BASE AND LIFTING RINGS.
3. PROVIDE NPT SYSTEM TOP CONNECTION.
4. PROVIDE STANDARD AIR CHARGING VALVE (STANDARD TIRE VALVE) WITH CAP.

SUPPLY AND EXHAUST FAN SCHEDULE EXISTING (REPLACEMENT)

PLAN MARK	SERVING	SELECTION BASED ON MANUFACTURER	SELECTION BASED ON MODEL	FAN TYPE	CFM	STATIC PRESSURE	DRIVE TYPE	FAN MOTOR RPM	FAN MOTOR HP	FAN MOTOR VOLT	FAN MOTOR PHASE	EMERGENCY POWER	WEIGHT (LB.)	ACCESSORIES
EF-1	TOILET EXHAUST	GREENHECK	GB-180-5	CENTRIFUGAL	3180	0.375	BELT DRIVE	1725	1/2	120	1/60	NO	88	1,3,4,5,7
EF-2	EXHAUST VEST STAIR 1	GREENHECK	GB-180-4	CENTRIFUGAL	1575	0.375	BELT DRIVE	1725	1/4	120	1/60	YES	83	1,3,4,5,7
EF-3	EXHAUST STAIR 1	GREENHECK	GB-141-7	CENTRIFUGAL	2500	0.25	BELT DRIVE	1438	3/4	460	3/60	YES	81	1,3,4,5,7
SF-1	PRESSURIZATION STAIR 1	GREENHECK	RSF-150	CENTRIFUGAL	3000	0.5	BELT DRIVE	1550	3/4	480	3/60	YES	367	1,7,12,21
SF-2	PRESSURIZATION VEST	GREENHECK	RSF-90	CENTRIFUGAL	1050	0.5	BELT DRIVE	1550	1/4	120	1/60	YES	168	1,7,12,21

NOTES:

1. BASIS OF DESIGN: GREENHECK.
2. PROVIDE FACTORY INSTALLED BELT DRIVEN BLOWER MOTOR.

1. BACKDRAFT DAMPER
2. THERMOSTAT
3. BIRDSCREEN
4. ROOF CURB
5. DISCONNECT SWITCH
6. DRAIN
7. EQUIPMENT SUPPORTS
8. INLET SCREEN
9. CURB MOUNT ROOF JACK
10 SPEED CONTROLLER
11. WALL SHUTTER
12. VIBRATION ISOLATORS
13. WALL CAP
14 WALL SHUTTER - MOTORIZED
15. WEATHER COVER
16. 2 SPEED / 1 WINDING
17. FILTERS
18. WALL COLLAR
19. FAN GUARD / SCREEN
20. COMPANION FLANGES
21 INSULATED HOUSING FOR SOUND CONTROL
22. HINGED FRAMES
22. SPARK / EXPLOSION PROOF
23. POWER VENTILATOR APPROVED FOR USE IN SMOKE CONTROL SYSTEM
24. WALL/COLUMN MOUNT BRACKET AND SPEED CONTROLLER
25. INTERLOCKED WITH ASSOCIATED VAV BOX (BOX CONTROLLED BY OCC. SENSOR)

SMOKE CONTROL FAN SCHEDULE

PLAN MARK	MODEL NO.	TYPE	FAN SERVICE	EMERGENCY POWER	CFM	STATIC PRESS.	FAN RPM	MOTOR RPM	MOTOR HP	VOLT/ PHASE	DRIVE TYPE	VFD	WEIGHT (LB.)	ACCESSORIES
SPF-2	TBI-CA-3H18-7	INLINE	STAIR 2 PRESSURIZATION	YES	3000	0.5	1598	1725	3/4	460/3	BELT	NO	95	1,2,3,5,8,12,13,15-26,28,29-33.
EEF-1	TBI-FS-4L36-150	INLINE	EMERGENCY SMOKE EXHAUST	YES	25000	1.25	1490	1725	15	460/3	BELT	NO	400	1,2,3,5,8,9,13,15,22,23,25,27-30,32
EPF-1	TBI-CA-3H24	INLINE	ELEVATOR PRESSURIZATION	YES	7000	0.35	1444	1725	11/2	460/3	BELT	NO	125	1,2,3,5,8,9,13,15,22,23,25,27-30,32

NOTES:

1. MODEL NUMBERS AND FAN SELECTION ARE BASED ON GREENHECK

1. PROVIDE MOTOR WITH CLASS F INSULATION
2. PROVIDE EXTENDED MOTOR LEADS
3. PROVIDE HI-PRO Z COATING, CONCRETE GRAY COLOR FOR COMPLETE FAN, CURB AND ATTACHED ACCESSORIES
4. PROVIDE 14" ROOF CURB - ALUMINUM CONSTRUCTION
5. PROVIDE UL/CUL-705 - "POWER VENTILATORS"
6. PROVIDE MOUNTING SUPPORT - ROOF MOUNT
7. PROVIDE INSPECTION DOOR - BOLTED
8. PROVIDE UL EMERGENCY SMOKE(150 C / 300 F FOR 5 HOURS)
9. PROVIDE STEEL BUTTERFLY DAMPER BLADES
10. PROVIDE MAGNETIC DAMPER LATCHES
11. PROVIDE EXTENDED LUBE LINES - NYLON
12. PROVIDE TIE DOWN POINTS (SET OF 4)
13. PROVIDE NEMA PREMIUM EFFICIENT MOTOR - MEETS NEMA TABLE 12-12, TIMES THE MINIMUM REQUIRED NUMBER OF BELTS
14. PROVIDE UL/CUL 762 LISTED - "POWER VENTILATORS FOR RESTAURANT EXHAUST".
15. PROVIDE SWITCH, NEMA-3R, TOGGLE, JUNCTION BOX MOUNTED & WIRED
16. PROVIDE HIGH WIND RATED (+/- 150 PSF RATING)
17. PROVIDE FLORIDA PRODUCT APPROVAL & MIAMI-DADE NOA (ROOF MOUNTED EQUIPMENT)
18. PROVIDE COATED WITH HI-PRO POLYESTER, CONCRETE GRAY FAN, CURB AND ATTACHED ACCESSORIES.
19. PROVIDE STAINLESS STEEL FASTENERS - 300 SERIES
20. PROVIDE DRAIN CONNECTION
21. PROVIDE BIRDSCREEN: ALUMINUM
22. PROVIDE HEAT BAFFLE (ATTACHED)
23. PROVIDE BEARINGS WITH GREASE FITTINGS, L10 LIFE OF 100,000 HRS (L50 AVG. LIFE 500,000 HRS)
24. PROVIDE CLEAN-OUT PORT
25. PROVIDE ALL BELT DRIVES WITH 1.5 TIMES THE MINIMUM REQUIRED NUMBER OF BELTS
26. PROVIDE NEMA-1, TOGGLE, JUNCTION BOX MOUNTED & WIRED SWITCH.
27. PROVIDE GRAVITY OPERATED BACKDRAFT DAMPER COATED.
28. PROVIDE ALUMINUM HOUSING
29. PROVIDE INSULATED HOUSING - 1 IN. THICK: FAN HOUSING, FILTER BOX, MOTOR COVER
30. PROVIDE MOTOR COVER, ALUMINUM
31. PROVIDE SLOPED FILTER BOX, 2 IN. PLEATED FILTERS, MERV 8
32. PROVIDE ISOLATORS & BRACKETS, SPRING HANGING (2 KIT(S): QTY 8, P/N: 850346) (SHIPPED LOOSE)
33. PROVIDE CORROSION RESISTANT FASTENERS ALL ROOF MOUNTED EQUIPMENT

ENGINEERING
FOR ARCHITECTURE
5757 Blue Lagoon Drive, Suite 400
Miami, Florida 33126
PH: 305.266.6553
Fax: 350.266.6695
www.tlc-engineers.com
COA 15

CUTLER BAY TOWN CENTER HVAC EQUIPMENT AND CONTROLS

10720 Caribbean Blvd. Cutler Bay, Florida 33189

Revisions:

No.	Date	Description

Seal

Chi S. Lui, P.E.
Florida License # 61748

CHI S. LUI LICENSE No. 61748 STATE OF FLORIDA PROFESSIONAL ENGINEER

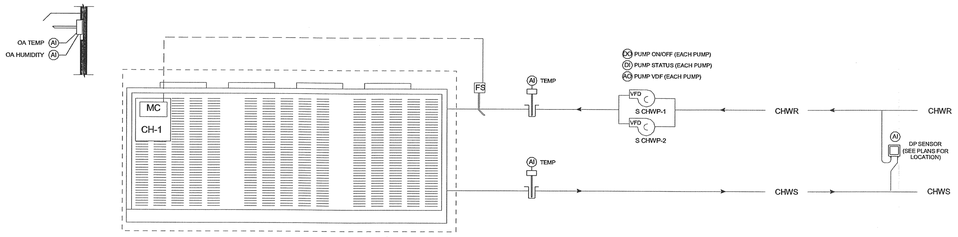
Project No.: Project Number
Issue Date: Issue Date
Drawn By: Author
Approved By: Approver
Scale: 12" = 1'-0"

Drawing Title:

MECHANICAL SCHEDULES

Drawing No.: M302

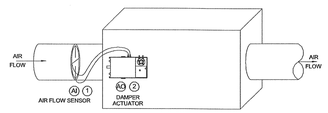
100% CD SUBMITTAL



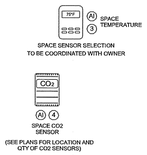
CHILLER PLANT SEQUENCE OF OPERATIONS:
CHILLER - RUN CONDITIONS : CHILLER SHALL BE ENABLED TO RUN WHENEVER:
- A DEFINABLE NUMBER OF CHILLED WATER COILS NEED COOLING
- AND THE OUTSIDE AIR TEMPERATURE IS GREATER THAN 54°F (ADJ.).

CHILLER CHILLED WATER SUPPLY SETPOINT : THE CHILLER SHALL MAINTAIN A CHILLED WATER SUPPLY TEMPERATURE SETPOINT AS DETERMINED BY ITS OWN INTERNAL CONTROLS (PROVIDED BY OTHERS).
CHILLED WATER TEMPERATURE MONITORING : THE FOLLOWING TEMPERATURES SHALL BE MONITORED: CHWS AND CHWR
EMERGENCY SHUTDOWN : THE CHILLER SHALL SHUT DOWN AND AN ALARM GENERATED UPON RECEIVING AN EMERGENCY SHUTDOWN SIGNAL STATUS.
CHILLED WATER PUMP LEAD/STANDBY OPERATION : ONE PUMP SHALL OPERATE AT ALL TIMES. THE SYSTEM IS SETUP AS A PRIMARY/STANDBY PUMP SET. THE LEAD PUMP SHALL START PRIOR TO THE CHILLER BEING ENABLED. THE 2 PUMPS SHALL BE SEQUENCED BASED ON TOTAL RUN TIME HOURS. THE PUMP RUNTIMES SHALL BE RECORDED AND THE PUMP WITH THE LOWEST RUNTIME WILL BECOME THE PRIMARY PUMP. THE HIGHEST RUNTIME WILL BECOME THE STANDBY PUMP. IF THE PRIMARY PUMP FAILS DURING NORMAL OPERATION, AS SENSED BY THE STATUS SWITCH, AFTER A 15 SECOND TIME-DELAY, THE STANDBY PUMP SHALL IMMEDIATELY BEGIN OPERATION.
CHILLED WATER DIFFERENTIAL PRESSURE CONTROL : THE CONTROLLER SHALL MEASURE CHILLED WATER DIFFERENTIAL PRESSURE AND MODULATE THE LEAD CHILLED WATER PUMP VFD TO MAINTAIN ITS CHILLED WATER DIFFERENTIAL PRESSURE SETPOINT. THE VFD MINIMUM SPEED SHALL NOT DROP BELOW 30% (ADJ.). ALL SETPOINTS SHALL BE FIELD ADJUSTED DURING THE COMMISSIONING PERIOD TO MEET THE REQUIREMENTS OF ACTUAL FIELD CONDITIONS.
ALARMS SHALL BE PROVIDED AS FOLLOWS:
- CHILLER/PUMP FAILURE: COMMANDED ON, BUT THE STATUS IS OFF.
- CHILLER/PUMP RUNNING IN HAND: COMMANDED OFF, BUT THE STATUS IS ON.
- HIGH/LOW CHILLED WATER SUPPLY TEMP

CHILLED WATER PLANT CONTROL DIAGRAM



CONTROL DIAGRAM



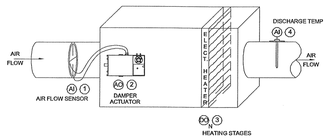
INPUT OUTPUT POINTS LIST					
TAG	DESCRIPTION	AI	AO	DI	DO
1	AIR FLOW SENSOR	X			
2	DAMPER ACTUATOR		X		
3	SPACE TEMP.	X			
4	SPACE CO2 SENSOR	X			

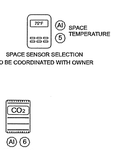
SEQUENCE OF OPERATIONS:
RUN CONDITIONS - SCHEDULED : THE UNIT SHALL RUN ACCORDING TO A USER DEFINABLE TIME SCHEDULE IN THE FOLLOWING MODES:
- OCCUPIED MODE: THE UNIT SHALL MAINTAIN A 74°F (ADJ.) COOLING SETPOINT.
- UNOCCUPIED MODE : THE UNIT SHALL CLOSE TO ITS MINIMUM POSITION.

ZONE SETPOINT ADJUST/OPTIMAL START/UNOCCUPIED OVERRIDE : THE OCCUPANT SHALL BE ABLE TO ADJUST THE ZONE TEMPERATURE HEATING AND COOLING SETPOINTS AT THE ZONE SENSOR. THE UNIT SHALL USE AN OPTIMAL START ALGORITHM FOR MORNING START-UP. THIS ALGORITHM SHALL MINIMIZE THE UNOCCUPIED WARM-UP OR COOL-DOWN PERIOD WHILE STILL ACHIEVING COMFORT CONDITIONS BY THE START OF SCHEDULED OCCUPIED PERIOD. A TIMED LOCAL OVERRIDE CONTROL SHALL ALLOW AN OCCUPANT TO OVERRIDE THE SCHEDULE AND PLACE THE UNIT INTO AN OCCUPIED MODE FOR AN ADJUSTABLE PERIOD OF TIME. AT THE EXPIRATION OF THIS TIME, CONTROL OF THE UNIT SHALL AUTOMATICALLY RETURN TO THE SCHEDULE.
FLOW CONTROL DURING OCCUPIED MODE :
- WHEN ZONE TEMPERATURE IS GREATER THAN THE SETPOINT, THE ZONE DAMPER SHALL MODULATE BETWEEN THE MINIMUM OCCUPIED AIRFLOW (ADJ.) AND THE MAXIMUM COOLING AIRFLOW (ADJ.) UNTIL THE ZONE IS SATISFIED.
- WHEN THE ZONE TEMPERATURE IS LESS THAN THE SETPOINT, THE ZONE DAMPER SHALL MAINTAIN THE MINIMUM REQUIRED ZONE VENTILATION (ADJ.).

ALARMS SHALL BE PROVIDED AS FOLLOWS:
- HIGH/LOW ZONE TEMP: IF THE ZONE TEMPERATURE IS GREATER/LOWER THAN THE COOLING SETPOINT BY A USER DEFINABLE AMOUNT (ADJ.).
- HIGH CO2 CONCENTRATION LEVEL.

VAV BOX COOLING ONLY (TYP.)





INPUT OUTPUT POINTS LIST					
TAG	DESCRIPTION	AI	AO	DI	DO
1	AIR FLOW SENSOR	X			
2	DAMPER ACTUATOR		X		
3	HEATING STAGES (NOTE 1)				X
4	DISCHARGE TEMP.	X			
5	SPACE TEMP.	X			
6	SPACE CO2 SENSOR	X			

NOTES:
1- SEE EQUIPMENT DATA FOR NUMBER OF STAGES.

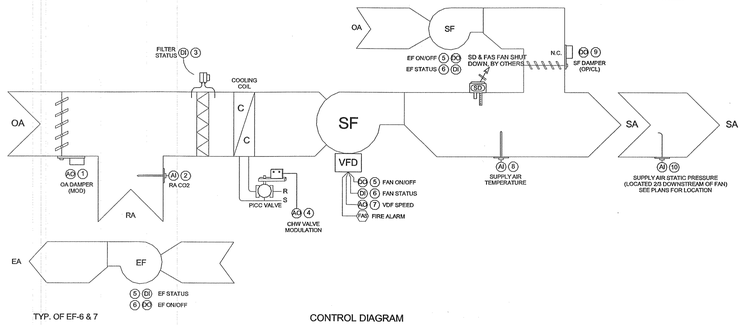
CONTROL DIAGRAM

SEQUENCE OF OPERATIONS:
RUN CONDITIONS - SCHEDULED : THE UNIT SHALL RUN ACCORDING TO A USER DEFINABLE TIME SCHEDULE IN THE FOLLOWING MODES:
- OCCUPIED MODE: THE UNIT SHALL MAINTAIN A 74°F (ADJ.) COOLING SETPOINT AND A 68°F (ADJ.) HEATING SETPOINT.
- UNOCCUPIED MODE : THE UNIT SHALL CLOSE TO ITS MINIMUM POSITION.

ZONE SETPOINT ADJUST/OPTIMAL START/UNOCCUPIED OVERRIDE : THE OCCUPANT SHALL BE ABLE TO ADJUST THE ZONE TEMPERATURE HEATING AND COOLING SETPOINTS AT THE ZONE SENSOR. THE UNIT SHALL USE AN OPTIMAL START ALGORITHM FOR MORNING START-UP. THIS ALGORITHM SHALL MINIMIZE THE UNOCCUPIED WARM-UP OR COOL-DOWN PERIOD WHILE STILL ACHIEVING COMFORT CONDITIONS BY THE START OF SCHEDULED OCCUPIED PERIOD. A TIMED LOCAL OVERRIDE CONTROL SHALL ALLOW AN OCCUPANT TO OVERRIDE THE SCHEDULE AND PLACE THE UNIT INTO AN OCCUPIED MODE FOR AN ADJUSTABLE PERIOD OF TIME. AT THE EXPIRATION OF THIS TIME, CONTROL OF THE UNIT SHALL AUTOMATICALLY RETURN TO THE SCHEDULE.
FLOW CONTROL DURING OCCUPIED MODE :
- WHEN ZONE TEMPERATURE IS GREATER THAN ITS COOLING SETPOINT, THE ZONE DAMPER SHALL MODULATE BETWEEN THE MINIMUM OCCUPIED AIRFLOW (ADJ.) AND THE MAXIMUM COOLING AIRFLOW (ADJ.) UNTIL THE ZONE IS SATISFIED.
- WHEN THE ZONE TEMPERATURE IS BETWEEN THE COOLING SETPOINT AND THE HEATING SETPOINT, THE ZONE DAMPER SHALL MAINTAIN THE MINIMUM REQUIRED ZONE VENTILATION (ADJ.).
- WHEN ZONE TEMPERATURE IS LESS THAN ITS HEATING SETPOINT, THE CONTROLLER SHALL ENABLE HEATING TO MAINTAIN THE ZONE TEMPERATURE AT ITS HEATING SETPOINT.

ELECTRIC HEATING STAGES : THE CONTROLLER SHALL MEASURE THE ZONE TEMPERATURE AND STAGE THE REHEATING TO MAINTAIN ITS SETPOINT. TO PREVENT SHORT CYCLING, THERE SHALL BE A USER DEFINABLE (ADJ.) DELAY BETWEEN STAGES, AND EACH STAGE SHALL HAVE A USER DEFINABLE (ADJ.) MINIMUM RUNTIME.
DISCHARGE AIR TEMPERATURE : THE CONTROLLER SHALL MONITOR THE DISCHARGE AIR TEMPERATURE.
ALARMS SHALL BE PROVIDED AS FOLLOWS:
- HIGH/LOW ZONE TEMP: IF THE ZONE TEMPERATURE IS GREATER/LOWER THAN THE COOLING SETPOINT BY A USER DEFINABLE AMOUNT (ADJ.).
- HIGH CO2 CONCENTRATION LEVEL

VAV BOX WITH HEATING (TYP.)



TYP. OF EF-6 & 7

CONTROL DIAGRAM

INPUT OUTPUT POINTS LIST					
TAG	DESCRIPTION	AI	AO	DI	DO
1	OA DAMPER ACTUATOR		X		
2	RA CO2. SENSOR	X			
3	FILTER DP SW			X	
4	CHW CONTROL VALVE		X		
5	FAN ON/OFF (EACH)				X
6	FAN STATUS (EACH)			X	
7	VFD SPEED		X		
8	SA TEMP SENSOR	X			
9	SF DAMPER ACTUATOR				X
10	SA STATIC PRESS. SENSOR	X			

NOTES:
1- SEE EQUIPMENT DATA FOR NUMBER OF STAGES.

SEQUENCE OF OPERATIONS:
RUN CONDITIONS - SCHEDULED : THE UNIT SHALL RUN BASED UPON AN OPERATOR ADJUSTABLE SCHEDULE IN ONE OF THE FOLLOWING MODES:
- OCCUPIED MODE: UNIT SHALL BE ENABLED AND OUTSIDE AIR DAMPER SHALL OPEN.
- UNOCCUPIED MODE: UNIT SHALL BE CYCLE AND NIGHT SET BACK SHALL BE IMPLEMENTED. OUTSIDE AIR DAMPER SHALL CLOSE.
- SMOKE CONTROL MODE: THE OA DAMPER SHALL BE FULLY OPEN, THE CHILLED WATER VALVE SHALL REMAIN OFF AND CLOSE, AND THE SUPPLY FAN SHALL BE ON. THE SUPPLY FAN VFD SHALL MODULATE TO ITS SMOKE CONTROL SET POINT UNTIL THE EVENT IS OVER. (SMOKE CONTROL/EMERGENCY MODE BY FIRE ALARM SYSTEM).

OPTIMAL START : THE UNIT SHALL USE AN OPTIMAL START ALGORITHM FOR MORNING START-UP. THIS ALGORITHM SHALL MINIMIZE THE UNOCCUPIED WARM-UP OR COOL-DOWN PERIOD WHILE STILL ACHIEVING COMFORT CONDITIONS BY THE START OF SCHEDULED OCCUPIED PERIOD.
SUPPLY FAN : THE SUPPLY FAN SHALL RUN ANYTIME THE UNIT IS COMMANDED TO RUN, UNLESS SHUTDOWN ON SAFETIES. TO PREVENT SHORT CYCLING, THE SUPPLY FAN SHALL HAVE A USER DEFINABLE (ADJ.) MINIMUM RUNTIME. ALARMS SHALL BE PROVIDED AS FOLLOWS:
- SUPPLY FAN FAILURE: COMMANDED ON, BUT THE STATUS IS OFF.
- SUPPLY FAN IN HAND: COMMANDED OFF, BUT THE STATUS IS ON.
- SUPPLY FAN RUNTIME EXCEEDED: STATUS RUNTIME EXCEEDS A USER DEFINABLE LIMIT (ADJ.).

SUPPLY AIR DUCT STATIC PRESSURE CONTROL : THE CONTROLLER SHALL MEASURE DUCT STATIC PRESSURE AND MODULATE THE SUPPLY FAN VFD SPEED TO MAINTAIN A DUCT STATIC PRESSURE SETPOINT. THE SPEED SHALL NOT DROP BELOW 30% (ADJ.). ALARMS SHALL BE PROVIDED AS FOLLOWS:
- HIGH/LOW SUPPLY AIR STATIC PRESSURE
- VFD FAULT

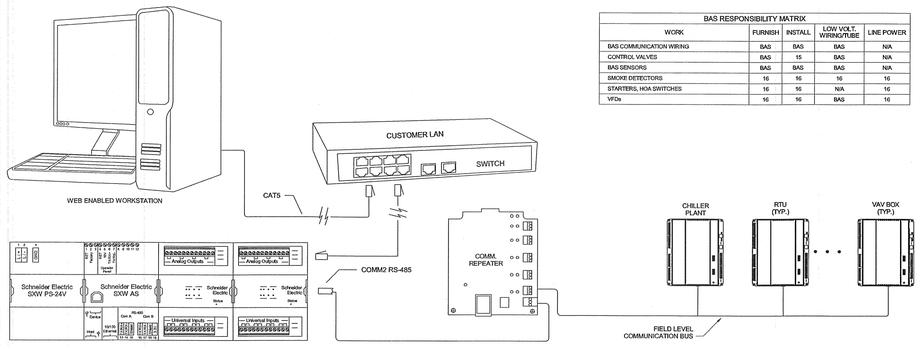
SUPPLY AIR TEMPERATURE SETPOINT - FIXED : THE CONTROLLER SHALL MONITOR THE SUPPLY AIR TEMPERATURE AND SHALL MAINTAIN A FIXED SUPPLY AIR TEMPERATURE SETPOINT OF 55°F (ADJ.).
COOLING COIL VALVE : THE CONTROLLER SHALL MEASURE THE SUPPLY AIR TEMPERATURE AND MODULATE THE COOLING COIL VALVE TO MAINTAIN ITS COOLING SETPOINT.
ALARMS SHALL BE PROVIDED AS FOLLOWS:
- HIGH / LOW SUPPLY AIR TEMP.

OA DAMPER: DURING OCCUPIED MODE THE OA DAMPER SHALL OPEN TO ALLOW IN THE MINIMUM OA REQUIREMENTS. DURING UNOCCUPIED MODE AND OPTIMAL START UP TIME THE OA DAMPER SHALL CLOSE ALLOWING AIR RECIRCULATION.
MINIMUM OUTSIDE AIR VENTILATION - CARBON DIOXIDE (CO2) CONTROL : WHEN IN THE OCCUPIED MODE, THE CONTROLLER SHALL MONITOR ZONES CO2 CONCENTRATION LEVEL SERVED BY THIS UNIT. THE CONTROLLER SHALL MODULATE THE OUTSIDE AIR DAMPER OPEN AND THE RETURN AIR DAMPER CLOSE ON RISING CO2 CONCENTRATIONS OVERRIDING NORMAL DAMPER OPERATION TO MAINTAIN A CO2 CONCENTRATION SETPOINT OF 750 PPM (ADJ.). AN ALARM SHALL BE SENT TO THE WORKSTATION IF THE CO2 LEVELS ARE GREATER THAN 10 % OF IAQ SETPOINT (ADJ.).
FILTER STATUS : A DIFFERENTIAL PRESSURE SWITCH SHALL MONITOR THE DIFFERENTIAL PRESSURE ACROSS THE FILTER WHEN THE FAN IS RUNNING. ALARMS SHALL BE PROVIDED AS FOLLOWS:
- FILTER DIRTY.

SMOKE SUPPLY FAN-1: IN NORMAL MODE SMOKE SUPPLY FAN SHALL BE OFF. IF A FIRE ALARM SIGNAL IS RECEIVED FROM THE FIRE ALARM PANEL THE SF DAMPER SHALL OPEN AND THE FAN SHALL BE COMMANDED TO RUN UNTIL THE EVENT IS OVER.
EXHAUST FANS 6 & 7: THE EXHAUST FANS SHALL BE INTERLOCKED TO RUN WHENEVER THE SMOKE SUPPLY FAN IS ON.

RTU (TYP.)

NETWORK CONTROL DIAGRAM



APPLICATION SERVER WITH TERMINAL BASE AND StruxureWare™ POWER SUPPLY

BAS RESPONSIBILITY MATRIX				
WORK	FURNISH	INSTALL	LOW VOLT. WIRING/TUBE	LINE POWER
BAS COMMUNICATION WIRING	BAS	BAS	BAS	N/A
CONTROL VALVES	BAS	15	BAS	N/A
BAS SENSORS	BAS	BAS	BAS	N/A
SMOKE DETECTORS	16	16	16	16
STARTERS, HOA SWITCHES	16	16	N/A	16
VFDs	16	16	BAS	16

GENERAL NOTES:

1. SPACE SENSORS LOCATED AS PER PLANS.
2. PROVIDE GLOBAL OUTSIDE AIR TEMPERATURE AND HUMIDITY POINTS.
3. FIRE ALARM CONTACTS TO BE PROVIDED BY DIV.16 ELECTRICAL CONTRACTOR. WIRE FROM LOCAL FIRE ALARM CONTACTS TO THE MOTOR SHALL BE BY DIVISION 16 FOR FAN SHUTDOWN.
4. SMOKE DETECTOR PROVIDED AND INSTALLED BY FIRE ALARM CONTRACTOR.
5. DAMPERS BY OTHERS.
6. WEB ENABLED CLIENT WORK STATION, INTERNET ACCESS AND STATIC IP ADDRESS TO BE PROVIDED BY OWNER.
7. DIV.16 ELECTRICAL CONTRACTOR IS TO PROVIDE 120 VAC POWER WITH TRUE EARTH GROUND AT THE CONTROL SYSTEM CABINETS.
7. EXISTING VAV BOXES MUST HAVE CROSS FLOW TUBES AND AN EXTERNAL SHAFT DAMPER.
8. EXISTING VAV BOX CONTROLLERS TO BE REPLACED WITH NEW DDC VAV BOX CONTROLLERS.
9. DIV.16 ELECTRICAL CONTRACTOR IS TO PROVIDE POWER AT EACH VAV BOX, INCLUDING A TRUE EARTH GROUND.

BASIS OF DESIGN SCHNEIDER ELECTRIC/ANDOVER/ADVANCED CONTROL CORP. (954) 491-6660

ADVANCED Control Corporation

ENGINEERING
FOR ARCHITECTURE
5757 Blue Lagoon Drive, Suite 400
Mimai, Florida 33126
PH: 305.266.6553
Fax: 350.266.6695
www.tlc-engineers.com
COA 15

CUTLER BAY TOWN CENTER HVAC EQUIPMENT AND CONTROLS

10720 Caribbean Blvd. Cutler Bay, Florida 33189

100% CD SUBMITTAL

Revisions:

No.	Date	Description

Seal

Chi S. Lui, P.E.
Florida License # 61748

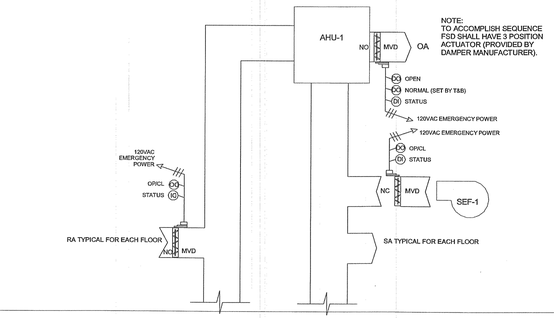
Project No.: Project Number
Issue Date: Issue Date
Drawn By: Author
Approved By: Approver
Scale: 12" = 1'-0"

Drawing Title:
MECHANICAL CONTROLS

Drawing No.:
M401

C:\Revit 2016 Local Models\616018_MEP_R16_shay.odonnell.rvt
2/7/2016 11:15:30 PM

TYPICAL FLOOR RISER



BUILDING SMOKE CONTROL

NORMAL MODE

THE AHU OUTDOOR AIR DAMPER SHALL OPEN TO PREDETERMINED POSITION (SET BY T&B) AND THE SMOKE MOTORIZED AIR DAMPER FOR SEF-1 SHALL REMAIN CLOSED.

SMOKE MODE

GENERAL

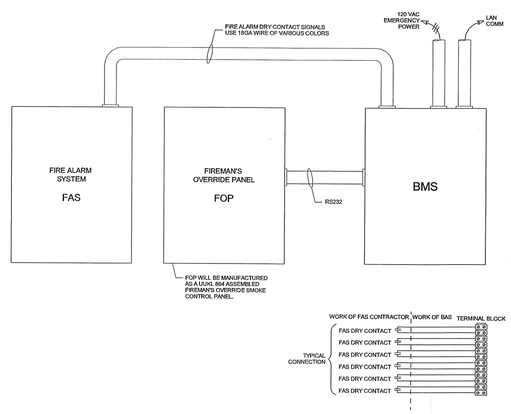
AHU-1 AND SEF-1 SHALL BE COMMANDED ON , AHU-1 O.A & SEF-1 MVD DAMPER SHALL OPEN FULLY. EF-6 & EF-7 SHALL BE COMMANDED ON, RETURN AIR DAMPER FROM TYPICAL FLOORS (MVD) SHALL BE COMMANDED OFF CLOSE.

FLOOR SMOKE CONTROL

NOTES:

1. THE CONTROLS CONTRACTOR SHALL PROVIDE THE SMOKE CONTROL SYSTEM AND FIREFIGHTERS OVERRIDE PANEL (FOP).
2. THE BUILDING SYSTEMS SHALL BE ANNUNCIATED AND COMMANDED BY THE FOP, SUCH AS, BUT NOT LIMITED TO, THE STAIRWELL PRESSURIZATION FANS, ELEVATOR PRESSURIZATION FANS, SMOKE EXHAUST FANS, SMOKE MAKE-UP FANS, ETC.
3. THE ENTIRE SMOKE CONTROL SYSTEM SHALL BE CONNECTED TO EMERGENCY POWER.
4. ALL COMPONENTS OF THE SMOKE CONTROL SYSTEM SHALL BE PROVIDED AS FAIL-SAFE.
5. ALL SMOKE CONTROL COMPONENTS ARE TO BE UL LISTED AND APPROVED.
6. THE SMOKE CONTROL SYSTEM SHALL INTERFACE WITH THE FIRE ALARM SYSTEM:
   A. THE FAS SHALL PROVIDE A DRY CONTACT PER SMOKE ZONE.
   B. THE FAS SHALL PROVIDE A DRY CONTACT FOR FAS GENERAL FIRE.
   C. THE FAS SHALL PROVIDE A DRY CONTACT FOR THE FAS TROUBLE STATUS.
   D. THE DRY CONTACTS WILL BE MOUNTED IN THE FCC BY THE FAS PROVIDER.
   E. FIRE ALARM CONTRACTOR SHALL PROVIDE THE CONDUIT AND WIRE FOR THE DRY CONTACTS.
7. THE FIREFIGHTERS OVERRIDE PANEL SHALL:
   A. THE PANEL SHALL HAVE A GRAPHIC DISPLAY.
   B. THE PANEL SHALL INCLUDE SWITCHES AND LED INDICATORS.
   C. PANEL SHALL BE LOCATED IN THE FIRE COMMAND CENTER.
   D. SMOKE CONTROL ZONES SHALL BE INDIVIDUALLY OPERATED AT THE FOP.
   E. STATUS INDICATION SHALL DISPLAY, ON/OFF, OPEN/CLOSED STATUS AND IF THE SYSTEM IS IN NORMAL OR IN FAULT.
   F. THE PANEL SHALL HAVE A MASTER SWITCH, KEYED.
   G. THE PANEL SHALL HAVE A TEST PUSHBUTTON THE ILLUMINATE ALL LIGHTS.
   H. THE PANEL SHALL HAVE A SIREN TO ALERT THE OPERATOR AND A PUSH-TO-SILENCE PUSHBUTTON.
8. THE EC SHALL PROVIDE 120 VAC EMERGENCY POWER FOR THE CONTROL PANELS, F/S DAMPERS, MOTORIZED DAMPERS, ETC,... AS NECESSARY.
9. FIRE ALARM CONTRACTOR SHALL PROVIDE FOR INDICATOR LIGHTS AND ANNUNCIATORS AS REQUIRED BY THE LOCAL AUTHORITY HAVING JURISDICTION (AHJ).
10. THE CONTROLS CONTRACTOR SHALL PROVIDE D.P. SWITCHES FOR FAN STATUS FOR FANS INVOLVED IN SMOKE CONTROL.
11. THE CONTROLS CONTRACTOR SHALL PROVIDE VERIFICATION OF THE PRESENCE OF POWER DOWNSTREAM OF ALL DISCONNECTS.
12. THE CONTROLS CONTRACTOR SHALL PROVIDE VERIFICATION THAT VFD'S AND MOTOR STARTERS ARE IN THE "AUTO" POSITION.

FIRE COMMAND ROOM



THE FOP PANEL AND GRAPHIC REPRESENTATION WILL BE MANUFACTURED WITH SPECIFIC INTERFACE FOR THE ANDOVER CONTROLS CONTINUUM / INFINITY PRODUCT LINE. THE FOP, INCLUDING GRAPHIC, LEDS, SWITCHES, ENCLOSURE AND INTERNAL MECHANISMS WILL BE UL LISTED 864 UUKL AS AN ASSEMBLY FOR ITS INTENDED PURPOSE. ITS INTENDED PURPOSE IS A SMOKE CONTROL FIREMAN'S OVERRIDE PANEL.

NOTES:

- THE FAS (FIRE ALARM SYSTEM) SHALL PROVIDE A DRY CONTACT CLOSURE FOR EACH FIRE ZONE, MINIMUM OF 1 PER FLOOR, PLUS A GENERAL FIRE AND TROUBLE DRY CONTACT.
- THE FAS DRY CONTACTS WILL BE PROVIDED AT THE FIRE COMMAND ROOM, WHERE BOTH THE FAS AND SMOKE CONTROL FOP WILL BE LOCATED.
- THE ELECTRICAL CONTRACTOR SHALL COORDINATE AND PROVIDE THE CONDUITS BETWEEN THE FOP AND THE FAS.

FOP - FAS INTERFACE

ENGINEERING
FOR ARCHITECTURE
5757 Blue Lagoon Drive, Suite 400
Mimai, Florida 33126
PH: 305.266.6553
Fax: 350.266.6695
www.tlc-engineers.com
COA 15

CUTLER BAY TOWN CENTER HVAC EQUIPMENT AND CONTROLS

10720 Caribbean Blvd. Cutler Bay, Florida 33189

Revisions:

No.	Date	Description

Seal

Chi S. Lui, P.E.
Florida License # 61748

CHI S. LUI LICENSE NO. 61748 STATE OF FLORIDA PROFESSIONAL ENGINEER

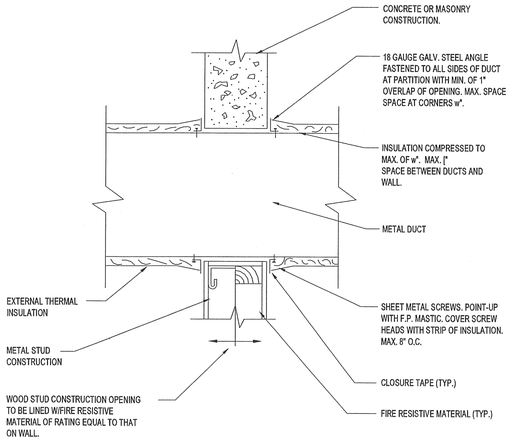
Project No.: Project Number
Issue Date: Issue Date

Drawn By: Author
Approved By: Approver
Scale: 12" = 1'-0"

Drawing Title:
MECHANICAL CONTROLS

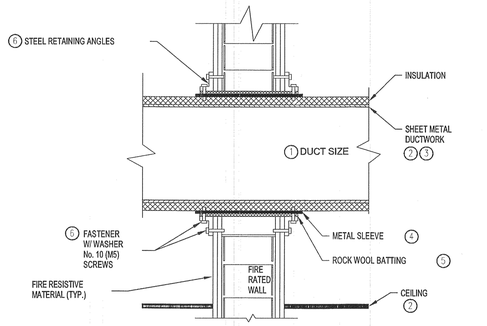
Drawing No.:
M402

100% CD SUBMITTAL



TYP. DUCT PENETRATION FOR NON-RATED WALLS | 6

No Scale

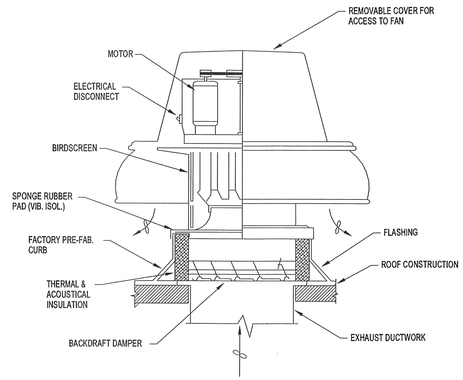


PER 1997SMC- 610.1.3 NOTES:

1. THE DUCTWORK SHALL NOT EXCEED 100 SQUARE INCHES. THE DUCTWORK SHALL BE CONSTRUCTED OF STEEL A MINIMUM OF 0.0217 INCH IN THICKNESS.
2. THE DUCT SHALL NOT HAVE OPENINGS THAT COMMUNICATE THE CORRIDOR WITH ADJACENT SPACES OR ROOMS. THE DUCT SHALL BE INSTALLED ABOVE THE CEILING.
3. THE DUCT SHALL NOT TERMINATE AT A WALL REGISTER IN THE FIRE-RESISTANCE-RATED WALL.
4. A MINIMUM 12-INCH-LONG BY 0.060-INCH-THICK STEEL SLEEVE SHALL BE CENTERED IN EACH DUCT OPENING.
5. THE ANNULAR SPACE BETWEEN THE STEEL SLEEVE AND THE WALL OPENING SHALL BE FILLED WITH ROCK (MINERAL) WOOL BATTING ON ALL SIDES.
6. THE STEEL SLEEVE SHALL BE SECURED TO BOTH SIDES OF THE WALL AND ALL FOUR SIDES OF THE SLEEVE WITH MINIMUM 1-1/2"x1-1/2"x0.06" STEEL RETAINING ANGLES.

DUCT THROUGH FIRE RATED WALL | 4

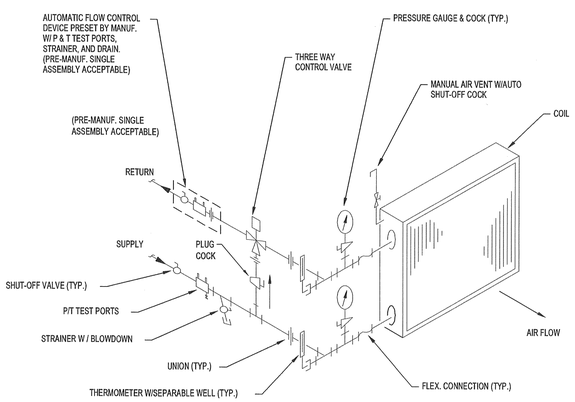
No Scale



NOTE: ALL ROOF MOUNTED EQUIPMENT MUST ADHERE TO CURRENT HURRICANE CODES REGARDING ROOF TIE-IN AND WIND RESISTANCE. REFERT TO M10-74 DETAIL # 2 FOR TIE-DOWN DETAIL.

ROOF MOUNTED EXHAUST FAN | 2

No Scale



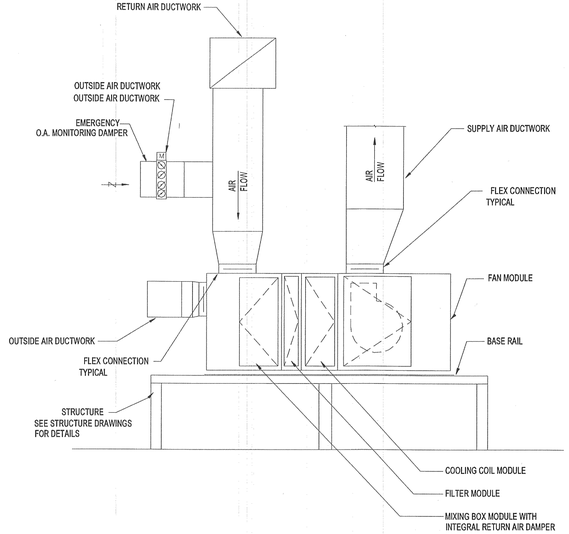
NOTES: 1. PROVIDE (4 x DIA.) OF STRAIGHT PIPE ON BOTH SIDES OF BALANCING VALVE

2. ALL COMPONENTS FULL LINE SIZE UNLESS NOTED OTHERWISE

3. LOCATE UNIONS TO ALLOW FOR COIL PULL

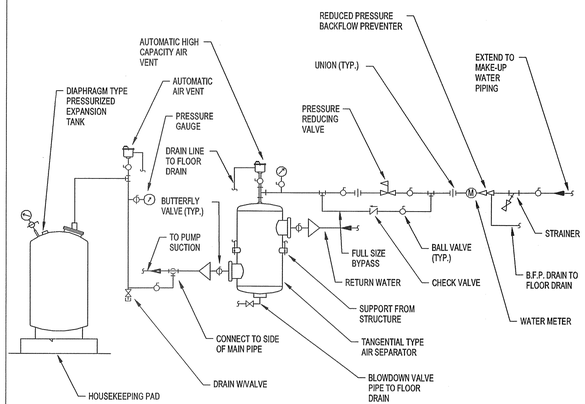
3-WAY COIL PIPING DIAGRAM | 5

No Scale



TYPICAL AHU INSTALLATION DETAIL | 3

No Scale



AIR SEPARATOR/ELIMIN. & EXPANSION TANK PIPING | 1

No Scale

ENGINEERING
FOR ARCHITECTURE
5757 Blue Lagoon Drive, Suite 400
Miami, Florida 33126
PH: 305.266.6553
Fax: 350.266.6695
www.tlc-engineers.com
COA 15

CUTLER BAY TOWN CENTER HVAC EQUIPMENT AND CONTROLS

10720 Caribbean Blvd. Cutler Bay, Florida 33189

Revisions:

No.	Date	Description

Seal

Chi S. Lui, P.E.
Florida License # 61748

CHI S. LUI LICENSE No. 61748 STATE OF FLORIDA PROFESSIONAL ENGINEER

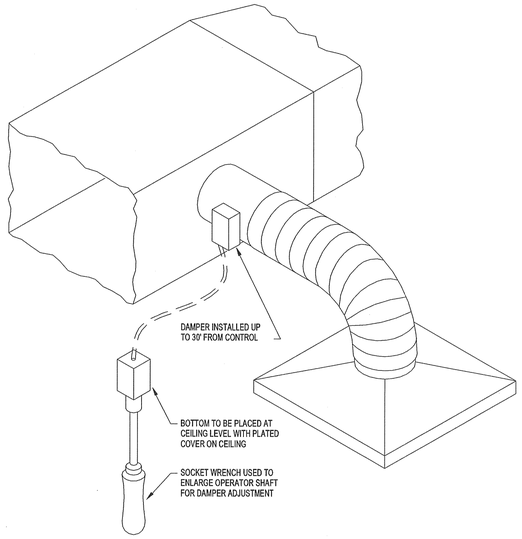
Project No.: Project Number
Issue Date: Issue Date
Drawn By: Author
Approved By: Approver
Scale: 12" = 1'-0"

Drawing Title: MECHANICAL DETAILS

Drawing No.: M501

100% CD SUBMITTAL

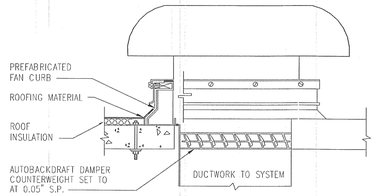
C:\Revit 2016 Local Models\616018_MEP_R16_ahay.odonnell.rvt
10/19/2016 2:38:32 PM



NOTE: FOR USE IN NON-ACCESSIBLE CEILINGS: I.E. OPERATING ROOM

CABLE CONTROL VOLUME DAMPER
No Scale

6



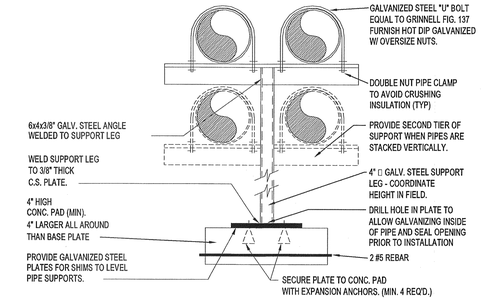
NOTE: ALL ROOF MOUNTED EQUIPMENT MUST ADHERE TO CURRENT HURRICANE CODES REGARDING ROOF TIE-IN AND WIND RESISTANCE.

GRAVITY RELIEF VENT DETAIL
No Scale

5

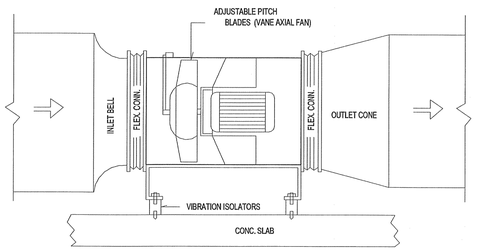
GENERAL NOTES:

1. PIPE SUPPORTS FOR HORIZONTAL PIPING AS SHOWN ON PLANS. VERTICAL PIPE SUPPORT SPACING TO BE A MAXIMUM OF 10 FEET, AT BRANCH TAPS OFF HEADER PIPING, VALVES, AND AT ELBOWS.
2. ALL EXTERIOR PIPING & FITTINGS TO RECEIVE A PRE-FABRICATED COVER TO PROTECT INSULATION. REFER TO PROJECT MANUAL FOR COMPLETE DESCRIPTION.
3. FURNISH AND INSTALL PIPING MARKERS & BANDS EVERY 15 FEET. REFER TO PROJECT MANUAL FOR COMPLETE DESCRIPTION.
4. CONTRACTOR SHALL PREPARE PIPING AND COORDINATE DRAWINGS FOR ALL PIPING INDICATED ON THIS DRAWING. COORDINATION PLAN SHALL BE SUBMITTED FOR ENGINEERS REVIEW & APPROVAL PRIOR TO BEGINNING FABRICATION OF PIPING.
5. ENTIRE PIPE SUPPORT (6x4 ANGLE/1"2x12" RISER/BASE PLATE) TO BE SHOP FABRICATED AND SENT OUT TO BE HOT DIP GALVANIZED PRIOR TO INSTALLATION. HOLES IN ANGLE FOR "U" BOLTS MAY BE DRILLED IN FIELD AND COLD GALVANIZED DURING PIPE INSTALLATION.



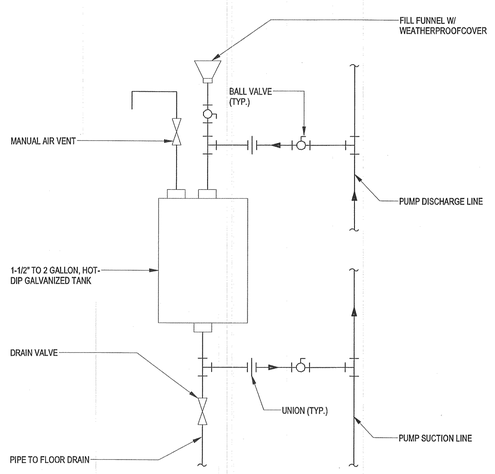
ROOF MOUNTED PIPE SUPPORTS
No Scale

4



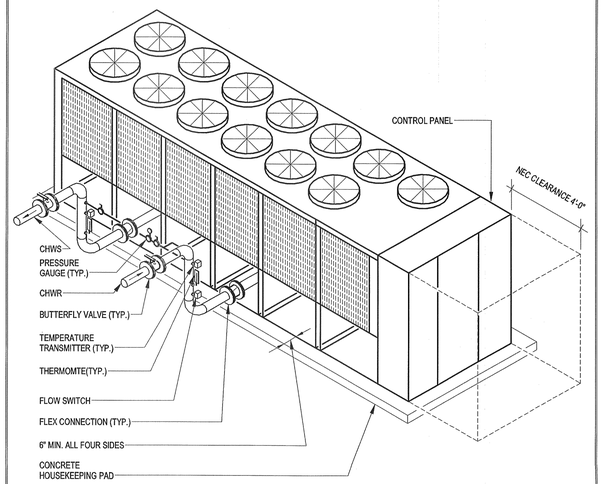
SMOKE EVACUATION EXHAUST FAN
No Scale

3



CHEMICAL SHOT FEEDER
No Scale

2



AIR COOLED CHILLER PIPING
No Scale

1

ENGINEERING
FOR ARCHITECTURE
5757 Blue Lagoon Drive, Suite 400
Miami, Florida 33126
PH: 305.266.6553
Fax: 350.266.6695
www.tlc-engineers.com
COA 15

CUTLER BAY TOWN CENTER HVAC EQUIPMENT AND CONTROLS

10720 Caribbean Blvd. Cutler Bay, Florida 33189

Revisions:

No.	Date	Description

Seal

Chi S. Lui, P.E.
Florida License # 61748

CHI S. LUI LICENSE NO. 61748 STATE OF FLORIDA PROFESSIONAL ENGINEER

100% CD SUBMITTAL

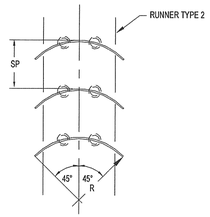
Project No.: Project Number
Issue Date: Issue Date
Drawn By: Author
Approved By: Approver
Scale: 12" = 1'-0"

Drawing Title:
MECHANICAL DETAILS

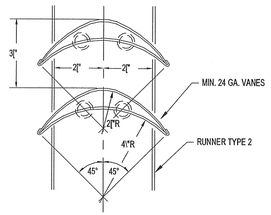
Drawing No.:
M502

C:\Revit 2016 Local Models\616018_MEP_R16_shay.cddetail.rvt
1/26/2016 1:15:34 PM

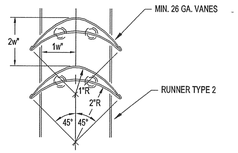
SINGLE VANE SCHEDULE			
	R (RADIUS)	SP	GAUGE
SMALL	2" (51 mm)	1½" (38 mm)	24 (0.70 mm)
LARGE	4½" (114 mm)	3¼" (83 mm)	22 (0.85 mm)



Single Vane

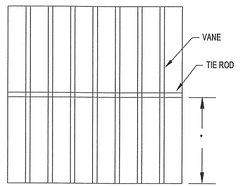


Large



Small

Double Vane

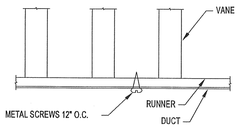


* MAXIMUM UNSUPPORTED VANE LENGTH

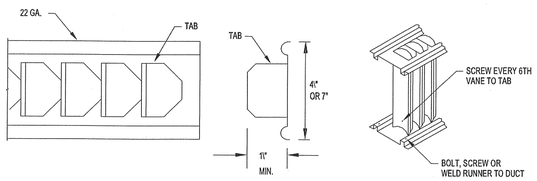
SMALL SINGLE VANE	36"
LARGE SINGLE VANE	36"
SMALL DOUBLE VANE	48"
LARGE DOUBLE VANE	72"

NOTE:
INSTALL VANES IN SECTIONS OR USE TIE RODS TO LIMIT THE UNBRACED VANE LENGTH.

NOTES:
1. VANES SHALL BE SECURELY FASTENED TO RUNNERS.
2. ALL VANES SHALL BE SECURE AND STABLE IN INSTALLED OPERATING POSITION.



Vane Support



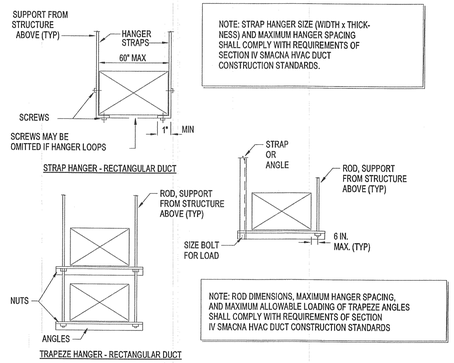
Runner Type 1

NOTE:

SEE MECHANICAL SPECIFICATIONS FOR ADDITIONAL INFORMATION.

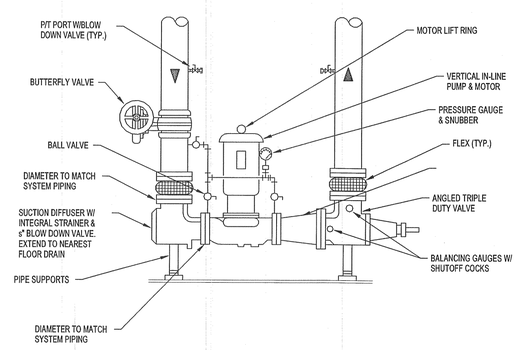
TURNING VANES
No Scale

5



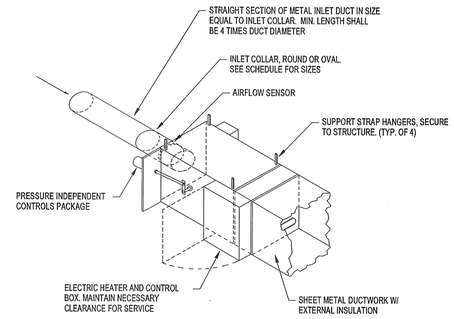
RECTANGULAR DUCT SUPPORT
No Scale

4



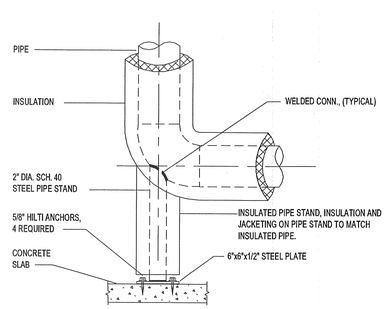
VERTICAL IN-LINE PUMP FLOOR MOUNTED TYPE
No Scale

3



VARIABLE VOLUME TERMINAL W/ELECTRIC HEAT
No Scale

2



INSULATED VERTICAL PIPE SUPPORT
No Scale

1

ENGINEERING
FOR ARCHITECTURE
5757 Blue Lagoon Drive, Suite 400
Miami, Florida 33126
PH: 305.266.6553
Fax: 350.266.6695
www.tlc-engineers.com
COA 15

CUTLER BAY TOWN CENTER HVAC EQUIPMENT AND CONTROLS

10720 Caribbean Blvd. Cutler Bay, Florida 33189

Revisions:

No.	Date	Description

Seal

Chi S. Lui, P.E.
Florida License # 61748

CHI S. LUI LICENSE No. 61748 STATE OF FLORIDA PROFESSIONAL ENGINEER

Project No.: Project Number
Issue Date: Issue Date

Drawn By: Author
Approved By: Approver
Scale: 12" = 1'-0"

Drawing Title:
MECHANICAL DETAILS

Drawing No.:
M503

100% CD SUBMITTAL

C:\Revit 2016 Local Models\616018_MEP_R16_shay.odonnell.rvt
2/2/2016 1:15:35 PM

SMOKE CONTROL SEQUENCE

1. GENERAL DESCRIPTION:

SMOKE CONTROL FOR THIS BUILDING IS ACCOMPLISHED VIA MECHANICAL SYSTEMS DESIGNED TO PRESSURE THE FLOORS ADJACENT TO THE ZONE OF FIRE ORIGIN (ZOFO) TO MINIMIZE SMOKE MIGRATION WHILE PUTTING THE FLOOR OF INCIDENT IN SMOKE EVACUATION MODE.
THE BUILDING LAYOUT CONSISTS OF SIX FLOOR OF OFFICES SPACES.
THE BUILDING'S SMOKE CONTROL SYSTEM INCLUDES PRESSURIZATION FANS SERVING; ELEVATOR HOIST SHAFTS AND STAIRWELLS.
THE DETECTION SYSTEM CONSISTS OF AUTOMATIC FIRE ALARM DETECTION DEVICES THAT INCLUDE SPRINKLER FLOW SWITCH AND SMOKE DETECTOR. SMOKE DETECTORS ARE PROVIDED ON EACH FLOOR IN THE WAITING AREA OF EACH ELEVATOR LOBBY AND IN THE ASSOCIATED EGRESS CORRIDORS. IN ALARM MODE, THE DETECTION SYSTEM SHALL IDENTIFY THE ZOFO AND ACTIVATE THE PRESSURIZATION SYSTEMS TO ISOLATE AND LIMIT THE MIGRATION OF SMOKE FROM SAID AREA.
SMOKE CONTROL FOR THIS BUILDING IS DESIGNED PER FBC 2014 AND NFPA 92A.
A GIVEN FLOOR SHALL BE CONSIDERED AS "ZOFO" UPON ACTIVATION OF FIRE ALARM INITIATION DEVICE.

2. AREAS UNDER CONTROL:

1ST FLOOR, ZONE OF FIRE ORIGIN (ZOFO)

- SUPPLY AIR SMOKE DAMPER AT 1ST LEVEL MAIN SHAFT SHALL REMAIN IN THE OPEN POSITION TO ACCOMMODATE FOR EMERGENCY MAKE-UP AIR
- SUPPLY AIR SMOKE DAMPERS AT 2ND AND 3RD LEVELS MAIN SHAFT SHALL REMAIN IN THE OPEN POSITION TO ACCOMMODATE FOR FLOOR PRESSURIZATION
- VAV BOXES ON LEVELS 1, 2 & 3 SHALL MODULATE TO THE FULL OPEN POSITION
- EMERGENCY OUTSIDE AIR DAMPER LOCATED AT ROOF LEVEL SHALL OPEN
- AIR HANDLING UNIT AHU-1 SHALL ENGAGE IN EMERGENCY MODE AND MODULATE VFD TO ESTABLISHED SET POINT. CHILLED WATER VALVE SHALL CLOSE
- RETURN AIR SMOKE DAMPER AT 1ST LEVEL MAIN SHAFT SHALL REMAIN OPEN TO ACCOMMODATE FOR SMOKE EXHAUST FROM ZOFO
- RETURN AIR SMOKE DAMPER AT ALL OTHER FLOORS MAIN SHAFT SHALL CLOSE
- RETURN AIR ISOLATION DAMPER AT ROOF LEVEL SHALL CLOSE
- EMERGENCY EXHAUST FAN EEF-1 SHALL BE ENERGIZED

2ND THRU 5TH FLOOR, ZONE OF FIRE ORIGIN (ZOFO)

- SUPPLY AIR SMOKE DAMPER AT ZOFO LEVEL MAIN SHAFT SHALL REMAIN IN THE OPEN POSITION TO ACCOMMODATE FOR EMERGENCY MAKE-UP AIR
- SUPPLY AIR SMOKE DAMPERS AT MAIN SHAFT IN LEVELS ABOVE AND BELOW ZOFO SHALL REMAIN IN THE OPEN POSITION TO ACCOMMODATE FOR FLOOR PRESSURIZATION
- VAV BOXES ON ZOFO AND LEVELS ABOVE AND BELOW SHALL MODULATE TO THE FULL OPEN POSITION
- EMERGENCY OUTSIDE AIR DAMPER LOCATED AT ROOF LEVEL SHALL OPEN
- AIR HANDLING UNIT AHU-1 SHALL ENGAGE IN EMERGENCY MODE AND MODULATE VFD TO ESTABLISHED SET POINT. CHILLED WATER VALVE SHALL CLOSE
- RETURN AIR SMOKE DAMPER AT ZOFO LEVEL MAIN SHAFT SHALL REMAIN OPEN TO ACCOMMODATE FOR SMOKE EXHAUST FROM ZOFO
- RETURN AIR SMOKE DAMPER AT ALL OTHER FLOORS MAIN SHAFT SHALL CLOSE
- RETURN AIR ISOLATION DAMPER AT ROOF LEVEL SHALL CLOSE
- EMERGENCY EXHAUST FAN EEF-1 SHALL BE ENERGIZED

6TH FLOOR, ZONE OF FIRE ORIGIN (ZOFO)

- SUPPLY AIR SMOKE DAMPER AT 6TH LEVEL MAIN SHAFT SHALL REMAIN IN THE OPEN POSITION TO ACCOMMODATE FOR EMERGENCY MAKE-UP AIR
- SUPPLY AIR SMOKE DAMPERS AT 4TH AND 5TH LEVELS MAIN SHAFT SHALL REMAIN IN THE OPEN POSITION TO ACCOMMODATE FOR FLOOR PRESSURIZATION
- VAV BOXES ON LEVELS 4, 5 & 6 SHALL MODULATE TO THE FULL OPEN POSITION
- EMERGENCY OUTSIDE AIR DAMPER LOCATED AT ROOF LEVEL SHALL OPEN
- AIR HANDLING UNIT AHU-1 SHALL ENGAGE IN EMERGENCY MODE AND MODULATE VFD TO ESTABLISHED SET POINT. CHILLED WATER VALVE SHALL CLOSE
- RETURN AIR SMOKE DAMPER AT 6TH LEVEL MAIN SHAFT SHALL REMAIN OPEN TO ACCOMMODATE FOR SMOKE EXHAUST FROM ZOFO
- RETURN AIR SMOKE DAMPER AT ALL OTHER FLOORS MAIN SHAFT SHALL CLOSE
- RETURN AIR ISOLATION DAMPER AT ROOF LEVEL SHALL CLOSE
- EMERGENCY EXHAUST FAN EEF-1 SHALL BE ENERGIZED

STAIR PRESSURIZATION

- STAIR PRESSURIZATION FANS SF-1 & SPF-2 SHALL ENERGIZE

STAIR 1 VESTIBULE SMOKE CONTROL

- FIRE/SMOKE DAMPERS LOCATED AT STAIR VESTIBULE SHALL OPEN IN ALL LEVELS
- FANS SF-2 AND EF-2 SHALL ENERGIZE

ELEVATOR SHAFTS

- ELEVATOR PRESSURIZATION FAN EPF-1 SHALL ENERGIZE
- ELEVATOR SHAFT MOTORIZED DAMPER AT SHAFT RELIEF LOUVER SHALL REMAIN IN THE CLOSED POSITION. DAMPER SHALL OPEN UPON DETECTION OF SMOKE INSIDE ELEVATOR SHAFT

TOILET EXHAUST FANS

- TOILET EXHAUST FANS (EF-1) SHALL SHUT DOWN UPON ACTIVATION OF SMOKE CONTROL SEQUENCE OF OPERATION

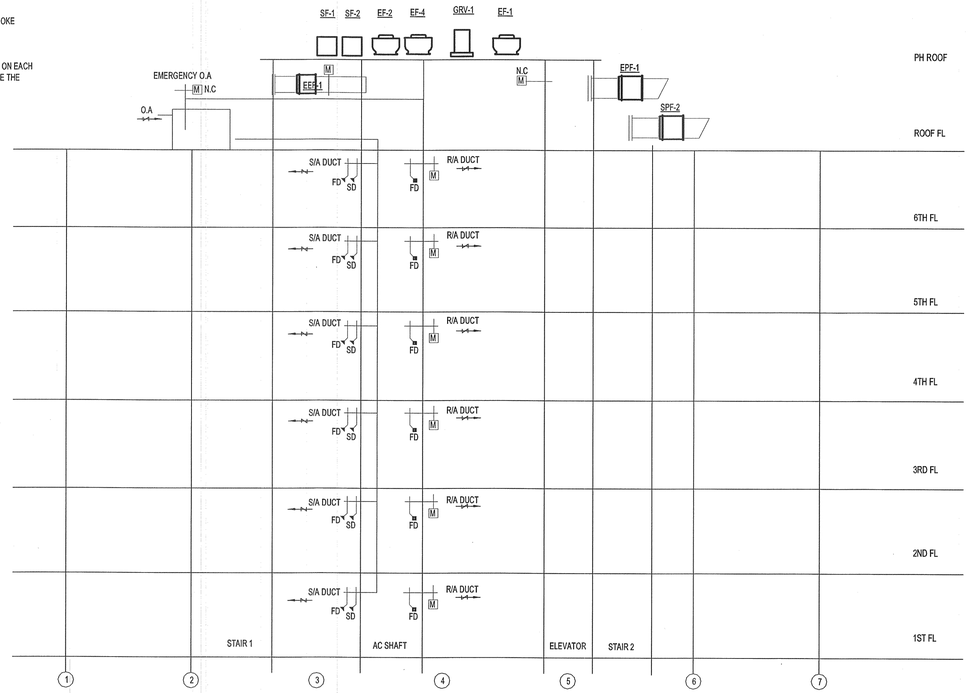
3. SYSTEM SHALL RETURN TO NORMAL OPERATING CONDITION UPON RECEIPT OF A MANUALLY INPUT CLEAR SIGNAL AS REGISTERED BY THE FACP

4. TESTS

ALL TESTS SHALL BE PERFORMED BY AN INDEPENDENT CERTIFIED TEST & BALANCE AGENCY. PRIOR TO SMOKE/PRESSURE TESTS, ALL MECHANICAL EQUIPMENT IN THE SMOKE CONTROL SYSTEM SHALL BE TESTED AND ADJUSTED FOR PROPER PERFORMANCE.

OBJECTIVES:

1. TO AFFORD REASONABLE SAFETY TO OCCUPANTS WHILE USING MEANS OF EGRESS.
2. TO PREVENT SPREAD OF SMOKE THROUGH VERTICAL OPENINGS FROM FLOOR TO FLOOR BEFORE OCCUPANTS HAVE ENTERED EXITS.



1 SMOKE CONTROL SYSTEM RISER DIAGRAM
N.T.S.

ENGINEERING
FOR ARCHITECTURE
5757 Blue Lagoon Drive, Suite 400
Mimai, Florida 33126
PH: 305.266.6553
Fax: 350.266.6695
www.tlc-engineers.com
COA 15

CUTLER BAY TOWN CENTER HVAC EQUIPMENT AND CONTROLS

10720 Caribbean Blvd. Cutler Bay, Florida 33189

Revisions:

No.	Date	Description

Seal

Chi S. Lui, P.E.
Florida License # 61748

CHI S. LUI LICENSE No. 61748 STATE OF FLORIDA PROFESSIONAL ENGINEER

100% CD SUBMITTAL

Project No.:	Project Number
Issue Date:	Issue Date
Drawn By:	Author
Approved By:	Approver
Scale:	12" = 1'-0"

Drawing Title:

MECHANICAL SMOKE CONTROL DIAGRAM AND SEQUENCE

Drawing No.:

M601

NOTE: ALL SHEET MUST BE REVIEWED

MIAMI-DADE COUNTY DEPARTMENT OF REGULATORY AND ECONOMIC RESOURCES
Herbert S. Saffir Permitting and Inspection Center
11805 SW 26th Street (Coral Way) • Miami, Florida 33175-2474 • (786) 315-2000

APPLICATION FOR MUNICIPAL PERMIT APPLICANTS THAT REQUIRE PLAN REVIEW FROM MIAMI-DADE FIRE RESCUE AND/OR ENVIRONMENTAL SERVICES

PROVIDE MUNICIPAL PROCESS NUMBER HERE

LOCATION OF IMPROVEMENTS

Job Address 10720 CARIBBEAN BLVD.
Folio 36-6007-024-0020
Lot _____ Block _____
Subdivision _____ PBpg _____
Metes and bounds _____

CONTRACTOR INFORMATION

Contractor No. TBD
Last four (4) digits of Qualifier No. _____
Contractor Name _____
Qualifier Name _____
Address _____
City _____ State ____ Zip _____

TYPE OF IMPROVEMENTS

[ ] New Construction on Vacant Land
[ ] Alteration Interior
[ ] Alteration Exterior
[ ] Relocation of Structure
[ ] Enclosure
[ ] Repair
[ ] Repair Due to Fire
[ ] Demolish
[ ] Shell Only
[ ] Addition Attached
[ ] Addition Detached
[ ] Re-Roof
[ ] Foundation Only
[ ] Tent

Current use of property OFFICE BUILDING / GOVERNMENT
Description of Work REPLACE HVAC
Sq. Ft. 76,688 Units _____ Floors _____
Value of Work $1,000,000

PERMIT TYPE

[ ] MBLD* Category _____
[ ] MELE _____
[ ] MLPG _____
[ ] MMEC _____
[X] FIRE _____

REVIEW STATUS

[ ] Chg. Contractor
[ ] Re-Issue
[ ] Re-Stamp
[ ] Revision
[ ] Not Applicable for Fire

OWNER'S NAME

Owner TOWN OF CUTLER BAY (ALFREDO PUBLIC WORKS)
Address 10720 CARIBBEAN BLVD.
City CUTLER BAY State FL. Zip 33189
Phone 305 234-4262
Last four (4) digits of Owner's Social Security No. _____

PERSON TO PICK UP PLANS

Name _____
Address _____
City _____ State ____ Zip _____
Phone _____

ARCHITECT / ENGINEER

Owner TLC ENGINEERING
Address 5757 BLUE LAGOON DRIVE
City MIAMI State FL Zip 33126
Phone 305-263-3866

FIRE SPECIAL REQUEST PLAN REVIEW (SRI)

I am requesting a Special Request Plan Review (SRI) to be scheduled as soon as possible at the rate of $190 for the first hour and $65 per each additional hour in addition to the review fees. Minimum charge one-hour.

1st Request: _____ Date: _____
2nd Request: _____ Date: _____
3rd Request: _____ Date: _____

PERA OPTIONAL PLAN REVIEW (OPR)

I am requesting Optional Plan Review (OPR) to be scheduled as soon as possible at the rate of $75 for each discipline.
Additional review fees may apply.

1st Request: _____ Date: _____
2nd Request: _____ Date: _____
3rd Request: _____ Date: _____

Processed by:

Digital Printing & Reprographics

305-262-4920

YEAR 2017

1000 GENERAL NOTES:

1. STRUCTURAL DRAWINGS SHALL BE USED IN CONJUNCTION WITH PROJECT SPECIFICATIONS AND ARCHITECTURAL, MECHANICAL, ELECTRICAL, PLUMBING, AND SITE DRAWINGS. CONSULT THESE DRAWINGS FOR OPENINGS, DEPRESSIONS, EQUIPMENT WEIGHTS AND LOCATIONS, EMBEDDED ITEMS AND OTHER DETAILS NOT SHOWN ON STRUCTURAL DRAWINGS.
2. DIMENSIONS AND CONDITIONS MUST BE VERIFIED IN THE FIELD. ANY DISCREPANCIES SHALL BE BROUGHT TO THE ATTENTION OF THE ENGINEER OF RECORD BEFORE PROCEEDING WITH THE AFFECTED PART OF THE WORK.
3. NO STRUCTURAL MEMBER OR COMPONENT SHALL BE CUT, NOTCHED, OR OTHERWISE ALTERED UNLESS APPROVED IN WRITING BY THE ENGINEER OF RECORD. THE CONTRACTOR SHALL BE RESPONSIBLE FOR ANY AND ALL COSTS INCURRED BY THE ENGINEER OF RECORD FOR REVIEW OF ANY SUCH DEVIATIONS.
4. DO NOT SCALE DRAWINGS.
5. THE STRUCTURE IS DESIGNED TO BE SELF-SUPPORTING AND STABLE AFTER THE BUILDING IS COMPLETE. IT IS THE CONTRACTOR'S RESPONSIBILITY TO DETERMINE ERECTION PROCEDURES AND SEQUENCE TO INSURE SAFETY OF THE BUILDING AND ITS COMPONENTS DURING ERECTION. THIS INCLUDES THE ADDITION OF NECESSARY SHORING, SHEETING, TEMPORARY BRACING, GUYS OR TIE-DOWNS.
6. DETAILS LABELED "TYPICAL DETAILS" ON THE DRAWINGS SHALL APPLY TO ALL SITUATIONS OCCURRING ON THE PROJECT THAT ARE THE SAME OR SIMILAR TO THOSE SPECIFICALLY DETAILED. THE APPLICABILITY OF THE DETAIL TO ITS LOCATION ON THE DRAWINGS CAN BE DETERMINED BY THE TITLE OF DETAIL. SUCH DETAILS SHALL APPLY WHETHER OR NOT THEY ARE REFERENCED AT EACH LOCATION. QUESTIONS REGARDING APPLICABILITY OF TYPICAL DETAILS SHALL BE DETERMINED BY THE ENGINEER OF RECORD.
7. THE GENERAL CONTRACTOR SHALL COMPARE THE ARCHITECTURAL, MECHANICAL, ELECTRICAL, PLUMBING, CIVIL AND STRUCTURAL DRAWINGS AND REPORT ANY DISCREPANCIES BETWEEN EACH SET OF DRAWINGS AND WITHIN EACH SET OF DRAWINGS TO THE ARCHITECT AND ENGINEER OF RECORD PRIOR TO THE FABRICATION AND INSTALLATION OF ANY STRUCTURAL MEMBERS.
8. THE CONTRACT STRUCTURAL DRAWINGS AND SPECIFICATIONS REPRESENT THE FINISHED STRUCTURE, AND DO NOT INDICATE THE METHOD OR MEANS OF CONSTRUCTION. THE CONTRACTOR SHALL SUPERVISE AND DIRECT THE WORK AND SHALL BE SOLELY RESPONSIBLE FOR ALL CONSTRUCTION MEANS, METHODS, PROCEDURES, TECHNIQUES, SEQUENCE AND SAFETY. THE ENGINEER DOES NOT HAVE CONTROL OR CHARGE OF, AND SHALL NOT BE RESPONSIBLE FOR, CONSTRUCTION MEANS, METHODS, TECHNIQUES, SEQUENCES, OR PROCEDURES, FOR SAFETY PRECAUTIONS AND PROGRAMS IN CONNECTION WITH THE WORK, FOR THE ACTS OR OMISSION OF THE CONTRACTOR, SUBCONTRACTOR OR ANY OTHER PERSONS PERFORMING ANY OF THE WORK, OR FOR THE FAILURE OF ANY OF THEM TO CARRY OUT THE WORK IN ACCORDANCE WITH THE CONTRACT DOCUMENTS.
9. THE STRUCTURAL ENGINEER'S OBLIGATIONS TO REVIEW SHOP DRAWINGS AND OTHER SUBMITTALS AND TO RETURN THEM IN A TIMELY MANNER ARE CONDITIONED UPON THE PRIOR REVIEW AND APPROVAL OF THE SHOP DRAWINGS OR SUBMITTALS BY THE CONTRACTOR AS REQUIRED IN THE CONSTRUCTION CONTRACT AND THE CONTRACTOR'S SUBMITTAL OF THE SHOP DRAWINGS AND OTHER SUBMITTALS IN ACCORDANCE WITH A WRITTEN SCHEDULE DISTRIBUTED IN ADVANCE TO THE ENGINEER IDENTIFYING THE DATES FOR THE SUBMITTAL OF THE VARIOUS SHOP DRAWINGS AND SUBMITTALS.
10. PERIODIC SITE OBSERVATION BY FIELD REPRESENTATIVES OF TLC ENGINEERING FOR ARCHITECTURE IS SOLELY FOR THE PURPOSE OF DETERMINING IF THE WORK OF THE CONTRACTOR IS PROCEEDING IN GENERAL ACCORDANCE WITH THE STRUCTURAL CONTRACT DOCUMENTS. THIS LIMITED SITE OBSERVATION SHALL NOT BE CONSTRUED AS EXHAUSTIVE OR CONTINUOUS TO CHECK THE QUALITY OR QUANTITY OF THE WORK.
11. ALL STRUCTURES REQUIRE PERIODIC MAINTENANCE TO EXCEED LIFESPAN AND TO ENSURE STRUCTURAL INTEGRITY FROM EXPOSURE TO THE ENVIRONMENT. A PLANNED PROGRAM OF MAINTENANCE SHALL BE ESTABLISHED BY THE OWNER. THIS PROGRAM SHALL INCLUDE ITEMS SUCH AS, BUT NOT LIMITED TO, PAINTING OF STRUCTURAL STEEL, PROTECTIVE COATINGS FOR CONCRETE, SEALANTS, CAULKED JOINTS, EXPANSION JOINTS, CONTROL JOINTS, SPALLS AND CRACKS IN CONCRETE, AND PRESSURE WASHING OF EXPOSED STRUCTURAL ELEMENTS EXPOSED TO SALT ENVIRONMENT OR OTHER HARSH CHEMICALS.
12. STRUCTURAL ENGINEER OF RECORD IS NOT RESPONSIBLE FOR THE DESIGN OF STEEL STAIRS, HANDRAILS, CURTAIN WALL/WINDOW WALL SYSTEMS, COLD-FORMED FRAMING, OR OTHER SYSTEMS NOT SHOWN IN THE STRUCTURAL DOCUMENTS. SUCH SYSTEMS SHALL BE DESIGNED, FURNISHED, AND INSTALLED AS REQUIRED BY OTHER PORTIONS OF THE CONTRACT DOCUMENTS.
13. IN THE PROFESSIONAL OPINION OF TLC ENGINEERING FOR ARCHITECTURE, INC. THE STRUCTURAL CONTRACT DOCUMENTS FOR THIS PROJECT HAVE BEEN PREPARED IN ACCORDANCE WITH THE DESIGN CRITERIA AS SET FORTH IN THE FLORIDA BUILDING CODE.
14. NO PROVISIONS HAVE BEEN MADE FOR VERTICAL OR HORIZONTAL EXPANSION.
15. THE USE OF REPRODUCTIONS OF THESE CONTRACT DOCUMENTS AND USE OF CAD FILES BY ANY CONTRACTOR, SUBCONTRACTOR, ERECTOR, FABRICATOR OR MATERIAL SUPPLIER IN LIEU OF PREPARATION OF SHOP DRAWINGS SIGNIFY HIS ACCEPTANCE OF ALL INFORMATION SHOWN HEREON AS CORRECT, AND OBLIGATES HIMSELF TO ANY JOB EXPENSE, REAL OR IMPLIED, ARISING DUE TO ANY ERRORS THAT MAY OCCUR HEREON.

1060 DESIGN LOADS:

1. THE STRUCTURAL SYSTEM FOR THIS BUILDING HAS BEEN DESIGNED IN ACCORDANCE WITH THE FLORIDA BUILDING CODE, 2014 EDITION.
2. THE FOLLOWING SUPERIMPOSED LOADINGS HAVE BEEN UTILIZED:

2.1	DEAD LOADS	
	CATWALK GRATING	5 PSF
	M/E/P LOADS HANGING LOADS	10 PSF
	RTU	21,000 LBS
	CHILLER	16,000 LBS
2.2	LIVE LOADS	
	ROOF	30 PSF
	EQUIPMENT PLATFORM	40 PSF

2.3 WIND: PER FBC 2014 BUILDING CODE, SECTION 16
SEE THIS SHEET FOR COMPONENTS AND CLADDING PRESSURES
Vult=186 MPH (3 SEC. GUST) REGION
Vasd=145 MPH
RISK CATEGORY=III
EXPOSURE =C

1330 SHOP DRAWING REVIEW:

1. SHOP DRAWINGS SHALL ADEQUATELY DEPICT THE STRUCTURAL ELEMENTS AND CONNECTIONS SHOWN ON THE CONTRACT DOCUMENTS. SHOP DRAWINGS WILL BE REVIEWED FOR GENERAL COMPLIANCE WITH THE DESIGN INTENT OF THE CONTRACT DOCUMENTS ONLY. IT SHALL BE THE RESPONSIBILITY OF THE CONTRACTOR TO VERIFY COMPLIANCE WITH THE CONTRACT DOCUMENTS AS TO QUANTITY, LENGTH, ELEVATIONS, DIMENSIONS, ETC. REVIEW OF SUBMITTALS AND SHOP DRAWINGS DOES NOT RELIEVE THE CONTRACTOR OF FULL RESPONSIBILITY FOR ERRORS AND OMISSIONS ASSOCIATED WITH THE PREPARATION OF THE SHOP DRAWINGS.
2. SHOP DRAWINGS SHALL BE REVIEWED BY THE CONTRACTOR AND MARKED "APPROVED" PRIOR TO SUBMITTAL TO THE ARCHITECT/ENGINEER. NON-CONFORMING DRAWINGS SUBMITTALS WILL BE RETURNED WITHOUT REVIEW.
3. SHOP DRAWING SUBMITTALS SHALL INCLUDE ONE GOOD QUALITY REPRODUCIBLE AND THREE SETS OF BLUEPRINTS. ONE SET OF PRINTS WILL BE RETAINED BY THE ENGINEER OF RECORD, ONE BY THE ARCHITECT, ONE BY THE LOCAL BUILDING DEPARTMENT (WHERE REQUIRED) AND THE CONTRACTOR SHALL MAKE PRINTS FROM THE REPRODUCIBLE AS REQUIRED FOR DISTRIBUTION.
4. THE CONTRACT DOCUMENTS WILL GOVERN OVER THE SHOP DRAWINGS UNLESS OTHERWISE SPECIFIED IN WRITING BY THE ENGINEER OF RECORD.
5. CHANGES AND ADDITIONS MADE ON RE-SUBMITTALS SHALL BE CLEARLY FLAGGED AND NOTED. THE PURPOSE OF THE RE-SUBMITTALS SHALL BE CLEARLY NOTED ON THE LETTER OF TRANSMITTAL. ARCHITECT/ENGINEER OF RECORD REVIEW WILL BE LIMITED TO THOSE ITEMS CAUSING THE RE-SUBMITTAL. CONTRACTOR IS RESPONSIBLE FOR COSTS CAUSED BY MULTIPLE RE-SUBMITTALS (MORE THAN ONE) AT ARCHITECT/ENGINEERS' CURRENT

1333 SUBMITTALS:

1. ALL SHOP DRAWINGS MUST BE REVIEWED AND STAMPED APPROVED BY THE GENERAL CONTRACTOR PRIOR TO SUBMITTAL.
2. THE GENERAL CONTRACTOR SHALL SUBMIT FOR ENGINEER REVIEW SHOP DRAWINGS FOR THE FOLLOWING ITEMS:
   A. STRUCTURAL STEEL (*)
   B. STEEL GRATING (*)
   C. STEEL CONNECTIONS

   ITEMS MARKED (*) SHALL HAVE SHOP DRAWINGS SEALED BY A PROFESSIONAL ENGINEER REGISTERED IN THE STATE IN WHICH THE PROJECT RESIDES.

   ITEMS MARKED (#) SHALL BE SUBMITTED FOR ENGINEERS RECORD ONLY.

   MANUFACTURER'S LITERATURE. SUBMIT TWO COPIES OF MANUFACTURER'S LITERATURE FOR ALL MATERIALS AND PRODUCTS USED IN CONSTRUCTION ON THE PROJECT.

1334 REQUEST FOR INTERPRETATION (RFI):

1. RFI SHALL ORIGINATE WITH CONTRACTOR AND SHALL BE SUBMITTED IN THE FORM SPECIFIED WITHIN CONTRACT DOCUMENTS. RFI SHALL BE SUBMITTED IN A PROMPT MANNER AS TO AVOID DELAYS IN CONTRACTORS WORK.
2. RFI SHALL BE SUBMITTED AS SPECIFIED WITHIN THE CONTRACT DOCUMENTS AND SHALL BE FORWARDED TO THE ENGINEER VIA THE ARCHITECT OR DIRECTLY BY CONTRACTOR TO ENGINEER WHEN APPROVED BY THE ARCHITECT.
3. ENGINEER SHALL TAKE UP TO 5 BUSINESS DAYS TO REVIEW AND RETURN RFI'S. HOWEVER, THE ENGINEER WILL ATTEMPT TO EXPEDITE THE REVIEW OF ALL RFI'S WITHIN A REASONABLE TIME FRAME.
4. RFI RESPONSES ARE NOT INTENDED TO AUTHORIZE ANY INCREASE IN CONSTRUCTION COST, SCHEDULE OR TIME EXTENSIONS, OR CONSTRUCTION IN CONFLICT WITH ANY APPLICABLE CODES OR SPECIFIED DESIGN STANDARDS. IT IS THE RESPONSIBILITY OF THE CONTRACTOR TO NOTIFY THE DESIGN TEAM IMMEDIATELY OF ANY PERCEIVED SCOPE, SCHEDULE, COST IMPACTS, OR ADJUSTMENTS. IF THE CONTRACTOR REQUESTS ANY ADDITIONAL COST, INCREASE IN SCHEDULE OR ADJUSTMENT IN SCOPE, THE CONTRACTOR SHALL NOT PROCEED WITH ADDITIONAL WORK UNTIL APPROVED IN WRITING BY THE CONSTRUCTION ADMINISTRATOR.

2210 DEMOLITION NOTES:

1. THE CONTRACTOR IS REQUIRED TO PROVIDE ALL TEMPORARY SCAFFOLDING, PLATFORMS, BARRICADES, RAILINGS, SCREENING, ETC. NECESSARY TO PROTECT EXISTING FACILITIES, STRUCTURES AND THE PUBLIC DURING DEMOLITION AND ERECTION OF THE NEW CONSTRUCTION, AS WELL AS FOR JOB SAFETY. JOB SAFETY, CONSTRUCTION AND DEMOLITION PROCEDURES ARE THE SOLE RESPONSIBILITY OF THE CONTRACTOR. THE CONTRACTOR IS REQUIRED TO TAKE ALL PRECAUTIONS TO MINIMIZE VIBRATION, NOISE, DUST AND DEBRIS IN ALL AREAS ADJACENT TO AREAS OF DEMOLITION.
2. THE CONTRACTOR IS REQUIRED TO COORDINATE WITH THE OWNER FOR THE TEMPORARY SUSPENSION OF USE OF ANY FACILITY OR PORTION THEREOF, AND THE ASSOCIATED BARRICADING REQUIREMENTS WITHIN A MINIMUM OF 7 DAYS PRIOR TO COMMENCING WORK.
3. THE CONTRACTOR IS REQUIRED TO PERFORM HIS WORK IN A MANNER, WHICH WILL NOT CONFLICT WITH ANY OPERATION, WHICH IS TO REMAIN FUNCTIONAL DURING THE COURSE OF THE PROJECT, UNTIL SUCH OPERATION IS SCHEDULED TO BE SHUT DOWN.
4. THE CONTRACTOR IS REQUIRED TO COORDINATE WITH OWNER FOR THE TEMPORARY SUSPENSION OF USE OF ANY UTILITY SYSTEM, A MINIMUM OF 3 DAYS PRIOR TO COMMENCING WORK.
5. AT ALL LOCATIONS WHERE NEW CONSTRUCTION WILL INTERFACE WITH EXISTING ELEMENTS, CUT THROUGH EXISTING STRUCTURE IN STRAIGHT AND TRUE LINES TO INSURE A NEAT INTERFACE.
6. AT ALL LOCATIONS WHERE THE DEMOLITION OF A CONCRETE MEMBER LEAVES THE ENDS OF REINFORCING STEEL EXPOSED, PROVIDE THE FOLLOWING:
   A. CHIP CONCRETE FROM AROUND THE STEEL TO A DEPTH OF 1".
   B. CUT OFF REINFORCING STEEL NOT LESS THAN 3/4" BELOW THE CONCRETE SURFACE.
   C. FILL THE CAVITY FLUSH WITH A HIGH MODULUS GEL EPOXY. SEE SPECIFICATIONS FOR ACCEPTED MANUFACTURERS.
7. BEFORE DEMOLISHING ANY STRUCTURAL ELEMENT, INSTALL ALL REQUIRED TEMPORARY AND/OR PERMANENT BRACING AND SUPPORTS.
8. PROVIDE TEMPORARY CLOSURE OF ALL ROOF FASCIA, WALL AND OTHER OPENINGS TO PROTECT BUILDING FROM EXPOSURE TO UNDESIRABLE ELEMENTS UNTIL NEW CONSTRUCTION IS WEATHERPROOFED, AT WHICH TIME SUCH TEMPORARY CONSTRUCTION SHALL BE REMOVED. ALL TEMPORARY EXTERIOR WALLS THAT ARE SUBJECT TO WIND LOADS ARE TO BE DESIGNED BY A DELEGATED ENGINEER.
9. UPON COMPLETION OF NEW CONSTRUCTION UNDER EACH PHASE, ALL DEMOLISHED AREAS SHALL BE RESTORED TO ACCEPTABLE USAGE ACCORDING TO THE CONTRACT DOCUMENTS AS DETERMINED BY THE A/E.
10. REMOVE COMPLETELY FROM THE SITE AND LEGALLY DISPOSE ALL DEBRIS GENERATED BY THE DEMOLITION WORK AS THE WORK PROGRESSES. STOCKPILING OF DEBRIS AND BURNING OF DEBRIS ON THE PREMISES IS STRICTLY PROHIBITED.

2220 EXISTING STRUCTURE:

1. INFORMATION SHOWN FOR THE EXISTING STRUCTURE ON THESE DRAWINGS WAS TAKEN FROM THE DRAWINGS THAT WERE PREPARED FOR:

   PREPARED BY: JAMES D. MARKS ASSOCIATES
   ENTITLED: CUTLER RIDGE TWO
   DATED: 12-30-1985

2. WORK SHOWN ON THESE DRAWINGS ASSUMES THAT THE ORIGINAL CONSTRUCTION WAS PERFORMED IN ACCORDANCE WITH THE ABOVE INDICATED ORIGINAL DRAWINGS INCLUDING (BUT NOT LIMITED TO) DIMENSIONS, ELEVATIONS, MEMBER SIZES, MATERIALS, DETAILS, ETC. IT SHALL BE THE RESPONSIBILITY OF THE CONTRACTOR TO VERIFY THE CONDITIONS RELATING TO THE EXISTING STRUCTURE AND TO NOTIFY THE ENGINEER IMMEDIATELY OF ANY DISCREPANCIES OR CONFLICTS.

5120 STRUCTURAL STEEL:

1. STEEL WORK SHALL BE NEW AND CONFORM TO THE AISC SPECIFICATION FOR STRUCTURAL STEEL BUILDINGS. – ALLOWABLE STRESS DESIGN AND LOAD AND RESISTANCE FACTOR DESIGN.
2. MATERIAL SHALL CONFORM TO THE FOLLOWING, EXCEPT AS NOTED:

WIDE FLANGE SHAPES	ASTM A992 (Fy=50 KSI)
ANGLES, CHANNELS AND PLATES	ASTM A36 (Fy=36 KSI)
PIPE	ASTM A53, GRADE B (Fy=35 KSI)
RECTANGULAR HSS	ASTM A500, GRADE B (Fy=46 KSI)
ROUND HSS	ASTM A500, GRADE B (Fy=42 KSI)
HIGH STRENGTH BOLTS	ASTM A325
THREADED RODS	ASTM A36 (Fy=36 KSI)
S.M. AND HP SHAPES	ASTM A36 (Fy=36 KSI)
HEAVY HEX NUTS	ASTM A563
HARDENED STEEL WASHERS	ASTM F436
DIRECT TENSION INDICATORS	ASTM F959, TYPE 325
ANCHOR RODS	ASTM F1554 GR. 36 (Fy=36 KSI)
HEADED STUD ANCHORS	ASTM A108 (Fy=50 KSI)
TWIST-OFF TENSION CONTROL BOLTS	ASTM F1852

3. CONNECTIONS:
   A. BOLTS SHALL BE HIGH-STRENGTH, BEARING TYPE. TIGHTEN BY AN AISC APPROVED METHOD.
   B. WELDING ELECTRODES SHALL BE PER AWS D1.1. RETURN FILLET WELDS FOR FRAMED CONNECTIONS 1/2" AT EACH END.
   C. FIELD CONNECTIONS SHALL BE MADE WITH 3/4" BOLTS, EXCEPT AS NOTED OTHERWISE.
   D. DESIGN BEAM CONNECTIONS TO DEVELOP THE REACTIONS SHOWN. IF NOT SHOWN, DESIGN CONNECTIONS TO DEVELOP THE REACTIONS DUE TO THE MAXIMUM ALLOWABLE UNIFORM LOAD FOR THE BEAM SIZE AND SPAN SHOWN, ASSUMING FULL LATERAL SUPPORT PER AISC BEAM (ALLOWABLE UNIFORM LOAD) TABLE VALUE FOR THE CORRESPONDING SPAN, U.N.O.
   E. DESIGN DIAGONAL BRACING CONNECTIONS TO DEVELOP THE REACTIONS SHOWN. IF REACTIONS ARE NOT SHOWN, DESIGN CONNECTIONS TO DEVELOP FULL TENSION CAPACITY OF THE DIAGONAL BRACING MEMBER.
   F. CALCULATIONS AND SHOP DRAWINGS FOR STRUCTURAL STEEL CONNECTIONS SHALL BE SUBMITTED FOR APPROVAL PRIOR TO FABRICATION AND SHALL BE SIGNED AND SEALED BY AN ENGINEER REGISTERED IN THE STATE IN WHICH THE PROJECT RESIDES.
4. ALL STRUCTURAL STEEL EXPOSED TO EXTERIOR CONDITIONS SHALL BE HOT DIPPED GALVANIZED PER ASTM A123 AND ALL FASTENERS AND HARDWARE SHALL BE HOT DIPPED GALVANIZED PER ASTM A153.
5. GROUT UNDER BEARING. PLATES SHALL BE NON-METALLIC, NON-SHRINK TYPE WITH A COMPRESSIVE STRENGTH OF AT LEAST 5,000 PSI IN 28 DAYS.
6. THE CAMBER OF STEEL MEMBERS SHALL BE VERIFIED IN THE SHOP AND THE FIELD. WHEN NO CAMBER IS INDICATED, TURN THE MEMBER NATURAL CAMBER UP.
7. IT IS THE INTENTION OF THESE DESIGN DOCUMENTS TO DELEGATE THE DESIGN OF ALL STRUCTURAL STEEL CONNECTIONS TO A QUALIFIED SPECIALTY PROFESSIONAL ENGINEER, REGISTERED IN THE STATE OF FLORIDA. THIS REQUIREMENT EXTENDS TO ALL CONNECTIONS, WITH THE EXCEPTION OF THOSE SPECIFICALLY FULLY DESIGNED IN THE DESIGN DOCUMENTS. IT IS ANTICIPATED THAT PROSPECTIVE STRUCTURAL STEEL FABRICATORS WILL PERFORM NECESSARY INVESTIGATION TO DETERMINE THE FULL IMPACT OF CONNECTION CLEARANCE REQUIREMENTS, AS WELL AS THE POTENTIAL NECESSARY INTRODUCTION OF DOUBLER PLATES, CONTINUITY PLATES, AND/OR WEB FLANGE OR OTHER STIFFENERS PRIOR TO SUBMITTING ANY BID FOR THIS WORK.
8. PROVIDE SIGNED AND SEALED CALCULATIONS FOR ALL STRUCTURAL STEEL CONNECTION DESIGN PREPARED BY A PROFESSIONAL ENGINEER REGISTERED IN THE STATE IN WHICH THE PROJECT RESIDES. CALCULATIONS ARE TO BE SUBMITTED SIMULTANEOUSLY WITH CORRESPONDING SUBMITTAL.
9. HIGH STRENGTH BOLTS IN BEARING CONDITION SUPPORTING SIMPLE SPAN BEAMS NOT SUBJECT TO AXIAL LOADS MAY BE INSTALLED TO "SNUG TIGHT" CONDITION IF NORMAL, SHORT SLOTTED OR OVERSIZED HOLES ARE USED. THE ENGINEER OF RECORD WILL BE THE ULTIMATE AUTHORITY IN THE USE OF "SNUG TIGHT" BOLTS.
10. IT IS THE RESPONSIBILITY OF THE GENERAL CONTRACTOR TO DETERMINE IF FIREPROOFING IS REQUIRED FOR THE STRUCTURAL STEEL.

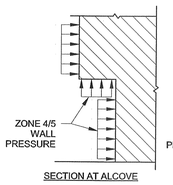
ASD (SERVICE) WIND PRESSURES (ASCE 7-10)

BUILDING	a (FT)	Vult (MPH)	Vasd (MPH)	A (SF)	ZONE 1 (PSF)	ZONE 2 (PSF)	ZONE 3 (PSF)	ZONE 4 (PSF)	ZONE 5 (PSF)	ZONE (2H) (PSF)	ZONE (3H) (PSF)
LOW ROOF	11' - 3"	186	144.1	<10	+24.7 -60.7	+24.7 -101.8	+24.7 -153.2	+60.7 -65.8	+60.7 -81.2	-87.4	-143.9
				20	+23.1 -59.1	+23.1 -91.0	+23.1 -126.9	+58.0 -63.1	+58.0 -75.8	-85.9	-113.0
				50	+21.2 -57.1	+21.2 -76.6	+21.2 -92.1	+54.3 -59.5	+54.3 -58.5	-83.8	-72.1
				100+	+19.6 -55.5	+19.6 -65.8	+19.6 -65.8	+51.6 -58.8	+51.6 -63.1	-82.3	-41.2

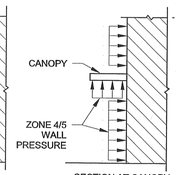
GROSS WIND PRESSURE PLAN NOTES:

1. WIND PRESSURE TABLE IS BASED ON FBC 2014 / ASCE 7-10 ALLOWABLE WIND SPEED. ULTIMATE OR NOMINAL PRESSURES MAY BE CALCULATED IN ACCORDANCE WITH FBC SECTION 1609.1.5 FOR COMPARISON WHERE TESTING FOR WIND LOAD RESISTANCE IS BASED ON ALLOWABLE OR NOMINAL WIND LOADS.

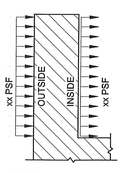
   A - INDICATES TRIBUTARY AREA IN S.F.
   a - INDICATES END ZONE WIDTH IN FT.
   Vult - INDICATES ULTIMATE DESIGN WIND SPEED IN MPH
   Vasd - INDICATES NOMINAL DESIGN WIND SPEED IN MPH
2. GROSS PRESSURES ARE FOR JOISTS, WINDOWS, DOORS, VENEER, LIGHT GAGE METAL FRAMING, METAL DECK ATTACHMENTS, ROOFING, ROOFING ACCESSORIES AND OTHER BUILDING COMPONENTS AND CLADDING.
3. GROSS PRESSURES SHALL BE LINEARLY INTERPOLATED FOR (A) NOT SHOWN IN TABLE.
4. POSITIVE PRESSURES INDICATE PRESSURES ACTING TOWARD A PROJECTED SURFACE. NEGATIVE PRESSURES INDICATE PRESSURES ACTING AWAY FROM A PROJECTED SURFACE.
5. ROOF AND ZONES (1) THRU (3)
6. WALL ZONES (4) AND (5)
7. OVERHANG ZONES (2H) AND (3H) APPLY ONLY TO ROOF OVERHANGS WHERE THE COMPONENT OR CLADDING RECEIVES PRESSURE SIMULTANEOUSLY ON BOTH SIDES (UPWARD SUCTION ON TOP AND UPWARD PRESSURE ON BOTTOM, SUCH AS AT OPEN SOFFITS), AND IS CONTINUOUS WITH FIELD OF ROOF.
8. NET DESIGN ROOF PRESSURES SHALL BE CALCULATED USING THE SELFWEIGHT (DEAD LOAD) OF THE MATERIALS. HOWEVER, THE MAXIMUM REDUCTION OF WIND UPLIFT PRESSURES SHALL BE LIMITED TO THE SELF WEIGHT OF THE ROOF SYSTEM PLUS 5 PSF FOR SUPERIMPOSED DEAD LOADS.
9. INTERNAL PRESSURE COEFFICIENT FOR ENCLOSED BUILDING EQUALS +0.18 AND -0.18
   INTERNAL PRESSURE COEFFICIENT FOR OPEN STRUCTURE EQUALS +/- 0.00
   INTERNAL PRESSURE COEFFICIENT FOR PARTIALLY ENCLOSED STRUCTURE EQUALS +/- 0.55
10. ROOF TOP EQUIPMENT SHALL BE DESIGNED FOR A SERVICE LATERAL PRESSURE AND A SIMULTANEOUS SERVICE UPLIFT PRESSURE AS SHOWN ON SHEET (ROOF TOP EQUIPMENT PER FBC SECTION 1609.8)
11. AT ALCOVES AND CANOPIES, THE TOTAL UPLIFT PRESSURE ON THE ALCOVE SOFFIT OR CANOPY SHALL EQUAL THE WALL PRESSURE IN THAT AREA.
12. PARAPET DESIGN WIND PRESSURE LOAD CASES:
    LOAD CASE 1: +XX PSF ON OUTSIDE FACE AND -XX PSF ON INSIDE FACE
    LOAD CASE 2: -XX PSF (ZONE 4) AND +XX PSF (ZONE 5) ON OUTSIDE FACE AND +XX PSF ON INSIDE FACE
    NOTE THAT CASE 1 & CASE 2 WIND PRESSURES ARE APPLIED INDEPENDENTLY.



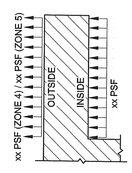
SECTION AT ALCOVE



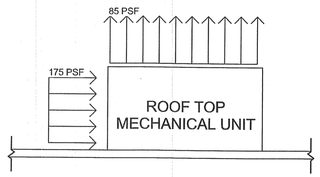
SECTION AT CANOPY

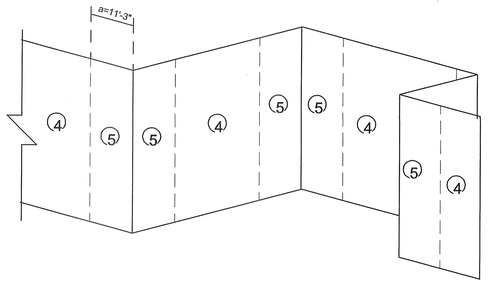


PARAPET LOAD CASE 1



PARAPET LOAD CASE 2





ENGINEERING
FOR ARCHITECTURE
5757 Blue Lagoon Drive, Suite 400
Miami, Florida 33126
PH: 305.266.6553
Fax: 350.266.6695
www.tlc-engineers.com
COA 15

CUTLER BAY TOWN CENTER HVAC EQUIPMENT AND CONTROLS

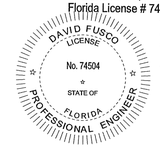
10720 Caribbean Blvd. Cutler Bay, Florida 33189

Revisions:

No.	Date	Description

Seal

David Fusco, P.E.
Florida License # 74504



This item has been electronically signed and sealed by David Fusco, PE on 10-07-2016 using a Digital Signature.

Printed copies of this document are not considered signed and sealed and the signature must be verified on any electronic copies.

100% CD SUBMITTAL

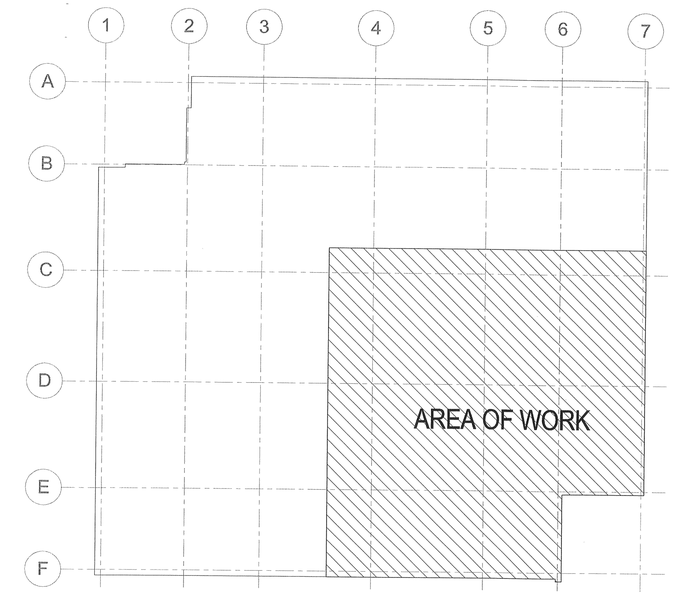
Project No.:	616018
Issue Date:	10-07-2016
Drawn By:	AR
Approved By:	DAF
Scale:	As indicated

Drawing Title:

GENERAL NOTES

Drawing No.:

S001



2 KEYPLAN OR ROOF LEVEL
1/16" = 1'-0"

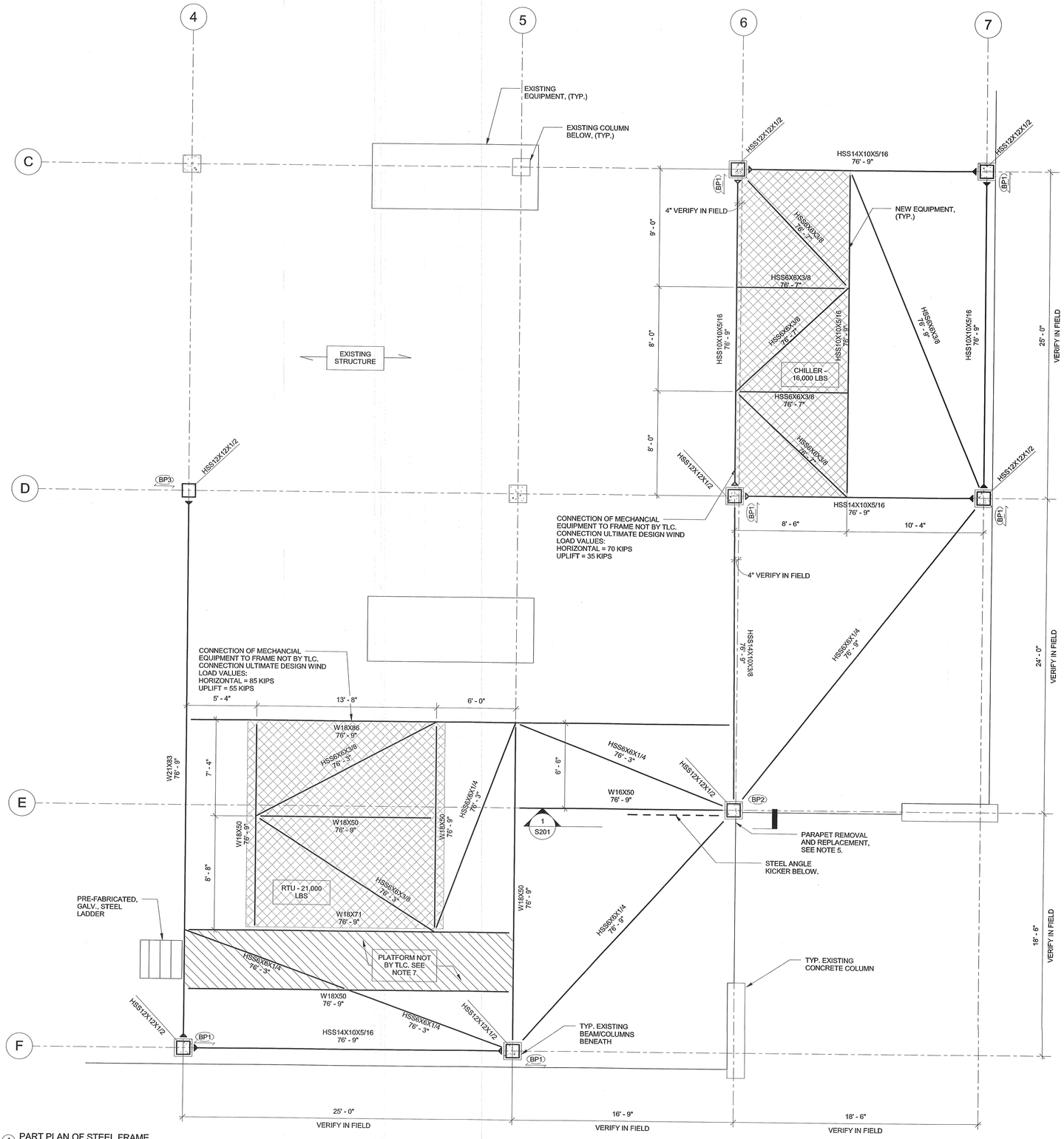
ROOF FRAMING PLAN NOTES

1. NEW STRUCTURAL STEEL FRAMING TO BE AT +4'-0" ABOVE THE TOP OF EXISTING ROOF ELEVATION UNLESS OTHERWISE NOTED ON PLAN.
2. ALL EXPOSED STRUCTURAL STEEL SHALL BE HOT DIPPED GALVANIZED.
3. ▶ INDICATES MOMENT CONNECTION.
   WXxX INDICATES BEAM SIZE AND ELEVATION.
   X'-X"
4. REMOVE PORTION OF EXISTING PARAPET TO ALLOW FOR INSTALLATION OF STEEL BASE PLATE. REPLACE PARAPET WITH LIGHT GAGE FRAMING AND PROVIDE FINISH TO MATCH EXISTING.
5. (BPx) INDICATES BASE PLATE TYPE WITH LONG SIDE OF PLATE PARALLEL TO ARROW. REFER TO SHEET S201 FOR DETAILS.
6. THE DESIGN OF PLATFORM AND PLATFORM SUPPORT MEMBERS ARE NOT BY TLC. ADDITIONAL SUPPORT MEMBERS SHALL BE DESIGNED BY EQUIPMENT MANUFACTURER AND PLATFORM PROVIDER.

ULTIMATE BEAM/BRACE REACTIONS

TYPE	SIZE	AXIAL TENSION (KIPS)	AXIAL COMPRESSION (KIPS)	SHEAR (VERTICAL) KIPS	SHEAR (LATERAL) KIPS	MAJOR MOMENT KIP-FT	MINOR MOMENT KIP-FT
PIN CONNECTIONS	6X6X1/4	95	95	5	5	N/A	N/A
	W18	30	30	35	50	N/A	N/A
	W16	60	55	35	35	N/A	N/A
	W14	65	70	5	10	N/A	N/A
	W12	50	50	10	20	N/A	N/A
MOMENT CONNECTIONS	W21	70	60	35	35	235	10
	HSS14	40	50	10	40	115	15
	HSS10	50	45	10	35	150	10

CONNECTION DESIGN IS DELEGATED, SEE GENERAL NOTES.



1 PART PLAN OF STEEL FRAME
1/4" = 1'-0"

ENGINEERING
FOR ARCHITECTURE
5757 Blue Lagoon Drive, Suite 400
Miami, Florida 33126
PH: 305.266.6553
Fax: 350.266.6695
www.tlc-engineers.com
COA 15

CUTLER BAY TOWN CENTER HVAC EQUIPMENT AND CONTROLS

10720 Caribbean Blvd. Cutler Bay, Florida 33189

Revisions:

No.	Date	Description

Seal

David Fusco, P.E.
Florida License # 74504

DAVID FUSCO LICENSE No. 74504 STATE OF FLORIDA PROFESSIONAL ENGINEER

This item has been electronically signed and sealed by David Fusco, PE on 10-07-2016 using a Digital Signature.

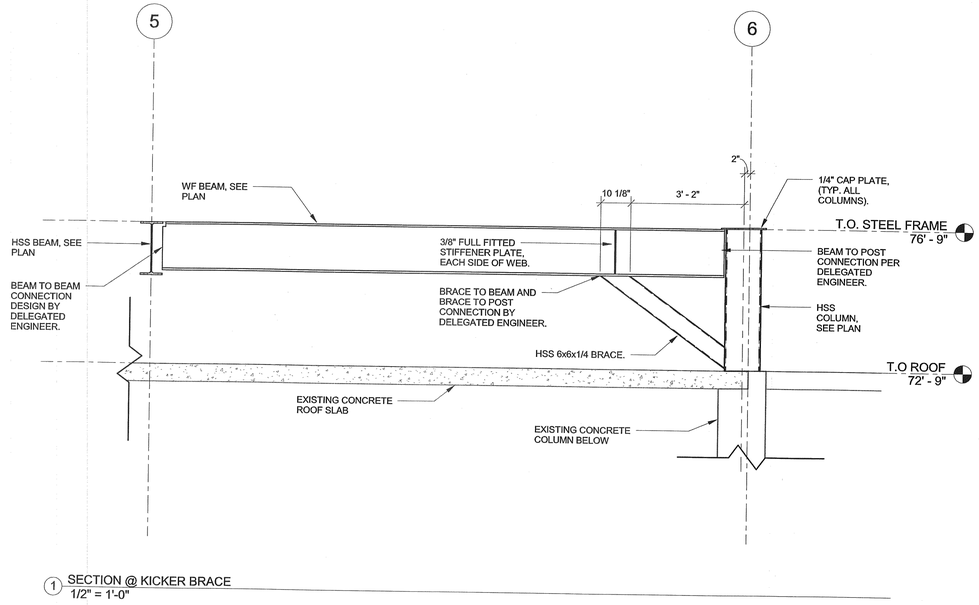
Printed copies of this document are not considered signed and sealed and the signature must be verified on any electronic copies.

Project No.: 616018
Issue Date: 10-07-2016
Drawn By: AR
Approved By: DAF
Scale: As indicated

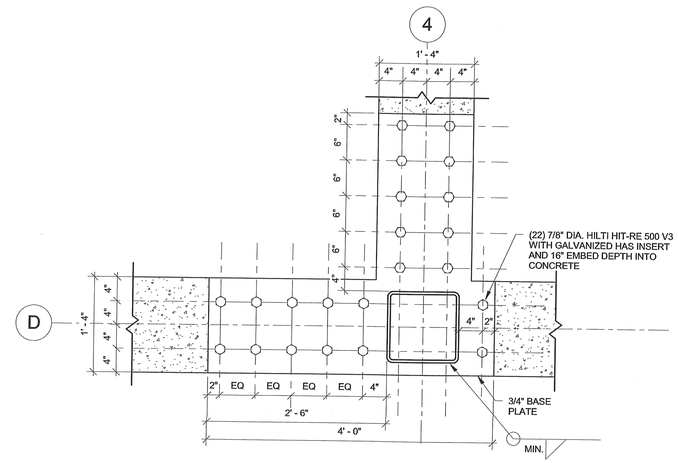
Drawing Title: EQUIPMENT SUPPORT FRAMING PLAN

Drawing No.: S101

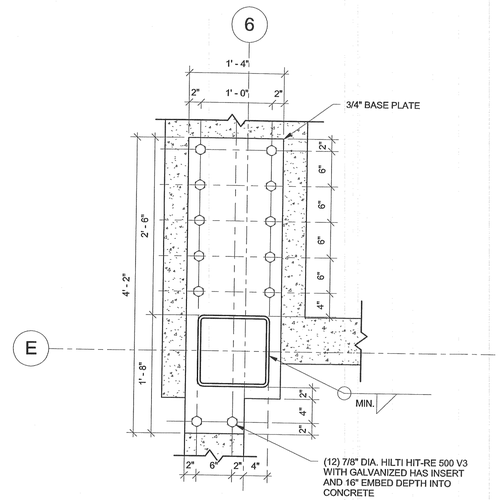
100% CD SUBMITTAL



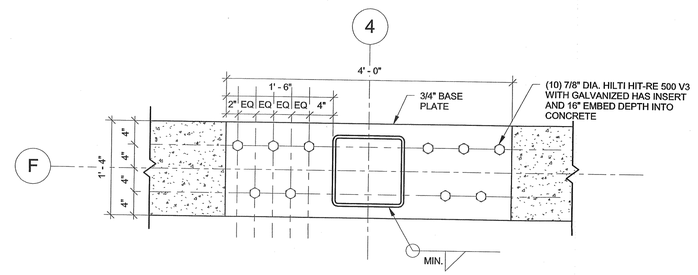
1 SECTION @ KICKER BRACE
1/2" = 1'-0"



3 BASE PLATE 3
1" = 1'-0"



4 BASE PLATE 2
1" = 1'-0"



2 BASE PLATE 1
1" = 1'-0"

ENGINEERING
FOR ARCHITECTURE
5757 Blue Lagoon Drive, Suite 400
Miami, Florida 33126
PH: 305.266.6553
Fax: 350.266.6695
www.tlc-engineers.com
COA 15

CUTLER BAY TOWN CENTER HVAC EQUIPMENT AND CONTROLS

10720 Caribbean Blvd. Cutler Bay, Florida 33189

100% CD SUBMITTAL

Revisions:

No.	Date	Description

Seal

David Fusco, P.E.
Florida License # 74504

DAVID FUSCO LICENSE No. 74504 STATE OF FLORIDA PROFESSIONAL ENGINEER

This item has been electronically signed and sealed by David Fusco, PE on 10-07-2016 using a Digital Signature.

Printed copies of this document are not considered signed and sealed and the signature must be verified on any electronic copies.

Project No.:	616018
Issue Date:	10-07-2016
Drawn By:	AR
Approved By:	DAF
Scale:	As indicated

Drawing Title:
STRUCTURAL DETAILS

Drawing No.:
S201

C:\Revit 2016 Local Models\616018_Cutler Bay_STR_R16_david.fusco.rvt
10/7/2016 12:37:37 PM

MEAC 10-16-0931
10720 Caribbean
BND

OFFICE COPY

OFFICE COPY

TOWN OF CUTLER BAY

THIS COPY OF PLAN MUST BE AVAILABLE ON BUILDING SITE OR NO INSPECTION WILL BE GIVEN

SECTION	APPROVED BY	APPROVED DATE	DISAPPROVED BY	DISAPPROVED DATE
ZONING				
LANDSCAPING				
PUBLIC WORKS				
BUILDING				
UTILITIES				
HANDICAP				
STRUCTURAL				
ELECTRICAL				
PLUMBING				
MECHANICAL		10/21/16		10-24-16
ENERGY				
FIRE				

Subject to compliance with all federal, state and county law, rules and regulations. The Town of Cutler Bay assumes no responsibility for accuracy of all results of these plans.
NOTICE: In addition to the requirements of these permits there may be additional restrictions applicable to this in the public record of this county and town

DISCLAIMER AND CONDITION

PURSUANT TO SECTION 166.033, FLORIDA STATUTES, as amended

Issuance of this building permit by the Town of Cutler Bay does not in any way create any right on the part of an applicant to obtain a permit from a state or federal agency and does not create any liability on the part of the Town of Cutler Bay for issuance of the permit if the applicant fails to obtain requisite approvals or fulfill the obligations imposed by a state or federal agency or undertakes actions that result in a violation of state or federal law.

All applicable state and federal permits must be obtained before commencement of the development.

TOWN OF CUTLER BAY
CUTLER BAY TOWN CENTER
HVAC EQUIPMENT AND CONTROLS REPLACEMENT AND MAINTENANCE SERVICES
RFP #17-05

EXHIBIT "B"

PROJECT SPECIFICATIONS

Reserved for Exhibit "B"

ENGINEERING
FOR ARCHITECTURE

Cutler Bay Town Center
Town of Cutler Bay, Florida

100% CONSTRUCTION DOCUMENTS

BY

TLC ENGINEERING FOR ARCHITECTURE
5757 BLUE LAGOON
MIAMI, FLORIDA 33126

TLC PROJECT NO.: 616018

OCTOBER 11, 2016

Table of Contents

SECTION 262816 - ENCLOSED SWITCHES AND CIRCUIT BREAKERS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Fusible switches.
2. Nonfusible switches.
3. Shunt trip switches.
4. Molded-case circuit breakers (MCCBs).
5. Enclosures.

1.3 DEFINITIONS

A. NC: Normally closed.

B. NO: Normally open.

C. SPDT: Single pole, double throw.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of enclosed switch, circuit breaker, accessory, and component indicated. Include nameplate ratings, dimensioned elevations, sections, weights, and manufacturers' technical data on features, performance, electrical characteristics, ratings, accessories, and finishes.

1. Enclosure types and details for types other than NEMA 250, Type 1.
2. Current and voltage ratings.
3. Short-circuit current ratings (interrupting and withstand, as appropriate).
4. Include evidence of a nationally recognized testing laboratory (NRTL) listing for series rating of installed devices.
5. Detail features, characteristics, ratings, and factory settings of individual overcurrent protective devices, accessories, and auxiliary components.

1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data: For qualified testing agency.

B. Seismic Qualification Certificates: For enclosed switches and circuit breakers, accessories, and components, from manufacturer.

1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.

C. Field quality-control reports.

1.6 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For enclosed switches and circuit breakers to include in emergency, operation, and maintenance manuals.

1. In addition to items specified in Section 017823 "Operation and Maintenance Data," include the following:

a. Manufacturer's written instructions for testing and adjusting enclosed switches and circuit breakers.

1.7 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Fuses: Equal to **10** percent of quantity installed for each size and type, but no fewer than **three** of each size and type.
2. Fuse Pullers: **Two** for each size and type.

1.8 QUALITY ASSURANCE

A. Testing Agency Qualifications: Accredited by NETA.

1. Testing Agency's Field Supervisor: Currently certified by NETA to supervise on-site testing.

1.9 FIELD CONDITIONS

A. Environmental Limitations: Rate equipment for continuous operation under the following conditions unless otherwise indicated:

1. Ambient Temperature: Not less than minus 22 deg F and not exceeding 104 deg F.
2. Altitude: Not exceeding 6600 feet.

1.10 WARRANTY

A. Manufacturer's Warranty: Manufacturer and Installer agree to repair or replace components that fail in materials or workmanship within specified warranty period.

1. Warranty Period: **One** year(s) from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 GENERAL REQUIREMENTS

A. Source Limitations: Obtain enclosed switches and circuit breakers, overcurrent protective devices, components, and accessories, within same product category, from single manufacturer.

B. Product Selection for Restricted Space: Drawings indicate maximum dimensions for enclosed switches and circuit breakers, including clearances between enclosures, and adjacent surfaces and other items. Comply with indicated maximum dimensions.

C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by an NRTL, and marked for intended location and application.

D. Comply with NFPA 70.

2.2 FUSIBLE SWITCHES

A. Manufacturers: Subject to compliance with requirements, [**provide products by the following**] [**provide products by one of the following**] [**available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following**]:

1. ABB Inc.
2. Eaton.
3. General Electric Company.
4. SIEMENS Industry, Inc.; Energy Management Division.
5. Square D; by Schneider Electric.

B. Type HD, Heavy Duty:

1. **Single** throw.
2. **Three** pole.
3. **240 or 600**-V ac.
4. UL 98 and NEMA KS 1, horsepower rated, with clips or bolt pads to accommodate fuses.
5. Lockable handle with capability to accept three padlocks, and interlocked with cover in closed position.

C. Accessories:

1. Equipment Ground Kit: Internally mounted and labeled for copper and aluminum ground conductors.

2. Neutral Kit: Internally mounted; insulated, capable of being grounded and bonded; labeled for copper and aluminum neutral conductors.
3. Isolated Ground Kit: Internally mounted; insulated, labeled for copper and aluminum neutral conductors.
4. Class R Fuse Kit: Provides rejection of other fuse types when Class R fuses are specified.
5. Auxiliary Contact Kit: **One** NO/NC (Form "C") auxiliary contact(s), arranged to activate before switch blades open. Contact rating - **120-V ac**.
6. Hookstick Handle: Allows use of a hookstick to operate the handle.
7. Lugs: **Mechanical** type, suitable for number, size, and conductor material.
8. Service-Rated Switches: Labeled for use as service equipment.
9.

2.3 MOLDED-CASE CIRCUIT BREAKERS

A. Manufacturers: Subject to compliance with requirements, **provide products by one of the following available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following**:

1. Eaton.
2. General Electric Company.
3. NOARK Electric North America.
4. SIEMENS Industry, Inc.; Energy Management Division.
5. Square D; by Schneider Electric.

B. Circuit breakers shall be constructed using glass-reinforced insulating material. Current carrying components shall be completely isolated from the handle and the accessory mounting area.

C. Circuit breakers shall have a toggle operating mechanism with common tripping of all poles, which provides quick-make, quick-break contact action. The circuit-breaker handle shall be over center, be trip free, and reside in a tripped position between on and off to provide local trip indication. Circuit-breaker escutcheon shall be clearly marked on and off in addition to providing international I/O markings. Equip circuit breaker with a push-to-trip button, located on the face of the circuit breaker to mechanically operate the circuit-breaker tripping mechanism for maintenance and testing purposes.

D. The maximum ampere rating and UL, IEC, or other certification standards with applicable voltage systems and corresponding interrupting ratings shall be clearly marked on face of circuit breaker. Circuit breakers shall be **100 percent rated**

E. MCCBs shall be equipped with a device for locking in the isolated position.

F. Lugs shall be suitable for **140 deg F rated wire on 125-A circuit breakers and below**

G. Standards: Comply with UL 489 and NEMA AB 3, with interrupting capacity to comply with available fault currents.

H. Thermal-Magnetic Circuit Breakers: Inverse time-current thermal element for low-level overloads and instantaneous magnetic trip element for short circuits. Adjustable magnetic trip setting for circuit-breaker frame sizes 250 A and larger.

I. Adjustable, Instantaneous-Trip Circuit Breakers: Magnetic trip element with front-mounted, field-adjustable trip setting.

J. Electronic Trip Circuit Breakers: Field-replaceable rating plug, rms sensing, with the following field-adjustable settings:

1. Instantaneous trip.
2. Long- and short-time pickup levels.
3. Long- and short-time time adjustments.
4. Ground-fault pickup level, time delay, and I-squared t response.

K. Current-Limiting Circuit Breakers: Frame sizes 400 A and smaller, and let-through ratings less than NEMA FU 1, RK-5.

L. Integrally Fused Circuit Breakers: Thermal-magnetic trip element with integral limiter-style fuse listed for use with circuit breaker and trip activation on fuse opening or on opening of fuse compartment door.

M. Ground-Fault Circuit-Interrupter (GFCI) Circuit Breakers: Single- and two-pole configurations with Class A ground-fault protection (6-mA trip).

N. Ground-Fault Equipment-Protection (GFEP) Circuit Breakers: With Class B ground-fault protection (30-mA trip).

O. Features and Accessories:

1. Standard frame sizes, trip ratings, and number of poles.
2. Lugs: **Mechanical** type, suitable for number, size, trip ratings, and conductor material.
3. Application Listing: Appropriate for application; Type SWD for switching fluorescent lighting loads; Type HID for feeding fluorescent and high-intensity discharge lighting circuits.
4. Ground-Fault Protection: Comply with UL 1053; **integrally mounted, self-powered**
5. An optional time-delay unit, which allows an adjustable time delay in release of the trip coil for overriding momentary fluctuations, is available for the undervoltage trip unit in first subparagraph below.
6. Undervoltage Trip: Set to operate at 35 to 75 percent of rated voltage without intentional time delay.
7. Auxiliary Contacts: **One SPDT switch** with "a" and "b" contacts; "a" contacts mimic circuit-breaker contacts, "b" contacts operate in reverse of circuit-breaker contacts.
8. Alarm Switch: One **NO** contact that operates only when circuit breaker has tripped.
9. Key Interlock Kit: Externally mounted to prohibit circuit-breaker operation; key shall be removable only when circuit breaker is in off position.
10. Zone-Selective Interlocking: Integral with [**electronic**] [**ground-fault**] trip unit; for interlocking ground-fault protection function.
11. Electrical Operator: Provide remote control for on, off, and reset operations.
12. Accessory Control Power Voltage: **Integrally mounted, self-powered 120-V ac**

2.4 MOLDED-CASE SWITCHES

A. Manufacturers: Subject to compliance with requirements, **provide products by one of the following available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following**:

1. Eaton.
2. General Electric Company.
3. NOARK Electric North America.
4. SIEMENS Industry, Inc.; Energy Management Division.
5. Square D; by Schneider Electric.

B. Description: MCCB with fixed, high-set instantaneous trip only, and short-circuit withstand rating equal to equivalent breaker frame size interrupting rating.

C. Features and Accessories:

1. Standard frame sizes and number of poles.
2. Lugs:

   a. **Mechanical** type, suitable for number, size, trip ratings, and conductor material.
   b. Lugs shall be suitable for **140 deg F rated wire on 125-A circuit breakers and below.**

3. Ground-Fault Protection: Comply with UL 1053; remote-mounted and powered type with mechanical ground-fault indicator; relay with adjustable pickup and time-delay settings, push-to-test feature, internal memory, and shunt trip unit; and three-phase, zero-sequence current transformer/sensor.
4. Shunt Trip: Trip coil energized from separate circuit, with coil-clearing contact.
5. Undervoltage Trip: Set to operate at 35 to 75 percent of rated voltage without intentional time delay.
6. Auxiliary Contacts: **One SPDT switch** with "a" and "b" contacts; "a" contacts mimic switch contacts, "b" contacts operate in reverse of switch contacts.
7. Alarm Switch: One **NO** contact that operates only when switch has tripped.
8. Key Interlock Kit: Externally mounted to prohibit switch operation; key shall be removable only when switch is in off position.
9. Zone-Selective Interlocking: Integral with ground-fault shunt trip unit; for interlocking ground-fault protection function.
10. Electrical Operator: Provide remote control for on, off, and reset operations.
11. Accessory Control Power Voltage: **Integrally mounted, self-powered 120-V ac.**

2.5 ENCLOSURES

A. Enclosed Switches and Circuit Breakers: UL 489, NEMA KS 1, NEMA 250, and UL 50, to comply with environmental conditions at installed location.

B. Conduit Entry: NEMA 250 Types 4, 4X, and 12 enclosures shall contain no knockouts. NEMA 250 Types 7 and 9 enclosures shall be provided with threaded conduit openings in both endwalls.

C. Enclosures designated as NEMA 250 Type 4, 4X stainless steel, 12, or 12K shall have a dual cover interlock mechanism to prevent unintentional opening of the enclosure cover when the circuit breaker is ON and to prevent turning the circuit breaker ON when the enclosure cover is open.

D. NEMA 250 Type 7/9 enclosures shall be furnished with a breather and drain kit to allow their use in outdoor and wet location applications.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine elements and surfaces to receive enclosed switches and circuit breakers for compliance with installation tolerances and other conditions affecting performance of the Work.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

1. Commencement of work shall indicate Installer's acceptance of the areas and conditions as satisfactory.

3.2 PREPARATION

A. Interruption of Existing Electric Service: Do not interrupt electric service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary electric service according to requirements indicated:

1. Notify **Construction Manager** no fewer than five days in advance of proposed interruption of electric service.
2. Indicate method of providing temporary electric service.
3. Do not proceed with interruption of electric service without **Construction Manager's** written permission.
4. Comply with NFPA 70E.

3.3 ENCLOSURE ENVIRONMENTAL RATING APPLICATIONS

A. Enclosed Switches and Circuit Breakers: Provide enclosures at installed locations with the following environmental ratings.

1. Indoor, Dry and Clean Locations: NEMA 250, **Type 1**.
2. Outdoor Locations: NEMA 250, **Type 3R**.
3. Other Wet or Damp, Indoor Locations: NEMA 250, **Type 4**.
4. Indoor Locations Subject to Dust, Falling Dirt, and Dripping Noncorrosive Liquids: NEMA 250, Type 12.

3.4 INSTALLATION

A. Coordinate layout and installation of switches, circuit breakers, and components with equipment served and adjacent surfaces. Maintain required workspace clearances and required clearances for equipment access doors and panels.

B. Install individual wall-mounted switches and circuit breakers with tops at uniform height unless otherwise indicated.

C. Comply with mounting and anchoring requirements specified in Section 260548.16 "Seismic Controls for Electrical Systems."

D. Temporary Lifting Provisions: Remove temporary lifting of eyes, channels, and brackets and temporary blocking of moving parts from enclosures and components.

E. Install fuses in fusible devices.

F. Comply with NFPA 70 and NECA 1.

3.5 IDENTIFICATION

A. Comply with requirements in Section 260553 "Identification for Electrical Systems."

1. Identify field-installed conductors, interconnecting wiring, and components; provide warning signs.
2. Label each enclosure with engraved metal or laminated-plastic nameplate.

3.6 FIELD QUALITY CONTROL

A. Testing Agency: Owner will engage a qualified testing agency to perform tests and inspections.

B. Testing Agency: Engage a qualified testing agency to perform tests and inspections.

C. Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect components, assemblies, and equipment installations, including connections.

D. Perform tests and inspections.

E. Retain one or both of "Tests and Inspections for Switches" Paragraph or "Tests and Inspections for Molded Case Circuit Breakers" Paragraph below. If both types of equipment are included in the Project, retain both paragraphs.

F. Tests and Inspections for Switches:

1. Visual and Mechanical Inspection:

a. Inspect physical and mechanical condition.
b. Inspect anchorage, alignment, grounding, and clearances.
c. Verify that the unit is clean.
d. Verify blade alignment, blade penetration, travel stops, and mechanical operation.

e. Verify that fuse sizes and types match the Specifications and Drawings.
f. Verify that each fuse has adequate mechanical support and contact integrity.
g. Inspect bolted electrical connections for high resistance using one of the two following methods:

1) Use a low-resistance ohmmeter.

a) Compare bolted connection resistance values to values of similar connections. Investigate values that deviate from those of similar bolted connections by more than 50 percent of the lowest value.

2) Verify tightness of accessible bolted electrical connections by calibrated torque-wrench method in accordance with manufacturer's published data or NETA ATS Table 100.12.

a) Bolt-torque levels shall be in accordance with manufacturer's published data. In the absence of manufacturer's published data, use NETA ATS Table 100.12.

h. Verify that operation and sequencing of interlocking systems is as described in the Specifications and shown on the Drawings.
i. Verify correct phase barrier installation.
j. Verify lubrication of moving current-carrying parts and moving and sliding surfaces.

2. Electrical Tests:

a. Perform resistance measurements through bolted connections with a low-resistance ohmmeter. Compare bolted connection resistance values to values of similar connections. Investigate values that deviate from adjacent poles or similar switches by more than 50 percent of the lowest value.
b. Measure contact resistance across each switchblade fuseholder. Drop values shall not exceed the high level of the manufacturer's published data. If manufacturer's published data are not available, investigate values that deviate from adjacent poles or similar switches by more than 50 percent of the lowest value.
c. Perform insulation-resistance tests for one minute on each pole, phase-to-phase and phase-to-ground with switch closed, and across each open pole. Apply voltage in accordance with manufacturer's published data. In the absence of manufacturer's published data, use Table 100.1 from the NETA ATS. Investigate values of insulation resistance less than those published in Table 100.1 or as recommended in manufacturer's published data.
d. Measure fuse resistance. Investigate fuse-resistance values that deviate from each other by more than 15 percent.
e. Perform ground fault test according to NETA ATS 7.14 "Ground Fault Protection Systems, Low-Voltage."

G. Tests and Inspections for Molded Case Circuit Breakers:

1. Visual and Mechanical Inspection:

a. Verify that equipment nameplate data are as described in the Specifications and shown on the Drawings.
b. Inspect physical and mechanical condition.
c. Inspect anchorage, alignment, grounding, and clearances.
d. Verify that the unit is clean.
e. Operate the circuit breaker to ensure smooth operation.
f. Inspect bolted electrical connections for high resistance using one of the two following methods:

1) Use a low-resistance ohmmeter.

a) Compare bolted connection resistance values to values of similar connections. Investigate values that deviate from those of similar bolted connections by more than 50 percent of the lowest value.

2) Verify tightness of accessible bolted electrical connections by calibrated torque-wrench method in accordance with manufacturer's published data or NETA ATS Table 100.12.

a) Bolt-torque levels shall be in accordance with manufacturer's published data. In the absence of manufacturer's published data, use NETA ATS Table 100.12.

g. Inspect operating mechanism, contacts, and chutes in unsealed units.
h. Perform adjustments for final protective device settings in accordance with the coordination study.

2. Electrical Tests:

a. Perform resistance measurements through bolted connections with a low-resistance ohmmeter. Compare bolted connection resistance values to values of similar connections. Investigate values that deviate from adjacent poles or similar switches by more than 50 percent of the lowest value.
b. Perform insulation-resistance tests for one minute on each pole, phase-to-phase and phase-to-ground with circuit breaker closed, and across each open pole. Apply voltage in accordance with manufacturer's published data. In the absence of manufacturer's published data, use Table 100.1 from the NETA ATS. Investigate values of insulation resistance less than those published in Table 100.1 or as recommended in manufacturer's published data.
c. Perform a contact/pole resistance test. Drop values shall not exceed the high level of the manufacturer's published data. If manufacturer's published data are not available, investigate values that deviate from adjacent poles or similar switches by more than 50 percent of the lowest value.
d. Perform insulation resistance tests on all control wiring with respect to ground. Applied potential shall be 500-V dc for 300-V rated cable and 1000-V dc for 600-V rated cable. Test duration shall be one minute. For units with solid state components, follow manufacturer's recommendation. Insulation resistance values shall be no less than two megohms.
e. Determine the following by primary current injection:

1) Long-time pickup and delay. Pickup values shall be as specified. Trip characteristics shall not exceed manufacturer's published time-current characteristic tolerance band, including adjustment factors.
2) Short-time pickup and delay. Short-time pickup values shall be as specified. Trip characteristics shall not exceed manufacturer's published time-current characteristic tolerance band, including adjustment factors.
3) Ground-fault pickup and time delay. Ground-fault pickup values shall be as specified. Trip characteristics shall not exceed manufacturer's published time-current characteristic tolerance band, including adjustment factors.
4) Instantaneous pickup. Instantaneous pickup values shall be as specified and within manufacturer's published tolerances.

f. Test functionality of the trip unit by means of primary current injection. Pickup values and trip characteristics shall be as specified and within manufacturer's published tolerances.
g. Perform minimum pickup voltage tests on shunt trip and close coils in accordance with manufacturer's published data. Minimum pickup voltage of the shunt trip and close coils shall be as indicated by manufacturer.
h. Verify correct operation of auxiliary features such as trip and pickup indicators; zone interlocking; electrical close and trip operation; trip-free, anti-pump function; and trip unit battery condition. Reset all trip logs and indicators. Investigate units that do not function as designed.
i. Verify operation of charging mechanism. Investigate units that do not function as designed.

3. Correct malfunctioning units on-site, where possible, and retest to demonstrate compliance; otherwise, replace with new units and retest.
4. Perform the following infrared scan tests and inspections and prepare reports:

a. Initial Infrared Scanning: After Substantial Completion, but not more than 60 days after Final Acceptance, perform an infrared scan of each enclosed switch and circuit breaker. Remove front panels so joints and connections are accessible to portable scanner.
b. Follow-up Infrared Scanning: Perform an additional follow-up infrared scan of each enclosed switch and circuit breaker 11 months after date of Substantial Completion.
c. Instruments and Equipment: Use an infrared scanning device designed to measure temperature or to detect significant deviations from normal values. Provide calibration record for device.

5. Test and adjust controls, remote monitoring, and safeties. Replace damaged and malfunctioning controls and equipment.

H. Enclosed switches and circuit breakers will be considered defective if they do not pass tests and inspections.

I. Prepare test and inspection reports.

1. Test procedures used.
2. Include identification of each enclosed switch and circuit breaker tested and describe test results.

3. List deficiencies detected, remedial action taken, and observations after remedial action.

3.7 ADJUSTING

A. Adjust moving parts and operable components to function smoothly, and lubricate as recommended by manufacturer.

END OF SECTION 262816

SECTION 262416 - PANELBOARDS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Distribution panelboards.
2. Lighting and appliance branch-circuit panelboards.

1.3 DEFINITIONS

A. ATS: Acceptance testing specification.

B. GFCI: Ground-fault circuit interrupter.

C. MCCB: Molded-case circuit breaker.

D. SPD: Surge protective device.

E. VPR: Voltage protection rating.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of panelboard.

1. Include materials, switching and overcurrent protective devices, SPDs, accessories, and components indicated.
2. Include dimensions and manufacturers' technical data on features, performance, electrical characteristics, ratings, and finishes.

B. Shop Drawings: For each panelboard and related equipment.

1. Include dimensioned plans, elevations, sections, and details.
2. Show tabulations of installed devices with nameplates, conductor termination sizes, equipment features, and ratings.
3. Detail bus configuration, current, and voltage ratings.
4. Short-circuit current rating of panelboards and overcurrent protective devices.
5. Include evidence of NRTL listing for series rating of installed devices.
6. Include evidence of NRTL listing for SPD as installed in panelboard.

7. Detail features, characteristics, ratings, and factory settings of individual overcurrent protective devices and auxiliary components.

1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data: For testing agency.

B. Panelboard Schedules: For installation in panelboards

1.6 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For panelboards and components to include in emergency, operation, and maintenance manuals. In addition to items specified in Section 017823 "Operation and Maintenance Data," include the following:

1. Manufacturer's written instructions for testing and adjusting overcurrent protective devices.
2. Time-current curves, including selectable ranges for each type of overcurrent protective device that allows adjustments.

1.7 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Keys: **Two** spares for each type of panelboard cabinet lock.
2. Circuit Breakers Including GFCI **Two** spares for each panelboard.
3. Fuses for Fused Switches: Equal to 10 percent of quantity installed for each size and type, but no fewer than three of each size and type.
4. Fuses for Fused Power-Circuit Devices: Equal to 10 percent of quantity installed for each size and type, but no fewer than three of each size and type.

1.8 QUALITY ASSURANCE

A. Manufacturer Qualifications: ISO 9001 or 9002 certified.

1.9 FIELD CONDITIONS

A. Environmental Limitations:

1. Do not deliver or install panelboards until spaces are enclosed and weathertight, wet work in spaces is complete and dry, work above panelboards is complete, and temporary HVAC system is operating and maintaining ambient temperature and humidity conditions at occupancy levels during the remainder of the construction period.

B. Service Conditions: NEMA PB 1, usual service conditions, as follows:

1. Ambient temperatures within limits specified.
2. Altitude not exceeding 6600 feet.

C. Interruption of Existing Electric Service: Do not interrupt electric service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary electric service according to requirements indicated:

1. Notify **Construction Manager** no fewer than four days in advance of proposed interruption of electric service.
2. Do not proceed with interruption of electric service without **Construction Manager's** written permission.
3. Comply with NFPA 70E.

1.10 WARRANTY

A. Manufacturer's Warranty: Manufacturer agrees to repair or replace panelboards that fail in materials or workmanship within specified warranty period.

1. Panelboard Warranty Period: **12** months from date of Substantial Completion.

B. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace SPD that fails in materials or workmanship within specified warranty period.

1. SPD Warranty Period: **Five** years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PANELBOARDS AND LOAD CENTERS COMMON REQUIREMENTS

A. Product Selection for Restricted Space: Drawings indicate maximum dimensions for panelboards including clearances between panelboards and adjacent surfaces and other items. Comply with indicated maximum dimensions.

B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

C. Comply with NEMA PB 1.

D. Comply with NFPA 70.

E. Enclosures: **Surface**-mounted, dead-front cabinets.

1. Rated for environmental conditions at installed location.

a. Indoor Dry and Clean Locations: NEMA 250, **Type 1**.
b. Outdoor Locations: NEMA 250, **Type 3R**.
c. Indoor Locations Subject to Dust, Falling Dirt, and Dripping Noncorrosive Liquids: NEMA 250.

2. Height: 84 inches maximum.
3. Front: Secured to box with concealed trim clamps. For surface-mounted fronts, match box dimensions; for flush-mounted fronts, overlap box. Trims shall cover all live parts and shall have no exposed hardware.
4. Hinged Front Cover: Entire front trim hinged to box and with standard door within hinged trim cover. Trims shall cover all live parts and shall have no exposed hardware.
5. Skirt for Surface-Mounted Panelboards: Same gage and finish as panelboard front with flanges for attachment to panelboard, wall, and ceiling or floor.
6. Gutter Extension and Barrier: Same gage and finish as panelboard enclosure; integral with enclosure body. Arrange to isolate individual panel sections.
7. Finishes:

    a. Panels and Trim: **Steel**, factory finished immediately after cleaning and pretreating with manufacturer's standard two-coat, baked-on finish consisting of prime coat and thermosetting topcoat.
    b. Back Boxes: **Same finish as panels and trim**.
    c. Fungus Proofing: Permanent fungicidal treatment for overcurrent protective devices and other components.

F. Incoming Mains:

1. Location: **Top or Bottom as required**.
2. Main Breaker: Main lug interiors up to 400 amperes shall be field convertible to main breaker.

G. Phase, Neutral, and Ground Buses:

1. Material: **Tin-plated aluminum**.

    a. Plating shall run entire length of bus.
    b. Bus shall be fully rated the entire length.

2. Interiors shall be factory assembled into a unit. Replacing switching and protective devices shall not disturb adjacent units or require removing the main bus connectors.
3. Equipment Ground Bus: Adequate for feeder and branch-circuit equipment grounding conductors; bonded to box.
4. Isolated Ground Bus: Adequate for branch-circuit isolated ground conductors; insulated from box.
5. Full-Sized Neutral: Equipped with full-capacity bonding strap for service entrance applications. Mount electrically isolated from enclosure. Do not mount neutral bus in gutter.
6. Extra-Capacity Neutral Bus: Neutral bus rated 200 percent of phase bus and listed and labeled by an NRTL acceptable to authority having jurisdiction, as suitable for nonlinear loads in electronic-grade panelboards and others designated on Drawings. Connectors shall be sized for double-sized or parallel conductors as indicated on Drawings. Do not mount neutral bus in gutter.
7. Split Bus: Vertical buses divided into individual vertical sections.

H. Conductor Connectors: Suitable for use with conductor material and sizes.

1. Material: **Tin-plated aluminum**.
2. Terminations shall allow use of 75 deg C rated conductors without derating.
3. Size: Lugs suitable for indicated conductor sizes, with additional gutter space, if required, for larger conductors.
4. Main and Neutral Lugs: **Mechanical** type, with a lug on the neutral bar for each pole in the panelboard.
5. Ground Lugs and Bus-Configured Terminators: **Mechanical** type, with a lug on the bar for each pole in the panelboard.
6. Feed-Through Lugs: **Mechanical** type, suitable for use with conductor material. Locate at opposite end of bus from incoming lugs or main device.
7. Subfeed (Double) Lugs: **Mechanical** type suitable for use with conductor material. Locate at same end of bus as incoming lugs or main device.
8. Gutter-Tap Lugs: **Mechanical** type suitable for use with conductor material and with matching insulating covers. Locate at same end of bus as incoming lugs or main device.
9. Extra-Capacity Neutral Lugs: Rated 200 percent of phase lugs mounted on extra-capacity neutral bus.

I. NRTL Label: Panelboards or load centers shall be labeled by an NRTL acceptable to authority having jurisdiction for use as service equipment with one or more main service disconnecting and overcurrent protective devices. Panelboards or load centers shall have meter enclosures, wiring, connections, and other provisions for utility metering. Coordinate with utility company for exact requirements.

J. Future Devices: Panelboards or load centers shall have mounting brackets, bus connections, filler plates, and necessary appurtenances required for future installation of devices.

1. Percentage of Future Space Capacity: **Ten** percent.

K. Panelboard Short-Circuit Current Rating: Rated for series-connected system with integral or remote upstream overcurrent protective devices and labeled by an NRTL. Include label or manual with size and type of allowable upstream and branch devices listed and labeled by an NRTL for series-connected short-circuit rating.

1. Panelboards rated 240 V or less shall have short-circuit ratings as shown on Drawings, but not less than 10,000 A rms symmetrical.
2. Panelboards rated above 240 V and less than 600 V shall have short-circuit ratings as shown on Drawings, but not less than 14,000 A rms symmetrical.

L. Panelboard Short-Circuit Current Rating: Fully rated to interrupt symmetrical short-circuit current available at terminals. Assembly listed by an NRTL for 100 percent interrupting capacity.

1. Panelboards and overcurrent protective devices rated 240 V or less shall have short-circuit ratings as shown on Drawings, but not less than 10,000 A rms symmetrical.
2. Panelboards and overcurrent protective devices rated above 240 V and less than 600 V shall have short-circuit ratings as shown on Drawings, but not less than 14,000 A rms symmetrical.

2.2 PERFORMANCE REQUIREMENTS

A. Seismic Performance: Panelboards shall withstand the effects of earthquake motions determined according to **ASCE/SEI 7**.

1. The term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified."

B. Surge Suppression: Factory installed as an integral part of indicated panelboards, complying with UL 1449 SPD **Type 1**.

2.3 POWER PANELBOARDS

A. Panelboards: NEMA PB 1, distribution type.

B. Doors: Secured with vault-type latch with tumbler lock; keyed alike.

1. For doors more than **36 inches** high, provide two latches, keyed alike.

C. Mains: **Circuit breaker**.

D. Branch Overcurrent Protective Devices for Circuit-Breaker: **Bolt-on circuit breakers**.

E. Branch Overcurrent Protective Devices: Fused switches.

F. Contactors in Main Bus: NEMA ICS 2, Class A, **mechanically** held, general-purpose controller, with same short-circuit interrupting rating as panelboard.

1. Internal Control-Power Source: Control-power transformer, with fused primary and secondary terminals, connected to main bus ahead of contactor connection.
2. External Control-Power Source: **120-V branch circuit**.

2.4 DISCONNECTING AND OVERCURRENT PROTECTIVE DEVICES

A. MCCB: Comply with UL 489, with **interrupting capacity** to meet available fault currents.

1. Thermal-Magnetic Circuit Breakers:

a. Inverse time-current element for low-level overloads.
b. Instantaneous magnetic trip element for short circuits.
c. Adjustable magnetic trip setting for circuit-breaker frame sizes 250 A and larger.

2. Adjustable Instantaneous-Trip Circuit Breakers: Magnetic trip element with front-mounted, field-adjustable trip setting.
3. Electronic Trip Circuit Breakers:

a. RMS sensing.
b. Field-replaceable rating plug or electronic trip.
c. Digital display of settings, trip targets, and indicated metering displays.
d. Multi-button keypad to access programmable functions and monitored data.

e. Ten-event, trip-history log. Each trip event shall be recorded with type, phase, and magnitude of fault that caused the trip.
f. Integral test jack for connection to portable test set or laptop computer.
g. Field-Adjustable Settings:

1) Instantaneous trip.
2) Long- and short-time pickup levels.
3) Long and short time adjustments.
4) Ground-fault pickup level, time delay, and I squared T response.

4. Current-Limiting Circuit Breakers: Frame sizes 400 A and smaller; let-through ratings less than NEMA FU 1, RK-5.
5. GFCI Circuit Breakers: Single- and double-pole configurations with Class A ground-fault protection (6-mA trip).
6. GFEP Circuit Breakers: Class B ground-fault protection (30-mA trip).
7. Arc-Fault Circuit Interrupter Circuit Breakers: Comply with UL 1699; 120/240-V, single-pole configuration.
8. Subfeed Circuit Breakers: Vertically mounted.
9. MCCB Features and Accessories:

a. Standard frame sizes, trip ratings, and number of poles.
b. Breaker handle indicates tripped status.
c. UL listed for reverse connection without restrictive line or load ratings.
d. Lugs: **Mechanical** style, suitable for number, size, trip ratings, and conductor materials.
e. Application Listing: Appropriate for application; Type SWD for switching fluorescent lighting loads; Type HID for feeding fluorescent and HID lighting circuits.
f. Ground-Fault Protection: **Integrally mounted** relay and trip unit with adjustable pickup and time-delay settings, push-to-test feature, and ground-fault indicator.
g. Undervoltage Trip: Set to operate at 35 to 75 percent of rated voltage **with field-adjustable 0.1- to 0.6-second** time delay.

B. Fused Switch: NEMA KS 1, Type HD; clips to accommodate specified fuses; lockable handle.

1. Fuses and Spare-Fuse Cabinet: Comply with requirements specified in Section 262813 "Fuses."
2. Fused Switch Features and Accessories:

a. Standard ampere ratings and number of poles.
b. Mechanical cover interlock with a manual interlock override, to prevent the opening of the cover when the switch is in the on position. The interlock shall prevent the switch from being turned on with the cover open. The operating handle shall have lock-off means with provisions for three padlocks.
c. Auxiliary Contacts: **One** normally open and normally closed contact(s) that operate with switch handle operation.

2.5 IDENTIFICATION

A. Panelboard Label: Manufacturer's name and trademark, voltage, amperage, number of phases, and number of poles shall be located on the interior of the panelboard door.

B. Breaker Labels: Faceplate shall list current rating, UL and IEC certification standards, and AIC rating.

C. Circuit Directory: Directory card inside panelboard door, mounted in **metal frame with transparent protective cover**.

1. Circuit directory shall identify specific purpose with detail sufficient to distinguish it from all other circuits.

D. Circuit Directory: Computer-generated circuit directory mounted inside panelboard door with transparent plastic protective cover.

1. Circuit directory shall identify specific purpose with detail sufficient to distinguish it from all other circuits.

2.6 ACCESSORY COMPONENTS AND FEATURES

A. Accessory Set: Include tools and miscellaneous items required for overcurrent protective device test, inspection, maintenance, and operation.

B. Portable Test Set: For testing functions of solid-state trip devices without removing from panelboard. Include relay and meter test plugs suitable for testing panelboard meters and switchboard class relays.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify actual conditions with field measurements prior to ordering panelboards to verify that equipment fits in allocated space in, and comply with, minimum required clearances specified in NFPA 70.

B. Receive, inspect, handle, and store panelboards according to **NECA 407**.

C. Examine panelboards before installation. Reject panelboards that are damaged, rusted, or have been subjected to water saturation.

D. Examine elements and surfaces to receive panelboards for compliance with installation tolerances and other conditions affecting performance of the Work.

E. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Coordinate layout and installation of panelboards and components with other construction that penetrates walls or is supported by them, including electrical and other types of equipment, raceways, piping, encumbrances to workspace clearance requirements, and adjacent surfaces. Maintain required workspace clearances and required clearances for equipment access doors and panels.

B. Comply with NECA 1.

C. Install panelboards and accessories according to **NECA 407**.

D. Equipment Mounting:

1. Install panelboards on cast-in-place concrete equipment base(s). Comply with requirements for equipment bases and foundations.
2. Attach panelboard to the vertical finished or structural surface behind the panelboard.
3. Comply with requirements for seismic control devices specified in Section 260548.16 "Seismic Controls for Electrical Systems."

E. Temporary Lifting Provisions: Remove temporary lifting eyes, channels, and brackets and temporary blocking of moving parts from panelboards.

F. Comply with mounting and anchoring requirements specified in Section 260548.16 "Seismic Controls for Electrical Systems."

G. Mount top of trim **90 inches** above finished floor unless otherwise indicated.

H. Mount panelboard cabinet plumb and rigid without distortion of box.

I. Mount recessed panelboards with fronts uniformly flush with wall finish and mating with back box.

J. Mount surface-mounted panelboards to steel slotted supports **5/8 inch** in depth. Orient steel slotted supports vertically.

K. Install overcurrent protective devices and controllers not already factory installed.

1. Set field-adjustable, circuit-breaker trip ranges.
2. Tighten bolted connections and circuit breaker connections using calibrated torque wrench or torque screwdriver per manufacturer's written instructions.

L. Make grounding connections and bond neutral for services and separately derived systems to ground. Make connections to grounding electrodes, separate grounds for isolated ground bars, and connections to separate ground bars.

M. Install filler plates in unused spaces.

N. Stub four 1-inch empty conduits from panelboard into accessible ceiling space or space designated to be ceiling space in the future. Stub four 1-inch empty conduits into raised floor space or below slab not on grade.

O. Arrange conductors in gutters into groups and bundle and wrap with wire ties **after completing load balancing**.

P. Mount spare fuse cabinet in accessible location.

3.3 IDENTIFICATION

A. Identify field-installed conductors, interconnecting wiring, and components; install warning signs complying with requirements in Section 260553 "Identification for Electrical Systems."

B. Create a directory to indicate installed circuit loads **after balancing panelboard loads**; incorporate Owner's final room designations. Obtain approval before installing. Handwritten directories are not acceptable. Install directory inside panelboard door.

C. Panelboard Nameplates: Label each panelboard with a nameplate complying with requirements for identification specified in Section 260553 "Identification for Electrical Systems."

D. Device Nameplates: Label each branch circuit device in power panelboards with a nameplate complying with requirements for identification specified in Section 260553 "Identification for Electrical Systems."

E. Install warning signs complying with requirements in Section 260553 "Identification for Electrical Systems" identifying source of remote circuit.

3.4 FIELD QUALITY CONTROL

A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust components, assemblies, and equipment installations, including connections.

B. Perform tests and inspections.

1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.

C. Acceptance Testing Preparation:

1. Test insulation resistance for each panelboard bus, component, connecting supply, feeder, and control circuit.
2. Test continuity of each circuit.

D. Tests and Inspections:

1. Perform each visual and mechanical inspection and electrical test for low-voltage air circuit breakers **and low-voltage surge arrestors** stated in NETA ATS, Paragraph 7.6 Circuit Breakers. **Perform** optional tests. Certify compliance with test parameters.
2. Correct malfunctioning units on-site, where possible, and retest to demonstrate compliance; otherwise, replace with new units and retest.
3. Perform the following infrared scan tests and inspections and prepare reports:

a. Initial Infrared Scanning: After Substantial Completion, but not more than 60 days after Final Acceptance, perform an infrared scan of each panelboard. Remove front panels so joints and connections are accessible to portable scanner.
b. Follow-up Infrared Scanning: Perform an additional follow-up infrared scan of each panelboard 11 months after date of Substantial Completion.
c. Instruments and Equipment:

1) Use an infrared scanning device designed to measure temperature or to detect significant deviations from normal values. Provide calibration record for device.

E. Panelboards will be considered defective if they do not pass tests and inspections.

F. Prepare test and inspection reports, including a certified report that identifies panelboards included and that describes scanning results, with comparisons of the two scans. Include notation of deficiencies detected, remedial action taken, and observations after remedial action.

3.5 ADJUSTING

A. Adjust moving parts and operable components to function smoothly, and lubricate as recommended by manufacturer.

B. Set field-adjustable circuit-breaker trip ranges **as indicated.**

C. Load Balancing: After Substantial Completion, but not more than 60 days after Final Acceptance, measure load balancing and make circuit changes. Prior to making circuit changes to achieve load balancing, inform Architect of effect on phase color coding.

1. Measure loads during period of normal facility operations.
2. Perform circuit changes to achieve load balancing outside normal facility operation schedule or at times directed by the Architect. Avoid disrupting services such as fax machines and on-line data processing, computing, transmitting, and receiving equipment.
3. After changing circuits to achieve load balancing, recheck loads during normal facility operations. Record load readings before and after changing circuits to achieve load balancing.
4. Tolerance: Maximum difference between phase loads, within a panelboard, shall not exceed 20 percent.

3.6 PROTECTION

A. Temporary Heating: Prior to energizing panelboards, apply temporary heat to maintain temperature according to manufacturer's written instructions.

END OF SECTION 262416

SECTION 260533 - RACEWAYS AND BOXES FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Metal conduits, tubing, and fittings.
2. Nonmetal conduits, tubing, and fittings.
3. Metal wireways and auxiliary gutters.

1.3 DEFINITIONS

A. GRC: Galvanized rigid steel conduit.

B. IMC: Intermediate metal conduit.

1.4 ACTION SUBMITTALS

A. Product Data: For surface raceways, wireways and fittings, floor boxes, hinged-cover enclosures, and cabinets.

1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data: For professional engineer.

B. Source quality-control reports.

PART 2 - PRODUCTS

2.1 METAL CONDUITS, TUBING, AND FITTINGS

A. Manufacturers: Subject to compliance with requirements, **provide products by one of the following available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following**:

1. AFC Cable Systems; a part of Atkore International.

2. Allied Tube & Conduit; a part of Atkore International.
3. Anamet Electrical, Inc.
4. FSR Inc.
5. Opti-Com Manufacturing Network, Inc (OMNI).
6. O-Z/Gedney; a brand of Emerson Industrial Automation.
7. Perma-Cote.
8. Picoma Industries, Inc.
9. Plasti-Bond.
10. Republic Conduit.
11. Southwire Company.
12. Thomas & Betts Corporation; A Member of the ABB Group.
13. Western Tube and Conduit Corporation.
14. Wheatland Tube Company.

B. Listing and Labeling: Metal conduits, tubing, and fittings shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

C. GRC: Comply with ANSI C80.1 and UL 6.

D. ARC: Comply with ANSI C80.5 and UL 6A.

E. IMC: Comply with ANSI C80.6 and UL 1242.

F. PVC-Coated Steel Conduit: PVC-coated [**rigid steel conduit**] [**IMC**].

1. Comply with NEMA RN 1.
2. Coating Thickness: 0.040 inch, minimum.

G. EMT: Comply with ANSI C80.3 and UL 797.

H. FMC: Comply with UL 1; **aluminum**.

I. LFMC: Flexible steel conduit with PVC jacket and complying with UL 360.

J. Fittings for Metal Conduit: Comply with NEMA FB 1 and UL 514B.

1. Conduit Fittings for Hazardous (Classified) Locations: Comply with UL 886 and NFPA 70.
2. Fittings for EMT:

    a. Material: **Steel**.
    b. Type: **compression**.

3. Expansion Fittings: PVC or steel to match conduit type, complying with UL 651, rated for environmental conditions where installed, and including flexible external bonding jumper.
4. Coating for Fittings for PVC-Coated Conduit: Minimum thickness of 0.040 inch, with overlapping sleeves protecting threaded joints.

K. Joint Compound for IMC, GRC, or ARC: Approved, as defined in NFPA 70, by authorities having jurisdiction for use in conduit assemblies, and compounded for use to lubricate and protect threaded conduit joints from corrosion and to enhance their conductivity.

2.2 NONMETALLIC CONDUITS, TUBING, AND FITTINGS

A. Manufacturers: Subject to compliance with requirements, [**provide products by the following**] [**provide products by one of the following**] [**available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following**]:

1. AFC Cable Systems; a part of Atkore International.
2. Anamet Electrical, Inc.
3. Arnco Corporation.
4. CANTEX INC.
5. CertainTeed Corporation.
6. Condux International, Inc.
7. Electri-Flex Company.
8. Kraloy.
9. Lamson & Sessions.
10. Niedax Inc.
11. RACO; Hubbell.
12. Thomas & Betts Corporation; A Member of the ABB Group.

B. Listing and Labeling: Nonmetallic conduits, tubing, and fittings shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

C. ENT: Comply with NEMA TC 13 and UL 1653.

D. RNC: **Type EPC-40-PVC**, complying with NEMA TC 2 and UL 651 unless otherwise indicated.

E. LFNC: Comply with UL 1660.

F. Fittings for ENT and RNC: Comply with NEMA TC 3; match to conduit or tubing type and material.

G. Fittings for LFNC: Comply with UL 514B.

H. Solvents and Adhesives: As recommended by conduit manufacturer.

2.3 METAL WIREWAYS AND AUXILIARY GUTTERS

A. Manufacturers: Subject to compliance with requirements, **provide products by one of the following available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following**:

1. B-line, an Eaton business.
2. Hoffman; a brand of Pentair Equipment Protection.

3. MonoSystems, Inc.
4. Square D.

B. Description: Sheet metal, complying with UL 870 and NEMA 250, **Type 1 & Type 3R** unless otherwise indicated, and sized according to NFPA 70.

1. Metal wireways installed outdoors shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

C. Fittings and Accessories: Include covers, couplings, offsets, elbows, expansion joints, adapters, hold-down straps, end caps, and other fittings to match and mate with wireways as required for complete system.

D. Finish: Manufacturer's standard enamel finish.

2.4 BOXES, ENCLOSURES, AND CABINETS

A. Manufacturers: Subject to compliance with requirements, **provide products by one of the following available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following**:

1. Adalet.
2. Crouse-Hinds, an Eaton business.
3. EGS/Appleton Electric.
4. Erickson Electrical Equipment Company.
5. FSR Inc.
6. Hoffman; a brand of Pentair Equipment Protection.
7. Hubbell Incorporated.
8. Kraloy.
9. Milbank Manufacturing Co.
10. MonoSystems, Inc.
11. Oldcastle Enclosure Solutions.
12. O-Z/Gedney; a brand of Emerson Industrial Automation.
13. Plasti-Bond.
14. RACO; Hubbell.
15. Spring City Electrical Manufacturing Company.
16. Stahlin Non-Metallic Enclosures.
17. Thomas & Betts Corporation; A Member of the ABB Group.
18. Topaz Electric; a division of Topaz Lighting Corp.
19. Wiremold / Legrand.

B. General Requirements for Boxes, Enclosures, and Cabinets: Boxes, enclosures, and cabinets installed in wet locations shall be listed for use in wet locations.

C. Sheet Metal Outlet and Device Boxes: Comply with NEMA OS 1 and UL 514A.

D. Cast-Metal Outlet and Device Boxes: Comply with NEMA FB 1, **aluminum**, Type FD, with gasketed cover.

E. Nonmetallic Outlet and Device Boxes: Comply with NEMA OS 2 and UL 514C.

F. Small Sheet Metal Pull and Junction Boxes: NEMA OS 1.

G. Cast-Metal Access, Pull, and Junction Boxes: Comply with NEMA FB 1 and UL 1773, **cast aluminum** with gasketed cover.

H. Box extensions used to accommodate new building finishes shall be of same material as recessed box.

I. Device Box Dimensions: **4 inches square by 2-1/8 inches deep & 4 inches by 2-1/8 inches by 2-1/8 inches deep**

J. Gangable boxes **are allowed**.

K. Cabinets:

1. NEMA 250, **Type 1 & Type 3R** galvanized-steel box with removable interior panel and removable front, finished inside and out with manufacturer's standard enamel.
2. Hinged door in front cover with flush latch and concealed hinge.
3. Key latch to match panelboards.
4. Metal barriers to separate wiring of different systems and voltage.
5. Accessory feet where required for freestanding equipment.
6. Nonmetallic cabinets shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

PART 3 - EXECUTION

3.1 RACEWAY APPLICATION

A. Outdoors: Apply raceway products as specified below unless otherwise indicated:

1. Exposed Conduit: **GRC**.
2. Concealed Conduit, Aboveground: **EMT**.
3. Connection to Vibrating Equipment (Including Transformers and Hydraulic, Pneumatic, Electric Solenoid, or Motor-Driven Equipment): **LFMC**.
4. Boxes and Enclosures, Aboveground: **Type 3R**.

B. Indoors: Apply raceway products as specified below unless otherwise indicated:

1. Exposed, Not Subject to Physical Damage: **EMT**.
2. Exposed, Not Subject to Severe Physical Damage: **EMT**.
3. Exposed and Subject to Severe Physical Damage: **GRC**. Raceway locations include the following:
   a. Mechanical rooms.

4. Concealed in Ceilings and Interior Walls and Partitions: **EMT**
5. Connection to Vibrating Equipment (Including Transformers and Hydraulic, Pneumatic, Electric Solenoid, or Motor-Driven Equipment): FMC, except use LFMC in damp or wet locations.
6. Damp or Wet Locations: **GRC**.

C. Minimum Raceway Size: **3/4-inch** trade size.

D. Raceway Fittings: Compatible with raceways and suitable for use and location.

1. Rigid and Intermediate Steel Conduit: Use threaded rigid steel conduit fittings unless otherwise indicated. Comply with NEMA FB 2.10.
2. PVC Externally Coated, Rigid Steel Conduits: Use only fittings listed for use with this type of conduit. Patch and seal all joints, nicks, and scrapes in PVC coating after installing conduits and fittings. Use sealant recommended by fitting manufacturer and apply in thickness and number of coats recommended by manufacturer.
3. EMT: Use co**mpression**, fittings. Comply with NEMA FB 2.10.
4. Flexible Conduit: Use only fittings listed for use with flexible conduit. Comply with NEMA FB 2.20.

E. Install nonferrous conduit or tubing for circuits operating above 60 Hz. Where aluminum raceways are installed for such circuits and pass through concrete, install in nonmetallic sleeve.

F. Do not install aluminum conduits, boxes, or fittings in contact with concrete or earth.

G. Install surface raceways only where indicated on Drawings.

H. Do not install nonmetallic conduit where ambient temperature exceeds **120 deg F**

3.2 INSTALLATION

A. Comply with NECA 1 and NECA 101 for installation requirements except where requirements on Drawings or in this article are stricter. Comply with NECA 102 for aluminum conduits. Comply with NFPA 70 limitations for types of raceways allowed in specific occupancies and number of floors.

B. Keep raceways at least 6 inches away from parallel runs of flues and steam or hot-water pipes. Install horizontal raceway runs above water and steam piping.

C. Complete raceway installation before starting conductor installation.

D. Comply with requirements in Section 260529 "Hangers and Supports for Electrical Systems" for hangers and supports.

E. Arrange stub-ups so curved portions of bends are not visible above finished slab.

F. Install no more than the equivalent of three 90-degree bends in any conduit run except for control wiring conduits, for which fewer bends are allowed. Support within 12 inches of changes in direction.

G. Conceal conduit and EMT within finished walls, ceilings, and floors unless otherwise indicated. Install conduits parallel or perpendicular to building lines.

H. Support conduit within 12 inchesof enclosures to which attached.

I. Stub-ups to Above Recessed Ceilings:

1. Use EMT, IMC, or RMC for raceways.
2. Use a conduit bushing or insulated fitting to terminate stub-ups not terminated in hubs or in an enclosure.

J. Threaded Conduit Joints, Exposed to Wet, Damp, Corrosive, or Outdoor Conditions: Apply listed compound to threads of raceway and fittings before making up joints. Follow compound manufacturer's written instructions.

K. Coat field-cut threads on PVC-coated raceway with a corrosion-preventing conductive compound prior to assembly.

L. Raceway Terminations at Locations Subject to Moisture or Vibration: Use insulating bushings to protect conductors including conductors smaller than No. 4 AWG.

M. Terminate threaded conduits into threaded hubs or with locknuts on inside and outside of boxes or cabinets. Install bushings on conduits up to 1-1/4-inch trade size and insulated throat metal bushings on 1-1/2-inch trade size and larger conduits terminated with locknuts. Install insulated throat metal grounding bushings on service conduits.

N. Install raceways square to the enclosure and terminate at enclosures with locknuts. Install locknuts hand tight plus 1/4 turn more.

O. Do not rely on locknuts to penetrate nonconductive coatings on enclosures. Remove coatings in the locknut area prior to assembling conduit to enclosure to assure a continuous ground path.

P. Cut conduit perpendicular to the length. For conduits 2-inch trade size and larger, use roll cutter or a guide to make cut straight and perpendicular to the length.

Q. Install pull wires in empty raceways. Use polypropylene or monofilament plastic line with not less than 200-lb tensile strength. Leave at least 12 inches of slack at each end of pull wire. Cap underground raceways designated as spare above grade alongside raceways in use.

R. Install raceway sealing fittings at accessible locations according to NFPA 70 and fill them with listed sealing compound. For concealed raceways, install each fitting in a flush steel box with a blank cover plate having a finish similar to that of adjacent plates or surfaces. Install raceway sealing fittings according to NFPA 70.

S. Install devices to seal raceway interiors at accessible locations. Locate seals so no fittings or boxes are between the seal and the following changes of environments. Seal the interior of all raceways at the following points:

1. Where conduits pass from warm to cold locations, such as boundaries of refrigerated spaces.
2. Where an underground service raceway enters a building or structure.
3. Where otherwise required by NFPA 70.

T. Comply with manufacturer's written instructions for solvent welding RNC and fittings.

U. Expansion-Joint Fittings:

1. Install in each run of aboveground RNC that is located where environmental temperature change may exceed 30 deg F and that has straight-run length that exceeds 25 feet. Install in each run of aboveground RMC **and EMT** conduit that is located where environmental temperature change may exceed 100 deg F and that has straight-run length that exceeds 100 feet.
2. Install type and quantity of fittings that accommodate temperature change listed for each of the following locations:

    a. Outdoor Locations Not Exposed to Direct Sunlight: **125 deg F**.
    b. Outdoor Locations Exposed to Direct Sunlight: **135 deg F** temperature change.
    c. Indoor Spaces Connected with Outdoors without Physical Separation: **125 deg F.** temperature change.

3. Install fitting(s) that provide expansion and contraction for at least 0.00041 inch per foot of length of straight run per deg F of temperature change for PVC conduits. Install fitting(s) that provide expansion and contraction for at least 0.000078 inch per foot of length of straight run per deg F of temperature change for metal conduits.
4. Install expansion fittings at all locations where conduits cross building or structure expansion joints.
5. Install each expansion-joint fitting with position, mounting, and piston setting selected according to manufacturer's written instructions for conditions at specific location at time of installation. Install conduit supports to allow for expansion movement.

V. Mount boxes at heights indicated on Drawings. If mounting heights of boxes are not individually indicated, give priority to ADA requirements. Install boxes with height measured to **center** of box unless otherwise indicated.

W. Recessed Boxes in Masonry Walls: Saw-cut opening for box in center of cell of masonry block, and install box flush with surface of wall. Prepare block surfaces to provide a flat surface for a raintight connection between box and cover plate or supported equipment and box.

X. Horizontally separate boxes mounted on opposite sides of walls so they are not in the same vertical channel.

Y. Locate boxes so that cover or plate will not span different building finishes.

Z. Support boxes of three gangs or more from more than one side by spanning two framing members or mounting on brackets specifically designed for the purpose.

AA. Fasten junction and pull boxes to or support from building structure. Do not support boxes by conduits.

BB. Set metal floor boxes level and flush with finished floor surface.

CC. Set nonmetallic floor boxes level. Trim after installation to fit flush with finished floor surface.

3.3 SLEEVE AND SLEEVE-SEAL INSTALLATION FOR ELECTRICAL PENETRATIONS

A. Install sleeves and sleeve seals at penetrations of exterior floor and wall assemblies. Comply with requirements in Section 260544 "Sleeves and Sleeve Seals for Electrical Raceways and Cabling."

3.4 FIRESTOPPING

A. Install firestopping at penetrations of fire-rated floor and wall assemblies. Comply with requirements in Section 078413 "Penetration Firestopping."

3.5 PROTECTION

A. Protect coatings, finishes, and cabinets from damage and deterioration.

1. Repair damage to galvanized finishes with zinc-rich paint recommended by manufacturer.
2. Repair damage to PVC coatings or paint finishes with matching touchup coating recommended by manufacturer.

END OF SECTION 260533

SECTION 260519 - LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Copper building wire rated 600 V or less.
2. Aluminum building wire rated 600 V or less.
3. Metal-clad cable, Type MC, rated 600 V or less.

1.3 DEFINITIONS

A. RoHS: Restriction of Hazardous Substances.

B. VFC: Variable-frequency controller.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Product Schedule: Indicate type, use, location, and termination locations.

1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data: For **manufacturer's authorized service representative**.

B. Field quality-control reports.

1.6 QUALITY ASSURANCE

A. Testing Agency Qualifications: Member company of NETA.

1. Testing Agency's Field Supervisor: Certified by NETA to supervise on-site testing.

PART 2 - PRODUCTS

2.1 COPPER BUILDING WIRE

A. Description: Flexible, insulated and uninsulated, drawn copper current-carrying conductor with an overall insulation layer or jacket, or both, rated 600 V or less.

B. Manufacturers: Subject to compliance with requirements, **provide products by one of the following available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following**:

1. Alpha Wire Company.
2. American Bare Conductor.
3. Belden Inc.
4. Cerro Wire LLC.
5. Encore Wire Corporation.
6. General Cable Technologies Corporation.
7. Okonite Company (The).
8. Service Wire Co.
9. Southwire Company.
10. WESCO.

C. Standards:

1. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and use.
2. RoHS compliant.
3. Conductor and Cable Marking: Comply with wire and cable marking according to UL's "Wire and Cable Marking and Application Guide."

D. Conductors: Copper, complying with ASTM B 3 for bare annealed copper and with stranded conductors.

E. Conductor Insulation:

1. Type NM: Comply with UL 83 and UL 719.
2. **Type THHN and Type THWN-2**: Comply with UL 83.

2.2 METAL-CLAD CABLE, TYPE MC

A. Description: A factory assembly of one or more current-carrying insulated conductors in an overall metallic sheath.

B. Manufacturers: Subject to compliance with requirements, **provide products by one of the following available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following**:

1. Alpha Wire Company.
2. American Bare Conductor.

3. Belden Inc.
4. Encore Wire Corporation.
5. General Cable Technologies Corporation.
6. Okonite Company (The).
7. Service Wire Co.
8. Southwire Company.
9. WESCO.

C. Standards:

1. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and use.
2. Comply with UL 1569.
3. RoHS compliant.
4. Conductor and Cable Marking: Comply with wire and cable marking according to UL's "Wire and Cable Marking and Application Guide."

D. Circuits:

1. **Single circuit**.
2. Power-Limited Fire-Alarm Circuits: Comply with UL 1424.

E. Conductors: **Copper, complying with ASTM B 3 for bare annealed copper and with ASTM B 8 for stranded conductors**.

F. Ground Conductor: **Insulated**.

G. Conductor Insulation:

1. Type TFN/THHN/THWN-2: Comply with UL 83.

2.3 CONNECTORS AND SPLICES

A. Description: Factory-fabricated connectors and splices of size, ampacity rating, material, type, and class for application and service indicated; listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and use.

B. Manufacturers: Subject to compliance with requirements, **provide products by one of the following available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following**:

1. 3M Electrical Products.
2. AFC Cable Systems; a part of Atkore International.
3. Gardner Bender.
4. Hubbell Power Systems, Inc.
5. Ideal Industries, Inc.
6. ILSCO.
7. NSi Industries LLC.
8. O-Z/Gedney; a brand of Emerson Industrial Automation.
9. Service Wire Co.

10. TE Connectivity Ltd.
11. Thomas & Betts Corporation; A Member of the ABB Group.

PART 3 - EXECUTION

3.1 CONDUCTOR MATERIAL APPLICATIONS

A. Feeders: Copper; solid for No. 10 AWG and smaller; stranded for No. 8 AWG and larger.

B. Feeders: Copper for feeders smaller than No. 4 AWG; copper or aluminum for feeders No. 4 AWG and larger. Conductors shall be solid for No. 10 AWG and smaller; stranded for No. 8 AWG and larger.

C. Branch Circuits: Copper. Solid for No. 10 AWG and smaller; stranded for No. 8 AWG and larger.

D. Branch Circuits: Copper. Solid for No. 12 AWG and smaller; stranded for No. 10 AWG and larger.

3.2 CONDUCTOR INSULATION AND MULTICONDUCTOR CABLE APPLICATIONS AND WIRING METHODS

A. Feeders Concealed in Ceilings, Walls, Partitions, and Crawlspaces: **Type THHN/THWN-2, single conductors in raceway**.

B. Feeders in Cable Tray: **Type THHN/THWN-2, single conductors in raceway. Metal-clad cable, Type MC**.

C. Exposed Branch Circuits, Including in Crawlspaces: **Type THHN/THWN-2, single conductors in raceway. Metal-clad cable, Type MC**.

D. Branch Circuits Concealed in Ceilings, Walls, and Partitions: **Type THHN/THWN-2, single conductors in raceway. Metal-clad cable, Type MC**.

E. Cord Drops and Portable Appliance Connections: Type SO, hard service cord with stainless-steel, wire-mesh, strain relief device at terminations to suit application.

3.3 INSTALLATION OF CONDUCTORS AND CABLES

A. Conceal cables in finished walls, ceilings, and floors unless otherwise indicated.

B. Complete raceway installation between conductor and cable termination points according to Section 260533 "Raceways and Boxes for Electrical Systems" prior to pulling conductors and cables.

C. Use manufacturer-approved pulling compound or lubricant where necessary; compound used must not deteriorate conductor or insulation. Do not exceed manufacturer's recommended maximum pulling tensions and sidewall pressure values.

D. Use pulling means, including fish tape, cable, rope, and basket-weave wire/cable grips that will not damage cables or raceway.

E. Install exposed cables parallel and perpendicular to surfaces of exposed structural members, and follow surface contours where possible.

F. Support cables according to Section 260529 "Hangers and Supports for Electrical Systems."

G. Complete cable tray systems installation according to Section 260536 "Cable Trays for Electrical Systems" prior to installing conductors and cables.

3.4 CONNECTIONS

A. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A-486B.

B. Make splices, terminations, and taps that are compatible with conductor material **and that possess equivalent or better mechanical strength and insulation ratings than unspliced conductors**.

1. Use oxide inhibitor in each splice, termination, and tap for aluminum conductors.

C. Wiring at Outlets: Install conductor at each outlet, with at least **6 inches** of slack.

3.5 IDENTIFICATION

A. Identify and color-code conductors and cables according to Section 260553 "Identification for Electrical Systems."

B. Identify each spare conductor at each end with identity number and location of other end of conductor, and identify as spare conductor.

3.6 SLEEVE AND SLEEVE-SEAL INSTALLATION FOR ELECTRICAL PENETRATIONS

A. Install sleeves and sleeve seals at penetrations of exterior floor and wall assemblies. Comply with NFPA and UL requirements for Electrical Raceways and Cabling.

3.7 FIRESTOPPING

A. Apply firestopping to electrical penetrations of fire-rated floor and wall assemblies to restore original fire-resistance rating of assembly according to Section 078413 "Penetration Firestopping."

3.8 FIELD QUALITY CONTROL

A. Testing Agency: Owner will engage a qualified testing agency to perform tests and inspections.

B. Testing Agency: Engage a qualified testing agency to perform tests and inspections.

C. Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect components, assemblies, and equipment installations, including connections.

D. Perform tests and inspections.

E. Performing NETA ATS tests on all conductors and cables can be expensive. Consider limiting testing to a certain group of conductors, such as service entrance and feeder conductors, or to those conductors feeding critical equipment and services.

1. After installing conductors and cables and before electrical circuitry has been energized, test service entrance and feeder conductors for compliance with requirements.

2. Perform each of the following visual and electrical tests:

a. Inspect exposed sections of conductor and cable for physical damage and correct connection according to the single-line diagram.
b. Test bolted connections for high resistance using one of the following:

1) A low-resistance ohmmeter.
2) Calibrated torque wrench.
3) Thermographic survey.

c. Inspect compression-applied connectors for correct cable match and indentation.
d. Inspect for correct identification.
e. Inspect cable jacket and condition.
f. Insulation-resistance test on each conductor for ground and adjacent conductors. Apply a potential of 500-V dc for 300-V rated cable and 1000-V dc for 600-V rated cable for a one-minute duration.
g. Continuity test on each conductor and cable.
h. Uniform resistance of parallel conductors.

3. Initial Infrared Scanning: After Substantial Completion, but before Final Acceptance, perform an infrared scan of each splice in conductors No. 3 AWG and larger. Remove box and equipment covers so splices are accessible to portable scanner. Correct deficiencies determined during the scan.

a. Instrument: Use an infrared scanning device designed to measure temperature or to detect significant deviations from normal values. Provide calibration record for device.
b. Record of Infrared Scanning: Prepare a certified report that identifies switches checked and that describes scanning results. Include notation of deficiencies detected, remedial action taken, and observations after remedial action.

4. Follow-up Infrared Scanning: Perform an additional follow-up infrared scan of each switch 11 months after date of Substantial Completion.

F. Cables will be considered defective if they do not pass tests and inspections.

G. Prepare test and inspection reports to record the following:

1. Procedures used.
2. Results that comply with requirements.
3. Results that do not comply with requirements, and corrective action taken to achieve compliance with requirements.

END OF SECTION 260519

SECTION 260010 - BASIC ELECTRICAL REQUIREMENTS

PART 1 - GENERAL

1.01 GENERAL

A. Basic Requirements: The Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification sections, apply to work of this section.

B. General Provisions: Provide all labor, materials, equipment, and incidentals required to make ready for use complete electrical systems as specified herein and shown on the drawings.

C. Provide and Install: The word "provide" where used on the Drawings or in the Specifications shall mean "furnish, install, mount, connect, test, complete, and make ready for operation". The word "install" where used on the Drawings or in the Specifications shall mean "mount, connect, test, complete, and make ready for operation". Perform work required by, and in accordance with, the Contract Documents.

D. Installation: Provide and place in satisfactory condition, ready for proper operation, raceways, wires, cables, and other material needed for all complete electrical systems required by the Contract Documents. Additional raceways and wiring shall be provided to complete the installation of the specific equipment provided. Include auxiliaries and accessories for complete and properly operating systems. Provide electrical systems and accessories to comply with the NEC, state and local codes and ordinances. It is the intent of these Specifications that the electrical systems be suitable in every way for the use intended. Material and work which is incidental to the work of this Contract shall be provided at no additional cost to the Contract.

E. Field Connections: Provide field connections to remote equipment and control panels provided under other Divisions of these Specifications. Provide raceway, wire, and interconnections between equipment, transmitters, local indicators, and receivers. Provide 120V and low voltage surge protection equipment in accordance with Section 264313 at equipment as required. Install field connections to "packaged" equipment provided under other Divisions of these Specifications.

1.02 SCOPE OF WORK

A. General: Provide labor, materials, permits, inspections and re-inspection fees, tools, equipment, transportation, insurance, temporary protection, temporary power and lighting, supervision and incidental items essential for proper installation and operation of the Electrical systems indicated in the Contract Documents. Provide materials not specifically mentioned or indicated but which are usually provided or are essential for proper installation and operation of the Electrical systems indicated in the contract documents.

B. Notices: Give notices, file Plans, pay fees, and obtain permits and approvals from authorities having jurisdiction. Include all fees in the Bid Price.

1.03 INTERPRETATION OF DRAWINGS

A. General: The Drawings are diagrammatic and are not intended to show exact locations of Raceway runs, outlet boxes, junction boxes, pull boxes, etc. The locations of equipment,

appliances, fixtures, Raceways, outlets, boxes and similar devices shown on the Drawings are approximate only. Exact locations shall be determined and coordinated in the field. The right is reserved to change, without additional cost, the location of any outlet within the same room or general area before it is permanently installed. Obtain all information relevant to the placing of electrical work and in case of interference with other work, proceed as directed by the Architect.

B. Discrepancies: Notify the Architect of any discrepancies found during construction of the project. The Architect will provide written instructions as to how to proceed with that portion of work. If a conflict exists between the Contract Documents and an applicable code or standard, the most stringent requirement shall apply.

C. Wiring: Each three-phase circuit shall be run in a separate Raceway unless otherwise shown on the Drawings. Unless otherwise accepted by the Architect, Raceway shall not be installed exposed. Where circuits are shown as "home-runs" all necessary fittings, supports, and boxes shall be provided for a complete raceway installation.

D. Layout: Circuit layouts are not intended to show the number of fittings, or other installation details. Connections to equipment shall be made as required, and in accordance with the accepted shop and manufacturer's setting drawings.

E. Coordination: Coordinate final equipment locations with drawings or other disciplines. Layout before installation so that all trades may install equipment in available space. Provide coordination as required for installation in a neat and workmanlike manner.

1.04 EQUIPMENT SIZE AND HANDLING

A. Coordination: Investigate each space in the structure through which equipment must pass to reach its final location. If necessary, ship the equipment in sections of specific sizes to permit the passing through the necessary areas within the structure.

B. Handling: Equipment shall be kept upright at all times. When equipment has to be tilted for ease of passage through restricted areas during transportation, the manufacturer shall be required to brace the equipment suitably, to insure that the tilting does not impair the functional integrity of the equipment.

1.05 RECORD DRAWINGS

A. Production: The Contractor shall provide two (2) sets of black or blue line on white drawings to maintain and submit record "As-Built Documents". Label each sheet of the Record Document set with “Project Record Documents” with company name of the installing contractor in stamped or printed letters. One set shall be maintained at the site and at all times be accurate, clear, and complete. These drawings shall be available at all times to the Architect's field representatives.

B. Recording: Record information concurrent with construction progress. Make entries within 24 hours upon receipt of information. The "As-Built" drawings shall accurately reflect installed electrical work specified or shown on the Contract Documents.

C. Completion: At the completion of the Work, transfer changes with a colored pencil onto the second set and submit to the Architect. The "As-Built" drawings shall be made available to the Architect to make the substantial completion punch list.

D. Final: Upon Contractor's completion of the Engineer's final punch list, transfer all "As-Built" conditions and all requirements by the Engineer to a reproducible set of drawings and CAD files. Submit drawings and CAD disks for review and acceptance. The Contractor shall provide updated disks which include final As-Built conditions.

1.06 ABBREVIATIONS

A. Abbreviations: The following abbreviations or initials may be used:

A/C	Air Conditioning
AC	Alternating Current
ABV CLG	Above Ceiling
ADA	Americans with Disabilities Act
AF	Ampere Frame
AFF	Above Finished Floor
AFG	Above Finished Grade
AHU	Air Handler Unit
AIC	Amps Interrupting Capacity
AL	Aluminum
AMP	Ampere
ANSI	American National Standards Institute
ASA	American Standards Association
AT	Ampere Trip
ATS	Automatic Transfer Switch
AUX	Auxiliary
AWG	American Wire Gauge
BC	Bare Copper
BIL	Basic Impulse Level
BMS	Building Management System
BRKR or BKR	Breaker
CAB	Cabinet
C	Conduit or Raceway
CB	Circuit Breaker
CBM	Certified Ballast Manufacturers
CCTV	Closed Circuit Television
CKT	Circuit
CLEC	Clock Equipment Cabinet
CLG	Ceiling
CO	Conduit or Raceway Only
COAX	Coaxial Cable
COND	Conductor
CONN	Connection
CPU	Central Processing Unit
CRT	Cathode Ray Terminal (Video display terminal)
CT	Current Transformer
CU	Copper
CW	Cold Water
DC	Direct Current
DDC	Direct Digital Control
DEG	Degree
DISC	Disconnect

DO	Draw Out
DN	Down
DPST	Double Pole Single Throw
EMT	Electrical Metallic Tubing
EO	Electrically Operated
EOL	End of Line Resistor
EWC	Electric Water Cooler
FAAP	Fire Alarm Annunciator Panel
FACP	Fire Alarm Control Panel
FCU	Fan Coil Unit
FLA	Full Load Amperes
FM	Factory Mutual
GF	Ground Fault
GFCI	Ground Fault Circuits Interrupter
GND	Ground
HOA	Hand-Off-Automatic
HORIZ	Horizontal
HP	Horsepower
IC	Intercom
ICU	Intensive Care Unit
IEEE	Institute of Electrical and Electronic Engineers
IES	Illuminating Engineering Society
IMC	Intermediate Metallic Raceway
IN	Inches
IT	Instantaneous Trip
IPCEA	Insulated Power Cable Engineers Association
JB	Junction Box
KCMIL	Thousand Circular Mills
KV	Kilovolt
KVA	Kilo-Volt-Amps
KW	Kilowatts
LBS	Pounds
LED	Light Emitting Diode
LT	Light
LTD	Long Time Delay
LTT	Long Time Trip
LTG	Lighting
MAX	Maximum
MCB	Main Circuit Breaker
MCC	Motor Control Center
MCP	Motor Circuit Protector
MIC	Microphone
MIN	Minimum
MLO	Main Lugs Only
MTD	Mounted
MTG	Mounting
MUX	Multiplex (Transponder) Panel
MVA	Mega Volt Amps
N	Neutral
NC	Normally Closed
NEC	National Electrical Code

NECA	National Electrical Contractors Association
NEMA	National Electrical Manufacturers Association
NFPA	National Fire Protection Association
NIC	Not in Contract
NF	Non Fused
NL	Non Linear
NO	Number or Normally Open
#	Number
∅	Phase
OL	Overload
OSHA	Occupational Safety and Health Administration
P	Pole
PB	Pullbox
PIV	Post Indicator Valve
PNL	Panel
PR	Pair
PWR	Power
PF	Power Factor
PRI	Primary
PT	Potential Transformer
PVC	Polyvinylchloride
REF	Refrigerator
RGC or GRC	Rigid Galvanized Raceway
RMS	Root-Mean-Square
RPM	Revolutions Per Minute
RECPT	Receptacle
SCA	Short Circuit Amps
SD	Smoke Detector
SEC	Secondary
S/N	Solid Neutral
SPKR	Speaker
SPST	Single Pole Single Throw
SST	Solid State Trip
ST	Short Time Trip
STD	Short Time Delay
SW	Switch
SWGR	Switchgear
SWBD	Switchboard
TEL	Telephone
TTB	Telephone Terminal Board
TTC	Telephone Terminal Cabinet
TVEC	Television Equipment Cabinet
TYP	Typical
UL	Underwriters Laboratories
UON	Unless Otherwise Noted
V	Volt
VFD	Variable Frequency Drive
VSD	Variable Speed Drive
W	Wire
WP	Weatherproof
XFMR	Transformer

1.07 CODES, FEES, AND STANDARDS

A. Application: The codes, standards and practices listed herein generally apply to the entire project and specification sections. Other codes, standards or practices that are more specific will be referenced within a particular specification.

B. Requirements: All materials and types of construction covered in the specifications will be required to meet or exceed applicable standards of manufacturer, testing, performance, and installation according to the requirements of UL, ANSI, NEMA, IEEE, and NEC referenced documents where indicated and the manufacturer's recommended practices. Requirements indicated on the contract documents that exceed but are not contrary to governing codes shall be followed.

C. Compliance and Certification: The installation shall comply with the governing state and local codes or ordinances. The completed electrical installation shall be inspected and certified by applicable agencies that it is in compliance with codes.

D. Utility Company: Comply with latest utility company regulations.

E. Building Code: Florida Building Code (2010 w/addendums).

1. Code of Miami-Dade County (Chapter 8)

F. Labels: Materials and equipment shall be new and free of defects, and shall be U.L. listed, bear the U.L. label or be labeled or listed with an approved, nationally recognized Electrical Testing Agency. Where no labeling or listing service is available or desired for certain types of equipment, test data shall be submitted to validate that equipment meets or exceeds available standards.

G. NFPA: National Fire Protection Association (NFPA) Standards

NFPA-70	(2011)	National Electrical Code
NFPA-72	(2013)	National Fire Alarm Code

H. AIA Guidelines, 2006 Edition

1.08 INVESTIGATION OF SITE

A. General: Before commencing work, verify existing conditions at the premises including, but not limited to, existing structural frame, existing openings; existing wall and partition locations, existing mechanical and electrical work, equipment type, and examine adjoining work on which work is in anyway dependent.

B. Responsibility: No waiver of responsibility for defective and inadequate work or additional cost as a result of existing conditions which should have been verified shall be considered unless notice of same has been filed by the Contractor and agreed to in writing by the Architect before the bid date.

C. Site Renovation: Verify and coordinate existing site raceways and pipes at any excavation on site. Provide hand-digging and required rerouting in areas of existing Raceways and pipes within bid price.

D. Renovation: Investigate site thoroughly and reroute raceway and wiring in area of new construction in order to maintain continuity of existing circuitry. Existing Raceways shown on plans show approximate locations only.

E. Special Considerations: Special attention is called to the fact that there will be piping, fixtures or other items in the existing building which must be removed or relocated in order to perform the alteration work. Include removal and relocation required for completion of the alterations and the new construction. All existing wiring that is to remain in renovated areas shall be made code compliant.

F. Power Outage: Special attention is called to the fact that work involved is in connection with existing buildings which shall remain in operation while work is being performed. Work must be done in accordance with the priority schedule. Schedule work for a minimum outage to Owner. Request written permission and receive written acceptance from the Owner no later than 72 hours in advance of power and communication shut-downs. Perform work required at other than standard working hours where outages cannot be accepted by Owner during regular working hours. Protect existing buildings and equipment during construction.

1.09 SUPERVISION OF THE WORK

A. Supervision: Provide one field superintendent who has had a minimum of four (4) years previous successful experience on projects of comparable sizes, type and complexity. The Superintendent shall be present at all times when work is being performed. At least one member of the Electrical Contracting Firm shall hold a State Master Certificate of Competency.

1.10 COORDINATION

A. General: Compare drawings and specifications with those of other trades and report any discrepancies between them to the Architect. Obtain from the Architect written instructions to make the necessary changes in any of the affected work. Work shall be installed in cooperation with other Trades installing interrelated work. Before installation, Trades shall make proper provisions to avoid interferences in a manner approved by the Architect.

B. Provide all required coordination and supervision where work connects to or is affected by work of others, and comply with all requirements affecting this Division. Work required under other divisions, specifications or drawings to be performed by this Division shall be coordinated with the Contractor and such work performed at no additional cost to Owner including but not limited to electrical work required for:

1. Door hardware
2. Roll-up doors
3. Roll-up grilles
4. Signage
5. Fire shutters
6. Elevators

7. Escalators
8. Sliding or automatic doors
9. Mechanical Division of the Specifications
10. Landscape Architect drawings
11. Lifts
12. Laundry equipment
13. Kitchen equipment
14. Conveyors
15. Interior design drawings
16. Fountains
17. Millwork design drawings and shop drawings

C. Obtain set of Contract Documents from Owner's Authorized Representative or Contractor for all areas of work noted above and include all electrical work in bid whether included in Division 26 Contract Documents or not.

D. Secure approved shop drawings from all required disciplines and verify final electrical characteristics before roughing power feeds to any equipment. When electrical data on approved shop drawings differs from that shown or called for in Construction Documents, make adjustments to the wiring, disconnects, and branch circuit protection to match that required for the equipment installed.

E. Damage from interference caused by inadequate coordination shall be corrected at no additional cost to the Owner.

F. Adjustments: Locations of raceway and equipment shall be adjusted to accommodate the work with interferences anticipated and encountered. Determine the exact routing and location of systems prior to fabrication or installation.

G. Priorities: Lines which pitch shall have the right of way over those which do not pitch. For example, plumbing drains shall normally have the right of way. Lines whose elevations cannot be changed shall have the right of way over lines whose elevations can be changed.

H. Modifications: Offsets and changes of direction in raceway systems shall be made to maintain proper headroom and pitch of sloping lines whether or not indicated on the drawings. Provide elbows, boxes, etc., as required to allow offsets and changes to suit job conditions.

I. Replacement: Work shall be installed in a way to permit removal (without damage to other parts) of other system components provided under this Contract requiring periodic replacement or maintenance. Raceway shall be arranged in a manner to clear the openings of swinging overhead access doors as well as ceiling tiles.

J. Layout: The Contract Drawings are diagrammatic only intending to show general runs and locations of raceway and equipment, and not necessarily showing required offsets, details and accessories and equipment to be connected. Work shall be accurately laid out with other Trades to avoid conflicts and to obtain a neat and workmanlike installation, which will afford maximum accessibility for operation, maintenance and headroom.

K. Contract Conflicts: Where discrepancies exist in the Scope of Work as to what Trade provides items such as starters, disconnects, flow switches, etc. such conflicts shall be coordinated between

the divisions involved. It is the intent of the Contract Documents that all work shall be provided complete as one bid price.

L. Drawing Conflicts: Where drawing details, plans or specification requirements are in conflict and where sizes of the same item run are shown to be different within the contract documents, the most stringent requirement shall be included in the Contract. Systems and equipment called for in the specification or as shown on the drawings shall be provided as if it was required by both the drawings and specifications. Prior to ordering or installation of any portion of work, which appears to be in conflict, such work shall be brought to Architect's attention for direction as to what is to be provided.

M. It is the responsibility of this Contractor to coordinate the exact required location of floor outlets, floor ducts, floor stub-ups, etc. with Owner’s Authorized Representative and Designer (and receive their approval) prior to rough-in. Locations indicated in Contract Documents are only approximate locations.

N. The Contract Documents describe specific sizes of switches, breakers, fuses, Raceways, conductors, motor starters and other items of wiring equipment. These sizes are based on specific items of power consuming equipment (heaters, lights, motors for fans, compressors, pumps, etc.). Coordinate the requirements of each load with each load’s respective circuitry shown and with each load’s requirements as noted on its nameplate data and manufacturer’s published electrical criteria. Adjust circuit breaker, fuse, Raceway, and conductor sizes to meet the actual requirements of the equipment being provided and installed and change from single point to multiple points of connection (or vice versa) to meet equipment requirements. Changes shall be made at no additional cost to the Owner.

O. Working Clearances: Minimum working clearances about electrical equipment shall be as referenced in the applicable edition NEC Article 110, and shall include equipment installed in ceiling spaces.

1.11 DEMOLITION

A. General: Relocate existing equipment and reroute existing raceways in areas being renovated as required to facilitate the installation of the new systems. The Owner shall require continuous operation of the existing systems, while demolition, relocation work or new tie-ins are performed.

B. Coordination: Prior to any deactivation, relocation or demolition work, arrange a conference with the Architect and the Owner's representative in the field to inspect each of the items to be deactivated, removed or relocated. Care shall be taken to protect equipment designated as being relocated and reused or equipment remaining in operation and integrated with the new systems.

C. Provisions: Deactivation, relocation, and temporary tie-ins shall be provided by the Contractor. Demolition, removal and the legal disposal of demolished materials shall be provided by the Contractor.

D. Owner’s Salvage: The Owner reserves the right to inspect the material scheduled for removal and salvage any items he deems usable as spare parts.

E. Phasing: The Contractor shall perform work in phases as directed by the Architect to suit the project progress schedule, as well as the completion date of the project.

PART 2 - PRODUCTS

2.01 MATERIALS

A. Specified Method: Where several brand names, make or manufacturers are listed as acceptable each shall be regarded as equally acceptable, based on the design selection but each must meet all specification requirements. Where a manufacturer's model number is listed, this model shall set the standard of quality and performance required. Where no brand name is specified, the source and quality shall be subject to Engineer's review and acceptance. Where manufacturers are listed, one of the listed manufacturers shall be submitted for acceptance. No substitutions are permitted.

B. Certification: When a product is specified to be in accordance with a trade association or government standard requested by the Engineer, Contractor shall provide a certificate that the product complies with the referenced standard. Upon request of Engineer, Contractor shall submit supporting test data to substantiate compliance.

C. Basis of Bid: Each bidder represents that his bid is based upon the manufacturer's, materials, and equipment described in the Contract Documents.

2.02 EQUIPMENT, MATERIALS, AND SUPPORTS

A. General: Each item of equipment or material shall be manufactured by a company regularly engaged in the manufacturer of the type and size of equipment, shall be suitable for the environment in which it is to be installed, shall be approved for its purpose, environment, and application, and shall bear the UL label.

B. Installation Requirements: Each item of equipment or material shall be installed in accordance with instructions and recommendations of the manufacturer, however, the methods shall not be less stringent than specified herein.

C. Required Accessories: Provide all devices and materials, such as expansion bolts, foundation bolts, screws, channels, angles, and other attaching means, required to fasten enclosures, raceways, and other electrical equipment and materials to be mounted on structures which are existing or new.

D. Protection: Electrical equipment shall at all times during construction be adequately protected against mechanical injury or damage by the elements. Equipment shall be stored in dry permanent shelters. If apparatus has been damaged, such damage shall be repaired at no additional cost or time extension to the Contract. If apparatus has been subject to possible injury, it shall be thoroughly cleaned, dried out and put through tests as directed by the Manufacturer and Engineer, or shall be replaced, if directed by the Engineer, at no additional cost to the Contract.

2.03 IDENTIFICATION OF EQUIPMENT

A. General: Electrical items shall be identified as specified in the Contract Documents. Such identification shall be in addition to the manufacturer's nameplates and shall serve to identify the item's function and the equipment or system, which it serves or controls. Refer to Identification Section of the specifications for additional information.

2.04 SURFACE MOUNTED EQUIPMENT

A. General: Surface mounted fixtures, outlets, cabinets, panels, etc. shall have a factory-applied finish or shall be painted as accepted by Engineer. Raceways and fittings, where allowed to be installed surface mounted, shall be painted to match the finish on which it was installed. Paint shall be in accordance with other applicable sections of these specifications.

2.05 CUTTING AND PATCHING

A. Core Drilling: The Contractor shall be responsible for core drilling as required for work under this section, but in no case shall the Contractor cut into or weld onto any structural element of the project without the written approval of the Architect.

B. Cutting and Patching: Cutting, rough patching and finish patching shall be provided as specified in the contract documents. Cutting and patching shall be performed in a neat and workmanlike manner. Upon completion, the patched area shall match adjacent surfaces.

C. Openings and Sleeves: Locate openings required for work performed under this section. Provide sleeves, guards or other accepted methods to allow passage of items installed under this section.

D. Roof Penetration: Provide roofer with pitch pans, fittings, etc., required for electrical items which penetrate the roof. Roof penetrations are to be waterproofed in such a manner that roofing guarantees are fully in force. Roof penetrations shall be coordinated with other Trades to ensure that roof warranty is not invalidated.

2.06 SLEEVES AND FORMS FOR OPENINGS

A. Sleeves: Provide sleeves for Raceways penetrating floors, walls, partitions, etc. Locate necessary slots for electrical work and form before concrete is poured. Watertight sleeves shall be line seal type WS. Fire rated partition sleeves shall be mild steel. Sleeves shall be Schedule 40 PVC or galvanized rigid steel unless specifically noted otherwise. Size shall be one standard diameter larger than pipe being installed or of a larger diameter to below 1/4" minimum clearance.

B. Forms: Provide boxed out forms for Raceway penetrations only where allowed by the Architect. Fill opening after Raceway installation, with equivalent material.

2.07 OPERATING AND MAINTENANCE INSTRUCTIONS

A. General: Thoroughly instruct the Owner’s Representative, to the complete satisfaction of the Architect and Engineer, in the proper operation of all systems and equipment provided. The Contractor shall make all arrangements, via the Architect, as to whom the instructions are to be given in the operation of the systems and the period of time in which they are to be given. The Architect shall be completely satisfied that the Owner’s Representative has been thoroughly and completely instructed in the proper operation of all systems and equipment before final payment is made. If the Architect determines that complete and thorough instructions have not been given by the Contractor to the Owner's Representative, then the Contractor shall be directed by the Architect to provide whatever instructions are necessary until the intent of this paragraph of the Specification has been complied with.

B. Information Requirements: Information shall indicate possible problems with equipment and suggested corrective action. The manuals shall be indexed for each type of equipment. Each

section shall be clearly divided from the other sections. A sub index for each section shall also be provided.

C. Instructions: The instructions shall contain information deemed necessary by the Architect and include but not limited to the following:

1. Introduction:
   a. Explanation of Manual and its use.
   b. Summary description of the Electrical Systems.
   c. Purpose of systems.

2. System:
   a. Detailed description of all systems.
   b. Illustrations, schematics, block diagrams, catalog cuts and other exhibits.

3. Operations:
   a. Complete detailed, step by step, sequential description of all phases of operation for all portions of the systems, including start up, shutdown and balancing. Include posted instruction charts.

4. Maintenance:
   a. Parts list and part numbers.
   b. Maintenance and replacement charts and the Manufacturer's recommendations for preventive maintenance.
   c. Trouble shooting charts for systems and components.
   d. Instructions for testing each type of part.
   e. Recommended list of on-hand spare parts.
   f. Complete calibration instructions for all parts and entire systems.
   g. General and miscellaneous maintenance notes.

5. Manufacturer's Literature:
   a. Complete listing for all parts.
   b. Names, addresses and telephone numbers.
   c. Care and operation.
   d. All pertinent brochures, illustrations, drawings, cuts, bulletins, technical data, certified performance charts and other literature with the model actually furnished to be clearly and conspicuously identified.
   e. Internal wiring diagrams and Engineering data sheets for all items and/or equipment furnished under each Contract.
   f. Guarantee and warranty data.

2.08 EXISTING CONDITIONS

A. Support: Existing Raceway and cables within the area of renovation shall be provided with proper supports as specified for new work in other sections of this specification.

B. Installation: Existing electrical which is designated for reworking or requires relocation, repair or adjustment shall conform to applicable codes and shall be treated as new work complying to all sections of this specification.

C. Violations: Where existing conditions are discovered which are not in compliance with the codes and standards, the Contractor shall submit proper documentation to the Architect for clarification and corrective work direction. Existing conditions shall not remain which will create a disapproval of the renovated area.

D. Patching: Existing Raceway and cable penetrations shall be properly fire treated per code and specification requirements. The Contractor shall thoroughly inspect existing locations and include the cost of patching and repair in his proposed construction cost.

PART 3 - EXECUTION

3.01 WORKMANSHIP

A. General: The installation of materials and equipment shall be performed in a neat, workmanlike and timely manner by an adequate number of craftsmen knowledgeable of the requirements of the Contract Documents. They shall be skilled in the methods and craftsmanship needed to produce a quality level of workmanship. Personnel who install materials and equipment shall be qualified by training and experience to perform their assigned tasks.

B. Acceptable Workmanship: Acceptable workmanship is characterized by first-quality appearance and function, conforming to applicable standards of building system construction, and exhibiting a high degree of quality and proficiency which is judged by the Architect as equivalent or better than that ordinarily produced by qualified industry tradesmen.

C. Performance: Personnel shall not be used in the performance of the installation of material and equipment who, in the opinion of the Architect, are deemed to be careless or unqualified to perform the assigned tasks. Material and equipment installations not in compliance with the Contract Documents, or installed with substandard workmanship and not acceptable to the Architect, shall be removed and reinstalled by qualified craftsmen, at no change in the contract price.

3.02 PROTECTION AND CLEAN UP

A. Protection and Restoration: Suitably protect equipment provided under this Division during construction. Restore damaged surfaces and items to "like new" condition before a request for substantial completion inspection.

B. Handling: Materials shall be properly protected and Raceway openings shall be temporarily closed by the Contractor to prevent obstruction and damage. Post notice prohibiting the use of systems provided under this Contract, prior to completion of work and acceptance of systems by the Owner's representative. The Contractor shall take precautions to protect his materials from damage and theft.

C. Safeguards: The Contractor shall furnish, place and maintain proper safety guards for the prevention of accidents that might be caused by the workmanship, materials, equipment or systems provided under this contract.

D. Cleanup: Keep the job site free from debris and rubbish. Remove debris and rubbish from the site and leave premises in clean condition on a daily basis.

3.03 SYSTEMS GUARANTEE

A. General: Provide a one-year guarantee. This guarantee shall be by the Contractor to the Owner for any defective workmanship or material, which has been provided under this Contract at no cost to the Owner for a period of one year from the date of substantial completion of the System. The guarantee shall include lamps, for ninety days after date of Substantial Completion of the System. Explain the provisions of guarantee to the Owner at the "Demonstration of Completed System".

3.04 FINAL OBSERVATION

A. General: Work shall be completed, and forms and other information shall be submitted for acceptance one week prior to the request for final observation of the installation.

3.05 SPECIAL CONSIDERATIONS

A. Comply with special requirements imposed at site by Owner. This may include badging of employees, prohibition of smoking, special working hours, or special working conditions.

END OF SECTION 260010

CERTIFICATE OF COMPLETED DEMONSTRATION MEMO

Note to Contractor: Do not submit this form at the time Technical Information Brochure is submitted. Submit five copies of information listed below for checking at least one week before scheduled completion of the building. After information has been accepted and inserted in each brochure, give the Owner a Demonstration of the Completed Electrical Systems and have the Owner sign five copies of this form. Provide one signed copy for each brochure. After this has been done, a written request for a final inspection of the System shall be made.

Re: _____
(Name of Project)

_____
(Division Number and Name)

This memo is for the information of all concerned that the Owner has been given a Demonstration of the Completed Electrical Systems on the work covered under this Division. This conference consisted of the system operation, a tour on which all major items of equipment were pointed out, and the following items were given to the Owner;

(a) Owner's copy of Technical Information Brochure containing approved submittal sheets on all items, including the following; (To be inserted in the Technical Information Brochure after the correct tab).
    (1) Maintenance Information published by manufacturer on equipment items.
    (2) Printed Warranties by manufacturers on equipment items.
    (3) Performance verification information as recorded by the Contractor.
    (4) Check-out Memo on equipment by manufacturer's representative.
    (5) Written operating instructions on any specialized items.
    (6) Explanation of the one-year guarantee on the system.

(b) "As-Built" conditions as described in the record drawing specifications.
(c) A demonstration of the System in Operation and of the maintenance procedures which shall be required.

_____
(Name of General Contractor)

By: _____
(Authorized Signature, Title & Date)

_____
(Name of SubContractor)

By: _____
(Authorized Signature, Title & Date)

Brochure, Instruction, Prints, Demonstration & Instruction in Operation Received:

_____
(Name of Owner)

By: _____
(Authorized Signature, Title, Date)

cc: Owner, Architect, Engineer, Contractor, Sub Contractor and General Contractor
(List names as stated in cc: above)

SECTION 236416 - CENTRIFUGAL WATER CHILLERS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Packaged, water-cooled, electric-motor-driven centrifugal chillers.
2. Packaged, portable refrigerant recovery units.

B. Related Section:

1. Retain subparagraph below for requirements Contractor might expect to find in this Section but are specified in other Sections.

C. Division 23 Section "Refrigerant Detection and Alarm" for refrigerant monitors, alarms, supplemental breathing apparatus, and ventilation equipment interlocks.

1.3 DEFINITIONS

A. BAS: Building automation system.

B. COP: Coefficient of performance. The ratio of the rate of heat removal to the rate of energy input using consistent units for any given set of rating conditions.

C. EER: Energy-efficiency ratio. The ratio of the cooling capacity given in terms of Btu/h to the total power input given in terms of watts at any given set of rating conditions.

D. IPLV: Integrated part-load value. A single-number part-load efficiency figure of merit calculated per the method defined by AHRI 550/590 and referenced to AHRI standard rating conditions.

E. 0.832 kW/Ton: The ratio of total power input of the chiller in kilowatts to the net refrigerating capacity in tons (kW) at any given set of rating conditions.

F. NPLV: Nonstandard part-load value. A single-number part-load efficiency figure of merit calculated per the method defined by AHRI 550/590 and intended for operating conditions other than the AHRI standard rating conditions.

1.4 PERFORMANCE REQUIREMENTS

A. Seismic Performance: Centrifugal chillers shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.

1. The term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified and the unit will be fully operational after the seismic event."

B. Condenser-Fluid Temperature Performance:

1. Startup Condenser-Fluid Temperature: Chiller shall be capable of starting with an entering condenser-fluid temperature of 40 deg F (4 deg C) and providing stable operation until the system temperature is elevated to the minimum operating entering condenser-fluid temperature.
2. Minimum Operating Condenser-Fluid Temperature: Chiller shall be capable of continuous operation over the entire capacity range indicated with an entering condenser-fluid temperature of 65 deg F (18 deg C).
3. Make factory modifications to standard chiller design if necessary to comply with performance indicated.

C. Site Altitude: Chiller shall be suitable for altitude at which installed without affecting performance indicated. Make adjustments to affected chiller components to account for site altitude.

D. Performance Tolerance: Comply with the following in lieu of AHRI 550/590:

1. Allowable Capacity Tolerance: Zero percent.
2. Allowable IPLV/NPLV Performance Tolerance: Zero percent.

1.5 SUBMITTALS

A. Product Data: For each type of product indicated. Include refrigerant, rated capacities, operating characteristics, furnished specialties, and accessories.

1. Performance at AHRI standard conditions and at conditions indicated.
2. Performance at AHRI standard unloading conditions.
3. Minimum evaporator flow rate.
4. Refrigerant capacity of chiller.
5. Oil capacity of chiller.
6. Fluid capacity of evaporator, condenser.
7. Characteristics of safety relief valves.
8. Minimum entering condenser-fluid temperature.
9. Performance at varying capacities with constant design condenser-fluid temperature. Repeat performance at varying capacities for different condenser-fluid temperatures from design to minimum in 5 deg F (3 deg C) increments.

B. LEED Submittals:

1. Product Data for Credit EA 4: Documentation indicating that equipment and refrigerants comply.

C. Shop Drawings: Include plans, elevations, sections, details, and attachments to other work.

1. Detail equipment assemblies and indicate dimensions, weights, load distribution, required clearances, method of field assembly, components, and location and size of each field connection.
2. Wiring Diagrams: For power, signal, and control wiring.

1.6 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Floor plans, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:

1. Structural supports.
2. Piping roughing-in requirements.
3. Wiring roughing-in requirements, including spaces reserved for electrical equipment.
4. Access requirements, including working clearances for mechanical controls and electrical equipment, and tube pull and service clearances.

B. Certificates: For certification required in "Quality Assurance" Article.

C. Seismic Qualification Certificates: For chillers, accessories, and components, from manufacturer.

1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.

D. Source quality-control reports.

E. Startup service reports.

F. Warranty: Sample of special warranty.

1.7 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For each chiller to include in emergency, operation, and maintenance manuals.

1.8 QUALITY ASSURANCE

A. AHRI Certification: Certify chiller according to AHRI 550 certification program.

B. AHRI Rating: Rate chiller performance according to requirements in AHRI 550/590.

C. ASHRAE Compliance:

1. ASHRAE 15 for safety code for mechanical refrigeration.
2. ASHRAE 147 for refrigerant leaks, recovery, and handling and storage requirements.

D. ASHRAE/IESNA Compliance: Applicable requirements in ASHRAE/IESNA 90.1.

E. ASME Compliance: Fabricate and label chillers to comply with ASME Boiler and Pressure Vessel Code: Section VIII, Division 1, as applicable to chiller design. For chillers charged with R-134a refrigerant, include an ASME U-stamp and nameplate certifying compliance.

F. Comply with NFPA 70.

G. Comply with requirements of UL and UL Canada, and include label by a qualified testing agency showing compliance.

1.9 DELIVERY, STORAGE, AND HANDLING

A. Ship each chiller with a full charge of refrigerant. Charge each chiller with nitrogen if refrigerant is shipped in containers separate from chiller.

1.10 COORDINATION

A. Coordinate sizes and locations of concrete bases with actual equipment provided. Cast anchor-bolt inserts into bases.

B. Coordinate sizes, locations, and anchoring attachments of structural-steel support structures.

1.11 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of chillers that fail in materials or workmanship within specified warranty period.

1. Extended warranties include, but are not limited to, the following:

a. Complete chiller including refrigerant and oil charge.
b. Complete compressor and drive assembly including refrigerant and oil charge.
c. Refrigerant and oil charge.
d. Parts and labor].
e. Loss of refrigerant charge for any reason.

2. Warranty Period: Five years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Basis-of-Design Product: Subject to compliance with requirements, provide the product indicated on Drawings or a comparable product by one of the following:

1. Carrier Corporation; a United Technologies company.
2. McQuay International.
3. Trane; a division of American Standard.
4. YORK by Johnson Controls.
5. SMARDT Inc.

2.2 MANUFACTURED UNIT

A. Description: Factory-assembled and -tested chiller complete with compressor, compressor motor, compressor motor controller, lubrication system evaporator, condenser, heat-reclaim condenser as indicated, controls, interconnecting unit piping and wiring, and indicated accessories.

1. Disassemble chiller into major assemblies as required by the installation after factory testing and before packaging for shipment.
2. For chillers with multiple compressors, provide each compressor with a dedicated motor and motor controller, and provide for continued operation when either compressor-drive assembly fails or is being serviced.

B. Fabricate chiller mounting base with reinforcement strong enough to resist chiller movement during a seismic event when chiller is anchored to field support structure.

2.3 COMPRESSOR-DRIVE ASSEMBLY

A. Description: Single-stage or multistage, variable-displacement, centrifugal-type compressor driven by an electric motor.

1. Where indicated, provide oil-free compressor technology using a permanent magnet synchronous motor, magnetic bearings, integral variable frequency controller, and digital electronic controls.

B. Compressor:

1. Casing: Cast iron, precision ground.
2. Impeller: High-strength cast aluminum or cast-aluminum alloy on carbon- or alloy-steel shaft.

C. Drive: Direct- or gear-drive, open or hermetic design using an electric motor as the driver.

1. Gear Drives: For chillers with gear drives, provide single- or double-helical gear design continuously coated with oil while chiller is operating. Gears shall comply with American Gear Manufacturer Association standards.
2. Drive Coupling: For chillers with open drives, provide flexible disc with all-metal construction and no wearing parts to ensure long life without the need for lubrication.
3. Seals: Seal drive assembly to prevent refrigerant leakage.

D. Compressor Motor:

1. Continuous-duty, squirrel-cage, induction-type, two-pole motor with energy efficiency required to suit chiller energy efficiency indicated.
2. Factory mounted, aligned, and balanced as part of compressor assembly before shipping.
3. Motor shall be of sufficient capacity to drive compressor throughout entire operating range without overload and with sufficient capacity to start and accelerate compressor without damage.
4. For chillers with open drives, provide motor with totally enclosed enclosure.
5. Provide motor with thermistor or RTD in each of three-phase motor windings to monitor temperature and report information to chiller control panel.
6. Provide motor with thermistor or RTD to monitor bearing temperature and report information to chiller control panel.
7. Provide open-drive motor with internal electric heater, internally powered from chiller power supply.

E. Vibration Balance: Balance chiller compressor and drive assembly to provide a precision balance that is free of noticeable vibration over the entire operating range.

1. Overspeed Test: 25 percent above design operating speed.

F. Service: Easily accessible for inspection and service.

1. Compressor's internal components shall be accessible without having to remove compressor-drive assembly from chiller.
2. Provide lifting lugs or eyebolts attached to casing.

G. Economizers: For multistage chillers, provide interstage economizers.

H. Capacity Control: Modulating, variable-inlet, guide-vane assembly combined with hot-gas bypass, if necessary, to achieve performance indicated.

1. Maintain stable operation that is free of surge, cavitation, and vibration throughout range of operation. Configure to achieve most energy-efficient operation possible.
2. Operating Range: From 100 to 15 percent of design capacity.
3. Condenser-Fluid Unloading Requirements over Operating Range: Drop-in entering condenser-fluid temperature of 2.5 deg F (1.4 deg C) for each 10 percent in capacity reduction .
4. Chillers with variable frequency controllers shall modulate compressor speed with variable-inlet, guide-vane control to achieve optimum energy efficiency.

I. Oil Lubrication System: Consisting of pump, filtration, heater, cooler, factory-wired power connection, and controls.

1. Provide lubrication to bearings, gears, and other rotating surfaces at all operating, startup, coastdown, and standby conditions including power failure.
2. Thermostatically controlled oil heater properly sized to remove refrigerant from oil.
3. Dual oil filters, one redundant, shall be the easily replaceable cartridge type, minimum 0.5-micron efficiency, with means of positive isolation while servicing.
4. Refrigerant –cooled oil cooler.
5. Factory-installed and pressure-tested piping with isolation valves and accessories.
6. Oil compatible with refrigerant and chiller components.
7. Positive visual indication of oil level.

2.4 REFRIGERATION

A. Refrigerant:

1. Type: **R-134a; ASHRAE 34, Class A1**.
2. Compatibility: Chiller parts exposed to refrigerants shall be fully compatible with refrigerants, and pressure components shall be rated for refrigerant pressures.

B. Refrigerant Flow Control: Manufacturer's standard refrigerant flow-control device satisfying performance requirements indicated.

C. Pressure Relief Device:

1. Comply with requirements in ASHRAE 15 and in applicable portions of ASME Boiler and Pressure Vessel Code: Section VIII, Division 1.
2. For Chillers Using R-123: Spring-loaded, pressure relief valve; single- or multiple-reseating type.
3. For Chillers Using R-134a: ASME-rated, spring-loaded, pressure relief valve; single- or multiple-reseating type. Pressure relief valve(s) shall be provided for each heat exchanger. Condenser shall have dual valves with one being redundant and configured to allow either valve to be replaced without loss of refrigerant.

D. Refrigeration Transfer: Provide service valves and other factory-installed accessories required to facilitate transfer of refrigerant from chiller to a remote refrigerant storage and recycling system. Comply with requirements in ASHRAE 15 and ASHRAE 147.

E. Refrigerant Isolation for Chillers Using R-134a: Factory install positive shutoff, manual isolation valves in the compressor discharge line to the condenser and the refrigerant liquid line leaving the condenser to allow for isolation and storage of full refrigerant charge in the chiller condenser shell. In addition, provide isolation valve on suction side of compressor from evaporator to allow for isolation and storage of full refrigerant charge in the chiller evaporator shell.

F. Purge System:

1. For chillers operating at subatmospheric pressures (using R-123 refrigerant), factory install an automatic purge system for collection and return of refrigerant and lubricating oil and for removal of noncondensables including, but not limited to, water, water vapor, and noncondensable gases.

2. System shall be a thermal purge design, refrigerant or air cooled, equipped with a carbon filter that includes an automatic regeneration cycle.
3. Factory wire to chiller's main power supply and system complete with controls, piping, and refrigerant valves to isolate the purge system from the chiller.
4. Construct components of noncorrodible materials.
5. Controls shall interface with chiller control panel to indicate modes of operation, set points, data reports, diagnostics, and alarms.
6. Efficiency of not more than 0.02 lb of refrigerant per pound of air (9 g of refrigerant per gram of air) when rated according to AHRI 580.
7. Operation independent of chiller per ASHRAE 147.

G. Positive-Pressure System:

1. For chillers operating at subatmospheric pressures (using R-123 refrigerant), factory install an automatic positive-pressure system.
2. During nonoperational periods, positive-pressure system shall automatically maintain a positive pressure for atmosphere in the refrigerant pressure vessel of not less than 0.5 psig (3 kPa) (adjustable) up to a pressure that remains within the vessel design pressure limits.
3. System shall be factory wired and include controller, electric heat, pressure transmitter, or switch.

2.5 EVAPORATOR

A. Description: Shell-and-tube design with water in tubes and refrigerant surrounding tubes within shell. Shell is separate from condenser.

B. Shell Material: Carbon-steel rolled plates with continuously welded seams or seamless pipe.

C. Designed to prevent liquid refrigerant carryover from entering compressor.

D. Provide evaporator with sight glass or other form of positive visual verification of liquid-refrigerant level.

E. Tubes:

1. Individually replaceable from either end and without damage to tube sheets and other tubes.
2. Mechanically expanded into end sheets and physically attached to intermediate tube sheets.
3. Material: Copper - .
4. Nominal OD: –3/4 or 1 inch (19 or 25 mm).
5. Minimum Wall Thickness: — 0.035 inch (0.9 mm).
6. External Finish: Manufacturer's standard.
7. Internal Finish: Enhanced or smooth.

F. End Tube Sheets: Continuously welded to each end of shell; drilled and reamed to accommodate tubes with positive seal between fluid in tubes and refrigerant in shell.

G. Intermediate Tube Sheets: Installed in shell and spaced along length of tube at intervals required to eliminate vibration and to avoid contact of tubes resulting in abrasion and wear.

H. Water Box:

1. Cast-iron or carbon-steel construction; arranged to provide visual inspection and cleaning of tubes from either end without disturbing refrigerant in shell.
2. Standard type for water box with piping connections. Standard type for water box without piping connections.
3. Provide water boxes with lifting lugs or eyebolts.
4. Nozzle Pipe Connections: – Grooved with mechanical-joint coupling and flange adapter.
5. Thermistor or RTD temperature sensor factory installed in each nozzle.
6. Fit each water box with 1-inch (25-mm) drain connection at low point and vent connection at high point, each with threaded plug.

I. Additional Corrosion Protection:

1. Electrolytic corrosion-inhibitor anode.
2. Coat wetted surfaces with a corrosion-resistant finish.
3. Using same material as tubes, clad surfaces of end tube sheets in contact with fluid. Coat other wetted surfaces, including water boxes, with a corrosion-resistant finish.

2.6 CONDENSER

A. Description: Shell-and-tube design with water in tubes and refrigerant surrounding tubes within shell. Shell is separate from evaporator.

B. Shell Material: Carbon-steel rolled plates with continuously welded seams or seamless pipe.

C. Designed to prevent direct impingement of high-velocity hot gas from compressor discharge on tubes.

D. Provide condenser with sight glass or other form of positive visual verification of refrigerant charge and condition.

E. Tubes:

1. Individually replaceable from either end and without damage to tube sheets and other tubes.
2. Mechanically expanded into end sheets and physically attached to intermediate tube sheets.
3. Material: Copper**.**
4. Nominal OD: 1 inch (25 mm).
5. Minimum Wall Thickness: 0.035 inch (0.9 mm).
6. External Finish: Manufacturer's standard.
7. Internal Finish: Smooth

F. End Tube Sheets: Continuously welded to each end of shell; drilled and reamed to accommodate tubes with positive seal between fluid in tubes and refrigerant in shell.

G. Intermediate Tube Sheets: Installed in shell and spaced along length of tube at intervals required to eliminate vibration and to avoid contact of tubes resulting in abrasion and wear.

H. Water Box:

1. Cast-iron or carbon-steel construction; arranged to provide visual inspection and cleaning of tubes from either end without disturbing refrigerant in shell.
2. Standard type for water box with piping connections. Standard type for water box without piping connections.
3. Provide water boxes and marine water-box covers with lifting lugs or eyebolts.
4. Nozzle Pipe Connections: Grooved with mechanical-joint coupling and flange adapter
5. Thermistor or RTD temperature sensor factory installed in each nozzle.
6. Fit each water box with 1-inch (25-mm) drain connection at low point and vent connection at high point, each with threaded plug.

I. Additional Corrosion Protection:

1. Electrolytic corrosion-inhibitor anode.
2. Coat wetted surfaces with a corrosion-resistant finish.
3. Using same material as tubes, clad surfaces of end tube sheets in contact with fluid. Coat other wetted surfaces, including water boxes, with a corrosion-resistant finish.

2.7 HEAT-RECLAIM CONDENSER

A. Description: Shell-and-tube design with water in tubes and refrigerant surrounding tubes within shell. Shell is separate from evaporator and condenser.

B. Shell Material: Carbon-steel rolled plates with continuously welded seams or seamless pipe.

C. Designed to prevent direct impingement of high-velocity hot gas from compressor discharge on tubes.

D. Tubes:

1. Individually replaceable from either end and without damage to tube sheets and other tubes.
2. Mechanically expanded into end sheets and physically attached to intermediate tube sheets.
3. Material: Copper.
4. Retain one of four options in first subparagraph below. First and fourth options give manufacturer the choice. Second option limits size available from listed manufacturers. Only Trane offers third option.
5. Nominal OD: 1 inch (25 mm) Retain one of four options in first subparagraph below. First option gives manufacturer the choice; second, third, and fourth options limit thickness. Second option is current standard of listed manufacturers but is subject to change. Third and fourth options are upgrades. If using materials other than copper, wall thickness may vary. See Evaluations.
6. Minimum Wall Thickness: 0.035 inch (0.9 mm).
7. External Finish: Manufacturer's standard.
8. Internal Finish: Smooth.

E. End Tube Sheets: Continuously welded to each end of shell; drilled and reamed to accommodate tubes with positive seal between fluid in tubes and refrigerant in shell.

F. Intermediate Tube Sheets: Installed in shell and spaced along length of tube at intervals required to eliminate vibration and to avoid contact of tubes resulting in abrasion and wear.

G. Water Box:

1. Cast-iron or carbon-steel construction; arranged to provide visual inspection and cleaning of tubes from either end without disturbing refrigerant in shell.
2. Standard type for water box with piping connections. Standard type for water box without piping connections.
3. Provide water boxes with lifting lugs or eyebolts.
4. Nozzle Pipe Connections: Grooved with mechanical-joint coupling and flange adapter.
5. Thermistor or RTD temperature sensor factory installed in each nozzle.
6. Fit each water box with 1-inch (25-mm) drain connection at low point and vent connection at high point, each with threaded plug.

H. Additional Corrosion Protection:

1. Electrolytic corrosion-inhibitor anode.
2. Coat wetted surfaces with a corrosion-resistant finish.
3. Using same material as tubes, clad surfaces of end tube sheets in contact with fluid. Coat other wetted surfaces, including water boxes, with a corrosion-resistant finish.

2.8 INSULATION

A. Closed-cell, flexible elastomeric thermal insulation complying with ASTM C 534, Type I for tubular materials and Type II for sheet materials.

1. Thickness: 1-1/2 inches (38 mm).

B. Adhesive: As recommended by insulation manufacturer.

Factory applied insulation over all cold surfaces of chiller capable of forming condensation. Components shall include, but not be limited to, evaporator shell and end tube sheets, evaporator water boxes including nozzles, refrigerant suction pipe from evaporator to compressor, cold surfaces of compressor, refrigerant-cooled motor, and auxiliary piping.

1. Apply adhesive to 100 percent of insulation contact surface.
2. Before insulating steel surfaces, prepare surfaces for paint, and prime and paint as indicated for other painted components. Do not insulate unpainted steel surfaces.
3. Seal seams and joints to provide a vapor barrier.
4. After adhesive has fully cured, paint exposed surfaces of insulation to match other painted parts.

2.9 ELECTRICAL

A. Factory installed and wired, and functionally tested at factory before shipment.

B. Single-point, field-power connection to fused disconnect switch switch Minimum withstand rating shall be as required by electrical power distribution system, but not less than 65,000A.

1. Branch power circuit to each motor, electric heater, dedicated electrical load, and control with disconnect switch or circuit breaker.

a. NEMA KS 1, heavy-duty, fusible switch with rejection-type fuse clips rated for fuses. Select and size fuses to provide Type 2 protection according to IEC 60947-4-1.
~~b.~~ NEMA AB 1, motor-circuit protector (circuit breaker) with field-adjustable, short-circuit-trip set point~~.~~

2. NEMA ICS 2-rated motor controller for auxiliary motors, hand-off-auto switch, and overcurrent protection for each motor. Provide variable frequency controller for each variable-speed motor furnished.
3. Control-circuit transformer with primary and secondary side fuses.

C. Terminal blocks with numbered and color-coded wiring to match wiring diagram. Spare wiring terminal block for connection to external controls or equipment.

D. Factory-installed wiring outside of enclosures shall be in metal raceway except make terminal connections with not more than a 24-inch (610-mm) length of liquid tight conduit.

E. Factory install and wire capacitor bank for the purpose of power factor correction to 0.95 at all operating conditions.

1. If capacitors are mounted in a dedicated enclosure, use same NEMA enclosure type as motor controller. Provide enclosure with service entrance knockouts and bushings for conduit.
2. Capacitors shall be non-PCB dielectric fluid, metallized electrode design, low loss with low-temperature rise. The kVAr ratings shall be indicated and shall not exceed the maximum limitations set by NFPA 70. Provide individual cells as required.
3. Provide each cell with current-limiting replaceable fuses and carbon-film discharge resistors to reduce residual voltage to less than 50 V within one minute after de-energizing.
4. Provide a ground terminal and a terminal block or individual connectors for phase connection.

2.10 MOTOR CONTROLLER

A. Enclosure: Factory installed, unit mounted NEMA 250, Type 1, with hinged full-front access door.

B. Control Circuit: Obtained from integral control power transformer with a control power **tr**ansformer of enough capacity to operate connected control devices.

C. Overload Relay: Shall be sized according to UL 1995 or shall be an integral component of chiller control microprocessor.

D. Across-the-Line Controller: NEMA ICS 2, Class A, full voltage, nonreversing; include isolation switch and current-limiting fuses.

E. Star-Delta, Reduced-Voltage Controller: NEMA ICS 2, closed transition.

F. Autotransformer Reduced-Voltage Controller: NEMA ICS 2, closed transition; include isolation switch and current-limiting fuses.

G. Solid-State, Reduced-Voltage Controller: NEMA ICS 2.

1. Surge suppressor in solid-state power circuits providing three-phase protection against damage from supply voltage surges 10 percent or more above nominal line voltage.
2. Visual indication of motor and control status, including the following conditions:

    a. Controller on.
    b. Overload trip.
    c. Loss of phase.
    d. Starter fault.

H. Accessories: Devices shall be factory installed in controller enclosure unless otherwise indicated.

1. Externally Operated**, Door-Interlocked** Disconnect: **Fused disconnect switch** Minimum withstand rating shall be as required by electrical power distribution system, but not less than **65,000**A.
2. Push-Button Stations, Pilot Lights, and Selector Switches: NEMA ICS 2, heavy-duty type.
3. Stop and Lockout Push-Button Station: Momentary-break, push-button station with a factory-applied hasp arranged so padlock can be used to lock push button in depressed position with control circuit open.
4. Control Relays: Time-delay relays.
5. Elapsed-Time Meters: Numerical readout in hours on face of enclosure.
6. Number-of-Starts Counter: Numerical readout on face of enclosure.
7. Meters: Panel type, 4-1/4 inches (108 mm) with 120-degree scale and **1** percent accuracy. Where indicated, provide transfer device with an off position. Meters shall indicate the following:

    a. Ammeter: Output current for each phase, with current sensors rated to suit application.
    b. Voltmeter: Output voltage for each phase.
    c. Frequency Meter: Output frequency.
    d. Real-time clock with current time and date.
    e. Total run time.

8. Multifunction Digital-Metering Monitor: Microprocessor-based unit suitable for three- or four-wire systems and with the following features:

    a. Selectable, digital display of the following:

        1) Phase Currents, Each Phase: Plus or minus 1 percent.

2) Phase-to-Phase Voltages, Three Phase: Plus or minus 1 percent.
3) Phase-to-Neutral Voltages, Three Phase: Plus or minus 1 percent.
4) Three-Phase Real Power: Plus or minus 2 percent.
5) Three-Phase Reactive Power: Plus or minus 2 percent.
6) Power Factor: Plus or minus 2 percent.
7) Frequency: Plus or minus 0.5 percent.
8) Integrated Demand with Demand Interval Selectable from Five to 60 Minutes: Plus or minus 2 percent.
9) Accumulated energy, in megawatt hours (joules), plus or minus 2 percent; stored values unaffected by power outages for up to 72 hours.

b. Mounting: Display and control unit flush or semirecessed in instrument compartment door.

9. Phase-Failure, Phase-Reversal, Undervoltage Relays: Solid-state sensing circuit with adjustable undervoltage setting and isolated output contacts for hardwired connection.
10. Power Protection: Chiller shall shut down within six cycles of power interruption.

2.11 VARIABLE FREQUENCY CONTROLLER

A. Motor controller shall be factory mounted and wired on the chiller to provide a single-point, field-power termination to the chiller and its auxiliaries.

B. Description: NEMA ICS 2; listed and labeled as a complete unit and arranged to provide variable speed by adjusting output voltage and frequency.

C. Enclosure: Unit mounted, NEMA 250, Type 1, with hinged full-front access door with lock and key.

D. IntegralD isconnecting Means: Door-interlocked, NEMA AB 1, instantaneous-trip circuit breaker with lockable handle. Minimum withstand rating shall be as required by electrical power distribution system, but not less than **65,000** A.

E. Technology: Pulse width modulated (PWM) output with insulated gate bipolar transistors (IGBT); suitable for variable torque loads.

F. Controller shall consist of a rectifier converter section, a digital/analog driver regulator section, and an inverter output section.

1. Rectifier section shall be a full-wave diode bridge that changes fixed-voltage, fixed-frequency, ac line power to a fixed dc voltage. Silicon controller rectifiers, current source inverters, and paralleling of devices are unacceptable. Rectifier shall be insensitive to phase rotation of the ac line.
2. Regulator shall provide full digital control of frequency and voltage.
3. Inverter section shall change fixed dc voltage to variable-frequency, variable ac voltage, for application to a squirrel-cage motor. Inverter shall produce a sine-coded, pulse width modulated (PWM) output wave form and shall conduct no radio-frequency interference back to the input power supply.

G. Output Rating: Three phase; with voltage proportional to frequency throughout voltage range.

H. Operating Requirements:

1. Capable of driving full load, without derating, under the following conditions:

   a. Ambient Temperature: 0 to 50 deg C.
   b. Relative Humidity: Up to 95 percent (noncondensing).
   c. Altitude: 3300 feet (1005 m).

2. Minimum Efficiency: 96 percent at 60 Hz, full load.
3. Minimum Displacement Primary-Side Power Factor: 95 percent without harmonic filter, 98 percent with harmonic filter.
4. Overload Capability: 1.05 times the full-load current for 7 seconds.
5. Starting Torque: As required by compressor-drive assembly.
6. Speed Regulation: Plus or minus 1 percent.
7. Isolated control interface to allow controller to follow control signal over a 10:1 speed range.
8. To avoid equipment resonant vibrations, provide critical speed lockout circuitry to allow bands of operating frequency at which controller shall not operate continuously.
9. Capable of being restarted into a motor coasting in either the forward or reverse direction without tripping.

I. Internal Adjustability Capabilities:

1. Minimum Output Frequency: 6 Hz.
2. Maximum Output Frequency: 60 Hz.
3. Acceleration: 2 seconds to a minimum of 60 seconds.
4. Deceleration: 2 seconds to a minimum of 60 seconds.
5. Current Limit: 30 percent to a minimum of 100 percent of maximum rating.

J. Self-Protection and Reliability Features: Subjecting the controller to any of the following conditions shall not result in component failure or the need for replacement:

1. Over temperature.
2. Short circuit at controller output.
3. Ground fault at controller output. Variable frequency controller shall be able to start a grounded motor.
4. Open circuit at controller output.
5. Input under voltage.
6. Input overvoltage.
7. Loss of input phase.
8. Reverse phase.
9. AC line switching transients.
10. Instantaneous overload, line to line or line to ground.
11. Sustained overload exceeding 100 percent of controller rated current.
12. Starting a rotating motor.

K. Motor Protection: Controller shall protect motor against overvoltage and undervoltage, phase loss, reverse phase, overcurrent, over temperature, and ground fault.

L. Automatic Reset and Restart: Capable of three restarts after controller fault or on return of power after an interruption and before shutting down for manual reset or fault correction. Controller shall be capable of automatic restart on phase-loss and overvoltage and undervoltage trips.

M. Visual Indication: On face of controller enclosure or chiller control enclosure; indicating the following conditions:

1. Power on.
2. Run.
3. Overvoltage.
4. Line fault.
5. Overcurrent.
6. External fault.
7. Motor speed (percent).
8. Fault or alarm status (code).
9. DC-link voltage.
10. Motor output voltage.
11. Input kilovolt amperes.
12. Total power factor.
13. Input kilowatts.
14. Input kilowatt-hours.
15. Three-phase input voltage.
16. Three-phase output voltage.
17. Three-phase input current.
18. Three-phase output current.
19. Three-phase input voltage total harmonic distortion.
20. Three-phase input current total harmonic distortion.
21. Output frequency (Hertz).
22. Elapsed operating time (hours).
23. Diagnostic and service parameters.

Operator Interface: At controller or chiller control panel; with start-stop and auto-manual selector with manual-speed-control potentiometer. Retain first paragraph below and revise to suit Project; delete if control signal interface is not required.

Control Signal Interface:

24. Electric Input Signal Interface: A minimum of two analog inputs (0 to 10 V or 0/4-20 mA) and six programmable digital inputs.

N. Active Harmonic Distortion Filter: Factory mounted and wired to limit total voltage and current distortion to **5** percent.

Input Line Conditioning:

Cooling: Air, refrigerant, or water cooled.

Accessories: Devices shall be factory installed in controller enclosure unless otherwise indicated.

1. Control Relays: Auxiliary and adjustable time-delay relays.

Chiller Capacity Control Interface: Equip chiller with adaptive control logic to automatically adjust the compressor motor speed and the compressor pre-rotation inlet vane position independently to achieve maximum part-load efficiency in response to sensor inputs that are integral to the chiller controls.

2.12 CONTROLS

A. Control: Standalone and microprocessor based, with all memory stored in nonvolatile memory so that reprogramming is not required on loss of electrical power.

B. Enclosure: Unit mounted, NEMA 250, Type 1, hinged or lockable; factory wired with a single-point, field-power connection and a separate control circuit.

C. Operator Interface: Multiple-character digital or graphic display with dynamic update of information and with keypad or touch-sensitive display located on front of control enclosure. In either imperial or metric units selectable through the interface, display the following information:

1. Date and time.
2. Operating or alarm status.
3. Fault history with not less than last 10 faults displayed.
4. Set points of controllable parameters.
5. Trend data.
6. Operating hours.
7. Number of chiller starts.
8. Outdoor-air temperature or space temperature if required for chilled-water reset.
9. Entering- and leaving-fluid temperatures of evaporator and condenser.
10. Difference in fluid temperatures of evaporator and condenser.
11. Fluid flow of evaporator and condenser.
12. Fluid pressure drop of evaporator and condenser.
13. Refrigerant pressures in evaporator and condenser.
14. Refrigerant saturation temperature in evaporator and condenser shell.
15. Compressor refrigerant suction and discharge temperature.
16. Compressor bearing temperature.
17. Motor bearing temperature.
18. Motor winding temperature.
19. Oil temperature.
20. Oil discharge pressure.
21. Phase current.
22. Percent of motor rated load amperage.
23. Phase voltage.
24. Demand power (kilowatts).
25. Energy use (kilowatt-hours).
26. Power factor.
27. For chillers equipped with variable frequency controllers and harmonic filters, include the following:

    a. Output voltage and frequency.

b. Voltage total harmonic distortion for each phase.
c. Supply current total demand distortion for each phase.
d. Inlet vane position.
e. Controller internal ambient temperature.
f. Heatsink temperature.

28. Purge suction temperature if purge system is provided.
29. Purge elapsed time if purge system is provided.
30. Control Functions:

31. Manual or automatic startup and shutdown time schedule.
32. Entering and leaving chilled-water temperatures, control set points, and motor load limits. Evaporator fluid temperature shall be reset based on return-water or outdoor-air temperature.
33. Current limit and demand limit.
34. Condenser-fluid temperature.
35. External chiller emergency stop.
36. Variable evaporator flow.
37. Thermal storage.
38. Heat reclaim.

D. Manually Reset Safety Controls: The following conditions shall shut down chiller and require manual reset:

1. Low evaporator pressure or temperature; high condenser pressure.
2. Low evaporator fluid temperature.
3. Low oil differential pressure.
4. High or low oil pressure.
5. High oil temperature.
6. High compressor-discharge temperature.
7. Loss of condenser-fluid flow.
8. Loss of evaporator fluid flow.
9. Motor overcurrent.
10. Motor overvoltage.
11. Motor under voltage.
12. Motor phase reversal.
13. Motor phase failure.
14. Sensor- or detection-circuit fault.
15. Processor communication loss.
16. Motor controller fault.
17. Extended compressor surge.
18. Excessive air-leakage detection for chillers using R-123 refrigerant.

E. Trending: Capability to trend analog data of up to five parameters simultaneously over an adjustable period and frequency of polling.

F. Security Access: Provide electronic security access to controls through identification and password with at least three levels of access: view only; view and operate; and view, operate, and service.

G. Control Authority: At least four conditions: Off, local manual control at chiller, local automatic control at chiller, and automatic control through a remote source.

H. Communication Port: RS-232 port, USB 2.0 port, or equivalent connection capable of connecting a printer and a notebook computer.

I. BAS Interface: Factory-installed hardware and software to enable the BAS to monitor, control, and display chiller status and alarms.

1. Hardwired Points:

a. Monitoring: On-off status, electrical power consumption (kilowatt-hours).
b. Control: On-off operation, chilled-water, discharge temperature set-point adjustment.

2. **ASHRAE 135 (BACnet)** communication interface with the BAS shall enable the BAS operator to remotely control and monitor the chiller from an operator workstation. Control features and monitoring points displayed locally at chiller control panel shall be available through the BAS.

2.13 FINISH

A. Paint chiller, using manufacturer's standard procedures, except comply with the following minimum requirements:

1. Provide at least one coat of primer with a total dry film thickness of at least 2 mils (0.05 mm).
2. Provide at least two coats of alkyd-modified, vinyl enamel finish with a total dry film thickness of at least 4 mils (0.10 mm).
3. Paint surfaces that are to be insulated before applying the insulation.
4. Paint installed insulation to match adjacent uninsulated surfaces.
5. Color of finish coat to be manufacturer's standard**.**

B. Provide Owner with quart container of paint used in application of topcoat to use in touchup applications after Project Closeout.

2.14 ACCESSORIES

A. Flow Switches:

1. Chiller manufacturer shall furnish a switch for each evaporator and condenser and verify field-mounting location before installation.

2. Pressure Differential Switches:

a. Construction: Wetted parts of body and trim constructed of Type 316 stainless steel.

b. Performance: Switch shall withstand, without damage, the full-pressure rating of the heat exchanger applied to either port and exhibit zero set-point shift due to variation in working pressure.
c. Set Point: Screw type, field adjustable.
d. Electrical Connections: Internally mounted screw-type terminal blocks.
e. Switch Enclosure: NEMA 250, Type 4.
f. Switch Action: Double-pole, double-throw switch with one pole field wired to the chiller control panel and the other pole field wired to the BAS.

B. Vibration Isolation:

1. Chiller manufacturer shall furnish vibration isolation for each chiller.
2. Neoprene Pad:

a. Two layers of 0.375-inch- (10-mm-) thick, ribbed- or waffle-pattern neoprene pads separated by a 16-gage, stainless-steel plate.
b. Fabricate pads from 40- to 50-durometer neoprene.
c. Provide stainless-steel square bearing plate to load the pad uniformly between 20 and 40 psig (138 and 276 kPa) with a 0.12- to 0.16-inch (3- to 4-mm) deflection.

C. Tool Kit: Chiller manufacturer shall assemble a tool kit specially designed for use in serving the chiller(s) furnished. Include special tools required to service chiller components not readily available to Owner service personnel in performing routine maintenance. Place tools in a lockable case with hinged cover. Provide a list of each tool furnished and attach the list to underside of case cover.

2.15 PACKAGED REFRIGERANT RECOVERY UNITS

A. Packaged portable unit consisting of compressor, air-cooled condenser, recovery system, tank pressure gages, filter-dryer, and valving that allows for switching between liquid and vapor recovery mode. Refrigerant recovery unit shall be factory mounted on an ASME-constructed and -stamped refrigerant storage vessel that is sized to hold the full refrigerant charge of the largest chiller furnished.
a.

2.16 SOURCE QUALITY CONTROL

A. Perform functional run tests of chillers before shipping.

B. Factory performance test chillers, before shipping, according to AHRI 550/590.

1. Test the following conditions:

a. Design conditions indicated.
~~b.~~ Reduction in capacity from design to minimum load in steps of 25% with condenser fluid at design conditions.
c. Reduction in capacity from design to minimum load in steps of 25% with varying entering condenser-fluid temperature from design to minimum conditions in 5 deg F (3 deg C) increments.

2. Allow Owner access to place where chillers are being tested. Notify Architect 14 days in advance of testing.
3. Prepare test report indicating test procedures, instrumentation, test conditions, and results. Submit copy of results within one week of test date.
4. Performance Test Witnessing: Provide accommodations, including travel, meals and lodging expenses, for the Owner and Design Engineer to witness the chiller performance testing in the factory

C. Factory sound test chillers, before shipping, according to AHRI 575.

1. Test the following conditions:

a. Design conditions indicated.
b. Chiller operating at calculated worst-case sound condition.
c. At four point(s) of varying part-load performance to be selected by Owner at time of test.

2. Allow Owner access to place where chillers are being tested. Notify Architect 14 days in advance of testing.
3. Prepare test report indicating test procedures, instrumentation, test conditions, and results. Submit copy of results within one week of test date.

D. For chillers using R-134a refrigerant, factory test and inspect evaporator and condenser according to ASME Boiler and Pressure Vessel Code: Section VIII, Division 1.

E. For chillers using R-123 refrigerant, factory test and inspect evaporator and condenseraccording to ASME Boiler and Pressure Vessel Code: Section VIII, Division 1. Pressure test fluid side of heat exchangers, including water boxes, to 1.5 times the rated pressure. Pressure proof test refrigerant side of heat exchangers to a minimum of 45 psig (310 kPa). Vacuum and pressure test for leaks.

F. Rate sound power level according to AHRI 575.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine chillers before installation. Reject chillers that are damaged.

B. Examine roughing-in for equipment support, anchor-bolt sizes and locations, piping, and electrical connections to verify actual locations, sizes, and other conditions affecting chiller performance, maintenance, and operations before equipment installation.

1. Final chiller locations indicated on Drawings are approximate. Determine exact locations before roughing-in for piping and electrical connections.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 CHILLER INSTALLATION

A. Install chillers on support structure indicated.

B. Equipment Mounting: Install chiller on concrete bases using elastomeric pads. Comply with requirements for concrete bases specified in Division 03 Section Miscellaneous Cast-in-Place Concrete. Comply with requirements for vibration isolation devices specified in Division 23 Section "Vibration and Seismic Controls for HVAC Piping and Equipment."

1. Minimum Deflection: 1/4 inch (6 mm).
2. Install dowel rods to connect concrete base to concrete floor. Unless otherwise indicated, install dowel rods on 18-inch (450-mm) centers around the full perimeter of concrete base.
3. For supported equipment, install epoxy-coated anchor bolts that extend through concrete base and anchor into structural concrete floor.
4. Place and secure anchorage devices. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
5. Install anchor bolts to elevations required for proper attachment to supported equipment.

C. Maintain manufacturer's recommended clearances for service and maintenance.

D. Charge chiller with refrigerant and fill with oil if not factory installed.

E. Install separate devices furnished by manufacturer and not factory installed.

F.

3.3 CONNECTIONS

A. Comply with requirements for piping specified in Division 23 Section "Hydronic Piping" and Division 23 Section "Refrigerant Piping." Drawings indicate general arrangement of piping, fittings, and specialties.

B. Install piping adjacent to chiller to allow service and maintenance.

C. Refrigerant Pressure Relief Device Connections: For chillers installed indoors, extend vent piping separate vent piping for each chiller to the outdoors without valves or restrictions. Comply with ASHRAE 15. Connect to chiller pressure relief device with flexible connector and dirt leg with drain valve.

D. For chillers equipped with a purge system, extend separate purge vent piping for each chiller to the outdoors. Comply with ASHRAE 15 and ASHRAE 147.

E. Connect each chiller drain connection with a union and drain pipe, and extend pipe, full size of connection, to floor drain. Provide a shutoff valve at each connection.

3.4 STARTUP SERVICE

A. Engage a factory-authorized service representative to perform startup service.

1. Complete installation and startup checks according to manufacturer's written instructions.
2. Verify that refrigerant charge is sufficient and chiller has been leak tested.
3. Verify that pumps are installed and functional.
4. Verify that thermometers and gages are installed.
5. Operate chiller for run-in period.
6. Check bearing lubrication and oil levels.
7. Verify that refrigerant pressure relief device is vented outside.
8. Verify proper motor rotation.
9. Verify static deflection of vibration isolators, including deflection during chiller startup and shutdown.
10. Verify and record performance of fluid flow and low-temperature interlocks for evaporator and condenser.
11. Verify and record performance of chiller protection devices.
12. Test and adjust controls and safeties. Replace damaged or malfunctioning controls and equipment.

B. Inspect field-assembled components, equipment installation, and piping and electrical connections for proper assembly, installation, and connection.

C. Prepare test and inspection startup reports.

3.5 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain chillers. Video record the training sessions.

END OF SECTION 236416

SECTION 233600 - AIR TERMINAL UNITS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Fan-powered air terminal units.
2. Shutoff, single-duct air terminal units.

1.2 PERFORMANCE REQUIREMENTS

A. Structural Performance: Hangers and supports shall withstand the effects of gravity loads and stresses within limits and under conditions described in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" and ASCE/SEI 7.

1.3 ACTION SUBMITTALS

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

B. LEED Submittals:

1. Product Data for Prerequisite IEQ 1: Documentation indicating that units comply with ASHRAE 62.1, Section 5 - "Systems and Equipment."

C. Shop Drawings: For air terminal units. Include plans, elevations, sections, details, and attachments to other work.

D. Delegated-Design Submittal:

1. Materials, fabrication, assembly, and spacing of hangers and supports.
2. Design Calculations: Calculations**,** including analysis data signed and sealed by the qualified professional engineer responsible for their preparation for selecting hangers and supports.

1.4 ACTION SUBMITTALS

A. Field quality-control reports.

1.5 CLOSEOUT SUBMITTALS

A. Operation and maintenance data.

1.6 QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

B. ASHRAE Compliance: Applicable requirements in ASHRAE 62.1, Section 5 - "Systems and Equipment" and Section 7 - "Construction and System Start-Up."

PART 2 - PRODUCTS

2.1 PARALLEL FAN-POWERED AIR TERMINAL UNITS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

B. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:

1. Anemostat Products; a Mestek Company.
2. Carnes.
3. Environmental Technologies, Inc.
4. Krueger.
5. METALAIRE, Inc.
6. Nailor Industries Inc.
7. Price Industries.
8. Titus.
9. Trane; a business of American Standard Companies.
10. Tuttle & Bailey.

C. Configuration: Volume-damper assembly and fan in parallel arrangement inside unit casing with control components inside a protective metal shroud.

D. Casing: 0.034-inch (0.85-mm) steel double wall.

1. Casing Lining: Adhesive attached, 1-inch- (25-mm-) thick, coated, fibrous-glass duct liner complying with ASTM C 1071, and having a maximum flame-spread index of 25 and a maximum smoke-developed index of 50, for both insulation and adhesive, when tested according to ASTM E 84.

   a. Cover liner with nonporous foil.
   b. Cover liner with nonporous foil and perforated metal.

2. Casing Lining: Adhesive attached, 1-inch- (25-mm-) thick, polyurethane foam insulation complying with UL 181 erosion requirements, and having a maximum flame-spread index of 25 and a maximum smoke-developed index of 50, for both insulation and adhesive, when tested according to ASTM E 84.
3. Air Inlets: Round stub connections or S-slip and drive connections for duct attachment.
4. Air Outlet: S-slip and drive connections.

5. Access: Removable panels for access to parts requiring service, adjustment, or maintenance; with airtight gasket and quarter-turn latches.
6. Fan: Forward-curved centrifugal, located at plenum air inlet.
7. Airstream Surfaces: Surfaces in contact with the airstream shall comply with requirements in ASHRAE 62.1.

E. Volume Damper: Galvanized steel with flow-sensing ring and peripheral gasket and self-lubricating bearings.

1. Maximum Damper Leakage: ARI 880 rated, 2 percent of nominal airflow at 3-inch wg (750-Pa) inlet static pressure.
2. Damper Position: Normally open.

F. Velocity Sensors: Multipoint array with velocity sensors in cold- and hot-deck air inlets and air outlets.

G. Motor:

1. Comply with NEMA designation, temperature rating, service factor, enclosure type, and efficiency requirements for motors specified in Division 23 Section "Common Motor Requirements for HVAC Equipment."
2. Type: Permanent-split capacitor with SCR for speed adjustment.
3. Fan-Motor Assembly Isolation: Rubber isolators.
4. Enclosure: Open drip proof.
5. Enclosure Materials: Rolled steel.
6. Motor Bearings:
7. Unusual Service Conditions:

   a. Ambient Temperature:
   b. Altitude: Retain first subparagraph below if application requires this rating.

   High humidity.Efficiency: Refer to Drawings.

   Premium efficient. Refer to Drawings.
8. NEMA Design: Refer to Drawings.
9.
10. Service Factor: Refer to Drawings.
11.
12. Motor Speed: Multispeed.

    a. Speed Control: Infinitely adjustable with electronic controls.

13. Electrical Characteristics:

    a. Horsepower: Refer to Drawings.
    b. Volts: Refer to Drawings.
    c. Phase: Refer to Drawings.
    d. Hz: 60
    e. Full-Load Amperes: Refer to Drawings.
    f. Minimum Circuit Ampacity: Refer to Drawings.
    g. Maximum Overcurrent Protection: Refer to Drawings.

H. Filters: Minimum arrestance according to ASHRAE 52.1 and a minimum efficiency reporting value (MERV) according to ASHRAE 52.2.

1. Material: 1 inch (25 mm), polyurethane foam having 70 percent arrestance and 3 MERV.
2. Material: 2 inches (50 mm, glass fiber treated with adhesive; having 80 percent arrestance and 5 MERV.
3. Material: 2 inches (50 mm), pleated cotton-polyester media having 90 percent arrestance and 7 MERV.

I. Attenuator Section: 0.034-inch (0.85-mm) steel sheet.

1. Lining: Adhesive attached, flame-spread index of 25 and a maximum smoke-developed 1-inch- (25-mm-) thick, coated, fibrous-glass duct liner complying with ASTM C 1071, and having a maximum index of 50, for both insulation and adhesive, when tested according to ASTM E 84.

   a. Cover liner with nonporous foil.
   b. Cover liner with nonporous foil and perforated metal.

2. Lining: Adhesive attached, 3/4-inch- (19-mm-) thick, polyurethane foam insulation complying with UL 181 erosion requirements, and having a maximum flame-spread index of 25 and a maximum smoke-developed index of 50, for both insulation and adhesive, when tested according to ASTM E 84.
3. Airstream Surfaces: Surfaces in contact with the airstream shall comply with requirements in ASHRAE 62.1.

J. Hydronic Coils: Copper tube, with mechanically bonded aluminum fins spaced no closer than 0.1 inch (2.5 mm), and rated for a minimum working pressure of 200 psig (1380 kPa) and a maximum entering-water temperature of 220 deg F (104 deg C). Include manual air vent and drain valve.

1. Location: Plenum air inlet.

K. Electric-Resistance Heating Coils: Nickel-chromium heating wire, free of expansion noise and hum, mounted in ceramic inserts in a galvanized-steel housing; with primary automatic, and secondary manual, reset thermal cutouts. Terminate elements in stainless-steel, machine-staked terminals secured with stainless-steel hardware.

1. Location: Plenum air inlet.
2. Stage(s): Refer to Drawings.
3. Access door interlocked disconnect switch.
4. Downstream air temperature sensor with local connection to override discharge-air temperature to not exceed a maximum temperature set point (adjustable.)
5. Nickel chrome 80/20 heating elements.
6. Airflow switch for proof of airflow.
7. Fan interlock contacts.
8. Fuses in terminal box for overcurrent protection (for coils more than 48 A).
9. Mercury contactors.
10. Magnetic contactor for each step of control (for three-phase coils).

L. Factory-Mounted and -Wired Controls: Electrical components mounted in control box with removable cover. Incorporate single-point electrical connection to power source.

1. Control Transformer: Factory mounted for control voltage on electric and electronic control units with terminal strip in control box for field wiring of thermostat and power source.
2. Wiring Terminations: Fan and controls to terminal strip. Terminal lugs to match quantities, sizes, and materials of branch-circuit conductors. Enclose terminal lugs in terminal box that is sized according to NFPA 70.
3. Disconnect Switch: Factory-mounted, fuse type.

M. Control Panel Enclosure: NEMA 250, Type 1, with access panel sealed from airflow and mounted on side of unit.

N. Electric Controls: 24-V damper actuator with wall-mounted electric thermostat and appropriate mounting hardware.

O. Electronic Controls: Bidirectional damper operator and microprocessor-based controller with integral airflow transducer and room sensor. Control devices shall be compatible with temperature controls specified in Division 23 Section "Instrumentation and Control for HVAC" and shall have the following features:

1. Occupied and unoccupied operating mode.
2. Remote reset of airflow or temperature set points.
3. Adjusting and monitoring with portable terminal.
4. Communication with temperature-control system specified in Division 23 Section "Instrumentation and Control for HVAC."

2.2 SERIES FAN-POWERED AIR TERMINAL UNITS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

B. Retain option in first paragraph below if manufacturer's name and model number are indicated in schedules or plans on Drawings; delete option and insert manufacturer's name and model number if not included on Drawings.

C. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:

1. Anemostat Products; a Mestek Company.
2. Carnes.
3. Environmental Technologies, Inc.
4. Krueger.
5. METALAIRE, Inc.
6. Nailor Industries Inc.
7. Price Industries.
8. Titus.
9. Trane; a business of American Standard Companies.
10. Tuttle & Bailey.

D. Configuration: Volume-damper assembly and fan in series arrangement inside unit casing with control components inside a protective metal shroud for installation above a ceiling and within a raised access floor.

E. Casing: 0.034-inch (0.85-mm) steel double wall.

1. Casing Lining: Adhesive attached, 1-inch- (25-mm-) thick, coated, fibrous-glass duct liner complying with ASTM C 1071, and having a maximum flame-spread index of 25 and a maximum smoke-developed index of 50, for both insulation and adhesive, when tested according to ASTM E 84.

    a. Cover liner with nonporous foil.
    b. Cover liner with nonporous foil and perforated metal.

2. Casing Lining: Adhesive attached, 1-inch- (25-mm-) thick, polyurethane foam insulation complying with UL 181 erosion requirements, and having a maximum flame-spread index of 25 and a maximum smoke-developed index of 50, for both insulation and adhesive, when tested according to ASTM E 84.
3. Air Inlets: Round stub connections or S-slip and drive connections for duct attachment.
4. Air Outlet: S-slip and drive connections.
5. Access: Removable panels for access to parts requiring service, adjustment, or maintenance; with airtight gasket and quarter-turn latches.
6. Fan: Forward-curved centrifugal.
7. Airstream Surfaces: Surfaces in contact with the airstream shall comply with requirements in ASHRAE 62.1.

F. Volume Damper: Galvanized steel with flow-sensing ring and peripheral gasket and self-lubricating bearings.

1. Maximum Damper Leakage: ARI 880 rated, **2** percent of nominal airflow at 3-inch wg inlet static pressure.
2. Damper Position: Normally open.

G. Velocity Sensors: Multipoint array with velocity sensors in cold- and hot-deck air inlets and air outlets.

H. Motor:

1. Comply with NEMA designation, temperature rating, service factor, enclosure type, and efficiency requirements for motors specified in Division 23 Section "Common Motor Requirements for HVAC Equipment."
2. Type: Permanent-split capacitor with SCR for speed adjustment. Fan-Motor Assembly Isolation: Rubber isolators.
3. Enclosure: Open drip proof.
4. Enclosure Materials: Rolled steel.
5. Motor Bearings:
6. Unusual Service Conditions: Refer to Drawings.

    a. Ambient Temperature: Refer to Drawings.

b. Altitude: Refer to Drawings.
c. High humidity. Refer to Drawings.

7. Efficiency: Premium efficient. Refer to Drawings.
8. NEMA Design: Refer to Drawings.
9. Service Factor: Refer to Drawings.
10. Motor Speed: Multispeed.

a. Speed Control: Infinitely adjustable with electronic controls.

11. Electrical Characteristics:

a. Horsepower: Refer to Drawings.
b. Volts: Refer to Drawings.
c. Phase: Refer to Drawings.
d. Hz: 60.
e. Full-Load Ampere: Refer to Drawings.
f. Minimum Circuit Ampacity: Refer to Drawings.
g. Maximum Overcurrent Protection: Refer to Drawings.

I. Filters: Minimum arrestance according to ASHRAE 52.1 and a minimum efficiency reporting value (MERV) according to ASHRAE 52.2.

1. Material: 1 inch (25 mm), polyurethane foam having 70 percent arrestance and 3 MERV.
2. Material: 2 inches (50 mm), glass fiber treated with adhesive; having 80 percent arrestance and 5 MERV.
3. Material: 2 inches (50 mm), pleated cotton-polyester media having 90 percent arrestance and 7 MERV.

J. Attenuator Section: 0.034-inch (0.85-mm) steel sheet.

1. Lining: Adhesive attached, 1-inch- (25-mm-) thick, coated, fibrous-glass duct liner complying with ASTM C 1071, and having a maximum flame-spread index of 25 and a maximum smoke-developed index of 50, for both insulation and adhesive, when tested according to ASTM E 84.

a. Cover liner with nonporous foil.
b. Cover liner with nonporous foil and perforated metal.

2. Lining: Adhesive attached, 3/4-inch- (19-mm-) thick, polyurethane foam insulation complying with UL 181 erosion requirements, and having a maximum flame-spread index of 25 and a maximum smoke-developed index of 50, for both insulation and adhesive, when tested according to ASTM E 84.
3. Airstream Surfaces: Surfaces in contact with the airstream shall comply with requirements in ASHRAE 62.1.

K. Hydronic Coils: Copper tube, with mechanically bonded aluminum fins spaced no closer than 0.1 inch (2.5 mm), and rated for a minimum working pressure of 200 psig (1380 kPa) and a maximum entering-water temperature of 220 deg F (104 deg C). Include manual air vent and drain valve.

L. Electric-Resistance Heating Coils: Nickel-chromium heating wire, free of expansion noise and hum, mounted in ceramic inserts in a galvanized-steel housing; with primary automatic, and secondary manual, reset thermal cutouts. Terminate elements in stainless-steel, machine-staked terminals secured with stainless-steel hardware.

1. Stage(s): 3
2. Access door interlocked disconnect switch.
3. Downstream air temperature sensor with local connection to override discharge-air temperature to not exceed a maximum temperature set point (adjustable.)
4. Nickel chrome 80/20 heating elements.
5. Airflow switch for proof of airflow.
6. Fan interlock contacts.
7. Fuses in terminal box for overcurrent protection (for coils more than 48 A).
8. Mercury contactors.
9. Magnetic contactor for each step of control (for three-phase coils).

M. Factory-Mounted and -Wired Controls: Electrical components mounted in control box with removable cover. Incorporate single-point electrical connection to power source.

1. Control Transformer: Factory mounted for control voltage on electric and electronic control units with terminal strip in control box for field wiring of thermostat and power source.
2. Wiring Terminations: Fan and controls to terminal strip. Terminal lugs to match quantities, sizes, and materials of branch-circuit conductors. Enclose terminal lugs in terminal box that is sized according to NFPA 70.
3. Disconnect Switch: Factory-mounted, fuse type.

N. Control Panel Enclosure: NEMA 250, Type 1, with access panel sealed from airflow and mounted on side of unit.

O. Electric Controls: 24-V damper actuator with wall-mounted electric thermostat and appropriate mounting hardware.

P. Electronic Controls: Bidirectional damper operator and microprocessor-based controller with integral airflow transducer and room sensor. Control devices shall be compatible with temperature controls specified in Division 23 Section "Instrumentation and Control for HVAC" and shall have the following features:

1. Occupied and unoccupied operating mode.
2. Remote reset of airflow or temperature set points.
3. Adjusting and monitoring with portable terminal.
4. Communication with temperature-control system specified in Division 23 Section "Instrumentation and Control for HVAC."

2.3 SHUTOFF, SINGLE-DUCT AIR TERMINAL UNITS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

B. Retain option in first paragraph below if manufacturer's name and model number are indicated in schedules or plans on Drawings; delete option and insert manufacturer's name and model number if not included on Drawings.

C. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:

1. Anemostat Products; a Mestek Company.
2. Carnes.
3. Environmental Technologies, Inc.
4. Krueger.
5. METALAIRE, Inc.
6. Nailor Industries Inc.
7. Phoenix Controls Corporation.
8. Price Industries.
9. Titus.
10. Trane; a business of American Standard Companies.
11. Trox USA Inc.; a subsidiary of the TROX GROUP.
12. Tuttle & Bailey.
13. Warren Technology.

D. Configuration: Volume-damper assembly inside unit casing with control components inside a protective metal shroud.

E. Casing: 0.034-inch (0.85-mm) steel double wall.

1. Casing Lining: Adhesive attached, 1-inch- (25-mm-) thick, coated, fibrous-glass duct liner complying with ASTM C 1071, and having a maximum flame-spread index of 25 and a maximum smoke-developed index of 50, for both insulation and adhesive, when tested according to ASTM E 84.

a. Cover liner with nonporous foil.
b. Cover liner with nonporous foil and perforated metal.

2. Casing Lining: Adhesive attached, 1-inch- (25-mm-) thick, polyurethane foam insulation complying with UL 181 erosion requirements, and having a maximum flame-spread index of 25 and a maximum smoke-developed index of 50, for both insulation and adhesive, when tested according to ASTM E 84.
3. Air Inlet: Round stub connection or S-slip and drive connections for duct attachment.
4. Air Outlet: S-slip and drive connections**,** size matching inlet size.
5. Access: Removable panels for access to parts requiring service, adjustment, or maintenance; with airtight gasket.
6. Airstream Surfaces: Surfaces in contact with the airstream shall comply with requirements in ASHRAE 62.1.

F. Regulator Assembly: System-air-powered bellows section incorporating polypropylene bellows for volume regulation and thermostatic control. Bellows shall operate at temperatures from 0 to 140 deg F (minus 18 to plus 60 deg C), shall be impervious to moisture and fungus, shall be suitable for 10-inch wg (2500-Pa) static pressure, and shall be factory tested for leaks.

G. Volume Damper: Galvanized steel with peripheral gasket and self-lubricating bearings.

1. Maximum Damper Leakage: ARI 880 rated, 2 percent of nominal airflow at 3-inch wg (750-Pa) inlet static pressure.
2. Damper Position: Normally open.

H. Attenuator Section: 0.034-inch (0.85-mm) steel sheet.

1. Lining: Adhesive attached, 1-inch- (25-mm-) thick, coated, fibrous-glass duct liner complying with ASTM C 1071, and having a maximum flame-spread index of 25 and a maximum smoke-developed index of 50, for both insulation and adhesive, when tested according to ASTM E 84.

   a. Cover liner with nonporous foil.
   b. Cover liner with nonporous foil and perforated metal.

2. Lining: Adhesive attached, 3/4-inch- (19-mm-) thick, polyurethane foam insulation complying with UL 181 erosion requirements, and having a maximum flame-spread index of 25 and a maximum smoke-developed index of 50, for both insulation and adhesive, when tested according to ASTM E 84.
3. Airstream Surfaces: Surfaces in contact with the airstream shall comply with requirements in ASHRAE 62.1.

I. Multioutlet Attenuator Section: With two, 6-inch- (150-mm-), 8-inch- (200-mm-), 10-inch- (250-mm-) diameter collars, each with locking butterfly balancing damper.

J. Hydronic Coils: Copper tube, with mechanically bonded aluminum fins spaced no closer than 0.1 inch (2.5 mm), and rated for a minimum working pressure of 200 psig (1380 kPa) and a maximum entering-water temperature of 220 deg F (104 deg C). Include manual air vent and drain valve.

K. Electric-Resistance Heating Coils: Nickel-chromium heating wire, free of expansion noise and hum, mounted in ceramic inserts in a galvanized-steel housing; with primary automatic, and secondary manual, reset thermal cutouts. Terminate elements in stainless-steel, machine-staked terminals secured with stainless-steel hardware.

1. Access door interlocked disconnect switch.
2. Downstream air temperature sensor with local connection to override discharge-air temperature to not exceed a maximum temperature set point (adjustable.)
3. Nickel chrome 80/20 heating elements.
4. Airflow switch for proof of airflow.
5. Fan interlock contacts.
6. Fuses in terminal box for overcurrent protection (for coils more than 48 A).
7. Mercury contactors.
8. Magnetic contactor for each step of control (for three-phase coils).

L. Electric Controls: Damper actuator and thermostat.

1. Damper Actuator: 24 V, powered closed, spring return open or powered open.
2. Thermostat: Wall-mounted electronic type with clock display, temperature display in Fahrenheit and Celsius, and space temperature set point.

M. Electronic Controls: Bidirectional damper operator and microprocessor-based thermostat with integral airflow transducer and room sensor. Control devices shall be compatible with temperature controls specified in Division 23 Section "Instrumentation and Control for HVAC" and shall have the following features:

1. Damper Actuator: 24 V, powered closed, spring return open or powered open.
2. Velocity Controller: Factory calibrated and field adjustable to minimum and maximum air volumes; shall maintain constant airflow dictated by thermostat within 5 percent of set point while compensating for inlet static-pressure variations up to 4-inch wg (1000 Pa); and shall have a multipoint velocity sensor at air inlet.
3. Thermostat: Wall-mounted electronic type with temperature set-point display in Fahrenheit and Celsius.

N. Direct Digital Controls: Single-package unitary controller and actuator specified in Division 23 Section "Instrumentation and Control for HVAC."

O. Direct Digital Controls: Bidirectional damper operators and microprocessor-based controller and room sensor. Control devices shall be compatible with temperature controls specified in Division 23 Section "Instrumentation and Control for HVAC" and shall have the following features:

1. Damper Actuator: 24 V, powered closed, spring return open or powered open.
2. Terminal Unit Controller: Pressure-independent, variable-air-volume controller with electronic airflow transducer with multipoint velocity sensor at air inlet, factory calibrated to minimum and maximum air volumes, and having the following features:

    a. Occupied and unoccupied operating mode.
    b. Remote reset of airflow or temperature set points.
    c. Adjusting and monitoring with portable terminal.
    d. Communication with temperature-control system specified in Division 23 Section "Instrumentation and Control for HVAC."

3. Room Sensor: Wall mounted, with temperature set-point adjustment and access for connection of portable operator terminal.

2.4 HANGERS AND SUPPORTS

A. Hanger Rods for Noncorrosive Environments: Cadmium-plated steel rods and nuts.

B. Hanger Rods for Corrosive Environments: Electrogalvanized, all-thread rods or galvanized rods with threads painted with zinc-chromate primer after installation.

C. Steel Cables: Galvanized steel complying with ASTM A 603.

D. Steel Cable End Connections: Cadmium-plated steel assemblies with brackets, swivel, and bolts designed for duct hanger service; with an automatic-locking and clamping device.

E. Air Terminal Unit Attachments: Sheet metal screws, blind rivets, or self-tapping metal screws; compatible with duct materials.

F. Trapeze and Riser Supports: Steel shapes and plates for units with steel casings; aluminum for units with aluminum casings.

2.5 SEISMIC-RESTRAINT DEVICES

A. General Requirements for Restraint Components: Rated strengths, features, and applications shall be as defined in reports by an agency acceptable to authorities having jurisdiction.

1. Structural Safety Factor: Allowable strength in tension, shear, and pullout force of components shall be at least four times the maximum seismic forces to which they will be subjected.

B. Channel Support System: Shop- or field-fabricated support assembly made of slotted steel channels rated in tension, compression, and torsion forces and with accessories for attachment to braced component at one end and to building structure at the other end. Include matching components and corrosion-resistant coating.

C. Restraint Cables: ASTM A 603, galvanized-steel cables with end connections made of cadmium-plated steel assemblies with brackets, swivel, and bolts designed for restraining cable service; with an automatic-locking and clamping device or double-cable clips.

D. Hanger Rod Stiffener: Steel tube or steel slotted-support-system sleeve with internally bolted connections to hanger rod.

E. Mechanical Anchor Bolts: Drilled-in and stud-wedge or female-wedge type. Select anchor bolts with strength required for anchor and as tested according to ASTM E 488.

2.6 SOURCE QUALITY CONTROL

A. Factory Tests: Test assembled air terminal units according to ARI 880.

1. Label each air terminal unit with plan number, nominal airflow, maximum and minimum factory-set airflows, coil type, and ARI certification seal.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install air terminal units according to NFPA 90A, "Standard for the Installation of Air Conditioning and Ventilating Systems."

B. Install air terminal units level and plumb. Maintain sufficient clearance for normal service and maintenance.

C. Install wall-mounted thermostats.

3.2 HANGER AND SUPPORT INSTALLATION

A. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Chapter 5, "Hangers and Supports."

B. Building Attachments: Concrete inserts, powder-actuated fasteners, or structural-steel fasteners appropriate for construction materials to which hangers are being attached.

1. Where practical, install concrete inserts before placing concrete.
2. Install powder-actuated concrete fasteners after concrete is placed and completely cured.
3. Use powder-actuated concrete fasteners for standard-weight aggregate concretes and for slabs more than 4 inches (100 mm) thick.
4. Do not use powder-actuated concrete fasteners for lightweight-aggregate concretes and for slabs less than 4 inches (100 mm) thick.
5. Do not use powder-actuated concrete fasteners for seismic restraints.

C. Hangers Exposed to View: Threaded rod and angle or channel supports.

D. Install upper attachments to structures. Select and size upper attachments with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.

3.3 SEISMIC-RESTRAINT-DEVICE INSTALLATION

A. Install hangers and braces designed to support the air terminal units and to restrain against seismic forces required by applicable building codes. Comply with ASCE/SEI 7.

B. Select seismic-restraint devices with capacities adequate to carry present and future static and seismic loads.

C. Install cables so they do not bend across edges of adjacent equipment or building structure.

D. Install cable restraints on air terminal units that are suspended with vibration isolators.

E. Install seismic-restraint devices using methods approved an agency acceptable to authorities having jurisdiction.

F. Attachment to Structure: If specific attachment is not indicated, anchor bracing and restraints to structure, to flanges of beams, to upper truss chords of bar joists, or to concrete members.

G. Drilling for and Setting Anchors:

1. Identify position of reinforcing steel and other embedded items before drilling holes for anchors. Do not damage existing reinforcement or embedded items during drilling. Notify the Architect if reinforcing steel or other embedded items are encountered during drilling. Locate and avoid prestressed tendons, electrical and telecommunications conduit, and gas lines.
2. Do not drill holes in concrete or masonry until concrete, mortar, or grout has achieved full design strength.

3. Wedge Anchors: Protect threads from damage during anchor installation. Install heavy-duty sleeve anchors with sleeve fully engaged in the structural element to which anchor is to be fastened.
4. Set anchors to manufacturer's recommended torque, using a torque wrench.
5. Install zinc-coated steel anchors for interior applications and stainless-steel anchors for applications exposed to weather.

3.4 CONNECTIONS

A. Install piping adjacent to air terminal unit to allow service and maintenance.

B. Hot-Water Piping: In addition to requirements in Division 23 Section "Hydronic Piping," connect heating coils to supply with shutoff valve, strainer, control valve, and union or flange; and to return with balancing valve and union or flange.

C. Connect ducts to air terminal units according to **Division 23 Section "Metal Ducts." And Division 23 Section "Nonmetal Ducts."**

D. Make connections to air terminal units with flexible connectors complying with requirements in Division 23 Section "Air Duct Accessories."

3.5 IDENTIFICATION

A. Label each air terminal unit with plan number, nominal airflow, and maximum and minimum factory-set airflows. Comply with requirements in Division 23 Section "Identification for HVAC Piping and Equipment" for equipment labels and warning signs and labels.

3.6 FIELD QUALITY CONTROL

A. Perform tests and inspections.

1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.

B. Tests and Inspections:

1. After installing air terminal units and after electrical circuitry has been energized, test for compliance with requirements.
2. Leak Test: After installation, fill water coils and test for leaks. Repair leaks and retest until no leaks exist.
3. Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation.
4. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

C. Air terminal unit will be considered defective if it does not pass tests and inspections.

D. Prepare test and inspection reports.

3.7 STARTUP SERVICE

A. Engage a factory-authorized service representative to perform startup service.

1. Complete installation and startup checks according to manufacturer's written instructions.
2. Verify that inlet duct connections are as recommended by air terminal unit manufacturer to achieve proper performance.
3. Verify that controls and control enclosure are accessible.
4. Verify that control connections are complete.
5. Verify that nameplate and identification tag are visible.
6. Verify that controls respond to inputs as specified.

3.8 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain air terminal units.

END OF SECTION 233600

SECTION 233423 - HVAC POWER VENTILATORS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Centrifugal roof ventilators.
2. Centrifugal wall ventilators.
3. Ceiling-mounted ventilators.
4. In-line centrifugal fans.
5. Propeller fans.

1.2 ACTION SUBMITTALS

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

B. Shop Drawings: Include plans, elevations, sections, details, and attachments to other work.

1. Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
2. Wiring Diagrams: For power, signal, and control wiring.
3. Vibration Isolation Base Details: Detail fabrication including anchorages and attachments to structure and to supported equipment. Include adjustable motor bases, rails, and frames for equipment mounting.
4. Design Calculations: Calculate requirements for selecting vibration isolators[**and seismic restraints**] and for designing vibration isolation bases.

1.3 CLOSEOUT SUBMITTALS

A. Operation and maintenance data.

1.4 QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

B. AMCA Compliance: Fans shall have AMCA-Certified performance ratings and shall bear the AMCA-Certified Ratings Seal.

PART 2 - PRODUCTS

2.1 CENTRIFUGAL ROOF VENTILATORS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

B. If retaining first paragraph below, retain option if manufacturer's name and model number are indicated in schedules or plans on Drawings; delete option and insert manufacturer's name and model number if not included on Drawings.

C. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:

1. Acme Engineering & Manufacturing Corporation.
2. Aerovent; a division of Twin City Fan Companies, Ltd.
3. American Coolair Corporation.
4. Ammerman; Millennium Equipment.
5. Breidert Air Products.
6. Broan-NuTone LLC.
7. Broan-NuTone LLC; NuTone Inc.
8. Carnes Company.
9. Central Blower Company.
10. Delhi Industries Inc.
11. Greenheck Fan Corporation.
12. Hartzell Fan Incorporated.
13. JencoFan.
14. Loren Cook Company.
15. PennBarry.
16. Quietaire Inc.
17. W.W. Grainger, Inc.; Dayton Products.

D. Housing: Removable, galvanized steel, mushroom-domed top; square, one-piece, aluminum base with venturi inlet cone.

1. Upblast Units: Provide spun-aluminum discharge baffle to direct discharge air upward, with rain and snow drains[and grease collector.
2. Hinged Subbase: Galvanized-steel hinged arrangement permitting service and maintenance.

E. Fan Wheels: Aluminum hub and wheel with backward-inclined blades.

F. Belt Drives:

1. Resiliently mounted to housing.
2. Fan Shaft: Turned, ground, and polished steel; keyed to wheel hub.
3. Shaft Bearings: Permanently lubricated, permanently sealed, self-aligning ball bearings.
4. Pulleys: Cast-iron, adjustable-pitch motor pulley.
5. Fan and motor isolated from exhaust airstream.

G. Accessories:

1. Variable-Speed Controller: Solid-state control to reduce speed from 100 to less than 50 percent.
2. Disconnect Switch: Nonfusible type, with thermal-overload protection mounted outside fan housing, factory wired through an internal aluminum conduit.
3. Bird Screens: Removable, 1/2-inch (13-mm) mesh, aluminum or brass wire.
4. Dampers: Counterbalanced, parallel-blade, backdraft dampers mounted in curb base; factory set to close when fan stops.
5. Motorized Dampers: Parallel-blade dampers mounted in curb base with electric actuator; wired to close when fan stops.

H. Roof Curbs: Galvanized steel; mitered and welded corners; 1-1/2-inch- (40-mm-) thick, rigid, fiberglass insulation adhered to inside walls; and 1-1/2-inch (40-mm) wood nailer. Size as required to suit roof opening and fan base.

1. Configuration: Built-in raised cant and mounting flange.
2. Overall Height: 18 inches (450 mm).
3. Sound Curb: Curb with sound-absorbing insulation.
4. Pitch Mounting: Manufacture curb for roof slope.
5. Metal Liner: Galvanized steel.
6. Burglar Bars: 3/4-inch- (19-mm-) thick steel bars welded in place to form 6-inch (150-mm) squares.
7. Mounting Pedestal: Galvanized steel with removable access panel.
8. Vented Curb: Unlined with louvered vents in vertical sides.

I. Capacities and Characteristics:

1. Airflow: Refer to Drawings.
2. External Static Pressure: Refer to Drawings.
3. Fan Diameter: Refer to Drawings.
4. Drive Arrangement: Refer to Drawings.
5. Fan rpm: Refer to Drawings.
6. Tip Speed: Refer to Drawings.
7. Sound: Refer to Drawings.
8. Curb Size: Refer to Drawings.
9. Curb Height: Refer to Drawings.
10. Damper: Refer to Drawings.
11. Damper Size: Refer to Drawings.
12. Brake Horsepower: Refer to Drawings.
13. Motor Size: Refer to Drawings.
14. Motor rpm: Refer to Drawings.
15. Electrical Characteristics: Refer to Drawings.

    a. Volts: Refer to Drawings.
    b. Phase: Refer to Drawings.
    c. Hertz: Refer to Drawings.

2.2 CENTRIFUGAL WALL VENTILATORS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

B. If retaining first paragraph below, retain option if manufacturer's name and model number are indicated in schedules or plans on Drawings; delete option and insert manufacturer's name and model number if not included on Drawings.

C. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:

1. Acme Engineering & Manufacturing Corporation.
2. Aerovent; a division of Twin City Fan Companies, Ltd.
3. American Coolair Corporation.
4. Ammerman; Millennium Equipment.
5. Breidert Air Products.
6. Broan-NuTone LLC.
7. Broan-NuTone LLC; NuTone Inc.
8. Carnes Company.
9. Greenheck Fan Corporation.
10. Hartzell Fan Incorporated.
11. JencoFan.
12. Loren Cook Company.
13. PennBarry.
14. W.W. Grainger, Inc.; Dayton Products.

D. Housing: Heavy-gage, removable, spun-aluminum, dome top and outlet baffle; venturi inlet cone.

E. Fan Wheel: Aluminum hub and wheel with backward-inclined blades.

F. Belt Drives:

1. Resiliently mounted to housing.
2. Fan Shaft: Turned, ground, and polished steel; keyed to wheel hub.
3. Shaft Bearings: Permanently lubricated, permanently sealed, self-aligning ball bearings.
4. Pulleys: Cast-iron, adjustable-pitch motor pulley.
5. Fan and motor isolated from exhaust airstream.

G. Accessories:

1. Variable-Speed Controller: Solid-state control to reduce speed from 100 to less than 50 percent.
2. Disconnect Switch: Non-fusible type, with thermal-overload protection mounted inside fan housing, factory wired through internal aluminum conduit.
3. Bird Screens: Removable, 1/2-inch (13-mm) mesh, aluminum or brass wire.
4. Wall Grille: Ring type for flush mounting.
5. Dampers: Counterbalanced, parallel-blade, backdraft dampers mounted in wall sleeve; factory set to close when fan stops.

6. Motorized Dampers: Parallel-blade dampers mounted in curb base with electric actuator; wired to close when fan stops.

H. Capacities and Characteristics:

1. Airflow: Refer to Drawings.
2. External Static Pressure: Refer to Drawings.
3. Fan Diameter: Refer to Drawings.
4. Drive Arrangement: Refer to Drawings.
5. Fan rpm: Refer to Drawings.
6. Tip Speed: Refer to Drawings.
7. Sound: Refer to Drawings.
8. Damper: Refer to Drawings.
9. Damper Size: Refer to Drawings.
10. Brake Horsepower: Refer to Drawings.
11. Motor Size: Refer to Drawings.
12. Motor rpm: Refer to Drawings.
13. Electrical Characteristics: Refer to Drawings.

a. Volts: Refer to Drawings.
b. Phase: Refer to Drawings.
c. Hertz: Refer to Drawings.

2.3 CEILING-MOUNTED VENTILATORS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

B. If retaining first paragraph below, retain option if manufacturer's name and model number are indicated in schedules or plans on Drawings; delete option and insert manufacturer's name and model number if not included on Drawings.

C. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:

1. American Coolair Corporation.
2. Ammerman; Millennium Equipment.
3. Breidert Air Products.
4. Broan-NuTone LLC.
5. Broan-NuTone LLC; NuTone Inc.
6. Carnes Company.
7. FloAire.
8. Greenheck Fan Corporation.
9. JencoFan.
10. Loren Cook Company.
11. PennBarry.
12. W.W. Grainger, Inc.; Dayton Products.

D. Housing: Steel, lined with acoustical insulation.

E. Fan Wheel: Centrifugal wheels directly mounted on motor shaft. Fan shrouds, motor, and fan wheel shall be removable for service.

F. Grille: Stainless steel, louvered grille with flange on intake and thumbscrew attachment to fan housing.

G. Electrical Requirements: Junction box for electrical connection on housing and receptacle for motor plug-in.

H. Accessories:

1. Variable-Speed Controller: Solid-state control to reduce speed from 100 to less than 50 percent.
2. Manual Starter Switch: Single-pole rocker switch assembly with cover and pilot light.
3. Time-Delay Switch: Assembly with single-pole rocker switch, timer, and cover plate.
4. Motion Sensor: Motion detector with adjustable shutoff timer.
5. Ceiling Radiation Damper: Fire-rated assembly with ceramic blanket, stainless-steel springs, and fusible link.
6. Filter: Washable aluminum to fit between fan and grille.
7. Isolation: Rubber-in-shear vibration isolators.
8. Manufacturer's standard roof jack or wall cap, and transition fittings.

I. Capacities and Characteristics:

1. Airflow: Refer to Drawings.
2. External Static Pressure: Refer to Drawings.
3. Sound: Refer to Drawings.
4. Motor Size: Refer to Drawings.
5. Motor rpm: Refer to Drawings.
6. Electrical Characteristics: Refer to Drawings.

a. Volts: Refer to Drawings.
b. Phase: Refer to Drawings.
c. Hertz: Refer to Drawings.

2.4 IN-LINE CENTRIFUGAL FANS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

B. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:

1. Acme Engineering & Manufacturing Corporation.
2. American Coolair Corporation.
3. Ammerman; Millennium Equipment.
4. Breidert Air Products.
5. Carnes Company.
6. FloAire.
7. Greenheck Fan Corporation.

8. Hartzell Fan Incorporated.
9. JencoFan.
10. Loren Cook Company.
11. Madison Manufacturing.
12. PennBarry.
13. Quietaire Inc.

C. Housing: Split, spun aluminum with aluminum straightening vanes, inlet and outlet flanges, and support bracket adaptable to floor, side wall, or ceiling mounting.

D. Direct-Drive Units: Motor mounted in airstream, factory wired to disconnect switch located on outside of fan housing with wheel, inlet cone, and motor on swing-out service door.

E. Belt-Driven Units: Motor mounted on adjustable base, with adjustable sheaves, enclosure around belts within fan housing, and lubricating tubes from fan bearings extended to outside of fan housing.

F. Fan Wheels: Aluminum, airfoil blades welded to aluminum hub.

G. Accessories:

1. Variable-Speed Controller: Solid-state control to reduce speed from 100 to less than 50 percent.
2. Volume-Control Damper: Manually operated with quadrant lock, located in fan outlet.
3. Companion Flanges: For inlet and outlet duct connections.
4. Fan Guards: 1/2- by 1-inch (13- by 25-mm) mesh of galvanized steel in removable frame. Provide guard for inlet or outlet for units not connected to ductwork.
5. Motor and Drive Cover (Belt Guard): Epoxy-coated steel.

H. Capacities and Characteristics:

1. Airflow: Refer to Drawings.
2. External Static Pressure: Refer to Drawings.
3. Fan Diameter: Refer to Drawings.
4. Wheel Type: Refer to Drawings.
5. Class: **I** .
6. Drive Arrangement: Refer to Drawings.
7. Fan rpm: Refer to Drawings.
8. Outlet Velocity: Refer to Drawings.
9. Brake Horsepower: Refer to Drawings.
10. Motor Size: Refer to Drawings.
11. Electrical Characteristics: Refer to Drawings.

    a. Volts: Refer to Drawings.
    b. Phase: Refer to Drawings.
    c. Hertz: Refer to Drawings.

12. Vibration Isolators:

    a. Type: **Elastomeric hangers**.

b. Static Deflection: 1 inch (25 mm).

13. Spark Arrestance Class: A.

2.5 PROPELLER FANS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

B. If retaining first paragraph below, retain option if manufacturer's name and model number are indicated in schedules or plans on Drawings; delete option and insert manufacturer's name and model number if not included on Drawings.

C. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:

1. Acme Engineering & Manufacturing Corporation.
2. Aerovent; a division of Twin City Fan Companies, Ltd.
3. Airmaster Fan Company.
4. American Coolair Corporation.
5. Ammerman; Millennium Equipment.
6. Breidert Air Products.
7. Broan-NuTone LLC; NuTone Inc.
8. Carnes Company.
9. Chicago Blower Corporation.
10. Cincinnati Fan.
11. Hartzell Fan Incorporated.
12. Howden Buffalo Inc.
13. JencoFan.
14. King Company; part of Mestek, Inc.
15. Loren Cook Company.
16. Madison Manufacturing.
17. Moffitt Corporation Inc.
18. New York Blower Company (The).
19. PennBarry.
20. Quietaire Inc.
21. Stanley Fans.
22. W.W. Grainger, Inc.; Dayton Products.

D. Housing: Galvanized-steel sheet with flanged edges and integral orifice ring with baked-enamel finish coat applied after assembly.

E. Steel Fan Wheels: Formed-steel blades riveted to heavy-gage steel spider bolted to cast-iron hub.

F. Fan Wheel: Replaceable, cast or extruded-aluminum, airfoil blades fastened to cast-aluminum hub; factory set pitch angle of blades.

G. Fan Drive: Motor mounted in airstream, factory wired to disconnect switch located on outside of fan housing.

H. Fan Drive:

1. Resiliently mounted to housing.
2. Statically and dynamically balanced.
3. Selected for continuous operation at maximum rated fan speed and motor horsepower, with final alignment and belt adjustment made after installation.
4. Extend grease fitting to accessible location outside of unit.
5. Service Factor Based on Fan Motor Size: 1.4.
6. Fan Shaft: Turned, ground, and polished steel; keyed to wheel hub.
7. Shaft Bearings: Permanently lubricated, permanently sealed, self-aligning ball bearings.

    a. Ball-Bearing Rating Life: ABMA 9, L10 of 100,000 hours.

8. Pulleys: Cast iron with split, tapered bushing; dynamically balanced at factory.
9. Motor Pulleys: Adjustable pitch for use with motors through 5 hp; fixed pitch for use with larger motors. Select pulley so pitch adjustment is at the middle of adjustment range at fan design conditions.
10. Belts: Oil resistant, nonsparking, and nonstatic; matched sets for multiple belt drives.
11. Belt Guards: Fabricate of steel for motors mounted on outside of fan cabinet.

I. Accessories:

1. Gravity Shutters: Aluminum blades in aluminum frame; interlocked blades with nylon bearings.
2. Motor-Side Back Guard: Galvanized steel, complying with OSHA specifications, removable for maintenance.
3. Wall Sleeve: Galvanized steel to match fan and accessory size.
4. Weathershield Hood: Galvanized steel to match fan and accessory size.
5. Weathershield Front Guard: Galvanized steel with expanded metal screen.
6. Variable-Speed Controller: Solid-state control to reduce speed from 100 to less than 50 percent.
7. Disconnect Switch: Nonfusible type, with thermal-overload protection mounted inside fan housing, factory wired through an internal aluminum conduit.

J. Capacities and Characteristics:

1. Airflow: Refer to Drawings.
2. Fan Diameter: Refer to Drawings.
3. Fan rpm: Refer to Drawings.
4. Brake Horsepower: Refer to Drawings.
5. Motor Size: Refer to Drawings.
6. Electrical Characteristics: Refer to Drawings.

    a. Volts: Refer to Drawings.
    b. Phase: Refer to Drawings.
    c. Hertz: Refer to Drawings.

7. Vibration Isolators:

a. Type: Spring isolators.
b. Static Deflection: 1 inch (25 mm).

8. Spark Arrestance Class: A.

2.6 MOTORS

A. Comply with NEMA designation, temperature rating, service factor, enclosure type, and efficiency requirements for motors specified in Division 23 Section "Common Motor Requirements for HVAC Equipment."

1. Motor Sizes: Minimum size as indicated. If not indicated, large enough so driven load will not require motor to operate in service factor range above 1.0.
2. Controllers, Electrical Devices, and Wiring: Comply with requirements for electrical devices and connections specified in Division 26 Sections.

B. Enclosure Type: Totally enclosed, fan cooled.

2.7 SOURCE QUALITY CONTROL

A. Certify sound-power level ratings according to AMCA 301, "Methods for Calculating Fan Sound Ratings from Laboratory Test Data." Factory test fans according to AMCA 300, "Reverberant Room Method for Sound Testing of Fans." Label fans with the AMCA-Certified Ratings Seal.

B. Certify fan performance ratings, including flow rate, pressure, power, air density, speed of rotation, and efficiency by factory tests according to AMCA 210, "Laboratory Methods of Testing Fans for Aerodynamic Performance Rating." Label fans with the AMCA-Certified Ratings Seal.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Secure roof-mounted fans to roof curbs with cadmium-plated hardware. See Division 07 Section "Roof Accessories" for installation of roof curbs.

B. Ceiling Units: Suspend units from structure; use steel wire or metal straps.

C. Support suspended units from structure using threaded steel rods and spring hangers with vertical-limit stops having a static deflection of 1 inch (25 mm). Vibration-control devices are specified in Division 23 Section "Vibration and Seismic Controls for HVAC Piping and Equipment."

D. Install units with clearances for service and maintenance.

E. Label units according to requirements specified in Division 23 Section "Identification for HVAC Piping and Equipment."

3.2 CONNECTIONS

A. Duct installation and connection requirements are specified in other Division 23 Sections. Drawings indicate general arrangement of ducts and duct accessories. Make final duct connections with flexible connectors. Flexible connectors are specified in Division 23 Section "Air Duct Accessories."

B. Install ducts adjacent to power ventilators to allow service and maintenance.

C. Ground equipment according to Division 26 Section "Grounding and Bonding for Electrical Systems."

D. Connect wiring according to Division 26 Section "Low-Voltage Electrical Power Conductors and Cables."

3.3 FIELD QUALITY CONTROL

A. Perform tests and inspections.

1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.

B. Tests and Inspections:

1. Verify that shipping, blocking, and bracing are removed.
2. Verify that unit is secure on mountings and supporting devices and that connections to ducts and electrical components are complete. Verify that proper thermal-overload protection is installed in motors, starters, and disconnect switches.
3. Verify that cleaning and adjusting are complete.
4. Disconnect fan drive from motor, verify proper motor rotation direction, and verify fan wheel free rotation and smooth bearing operation. Reconnect fan drive system, align and adjust belts, and install belt guards.
5. Adjust belt tension.
6. Adjust damper linkages for proper damper operation.
7. Verify lubrication for bearings and other moving parts.
8. Verify that manual and automatic volume control and fire and smoke dampers in connected ductwork systems are in fully open position.
9. Disable automatic temperature-control operators, energize motor and adjust fan to indicated rpm, and measure and record motor voltage and amperage.
10. Shut unit down and reconnect automatic temperature-control operators.
11. Remove and replace malfunctioning units and retest as specified above.

C. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

D. Prepare test and inspection reports.

3.4 ADJUSTING

A. Adjust damper linkages for proper damper operation.

B. Adjust belt tension.

C. Comply with requirements in Division 23 Section "Testing, Adjusting, and Balancing for HVAC" for testing, adjusting, and balancing procedures.

D. Replace fan and motor pulleys as required to achieve design airflow.

E. Lubricate bearings.

END OF SECTION 233423

SECTION 233416 - CENTRIFUGAL HVAC FANS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes: For each product.

1. Backward-inclined centrifugal fans.
2. Forward-curved centrifugal fans.

1.2 ACTION SUBMITTALS

A. Product Data:

1. Include rated capacities, furnished specialties, and accessories for each fan.
2. Certified fan performance curves with system operating conditions indicated.
3. Certified fan sound-power ratings.
4. Motor ratings and electrical characteristics, plus motor and electrical accessories.
5. Material thickness and finishes, including color charts.
6. Dampers, including housings, linkages, and operators.

B. Shop Drawings:

1. Include plans, elevations, sections, and attachment details.
2. Include details of equipment assemblies. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
3. Include diagrams for power, signal, and control wiring.
4. Design Calculations: Calculate requirements for selecting vibration isolators and seismic restraints and for designing vibration isolation bases.
5. Vibration Isolation Base Details: Detail fabrication, including anchorages and attachments to structure and to supported equipment. Include auxiliary motor slides and rails, and base weights.

1.3 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Show fan room layout and relationships between components and adjacent structural and mechanical elements. Show support locations, type of support, and weight on each support. Indicate and certify field measurements.

B. Field quality-control reports.

1.4 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For centrifugal fans to include in emergency, operation, and maintenance manuals.

1.5 MAINTENANCE MATERIAL SUBMITTALS

A. Belts: One set(s) for each belt-driven unit.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. AMCA Compliance: Comply with AMCA performance requirements and bear the AMCA-Certified Ratings Seal.

B. Capacities and Characteristics:

1. Total Airflow: Refer to Drawings.
2. External Static Pressure: Refer to Drawings
3. Class: **I.**
4. Arrangement: Refer to Drawings.
5. Housing Material: **Stainless steel**.
6. Special Housing Coating: **Hot-dip galvanized.**
7. Wheel Size (Diameter): Refer to Drawings.
8. Wheel Material: S**teel**.
9. Special Wheel Coating:**Hot-dip galvanized**.
10. Brake Horsepower: Refer to Drawings.
11. Drive Type: Refer to Drawings.
12. Fan Rpm: Refer to Drawings.
13. Outlet Velocity: Refer to Drawings.
14. Motor: Refer to Drawings.

    a. Electrical Characteristics:

        1) Motor Size: Refer to Drawings.
        2) Motor Rpm: Refer to Drawings.
        3) Volts: Refer to Drawings.
        4) Phase: [**Single**] [**Poly**].
        5) Hertz: 60.
        6) Full-Load Amperes: Refer to Drawings.
        7) Minimum Circuit Ampacity: Refer to Drawings.
        8) Maximum Overcurrent Protection: Refer to Drawings.

15. Discharge Sound Power:

    a. 1st Octave: Refer to Drawings.
    b. 2nd Octave: Refer to Drawings.

c. 3rd Octave: Refer to Drawings.
d. 4th Octave: Refer to Drawings.
e. 5th Octave: Refer to Drawings.
f. 6th Octave: Refer to Drawings.
g. 7th Octave: Refer to Drawings.
h. 8th Octave: Refer to Drawings.

16. Inlet Sound Power:

a. 1st Octave: Refer to Drawings.
b. 2nd Octave: Refer to Drawings.
c. 3rd Octave: Refer to Drawings.
d. 4th Octave: Refer to Drawings.
e. 5th Octave: Refer to Drawings.
f. 6th Octave Refer to Drawings.
g. 7th Octave: Refer to Drawings.
h. 8th Octave: Refer to Drawings.

17. Vibration Isolators: Spring isolators having a static deflection of 1 inch (25 mm)
18. Spark-Resistance Class: A.

2.2 BACKWARD-INCLINED CENTRIFUGAL FANS

A. Manufacturers: Subject to compliance with requirements, provide products by the following] [provide products by one of the following:

B. Retain "Basis-of-Design Product" Paragraph and list of manufacturers below to identify a specific product or a comparable product from manufacturers listed. Retain option and delete insert note if manufacturer's name and model number are indicated on Drawings.

C. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or a comparable product by one of the following:

1. Acme Engineering & Mfg. Corp.
2. Aerovent; a Twin City Fan company.
3. Central Blower Company.
4. Chicago Blower Corporation.
5. Cincinnati Fan.
6. CML Northern Blower Inc.
7. Howden Buffalo Inc.
8. Loren Cook Company.
9. New York Blower Company (The).

D. Description:

1. Factory-fabricated, -assembled, -tested, and -finished, belt-driven centrifugal fans consisting of housing, wheel, fan shaft, bearings, motor, drive assembly, and support structure.
2. Deliver fans as factory-assembled units, to the extent allowable by shipping limitations.

3. Factory-installed and -wired disconnect switch.

E. Housings:

1. Formed panels to make curved-scroll housings with shaped cutoff.
2. Panel Bracing: Steel angle- or channel-iron member supports for mounting and supporting fan scroll, wheel, motor, and accessories.
3. Horizontally split, bolted-flange housing.
4. Spun inlet cone with flange.
5. Outlet flange.

F. Backward-Inclined Wheels:

1. Single-width-single-inlet and double-width-double-inlet construction with curved inlet flange, backplate, backward-inclined blades, and fastened to shaft with set screws.
2. Welded or riveted to flange and backplate; cast-iron or cast-steel hub riveted to backplate.

G. Shafts:

1. Statically and dynamically balanced and selected for continuous operation at maximum rated fan speed and motor horsepower, with adjustable alignment and belt tensioning.
2. Turned, ground, and polished hot-rolled steel with keyway. Ship with protective coating of lubricating oil.
3. Designed to operate at no more than 70 percent of first critical speed at top of fan's speed range.

H. Grease-Lubricated Shaft Bearings:

1. Self-aligning, pillow-block-type, ball or roller bearings with adapter mount and two-piece, cast-iron housing.

I. Belt Drives:

1. Factory mounted, with adjustable alignment and belt tensioning.
2. Service Factor Based on Fan Motor Size: 1.5.
3. Fan Pulleys: Cast iron or cast steel with split, tapered bushing; dynamically balanced at factory.
4. Motor Pulleys: Adjustable pitch for use with motors through 5 hp; fixed pitch for use with larger motors. Select pulley so pitch adjustment is at the middle of adjustment range at fan design conditions.
5. Belts: Oil resistant, nonsparking, and nonstatic; matched sets for multiple belt drives.
6. Belt Guards: Fabricate to comply with OSHA and SMACNA requirements of diamond-mesh wire screen welded to steel angle frame or equivalent, prime coated. Secure to fan or fan supports without short circuiting vibration isolation. Include provisions for adjustment of belt tension, lubrication, and use of tachometer with guard in place.
7. Motor Mount: Adjustable for belt tensioning.

J. Accessories:

1. Access for Inspection, Cleaning, and Maintenance: Comply with requirements in ASHRAE 62.1.

2. Scroll Drain Connection: NPS 1 (DN 25) steel pipe coupling welded to low point of fan scroll.
3. Companion Flanges: Rolled flanges for duct connections of same material as housing.
4. Variable Inlet Vanes: With blades supported at both ends with two permanently lubricated bearings of same material as housing. Variable mechanism terminating in single control lever with control shaft for double-width fans.
5. Discharge Dampers: Assembly with opposed blades constructed of two plates formed around and to shaft, channel frame, and sealed ball bearings; with blades linked outside of airstream to single control lever of same material as housing.
6. Inlet Screens: Grid screen of same material as housing.
7. Shaft Cooler: Metal disk between bearings and fan wheel, designed to dissipate heat from shaft.
8. Spark-Resistant Construction: AMCA 99.
9. Shaft Seals: Airtight seals installed around shaft on drive side of single-width fans.
10. Weather Cover: Enameled-steel sheet with ventilation slots, bolted to housing.

2.3 FORWARD-CURVED CENTRIFUGAL FANS

A. Manufacturers: Subject to compliance with requirements, **provide products by the following**:

B. Retain "Basis-of-Design Product" Paragraph and list of manufacturers below to identify a specific product or a comparable product from manufacturers listed. Retain option and delete insert note if manufacturer's name and model number are indicated on Drawings.

C. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:

1. Acme Engineering & Mfg. Corp.
2. Central Blower Company.
3. Howden Buffalo Inc.
4. Lau Industries.
5. New York Blower Company (The).

D. Description:

1. Factory-fabricated, -assembled, -tested, and -finished, belt-driven centrifugal fans consisting of housing, wheel, fan shaft, bearings, motor, drive assembly, and support structure.
2. Deliver fans as factory-assembled units, to the extent allowable by shipping limitations.
3. Factory-installed and -wired disconnect switch.

E. Housings:

1. Formed panels to make curved-scroll housings with shaped cutoff.
2. Panel Bracing: Steel angle- or channel-iron member supports for mounting and supporting fan scroll, wheel, motor, and accessories.
3. Horizontally split, bolted-flange housing.
4. Spun inlet cone with flange.
5. Outlet flange.

F. Forward-Curved Wheels:

1. Black-enameled or galvanized-steel construction with inlet flange, backplate, shallow blades with inlet and tip curved forward in direction of airflow.
2. Mechanically secured to flange and backplate; cast-steel hub swaged to backplate and fastened to shaft with set screws.

G. Shafts:

1. Statically and dynamically balanced and selected for continuous operation at maximum rated fan speed and motor horsepower, with adjustable alignment and belt tensioning.
2. Turned, ground, and polished hot-rolled steel with keyway. Ship with protective coating of lubricating oil.
3. Designed to operate at no more than 70 percent of first critical speed at top of fan's speed range.

H. Grease-Lubricated Shaft Bearings:

1. Self-aligning, pillow-block-type, ball or roller bearings with adapter mount and two-piece, cast-iron housing.

I. Belt Drives:

1. Factory mounted, with adjustable alignment and belt tensioning.
2. Service Factor Based on Fan Motor Size: 1.5.
3. Fan Pulleys: Cast iron or cast steel with split, tapered bushing; dynamically balanced at factory.
4. Motor Pulleys: Adjustable pitch for use with motors through 5 hp; fixed pitch for use with larger motors. Select pulley so pitch adjustment is at the middle of adjustment range at fan design conditions.
5. Belts: Oil resistant, nonsparking, and nonstatic; matched sets for multiple belt drives.
6. Belt Guards: Fabricate to comply with OSHA and SMACNA requirements of diamond-mesh wire screen welded to steel angle frame or equivalent, prime coated. Secure to fan or fan supports without short circuiting vibration isolation. Include provisions for adjustment of belt tension, lubrication, and use of tachometer with guard in place.
7. Motor Mount: Adjustable for belt tensioning.

J. Accessories:

1. Access for Inspection, Cleaning, and Maintenance: Comply with requirements in ASHRAE 62.1.
2. Scroll Drain Connection: NPS 1 (DN 25) steel pipe coupling welded to low point of fan scroll.
3. Companion Flanges: Rolled flanges for duct connections of same material as housing.
4. Variable Inlet Vanes: With blades supported at both ends with two permanently lubricated bearings of same material as housing. Variable mechanism terminating in single control lever with control shaft for double-width fans.
5. Discharge Dampers: Assembly with parallel or opposed blades constructed of two plates formed around and to shaft, channel frame, and sealed ball bearings; with blades linked outside of airstream to single control lever of same material as housing.
6. Inlet Screens: Grid screen of same material as housing.

7. Shaft Cooler: Metal disk between bearings and fan wheel, designed to dissipate heat from shaft.
8. Spark-Resistant Construction: AMCA 99.
9. Shaft Seals: Airtight seals installed around shaft on drive side of single-width fans.
10. Weather Cover: Enameled-steel sheet with ventilation slots, bolted to housing.

2.4 SOURCE QUALITY CONTROL

A. Sound-Power Level Ratings: Comply with AMCA 301, "Methods for Calculating Fan Sound Ratings from Laboratory Test Data." Factory test fans according to AMCA 300, "Reverberant Room Method for Sound Testing of Fans." Label fans with the AMCA-Certified Ratings Seal.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install centrifugal fans level and plumb.

B. Disassemble and reassemble units, as required for moving to the final location, according to manufacturer's written instructions.

C. Lift and support units with manufacturer's designated lifting or supporting points.

D. Equipment Mounting: Install centrifugal fans on cast-in-place concrete equipment base(s) using restrained spring isolators. Comply with requirements for equipment bases specified in Division 03 Section "Cast-in-Place Concrete or Miscellaneous Cast-in-Place Concrete." Comply with requirements for vibration isolation devices specified in Division 23 Section "Vibration and Seismic Controls for HVAC Piping and Equipment."

1. Minimum Deflection: 1/4 inch (6 mm)

E. Equipment Mounting: Install centrifugal fans using restrained spring isolator. Comply with requirements for vibration isolation devices specified in Division 23 Section "Vibration and Seismic Controls for HVAC Piping and Equipment."

1. Minimum Deflection: **1/4 inch (6 mm)**.

F. Equipment Mounting: Install centrifugal fans on vibration isolation equipment base. Comply with requirements specified in Division 23 Section "Vibration and Seismic Controls for HVAC Piping and Equipment."

G. Equipment Mounting: Install centrifugal fans with. Comply with requirements for seismic-restraint devices specified in Division 23 Section "Vibration and Seismic Controls for HVAC Piping and Equipment."

H. Equipment Mounting: Install continuous-thread hanger rods and spring hangers with vertical-limit stop of size required to support weight of dehumidification unit.

1. Comply with requirements for seismic-restraint devices specified in Division 23 Section "Vibration and Seismic Controls for HVAC Piping and Equipment."
2. Comply with requirements for hangers and supports specified in Division 23 Section "Hangers and Supports for HVAC Piping and Equipment."

I. Curb Support: Install roof curb on roof structure, level and secure, according to "The NRCA Roofing and Waterproofing Manual," Low-Slope Membrane Roofing Construction Details Section, Illustration "Raised Curb Detail for Rooftop Air Handling Units and Ducts." Install and secure centrifugal fans on curbs, and coordinate roof penetrations and flashing with roof construction. Secure units to curb support with anchor bolts.

J. Unit Support: Install centrifugal fans level on structural curbs. Coordinate wall penetrations and flashing with wall construction. Secure units to structural support with anchor bolts.

K. Isolation Curb Support: Install centrifugal fans on isolation curbs, and install flexible duct connectors and vibration isolation and seismic-control devices.

1. Comply with requirements in Division 23 Section "Air Duct Accessories" for flexible duct connectors.
2. Comply with requirements in Division 23 Section "Vibration and Seismic Controls for HVAC Piping and Equipment" for vibration isolation and seismic-control devices.

L. Install units with clearances for service and maintenance.

M. Label fans according to requirements specified in Division 23 Section "Identification for HVAC Piping and Equipment."

3.2 CONNECTIONS

A. Duct installation and connection requirements are specified in other Division 23 Sections. Drawings indicate general arrangement of ducts and duct accessories. Make final duct connections with flexible connectors. Flexible connectors are specified in Division 23 Section "Air Duct Accessories."

B. Install ducts adjacent to fans to allow service and maintenance.

C. Install piping from scroll drain connection, with trap with seal equal to 1.5 times specified static pressure, to nearest floor drain with pipe sizes matching the drain connection.

3.3 FIELD QUALITY CONTROL

A. Perform the following tests and inspections with the assistance of a factory-authorized service representative:

1. Verify that shipping, blocking, and bracing are removed.
2. Verify that unit is secure on mountings and supporting devices and that connections to ducts and electrical components are complete. Verify that proper thermal-overload protection is installed in motors, starters, and disconnect switches.
3. Verify that cleaning and adjusting are complete.

4. Disconnect fan drive from motor, verify proper motor rotation direction, and verify fan wheel free rotation and smooth bearing operation. Reconnect fan drive system, align and adjust belts, and install belt guards.
5. Adjust belt tension.
6. Adjust damper linkages for proper damper operation.
7. Verify lubrication for bearings and other moving parts.
8. Verify that manual and automatic volume control and fire and smoke dampers in connected ductwork systems are in fully open position.
9. See Division 23 Section "Testing, Adjusting, and Balancing For HVAC" for testing, adjusting, and balancing procedures.
10. Remove and replace malfunctioning units and retest as specified above.

B. Test and adjust controls and safeties. Controls and equipment will be considered defective if they do not pass tests and inspections.

C. Prepare test and inspection reports.

END OF SECTION 233416

SECTION 233300 - AIR DUCT ACCESSORIES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Backdraft and pressure relief dampers.
2. Manual volume dampers.
3. Control dampers.
4. Fire dampers.
5. Smoke dampers.
6. Flange connectors.
7. Turning vanes.
8. Duct-mounted access doors.
9. Flexible connectors.
10. Flexible ducts.
11. Duct accessory hardware.

1.2 ACTION SUBMITTALS

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

B. LEED Submittals:

1. Product Data for Prerequisite IEQ 1: Documentation indicating that units comply with ASHRAE 62.1, Section 5 - "Systems and Equipment."
2. Product Data for Prerequisite EA 2: Documentation indicating that duct insulation R-values comply with tables in ASHRAE/IESNA 90.1, Section 6 - "Heating, Ventilating, and Air Conditioning."

C. Shop Drawings: For duct accessories. Include plans, elevations, sections, details and attachments to other work.

1. Detail duct accessories fabrication and installation in ducts and other construction. Include dimensions, weights, loads, and required clearances; and method of field assembly into duct systems and other construction. Include the following:

a. Special fittings.
b. Manual volume damper installations.
c. Control damper installations.
d. Fire-damper and smoke-damper installations, including sleeves; and duct-mounted access doors.
e. Wiring Diagrams: For power, signal, and control wiring.

1.3 CLOSEOUT SUBMITTALS

A. Operation and maintenance data.

1.4 QUALITY ASSURANCE

A. Comply with NFPA 90A, "Installation of Air Conditioning and Ventilating Systems," and with NFPA 90B, "Installation of Warm Air Heating and Air Conditioning Systems."

B. Comply with AMCA 500-D testing for damper rating.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for acceptable materials, material thicknesses, and duct construction methods unless otherwise indicated. Sheet metal materials shall be free of pitting, seam marks, roller marks, stains, discolorations, and other imperfections.

B. Galvanized Sheet Steel: Comply with ASTM A 653/A 653M.

1. Galvanized Coating Designation: **G90 (Z275)**.
2. Exposed-Surface Finish: Mill phosphatized.

C. Stainless-Steel Sheets: Comply with ASTM A 480/A 480M, Type 304, and having a **No. 2** finish for concealed ducts and finish for exposed ducts.

D. Aluminum Sheets: Comply with ASTM B 209 (ASTM B 209M), Alloy 3003, Temper H14; with mill finish for concealed ducts and standard, 1-side bright finish for exposed ducts.

E. Extruded Aluminum: Comply with ASTM B 221 (ASTM B 221M), Alloy 6063, Temper T6.

F. Reinforcement Shapes and Plates: Galvanized-steel reinforcement where installed on galvanized sheet metal ducts; compatible materials for aluminum and stainless-steel ducts.

G. Tie Rods: Galvanized steel, 1/4-inch (6-mm) minimum diameter for lengths 36 inches (900 mm) or less; 3/8-inch (10-mm) minimum diameter for lengths longer than 36 inches (900 mm).

2.2 BACKDRAFT AND PRESSURE RELIEF DAMPERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Air Balance Inc.; a division of Mestek, Inc.
2. American Warming and Ventilating; a division of Mestek, Inc.
3. Cesco Products; a division of Mestek, Inc.
4. Duro Dyne Inc.

5. Greenheck Fan Corporation.
6. Lloyd Industries, Inc.
7. Nailor Industries Inc.
8. NCA Manufacturing, Inc.
9. Pottorff; a division of PCI Industries, Inc.
10. Ruskin Company.
11. SEMCO Incorporated.
12. Vent Products Company, Inc.

B. Description: Gravity balanced.

C. Maximum Air Velocity: 3000 fpm (15 m/s).

D. Maximum System Pressure: 2-inch wg (0.5 kPa).

E. Frame: 0.052-inch- (1.3-mm-) thick, galvanized sheet steel, with welded corners and mounting flange.

F. Blades: Multiple single-piece blades, center-pivoted, maximum 6-inch (150-mm) width, noncombustible, tear-resistant, neoprene-coated fiberglass with sealed edges.

G. Blade Action: Parallel.

H. Blade Seals: Neoprene, mechanically locked.

I. Blade Axles:

1. Material: Stainless steel.
2. Diameter: [0.20 inch (5 mm).

J. Tie Bars and Brackets: Galvanized steel.

K. Return Spring: Adjustable tension.

L. Bearings: Steel ball.

M. Accessories:

1. Adjustment device to permit setting for varying differential static pressure.
2. Counterweights and spring-assist kits for vertical airflow installations.
3. Electric actuators.
4. Chain pulls.
5. Screen Mounting: Front mounted in sleeve.
6. Sleeve Thickness: 20-gage (1.0-mm) minimum.
7. Sleeve Length: 6 inches (152 mm) minimum.
8. Screen Mounting: Rear mounted.
9. Screen Material: Galvanized steel.
10. Screen Type: Bird & Insect.
11. 90-degree stops.

2.3 MANUAL VOLUME DAMPERS

A. Standard, Steel, Manual Volume Dampers:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

   a. Air Balance Inc.; a division of Mestek, Inc.
   b. American Warming and Ventilating; a division of Mestek, Inc.
   c. Flexmaster U.S.A., Inc.
   d. McGill AirFlow LLC.
   e. METALAIRE, Inc.
   f. Nailor Industries Inc.
   g. Pottorff; a division of PCI Industries, Inc.
   h. Ruskin Company.
   i. Trox USA Inc.
   j. Vent Products Company, Inc.

2. Standard leakage rating, with linkage outside airstream.
3. Suitable for horizontal or vertical applications.
4. Frames:

   a. Hat-shaped, stainless-steel channels, 0.064-inch (1.62-mm) minimum thickness.
   b. Mitered and welded corners.
   c. Flanges for attaching to walls and flangeless frames for installing in ducts.

5. Blades:

   a. Multiple or single blade.
   b. Parallel- or opposed-blade design.
   c. Stiffen damper blades for stability.
   d. Stainless-steel, 0.064 inch (1.62 mm) thick.

6. Blade Axles: Stainless steel.
7. Bearings:

   a. Stainless-steel sleeve.
   b. Dampers in ducts with pressure classes of 3-inch wg (750 Pa) or less shall have axles full length of damper blades and bearings at both ends of operating shaft.

8. Tie Bars and Brackets: Galvanized steel.

B. Standard, Aluminum, Manual Volume Dampers:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

   a. Air Balance Inc.; a division of Mestek, Inc.
   b. American Warming and Ventilating; a division of Mestek, Inc.
   c. Flexmaster U.S.A., Inc.

d. McGill AirFlow LLC.
e. METALAIRE, Inc.
f. Nailor Industries Inc.
g. Pottorff; a division of PCI Industries, Inc.
h. Ruskin Company.
i. Trox USA Inc.
j. Vent Products Company, Inc.

2. Standard leakage rating**,** with linkage outside airstream.
3. Suitable for horizontal or vertical applications.
4. Frames: Hat-shaped, 0.10-inch- (2.5-mm-) thick, aluminum sheet channels; frames with flanges for attaching to walls and flangeless frames for installing in ducts.
5. Blades:

a. Multiple or single blade.
b. Parallel- or opposed-blade design.
c. Stiffen damper blades for stability.
d. Roll-Formed Aluminum Blades: 0.10-inch- (2.5-mm-) thick aluminum sheet.
e. Extruded-Aluminum Blades: 0.050-inch- (1.2-mm-) thick extruded aluminum.

6. Blade Axles: Stainless steel metal.
7. Bearings:

a. Stainless-steel sleeve.
b. Dampers in ducts with pressure classes of 3-inch wg (750 Pa) or less shall have axles full length of damper blades and bearings at both ends of operating shaft.

8. Tie Bars and Brackets: Aluminum.

C. Jackshaft:

1. Size: 1-inch (25-mm) diameter.
2. Material: Galvanized-steel pipe rotating within pipe-bearing assembly mounted on supports at each mullion and at each end of multiple-damper assemblies.
3. Length and Number of Mountings: As required to connect linkage of each damper in multiple-damper assembly.

D. Damper Hardware:

1. Zinc-plated, die-cast core with dial and handle made of 3/32-inch- (2.4-mm-) thick zinc-plated steel, and a 3/4-inch (19-mm) hexagon locking nut.
2. Include center hole to suit damper operating-rod size.
3. Include elevated platform for insulated duct mounting.

2.4 CONTROL DAMPERS

A. Manufacturers: Subject to compliance with requirements, [**provide products by one of the following**] [**available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following**]:

1. American Warming and Ventilating; a division of Mestek, Inc.
2. Arrow United Industries; a division of Mestek, Inc.
3. Cesco Products; a division of Mestek, Inc.
4. Duro Dyne Inc.
5. Flexmaster U.S.A., Inc.
6. Greenheck Fan Corporation.
7. Lloyd Industries, Inc.
8. M&I Air Systems Engineering; Division of M&I Heat Transfer Products Ltd.
9. McGill AirFlow LLC.
10. METALAIRE, Inc.
11. Metal Form Manufacturing, Inc.
12. Nailor Industries Inc.
13. NCA Manufacturing, Inc.
14. Ruskin Company.
15. Vent Products Company, Inc.
16. Young Regulator Company.

B. Frames:

1. Angle shaped.
2. Stainless-steel channels, 0.064 inch (1.62 mm) thick.
3. Mitered and welded corners.

C. Blades:

1. Multiple blade with maximum blade width of 8 inches (200 mm).
2. **Opposed**-blade design.
3. Stainless steel.
4. 0.064 inch (1.62 mm) thick.
5. Blade Edging: Closed-cell neoprene edging.
6. Blade Edging: Inflatable seal blade edging, or replaceable rubber seals.

D. Blade Axles: 1/2-inch- (13-mm-) diameter; stainless steel; blade-linkage hardware of zinc-plated steel and brass; ends sealed against blade bearings.

1. Operating Temperature Range: From minus 40 to plus 200 deg F (minus 40 to plus 93 deg C).

E. Bearings:

1. Stainless-steel sleeve.
2. Dampers in ducts with pressure classes of 3-inch wg (750 Pa) or less shall have axles full length of damper blades and bearings at both ends of operating shaft.
3. Thrust bearings at each end of every blade.

2.5 FIRE DAMPERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Air Balance Inc.; a division of Mestek, Inc.
2. Arrow United Industries; a division of Mestek, Inc.
3. Cesco Products; a division of Mestek, Inc.
4. Greenheck Fan Corporation.
5. McGill AirFlow LLC.
6. METALAIRE, Inc.
7. Nailor Industries Inc.
8. NCA Manufacturing, Inc.
9. PHL, Inc.
10. Pottorff; a division of PCI Industries, Inc.
11. Prefco; Perfect Air Control, Inc.
12. Ruskin Company.
13. Vent Products Company, Inc.
14. Ward Industries, Inc.; a division of Hart & Cooley, Inc.

B. Type: Static and dynamic; rated and labeled according to UL 555 by an NRTL.

C. Closing rating in ducts up to 4-inch wg (1-kPa)] static pressure class and minimum 4000-fpm (20-m/s) velocity.

D. Fire Rating: 3 hours.

E. Frame: Curtain type with blades outside airstream; fabricated with roll-formed, 0.034-inch- (0.85-mm-) thick galvanized steel; with mitered and interlocking corners.

F. Mounting Sleeve: Factory- or field-installed, galvanized sheet steel.

1. Minimum Thickness: 0.052 or 0.138 inch (1.3 or 3.5 mm) thick, as indicated, and of length to suit application.
2. Exception: Omit sleeve where damper-frame width permits direct attachment of perimeter mounting angles on each side of wall or floor; thickness of damper frame must comply with sleeve requirements.

G. Mounting Orientation: Vertical or horizontal as indicated.

H. Blades: Roll-formed, interlocking, 0.034-inch- (0.85-mm-) thick, galvanized sheet steel. In place of interlocking blades, use full-length, 0.034-inch- (0.85-mm-) thick, galvanized-steel blade connectors.

I. Horizontal Dampers: Include blade lock and stainless-steel closure spring.

J. Heat-Responsive Device: Replaceable, 212 deg F (100 deg C) rated, fusible links.

K. Heat-Responsive Device: Pneumatic resettable link and switch package, factory installed, 212 deg F (100 deg C) rated.

2.6 SMOKE DAMPERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Air Balance Inc.; a division of Mestek, Inc.
2. Cesco Products; a division of Mestek, Inc.
3. Greenheck Fan Corporation.
4. Nailor Industries Inc.
5. PHL, Inc.
6. Ruskin Company.

B. General Requirements: Label according to UL 555S by an NRTL.

C. Smoke Detector: Integral, factory wired for single-point connection.

D. Frame: Curtain type with blades outside airstream; fabricated with roll-formed, 0.034-inch- (0.85-mm-) thick galvanized steel; with mitered and interlocking corners.

Vertical blades are available for special applications.

E. Blades: Roll-formed, horizontal, interlocking, 0.034-inch- (0.85-mm-) thick, galvanized sheet steel. In place of interlocking blades, use full-length, 0.034-inch- (0.85-mm-) thick, galvanized-steel blade connectors.

F. Leakage: Class I.

G. Rated pressure and velocity to exceed design airflow conditions.

H. Mounting Sleeve: Factory-installed, 0.052-inch- (1.3-mm-) thick, galvanized sheet steel; length to suit wall or floor application with factory-furnished silicone calking.

I. Damper Motors: Modulating action.

J. Comply with NEMA designation, temperature rating, service factor, enclosure type, and efficiency requirements for motors specified in Division 23 Section "Common Motor Requirements for HVAC Equipment."

1. Motor Sizes: Minimum size as indicated. If not indicated, large enough so driven load will not require motor to operate in service factor range above 1.0.
2. Controllers, Electrical Devices, and Wiring: Comply with requirements for electrical devices and connections specified in Division 23 Section "Instrumentation and Control for HVAC."Division 26 Sections.
3. Permanent-Split-Capacitor or Shaded-Pole Motors: With oil-immersed and sealed gear trains.
4. Spring-Return Motors: Equip with an integral spiral-spring mechanism where indicated. Enclose entire spring mechanism in a removable housing designed for service or adjustments. Size for running torque rating of 150 in. x lbf (17 N x m) and breakaway torque rating of 150 in. x lbf (17 N x m).

5. Outdoor Motors and Motors in Outdoor-Air Intakes: Equip with O-ring gaskets designed to make motors weatherproof. Equip motors with internal heaters to permit normal operation at minus 40 deg F (minus 40 deg C).
6. Nonspring-Return Motors: For dampers larger than 25 sq. ft. (2.3 sq. m), size motor for running torque rating of 150 in. x lbf (17 N x m) and breakaway torque rating of 300 in. x lbf (34 N x m).
7. Electrical Connection: 115 V, single phase, 60 Hz.

K. Accessories:

1. Auxiliary switches for position indication.

L. Test and reset roll-formed, factory-fabricated, slide-on transverse flange connectors, gaskets, and components.

M. Material: Galvanized steel.

N. Gage and Shape: Match connecting ductwork.

2.7 TURNING VANES

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Ductmate Industries, Inc.
2. Duro Dyne Inc.
3. METALAIRE, Inc.
4. SEMCO Incorporated.
5. Ward Industries, Inc.; a division of Hart & Cooley, Inc.

B. Manufactured Turning Vanes for Metal Ducts: Curved blades of galvanized sheet steel; support with bars perpendicular to blades set; set into vane runners suitable for duct mounting.

1. Acoustic Turning Vanes: Fabricate airfoil-shaped aluminum extrusions with perforated faces and fibrous-glass fill.

C. Manufactured Turning Vanes for Nonmetal Ducts: Fabricate curved blades of resin-bonded fiberglass with acrylic polymer coating; support with bars perpendicular to blades set; set into vane runners suitable for duct mounting.

D. General Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible"; Figures 4-3, "Vanes and Vane Runners," and 4-4, "Vane Support in Elbows."

E. Vane Construction: Double wall.

F. Vane Construction: Single wall for ducts up to **48 inches (1200 mm)** wide and double wall for larger dimensions.

2.8 DUCT-MOUNTED ACCESS DOORS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. American Warming and Ventilating; a division of Mestek, Inc.
2. Cesco Products; a division of Mestek, Inc.
3. Ductmate Industries, Inc.
4. Flexmaster U.S.A., Inc.
5. Greenheck Fan Corporation.
6. McGill AirFlow LLC.
7. Nailor Industries Inc.
8. Pottorff; a division of PCI Industries, Inc.
9. Ventfabrics, Inc.
10. Ward Industries, Inc.; a division of Hart & Cooley, Inc.

B. Duct-Mounted Access Doors: Fabricate access panels according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible"; Figures 7-2 (7-2M), "Duct Access Doors and Panels," and 7-3, "Access Doors - Round Duct."

1. Door:

a. Double wall, rectangular.
b. Galvanized sheet metal with insulation fill and thickness as indicated for duct pressure class.
c. Vision panel.
d. Hinges and Latches: 1-by-1-inch (25-by-25-mm) butt or piano hinge and cam latches.
e. Fabricate doors airtight and suitable for duct pressure class.

2. Frame: Galvanized sheet steel, with bend-over tabs and foam gaskets.
3. Number of Hinges and Locks:

a. Access Doors Less Than 12 Inches (300 mm) Square: No hinges and two sash locks.
b. Access Doors up to 18 Inches (460 mm) Square: Two hinges and two sash locks.
c. Access Doors up to 24 by 48 Inches (600 by 1200 mm): Three hinges and two compression latches with outside and inside handles.
d. Access Doors Larger Than 24 by 48 Inches (600 by 1200 mm): Four hinges and two compression latches with outside and inside handles.

C. Pressure Relief Access Door:

1. Door and Frame Material: Galvanized sheet steel.
2. Door: Double wall with insulation fill with metal thickness applicable for duct pressure class.
3. Operation: Open outward for positive-pressure ducts and inward for negative-pressure ducts.
4. Factory set at 10-inch wg (2500 Pa).
5. Doors close when pressures are within set-point range.

6. Hinge: Continuous piano.
7. Latches: Cam.
8. Seal: Neoprene or foam rubber.
9. Insulation Fill: 1-inch- (25-mm-) thick, fibrous-glass or polystyrene-foam board.

2.9 DUCT ACCESS PANEL ASSEMBLIES

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Ductmate Industries, Inc.
2. Flame Gard, Inc.
3. 3M.

B. Labeled according to UL 1978 by an NRTL.

C. Panel and Frame: Minimum thickness 0.0528-inch (1.3-mm) carbon steel.

D. Fasteners: Stainless steel. Panel fasteners shall not penetrate duct wall.

E. Gasket: Comply with NFPA 96; grease-tight, high-temperature ceramic fiber, rated for minimum 2000 deg F (1093 deg C).

F. Minimum Pressure Rating: 10-inch wg (2500 Pa), positive or negative.

2.10 FLEXIBLE CONNECTORS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Ductmate Industries, Inc.
2. Duro Dyne Inc.
3. Ventfabrics, Inc.
4. Ward Industries, Inc.; a division of Hart & Cooley, Inc.

B. Materials: Flame-retardant or noncombustible fabrics.

C. Coatings and Adhesives: Comply with UL 181, Class 1.

D. Metal-Edged Connectors: Factory fabricated with a fabric strip 5-3/4 inches (146 mm) wide attached to 2 strips of 2-3/4-inch- (70-mm-) wide, 0.028-inch- (0.7-mm-) thick, galvanized sheet steel or 0.032-inch- (0.8-mm-) thick aluminum sheets. Provide metal compatible with connected ducts.

E. Indoor System, Flexible Connector Fabric: Glass fabric double coated with neoprene.

1. Minimum Weight: 26 oz./sq. yd. (880 g/sq. m).

2. Tensile Strength: 480 lbf/inch (84 N/mm) in the warp and 360 lbf/inch (63 N/mm) in the filling.
3. Service Temperature: Minus 40 to plus 200 deg F (Minus 40 to plus 93 deg C).

F. Outdoor System, Flexible Connector Fabric: Glass fabric double coated with weatherproof, synthetic rubber resistant to UV rays and ozone.

1. Minimum Weight: 24 oz./sq. yd. (810 g/sq. m).
2. Tensile Strength: 530 lbf/inch (93 N/mm) in the warp and 440 lbf/inch (77 N/mm) in the filling.
3. Service Temperature: Minus 50 to plus 250 deg F (Minus 45 to plus 121 deg C).

G. Thrust Limits: Combination coil spring and elastomeric insert with spring and insert in compression, and with a load stop. Include rod and angle-iron brackets for attaching to fan discharge and duct.

1. Frame: Steel, fabricated for connection to threaded rods and to allow for a maximum of 30 degrees of angular rod misalignment without binding or reducing isolation efficiency.
2. Outdoor Spring Diameter: Not less than 80 percent of the compressed height of the spring at rated load.
3. Minimum Additional Travel: 50 percent of the required deflection at rated load.
4. Lateral Stiffness: More than 80 percent of rated vertical stiffness.
5. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.
6. Elastomeric Element: Molded, oil-resistant rubber or neoprene.
7. Coil Spring: Factory set and field adjustable for a maximum of 1/4-inch (6-mm) movement at start and stop.

2.11 FLEXIBLE DUCTS

A. Manufacturers: Subject to compliance with requirements, [**provide products by one of the following**] [**available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following**]:

1. Flexmaster U.S.A., Inc.
2. McGill AirFlow LLC.
3. Ward Industries, Inc.; a division of Hart & Cooley, Inc.

B. Noninsulated, Flexible Duct: UL 181, Class 1, 2-ply vinyl film supported by helically wound, spring-steel wire.

1. Pressure Rating: 10-inch wg (2500 Pa) positive and 1.0-inch wg (250 Pa) negative.
2. Maximum Air Velocity: 4000 fpm (20 m/s).
3. Temperature Range: Minus 10 to plus 160 deg F (Minus 23 to plus 71 deg C).

C. Noninsulated, Flexible Duct: UL 181, Class 1, black polymer film supported by helically wound, spring-steel wire.

1. Pressure Rating: 4-inch wg (1000 Pa) positive and 0.5-inch wg (125 Pa) negative.

2. Maximum Air Velocity: 4000 fpm (20 m/s).
3. Temperature Range: Minus 20 to plus 175 deg F (Minus 29 to plus 79 deg C).

D. Noninsulated, Flexible Duct: UL 181, Class 1, multiple layers of aluminum laminate supported by helically wound, spring-steel wire.

1. Pressure Rating: 10-inch wg (2500 Pa) positive and 1.0-inch wg (250 Pa) negative.
2. Maximum Air Velocity: 4000 fpm (20 m/s).
3. Temperature Range: Minus 20 to plus 210 deg F (Minus 29 to plus 99 deg C).

E. Noninsulated, Flexible Duct: UL 181, Class 1, aluminum laminate and polyester film with latex adhesive supported by helically wound, spring-steel wire.

1. Pressure Rating: 10-inch wg (2500 Pa) positive and 1.0-inch wg (250 Pa) negative.
2. Maximum Air Velocity: 4000 fpm (20 m/s).
3. Temperature Range: Minus 20 to plus 210 deg F (Minus 29 to plus 99 deg C).

F. Noninsulated, Flexible Duct: UL 181, Class 0, interlocking spiral of aluminum foil.

1. Pressure Rating: 8-inch wg (2280 Pa) positive or negative.
2. Maximum Air Velocity: 5000 fpm (25 m/s).
3. Temperature Range: Minus 100 to plus 435 deg F (Minus 73 to plus 224 deg C).

G. Insulated, Flexible Duct: UL 181, Class 1, 2-ply vinyl film supported by helically wound, spring-steel wire; fibrous-glass insulation; polyethylene or aluminized vapor-barrier film.

1. Pressure Rating: 10-inch wg (2500 Pa) positive and 1.0-inch wg (250 Pa) negative.
2. Maximum Air Velocity: 4000 fpm (20 m/s).
3. Temperature Range: Minus 10 to plus 160 deg F (Minus 23 to plus 71 deg C).
4. Insulation R-value: Comply with ASHRAE/IESNA 90.1.

H. Insulated, Flexible Duct: UL 181, Class 1, black polymer film supported by helically wound, spring-steel wire; fibrous-glass insulation; polyethylene or aluminized vapor-barrier film.

1. Pressure Rating: 4-inch wg (1000 Pa) positive and 0.5-inch wg (125 Pa) negative.
2. Maximum Air Velocity: 4000 fpm (20 m/s).
3. Temperature Range: Minus 20 to plus 175 deg F (Minus 29 to plus 79 deg C).
4. Insulation R-Value: Comply with ASHRAE/IESNA 90.1.

I. Insulated, Flexible Duct: UL 181, Class 1, multiple layers of aluminum laminate supported by helically wound, spring-steel wire; fibrous-glass insulation; polyethylene or aluminized vapor-barrier film.

1. Pressure Rating: 10-inch wg (2500 Pa) positive and 1.0-inch wg (250 Pa) negative.
2. Maximum Air Velocity: 4000 fpm (20 m/s).
3. Temperature Range: Minus 20 to plus 210 deg F (Minus 29 to plus 99 deg C).
4. Insulation R-value: Comply with ASHRAE/IESNA 90.1.

J. Insulated, Flexible Duct: UL 181, Class 1, aluminum laminate and polyester film with latex adhesive supported by helically wound, spring-steel wire; fibrous-glass insulation; polyethylene or aluminized vapor-barrier film.

1. Pressure Rating: 10-inch wg (2500 Pa) positive and 1.0-inch wg (250 Pa) negative.
2. Maximum Air Velocity: 4000 fpm (20 m/s).
3. Temperature Range: Minus 20 to plus 210 deg F (Minus 29 to plus 99 deg C).
4. Insulation R-value: [**Comply with ASHRAE/IESNA 90.1**] <**Insert value**>.

K. Insulated, Flexible Duct: UL 181, Class 0, interlocking spiral of aluminum foil; fibrous-glass insulation; [**polyethylene**] [**aluminized**] vapor-barrier film.

1. Pressure Rating: 8-inch wg (2280 Pa) positive or negative.
2. Maximum Air Velocity: 5000 fpm (25 m/s).
3. Temperature Range: Minus 20 to plus 250 deg F (Minus 29 to plus 121 deg C).
4. Insulation R-value: Comply with ASHRAE/IESNA 90.1.

L. Flexible Duct Connectors:

1. Clamps: Stainless-steel band with cadmium-plated hex screw to tighten band with a worm-gear action in sizes 3 through 18 inches (75 through 460 mm), to suit duct size.
2. Non-Clamp Connectors: Adhesive plus sheet metal screws.

2.12 DUCT ACCESSORY HARDWARE

A. Instrument Test Holes: Cast iron or cast aluminum to suit duct material, including screw cap and gasket. Size to allow insertion of pitot tube and other testing instruments and of length to suit duct-insulation thickness.

B. Adhesives: High strength, quick setting, neoprene based, waterproof, and resistant to gasoline and grease.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install duct accessories according to applicable details in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for metal ducts and in NAIMA AH116, "Fibrous Glass Duct Construction Standards," for fibrous-glass ducts.

B. Install duct accessories of materials suited to duct materials; use galvanized-steel accessories in galvanized-steel and fibrous-glass ducts, stainless-steel accessories in stainless-steel ducts, and aluminum accessories in aluminum ducts.

C. Install backdraft dampers at inlet of exhaust fans or exhaust ducts as close as possible to exhaust fan unless otherwise indicated.

D. Install volume dampers at points on supply, return, and exhaust systems where branches extend from larger ducts. Where dampers are installed in ducts having duct liner, install dampers with hat channels of same depth as liner, and terminate liner with nosing at hat channel.

1. Install steel volume dampers in steel ducts.

2. Install aluminum volume dampers in aluminum ducts.

E. Set dampers to fully open position before testing, adjusting, and balancing.

F. Install test holes at fan inlets and outlets and elsewhere as indicated.

G. Install fire and smoke dampers according to UL listing.

H. Install duct access doors on sides of ducts to allow for inspecting, adjusting, and maintaining accessories and equipment at the following locations:

1. On both sides of duct coils.
2. Upstream and downstream from duct filters.
3. At outdoor-air intakes and mixed-air plenums.
4. At drain pans and seals.
5. Downstream from manual volume dampers, control dampers, backdraft dampers, and equipment.
6. Adjacent to and close enough to fire or smoke dampers, to reset or reinstall fusible links. Access doors for access to fire or smoke dampers having fusible links shall be pressure relief access doors; and shall be outward operation for access doors installed upstream from dampers and inward operation for access doors installed downstream from dampers.
7. At each change in direction and at maximum 50-foot (15-m) spacing.
8. Upstream and downstream from turning vanes.
9. Control devices requiring inspection.
10. Elsewhere as indicated.

I. Install access doors with swing against duct static pressure.

J. Access Door Sizes:

1. One-Hand or Inspection Access: 8 by 5 inches (200 by 125 mm).
2. Two-Hand Access: 12 by 6 inches (300 by 150 mm).
3. Head and Hand Access: 18 by 10 inches (460 by 250 mm).
4. Head and Shoulders Access: 21 by 14 inches (530 by 355 mm).
5. Body Access: 25 by 14 inches (635 by 355 mm).
6. Body plus Ladder Access: 25 by 17 inches (635 by 430 mm).

K. Label access doors according to Division 23 Section "Identification for HVAC Piping and Equipment" to indicate the purpose of access door.

L. Install flexible connectors to connect ducts to equipment.

M. For fans developing static pressures of 5-inch wg (1250 Pa) and more, cover flexible connectors with loaded vinyl sheet held in place with metal straps.

N. Connect terminal units to supply ducts directly or with maximum 12-inch (300-mm) lengths of flexible duct. Do not use flexible ducts to change directions.

O. Connect diffusers or light troffer boots to ducts directly or with maximum 60-inch (1500-mm) lengths of flexible duct clamped or strapped in place.

P. Connect flexible ducts to metal ducts with adhesive plus sheet metal screws.

Q. Install duct test holes where required for testing and balancing purposes.

R. Install thrust limits at centerline of thrust, symmetrical on both sides of equipment. Attach thrust limits at centerline of thrust and adjust to a maximum of 1/4-inch (6-mm) movement during start and stop of fans.

3.2 FIELD QUALITY CONTROL

A. Tests and Inspections:

1. Operate dampers to verify full range of movement.
2. Inspect locations of access doors and verify that purpose of access door can be performed.
3. Operate fire and smoke dampers to verify full range of movement and verify that proper heat-response device is installed.
4. Inspect turning vanes for proper and secure installation.

END OF SECTION 233300

SECTION 233113 - METAL DUCTS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Rectangular ducts and fittings.
2. Round ducts and fittings.
3. Sheet metal materials.
4. Sealants and gaskets.
5. Hangers and supports.
6. Seismic-restraint devices.

B. Related Sections:

1. Division 23 Section "Testing, Adjusting, and Balancing for HVAC" for testing, adjusting, and balancing requirements for metal ducts.
2. Division 23 Section "Nonmetal Ducts" for fibrous-glass ducts, thermoset fiber-reinforced plastic ducts, thermoplastic ducts, PVC ducts, and concrete ducts.
3. Division 23 Section "HVAC Casings" for factory- and field-fabricated casings for mechanical equipment.
4. Division 23 Section "Air Duct Accessories" for dampers, sound-control devices, duct-mounting access doors and panels, turning vanes, and flexible ducts.

1.2 PERFORMANCE REQUIREMENTS

A. Delegated Duct Design: Duct construction, including sheet metal thicknesses, seam and joint construction, reinforcements, and hangers and supports, shall comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" and performance requirements and design criteria indicated in "Duct Schedule" Article.

B. Structural Performance: Duct hangers and supports shall withstand the effects of gravity and seismic loads and stresses within limits and under conditions described in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" and ASCE/SEI 7**.**

1. Seismic Hazard Level A: Seismic force to weight ratio, 0.48.
2. Seismic Hazard Level B: Seismic force to weight ratio, 0.30.
3. Seismic Hazard Level C: Seismic force to weight ratio, 0.15.

C. Airstream Surfaces: Surfaces in contact with the airstream shall comply with requirements in ASHRAE 62.1.

1.3 ACTION SUBMITTALS

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

B. LEED Submittals:

1. Product Data for Prerequisite IEQ 1: Documentation indicating that duct systems comply with ASHRAE 62.1, Section 5 - "Systems and Equipment."
2. Product Data for Prerequisite EA 2: Documentation indicating that duct systems comply with ASHRAE/IESNA 90.1, Section 6.4.4 - "HVAC System Construction and Insulation."
3. Duct-Cleaning Test Report for Prerequisite IEQ 1: Documentation of work performed for compliance with ASHRAE 62.1, Section 7.2.4 - "Ventilation System Start-up."
4. Product Data for Credit IEQ 4.1: For adhesives and sealants, documentation including printed statement of VOC content.
5. Laboratory Test Reports for Credit IEQ 4: For adhesives and sealants, documentation indicating that products comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

C. Shop Drawings:

1. Fabrication, assembly, and installation, including plans, elevations, sections, components, and attachments to other work.
2. Factory- and shop-fabricated ducts and fittings.
3. Duct layout indicating sizes, configuration, and static-pressure classes.
4. Elevation of top of ducts.
5. Dimensions of main duct runs from building grid lines.
6. Fittings.
7. Reinforcement and spacing.
8. Seam and joint construction.
9. Penetrations through fire-rated and other partitions.
10. Equipment installation based on equipment being used on Project.
11. Locations for duct accessories, including dampers, turning vanes, and access doors and panels.
12. Hangers and supports, including methods for duct and building attachment and vibration isolation.

D. Delegated-Design Submittal:

1. Sheet metal thicknesses.
2. Joint and seam construction and sealing.
3. Reinforcement details and spacing.
4. Materials, fabrication, assembly, and spacing of hangers and supports.
5. Design Calculations: Calculations**,** including analysis data signed and sealed by the qualified professional engineer responsible for their preparation for selecting hangers and supports.

1.4 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Plans, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:

1. Duct installation in congested spaces, indicating coordination with general construction, building components, and other building services. Indicate proposed changes to duct layout.
2. Suspended ceiling components.
3. Structural members to which duct will be attached.
4. Size and location of initial access modules for acoustical tile.
5. Penetrations of smoke barriers and fire-rated construction.
6. Items penetrating finished ceiling including the following:

a. Lighting fixtures.
b. Air outlets and inlets.
c. Speakers.
d. Sprinklers.
e. Access panels.
f. Perimeter moldings.

B. Welding certificates.

1.5 QUALITY ASSURANCE

A. Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel," for hangers and supports and AWS D1.2/D1.2M, "Structural Welding Code - Aluminum," for aluminum supports and AWS D9.1M/D9.1, "Sheet Metal Welding Code," for duct joint and seam welding.

B. Welding Qualifications: Qualify procedures and personnel according to the following:

1. AWS D1.1/D1.1M, "Structural Welding Code - Steel," for hangers and supports.
2. AWS D1.2/D1.2M, "Structural Welding Code - Aluminum," for aluminum supports.
3. AWS D9.1M/D9.1, "Sheet Metal Welding Code," for duct joint and seam welding.

C. ASHRAE Compliance: Applicable requirements in ASHRAE 62.1, Section 5 - "Systems and Equipment" and Section 7 - "Construction and System Start-up."

D. ASHRAE/IESNA Compliance: Applicable requirements in ASHRAE/IESNA 90.1, Section 6.4.4 - "HVAC System Construction and Insulation."

PART 2 - PRODUCTS

2.1 RECTANGULAR DUCTS AND FITTINGS

A. General Fabrication Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" based on indicated static-pressure class unless otherwise indicated.

B. Transverse Joints: Select joint types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 2-1, "Rectangular Duct/Transverse Joints," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

C. Longitudinal Seams: Select seam types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 2-2, "Rectangular Duct/Longitudinal Seams," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

D. Elbows, Transitions, Offsets, Branch Connections, and Other Duct Construction: Select types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Chapter 4, "Fittings and Other Construction," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

2.2 ROUND DUCTS AND FITTINGS

A. General Fabrication Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Chapter 3, "Round, Oval, and Flexible Duct," based on indicated static-pressure class unless otherwise indicated.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Lindab Inc.
b. McGill AirFlow LLC.
c. SEMCO Incorporated.
d. Sheet Metal Connectors, Inc.
e. Spiral Manufacturing Co., Inc.

B. Transverse Joints: Select joint types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-1, "Round Duct Transverse Joints," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

1. Transverse Joints in Ducts Larger Than 60 Inches (1524 mm) in Diameter: Flanged.

C. Longitudinal Seams: Select seam types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-2, "Round Duct Longitudinal Seams," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

1. Fabricate round ducts larger Than 90 inches (2286 mm) in diameter with butt-welded longitudinal seams.

D. Tees and Laterals: Select types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-5, "90 Degree Tees and Laterals," and Figure 3-6, "Conical Tees," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

2.3 SHEET METAL MATERIALS

A. General Material Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for acceptable materials, material thicknesses, and duct construction methods unless otherwise indicated. Sheet metal materials shall be free of pitting, seam marks, roller marks, stains, discolorations, and other imperfections.

B. Galvanized Sheet Steel: Comply with ASTM A 653/A 653M.

1. Galvanized Coating Designation: G90 (Z275.
2. Finishes for Surfaces Exposed to View: Mill phosphatized.

C. Carbon-Steel Sheets: Comply with ASTM A 1008/A 1008M, with oiled, matte finish for exposed ducts.

D. Stainless-Steel Sheets: Comply with ASTM A 480/A 480M, Type 304 or 316, as indicated in the "Duct Schedule" Article; cold rolled, annealed, sheet. Exposed surface finish shall be No. 2B, No. 2D, No. 3, or No. 4 as indicated in the "Duct Schedule" Article.

E. Aluminum Sheets: Comply with ASTM B 209 (ASTM B 209M) Alloy 3003, H14 temper; with mill finish for concealed ducts, and standard, one-side bright finish for duct surfaces exposed to view.

F. Reinforcement Shapes and Plates: ASTM A 36/A 36M, steel plates, shapes, and bars; black and galvanized.

1. Where black- and galvanized-steel shapes and plates are used to reinforce aluminum ducts, isolate the different metals with butyl rubber, neoprene, or EPDM gasket materials.

G. Tie Rods: Galvanized steel, 1/4-inch (6-mm) minimum diameter for lengths 36 inches (900 mm) or less; 3/8-inch (10-mm) minimum diameter for lengths longer than 36 inches (900 mm).

2.4 SEALANT AND GASKETS

A. General Sealant and Gasket Requirements: Surface-burning characteristics for sealants and gaskets shall be a maximum flame-spread index of 25 and a maximum smoke-developed index of 50 when tested according to UL 723; certified by an NRTL.

B. Two-Part Tape Sealing System:

1. Tape: Woven cotton fiber impregnated with mineral gypsum and modified acrylic/silicone activator to react exothermically with tape to form hard, durable, airtight seal.
2. Tape Width: 6 inches (152 mm).
3. Sealant: Modified styrene acrylic.
4. Water resistant.
5. Mold and mildew resistant.
6. Maximum Static-Pressure Class: 10-inch wg (2500 Pa), positive and negative.
7. Service: Indoor and outdoor.
8. Service Temperature: Minus 40 to plus 200 deg F.
9. Substrate: Compatible with galvanized sheet steel (both PVC coated and bare), stainless steel, or aluminum.
10. For indoor applications, sealant shall have a VOC content of 250 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
11. Sealant shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

C. Water-Based Joint and Seam Sealant:

1. Application Method: Brush on.
2. Solids Content: Minimum 65 percent.
3. Shore A Hardness: Minimum 20.
4. Water resistant.
5. Mold and mildew resistant.
6. VOC: Maximum 75 g/L (less water).
7. Maximum Static-Pressure Class: 10-inch wg (2500 Pa), positive and negative.
8. Service: Indoor or outdoor.
9. Substrate: Compatible with galvanized sheet steel (both PVC coated and bare), stainless steel, or aluminum sheets.

D. Flanged Joint Sealant: Comply with ASTM C 920.

1. General: Single-component, acid-curing, silicone, elastomeric.
2. Type: S.
3. Grade: NS.
4. Class: 25.
5. Use: O.
6. For indoor applications, sealant shall have a VOC content of 250 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
7. Sealant shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

E. Flange Gaskets: Butyl rubber, neoprene, or EPDM polymer with polyisobutylene plasticizer.

F. Round Duct Joint O-Ring Seals:

1. Seal shall provide maximum leakage class of 3 cfm/100 sq. ft. at 1-inch wg (0.14 L/s per sq. m at 250 Pa) and shall be rated for 10-inch wg (2500-Pa) static-pressure class, positive or negative.
2. EPDM O-ring to seal in concave bead in coupling or fitting spigot.
3. Double-lipped, EPDM O-ring seal, mechanically fastened to factory-fabricated couplings and fitting spigots.

2.5 HANGERS AND SUPPORTS

A. Hanger Rods for Noncorrosive Environments: Cadmium-plated steel rods and nuts.

B. Hanger Rods for Corrosive Environments: Electrogalvanized, all-thread rods or galvanized rods with threads painted with zinc-chromate primer after installation.

C. Strap and Rod Sizes: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Table 5-1 (Table 5-1M), "Rectangular Duct Hangers Minimum Size," and Table 5-2, "Minimum Hanger Sizes for Round Duct."

D. Steel Cables for Galvanized-Steel Ducts: Galvanized steel complying with ASTM A 603.

E. Steel Cables for Stainless-Steel Ducts: Stainless steel complying with ASTM A 492.

F. Steel Cable End Connections: Cadmium-plated steel assemblies with brackets, swivel, and bolts designed for duct hanger service; with an automatic-locking and clamping device.

G. Duct Attachments: Sheet metal screws, blind rivets, or self-tapping metal screws; compatible with duct materials.

H. Trapeze and Riser Supports:

1. Supports for Galvanized-Steel Ducts: Galvanized-steel shapes and plates.
2. Supports for Stainless- Stainless Steel Ducts: -steel shapes and plates.
3. Supports for Aluminum Ducts: Aluminum or galvanized steel coated with zinc chromate.

2.6 SEISMIC-RESTRAINT DEVICES

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Cooper B-Line, Inc.; a division of Cooper Industries.
2. Ductmate Industries, Inc.
3. Hilti Corp.
4. Kinetics Noise Control.
5. Loos & Co.; Cableware Division.

6. Mason Industries.
7. TOLCO; a brand of NIBCO INC.
8. Unistrut Corporation; Tyco International, Ltd.

B. General Requirements for Restraint Components: Rated strengths, features, and applications shall be as defined in reports by an agency acceptable to authorities having jurisdiction.

1. Structural Safety Factor: Allowable strength in tension, shear, and pullout force of components shall be at least four times the maximum seismic forces to which they will be subjected.

C. Channel Support System: Shop- or field-fabricated support assembly made of slotted steel channels rated in tension, compression, and torsion forces and with accessories for attachment to braced component at one end and to building structure at the other end. Include matching components and corrosion-resistant coating.

D. Restraint Cables: ASTM A 492, stainless-steel cables with end connections made of cadmium-plated steel assemblies with brackets, swivel, and bolts designed for restraining cable service; and with an automatic-locking and clamping device or double-cable clips.

E. Hanger Rod Stiffener: Steel tube or steel slotted-support-system sleeve with internally bolted connections to hanger rod.

F. Mechanical Anchor Bolts: Drilled-in and stud-wedge or female-wedge type. Select anchor bolts with strength required for anchor and as tested according to ASTM E 488.

PART 3 - EXECUTION

3.1 DUCT INSTALLATION

A. Drawing plans, schematics, and diagrams indicate general location and arrangement of duct system. Indicated duct locations, configurations, and arrangements were used to size ducts and calculate friction loss for air-handling equipment sizing and for other design considerations. Install duct systems as indicated unless deviations to layout are approved on Shop Drawings and Coordination Drawings.

B. Install ducts according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" unless otherwise indicated.

C. Install round ducts in maximum practical lengths.

D. Install ducts with fewest possible joints.

E. Install factory- or shop-fabricated fittings for changes in direction, size, and shape and for branch connections.

F. Unless otherwise indicated, install ducts vertically and horizontally, and parallel and perpendicular to building lines.

G. Install ducts close to walls, overhead construction, columns, and other structural and permanent enclosure elements of building.

H. Install ducts with a clearance of 1 inch (25 mm), plus allowance for insulation thickness.

I. Route ducts to avoid passing through transformer vaults and electrical equipment rooms and enclosures.

J. Where ducts pass through non-fire-rated interior partitions and exterior walls and are exposed to view, cover the opening between the partition and duct or duct insulation with sheet metal flanges of same metal thickness as the duct. Overlap openings on four sides by at least 1-1/2 inches (38 mm).

K. Where ducts pass through fire-rated interior partitions and exterior walls, install fire dampers. Comply with requirements in Division 23 Section "Air Duct Accessories" for fire and smoke dampers.

L. Protect duct interiors from moisture, construction debris and dust, and other foreign materials. Comply with SMACNA's "IAQ Guidelines for Occupied Buildings Under Construction," Appendix G, "Duct Cleanliness for New Construction Guidelines."

3.2 INSTALLATION OF EXPOSED DUCTWORK

A. Protect ducts exposed in finished spaces from being dented, scratched, or damaged.

B. Trim duct sealants flush with metal. Create a smooth and uniform exposed bead. Do not use two-part tape sealing system.

C. Grind welds to provide smooth surface free of burrs, sharp edges, and weld splatter. When welding stainless steel with a No. 3 or 4 finish, grind the welds flush, polish the exposed welds, and treat the welds to remove discoloration caused by welding.

D. Maintain consistency, symmetry, and uniformity in the arrangement and fabrication of fittings, hangers and supports, duct accessories, and air outlets.

E. Repair or replace damaged sections and finished work that does not comply with these requirements.

3.3 ADDITIONAL INSTALLATION REQUIREMENTS FOR COMMERCIAL KITCHEN HOOD EXHAUST DUCT

A. Install commercial kitchen hood exhaust ducts without dips and traps that may hold grease, and sloped a minimum of 2 percent to drain grease back to the hood.

B. Install fire-rated access panel assemblies at each change in direction and at maximum intervals of 20 feet (6 m)] [12 feet (3.7 m) in horizontal ducts, and at every floor for vertical ducts, or as indicated on Drawings. Locate access panel on top or sides of duct a minimum of 1-1/2 inches (38 mm) from bottom of duct.

C. Do not penetrate fire-rated assemblies except as allowed by applicable building codes and authorities having jurisdiction.

3.4 DUCT SEALING

A. Seal ducts for duct static-pressure, seal classes, and leakage classes specified in "Duct Schedule" Article according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

B. Seal ducts to the following seal classes according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible":

1. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."
2. Outdoor, Supply-Air Ducts: Seal Class A.
3. Outdoor, Exhaust Ducts: Seal Class C.
4. Outdoor, Return-Air Ducts: Seal Class C.
5. Unconditioned Space, Supply-Air Ducts in Pressure Classes 2-Inch wg (500 Pa) and Lower: Seal Class B.
6. Unconditioned Space, Supply-Air Ducts in Pressure Classes Higher Than 2-Inch wg (500 Pa): Seal Class A.
7. Unconditioned Space, Exhaust Ducts: Seal Class C.
8. Unconditioned Space, Return-Air Ducts: Seal Class B.
9. Conditioned Space, Supply-Air Ducts in Pressure Classes 2-Inch wg (500 Pa) and Lower: Seal Class C.
10. Conditioned Space, Supply-Air Ducts in Pressure Classes Higher Than 2-Inch wg (500 Pa): Seal Class B.
11. Conditioned Space, Exhaust Ducts: Seal Class B.
12. Conditioned Space, Return-Air Ducts: Seal Class C.

3.5 HANGER AND SUPPORT INSTALLATION

A. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Chapter 5, "Hangers and Supports."

B. Building Attachments: Concrete inserts, powder-actuated fasteners, or structural-steel fasteners appropriate for construction materials to which hangers are being attached.

1. Where practical, install concrete inserts before placing concrete.
2. Install powder-actuated concrete fasteners after concrete is placed and completely cured.
3. Use powder-actuated concrete fasteners for standard-weight aggregate concretes or for slabs more than 4 inches (100 mm) thick.
4. Do not use powder-actuated concrete fasteners for lightweight-aggregate concretes or for slabs less than 4 inches (100 mm) thick.
5. Do not use powder-actuated concrete fasteners for seismic restraints.

C. Hanger Spacing: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Table 5-1 (Table 5-1M), "Rectangular Duct Hangers Minimum Size," and Table 5-2, "Minimum Hanger Sizes for Round Duct," for maximum hanger spacing; install hangers and

supports within 24 inches (610 mm) of each elbow and within 48 inches (1200 mm) of each branch intersection.

D. Hangers Exposed to View: Threaded rod and angle or channel supports.

E. Support vertical ducts with steel angles or channel secured to the sides of the duct with welds, bolts, sheet metal screws, or blind rivets; support at each floor and at a maximum intervals of 16 feet (5 m).

F. Install upper attachments to structures. Select and size upper attachments with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.

3.6 SEISMIC-RESTRAINT-DEVICE INSTALLATION

A. Install ducts with hangers and braces designed to support the duct and to restrain against seismic forces required by applicable building codes. "ASCE/SEI 7.]

1. Space lateral supports a maximum of 40 feet (12 m) o.c., and longitudinal supports a maximum of 80 feet (24 m) o.c.
2. Brace a change of direction longer than 12 feet (3.7 m).

B. Select seismic-restraint devices with capacities adequate to carry present and future static and seismic loads.

C. Install cables so they do not bend across edges of adjacent equipment or building structure.

D. Install cable restraints on ducts that are suspended with vibration isolators.

E. Install seismic-restraint devices using methods approved by an agency acceptable to authorities having jurisdiction.

F. Attachment to Structure: If specific attachment is not indicated, anchor bracing and restraints to structure, to flanges of beams, to upper truss chords of bar joists, or to concrete members.

G. Drilling for and Setting Anchors:

1. Identify position of reinforcing steel and other embedded items prior to drilling holes for anchors. Do not damage existing reinforcement or embedded items during drilling. Notify the Architect if reinforcing steel or other embedded items are encountered during drilling. Locate and avoid prestressed tendons, electrical and telecommunications conduit, and gas lines.
2. Do not drill holes in concrete or masonry until concrete, mortar, or grout has achieved full design strength.
3. Wedge Anchors: Protect threads from damage during anchor installation. Heavy-duty sleeve anchors shall be installed with sleeve fully engaged in the structural element to which anchor is to be fastened.
4. Set anchors to manufacturer's recommended torque, using a torque wrench.
5. Install zinc-coated steel anchors for interior applications and stainless-steel anchors for applications exposed to weather.

3.7 CONNECTIONS

A. Make connections to equipment with flexible connectors complying with Division 23 Section "Air Duct Accessories."

B. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for branch, outlet and inlet, and terminal unit connections.

3.8 DUCT CLEANING

A. Clean new and existing duct system(s) before testing, adjusting, and balancing.

B. Use service openings for entry and inspection.

1. Create new openings and install access panels appropriate for duct static-pressure class if required for cleaning access. Provide insulated panels for insulated or lined duct. Patch insulation and liner as recommended by duct liner manufacturer. Comply with Division 23 Section "Air Duct Accessories" for access panels and doors.
2. Disconnect and reconnect flexible ducts as needed for cleaning and inspection.
3. Remove and reinstall ceiling to gain access during the cleaning process.

C. Particulate Collection and Odor Control:

1. When venting vacuuming system inside the building, use HEPA filtration with 99.97 percent collection efficiency for 0.3-micron-size (or larger) particles.
2. When venting vacuuming system to outdoors, use filter to collect debris removed from HVAC system, and locate exhaust downwind and away from air intakes and other points of entry into building.

D. Clean the following components by removing 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.
4. Coils and related components.
5. Return-air ducts, dampers, actuators, and turning vanes except in ceiling plenums and mechanical equipment rooms.
6. Supply-air ducts, dampers, actuators, and turning vanes.
7. Dedicated exhaust and ventilation components and makeup air systems.

E. Mechanical Cleaning Methodology:

1. Clean metal duct systems using mechanical cleaning methods that extract contaminants from within duct systems and remove contaminants from building.

2. Use vacuum-collection devices that are operated continuously during cleaning. Connect vacuum device to downstream end of duct sections so areas being cleaned are under negative pressure.
3. Use mechanical agitation to dislodge debris adhered to interior duct surfaces without damaging integrity of metal ducts, duct liner, or duct accessories.
4. Clean fibrous-glass duct liner with HEPA vacuuming equipment; do not permit duct liner to get wet. Replace fibrous-glass duct liner that is damaged, deteriorated, or delaminated or that has friable material, mold, or fungus growth.
5. Clean coils and coil drain pans according to NADCA 1992. Keep drain pan operational. Rinse coils with clean water to remove latent residues and cleaning materials; comb and straighten fins.
6. Provide drainage and cleanup for wash-down procedures.
7. Antimicrobial Agents and Coatings: Apply EPA-registered antimicrobial agents if fungus is present. Apply antimicrobial agents according to manufacturer's written instructions after removal of surface deposits and debris.

3.9 START UP

A. Air Balance: Comply with requirements in Division 23 Section "Testing, Adjusting, and Balancing for HVAC."

3.10 DUCT SCHEDULE

A. Fabricate ducts with galvanized sheet steel except as otherwise indicated and as follows:

1. Underground Ducts: Concrete-encased, stainless steel.

B. Supply Ducts:

1. Ducts Connected to Fan Coil Units, Furnaces, Heat Pumps, and Terminal Units.

   a. Pressure Class: Positive 2-inch wg (500 Pa)
   b. Minimum SMACNA Seal Class: A.
   c. SMACNA Leakage Class for Rectangular: 12.
   d. SMACNA Leakage Class for Round and Flat Oval: 12.

2. Ducts Connected to Constant-Volume Air-Handling Units:

   a. Pressure Class: Positive 3-inch wg (750 Pa).
   b. Minimum SMACNA Seal Class: A.
   c. SMACNA Leakage Class for Rectangular: 6
   d. SMACNA Leakage Class for Round and Flat Oval: 6

3. Ducts Connected to Variable-Air-Volume Air-Handling Units:

   a. Pressure Class: Positive 4-inch wg (1000 Pa).
   b. Minimum SMACNA Seal Class: A.
   c. SMACNA Leakage Class for Rectangular: 3.
   d. SMACNA Leakage Class for Round and Flat Oval: 3.

4. Ducts Connected to Equipment Not Listed Above:

   a. Pressure Class: Positive 4-inch wg (1000 Pa)
   b. Minimum SMACNA Seal Class: A.
   c. SMACNA Leakage Class for Rectangular: 3.
   d. SMACNA Leakage Class for Round and Flat Oval: 3.

C. Return Ducts:

1. Ducts Connected to Fan Coil Units, Furnaces, Heat Pumps, and Terminal Unit:

   a. Pressure Class: Positive or negative: 2-inch wg (500 Pa)
   b. Minimum SMACNA Seal Class: A.
   c. SMACNA Leakage Class for Rectangular: 12.
   d. SMACNA Leakage Class for Round and Flat Oval: 12.

2. Ducts Connected to Air-Handling Units :

   a. Pressure Class: Positive or negative: 3-inch wg (750 Pa).
   b. Minimum SMACNA Seal Class: A.
   c. SMACNA Leakage Class for Rectangular: 6.
   d. SMACNA Leakage Class for Round and Flat Oval: 6.

3. Ducts Connected to Equipment Not Listed Above:

   a. Pressure Class: Positive or negative: 4-inch wg (1000 Pa)
   b. Minimum SMACNA Seal Class: A.
   c. SMACNA Leakage Class for Rectangular: 3.
   d. SMACNA Leakage Class for Round and Flat Oval: 3.

D. Exhaust Ducts:

1. Ducts Connected to Fans Exhausting (ASHRAE 62.1, Class 1 and 2) Air:

   a. Pressure Class: Negative: 3-inch wg (750 Pa).
   b. Minimum SMACNA Seal Class: A if negative pressure, and A if positive pressure.
   c. SMACNA Leakage Class for Rectangular: 12.
   d. SMACNA Leakage Class for Round and Flat Oval: 6.

2. Ducts Connected to Air-Handling Units:

   a. Pressure Class: Positive or negative 3-inch wg (750 Pa).
   b. Minimum SMACNA Seal Class: A if negative pressure, and A if positive pressure.
   c. SMACNA Leakage Class for Rectangular: 6.
   d. SMACNA Leakage Class for Round and Flat Oval: 3.

3. Ducts Connected to Commercial Kitchen Hoods: Comply with NFPA 96.

   a. Exposed to View: Type 304, stainless-steel sheet, No. 4 finish.
   b. Concealed: Type 304, stainless-steel sheet, No. 2D finish.
   c. Welded seams and joints.

d. Pressure Class: Positive or negative 4-inch wg (1000 Pa).
e. Minimum SMACNA Seal Class: Welded seams, joints, and penetrations.
f. SMACNA Leakage Class: 3.

4. Ducts Connected to Dishwasher Hoods:

a. Type 304, stainless-steel sheet.
b. Exposed to View: No. 4 finish.
c. Concealed: No. 2D finish.
d. Welded seams and flanged joints with watertight EPDM gaskets.
e. Pressure Class: Positive or negative 3-inch wg (750 Pa).
f. Minimum SMACNA Seal Class: Welded seams, joints, and penetrations.
g. SMACNA Leakage Class: 3.

5. Ducts Connected to Fans Exhausting Laboratory and Process (ASHRAE 62.1, Class 3 and 4) Air:

Retain one of first two subparagraphs below.

a. Type 316, stainless-steel sheet.

1) Exposed to View: No. 3 finish.
2) Concealed: No. 2B finish.

b. PVC-coated, galvanized sheet steel with thicker coating on duct interior.
c. Pressure Class: Positive or negative 6-inch wg (1500 Pa).
d. Minimum SMACNA Seal Class: A Welded seams, joints, and penetrations].
e. SMACNA Leakage Class: 3.

6. Ducts Connected to Equipment Not Listed Above:

a. Pressure Class: Positive or negative: 4-inch wg (1000 Pa).
b. Minimum SMACNA Seal Class: A if negative pressure, and A if positive pressure.
c. SMACNA Leakage Class for Rectangular: 6.
d. SMACNA Leakage Class for Round and Flat Oval: 3.

E. Outdoor-Air (Not Filtered, Heated, or Cooled) Ducts:

1. Ducts Connected to Fan Coil Units, Furnaces, Heat Pumps, and Terminal Units:

a. Pressure Class: Positive or negative 2-inch wg (500 Pa).
b. Minimum SMACNA Seal Class: A.
c. SMACNA Leakage Class for Rectangular: 12.
d. SMACNA Leakage Class for Round and Flat Oval: 6.

2. Ducts Connected to Air-Handling Units:

a. Pressure Class: Positive or negative 3-inch wg (750 Pa).
b. Minimum SMACNA Seal Class: A.
c. SMACNA Leakage Class for Rectangular: 6.
d. SMACNA Leakage Class for Round and Flat Oval: 3.

3. Ducts Connected to Equipment Not Listed Above:

   a. Pressure Class: Positive or negative **4-inch wg (1000 Pa)**.
   b. Minimum SMACNA Seal Class: A
   c. SMACNA Leakage Class for Rectangular: **3.**
   d. SMACNA Leakage Class for Round and Flat Oval: **3.**

F. Intermediate Reinforcement:

1. Galvanized-Steel Ducts: Galvanized steel
2. PVC-Coated Ducts:

   a. Exposed to Airstream: Match duct material.
   b. Not Exposed to Airstream: Galvanized.

3. Stainless-Steel Ducts:

   a. Exposed to Airstream: Match duct material.
   b. Not Exposed to Airstream: Galvanized.

4. Aluminum Ducts: Aluminum.

G. Elbow Configuration:

1. Rectangular Duct: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 4-2, "Rectangular Elbows."

   a. Velocity 1000 fpm (5 m/s) or Lower:

      1) Radius Type RE 1 with minimum 0.5 radius-to-diameter ratio.
      2) Mitered Type RE 4 without vanes.

   b. Velocity 1000 to 1500 fpm (5 to 7.6 m/s):

      1) Radius Type RE 1 with minimum 1.0 radius-to-diameter ratio.
      2) Radius Type RE 3 with minimum 0.5 radius-to-diameter ratio and two vanes.
      3) Mitered Type RE 2 with vanes complying with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 4-3, "Vanes and Vane Runners," and Figure 4-4, "Vane Support in Elbows."

   c. Velocity 1500 fpm (7.6 m/s) or Higher:

      1) Radius Type RE 1 with minimum 1.5 radius-to-diameter ratio.
      2) Radius Type RE 3 with minimum 1.0 radius-to-diameter ratio and two vanes.
      3) Mitered Type RE 2 with vanes complying with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 4-3, "Vanes and Vane Runners," and Figure 4-4, "Vane Support in Elbows."

2. Rectangular Duct: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 4-2, "Rectangular Elbows."

   a. Radius Type RE 1 with minimum 1.5 radius-to-diameter ratio.
   b. Radius Type RE 3 with minimum 1.0 radius-to-diameter ratio and two vanes.
   c. Mitered Type RE 2 with vanes complying with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 4-3, "Vanes and Vane Runners," and Figure 4-4, "Vane Support in Elbows."

3. Round Duct: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-4, "Round Duct Elbows."

   a. Minimum Radius-to-Diameter Ratio and Elbow Segments: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Table 3-1, "Mitered Elbows." Elbows with less than 90-degree change of direction have proportionately fewer segments.

      1) Velocity 1000 fpm (5 m/s) or Lower: 0.5 radius-to-diameter ratio and three segments for 90-degree elbow.
      2) Velocity 1000 to 1500 fpm (5 to 7.6 m/s): 1.0 radius-to-diameter ratio and four segments for 90-degree elbow.
      3) Velocity 1500 fpm (7.6 m/s) or Higher: 1.5 radius-to-diameter ratio and five segments for 90-degree elbow.
      4) Radius-to Diameter Ratio: 1.5.

   b. Round Elbows, 12 Inches (305 mm) and Smaller in Diameter: Stamped or pleated.
   c. Round Elbows, 14 Inches (356 mm) and Larger in Diameter: Standing seam.

H. Branch Configuration:

1. Rectangular Duct: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 4-6, "Branch Connection."

   a. Rectangular Main to Rectangular Branch: 45-degree entry.
   b. Rectangular Main to Round Branch: Spin in.

2. Round: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-5, "90 Degree Tees and Laterals," and Figure 3-6, "Conical Tees." Saddle taps are permitted in existing duct.

   a. Velocity 1000 fpm (5 m/s) or Lower: 90-degree tap.
   b. Velocity 1000 to 1500 fpm (5 to 7.6 m/s): Conical tap.
   c. Velocity 1500 fpm (7.6 m/s) or Higher: 45-degree lateral.

END OF SECTION 233113

SECTION 232500 - HVAC WATER TREATMENT

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes the following HVAC water-treatment systems:

1. Bypass chemical-feed equipment and controls.
2. Biocide chemical-feed equipment and controls.
3. Chemical treatment test equipment.
4. HVAC water-treatment chemicals.

1.2 PERFORMANCE REQUIREMENTS

A. Water quality for HVAC systems shall minimize corrosion, scale buildup, and biological growth for optimum efficiency of HVAC equipment without creating a hazard to operating personnel or the environment.

B. Base HVAC water treatment on quality of water available at Project site, HVAC system equipment material characteristics and functional performance characteristics, operating personnel capabilities, and requirements and guidelines of authorities having jurisdiction.

C. Closed hydronic systems, including chilled water, dual-temperature water , shall have the following water qualities:

1. pH: Maintain a value within 9.0 to 10.5.
2. "P" Alkalinity: Maintain a value within 100 to 500 ppm.
3. Boron: Maintain a value within 100 to 200 ppm.
4. Chemical Oxygen Demand: Maintain a maximum value of 100 ppm.
5. Soluble Copper: Maintain a maximum value of 0.20 ppm.
6. TDS: Maintain a maximum value of 10 ppm.
7. Ammonia: Maintain a maximum value of 20 ppm.
8. Free Caustic Alkalinity: Maintain a maximum value of 20 ppm.
9. Microbiological Limits:

    a. Total Aerobic Plate Count: Maintain a maximum value of 1000 organisms/ml.
    b. Total Anaerobic Plate Count: Maintain a maximum value of 100 organisms/ml.
    c. Nitrate Reducers: Maintain a maximum value of 100 organisms/ml.
    d. Sulfate Reducers: Maintain a maximum value of 0 organisms/ml.
    e. Iron Bacteria: Maintain a maximum value of 0 organisms/ml.

D. Open hydronic systems, including condenser & fluid-cooler spray water, shall have the following water qualities:

1. pH: Maintain a value within 8.0 to 9.1.
2. "P" Alkalinity: Maintain a maximum value of 100 ppm.

3. Chemical Oxygen Demand: Maintain a maximum value of 100 pm.
4. Soluble Copper: Maintain a maximum value of 0.20 ppm.
5. TDS: Maintain a maximum value of 10 ppm.
6. Ammonia: Maintain a maximum value of 20 ppm.
7. Free "OH" Alkalinity: Maintain a maximum value of 0 ppm.
8. Microbiological Limits:

    a. Total Aerobic Plate Count: Maintain a maximum value of 10,000 organisms/ml.
    b. Total Anaerobic Plate Count: Maintain a maximum value of 1000 organisms/ml.
    c. Nitrate Reducers: Maintain a maximum value of 100 organisms/ml.
    d. Sulfate Reducers: Maintain a maximum value of 0 organisms/ml.
    e. Iron Bacteria: Maintain a maximum value of 0 organisms/ml.

9. Polymer Testable: Maintain a minimum value within 10 to 40.

E. Passivation for Galvanized Steel: For the first 60 days of operation.

1. pH: Maintain a value within 7 to 8.
2. Calcium Carbonate Hardness: Maintain a value within 100 to 300 ppm.
3. Calcium Carbonate Alkalinity: Maintain a value within 100 to 300 ppm.

1.3 ACTION SUBMITTALS

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

B. Shop Drawings: Pretreatment and chemical treatment equipment showing tanks, maintenance space required, and piping connections to HVAC systems. Include plans, elevations, sections, details, and attachments to other work.

1. Wiring Diagrams: Power and control wiring.

1.4 INFORMATIONAL SUBMITTALS

A. Field quality-control test reports.

B. Other Informational Submittals:

1. Water-Treatment Program: Written sequence of operation on an annual basis for the application equipment required to achieve water quality defined in the "Performance Requirements" Article above.
2. Water Analysis: Illustrate water quality available at Project site.
3. Passivation Confirmation Report: Verify passivation of galvanized-steel surfaces, and confirm this observation in a letter to Architect.

1.5 QUALITY ASSURANCE

A. HVAC Water-Treatment Service Provider Qualifications: An experienced HVAC water-treatment service provider capable of analyzing water qualities, installing water-treatment equipment, and applying water treatment as specified in this Section.

B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Ampion Corp.
2. Anderson Chemical Co, Inc.
3. Aqua-Chem, Inc.; Cleaver-Brooks Div.
4. Barclay Chemical Co.; Water Management, Inc.
5. Boland Trane Services.
6. GE Betz.
7. GE Osmonics.
8. H-O-H Chemicals, Inc.
9. Metro Group. Inc. (The); Metropolitan Refining Div.
10. ONDEO Nalco Company.
11. Watcon, Inc.

2.2 MANUAL CHEMICAL-FEED EQUIPMENT

A. Bypass Feeders: Steel, with corrosion-resistant exterior coating, minimum 3-1/2-inch (89-mm) fill opening in the top, and NPS 3/4 (DN 20) bottom inlet and top side outlet. Quarter turn or threaded fill cap with gasket seal and diaphragm to lock the top on the feeder when exposed to system pressure in the vessel.

1. Capacity: 5 gal. (19 L).
2. Minimum Working Pressure: 175 psig (1210 kPa).

2.3 AUTOMATIC CHEMICAL-FEED EQUIPMENT

A. Water Meter:

1. AWWA C700, oscillating-piston, magnetic-drive, totalization meter.
2. Body: Bronze.
3. Maximum Pressure Loss at Design Flow: 3 psig (20 kPa).
4. Registration: Gallons (Liters) or cubic feet (cubic meters).
5. Controls: Flow-control switch with normally open contacts; rated for maximum 10 A, 250-V ac; and that will close at adjustable increments of total flow.

B. Inhibitor Injection Timers:

1. Microprocessor-based controller with LCD display in NEMA 250, Type 12 enclosure with gasketed and lockable door. Interface for start/stop and status indication at central workstation as described in Division 23 Section "Instrumentation and Control for HVAC."
2. Programmable timers with infinite adjustment over full range, and mounted in cabinet with hand-off-auto switches and status lights.
3. Test switch.
4. Hand-off-auto switch for chemical pump.
5. Illuminated legend to indicate feed when pump is activated.
6. Programmable lockout timer with indicator light. Lockout timer to deactivate the pump and activate alarm circuits.
7. LCD makeup totalizer to measure amount of makeup and bleed-off water from two water meter inputs.

C. pH Controller:

1. Microprocessor-based controller, 1 percent accuracy in a range from zero to 14 units. Incorporate solid-state integrated circuits and digital LCD display in NEMA 250, Type 12 enclosure with gasketed and lockable door. Interface for start/stop and status indication at central workstation as described in Division 23 Section "Instrumentation and Control for HVAC."
2. Digital display and touch pad for input.
3. Sensor probe adaptable to sample stream manifold.
4. High, low, and normal pH indication.
5. High or low pH alarm light, trip points field adjustable; with silence switch.
6. Hand-off-auto switch for acid pump.
7. Internal adjustable hysteresis or deadband.

D. TDS Controller:

1. Microprocessor-based controller, 1 percent accuracy in a range from zero to 5000 micromhos. Incorporate solid-state integrated circuits and digital LCD display in NEMA 250, Type 12 enclosure with gasketed and lockable door. Interface for start/stop and status indication at central workstation as described in Division 23 Section "Instrumentation and Control for HVAC."
2. Digital display and touch pad for input.
3. Sensor probe adaptable to sample stream manifold.
4. High, low, and normal conductance indication.
5. High or low conductance alarm light, trip points field adjustable; with silence switch.
6. Hand-off-auto switch for solenoid bleed-off valve.
7. Bleed-off valve activated indication.
8. Internal adjustable hysteresis or deadband.

9. Bleed Valves:

   a. Cooling Systems: Forged-brass body, globe pattern, general-purpose solenoid with continuous-duty coil, or motorized valve.

E. Biocide Feeder Timer:

1. Microprocessor-based controller with digital LCD display in NEMA 250, Type 12 enclosure with gasketed and lockable door. Interface for start/stop and status indication at central workstation as described in Division 23 Section "Instrumentation and Control for HVAC."
2. 24-hour timer with 14-day skip feature to permit activation any hour of day.
3. Precision, solid-state, bleed-off lockout timer and clock-controlled biocide pump timer. Prebleed and bleed lockout timers.
4. Solid-state alternator to enable use of two different formulations.
5. 24-hour display of time of day.
6. 14-day display of day of week.
7. Battery backup so clock is not disturbed by power outages.
8. Hand-off-auto switches for biocide pumps.
9. Biocide A and Biocide B pump running indication.

F. Chemical Solution Tanks:

1. Chemical-resistant reservoirs fabricated from high-density opaque polyethylene with minimum 110 percent containment vessel.
2. Molded cover with recess for mounting pump.
3. Capacity: 120 gal. (454 L).

G. Chemical Solution Injection Pumps:

1. Self-priming, positive-displacement; rated for intended chemical with minimum 25 percent safety factor for design pressure and temperature.
2. Adjustable flow rate.
3. Metal and thermoplastic construction.
4. Built-in relief valve.
5. Fully enclosed, continuous-duty, single-phase motor. Comply with requirements in Division 23 Section "Common Motor Requirements for HVAC Equipment."

H. Chemical Solution Tubing: Polyethylene tubing with compression fittings and joints.

I. Injection Assembly:

1. Quill: Minimum NPS 1/2 (DN 15) with insertion length sufficient to discharge into at least 25 percent of pipe diameter.
2. Ball Valve: Three-piece, stainless steel; selected to fit quill.
3. Packing Gland: Mechanical seal on quill of sufficient length to allow quill removal during system operation.
4. Assembly Pressure/Temperature Rating: Minimum 600 psig (4137 kPa) at 200 deg F (93 deg C).

2.4 CHEMICAL TREATMENT TEST EQUIPMENT

A. Test Kit: Manufacturer-recommended equipment and chemicals in a wall-mounting cabinet for testing pH, TDS, inhibitor, chloride, alkalinity, and hardness; sulfite and testable polymer tests for high-pressure boilers, and oxidizing biocide test for open cooling systems.

B. Corrosion Test-Coupon Assembly: Constructed of corrosive-resistant material, complete with piping, valves, and mild steel and copper coupons. Locate copper coupon downstream from mild steel coupon in the test-coupon assembly.

1. Two station rack for closed-loop systems.
2. Four-station rack for open systems.

2.5 CHEMICALS

A. Chemicals shall be as recommended by water-treatment system manufacturer that are compatible with piping system components and connected equipment, and that can attain water quality specified in Part 1 "Performance Requirements" Article.

B. Water Softener Chemicals:

1. Mineral: High-capacity, sulfonated-polystyrene ion-exchange resin that is stable over entire pH range with good resistance to bead fracture from attrition or shock. Resin exchange capacity minimum 30,000 grains/cu. ft. (69 kg/cu. m) of calcium carbonate of resin when regenerated with 15 lb (6.8 kg) of salt.
2. Salt for Brine Tanks: High-purity sodium chloride, free of dirt and foreign material. Rock and granulated forms are not acceptable.

PART 3 - EXECUTION

3.1 WATER ANALYSIS

A. Perform an analysis of supply water to determine quality of water available at Project site.

3.2 INSTALLATION

A. Install chemical application equipment on concrete bases, level and plumb. Maintain manufacturer's recommended clearances. Arrange units so controls and devices that require servicing are accessible. Anchor chemical tanks and floor-mounting accessories to substrate.

B. Install water testing equipment on wall near water chemical application equipment.

C. Install interconnecting control wiring for chemical treatment controls and sensors.

D. Mount sensors and injectors in piping circuits.

E. Bypass Feeders: Install in closed hydronic systems, including chilled water and dual-temperature water , and equipped with the following:

1. Install bypass feeder in a bypass circuit around circulating pumps, unless otherwise indicated on Drawings.
2. Install water meter in makeup water supply.
3. Install test-coupon assembly in bypass circuit around circulating pumps, unless otherwise indicated on Drawings.
4. Install a gate or full-port ball isolation valves on inlet, outlet, and drain below feeder inlet.
5. Install a swing check on inlet after the isolation valve.

F. Install automatic chemical-feed equipment for condenser and fluid-cooler spray water and include the following:

1. Install makeup water softener.
2. Install water meter in makeup water supply.
3. Install inhibitor injection pumps and solution tanks with injection timer sensing contacts in water meter.

    a. Pumps shall operate for timed interval on contact closure at water meter in makeup water supply connection. Injection pump shall discharge into boiler feedwater tank or feedwater supply connection at boiler.

4. Install test equipment and provide test-kit to Owner. Install test-coupon assembly in bypass circuit around circulating pumps, unless otherwise indicated on Drawings.
5. Install TDS controller with sensor and bleed valves.

    a. Bleed valves shall cycle to maintain maximum TDS concentration.

6. Install pH sensor and controller with injection pumps and solution tanks.

    a. Injector pumps shall operate to maintain required pH.

7. Install biocide feeder alternating timer with two sets of injection pumps and solution tanks.

    a. Injection pumps shall operate to feed biocide on an alternating basis.

3.3 CONNECTIONS

A. Piping installation requirements are specified in other Division 23 Sections. Drawings indicate general arrangement of piping, fittings, and specialties.

B. Install piping adjacent to equipment to allow service and maintenance.

C. Make piping connections between HVAC water-treatment equipment and dissimilar-metal piping with dielectric fittings. Dielectric fittings are specified in Division 23 Section "Hydronic Piping."

D. Install shutoff valves on HVAC water-treatment equipment inlet and outlet. Metal general-duty valves are specified in Division 23 Section "General-Duty Valves for HVAC Piping."

E. Refer to Division 22 Section "Domestic Water Piping Specialties" for backflow preventers required in makeup water connections to potable-water systems.

F. Confirm applicable electrical requirements in Division 26 Sections for connecting electrical equipment.

G. Ground equipment according to Division 26 Section "Grounding and Bonding for Electrical Systems."

H. Connect wiring according to Division 26 Section "Low-Voltage Electrical Power Conductors and Cables."

3.4 FIELD QUALITY CONTROL

A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust components, assemblies, and equipment installations, including connections. Report results in writing.

B. Perform tests and inspections and prepare test reports.

1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.

C. Tests and Inspections:

1. Inspect field-assembled components and equipment installation, including piping and electrical connections.
2. Inspect piping and equipment to determine that systems and equipment have been cleaned, flushed, and filled with water, and are fully operational before introducing chemicals for water-treatment system.
3. Place HVAC water-treatment system into operation and calibrate controls during the preliminary phase of HVAC systems' startup procedures.
4. Do not enclose, cover, or put piping into operation until it is tested and satisfactory test results are achieved.
5. Test for leaks and defects. If testing is performed in segments, submit separate report for each test, complete with diagram of portion of piping tested.
6. Leave uncovered and unconcealed new, altered, extended, and replaced water piping until it has been tested and approved. Expose work that has been covered or concealed before it has been tested and approved.
7. Cap and subject piping to static water pressure of 50 psig (345 kPa) above operating pressure, without exceeding pressure rating of piping system materials. Isolate test source and allow test pressure to stand for four hours. Leaks and loss in test pressure constitute defects.
8. Repair leaks and defects with new materials and retest piping until no leaks exist.

D. Remove and replace malfunctioning units and retest as specified above.

E. At eight week intervals following Substantial Completion, perform separate water analyses on hydronic systems to show that automatic chemical-feed systems are maintaining water quality

within performance requirements specified in this Section. Submit written reports of water analysis advising Owner of changes necessary to adhere to Part 1 "Performance Requirements" Article.

F. Comply with ASTM D 3370 and with the following standards:

1. Silica: ASTM D 859.
2. Acidity and Alkalinity: ASTM D 1067.
3. Iron: ASTM D 1068.
4. Water Hardness: ASTM D 1126.

3.5 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain HVAC water-treatment systems and equipment. Refer to Division 01 Section "Demonstration and Training."

END OF SECTION 232500

SECTION 232123 - HYDRONIC PUMPS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Close-coupled, in-line centrifugal pumps.
2. Close-coupled, end-suction centrifugal pumps.
3. Separately coupled, horizontally mounted, in-line centrifugal pumps.
4. Separately coupled, vertically mounted, in-line centrifugal pumps.
5. Separately coupled, base-mounted, end-suction centrifugal pumps.
6. Automatic condensate pump units.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of pump.

B. Shop Drawings: For each pump.

1. Show pump layout and connections.
2. Include setting drawings with templates for installing foundation and anchor bolts and other anchorages.
3. Include diagrams for power, signal, and control wiring.

1.3 CLOSEOUT SUBMITTALS

A. Operation and maintenance data.

PART 2 - PRODUCTS

2.1 CLOSE-COUPLED, IN-LINE CENTRIFUGAL PUMPS

A. Manufacturers: Subject to compliance with requirements, provide products by the following] provide products by one of the following:

B. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:

1. Armstrong Pumps Inc.
2. Aurora Pump; Division of Pentair Pump Group.
3. Crane Pumps & Systems.
4. Flowserve Corporation.
5. Grundfos Pumps Corporation.

6. ITT Corporation; Bell & Gossett.
7. Mepco, LLC.
8. PACO Pumps.
9. Patterson Pump Co.; a subsidiary of the Gorman-Rupp Co.
10. Peerless Pump Company.
11. TACO Incorporated.
12. Thrush Company Inc.

C. Description: Factory-assembled and -tested, centrifugal, overhung-impeller, close-coupled, in-line pump as defined in HI 1.1-1.2 and HI 1.3; designed for installation with pump and motor shafts mounted horizontally or vertically.

D. Pump Construction:

1. Casing: Radially split, cast iron, with threaded gage tappings at inlet and outlet[**,** replaceable bronze wear rings, and threaded companion-flange connections.
2. Impeller: ASTM B 584, cast bronze; statically and dynamically balanced, keyed to shaft, and secured with a locking cap screw. For constant-speed pumps, trim impeller to match specified performance.
3. Pump Shaft: Stainless steel.
4. Seal: Mechanical seal consisting of carbon rotating ring against a ceramic seat held by a stainless-steel spring, and EPT bellows and gasket. Include water slinger on shaft between motor and seal.
5. Seal: Packing seal consisting of stuffing box with a minimum of four rings of graphite-impregnated braided yarn with bronze lantern ring between center two graphite rings, and bronze packing gland.
6. Pump Bearings: Permanently lubricated ball bearings.

E. Motor: Single speed and rigidly mounted to pump casing.

1. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
2. Comply with NEMA designation, temperature rating, service factor, and efficiency requirements for motors specified in Division 23 Section "Common Motor Requirements for HVAC Equipment."

    a. Enclosure: **Open, dripproof**.
    b. Enclosure Materials: **Cast iron**.
    c. Motor Bearings: **Permanently lubricated** ball bearings.
    d. Unusual Service Conditions:

        1) Ambient Temperature: Refer to Drawings.
        2) Altitude: 70 **feet** above sea level.
        3) High humidity.

    e. Efficiency: Premium efficient.
    f. NEMA Design: Refer to Drawings.
    g. Service Factor: Refer to Drawings.

F. Capacities and Characteristics:

1. Capacity: Refer to Drawings **gpm (L/s)**.
2. Total Dynamic Head: **feet (kPa)**>.
3. Maximum Operating Pressure: Refer to Drawings.
4. Maximum Continuous Operating Temperature: Refer to Drawings.
5. Inlet and Outlet Size: Refer to Drawings.
6. Impeller Size: Refer to Drawings.
7. Motor Speed: Refer to Drawings.
8. Motor Horsepower: Refer to Drawings.
9. Electrical Characteristics:

    a. Volts: Refer to Drawings.
    b. Phase: Refer to Drawings.
    c. Hertz: 60.
    d. Full-Load Amperes: Refer to Drawings.
    e. Minimum Circuit Ampacity: Refer to Drawings.
    f. Maximum Overcurrent Protection: Refer to Drawings.

2.2 CLOSE-COUPLED, END-SUCTION CENTRIFUGAL PUMPS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following

B. Retain "Basis-of-Design Product" Paragraph and list of manufacturers below to identify a specific product or a comparable product from manufacturers listed. Retain option and delete insert note if manufacturer's name and model number are indicated on Drawings.

C. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:

1. American-Marsh Pumps.
2. Armstrong Pumps Inc.
3. Aurora Pump; Division of Pentair Pump Group.
4. Buffalo Pumps, Inc.
5. Crane Pumps & Systems.
6. Flowserve Corporation.
7. ITT Corporation; Bell & Gossett.
8. ITT Corporation; Goulds Pumps.
9. Lancaster Pump.
10. Mepco, LLC.
11. PACO Pumps.
12. Patterson Pump Co.; a subsidiary of the Gorman-Rupp Co.
13. Peerless Pump Company.
14. Scot Pump; Div. of Ardox Corp.
15. TACO Incorporated.
16. Thrush Company Inc.

D. Description: Factory-assembled and -tested, centrifugal, overhung-impeller, close-coupled, end-suction pump as defined in HI 1.1-1.2 and HI 1.3; designed for installation with pump and motor shafts mounted horizontally.

E. Pump Construction:

1. Casing: Radially split, cast iron, with replaceable bronze wear rings, drain plug at bottom and air vent at top of volute, threaded gage tappings at inlet and outlet, and flanged connections.
2. Impeller: ASTM B 584, cast bronze; statically and dynamically balanced, keyed to shaft, and secured with a locking cap screw. For constant-speed pumps, trim impeller to match specified performance.
3. Pump Shaft: Stainless steel.
4. Mechanical Seal: Carbon rotating ring against a ceramic seat held by a stainless-steel spring, and EPT bellows and gasket. Include water slinger on shaft between motor and seal.
5. Pump Bearings: Permanently lubricated ball bearings.

F. Motor: Single speed and rigidly mounted to pump casing with integral pump support.

1. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
2. Comply with NEMA designation, temperature rating, service factor, and efficiency requirements for motors specified in Division 23 Section "Common Motor Requirements for HVAC Equipment."

    a. Enclosure: Open, drip proof.
    b. Enclosure Materials: Rolled steel.
    c. Motor Bearings: Permanently lubricated ball bearings.
    d. Unusual Service Conditions:

        1) Ambient Temperature: Refer to Drawings.
        2) Altitude: Refer to Drawings above sea level.
        3) High humidity.

    e. Efficiency: Premium efficient.
    f. NEMA Design: Refer to Drawings.
    g. Service Factor: Refer to Drawings.

G. Capacities and Characteristics:

1. Capacity: Refer to Drawings.
2. Total Dynamic Head: Refer to Drawings
3. Maximum Operating Pressure: 175 psig (1204 kPa).
4. Maximum Continuous Operating Temperature Refer to Drawings
5. Inlet and Outlet Size: Refer to Drawings
6. Impeller Size: Refer to Drawings
7. Motor Speed: Refer to Drawings
8. Motor Horsepower: Refer to Drawings
9. Electrical Characteristics:

    a. Volts: Refer to Drawings.
    b. Phase: Refer to Drawings.

c. Hertz: 60.
d. Full-Load Amperes: Refer to Drawings.
e. Minimum Circuit Ampacity: Refer to Drawings
f. Maximum Overcurrent Protection: Refer to Drawings

2.3 SEPARATELY COUPLED, HORIZONTALLY MOUNTED, IN-LINE CENTRIFUGAL PUMPS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

B. Retain "Basis-of-Design Product" Paragraph and list of manufacturers below to identify a specific product or a comparable product from manufacturers listed. Retain option and delete insert note if manufacturer's name and model number are indicated on Drawings.

C. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:

1. Armstrong Pumps Inc.
2. Aurora Pump; Division of Pentair Pump Group.
3. Flowserve Corporation.
4. Grundfos Pumps Corporation.
5. ITT Corporation; Bell & Gossett.
6. Mepco, LLC.
7. PACO Pumps.
8. Scot Pump; Div. of Ardox Corp.
9. TACO Incorporated.
10. Thrush Company Inc.

D. Description: Factory-assembled and -tested, centrifugal, overhung-impeller, separately coupled, in-line pump as defined in HI 1.1-1.2 and HI 1.3; designed for installation with pump and motor shafts mounted horizontally.

E. Pump Construction:

1. Casing: Radially split, cast iron, with threaded gage tappings at inlet and outlet, and threaded companion-flange connections.
2. Impeller: ASTM B 584, cast bronze; statically and dynamically balanced, and keyed to shaft. For pumps not frequency-drive controlled, trim impeller to match specified performance.
3. Pump Shaft: Stainless steel.
4. Mechanical Seal: Carbon rotating ring against a ceramic seat held by a stainless-steel spring, and EPT bellows and gasket. Include water slinger on shaft between motor and seal.
5. Pump Bearings: Permanently lubricated ball bearings.

F. Shaft Coupling: Interlocking frame with interconnecting springs capable of absorbing vibration.

G. Motor: Single speed and rigidly mounted to pump casing.

1. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
2. Comply with NEMA designation, temperature rating, service factor, and efficiency requirements for motors specified in Division 23 Section "Common Motor Requirements for HVAC Equipment."

    a. Enclosure: Open, drip proof

    b. Retain "Enclosure Materials," "Motor Bearings," "Unusual Service Conditions," "Efficiency," "NEMA Design," and "Service Factor" subparagraphs below if options are available from pump manufacturers and are different from default requirements specified in Division 23 Section "Common Motor Requirements for HVAC Equipment." Consider each subparagraph and retain only those that vary from default requirements.
    c. Enclosure Materials: Rolled steel.
    d. Motor Bearings: Permanently lubricated ball bearings.
    e. Unusual Service Conditions:

        1) Ambient Temperature: Refer to Drawings
        2) Altitude: Refer to Drawings
        3) High humidity.

    f. Efficiency: Premium efficient.
    g. NEMA Design: Refer to Drawings
    h. Service Factor: Refer to Drawings

    If Project has more than one type or configuration of separately coupled, horizontally mounted, in-line centrifugal pump, delete "Capacities and Characteristics" Paragraph below and schedule pumps on Drawings.

H. Capacities and Characteristics:

1. Capacity: Refer to Drawings
2. Total Dynamic Head: Refer to Drawings
3. Maximum Operating Pressure: 175 psig (1204 kPa).
4. Maximum Continuous Operating Temperature: Refer to Drawings
5. Inlet and Outlet Size: Refer to Drawings
6. Impeller Size: Refer to Drawings
7. Motor Speed: Refer to Drawings
8. Motor Horsepower: Refer to Drawings
9. Electrical Characteristics:

    a. Volts: Refer to Drawings
    b. Phase: Refer to Drawings
    c. Hertz: 60.
    d. Full-Load Amperes: Refer to Drawings
    e. Minimum Circuit Ampacity: Refer to Drawings
    f. Maximum Overcurrent Protection: Refer to Drawings

2.4 SEPARATELY COUPLED, VERTICALLY MOUNTED, IN-LINE CENTRIFUGAL PUMPS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

B. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:

1. Armstrong Pumps Inc.
2. Aurora Pump; Division of Pentair Pump Group.
3. Crane Pumps & Systems.
4. Flowserve Corporation.
5. ITT Corporation; Bell & Gossett.
6. Mepco, LLC.
7. PACO Pumps.
8. Peerless Pump Company.
9. Patterson Pump Co.; a subsidiary of the Gorman-Rupp Co.
10. TACO Incorporated.
11. Thrush Company Inc.

C. Description: Factory-assembled and -tested, centrifugal, overhung-impeller, separately coupled, in-line pump as defined in HI 1.1-1.2 and HI 1.3; designed for installation with pump and motor shafts mounted vertically.

D. Pump Construction:

1. Casing: Radially split, cast iron, with threaded gage tappings at inlet and outlet**,** replaceable bronze wear rings, and threaded companion-flange connections.
2. Impeller: ASTM B 584, cast bronze; statically and dynamically balanced, keyed to shaft, and secured with a locking cap screw. For pumps not frequency-drive controlled, trim impeller to match specified performance.
3. Pump Shaft: Stainless steel.
4. Seal: Mechanical seal consisting of carbon rotating ring against a ceramic seat held by a stainless-steel spring, and EPT bellows and gasket. Include water slinger on shaft between motor and seal.
5. Seal: Packing seal consisting of stuffing box with a minimum of four rings of graphite-impregnated braided yarn with bronze lantern ring between center two graphite rings, and bronze packing gland.
6. Pump Bearings: Permanently lubricated ball bearings.

E. Shaft Coupling: Axially split spacer coupling.

F. Motor: Single speed and rigidly mounted to pump casing with lifting eyebolt and supporting lugs in motor enclosure.

1. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

2. Comply with NEMA designation, temperature rating, service factor, and efficiency requirements for motors specified in Division 23 Section "Common Motor Requirements for HVAC Equipment."

    a. Enclosure: Open, drip proof Retain "Enclosure Materials," "Motor Bearings," "Unusual Service Conditions," "Efficiency," "NEMA Design," and "Service Factor" subparagraphs below if options are available from pump manufacturers and are different from default requirements specified in Division 23 Section "Common Motor Requirements for HVAC Equipment." Consider each subparagraph and retain only those that vary from default requirements.
    b. Enclosure Materials: Rolled steel.
    c. Motor Bearings: Permanently lubricated ball bearings.
    d. Unusual Service Conditions:

        1) Ambient Temperature: Refer to Drawings
        2) Altitude: Refer to Drawings.
        3) High humidity.

    e. Efficiency: Premium efficient.
    f. NEMA Design: Refer to Drawings.
    g. Service Factor: Refer to Drawings.
    h. If Project has more than one type or configuration of separately coupled, vertically mounted, in-line centrifugal pump, delete "Capacities and Characteristics" Paragraph below and schedule pumps on Drawings.

G. Capacities and Characteristics:

1. Capacity: Refer to Drawings
2. Total Dynamic Head: Refer to Drawings
3. Maximum Operating Pressure: Refer to Drawings
4. Maximum Continuous Operating Temperature: Refer to Drawings
5. Inlet and Outlet Size: Refer to Drawings
6. Impeller Size: Refer to Drawings
7. Motor Speed: Refer to Drawings
8. Motor Horsepower: Refer to Drawings
9. Electrical Characteristics:

    a. Volts: Refer to Drawings
    b. Phase: Refer to Drawings
    c. Hertz: 60.
    d. Full-Load Amperes: Refer to Drawings
    e. Minimum Circuit Ampacity : Refer to Drawings
    f. Maximum Overcurrent Protection: Refer to Drawings

2.5 SEPARATELY COUPLED, BASE-MOUNTED, END-SUCTION CENTRIFUGAL PUMPS

A. Manufacturers: Subject to compliance with requirement provide products by one of the following:

B. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:

1. American-Marsh Pumps.
2. Armstrong Pumps Inc.
3. Aurora Pump; Division of Pentair Pump Group.
4. Buffalo Pumps, Inc.
5. Crane Pumps & Systems.
6. Flowserve Corporation.
7. ITT Corporation; Bell & Gossett.
8. Mepco, LLC.
9. PACO Pumps.
10. Peerless Pump Company.
11. Scot Pump; Div. of Ardox Corp.
12. TACO Incorporated.
13. Thrush Company Inc.

C. Description: Factory-assembled and -tested, centrifugal, overhung-impeller, separately coupled, end-suction pump as defined in HI 1.1-1.2 and HI 1.3; designed for base mounting, with pump and motor shafts horizontal.

D. Pump Construction:

1. Casing: Radially split, cast iron, with replaceable bronze wear rings, threaded gage tappings at inlet and outlet, drain plug at bottom and air vent at top of volute, and flanged connections. Provide integral mount on volute to support the casing, and provide attached piping to allow removal and replacement of impeller without disconnecting piping or requiring the realignment of pump and motor shaft.
2. Impeller: ASTM B 584, cast bronze; statically and dynamically balanced, keyed to shaft, and secured with a locking cap screw. For pumps not frequency-drive controlled, trim impeller to match specified performance.
3. Pump Shaft: Stainless steel.
4. Seal: Mechanical seal consisting of carbon rotating ring against a ceramic seat held by a stainless-steel spring, and EPT bellows and gasket.
5. Seal: Packing seal consisting of stuffing box with a minimum of four rings of graphite-impregnated braided yarn with bronze lantern ring between center two graphite rings, and bronze packing gland.
6. Pump Bearings: Grease-lubricated ball bearings in cast-iron housing with grease fittings.

E. Shaft Coupling: Molded-rubber insert and interlocking spider capable of absorbing vibration. Couplings shall be drop-out type to allow disassembly and removal without removing pump shaft or motor.

F. Coupling Guard: Dual rated; ANSI B15.1, Section 8; OSHA 1910.219 approved; steel; removable; attached to mounting frame.

G. Mounting Frame: Welded-steel frame and cross members, factory fabricated from ASTM A 36/A 36M channels and angles. Fabricate to mount pump casing, coupling guard, and motor.

H. Motor: Single speed, secured to mounting frame, with adjustable alignment.

1. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
2. Comply with NEMA designation, temperature rating, service factor, and efficiency requirements for motors specified in Division 23 Section "Common Motor Requirements for HVAC Equipment."

    a. Enclosure: Open, drip proof.

    b. Retain "Enclosure Materials," "Motor Bearings," "Unusual Service Conditions," "Efficiency," "NEMA Design," and "Service Factor" subparagraphs below if options are available from pump manufacturers and are different from default requirements specified in Division 23 Section "Common Motor Requirements for HVAC Equipment." Consider each subparagraph and retain only those that vary from default requirements.
    c. Enclosure Materials: Rolled steel.
    d. Motor Bearings: Permanently lubricated ball bearings.
    e. Unusual Service Conditions:

        1) Ambient Temperature: Refer to Drawings
        2) Altitude: Refer to Drawings above sea level.
        3) High humidity.

    f. Efficiency: Premium efficient.
    g. NEMA Design: Refer to Drawings
    h. Service Factor: Refer to Drawings

I. Capacities and Characteristics:

1. Capacity: Refer to Drawings
2. Total Dynamic Head: Refer to Drawings
3. Maximum Operating Pressure: Refer to Drawings
4. Maximum Continuous Operating Temperature: Refer to Drawings
5. Inlet and Outlet Size: Refer to Drawings
6. Impeller Size: Refer to Drawings
7. Motor Speed: Refer to Drawings
8. Motor Horsepower: Refer to Drawings
9. Electrical Characteristics: Refer to Drawings

    a. Volts: Refer to Drawings
    b. Phase: Refer to Drawings
    c. Hertz: 60.
    d. Full-Load Amperes: Refer to Drawings
    e. Minimum Circuit Ampacity: Refer to Drawings
    f. Maximum Overcurrent Protection: Refer to Drawings

2.6 AUTOMATIC CONDENSATE PUMP UNITS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

B. Retain "Basis-of-Design Product" Paragraph and list of manufacturers below to identify a specific product or a comparable product from manufacturers listed. Retain option and delete insert note if manufacturer's name and model number are indicated on Drawings.

C. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:

1. Beckett Corporation.
2. Hartell Pumps Div.; Milton Roy Co.
3. Little Giant Pump Co.
4. Mepco, LLC.

D. Description: Packaged units with corrosion-resistant pump, plastic tank with cover, and automatic controls. Include factory- or field-installed check valve and a 72-inch- (1800-mm-) minimum, electrical power cord with plug.

E. Capacities and Characteristics:

1. Capacity: Refer to Drawings
2. Total Dynamic Head: Refer to Drawings
3. Maximum Height to Inlet: Refer to Drawings.
4. Inlet and Outlet Size: Refer to Drawings Refer to Drawings
5. Motor Speed: Refer to Drawings
6. Motor Horsepower: Refer to Drawings
7. Electrical Characteristics:

    a. Volts: Refer to Drawings
    b. Phase: Single.
    c. Hertz: 60.
    d. Full-Load Amperes: Refer to Drawings
    e. Minimum Circuit Ampacity: Refer to Drawings
    f. Maximum Overcurrent Protection: Refer to Drawings

2.7 PUMP SPECIALTY FITTINGS

A. Suction Diffuser:

1. Angle pattern.
2. 300-psig (2060-kPa) pressure rating, Cast-iron body and end cap, pump-inlet fitting.
3. Bronze startup and bronze or stainless-steel permanent strainers.
4. Bronze or stainless-steel straightening vanes.
5. Drain plug.
6. Factory-fabricated support.

B. Triple-Duty Valve:

1. Angle or straight pattern.
2. 300-psig (2060-kPa)] pressure rating, cast -iron body, pump-discharge fitting.
3. Drain plug and bronze-fitted shutoff, balancing, and check valve features.
4. Brass gage ports with integral check valve and orifice for flow measurement.

PART 3 - EXECUTION

3.1 PUMP INSTALLATION

A. Comply with HI 1.4.

B. Install pumps to provide access for periodic maintenance including removing motors, impellers, couplings, and accessories.

C. Independently support pumps and piping so weight of piping is not supported by pumps and weight of pumps is not supported by piping.

D. Automatic Condensate Pump Units: Install units for collecting condensate and extend to open drain.

E. Equipment Mounting: Install base-mounted pumps on cast-in-place concrete equipment bases. Comply with requirements for equipment bases specified in Division 03 Section "Cast-in-Place Concrete or Miscellaneous Cast-in-Place Concrete]."

1. Coordinate sizes and locations of concrete bases with actual equipment provided.
2. Construct bases to withstand, without damage to equipment, seismic force required by code.
3. Construct concrete bases 6 inches (150 mm) high and extend base not less than 6 inches (150 mm) in all directions beyond the maximum dimensions of base-mounted pumps unless otherwise indicated or unless required for seismic-anchor support.
4. Minimum Compressive Strength: 5000 psi (34.5 MPa) at 28 days.

F. Equipment Mounting: Install base-mounted pumps on cast-in-place concrete equipment base(s) using restrained spring isolators. Comply with requirements for equipment bases specified in Division 03 Section "Cast-in-Place Concrete Miscellaneous Cast-in-Place Concrete." Comply with requirements for vibration isolation devices specified in Division 23 Section "Vibration and Seismic Controls for HVAC Piping and Equipment."

1. Minimum Deflection: 1/4 inch (6 mm).
2. Coordinate sizes and locations of concrete bases with actual equipment provided. Cast anchor-bolt inserts into bases.
3. Install dowel rods to connect concrete base to concrete floor. Unless otherwise indicated, install dowel rods on 18-inch (450-mm) centers around full perimeter of concrete base.
4. For supported equipment, install epoxy-coated anchor bolts that extend through concrete base and anchor into structural concrete floor.
5. Place and secure anchorage devices. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
6. Install anchor bolts to elevations required for proper attachment to supported equipment.

7. Install on 6-inch- (150-mm-) high concrete base designed to withstand, without damage to equipment, seismic force required by code.

G. Equipment Mounting: Install base-mounted pumps using restrained spring isolators. Comply with requirements for vibration isolation devices specified in Division 23 Section "Vibration and Seismic Controls for HVAC Piping and Equipment."

1. Minimum Deflection: 1/4 inch (6 mm).

2. Retain "Equipment Mounting" Paragraph below for in-line pumps suspended from structure.

H. Equipment Mounting: Install in-line pumps with continuous-thread hanger rods and spring hangers with vertical-limit stop of size required to support weight of in-line pumps.

1. Comply with requirements for seismic-restraint devices specified in Division 23 Section "Vibration and Seismic Controls for HVAC Piping and Equipment."
2. Comply with requirements for hangers and supports specified in Division 23 Section "Hangers and Supports for HVAC Piping and Equipment."

3.2 ALIGNMENT

A. Engage a factory-authorized service representative to perform alignment service.

B. Comply with requirements in Hydronics Institute standards for alignment of pump and motor shaft. Add shims to the motor feet and bolt motor to base frame. Do not use grout between motor feet and base frame.

C. Comply with pump and coupling manufacturers' written instructions.

D. After alignment is correct, tighten foundation bolts evenly but not too firmly. Completely fill baseplate with nonshrink, nonmetallic grout while metal blocks and shims or wedges are in place. After grout has cured, fully tighten foundation bolts.

3.3 CONNECTIONS

A. Comply with requirements for piping specified in Division 23 Section "Steam and Condensate Heating Piping." Drawings indicate general arrangement of piping, fittings, and specialties.

B. Where installing piping adjacent to pump, allow space for service and maintenance.

C. Connect piping to pumps. Install valves that are same size as piping connected to pumps.

D. Install suction and discharge pipe sizes equal to or greater than diameter of pump nozzles.

E. Install check, shutoff, and throttling valves on discharge side of pumps.

F. Install suction diffuser and shutoff valve on suction side of pumps.

G. Install flexible connectors on suction and discharge sides of base-mounted pumps between pump casing and valves.

H. Install pressure gages on pump suction and discharge or at integral pressure-gage tapping, or install single gage with multiple-input selector valve.

I. Install check valve and gate or ball valve on each condensate pump unit discharge.

J. Ground equipment according to Division 26 Section "Grounding and Bonding for Electrical Systems."

K. Connect wiring according to Division 26 Section "Low-Voltage Electrical Power Conductors and Cables."

END OF SECTION 232123

SECTION 232113 - HYDRONIC PIPING

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes pipe and fitting materials, joining methods, special-duty valves, and specialties for the following:

1. Hot-water heating piping.
2. Chilled-water piping.
3. Condenser-water piping.
4. Makeup-water piping.
5. Condensate-drain piping.
6. Blowdown-drain piping.
7. Air-vent piping.
8. Safety-valve-inlet and -outlet piping.

B. See Division 23 Section "Hydronic Pumps" for pumps, motors, and accessories for hydronic piping.

1.2 PERFORMANCE REQUIREMENTS

A. Hydronic piping components and installation shall be capable of withstanding the following minimum working pressure and temperature:

1. Hot-Water Heating Piping: at 200 deg F (93 deg C).
2. Chilled-Water Piping: at 200 deg F (93 deg C).
3. Condenser-Water Piping: at 150 deg F (66 deg C).
4. Makeup-Water Piping: 80 psig (552 kPa) at 150 deg F (66 deg C).
5. Condensate-Drain Piping: 150 deg F (66 deg C).
6. Blowdown-Drain Piping: 200 deg F (93 deg C).
7. Air-Vent Piping: 200 deg F (93 deg C).
8. Safety-Valve-Inlet and -Outlet Piping: Equal to the pressure of the piping system to which it is attached.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of the following:

1. Plastic pipe and fittings with solvent cement.
2. Pressure-seal fittings.
3. Valves. Include flow and pressure drop curves based on manufacturer's testing for calibrated-orifice balancing valves and automatic flow-control valves.
4. Air control devices.
5. Chemical treatment.

6. Hydronic specialties.

B. LEED Submittals:

1. Product Data for Credit IEQ 4.1: For solvent cements and adhesive primers, documentation including printed statement of VOC content.
2. Laboratory Test Reports for Credit IEQ 4: For solvent cements and adhesive primers, documentation indicating that products comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

C. Shop Drawings: Detail, at 1/4 (1:50) scale, the piping layout, fabrication of pipe anchors, hangers, supports for multiple pipes, alignment guides, expansion joints and loops, and attachments of the same to the building structure. Detail location of anchors, alignment guides, and expansion joints and loops.

1.4 INFORMATIONAL SUBMITTALS

A. Field quality-control test reports.

1.5 CLOSEOUT SUBMITTALS

A. Operation and maintenance data.

1.6 QUALITY ASSURANCE

A. ASME Compliance: Comply with ASME B31.9, "Building Services Piping," for materials, products, and installation. Safety valves and pressure vessels shall bear the appropriate ASME label. Fabricate and stamp air separators and expansion tanks to comply with ASME Boiler and Pressure Vessel Code: Section VIII, Division 1.

PART 2 - PRODUCTS

2.1 COPPER TUBE AND FITTINGS

A. Drawn-Temper Copper Tubing: ASTM B 88, Type L (ASTM B 88M, Type B).

B. Annealed-Temper Copper Tubing: ASTM B 88, Type K (ASTM B 88M, Type A).

C. DWV Copper Tubing: ASTM B 306, Type DWV.

D. Wrought-Copper Fittings: ASME B16.22.

1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
3. Basis-of-Design Product: Subject to compliance with requirements, provide the product indicated on Drawings or a comparable product by one of the following:

   a. Anvil International, Inc.
   b. S. P. Fittings; a division of Star Pipe Products.
   c. Victaulic Company.

4. Grooved-End Copper Fittings: ASTM B 75 (ASTM B 75M), copper tube or ASTM B 584, bronze casting.
5. Grooved-End-Tube Couplings: Rigid pattern, unless otherwise indicated; gasketed fitting. Ductile-iron housing with keys matching pipe and fitting grooves, prelubricated EPDM gasket rated for minimum 230 deg F (110 deg C) for use with housing, and steel bolts and nuts.

E. Wrought-Copper Unions: ASME B16.22.

2.2 STEEL PIPE AND FITTINGS

A. Steel Pipe: ASTM A 53/A 53M, black steel with plain ends; type, grade, and wall thickness as indicated in Part 3 "Piping Applications" Article.

B. Cast-Iron Threaded Fittings: ASME B16.4; Classes 125 and 250 as indicated in Part 3 "Piping Applications" Article.

C. Malleable-Iron Threaded Fittings: ASME B16.3, Classes 150 and 300 as indicated in Part 3 "Piping Applications" Article.

D. Malleable-Iron Unions: ASME B16.39; Classes 150, 250, and 300 as indicated in Part 3 "Piping Applications" Article.

E. Cast-Iron Pipe Flanges and Flanged Fittings: ASME B16.1, Classes 25, 125, and 250; raised ground face, and bolt holes spot faced as indicated in Part 3 "Piping Applications" Article.

F. Wrought Cast- and Forged-Steel Flanges and Flanged Fittings: ASME B16.5, including bolts, nuts, and gaskets of the following material group, end connections, and facings:

1. Material Group: 1.1.
2. End Connections: Butt welding.
3. Facings: Raised face.

G. Grooved Mechanical-Joint Fittings and Couplings:

1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

3. Basis-of-Design Product: Subject to compliance with requirements, provide the product indicated on Drawings or a comparable product by one of the following:

   a. Anvil International, Inc.
   b. Central Sprinkler Company; a division of Tyco Fire & Building Products.
   c. National Fittings, Inc.
   d. S. P. Fittings; a division of Star Pipe Products.
   e. Victaulic Company.

4. Joint Fittings: ASTM A 536, Grade 65-45-12 ductile iron; ASTM A 47/A 47M, Grade 32510 malleable iron; ASTM A 53/A 53M, Type F, E, or S, Grade B fabricated steel; or ASTM A 106, Grade B steel fittings with grooves or shoulders constructed to accept grooved-end couplings; with nuts, bolts, locking pin, locking toggle, or lugs to secure grooved pipe and fittings.
5. Couplings: Ductile- or malleable-iron housing and synthetic rubber gasket of central cavity pressure-responsive design; with nuts, bolts, locking pin, locking toggle, or lugs to secure grooved pipe and fittings.

2.3 PLASTIC PIPE AND FITTINGS

A. CPVC Plastic Pipe: ASTM F 441/F 441M, Schedules 40 and 80, plain ends as indicated in Part 3 "Piping Applications" Article.

B. CPVC Plastic Pipe Fittings: Socket-type pipe fittings, ASTM F 438 for Schedule 40 pipe; ASTM F 439 for Schedule 80 pipe.

C. PVC Plastic Pipe: ASTM D 1785, Schedules 40 and 80, plain ends as indicated in Part 3 "Piping Applications" Article.

D. PVC Plastic Pipe Fittings: Socket-type pipe fittings, ASTM D 2466 for Schedule 40 pipe; ASTM D 2467 for Schedule 80 pipe.

2.4 JOINING MATERIALS

A. Pipe-Flange Gasket Materials: Suitable for chemical and thermal conditions of piping system contents.

1. ASME B16.21, nonmetallic, flat, asbestos free, 1/8-inch (3.2-mm) maximum thickness unless thickness or specific material is indicated.

   a. Full-Face Type: For flat-face, Class 125, cast-iron and cast-bronze flanges.
   b. Narrow-Face Type: For raised-face, Class 250, cast-iron and steel flanges.

B. Flange Bolts and Nuts: ASME B18.2.1, carbon steel, unless otherwise indicated.

C. Plastic, Pipe-Flange Gasket, Bolts, and Nuts: Type and material recommended by piping system manufacturer, unless otherwise indicated.

D. Solder Filler Metals: ASTM B 32, lead-free alloys. Include water-flushable flux according to ASTM B 813.

E. Brazing Filler Metals: AWS A5.8, BCuP Series, copper-phosphorus alloys for joining copper with copper; or BAg-1, silver alloy for joining copper with bronze or steel.

F. Solvent Cements for Joining Plastic Piping:

1. CPVC Piping: ASTM F 493.

a. CPVC solvent cement shall have a VOC content of 490 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
b. Adhesive primer shall have a VOC content of 550 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
c. Solvent cement and adhesive primer shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

2. PVC Piping: ASTM D 2564. Include primer according to ASTM F 656.

a. PVC solvent cement shall have a VOC content of 510 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
b. Adhesive primer shall have a VOC content of 550 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
c. Solvent cement and adhesive primer shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

G. Gasket Material: Thickness, material, and type suitable for fluid to be handled and working temperatures and pressures.

2.5 TRANSITION FITTINGS

A. Plastic-to-Metal Transition Fittings:

1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Charlotte Pipe and Foundry Company.
b. IPEX Inc.
c. KBi.

3. CPVC and PVC one-piece fitting with one threaded brass or copper insert and one Schedule 80 solvent-cement-joint end.

B. Plastic-to-Metal Transition Unions:

1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

   a. Charlotte Pipe and Foundry Company.
   b. IPEX Inc.
   c. KBi.
   d. NIBCO INC.

3. MSS SP-107, CPVC and PVC union. Include brass or copper end, Schedule 80 solvent-cement-joint end, rubber gasket, and threaded union.

2.6 DIELECTRIC FITTINGS

A. General Requirements: Assembly of copper alloy and ferrous materials with separating nonconductive insulating material. Include end connections compatible with pipes to be joined.

B. Dielectric Unions:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

   a. Capitol Manufacturing Company.
   b. Central Plastics Company.
   c. Hart Industries International, Inc.
   d. Jomar International Ltd.
   e. Matco-Norca, Inc.
   f. McDonald, A. Y. Mfg. Co.
   g. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
   h. Wilkins; a Zurn company.

2. Description:

   a. Standard: ASSE 1079.
   b. Pressure Rating: 125 psig (860 kPa) minimum at 180 deg F (82 deg C) 150 psig (1035 kPa).
   c. End Connections: Solder-joint copper alloy and threaded ferrous.

2.7 VALVES

A. Gate, Globe, Check, Ball, and Butterfly Valves: Comply with requirements specified in Division 23 Section "General-Duty Valves for HVAC Piping."

B. Automatic Temperature-Control Valves, Actuators, and Sensors: Comply with requirements specified in Division 23 Section "Instrumentation and Control for HVAC."

C. Bronze, Calibrated-Orifice, Balancing Valves:

1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
3. Basis-of-Design Product: Subject to compliance with requirements, provide the product indicated on Drawings or a comparable product by one of the following:

    a. Armstrong Pumps, Inc.
    b. Bell & Gossett Domestic Pump; a division of ITT Industries.
    c. Flow Design Inc.
    d. Gerand Engineering Co.
    e. Griswold Controls.
    f. Taco.
    g. Tour & Andersson; available through Victaulic Company.

4. Body: Bronze, ball or plug type with calibrated orifice or venturi.
5. Ball: Brass or stainless steel.
6. Plug: Resin.
7. Seat: PTFE.
8. End Connections: Threaded or socket.
9. Pressure Gage Connections: Integral seals for portable differential pressure meter.
10. Handle Style: Lever, with memory stop to retain set position.
11. CWP Rating: Minimum 125 psig (860 kPa).
12. Maximum Operating Temperature: 250 deg F (121 deg C).

D. Cast-Iron or Steel, Calibrated-Orifice, Balancing Valves:

1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
3. Basis-of-Design Product: Subject to compliance with requirements, provide the product indicated on Drawings or a comparable product by one of the following:

    a. Armstrong Pumps, Inc.
    b. Bell & Gossett Domestic Pump; a division of ITT Industries.
    c. Flow Design Inc.
    d. Gerand Engineering Co.
    e. Griswold Controls.
    f. Taco.

4. Body: Cast-iron or steel body, ball, plug, or globe pattern with calibrated orifice or venturi.
5. Ball: Brass or stainless steel.
6. Stem Seals: EPDM O-rings.
7. Disc: Glass and carbon-filled PTFE.
8. Seat: PTFE.
9. End Connections: Flanged or grooved.
10. Pressure Gage Connections: Integral seals for portable differential pressure meter.
11. Handle Style: Lever, with memory stop to retain set position.
12. CWP Rating: Minimum 125 psig (860 kPa).
13. Maximum Operating Temperature: 250 deg F (121 deg C).

E. Diaphragm-Operated, Pressure-Reducing Valves:

1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
3. Basis-of-Design Product: Subject to compliance with requirements, provide the product indicated on Drawings or a comparable product by one of the following:

    a. Amtrol, Inc.
    b. Armstrong Pumps, Inc.
    c. Bell & Gossett Domestic Pump; a division of ITT Industries.
    d. Conbraco Industries, Inc.
    e. Spence Engineering Company, Inc.
    f. Watts Regulator Co.; a division of Watts Water Technologies, Inc.

4. Body: Bronze or brass.
5. Disc: Glass and carbon-filled PTFE.
6. Seat: Brass.
7. Stem Seals: EPDM O-rings.
8. Diaphragm: EPT.
9. Low inlet-pressure check valve.
10. Inlet Strainer: removable without system shutdown.
11. Valve Seat and Stem: Noncorrosive.
12. Valve Size, Capacity, and Operating Pressure: Selected to suit system in which installed, with operating pressure and capacity factory set and field adjustable.

F. Diaphragm-Operated Safety Valves:

1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
3. Basis-of-Design Product: Subject to compliance with requirements, provide the product indicated on Drawings or a comparable product by one of the following:

a. Amtrol, Inc.
b. Armstrong Pumps, Inc.
c. Bell & Gossett Domestic Pump; a division of ITT Industries.
d. Conbraco Industries, Inc.
e. Spence Engineering Company, Inc.
f. Watts Regulator Co.; a division of Watts Water Technologies, Inc.

4. Body: Bronze or brass.
5. Disc: Glass and carbon-filled PTFE.
6. Seat: Brass.
7. Stem Seals: EPDM O-rings.
8. Diaphragm: EPT.
9. Wetted, Internal Work Parts: Brass and rubber.
10. Inlet Strainer: removable without system shutdown.
11. Valve Seat and Stem: Noncorrosive.
12. Valve Size, Capacity, and Operating Pressure: Comply with ASME Boiler and Pressure Vessel Code: Section IV, and selected to suit system in which installed, with operating pressure and capacity factory set and field adjustable.

G. Automatic Flow-Control Valves:

1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
3. Basis-of-Design Product: Subject to compliance with requirements, provide the product indicated on Drawings or a comparable product by one of the following:

a. Flow Design Inc.
b. Griswold Controls.

4. Body: Brass or ferrous metal.
5. Piston and Spring Assembly: Stainless steel, tamper proof, self cleaning, and removable.
6. Combination Assemblies: Include bonze or brass-alloy ball valve.
7. Identification Tag: Marked with zone identification, valve number, and flow rate.
8. Size: Same as pipe in which installed.
9. Performance: Maintain constant flow, plus or minus 5 percent over system pressure fluctuations.
10. Minimum CWP Rating: 175 psig (1207 kPa).
11. Maximum Operating Temperature: 200 deg F (93 deg C).

2.8 AIR CONTROL DEVICES

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Amtrol, Inc.
2. Armstrong Pumps, Inc.
3. Bell & Gossett Domestic Pump; a division of ITT Industries.
4. Taco.

C. Manual Air Vents:

1. Body: Bronze.
2. Internal Parts: Nonferrous.
3. Operator: Screwdriver or thumbscrew.
4. Inlet Connection: NPS 1/2 (DN 15).
5. Discharge Connection: NPS 1/8 (DN 6).
6. CWP Rating: 150 psig (1035 kPa).
7. Maximum Operating Temperature: 225 deg F (107 deg C).

D. Expansion Tanks:

1. Tank: Welded steel, rated for 125-psig (860-kPa) working pressure and 375 deg F (191 deg C) maximum operating temperature, with taps in bottom of tank for tank fitting and taps in end of tank for gage glass. Tanks shall be factory tested with taps fabricated and labeled according to ASME Boiler and Pressure Vessel Code: Section VIII, Division 1.
2. Air-Control Tank Fitting: Cast-iron body, copper-plated tube, brass vent tube plug, and stainless-steel ball check, 100-gal. (379-L) unit only; sized for compression-tank diameter. Provide tank fittings for 125-psig (860-kPa) working pressure and 250 deg F (121 deg C) maximum operating temperature.
3. Tank Drain Fitting: Brass body, nonferrous internal parts; 125-psig (860-kPa) working pressure and 240 deg F (116 deg C) maximum operating temperature; constructed to admit air to compression tank, drain water, and close off system.
4. Gage Glass: Full height with dual manual shutoff valves, 3/4-inch- (20-mm-) diameter gage glass, and slotted-metal glass guard.

E. In-Line Air Separators:

1. Tank: One-piece cast iron with an integral weir constructed to decelerate system flow to maximize air separation.
2. Maximum Working Pressure: Up to 175 psig (1207 kPa).
3. Maximum Operating Temperature: Up to 300 deg F (149 deg C).

2.9 CHEMICAL TREATMENT

A. Bypass Chemical Feeder: Welded steel construction; 125-psig (860-kPa) working pressure; 5-gal. (19-L) capacity; with fill funnel and inlet, outlet, and drain valves.

1. Chemicals: Specially formulated, based on analysis of makeup water, to prevent accumulation of scale and corrosion in piping and connected equipment.

B. Ethylene and Propylene Glycol: Industrial grade with corrosion inhibitors and environmental-stabilizer additives for mixing with water in systems indicated to contain antifreeze or glycol solutions.

2.10 HYDRONIC PIPING SPECIALTIES

A. Y-Pattern Strainers:

1. Body: ASTM A 126, Class B, cast iron with bolted cover and bottom drain connection.
2. End Connections: Threaded ends for NPS 2 (DN 50) and smaller; flanged ends for NPS 2-1/2 (DN 65) and larger.
3. Strainer Screen: 60-mesh startup strainer, and perforated stainless-steel basket with 50 percent free area.
4. CWP Rating: 125 psig (860 kPa).

B. Stainless-Steel Bellow, Flexible Connectors:

1. Body: Stainless-steel bellows with woven, flexible, bronze, wire-reinforcing protective jacket.
2. End Connections: Threaded or flanged to match equipment connected.
3. Performance: Capable of 3/4-inch (20-mm) misalignment.
4. CWP Rating: 150 psig (1035 kPa).
5. Maximum Operating Temperature: 250 deg F (121 deg C).

C. Expansion fittings are specified in Division 23 Section "Expansion Fittings and Loops for HVAC Piping."

PART 3 - EXECUTION

3.1 PIPING APPLICATIONS

A. Hot-water heating piping, aboveground, NPS 2 (DN 50) and smaller, shall be any of the following:

1. Type L (B), drawn-temper copper tubing, wrought-copper fittings, and soldered joints.
2. Schedule 40 steel pipe; Class 150, malleable-iron fittings; cast-iron flanges and flange fittings; and threaded joints.
3. Schedule 40 CPVC plastic pipe and fittings and solvent-welded joints.

B. Hot-water heating piping, aboveground, NPS 2-1/2 (DN 65) and larger, shall be any of the following:

1. Type L (B), drawn-temper copper tubing, wrought-copper fittings, and brazed joints.
2. Schedule 40 steel pipe, wrought-steel fittings and wrought-cast or forged-steel flanges and flange fittings, and welded and flanged joints.
3. Schedule 40 steel pipe; grooved, mechanical joint coupling and fittings; and grooved, mechanical joints.
4. Schedule 40 CPVC plastic pipe and fittings and solvent-welded joints.

C. Hot-Water Heating Piping Installed Belowground and within Slabs: Type K (A), annealed-temper copper tubing, wrought-copper fittings, and soldered joints. Use the fewest possible joints.

D. Chilled-water piping, aboveground, NPS 2 (DN 50) and smaller, shall be any of the following:

1. Type L (B), drawn-temper copper tubing, wrought-copper fittings, and soldered joints.
2. Schedule 40 steel pipe; Class 150, malleable-iron fittings; cast-iron flanges and flange fittings; and threaded joints.
3. Schedule 40 CPVC plastic pipe and fittings and solvent-welded joints.

E. Chilled-water piping, aboveground, NPS 2-1/2 (DN 65) and larger, shall be the following:
1. Schedule 40 steel pipe, wrought-steel fittings and wrought-cast or forged-steel flanges and flange fittings, and welded and flanged joints.
2. Schedule 40 steel pipe; grooved, mechanical joint coupling and fittings; and grooved, mechanical joints.

F. Chilled-Water Piping Installed Belowground and within Slabs: Type K (A), annealed-temper copper tubing, wrought-copper fittings, and soldered joints. Use the fewest possible joints.

G. Condenser-water piping, aboveground, NPS 2 (DN 50) and smaller, shall be any of the following:

1. Type L (B), drawn-temper copper tubing, wrought-copper fittings, and soldered joints.
2. Schedule 40 steel pipe; Class 150, malleable-iron fittings; cast-iron flanges and flange fittings; and threaded joints.
3. Schedule 40 CPVC plastic pipe and fittings and solvent-welded joints.

H. Condenser-water piping, aboveground, NPS 2-1/2 (DN 65) and larger, shall be any of the following:

1. Type L (B), drawn-temper copper tubing, wrought-copper fittings, and soldered joints.
2. Schedule 40 steel pipe, wrought-steel fittings and wrought-cast or forged-steel flanges and flange fittings, and welded and flanged joints.
3. Schedule 40 steel pipe; grooved, mechanical joint coupling and fittings; and grooved, mechanical joints.
4. Schedule 40 CPVC plastic pipe and fittings and solvent-welded joints.

I. Condenser-Water Piping Installed Belowground and within Slabs: Type K (A), annealed-temper copper tubing, wrought-copper fittings, and soldered joints. Use the fewest possible joints.

J. Makeup-water piping installed aboveground shall be either of the following:

1. Type L (B), drawn-temper copper tubing, wrought-copper fittings, and soldered joints.
2. Schedule 40 CPVC plastic pipe and fittings, and solvent-welded joints.

K. Makeup-Water Piping Installed Belowground and within Slabs: Type K (A), annealed-temper copper tubing, wrought-copper fittings, and soldered joints. Use the fewest possible joints.

L. Condensate-Drain Piping: Type M (C) DWV, drawn-temper copper tubing, wrought-copper fittings, and soldered joints or Schedule 40 PVC plastic pipe and fittings and solvent-welded joints.

M. Condensate-Drain Piping: Schedule 40 PVC plastic pipe and fittings and solvent-welded joints.

N. Blowdown-Drain Piping: Same materials and joining methods as for piping specified for the service in which blowdown drain is installed.

O. Air-Vent Piping:

1. Inlet: Same as service where installed with metal-to-plastic transition fittings for plastic piping systems according to the piping manufacturer's written instructions.
2. Outlet: Type K (A), annealed-temper copper tubing with soldered or flared joints.

P. Safety-Valve-Inlet and -Outlet Piping for Hot-Water Piping: Same materials and joining methods as for piping specified for the service in which safety valve is installed with metal-to-plastic transition fittings for plastic piping systems according to the piping manufacturer's written instructions.

3.2 VALVE APPLICATIONS

A. Install shut-off duty valves at each branch connection to supply mains, and at supply connection to each piece of equipment.

B. Install calibrated-orifice, balancing valves at each branch connection to return main.

C. Install calibrated-orifice, balancing valves in the return pipe of each heating or cooling terminal.

D. Install check valves at each pump discharge and elsewhere as required to control flow direction.

E. Install safety valves at hot-water generators and elsewhere as required by ASME Boiler and Pressure Vessel Code. Install drip-pan elbow on safety-valve outlet and pipe without valves to the outdoors; and pipe drain to nearest floor drain or as indicated on Drawings. Comply with ASME Boiler and Pressure Vessel Code: Section VIII, Division 1, for installation requirements.

F. Install pressure-reducing valves at makeup-water connection to regulate system fill pressure.

3.3 PIPING INSTALLATIONS

A. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems. Indicate piping locations and arrangements if such were used to size pipe and calculate friction loss, expansion, pump sizing, and other design considerations. Install piping as indicated unless deviations to layout are approved on Coordination Drawings.

B. Install piping in concealed locations, unless otherwise indicated and except in equipment rooms and service areas.

C. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.

D. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.

E. Install piping to permit valve servicing.

F. Install piping at indicated slopes.

G. Install piping free of sags and bends.

H. Install fittings for changes in direction and branch connections.

I. Install piping to allow application of insulation.

J. Select system components with pressure rating equal to or greater than system operating pressure.

K. Install groups of pipes parallel to each other, spaced to permit applying insulation and servicing of valves.

L. Install drains, consisting of a tee fitting, NPS 3/4 (DN 20) ball valve, and short NPS 3/4 (DN 20) threaded nipple with cap, at low points in piping system mains and elsewhere as required for system drainage.

M. Install piping at a uniform grade of 0.2 percent upward in direction of flow.

N. Reduce pipe sizes using eccentric reducer fitting installed with level side up.

O. Install branch connections to mains using mechanically formed tee fittings in main pipe, with the branch connected to the bottom of the main pipe. For up-feed risers, connect the branch to the top of the main pipe.

P. Install valves according to Division 23 Section "General-Duty Valves for HVAC Piping."

Q. Install unions in piping, NPS 2 (DN 50) and smaller, adjacent to valves, at final connections of equipment, and elsewhere as indicated.

R. Install flanges in piping, NPS 2-1/2 (DN 65) and larger, at final connections of equipment and elsewhere as indicated.

S. Install strainers on inlet side of each control valve, pressure-reducing valve, solenoid valve, in-line pump, and elsewhere as indicated. Install NPS 3/4 (DN 20) nipple and ball valve in blowdown connection of strainers NPS 2 (DN 50) and larger. Match size of strainer blowoff connection for strainers smaller than NPS 2 (DN 50).

T. Install expansion loops, expansion joints, anchors, and pipe alignment guides as specified in Division 23 Section "Expansion Fittings and Loops for HVAC Piping."

U. Identify piping as specified in Division 23 Section "Identification for HVAC Piping and Equipment."

V. Install sleeves for piping penetrations of walls, ceilings, and floors. Comply with requirements for sleeves specified in Division 23 Section "Sleeves and Sleeve Seals for HVAC Piping."

W. Install sleeve seals for piping penetrations of concrete walls and slabs. Comply with requirements for sleeve seals specified in Division 23 Section "Sleeves and Sleeve Seals for HVAC Piping."

X. Install escutcheons for piping penetrations of walls, ceilings, and floors. Comply with requirements for escutcheons specified in Division 23 Section "Escutcheons for HVAC Piping."

3.4 HANGERS AND SUPPORTS

A. Hanger, support, and anchor devices are specified in Division 23 Section "Hangers and Supports for HVAC Piping and Equipment." Comply with the following requirements for maximum spacing of supports.

B. Seismic restraints are specified in Division 23 Section "Vibration and Seismic Controls for HVAC Piping and Equipment."

C. Install the following pipe attachments:

1. Adjustable steel clevis hangers for individual horizontal piping less than 20 feet (6 m) long.
2. Adjustable roller hangers and spring hangers for individual horizontal piping 20 feet (6 m) or longer.
3. Pipe Roller: MSS SP-58, Type 44 for multiple horizontal piping 20 feet (6 m) or longer, supported on a trapeze.
4. Spring hangers to support vertical runs.
5. Provide copper-clad hangers and supports for hangers and supports in direct contact with copper pipe.
6. On plastic pipe, install pads or cushions on bearing surfaces to prevent hanger from scratching pipe.

D. Install hangers for steel piping with the following maximum spacing and minimum rod sizes:

1. NPS 3/4 (DN 20): Maximum span, 7 feet (2.1 m); minimum rod size, 1/4 inch (6.4 mm).
2. NPS 1 (DN 25): Maximum span, 7 feet (2.1 m); minimum rod size, 1/4 inch (6.4 mm).
3. NPS 1-1/2 (DN 40): Maximum span, 9 feet (2.7 m); minimum rod size, 3/8 inch (10 mm).
4. NPS 2 (DN 50): Maximum span, 10 feet (3 m); minimum rod size, 3/8 inch (10 mm).
5. NPS 2-1/2 (DN 65): Maximum span, 11 feet (3.4 m); minimum rod size, 3/8 inch (10 mm).
6. NPS 3 (DN 80): Maximum span, 12 feet (3.7 m); minimum rod size, 3/8 inch (10 mm).
7. NPS 4 (DN 100): Maximum span, 14 feet (4.3 m); minimum rod size, 1/2 inch (13 mm).

E. Install hangers for drawn-temper copper piping with the following maximum spacing and minimum rod sizes:

1. NPS 3/4 (DN 20): Maximum span, 5 feet (1.5 m); minimum rod size, 1/4 inch (6.4 mm).
2. NPS 1 (DN 25): Maximum span, 6 feet (1.8 m); minimum rod size, 1/4 inch (6.4 mm).
3. NPS 1-1/2 (DN 40): Maximum span, 8 feet (2.4 m); minimum rod size, 3/8 inch (10 mm).
4. NPS 2 (DN 50): Maximum span, 8 feet (2.4 m); minimum rod size, 3/8 inch (10 mm).

5. NPS 2-1/2 (DN 65): Maximum span, 9 feet (2.7 m); minimum rod size, 3/8 inch (10 mm).
6. NPS 3 (DN 80): Maximum span, 10 feet (3 m); minimum rod size, 3/8 inch (10 mm).

F. Plastic Piping Hanger Spacing: Space hangers according to pipe manufacturer's written instructions for service conditions. Avoid point loading. Space and install hangers with the fewest practical rigid anchor points.

G. Support vertical runs at roof, at each floor, and at 10-foot (3-m) intervals between floors.

3.5 PIPE JOINT CONSTRUCTION

A. Join pipe and fittings according to the following requirements and Division 23 Sections specifying piping systems.

B. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.

C. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.

D. Soldered Joints: Apply ASTM B 813, water-flushable flux, unless otherwise indicated, to tube end. Construct joints according to ASTM B 828 or CDA's "Copper Tube Handbook," using lead-free solder alloy complying with ASTM B 32.

E. Brazed Joints: Construct joints according to AWS's "Brazing Handbook," "Pipe and Tube" Chapter, using copper-phosphorus brazing filler metal complying with AWS A5.8.

F. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:

1. Apply appropriate tape or thread compound to external pipe threads unless dry seal threading is specified.
2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged. Do not use pipe sections that have cracked or open welds.

G. Flanged Joints: Select appropriate gasket material, size, type, and thickness for service application. Install gasket concentrically positioned. Use suitable lubricants on bolt threads.

H. Plastic Piping Solvent-Cemented Joints: Clean and dry joining surfaces. Join pipe and fittings according to the following:

1. Comply with ASTM F 402 for safe-handling practice of cleaners, primers, and solvent cements.
2. CPVC Piping: Join according to ASTM D 2846/D 2846M Appendix.
3. PVC Pressure Piping: Join ASTM D 1785 schedule number, PVC pipe and PVC socket fittings according to ASTM D 2672. Join other-than-schedule number PVC pipe and socket fittings according to ASTM D 2855.
4. PVC Nonpressure Piping: Join according to ASTM D 2855.

I. Grooved Joints: Assemble joints with coupling and gasket, lubricant, and bolts. Cut or roll grooves in ends of pipe based on pipe and coupling manufacturer's written instructions for pipe wall thickness. Use grooved-end fittings and rigid, grooved-end-pipe couplings.

J. Mechanically Formed, Copper-Tube-Outlet Joints: Use manufacturer-recommended tool and procedure, and brazed joints.

3.6 HYDRONIC SPECIALTIES INSTALLATION

A. Install manual air vents at high points in piping, at heat-transfer coils, and elsewhere as required for system air venting.

B. Install piping from boiler air outlet, air separator, or air purger to expansion tank with a 2 percent upward slope toward tank.

C. Install in-line air separators in pump suction. Install drain valve on air separators NPS 2 (DN 50) and larger.

D. Install bypass chemical feeders in each hydronic system where indicated, in upright position with top of funnel not more than 48 inches (1200 mm) above the floor. Install feeder in minimum NPS 3/4 (DN 20) bypass line, from main with full-size, full-port, ball valve in the main between bypass connections. Install NPS 3/4 (DN 20) pipe from chemical feeder drain, to nearest equipment drain and include a full-size, full-port, ball valve.

E. Install expansion tanks above the air separator. Install tank fitting in tank bottom and charge tank. Use manual vent for initial fill to establish proper water level in tank.

1. Install tank fittings that are shipped loose.
2. Support tank from floor or structure above with sufficient strength to carry weight of tank, piping connections, fittings, plus tank full of water. Do not overload building components and structural members.

3.7 TERMINAL EQUIPMENT CONNECTIONS

A. Sizes for supply and return piping connections shall be the same as or larger than equipment connections.

B. Install control valves in accessible locations close to connected equipment.

C. Install bypass piping with globe valve around control valve. If parallel control valves are installed, only one bypass is required.

D. Install ports for pressure gages and thermometers at coil inlet and outlet connections according to Division 23 Section "Meters and Gages for HVAC Piping."

3.8 CHEMICAL TREATMENT

A. Fill system with fresh water and add liquid alkaline compound with emulsifying agents and detergents to remove grease and petroleum products from piping. Circulate solution for a minimum of 24 hours, drain, clean strainer screens, and refill with fresh water.

B. Add initial chemical treatment and maintain water quality in ranges noted above for the first year of operation.

3.9 FIELD QUALITY CONTROL

A. Prepare hydronic piping according to ASME B31.9 and as follows:

1. Leave joints, including welds, uninsulated and exposed for examination during test.
2. Provide temporary restraints for expansion joints that cannot sustain reactions due to test pressure. If temporary restraints are impractical, isolate expansion joints from testing.
3. Flush hydronic piping systems with clean water; then remove and clean or replace strainer screens.
4. Isolate equipment from piping. If a valve is used to isolate equipment, its closure shall be capable of sealing against test pressure without damage to valve. Install blinds in flanged joints to isolate equipment.
5. Install safety valve, set at a pressure no more than one-third higher than test pressure, to protect against damage by expanding liquid or other source of overpressure during test.

B. Perform the following tests on hydronic piping:

1. Use ambient temperature water as a testing medium unless there is risk of damage due to freezing. Another liquid that is safe for workers and compatible with piping may be used.
2. While filling system, use vents installed at high points of system to release air. Use drains installed at low points for complete draining of test liquid.
3. Isolate expansion tanks and determine that hydronic system is full of water.
4. Subject piping system to hydrostatic test pressure that is not less than 1.5 times the system's working pressure. Test pressure shall not exceed maximum pressure for any vessel, pump, valve, or other component in system under test. Verify that stress due to pressure at bottom of vertical runs does not exceed 90 percent of specified minimum yield strength or 1.7 times "SE" value in Appendix A in ASME B31.9, "Building Services Piping."
5. After hydrostatic test pressure has been applied for at least 10 minutes, examine piping, joints, and connections for leakage. Eliminate leaks by tightening, repairing, or replacing components, and repeat hydrostatic test until there are no leaks.
6. Prepare written report of testing.

C. Perform the following before operating the system:

1. Open manual valves fully.
2. Inspect pumps for proper rotation.
3. Set makeup pressure-reducing valves for required system pressure.
4. Inspect air vents at high points of system and determine if all are installed and operating freely (automatic type), or bleed air completely (manual type).

5. Set temperature controls so all coils are calling for full flow.
6. Inspect and set operating temperatures of hydronic equipment, such as boilers, chillers, cooling towers, to specified values.
7. Verify lubrication of motors and bearings.

END OF SECTION 232113

SECTION 230993 - SEQUENCE OF OPERATIONS FOR HVAC CONTROLS

PART 1 - GENERAL

1.1 DESCRIPTION

A. This Section covers direct digital control (DDC) systems and equipment.

B. The Owner is hiring, under a separate contract, a Systems Integrator (SI) to connect the controls provided under this contract with the existing LONWORKS®-based campus Facility Management and Control System (FMCS). It shall be the responsiblity of the Division 26 contractor (Control Contractor) to coordinate all work with the (SI). See Division 17 specifications.

The Division 26 contractor (Control Contractor) shall integrate the new LONWORKS® Network Services (LNS) database with the existing SI campus LNS database. See Division 17 specifications.

C. General provisions and mechanical systems are specified in other Sections of Division 26.

D. The contractor shall provide a peer-to-peer networked, stand-alone, distributed control system for building mechanical and electrical systems. This direct digital control (DDC) system shall include one portable operator terminal - laptop, one digital display unit, microprocessor-based LONWORKS® nodes, instrumentation, end control devices, wiring, piping, software, LNS database, and related systems.

E. The system shall use EIA Standard 709.1, the LonTalk® protocol, as the communication protocol from node-to-node and from nodes and to the existing operator workstations. Gateways to transfer data from another protocol to LONWORKS® are not acceptable.

F. All labor, material, equipment and software not specifically referred to herein or on the plans, that are required to meet the functional intent of this specification, shall be provided without additional cost to the Owner.

1.2 RELATED WORK

A. The installation of motor starters that are not factory-installed, thermal overload switches, and power wiring to motors, starters, thermal overload switches, and contactors, is specified in another Division. This Section includes the furnishing and installation of controls and wiring for automatic controls, electric damper and valve operators, terminal control units, interlocks, starting circuits, and wiring to power consuming control devices.

Area smoke detectors are provided, installed and wired under Division 26. Duct smoke detectors shall be installed under Division 26, but furnished and wired into the fire alarm system under Division 26. This Section includes wiring fire alarm signal relays, provided and installed under another Division, to the automatic temperature control systems.

B. The Division 26 and 16 contractors shall be responsible for all LONWORKS® controllers, control devices, control panels, controller programming, controller programming software, controller input/output and power wiring and controller network wiring.

C. The Division 17 SI will be responsible for the Area Controller(s) (AC), graphical user interface software (GUI), development of all graphical screens, setup of schedules, logs and alarm routing, and connection of the AC to the local or wide area network. See Division 17 specifications.

1.3 QUALITY ASSURANCE

A. All components shall be commercial-institutional control quality, manufactured by those with a minimum of 5 years experience.

B. All work described in this section shall be installed, wired, tested and calibrated by factory certified technicians qualified for this work and in the regular employment of the temperature control system manufacturer or their approved distributor. Supplier shall have an in place support facility within 50 miles of the project site with technical staff, spare parts inventory and all necessary test and diagnostic equipment. The manufacturer shall be ISO 9000 certified.

C. The Building Controls Contractor shall submit a list of the configuration parameters from application specific controllers. The submittal shall include the parameter point name, type, object ID, Device ID, Object Name, and I/O Type. The Building Controls Contractor shall submit an electronic copy of the application documentation for each application specific node installed.

D. Units installed for the same purpose (i.e., control of an air handling unit) shall be products of a single manufacturer. Each major component of equipment shall have the manufacturer's name and address, and the model and serial number, in a conspicuous place. All materials and equipment shall be currently in production.

1.4 RELATED SECTIONS

A. Section 238119 - Air Handling Equipment.

B. Section 233713- Air Distribution.

C. Section 230593 - Test and Balance.

D. Section 230800 – Commissioning.

E. Section 233600 - Air Terminal Devices.

F. Section 262726 - General Wiring.

G. Section 262726 - Equipment and Motor Wiring.

H. Section 263600 – Transfer Switch.

I. Section 283111 - Fire Alarm Systems.

1.5 DEFINITIONS

A. Algorithm: A logical procedure for solving a recurrent mathematical problem.

B. Analog: A continuously varying signal value (temperature current, velocity, etc.).

C. Application Specific Device: A device that is furnished with a pre-established built in application that is configurable but not re-programmable.

D. Binary: A two-state system where an "ON" condition is represented by a high signal level and an "OFF" condition is represented by a low signal level.

E. Control Wiring: This includes conduit, wire, and wiring devices to install complete HVAC control systems, including motor control circuits, interlocks, sensors, PE and EP switches, and like devices. This also includes all wiring from node to node, and nodes to all sensors and points defined in the I/O summary shown on drawings or specified herein, and required to execute the sequence of operation. Does not include line voltage power wiring.

F. Diagnostic Program: Machine-executable instructions used to detect and isolate system and component malfunctions.

G. Distributed Control: A system whereby all control processing is decentralized and independent of a central computer.

H. Gateway: A device that contains an input/output (I/O) software driver to translate input data from one format to output data in a second format.

I. Human-Machine Interface (HMI): Human-machine interfacing allows the operator to manage, command, monitor, and program the system.

J. HVAC Control Systems: The complete LONWORKS® control system, comprising the user interface and routers, gateways, repeaters, nodes, the operator workstation, software, portable operator terminals, network communications wiring and raceways, and required field hardware, etc.

K. Integration: Establishing communication between two devices through the use of a gateway.

L. Interoperable: Establishing communication between two devices through the use of a common protocol and without the use of any gateways.

M. LonTalk®: Open communication protocol developed by the Echelon® Corporation.

N. LONWORKS®: The overall communications technology for control systems developed by Echelon® Corporation. The technology employs routers, gateways, bridges, and multimedia transceivers to permit topology and media-independent control solutions.

O. LONMARK® Interoperability Association: Standards committee consisting of numerous independent product developers and systems integrators dedicated to determining and maintaining the interoperability guidelines for the LONWORKS® industry.

P. LonMarked®- device has been certified for compliance with LonMark® standards by the LonMark® association.

Q. LONWORKS® Application Specific Nodes (LASN) - a networked device or node that contains a complete, configurable application that is specific to a particular task.

R. LONWORKS® Programmable Nodes (LPN) - a programmable control product that incorporates solid state components based upon the Neuron® chip to perform control loops or functions. The application in the controller is custom software produced by the integrator specifically for the project.

S. LONWORKS® Single Point Nodes (LSPN): devices such as temperature and humidity sensors, that have an on-board Neuron® microprocessor and network interface allowing them to communicate on the LONWORKS® network.

T. LONWORKS® Network Services (LNS): the database format for addressing nodes and variable bindings node-to-node.

U. Network: A system of distributed control units that are linked together on a communication bus. A network allows sharing of point information between all control units. Additionally, a network provides central monitoring and control of the entire system from any distributed control unit location.

V. Node: An intelligent LONWORKS® device with a Neuron® chip and LonTalk® transceiver attached to the network.

W. Operating System (OS): Software which controls the execution of computer programs and which provides scheduling, debugging, input/output controls, accounting, compilation, storage assignment, data management, and related services.

X. Operator Workstation (OW): The OW consists of a high-level processing personal computer that provides graphic user interface to network.

Y. Peripheral: Input/Output (I/O) equipment used to communicate to and from the computer and make hard copies of system outputs and magnetic files. Peripherals include CRTs, printers, hard drives, disk drives, and modems, etc.

Z. Portable Operators Terminal (POT): Permits remote operator interface to facilitate network management, node commissioning, diagnostics, and general operator interface with the installed LONWORKS® control system.

AA. Programmable Device: A device that does have a pre-established built-in application. An application creation software tool is required for an application to be created and downloaded to the device.

BB. Router: A device which routes messages destined for a node on another segment subnet or domain of the control network. The device controls message traffic based on node address and priority. Routers shall also serve as communication links between powerline, twisted pair, fiber, coax, and RF media.

CC. XIF: "External Interface File" contains the contents of the manufacturer's product documentation.

1.6 CODES AND STANDARDS

A. All work, materials, and equipment shall comply with the rules and regulations of all codes and ordinances of the local and state, and federal authorities. Such codes, when more restrictive, shall take precedence over these plans and specifications. As a minimum, the installation shall comply with current editions in effect 90 days prior to receipt of bids of the following codes.

1. All products shall be labeled with the appropriate approval markings. System installation shall comply with NFPA, NEMA, Local and National codes.

2. The DDC System manufacturer shall provide documentation supporting compliance with ISO 9000 certification mark from applicable registrar.

3. Terminal control units shall conform to the appropriate LONMARK® functional profile configurations based on intended use and shall be so labeled.

1.7 SUBMITTALS

A. Product Data and Shop Drawings: Meet requirements of Shop Drawings, Product Data, and Samples. In addition, Contractor shall provide shop drawings or other submittals on all hardware, software, and installation to be provided. No work may begin on any segment of this project until Engineer has reviewed submittals for conformity with the design intent.

B. Diagrams: Contractor shall provide separate diagrams for each system, including pneumatic piping, motor starting and interlock wiring, ladder diagrams, push buttons, control wiring, interior electrical circuits of control instruments with terminal designations, control motors, colors of wires, locations of instruments and remote elements, and normal position of valves, dampers and relays. A detailed description of the operation of the control system including control device designations shall accompany the drawings. Each diagram shall delineate between existing piping, wiring or equipment, and new piping, wiring, and equipment.

C. DDC system data: Contractor shall provide manufacturer's data sheets on DDC panels, sensors, control interface devices, terminal control units, protection devices and software; complete field wiring diagram with terminals labeled as they will be marked on the equipment, including sensors, control and power wiring for each sensor, control and DDC panel; programmer's manual, copies of object-oriented programming diagrams for LONWORKS® programmable controllers; vendor sequence of control for application specific nodes; table of LONWORKS® bindings which indicates sending variable names with SNVT types and corresponding receiving node variable names; and floor plans locating DDC panels and terminal control units coordinated with work of other trades.

D. The Building Controls Contractor shall submit a list of the configuration parameters from application specific controllers. The submittal shall include the parameter name, purpose and SNVT type. The Building Controls Contractor shall submit an electronic copy of the application documentation for each application specific node installed.

E. Portable Operators Terminal: Contractor shall provide manufacturer's data sheets on Portable Operators Terminal equipment including computers, disk systems, protection and communications equipment, and software; complete field wiring diagrams for data communications with DDC panels and interconnection of operator workstation equipment with SI.

F. Shop drawings shall be AutoCAD®- or Visio®-generated for the entire DDC system, including conduit, pipe, tubing routing, and details of control panels and device connections, and location of field devices. Provide a computer file copy and reproducible originals of each drawing.

G. Provide a schematic diagram of the Local Area Network and a LONWORKS® architecture diagram indicating nodes, including all devices and controllers installed by other trade contractors. This shall be accompanied by information regarding configuration of Routers and Repeaters. Schematic shall also include ANY interface requirements with other systems including but not limited to: security systems, lighting controls, fire alarm, elevator status, and power monitoring systems. Gateways are not acceptable. Each schematic shall have all control points labeled. The schematic shall graphically show all control elements.

H. Project Record Documents: Upon completion of installation, submit copies of record (as-built) documents. The documents shall be submitted for approval prior to final acceptance and shall include:

1. Project Record Drawings: These shall be as-built versions of the submittal shop drawings. One set of CAD, .DWG, .VSD or .DXF drawing files shall also be provided on CD Rom.

2. Testing and Commissioning Reports and Checklists: Provide completed versions of all reports and checklists used to complete the requirements of Section "____" Control System Demonstration and Acceptance".

3. Operation and Maintenance (O & M) Manual: This shall include as-built versions of the submittal product data. In addition to the information required for submittals, the O & M manual shall include:

   a. Names, addresses, and 24-hour telephone numbers of Contractors installing equipment, and the control systems and service representatives of each.

   b. Operator's Manual with procedures for operating the control systems, including logging on/off, producing point reports, trending dated overriding computer control, and changing setpoints and other variables.

   c. Programming Manual with a description of the programming language (including syntax), statement descriptions (including algorithms and calculations used), point database creation and modification, program creation and modification, and use of the editor.

   d. A listing and documentation of all custom software created using the programming language, including the point database. Files of the software and database shall be provided on CD Rom.

   e. A list of recommended spare parts, catalog numbers and suppliers shall be provided.

f. Complete original issue documentation, installation and maintenance information for all third-party hardware provided, including computer equipment and sensors.

g. Complete original issue diskettes for all software provided, including operating systems, programming language, operator workstation software and graphics software.

h. Licenses, guarantee and warranty documents for all equipment and systems.

I. Training documentation: Lesson plans and training manuals for the training phases shall be delivered for approval; these shall include type of training to be provided, with a list of reference material.

1.8 OWNERSHIP OF PROPRIETARY MATERIAL

A. The Owner shall sign a copy of the manufacturer's standard software and firmware licensing agreement as a condition of this contract. Such license shall grant use of all programs and application software to Owner as defined by the manufacturer's license agreement, but shall protect manufacturer's rights to disclosure of Trade secrets contained within such software. All project developed software and documentation shall become the property of the Owner. These include, but are not limited to:

1. Project graphic images

2. Record drawings

3. Project network database

4. Project-specific application programming code

5. All documentation.

1.9 WARRANTIES

A. All components, system software, and parts furnished and installed by the DDC controls contractor shall be guaranteed against defects in materials and workmanship for one year from acceptance date. Labor to repair, reprogram, or replace these components shall be furnished by the DDC system contractor at no charge during the warranty period. Materials furnished but not installed by the DDC system contractor shall be covered to the extent of the product only. Installation labor shall be the responsibility of the trade contractor performing the installation. All corrective software modifications made during warranty periods shall be updated on all user documentation and on user and manufacturer archived software disks. The Contractor shall respond to the Owner's request for warranty service within 24 hours during normal business hours.

B. At the end of the final startup, testing and commissioning phase, if equipment and systems are operating satisfactorily to the Owner's Authorized Representative and Engineer, the Owner's Authorized Representative shall sign certificates certifying that the control systems' operation has been tested and accepted in accordance with the terms of this specification.

C. Project-specific software, database software, and firmware updates which resolve known software deficiencies as identified by the DDC system Contractor shall be provided to the Owner at no charge during the warranty period. Any upgrades or functional enhancements associated with the above mentioned items may be provided during the warranty period for an additional charge to the Owner by purchasing an in-warranty service agreement from the DDC system Contractor. Written authorization by the Owner must, however, be granted prior to the installation of any of the above items.

1.10 ACCEPTABLE MANUFACTURERS

A. TAC-Americas (formerly, Control System International)
B. Johnson Controls, Inc.

PART 2 PRODUCTS

2.1 PROJECT DESCRIPTION

A. The contractor shall provide an open, interoperable peer-to-peer networked, distributed control system using ANSI/EIA Standard 709.1-A-1999, LONWORKS® technology communication protocols. The system shall provide total integration of the facility infrastructure systems with user access to all system data via existing operator workstations connected to the campus network at the Ethernet level.

B. The supplied computer software shall employ object-oriented technology (OOT) for representing all data and control devices within the system. Adherence to industry standards ANSI/EIA Standard 709.1-A-1999, LONWORKS® to assure interoperability between all system components is required. For each LONWORKS® device that does not have LONMARK® certification, the device supplier must provide an XIF file for the device if it is application specific and the XIF file and application file if the device is programmable.

2.2 NETWORKS

A. The LONWORKS® system architecture shall support the following levels.

1. 78kbyte FTT 10 channels for operating nodes

2. 1.25 mB high speed bus to tie together multiple 78kbyte FTT 10 channels

3. The controls contractor may use an IP-to-LON router or other network controller to convert from Ethernet, IEEE standard 802.3, to LONWORKS®, to setup the LNS database and program-troubleshoot nodes over the campus wide-area-network (WAN). All control programs shall reside in the nodes on the LONWORKS® network. No control programs shall be on systems that communicate over the campus WAN. The controls contractor shall provide all the necessary cable, IP routers, network controllers, and connections to the WAN if required for their system.

2.3 NETWORK ACCESS

A. Remote access to installations on the campus WAN Intranet:

1. The owner shall provide the IP address(es) for remote access by the contractor to the control system via the campus WAN.

2.4 PROGRAMMABLE NODES

A. General Requirements

1. LPNs shall support all necessary point inputs and outputs to perform the sequence of operation as shown on drawings and as specified herein.

2. LPNs shall be equipped with a 3120® Neuron® with co-processor or 3150® Neuron® microprocessor controller, (flash or EEPROM) memory for general data processing, power supply, network transceivers.

3. Operating system software, custom operating sequence software and application programs shall be stored in programmable, non-volatile memory.

4. An LPN shall operate totally stand-alone and independent of a central computer for all specified control applications. Software shall include a complete operating system (OS), communications handler, point processing, standard control algorithms, and specific control sequences.

5. LPNs shall include a battery backed hardware calendar/clock device.

6. LPN packaging shall be such that complete installation and check-out of field wiring can be performed prior to the installation of electronic boards. The complete LPN including power supplies, etc., wired and housed in a NEMA 1 enclosure or as required by the location and local code requirements.

7. The LPN LONWORKS® network interface shall be a Type 1 transceiver. A communication connection shall be provided for attaching POT to node for downloading and troubleshooting applications.

8. The LPN shall provide for a RS232 PC connection.

9. The LPN shall provide for a RS232 modem connection.

10. The LPN shall provide for a connection to a local digital display unit.

11. LPNs shall include:
    - Network service pin.
    - Power On indicator light.
    - Network communication indicator light.

B. Input/Output Requirements

1. Binary Input (BI) Types Supported by the LPN: The BI function shall accept on-off, open-close, or other change of state (two state data) indications.

2. Analog inputs shall include, 0-10 Vdc, 0-20 mA, 4-20 mA, and 1800 ohm (25ºC) or 10,000 ohm (25ºC) thermistors. Resolution of the Analog to Digital converter shall be a minimum of 10 bits.

3. LPNs shall include universal inputs that support either of the above describe inputs.

4. The LPN shall accommodate both binary and true analog outputs, 0-10Vdc. The resolution of the digital to analog converter shall be a minimum of 8 bits.

5. Binary outputs shall be capable of handling maintained as well as pulsed outputs for momentary or magnetic latching circuits.

6. The LPN shall accommodate expansion input/output units.

7. Enclosure shall be NEMA 1.

8. The LPN shall include all hardware and software required for communications with other nodes, PCs, and the OW over the LONWORKS® LANs.

2.5 VARIABLE AIR VOLUME (VAV) AIR DISTRIBUTION TERMINAL CONTROL UNIT (TCU) NODE

A. Control of VAV air distribution terminal units shall be accomplished by an individual TCU node with network interface to the DDC system. The TCU shall be equipped with a 3120 or 3150 Neuron® microprocessor controller, programmable non-volatile (Flash or EEPROM) memory, power supply, I/O, terminal blocks, and network transceivers.

B. The TCUs shall be LASN.

C. Air distribution terminal unit TCUs shall be provided with transformers as necessary for 120

Vac operation.

D. Each air distribution terminal unit TCU shall contain resident programs, which are field configurable for a specific application. Resident programs shall be contained in nonvolatile memory using EEPROM and FlashRam.

E. The TCU shall support the following functions:

1. Both pressure independent and pressure dependent control strategies. For pressure independent control, the damper control algorithm shall be based on fuzzy logic.

2. Multiple heating and cooling set points (occupied, standby and unoccupied)

3. Timed occupancy override with a configurable time period.

4. Support for occupied, standby and unoccupied modes

5. Minimum airflow settings for heating and cooling in both the occupied and unoccupied modes. In the occupied mode, these settings shall be dynamically reset as a function of a CO2 value sent to the controller over the network or locally measured.

F. The TCU shall support the following interfaces:

1. Damper only VAV terminals

2. Series fan powered VAV terminals

3. Parallel fan powered VAV terminals

4. Hydronic reheat coils with tri-state actuators

5. Up to 3 stages of electric reheat (two position control)

6. Local occupancy sensor-PIR

7. Local CO2 sensor

8. Room Temperature Sensor with local display, occupancy override, and set point adjustment.

9. Connection to the TCU through the room sensor for air balance configuration.

G. TCU Configuration and commissioning – provide TCU configuration and commissioning via POT connected to the network, or service device connected to the TCU through the zone sensor.

H. The TCU shall be LonMark™-certified for functional profile of a VAV controller.

I. LONWORKS® Network interface, the TCU, shall use a Type 1 transceiver.

2.6 FAN COIL TCU

A. Control of fan coil units shall be accomplished by an individual TCU node with network interface to the DDC system. The TCU shall be equipped with a 3120 or 3150 Neuron® microprocessor controller, programmable non-volatile (Flash or EEPROM) memory, power supply, I/O, terminal blocks, and network transceivers.

B. The TCUs shall be LASN.

C. TCUs shall be provided with transformers as necessary for 120 Vac operation.

D. Each TCU shall contain resident programs, which are field configurable for a specific application. Resident programs shall be contained in nonvolatile memory using EEPROM and FlashRam.

E. The TCU shall support the following functions:

1. Zone room temperature control or discharge air temperature control with reset from zone temperature

2. Multiple heating and cooling set points (occupied, standby and unoccupied)

3. Timed occupancy override with a configurable time period.

4. Support for occupied, standby and unoccupied modes

F. The TCU shall support the following interfaces:

1. Hydronic heating coils

2. Hydronic cooling coils

3. Fan with variable speed control or on-off control

4. Local occupancy sensor-PIR

5. Local lockout sensor

6. Discharge air temperature sensor

7. Room Temperature Sensor with occupancy override, and set point adjustment.

8. Connection to the TCU through the room sensor for setting configuration parameters and set points

G. TCU Configuration and commissioning – provide TCU configuration and commissioning via POT connected to the network, or service device connected to the TCU through the zone sensor.

H. The TCU shall be LonMark™-certified for functional profile of a fan coil controller.

I. LonWorks® Network interface for TCU shall use a Type 1 transceiver.

2.7 PORTABLE OPERATORS TERMINAL (POT) – LAPTOP COMPUTER

A. General Requirements.

Furnish one POT for the project. The POT shall permit the project operating staff to perform network management, node configuration, node programming, and node diagnostic.

B. Laptop computer with the following components:

- Minimum Pentium® 4, 2.5 Ghz or AMD processor.
- Minimum 512 MB RAM.
- 60 GB Hard Drive.
- 1 Type III or 2 Type II, PCMCIA Card Slot.
- 24x CD-ROM.
- 3-1/2" 1.44MB Floppy Drive.
- LONWORKS® PCC-10 Card.
- Ethernet Network Interface Card
- 16" SXGA Color Display.
- 56 Kbps V.90 Fax/Modem.
- Mouse.
- Built-in 16 bit sound card and stereo speakers.
- Touchpad or integral point device.
- 1 serial, 1 parallel, and 2 USB ports.

C. POT Command & Operating Software

1. The POT shall be equipped with the latest version of Windows, Windows® NT, Windows® 2000, or Windows XP as the main user terminal operating software.

2. As a minimum, the menu driven command and operating software shall permit the operator to perform the following tasks with a minimum knowledge of the HVAC Control System provided and basic computing skills.

    - Configure the network.
    - Create control sequences.
    - Graphical interface to systems.

3. Provide additional third party software to permit the operator to manage hard drive files such as access, delete, copy, modify, etc. The package shall be object oriented and permit the user to manage directories upon boot-up. The file management software shall organize directories and sub-directories using files, file folder objects.

4. Online Help. Provide a context sensitive, on-line help system to assist the operator in operation and editing of the system. Online help shall be available for all applications and shall provide the relevant data for that particular screen. Additional help information shall be available through the use of hypertext.

5. Security. Each operator shall be required to log on to that system with a user name and password in order to view, edit, add, or delete data. System security shall be selectable

for each operator. The system supervisor shall have the ability to set passwords and security levels for all other operators. Each operator password shall be able to restrict the operator's access for viewing and/or changing each system application, full screen editor, and object. Each operator shall automatically be logged off of the system if no keyboard or mouse activity is detected. This auto log-off time shall be set per operator password. All system security data shall be stored in an encrypted format.

D. POT Graphical Object-Oriented Programming Software

The system shall include a graphical object-oriented programming function which shall be used to create all control sequences utilized in LONWORKS® programmable nodes. The graphical object-oriented programming function shall provide programming elements to be connected together to create a logic diagram. The graphical object-oriented programming function shall include elements for mathematical, logical, timing, setpoint, display and input/output functions to create logic diagrams that represent sequences of operation for LPNs.

1. Program elements shall be able to be combined into a custom template which can then be used as a standard function.

2. Program checkout and debug tools shall include display of real-time and/or simulated system variables and inter-object data on the programming screens. The user shall be able to assign fixed or variable values to inputs during the dynamic debugging of the control sequence.

3. The graphical programming tools shall provide the ability to print I/O lists, lists of standard network variables and lists of all parameters to be viewed by the HMI.

4. The programming software shall reside on each POT for programming and/or configuring each model of LPN on the project. The applications shall be downloaded and executed at the appropriate nodes. The software shall allow for updated applications via the network from the OW.

5. DDC programs are to be provided to meet the control strategies as called for in the sequence of operation sections of these specifications. Each LPN shall have available a full library of DDC algorithms, intrinsic control operators, arithmetic, trigonometric, logic, Proportional Control, Proportional plus Integral (PI), Proportional plus Integral plus Derivative (PID), and relational operators for implementation of control sequences. 2-POSITION, FLOATING, STANDARD I/O AND COUNTER INPUTS, TIME BASED DATA, CURVE FIT FUNCTION, PSYCHOMETRIC FUNCTIONS, INTEGRATION,

6. All DDC setpoints, gains, and time constants associated with DDC programs shall be available to the operator for display and modification via the POT, DDU or OW interface.

7. Library of Applications: A library of control, application, and graphic objects shall be provided to enable the creation of applications and user interface screens. Provide the capability to cut & paste objects and libraries into applications for a node/system. Applications are to be created by selecting the desired control objects from the library, dragging or pasting them on the screen, and linking them together, using a built-in

graphical connection tool. Completed applications may be stored in the library for future use.

8. Off-line simulations (step function, continuous run function, simulation of external inputs)

9. Dynamic presentation of logic in on-line state (all intermediate values)

- Text to logic screens
- Memory monitoring
- Power cycle restart function
- Run-time capability
- Calculator objects, (basic stuff), including if-then-else, log, ln, exp, and trig functions.
- Recognize standard network variable type data (nvi) and create network variables to put on the network (nvo)

E. Application Specific Node Configuration software Tools: Provide application specific node configuration software tools that will permit the individual LASN to be configured and commissioned with appropriate parameters. This software will reside on the POT. Functionality shall include:

1. Recognize all Standard Configuration Parameters (SCPTs)

2. Provide capability for setting all Standard Configuration Parameters (SCPTs)

3. Translation capability for user defined configuration parameters

4. Monitoring capability for nvos from the nodes

5. Ability to set the values for nvis to the nodes

F. Network Management – LonMaker™ for Windows

1. The controls contractor shall provide latest released version of LonMaker™ for Windows for providing network management.

2. The existing Network Management Network Services Server Application (NSS) resides on the existing campus FMCS server which is connected to the campus Wide Area Network. See Division 17 specifications.

The controls contractor shall setup the LONWORKS® network management using LonMaker™ for Windows by assigning domain, subnet, and node addresses to nodes; configure all routers and repeaters; define network data connections between LONWORKS® device network variables, known as “binding;” and record binding data into node addressing tables, and create a database of all addressing and binding information for all nodes on the network. This database shall then be merged onto the existing NSS. This shall be coordinated with the campus SI. See Division 17 specifications.

2.8 DIGITAL DISPLAY UNIT (DDU) – Liquid Crystal Display

A. General Requirements.

Furnish one DDU for the project. The DDU shall permit the project operating staff to:

- Display point values
- Display parameters
- Change time schedule elements
- List and acknowledge alarms
- Monitor points in the system
- Command points (manual overrides) of points
- Override input points (put inputs in test)
- Read and check LONWORKS® variables on the network
- Password protected
- Node configuration for VAV, Fan Coil and Rooftop Unit TCUs

B. DDU with the following components:

- Liquid Crystal Display
- Minimum 4x20 character
- Pushbuttons for scrolling display and enter
- Permanent mount or portable connection.

2.9 LON ROUTERS, REPEATERS AND TRANSCEIVERS

A. General

Equip each router with a LONWORKS® network transceiver on each network port (inbound and outbound) as dictated by the network type.

1. The network router shall be designed to route messages from a segment, sub-net, or domain in full duplex communication mode.

2. Routers shall utilize LonTalk® protocol transport, network, session layers to transparently route messages bound for a node address in another sub-net or domain.

3. Routers and repeaters shall be fully programmable and permit a systems integrator to define message traffic, destination, and other network management functions utilizing LONWORKS® software tool.

4. The routers and repeaters shall be capable of DIN rail or panel mounting and be equipped with status LED lights for Network traffic and power.

5. Provide a minimum of two Neuron® 3120® or 3150® processors for use as the network router communication controller.

B. Ethernet IP Router

1. Equip each router with a Ethernet IP communication on one side and a LonTalk® transceiver Type 1 FTT or Type 2 - TP on the other side.

2. The network router shall be designed to route messages from a segment, sub-net, or domain in full duplex communication mode.

3. On Ethernet IP side, the router shall utilize Ethernet IP protocol transport to route messages.

4. On the LonTalk® side, the routers shall utilize LonTalk® protocol transport, network, session layers to transparently route messages bound for a node address in another sub-net or domain.

5. Routers shall be fully programmable and permit a systems integrator to define message traffic, destination, and other network management functions utilizing LONWORKS® software tool.

6. The routers shall be capable of DIN rail or panel mounting and be equipped with status LED lights for Network traffic and power.

C. Transceivers

1. Type 1 network transceiver, free topology, twisted pair: Provide a transformer isolated, twisted pair transceiver capable of mounting directly on a printed circuit board. The transceiver shall meet the following specifications:

   - Meets LONMARK® Interoperability Association Standards.
   - Differential Manchester encoded signaling for polarity insensitive network wiring.
   - Transformer isolated for common mode rejection.
   - 78kbs network bit rate up to distances of 2000 meters.
   - Free topology supports star, home run, multi-drop and loop wiring topologies.
   - Complies with FCC and VDE requirements.
   - UL recognized component.

2. Type 2 Network Transceiver, Twisted Pair: Provide a transformer isolated twisted pair transceiver capable of mounting directly on a printed circuit board. The transceiver shall meet the following specifications:

   - Meets LONWORKS® interoperability standards.
   - Differential Manchester encoded signaling for polarity insensitive network wiring.
   - Transformer isolation for common mode rejection.
   - 1.25Mbs network bit rate up to distances of 1000 meters.
   - FCC and VDE Level B requirements compliance.
   - UL recognized component.

3. Type 3 Network Transceiver, Power Line:

   - Provide a direct sequence, spread spectrum power line transceiver which is equipped with signal processing and error correction capabilities to provide robust and error free communications.

- The transceiver shall be able to operate using the controller power supply and coupling circuit.

4. Type 4 Network Transceiver, Link Power: Provide a twisted pair transceiver that utilizes the twisted pair communication media to provide power for the LONWORKS® Controller(s). The transceiver shall meet the following specifications:

   - Free single-in-line package (SIP) construction.
   - Send both network data and power on a twisted wire pair.
   - Meets LONWORKS® Interoperability Standard.
   - Differential Manchester encoded signaling for polarity insensitive network wiring.
   - 78kps network bit rate up to distances of 320 meters.
   - Supports star, home run, multi-drop, and loop wiring.
   - Compliance with FCC and VDE requirements.
   - UL recognized component.

5. Type 5 Network Transceiver, Radio Frequency: Provide a direct sequence, spread spectrum RF transceiver that meets the following specifications:

   - 100 meter open field range.
   - Wireless communications extends network between buildings and to vehicles and portable devices.
   - FCC type certifiable, 48 MHZ.
   - Carrier detect output to drive a status indicator LED.

2.10 HARDWARE LEVEL WEB SERVER (HLWS) – Not Applicable

2.11 OPERATOR WORKSTATION (OW)

The Division 17 SI will be responsible for the operator workstation. The controls contractor shall coordinate the integration of the nodes to the SI. See Division 17 specification.

2.12 AUXILIARY CONTROL DEVICES

A. Motorized control dampers, unless otherwise specified elsewhere, shall be as follows:

1. Control dampers shall be parallel or opposed blade type as below or as scheduled on drawings.

   a. Outdoor and/or return air mixing dampers shall be parallel blade, arranged to direct airstreams toward each other.

   b. Other modulating dampers shall be opposed blade type.

   c. Two-position shutoff dampers may be parallel or opposed blade type with blade and side seals.

2. Damper frames shall be 13 gauge galvanized steel channel or 1/8 extruded aluminum with reinforced corner bracing.

3. Damper blades shall not exceed 8” in width or 48" in length. Blades are to be suitable for medium velocity performance 2,000 fpm. Blades shall be not less than 16 gauge.

4. Damper shaft bearings shall be as recommended by manufacturer for application, Oilite or better.

5. All blade edges and top and bottom of the frame shall be provided with replaceable butyl rubber or neoprene seals. Side seals shall be spring-loaded stainless steel. The blade seals shall provide for a maximum leakage rate of 10 cfm per sq. ft. at 4" w.c. differential pressure. Provide airfoil blades suitable for a wide-open face velocity of 1,500 fpm.

6. Individual damper sections shall not be larger than 48" x 60n. Provide a minimum of one damper actuator per section.

7. Modulating dampers shall provide a linear flow characteristic where possible.

8. Dampers shall have exposed linkages. Dampers over 48" in applications where sectioning is not applicable shall be supplied with a jackshaft to provide sufficient force throughout the intended operating range.

9. Acceptable manufacturers: Ruskin or approved equal.

B. Electric damper/valve actuators

1. The actuator shall have electronic overload or digital rotation sensing circuitry to prevent damage to the actuator throughout the rotation of the actuator.

2. Where shown, for power-failure/safety applications, an internal mechanical spring-return mechanism shall be built into the actuator housing.

3. All rotary spring-return actuators shall be capable of clockwise or counter-clockwise spring-return operation. Linear actuators shall spring return to the retracted position.

4. Proportional actuators shall accept a 0 to 10 VDC or 0 to 20 mA control signal and provide a 2 to 10 VDC or 4 to 20 mA operating range.

5. All 24 VAC/VDC actuators shall operate on Class 2 wiring and shall not require more than 10 VA for AC or more than 8 W for DC applications. Actuators operating on 120 VAC or 230 VAC shall not require more than 11 VA.

6. All non-spring-return actuators shall have an external manual gear release to allow manual positioning of the damper when the actuator is not powered. Spring-return actuators with more than 7 N.m [60 in-lb.] torque capacity shall have a manual crank for this purpose.

7. All modulating actuators shall have an external, built-in switch to allow the reversing of direction of rotation.

8. Actuators shall be provided with a raceway fitting and a minimum 1m electrical cable and shall be pre-wired to eliminate the necessity of opening the actuator housing to make electrical connections.

9. Actuators shall be UL Standard 873 Listed as meeting correct safety requirements and recognized industry standards.

10. Actuators shall be designed for a minimum of 60,000 full-stroke cycles at the actuator's rated torque.

C. Control Valves

1. Control valves shall be two-way or three-way type for two-position or modulating service as shown.

2. Close-off (differential) Pressure Rating: Valve actuator and trim shall be furnished to provide the following minimum close-off pressure ratings:

a. Water Valves:

1) Two-way: 150% of total system (pump) head.

2) Three-way: 300% of pressure differential between ports A and B at design flow or 100% of total system (pump) head.

b. Steam Valves: 150% of operating (inlet) pressure.

3. Water Valves:

a. Body and trim style and materials shall be per manufacturer's recommendations for design conditions-and service shown, with equal percentage ports for modulating service.

b. Sizing Criteria:

1) Two-position service: Line size, unless otherwise shown.

2) Two-way modulating service: Pressure drop shall be equal to twice the pressure drop through heat exchanger (load), 50% of the pressure difference between supply and return mains, or 3 psi, whichever is greater.

3) Three-way modulating service: Pressure drop equal to twice the pressure drop through the coil exchanger (load), 35 kPa [5 psi] maximum.

4) Valves ½" through 2" shall be bronze body or cast brass ANSI Class 250, spring-loaded, Teflon packing, quick opening for two-position service. Two-way valves to have replaceable composition disc, or stainless steel ball.

5) 2-½" valves and larger shall be cast iron ANSI Class 125 with flanged connections, guided plug and Teflon packing, unless otherwise shown.

c. Water valves shall fail normally open or closed as scheduled on plans, or as follows:

1) Water zone valves – normally opened preferred.

2) Heating coils in air handlers – normally open.

3) Chilled water control valves – normally closed.

4) Other applications – as scheduled or as required by sequences of operation.

4. Steam Valves:

a. Body and trim materials shall be per manufacturer's recommendations for design conditions and service. Linear ports for modulating service.

b. Sizing Criteria:

1) Two-position service: pressure drop 10% to 20% of inlet psig.

2) Modulating service: 100 kPa [15 psig] or less: pressure drop 80% of inlet psig.

3) Modulating service: 101 to 350 kPa [16 to 50 psig]: pressure drop 50% of inlet psig.

4) Modulating service: over 350 kPa [50 psig]; pressure drop as scheduled on plans.

D. Binary Temperature Devices

1. Low-voltage space thermostat shall be 24 V. bimetal-operated, snap action type, with either adjustable or fixed anticipation heater, concealed set point adjustment, 13°C to 30°C [55°F to 85°F] set point range, 1°C [2° F] maximum differential, and vented ABS plastic cover.

2. Line-voltage space thermostat shall be bimetal-actuated, open contact or bimetal-actuated, enclosed, snap-switch type, or equivalent solid-state type, with heat anticipator, UL listed for electrical rating, concealed setpoint.

3. Low-limit thermostats: Low-limit thermostats shall be vapor pressure type with an element 6 m [20 ft] minimum length. Element shall respond to the lowest temperature sensed by any 30 cm {1 ft} section. The low-limit thermostat shall be manual (automatic) reset only.

E. Temperature Sensors

1. Temperature measurement shall be by transmitters with embedded Resistance Temperature Device (RTD) or simple thermistor-based sensors.

2. Duct sensors shall be rigid or averaging as shown. Averaging sensors shall be a

minimum of 1.5 m [5 feet] in length.

3. Immersion sensors shall be provided with a separable stainless steel, or copper well. Pressure rating of well is to be consistent with the system pressure in which it is to be installed.

4. Space sensors shall be equipped with set point adjustment, override switch, display, and/or communication port as shown.

5. Provide matched temperature sensors for differential temperature measurement.

F. Humidity Sensors

1. Duct and room sensors shall have a sensing range of 5% to 95%.

2. Duct sensors shall be provided with a sampling chamber.

3. Outdoor air humidity sensors shall have a sensing range of 20% to 95% RH. They shall be suitable for ambient conditions of -40°C to 75°C [-40°F to 170° F].

4. Humidity sensor's drift shall not exceed 3% of full scale per year.

G. Flow Switches

1. Flow-proving switches shall be either paddle or differential pressure type, as shown.

2. Paddle type switches (water service only) shall be UL Listed, SPDT snap-acting with pilot duty rating (125 VA minimum). Adjustable sensitivity with NEMA 1 enclosure unless otherwise specified.

3. Differential pressure type switches (air or water service) shall be UL Listed, SPDT snap-acting, pilot duty rated (125 VA minimum), NEMA 1 enclosure, with scale range and differential suitable for intended application, or as specified.

H. Relays

1. Control relays shall be UL Listed plug-in type. Contact rating, configuration, and coil voltage suitable for application.

2. Time delay relays shall be UL Listed solid-state plug-in type with adjustable time delay. Delay shall be adjustable ±200% (minimum) from set point shown on plans. Contact rating, configuration, and coil voltage suitable for application. Provide NEMA 1 enclosure when not installed in local control panels.

I. Override Timers

1. Override timers shall be spring-wound line voltage UL Listed, contact rating and configuration as required by application. Provide 0-to-6 hour calibrated dial unless otherwise specified; suitable for flush mounting on control panel face, located on local control panels or where shown.

J. Current Transmitters

1. AC current transmitters shall be self-powered combination split-core current transformer type with built-in rectifier and high-gain servo amplifier with 4 to 20 mA two-wire output. Unit ranges shall be 10 A, 20 A, 50 A, 100 A, 150 A, and 200 A full scale, internal zero and span adjustment and ±1% full-scale accuracy at 500 ohm maximum burden.

2. Transmitter shall meet or exceed ANSI/ISA S50.1 requirements and shall be UL/CSA Recognized.

3. Unit shall be split-core type for clamp-on installation on existing wiring.

K. Current Transformers

1. AC current transformers shall be UL/CSA Recognized and completely encased (except for terminals) in approved plastic material.

2. Transformers shall be available in various current ratios and shall be selected for ±1% accuracy at 5A full scale output.

3. Transformers shall be fixed-core or split-core type for installation on new or existing wiring, respectively.

L. Voltage Transmitters

1. AC voltage transmitters shall be self-powered single loop (two-wire) type, 4 to 20 mA output with zero and span adjustment.

2. Ranges shall include 200 to 130 VAC, 200 to 250 VAC, 250 to 330 VAC, and 400 to 600 VAC full-scale, adjustable, with ±1% full-scale accuracy with 500 ohm maximum burden.

3. Transmitters shall be UL/CSA Recognized at 600 VAC rating and meet or exceed ANSI/ISA S50.1 requirements.

M. Voltage Transformers

1. AC voltage transformers shall be UL/CSA Recognized, 600 VAC rated.

2. Transformers shall be suitable for ambient temperatures of 4 to 55°C [40 to 130°F1 and shall provide ±0.5% accuracy at 24 VAC and a 5 VA load.

3. Windings (except for terminals) shall be completely enclosed with metal or plastic material.

N. Power Monitors

1. Power monitors shall be three-phase type furnished with three-phase disconnect/shorting switch assembly, UL Listed voltage transformers and UL Listed split-core current transformers.

2. Shall provide a selectable rate pulse output for kWh reading and a 4 to 20 mA output for kW reading. Shall operate with 5 A current inputs with a maximum error of ±2% at 1.0 power factor or ±2.5% at 0.5 power factor.

O. Current Switches

1. Current-operated switches shall be self-powered, solid-state with adjustable trip current. The switches shall be selected to match the current of the application and output requirements of the DDC system.

P. Pressure Transducers

1. Transducer shall have linear output signal. Zero and span shall be field adjustable.

2. Transducer sensing elements shall withstand continuous operating conditions of positive or negative pressure 50% greater than calibrated span without damage.

3. Water pressure transducer shall have stainless steel diaphragm construction, proof pressure of 150 psi minimum. Transducer shall be complete with 4 to 20 mA output, required mounting brackets, and block and bleed valves.

4. Water differential pressure transducer shall have stainless steel diaphragm construction, proof pressure of 150 psi minimum. Over-range limit (differential pressure) and maximum static pressure shall be 300 psi. Transducer shall be complete with 4 to 20 mA output, required mounting brackets, and five-valve manifold.

Q. Differential pressure type switches (air or water service) shall be UL listed, SPDT snap-acting, pilot duty rated (125 VA minimum), NEMA 4 enclosure, with scale range and differential suitable for intended application, or as shown.

R. Pressure-Electric (PE Switches)

1. Shall be metal or neoprene diaphragm actuated, operating pressure rated 0-175 kPa [0-25 psig], with calibrated scale set point range of 14-125 kPa [2-18 psig] minimum, UL listed.

2. Provide ones or two-stage switch action SPOT, DPST, or DPDT, as required by application. Electrically rated for pilot duty service (125 VA minimum), and/or for motor control.

3. Shall be open type (panel-mounted) or enclosed type for remote installation. Enclosed type shall be NEMA 1 unless otherwise specified.

4. Shall have a permanent indicating gauge on each pneumatic signal line to PE switches.

- Flow meter
- Airflow measuring station.

S. Local Control Panels

1. All indoor control cabinets shall be fully enclosed NEMA 1 construction with [hinged door], key-lock latch, removable sub-panels. A single key shall be common to all field panels and sub-panels.

2. Interconnections between internal and face-mounted devices pre-wired with color-coded stranded conductors neatly installed in plastic troughs and/or tie-wrapped. Terminals for field connections shall be UL Listed for 600 volt service, individually identified per control/interlock drawings, with adequate clearance for field wiring. Control terminations for field connection shall be individually identified per control drawings.

3. Provide ON/OFF power switch with over-current protection for control power sources to each local panel.

4. All control panels must be built in accordance with UL508A standards and be labeled with separate UL label numbers.

T. Annular Pitot Tube Flow Meter

1. Annular pitot tube shall be averaging type differential pressure sensors with four total head pressure ports and one static port made of austenitic stainless steel. Sensor shall have an accuracy of ± .25% of full flow and a repeatability of ± .05% of measured value. Transmitter shall be electronic and shall produce a linear output of 4 to 20 mAdc corresponding to the required flow span. The transmitter shall include noninteracting zero and span adjustments.

2. Acceptable Manufacturers:
Pitot Tube: Dieterich Annubar
Transmitter: Setra or Dieterich

2.13. PNEUMATIC EQUIPMENT AND ACCESSORIES – Not Applicable

2.14. ELECTRICAL CONTROL POWER AND LOW VOLTAGE WIRING

A. Provide interlock wiring between supply and exhaust fans, electrical wiring for relays (including power feed) for temperature and pressure indication. Provide interlock wiring between refrigeration machines, pumps and condensing equipment as required for the specified sequence of operation and the refrigeration system integral controller(s). Do not provide interlock wiring if a dedicated binary output has been specified for the equipment or the sequence of operation requires independent start/stop.

B. Provide power wiring, conduit and connections for low temperature thermostats, high temperature thermostats, alarms, flow switches, actuating devices for temperature, humidity, pressure and flow indication and point resets.

C. Install all wiring raceway systems complying with the requirements of the National Electrical Code, Division 26 documents.

D. Network Communication Requirements

1. Wired network communication shall be via channels consisting of twisted pair installed in a 3/4" EMT. Wire type and size shall meet LONWORKS® transceiver requirements.

2. Care shall be taken to route the cable as far from interference generating devices as possible.

3. When shielded wire is used, all shields shall be grounded (earth ground) at one point only, to eliminate ground loops.

4. There shall be no power wiring, in excess of 30 VAC rms, run in conduit with communications wiring. In cases where signal wiring is run in conduit with communication wiring, all communication wiring and signal wiring shall be run using separate twisted shielded pairs (24 AWG) with the shields grounded in accordance with the manufacturer's wiring practices.

E. Input/Output Control Wiring

1. Sensor wiring shall be two-wire, three-wire, or four-wire twisted, shielded, minimum 22 gauge.

2. Other analog inputs shall be a minimum of number 22 gauge, twisted, shielded.

3. Binary control function wiring shall be a minimum of number 18 gauge.

4. Analog output control functions shall be a minimum of number 18 gauge, twisted, shielded.

5. Binary input wiring shall be a minimum of number 18 gauge.

6. Thermistors shall be equipped with the manufacturers calibrated lead wiring.

7. 120V control wiring shall be #14 THHN in minimum of 3/4" conduit. Provide 4 or 20% fill extra wire in each conduit.

F. Splices: Splices in shielded cables shall consist of terminations and the use of shielded cable couplers, which maintain the integrity of the shielding. Terminations shall be in accessible locations. Cables shall be harnessed with cable ties as specified herein.

G.Conduit and Fittings

1. Conduit for Control Wiring, Control Cable and Transmission Cable: Electrical metallic tubing (EMT) with compression fittings, cold rolled steel, zinc coated or zinc-coated rigid steel with threaded connections.

2. Outlet Boxes (Dry Location): Sheradized or galvanized drawn steel suited to each application, in general, four inches square or octagon with suitable raised cover.

3. Outlet Boxes (Exposed to Weather): Threaded hub cast aluminum or iron boxes with gasket device plate.

4. Pull and Junction Boxes: Size according to number, size, and position of entering raceway as required by National Electrical Codes. Enclosure type shall be suited to location.

5. See Division 26 specifications for conduit and fittings.

2.17 HVAC CONTROL HARDWARE IDENTIFICATION

A. Automatic Control Valve Tags

1. For valves, etc., use metal tags with a 2-inch minimum diameter, fabricated of brass, stainless steel or aluminum. Attach tags with chain of same materials. For lubrication instructions, use linen or heavy duty shipping tag.

2. Tag valves with identifying number and system.

3. Prepare lists of all tagged valves showing location, floor level, tag number, use. Prepare separate lists for each system. Include copies in each maintenance manual.

B. Wire Tags

1. All multi-conductor cables in all pull boxes and terminal strip cabinets shall be tagged.

2. Provide wire Tags as per Division 26.

C. Conduit Tags: Provide tagging or labeling of conduit so that it is always readily observable which conduit was installed or used in implementation of this Work.

D. Miscellaneous Equipment Identification

1. Screwed-on, engraved black lamicoid sheet with white lettering on all control panels and remote processing panels. Lettering sizes subject to approval. Inscription, subject to review and acceptance, indicating equipment, system numbers, functions and switches. For panel interior wiring, input/output modules, local control panel device identification.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify that systems are ready to receive work.

B. Beginning of installation means installer accepts existing conditions.

C. The project plans shall be thoroughly examined for control device and equipment locations, and any discrepancies, conflicts, or omissions shall be reported to the Architect/Engineer for resolution before rough-in work is started.

D. The Contractor shall inspect the site to verify that equipment is installable as shown, and any discrepancies, conflicts, or omissions shall be reported to the Architect/Engineer for resolution before rough-in work is started.

E. The Contractor shall examine the drawings and specifications for other parts of the work, and if head room or space conditions appear inadequate or if any discrepancies occur between the plans and his work and the plans for the work of others, he shall report such discrepancies to the Architect/Engineer and shall obtain written instructions for any changes necessary to accommodate his work with the work of others.

3.2 COORDINATION

A. Controls Contractor and Campus System Integrator (SI)

1. The controls contractor shall coordinate network installation with the campus SI.

2. The controls contractor shall coordinate all SNVT inputs and outputs required with the system integrator. See Division 17 specifications.

B. Test and Balance

1. The contractor shall furnish all tools necessary to interface to the control system for test and balance purposes.

2. The contractor shall provide training in the use of these tools. This training will be planned for a minimum of 4 hours.

3. In addition, the contractor shall provide a qualified technician to assist in the test and balance process, until the first 20 terminal units are balanced.

4. The tools used during the test and balance process will be returned at the completion of the testing and balancing.

C. Life Safety

1. Duct smoke detectors required for air handler shutdown are supplied under Division 26. The contractor shall interlock smoke detectors to air handlers for shutdown as described in Sequences of Operations.

2. Smoke dampers and actuators required for duct smoke isolation are provided under Division 26. The contractor shall interlock these dampers to the air handlers as described in Sequences of Operations.

3. Fire/Smoke dampers and actuators required for fire rated walls are provided under Division 23.

D. Coordination with controls specified in other sections or divisions. Other sections and/or divisions of this specification include controls and control devices that are to be part of or interfaced to the controls system specified in this section. These controls shall be integrated into the system and coordinated by the contractor as follows:

1. All communication media and equipment shall be provided as specified in Part 2: “Communication" of this specification.

2. Each supplier of each control product is responsible for the configuration, programming, start-up and testing of that product to meet the sequences of operation described in this section.

3.3 GENERAL INSTALLATION REQUIREMENTS

A. Install all control components in accordance with manufacturer’s instructions and recommendations and provide necessary interconnections, services, and adjustments required for a complete and operable system.

B. Mount control panels adjacent to associated equipment on vibration-free walls or free-standing angle iron supports. Once cabinet may accommodate more than one system in same equipment room. Provide engraved plastic nameplates for instruments and controls inside cabinet and engraved lamicoid nameplates on cabinet face.

C. Install “hand/off/auto” selector switches to override automatic interlock controls when switch is in “hand” position.

D. Install equipment, piping, wiring/conduit parallel to building lines (i.e., horizontal, vertical, and parallel to walls) wherever possible.

E. Provide sufficient slack and flexible connections to allow for vibration of piping and equipment.

F. Install all equipment in readily accessible location as defined by Chapter 1, Article 100, Part A of the NEC.

G. Verify integrity of all wiring to ensure continuity and freedom from shorts and grounds.

H. All equipment, installation, and wiring shall comply with acceptable industry specifications and standards for performance, reliability, and compatibility and be executed in strict adherence to local codes and standard practices.

I. The DDC system shall be completely installed and ready for operation, as specified and shown,

J. Dielectric isolation shall be provided where dissimilar metals are used for connection and support.

K. Penetrations through and mounting holes in the building exteriors shall be made watertight. Holes in concrete, brick, steel and wood walls shall be drilled or core drilled with proper equipment; conduits installed through openings shall be sealed with materials which are compatible with existing materials. Openings in fire/smoke partitions shall be sealed with materials which meet the requirements of NFPA 70, FIRESTOPPING.

L. The DDC system installation shall provide clearance for control-system maintenance by maintaining access space between coils, access space to mixed-air plenums, and other access space required to calibrate, remove, repair, or replace control-system devices. The control-

system installation shall not interfere with the clearance requirements for mechanical and electrical system maintenance.

3.4 SOFTWARE

A. The Contractor shall load all software required for an operational DDC system, including data bases (to include data bases for all points specified and shown), operational parameters, and system, command, and application programs.

B. Within 30 days of the Owner obtaining title to the DDC network provided under this Contract, the Contractor shall provide original and backup copies of software, on each type of media utilized.

3.5 PROGRAMMING

A. Point Naming: System point names shall be modular in design, allowing easy operator interface without the use of a written point index.

B. Software Programming: Provide programming for the system as per specifications and adhere to the strategy algorithms provided. All other network management and system programming necessary for the operation of the system but not specified in this document shall also be provided by the HVAC Control System Contractor. Embed into the control program sufficient comment statements to clearly describe each section of the program. The comment statements reflect the language used in the sequence of operations.

C. Operator's interface graphic will be provided by the SI. See Division 17 specifications.

3.6 WIRING

A. All control and interlock wiring shall comply with national and local electrical codes and Division 26 of this specification. Where the requirements of this section differ with those in Division 26, the requirements of this section shall take precedence.

B. All NEC Class 1 (line voltage) wiring shall be UL Listed in approved raceway per NEC and Division 26 requirements.

C. All low voltage wiring shall meet NEC Class 2 requirements. (Low voltage power circuits shall be sub-fused when required to meet Class 2 current limit.)

D. Where NEC Class 2 (current limited) wires are in concealed and accessible locations including ceiling return air plenums, approved cables not in raceway may be used, provided that cables are UL Listed for the intended application.

E. All wiring in mechanical, electrical or service rooms - or where subject to mechanical damage - shall be installed in raceway at levels below 10ft.

F. Do not install Class 2 wiring in raceway containing Class 1 wiring. Boxes and panels containing high voltage wiring and equipment may not be used for low voltage wiring except for the purpose of interfacing the two (e.g. relays and transformers).

G. Do not install wiring in raceway containing tubing.

H. Where Class 2 wiring is run exposed, wiring is to be run parallel along a surface or perpendicular to it, and neatly tied at 10ft intervals.

I. Where plenum cables are used without raceway, they shall be supported from or anchored to structural members. Cables shall not be supported by or anchored to ductwork, electrical raceways, piping or ceiling suspension systems.

J. All wire-to-device connections shall be made at a terminal block or terminal strip in a control panel or at a junction box.

K. All wiring within enclosures shall be neatly bundled and anchored to permit access and prevent restriction to devices and terminals.

L. Maximum allowable voltage for control wiring shall be 120v. If only higher voltages are available, the contractor shall provide step-down transformers.

M. All wiring shall be installed as continuous lengths, with no splices permitted between termination points.

N. Install plenum wiring in sleeves where it passes through walls and floors. Maintain fire rating at all penetrations.

O. Size of raceway and size and type of wire shall be the responsibility of the contractor, in keeping with the manufacturer's recommendation and NEC requirements, except as noted elsewhere.

P. Include one pull string in each raceway 1” or larger.

Q. Use coded conductors throughout.

R. Control and status relays are to be located in designated enclosures only. These enclosures include packaged equipment control panel enclosures unless they also contain Class 1 starters.

S. Conceal all raceways, except within mechanical, electrical or service rooms. Install raceway to maintain a minimum clearance of 6” from high temperature equipment (e.g. steam pipes or flues).

T. Secure raceways with raceway clamps fastened to the structure and spaced according to code requirements. Raceways and pull boxes may not be hung on flexible duct strap or tie rods. Raceways may not be run on or attached to ductwork.

U. Adhere to Division 26 requirements where raceway crosses building expansion joints.

V. Install insulated bushings on all raceway ends and openings to enclosures. Seal top end of all vertical raceways.

W. The contractor shall terminate all control and interlock wiring, and shall maintain updated wiring diagrams with terminations identified at the job site.

X. Flexible metal raceways and liquid-tight, flexible metal raceways shall not exceed 3 feet in length and shall be supported at each end. Flexible metal raceway less than 3/4-inch electrical trade size shall not be used. In areas exposed to moisture - including chiller and boiler rooms - liquid-tight, flexible metal raceways shall be used.

Y. Raceway must be rigidly installed, adequately supported, properly reamed at both ends and left clean and free of obstructions. Raceway sections shall be joined with couplings (per code). Terminations must be made with fittings at boxes, and ends not terminating in boxes shall have bushings installed.

3.7. COMMUNICATION WIRING

A. The contractor shall adhere to the items listed for other low voltage wiring as listed in this section.

B. All cabling shall be installed in a neat and workmanlike manner. Follow manufacturers installation recommendations for all communication cabling.

C. Do not install communication wiring in raceway and enclosures containing Class 1 power wiring.

D. Maximum pulling, tension and bend radius for cable installation as specified by the cable manufacturer shall not be exceeded during the installation.

E. Contractor shall verify the integrity of the entire network following the cable installation. Use appropriate test measures for each particular cable.

F. When a cable enters or exits a building, a lightning arrestor must be installed between the lines and ground. The lightning arrestor shall be installed according to the manufacturers instructions.

G. All runs of communication wiring shall be unspliced length when that length is commercially available.

H. All communication wiring shall be labeled to indicate origination and destination data.

I. Grounding of coaxial cable shall be in accordance with NEC regulations Article on Communication Circuits, Cable and Protector Grounding.

3.8 SENSORS

A. Install sensors in accordance with the manufacturer's recommendations.

B. Mount sensors rigidly and adequately for the environment within which the sensor operates.

C. All wires attached to sensors shall be air sealed in their raceways or in the wall to stop air transmitted from other areas affecting sensor readings.

D. Sensors used in mixing plenums and where specified in the sequence of operations shall be of the averaging type. Averaging sensors shall be installed in a serpentine manner vertically across duct. Each bend shall be supported with a capillary clip.

E. Low limit sensors used in coil discharge shall be installed in a serpentine manner horizontally across duct. Each bend shall be supported with a capillary clip. Provide 1ft of sensing element for each square ft of coil area.

F. All pipe mounted temperature sensors shall be installed in wells. Install all liquid temperature sensors with heat-conducting fluid in thermal wells.

G. Install outdoor air temperature sensors on north wall, complete with sun shield at designated location.

H. Differential air static pressure

1. Supply duct static pressure: Pipe the high pressure tap to the duct using a pilot tube. Pipe the low pressure port to a tee in the high pressure tap tubing of the corresponding building static pressure sensor (if applicable) or to the location of the duct high pressure tap and leave open to the plenum.

2. Return duct static pressure: Pipe the high pressure tap to the duct using a pilot tube. Pipe the low pressure port to a tee in the low pressure tap tubing of the corresponding building static pressure sensor.

3. Building static pressure: Pipe the low pressure port of the pressure sensor to the static pressure port located on the outside of the building at roof level to serve as a common outdoor reference. Pipe the high pressure port to a location behind a thermostat cover.

4. The piping to pressure ports on all pressure transducers shall contain a capped test port located adjacent to the transducer.

5. All pressure transducers other than those controlling VAV boxes shall be located in field device panels, not on the equipment monitored or on ductwork. Mount transducers in a location accessible for service without the use of ladders or special equipment.

6. All air and water differential pressure sensors shall have gauge tees mounted adjacent to all taps. Water gauges shall also have shutoff valves installed before the tee.

I. Annual pitot tubes shall be installed so that the total head pressure ports are set-in-line with the pipe axis upstream and the static port facing downstream. The total head pressure ports shall extend diametrically across the entire pipe. Annual pitot tubes shall not be used where the flow is pulsating or where pipe vibration exists.

3.9 ACTUATORS

A. Mount and link control damper actuators per manufacturer's instructions.

1. Check operation of damper/actuator combination to confirm that actuator modulates damper smoothly throughout stroke to both open and closed positions.

2. Provide all mounting hardware and linkages for actuator installation.

B. Electric/Electronic

1. Dampers: Actuators shall be direct-mounted on damper shaft or jackshaft unless shown as a linkage installation. Actuators shall be mounted following manufacturer's recommendations.

2. Valves, Actuators shall be connected to valves with adapters approved by the actuator manufacturer. Actuators and adapters shall be mounted following the actuator manufacturer's recommendations.

3.10 CONTROLLERS

A. Provide a minimum of one separate node for each AHU or other HVAC system. Multiple DDC controllers may control one system provided that all points associated with individual control loops are assigned to the same DDC controller. Points used for control loop reset such as outside air or space temperature are exempt from this requirement.

B. LPNs shall be selected to provide a minimum of 10% spare I/O point capacity for each point type found at each location. If input points are not universal, 10% of each type is required. If outputs are not universal, 10% of each type is required. A minimum of one spare is required for each type of point used.

3.12 AIR PIPING – Not Applicable

3.13 SPARE PARTS

The contractor shall provide the following spare parts to be stocked at the University:

- One of each type control node used on the project.
- One space temperature sensor used on the project.

3.14 CONTROL DAMPERS

A. Install dampers in accordance with manufacturer's instructions to operate and to obtain leakage rates specified herein. Adjust the damper linkage such that the damper closes before the actuator is fully closed to assure tight shutoff of the damper

B. Blank-off and seal around dampers and between dampers and sleeves or frames to eliminate air bypass.

C. For outdoor air damper assemblies, stage the opening of each section to prevent stratification and poor mixing of outside and return air.

D. Maximum damper area per motor: 15 square feet.

3.15 CONTROL VALVES

A. Install in an accessible location, with room for actuator removal and service. Adjust the actuator to provide tight shutoff. Provide valve stem travel indicator and adjust to indicate proper travel. Where butterfly valves are used, permanently mark the end of the valve shaft to indicate valve position. Provide high pressure air if necessary for valve actuator.

3.16 IDENTIFICATION OF HARDWARE AND WIRING

A. All wiring and cabling, including that within factory-fabricated panels, shall be labeled at each end within 2" of termination with a cable identifier and other descriptive information.

B. Permanently label or code each point of field terminal strips to show the instrument or item served.

C. Identify control panels with minimum 1 cm letters on laminated plastic nameplates.

D. Identify all other control components with permanent labels. Identifiers shall match record documents. All plug-in components shall be labeled such that removal of the component does not remove the label.

E. Identify room sensors relating to terminal box or valves with nameplates.

3.17 PROTECTION

A. The Contractor shall protect all work and material from damage by his/her work or workers, and shall be liable for all damage thus caused.

B. The Contractor shall be responsible for his/her work and equipment until finally inspected, tested, and accepted. The Contractor shall protect his/her work against theft or damage, and shall carefully store material and equipment received on-site that is not immediately installed. The Contractor shall close all open ends of work with temporary covers or plugs during storage and construction to prevent entry of foreign objects.

3.18 FIELD QUALITY CONTROL

A. All work, materials and equipment shall comply with the rules and regulations of applicable local, state, and federal codes and ordinances as identified in Part 1 of this Section.

B. Contractor shall continually monitor the field installation for code compliance and quality of workmanship. All visible piping and/or wiring runs shall be installed parallel to building lines and properly supported.

C. Contractor shall arrange for field inspections by local and/or state authorities having jurisdiction over the work.

3.19 CONTROL SYSTEM CHECKOUT AND TESTING

A. Startup Testing: All testing listed in this article shall be performed by the Contractor and shall make up part of the necessary verification of an operating control system. This testing shall be completed before the Owners Representative is notified of the system demonstration.

1. The Contractor shall furnish all labor and test apparatus required to calibrate and prepare for service of all instruments, controls, and accessory equipment furnished under this specification.

2. Verify that all control wiring is properly connected and free of all shorts and ground faults. Verify that terminations are tight.

3. Enable the control systems and verify calibration of all input devices individually. Perform calibration procedures per manufacturers' recommendations.

4. Upon completion of component or system installation, the contractor shall initiate comprehensive point-to-point and basic function testing. Factory calibration and bench testing will not be considered acceptable alternates to onsite field-testing.

5. Start-up/Point-to-Point Scope

   a. Testing all end field devices through proper input/output to graphic and operator interface.

   b. Testing must be complete, detailed, and documented on approved point-to-point verification forms.

   c. All field calibration must be done with high quality instrumentation. Test instrumentation selected for calibrating field devices shall be suitable for application. Instruments shall display current (12-month) NIST traceable calibration sticker. Associated instrument calibration certificates shall be made available with 24 hours of request for copy.

6. Calibration Criteria

   a. Space Temperature ∀1°

   b. Air Temperature – Unitary ∀1°

   c. Fluid Temperature ∀1°

   d. Air Flow Rate ∀5%

   e. Liquid Flow Rate ∀5%

f. Differential Pressure ∀3%

g. Gage Pressure ∀5%

h. Relative Humidity ∀2%

i. CO Monitor ∀5% mid range

j. CO2 Monitor ∀5% mid range

k. Refrigerant Monitor ∀5% at 50 PPM

7. Verify that all binary output devices (relays, solenoid valves, two-position actuators and control valves, magnetic starters, etc.) operate properly and that the normal positions are correct.

8. Verify that all analog output devices (I/Ps, actuators, etc.) are functional, that start and span are correct, and that direction and normal positions are correct. The Contractor shall check all control valves and automatic dampers to ensure proper action and closure. The Contractor shall make any necessary adjustments to valve stem and damper blade travel.

9. Verify that the system operation adheres to the Sequences of Operation. Simulate and observe all modes of operation by overriding and varying inputs and schedules. Tune all DDC loops and optimum Start/Stop routines.

10. Alarms and Interlocks:

a. Check each alarm separately by including an appropriate signal at a value that will trip the alarm.

b. Interlocks shall be tripped using field contacts to check the logic, as well as to ensure that the fail-safe condition for all actuators is in the proper direction.

c. Interlock actions shall be tested by simulating alarm conditions to check the initiating value of the variable and interlock action.

d. Alarm conditions shall be generated at the controllers and sent onto the LONWORKS® network via appropriate SNVT. Alarms shall be coordinated with the SI, see specifications Div 17.

3.20 CONTROL SYSTEM DEMONSTRATION AND ACCEPTANCE

A. Demonstration

1. Prior to acceptance, the control system shall undergo a series of performance tests for the Owner-A/E to verify operation and compliance with this specification. These tests shall occur after the Contractor has completed the installation, started up the system, and performed its own tests.

2. A test procedure plan shall be submitted a minimum of two weeks prior to acceptance test for review and comment by the engineer.

3.21 TRAINING

A. Provide minimum of 40 hours of on-site training as part of the construction project.

B. Factory training shall be made available for all levels of operation. Cost of the classes and transportation shall be the responsibility of the owner.

C. The training shall be in three sessions as follows:

1. Initial Training: One-day session (8 hours) after system is started up and at least one week before first acceptance test. Manual shall have been submitted at least two weeks prior to training so that the owners' personnel can start to familiarize themselves with the system before classroom instruction begins.

2. First Formal Training: Two days (16 hours total) approximately two weeks after initial training, and before Formal Acceptance. These sessions shall cover topics as requested by the owner such as: how to add additional points, network management, programming, creating and gathering data for trends, or modification of control routines.

3. Warranty Follow-up: Two days (16 hours total) in no less than 4-hour increments, to be scheduled at the request of the owner during the one-year warranty period. These sessions will deal with more advanced topics and answer questions.

END OF SECTION 230993

SECTION 230900 - INSTRUMENTATION AND CONTROL FOR HVAC

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes control equipment for HVAC systems and components, including control components for terminal heating and cooling units not supplied with factory-wired controls.

B. See Division 23 Section "Sequence of Operations for HVAC Controls" for requirements that relate to this Section.

1.2 ACTION SUBMITTALS

A. Product Data: For each control device indicated.

B. Shop Drawings:

1. Schematic flow diagrams.
2. Power, signal, and control wiring diagrams.
3. Details of control panel faces.
4. Damper schedule.
5. Valve schedule.
6. DDC System Hardware: Wiring diagrams, schematic floor plans, and schematic control diagrams.
7. Control System Software: Schematic diagrams, written descriptions, and points list.

1.3 INFORMATIONAL SUBMITTALS

A. Field quality-control test reports.

1.4 CLOSEOUT SUBMITTALS

A. Operation and maintenance data.

B. Software and firmware operational documentation.

1.5 QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:

1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, manufacturers specified.
2. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified.

2.2 CONTROL SYSTEM

A. Available Manufacturers:
1. Andover Controls Corporation.
2. Delta Controls Inc.
3. Honeywell International Inc.; Home & Building Control.
4. Johnson Controls, Inc.; Controls Group.
5. Siemens Building Technologies, Inc.
6. Trane; Worldwide Applied Systems Group.
7. Triangle MicroSystems, Inc.
8. Voltec, Inc.

B. Control system shall consist of sensors, indicators, actuators, final control elements, interface equipment, other apparatus, and accessories to control mechanical systems.

C. Control system shall consist of sensors, indicators, actuators, final control elements, interface equipment, other apparatus, accessories, and software connected to distributed controllers operating in multiuser, multitasking environment on token-passing network and programmed to control mechanical systems. An operator workstation permits interface with the network via dynamic color graphics with each mechanical system, building floor plan, and control device depicted by point-and-click graphics.

2.3 DDC EQUIPMENT

A. Operator Workstation: PC-based microcomputer with minimum configuration as follows:

1. Motherboard: With 8 integrated USB 2.0 ports, integrated Intel Pro 10/100 (Ethernet), integrated audio, bios, and hardware monitoring.
2. Processor: Intel Pentium 4,
3. Random-Access Memory: 512 MB.
4. Graphics: Video adapter, minimum 1280 x 1024 pixels, 64-MB video memory, with TV out.
5. Monitor: 19 inches (480 mm), LCD color.
6. Keyboard: QWERTY, 105 keys in ergonomic shape.

7. Floppy-Disk Drive: 1.44 MB.
8. Hard-Disk Drive: 80 GB.
9. CD-ROM Read/Write Drive: 48x24x48.
10. Mouse: Three button, optical.
11. Uninterruptible Power Supply: 2 kVa.
12. Operating System: Microsoft Windows 7 Professional with high-speed Internet access.
13. Printer: Color, ink-jet type as follows:

    a. Print Head: 4800 x 1200 dpi optimized color resolution.
    b. Paper Handling: Minimum of 100 sheets.
    c. Print Speed: Minimum of 17 ppm in black and 12 ppm in color.
    d. Application Software.

B. Control Units: Modular, comprising processor board with programmable, nonvolatile, random-access memory; local operator access and display panel; integral interface equipment; and backup power source.

1. Units monitor or control each I/O point; process information; execute commands from other control units, devices, and operator stations; and download from or upload to operator workstation.
2. Stand-alone mode control functions operate regardless of network status. Functions include the following:

    a. Global communications.
    b. Discrete/digital, analog, and pulse I/O.
    c. Monitoring, controlling, or addressing data points.
    d. Software applications, scheduling, and alarm processing.
    e. Testing and developing control algorithms without disrupting field hardware and controlled environment.

C. Local Control Units: Modular, comprising processor board with electronically programmable, nonvolatile, read-only memory; and backup power source.

1. Units monitor or control each I/O point, process information, and download from or upload to operator workstation or diagnostic terminal unit.
2. Stand-alone mode control functions operate regardless of network status. Functions include the following:

    a. Global communications.
    b. Discrete/digital, analog, and pulse I/O.
    c. Monitoring, controlling, or addressing data points.

3. Local operator interface provides for download from or upload to operator workstation.

D. I/O Interface: Hardwired inputs and outputs may tie into system through controllers. Protect points so that shorting will cause no damage to controllers.

1. Binary Inputs: Allow monitoring of on-off signals without external power.
2. Pulse Accumulation Inputs: Accept up to 10 pulses per second.
3. Analog Inputs: Allow monitoring of low-voltage (0- to 10-V dc), current (4 to 20 mA), or resistance signals.

4. Binary Outputs: Provide on-off or pulsed low-voltage signal, selectable for normally open or normally closed operation with three-position (on-off-auto) override switches and status lights.
5. Analog Outputs: Provide modulating signal, either low voltage (0- to 10-V dc) or current (4 to 20 mA) with status lights, two-position (auto-manual) switch, and manually adjustable potentiometer.
6. Tri-State Outputs: Provide two coordinated binary outputs for control of three-point, floating-type electronic actuators.
7. Universal I/Os: Provide software selectable binary or analog outputs.

E. Power Supplies: Transformers with Class 2 current-limiting type or overcurrent protection; limit connected loads to 80 percent of rated capacity. DC power supply shall match output current and voltage requirements and be full-wave rectifier type with the following:

1. Output ripple of 5.0 mV maximum peak to peak.
2. Combined 1 percent line and load regulation with 100-mic.sec. response time for 50 percent load changes.
3. Built-in overvoltage and overcurrent protection and be able to withstand 150 percent overload for at least 3 seconds without failure.

F. Power Line Filtering: Internal or external transient voltage and surge suppression for workstations or controllers with the following:

1. Minimum dielectric strength of 1000 V.
2. Maximum response time of 10 nanoseconds.
3. Minimum transverse-mode noise attenuation of 65 dB.
4. Minimum common-mode noise attenuation of 150 dB at 40 to 100 Hz.

2.4 UNITARY CONTROLLERS

A. Unitized, capable of stand-alone operation with sufficient memory to support its operating system, database, and programming requirements, and with sufficient I/O capacity for the application.

1. Configuration: Local keypad and display; diagnostic LEDs for power, communication, and processor; wiring termination to terminal strip or card connected with ribbon cable; memory with bios; and 72-hour battery backup.
2. Operating System: Manage I/O communication to allow distributed controllers to share real and virtual object information and allow central monitoring and alarms. Perform scheduling with real-time clock. Perform automatic system diagnostics; monitor system and report failures.
3. Enclosure: Dustproof rated for operation at 32 to 120 deg F (0 to 50 deg C).

2.5 ANALOG CONTROLLERS

A. Step Controllers: 6- or 10-stage type, with heavy-duty switching rated to handle loads and operated by electric motor.

B. Electric, Outdoor-Reset Controllers: Remote-bulb or bimetal rod-and-tube type, proportioning action with adjustable throttling range, adjustable set point, scale range minus 10 to plus 70 deg F (minus 23 to plus 21 deg C), and single- or double-pole contacts.

C. Electronic Controllers: Wheatstone-bridge-amplifier type, in steel enclosure with provision for remote-resistance readjustment. Identify adjustments on controllers, including proportional band and authority.

1. Single controllers can be integral with control motor if provided with accessible control readjustment potentiometer.

D. Fan-Speed Controllers: Solid-state model providing field-adjustable proportional control of motor speed from maximum to minimum of 55 percent and on-off action below minimum fan speed. Controller shall briefly apply full voltage, when motor is started, to rapidly bring motor up to minimum speed. Equip with filtered circuit to eliminate radio interference.

2.6 TIME CLOCKS

A. Manufacturers:

1. ATC-Diversified Electronics.
2. Grasslin Controls Corporation.
3. Paragon Electric Co., Inc.
4. Precision Multiple Controls, Inc.
5. SSAC Inc.; ABB USA.
6. TCS/Basys Controls.
7. Theben AG - Lumilite Control Technology, Inc.
8. Time Mark Corporation.

B. Seven-day, programming-switch timer with synchronous-timing motor and seven-day dial; continuously charged, nickel-cadmium-battery-driven, eight-hour, power-failure carryover; multiple-switch trippers; minimum of two and maximum of eight signals per day with two normally open and two normally closed output contacts.

C. Solid-state, programmable time control with 8 separate programs each with up to 100 on-off operations; 1-second resolution; lithium battery backup; keyboard interface and manual override; individual on-off-auto switches for each program; 365-day calendar with 20 programmable holidays; choice of fail-safe operation for each program; system fault alarm; and communications package allowing networking of time controls and programming from PC.

2.7 ELECTRONIC SENSORS

A. Description: Vibration and corrosion resistant; for wall, immersion, or duct mounting as required.

B. Thermistor Temperature Sensors and Transmitters:

1. Manufacturers:

a. BEC Controls Corporation.
b. Ebtron, Inc.
c. Heat-Timer Corporation.
d. I.T.M. Instruments Inc.
e. MAMAC Systems, Inc.
f. RDF Corporation.

2. Accuracy: Plus or minus 0.36 deg F (0.2 deg C) at calibration point.
3. Wire: Twisted, shielded-pair cable.
4. Insertion Elements in Ducts: Single point, 18 inches (460 mm) long; use where not affected by temperature stratification or where ducts are smaller than 9 sq. ft. (0.84 sq. m).
5. Averaging Elements in Ducts: 36 inches (915 mm) long, flexible; use where prone to temperature stratification or where ducts are larger than 10 sq. ft. (1 sq. m).
6. Insertion Elements for Liquids: Brass or stainless-steel socket with minimum insertion length of 2-1/2 inches (64 mm).
7. Room Sensor Cover Construction: Manufacturer's standard locking covers.

a. Set-Point Adjustment: Concealed.
b. Set-Point Indication: Concealed.
c. Thermometer: Concealed.
d. Color: Metalic
e. Orientation: Vertical.

8. Outside-Air Sensors: Watertight inlet fitting, shielded from direct sunlight.
9. Room Security Sensors: Stainless-steel cover plate with insulated back and security screws.

C. RTDs and Transmitters:

1. Manufacturers:

a. BEC Controls Corporation.
b. MAMAC Systems, Inc.
c. RDF Corporation.

2. Accuracy: Plus or minus 0.2 percent at calibration point.
3. Wire: Twisted, shielded-pair cable.
4. Insertion Elements in Ducts: Single point, 18 inches (460 mm) long; use where not affected by temperature stratification or where ducts are smaller than 9 sq. ft. (0.84 sq. m).
5. Averaging Elements in Ducts: 24 inches (610 mm) long, rigid 24 feet (7.3 m) long, flexible; use where prone to temperature stratification or where ducts are larger than 9 sq. ft. (0.84 sq. m); length as required.
6. Insertion Elements for Liquids: Brass socket with minimum insertion length of 2-1/2 inches (64 mm).
7. Room Sensor Cover Construction: Manufacturer's standard locking covers.

a. Set-Point Adjustment: Concealed.

b. Set-Point Indication: Concealed.
c. Thermometer: Concealed.
d. Color: Metalic
e. Orientation: Vertical.

8. Outside-Air Sensors: Watertight inlet fitting, shielded from direct sunlight.
9. Room Security Sensors: Stainless-steel cover plate with insulated back and security screws.

D. Humidity Sensors: Bulk polymer sensor element.

1. Manufacturers:

a. BEC Controls Corporation.
b. General Eastern Instruments.
c. MAMAC Systems, Inc.
d. ROTRONIC Instrument Corp.
e. TCS/Basys Controls.
f. Vaisala.
g.

2. Accuracy: 2 percent full range with linear output.
3. Room Sensor Range: 20 to 80 percent relative humidity.
4. Room Sensor Cover Construction: Manufacturer's standard locking covers.

a. Set-Point Adjustment: Concealed.
b. Set-Point Indication: Concealed.
c. Thermometer: Concealed.
d. Color: Metallic
e. Orientation: Vertical.

5. Duct Sensor: 20 to 80 percent relative humidity range with element guard and mounting plate.
6. Outside-Air Sensor: 20 to 80 percent relative humidity range with mounting enclosure, suitable for operation at outdoor temperatures of minus 22 to plus 185 deg F (minus 30 to plus 85 deg C).
7. Duct and Sensors: With element guard and mounting plate, range of 0 to 100 percent relative humidity.

E. Pressure Transmitters/Transducers:

1. Manufacturers:

a. BEC Controls Corporation.
b. General Eastern Instruments.
c. MAMAC Systems, Inc.
d. ROTRONIC Instrument Corp.
e. TCS/Basys Controls.
f. Vaisala.

2. Static-Pressure Transmitter: Non-directional sensor with suitable range for expected input, and temperature compensated.

   a. Accuracy: 2 percent of full scale with repeatability of 0.5 percent.
   b. Output: 4 to 20 mA.
   c. Building Static-Pressure Range: 0- to 0.25-inch wg (0 to 62 Pa).
   d. Duct Static-Pressure Range: 0- to 5-inch wg (0 to 1240 Pa).

3. Water Pressure Transducers: Stainless-steel diaphragm construction, suitable for service; minimum 150-psig (1034-kPa) operating pressure; linear output 4 to 20 mA.
4. Water Differential-Pressure Transducers: Stainless-steel diaphragm construction, suitable for service; minimum 150-psig (1034-kPa) operating pressure and tested to 300-psig (2070-kPa); linear output 4 to 20 mA.
5. Differential-Pressure Switch (Air or Water): Snap acting, with pilot-duty rating and with suitable scale range and differential.
6. Pressure Transmitters: Direct acting for gas or liquid service; range suitable for system; linear output 4 to 20 mA.

F. Room Sensor Cover Construction: Manufacturer's standard locking covers.

1. Set-Point Adjustment: Concealed.
2. Set-Point Indication: Concealed.
3. Thermometer: Concealed.
4. Color: Metallic
5. Orientation: Vertical.

G. Room sensor accessories include the following:

1. Insulating Bases: For sensors located on exterior walls.
2. Guards: Locking; heavy-duty, transparent plastic; mounted on separate base.
3. Adjusting Key: As required for calibration and cover screws.

2.8 STATUS SENSORS

A. Status Inputs for Fans: Differential-pressure switch with pilot-duty rating and with adjustable range of 0- to 5-inch wg (0 to 1240 Pa).

B. Status Inputs for Pumps: Differential-pressure switch with pilot-duty rating and with adjustable pressure-differential range of 8 to 60 psig (55 to 414 kPa), piped across pump.

C. Status Inputs for Electric Motors: Comply with ISA 50.00.01, current-sensing fixed- or split-core transformers with self-powered transmitter, adjustable and suitable for 175 percent of rated motor current.

D. Voltage Transmitter (100- to 600-V ac): Comply with ISA 50.00.01, single-loop, self-powered transmitter, adjustable, with suitable range and 1 percent full-scale accuracy.

E. Power Monitor: 3-phase type with disconnect/shorting switch assembly, listed voltage and current transformers, with pulse kilowatt hour output and 4- to 20-mA kW output, with maximum 2 percent error at 1.0 power factor and 2.5 percent error at 0.5 power factor.

F. Current Switches: Self-powered, solid-state with adjustable trip current, selected to match current and system output requirements.

G. Electronic Valve/Damper Position Indicator: Visual scale indicating percent of travel and 2- to 10-V dc, feedback signal.

H. Water-Flow Switches: Bellows-actuated mercury or snap-acting type with pilot-duty rating, stainless-steel or bronze paddle, with appropriate range and differential adjustment, in NEMA 250, Type 1 enclosure.

1. Manufacturers:

a. BEC Controls Corporation.
b. I.T.M. Instruments Inc.

2.9 GAS DETECTION EQUIPMENT

A. Manufacturers:

1. B. W. Technologies.
2. CEA Instruments, Inc.
3. Ebtron, Inc.
4. Gems Sensors Inc.
5. Greystone Energy Systems Inc.
6. Honeywell International Inc.; Home & Building Control.
7. INTEC Controls, Inc.
8. I.T.M. Instruments Inc.
9. MSA Canada Inc.
10. QEL/Quatrosense Environmental Limited.
11. Sauter Controls Corporation.
12. Sensidyne, Inc.
13. TSI Incorporated.
14. Vaisala.
15. Vulcain Inc.

B. Carbon Monoxide Detectors: Single or multichannel, dual-level detectors using solid-state plug-in sensors with a 3-year minimum life; suitable over a temperature range of 32 to 104 deg F (0 to 40 deg C); with 2 factory-calibrated alarm levels at 35 and 200 ppm.

C. Carbon Dioxide Sensor and Transmitter: Single detectors using solid-state infrared sensors; suitable over a temperature range of 23 to 130 deg F (minus 5 to plus 55 deg C) and calibrated for 0 to 2 percent, with continuous or averaged reading, 4- to 20-mA output;, for wall mounting.

D. Occupancy Sensor: Passive infrared, with time delay, daylight sensor lockout, sensitivity control, and 180-degree field of view with vertical sensing adjustment; for flush mounting.

2.10 THERMOSTATS

A. Manufacturers:

1. Erie Controls.
2. Danfoss Inc.; Air-Conditioning and Refrigeration Div.
3. Heat-Timer Corporation.
4. Sauter Controls Corporation.
5. tekmar Control Systems, Inc.
6. Theben AG - Lumilite Control Technology, Inc.

B. Electric, solid-state, microcomputer-based room thermostat with remote sensor.

1. Automatic switching from heating to cooling.
2. Preferential rate control to minimize overshoot and deviation from set point.
3. Set up for four separate temperatures per day.
4. Instant override of set point for continuous or timed period from 1 hour to 31 days.
5. Short-cycle protection.
6. Programming based on every day of week.
7. Selection features include degree F or degree C display, 12- or 24-hour clock, keyboard disable, remote sensor, and fan on-auto.
8. Battery replacement without program loss.
9. Thermostat display features include the following:

    a. Time of day.
    b. Actual room temperature.
    c. Programmed temperature.
    d. Programmed time.
    e. Duration of timed override.
    f. Day of week.
    g. System mode indications include "heating," "off," "fan auto," and "fan on."

C. Low-Voltage, On-Off Thermostats: NEMA DC 3, 24-V, bimetal-operated, mercury-switch type, with adjustable or fixed anticipation heater, concealed set-point adjustment, 55 to 85 deg F (13 to 30 deg C) set-point range, and 2 deg F (1 deg C) maximum differential.

D. Line-Voltage, On-Off Thermostats: Bimetal-actuated, open contact or bellows-actuated, enclosed, snap-switch or equivalent solid-state type, with heat anticipator; listed for electrical rating; with concealed set-point adjustment, 55 to 85 deg F (13 to 30 deg C) set-point range, and 2 deg F (1 deg C) maximum differential.

1. Electric Heating Thermostats: Equip with off position on dial wired to break ungrounded conductors.
2. Selector Switch: Integral, manual on-off-auto.

E. Remote-Bulb Thermostats: On-off or modulating type, liquid filled to compensate for changes in ambient temperature; with copper capillary and bulb, unless otherwise indicated.

1. Bulbs in water lines with separate wells of same material as bulb.
2. Bulbs in air ducts with flanges and shields.

3. Averaging Elements: Copper tubing with either single- or multiple-unit elements, extended to cover full width of duct or unit; adequately supported.
4. Scale settings and differential settings are clearly visible and adjustable from front of instrument.
5. On-Off Thermostat: With precision snap switches and with electrical ratings required by application.
6. Modulating Thermostats: Construct so complete potentiometer coil and wiper assembly is removable for inspection or replacement without disturbing calibration of instrument.

F. Fire-Protection Thermostats: Listed and labeled by an NRTL acceptable to authorities having jurisdiction; with fixed or adjustable settings to operate at not less than 75 deg F (24 deg C) above normal maximum operating temperature, and the following:

1. Reset: Manual.
2. Reset: Automatic, with control circuit arranged to require manual reset at central control panel; with pilot light and reset switch on panel labeled to indicate operation.

G. Room Thermostat Cover Construction: Manufacturer's standard locking covers.

1. Set-Point Adjustment: Concealed.
2. Set-Point Indication: Concealed.
3. Thermometer: Concealed.
4. Color: Metallic
5. Orientation: Vertical.

H. Room thermostat accessories include the following:

1. Insulating Bases: For thermostats located on exterior walls.
2. Thermostat Guards: Locking; heavy-duty, transparent plastic; mounted on separate base.
3. Adjusting Key: As required for calibration and cover screws.
4. Set-Point Adjustment: 1/2-inch- (13-mm-) diameter, adjustment knob.

I. Immersion Thermostat: Remote-bulb or bimetal rod-and-tube type, proportioning action with adjustable throttling range and adjustable set point.

J. Airstream Thermostats: Two-pipe, fully proportional, single-temperature type; with adjustable set point in middle of range, adjustable throttling range, plug-in test fitting or permanent pressure gage, remote bulb, bimetal rod and tube, or averaging element.

K. Electric, Low-Limit Duct Thermostat: Snap-acting, single-pole, single-throw, manual- or automatic- reset switch that trips if temperature sensed across any 12 inches (300 mm) of bulb length is equal to or below set point.

1. Bulb Length: Minimum 20 feet (6 m).
2. Quantity: One thermostat for every 20 sq. ft. (2 sq. m) of coil surface.

L. Electric, High-Limit Duct Thermostat: Snap-acting, single-pole, single-throw, manual- or automatic- reset switch that trips if temperature sensed across any 12 inches (300 mm) of bulb length is equal to or above set point.

1. Bulb Length: Minimum 20 feet (6 m).

2. Quantity: One thermostat for every 20 sq. ft. (2 sq. m) of coil surface.

M. Heating/Cooling Valve-Top Thermostats: Proportional acting for proportional flow, with molded-rubber diaphragm, remote-bulb liquid-filled element, direct and reverse acting at minimum shutoff pressure of 25 psig (172 kPa), and cast housing with position indicator and adjusting knob.

2.11 HUMIDISTATS

A. Manufacturers:

1. MAMAC Systems, Inc.
2. ROTRONIC Instrument Corp.

B. Duct-Mounting Humidistats: Electric insertion, 2-position type with adjustable, 2 percent throttling range, 20 to 80 percent operating range, and single- or double-pole contacts.

2.12 ACTUATORS

A. Electric Motors: Size to operate with sufficient reserve power to provide smooth modulating action or two-position action.

1. Comply with requirements in Division 23 Section "Common Motor Requirements for HVAC Equipment."
2. Permanent Split-Capacitor or Shaded-Pole Type: Gear trains completely oil immersed and sealed. Equip spring-return motors with integral spiral-spring mechanism in housings designed for easy removal for service or adjustment of limit switches, auxiliary switches, or feedback potentiometer.
3. Nonspring-Return Motors for Valves Larger Than NPS 2-1/2 (DN 65): Size for running torque of 150 in. x lbf (16.9 N x m) and breakaway torque of 300 in. x lbf (33.9 N x m).
4. Spring-Return Motors for Valves Larger Than NPS 2-1/2 (DN 65): Size for running and breakaway torque of 150 in. x lbf (16.9 N x m).
5. Nonspring-Return Motors for Dampers Larger Than 25 Sq. Ft. (2.3 sq. m): Size for running torque of 150 in. x lbf (16.9 N x m) and breakaway torque of 300 in. x lbf (33.9 N x m).
6. Spring-Return Motors for Dampers Larger Than 25 Sq. Ft. (2.3 sq. m): Size for running and breakaway torque of 150 in. x lbf (16.9 N x m).

B. Electronic Actuators: Direct-coupled type designed for minimum 60,000 full-stroke cycles at rated torque.

1. Manufacturers:

a. Belimo Aircontrols (USA), Inc.

2. Valves: Size for torque required for valve close off at maximum pump differential pressure.

3. Dampers: Size for running torque calculated as follows:

   a. Parallel-Blade Damper with Edge Seals: 7 inch-lb/sq. ft. (86.8 kg-cm/sq. m) of damper.
   b. Opposed-Blade Damper with Edge Seals: 5 inch-lb/sq. ft. (62 kg-cm/sq. m) of damper.
   c. Parallel-Blade Damper without Edge Seals: 4 inch-lb/sq. ft (49.6 kg-cm/sq. m) of damper.
   d. Opposed-Blade Damper without Edge Seals: 3 inch-lb/sq. ft. (37.2 kg-cm/sq. m) of damper.
   e. Dampers with 2- to 3-Inch wg (500 to 750 Pa) of Pressure Drop or Face Velocities of 1000 to 2500 fpm (5 to 13 m/s): Increase running torque by 1.5.
   f. Dampers with 3- to 4-Inch wg (750 to 1000 Pa) of Pressure Drop or Face Velocities of 2500 to 3000 fpm (13 to 15 m/s): Increase running torque by 2.0.

4. Coupling: V-bolt and V-shaped, toothed cradle.
5. Overload Protection: Electronic overload or digital rotation-sensing circuitry.
6. Fail-Safe Operation: Mechanical, spring-return mechanism. Provide external, manual gear release on nonspring-return actuators.
7. Power Requirements (Two-Position Spring Return): 24 120-V ac.
8. Power Requirements (Modulating): Maximum 10 VA at 24-V ac or 8 W at 24-V dc.
9. Proportional Signal: 2- to 10-V dc or 4 to 20 mA, and 2- to 10-V dc position feedback signal.
10. Temperature Rating: Minus 22 to plus 122 deg F (Minus 30 to plus 50 deg C).
11. Temperature Rating (Smoke Dampers): Minus 22 to plus 250 deg F (Minus 30 to plus 121 deg C).
12. Run Time: 12 seconds open, 5 seconds closed.

2.13 CONTROL VALVES

A. Manufacturers:

1. Danfoss Inc.; Air Conditioning & Refrigeration Div.
2. Erie Controls.
3. Hayward Industrial Products, Inc.
4. Magnatrol Valve Corporation.
5. Neles-Jamesbury.
6. Parker Hannifin Corporation; Skinner Valve Division.
7. Pneuline Controls.
8. Sauter Controls Corporation.
9.

B. Control Valves: Factory fabricated, of type, body material, and pressure class based on maximum pressure and temperature rating of piping system, unless otherwise indicated.

C. Hydronic system globe valves shall have the following characteristics:

1. NPS 2 (DN 50) and Smaller: Class 125 250 bronze body, bronze trim, rising stem, renewable composition disc, and screwed ends with backseating capacity repackable under pressure.

2. NPS 2-1/2 (DN 65) and Larger: Class 125 iron body, bronze trim, rising stem, plug-type disc, flanged ends, and renewable seat and disc.
3. Internal Construction: Replaceable plugs and stainless-steel or brass seats.

    a. Single-Seated Valves: Cage trim provides seating and guiding surfaces for plug on top and bottom.
    b. Double-Seated Valves: Balanced plug; cage trim provides seating and guiding surfaces for plugs on top and bottom.

4. Sizing: 3-psig (21-kPa) maximum pressure drop at design flow rate or the following:

    a. Two Position: Line size.
    b. Two-Way Modulating: Either the value specified above or twice the load pressure drop, whichever is more.
    c. Three-Way Modulating: Twice the load pressure drop, but not more than value specified above.

5. Flow Characteristics: Two-way valves shall have equal percentage characteristics; three-way valves shall have linear characteristics.
6. Close-Off (Differential) Pressure Rating: Combination of actuator and trim shall provide minimum close-off pressure rating of 150 percent of total system (pump) head for two-way valves and 100 percent of pressure differential across valve or 100 percent of total system (pump) head.

D. Butterfly Valves: 200-psig (1380-kPa), 150-psig (1034-kPa) maximum pressure differential, ASTM A 126 cast-iron or ASTM A 536 ductile-iron body and bonnet, extended neck, stainless-steel stem, field-replaceable EPDM or Buna N sleeve and stem seals.

1. Body Style: Wafer.
2. Disc Type: Nickel-plated ductile iron.
3. Sizing: 1-psig (7-kPa) maximum pressure drop at design flow rate.

E. Terminal Unit Control Valves: Bronze body, bronze trim, two or three ports as indicated, replaceable plugs and seats, and union and threaded ends.

1. Rating: Class 125 for service at 125 psig (860 kPa) and 250 deg F (121 deg C) operating conditions.
2. Sizing: 3-psig (21-kPa) maximum pressure drop at design flow rate, to close against pump shutoff head.
3. Flow Characteristics: Two-way valves shall have equal percentage characteristics; three-way valves shall have linear characteristics.

F. Self-Contained Control Valves: Bronze body, bronze trim, two or three ports as indicated, replaceable plugs and seats, and union and threaded ends.

1. Rating: Class 125 for service at 125 psig (860 kPa) and 250 deg F (121 deg C) operating conditions.
2. Thermostatic Operator: Wax Liquid-filled integral sensor with integral adjustable dial.

2.14 DAMPERS

A. Manufacturers:

1. Air Balance Inc.
2. Don Park Inc.; Autodamp Div.
3. TAMCO (T. A. Morrison & Co. Inc.).
4. United Enertech Corp.
5. Vent Products Company, Inc.

B. Dampers: AMCA-rated, parallel-blade design; 0.108-inch- (2.8-mm-) minimum thick, galvanized-steel or 0.125-inch- (3.2-mm-) minimum thick, extruded-aluminum frames with holes for duct mounting; damper blades shall not be less than 0.064-inch- (1.6-mm-) thick galvanized steel with maximum blade width of 8 inches (200 mm) and length of 48 inches (1220 mm).

1. Secure blades to 1/2-inch- (13-mm-) diameter, zinc-plated axles using zinc-plated hardware, with oil-impregnated sintered bronze blade bearings, blade-linkage hardware of zinc-plated steel and brass, ends sealed against spring-stainless-steel blade bearings, and thrust bearings at each end of every blade.
2. Operating Temperature Range: From minus 40 to plus 200 deg F (minus 40 to plus 93 deg C).
3. Edge Seals, Standard Pressure Applications: Closed-cell neoprene.
4. Edge Seals, Low-Leakage Applications: Use inflatable blade edging or replaceable rubber blade seals and spring-loaded stainless-steel side seals, rated for leakage at less than 10 cfm per sq. ft. (50 L/s per sq. m) of damper area, at differential pressure of 4-inch wg (1000 Pa) when damper is held by torque of 50 in. x lbf (5.6 N x m); when tested according to AMCA 500D.

2.15 CONTROL CABLE

A. Electronic and fiber-optic cables for control wiring are specified in Division 27 Section "Communications Horizontal Cabling."

PART 3 - EXECUTION

3.1 INSTALLATION

A. Verify location of thermostats, humidistats, and other exposed control sensors with Drawings and room details before installation. Install devices 60 inches (1530 mm) above the floor.

1. Install averaging elements in ducts and plenums in crossing or zigzag pattern.

B. Install guards on thermostats in the following locations:

1. Entrances.
2. Public areas.

3. Where indicated.

C. Install automatic dampers according to Division 23 Section "Air Duct Accessories."

D. Install damper motors on outside of duct in warm areas, not in locations exposed to outdoor temperatures.

E. Install labels and nameplates to identify control components according to Division 23 Section "Identification for HVAC Piping and Equipment."

F. Install hydronic instrument wells, valves, and other accessories according to Division 23 Section "Hydronic Piping."

G. Install refrigerant instrument wells, valves, and other accessories according to Division 23 Section "Refrigerant Piping."

H. Install duct volume-control dampers according to Division 23 Sections specifying air ducts.

I. Install electronic and fiber-optic cables according to Division 27 Section "Communications Horizontal Cabling."

3.2 ELECTRICAL WIRING AND CONNECTION INSTALLATION

A. Install raceways, boxes, and cabinets according to Division 26 Section "Raceway and Boxes for Electrical Systems."

B. Install building wire and cable according to Division 26 Section "Low-Voltage Electrical Power Conductors and Cables."

C. Install signal and communication cable according to Division 27 Section "Communications Horizontal Cabling."

1. Conceal cable, except in mechanical rooms and areas where other conduit and piping are exposed.
2. Install exposed cable in raceway.
3. Install concealed cable in raceway.
4. Bundle and harness multiconductor instrument cable in place of single cables where several cables follow a common path.
5. Fasten flexible conductors, bridging cabinets and doors, along hinge side; protect against abrasion. Tie and support conductors.
6. Number-code or color-code conductors for future identification and service of control system, except local individual room control cables.
7. Install wire and cable with sufficient slack and flexible connections to allow for vibration of piping and equipment.

D. Connect manual-reset limit controls independent of manual-control switch positions. Automatic duct heater resets may be connected in interlock circuit of power controllers.

E. Connect hand-off-auto selector switches to override automatic interlock controls when switch is in hand position.

3.3 FIELD QUALITY CONTROL

A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust field-assembled components and equipment installation, including connections. Report results in writing.

B. Perform the following field tests and inspections and prepare test reports:

1. Operational Test: After electrical circuitry has been energized, start units to confirm proper unit operation. Remove and replace malfunctioning units and retest.
2. Test and adjust controls and safeties.
3. Test calibration of controllers by disconnecting input sensors and stimulating operation with compatible signal generator.
4. Test each point through its full operating range to verify that safety and operating control set points are as required.
5. Test each control loop to verify stable mode of operation and compliance with sequence of operation. Adjust PID actions.
6. Test each system for compliance with sequence of operation.
7. Test software and hardware interlocks.

C. DDC Verification:

1. Verify that instruments are installed before calibration, testing, and loop or leak checks.
2. Check instruments for proper location and accessibility.
3. Check instrument installation for direction of flow, elevation, orientation, insertion depth, and other applicable considerations.
4. Check instrument tubing for proper fittings, slope, material, and support.
5. Check pressure instruments, piping slope, installation of valve manifold, and self-contained pressure regulators.
6. Check temperature instruments and material and length of sensing elements.
7. Check control valves. Verify that they are in correct direction.
8. Check air-operated dampers. Verify that pressure gages are provided and that proper blade alignment, either parallel or opposed, has been provided.
9. Check DDC system as follows:

a. Verify that DDC controller power supply is from emergency power supply, if applicable.
b. Verify that wires at control panels are tagged with their service designation and approved tagging system.
c. Verify that spare I/O capacity has been provided.
d. Verify that DDC controllers are protected from power supply surges.

D. Replace damaged or malfunctioning controls and equipment and repeat testing procedures.

3.4 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain HVAC instrumentation and controls. Refer to Division 01 Section "Demonstration and Training."

END OF SECTION 230900

SECTION 230800 - COMMISSIONING OF HVAC

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section includes commissioning process requirements for HVAC&R systems, assemblies, and equipment.

B. Related Sections:

1. Refer to Division 01 Section 019113 “General Commissioning Requirements for additional commissioning scope and requirements. All testing and commissioning requirements of that section shall be met.

1.3 DEFINITIONS

A. BOD: Basis of Design: A document that records concepts, calculations, decisions, and product selections used to meet the OPR and to satisfy applicable regulatory requirements, standards, and guidelines. The document includes both narrative descriptions and lists of individual items that support the design process.

B. Commissioning Agent (CxA): Owner compensated independent agent, not otherwise associated with the Commissioning team members or the Contractor. The CxA directs and coordinates the day-to-day commissioning activities.

C. Cx: Commissioning.

D. Commissioning Plan: Overall plan that provides the structure, schedule and coordination planning for the commissioning process.

E. Functional Performance Test: Test of the function and operation of equipment and systems. Functional testing is the dynamic and interactive testing of systems under full operation. Systems are tested under various modes, such as during low cooling or heating loads, high loads, component failures, unoccupied, varying outside air temperatures, power failure, etc. The systems are run through all the control system's sequences of operation and components are verified to be responding as the sequences state. The commissioning agent develops the functional test procedures in a sequential written form, coordinates, oversees and documents the actual testing, which is performed by the installing contractor or vendor. Functional tests are performed after prefunctional checklists and startup are complete. Functional Performance Testing is not traditional air or water test and balancing.

F. Pre-functional Checklist: A list of items to inspect and elementary component tests to conduct to verify proper installation of equipment, provided by the CxA to the Contractor. Pre-functional checklists are primarily static inspections and procedures to prepare the equipment or system for initial operation. Some pre-functional checklist items entail simple testing of the function of a component, a piece of equipment or system. Pre-functional checklists augment and are combined with the manufacturer's start-up checklist. The commissioning process requires that the procedures be documented in writing, and that CxA witness much of the pre-functional work and all of the larger or more critical pieces of equipment.

G. OPR: Owner's Project Requirements: A document that details the functional requirements of a project and the expectations of how it will be used and operated. These include Project goals, measurable performance criteria, cost considerations, benchmarks, success criteria, and supporting information.

H. Startup: Initial starting or activating of dynamic equipment, including executing pre-functional checklists.

1.4 Systems, Subsystems, Equipment, and Components: Where these terms are used together or separately, they shall mean "as-built" systems, subsystems, equipment, and components.

1.5 CONTRACTOR'S RESPONSIBILITIES

A. Perform commissioning tests at the direction of the CxA.

B. Attend construction phase controls coordination meeting.

C. Attend testing, adjusting, and balancing review and coordination meeting.

D. Participate in HVAC&R systems, assemblies, equipment, and component maintenance orientation and inspection as directed by the CxA.

E. Provide information requested by the CxA for final commissioning documentation.

F. Provide measuring instruments and logging devices to record test data, and provide data acquisition equipment to record data for the complete range of testing for the required test period.

1.6 COMMISSIONING TEAM

A. Members Appointed by Contractor(s): Individuals, each having the authority to act on behalf of the entity he or she represents, explicitly organized to implement the commissioning process through coordinated action. The commissioning team shall consist of, but not be limited to, representatives of Contractor, including Project superintendent and subcontractors, installers, suppliers, and specialists deemed appropriate by the CxA.

B. Members Appointed by Owner: Include CxA, Representatives of the facility user and operation and maintenance personnel, and Architect and engineering design professionals.

1.7 SUBMITTALS

A. Documents: For all systems to be commissioned, the following shall be distributed to the CxA prior to equipment purchase and concurrently with Architect and Engineer of Record. CxA's review of submittal does not alter the scope or responsibility of the Architect or the Engineer of Record.

1. Manufacture's cut sheets.
2. Performance data including but not limited to the following:
   a. Fan curves.
   b. Pump curves.
3. Installation and startup manual.
4. Operation, troubleshooting, and maintenance manuals.
5. Shop drawings.

B. Documents: For all systems to be commissioned, the following shall be distributed to the CxA prior to the drafting of Pre-functional Checklists and Functional Test Procedures.

1. Sequence of operations including but not limited to the following:
   a. An overview narrative of the system describing its purpose, components and function.
   b. All interactions and interlocks with other systems.
   c. Detailed delineation of control between any packaged controls and the building automation system.
   d. Written sequences of control for packaged controlled equipment.
   e. Start-up sequences.
   f. Warm-up mode sequences.
   g. Normal operating mode sequences.
   h. Unoccupied mode sequences.
   i. Shutdown sequences.
   j. Temperature and pressure control: setbacks, setups, resets.
   k. Effects of power or equipment failure with all standby component functions.
   l. All alarms and emergency shut downs.
   m. Seasonal operational differences and recommendations.
   n. Initial and recommended values for all adjustable settings, set-points and parameters that are typically set or adjusted by operating staff; and any other control settings or fixed values, and delays, that shall be useful during testing and operating the equipment.
   o. Schedules.
2. Factory test reports.
3. Start-up and checkout materials that are shipped inside the equipment and the field checkout sheet forms to be used by the factory or field technicians.
4. Pipe flushing procedures.
5. Test and balance plan.
6. Test and balance reports.
7. Training Plan: Provide plan for and presentation materials related to training of building personnel on the commissioned systems.
8. Warranty information, including all responsibilities of the Owner to keep the warranty in force clearly identified.
9. Updated as-built versions of the control drawings and sequences of operation.

C. Provide the CxA with requested additional documentation in order to complete the commissioning process.

1.8 OWNER'S RESPONSIBILITIES

A. Provide the OPR documentation to the CxA and Contractor for information and use.

B. Assign operation and maintenance personnel and schedule them to participate in commissioning team activities.

C. Provide the BOD documentation, prepared by Architect and approved by Owner, to the CxA and Contractor for use in developing the commissioning plan, systems manual, and operation and maintenance training plan.

1.9 CONTRACTOR'S RESPONSIBILITIES

A. Contractor shall assign representatives with expertise and authority to act on its behalf and shall schedule them to participate in and perform commissioning process activities including, but not limited to, the following:

1. Evaluate performance deficiencies identified in test reports and, in collaboration with entity responsible for system and equipment installation, recommend corrective action.
2. Cooperate with the CxA for resolution of issues recorded in the Issues Log.
3. Attend commissioning team meetings held as needed.
4. Integrate and coordinate commissioning process activities with construction schedule.
5. Review and accept construction checklists provided by the CxA.
6. Complete paper or electronic construction checklists as Work is completed and provide to the Commissioning Authority.
7. Review and accept commissioning process test procedures provided by the Commissioning Authority.
8. Complete current Architect, Engineer of Record, and Issues Log punch list items before functional testing.
9. Complete commissioning process test procedures.

1.10 CxA'S RESPONSIBILITIES

A. Organize and lead the commissioning team.

B. Provide commissioning plan.

C. Convene commissioning team meetings.

D. Provide Project-specific construction checklists and commissioning process test procedures.

E. Verify the execution of commissioning process activities using random sampling. The sampling rate may vary from 1 to 100 percent. Verification will include, but is not limited to, equipment submittals, construction checklists, training, operating and maintenance data, tests,

and test reports to verify compliance with the OPR. When a random sample does not meet the requirement, the CxA will report the failure in the Issues Log.

F. Witness systems, assemblies, equipment, and component startup.

G. Compile test data, inspection reports, and certificates; include them in the systems manual and commissioning process report.

H. The CxA will be responsible for overseeing and approving the content and adequacy of the training of Owner personnel for commissioned equipment.

1.11 COMMISSIONING DOCUMENTATION

A. Provide the following information to the CxA for inclusion in the commissioning plan:

1. Plan for delivery and review of submittals, systems manuals, and other documents and reports.
2. Identification of installed systems, assemblies, equipment, and components including design changes that occurred during the construction phase.
3. Process and schedule for completing construction checklists and manufacturer's prestart and startup checklists for HVAC&R systems, assemblies, equipment, and components to be verified and tested.
4. Certificate of completion certifying that installation, prestart checks, and startup procedures have been completed.
5. Certificate of readiness certifying that HVAC&R systems, subsystems, equipment, and associated controls are ready for testing.
6. Test and inspection reports and certificates.
7. Corrective action documents.
8. Verification of testing, adjusting, and balancing reports.

1.12 SUBMITTALS

A. Certificates of readiness.

B. Certificates of completion of installation, prestart, and startup activities.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 TESTING PREPARATION

A. Certify that HVAC&R systems, subsystems, and equipment have been installed, calibrated, and started and are operating according to the Contract Documents.

B. Certify that HVAC&R instrumentation and control systems have been completed and calibrated, that they are operating according to the Contract Documents, and that pretest set points have been recorded.

C. Certify that testing, adjusting, and balancing procedures have been completed and that testing, adjusting, and balancing reports have been submitted, discrepancies corrected, and corrective work approved.

D. Set systems, subsystems, and equipment into operating mode to be tested (e.g., normal shutdown, normal auto position, normal manual position, unoccupied cycle, emergency power, and alarm conditions).

E. Inspect and verify the position of each device and interlock identified on checklists.

F. Check safety cutouts, alarms, and interlocks with smoke control and life-safety systems during each mode of operation.

G. Testing Instrumentation: Install measuring instruments and logging devices to record test data as directed by the CxA.

3.2 TESTING AND BALANCING VERIFICATION

A. Prior to performance of testing and balancing Work, provide copies of reports, sample forms, checklists, and certificates to the CxA.

B. Notify the CxA at 10 days in advance of testing and balancing Work, and provide access for the CxA to witness testing and balancing Work.

C. Provide technicians, instrumentation, and tools to verify testing and balancing of HVAC&R systems at the direction of the CxA.

1. The CxA will notify testing and balancing Subcontractor 7 days in advance of the date of field verification. Notice will not include data points to be verified.
2. The testing and balancing Subcontractor shall use the same instruments (by model and serial number) that were used when original data were collected.
3. Failure of an item includes, other than sound, a deviation of more than 10 percent. Failure of more than 10 percent of selected items shall result in rejection of final testing, adjusting, and balancing report. For sound pressure readings, a deviation of 3 dB shall result in rejection of final testing. Variations in background noise must be considered.
4. Remedy the deficiency and notify the CxA so verification of failed portions can be performed.

3.3 GENERAL TESTING REQUIREMENTS

A. Provide technicians, instrumentation, and tools to perform commissioning test at the direction of the CxA.

B. Scope of HVAC&R testing shall include entire HVAC&R installation, from central equipment for heat generation and refrigeration through distribution systems to each conditioned space.

Testing shall include measuring capacities and effectiveness of operational and control functions.

1. Testing Strategies and Sampling: Refer to section 019113 for testing of equipment strategies and sampling requirement functional performance test requirements.
2.

C. Test all operating modes, interlocks, control responses, and responses to abnormal or emergency conditions, and verify proper response of building automation system controllers and sensors.

D. The CxA along with the HVAC&R Subcontractor, testing and balancing Subcontractor, and HVAC&R Instrumentation and Control Subcontractor shall prepare detailed testing plans, procedures, and checklists for HVAC&R systems, subsystems, and equipment.

E. Tests will be performed using design conditions whenever possible.

F. Simulated conditions may need to be imposed using an artificial load when it is not practical to test under design conditions. Before simulating conditions, calibrate testing instruments. Provide equipment to simulate loads. Set simulated conditions as directed by the CxA and document simulated conditions and methods of simulation. After tests, return settings to normal operating conditions.

G. The CxA may direct that set points be altered when simulating conditions is not practical.

H. The CxA may direct that sensor values be altered with a signal generator when design or simulating conditions and altering set points are not practical.

I. If tests cannot be completed because of a deficiency outside the scope of the HVAC&R system, document the deficiency and report it to the Owner. After deficiencies are resolved, reschedule tests.

J. If the testing plan indicates specific seasonal testing, complete appropriate initial performance tests and documentation and schedule seasonal tests.

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

A. Boiler Testing and Acceptance Procedures: Testing requirements are specified in Division 23 boiler Sections. Provide submittals, test data, inspector record, and boiler certification to the CxA.

B. HVAC&R Instrumentation and Control System Testing: Field testing plans and testing requirements are specified in Division 23 Sections "Instrumentation and Control for HVAC" and "Sequence of Operations for HVAC Controls." Assist the CxA with preparation of testing plans.

C. Pipe system cleaning, flushing, hydrostatic tests, and chemical treatment requirements are specified in Division 23 piping Sections. HVAC&R Subcontractor shall prepare a pipe system

cleaning, flushing, and hydrostatic testing plan. Provide cleaning, flushing, testing, and treating plan and final reports to the CxA. Plan shall include the following:

1. Sequence of testing and testing procedures for each section of pipe to be tested, identified by pipe zone or sector identification marker. Markers shall be keyed to Drawings for each pipe sector, showing the physical location of each designated pipe test section. Drawings keyed to pipe zones or sectors shall be formatted to allow each section of piping to be physically located and identified when referred to in pipe system cleaning, flushing, hydrostatic testing, and chemical treatment plan.
2. Description of equipment for flushing operations.
3. Minimum flushing water velocity.
4. Tracking checklist for managing and ensuring that all pipe sections have been cleaned, flushed, hydrostatically tested, and chemically treated.

D. Refrigeration System Testing: Provide technicians, instrumentation, tools, and equipment to test performance of chillers, cooling towers, refrigerant compressors and condensers, heat pumps, and other refrigeration systems. The CxA shall determine the sequence of testing and testing procedures for each equipment item and pipe section to be tested.

E. HVAC&R Distribution System Testing: Provide technicians, instrumentation, tools, and equipment to test performance of air, steam, and hydronic distribution systems; special exhaust; and other distribution systems, including HVAC&R terminal equipment and unitary equipment.

F. Vibration and Sound Tests: Provide technicians, instrumentation, tools, and equipment to test performance of vibration isolation controls.

3.5 NON-CONFORMANCE

A. The CxA will record the results of the Functional Performance Tests. All deficiencies, non-conformance issues, or test failures will be noted and reported to the Contractors in a deficiency list or in a punch-list format.

B. Corrections of minor deficiencies identified may be made during the tests at the discretion of the CxA. In such cases the deficiency and resolution will be documented on the procedure form.

C. Every effort will be made to expedite the testing process and minimize unnecessary delays, while not compromising the integrity of the procedures. However, the CxA will not be pressured into overlooking deficient work or loosening acceptance criteria to satisfy scheduling or cost issues, unless there is an overriding reason to do so at the request of the Owners Representative.

D. Re-testing.
1. If a Functional Performance Test fails, corrections shall be made to the deficient equipment or systems by the Contractors. The systems will be re-tested until they pass the Tests.
2. The time/cost for the CxA to perform any re-testing required because of improper set up of the systems by the contractors or failed functional or performance tests will be back-charged to the Contractor (who may choose to recover costs from the party responsible for executing faulty equipment start-up/checkout and associated checklists). This

includes instances where a specific item was overlooked in the equipment start-up and checkout procedures, reported to have been successfully completed, but determined during Functional Performance testing to be faulty.

3. Any required re-testing by any contractor, sub-contractor, or vendor shall not be considered a justified reason for a claim of delay or for a time extension by the Contractor.

3.6 Deficiencies and retesting

A. The CxA documents the results of each test. (Corrections of minor installation or sequence of operation deficiencies are made during tests at the discretion of CxA.)

B. Deficiencies/non-conformance issues not corrected during testing are reported to the Contractors for corrective action. Upon completion, a request is made by the Contractors to CxA for retest.

.

END OF SECTION 230800

SECTION 230719 - HVAC PIPING INSULATION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section includes insulating the following HVAC piping systems:

1. Condensate drain piping, indoors.
2. Chilled-water and brine piping, indoors and outdoors.
3. Heating hot-water piping, indoors and outdoors.
4. Steam and steam condensate piping, indoors and outdoors.
5. Refrigerant suction and hot-gas piping, indoors and outdoors.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product indicated. Include thermal conductivity, water-vapor permeance thickness, and jackets (both factory and field applied if any).

B. LEED Submittals:

1. Product Data for Credit IEQ 4.1: For adhesives and sealants, documentation including printed statement of VOC content.
2. Laboratory Test Reports for Credit IEQ 4: For adhesives and sealants, documentation indicating that products comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

1.4 INFORMATIONAL SUBMITTALS

A. Field quality-control reports.

1.5 QUALITY ASSURANCE

A. Installer Qualifications: Skilled mechanics who have successfully completed an apprenticeship program or another craft training program certified by the Department of Labor, Bureau of Apprenticeship and Training.

B. Surface-Burning Characteristics: For insulation and related materials, as determined by testing identical products according to ASTM E 84, by a testing and inspecting agency acceptable to

authorities having jurisdiction. Factory label insulation and jacket materials and adhesive, mastic, tapes, and cement material containers, with appropriate markings of applicable testing agency.

1. Insulation Installed Indoors: Flame-spread index of 25 or less, and smoke-developed index of 50 or less.
2. Insulation Installed Outdoors: Flame-spread index of 75 or less, and smoke-developed index of 150 or less.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Packaging: Insulation material containers shall be marked by manufacturer with appropriate ASTM standard designation, type and grade, and maximum use temperature.

1.7 COORDINATION

A. Coordinate sizes and locations of supports, hangers, and insulation shields specified in Division 23 Section "Hangers and Supports for HVAC Piping and Equipment."

B. Coordinate clearance requirements with piping Installer for piping insulation application. Before preparing piping Shop Drawings, establish and maintain clearance requirements for installation of insulation and field-applied jackets and finishes and for space required for maintenance.

C. Coordinate installation and testing of heat tracing.

1.8 SCHEDULING

A. Schedule insulation application after pressure testing systems and, where required, after installing and testing heat tracing. Insulation application may begin on segments that have satisfactory test results.

B. Complete installation and concealment of plastic materials as rapidly as possible in each area of construction.

PART 2 - PRODUCTS

2.1 INSULATION MATERIALS

A. Comply with requirements in "Piping Insulation Schedule, General," "Indoor Piping Insulation Schedule," and "Outdoor, Aboveground Piping Insulation Schedule" articles for where insulating materials shall be applied.

B. Products shall not contain asbestos, lead, mercury, or mercury compounds.

C. Products that come in contact with stainless steel shall have a leachable chloride content of less than 50 ppm when tested according to ASTM C 871.

D. Insulation materials for use on austenitic stainless steel shall be qualified as acceptable according to ASTM C 795.

E. Foam insulation materials shall not use CFC or HCFC blowing agents in the manufacturing process.

F. Cellular Glass: Inorganic, incombustible, foamed or cellulated glass with annealed, rigid, hermetically sealed cells. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.

1. Products: Subject to compliance with requirements, provide the following :

a. Pittsburgh Corning Corporation; Foamglas.

2. Block Insulation: ASTM C 552, Type I.
3. Special-Shaped Insulation: ASTM C 552, Type III.
4. Board Insulation: ASTM C 552, Type IV.
5. Preformed Pipe Insulation with Factory-Applied ASJ-SSL: Comply with ASTM C 552, Type II, Class 2.
6. Factory fabricate shapes according to ASTM C 450 and ASTM C 585.

G. Flexible Elastomeric Insulation: Closed-cell, sponge- or expanded-rubber materials. Comply with ASTM C 534, Type I for tubular materials.

1. Products: Subject to compliance with requirements, provide the following :

a. Aeroflex USA, Inc.; Aerocel.
b. Armacell LLC; AP Armaflex.
c. K-Flex USA; Insul-Lock, Insul-Tube, and K-FLEX LS.

H. Mineral-Fiber, Pipe and Tank Insulation: Mineral or glass fibers bonded with a thermosetting resin. Semirigid board material with factory-applied ASJ complying with ASTM C 1393, Type II or Type IIIA Category 2, or with properties similar to ASTM C 612, Type IB. Nominal density is 2.5 lb/cu. ft. or more. Thermal conductivity (k-value) at 100 deg F is 0.29 Btu x in./h x sq. ft. x deg F or less. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.

1. Products: Subject to compliance with requirements, provide the following:

a. CertainTeed Corp.; CrimpWrap.
b. Johns Manville; MicroFlex.
c. Knauf Insulation; Pipe and Tank Insulation.
d. Owens Corning; Fiberglas Pipe and Tank Insulation.

2.2 INSULATING CEMENTS

A. Mineral-Fiber Insulating Cement: Comply with ASTM C 195.

1. Products: Subject to compliance with requirements, provide the following :

a. Ramco Insulation, Inc.; Super-Stik.

B. Mineral-Fiber, Hydraulic-Setting Insulating and Finishing Cement: Comply with ASTM C 449.

1. Products: Subject to compliance with requirements, provide the following :

a. Ramco Insulation, Inc.; Ramcote 1200 and Quik-Cote.

2.3 ADHESIVES

A. Materials shall be compatible with insulation materials, jackets, and substrates and for bonding insulation to itself and to surfaces to be insulated unless otherwise indicated.

B. Cellular-Glass Adhesive: Two-component, thermosetting urethane adhesive containing no flammable solvents, with a service temperature range of minus 100 to plus 200 deg F.

1. Products: Subject to compliance with requirements, provide the following :

a. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 81-84.

2. For indoor applications, adhesive shall have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
3. Adhesive shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

C. Flexible Elastomeric Adhesive: Comply with MIL-A-24179A, Type II, Class I.

1. Products: Subject to compliance with requirements, provide the following :

a. Aeroflex USA, Inc.; Aeroseal.
b. Armacell LLC; Armaflex 520 Adhesive.
c. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 85-75.
d. K-Flex USA; R-373 Contact Adhesive.

2. For indoor applications, adhesive shall have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
3. Adhesive shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

D. Mineral-Fiber Adhesive: Comply with MIL-A-3316C, Class 2, Grade A.

1. Products: Subject to compliance with requirements, provide the following :

a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; CP-127.
b. Eagle Bridges - Marathon Industries; 225.

c. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 85-60/85-70.
d. Mon-Eco Industries, Inc.; 22-25.

2. For indoor applications, adhesive shall have a VOC content of 80 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
3. Adhesive shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

E. ASJ Adhesive: Comply with MIL-A-3316C, Class 2, Grade A for bonding insulation jacket lap seams and joints.

1. Products: Subject to compliance with requirements, provide the following :

a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; CP-82.
b. Eagle Bridges - Marathon Industries; 225.
c. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 85-50.
d. Mon-Eco Industries, Inc.; 22-25.

2. For indoor applications, adhesive shall have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
3. Adhesive shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

F. PVC Jacket Adhesive: Compatible with PVC jacket.

1. Products: Subject to compliance with requirements, provide the following :

a. Dow Corning Corporation; 739, Dow Silicone.
b. Johns Manville; Zeston Perma-Weld, CEEL-TITE Solvent Welding Adhesive.
c. P.I.C. Plastics, Inc.; Welding Adhesive.
d. Speedline Corporation; Polyco VP Adhesive.

2. For indoor applications, adhesive shall have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
3. Adhesive shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

2.4 MASTICS

A. Materials shall be compatible with insulation materials, jackets, and substrates; comply with MIL-PRF-19565C, Type II.

1. For indoor applications, use mastics that have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

B. Vapor-Barrier Mastic: Water based; suitable for indoor use on below-ambient services.

1. Products: Subject to compliance with requirements, provide the following :

a. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 30-80/30-90.
b. Vimasco Corporation; 749**.**.

2. Water-Vapor Permeance: ASTM E 96/E 96M, Procedure B, 0.013 perm at 43-mil dry film thickness.
3. Service Temperature Range: Minus 20 to plus 180 deg F.
4. Solids Content: ASTM D 1644, 58 percent by volume and 70 percent by weight.
5. Color: White.

C. Vapor-Barrier Mastic: Solvent based; suitable for outdoor use on below-ambient services.

1. Products: Subject to compliance with requirements, provide the following :

a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; Encacel.
b. Eagle Bridges - Marathon Industries; 570.
c. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 60-95/60-96.

2. Water-Vapor Permeance: ASTM F 1249, 0.05 perm at 30-mil dry film thickness.
3. Service Temperature Range: Minus 50 to plus 220 deg F.
4. Solids Content: ASTM D 1644, 33 percent by volume and 46 percent by weight.
5. Color: White.

D. Breather Mastic: Water based; suitable for indoor and outdoor use on above-ambient services.

1. Products: Subject to compliance with requirements, provide the following :

a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; CP-10.
b. Eagle Bridges - Marathon Industries; 550.
c. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 46-50.

2. Water-Vapor Permeance: ASTM F 1249, 1.8 perms at 0.0625-inch dry film thickness.
3. Service Temperature Range: Minus 20 to plus 180 deg F.
4. Solids Content: 60 percent by volume and 66 percent by weight.
5. Color: White.

2.5 SEALANTS

A. Joint Sealants:

1. Joint Sealants for Cellular-Glass Products: Subject to compliance with requirements, provide the following :

a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; CP-76.
b. Eagle Bridges - Marathon Industries; 405.
c. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 30-45.

2. Materials shall be compatible with insulation materials, jackets, and substrates.
3. Permanently flexible, elastomeric sealant.
4. Service Temperature Range: Minus 100 to plus 300 deg F.
5. Color: White or gray.
6. For indoor applications, sealants shall have a VOC content of 420 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
7. Sealants shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

B. Metal Jacket Flashing Sealants:

1. Products: Subject to compliance with requirements, provide the following :

a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; CP-76.
b. Eagle Bridges - Marathon Industries; 405.
c. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 95-44.

2. Materials shall be compatible with insulation materials, jackets, and substrates.
3. Fire- and water-resistant, flexible, elastomeric sealant.
4. Service Temperature Range: Minus 40 to plus 250 deg F.
5. Color: Aluminum.
6. For indoor applications, sealants shall have a VOC content of 420 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
7. Sealants shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

C. ASJ Flashing Sealants and PVC Jacket Flashing Sealants:

1. Products: Subject to compliance with requirements, provide the following :

a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; CP-76.

2. Materials shall be compatible with insulation materials, jackets, and substrates.
3. Fire- and water-resistant, flexible, elastomeric sealant.
4. Service Temperature Range: Minus 40 to plus 250 deg F.
5. Color: White.
6. For indoor applications, sealants shall have a VOC content of 420 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

7. Sealants shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

2.6 FACTORY-APPLIED JACKETS

A. Insulation system schedules indicate factory-applied jackets on various applications. When factory-applied jackets are indicated, comply with the following:
1. ASJ-SSL: ASJ with self-sealing, pressure-sensitive, acrylic-based adhesive covered by a removable protective strip; complying with ASTM C 1136, Type I.

2.7 FIELD-APPLIED JACKETS

A. Field-applied jackets shall comply with ASTM C 921, Type I, unless otherwise indicated.

B. PVC Jacket: High-impact-resistant, UV-resistant PVC complying with ASTM D 1784, Class 16354-C; thickness as scheduled; roll stock ready for shop or field cutting and forming. Thickness is indicated in field-applied jacket schedules.

1. Products: Subject to compliance with requirements, provide the following :

a. Johns Manville; Zeston.
b. P.I.C. Plastics, Inc.; FG Series.
c. Proto Corporation; LoSmoke.

2. Adhesive: As recommended by jacket material manufacturer.
3. Color: White.
4. Factory-fabricated fitting covers to match jacket if available; otherwise, field fabricate.

a. Shapes: 45- and 90-degree, short- and long-radius elbows, tees, valves, flanges, unions, reducers, end caps, traps, and mechanical joints.

C. Metal Jacket:

1. Products: Subject to compliance with requirements, provide the following :

a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; Metal Jacketing Systems.
b. ITW Insulation Systems; Aluminum and Stainless Steel Jacketing.
c. RPR Products, Inc.; Insul-Mate.**.**

2. Aluminum Jacket: Comply with ASTM B 209, Alloy 3003, 3005, 3105, or 5005, Temper H-14.

a. Factory cut and rolled to size.
b. Finish and thickness are indicated in field-applied jacket schedules.
c. Moisture Barrier for Outdoor Applications: 3-mil- thick, heat-bonded polyethylene and kraft paper.
d. Factory-Fabricated Fitting Covers:

1) Same material, finish, and thickness as jacket.
2) Preformed 2-piece or gore, 45- and 90-degree, short- and long-radius elbows.
3) Tee covers.
4) Flange and union covers.
5) End caps.
6) Beveled collars.
7) Valve covers.
8) Field fabricate fitting covers only if factory-fabricated fitting covers are not available.

D. Self-Adhesive Outdoor Jacket: 60-mil- thick, laminated vapor barrier and waterproofing membrane for installation over insulation located aboveground outdoors; consisting of a rubberized bituminous resin on a crosslaminated polyethylene film covered with stucco-embossed aluminum-foil facing.

1. Products: Subject to compliance with requirements, provide the following :

a. Polyguard Products, Inc.; Alumaguard 60.

2.8 TAPES

A. PVC Tape: White vapor-retarder tape matching field-applied PVC jacket with acrylic adhesive; suitable for indoor and outdoor applications.

1. Products: Subject to compliance with requirements, provide the following :

a. ABI, Ideal Tape Division; 370 White PVC tape.
b. Compac Corporation; 130.
c. Venture Tape; 1506 CW NS.

2. Width: 2 inches.
3. Thickness: 6 mils.
4. Adhesion: 64 ounces force/inch in width.
5. Elongation: 500 percent.
6. Tensile Strength: 18 lbf/inch in width.

B. Aluminum-Foil Tape: Vapor-retarder tape with acrylic adhesive.

1. Products: Subject to compliance with requirements, provide the following :

a. ABI, Ideal Tape Division; 488 AWF.
b. Avery Dennison Corporation, Specialty Tapes Division; Fasson 0800.
c. Compac Corporation; 120.
d. Venture Tape; 3520 CW.

2. Width: 2 inches.
3. Thickness: 3.7 mils.
4. Adhesion: 100 ounces force/inch in width.
5. Elongation: 5 percent.

6. Tensile Strength: 34 lbf/inch in width.

2.9 SECUREMENTS

A. Bands:

1. Products: Subject to compliance with requirements, provide the following :

   a. ITW Insulation Systems; Gerrard Strapping and Seals.
   b. RPR Products, Inc.; Insul-Mate Strapping, Seals, and Springs..

2. Aluminum: ASTM B 209, Alloy 3003, 3005, 3105, or 5005; Temper H-14, 0.020 inch thick, 3/4 inch wide with wing seal .

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates and conditions for compliance with requirements for installation tolerances and other conditions affecting performance of insulation application.

1. Verify that systems to be insulated have been tested and are free of defects.
2. Verify that surfaces to be insulated are clean and dry.
3. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Surface Preparation: Clean and dry surfaces to receive insulation. Remove materials that will adversely affect insulation application.

B. Surface Preparation: Clean and prepare surfaces to be insulated. Before insulating, apply a corrosion coating to insulated surfaces as follows:

1. Carbon Steel: Coat carbon steel operating at a service temperature between 32 and 300 deg F with an epoxy coating. Consult coating manufacturer for appropriate coating materials and application methods for operating temperature range.

C. Coordinate insulation installation with the trade installing heat tracing. Comply with requirements for heat tracing that apply to insulation.

D. Mix insulating cements with clean potable water; if insulating cements are to be in contact with stainless-steel surfaces, use demineralized water.

3.3 GENERAL INSTALLATION REQUIREMENTS

A. Install insulation materials, accessories, and finishes with smooth, straight, and even surfaces; free of voids throughout the length of piping including fittings, valves, and specialties.

B. Install insulation materials, forms, vapor barriers or retarders, jackets, and thicknesses required for each item of pipe system as specified in insulation system schedules.

C. Install accessories compatible with insulation materials and suitable for the service. Install accessories that do not corrode, soften, or otherwise attack insulation or jacket in either wet or dry state.

D. Install insulation with longitudinal seams at top and bottom of horizontal runs.

E. Install multiple layers of insulation with longitudinal and end seams staggered.

F. Do not weld brackets, clips, or other attachment devices to piping, fittings, and specialties.

G. Keep insulation materials dry during application and finishing.

H. Install insulation with tight longitudinal seams and end joints. Bond seams and joints with adhesive recommended by insulation material manufacturer.

I. Install insulation with least number of joints practical.

J. Where vapor barrier is indicated, seal joints, seams, and penetrations in insulation at hangers, supports, anchors, and other projections with vapor-barrier mastic.

1. Install insulation continuously through hangers and around anchor attachments.
2. For insulation application where vapor barriers are indicated, extend insulation on anchor legs from point of attachment to supported item to point of attachment to structure. Taper and seal ends at attachment to structure with vapor-barrier mastic.
3. Install insert materials and install insulation to tightly join the insert. Seal insulation to insulation inserts with adhesive or sealing compound recommended by insulation material manufacturer.
4. Cover inserts with jacket material matching adjacent pipe insulation. Install shields over jacket, arranged to protect jacket from tear or puncture by hanger, support, and shield.

K. Apply adhesives, mastics, and sealants at manufacturer's recommended coverage rate and wet and dry film thicknesses.

L. Install insulation with factory-applied jackets as follows:

1. Draw jacket tight and smooth.
2. Cover circumferential joints with 3-inch- wide strips, of same material as insulation jacket. Secure strips with adhesive and outward clinching staples along both edges of strip, spaced 4 inches o.c.
3. Overlap jacket longitudinal seams at least 1-1/2 inches. Install insulation with longitudinal seams at bottom of pipe. Clean and dry surface to receive self-sealing lap.
4. Cover joints and seams with tape, according to insulation material manufacturer's written instructions, to maintain vapor seal.
5. Where vapor barriers are indicated, apply vapor-barrier mastic on seams and joints and at ends adjacent to pipe flanges and fittings.

M. Cut insulation in a manner to avoid compressing insulation more than 75 percent of its nominal thickness.

N. Finish installation with systems at operating conditions. Repair joint separations and cracking due to thermal movement.

O. Repair damaged insulation facings by applying same facing material over damaged areas. Extend patches at least 4 inches beyond damaged areas. Adhere, staple, and seal patches similar to butt joints.

P. For above-ambient services, do not install insulation to the following:

1. Vibration-control devices.
2. Testing agency labels and stamps.
3. Nameplates and data plates.
4. Manholes.
5. Handholes.
6. Cleanouts.

3.4 PENETRATIONS

A. Insulation Installation at Roof Penetrations: Install insulation continuously through roof penetrations.

1. Seal penetrations with flashing sealant.
2. For applications requiring only indoor insulation, terminate insulation above roof surface and seal with joint sealant. For applications requiring indoor and outdoor insulation, install insulation for outdoor applications tightly joined to indoor insulation ends. Seal joint with joint sealant.
3. Extend jacket of outdoor insulation outside roof flashing at least 2 inches below top of roof flashing.
4. Seal jacket to roof flashing with flashing sealant.

B. Insulation Installation at Underground Exterior Wall Penetrations: Terminate insulation flush with sleeve seal. Seal terminations with flashing sealant.

C. Insulation Installation at Aboveground Exterior Wall Penetrations: Install insulation continuously through wall penetrations.

1. Seal penetrations with flashing sealant.
2. For applications requiring only indoor insulation, terminate insulation inside wall surface and seal with joint sealant. For applications requiring indoor and outdoor insulation, install insulation for outdoor applications tightly joined to indoor insulation ends. Seal joint with joint sealant.
3. Extend jacket of outdoor insulation outside wall flashing and overlap wall flashing at least 2 inches.
4. Seal jacket to wall flashing with flashing sealant.

D. Insulation Installation at Interior Wall and Partition Penetrations (That Are Not Fire Rated): Install insulation continuously through walls and partitions.

E. Insulation Installation at Fire-Rated Wall and Partition Penetrations: Install insulation continuously through penetrations of fire-rated walls and partitions.

1. Comply with requirements in Division 07 Section "Penetration Firestopping" for firestopping and fire-resistive joint sealers.

F. Insulation Installation at Floor Penetrations:

1. Pipe: Install insulation continuously through floor penetrations.
2. Seal penetrations through fire-rated assemblies. Comply with requirements in Division 07 Section "Penetration Firestopping."

3.5 GENERAL PIPE INSULATION INSTALLATION

A. Requirements in this article generally apply to all insulation materials except where more specific requirements are specified in various pipe insulation material installation articles.

B. Insulation Installation on Fittings, Valves, Strainers, Flanges, and Unions:

1. Install insulation over fittings, valves, strainers, flanges, unions, and other specialties with continuous thermal and vapor-retarder integrity unless otherwise indicated.
2. Insulate pipe elbows using preformed fitting insulation or mitered fittings made from same material and density as adjacent pipe insulation. Each piece shall be butted tightly against adjoining piece and bonded with adhesive. Fill joints, seams, voids, and irregular surfaces with insulating cement finished to a smooth, hard, and uniform contour that is uniform with adjoining pipe insulation.
3. Insulate tee fittings with preformed fitting insulation or sectional pipe insulation of same material and thickness as used for adjacent pipe. Cut sectional pipe insulation to fit. Butt each section closely to the next and hold in place with tie wire. Bond pieces with adhesive.
4. Insulate valves using preformed fitting insulation or sectional pipe insulation of same material, density, and thickness as used for adjacent pipe. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker. For valves, insulate up to and including the bonnets, valve stuffing-box studs, bolts, and nuts. Fill joints, seams, and irregular surfaces with insulating cement.
5. Insulate strainers using preformed fitting insulation or sectional pipe insulation of same material, density, and thickness as used for adjacent pipe. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker. Fill joints, seams, and irregular surfaces with insulating cement. Insulate strainers so strainer basket flange or plug can be easily removed and replaced without damaging the insulation and jacket. Provide a removable reusable insulation cover. For below-ambient services, provide a design that maintains vapor barrier.
6. Insulate flanges and unions using a section of oversized preformed pipe insulation. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker.
7. Cover segmented insulated surfaces with a layer of finishing cement and coat with a mastic. Install vapor-barrier mastic for below-ambient services and a breather mastic for above-ambient services. Reinforce the mastic with fabric-reinforcing mesh. Trowel the mastic to a smooth and well-shaped contour.

8. For services not specified to receive a field-applied jacket except for flexible, install fitted PVC cover over elbows, tees, strainers, valves, flanges, and unions. Terminate ends with PVC end caps. Tape PVC covers to adjoining insulation facing using PVC tape.
9. Stencil or label the outside insulation jacket of each union with the word "union." Match size and color of pipe labels.

C. Insulate instrument connections for thermometers, pressure gages, pressure temperature taps, test connections, flow meters, sensors, switches, and transmitters on insulated pipes. Shape insulation at these connections by tapering it to and around the connection with insulating cement and finish with finishing cement, mastic, and flashing sealant.

D. Install removable insulation covers at locations indicated. Installation shall conform to the following:

1. Make removable flange and union insulation from sectional pipe insulation of same thickness as that on adjoining pipe. Install same insulation jacket as adjoining pipe insulation.
2. When flange and union covers are made from sectional pipe insulation, extend insulation from flanges or union long at least two times the insulation thickness over adjacent pipe insulation on each side of flange or union. Secure flange cover in place with stainless-steel or aluminum bands. Select band material compatible with insulation and jacket.
3. Construct removable valve insulation covers in same manner as for flanges, except divide the two-part section on the vertical center line of valve body.
4. When covers are made from block insulation, make two halves, each consisting of mitered blocks wired to stainless-steel fabric. Secure this wire frame, with its attached insulation, to flanges with tie wire. Extend insulation at least 2 inches over adjacent pipe insulation on each side of valve. Fill space between flange or union cover and pipe insulation with insulating cement. Finish cover assembly with insulating cement applied in two coats. After first coat is dry, apply and trowel second coat to a smooth finish.
5. Unless a PVC jacket is indicated in field-applied jacket schedules, finish exposed surfaces with a metal jacket.

3.6 INSTALLATION OF CELLULAR-GLASS INSULATION

A. Insulation Installation on Straight Pipes and Tubes:

1. Secure each layer of insulation to pipe with wire or bands and tighten bands without deforming insulation materials.
2. Where vapor barriers are indicated, seal longitudinal seams, end joints, and protrusions with vapor-barrier mastic and joint sealant.
3. For insulation with factory-applied jackets, do not staple longitudinal tabs. Instead, secure tabs with additional adhesive as recommended by insulation material manufacturer and seal with vapor-barrier mastic and flashing sealant.

B. Insulation Installation on Pipe Flanges:

1. Install preformed pipe insulation to outer diameter of pipe flange.
2. Make width of insulation section same as overall width of flange and bolts, plus twice the thickness of pipe insulation.

3. Install jacket material with manufacturer's recommended adhesive, overlap seams at least 1 inch, and seal joints with flashing sealant.

C. Insulation Installation on Pipe Fittings and Elbows:

1. Install preformed sections of same material as straight segments of pipe insulation when available. Secure according to manufacturer's written instructions.
2. When preformed sections of insulation are not available, install mitered sections of cellular-glass insulation. Secure insulation materials with wire or bands.

D. Insulation Installation on Valves and Pipe Specialties:

1. Install preformed sections of cellular-glass insulation to valve body.
2. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
3. Install insulation to flanges as specified for flange insulation application.

3.7 INSTALLATION OF FLEXIBLE ELASTOMERIC INSULATION

A. Seal longitudinal seams and end joints with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

B. Insulation Installation on Pipe Flanges:

1. Install pipe insulation to outer diameter of pipe flange.
2. Make width of insulation section same as overall width of flange and bolts, plus twice the thickness of pipe insulation.
3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with cut sections of sheet insulation of same thickness as pipe insulation.
4. Secure insulation to flanges and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

C. Insulation Installation on Pipe Fittings and Elbows:

1. Install mitered sections of pipe insulation.
2. Secure insulation materials and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

D. Insulation Installation on Valves and Pipe Specialties:

1. Install preformed valve covers manufactured of same material as pipe insulation when available.
2. When preformed valve covers are not available, install cut sections of pipe and sheet insulation to valve body. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
3. Install insulation to flanges as specified for flange insulation application.
4. Secure insulation to valves and specialties and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

3.8 INSTALLATION OF MINERAL-FIBER INSULATION

A. Insulation Installation on Straight Pipes and Tubes:

1. Secure each layer of preformed pipe insulation to pipe with wire or bands and tighten bands without deforming insulation materials.
2. Where vapor barriers are indicated, seal longitudinal seams, end joints, and protrusions with vapor-barrier mastic and joint sealant.
3. For insulation with factory-applied jackets on above-ambient surfaces, secure laps with outward-clinched staples at 6 inches o.c.
4. For insulation with factory-applied jackets on below-ambient surfaces, do not staple longitudinal tabs. Instead, secure tabs with additional adhesive as recommended by insulation material manufacturer and seal with vapor-barrier mastic and flashing sealant.

B. Insulation Installation on Pipe Flanges:

1. Install preformed pipe insulation to outer diameter of pipe flange.
2. Make width of insulation section same as overall width of flange and bolts, plus twice the thickness of pipe insulation.
3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with mineral-fiber blanket insulation.
4. Install jacket material with manufacturer's recommended adhesive, overlap seams at least 1 inch, and seal joints with flashing sealant.

C. Insulation Installation on Pipe Fittings and Elbows:

1. Install preformed sections of same material as straight segments of pipe insulation when available.
2. When preformed insulation elbows and fittings are not available, install mitered sections of pipe insulation, to a thickness equal to adjoining pipe insulation. Secure insulation materials with wire or bands.

D. Insulation Installation on Valves and Pipe Specialties:

1. Install preformed sections of same material as straight segments of pipe insulation when available.
2. When preformed sections are not available, install mitered sections of pipe insulation to valve body.
3. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
4. Install insulation to flanges as specified for flange insulation application.

3.9 FIELD-APPLIED JACKET INSTALLATION

A. Where glass-cloth jackets are indicated, install directly over bare insulation or insulation with factory-applied jackets.

1. Draw jacket smooth and tight to surface with 2-inch overlap at seams and joints.
2. Embed glass cloth between two 0.062-inch- thick coats of lagging adhesive.
3. Completely encapsulate insulation with coating, leaving no exposed insulation..

B. Where PVC jackets are indicated, install with 1-inch overlap at longitudinal seams and end joints; for horizontal applications. Seal with manufacturer's recommended adhesive.

1. Apply two continuous beads of adhesive to seams and joints, one bead under lap and the finish bead along seam and joint edge.

C. Where metal jackets are indicated, install with 2-inch overlap at longitudinal seams and end joints. Overlap longitudinal seams arranged to shed water. Seal end joints with weatherproof sealant recommended by insulation manufacturer. Secure jacket with stainless-steel bands 12 inches o.c. and at end joints.

3.10 FINISHES

Pipe Insulation with ASJ, Glass-Cloth, or Other Paintable Jacket Material: Paint jacket with paint system identified below and as specified in Division 09 painting Sections.

1. Flat Acrylic Finish: Two finish coats over a primer that is compatible with jacket material and finish coat paint. Add fungicidal agent to render fabric mildew proof.

a. Finish Coat Material: Interior, flat, latex-emulsion size.

B. Flexible Elastomeric Thermal Insulation: After adhesive has fully cured, apply two coats of insulation manufacturer's recommended protective coating.

C. Color: Final color as selected by Architect. Vary first and second coats to allow visual inspection of the completed Work.

D. Do not field paint aluminum jackets.

3.11 PIPING INSULATION SCHEDULE, GENERAL

A. Acceptable preformed pipe and tubular insulation materials and thicknesses are identified for each piping system and pipe size range. If more than one material is listed for a piping system, selection from materials listed is Contractor's option.

B. Items Not Insulated: Unless otherwise indicated, do not install insulation on the following:

1. Drainage piping located in crawl spaces.
2. Underground piping.
3. Chrome-plated pipes and fittings unless there is a potential for personnel injury.

3.12 INDOOR PIPING INSULATION SCHEDULE

A. Condensate and Equipment Drain Water below 60 Deg F:

1. All Pipe Sizes: Insulation shall be one of the following:

a. Cellular Glass: 1-1/2 inches thick.
b. Flexible Elastomeric: 3/4 inch thick.

B. Chilled Water and Brine, above 40 Deg F:

1. NPS 1 and Smaller:

a. Flexible Elastomeric: 1/2 inch thick.

2. NPS 1 to NPS 12: Insulation shall be one of the following:

a. Cellular Glass: 1-1/2 inches thick.

3. NPS 14 and Larger: Insulation shall be the following:

a. Cellular Glass: 2 inches thick.

C. Heating-Hot-Water Supply and Return, 200 Deg F and Below:

1. NPS 1 and Smaller:

a. Mineral-Fiber, Preformed Pipe, Type I: 1 inch thick

2. NPS 1 to NPS 12: Insulation shall be the following:
a. Mineral-Fiber, Preformed Pipe, Type I: 1-1/2 inch thick.

3.13 OUTDOOR, ABOVEGROUND PIPING INSULATION SCHEDULE

A. Chilled Water:

1. All Pipe Sizes: Insulation shall be one of the following:

a. Cellular Glass: 3 inches thick.

B. Brine (less than 40 deg F):

1. All Pipe Sizes: Insulation shall be one of the following:

a. Cellular Glass: 3 inches thick.

C. Heating-Hot-Water Supply and Return, 200 Deg F and Below:

1. All Pipe Sizes: Insulation shall be the following:

a. Cellular Glass: 3 inches thick.

D. Refrigerant Suction and Hot-Gas Piping:

1. All Pipe Sizes: Insulation shall be the following:
a. Flexible Elastomeric: 2 inches thick.

3.14 INDOOR, FIELD-APPLIED JACKET SCHEDULE

A. Install jacket over insulation material. For insulation with factory-applied jacket, install the field-applied jacket over the factory-applied jacket.

B. If more than one material is listed, selection from materials listed is Contractor's option.

C. Piping, Concealed:

1. None.

D. Piping, Exposed in finished spaces:
1. PVC: 20 mils thick.

E. Piping, Exposed in unfinished spaces up to six feet above floor:
1. Aluminum, Smooth: 0.020 inch thick.

3.15 OUTDOOR, FIELD-APPLIED JACKET SCHEDULE

A. Install jacket over insulation material. For insulation with factory-applied jacket, install the field-applied jacket over the factory-applied jacket.

B. If more than one material is listed, selection from materials listed is Contractor's option.

C. Piping, Concealed:

1. None.

D. Piping, Exposed:
1. Aluminum, Smooth or Stucco Embossed: 0.020 inch thick.
2. Stainless Steel, Type 304 or 316, Smooth 2B Finish: 0.016 inch] thick.

END OF SECTION 230719

SECTION 230713 - DUCT INSULATION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section includes insulating the following duct services:

1. Indoor, concealed supply and outdoor air.
2. Indoor, exposed supply and outdoor air.
3. Indoor, concealed return located in unconditioned space.
4. Indoor, exposed return located in unconditioned space.
5. Outdoor, concealed supply and return.
6. Outdoor, exposed supply and return.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product indicated. Include thermal conductivity, water-vapor permeance thickness, and jackets (both factory- and field-applied if any).

B. LEED Submittals:

1. Product Data for Credit IEQ 4.1: For adhesives and sealants, documentation including printed statement of VOC content.
2. Laboratory Test Reports for Credit IEQ 4: For adhesives and sealants, documentation indicating that products comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

C. Shop Drawings: Include plans, elevations, sections, details, and attachments to other work.

1. Detail application of protective shields, saddles, and inserts at hangers for each type of insulation and hanger.
2. Detail insulation application at elbows, fittings, dampers, specialties and flanges for each type of insulation.
3. Detail application of field-applied jackets.
4. Detail application at linkages of control devices.

D. Samples: For each type of insulation and jacket indicated. Identify each Sample, describing product and intended use. Sample sizes are as follows:

1. Sheet Form Insulation Materials: 12 inches (300 mm) square.

2. Sheet Jacket Materials: 12 inches (300 mm) square.
3. Manufacturer's Color Charts: For products where color is specified, show the full range of colors available for each type of finish material.

1.4 INFORMATIONAL SUBMITTALS

A. Qualification Data: For qualified Installer.

B. Material Test Reports: From a qualified testing agency acceptable to authorities having jurisdiction indicating, interpreting, and certifying test results for compliance of insulation materials, sealers, attachments, cements, and jackets, with requirements indicated. Include dates of tests and test methods employed.

C. Field quality-control reports.

1.5 QUALITY ASSURANCE

A. Installer Qualifications: Skilled mechanics who have successfully completed an apprenticeship program or another craft training program certified by the Department of Labor, Bureau of Apprenticeship and Training.

B. Surface-Burning Characteristics: For insulation and related materials, as determined by testing identical products according to ASTM E 84, by a testing agency acceptable to authorities having jurisdiction. Factory label insulation and jacket materials and adhesive, mastic, tapes, and cement material containers, with appropriate markings of applicable testing agency.

1. Insulation Installed Indoors: Flame-spread index of 25 or less, and smoke-developed index of 50 or less.
2. Insulation Installed Outdoors: Flame-spread index of 75 or less, and smoke-developed index of 150 or less.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Packaging: Insulation material containers shall be marked by manufacturer with appropriate ASTM standard designation, type and grade, and maximum use temperature.

1.7 COORDINATION

A. Coordinate sizes and locations of supports, hangers, and insulation shields specified in Section 230529 "Hangers and Supports for HVAC Piping and Equipment."

B. Coordinate clearance requirements with duct Installer for duct insulation application. Before preparing ductwork Shop Drawings, establish and maintain clearance requirements for installation of insulation and field-applied jackets and finishes and for space required for maintenance.

C. Coordinate installation and testing of heat tracing.

1.8 SCHEDULING

A. Schedule insulation application after pressure testing systems and, where required, after installing and testing heat tracing. Insulation application may begin on segments that have satisfactory test results.

B. Complete installation and concealment of plastic materials as rapidly as possible in each area of construction.

PART 2 - PRODUCTS

2.1 INSULATION MATERIALS

A. Comply with requirements in "Duct Insulation Schedule, General," "Indoor Duct and Plenum Insulation Schedule," and "Aboveground, Outdoor Duct and Plenum Insulation Schedule" articles for where insulating materials shall be applied.

B. Products shall not contain asbestos, lead, mercury, or mercury compounds.

C. Products that come in contact with stainless steel shall have a leachable chloride content of less than 50 ppm when tested according to ASTM C 871.

D. Insulation materials for use on austenitic stainless steel shall be qualified as acceptable according to ASTM C 795.

E. Foam insulation materials shall not use CFC or HCFC blowing agents in the manufacturing process.

F. Flexible Elastomeric Insulation: Closed-cell, sponge- or expanded-rubber materials. Comply with ASTM C 534, Type II for sheet materials.

1. Products: Subject to compliance with requirements, provide one of the following:

a. Aeroflex USA, Inc.; Aerocel.
b. Armacell LLC; AP Armaflex.
c. K-Flex USA; Insul-Sheet, K-Flex Gray Duct Liner, and K-FLEX LS.

G. Mineral-Fiber Blanket Insulation: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C 553, Type II and ASTM C 1290, Type III with factory-applied FSK jacket. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.

1. Products: Subject to compliance with requirements, provide one of the following:

a. CertainTeed Corp.; SoftTouch Duct Wrap.
b. Johns Manville; Microlite.
c. Knauf Insulation; Friendly Feel Duct Wrap.
d. Manson Insulation Inc.; Alley Wrap.
e. Owens Corning; SOFTR All-Service Duct Wrap.

H. Mineral-Fiber Board Insulation: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C 612, Type IA or Type IB. For duct and plenum applications, provide insulation with factory-applied FSK jacket. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.

1. Products: Subject to compliance with requirements, provide one of the following:

a. CertainTeed Corp.; Commercial Board.
b. Fibrex Insulations Inc.; FBX.
c. Johns Manville; 800 Series Spin-Glas.
d. Knauf Insulation; Insulation Board.
e. Manson Insulation Inc.; AK Board.
f. Owens Corning; Fiberglas 700 Series.

I. Mineral-Fiber, Pipe and Tank Insulation: Mineral or glass fibers bonded with a thermosetting resin. Semirigid board material with factory-applied FSK jacket complying with ASTM C 1393, Type II or Type IIIA Category 2, or with properties similar to ASTM C 612, Type IB. Nominal density is 2.5 lb/cu. ft. (40 kg/cu. m) or more. Thermal conductivity (k-value) at 100 deg F (55 deg C) is 0.29 Btu x in./h x sq. ft. x deg F (0.042 W/m x K) or less. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.

1. Products: Subject to compliance with requirements, provide one of the following:

a. CertainTeed Corp.; CrimpWrap.
b. Johns Manville; MicroFlex.
c. Knauf Insulation; Pipe and Tank Insulation.
d. Manson Insulation Inc.; AK Flex.
e. Owens Corning; Fiberglas Pipe and Tank Insulation.

2.2 FIRE-RATED INSULATION SYSTEMS

A. Fire-Rated Board: Structural-grade, press-molded, xonolite calcium silicate, fireproofing board suitable for operating temperatures up to 1700 deg F (927 deg C). Comply with ASTM C 656, Type II, Grade 6. Tested and certified to provide a 2-hour fire rating by an NRTL acceptable to authorities having jurisdiction.

1. Products: Subject to compliance with requirements, provide one of the following:

a. Johns Manville; Super Firetemp M.

B. Fire-Rated Blanket: High-temperature, flexible, blanket insulation with FSK jacket that is tested and certified to provide a [**1**] [**2**]-hour fire rating by an NRTL acceptable to authorities having jurisdiction.

1. Products: Subject to compliance with requirements, provide one of the following:

a. Nelson Fire Stop Products; Nelson FSB Flameshield Blanket.
b. Thermal Ceramics; FireMaster Duct Wrap.
c. 3M; Fire Barrier Wrap Products.
d. Unifrax Corporation; FyreWrap.

2.3 ADHESIVES

A. Materials shall be compatible with insulation materials, jackets, and substrates and for bonding insulation to itself and to surfaces to be insulated unless otherwise indicated.

B. Flexible Elastomeric and Polyolefin Adhesive: Comply with MIL-A-24179A, Type II, Class I.

1. Products: Subject to compliance with requirements, provide one of the following:

a. Armacell LLC; Armaflex 520 Adhesive.
b. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 85-75.K-Flex USA; R-373 Contact Adhesive.

2. For indoor applications, adhesive shall have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
3. Adhesive shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

C. Mineral-Fiber Adhesive: Comply with MIL-A-3316C, Class 2, Grade A.

1. Products: Subject to compliance with requirements provide one of the following:

a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; CP-127.Eagle Bridges - Marathon Industries; 225.
b. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 85-60/85-70.Mon-Eco Industries, Inc.; 22-25.

2. For indoor applications, adhesive shall have a VOC content of 80 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
3. Adhesive shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

D. ASJ Adhesive, and FSK Jacket Adhesive: Comply with MIL-A-3316C, Class 2, Grade A for bonding insulation jacket lap seams and joints.

1. Products: Subject to compliance with requirements, provide one of the following:

a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; CP-82.
b. Eagle Bridges - Marathon Industries; 225.
c. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 85-50.Mon-Eco Industries, Inc.; 22-25.

2. For indoor applications, adhesive shall have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
3. Adhesive shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

E. PVC Jacket Adhesive: Compatible with PVC jacket.

1. Products: Subject to compliance with requirements, provide one of the following:

a. Dow Corning Corporation; 739, Dow Silicone.
b. Johns Manville; Zeston Perma-Weld, CEEL-TITE Solvent Welding Adhesive.
c. P.I.C. Plastics, Inc.; Welding Adhesive.
d. Speedline Corporation; Polyco VP Adhesive.

2. For indoor applications, adhesive shall have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
3. Adhesive shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

2.4 MASTICS

A. Materials shall be compatible with insulation materials, jackets, and substrates; comply with MIL-PRF-19565C, Type II.

1. For indoor applications, use mastics that have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

B. Vapor-Barrier Mastic: Water based; suitable for indoor use on below ambient services.

1. Products: Subject to compliance with requirements, provide one of the following:

a. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 30-80/30-90.
b. Vimasco Corporation; 749.

2. Water-Vapor Permeance: ASTM E 96/E 96M, Procedure B, 0.013 perm (0.009 metric perm) at 43-mil (1.09-mm) dry film thickness.
3. Service Temperature Range: Minus 20 to plus 180 deg F).
4. Solids Content: ASTM D 1644, 58 percent by volume and 70 percent by weight.
5. Color: White.

C. Breather Mastic: Water based; suitable for indoor and outdoor use on above ambient services.

1. Products: Subject to compliance with requirements, provide one of the following:

a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; CP-10.
b. Eagle Bridges - Marathon Industries; 550.
c. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 46-50.
d. Mon-Eco Industries, Inc.; 55-50.
e. Vimasco Corporation; WC-1/WC-5.

2. Water-Vapor Permeance: ASTM F 1249, 1.8 perms (1.2 metric perms) at 0.0625-inch (1.6-mm) dry film thickness.
3. Service Temperature Range: Minus 20 to plus 180 deg F (Minus 29 to plus 82 deg C).
4. Solids Content: 60 percent by volume and 66 percent by weight.
5. Color: White.

2.5 SEALANTS

A. FSK and Metal Jacket Flashing Sealants:

1. Products: Subject to compliance with requirements, provide one of the following:

   a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; CP-76.Eagle Bridges - Marathon Industries; 405.
   b. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 95-44.
   c. Mon-Eco Industries, Inc.; 44-05.

2. Materials shall be compatible with insulation materials, jackets, and substrates.
3. Fire- and water-resistant, flexible, elastomeric sealant.
4. Service Temperature Range: Minus 40 to plus 250 deg F (Minus 40 to plus 121 deg C).
5. Color: Aluminum.
6. For indoor applications, sealants shall have a VOC content of 420 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
7. Sealants shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

B. ASJ Flashing Sealants, and Vinyl and PVC Jacket Flashing Sealants:

1. Products: Subject to compliance with requirements, provide one of the following:

   a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; CP-76.

2. Materials shall be compatible with insulation materials, jackets, and substrates.
3. Fire- and water-resistant, flexible, elastomeric sealant.
4. Service Temperature Range: Minus 40 to plus 250 deg F (Minus 40 to plus 121 deg C).
5. Color: White.
6. For indoor applications, sealants shall have a VOC content of 420 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
7. Sealants shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

2.6 FACTORY-APPLIED JACKETS

A. Insulation system schedules indicate factory-applied jackets on various applications. When factory-applied jackets are indicated, comply with the following:

1. ASJ: White, kraft-paper, fiberglass-reinforced scrim with aluminum-foil backing; complying with ASTM C 1136, Type I.
2. ASJ-SSL: ASJ with self-sealing, pressure-sensitive, acrylic-based adhesive covered by a removable protective strip; complying with ASTM C 1136, Type I.
3. FSK Jacket: Aluminum-foil, fiberglass-reinforced scrim with kraft-paper backing; complying with ASTM C 1136, Type II.
4. FSP Jacket: Aluminum-foil, fiberglass-reinforced scrim with polyethylene backing; complying with ASTM C 1136, Type II.
5. Vinyl Jacket: White vinyl with a permeance of 1.3 perms (0.86 metric perm) when tested according to ASTM E 96/E 96M, Procedure A, and complying with NFPA 90A and NFPA 90B.

2.7 FIELD-APPLIED FABRIC-REINFORCING MESH

A. Woven Glass-Fiber Fabric: Approximately 6 oz./sq. yd. (203 g/sq. m) with a thread count of 5 strands by 5 strands/sq. in. (2 strands by 2 strands/sq. mm) for covering ducts.

1. Products: Subject to compliance with requirements, provide one of the following:

a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; Chil-Glas No. 5.

B. Woven Polyester Fabric: Approximately 1 oz./sq. yd. (34 g/sq. m) with a thread count of 10 strands by 10 strands/sq. in. (4 strands by 4 strands/sq. mm), in a Leno weave, for ducts.

1. Products: Subject to compliance with requirements, provide one of the following:

a. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; Mast-A-Fab.
b. Vimasco Corporation; Elastafab 894.

2.8 FIELD-APPLIED CLOTHS

A. Woven Glass-Fiber Fabric: Comply with MIL-C-20079H, Type I, plain weave, and presized a minimum of 8 oz./sq. yd. (271 g/sq. m).

1. Products: Subject to compliance with requirements, provide one of the following:

a. Alpha Associates, Inc.; Alpha-Maritex 84215 and 84217/9485RW, Luben 59.

2.9 FIELD-APPLIED JACKETS

A. Field-applied jackets shall comply with ASTM C 921, Type I, unless otherwise indicated.

B. FSK Jacket: Aluminum-foil-face, fiberglass-reinforced scrim with kraft-paper backing.

C. PVC Jacket: High-impact-resistant, UV-resistant PVC complying with ASTM D 1784, Class 16354-C; thickness as scheduled; roll stock ready for shop or field cutting and forming. Thickness is indicated in field-applied jacket schedules.

1. Products: Subject to compliance with requirements, provide one of the following:

a. Johns Manville; Zeston.
b. P.I.C. Plastics, Inc.; FG Series.
c. Proto Corporation; LoSmoke.
d. Speedline Corporation; SmokeSafe.

2. Adhesive: As recommended by jacket material manufacturer.
3. Color: Color as selected by Architect.

D. Metal Jacket:

1. Products: Subject to compliance with requirements, provide one of the following:

a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; Metal Jacketing Systems.
b. ITW Insulation Systems; Aluminum and Stainless Steel Jacketing.
c. RPR Products, Inc.; Insul-Mate.

2. Aluminum Jacket: Comply with ASTM B 209 (ASTM B 209M), Alloy 3003, 3005, 3105, or 5005, Temper H-14.

a. Factory cut and rolled to size.
b. Finish and thickness are indicated in field-applied jacket schedules.
c. Moisture Barrier for Indoor Applications: 3-mil- (0.075-mm-) thick, heat-bonded polyethylene and kraft paper.
d. Moisture Barrier for Outdoor Applications: 3-mil- (0.075-mm-) thick, heat-bonded polyethylene and kraft paper.

3. Stainless-Steel Jacket: ASTM A 167 or ASTM A 240/A 240M.

a. Factory cut and rolled to size.
b. Material, finish, and thickness are indicated in field-applied jacket schedules.
c. Moisture Barrier for Indoor Applications: 1-mil- (0.025-mm-) thick, heat-bonded polyethylene and kraft paperMoisture Barrier for Outdoor Applications: 3-mil- (0.075-mm-) thick, heat-bonded polyethylene and kraft paper tick polysurlyn.

E. Self-Adhesive Outdoor Jacket: 60-mil- (1.5-mm-) thick, laminated vapor barrier and waterproofing membrane for installation over insulation located aboveground outdoors; consisting of a rubberized bituminous resin on a crosslaminated polyethylene film covered with white aluminum-foil facing.

1. Products: Subject to compliance with requirements, provide the following:

a. Polyguard Products, Inc.; Alumaguard 60.

2.10 TAPES

A. ASJ Tape: White vapor-retarder tape matching factory-applied jacket with acrylic adhesive, complying with ASTM C 1136.

1. Products: Subject to compliance with requirements, provide one of the following:

a. ABI, Ideal Tape Division; 428 AWF ASJ.
b. Avery Dennison Corporation, Specialty Tapes Division; Fasson 0836.
c. Compac Corporation; 104 and 105.
d. Venture Tape; 1540 CW Plus, 1542 CW Plus, and 1542 CW Plus/SQ.

2. Width: 3 inches (75 mm).
3. Thickness: 11.5 mils (0.29 mm).
4. Adhesion: 90 ounces force/inch (1.0 N/mm) in width.
5. Elongation: 2 percent.
6. Tensile Strength: 40 lbf/inch (7.2 N/mm) in width.
7. ASJ Tape Disks and Squares: Precut disks or squares of ASJ tape.

B. FSK Tape: Foil-face, vapor-retarder tape matching factory-applied jacket with acrylic adhesive; complying with ASTM C 1136.

1. Products: Subject to compliance with requirements, provide one of the following:

a. ABI, Ideal Tape Division; 491 AWF FSK.
b. Avery Dennison Corporation, Specialty Tapes Division; Fasson 0827.
c. Compac Corporation; 110 and 111.
d. Venture Tape; 1525 CW NT, 1528 CW, and 1528 CW/SQ.

2. Width: 3 inches (75 mm).
3. Thickness: 6.5 mils (0.16 mm).
4. Adhesion: 90 ounces force/inch (1.0 N/mm) in width.
5. Elongation: 2 percent.
6. Tensile Strength: 40 lbf/inch (7.2 N/mm) in width.
7. FSK Tape Disks and Squares: Precut disks or squares of FSK tape.

C. PVC Tape: White vapor-retarder tape matching field-applied PVC jacket with acrylic adhesive; suitable for indoor and outdoor applications.

1. Products: Subject to compliance with requirements, provide one of the following:

a. ABI, Ideal Tape Division; 370 White PVC tape.
b. Compac Corporation; 130.
c. Venture Tape; 1506 CW NS.

2. Width: 2 inches (50 mm).
3. Thickness: 6 mils (0.15 mm).
4. Adhesion: 64 ounces force/inch (0.7 N/mm) in width.
5. Elongation: 500 percent.
6. Tensile Strength: 18 lbf/inch (3.3 N/mm) in width.

D. Aluminum-Foil Tape: Vapor-retarder tape with acrylic adhesive.

1. Products: Subject to compliance with requirements, provide one of the following:

a. ABI, Ideal Tape Division; 488 AWF.
b. Avery Dennison Corporation, Specialty Tapes Division; Fasson 0800.
c. Compac Corporation; 120.
d. Venture Tape; 3520 CW.

2. Width: 2 inches (50 mm).
3. Thickness: 3.7 mils (0.093 mm).
4. Adhesion: 100 ounces force/inch (1.1 N/mm) in width.
5. Elongation: 5 percent.
6. Tensile Strength: 34 lbf/inch (6.2 N/mm) in width.

2.11 SECUREMENTS

A. Bands:

1. Products: Subject to compliance with requirements, provide one of the following:

a. ITW Insulation Systems; Gerrard Strapping and Seals.
b. RPR Products, Inc.; Insul-Mate Strapping, Seals, and Springs.

2. Stainless Steel: ASTM A 167 or ASTM A 240/A 240M, Type 304 or Type 316; 3/4 inch (19 mm)] wide with closed seal.
3. Aluminum: ASTM B 209 (ASTM B 209M), Alloy 3003, 3005, 3105, or 5005; Temper H-14, **3/4 inch (19 mm)** wide with closed seal.
4. Springs: Twin spring set constructed of stainless steel with ends flat and slotted to accept metal bands. Spring size determined by manufacturer for application.

B. Insulation Pins and Hangers:

1. Capacitor-Discharge-Weld Pins: Copper- or zinc-coated steel pin, fully annealed for capacitor-discharge welding, 0.106-inch- (2.6-mm-) diameter shank, length to suit depth of insulation indicated.

a. Products: Subject to compliance with requirements, provide one of the following:

1) AGM Industries, Inc.; CWP-1.
2) GEMCO; CD.
3) Midwest Fasteners, Inc.; CD.
4) Nelson Stud Welding; TPA, TPC, and TPS.

2. Cupped-Head, Capacitor-Discharge-Weld Pins: Copper- or zinc-coated steel pin, fully annealed for capacitor-discharge welding, 0.135-inch- (3.5-mm-) diameter shank, length to suit depth of insulation indicated with integral 1-1/2-inch (38-mm) galvanized carbon-steel washer.

a. Products: Subject to compliance with requirements, provide one of the following:

1) AGM Industries, Inc.; CHP-1.
2) GEMCO; Cupped Head Weld Pin.
3) Midwest Fasteners, Inc.; Cupped Head.
4) Nelson Stud Welding; CHP.

3. Metal, Adhesively Attached, Perforated-Base Insulation Hangers: Baseplate welded to projecting spindle that is capable of holding insulation, of thickness indicated, securely in position indicated when self-locking washer is in place. Comply with the following requirements:

   a. Products: Subject to compliance with requirements, provide one of the following:

      1) AGM Industries, Inc.; Tactoo Perforated Base Insul-Hangers.
      2) GEMCO; Perforated Base.
      3) Midwest Fasteners, Inc.; Spindle.

   b. Baseplate: Perforated, galvanized carbon-steel sheet, 0.030 inch (0.76 mm) thick by 2 inches (50 mm) square.
   c. Spindle: Stainless steel, fully annealed, 0.106-inch- (2.6-mm-) diameter shank, length to suit depth of insulation indicated.
   d. Adhesive: Recommended by hanger manufacturer. Product with demonstrated capability to bond insulation hanger securely to substrates indicated without damaging insulation, hangers, and substrates.

4. Nonmetal, Adhesively Attached, Perforated-Base Insulation Hangers: Baseplate fastened to projecting spindle that is capable of holding insulation, of thickness indicated, securely in position indicated when self-locking washer is in place. Comply with the following requirements:

   a. Products: Subject to compliance with requirement provide one of the following:

   b. GEMCO; Nylon Hangers.
      1) Midwest Fasteners, Inc.; Nylon Insulation Hangers.

   c. Baseplate: Perforated, nylon sheet, 0.030 inch (0.76 mm) thick by 1-1/2 inches (38 mm) in diameter.
   d. Spindle: Nylon, 0.106-inch- (2.6-mm-) diameter shank, length to suit depth of insulation indicated, up to 2-1/2 inches (63 mm).
   e. Adhesive: Recommended by hanger manufacturer. Product with demonstrated capability to bond insulation hanger securely to substrates indicated without damaging insulation, hangers, and substrates.

5. Self-Sticking-Base Insulation Hangers: Baseplate welded to projecting spindle that is capable of holding insulation, of thickness indicated, securely in position indicated when self-locking washer is in place. Comply with the following requirements:

   a. Products: Subject to compliance with requirements, provide one of the following:

      1) AGM Industries, Inc.; Tactoo Self-Adhering Insul-Hangers.
      2) GEMCO; Peel & Press.
      3) Midwest Fasteners, Inc.; Self Stick.

b. Baseplate: Galvanized carbon-steel sheet, 0.030 inch (0.76 mm) thick by 2 inches (50 mm) square.
c. Spindle: Stainless steel, fully annealed, 0.106-inch- (2.6-mm-) diameter shank, length to suit depth of insulation indicated.
d. Adhesive-backed base with a peel-off protective cover.

6. Insulation-Retaining Washers: Self-locking washers formed from 0.016-inch- (0.41-mm-) thick stainless-steel sheet, with beveled edge sized as required to hold insulation securely in place but not less than 1-1/2 inches (38 mm) in diameter.

a. Products: Subject to compliance with requirements, provide one of the following:

1) AGM Industries, Inc.; RC-150.
2) GEMCO; R-150.
3) Midwest Fasteners, Inc.; WA-150.
4) Nelson Stud Welding; Speed Clips.

b. Protect ends with capped self-locking washers incorporating a spring steel insert to ensure permanent retention of cap in exposed locations.

7. Nonmetal Insulation-Retaining Washers: Self-locking washers formed from 0.016-inch- (0.41-mm-) thick nylon sheet, with beveled edge sized as required to hold insulation securely in place but not less than 1-1/2 inches (38 mm) in diameter.

a. Manufacturers: Subject to compliance with requirements, provide products by one of the following

1) Midwest Fasteners, Inc.

C. Staples: Outward-clinching insulation staples, nominal 3/4-inch- (19-mm-) wide, stainless steel or Monel.

D. Wire: 0.062-inch (1.6-mm) soft-annealed, stainless steel.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

a. C & F Wire.

2.12 CORNER ANGLES

A. PVC Corner Angles: [30 mils (0.8 mm) thick, minimum 1 by 1 inch (25 by 25 mm), PVC according to ASTM D 1784, Class 16354-C. White or color-coded to match adjacent surface.

B. Aluminum Corner Angles: 0.040 inch (1.0 mm) thick, minimum 1 by 1 inch (25 by 25 mm), aluminum according to ASTM B 209 (ASTM B 209M), Alloy 3003, 3005, 3105, or 5005; Temper H-14.

C. Stainless-Steel Corner Angles: [0.024 inch (0.61 mm) thick, minimum 1 by 1 inch (25 by 25 mm), stainless steel according to ASTM A 167 or ASTM A 240/A 240M, Type 304 or Type 316.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates and conditions for compliance with requirements for installation tolerances and other conditions affecting performance of insulation application.

1. Verify that systems to be insulated have been tested and are free of defects.
2. Verify that surfaces to be insulated are clean and dry.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Surface Preparation: Clean and dry surfaces to receive insulation. Remove materials that will adversely affect insulation application.

3.3 GENERAL INSTALLATION REQUIREMENTS

A. Install insulation materials, accessories, and finishes with smooth, straight, and even surfaces; free of voids throughout the length of ducts and fittings.

B. Install insulation materials, vapor barriers or retarders, jackets, and thicknesses required for each item of duct system as specified in insulation system schedules.

C. Install accessories compatible with insulation materials and suitable for the service. Install accessories that do not corrode, soften, or otherwise attack insulation or jacket in either wet or dry state.

D. Install insulation with longitudinal seams at top and bottom of horizontal runs.

E. Install multiple layers of insulation with longitudinal and end seams staggered.

F. Keep insulation materials dry during application and finishing.

G. Install insulation with tight longitudinal seams and end joints. Bond seams and joints with adhesive recommended by insulation material manufacturer.

H. Install insulation with least number of joints practical.

I. Where vapor barrier is indicated, seal joints, seams, and penetrations in insulation at hangers, supports, anchors, and other projections with vapor-barrier mastic.

1. Install insulation continuously through hangers and around anchor attachments.
2. For insulation application where vapor barriers are indicated, extend insulation on anchor legs from point of attachment to supported item to point of attachment to structure. Taper and seal ends at attachment to structure with vapor-barrier mastic.
3. Install insert materials and install insulation to tightly join the insert. Seal insulation to insulation inserts with adhesive or sealing compound recommended by insulation material manufacturer.

J. Apply adhesives, mastics, and sealants at manufacturer's recommended coverage rate and wet and dry film thicknesses.

K. Install insulation with factory-applied jackets as follows:

1. Draw jacket tight and smooth.
2. Cover circumferential joints with 3-inch- (75-mm-) wide strips, of same material as insulation jacket. Secure strips with adhesive and outward clinching staples along both edges of strip, spaced 4 inches (100 mm) o.c.
3. Overlap jacket longitudinal seams at least 1-1/2 inches (38 mm). Clean and dry surface to receive self-sealing lap. Staple laps with outward clinching staples along edge at **4 inches (100 mm)** o.c.

    a. For below ambient services, apply vapor-barrier mastic over staples.

4. Cover joints and seams with tape, according to insulation material manufacturer's written instructions, to maintain vapor seal.
5. Where vapor barriers are indicated, apply vapor-barrier mastic on seams and joints and at ends adjacent to duct flanges and fittings.

L. Cut insulation in a manner to avoid compressing insulation more than 75 percent of its nominal thickness.

M. Finish installation with systems at operating conditions. Repair joint separations and cracking due to thermal movement.

N. Repair damaged insulation facings by applying same facing material over damaged areas. Extend patches at least 4 inches (100 mm) beyond damaged areas. Adhere, staple, and seal patches similar to butt joints.

3.4 PENETRATIONS

A. Insulation Installation at Roof Penetrations: Install insulation continuously through roof penetrations.

1. Seal penetrations with flashing sealant.
2. For applications requiring only indoor insulation, terminate insulation above roof surface and seal with joint sealant. For applications requiring indoor and outdoor insulation,

install insulation for outdoor applications tightly joined to indoor insulation ends. Seal joint with joint sealant.

3. Extend jacket of outdoor insulation outside roof flashing at least 2 inches (50 mm) below top of roof flashing.
4. Seal jacket to roof flashing with flashing sealant.

B. Insulation Installation at Aboveground Exterior Wall Penetrations: Install insulation continuously through wall penetrations.

1. Seal penetrations with flashing sealant.
2. For applications requiring only indoor insulation, terminate insulation inside wall surface and seal with joint sealant. For applications requiring indoor and outdoor insulation, install insulation for outdoor applications tightly joined to indoor insulation ends. Seal joint with joint sealant.
3. Extend jacket of outdoor insulation outside wall flashing and overlap wall flashing at least 2 inches (50 mm).
4. Seal jacket to wall flashing with flashing sealant.

C. Insulation Installation at Interior Wall and Partition Penetrations (That Are Not Fire Rated): Install insulation continuously through walls and partitions.

D. Insulation Installation at Fire-Rated Wall and Partition Penetrations: Terminate insulation at fire damper sleeves for fire-rated wall and partition penetrations. Externally insulate damper sleeves to match adjacent insulation and overlap duct insulation at least 2 inches (50 mm).

1. Comply with requirements in Section 078413 "Penetration Firestopping"irestopping and fire-resistive joint sealers.

E. Insulation Installation at Floor Penetrations:

1. Duct: For penetrations through fire-rated assemblies, terminate insulation at fire damper sleeves and externally insulate damper sleeve beyond floor to match adjacent duct insulation. Overlap damper sleeve and duct insulation at least 2 inches (50 mm).
2. Seal penetrations through fire-rated assemblies. Comply with requirements in Section 078413 "Penetration Firestopping."

3.5 INSTALLATION OF FLEXIBLE ELASTOMERIC INSULATION

A. Seal longitudinal seams and end joints with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

3.6 INSTALLATION OF MINERAL-FIBER INSULATION

A. Blanket Insulation Installation on Ducts and Plenums: Secure with adhesive and insulation pins.

1. Apply adhesives according to manufacturer's recommended coverage rates per unit area, for 100 percent coverage of duct and plenum surfaces.
2. Apply adhesive to entire circumference of ducts and to all surfaces of fittings and transitions.

3. Install either capacitor-discharge-weld pins and speed washers or cupped-head, capacitor-discharge-weld pins on sides and bottom of horizontal ducts and sides of vertical ducts as follows:

    a. On duct sides with dimensions 18 inches (450 mm) and smaller, place pins along longitudinal centerline of duct. Space 3 inches (75 mm) maximum from insulation end joints, and 16 inches (400 mm) o.c.
    b. On duct sides with dimensions larger than 18 inches (450 mm), place pins 16 inches (400 mm) o.c. each way, and 3 inches (75 mm) maximum from insulation joints. Install additional pins to hold insulation tightly against surface at cross bracing.
    c. Pins may be omitted from top surface of horizontal, rectangular ducts and plenums.
    d. Do not overcompress insulation during installation.
    e. Impale insulation over pins and attach speed washers.
    f. Cut excess portion of pins extending beyond speed washers or bend parallel with insulation surface. Cover exposed pins and washers with tape matching insulation facing.

4. For ducts and plenums with surface temperatures below ambient, install a continuous unbroken vapor barrier. Create a facing lap for longitudinal seams and end joints with insulation by removing 2 inches (50 mm) from one edge and one end of insulation segment. Secure laps to adjacent insulation section with 1/2-inch (13-mm) outward-clinching staples, 1 inch (25 mm) o.c. Install vapor barrier consisting of factory- or field-applied jacket, adhesive, vapor-barrier mastic, and sealant at joints, seams, and protrusions.

    a. Repair punctures, tears, and penetrations with tape or mastic to maintain vapor-barrier seal.
    b. Install vapor stops for ductwork and plenums operating below 50 deg F (10 deg C) at 18-foot (5.5-m) intervals. Vapor stops shall consist of vapor-barrier mastic applied in a Z-shaped pattern over insulation face, along butt end of insulation, and over the surface. Cover insulation face and surface to be insulated a width equal to two times the insulation thickness, but not less than 3 inches (75 mm).

5. Overlap unfaced blankets a minimum of 2 inches (50 mm) on longitudinal seams and end joints. At end joints, secure with steel bands spaced a maximum of 18 inches (450 mm) o.c.
6. Install insulation on rectangular duct elbows and transitions with a full insulation section for each surface. Install insulation on round and flat-oval duct elbows with individually mitered gores cut to fit the elbow.
7. Insulate duct stiffeners, hangers, and flanges that protrude beyond insulation surface with 6-inch- (150-mm-) wide strips of same material used to insulate duct. Secure on alternating sides of stiffener, hanger, and flange with pins spaced 6 inches (150 mm) o.c.

B. Board Insulation Installation on Ducts and Plenums: Secure with adhesive and insulation pins.

1. Apply adhesives according to manufacturer's recommended coverage rates per unit area, for 100 percent coverage of duct and plenum surfaces.
2. Apply adhesive to entire circumference of ducts and to all surfaces of fittings and transitions.

3. Install either capacitor-discharge-weld pins and speed washers or cupped-head, capacitor-discharge-weld pins on sides and bottom of horizontal ducts and sides of vertical ducts as follows:

    a. On duct sides with dimensions 18 inches (450 mm) and smaller, place pins along longitudinal centerline of duct. Space 3 inches (75 mm) maximum from insulation end joints, and 16 inches (400 mm) o.c.
    b. On duct sides with dimensions larger than 18 inches (450 mm), space pins 16 inches (400 mm) o.c. each way, and 3 inches (75 mm) maximum from insulation joints. Install additional pins to hold insulation tightly against surface at cross bracing.
    c. Pins may be omitted from top surface of horizontal, rectangular ducts and plenums.
    d. Do not overcompress insulation during installation.
    e. Cut excess portion of pins extending beyond speed washers or bend parallel with insulation surface. Cover exposed pins and washers with tape matching insulation facing.

4. For ducts and plenums with surface temperatures below ambient, install a continuous unbroken vapor barrier. Create a facing lap for longitudinal seams and end joints with insulation by removing 2 inches (50 mm) from one edge and one end of insulation segment. Secure laps to adjacent insulation section with 1/2-inch (13-mm) outward-clinching staples, 1 inch (25 mm) o.c. Install vapor barrier consisting of factory- or field-applied jacket, adhesive, vapor-barrier mastic, and sealant at joints, seams, and protrusions.

    a. Repair punctures, tears, and penetrations with tape or mastic to maintain vapor-barrier seal.
    b. Install vapor stops for ductwork and plenums operating below 50 deg F (10 deg C) at 18-foot (5.5-m) intervals. Vapor stops shall consist of vapor-barrier mastic applied in a Z-shaped pattern over insulation face, along butt end of insulation, and over the surface. Cover insulation face and surface to be insulated a width equal to two times the insulation thickness, but not less than 3 inches (75 mm).

5. Install insulation on rectangular duct elbows and transitions with a full insulation section for each surface. Groove and score insulation to fit as closely as possible to outside and inside radius of elbows. Install insulation on round and flat-oval duct elbows with individually mitered gores cut to fit the elbow.
6. Insulate duct stiffeners, hangers, and flanges that protrude beyond insulation surface with 6-inch- (150-mm-) wide strips of same material used to insulate duct. Secure on alternating sides of stiffener, hanger, and flange with pins spaced 6 inches (150 mm) o.c.

3.7 FIELD-APPLIED JACKET INSTALLATION

A. Where glass-cloth jackets are indicated, install directly over bare insulation or insulation with factory-applied jackets.

    1. Draw jacket smooth and tight to surface with 2-inch (50-mm) overlap at seams and joints.
    2. Completely encapsulate insulation with coating, leaving no exposed insulation.

B. Where FSK jackets are indicated, install as follows:

1. Draw jacket material smooth and tight.
2. Install lap or joint strips with same material as jacket.
3. Secure jacket to insulation with manufacturer's recommended adhesive.
4. Install jacket with 1-1/2-inch (38-mm) laps at longitudinal seams and 3-inch- (75-mm-) wide joint strips at end joints.
5. Seal openings, punctures, and breaks in vapor-retarder jackets and exposed insulation with vapor-barrier mastic.

C. Where PVC jackets are indicated, install with 1-inch (25-mm) overlap at longitudinal seams and end joints; for horizontal applications, install with longitudinal seams along top and bottom of tanks and vessels. Seal with manufacturer's recommended adhesive.

1. Apply two continuous beads of adhesive to seams and joints, one bead under lap and the finish bead along seam and joint edge.

D. Where metal jackets are indicated, install with 2-inch (50-mm) overlap at longitudinal seams and end joints. Overlap longitudinal seams arranged to shed water. Seal end joints with weatherproof sealant recommended by insulation manufacturer. Secure jacket with stainless-steel bands 12 inches (300 mm) o.c. and at end joints.

3.8 FIRE-RATED INSULATION SYSTEM INSTALLATION

A. Where fire-rated insulation system is indicated, secure system to ducts and duct hangers and supports to maintain a continuous fire rating.

B. Insulate duct access panels and doors to achieve same fire rating as duct.

C. Install firestopping at penetrations through fire-rated assemblies. Fire-stop systems are specified in Section 078413 "Penetration Firestopping."

3.9 FINISHES

A. Insulation with ASJ, Glass-Cloth, or Other Paintable Jacket Material: Paint jacket with paint system identified below and as specified in Section 099113 "Exterior Painting" and Section 099123 "Interior Painting."

1. Flat Acrylic Finish: Two finish coats over a primer that is compatible with jacket material and finish coat paint. Add fungicidal agent to render fabric mildew proof.

a. Finish Coat Material: Interior, flat, latex-emulsion size.

B. Flexible Elastomeric Thermal Insulation: After adhesive has fully cured, apply two coats of insulation manufacturer's recommended protective coating.

C. Color: Final color as selected by Architect. Vary first and second coats to allow visual inspection of the completed Work.

D. Do not field paint aluminum or stainless-steel jackets.

3.10 FIELD QUALITY CONTROL

A. Testing Agency: Owner will engage a qualified testing agency to perform tests and inspections.

Retain first paragraph below to require Contractor to perform tests and inspections.

B. Perform tests and inspections.

C. Tests and Inspections:

1. Inspect ductwork, randomly selected by Architect, by removing field-applied jacket and insulation in layers in reverse order of their installation. Extent of inspection shall be limited to one location(s) for each duct system defined in the "Duct Insulation Schedule, General" Article.

D. All insulation applications will be considered defective Work if sample inspection reveals noncompliance with requirements.

3.11 DUCT INSULATION SCHEDULE, GENERAL

A. Plenums and Ducts Requiring Insulation:

1. Indoor, concealed supply and outdoor air.
2. Indoor, exposed supply and outdoor air.
3. Indoor, concealed return located in unconditioned space.
4. Indoor, exposed return located in unconditioned space.
5. Outdoor, concealed supply and return.
6. Outdoor, exposed supply and return.

B. Items Not Insulated:

1. Fibrous-glass ducts.
2. Metal ducts with duct liner of sufficient thickness to comply with energy code and ASHRAE/IESNA 90.1.
3. Factory-insulated flexible ducts.
4. Factory-insulated plenums and casings.
5. Flexible connectors.
6. Vibration-control devices.
7. Factory-insulated access panels and doors.

3.12 INDOOR DUCT AND PLENUM INSULATION SCHEDULE

A. Concealed, supply-air duct insulation shall be the following:
1. Mineral-Fiber Blanket: 3 inches (75 mm) thick and 3-lb/cu. ft. (48-kg/cu. m) nominal density.
2. Mineral-Fiber Board: 3 inches (75 mm) thick and 6-lb/cu. ft. (96-kg/cu. m) nominal density.

B. Concealed, return-air duct insulation shall be the following:

1. Mineral-Fiber Blanket: 3 inches (75 mm) thick and 3-lb/cu. ft. (48-kg/cu. m) nominal density.
2. Mineral-Fiber Board: 3 inches (75 mm) thick and 6-lb/cu. ft. (96-kg/cu. m) nominal density.

C. Concealed, outdoor-air duct insulation shall be the following:
1. Mineral-Fiber Blanket: 3 inches (75 mm) thick and 3-lb/cu. ft. (48-kg/cu. m) nominal density.
2. Mineral-Fiber Board: 3 inches (75) thick and 6-lb/cu. ft. (96-kg/cu. m) nominal density.

D. Exposed, supply-air duct insulation shall be the following:
1. Mineral-Fiber Blanket: 3 inches (75 mm) thick and 3-lb/cu. ft. (48-kg/cu. m) nominal density.
2. Mineral-Fiber Board: 3 inches (75 mm) thick and 3-lb/cu. ft. (48-kg/cu. m)] [6-lb/cu. ft. (96-kg/cu. m) nominal density.
3. Mineral-Fiber Pipe and Tank: 3 inches (75 mm) thick.

E. Exposed, return-air duct insulation shall be the following:
1. Mineral-Fiber Blanket: 3 inches (75 mm) thick and 3-lb/cu. ft. (48-kg/cu. m) nominal density.
2. Mineral-Fiber Board: 3 inches (75 mm) thick and 6-lb/cu. ft. (96-kg/cu. m) nominal density.
3. Mineral-Fiber Pipe and Tank: 3 inches (75 mm) thick.

F. Exposed, outdoor-air duct insulation shall be the following:
1. Mineral-Fiber Blanket: 3 inches (75 mm) thick and 3-lb/cu. ft. (48-kg/cu. m) nominal density.
2. Mineral-Fiber Board: 3 inches (75 mm) thick and 6-lb/cu. ft. (96-kg/cu. m) nominal density.
3. Mineral-Fiber Pipe and Tank: 3 inches (75 mm) thick.

END OF SECTION 230713

SECTION 230593 - TESTING, ADJUSTING, AND BALANCING FOR HVAC

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Balancing Air Systems:

a. Constant-volume air systems.
b. Dual-duct systems.
c. Variable-air-volume systems.

2. Balancing Hydronic Piping Systems:

a. Constant-flow hydronic systems.
b. Variable-flow hydronic systems.
c. Primary-secondary hydronic systems.

1.3 DEFINITIONS

A. AABC: Associated Air Balance Council.

B. NEBB: National Environmental Balancing Bureau.

C. TAB: Testing, adjusting, and balancing.

D. TABB: Testing, Adjusting, and Balancing Bureau.

E. TAB Specialist: An entity engaged to perform TAB Work.

1.4 SUBMITTALS

A. LEED Submittal:

1. Air-Balance Report for LEED Prerequisite EQ 1: Documentation of work performed for ASHRAE 62.1-2004, Section 7.2.2, "Air Balancing."

B. Qualification Data: Within 30 days of Contractor's Notice to Proceed, submit documentation that the TAB contractor and this Project's TAB team members meet the qualifications specified in "Quality Assurance" Article.

C. Contract Documents Examination Report: Within 30 days of Contractor's Notice to Proceed, submit the Contract Documents review report as specified in Part 3.

D. Strategies and Procedures Plan: Within 60 days of Contractor's Notice to Proceed, submit TAB strategies and step-by-step procedures as specified in "Preparation" Article.

E. Certified TAB reports.

F. Sample report forms.

G. Instrument calibration reports, to include the following:

1. Instrument type and make.
2. Serial number.
3. Application.
4. Dates of use.
5. Dates of calibration.

1.5 QUALITY ASSURANCE

A. TAB Contractor Qualifications: Engage a TAB entity certified by AABC NEBB .

1. TAB Field Supervisor: Employee of the TAB contractor and certified by AABC or NEBB .
2. TAB Technician: Employee of the TAB contractor and who is certified by AABC or NEBB as a TAB technician.

B. TAB Conference: Meet with Architect Owner, Construction Manager or Commissioning Authority on approval of the TAB strategies and procedures plan to develop a mutual understanding of the details. Require the participation of the TAB field supervisor and technicians. Provide seven days' advance notice of scheduled meeting time and location.

1. Agenda Items:

a. The Contract Documents examination report.
b. The TAB plan.
c. Coordination and cooperation of trades and subcontractors.
d. Coordination of documentation and communication flow.

C. Certify TAB field data reports and perform the following:

1. Review field data reports to validate accuracy of data and to prepare certified TAB reports.
2. Certify that the TAB team complied with the approved TAB plan and the procedures specified and referenced in this Specification.

D. TAB Report Forms: Use standard TAB contractor's forms approved by Architect .

E. Instrumentation Type, Quantity, Accuracy, and Calibration: As described in ASHRAE 111, Section 5, "Instrumentation."

1.6 PROJECT CONDITIONS

A. Full Owner Occupancy: Owner will occupy the site and existing building during entire TAB period. Cooperate with Owner during TAB operations to minimize conflicts with Owner's operations.

B. Partial Owner Occupancy: Owner may occupy completed areas of building before Substantial Completion. Cooperate with Owner during TAB operations to minimize conflicts with Owner's operations.

1.7 COORDINATION

A. Notice: Provide seven days' advance notice for each test. Include scheduled test dates and times.

B. Perform TAB after leakage and pressure tests on air and water distribution systems have been satisfactorily completed.

PART 2 - PRODUCTS (Not Applicable)

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine the Contract Documents to become familiar with Project requirements and to discover conditions in systems' designs that may preclude proper TAB of systems and equipment.

B. Examine systems for installed balancing devices, such as test ports, gage cocks, thermometer wells, flow-control devices, balancing valves and fittings, and manual volume dampers. Verify that locations of these balancing devices are accessible.

C. Examine the approved submittals for HVAC systems and equipment.

D. Examine design data including HVAC system descriptions, statements of design assumptions for environmental conditions and systems' output, and statements of philosophies and assumptions about HVAC system and equipment controls.

E. Examine ceiling plenums and underfloor air plenums used for supply, return, or relief air to verify that they meet the leakage class of connected ducts as specified in Division 23 Section "Metal Ducts " and are properly separated from adjacent areas. Verify that penetrations in plenum walls are sealed and fire-stopped if required.

F. Examine equipment performance data including fan and pump curves.

1. Relate performance data to Project conditions and requirements, including system effects that can create undesired or unpredicted conditions that cause reduced capacities in all or part of a system.
2. Calculate system-effect factors to reduce performance ratings of HVAC equipment when installed under conditions different from the conditions used to rate equipment performance. To calculate system effects for air systems, use tables and charts found in AMCA 201, "Fans and Systems," or in SMACNA's "HVAC Systems - Duct Design." Compare results with the design data and installed conditions.

G. Examine system and equipment installations and verify that field quality-control testing, cleaning, and adjusting specified in individual Sections have been performed.

H. Examine test reports specified in individual system and equipment Sections.

I. Examine HVAC equipment and filters and verify that bearings are greased, belts are aligned and tight, and equipment with functioning controls is ready for operation.

J. Examine terminal units, such as variable-air-volume boxes, and verify that they are accessible and their controls are connected and functioning.

K. Examine strainers. Verify that startup screens are replaced by permanent screens with indicated perforations.

L. Examine three-way valves for proper installation for their intended function of diverting or mixing fluid flows.

M. Examine heat-transfer coils for correct piping connections and for clean and straight fins.

N. Examine system pumps to ensure absence of entrained air in the suction piping.

O. Examine operating safety interlocks and controls on HVAC equipment.

P. Report deficiencies discovered before and during performance of TAB procedures. Observe and record system reactions to changes in conditions. Record default set points if different from indicated values.

3.2 PREPARATION

A. Prepare a TAB plan that includes strategies and step-by-step procedures.

B. Complete system-readiness checks and prepare reports. Verify the following:

1. Permanent electrical-power wiring is complete.
2. Hydronic systems are filled, clean, and free of air.
3. Automatic temperature-control systems are operational.
4. Equipment and duct access doors are securely closed.
5. Balance, smoke, and fire dampers are open.
6. Isolating and balancing valves are open and control valves are operational.

7. Ceilings are installed in critical areas where air-pattern adjustments are required and access to balancing devices is provided.
8. Windows and doors can be closed so indicated conditions for system operations can be met.

3.3 GENERAL PROCEDURES FOR TESTING AND BALANCING

A. Perform testing and balancing procedures on each system according to the procedures contained in AABC's "National Standards for Total System Balance", ASHRAE 111, NEBB's "Procedural Standards for Testing, Adjusting, and Balancing of Environmental Systems" and in this Section.

1. Comply with requirements in ASHRAE 62.1-2004, Section 7.2.2, "Air Balancing."

B. Cut insulation, ducts, pipes, and equipment cabinets for installation of test probes to the minimum extent necessary for TAB procedures.

1. After testing and balancing, patch probe holes in ducts with same material and thickness as used to construct ducts.
2. After testing and balancing, install test ports and duct access doors that comply with requirements in Division 23 Section "Air Duct Accessories."
3. Install and join new insulation that matches removed materials. Restore insulation, coverings, vapor barrier, and finish according to Division 23 Section "HVAC Insulation."

C. Mark equipment and balancing devices, including damper-control positions, valve position indicators, fan-speed-control levers, and similar controls and devices, with paint or other suitable, permanent identification material to show final settings.

D. Take and report testing and balancing measurements in inch-pound (IP) units.

3.4 GENERAL PROCEDURES FOR BALANCING AIR SYSTEMS

A. Prepare test reports for both fans and outlets. Obtain manufacturer's outlet factors and recommended testing procedures. Crosscheck the summation of required outlet volumes with required fan volumes.

B. Prepare schematic diagrams of systems' "as-built" duct layouts.

C. For variable-air-volume systems, develop a plan to simulate diversity.

D. Determine the best locations in main and branch ducts for accurate duct-airflow measurements.

E. Check airflow patterns from the outdoor-air louvers and dampers and the return- and exhaust-air dampers through the supply-fan discharge and mixing dampers.

F. Locate start-stop and disconnect switches, electrical interlocks, and motor starters.

G. Verify that motor starters are equipped with properly sized thermal protection.

H. Check dampers for proper position to achieve desired airflow path.

I. Check for airflow blockages.

J. Check condensate drains for proper connections and functioning.

K. Check for proper sealing of air-handling-unit components.

L. Verify that air duct system is sealed as specified in Division 23 Section "Metal Ducts."

3.5 PROCEDURES FOR CONSTANT-VOLUME AIR SYSTEMS

A. Adjust fans to deliver total indicated airflows within the maximum allowable fan speed listed by fan manufacturer.

1. Measure total airflow.

    a. Where sufficient space in ducts is unavailable for Pitot-tube traverse measurements, measure airflow at terminal outlets and inlets and calculate the total airflow.

2. Measure fan static pressures as follows to determine actual static pressure:

    a. Measure outlet static pressure as far downstream from the fan as practical and upstream from restrictions in ducts such as elbows and transitions.
    b. Measure static pressure directly at the fan outlet or through the flexible connection.
    c. Measure inlet static pressure of single-inlet fans in the inlet duct as near the fan as possible, upstream from the flexible connection, and downstream from duct restrictions.
    d. Measure inlet static pressure of double-inlet fans through the wall of the plenum that houses the fan.

3. Measure static pressure across each component that makes up an air-handling unit, rooftop unit, and other air-handling and -treating equipment.

    a. Report the cleanliness status of filters and the time static pressures are measured.

4. Measure static pressures entering and leaving other devices, such as sound traps, heat-recovery equipment, and air washers, under final balanced conditions.
5. Review Record Documents to determine variations in design static pressures versus actual static pressures. Calculate actual system-effect factors. Recommend adjustments to accommodate actual conditions.
6. Obtain approval from Architect for adjustment of fan speed higher or lower than indicated speed. Comply with requirements in Division 23 Sections for air-handling units for adjustment of fans, belts, and pulley sizes to achieve indicated air-handling-unit performance.
7. Do not make fan-speed adjustments that result in motor overload. Consult equipment manufacturers about fan-speed safety factors. Modulate dampers and measure fan-motor amperage to ensure that no overload will occur. Measure amperage in full-cooling, full-heating, economizer, and any other operating mode to determine the maximum required brake horsepower.

B. Adjust volume dampers for main duct, submain ducts, and major branch ducts to indicated airflows within specified tolerances.

1. Measure airflow of submain and branch ducts.

a. Where sufficient space in submain and branch ducts is unavailable for Pitot-tube traverse measurements, measure airflow at terminal outlets and inlets and calculate the total airflow for that zone.

2. Measure static pressure at a point downstream from the balancing damper, and adjust volume dampers until the proper static pressure is achieved.
3. Remeasure each submain and branch duct after all have been adjusted. Continue to adjust submain and branch ducts to indicated airflows within specified tolerances.

C. Measure air outlets and inlets without making adjustments.

1. Measure terminal outlets using a direct-reading hood or outlet manufacturer's written instructions and calculating factors.

D. Adjust air outlets and inlets for each space to indicated airflows within specified tolerances of indicated values. Make adjustments using branch volume dampers rather than extractors and the dampers at air terminals.

1. Adjust each outlet in same room or space to within specified tolerances of indicated quantities without generating noise levels above the limitations prescribed by the Contract Documents.
2. Adjust patterns of adjustable outlets for proper distribution without drafts.

3.6 PROCEDURES FOR VARIABLE-AIR-VOLUME SYSTEMS

A. Compensating for Diversity: When the total airflow of all terminal units is more than the indicated airflow of the fan, place a selected number of terminal units at a minimum set-point airflow with the remainder at maximum-airflow condition until the total airflow of the terminal units equals the indicated airflow of the fan. Select the reduced-airflow terminal units so they are distributed evenly among the branch ducts.

B. Pressure-Independent, Variable-Air-Volume Systems: After the fan systems have been adjusted, adjust the variable-air-volume systems as follows:

1. Set outdoor-air dampers at minimum, and set return- and exhaust-air dampers at a position that simulates full-cooling load.
2. Select the terminal unit that is most critical to the supply-fan airflow and static pressure. Measure static pressure. Adjust system static pressure so the entering static pressure for the critical terminal unit is not less than the sum of the terminal-unit manufacturer's recommended minimum inlet static pressure plus the static pressure needed to overcome terminal-unit discharge system losses.
3. Measure total system airflow. Adjust to within indicated airflow.
4. Set terminal units at maximum airflow and adjust controller or regulator to deliver the designed maximum airflow. Use terminal-unit manufacturer's written instructions to

make this adjustment. When total airflow is correct, balance the air outlets downstream from terminal units the same as described for constant-volume air systems.

5. Set terminal units at minimum airflow and adjust controller or regulator to deliver the designed minimum airflow. Check air outlets for a proportional reduction in airflow the same as described for constant-volume air systems.

    a. If air outlets are out of balance at minimum airflow, report the condition but leave outlets balanced for maximum airflow.

6. Re-measure the return airflow to the fan while operating at maximum return airflow and minimum outdoor airflow.

    a. Adjust the fan and balance the return-air ducts and inlets the same as described for constant-volume air systems.

7. Measure static pressure at the most critical terminal unit and adjust the static-pressure controller at the main supply-air sensing station to ensure that adequate static pressure is maintained at the most critical unit.
8. Record final fan-performance data.

3.7 GENERAL PROCEDURES FOR HYDRONIC SYSTEMS

A. Prepare test reports with pertinent design data, and number in sequence starting at pump to end of system. Check the sum of branch-circuit flows against the approved pump flow rate. Correct variations that exceed plus or minus 5 percent.

B. Prepare schematic diagrams of systems' "as-built" piping layouts.

C. Prepare hydronic systems for testing and balancing according to the following, in addition to the general preparation procedures specified above:

1. Open all manual valves for maximum flow.
2. Check liquid level in expansion tank.
3. Check makeup water-station pressure gage for adequate pressure for highest vent.
4. Check flow-control valves for specified sequence of operation, and set at indicated flow.
5. Set differential-pressure control valves at the specified differential pressure. Do not set at fully closed position when pump is positive-displacement type unless several terminal valves are kept open.
6. Set system controls so automatic valves are wide open to heat exchangers.
7. Check pump-motor load. If motor is overloaded, throttle main flow-balancing device so motor nameplate rating is not exceeded.
8. Check air vents for a forceful liquid flow exiting from vents when manually operated.

3.8 PROCEDURES FOR CONSTANT-FLOW HYDRONIC SYSTEMS

A. Measure water flow at pumps. Use the following procedures except for positive-displacement pumps:

1. Verify impeller size by operating the pump with the discharge valve closed. Read pressure differential across the pump. Convert pressure to head and correct for differences in gage heights. Note the point on manufacturer's pump curve at zero flow and verify that the pump has the intended impeller size.

    a. If impeller sizes must be adjusted to achieve pump performance, obtain approval from Architect and comply with requirements in Division 23 Section "Hydronic Pumps."

2. Check system resistance. With all valves open, read pressure differential across the pump and mark pump manufacturer's head-capacity curve. Adjust pump discharge valve until indicated water flow is achieved.

    a. Monitor motor performance during procedures and do not operate motors in overload conditions.

3. Verify pump-motor brake horsepower. Calculate the intended brake horsepower for the system based on pump manufacturer's performance data. Compare calculated brake horsepower with nameplate data on the pump motor. Report conditions where actual amperage exceeds motor nameplate amperage.
4. Report flow rates that are not within plus or minus 10 percent of design.

B. Measure flow at all automatic flow control valves to verify that valves are functioning as designed.

C. Measure flow at all pressure-independent characterized control valves, with valves in fully open position, to verify that valves are functioning as designed.

D. Set calibrated balancing valves, if installed, at calculated presettings.

E. Measure flow at all stations and adjust, where necessary, to obtain first balance.

1. System components that have Cv rating or an accurately cataloged flow-pressure-drop relationship may be used as a flow-indicating device.

F. Measure flow at main balancing station and set main balancing device to achieve flow that is 5 percent greater than indicated flow.

G. Adjust balancing stations to within specified tolerances of indicated flow rate as follows:

1. Determine the balancing station with the highest percentage over indicated flow.
2. Adjust each station in turn, beginning with the station with the highest percentage over indicated flow and proceeding to the station with the lowest percentage over indicated flow.
3. Record settings and mark balancing devices.

H. Measure pump flow rate and make final measurements of pump amperage, voltage, rpm, pump heads, and systems' pressures and temperatures including outdoor-air temperature.

I. Measure the differential-pressure-control-valve settings existing at the conclusion of balancing.

J. Check settings and operation of each safety valve. Record settings.

3.9 PROCEDURES FOR VARIABLE-FLOW HYDRONIC SYSTEMS

A. Balance systems with automatic two- and three-way control valves by setting systems at maximum flow through heat-exchange terminals and proceed as specified above for hydronic systems.

3.10 PROCEDURES FOR PRIMARY-SECONDARY HYDRONIC SYSTEMS

A. Balance the primary circuit flow first and then balance the secondary circuits.

3.11 PROCEDURES FOR HEAT EXCHANGERS

A. Measure water flow through all circuits.

B. Adjust water flow to within specified tolerances.

C. Measure inlet and outlet water temperatures.

D. Measure inlet steam pressure.

E. Check settings and operation of safety and relief valves. Record settings.

3.12 PROCEDURES FOR MOTORS

A. Motors, 1/2 HP and Larger: Test at final balanced conditions and record the following data:

1. Manufacturer's name, model number, and serial number.
2. Motor horsepower rating.
3. Motor rpm.
4. Efficiency rating.
5. Nameplate and measured voltage, each phase.
6. Nameplate and measured amperage, each phase.
7. Starter thermal-protection-element rating.

B. Motors Driven by Variable-Frequency Controllers: Test for proper operation at speeds varying from minimum to maximum. Test the manual bypass of the controller to prove proper operation. Record observations including name of controller manufacturer, model number, serial number, and nameplate data.

3.13 PROCEDURES FOR CHILLERS

A. Balance water flow through each evaporator and condenser to within specified tolerances of indicated flow with all pumps operating. With only one chiller operating in a multiple chiller installation, do not exceed the flow for the maximum tube velocity recommended by the chiller

manufacturer. Measure and record the following data with each chiller operating at design conditions:

1. Evaporator-water entering and leaving temperatures, pressure drop, and water flow.
2. For water-cooled chillers, condenser-water entering and leaving temperatures, pressure drop, and water flow.
3. Evaporator and condenser refrigerant temperatures and pressures, using instruments furnished by chiller manufacturer.
4. Power factor if factory-installed instrumentation is furnished for measuring kilowatts.
5. Kilowatt input if factory-installed instrumentation is furnished for measuring kilowatts.
6. Capacity: Calculate in tons of cooling.
7. For air-cooled chillers, verify condenser-fan rotation and record fan and motor data including number of fans and entering- and leaving-air temperatures.

3.14 PROCEDURES FOR COOLING TOWERS

A. Shut off makeup water for the duration of the test, and verify that makeup and blowdown systems are fully operational after tests and before leaving the equipment. Perform the following tests and record the results:

1. Measure condenser-water flow to each cell of the cooling tower.
2. Measure entering- and leaving-water temperatures.
3. Measure wet- and dry-bulb temperatures of entering air.
4. Measure wet- and dry-bulb temperatures of leaving air.
5. Measure condenser-water flow rate recirculating through the cooling tower.
6. Measure cooling-tower spray pump discharge pressure.
7. Adjust water level and feed rate of makeup water system.
8. Measure flow through bypass.

3.15 PROCEDURES FOR CONDENSING UNITS

A. Verify proper rotation of fans.

B. Measure entering- and leaving-air temperatures.

C. Record compressor data.

3.16 PROCEDURES FOR BOILERS

A. Hydronic Boilers: Measure and record entering- and leaving-water temperatures and water flow.

B. Steam Boilers: Measure and record entering-water temperature and flow and leaving-steam pressure, temperature, and flow.

3.17 PROCEDURES FOR HEAT-TRANSFER COILS

A. Measure, adjust, and record the following data for each water coil:

1. Entering- and leaving-water temperature.
2. Water flow rate.
3. Water pressure drop.
4. Dry-bulb temperature of entering and leaving air.
5. Wet-bulb temperature of entering and leaving air for cooling coils.
6. Airflow.
7. Air pressure drop.

B. Measure, adjust, and record the following data for each electric heating coil:

1. Nameplate data.
2. Airflow.
3. Entering- and leaving-air temperature at full load.
4. Voltage and amperage input of each phase at full load and at each incremental stage.
5. Calculated kilowatt at full load.
6. Fuse or circuit-breaker rating for overload protection.

C. Measure, adjust, and record the following data for each steam coil:

1. Dry-bulb temperature of entering and leaving air.
2. Airflow.
3. Air pressure drop.
4. Inlet steam pressure.

D. Measure, adjust, and record the following data for each refrigerant coil:

1. Dry-bulb temperature of entering and leaving air.
2. Wet-bulb temperature of entering and leaving air.
3. Airflow.
4. Air pressure drop.
5. Refrigerant suction pressure and temperature.

3.18 PROCEDURES FOR TESTING, ADJUSTING, AND BALANCING EXISTING SYSTEMS

A. Perform a preconstruction inspection of existing equipment that is to remain and be reused.

1. Measure and record the operating speed, airflow, and static pressure of each fan.
2. Measure motor voltage and amperage. Compare the values to motor nameplate information.
3. Check the refrigerant charge.
4. Check the condition of filters.
5. Check the condition of coils.
6. Check the operation of the drain pan and condensate-drain trap.
7. Check bearings and other lubricated parts for proper lubrication.
8. Report on the operating condition of the equipment and the results of the measurements taken. Report deficiencies.

B. Before performing testing and balancing of existing systems, inspect existing equipment that is to remain and be reused to verify that existing equipment has been cleaned and refurbished. Verify the following:

1. New filters are installed.
2. Coils are clean and fins combed.
3. Drain pans are clean.
4. Fans are clean.
5. Bearings and other parts are properly lubricated.
6. Deficiencies noted in the preconstruction report are corrected.

C. Perform testing and balancing of existing systems to the extent that existing systems are affected by the renovation work.

1. Compare the indicated airflow of the renovated work to the measured fan airflows, and determine the new fan speed and the face velocity of filters and coils.
2. Verify that the indicated airflows of the renovated work result in filter and coil face velocities and fan speeds that are within the acceptable limits defined by equipment manufacturer.
3. If calculations increase or decrease the air flow rates and water flow rates by more than 5 percent, make equipment adjustments to achieve the calculated rates. If increase or decrease is 5 percent or less, equipment adjustments are not required.
4. Balance each air outlet.

3.19 TOLERANCES

A. Set HVAC system's air flow rates and water flow rates within the following tolerances:

1. Supply, Return, and Exhaust Fans and Equipment with Fans: Plus or minus 10 percent.
2. Air Outlets and Inlets: Plus or minus 10 percent.
3. Heating-Water Flow Rate: Plus or minus 10 percent.
4. Cooling-Water Flow Rate: Plus or minus 10 percent.

3.20 REPORTING

A. Initial Construction-Phase Report: Based on examination of the Contract Documents as specified in "Examination" Article, prepare a report on the adequacy of design for systems' balancing devices. Recommend changes and additions to systems' balancing devices to facilitate proper performance measuring and balancing. Recommend changes and additions to HVAC systems and general construction to allow access for performance measuring and balancing devices.

B. Status Reports: Prepare biweekly progress reports to describe completed procedures, procedures in progress, and scheduled procedures. Include a list of deficiencies and problems found in systems being tested and balanced. Prepare a separate report for each system and each building floor for systems serving multiple floors.

3.21 FINAL REPORT

A. General: Prepare a certified written report; tabulate and divide the report into separate sections for tested systems and balanced systems.

1. Include a certification sheet at the front of the report's binder, signed and sealed by the certified testing and balancing engineer.
2. Include a list of instruments used for procedures, along with proof of calibration.

B. Final Report Contents: In addition to certified field-report data, include the following:

1. Pump curves.
2. Fan curves.
3. Manufacturers' test data.
4. Field test reports prepared by system and equipment installers.
5. Other information relative to equipment performance; do not include Shop Drawings and product data.

C. General Report Data: In addition to form titles and entries, include the following data:

1. Title page.
2. Name and address of the TAB contractor.
3. Project name.
4. Project location.
5. Architect's name and address.
6. Engineer's name and address.
7. Contractor's name and address.
8. Report date.
9. Signature of TAB supervisor who certifies the report.
10. Table of Contents with the total number of pages defined for each section of the report. Number each page in the report.
11. Summary of contents including the following:

    a. Indicated versus final performance.
    b. Notable characteristics of systems.
    c. Description of system operation sequence if it varies from the Contract Documents.

12. Nomenclature sheets for each item of equipment.
13. Data for terminal units, including manufacturer's name, type, size, and fittings.
14. Notes to explain why certain final data in the body of reports vary from indicated values.
15. Test conditions for fans and pump performance forms including the following:

    a. Settings for outdoor-, return-, and exhaust-air dampers.
    b. Conditions of filters.
    c. Cooling coil, wet- and dry-bulb conditions.
    d. Face and bypass damper settings at coils.
    e. Fan drive settings including settings and percentage of maximum pitch diameter.
    f. Inlet vane settings for variable-air-volume systems.
    g. Settings for supply-air, static-pressure controller.
    h. Other system operating conditions that affect performance.

D. System Diagrams: Include schematic layouts of air and hydronic distribution systems. Present each system with single-line diagram and include the following:

1. Quantities of outdoor, supply, return, and exhaust airflows.

2. Water and steam flow rates.
3. Duct, outlet, and inlet sizes.
4. Pipe and valve sizes and locations.
5. Terminal units.
6. Balancing stations.
7. Position of balancing devices.

E. Air-Handling-Unit Test Reports: For air-handling units with coils, include the following:

1. Unit Data:

   a. Unit identification.
   b. Location.
   c. Make and type.
   d. Model number and unit size.
   e. Manufacturer's serial number.
   f. Unit arrangement and class.
   g. Discharge arrangement.
   h. Sheave make, size in inches, and bore.
   i. Center-to-center dimensions of sheave, and amount of adjustments in inches.
   j. Number, make, and size of belts.
   k. Number, type, and size of filters.

2. Motor Data:

   a. Motor make, and frame type and size.
   b. Horsepower and rpm.
   c. Volts, phase, and hertz.
   d. Full-load amperage and service factor.
   e. Sheave make, size in inches, and bore.
   f. Center-to-center dimensions of sheave, and amount of adjustments in inches.

3. Test Data (Indicated and Actual Values):

   a. Total air flow rate in cfm.
   b. Total system static pressure in inches wg.
   c. Fan rpm.
   d. Discharge static pressure in inches wg.
   e. Filter static-pressure differential in inches wg.
   f. Preheat-coil static-pressure differential in inches wg.
   g. Cooling-coil static-pressure differential in inches wg.
   h. Heating-coil static-pressure differential in inches wg.
   i. Outdoor airflow in cfm.
   j. Return airflow in cfm.
   k. Outdoor-air damper position.
   l. Return-air damper position.
   m. Vortex damper position.

F. Apparatus-Coil Test Reports:

1. Coil Data:

a. System identification.
b. Location.
c. Coil type.
d. Number of rows.
e. Fin spacing in fins per inch o.c.
f. Make and model number.
g. Face area in sq. ft..
h. Tube size in NPS.
i. Tube and fin materials.
j. Circuiting arrangement.

2. Test Data (Indicated and Actual Values):

a. Air flow rate in cfm.
b. Average face velocity in fpm.
c. Air pressure drop in inches wg.
d. Outdoor-air, wet- and dry-bulb temperatures in deg F.
e. Return-air, wet- and dry-bulb temperatures in deg F.
f. Entering-air, wet- and dry-bulb temperatures in deg F.
g. Leaving-air, wet- and dry-bulb temperatures in deg F.
h. Water flow rate in gpm.
i. Water pressure differential in feet of head or psig.
j. Entering-water temperature in deg F.
k. Leaving-water temperature in deg F.
l. Refrigerant expansion valve and refrigerant types.
m. Refrigerant suction pressure in psig.
n. Refrigerant suction temperature in deg F.
o. Inlet steam pressure in psig.

G. Electric-Coil Test Reports: For electric furnaces, duct coils, and electric coils installed in central-station air-handling units, include the following:

1. Unit Data:

a. System identification.
b. Location.
c. Coil identification.
d. Capacity in Btu/h.
e. Number of stages.
f. Connected volts, phase, and hertz.
g. Rated amperage.
h. Air flow rate in cfm.
i. Face area in sq. ft..
j. Minimum face velocity in fpm.

2. Test Data (Indicated and Actual Values):

a. Heat output in Btu/h.
b. Air flow rate in cfm.
c. Air velocity in fpm.
d. Entering-air temperature in deg F.

e. Leaving-air temperature in deg F.
f. Voltage at each connection.
g. Amperage for each phase.

H. Fan Test Reports: For supply, return, and exhaust fans, include the following:

1. Fan Data:

a. System identification.
b. Location.
c. Make and type.
d. Model number and size.
e. Manufacturer's serial number.
f. Arrangement and class.
g. Sheave make, size in inches, and bore.
h. Center-to-center dimensions of sheave, and amount of adjustments in inches.

2. Motor Data:

a. Motor make, and frame type and size.
b. Horsepower and rpm.
c. Volts, phase, and hertz.
d. Full-load amperage and service factor.
e. Sheave make, size in inches, and bore.
f. Center-to-center dimensions of sheave, and amount of adjustments in inches.
g. Number, make, and size of belts.

3. Test Data (Indicated and Actual Values):

a. Total airflow rate in cfm.
b. Total system static pressure in inches wg.
c. Fan rpm.
d. Discharge static pressure in inches wg.
e. Suction static pressure in inches wg.

I. Round, Flat-Oval, and Rectangular Duct Traverse Reports: Include a diagram with a grid representing the duct cross-section and record the following:

1. Report Data:

a. System and air-handling-unit number.
b. Location and zone.
c. Traverse air temperature in deg F.
d. Duct static pressure in inches wg.
e. Duct size in inches.
f. Duct area in sq. ft..
g. Indicated air flow rate in cfm.
h. Indicated velocity in fpm.
i. Actual air flow rate in cfm.
j. Actual average velocity in fpm.
k. Barometric pressure in psig.

J. Air-Terminal-Device Reports:

1. Unit Data:

a. System and air-handling unit identification.
b. Location and zone.
c. Apparatus used for test.
d. Area served.
e. Make.
f. Number from system diagram.
g. Type and model number.
h. Size.
i. Effective area in sq. ft..

2. Test Data (Indicated and Actual Values):

a. Air flow rate in cfm.
b. Air velocity in fpm.
c. Preliminary air flow rate as needed in cfm.
d. Preliminary velocity as needed in fpm.
e. Final air flow rate in cfm.
f. Final velocity in fpm.
g. Space temperature in deg F.

K. System-Coil Reports: For reheat coils and water coils of terminal units, include the following:

1. Unit Data:

a. System and air-handling-unit identification.
b. Location and zone.
c. Room or riser served.
d. Coil make and size.
e. Flowmeter type.

2. Test Data (Indicated and Actual Values):

a. Air flow rate in cfm.
b. Entering-water temperature in deg F.
c. Leaving-water temperature in deg F.
d. Water pressure drop in feet of head or psig.
e. Entering-air temperature in deg F.
f. Leaving-air temperature in deg F.

L. Pump Test Reports: Calculate impeller size by plotting the shutoff head on pump curves and include the following:

1. Unit Data:

a. Unit identification.
b. Location.
c. Service.

d. Make and size.
e. Model number and serial number.
f. Water flow rate in gpm.
g. Water pressure differential in feet of head or psig.
h. Required net positive suction head in feet of head or psig.
i. Pump rpm.
j. Impeller diameter in inches.
k. Motor make and frame size.
l. Motor horsepower and rpm.
m. Voltage at each connection.
n. Amperage for each phase.
o. Full-load amperage and service factor.
p. Seal type.

2. Test Data (Indicated and Actual Values):

a. Static head in feet of head or psig.
b. Pump shutoff pressure in feet of head or psig.
c. Actual impeller size in inches.
d. Full-open flow rate in gpm.
e. Full-open pressure in feet of head or psig.
f. Final discharge pressure in feet of head or psig.
g. Final suction pressure in feet of head or psig.
h. Final total pressure in feet of head or psig.
i. Final water flow rate in gpm.
j. Voltage at each connection.
k. Amperage for each phase.

M. Instrument Calibration Reports:

1. Report Data:

a. Instrument type and make.
b. Serial number.
c. Application.
d. Dates of use.
e. Dates of calibration.

3.22 INSPECTIONS

A. Initial Inspection:

1. After testing and balancing are complete, operate each system and randomly check measurements to verify that the system is operating according to the final test and balance readings documented in the final report.
2. Check the following for each system:

a. Measure airflow of at least 25 percent of air outlets.
b. Measure water flow of at least 10 percent of terminals.

c. Measure room temperature at each thermostat/temperature sensor. Compare the reading to the set point.
d. Verify that balancing devices are marked with final balance position.
e. Note deviations from the Contract Documents in the final report.

B. Final Inspection:

1. After initial inspection is complete and documentation by random checks verifies that testing and balancing are complete and accurately documented in the final report, request that a final inspection be made by Architect Construction Manager.
2. The TAB contractor's test and balance engineer shall conduct the inspection in the presence of Architect, Construction Manager, and or Commissioning Authority.
3. Architect or Commissioning Authority shall randomly select measurements, documented in the final report, to be rechecked. Rechecking shall be limited to either 10 percent of the total measurements recorded or the extent of measurements that can be accomplished in a normal 8-hour business day.
4. If rechecks yield measurements that differ from the measurements documented in the final report by more than the tolerances allowed, the measurements shall be noted as "FAILED."
5. If the number of "FAILED" measurements is greater than 10 percent of the total measurements checked during the final inspection, the testing and balancing shall be considered incomplete and shall be rejected.

C. TAB Work will be considered defective if it does not pass final inspections. If TAB Work fails, proceed as follows:

1. Recheck all measurements and make adjustments. Revise the final report and balancing device settings to include all changes; resubmit the final report and request a second final inspection.
2. If the second final inspection also fails, Owner may contract the services of another TAB contractor to complete TAB Work according to the Contract Documents and deduct the cost of the services from the original TAB contractor's final payment.

D. Prepare test and inspection reports.

E. Within 90 days of completing TAB, perform additional TAB to verify that balanced conditions are being maintained throughout and to correct unusual conditions.

F. Seasonal Periods: If initial TAB procedures were not performed during near-peak summer and winter conditions, perform additional TAB during near-peak summer and winter conditions.

G. The TAB shall provide a technician to support the commissioning of the project with rechecks of air and or water flow, pressure tests of duct high pressure limits, smoke detectors, coil and filter pressure drop signals, terminal air flow and space temperature, humidity and CO2 sensor verification of calibration on up to not less than 25% (or higher if the Cx A sampling is specified to be higher) of the VAV terminal, temperature control zones.

END OF SECTION 230593

SECTION 230553 - IDENTIFICATION FOR HVAC PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Equipment labels.
2. Warning signs and labels.
3. Pipe labels.
4. Duct labels.
5. Stencils.
6. Valve tags.
7. Warning tags.

1.3 ACTION SUBMITTALS

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

B. Samples: For color, letter style, and graphic representation required for each identification material and device.

C. Equipment Label Schedule: Include a listing of all equipment to be labeled with the proposed content for each label.

D. Valve numbering scheme.

E. Valve Schedules: For each piping system to include in maintenance manuals.

1.4 COORDINATION

A. Coordinate installation of identifying devices with completion of covering and painting of surfaces where devices are to be applied.

B. Coordinate installation of identifying devices with locations of access panels and doors.

C. Install identifying devices before installing acoustical ceilings and similar concealment.

PART 2 - PRODUCTS

2.1 EQUIPMENT LABELS

A. Metal Labels for Equipment:

1. Material and Thickness: Brass, 0.032-inch , Stainless steel, 0.025-inch or anodized aluminum, 0.032-inch minimum thickness, and having predrilled or stamped holes for attachment hardware.
2. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.
3. Minimum Letter Size: 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.
4. Fasteners: Stainless-steel rivets or self-tapping screws.
5. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.

B. Plastic Labels for Equipment:

1. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, 1/8 inch thick, and having predrilled holes for attachment hardware.
2. Letter Color: White
3. Background Color: Black
4. Maximum Temperature: Able to withstand temperatures up to 160 deg F.
5. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.
6. Minimum Letter Size: 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.
7. Fasteners: Stainless-steel rivets or self-tapping screws.
8. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.

C. Label Content: Include equipment's Drawing designation or unique equipment number, Drawing numbers where equipment is indicated (plans, details, and schedules), plus the Specification Section number and title where equipment is specified.

D. Equipment Label Schedule: For each item of equipment to be labeled, on 8-1/2-by-11-inch bond paper. Tabulate equipment identification number and identify Drawing numbers where equipment is indicated (plans, details, and schedules), plus the Specification Section number and title where equipment is specified. Equipment schedule shall be included in operation and maintenance data.

2.2 WARNING SIGNS AND LABELS

A. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, 1/8 inch thick, and having predrilled holes for attachment hardware.

B. Letter Color: Yellow

C. Background Color: Red

D. Maximum Temperature: Able to withstand temperatures up to 160 deg F.

E. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.

F. Minimum Letter Size: 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.

G. Fasteners: Stainless-steel rivets or self-tapping screws.

H. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.

I. Label Content: Include caution and warning information, plus emergency notification instructions.

2.3 PIPE LABELS

A. General Requirements for Manufactured Pipe Labels: Preprinted, color-coded, with lettering indicating service, and showing flow direction.

B. Pre-tensioned Pipe Labels: Pre-coiled, semi-rigid plastic formed to cover full circumference of pipe and to attach to pipe without fasteners or adhesive.

C. Self-Adhesive Pipe Labels: Printed plastic with contact-type, permanent-adhesive backing.

D. Pipe Label Contents: Include identification of piping service using same designations or abbreviations as used on Drawings, pipe size, and an arrow indicating flow direction.

1. Flow-Direction Arrows: Integral with piping system service lettering to accommodate both directions, or as separate unit on each pipe label to indicate flow direction.
2. Lettering Size: At least 1-1/2 inches high.

2.4 STENCILS

A. Stencils: Prepared with letter sizes according to ASME A13.1 for piping; minimum letter height of 1-1/4 inches for ducts; and minimum letter height of 3/4 inch for access panel and door labels, equipment labels, and similar operational instructions.

1. Stencil Material: Aluminum, Brass, Fiberboard or metal.
2. Stencil Paint: Exterior, gloss, alkyd enamel or acrylic enamel (as appropriate for the material being painted) , black unless otherwise indicated. Paint may be in pressurized spray-can form.
3. Identification Paint: Exterior, alkyd enamel or acrylic enamel in colors according to ASME A13.1 unless otherwise indicated.

2.5 VALVE TAGS

A. Valve Tags: Stamped or engraved with 1/4-inch letters for piping system abbreviation and 1/2-inch numbers.

1. Tag Material: Brass, 0.032-inch , Stainless steel, 0.025-inch or anodized aluminum, 0.032-inch minimum thickness, and having predrilled or stamped holes for attachment hardware.
2. Fasteners: Brass wire-link or beaded chain; or S-hook.

B. Valve Schedules: For each piping system, on 8-1/2-by-11-inch bond paper. Tabulate valve number, piping system, system abbreviation (as shown on valve tag), location of valve (room or space), normal-operating position (open, closed, or modulating), and variations for identification. Mark valves for emergency shutoff and similar special uses.

1. Valve-tag schedule shall be included in operation and maintenance data.

2.6 WARNING TAGS

A. Warning Tags: Preprinted or partially preprinted, accident-prevention tags, of plasticized card stock with matte finish suitable for writing.

1. Size: 3 by 5-1/4 inches minimum Approximately 4 by 7 inches.
2. Fasteners: Brass grommet and wire.
3. Nomenclature: Large-size primary caption such as "DANGER," "CAUTION," or "DO NOT OPERATE."
4. Color: Yellow background with black lettering.

PART 3 - EXECUTION

3.1 PREPARATION

A. Clean piping and equipment surfaces of substances that could impair bond of identification devices, including dirt, oil, grease, release agents, and incompatible primers, paints, and encapsulants.

3.2 EQUIPMENT LABEL INSTALLATION

A. Install or permanently fasten labels on each major item of mechanical equipment.

B. Locate equipment labels where accessible and visible.

3.3 PIPE LABEL INSTALLATION

A. Piping Color-Coding: Painting of piping is specified in [**Section 099123 "Interior Painting"**] [**Section 099600 "High Performance Coatings"**]

B. Stenciled Pipe Label Option: Stenciled labels may be provided instead of manufactured pipe labels, at Installer's option. Install stenciled pipe labels with painted, color-coded bands or rectangles , complying with ASME A13.1, on each piping system.

1. Identification Paint: Use for contrasting background.
2. Stencil Paint: Use for pipe marking.

C. Locate pipe labels where piping is exposed or above accessible ceilings in finished spaces; machine rooms; accessible maintenance spaces such as shafts, tunnels, and plenums; and exterior exposed locations as follows:

1. Near each valve and control device.
2. Near each branch connection, excluding short takeoffs for fixtures and terminal units. Where flow pattern is not obvious, mark each pipe at branch.
3. Near penetrations through walls, floors, ceilings, and inaccessible enclosures.
4. At access doors, manholes, and similar access points that permit view of concealed piping.
5. Near major equipment items and other points of origination and termination.
6. Spaced at maximum intervals of 50 feet along each run. Reduce intervals to 25 feet Insert dimension in areas of congested piping and equipment.
7. On piping above removable acoustical ceilings. Omit intermediately spaced labels.

D. Pipe Label Color Schedule:

1. Chilled-Water Piping:

   a. Background Color: Green
   b. Letter Color: White

2. Condenser-Water Piping:

   a. Background Color: **Green**
   b. Letter Color: White

3. Heating Water Piping:

   a. Background Color: **Yellow**
   b. Letter Color: Black

4. Refrigerant Piping:

   a. Background Color: Yellow
   b. Letter Color: Black

3.4 DUCT LABEL INSTALLATION

A. Stenciled Duct Label Option: Stenciled labels, showing service and flow direction, may be provided instead of plastic-laminated duct labels, at Installer's option, if lettering larger than 1 inch high is needed for proper identification because of distance from normal location of required identification.

B. Locate labels near points where ducts enter into concealed spaces and at maximum intervals of 50 feet in each space where ducts are exposed or concealed by removable ceiling system.

3.5 VALVE-TAG INSTALLATION

A. Install tags on valves and control devices in piping systems, except check valves; valves within factory-fabricated equipment units; shutoff valves; faucets; convenience and lawn-watering hose connections; and HVAC terminal devices and similar roughing-in connections of end-use fixtures and units. List tagged valves in a valve schedule.

B. Valve-Tag Application Schedule: Tag valves according to size, shape, and color scheme and with captions similar to those indicated in the following subparagraphs:

1. Valve-Tag Size and Shape:

a.	Chilled Water:	1-1/2 inches, round.
b.	Condenser Water:	1-1/2 inches, round.
c.	Refrigerant:	1-1/2 inches, square.
d.	Hot Water:	1-1/2 inches, round.
e.	Gas:	1-1/2 inches, square.

3.6 WARNING-TAG INSTALLATION

A. Write required message on, and attach warning tags to, equipment and other items where required.

END OF SECTION 230553

1.01 ADDITIONALLY - IDENTIFICATION OF PIPING AND EQUIPMENT

A. General: Comply with ANSI A13.1-1994, "Scheme for Identification of Piping Systems" and OSHA requirements, or as otherwise indicated.

B. Manufacturer:

1. Refer to paragraph entitled "MANUFACTURERS" in Section 15010. Model numbers or product type listed for one or more manufacturers are given to provide an example of the item required.

C. Markers: Legends or arrows painted with stencils are not acceptable. Markers must have approved color coded background, proper color of legend in relation to background color and flow arrow indicator. Markers higher than 12 feet above the floor shall have minimum 2 inch letters. Markers shall comply with the following table:

TABLE - IDENTIFICATION MARKER SIZES

O.D. of Pipe or Covering	Length of Color Field	Size of Letters
¾ to 1-1/4 inch	8 inches	1/2 inch
1-1/2 to 2 inches	8 inches	3/4 inch
2-1/2 to 6 inches	12 inches	1-1/4 inch
Above 6 inches	12 inches	2 inches

1. Manufacturer:

a. Pipes 3/4 inch through 5 inch O.D.: Seton, Setmark Type SNA.

b. Pipes 6 inch O.D. and Greater: Seton, Setmark Type STR.

D. Bands: Color coded in minimum widths of 2-1/4 inch for pipe through 12 inch O.D. and 4 inch for pipe 14 inch O.D. and greater.

1. Manufacturer:

a. Brady, B-500 Vinyl Cloth, B-350 PermaCode or B-946 Outdoor Film.

E. Valve Tags: Each tag shall designate appropriate service and valve number. Secure attach with meter seals, 4-ply 0.018 copper smooth wire, brass "S" hooks, or brass jack chain to allow easy reading. All valve tags used on a project shall be the same type and manufacturer.

1. Manufacturer: Provide either of the following types:

a. Brass Type: Minimum 19 gauge polished brass; 1-1/2 inch min. diameter. Seton, Style 250-BL.

b. Aluminum Color Coded Type: Anodized aluminum; 2 inch min. diameter. Seton, Style 2070.

c. Aluminum Alloy Type: 16 Gauge sheet aluminum: Depressed type letters filled with black enamel. Face and periphery of satin finish shall be free from burns and scratches. Seton, Type 4.

d. Fiber Glass Type: 1/16 inch thick glass fiber reinforced resin. 2 inch x 2 inch size of 2-1/2 inch x 9 inch size as necessary to identify item. Brady, Series No. 2297.

F. Equipment Labels: Provide either of the following types:

1. Plastic Type: Outdoor grade acrylic plastic to withstand weather, abrasion, grease, acid, chemical and other corrosive conditions; 1/16 inch min. thickness. Sized 3/4 inch x 2-1/2 inch, 1 inch x 2-1/2 inch, 1 inch x 3 inch or 1-1/2 inch x 4 inch as necessary to identify item.

a. Manufacturer:

(1) Seton, Setonite.

2. Aluminum Type: Engraved, flexible, 0.020 inch thick aluminum. Sized 3/4 inch x 2-1/2 inch, 1 inch x 3 inch, 1-1/2 inch x 4 inch or 3 inch x 6 inch as necessary to identify item.

a. Manufacturer:

(1) Seton, No. 06505.

1.02 PAINTING

General: Paint all exposed piping, insulation, equipment, structural bases, racks, in equipment rooms and on roof, furnished under Division 15 of these specifications. All exposed metal surfaces shall be given one prime coat and two finish coats. All insulated surfaces shall be given one coat of glue sizing (omit this step if factory applied finish is suitable to receive prime coat), one prime coat and one finish coat. Factory painted or finished items do not require field painting but shall require "touch-up" with matching paint or finish where scratched. Follow manufacturers recommendations on ambient conditions for painting, coat thickness, and drying time between coats.

Ancillary Items: Pipe hangers, saddles, supports, riser clamps and accessories shall be painted to match their piping.

Inaccessible Items: Equipment not completely accessible for painting when set in place shall be thoroughly cleaned and painted before installation and suitably protected.

Concealed Items: Concealed piping need not be painted.

Metal Surfaces: Use a scraper or wire brush to remove rust and roughen metal surfaces prior to painting. After wire brushing, wash surfaces to remove particulates, apply primer coat after surface is dry but not more than 48 hours after wire brushing.

Colors: Colors for piping systems and equipment which are required to be painted shall be as indicated in the following table:

TABLE - PIPING PAINTING SCHEDULE

Class	Paint Color
F – Fire Protection Equipment	Red
D – Dangerous Material	Yellow (or Orange)
S – Safe Material	Green (or the achromatic colors White, Black, Gray or Aluminum)
P – Protective Material	Bright Blue
V – Valuable Material	Deep Purple

1.03 IDENTIFICATION OF PIPING, DUCTWORK AND EQUIPMENT

General: Apply after completion of insulation, painting and cleaning work so that final identification is not disfigured.

Coordinate with composition and operating temperatures of surface for permanent adhesion of markers and labels to surface.

Locate marking and banding to facilitate ease of visual tracking. (For example, mark and band parallel runs of pipe and duct which are side-by-side at the same general place.) Labels on vertical piping and ductwork shall be 7 foot above the floor.

Pipes less than 3/4 inch diameter may be identified with tags similar to those specified for valves.

Adhere or affix all identification items permanently except where removal may be necessary for maintenance or service. Where labels or arrows are used, overlap the label ends 2 inches with matching color bands completely encircling the pipe.

Apply labels on the bottom lower quarters of overhead pipe. Pipe within 24 inches of a wall does not require a label on the quarter facing the wall.

Markers and Bands: Provide on piping as follows:

Pipe Concealed in Otherwise Inaccessible Locations (e.g., Chases, non-accessible ceilings): No identification required, except at access doors.

Pipe Concealed in Accessible Locations (e.g., Ceiling Plenums): Markers every 30 feet of pipe length. Bands every 15 feet of pipe length.

Pipe Exposed in Equipment Rooms: Markers and bands every 15 feet of pipe length for pipe through 12 inch O.D. and every 30 feet for pipe 14 inch O.D. and greater.

Exterior Pipe, Exposed: Markers and bands every 40 feet of pipe length.

Exterior Pipe, Underground: Place a color-coded 6 inch wide, 0.004 inch thick polyethylene printed identification tape directly above all underground piping systems. The tapes shall be located approximately 12 inches below finish grade. Each tape shall be continuously printed with the words "CAUTION" in large bold lettering, and with the type of service piping also indicated.

Valve Tags: Valve tags shall be installed on the following items:

All control valves (except those valves associated with direct control of flow to air handling apparatus whereby the valve may be identified by reference to the item of equipment it serves).

All fire protection system valves located in mains and branches (except those valves in fire hose cabinets).

Valves installed under this division of the specifications except check valves, drain valves, gauge valves, and manual air vent valves.

Small piping (other than domestic water) where markers are impractical.

Small but critical equipment items on which it is impractical to install labels.

Valve Tag List: Prior to substantial completion, provide a complete list of all valves having tags. Frame under glass and mount in the mechanical equipment room at a location acceptable to the Architect. Indicate the following:

Valve size.
Valve location.
Valve type.
Service application.
Valve manufacturer and model number.
Pressure class and allowable working pressure.
Safety warnings.
Sequencing information.
Seasonal operating position (normally open/normally closed).

Labels: Provide labels of proper size on mechanical system equipment including but not limited to, pumps, chillers, tanks, major piping components such as air separators, air handling equipment, fans, control panels, terminal units, flow stations, reheat coils and similar items. Provide labels on access panels indicating the item accessible through the panel. Equipment labels shall be mechanically fastened with machine screws or rivets; adhesive securing is not acceptable.

Identification: Coordinate colors and finishes with pipe identification markers.

SECTION 230548.13 - VIBRATION CONTROLS FOR HVAC

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Elastomeric isolation pads.
2. Elastomeric isolation mounts.
3. Restrained elastomeric isolation mounts.
4. Open-spring isolators.
5. Housed-spring isolators.
6. Restrained-spring isolators.
7. Housed-restrained-spring isolators.
8. Pipe-riser resilient supports.
9. Resilient pipe guides.
10. Air-spring isolators.
11. Restrained-air-spring isolators.
12. Elastomeric hangers.
13. Spring hangers.
14. Vibration isolation equipment bases.
15. Restrained isolation roof-curb rails.

B. Related Requirements:

1. Section 210548.13 "Vibration Controls for Fire Suppression" for devices for fire-suppression equipment and systems.
2. Section 220548.13 "Vibration Controls for Plumbing" for devices for plumbing equipment and systems.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include rated load, rated deflection, and overload capacity for each vibration isolation device.
2. Illustrate and indicate style, material, strength, fastening provision, and finish for each type and size of vibration isolation device type required.

B. Shop Drawings:

1. Detail fabrication and assembly of equipment bases. Detail fabrication including anchorages and attachments to structure and to supported equipment. Include adjustable motor bases, rails, and frames for equipment mounting.
2. Vibration Isolation Base Details: Detail fabrication including anchorages and attachments to structure and to supported equipment. Include adjustable motor bases, rails, and frames for equipment mounting.

C. Delegated-Design Submittal: For each vibration isolation device.

1. Include design calculations for selecting vibration isolators and for designing vibration isolation bases.

1.4 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Show coordination of vibration isolation device installation for HVAC piping and equipment with other systems and equipment in the vicinity, including other supports and restraints, if any.

B. Qualification Data: For testing agency.

C. Welding certificates.

D. Air-Mounting System Performance Certification: Include natural frequency, load, and damping test data[**performed by an independent agency**].

1.5 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For [**air-spring mounts**] [**and**] [**restrained-air-spring mounts**] to include in operation and maintenance manuals.

1.6 QUALITY ASSURANCE

A. Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."

PART 2 - PRODUCTS

2.1 ELASTOMERIC ISOLATION PADS

A. Elastomeric Isolation Pads:
1. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:

a. Ace Mountings Co., Inc.
b. California Dynamics Corporation.
c. Isolation Technology, Inc.
d. Kinetics Noise Control, Inc.

e. Mason Industries, Inc.
f. Vibration Eliminator Co., Inc.
g. Vibration Isolation.
h. Vibration Mountings & Controls, Inc.

2. Fabrication: Single or multiple layers of sufficient durometer stiffness for uniform loading over pad area.
3. Size: Factory or field cut to match requirements of supported equipment.
4. Pad Material: Oil and water resistant with elastomeric properties.
5. Surface Pattern: Smooth or Ribbed pattern.
6. Infused nonwoven cotton or synthetic fibers.
7. Load-bearing metal plates adhered to pads.
8. Sandwich-Core Material: Resilient and elastomeric**.**

a. Surface Pattern: Smooth Ribbed pattern.
b. Infused nonwoven cotton or synthetic fibers.

2.2 ELASTOMERIC ISOLATION MOUNTS

A. Double-Deflection, Elastomeric Isolation Mounts:

1. Manufacturers: Subject to compliance with requirements, provide products by the following, but are not limited to, the following:
2. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:

a. Ace Mountings Co., Inc.
b. California Dynamics Corporation.
c. Isolation Technology, Inc.
d. Kinetics Noise Control, Inc.
e. Mason Industries, Inc.
f. Vibration Eliminator Co., Inc.
g. Vibration Isolation.
h. Vibration Mountings & Controls, Inc.

3. Mounting Plates:

a. Top Plate: Encapsulated steel load transfer top plates, factory drilled and threaded with threaded studs or bolts.
b. Baseplate: Encapsulated steel bottom plates with holes provided for anchoring to support structure.

4. Elastomeric Material: Molded, oil-resistant rubber, neoprene, or other elastomeric material.

2.3 RESTRAINED ELASTOMERIC ISOLATION MOUNTS

A. Restrained Elastomeric Isolation Mounts:

1. Manufacturers: Subject to compliance with requirements, provide products by the following
2. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:

    a. Ace Mountings Co., Inc.
    b. California Dynamics Corporation.
    c. Isolation Technology, Inc.
    d. Kinetics Noise Control, Inc.
    e. Mason Industries, Inc.
    f. Vibration Eliminator Co., Inc.
    g. Vibration Isolation.
    h. Vibration Mountings & Controls, Inc.

3. Description: All-directional isolator with restraints containing two separate and opposing elastomeric elements that prevent central threaded element and attachment hardware from contacting the housing during normal operation.

    a. Housing: Cast-ductile iron or welded steel.
    b. Elastomeric Material: Molded, oil-resistant rubber, neoprene, or other elastomeric material.

2.4 OPEN-SPRING ISOLATORS

A. Freestanding, Laterally Stable, Open-Spring Isolators:

1. Manufacturers: Subject to compliance with requirements, provide products by the following:

2. Retain "Basis-of-Design Product" Subparagraph and list of manufacturers below to identify a specific product or a comparable product from manufacturers listed. Retain option and delete insert note if manufacturer's name and model number are indicated on Drawings.
3. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:

    a. Ace Mountings Co., Inc.
    b. California Dynamics Corporation.
    c. Isolation Technology, Inc.
    d. Kinetics Noise Control, Inc.
    e. Mason Industries, Inc.
    f. Vibration Eliminator Co., Inc.
    g. Vibration Isolation.
    h. Vibration Mountings & Controls, Inc.

4. Outside Spring Diameter: Not less than 80 percent of the compressed height of the spring at rated load.
5. Minimum Additional Travel: 50 percent of the required deflection at rated load.
6. Lateral Stiffness: More than 80 percent of rated vertical stiffness.

7. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.
8. Baseplates: Factory-drilled steel plate for bolting to structure with an elastomeric isolator pad attached to the underside. Baseplates shall limit floor load to 500 psig (3447 kPa).
9. Top Plate and Adjustment Bolt: Threaded top plate with adjustment bolt and cap screw to fasten and level equipment.

2.5 HOUSED-SPRING ISOLATORS

A. Freestanding, Laterally Stable, Open-Spring Isolators in Two-Part Telescoping Housing:

B. Retain "Manufacturers" Subparagraph and list of manufacturers below to require products from manufacturers listed or a comparable product from other manufacturers.

1. Manufacturers: Subject to compliance with requirements, provide products by the following:
2. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:

    a. Ace Mountings Co., Inc.
    b. California Dynamics Corporation.
    c. Isolation Technology, Inc.
    d. Kinetics Noise Control, Inc.
    e. Mason Industries, Inc.
    f. Vibration Eliminator Co., Inc.
    g. Vibration Isolation.
    h. Vibration Mountings & Controls, Inc.

3. Outside Spring Diameter: Not less than 80 percent of the compressed height of the spring at rated load.
4. Minimum Additional Travel: 50 percent of the required deflection at rated load.
5. Lateral Stiffness: More than 80 percent of rated vertical stiffness.
6. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.
7. Two-Part Telescoping Housing: A steel top and bottom frame separated by an elastomeric material and enclosing the spring isolators.

    a. Drilled base housing for bolting to structure with an elastomeric isolator pad attached to the underside. Bases shall limit floor load to 500 psig (3447 kPa).
    b. Top housing with threaded mounting holes and internal leveling device.

2.6 RESTRAINED-SPRING ISOLATORS

A. Freestanding, Laterally Stable, Open-Spring Isolators with Vertical-Limit Stop Restraint:

1. Manufacturers: Subject to compliance with requirements, provide products by the following:

2. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:

    a. Ace Mountings Co., Inc.
    b. California Dynamics Corporation.
    c. Isolation Technology, Inc.
    d. Kinetics Noise Control, Inc.
    e. Mason Industries, Inc.
    f. Vibration Eliminator Co., Inc.
    g. Vibration Isolation.
    h. Vibration Mountings & Controls, Inc.

3. Housing: Steel housing with vertical-limit stops to prevent spring extension due to weight being removed.

    a. Base with holes for bolting to structure with an elastomeric isolator pad attached to the underside. Bases shall limit floor load to 500 psig (3447 kPa).
    b. Top plate with threaded mounting holes.
    c. Internal leveling bolt that acts as blocking during installation.

4. Restraint: Limit stop as required for equipment and authorities having jurisdiction.
5. Outside Spring Diameter: Not less than 80 percent of the compressed height of the spring at rated load.
6. Minimum Additional Travel: 50 percent of the required deflection at rated load.
7. Lateral Stiffness: More than 80 percent of rated vertical stiffness.
8. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.

2.7 HOUSED-RESTRAINED-SPRING ISOLATORS

A. Freestanding, Steel, Open-Spring Isolators with Vertical-Limit Stop Restraint in Two-Part Telescoping Housing:

1. Manufacturers: Subject to compliance with requirements,

2. Retain "Basis-of-Design Product" Subparagraph and list of manufacturers below to identify a specific product or a comparable product from manufacturers listed. Retain option and delete insert note if manufacturer's name and model number are indicated on Drawings.
3. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:

    a. Ace Mountings Co., Inc.
    b. California Dynamics Corporation.
    c. Isolation Technology, Inc.
    d. Kinetics Noise Control, Inc.
    e. Mason Industries, Inc.
    f. Vibration Eliminator Co., Inc.
    g. Vibration Isolation.
    h. Vibration Mountings & Controls, Inc.

4. Two-Part Telescoping Housing: A steel top and bottom frame separated by an elastomeric material and enclosing the spring isolators. Housings are equipped with adjustable snubbers to limit vertical movement.

    a. Drilled base housing for bolting to structure with an elastomeric isolator pad attached to the underside. Bases shall limit floor load to 500 psig (3447 kPa).
    b. Threaded top housing with adjustment bolt and cap screw to fasten and level equipment.

5. Outside Spring Diameter: Not less than 80 percent of the compressed height of the spring at rated load.
6. Minimum Additional Travel: 50 percent of the required deflection at rated load.
7. Lateral Stiffness: More than 80 percent of rated vertical stiffness.
8. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.

2.8 PIPE-RISER RESILIENT SUPPORT

A. Description: All-directional, acoustical pipe anchor consisting of two steel tubes separated by a minimum 1/2-inch- (13-mm-) thick neoprene.

1. Vertical-Limit Stops: Steel and neoprene vertical-limit stops arranged to prevent vertical travel in both directions.
2. Maximum Load Per Support: 500 psig (3.45 MPa) on isolation material providing equal isolation in all directions.

2.9 RESILIENT PIPE GUIDES

A. Description: Telescopic arrangement of two steel tubes or post and sleeve arrangement separated by a minimum 1/2-inch- (13-mm-) thick neoprene.

1. Factory-Set Height Guide with Shear Pin: Shear pin shall be removable and reinsertable to allow for selection of pipe movement. Guides shall be capable of motion to meet location requirements.

2.10 AIR-SPRING ISOLATORS

A. Freestanding, Single or Multiple, Compressed-Air Bellows:

1. Manufacturers: Subject to compliance with requirements, provide products by the following:
2. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:

    a. Firestone Industrial Products Company.
    b. Mason Industries, Inc.

3. Bellows Assembly: Upper and lower powder-coated steel sections connected by a replaceable, flexible, nylon-reinforced neoprene bellows or similar elastomeric material.
4. Maximum Natural Frequency: 3 Hz.
5. Operating Pressure Range: 25 to 100 psig (172 to 690 kPa).
6. Burst Pressure: At least three times manufacturer's published maximum operating pressure.
7. Tank valves.

2.11 RESTRAINED-AIR-SPRING ISOLATORS

A. Freestanding, Single or Multiple, Compressed-Air Bellows with Vertical-Limit Stop Restraint:

B. Retain "Manufacturers" Subparagraph and list of manufacturers below to require products from manufacturers listed or a comparable product from other manufacturers.

1. Manufacturers: Subject to compliance with requirements, provide products by the following:
2. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:

    a. Firestone Industrial Products Company.
    b. Mason Industries, Inc.

3. Housing: Steel housing with vertical-limit stops to prevent spring extension due to weight being removed.

    a. Base with holes for bolting to structure with an elastomeric isolator pad attached to the underside. Bases shall limit floor load to 500 psig (3447 kPa).
    b. Top plate with threaded mounting holes.
    c. Internal leveling bolt that acts as blocking during installation.

4. Restraint: Limit stop as required for equipment and authorities having jurisdiction.
5. Outside Spring Diameter: Not less than 80 percent of the compressed height of the spring at rated load.
6. Minimum Additional Travel: 50 percent of the required deflection at rated load.
7. Lateral Stiffness: More than 80 percent of rated vertical stiffness.
8. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.
9. Bellows Assembly: Upper and lower powder-coated steel sections connected by a replaceable, flexible, nylon-reinforced neoprene bellows or similar elastomeric material.
10. Maximum Natural Frequency: 3 Hz.
11. Operating Pressure Range: 25 to 100 psig (172 to 690 kPa).
12. Burst Pressure: At least three times manufacturer's published maximum operating pressure.
13. Tank valves.

2.12 ELASTOMERIC HANGERS

A. Elastomeric Mount in a Steel Frame with Upper and Lower Steel Hanger Rods:

B. Retain "Manufacturers" Subparagraph and list of manufacturers below to require products from manufacturers listed or a comparable product from other manufacturers.

1. Manufacturers: Subject to compliance with requirements, provide products by the following:
2. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:

   a. Ace Mountings Co., Inc.
   b. California Dynamics Corporation.
   c. Isolation Technology, Inc.
   d. Kinetics Noise Control, Inc.
   e. Mason Industries, Inc.
   f. Vibration Eliminator Co., Inc.
   g. Vibration Mountings & Controls, Inc.

3. Frame: Steel, fabricated with a connection for an upper threaded hanger rod and an opening on the underside to allow for a maximum of 30 degrees of angular lower hanger-rod misalignment without binding or reducing isolation efficiency.
4. Dampening Element: Molded, oil-resistant rubber, neoprene, or other elastomeric material with a projecting bushing for the underside opening preventing steel to steel contact.

2.13 SPRING HANGERS

A. Combination Coil-Spring and Elastomeric-Insert Hanger with Spring and Insert in Compression:

1. Manufacturers: Subject to compliance with requirements, provide products by the following:
2. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:

   a. Ace Mountings Co., Inc.
   b. California Dynamics Corporation.
   c. Kinetics Noise Control, Inc.
   d. Mason Industries, Inc.
   e. Vibration Eliminator Co., Inc.
   f. Vibration Isolation.
   g. Vibration Mountings & Controls, Inc.

   Frame: Steel, fabricated for connection to threaded hanger rods and to allow for a maximum of 30 degrees of angular hanger-rod misalignment without binding or reducing isolation efficiency.
3. Outside Spring Diameter: Not less than 80 percent of the compressed height of the spring at rated load.
4. Minimum Additional Travel: 50 percent of the required deflection at rated load.
5. Lateral Stiffness: More than 80 percent of rated vertical stiffness.
6. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.

7. Elastomeric Element: Molded, oil-resistant rubber or neoprene. Steel-washer-reinforced cup to support spring and bushing projecting through bottom of frame.
8. Adjustable Vertical Stop: Steel washer with neoprene washer "up-stop" on lower threaded rod.
9. Self-centering hanger rod cap to ensure concentricity between hanger rod and support spring coil.

2.14 VIBRATION ISOLATION EQUIPMENT BASES

A. Manufacturers: Subject to compliance with requirements, provide products by the following:

B. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:

1. California Dynamics Corporation.
2. Kinetics Noise Control.
3. Mason Industries, Inc.
4. Vibration Eliminator Co., Inc.
5. Vibration Isolation.
6. Vibration Mountings & Controls, Inc.

C. Steel Rails: Factory-fabricated, welded, structural-steel rails.

1. Design Requirements: Lowest possible mounting height with not less than 1-inch (25-mm) clearance above the floor. Include equipment anchor bolts and auxiliary motor slide rails.

    a. Include supports for suction and discharge elbows for pumps.

2. Structural Steel: Steel shapes, plates, and bars complying with ASTM A 36/A 36M. Rails shall have shape to accommodate supported equipment.
3. Support Brackets: Factory-welded steel brackets on frame for outrigger isolation mountings and to provide for anchor bolts and equipment support.

D. Steel Bases: Factory-fabricated, welded, structural-steel bases and rails.

1. Design Requirements: Lowest possible mounting height with not less than 1-inch (25-mm) clearance above the floor. Include equipment anchor bolts and auxiliary motor slide bases or rails.

    a. Include supports for suction and discharge elbows for pumps.

2. Structural Steel: Steel shapes, plates, and bars complying with ASTM A 36/A 36M. Bases shall have shape to accommodate supported equipment.
3. Support Brackets: Factory-welded steel brackets on frame for outrigger isolation mountings and to provide for anchor bolts and equipment support.

E. Concrete Inertia Base: Factory-fabricated, welded, structural-steel bases and rails ready for placement of cast-in-place concrete.

1. Design Requirements: Lowest possible mounting height with not less than 1-inch (25-mm) clearance above the floor. Include equipment anchor bolts and auxiliary motor slide bases or rails.

    a. Include supports for suction and discharge elbows for pumps.

2. Structural Steel: Steel shapes, plates, and bars complying with ASTM A 36/A 36M. Bases shall have shape to accommodate supported equipment.
3. Support Brackets: Factory-welded steel brackets on frame for outrigger isolation mountings and to provide for anchor bolts and equipment support.
4. Fabrication: Fabricate steel templates to hold equipment anchor-bolt sleeves and anchors in place during placement of concrete. Obtain anchor-bolt templates from supported equipment manufacturer.

2.15 RESTRAINED ISOLATION ROOF-CURB RAILS

A. Manufacturers: Subject to compliance with requirements, provide products by the following:

B. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:

1. Ace Mountings Co., Inc.
2. California Dynamics Corporation.
3. Kinetics Noise Control.
4. Mason Industries, Inc.
5. Thybar Corporation.

C. Description: Factory-assembled, fully enclosed, insulated, air- and watertight curb rail designed to resiliently support equipment.

D. Upper Frame: Upper frame shall provide continuous and captive support for equipment.

E. Lower Support Assembly: The lower support assembly shall be formed sheet metal section containing adjustable and removable steel springs that support upper frame. The lower support assembly shall have a means for attaching to building structure and a wood nailer for attaching roof materials and shall be insulated with a minimum of 2 inches (50 mm) of rigid glass-fiber insulation on inside of assembly. Adjustable, restrained-spring isolators shall be mounted on elastomeric vibration isolation pads and shall have access ports, for level adjustment, with removable waterproof covers at all isolator locations. Isolators shall be located so they are accessible for adjustment at any time during the life of the installation without interfering with the integrity of the roof.

F. Snubber Bushings: All-directional, elastomeric snubber bushings at least 1/4 inch (6 mm) thick.

G. Water Seal: Galvanized sheet metal with EPDM seals at corners, attached to upper support frame, extending down past wood nailer of lower support assembly, and counter flashed over roof materials.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas and equipment to receive vibration isolation control devices for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

B. Examine roughing-in of reinforcement and cast-in-place anchors to verify actual locations before installation.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 VIBRATION CONTROL DEVICE INSTALLATION

A. Coordinate the location of embedded connection hardware with supported equipment attachment and mounting points and with requirements for concrete reinforcement and formwork specified in Section 033000 "Cast-in-Place Concrete or Section 033053 "Miscellaneous Cast-in-Place Concrete.

B. Installation of vibration isolators must not cause any change of position of equipment, piping, or ductwork resulting in stresses or misalignment.

3.3 AIR-SPRING ISOLATORS INSTALLATION

A. Independent Isolator Installation:

1. Install tank valve into each air isolator.
2. Inflate each isolator to height and pressure specified on Drawings.

B. Pressure-Regulated Isolator Installation:

1. Coordinate the constant pressure-regulated air supply to air springs with the requirements for piping and connections specified in Section 221513 "General-Service Compressed-Air Piping."
2. Connect all pressure regulators to a single dry, filtered facility air supply.
3. Inflate isolators to height and or pressure specified on Drawings.

3.4 VIBRATION ISOLATION EQUIPMENT BASES INSTALLATION

A. Coordinate the location of embedded connection hardware with supported equipment attachment and mounting points and with requirements for concrete reinforcement and formwork specified in Section 033000 Cast-in-Place Concrete or Section 033053 Miscellaneous Cast-in-Place Concrete.

END OF SECTION 230548.13

SECTION 230529 - HANGERS AND SUPPORTS FOR HVAC PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Metal pipe hangers and supports.
2. Trapeze pipe hangers.
3. Metal framing systems.
4. Thermal-hanger shield inserts.
5. Fastener systems.
6. Pipe stands.
7. Equipment supports.

B. Related Sections:

1. Division 05 Section "Metal Fabrications" for structural-steel shapes and plates for trapeze hangers for pipe and equipment supports.
2. Division 23 Section "Expansion Fittings and Loops for HVAC Piping" for pipe guides and anchors.
3. Division 23 Section "Vibration and Seismic Controls for HVAC Piping and Equipment" for vibration isolation devices.
4. Division 23 Section(s) [**"Metal Ducts"**][**and**][**"Nonmetal Ducts"**] for duct hangers and supports.

1.3 DEFINITIONS

A. MSS: Manufacturers Standardization Society of The Valve and Fittings Industry Inc.

1.4 PERFORMANCE REQUIREMENTS

A. Delegated Design: Design trapeze pipe hangers and equipment supports, including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.

B. Structural Performance: Hangers and supports for HVAC piping and equipment shall withstand the effects of gravity loads and stresses within limits and under conditions indicated according to ASCE/SEI 7.

1. Design supports for multiple pipes, including pipe stands, capable of supporting combined weight of supported systems, system contents, and test water.
2. Design equipment supports capable of supporting combined operating weight of supported equipment and connected systems and components.
3. Design seismic-restraint hangers and supports for piping and equipment[**and obtain approval from authorities having jurisdiction**].

1.5 ACTION SUBMITTALS

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

B. Shop Drawings:[**Signed and sealed by a qualified professional engineer.**] Show fabrication and installation details and include calculations for the following; include Product Data for components:

1. Trapeze pipe hangers.
2. Metal framing systems.
3. Pipe stands.
4. Equipment supports.

C. Delegated-Design Submittal: For trapeze hangers indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1. Detail fabrication and assembly of trapeze hangers.
2. Design Calculations: Calculate requirements for designing trapeze hangers.

1.6 INFORMATIONAL SUBMITTALS

A. Welding certificates.

1.7 QUALITY ASSURANCE

A. Structural Steel Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."

B. Pipe Welding Qualifications: Qualify procedures and operators according to ASME Boiler and Pressure Vessel Code.

PART 2 - PRODUCTS

2.1 METAL PIPE HANGERS AND SUPPORTS

A. Carbon-Steel Pipe Hangers and Supports:

1. Description: MSS SP-58, Types 1 through 58, factory-fabricated components.
2. Galvanized Metallic Coatings: Pregalvanized or hot dipped.

3. Nonmetallic Coatings: Plastic coating, jacket, or liner.
4. Padded Hangers: Hanger with fiberglass or other pipe insulation pad or cushion to support bearing surface of piping.
5. Hanger Rods: Continuous-thread rod, nuts, and washer made of carbon steel .

B. Copper Pipe Hangers:

1. Description: MSS SP-58, Types 1 through 58, copper-coated-steel, factory-fabricated components.
2. Hanger Rods: Continuous-thread rod, nuts, and washer made of copper-coated steel or stainless steel .

2.2 TRAPEZE PIPE HANGERS

A. Description: MSS SP-69, Type 59, shop- or field-fabricated pipe-support assembly made from structural carbon-steel shapes with MSS SP-58 carbon-steel hanger rods, nuts, saddles, and U-bolts.

2.3 METAL FRAMING SYSTEMS

A. MFMA Manufacturer Metal Framing Systems:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following :
2. Basis-of-Design Product: Subject to compliance with requirements, provide or comparable product by one of the following:
   a. Cooper B-Line, Inc.
   b. Flex-Strut Inc.
   c. GS Metals Corp.
   d. Thomas & Betts Corporation.
   e. Unistrut Corporation; Tyco International, Ltd.

3. Description: Shop- or field-fabricated pipe-support assembly for supporting multiple parallel pipes.
4. Standard: MFMA-4.
5. Channels: Continuous slotted steel channel with inturned lips.
6. Channel Nuts: Formed or stamped steel nuts or other devices designed to fit into channel slot and, when tightened, prevent slipping along channel.
7. Hanger Rods: Continuous-thread rod, nuts, and washer made of stainless steel .
8. Metallic Coating: Hot-dipped galvanized .

2.4 THERMAL-HANGER SHIELD INSERTS

A. Manufacturers: Subject to compliance with requirements, [**provide products by one of the following**] [**available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following**]:

B. Basis-of-Design Product: Subject to compliance with requirements, provide [**product indicated on Drawings**] <**Insert manufacturer's name; product name or designation**> or comparable product by one of the following:

1. Carpenter & Paterson, Inc.
2. Clement Support Services.
3. ERICO International Corporation.
4. National Pipe Hanger Corporation.
5. PHS Industries, Inc.
6. Pipe Shields, Inc.; a subsidiary of Piping Technology & Products, Inc.
7. Piping Technology & Products, Inc.
8. Rilco Manufacturing Co., Inc.
9. Value Engineered Products, Inc.

C. Insulation-Insert Material for Cold Piping: [**ASTM C 552, Type II cellular glass with 100-psig**] [**or**] [**ASTM C 591, Type VI, Grade 1 polyisocyanurate with 125-psig**] minimum compressive strength and vapor barrier.

D. Insulation-Insert Material for Hot Piping: [**Water-repellent treated, ASTM C 533, Type I calcium silicate with 100-psig**] [**ASTM C 552, Type II cellular glass with 100-psig**] [**or**] [**ASTM C 591, Type VI, Grade 1 polyisocyanurate with 125-psig**] minimum compressive strength.

E. For Trapeze or Clamped Systems: Insert and shield shall cover entire circumference of pipe.

F. For Clevis or Band Hangers: Insert and shield shall cover lower 180 degrees of pipe.

G. Insert Length: Extend 2 inches beyond sheet metal shield for piping operating below ambient air temperature.

2.5 FASTENER SYSTEMS

A. Powder-Actuated Fasteners: Threaded-steel stud, for use in hardened portland cement concrete with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.

B. Mechanical-Expansion Anchors: Insert-wedge-type, [**zinc-coated**] [**stainless-**] steel anchors, for use in hardened portland cement concrete; with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.

2.6 PIPE STANDS

A. General Requirements for Pipe Stands: Shop- or field-fabricated assemblies made of manufactured corrosion-resistant components to support roof-mounted piping.

B. Compact Pipe Stand: One-piece plastic unit with integral-rod roller, pipe clamps, or V-shaped cradle to support pipe, for roof installation without membrane penetration.

C. Low-Type, Single-Pipe Stand: One-piece [**plastic**] [**stainless-steel**] base unit with plastic roller, for roof installation without membrane penetration.

D. High-Type, Single-Pipe Stand:

1. Description: Assembly of base, vertical and horizontal members, and pipe support, for roof installation without membrane penetration.
2. Base: [**Plastic**] [**Stainless steel**].
3. Vertical Members: Two or more cadmium-plated-steel or stainless-steel, continuous-thread rods.
4. Horizontal Member: Cadmium-plated-steel or stainless-steel rod with plastic or stainless-steel, roller-type pipe support.

E. High-Type, Multiple-Pipe Stand:

1. Description: Assembly of bases, vertical and horizontal members, and pipe supports, for roof installation without membrane penetration.
2. Bases: One or more; plastic.
3. Vertical Members: Two or more protective-coated-steel channels.
4. Horizontal Member: Protective-coated-steel channel.
5. Pipe Supports: Galvanized-steel, clevis-type pipe hangers.

F. Curb-Mounted-Type Pipe Stands: Shop- or field-fabricated pipe supports made from structural-steel shapes, continuous-thread rods, and rollers, for mounting on permanent stationary roof curb.

2.7 EQUIPMENT SUPPORTS

A. Description: Welded, shop- or field-fabricated equipment support made from structural carbon-steel shapes.

2.8 MISCELLANEOUS MATERIALS

A. Structural Steel: ASTM A 36/A 36M, carbon-steel plates, shapes, and bars; black and galvanized.

B. Grout: ASTM C 1107, factory-mixed and -packaged, dry, hydraulic-cement, nonshrink and nonmetallic grout; suitable for interior and exterior applications.

1. Properties: Nonstaining, noncorrosive, and nongaseous.
2. Design Mix: 5000-psi, 28-day compressive strength.

PART 3 - EXECUTION

3.1 HANGER AND SUPPORT INSTALLATION

A. Metal Pipe-Hanger Installation: Comply with MSS SP-69 and MSS SP-89. Install hangers, supports, clamps, and attachments as required to properly support piping from the building structure.

B. Metal Trapeze Pipe-Hanger Installation: Comply with MSS SP-69 and MSS SP-89. Arrange for grouping of parallel runs of horizontal piping, and support together on field-fabricated trapeze pipe hangers.

1. Pipes of Various Sizes: Support together and space trapezes for smallest pipe size or install intermediate supports for smaller diameter pipes as specified for individual pipe hangers.
2. Field fabricate from ASTM A 36/A 36M, carbon-steel shapes selected for loads being supported. Weld steel according to AWS D1.1/D1.1M.

C. Metal Framing System Installation: Arrange for grouping of parallel runs of piping, and support together on field-assembled metal framing systems.

D. Thermal-Hanger Shield Installation: Install in pipe hanger or shield for insulated piping.

E. Fastener System Installation:
1. Install mechanical-expansion anchors in concrete after concrete is placed and completely cured. Install fasteners according to manufacturer's written instructions.

F. Pipe Stand Installation:

1. Pipe Stand Types except Curb-Mounted Type: Assemble components and mount on smooth roof surface. Do not penetrate roof membrane.
2. Curb-Mounted-Type Pipe Stands: Assemble components or fabricate pipe stand and mount on permanent, stationary roof curb. See Division 07 Section "Roof Accessories" for curbs.

G. Install hangers and supports complete with necessary attachments, inserts, bolts, rods, nuts, washers, and other accessories.

H. Equipment Support Installation: Fabricate from welded-structural-steel shapes.

I. Install hangers and supports to allow controlled thermal and seismic movement of piping systems, to permit freedom of movement between pipe anchors, and to facilitate action of expansion joints, expansion loops, expansion bends, and similar units.

J. Install lateral bracing with pipe hangers and supports to prevent swaying.

K. Install building attachments within concrete slabs or attach to structural steel. Install additional attachments at concentrated loads, including valves, flanges, and strainers, **NPS 2-1/2** and larger and at changes in direction of piping. Install concrete inserts before concrete is placed; fasten inserts to forms and install reinforcing bars through openings at top of inserts.

L. Load Distribution: Install hangers and supports so that piping live and dead loads and stresses from movement will not be transmitted to connected equipment.

M. Pipe Slopes: Install hangers and supports to provide indicated pipe slopes and to not exceed maximum pipe deflections allowed by ASME B31.9 for building services piping.

N. Insulated Piping:

1. Attach clamps and spacers to piping.

   a. Piping Operating above Ambient Air Temperature: Clamp may project through insulation.
   b. Piping Operating below Ambient Air Temperature: Use thermal-hanger shield insert with clamp sized to match OD of insert.
   c. Do not exceed pipe stress limits allowed by ASME B31.9 for building services piping.

2. Install MSS SP-58, Type 39, protection saddles if insulation without vapor barrier is indicated. Fill interior voids with insulation that matches adjoining insulation.

   a. Option: Thermal-hanger shield inserts may be used. Include steel weight-distribution plate for pipe NPS 4 and larger if pipe is installed on rollers.

3. Install MSS SP-58, Type 40, protective shields on cold piping with vapor barrier. Shields shall span an arc of 180 degrees.

   a. Option: Thermal-hanger shield inserts may be used. Include steel weight-distribution plate for pipe NPS 4 and larger if pipe is installed on rollers.

4. Shield Dimensions for Pipe: Not less than the following:

   a. NPS 1/4 to NPS 3-1/2: 12 inches long and 0.048 inch thick.
   b. NPS 4: 12 inches long and 0.06 inch thick.
   c. NPS 5 and NPS 6: 18 inches long and 0.06 inch thick.
   d. NPS 8 to NPS 14: 24 inches long and 0.075 inch thick.
   e. NPS 16 to NPS 24: 24 inches long and 0.105 inch thick.

5. Pipes NPS 8 and Larger: Include wood or reinforced calcium-silicate-insulation inserts of length at least as long as protective shield.
6. Thermal-Hanger Shields: Install with insulation same thickness as piping insulation.

3.2 EQUIPMENT SUPPORTS

A. Fabricate structural-steel stands to suspend equipment from structure overhead or to support equipment above floor.

B. Grouting: Place grout under supports for equipment and make bearing surface smooth.

C. Provide lateral bracing, to prevent swaying, for equipment supports.

3.3 METAL FABRICATIONS

A. Cut, drill, and fit miscellaneous metal fabrications for trapeze pipe hangers and equipment supports.

B. Fit exposed connections together to form hairline joints. Field weld connections that cannot be shop welded because of shipping size limitations.

C. Field Welding: Comply with AWS D1.1/D1.1M procedures for shielded, metal arc welding; appearance and quality of welds; and methods used in correcting welding work; and with the following:

1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
2. Obtain fusion without undercut or overlap.
3. Remove welding flux immediately.
4. Finish welds at exposed connections so no roughness shows after finishing and so contours of welded surfaces match adjacent contours.

3.4 ADJUSTING

A. Hanger Adjustments: Adjust hangers to distribute loads equally on attachments and to achieve indicated slope of pipe.

B. Trim excess length of continuous-thread hanger and support rods to 1-1/2 inches (40 mm).

3.5 PAINTING

A. Touchup: Clean field welds and abraded areas of shop paint. Paint exposed areas immediately after erecting hangers and supports. Use same materials as used for shop painting. Comply with SSPC-PA 1 requirements for touching up field-painted surfaces.

1. Apply paint by brush or spray to provide a minimum dry film thickness of 2.0 mils.

B. Touchup: Cleaning and touchup painting of field welds, bolted connections, and abraded areas of shop paint on miscellaneous metal are specified in Division 09

C. Galvanized Surfaces: Clean welds, bolted connections, and abraded areas and apply galvanizing-repair paint to comply with ASTM A 780.

3.6 HANGER AND SUPPORT SCHEDULE

A. Specific hanger and support requirements are in Sections specifying piping systems and equipment.

B. Comply with MSS SP-69 for pipe-hanger selections and applications that are not specified in piping system Sections.

C. Use hangers and supports with galvanized metallic coatings for piping and equipment that will not have field-applied finish.

D. Use nonmetallic coatings on attachments for electrolytic protection where attachments are in direct contact with copper tubing.

E. Use carbon-steel pipe hangers and supports metal trapeze pipe hangers and metal framing systems and attachments for general service applications.

F. Use stainless-steel pipe hangers and fiberglass pipe hangers and fiberglass strut systems] and stainless-steel or corrosion-resistant attachments for hostile environment applications.

G. Use copper-plated pipe hangers and copper or stainless-steel attachments for copper piping and tubing.

H. Use padded hangers for piping that is subject to scratching.

I. Use thermal-hanger shield inserts for insulated piping and tubing.

J. Horizontal-Piping Hangers and Supports: Unless otherwise indicated and except as specified in piping system Sections, install the following types:

1. Adjustable, Steel Clevis Hangers (MSS Type 1): For suspension of non-insulated or insulated, stationary pipes NPS 1/2 to NPS 30.
2. Yoke-Type Pipe Clamps (MSS Type 2): For suspension of up to 1050 deg F, pipes NPS 4 to NPS 24, requiring up to 4 inches of insulation.
3. Carbon- or Alloy-Steel, Double-Bolt Pipe Clamps (MSS Type 3): For suspension of pipes NPS 3/4 to NPS 36, requiring clamp flexibility and up to 4 inches of insulation.
4. Steel Pipe Clamps (MSS Type 4): For suspension of cold and hot pipes NPS 1/2 to NPS 24 if little or no insulation is required.
5. Pipe Hangers (MSS Type 5): For suspension of pipes NPS 1/2 to NPS 4, to allow off-center closure for hanger installation before pipe erection.
6. Adjustable, Swivel Split- or Solid-Ring Hangers (MSS Type 6): For suspension of non-insulated, stationary pipes NPS 3/4 to NPS 8.
7. Adjustable, Steel Band Hangers (MSS Type 7): For suspension of non-insulated, stationary pipes NPS 1/2 to NPS 8.
8. Adjustable Band Hangers (MSS Type 9): For suspension of non-insulated, stationary pipes NPS 1/2 to NPS 8.
9. Adjustable, Swivel-Ring Band Hangers (MSS Type 10): For suspension of non-insulated, stationary pipes NPS 1/2 to NPS 8.
10. Split Pipe Ring with or without Turnbuckle Hangers (MSS Type 11): For suspension of non-insulated, stationary pipes NPS 3/8 to NPS 8.
11. Extension Hinged or Two-Bolt Split Pipe Clamps (MSS Type 12): For suspension of non-insulated, stationary pipes NPS 3/8 to NPS 3.
12. U-Bolts (MSS Type 24): For support of heavy pipes NPS 1/2 to NPS 30.
13. Clips (MSS Type 26): For support of insulated pipes not subject to expansion or contraction.
14. Pipe Saddle Supports (MSS Type 36): For support of pipes NPS 4 to NPS 36, with steel-pipe base stanchion support and cast-iron floor flange or carbon-steel plate.

15. Pipe Stanchion Saddles (MSS Type 37): For support of pipes NPS 4 to NPS 36, with steel-pipe base stanchion support and cast-iron floor flange or carbon-steel plate, and with U-bolt to retain pipe.
16. Adjustable Pipe Saddle Supports (MSS Type 38): For stanchion-type support for pipes NPS 2-1/2 to NPS 36 if vertical adjustment is required, with steel-pipe base stanchion support and cast-iron floor flange.
17. Single-Pipe Rolls (MSS Type 41): For suspension of pipes NPS 1 to NPS 30, from two rods if longitudinal movement caused by expansion and contraction might occur.
18. Adjustable Roller Hangers (MSS Type 43): For suspension of pipes NPS 2-1/2 to NPS 24, from single rod if horizontal movement caused by expansion and contraction might occur.
19. Complete Pipe Rolls (MSS Type 44): For support of pipes NPS 2 to NPS 42 if longitudinal movement caused by expansion and contraction might occur but vertical adjustment is not necessary.
20. Pipe Roll and Plate Units (MSS Type 45): For support of pipes NPS 2 to NPS 24 if small horizontal movement caused by expansion and contraction might occur and vertical adjustment is not necessary.
21. Adjustable Pipe Roll and Base Units (MSS Type 46): For support of pipes NPS 2 to NPS 30 if vertical and lateral adjustment during installation might be required in addition to expansion and contraction.

K. Vertical-Piping Clamps: Unless otherwise indicated and except as specified in piping system Sections, install the following types:

1. Extension Pipe or Riser Clamps (MSS Type 8): For support of pipe risers NPS 3/4 to NPS 24.
2. Carbon- or Alloy-Steel Riser Clamps (MSS Type 42): For support of pipe risers NPS 3/4 to NPS 24 if longer ends are required for riser clamps.

L. Hanger-Rod Attachments: Unless otherwise indicated and except as specified in piping system Sections, install the following types:

1. Steel Turnbuckles (MSS Type 13): For adjustment up to 6 inches for heavy loads.
2. Steel Clevises (MSS Type 14): For 120 to 450 deg F piping installations.
3. Swivel Turnbuckles (MSS Type 15): For use with MSS Type 11, split pipe rings.
4. Malleable-Iron Sockets (MSS Type 16): For attaching hanger rods to various types of building attachments.
5. Steel Weldless Eye Nuts (MSS Type 17): For 120 to 450 deg F piping installations.

M. Building Attachments: Unless otherwise indicated and except as specified in piping system Sections, install the following types:

1. Steel or Malleable Concrete Inserts (MSS Type 18): For upper attachment to suspend pipe hangers from concrete ceiling.
2. Top-Beam C-Clamps (MSS Type 19): For use under roof installations with bar-joist construction, to attach to top flange of structural shape.
3. Side-Beam or Channel Clamps (MSS Type 20): For attaching to bottom flange of beams, channels, or angles.
4. Center-Beam Clamps (MSS Type 21): For attaching to center of bottom flange of beams.
5. Welded Beam Attachments (MSS Type 22): For attaching to bottom of beams if loads are considerable and rod sizes are large.

6. C-Clamps (MSS Type 23): For structural shapes.
7. Top-Beam Clamps (MSS Type 25): For top of beams if hanger rod is required tangent to flange edge.
8. Side-Beam Clamps (MSS Type 27): For bottom of steel I-beams.
9. Steel-Beam Clamps with Eye Nuts (MSS Type 28): For attaching to bottom of steel I-beams for heavy loads.
10. Linked-Steel Clamps with Eye Nuts (MSS Type 29): For attaching to bottom of steel I-beams for heavy loads, with link extensions.
11. Malleable-Beam Clamps with Extension Pieces (MSS Type 30): For attaching to structural steel.
12. Welded-Steel Brackets: For support of pipes from below or for suspending from above by using clip and rod. Use one of the following for indicated loads:

    a. Light (MSS Type 31): 750 lb.
    b. Medium (MSS Type 32): 1500 lb.
    c. Heavy (MSS Type 33): 3000 lb.

13. Side-Beam Brackets (MSS Type 34): For sides of steel or wooden beams.
14. Plate Lugs (MSS Type 57): For attaching to steel beams if flexibility at beam is required.
15. Horizontal Travelers (MSS Type 58): For supporting piping systems subject to linear horizontal movement where headroom is limited.

N. Saddles and Shields: Unless otherwise indicated and except as specified in piping system Sections, install the following types:

1. Steel-Pipe-Covering Protection Saddles (MSS Type 39): To fill interior voids with insulation that matches adjoining insulation.
2. Protection Shields (MSS Type 40): Of length recommended in writing by manufacturer to prevent crushing insulation.
3. Thermal-Hanger Shield Inserts: For supporting insulated pipe.

O. Spring Hangers and Supports: Unless otherwise indicated and except as specified in piping system Sections, install the following types:

1. Restraint-Control Devices (MSS Type 47): Where indicated to control piping movement.
2. Spring Cushions (MSS Type 48): For light loads if vertical movement does not exceed 1-1/4 inches.
3. Spring-Cushion Roll Hangers (MSS Type 49): For equipping Type 41, roll hanger with springs.
4. Spring Sway Braces (MSS Type 50): To retard sway, shock, vibration, or thermal expansion in piping systems.
5. Variable-Spring Hangers (MSS Type 51): Preset to indicated load and limit variability factor to 25 percent to allow expansion and contraction of piping system from hanger.
6. Variable-Spring Base Supports (MSS Type 52): Preset to indicated load and limit variability factor to 25 percent to allow expansion and contraction of piping system from base support.
7. Variable-Spring Trapeze Hangers (MSS Type 53): Preset to indicated load and limit variability factor to 25 percent to allow expansion and contraction of piping system from trapeze support.
8. Constant Supports: For critical piping stress and if necessary to avoid transfer of stress from one support to another support, critical terminal, or connected equipment. Include

auxiliary stops for erection, hydrostatic test, and load-adjustment capability. These supports include the following types:

a. Horizontal (MSS Type 54): Mounted horizontally.
b. Vertical (MSS Type 55): Mounted vertically.
c. Trapeze (MSS Type 56): Two vertical-type supports and one trapeze member.

P. Comply with MSS SP-69 for trapeze pipe-hanger selections and applications that are not specified in piping system Sections.

Q. Comply with MFMA-103 for metal framing system selections and applications that are not specified in piping system Sections.

R. Use mechanical-expansion anchors instead of building attachments where required in concrete construction.

END OF SECTION 230529

SECTION 230523 - GENERAL-DUTY VALVES FOR HVAC PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

1. Bronze angle valves.
2. Bronze ball valves.
3. Iron, single-flange butterfly valves.
4. Iron, grooved-end butterfly valves.
5. High-performance butterfly valves.
6. Bronze lift check valves.
7. Bronze swing check valves.
8. Iron swing check valves.
9. Iron swing check valves with closure control.
10. Iron, grooved-end swing-check valves.
11. Iron, center-guided check valves.
12. Iron, plate-type check valves.
13. Bronze gate valves.
14. Iron gate valves.
15. Bronze globe valves.
16. Iron globe valves.
17. Eccentric plug valves.
18. Chainwheels.

B. Related Sections:

1. Division 23 HVAC piping Sections for specialty valves applicable to those Sections only.
2. Division 23 Section "Identification for HVAC Piping and Equipment" for valve tags and schedules.

1.3 DEFINITIONS

A. CWP: Cold working pressure.

B. EPDM: Ethylene propylene copolymer rubber.

C. NBR: Acrylonitrile-butadiene, Buna-N, or nitrile rubber.

D. NRS: Non-rising stem.

E. OS&Y: Outside screw and yoke.

F. RS: Rising stem.

G. SWP: Steam working pressure.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of valve indicated.

1.5 QUALITY ASSURANCE

A. Source Limitations for Valves: Obtain each type of valve from single source from single manufacturer.

B. ASME Compliance:

1. ASME B16.10 and ASME B16.34 for ferrous valve dimensions and design criteria.
2. ASME B31.1 for power piping valves.
3. ASME B31.9 for building services piping valves.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Prepare valves for shipping as follows:

1. Protect internal parts against rust and corrosion.
2. Protect threads, flange faces, grooves, and weld ends.
3. Set angle, gate, and globe valves closed to prevent rattling.
4. Set ball and plug valves open to minimize exposure of functional surfaces.
5. Set butterfly valves closed or slightly open.
6. Block check valves in either closed or open position.

B. Use the following precautions during storage:

1. Maintain valve end protection.
2. Store valves indoors and maintain at higher than ambient dew point temperature. If outdoor storage is necessary, store valves off the ground in watertight enclosures.

C. Use sling to handle large valves; rig sling to avoid damage to exposed parts. Do not use hand wheels or stems as lifting or rigging points.

PART 2 - PRODUCTS

2.1 GENERAL REQUIREMENTS FOR VALVES

A. Refer to HVAC valve schedule articles for applications of valves.

B. Valve Pressure and Temperature Ratings: Not less than indicated and as required for system pressures and temperatures.

C. Valve Sizes: Same as upstream piping unless otherwise indicated.

D. Valve Actuator Types:

1. Gear Actuator: For quarter-turn valves NPS 8 and larger.
2. Hand wheel: For valves other than quarter-turn types.
3. Hand lever: For quarter-turn valves NPS 6 and smaller
4. Chain wheel: Device for attachment to valve hand wheel, stem, or other actuator; of size and with chain for mounting height, as indicated in the "Valve Installation" Article.

E. Valves in Insulated Piping: With 2-inch stem extensions and the following features:

1. Gate Valves: With rising stem.
2. Ball Valves: With extended operating handle of non-thermal-conductive material, and protective sleeve that allows operation of valve without breaking the vapor seal or disturbing insulation.
3. Butterfly Valves: With extended neck.

F. Valve-End Connections:

1. Flanged: With flanges according to ASME B16.1 for iron valves.
2. Grooved: With grooves according to AWWA C606.
3. Solder Joint: With sockets according to ASME B16.18.
4. Threaded: With threads according to ASME B1.20.1.

G. Valve Bypass and Drain Connections: MSS SP-45.

2.2 BRONZE ANGLE VALVES

A. Class 150, Bronze Angle Valves with Bronze Disc:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following

a. Crane Co.; Crane Valve Group; Stockham Division.
b. Kitz Corporation.

2. Description:

a. Standard: MSS SP-80, Type 1.
b. CWP Rating: 300 psig.
c. Body Material: ASTM B 62, bronze with integral seat and union-ring bonnet.
d. Ends: Threaded.
e. Stem and Disc: Bronze.

f. Packing: Asbestos free.
g. Hand wheel: Malleable iron, bronze, or aluminum.

2.3 BRONZE BALL VALVES

A. Two-Piece, Full-Port, Bronze Ball Valves with Stainless-Steel Trim:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Conbraco Industries, Inc.; Apollo Valves.
b. Crane Co.; Crane Valve Group; Crane Valves.
c. Hammond Valve.
d. Lance Valves; a division of Advanced Thermal Systems, Inc.
e. Milwaukee Valve Company.
f. NIBCO INC.
g. Watts Regulator Co.; a division of Watts Water Technologies, Inc.

2. Description:

a. Standard: MSS SP-110.
b. SWP Rating: 150 psig.
c. CWP Rating: 600 psig.
d. Body Design: Two piece.
e. Body Material: Bronze.
f. Ends: Threaded.
g. Seats: PTFE or TFE.
h. Stem: Stainless steel.
i. Ball: Stainless steel, vented.
j. Port: Full.

3. Description:

a. Standard: MSS SP-110.
b. SWP Rating: 150 psig.
c. CWP Rating: 600 psig.
d. Body Design: Three piece.
e. Body Material: Bronze.
f. Ends: Threaded.
g. Seats: PTFE or TFE.
h. Stem: Stainless steel.
i. Ball: Stainless steel, vented.
j. Port: Full.

2.4 IRON, SINGLE-FLANGE BUTTERFLY VALVES

A. 150 CWP, Iron, Single-Flange Butterfly Valves with EPDM Seat and Aluminum-Bronze Disc:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following]:
   a. Bray Controls; a division of Bray International.
   b. Conbraco Industries, Inc.; Apollo Valves.
   c. Cooper Cameron Valves; a division of Cooper Cameron Corp.
   d. Crane Co.; Crane Valve Group; Jenkins Valves.
   e. Crane Co.; Crane Valve Group; Stockham Division.
   f. DeZurik Water Controls.
   g. Hammond Valve.
   h. Kitz Corporation.
   i. Milwaukee Valve Company.
   j. NIBCO INC.
   k. Norriseal; a Dover Corporation company.
   l. Red-White Valve Corporation.
   m. Spence Strainers International; a division of CIRCOR International.
   n. Tyco Valves & Controls; a unit of Tyco Flow Control.
   o. Watts Regulator Co.; a division of Watts Water Technologies, Inc.

2. Description:

   a. Standard: MSS SP-67, Type I.
   b. CWP Rating: 150 psig.
   c. Body Design: Lug type; suitable for bidirectional dead-end service at rated pressure without use of downstream flange.
   d. Body Material: ASTM A 126, cast iron or ASTM A 536, ductile iron.
   e. Seat: EPDM.
   f. Stem: One- or two-piece stainless steel.
   g. Disc: Aluminum bronze.

B. 150 CWP, Iron, Single-Flange Butterfly Valves with EPDM Seat and Stainless-Steel Disc:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following
   a. Bray Controls; a division of Bray International.
   b. Conbraco Industries, Inc.; Apollo Valves.
   c. Crane Co.; Crane Valve Group; Jenkins Valves.
   d. Crane Co.; Crane Valve Group; Stockham Division.
   e. Hammond Valve.
   f. Milwaukee Valve Company.
   g. Mueller Steam Specialty; a division of SPX Corporation.
   h. NIBCO INC.
   i. Red-White Valve Corporation.
   j. Tyco Valves & Controls; a unit of Tyco Flow Control.
   k. Watts Regulator Co.; a division of Watts Water Technologies, Inc.

2. Description:

   a. Standard: MSS SP-67, Type I.
   b. CWP Rating: 150 psig.
   c. Body Design: Lug type; suitable for bidirectional dead-end service at rated pressure without use of downstream flange.

d. Body Material: ASTM A 126, cast iron or ASTM A 536, ductile iron.
e. Seat: EPDM.
f. Stem: One- or two-piece stainless steel.
g. Disc: Stainless steel.

C. 200 CWP, Iron, Single-Flange Butterfly Valves with EPDM Seat and Aluminum-Bronze Disc:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following :

a. ABZ Valve and Controls; a division of ABZ Manufacturing, Inc.
b. Conbraco Industries, Inc.; Apollo Valves.
c. Cooper Cameron Valves; a division of Cooper Cameron Corp.
d. Crane Co.; Crane Valve Group; Jenkins Valves.
e. Crane Co.; Crane Valve Group; Stockham Division.
f. DeZurik Water Controls.
g. Flo Fab Inc.
h. Hammond Valve.
i. Kitz Corporation.
j. Legend Valve.
k. Milwaukee Valve Company.
l. NIBCO INC.
m. Norriseal; a Dover Corporation company.
n. Red-White Valve Corporation.
o. Spence Strainers International; a division of CIRCOR International.
p. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
q. .

2. Description:

a. Standard: MSS SP-67, Type I.
b. CWP Rating: 200 psig.
c. Body Design: Lug type; suitable for bidirectional dead-end service at rated pressure without use of downstream flange.
d. Body Material: ASTM A 126, cast iron or ASTM A 536, ductile iron.
e. Seat: EPDM.
f. Stem: One- or two-piece stainless steel.
g. Disc: Aluminum bronze.
h.

D. 200 CWP, Iron, Single-Flange Butterfly Valves with EPDM Seat and Stainless-Steel Disc:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following :

a. ABZ Valve and Controls; a division of ABZ Manufacturing, Inc.
b. American Valve, Inc.
c. Conbraco Industries, Inc.; Apollo Valves.
d. Cooper Cameron Valves; a division of Cooper Cameron Corp.
e. Crane Co.; Crane Valve Group; Jenkins Valves.
f. Crane Co.; Crane Valve Group; Stockham Division.

g. DeZurik Water Controls.
h. Flo Fab Inc.
i. Hammond Valve.
j. Kitz Corporation.
k. Legend Valve.
l. Milwaukee Valve Company.
m. Mueller Steam Specialty; a division of SPX Corporation.
n. NIBCO INC.
o. Norriseal; a Dover Corporation company.
p. Red-White Valve Corporation.
q. Spence Strainers International; a division of CIRCOR International.
r. Sure Flow Equipment Inc.
s. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
t. .

2. Description:

a. Standard: MSS SP-67, Type I.
b. CWP Rating: 200 psig.
c. Body Design: Lug type; suitable for bidirectional dead-end service at rated pressure without use of downstream flange.
d. Body Material: ASTM A 126, cast iron or ASTM A 536, ductile iron.
e. Seat: EPDM.
f. Stem: One- or two-piece stainless steel.
g. Disc: Stainless steel.

2.5 IRON, GROOVED-END BUTTERFLY VALVES

A. 175 CWP, Iron, Grooved-End Butterfly Valves:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following :

a. Kennedy Valve; a division of McWane, Inc.
b. Shurjoint Piping Products.
c. Tyco Fire Products LP; Grinnell Mechanical Products.
d. Victaulic Company.
e. .

2. Description:

a. Standard: MSS SP-67, Type I.
b. CWP Rating: 175 psig.
c. Body Material: Coated, ductile iron.
d. Stem: Two-piece stainless steel.
e. Disc: Coated, ductile iron.
f. Seal: EPDM.

B. 300 CWP, Iron, Grooved-End Butterfly Valves:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following :

   a. Anvil International, Inc.
   b. Kennedy Valve; a division of McWane, Inc.
   c. Mueller Steam Specialty; a division of SPX Corporation.
   d. NIBCO INC.
   e. Shurjoint Piping Products.
   f. Tyco Fire Products LP; Grinnell Mechanical Products.
   g. Victaulic Company.
   h. .

2. Description:

   a. Standard: MSS SP-67, Type I.
   b. NPS 8 and Smaller CWP Rating: 300 psig.
   c. NPS 10 and Larger CWP Rating: 200 psig.
   d. Body Material: Coated, ductile iron.
   e. Stem: Two-piece stainless steel.
   f. Disc: Coated, ductile iron.
   g. Seal: EPDM.

2.6 HIGH-PERFORMANCE BUTTERFLY VALVES

A. Class 150, Single-Flange, High-Performance Butterfly Valves:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following :
   a. Bray Controls; a division of Bray International.
   b. Crane Co.; Crane Valve Group; Flowseal.
   c. Crane Co.; Crane Valve Group; Stockham Division.
   d. DeZurik Water Controls.
   e. Milwaukee Valve Company.
   f. NIBCO INC.
   g. Tyco Valves & Controls; a unit of Tyco Flow Control.

2. Description:

   a. Standard: MSS SP-68.
   b. CWP Rating: 285 psig at 100 deg F.
   c. Body Design: Lug type; suitable for bidirectional dead-end service at rated pressure without use of downstream flange.
   d. Body Material: Carbon steel, cast iron, ductile iron, or stainless steel.
   e. Seat: Reinforced PTFE or metal.
   f. Stem: Stainless steel; offset from seat plane.
   g. Disc: Carbon steel.
   h. Service: Bidirectional.

B. Class 300, Single-Flange, High-Performance Butterfly Valves:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following :
   a. Bray Controls; a division of Bray International.
   b. Crane Co.; Crane Valve Group; Flowseal.
   c. Crane Co.; Crane Valve Group; Stockham Division.
   d. DeZurik Water Controls.
   e. Milwaukee Valve Company.
   f. NIBCO INC.
   g. Tyco Valves & Controls; a unit of Tyco Flow Control.

2. Description:

   a. Standard: MSS SP-68.
   b. CWP Rating: 720 psig at 100 deg F.
   c. Body Design: Lug type; suitable for bidirectional dead-end service at rated pressure without use of downstream flange.
   d. Body Material: Carbon steel, cast iron, or ductile iron.
   e. Seat: Reinforced PTFE or metal.
   f. Stem: Stainless steel; offset from seat plane.
   g. Disc: Carbon steel.
   h. Service: Bidirectional.

2.7 BRONZE LIFT CHECK VALVES

A. Class 125, Lift Check Valves with Bronze Disc:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following :

   a. Crane Co.; Crane Valve Group; Crane Valves.
   b. Crane Co.; Crane Valve Group; Jenkins Valves.
   c. Crane Co.; Crane Valve Group; Stockham Division.
   d. .

2. Description:

   a. Standard: MSS SP-80, Type 1.
   b. CWP Rating: 200 psig.
   c. Body Design: Vertical flow.
   d. Body Material: ASTM B 61 or ASTM B 62, bronze.
   e. Ends: Threaded.
   f. Disc: Bronze.

2.8 BRONZE SWING CHECK VALVES

A. Class 150, Bronze Swing Check Valves with Bronze Disc:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following :

a. American Valve, Inc.
b. Crane Co.; Crane Valve Group; Crane Valves.
c. Crane Co.; Crane Valve Group; Jenkins Valves.
d. Crane Co.; Crane Valve Group; Stockham Division.
e. Kitz Corporation.
f. Milwaukee Valve Company.
g. NIBCO INC.
h. Red-White Valve Corporation.

2. Description:

a. Standard: MSS SP-80, Type 3.
b. CWP Rating: 300 psig.
c. Body Design: Horizontal flow.
d. Body Material: ASTM B 62, bronze.
e. Ends: Threaded.
f. Disc: Bronze.

2.9 IRON SWING CHECK VALVES

A. Class 250, Iron Swing Check Valves with Metal Seats:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following :

a. Crane Co.; Crane Valve Group; Crane Valves.
b. Crane Co.; Crane Valve Group; Jenkins Valves.
c. Crane Co.; Crane Valve Group; Stockham Division.
d. Hammond Valve.
e. Milwaukee Valve Company.
f. NIBCO INC.
g. Watts Regulator Co.; a division of Watts Water Technologies, Inc.

2. Description:

a. Standard: MSS SP-71, Type I.
b. NPS 2-1/2 to NPS 12, CWP Rating: 500 psig.
c. NPS 14 to NPS 24, CWP Rating: 300 psig.
d. Body Design: Clear or full waterway.
e. Body Material: ASTM A 126, gray iron with bolted bonnet.
f. Ends: Flanged.
g. Trim: Bronze.
h. Gasket: Asbestos free.

2.10 IRON SWING CHECK VALVES WITH CLOSURE CONTROL

A. Class 125, Iron Swing Check Valves with Lever- and Spring-Closure Control:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following :

   a. NIBCO INC.

2. Description:

   a. Standard: MSS SP-71, Type I.
   b. NPS 2-1/2 to NPS 12, CWP Rating: 200 psig.
   c. NPS 14 to NPS 24, CWP Rating: 150 psig.
   d. Body Design: Clear or full waterway.
   e. Body Material: ASTM A 126, gray iron with bolted bonnet.
   f. Ends: Flanged.
   g. Trim: Bronze.
   h. Gasket: Asbestos free.
   i. Closure Control: Factory-installed, exterior lever and spring.

B. Class 125, Iron Swing Check Valves with Lever and Weight-Closure Control:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following :

   a. Crane Co.; Crane Valve Group; Crane Valves.
   b. Crane Co.; Crane Valve Group; Jenkins Valves.
   c. Crane Co.; Crane Valve Group; Stockham Division.
   d. Hammond Valve.
   e. Milwaukee Valve Company.
   f. NIBCO INC.
   g. Watts Regulator Co.; a division of Watts Water Technologies, Inc.

2. Description:

   a. Standard: MSS SP-71, Type I.
   b. NPS 2-1/2 to NPS 12, CWP Rating: 200 psig.
   c. NPS 14 to NPS 24, CWP Rating: 150 psig.
   d. Body Design: Clear or full waterway.
   e. Body Material: ASTM A 126, gray iron with bolted bonnet.
   f. Ends: Flanged.
   g. Trim: Bronze.
   h. Gasket: Asbestos free.
   i. Closure Control: Factory-installed, exterior lever and weight.

2.11 IRON, GROOVED-END SWING CHECK VALVES

A. 300 CWP, Iron, Grooved-End Swing Check Valves:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following :

   a. Anvil International, Inc.

b. Shurjoint Piping Products.
c. Tyco Fire Products LP; Grinnell Mechanical Products.
d. Victaulic Company.

2. Description:

a. CWP Rating: 300 psig.
b. Body Material: ASTM A 536, ductile iron.
c. Seal: EPDM.
d. Disc: Spring operated, ductile iron or stainless steel.

2.12 IRON, CENTER-GUIDED CHECK VALVES

A. Class 125, Iron, Compact-Wafer, Center-Guided Check Valves with Resilient Seat:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following :

a. APCO Willamette Valve and Primer Corporation.
b. Crispin Valve.
c. DFT Inc.
d. Flo Fab Inc.
e. Hammond Valve.
f. Milwaukee Valve Company.
g. NIBCO INC.
h. Spence Strainers International; a division of CIRCOR International.
i. Sure Flow Equipment Inc.
j. Val-Matic Valve & Manufacturing Corp.

2. Description:

a. Standard: MSS SP-125.
b. NPS 2-1/2 to NPS 12, CWP Rating: 200 psig.
c. NPS 14 to NPS 24, CWP Rating: 150 psig.
d. Body Material: ASTM A 126, gray iron.
e. Style: Compact wafer.
f. Seat: EPDM.

B. Class 150, Iron, Compact-Wafer, Center-Guided Check Valves with Resilient Seat:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following :

a. APCO Willamette Valve and Primer Corporation.
b. Crispin Valve.
c. Val-Matic Valve & Manufacturing Corp.

2. Description:

a. Standard: MSS SP-125.

b. NPS 2-1/2 to NPS 12, CWP Rating: 300 psig.
c. NPS 14 to NPS 24, CWP Rating: 250 psig.
d. Body Material: ASTM A 395/A 395M or ASTM A 536, ductile iron.
e. Style: Compact wafer.
f. Seat: EPDM.

C. Class 150, Iron, Globe, Center-Guided Check Valves with Resilient Seat:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following :

a. APCO Willamette Valve and Primer Corporation.
b. Crispin Valve.
c. DFT Inc.
d. Val-Matic Valve & Manufacturing Corp.

2. Description:

a. Standard: MSS SP-125.
b. NPS 2-1/2 to NPS 12, CWP Rating: 300 psig.
c. NPS 14 to NPS 24, CWP Rating: 250 psig.
d. Body Material: ASTM A 395/A 395M or ASTM A 536, ductile iron.
e. Style: Globe, spring loaded.
f. Ends: Flanged.
g. Seat: EPDM .

D. Class 250, Iron, Compact-Wafer, Center-Guided Check Valves with Resilient Seat:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following :

a. APCO Willamette Valve and Primer Corporation.
b. Crispin Valve.
c. DFT Inc.
d. Flo Fab Inc.
e. Hammond Valve.
f. Milwaukee Valve Company.
g. NIBCO INC.
h. Sure Flow Equipment Inc.
i. Val-Matic Valve & Manufacturing Corp.

2. Description:

a. Standard: MSS SP-125.
b. NPS 2-1/2 to NPS 12, CWP Rating: 400 psig.
c. NPS 14 to NPS 24, CWP Rating: 300 psig.
d. Body Material: ASTM A 126, gray iron.
e. Style: Compact wafer, spring loaded.
f. Seat: EPDM .

E. Class 250, Iron, Globe, Center-Guided Check Valves with Resilient Seat:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following :

   a. APCO Willamette Valve and Primer Corporation.
   b. Crispin Valve.
   c. DFT Inc.
   d. Hammond Valve.
   e. Milwaukee Valve Company.
   f. NIBCO INC.
   g. Val-Matic Valve & Manufacturing Corp.

2. Description:

   a. Standard: MSS SP-125.
   b. NPS 2-1/2 to NPS 12, CWP Rating: 400 psig.
   c. NPS 14 to NPS 24, CWP Rating: 300 psig.
   d. Body Material: ASTM A 126, gray iron.
   e. Style: Globe, spring loaded.
   f. Ends: Flanged.
   g. Seat: EPDM .

2.13 IRON, PLATE-TYPE CHECK VALVES

A. Class 150, Iron, Dual-Plate Check Valves with Metal Seat:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following :

   a. APCO Willamette Valve and Primer Corporation.
   b. Crane Co.; Crane Valve Group; Crane Valves.
   c. Mueller Steam Specialty; a division of SPX Corporation.
   d. Val-Matic Valve & Manufacturing Corp.

2. Description:

   a. Standard: API 594.
   b. NPS 2-1/2 to NPS 12, CWP Rating: 300 psig.
   c. NPS 14 to NPS 24, CWP Rating: 250 psig.
   d. Body Design: Wafer, spring-loaded plates.
   e. Body Material: ASTM A 395/A 395M or ASTM A 536, ductile iron.
   f. Seat: Bronze.

B. Class 250, Iron, Dual-Plate Check Valves with Metal Seat:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following :

   a. APCO Willamette Valve and Primer Corporation.
   b. Crane Co.; Crane Valve Group; Crane Valves.

2. Description:

a. Standard: API 594.
b. NPS 2-1/2 to NPS 12, CWP Rating: 400 psig.
c. NPS 14 to NPS 24, CWP Rating: 300 psig.
d. Body Design: Wafer, spring-loaded plates.
e. Body Material: ASTM A 126, gray iron.
f. Seat: Bronze.

C. Class 150, Iron, Dual-Plate Check Valves with Resilient Seat:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following :

a. APCO Willamette Valve and Primer Corporation.
b. Crane Co.; Crane Valve Group; Crane Valves.
c. Crane Co.; Crane Valve Group; Jenkins Valves.
d. Val-Matic Valve & Manufacturing Corp.

2. Description:

a. Standard: API 594.
b. NPS 2-1/2 to NPS 12, CWP Rating: 300 psig.
c. NPS 14 to NPS 24, CWP Rating: 250 psig.
d. Body Design: Wafer, spring-loaded plates.
e. Body Material: ASTM A 395/A 395M or ASTM A 536, ductile iron.
f. Seat: EPDM .

D. Class 250, Iron, Wafer, Single-Plate Check Valves with Resilient Seat:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following :

a. Sure Flow Equipment Inc.

2. Description:

a. Standard: API 594.
b. NPS 2-1/2 to NPS 12, CWP Rating: 400 psig.
c. NPS 14 to NPS 24, CWP Rating: 300 psig.
d. Body Design: Wafer, spring-loaded plate.
e. Body Material: ASTM A 126, gray iron.
f. Seat: EPDM .

E. Class 250, Iron, Dual-Plate Check Valves with Resilient Seat:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following :

a. APCO Willamette Valve and Primer Corporation.
b. Crane Co.; Crane Valve Group; Crane Valves.

c. Sure Flow Equipment Inc.

2. Description:

a. Standard: API 594.
b. NPS 2-1/2 to NPS 12, CWP Rating: 400 psig.
c. NPS 14 to NPS 24, CWP Rating: 300 psig.
d. Body Design: Wafer, spring-loaded plates.
e. Body Material: ASTM A 126, gray iron.
f. Seat: EPDM .

2.14 BRONZE GATE VALVES

A. Class 150, NRS Bronze Gate Valves:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following :

a. Hammond Valve.
b. Kitz Corporation.
c. Milwaukee Valve Company.
d. NIBCO INC.
e. Powell Valves.
f. Red-White Valve Corporation.
g. Watts Regulator Co.; a division of Watts Water Technologies, Inc.

2. Description:

a. Standard: MSS SP-80, Type 1.
b. CWP Rating: 300 psig.
c. Body Material: ASTM B 62, bronze with integral seat and union-ring bonnet.
d. Ends: Threaded.
e. Stem: Bronze.
f. Disc: Solid wedge; bronze.
g. Packing: Asbestos free.
h. Handwheel: Malleable iron, bronze, or aluminum.

B. Class 150, RS Bronze Gate Valves:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following :

a. Crane Co.; Crane Valve Group; Crane Valves.
b. Crane Co.; Crane Valve Group; Stockham Division.
c. Hammond Valve.
d. Kitz Corporation.
e. Milwaukee Valve Company.
f. NIBCO INC.

g. Powell Valves.
h. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
i. Zy-Tech Global Industries, Inc.

2. Description:

a. Standard: MSS SP-80, Type 2.
b. CWP Rating: 300 psig.
c. Body Material: ASTM B 62, bronze with integral seat and union-ring bonnet.
d. Ends: Threaded.
e. Stem: Bronze.
f. Disc: Solid wedge; bronze.
g. Packing: Asbestos free.
h. Handwheel: Malleable iron, bronze, or aluminum.

2.15 IRON GATE VALVES

A. Class 125, OS&Y, Iron Gate Valves:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following :

a. Crane Co.; Crane Valve Group; Crane Valves.
b. Crane Co.; Crane Valve Group; Jenkins Valves.
c. Crane Co.; Crane Valve Group; Stockham Division.
d. Flo Fab Inc.
e. Hammond Valve.
f. Kitz Corporation.
g. Legend Valve.
h. Milwaukee Valve Company.
i. NIBCO INC.
j. Powell Valves.
k. Red-White Valve Corporation.
l. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
m. Zy-Tech Global Industries, Inc.

2. Description:

a. Standard: MSS SP-70, Type I.
b. NPS 2-1/2 to NPS 12, CWP Rating: 200 psig.
c. NPS 14 to NPS 24, CWP Rating: 150 psig.
d. Body Material: ASTM A 126, gray iron with bolted bonnet.
e. Ends: Flanged.
f. Trim: Bronze.
g. Disc: Solid wedge.
h. Packing and Gasket: Asbestos free.

B. Class 250, NRS, Iron Gate Valves:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following :

   a. Crane Co.; Crane Valve Group; Crane Valves.
   b. Crane Co.; Crane Valve Group; Stockham Division.
   c. NIBCO INC.

2. Description:

   a. Standard: MSS SP-70, Type I.
   b. NPS 2-1/2 to NPS 12, CWP Rating: 500 psig.
   c. NPS 14 to NPS 24, CWP Rating: 300 psig.
   d. Body Material: ASTM A 126, gray iron with bolted bonnet.
   e. Ends: Flanged.
   f. Trim: Bronze.
   g. Disc: Solid wedge.
   h. Packing and Gasket: Asbestos free.

C. Class 250, OS&Y, Iron Gate Valves:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following :

   a. Crane Co.; Crane Valve Group; Crane Valves.
   b. Crane Co.; Crane Valve Group; Stockham Division.
   c. Hammond Valve.
   d. Milwaukee Valve Company.
   e. NIBCO INC.
   f. Powell Valves.
   g. Watts Regulator Co.; a division of Watts Water Technologies, Inc.

2. Description:

   a. Standard: MSS SP-70, Type I.
   b. NPS 2-1/2 to NPS 12, CWP Rating: 500 psig.
   c. NPS 14 to NPS 24, CWP Rating: 300 psig.
   d. Body Material: ASTM A 126, gray iron with bolted bonnet.
   e. Ends: Flanged.
   f. Trim: Bronze.
   g. Disc: Solid wedge.
   h. Packing and Gasket: Asbestos free.

2.16 BRONZE GLOBE VALVES

A. Class 125, Bronze Globe Valves with Bronze Disc:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following :

   a. Crane Co.; Crane Valve Group; Crane Valves.

b. Crane Co.; Crane Valve Group; Stockham Division.
c. Hammond Valve.
d. Kitz Corporation.
e. Milwaukee Valve Company.
f. NIBCO INC.
g. Powell Valves.
h. Red-White Valve Corporation.
i. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
j. Zy-Tech Global Industries, Inc.

2. Description:

a. Standard: MSS SP-80, Type 1.
b. CWP Rating: 200 psig.
c. Body Material: ASTM B 62, bronze with integral seat and screw-in bonnet.
d. Ends: Threaded or solder joint.
e. Stem and Disc: Bronze.
f. Packing: Asbestos free.
g. Handwheel: Malleable iron.

B. Class 150, Bronze Globe Valves with Nonmetallic Disc:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following :

a. Crane Co.; Crane Valve Group; Crane Valves.
b. Hammond Valve.
c. Kitz Corporation.
d. Milwaukee Valve Company.
e. NIBCO INC.
f. Powell Valves.
g. Red-White Valve Corporation.
h. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
i. Zy-Tech Global Industries, Inc.

2. Description:

a. Standard: MSS SP-80, Type 2.
b. CWP Rating: 300 psig.
c. Body Material: ASTM B 62, bronze with integral seat and union-ring bonnet.
d. Ends: Threaded.
e. Stem: Bronze.
f. Disc: PTFE or TFE.
g. Packing: Asbestos free.
h. Handwheel: Malleable iron.

2.17 IRON GLOBE VALVES

A. Class 250, Iron Globe Valves:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following :

   a. Crane Co.; Crane Valve Group; Crane Valves.
   b. Crane Co.; Crane Valve Group; Jenkins Valves.
   c. Crane Co.; Crane Valve Group; Stockham Division.
   d. Hammond Valve.
   e. Milwaukee Valve Company.
   f. NIBCO INC.
   g. Watts Regulator Co.; a division of Watts Water Technologies, Inc.

2. Description:

   a. Standard: MSS SP-85, Type I.
   b. CWP Rating: 500 psig.
   c. Body Material: ASTM A 126, gray iron with bolted bonnet.
   d. Ends: Flanged.
   e. Trim: Bronze.
   f. Packing and Gasket: Asbestos free.

2.18 CHAINWHEELS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following :

   1. Babbitt Steam Specialty Co.
   2. Roto Hammer Industries.
   3. Trumbull Industries.

B. Description: Valve actuation assembly with sprocket rim, brackets, and chain.

   1. Brackets: Type, number, size, and fasteners required to mount actuator on valve.
   2. Attachment: For connection to ball and butterfly valve stems.
   3. Sprocket Rim with Chain Guides: Ductile or cast iron , of type and size required for valve. Include zinc coating for exterior applications
   4. Chain: Hot-dip, galvanized steel, of size required to fit sprocket rim.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine valve interior for cleanliness, freedom from foreign matter, and corrosion. Remove special packing materials, such as blocks, used to prevent disc movement during shipping and handling.

B. Operate valves in positions from fully open to fully closed. Examine guides and seats made accessible by such operations.

C. Examine threads on valve and mating pipe for form and cleanliness.

D. Examine mating flange faces for conditions that might cause leakage. Check bolting for proper size, length, and material. Verify that gasket is of proper size, that its material composition is suitable for service, and that it is free from defects and damage.

E. Do not attempt to repair defective valves; replace with new valves.

3.2 VALVE INSTALLATION

A. Install valves with unions or flanges at each piece of equipment arranged to allow service, maintenance, and equipment removal without system shutdown.

B. Locate valves for easy access and provide separate support where necessary.

C. Install valves in horizontal piping with stem at or above center of pipe.

D. Install valves in position to allow full stem movement.

E. Install chain wheels on operators for butterfly gate and globe valves NPS 4 and larger and more than 96 inches above floor. Extend chains to 60 inches above finished floor.

F. Install check valves for proper direction of flow and as follows:

1. Swing Check Valves: In horizontal position with hinge pin level.
2. Center-Guided and Plate-Type Check Valves: In horizontal or vertical position, between flanges.
3. Lift Check Valves: With stem upright and plumb.

3.3 ADJUSTING

A. Adjust or replace valve packing after piping systems have been tested and put into service but before final adjusting and balancing. Replace valves if persistent leaking occurs.

3.4 GENERAL REQUIREMENTS FOR VALVE APPLICATIONS

A. If valve applications are not indicated, use the following:

1. Shutoff Service: Ball, butterfly, or gate valves.
2. Butterfly Valve Dead-End Service: Single-flange (lug) type. Provide a spool piece with diameter greater than the pipe diameter with a blind flange to allow regular exercising of the butterfly valve.
3. Throttling Service except Steam: Ball or butterfly valves.
4. Throttling Service, Steam: Globe or angle valves.
5. Pump-Discharge Check Valves:

    a. NPS 2 and Smaller: Bronze swing check valves with bronze or nonmetallic disc.

b. NPS 2-1/2 and Larger: Iron swing check valves with lever and weight or with spring or iron, center-guided, metal or resilient-seat check valves.
c. All Pump-Discharge Check Valves shall be located a minimum of 5 pipe diameters from the pump discharge.

B. If valves with specified SWP classes or CWP ratings are not available, the same types of valves with higher SWP classes or CWP ratings may be substituted.

C. Select valves, except wafer types, with the following end connections:

1. For Copper Tubing, NPS 2 and Smaller: Threaded ends except where solder-joint valve-end option is indicated in valve schedules below.
2. For Copper Tubing, NPS 2-1/2 to NPS 4: Flanged ends except where threaded valve-end option is indicated in valve schedules below.
3. For Copper Tubing, NPS 5 and Larger: Flanged ends.
4. For Steel Piping, NPS 2 and Smaller: Threaded ends.
5. For Steel Piping, NPS 2-1/2 to NPS 4: Flanged ends except where threaded valve-end option is indicated in valve schedules below.
6. For Steel Piping, NPS 5 and Larger: Flanged ends.
7. For Grooved-End Copper Tubing and Steel Piping except Steam and Steam Condensate Piping: Valve ends may be grooved.

3.5 CHILLED-WATER VALVE SCHEDULE

A. Pipe NPS 2 and Smaller:

1. Bronze Valves: May be provided with solder-joint ends instead of threaded ends.
2. Bronze Angle Valves: Class 150, bronze disc.
3. Ball Valves: One or Two piece, full port, bronze with stainless-steel trim.
4. Bronze Swing Check Valves: Class 150 nonmetallic disc.
5. Bronze Gate Valves: Class 150, RS, bronze.
6. Bronze Globe Valves: Class 150, bronze disc.

B. Pipe NPS 2-1/2 and Larger:

1. Iron Valves, NPS 2-1/2 to NPS 4: May be provided with threaded ends instead of flanged ends.
2. Iron Ball Valves, NPS 2-1/2 to NPS 10: Class 150.
3. Iron, Single-Flange Butterfly Valves, NPS 2-1/2 to NPS 12: 200 CWP,EPDM **ductile-iron** disc.
4. Iron, Single-Flange Butterfly Valves, NPS 14 to NPS 24: 150 CWP,EPDM seat, **ductile-iron** disc.
5. Iron, Grooved-End Butterfly Valves, NPS 2-1/2 to NPS 12: 175 CWP.
6. High-Performance Butterfly Valves: Class 150, single flange.
7. Iron Swing Check Valves: Class 125, nonmetallic-to-metal seats.
8. Iron Swing Check Valves with Closure Control, NPS 2-1/2 to NPS 12: Class 125, lever and spring.
9. Iron, Grooved-End Check Valves, NPS 3 to NPS 12: 300 CWP.
10. Iron, Center-Guided Check Valves: Class 150, **globe**,resilient seat.
11. Iron, Plate-Type Check Valves: Class 150; dual plate; resilient seat.

12. Iron Gate Valves: Class 125, OS&Y.
13. Iron Globe Valves: Class 125.
14. Lubricated Plug Valves: Class 125, regular gland, threaded or flanged.
15. Eccentric Plug Valves: 175 CWP, resilient seating.

END OF SECTION 230523

SECTION 230519 - METERS AND GAGES FOR HVAC PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:
1. Filled-system thermometers.
2. Liquid-in-glass thermometers.
3. Light-activated thermometers.
4. Thermowells.
5. Dial-type pressure gages.
6. Gage attachments.
7. Test plugs.
8. Test-plug kits.
9. Sight flow indicators.
10. Orifice flowmeters.
11. Pitot-tube flowmeters.
12. Turbine flowmeters.
13. Venturi flowmeters.
14. Vortex-shedding flowmeters.
15. Impeller-turbine, thermal-energy meters.
16. Ultrasonic, thermal-energy meters.

B. Related Sections:

1. Section 231123 "Facility Natural-Gas Piping" for gas meters.
2. Section 232216 "Steam and Condensate Piping Specialties" for steam and condensate meters.

1.3 ACTION SUBMITTALS

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

B. Wiring Diagrams: For power, signal, and control wiring.

1.4 INFORMATIONAL SUBMITTALS

A. Product Certificates: For each type of meter and gage, from manufacturer.

1.5 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For meters and gages to include in operation and maintenance manuals.

PART 2 - PRODUCTS

2.1 LIQUID-IN-GLASS THERMOMETERS

A. Metal-Case, Compact-Style, Liquid-in-Glass Thermometers:

B. See Editing Instruction No. 1 in the Evaluations for cautions about naming manufacturers. Retain one of first two subparagraphs and list of manufacturers below. See Section 016000 "Product Requirements."

C. Manufacturers: Subject to compliance with requirements, provide products by one of the following see below:

D. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:

a. Trerice, H. O. Co.

2. Standard: ASME B40.200.

3. Case: Cast aluminum; 6-inch (152-mm) nominal size.

4. Case Form: Straight unless otherwise indicated.

5. Tube: Glass with magnifying lens and RED organic liquid.

6. Tube Background: Nonreflective aluminum with permanently etched scale markings graduated in deg F (deg C).

7. Window: Glass or plastic.

8. Stem: Aluminum or brass and of length to suit installation.

a. Design for Air-Duct Installation: With ventilated shroud.
b. Design for Thermowell Installation: Bare stem.

9. Connector: 3/4 inch, with ASME B1.1 screw threads.
10. Accuracy: Plus or minus 1 percent of scale range or one scale division, to a maximum of 1.5 percent of scale range.

E. Plastic-Case, Compact-Style, Liquid-in-Glass Thermometers:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following see below:

2. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:

    a. Flo Fab Inc.
    b. Miljoco Corporation.
    c. Tel-Tru Manufacturing Company.
    d. Watts Regulator Co.; a div. of Watts Water Technologies, Inc.
    e. Weiss Instruments, Inc.
    f. WIKA Instrument Corporation - USA.

3. Standard: ASME B40.200.
4. Case: Plastic; 6-inch nominal size.
5. Case Form: Straight unless otherwise indicated.
6. Tube: Glass with magnifying lens and red organic liquid.
7. Tube Background: Nonreflective with permanently etched scale markings graduated in deg F.
8. Window: Glass or plastic.
9. Stem: Aluminum or brass and of length to suit installation.

    a. Design for Air-Duct Installation: With ventilated shroud.
    b. Design for Thermowell Installation: Bare stem.

10. Connector: 3/4 inch, with ASME B1.1 screw threads.
11. Accuracy: Plus or minus 1 percent of scale range or one scale division, to a maximum of 1.5 percent of scale range.

F. Metal-Case, Industrial-Style, Liquid-in-Glass Thermometers:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
2. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:

    a. Flo Fab Inc.
    b. Miljoco Corporation.
    c. Palmer Wahl Instrumentation Group.
    d. Tel-Tru Manufacturing Company.
    e. Trerice, H. O. Co.
    f. Weiss Instruments, Inc.
    g. Winters Instruments - U.S.

3. Standard: ASME B40.200.
4. Case: Cast aluminum ; 9-inch nominal size unless otherwise indicated.
5. Case Form: Straight unless otherwise indicated.
6. Tube: Glass with magnifying lens and red organic liquid.
7. Tube Background: Nonreflective aluminum with permanently etched scale markings graduated in deg F.
8. Window: Glass.
9. Stem: Aluminum and of length to suit installation.

    a. Design for Air-Duct Installation: With ventilated shroud.

b. Design for Thermowell Installation: Bare stem.

10. Connector: 1-1/4 inches, with ASME B1.1 screw threads.
11. Accuracy: Plus or minus 1 percent of scale range or one scale division, to a maximum of 1.5 percent of scale range.

G. Plastic-Case, Industrial-Style, Liquid-in-Glass Thermometers:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
2. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:

a. Ernst Flow Industries.
b. Marsh Bellofram.
c. Miljoco Corporation.
d. Palmer Wahl Instrumentation Group.
e. REOTEMP Instrument Corporation.
f. Watts Regulator Co.; a div. of Watts Water Technologies, Inc.
g. Weiss Instruments, Inc.
h. WIKA Instrument Corporation - USA.

3. Standard: ASME B40.200.
4. Case: Plastic; 9-inch nominal size unless otherwise indicated.
5. Case Form: Straight unless otherwise indicated.
6. Tube: Glass with magnifying lens and or red organic liquid.
7. Tube Background: Nonreflective aluminum with permanently etched scale markings graduated in deg F.
8. Window: Glass.
9. Stem: Aluminum, brass, or stainless steel and of length to suit installation.

a. Design for Air-Duct Installation: With ventilated shroud.
b. Design for Thermowell Installation: Bare stem.

10. Connector: 1-1/4 inches, with ASME B1.1 screw threads.
11. Accuracy: Plus or minus 1 percent of scale range or one scale division, to a maximum of 1.5 percent of scale range.

2.2 LIGHT-ACTIVATED THERMOMETERS

A. Direct-Mounted, Light-Activated Thermometers:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
2. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:

a. Flo Fab Inc.
b. REOTEMP Instrument Corporation.
c. Trerice, H. O. Co.

d. Weiss Instruments, Inc.
e. WIKA Instrument Corporation - USA.
f. Winters Instruments - U.S.

3. Case: Metal 9-inch nominal size unless otherwise indicated.
4. Scale(s): Deg F.
5. Case Form: Adjustable angle.
6. Connector: 1-1/4 inches, with ASME B1.1 screw threads.
7. Stem: Aluminum and of length to suit installation.

a. Design for Air-Duct Installation: With ventilated shroud.
b. Design for Thermowell Installation: Bare stem.

8. Display: Digital.
9. Accuracy: Plus or minus 2 deg F.

B. Remote-Mounted, Light-Activated Thermometers:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
2. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:

a. Miljoco Corporation.
b. Weiss Instruments, Inc.
c. Winters Instruments - U.S.

3. Case: Plastic, for wall mounting.
4. Scale(s): Deg F.
5. Sensor: Bulb and thermister wire.

a. Design for Air-Duct Installation: With ventilated shroud.
b. Design for Thermowell Installation: Bare stem.

6. Display: Digital.
7. Accuracy: Plus or minus 2 deg F.

2.3 THERMOWELLS

A. Thermowells:

1. Standard: ASME B40.200.
2. Description: Pressure-tight, socket-type fitting made for insertion into piping tee fitting.
3. Material for Use with Copper Tubing: CNR.
4. Material for Use with Steel Piping: CRES.
5. Type: Stepped shank unless straight or tapered shank is indicated.
6. External Threads: NPS 1/2, NPS 3/4, or NPS 1, ASME B1.20.1 pipe threads.
7. Internal Threads: 1/2, 3/4, and 1 inch, with ASME B1.1 screw threads.
8. Bore: Diameter required to match thermometer bulb or stem.
9. Insertion Length: Length required to match thermometer bulb or stem.

10. Lagging Extension: Include on thermowells for insulated piping and tubing.
11. Bushings: For converting size of thermowell's internal screw thread to size of thermometer connection.

B. Heat-Transfer Medium: Mixture of graphite and glycerin.

2.4 PRESSURE GAGES

A. Direct-Mounted, Metal-Case, Dial-Type Pressure Gages:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
2. Basis-of-Design Product: Subject to compliance with requirements, provide or comparable product by one of the following:

    a. AMETEK, Inc.; U.S. Gauge.
    b. Ashcroft Inc.
    c. Ernst Flow Industries.
    d. Flo Fab Inc.
    e. Marsh Bellofram.
    f. Miljoco Corporation.
    g. Noshok.
    h. Palmer Wahl Instrumentation Group.
    i. REOTEMP Instrument Corporation.
    j. Tel-Tru Manufacturing Company.
    k. Trerice, H. O. Co.
    l. Watts Regulator Co.; a div. of Watts Water Technologies, Inc.
    m. Weiss Instruments, Inc.
    n. WIKA Instrument Corporation - USA.
    o. Winters Instruments - U.S.

3. Standard: ASME B40.100.
4. Case: [Liquid-filled] [Sealed] [Open-front, pressure relief] [Solid-front, pressure relief] <Insert type> type(s); [cast aluminum or drawn steel] <Insert material>; [4-1/2-inch] [6-inch] <Insert dimension> nominal diameter.
5. Pressure-Element Assembly: Bourdon tube unless otherwise indicated.

    Match pressure connection size in first subparagraph below with gage attachment size.
6. Pressure Connection: Brass, with [NPS 1/4] [NPS 1/4 or NPS 1/2] [NPS 1/2], ASME B1.20.1 pipe threads and bottom-outlet type unless back-outlet type is indicated.
7. Movement: Mechanical, with link to pressure element and connection to pointer.
8. Dial: Nonreflective aluminum with permanently etched scale markings graduated in psi.
9. Pointer: Dark-colored metal.
10. Window: Glass.
11. Ring: Stainless steel.
12. Accuracy: Grade A, plus or minus 1 percent of middle half of scale range.

2.5 GAGE ATTACHMENTS

A. Snubbers: ASME B40.100, brass; with NPS 1/4 or NPS 1/2, ASME B1.20.1 pipe threads and piston-type surge-dampening device. Include extension for use on insulated piping.

B. Siphons: Loop-shaped section of steel pipe with NPS 1/4 or NPS 1/2 pipe threads.

C. Valves: Brass or stainless-steel needle, with NPS 1/4 or NPS 1/2, ASME B1.20.1 pipe threads.

2.6 TEST PLUGS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

B. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:

1. Flow Design, Inc.
2. Miljoco Corporation.
3. National Meter, Inc.
4. Peterson Equipment Co., Inc.
5. Sisco Manufacturing Company, Inc.
6. Trerice, H. O. Co.
7. Watts Regulator Co.; a div. of Watts Water Technologies, Inc.
8. Weiss Instruments, Inc.

C. Description: Test-station fitting made for insertion into piping tee fitting.

D. Body: Brass or stainless steel with core inserts and gasketed and threaded cap. Include extended stem on units to be installed in insulated piping.

E. Thread Size: NPS 1/2, ASME B1.20.1 pipe thread.

F. Minimum Pressure and Temperature Rating: 500 psig at 200 deg F.

G. Core Inserts: Chlorosulfonated polyethylene synthetic and EPDM self-sealing rubber.

2.7 TEST-PLUG KITS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

B. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:

1. Flow Design, Inc.
2. Miljoco Corporation.
3. National Meter, Inc.
4. Peterson Equipment Co., Inc.

5. Sisco Manufacturing Company, Inc.
6. Trerice, H. O. Co.
7. Watts Regulator Co.; a div. of Watts Water Technologies, Inc.
8. Weiss Instruments, Inc.

C. Furnish one test-plug kit(s) containing one thermometer(s), one pressure gage and adapter, and carrying case. Thermometer sensing elements, pressure gage, and adapter probes shall be of diameter to fit test plugs and of length to project into piping.

D. Low-Range Thermometer: Small, bimetallic insertion type with 1- to 2-inch- diameter dial and tapered-end sensing element. Dial range shall be at least 25 to 125 deg F.

E. High-Range Thermometer: Small, bimetallic insertion type with 1- to 2-inch diameter dial and tapered-end sensing element. Dial range shall be at least 0 to 220 deg F.

F. Pressure Gage: Small, Bourdon-tube insertion type with 2- to 3-inch diameter dial and probe. Dial range shall be at least 0 to 200 psig.

G. Carrying Case: Metal or plastic, with formed instrument padding.

2.8 FLOWMETERS

A. Turbine Flowmeters:

See Editing Instruction No. 1 in the Evaluations for cautions about naming manufacturers. Retain one of first two subparagraphs and list of manufacturers below. See Section 016000 "Product Requirements."

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
2. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:

    a. ABB; Instrumentation and Analytical.
    b. Data Industrial Corp.
    c. EMCO Flow Systems; a division of Spirax Sarco, Inc.
    d. ERDCO Engineering Corp.
    e. Hoffer Flow Controls, Inc.
    f. Liquid Controls; a unit of IDEX Corporation.
    g. McCrometer, Inc.
    h. Midwest Instruments & Controls Corp.
    i. ONICON Incorporated.
    j. SeaMetrics, Inc.
    k. Sponsler, Inc.; a unit of IDEX Corporation.

3. Description: Flowmeter with sensor and indicator.
4. Flow Range: Sensor and indicator shall cover operating range of equipment or system served.
5. Sensor: Impeller turbine; for inserting into pipe fitting or for installing in piping and measuring flow directly in gallons per minute.

a. Design: Device or pipe fitting with inline turbine and integral direct-reading scale for water.
b. Construction: Bronze or stainless-steel body, with plastic turbine or impeller.
c. Minimum Pressure Rating: 150 psig.
d. Minimum Temperature Rating: 180 deg F.

6. Indicator: Hand-held meter; either an integral part of sensor or a separate meter.
7. Accuracy: Plus or minus 1-1/2 percent.
8. Display: Shows rate of flow with register to indicate total volume in gallons.
9. Operating Instructions: Include complete instructions with each flowmeter.

B. Venturi Flowmeters:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
2. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:

a. ABB; Instrumentation and Analytical.
b. Gerand Engineering Co.
c. Hyspan Precision Products, Inc.
d. Preso Meters; a division of Racine Federated Inc.
e. S. A. Armstrong Limited; Armstrong Pumps Inc.
f. Victaulic Company.

3. Description: Flowmeter with calibrated flow-measuring element, hoses or tubing, fittings, valves, indicator, and conversion chart.
4. Flow Range: Sensor and indicator shall cover operating range of equipment or system served.
5. Sensor: Venturi-type, calibrated, flow-measuring element; for installation in piping.

a. Design: Differential-pressure-type measurement for water.
b. Construction: Bronze, brass, or factory-primed steel, with brass fittings and attached tag with flow conversion data.
c. Minimum Pressure Rating: 250 psig.
d. Minimum Temperature Rating: 250 deg F.
e. End Connections for NPS 2 and Smaller: Threaded.
f. End Connections for NPS 2-1/2 and Larger: Flanged or welded.
g. Flow Range: Flow-measuring element and flowmeter shall cover operating range of equipment or system served.

6. Permanent Indicators: Meter suitable for wall or bracket mounting, calibrated for connected flowmeter element, and having 6-inch- diameter, or equivalent, dial with fittings and copper tubing for connecting to flowmeter element.

a. Scale: Gallons per minute.
b. Accuracy: Plus or minus 1 percent between 20 and 80 percent of scale range.

7. Portable Indicators: Hand-held, differential-pressure type, calibrated for connected flowmeter element and having two 12-foot hoses, with carrying case.

a. Scale: Gallons per minute.
b. Accuracy: Plus or minus 2 percent between 20 and 80 percent of scale range.

8. Display: Shows rate of flow, with register to indicate total volume in gallons.
9. Conversion Chart: Flow rate data compatible with sensor.
10. Operating Instructions: Include complete instructions with each flowmeter.

C. Vortex-Shedding Flowmeters:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
2. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:

a. ABB; Instrumentation and Analytical.
b. Eastech Flow Controls.
c. EMCO Flow Systems; a division of Spirax Sarco, Inc.
d. Emerson Process Management; Rosemount.
e. Endress+Hauser.
f. ISTEC Corporation.

3. Description: Flowmeter with sensor and indicator.
4. Flow Range: Sensor and indicator shall cover operating range of equipment or system served.
5. Sensor: Inline type; for installing between pipe flanges and measuring flow directly in gallons per minute.

a. Design: Flow obstruction device, vortex-measurement type for liquids.
b. Construction: Stainless-steel body, with integral transmitter and direct-reading scale.
c. Minimum Pressure Rating: 1000 psig.
d. Minimum Temperature Rating: 500 deg F.
e. Integral Transformer: For low-voltage power operation.

6. Indicator: Hand-held meter; either an integral part of sensor or a separate meter.
7. Accuracy: Plus or minus 0.25 percent for liquids and 0.75 percent for gases.
8. Display: Shows rate of flow with register to indicate total volume in gallons.
9. Operating Instructions: Include complete instructions with each flowmeter.

2.9 THERMAL-ENERGY METERS

A. Impeller-Turbine, Thermal-Energy Meters:

See Editing Instruction No. 1 in the Evaluations for cautions about naming manufacturers. Retain one of first two subparagraphs and list of manufacturers below. See Section 016000 "Product Requirements."

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

2. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:

    a. Data Industrial Corp.
    b. Hoffer Flow Controls, Inc.
    c. ISTEC Corporation.
    d. ONICON Incorporated.

3. Description: System with strainer, flow sensor, temperature sensors, transmitter, indicator, and connecting wiring.
4. Flow Sensor: Impeller turbine with corrosion-resistant-metal body and transmitter; for installing in piping.

    a. Design: Total thermal-energy measurement.
    b. Minimum Pressure Rating: 150 psig.
    c. Minimum Temperature Range: 40 to 250 deg F.

5. Temperature Sensors: Insertion-type transducer.
6. Indicator: Solid-state, integrating-type meter[with integral battery pack; for wall mounting.

    a. Data Output: Six-digit electromechanical counter with readout in kilowatts per hour or British thermal units.
    b. Battery Pack: Five-year lithium battery.

7. Accuracy: Plus or minus 1 percent.
8. Display: Visually indicates total fluid volume in gallons and thermal-energy flow in kilowatts per hour or British thermal units.
9. Strainer: Full size of main line piping.
10. Operating Instructions: Include complete instructions with each thermal-energy meter system.

B. Ultrasonic, Thermal-Energy Meters:

    See Editing Instruction No. 1 in the Evaluations for cautions about naming manufacturers. Retain one of first two subparagraphs and list of manufacturers below. See Section 016000 "Product Requirements."

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
2. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:

    a. EMCO Flow Systems; a division of Spirax Sarco, Inc.
    b. Siemens Energy & Automation, Inc.

3. Description: Meter with flow sensor, temperature sensors, transmitter, indicator, and connecting wiring.
4. Flow Sensor: Transit-time ultrasonic type with transmitter.
5. Temperature Sensors: Insertion-type or strap-on transducer.
6. Indicator: Solid-state, integrating-type meter with integral battery pack.

a. Data Output: Six-digit electromechanical counter with readout in kilowatts per hour or British thermal units.
b. Battery Pack: Five-year lithium battery.

7. Accuracy: Plus or minus 1 percent.
8. Display: Visually indicates total fluid volume in gallons and thermal-energy flow in kilowatts per hour or British thermal units.
9. Operating Instructions: Include complete instructions with each thermal-energy meter system.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install thermowells with socket extending to center of pipe and in vertical position in piping tees.

B. Install thermowells of sizes required to match thermometer connectors. Include bushings if required to match sizes.

C. Install thermowells with extension on insulated piping.

D. Fill thermowells with heat-transfer medium.

E. Install direct-mounted thermometers in thermowells and adjust vertical and tilted positions.

F. Install direct-mounted pressure gages in piping tees with pressure gage located on pipe at the most readable position.

G. Install valve and snubber in piping for each pressure gage for fluids (except steam).

H. Install valve and syphon fitting in piping for each pressure gage for steam.

I. Install test plugs in piping tees.

J. Install flow indicators in piping systems in accessible positions for easy viewing.

K. Assemble and install connections, tubing, and accessories between flow-measuring elements and flowmeters according to manufacturer's written instructions.

L. Install flowmeter elements in accessible positions in piping systems.

M. Install differential-pressure-type flowmeter elements, with at least minimum straight lengths of pipe, upstream and downstream from element according to manufacturer's written instructions.

N. Install permanent indicators on walls or brackets in accessible and readable positions.

O. Install connection fittings in accessible locations for attachment to portable indicators.

P. Mount thermal-energy meters on wall if accessible; if not, provide brackets to support meters.

Q. Install thermometers in the following locations:

1. Inlet and outlet of each hydronic zone.
2. Inlet and outlet of each hydronic boiler.
3. Two inlets and two outlets of each chiller.
4. Inlet and outlet of each hydronic coil in air-handling units.
5. Two inlets and two outlets of each hydronic heat exchanger.
6. Inlet and outlet of each thermal-storage tank.
7. Outside-, return-, supply-, and mixed-air ducts.

R. Install pressure gages in the following locations:

1. Discharge of each pressure-reducing valve.
2. Inlet and outlet of each chiller chilled-water and condenser-water connection.
3. Suction and discharge of each pump.

3.2 CONNECTIONS

A. Install meters and gages adjacent to machines and equipment to allow service and maintenance of meters, gages, machines, and equipment.

B. Connect flowmeter-system elements to meters.

C. Connect flowmeter transmitters to meters.

D. Connect thermal-energy meter transmitters to meters.

3.3 ADJUSTING

A. After installation, calibrate meters according to manufacturer's written instructions.

B. Adjust faces of meters and gages to proper angle for best visibility.

3.4 THERMOMETER SCHEDULE

A. Thermometers at inlet and outlet of each hydronic zone shall be the following:
1. Compact Industrial-style, liquid-in-glass type.
2. Direct -mounted, light-activated type.
3. Test plug with chlorosulfonated polyethylene synthetic self-sealing rubber inserts.

B. Thermometers at inlet and outlet of each hydronic boiler shall be the following:
1. Compact Industrial -style, liquid-in-glass type.
2. Direct-mounted, light-activated type.
3. Test plug with **c**hlorosulfonated polyethylene synthetic self-sealing rubber inserts.

C. Thermometers at inlets and outlets of each chiller shall be the following:
1. Compact Industrial-style, liquid-in-glass type.
2. Direct-mounted, light-activated type.

3. Test plug with chlorosulfonated polyethylene synthetic self-sealing rubber inserts.

D. Thermometers at inlet and outlet of each hydronic coil in air-handling units and built-up central systems shall be the following:
1. Compact Industrial-style, liquid-in-glass type.
2. Direct -mounted, light-activated type.
3. Test plug with chlorosulfonated polyethylene synthetic self-sealing rubber inserts.

E. Thermometers at inlets and outlets of each hydronic heat exchanger shall be the following:
1. Compact Industrial-style, liquid-in-glass type.
2. Direct Remote-mounted, light-activated type.
3. Test plug with chlorosulfonated polyethylene synthetic self-sealing rubber inserts.

F. Thermometer stems shall be of length to match thermowell insertion length.

3.5 THERMOMETER SCALE-RANGE SCHEDULE

A. Scale Range for Chilled-Water Piping:0 to 100 deg F.

B. Scale Range for Condenser-Water Piping: 0 to 150 deg F

C. Insert additional paragraphs for thermometer scale ranges and applications here.

3.6 PRESSURE-GAGE SCHEDULE

A. Pressure gages at discharge of each pressure-reducing valve shall be the following:

1. Solid-front, pressure-relief direct -mounted, metal case.
2. Sealed direct -mounted, plastic case.
3. Test plug with chlorosulfonated polyethylene synthetic self-sealing rubber inserts.

B. Pressure gages at inlet and outlet of each chiller chilled-water and condenser-water connection shall be **one of** the following:

1. Liquid-filled Sealed Open-front, pressure-relief Solid-front, pressure-relief, direct-mounted, metal case.
2. Sealed direct -mounted, plastic case.
3. Test plug with chlorosulfonated polyethylene synthetic self-sealing rubber inserts.

C. Pressure gages at suction and discharge of each pump shall be one of the following:Retain one or more of three subparagraphs below. If retaining more than one type of pressure gage, indicate location of each on Drawings.

1. Liquid-filled, Sealed, Open-front, pressure-relief Solid-front, pressure-relief direct mounted, metal case.
2. Sealed direct -mounted, plastic case.
3. Test plug with chlorosulfonated polyethylene synthetic self-sealing rubber inserts.

3.7 PRESSURE-GAGE SCALE-RANGE SCHEDULE

A. Scale Range for Chilled-Water Piping: 0 to 100 psi.

B. Scale Range for Chilled-Water Piping: 0 to 160 psi.

C. Scale Range for Condenser-Water Piping: 0 to 100 psi.

D. Scale Range for Condenser-Water Piping: 0 to 160 psi.

E. Insert additional paragraphs for pressure-gage scale ranges and applications here.

3.8 FLOWMETER SCHEDULE

A. Flowmeters for Chilled-Water Piping: Orifice Pitot-tube Turbine] Venturi Vortex-shedding type.

B. Flowmeters for Condenser-Water Piping: Orifice Pitot-tube Turbine Venturi Vortex-shedding type.

C. Flowmeters for Heating, Hot-Water Piping: Orifice Pitot-tube Turbine Venturi Vortex-shedding type.

D. Flowmeters for Steam and Steam-Condensate Piping: Orifice Turbine Venturi Vortex-shedding type.

3.9 THERMAL-ENERGY METER SCHEDULE

A. Thermal-Energy Meters for Chilled-Water Piping: Impeller-turbine Ultrasonic type.

B. Thermal-Energy Meters for Condenser-Water Piping: Impeller-turbine Ultrasonic type.

C. Thermal-Energy Meters for Heating, Hot-Water Piping: Impeller-turbine Ultrasonic type.

D. Thermal-Energy Meters for Steam and Steam-Condensate Piping: Impeller-turbine Ultrasonic type.

END OF SECTION 230519

SECTION 230010 - BASIC MECHANICAL REQUIREMENTS

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

A. Basic Requirements: Requirements of the Contract Forms, Conditions of the Contract, Specifications, Drawings, and Addenda and Contract Modifications (the Contract Documents), apply to the requirements of each Section of Division 23.

B. Conflicts: Nothing contained in this Section shall be construed to conflict in any way with other provisions or requirements of the Contract documents. The intent is that this Section will take precedence. Where differences arise, the Architect shall decide which directions or instructions take precedence.

1.02 SUMMARY

A. General: Unless an item is specifically mentioned as being provided by others, the requirements of Division 23 Contract Documents shall be completed. The systems, equipment, devices and accessories shall be installed, finished, tested and adjusted for continuous and proper operation. Any apparatus, material or device not shown on the Drawings but mentioned in these Specifications, or vice versa, or any incidental accessories necessary to make the project complete and operational in all respects, shall be furnished, delivered and installed without additional expense to the Owner. Include all materials, equipment, supervision, operation, methods and labor for the fabrication, installation, start-up and tests necessary for complete and properly functioning systems.

1.03 APPLICABLE STANDARDS

A. Code Compliance: Refer to Division 1. As a minimum, unless otherwise indicated, comply with all rules, regulations, standards, codes, ordinances and laws of local, state and federal governments and the amendments and interpretation of such rules, regulations, standards, codes, ordinances and laws of local, state and federal governments by the authorities having lawful jurisdiction.

B. ADA: Comply with the requirements of the Americans with Disabilities Act (ADA).

C. Comply: With the National Fire Protection Association (NFPA) Standards and other Codes and Standards as adopted by the Local Authority having Jurisdiction.

D. Comply: With the National Fire Protection Association (NFPA) Standards and other Codes and Standards indicated.

E. Florida Building Code 2014: Conform in strict compliance to the Florida Building Code (FBC) and the amendments which are enforced by the local authority having jurisdiction.

1. Florida Building Code – Mechanical
2. Florida Building Code – Plumbing
3. Florida Building Code – Fuel Gas

4. Florida Building Code – Energy Conservation

F. International Building Code: Conform in strict compliance to the International Code Council, Inc. (ICC), International Building Code, 2009 Edition, and the amendments which are enforced by the local authority having jurisdiction.

1. International Mechanical Code
2. International Plumbing Code
3. International Fuel Gas Code
4. International Fire Code
5. International Energy Conservation Code

G. NATIONAL FIRE PROTECTION (NFPA) Standards:

1. NFPA-1, Uniform Fire Code™, 2006 Revision

2. NFPA-10, Standard for Portable Fire Extinguishers, 2002 Revision

3. NFPA-11A, Standard for Medium and High Expansion Foam Systems, 1999 Revision

4. NFPA-13, Standard for the Installation of Sprinkler Systems, 2002 Revision

5. NFPA-14, Standard for the Installation of Standpipe and Hose Systems, 2003 Revision

6. NFPA-15, Standard for Water Spray Fixed Systems for Fire Protection, 2001 Revision

7. NFPA-16, Standard for the Installation of Foam Water Sprinkler and Foam Water Spray Systems, 2003 Revision

8. NFPA-17, Standard for Dry-Chemical Extinguishing Systems, 2002 Revision

9. NFPA-20, Standard for the Installation of Stationary Pumps for Fire Protection, 2003 Revision

10. NFPA-24, Standards for the Installation of Private Fire Service Mains and Their Appurtenances, 2002 Revision

11. NFPA-30, Flammable and Combustible Liquids Code, 2003 Revision

12. NFPA-31, Standard for the Installation of Oil Burning Equipment, 2001 Revision

13. NFPA-45, Standard on Fire Protection for Laboratories Using Chemicals, 2004 Revision

14. NFPA-50, Standard for Bulk Oxygen Systems at Consumer Sites, 2001 Revision

15. NFPA-51, Standard for the Design and Installation of Oxygen-Fuel Gas Systems for Welding, Cutting and Allied Process, 2002 Revision

16. NFPA-54, National Fuel Gas Code, 2006 Revision

17. NFPA-58, Standard for Storage and Handling of Liquified Petroleum Gases, 2004 Revision

18. NFPA-70, National Electrical Code, 2005 Revision

19. NFPA-72, National Fire Alarm Code, 2002 Revision

20. NFPA-75, Standard for the Protection of Information Technology Equipment, 2003 Revision

21. NFPA-82, Standard on Incinerators, Waste and Linen Handling Systems and Equipment, 2004 Revision

22. NFPA-88A, Standard for Parking Structures, 2002 Revision

23. NFPA-90A, Standard for the Installation of Air Conditioning and Ventilation Systems, 2002 Revision

24. NFPA-90B, Standard for the Installation of Warm Air Heating and Air Conditioning Systems, 2006 Revision

25. NFPA-91, Standard for Exhaust Systems for Air Conveying of Vapors, Gases, Mists and Noncombustible Particulate Solids, 2004 Revision

26. NFPA-92A, Recommended Practice for Smoke-Control Systems, 2006 Edition

27. NFPA-92B, Guide for Smoke Management Systems in Malls, Atria, and Large Areas, 2005 Edition

28. NFPA-96, Standard for Ventilation Control and Fire Prevention of Commercial Cooking Operations, 2004 Revision {Subdivision 7-2.2 of NFPA 96 applies prospectively only. Existing installations are permitted to remain in place subject to the approval of the authority having jurisdiction.}

29. NFPA-99, Standard for Health Care Facilities, 2005 Revision

30. NFPA-101A, Guide to Alternative Approaches to Life Safety, 2004 Revision

31. NFPA-101B, Standard on Means of Egress for Buildings and Structures, 2002 Revision

32. NFPA-211, Standard for Chimneys, Fireplaces, Vents and Solid Fuel Burning Appliances, 2003 Revision

33. NFPA-214, Water Cooling Towers, 2005 Revision

34. NFPA-418, Standard for Rooftop Heliport Construction and Protection, 2001 Revision

35. NFPA-704, Standard System for the Identification of the Fire Hazards of Materials for Emergency Response, 2001 Revision

36. NFPA-780, Installation of Lightning Protection Systems, 2004 Revision

37. NFPA-1962, Standard for Inspection, Care and Use of Fire Hose including Couplings and Nozzles; and the Service Testing of Fire Hose, 2003 Revision

38. NFPA-1963, Standard for Fire Hose Connections, 2003 Revision

39. NFPA-2001, Standard on Clean Agent Fire Extinguishing Systems, 2004 Edition

H. Notification: Comply with all of the requirements of the Federal "Right-To-Know" Regulations and the Florida "Right-To-Know" Law and provide notification to all parties concerned as to the use of toxic substances.

I. Owner Design Guidelines: Comply with all the requirements of the latest Owner MEP Engineering Design Guidelines and the latest Owner Architectural Construction Standards.

1.04 DRAWINGS AND SPECIFICATIONS

A. Intent: The intent of the drawings and specifications is to establish minimum acceptable quality standards for materials, equipment and workmanship, and to provide operable mechanical systems complete in every respect.

B. Equipment Placement: The drawings are diagrammatic, intended to show general arrangement, capacity and location of various components, equipment and devices. Each location shall be determined by reference to the general building plans and by actual measurements in the building as built. Reasonable changes in locations ordered by the Architect prior to the performance of the affected Work shall be provided at no additional cost to the Owner.

C. Drawing Scale: Due to the small scale of the drawings, and to unforeseen job conditions, all required offsets, transitions and fittings may not be shown but shall be provided at no additional cost.

D. Conflict: In the event of a conflict, the Architect will render an interpretation in accordance with the General Conditions.

1.05 DEFINITIONS

A. Provide/Install: The word "provide" shall mean furnish, install, connect, test, complete, and leave ready for operation. The word "install" where used in conjunction with equipment furnished by the Owner or under another contract shall mean mount, connect, complete, and leave ready for operation.

B. Concealed: The surface of insulated or non-insulated piping, ductwork or equipment is concealed from view when standing inside a finished room, such as inside a chase or above a ceiling.

C. Exposed: The surface of insulated or non-insulated piping, ductwork or equipment is seen from inside a finished room, such as inside an equipment or air handling unit room.

D. Protected: The surface of insulated or non-insulated piping, ductwork or equipment on the exterior of the building but protected from direct exposure to rain by an overhang, eave, in an unconditioned parking garage or building crawl space.

E. Unprotected: The surface of insulated or non-insulated piping, ductwork or equipment on the exterior of the building and exposed to rain.

F. Abbreviations: Abbreviations, where not defined in the Contract Documents, shall be interpreted to mean the normal construction industry terminology, as determined by the Architect. Plural words shall be interpreted as singular and singular words shall be interpreted as plural where applicable for context of the Contract Documents.

1.06 SHOP DRAWINGS

A. General: Refer to paragraph entitled "SUBMITTAL" in this section. Include the following data:

1. Shop Drawings:

a. Submit shop drawings for the following:

(1) Each piping system
(2) Ductwork systems
(3) Coordination drawings

1.07 RECORD DRAWINGS

A. Production: Maintain one set of black or blue line on white project record "as-built" drawings at the site. At all times the set shall be accurate, clear, and complete, indicating the actual installation. Record drawings shall be updated weekly to record the present stage of progress. These drawings shall be available to the Architect at all times. Equipment schedules, control diagrams, sequences of operation shall also be updated.

B. Completion: Prior to substantial completion, transfer onto an unmarked second set of drawings all changes, marked in colored pencil, and submit them to the Architect. Upon completion of all punch lists, transfer all "As-Built" conditions to the AutoCAD drawing files, package three (3) print sets of full size drawings and two (2) CDs of the AutoCAD drawing files with associated reference files and submit them to the Architect for review and approval.

1.08 SUBMITTAL

A. General: The provisions of this section are supplemental to the requirements in Division 1, and only apply to the material and equipment covered in Division 23.

B. Time: Submit manufacturer's literature, performance data and installation instructions covered in each Section of Division 23 under an individual letter of transmittal within 30 days after Notice to Proceed unless otherwise indicated.

C. Submitter's Review: All items required for each section shall be reviewed before submittal. Submittal information for each item shall bear a review stamp of approval, indicating the name of the Contractor and Subcontractor (where applicable), the material suppliers, the initials of submitter and date checked. Responsibility for errors or omissions in submittals shall not be relieved by the Architect's review of submittals. Responsibility for submittals cannot be subrogated to material suppliers by Contractors or Subcontractors.

1. Review of the submittal data, whether indicated with "APPROVED" or with review comments, does not constitute authorization for or acceptance of a change in the contract price.

D. Architect's Review: The submittal data shall be reviewed only for general conformance with the design concept of the project and for general compliance with the Contract Documents. Any action indicated is subject to the requirements of the Contract Documents. Reviews of submittal data review shall not include quantities; dimensions (which shall be confirmed and correlated at the job site); fabrication processes; techniques of construction; and co-ordination of the submittal data with all other trades. Copies of the submittal data will be returned marked "ACCEPTED AS SUBMITTED", "ACCEPTED AS NOTED", "REVISED AS NOTED AND RESUBMIT", "REJECTED, REVISED AS NOTED AND RESUBMIT".

E. Submittal Items: Submittal items shall be inserted in a Technical Information Brochure. Mark the appropriate specification section or drawing reference number in the right hand corner of each item. All typewritten pages shall be on the product or equipment manufacturer's printed letterhead.

1. Manufacturer's Literature: Where indicated, include the manufacturer's printed literature. Literature shall be clearly marked to indicate the item intended for use.

2. Performance Data: Provide performance data, wiring and control diagrams and scale drawings which show that proposed equipment will fit into allotted space (indicate areas required for service access, connections, etc.), and other data required for the Architect to determine that the equipment complies with the Contract Documents. Where noted, performance data shall be certified by the manufacturer at the design rating points.

3. Installation Instructions: Where requested, each product submittal shall include the manufacturer's installation instructions. Generic installation instructions are not acceptable. Instructions shall be the same as those included with the product when it is shipped from the factory.

4. Written Operating Instructions: Instructions shall be the manufacturer's written operating instructions for the specified product. If the instructions cover more than one model or type of product they shall be clearly marked to identify the instructions that cover the product delivered to the project. Operating Instructions shall be submitted immediately after the product or equipment submittal has been returned from the Architect marked "APPROVED" or "APPROVED AS NOTED".

5. Maintenance Instructions: Information shall be the manufacturer's printed instructions and parts lists for the equipment furnished. If the instructions cover more than one model or type of equipment they shall be marked to identify the instructions for the furnished product. Submit maintenance instructions immediately after the product or equipment submittal has been returned from the Architect marked "APPROVED" or "APPROVED AS NOTED".

F. Substitutions:

1. General: Refer to Division 1. Substitutions may be considered for any product or equipment of a manufacturer. See paragraph entitled "MANUFACTURER" in this Section. Any product or equipment may be submitted for review; however, only one substitution per item will be considered. If a substituted product or equipment item is rejected, provide the specified product or equipment.

   a. Submittal shall include the name of the material or equipment to be substituted, equipment model numbers, drawings, catalog cuts, performance and test data and any other data or information necessary for the Architect to determine that the equipment meets the specification requirements. If the Architect accepts any proposed substitutions, such acceptance will be set forth in writing.
   b. Substituted equipment with all accessories installed or optional equipment where permitted and found acceptable, must conform to space requirements. Substituted equipment that cannot meet space requirements, whether accepted or not, shall be replaced at no additional expense to the Owner. If the substituted item affects the work of other trades, the Request for Substitution form shall include a list of the necessary modifications.

2. Deviations: The Request for Substitution form shall include a complete list of deviations from the scheduled item stating both the features and functions of the scheduled item and the comparable features and functions of the proposed substitution.

   a. Any deviation not indicated in writing will be assumed to be identical to the specified item even if it is shown otherwise on the submittal data.
   b. If a deviation not listed is found anytime after review and acceptance by the Architect and that deviation, in the opinion of the Architect, renders the substituted item as unacceptable, the item shall be removed and replaced by the scheduled item at no additional cost to the Owner.
   c. The Architect shall retain the right to specify modifications to the substituted item, correcting or adjusting for the deviation, if the Architect deems it to be in the best interest of the Owner.

3. Scheduled Item: A scheduled item is a product or item of equipment indicated in the Contract Documents by manufacturer's name and model number identifying a single item. The manufacturer's trade name for a group of products that does not signify a single item including type, style, quality, performance, and sound rating shall not be classified as a scheduled item. Where more than one manufacturer and product model number are indicated, each shall be considered as a scheduled item.

4. Form: When a product or item of equipment is proposed as a substitution a "REQUEST FOR SUBSTITUTION" form shall be completed and submitted with the required data. A copy of the form is included after the end of this section.

5. Rejection: Substituted products or equipment will be rejected if, in the opinion of the Architect, the submittal does not meet any one of the following conditions or requirements:

   a. The submittal data is insufficient or not clearly identified. The Architect may or may not request additional information.
   b. The product or equipment will not fit the space available and still provide the manufacturers published service area requirements.
   c. The product or equipment submitted is not equivalent to or better than the specified item. Products or equipment of lesser quality may be considered provided an equitable financial rebate, satisfactory to the Architect, is to be returned to the Owner.
   d. The product or equipment submitted has less capacity, efficiency and safety provisions than the specified item.
   e. The product or equipment submitted does not have warranty, service and factory representation equivalent to that specified.
   f. The Owner prefers not to accept the submitted product.

G. Technical Information Brochure:

1. Binder: Include binders with the first submittal for the Technical Information Brochure. Each binder shall be size 3 inch, hardcover, 3-ring type for 8-1/2" X 11" sheets. Provide correct designation on outside cover and on spine of each binder, i.e., MECHANICAL SUBMITTAL DATA, MECHANICAL OPERATION INSTRUCTION and MECHANICAL MAINTENANCE INSTRUCTIONS.

2. Number: Submit not less than five sets of binders for each of the three mechanical brochures indicated above. Each set shall consist of a minimum of two binders for submittal data and 1 binder each for operating instructions and for maintenance instructions. Additional binders shall be submitted at the request of the Architect. One set of binders shall be retained by the Architect. Three sets of binders shall be maintained for the Owner and the remaining set shall become the property of the Engineer.

3. Index: First sheet in each brochure shall be a photocopy of the "Division 23 Index" of the specifications. Second sheet shall list the firm name, address, phone number, superintendent's name for the contractor and all major subcontractors and suppliers associated with the project.

4. Dividers: Provide reinforced separation sheets tabbed with the appropriate specifications Section reference number for each Section in which submittal data or operation and maintenance instructions is required.

5. Specifications: Insert a copy of the specifications for each Section and all addenda applicable to the Section between each of the Section dividers.

1.09 SHOP DRAWINGS FOR PIPING SYSTEMS

A. Requirements: Make Shop Drawings for piping systems at a minimum scale of 1/4 inch per foot in AutoCAD Version 2010 (or later) and print on reproducible transparencies to verify clearances and equipment locations. Show required maintenance and operational clearances. Identify Shop Drawings by project name and include names of Architect, Engineer, Contractors, Subcontractors and supplier, date in Shop Drawing title block. Number drawings sequentially and indicate:

1. Architectural and structural backgrounds with room names and numbers, etc., including but not limited to plans, sections, elevations, details, etc.
2. Fabrication and erection dimensions.
3. Arrangements and sectional views.
4. Necessary details, including complete information for making connections to equipment.
5. Descriptive names of equipment.
6. Modifications and options to standard equipment required by Contract Documents.

B. Stamp Area: Leave 4 inch by 2-1/2 inch blank area near title block for Architect's shop drawing stamp. The acceptance of a shop drawing by indicating "APPROVED" does not relieve the contractor from full compliance with the sizes and equipment connections shown on the contract documents unless the changes are specifically indicated on the shop drawing.

C. Reference Key: Indicate by cross-reference the Contract Drawings, notes, or Specification paragraph numbers where item(s) occur in the Contract Documents.

D. Additional Requirements: See specific Sections for additional requirements.

1.10 SHOP DRAWINGS FOR DUCT SYSTEMS

A. Requirements: Make Shop Drawings for duct systems at a minimum scale of 1/4 inch per foot in AutoCAD Version 2010 (or later) and print on reproducible transparencies to verify clearances and equipment locations. Show required maintenance and operational clearances. Identify Shop Drawings by project name and include names of Architect, Engineer, Contractors, Subcontractors and supplier, date in Shop Drawing title block. Number drawings sequentially and indicate:

1. Architectural and structural backgrounds with room names and numbers, etc., including but not limited to plans, sections, elevations, details, etc.
2. Fabrication and erection dimensions.
3. Arrangements and sectional views.
4. Necessary details, including complete information for making connections to air distribution devices and air handling equipment.
5. Kinds of materials and finishes.
6. Descriptive names of equipment.
7. Modifications and options to standard equipment required.

B. Stamp Area: Leave 4 inch by 2-1/2 inch blank area near title block for Architect's shop drawing stamp. The acceptance of a shop drawing by indicating "APPROVED" does not relieve the contractor from full compliance with the sizes and connections shown on the contract documents unless the changes are specifically indicated on the shop drawing.

C. Reference Key: Indicate by cross-reference the Contract Drawings, notes, or Specification paragraph numbers where item(s) occur in the Contract Documents.

D. Ceiling Plans: Provide Shop Drawings, using sepias of architectural reflected ceiling plans, which indicate locations of exposed air distribution devices, sprinkler heads, lights and access panel.

E. Additional Requirements: See specific Sections for additional requirements.

1.11 COORDINATION DRAWINGS

A. General: Provide detailed (minimum 1/4 inch per foot) scaled coordination drawings showing locations and positions of all architectural, structural, (FF&E) equipment, electrical, plumbing, fire protection and mechanical elements for all installations. Provide overlay drawings, prior to beginning work, indicating work in and above ceilings and in mechanical and electrical rooms with horizontal and vertical dimensions, to avoid interference with structural framing, ceilings, partitions and other services. Accommodate phasing and temporary conditions indicated on the contract drawings as necessary to complete the work without disruption to the Owner's use of the existing occupied areas of the building(s).

B. Coordination of Space: Coordinate use of project space and sequence of installation of mechanical and electrical work which is indicated diagrammatically on drawings. Follow routings shown for pipes, ducts and conduits as closely as practicable, with due allowance for available physical space; make runs parallel with lines of building. Utilize space efficiently to maximize accessibility for other installations, for maintenance, and for repairs.
In finished areas except as otherwise shown, conceal pipes, ducts, and wiring in construction. Coordinate locations of fixtures and outlets with finish elements. Contractor shall provide background drawings showing partitions, ceiling heights, and structural framing locations and elevations, and existing obstructions. Contractor shall resolve major interferences at initial coordination meeting prior to production of coordination drawings.

C. Precedence of Services: In event of conflicts and interferences involving location and layout of work, use the following priority to resolve interferences:

1. Structure has highest priority.
2. Walls systems.
3. Ceiling grid/light fixtures.
4. Gravity drainage lines.
5. Large pipe mains.
6. Ductwork/diffusers, registers and grilles.
7. Sprinkler heads.
8. Small piping and tubing/electrical conduit.
9. Access panels.

D. Drawings shall be developed on AutoCAD Version 2010 (or later), and utilize AIA Standard layering conventions. At the completion of the project construction, the Contractor shall provide two (2) full-sized print sets and two (2) CDs of all drawing files with related reference files representing as-built installations for Architect review. Upon approval that the submitted information is complete, a similar submittal shall be provided to the Owner.

E. Stamp Area: Leave 4 inch by 2-1/2 inch blank area near title block for Architect's shop drawing stamp.

F. Reference Key: Indicate by cross-reference the Contract Drawings, notes, or Specification paragraph numbers where item(s) occur in the Contract Documents.

G. Additional Requirements: See specific Sections for additional requirements.

1.12 MANUFACTURER'S CHECKOUT

A. Start-up and Checkout: At completion of installation and prior to performance verification, a factory-trained representative of the manufacturer shall provide start-up and checkout service. After the performance verification the manufacturer's representative shall examine performance information and check the equipment in operation, and sign "Check-Out Memo" for the record. Submit a copy of Memo on each item of equipment where indicated in individual sections of these specifications for inclusion in each Technical Information Brochure. The "Check-Out Memo" shall be included with the performance verification data. Do not request "Instruction in Operation Conference" or request final inspection until Memos have been submitted and found acceptable.

1.13 INSTRUCTION TO OWNER

A. General: Instructions to the Owner shall be by competent representatives of the manufacturers involved, with time allowed for complete coverage of all operating procedures. Provide classroom instruction and field training in the design, operation and maintenance of the equipment and troubleshooting procedures. Explain the identification system, operational diagrams, emergency and alarm provisions, sequencing requirements, seasonal provisions, security, safety, efficiency and similar provisions of the systems. On the date of substantial completion, turn over the prime responsibility for operation of the mechanical equipment and systems to the Owner's operating personnel.

B. Training Period: Unless otherwise indicated training periods shall encompass the following number of hours of classroom and hands-on instructions with a maximum period of 4 hours per day for either. Mixing classroom instructions and hands on training in the same day is unacceptable.

1. Training periods:
   a. 4 hours Classroom
   b. 6 hours Classroom
   c. 8 hours Classroom
   d. 12 hours Classroom
   e. 4 hours Hands-on
   f. 6 hours Hands-on
   g. 8 hours Hands-on
   h. 12 hours Hands-on

C. Scheduling: Submit any remaining required items for checking at least one week before final inspection of building. When submittal items are found acceptable, notify Owner, in writing,

that an "Instruction in Operation Conference" may proceed. Conference will be scheduled by the Owner. After the conference, copies of a memo certifying that the "Instruction in Operation Conference" and "Completed Demonstration" have been made will by signed by Owner and the instructors, and one copy will be inserted in each Technical Information Brochure.

1.14 ALLOWANCES

A. General: Division 1.

1.15 ALTERNATES

A. Refer to Division 1.

1.16 STRUCTURAL CALCULATIONS FOR ROOF-MOUNTED EQUIPMENT

A. All roof-mounted devices, equipment and systems shall be constructed, designed and fastened to withstand wind loads of velocities up to 155 mph, as applicable to the wind zone of the project. Structural calculations for roof-mounted equipment shall be completed in accordance with Florida Building Code requirements and Florida Administrative Code Rule 9B-72 and submitted by a structural engineer registered in the State of Florida.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

A. Specified Products: Manufacturer’s names and product model numbers indicated on the drawings and in these specifications establish the type, style, quality, performance, and sound rating of the desired product. Listing of other manufacturers indicates that their equivalent products would be acceptable if they meet the specification requirements, the specific use and installation shown on the drawings, including space and clearance requirements, and the energy consumption and efficiency of the specified product. The listing of additional manufacturers in no way indicates that the manufacturer can provide an acceptable product.

B. Space Requirements: All manufactured products furnished on this project must have the required space and service areas indicated in the manufacturer's printed literature or shown on their shop drawing. When the manufacturer does not indicate the space required for servicing the equipment, the space shown on the drawings or as required by the Architect must be provided.

2.02 MATERIAL AND EQUIPMENT

A. General: Material and equipment used shall be produced by manufacturers regularly engaged in the production of similar items, and with a history of satisfactory use as judged by the Architect.

B. Specified Equipment: Equipment shall be the capacity and types indicated or shall be equivalent in the opinion of the Architect. Material and equipment furnished and installed shall be new, recently manufactured, of standard first grade quality and designed for the specific purpose. Equipment and material furnished shall be the manufacturer's standard item of production unless specified or required to be modified to suit job conditions. Sizes, material, finish, dimensions and the capacities for the specified application shall be published in catalogs for national distribution. Ratings and capacities shall be certified by a recognized rating bureau. Products

shall be complete with accessories, trim, finish, safety guards and other devices and details needed for a complete installation and for the intended use and effect.

C. Compatibility: Material and equipment of one and the same kind, type or classification and used for identical or similar purposes shall be made by the same manufacturer. Where more than one choice is available, select the options which are compatible with other products already selected. Compatibility is a basic general requirement of product selection.

PART 3 - EXECUTION

3.01 WORKMANSHIP

A. General: The installation of materials and equipment shall be done in a neat, workmanlike and timely manner by an adequate number of craftsmen knowledgeable of the requirements of the Contract Documents. They shall be skilled in the methods and craftsmanship needed to produce a first-quality installation. Personnel who install materials and equipment shall be qualified by training and experience to perform their assigned tasks. All materials and equipment shall be installed per the manufacturer's written requirements.

B. Acceptable Workmanship: Acceptable workmanship is characterized by first-quality appearance and function which conforms to applicable standards of building system construction and exhibits a degree of quality and proficiency which is judged by the Architect as equivalent or better than that ordinarily produced by qualified industry tradesmen.

C. Performance: Personnel shall not be used in the performance of the installation of material and equipment who, in the opinion of the Architect, are deemed to be careless or unqualified to perform the assigned tasks. Material and equipment installations not in compliance with the Contract Documents, or installed with substandard workmanship in the opinion of the Architect, shall be removed and reinstalled by qualified craftsmen at no change in the contract price.

3.02 CLEANING AND PROTECTION

A. General: Refer to Division 1.

B. Emergency Contacts: Prior to the beginning of the project, provide the Owner with a list of names, emergency telephone and beeper numbers of individuals who can be contacted during working and non-working hours, including weekends, for assistance throughout the warranty period if leaks, equipment failure or other damages occur. Update the list throughout installation and warranty to provide continuous availability of responsible parties to the Owner. If the Owner cannot contact the responsible party during an emergency situation, the Owner may effect emergency repairs through other means and may backcharge for the costs of repair material and labor incurred.

C. Emergency Contacts: Along with the operating and maintenance manual submittal, provide the Owner with a list of the names and emergency telephone and beeper numbers of individuals who can be contacted during working and non-working hours, including weekends, for assistance throughout the warranty period should leaks, equipment failure or other damage occur. Update the list throughout warranty to provide continuous availability of responsible parties to the Owner. If the Owner cannot contact the responsible party during an emergency situation, the

Owner may effect emergency repairs through other means and may backcharge for the costs of repair material and labor incurred.

D. Housekeeping: Keep interiors of duct and pipe systems clean and free from dirt, rubbish and foreign matter. Close open ends of piping and ductwork at all times throughout the installation. Install 30% efficient filter media over each return air grille and open return duct opening; change media regularly during construction when dirty to keep duct interiors clean. Prevent dust, debris and foreign material from entering the piping and ductwork.

E. Equipment Protection: Protect fan motors, switches, equipment, fixtures, and other items from dirt, rubbish and foreign matter. Do not operate air-handling equipment if the building is not clean or if dust can enter the coils or the fan housings.

F. Equipment Cleaning: Thoroughly clean equipment and entire piping systems internally upon completion of installation and immediately prior to final acceptance. Open dirt pockets and strainers, blow down each piping system and clean strainer screens of accumulated debris. Remove accumulated dirt, scale, oil and foreign substances. Thoroughly wipe clean internal surfaces of ductwork and air handling units prior to request for substantial completion. (See para. 3.2 above.)

G. Building Cleanup: Remove debris, rubbish, leftover materials, tools and equipment from work areas and site. Clean tunnels and closed off spaces of packing boxes, wood frame members and other waste materials used in the installation. Final acceptance shall not be approved until site is cleaned.

H. Fixture Cleanup: Remove temporary labels, stickers, etc., from fixtures and equipment. Do not remove permanent nameplates, equipment model numbers, ratings, etc.

I. Filter Replacement: Provide filters, with the same efficiency rating as required for the final installation, for the protection of the air moving equipment and ductwork continuously throughout the construction phase. Provide a new set of clean filters for the test and balance of the air side equipment.

J. Protection of Finished Installation: Where installation is required in areas previously finished by other trades, protect the area from marring, soiling or other damage.

K. Air Handling Unit Operation: During Construction Phase: Do not operate air handling equipment during building construction phase unless filter fabric is fastened to all duct systems' inlets and all specified and scheduled air filters are installed to minimize dirt entry into ductwork and air moving equipment. When running air handling units to dry out the building, control the building temperature to drop very slowly, and verify all HVAC insulation is completed and doors and windows are installed and closed, to prevent condensation of water from humid air on building interior surfaces, equipment, materials and ductwork.

3.03 CORRECTION OF WORK

A. General: At no additional cost to the Owner, rectify discrepancies between the actual installation and contract documents when in the opinion of the T&B Agency or the Architect the discrepancies will affect system balance and performance.

B. Drive Changes: Include the cost of all pulley, belt, and drive changes, as well as balancing dampers, valves and fittings, and access panels to achieve proper system balance recommended by the T&B Agency.

3.04 COORDINATION AND ASSISTANCE

A. General: Provide all labor, equipment, tools and material required to operate the equipment and systems necessary for the testing and balancing of the systems and for the adjustment, calibration or repair of all electric or pneumatic automated control devices and components. These services shall be available on each working day during the period of final testing and balancing.

B. Drawings and Specifications: Provide to the T&B Agency a complete set of project record drawings and specifications and an approved copy of all HVAC shop drawings and equipment submittals. The T&B Agency shall be informed of all changes made to the system during construction, including applicable change orders.

C. Coordination: Coordinate the work of all trades and equipment suppliers to complete the modifications recommended by the T&B Agency and accepted by the Architect. Cut or drill holes for the insertion of air measuring devices as directed for test purposes; repair to as-new condition, inserting plastic caps or covers to prevent air leakage. Repair or replace insulation and re-establish the integrity of the vapor retardant.

3.05 PREPARATIONS FOR PERFORMANCE VERIFICATION

A. Verification: Prior to commencement of the balancing by the T&B Agency, the Contractor shall verify in writing:

1. That air filters have been replaced and are in clean condition.

2. That linkages between dampers and their actuators are secure, non-overloading and non-binding.

3. That ductwork specialties are in their normal operating positions.

4. That fans are operating at the correct rotation and specified RPM.

5. That ductwork has been pressure tested and accepted.

6. That strainers have been removed, cleaned and replaced, and that temporary construction strainers have been removed.

7. That compression or expansion tanks have been inspected, are not air-bound or water-logged and are pre-charged, and that the piping systems have been completely vented and filled with water.

8. That air vents at coils and high points of the piping systems have been inspected and installed and operating freely.

9. That automatic valves, hand valves, and balancing valves have been placed in a fixed open position for full flow through all devices.

10. That linkages between valves and their actuators are secure, non-overloading and non-binding.

11. That pressures for hydronic reducing valves have been set.

12. That operating temperatures have been set for chillers, regulating valves, etc.

13. That pumps are operating at the correct rotation and specified horsepower.

14. That piping has been pressure tested and accepted and piping systems have been cleaned, flushed, sterilized and refilled with chemicals and prescribed treated water and vented.

15. That operating temperatures have been set for boilers, regulating valves, etc.

16. That the operating safeties (thermal overloads, firestat/freezestats, smoke detectors, relief valves, etc.), are installed and fully functional.

17. That equipment has been lubricated and can be operated without damage.

18. That the systems are operational and complete.

19. That no latent residual work remains to be completed.

3.06 ASBESTOS AND HAZARDOUS MATERIALS

A. General: Should asbestos or other hazardous material be encountered during execution of the work, or should the presence of asbestos or other hazardous material be suspected, immediately notify the Architect and suspend work in the affected area. The Owner will initiate a study to determine if asbestos or other hazardous materials are present and will determine what action will be taken. Removal of asbestos or other hazardous materials will be done under a separate contract.

3.07 COORDINATION OF SERVICES

A. General: Coordinate interruption of services to Owner-occupied areas in writing in advance with the Architect. Shutdown time and duration of services interruption shall be decided by the Owner. Provide shutoff valves at points of interconnection to minimize downtime. Procedures incidental to the outage shall be prepared in advance to minimize downtime.

B. General: Coordinate interruption of existing services in writing at least 1 week in advance with the Architect. Shutdown time and duration of services interruption shall be decided by the Owner. Provide shutoff valves at points of interconnection to minimize downtime. Procedures incidental to the outage shall be prepared in advance to minimize downtime.

C. Fire Safety in Existing facilities: Do not decrease the fire rating of walls, partitions, ceilings, floors, doors or combinations thereof in adjacent areas or means of egress. Do not interrupt fire

sprinkling or life safety systems without prior coordination with the Architect. Inform all necessary parties (Fire Department, Owner's insurance carrier, etc.) in advance, prior to and immediately after shutdown, disconnection or isolation of any portion of life safety or fire sprinkler system.

D. Protection of Facilities: Portions of the building may be operational during construction. Maintain operation of the equipment and systems whenever the installation interfaces with existing equipment or systems. Provide protection for the building, its contents and occupants wherever installation under the contract is performed. As necessary, move, store, and protect furniture, office fixtures and carpets. Provide acoustical isolation of the work area with temporary doors, partitions, etc., to allow normal work functions. Provide exhaust fans, temporary dust barrier partitions and any containment measures required to prevent dirt, dust or fumes from reaching adjacent occupied spaces as required by the Owner or Architect. Access to the building, including exit stairs, doors and passageways, and loading dock and other delivery areas shall be kept open and continuously accessible to the occupants. Workmen shall be confined to those areas directly involved in the project installation, and only during time periods indicated and approved by the Owner.

3.08 LAYOUT OF EXISTING EQUIPMENT

A. General: Existing equipment, piping, ductwork, etc., as indicated on the drawings have, for the most part, been provided to the Architect through existing drawings. The layouts shown may not be from as-built drawings and may be from partial copies of original design documents not produced by the Architect. The Architect is not responsible for the accuracy nor completeness of the existing installation and all layouts are shown for reference only. It is to be understood that unforeseen conditions probably exist and that existing and new work may not be field located exactly as shown on the drawings. Verify existing conditions in the field and notify the Architect of any deviations required to install the work as shown. Coordinate new work with existing equipment, including removing, relocating, rerouting, extending with new materials, and reinstall existing piping, ductwork, conduits, wiring, tubing, supports and other equipment. The Architect shall make the final decision on all deviations or modifications required by the existing conditions.

3.09 OWNERSHIP OF REMOVED EQUIPMENT

A. General: Construction materials and items of mechanical and electrical equipment which are removed and not reused shall be removed from the job-site unless indicated as to be retained for the Owner. Include rigging, removal and hauling cost, as well as any salvage value, in the contract.

3.10 CLEAN-UP

A. General: Debris and rubbish shall not be disposed into the Owner's containers.

END OF SECTION 230010

SECTION 051200 - STRUCTURAL STEEL FRAMING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Structural steel.
2. Field-installed connectors.
3. Grout.

1.3 DEFINITIONS

A. Structural Steel: Elements of the structural frame indicated on Drawings and as described in AISC 303, "Code of Standard Practice for Steel Buildings and Bridges."

1.4 COORDINATION

A. Coordinate installation of anchorage items to be embedded in or attached to other construction without delaying the Work. Provide setting diagrams, sheet metal templates, instructions, and directions for installation.

1.5 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1.6 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings: Show fabrication of structural-steel components.

1. Include details of cuts, connections, splices, camber, holes, and other pertinent data.
2. Indicate welds by standard AWS symbols, distinguishing between shop and field welds, and show size, length, and type of each weld. Show backing bars that are to be removed and supplemental fillet welds where backing bars are to remain.
3. Indicate type, size, and length of bolts, distinguishing between shop and field bolts.

C. Welding Procedure Specifications (WPSs) and Procedure Qualification Records (PQRs): Provide according to AWS D1.1/D1.1M, "Structural Welding Code - Steel," for each welded joint whether prequalified or qualified by testing, including the following:

1. Power source (constant current or constant voltage).
2. Electrode manufacturer and trade name, for demand critical welds.

D. Delegated-Design Submittal: For structural-steel connections indicated to comply with design loads, include analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1.7 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer, fabricator, professional engineer, testing agency.

B. Welding certificates.

C. Mill test reports for structural steel, including chemical and physical properties.

D. Product Test Reports: For the following:

1. Bolts, nuts, and washers including mechanical properties and chemical analysis.
2. Nonshrink grout.

E. Survey of existing conditions.

F. Source quality-control reports.

G. Field quality-control and special inspection reports.

1.8 QUALITY ASSURANCE

A. Fabricator Qualifications: A qualified fabricator that participates in the AISC Quality Certification Program and is designated an AISC-Certified Plant, Category STD, or is accredited by the IAS Fabricator Inspection Program for Structural Steel (AC 172).

B. Installer Qualifications: A qualified installer who participates in the AISC Quality Certification Program and is designated an AISC-Certified Erector, Category ACSE.

C. Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."

1. Welders and welding operators performing work on bottom-flange, demand-critical welds shall pass the supplemental welder qualification testing, as required by AWS D1.8/D1.8M. FCAW-S and FCAW-G shall be considered separate processes for welding personnel qualification.

D. Comply with applicable provisions of the following specifications and documents:

1. AISC 303.

2. AISC 341 and AISC 341s1.
3. AISC 360.
4. RCSC's "Specification for Structural Joints Using ASTM A 325 or A 490 Bolts."

1.9 DELIVERY, STORAGE, AND HANDLING

A. Store materials to permit easy access for inspection and identification. Keep steel members off ground and spaced by using pallets, dunnage, or other supports and spacers. Protect steel members and packaged materials from corrosion and deterioration.

1. Do not store materials on structure in a manner that might cause distortion, damage, or overload to members or supporting structures. Repair or replace damaged materials or structures as directed.

B. Store fasteners in a protected place in sealed containers with manufacturer's labels intact.

1. Fasteners may be repackaged provided Owner's testing and inspecting agency observes repackaging and seals containers.
2. Clean and relubricate bolts and nuts that become dry or rusty before use.
3. Comply with manufacturers' written recommendations for cleaning and lubricating ASTM F 1852 fasteners and for retesting fasteners after lubrication.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Connections: Provide details of simple shear connections required by the Contract Documents to be selected or completed by structural-steel fabricator, including comprehensive engineering analysis by a qualified professional engineer, to withstand loads indicated and comply with other information and restrictions indicated.

1. Select and complete connections using schematic details indicated and AISC 360.
2. Use Allowable Stress Design; data are given at service-load level.

B. Moment Connections: Type FR, fully restrained.

C. Construction: Combined system of moment frame and braced frame.

2.2 STRUCTURAL-STEEL MATERIALS

A. W-Shapes: ASTM A 992/A 992M.

B. Corrosion-Resisting Structural-Steel Shapes, Plates, and Bars: ASTM A 588/A 588M, Grade 50 (345).

C. Cold-Formed Hollow Structural Sections: ASTM A 500/A 500M, [Grade B] [Grade C], structural tubing.

D. Corrosion-Resisting, Cold-Formed Hollow Structural Sections: ASTM A 847/A 847M, structural tubing.

E. Welding Electrodes: Comply with AWS requirements.

2.3 BOLTS, CONNECTORS, AND ANCHORS

A. High-Strength Bolts, Nuts, and Washers: ASTM A 325 (ASTM A 325M), Type 1, heavy-hex steel structural bolts; ASTM A 563, Grade C, (ASTM A 563M, Class 8S) heavy-hex carbon-steel nuts; and ASTM F 436 (ASTM F 436M), Type 1, hardened carbon-steel washers; all with plain finish.

B. High-Strength Bolts, Nuts, and Washers: ASTM A 490 (ASTM A 490M), Type 1, heavy-hex steel structural bolts[or tension-control, bolt-nut-washer assemblies with splined ends]; ASTM A 563, Grade DH, (ASTM A 563M, Class 10S) heavy-hex carbon-steel nuts; and ASTM F 436 (ASTM F 436M), Type 1, hardened carbon-steel washers with plain finish.

C. Zinc-Coated High-Strength Bolts, Nuts, and Washers: ASTM A 325 (ASTM A 325M), Type 1, heavy-hex steel structural bolts; ASTM A 563, Grade DH (ASTM A 563M, Class 10S) heavy-hex carbon-steel nuts; and ASTM F 436 (ASTM F 436M), Type 1, hardened carbon-steel washers.

1. Finish: Hot-dip or mechanically deposited zinc coating.

D. Galvanizing Repair Paint: [MPI#18, MPI#19, or SSPC-Paint 20] [ASTM A 780/A 780M].

2.4 GROUT

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

2.5 FABRICATION

A. Structural Steel: Fabricate and assemble in shop to greatest extent possible. Fabricate according to AISC 303, "Code of Standard Practice for Steel Buildings and Bridges," and to AISC 360.
1. Fabricate beams with rolling camber up.
2. Identify high-strength structural steel according to ASTM A 6/A 6M and maintain markings until structural steel has been erected.
3. Mark and match-mark materials for field assembly.
4. Complete structural-steel assemblies, including welding of units, before starting shop-priming operations.

B. Thermal Cutting: Perform thermal cutting by machine to greatest extent possible.

1. Plane thermally cut edges to be welded to comply with requirements in AWS D1.1/D1.1M.

C. Bolt Holes: Cut, drill, or punch standard bolt holes perpendicular to metal surfaces.

D. Finishing: Accurately finish ends of columns and other members transmitting bearing loads.

2.6 SHOP CONNECTIONS

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

1. Joint Type: Snug tightened.

B. Weld Connections: Comply with AWS D1.1/D1.1M[and AWS D1.8/D1.8M] for tolerances, appearances, welding procedure specifications, weld quality, and methods used in correcting welding work.

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

2.7 SHOP PRIMING

A. Shop prime steel surfaces except the following:

1. Surfaces embedded in concrete or mortar. Extend priming of partially embedded members to a depth of 2 inches (50 mm).
2. Surfaces to be field welded.
3. Surfaces of high-strength bolted, slip-critical connections.
4. Surfaces to receive sprayed fire-resistive materials (applied fireproofing).
5. Galvanized surfaces.
6. Surfaces enclosed in interior construction.

2.8 GALVANIZING

A. Hot-Dip Galvanized Finish: Apply zinc coating by the hot-dip process to structural steel according to ASTM A 123/A 123M.

1. Fill vent and drain holes that are exposed in the finished Work unless they function as weep holes, by plugging with zinc solder and filing off smooth.

2.9 SOURCE QUALITY CONTROL

A. Testing Agency: Owner will engage a qualified testing agency to perform shop tests and inspections.

1. Provide testing agency with access to places where structural-steel work is being fabricated or produced to perform tests and inspections.

B. Bolted Connections: Inspect shop-bolted connections according to RCSC's "Specification for Structural Joints Using ASTM A 325 or A 490 Bolts."

C. Welded Connections: Visually inspect shop-welded connections according to AWS D1.1/D1.1M and the following inspection procedures, at testing agency's option:

1. Liquid Penetrant Inspection: ASTM E 165.
2. Magnetic Particle Inspection: ASTM E 709; performed on root pass and on finished weld. Cracks or zones of incomplete fusion or penetration are not accepted.
3. Ultrasonic Inspection: ASTM E 164.
4. Radiographic Inspection: ASTM E 94.

D. In addition to visual inspection, test and inspect shop-welded shear connectors according to requirements in AWS D1.1/D1.1M for stud welding and as follows:

1. Perform bend tests if visual inspections reveal either a less-than-continuous 360-degree flash or welding repairs to any shear connector.
2. Conduct tests according to requirements in AWS D1.1/D1.1M on additional shear connectors if weld fracture occurs on shear connectors already tested.

E. Prepare test and inspection reports.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify, with certified steel erector present, elevations of concrete- and masonry-bearing surfaces and locations of anchor rods, bearing plates, and other embedments for compliance with requirements.

1. Prepare a certified survey of existing conditions. Include bearing surfaces, anchor rods, bearing plates, and other embedments showing dimensions, locations, angles, and elevations.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Provide temporary shores, guys, braces, and other supports during erection to keep structural steel secure, plumb, and in alignment against temporary construction loads and loads equal in intensity to design loads. Remove temporary supports when permanent structural steel, connections, and bracing are in place unless otherwise indicated.

1. Do not remove temporary shoring supporting composite deck construction until cast-in-place concrete has attained its design compressive strength.

3.3 ERECTION

A. Set structural steel accurately in locations and to elevations indicated and according to AISC 303 and AISC 360.

B. Baseplates: Clean concrete- and masonry-bearing surfaces of bond-reducing materials, and roughen surfaces prior to setting plates. Clean bottom surface of plates.

1. Set plates for structural members on wedges, shims, or setting nuts as required.
2. Weld plate washers to top of baseplate.
3. Snug-tighten anchor rods after supported members have been positioned and plumbed. Do not remove wedges or shims but, if protruding, cut off flush with edge of plate before packing with grout.
4. Promptly pack grout solidly between bearing surfaces and plates so no voids remain. Neatly finish exposed surfaces; protect grout and allow to cure. Comply with manufacturer's written installation instructions for shrinkage-resistant grouts.

C. Maintain erection tolerances of structural steel within AISC 303, "Code of Standard Practice for Steel Buildings and Bridges."

D. Align and adjust various members that form part of complete frame or structure before permanently fastening. Before assembly, clean bearing surfaces and other surfaces that are in permanent contact with members. Perform necessary adjustments to compensate for discrepancies in elevations and alignment.

1. Level and plumb individual members of structure.
2. Make allowances for difference between temperature at time of erection and mean temperature when structure is completed and in service.

E. Splice members only where indicated.

F. Do not use thermal cutting during erection.

G. Do not enlarge unfair holes in members by burning or using drift pins. Ream holes that must be enlarged to admit bolts.

H. Shear Connectors: Prepare steel surfaces as recommended by manufacturer of shear connectors. Use automatic end welding of headed-stud shear connectors according to AWS D1.1/D1.1M and manufacturer's written instructions.

3.4 FIELD CONNECTIONS

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

1. Joint Type: Snug tightened.

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

1. Comply with AISC 303 and AISC 360 for bearing, alignment, adequacy of temporary connections, and removal of paint on surfaces adjacent to field welds.
2. Remove backing bars or runoff tabs, back gouge, and grind steel smooth.

3. Assemble and weld built-up sections by methods that maintain true alignment of axes without exceeding tolerances in AISC 303, "Code of Standard Practice for Steel Buildings and Bridges," for mill material.

3.5 FIELD QUALITY CONTROL

A. Special Inspections: Owner will engage a qualified special inspector to perform the following special inspections:

1. Verify structural-steel materials and inspect steel frame joint details.
2. Verify weld materials and inspect welds.
3. Verify connection materials and inspect high-strength bolted connections.

B. Testing Agency: Owner will engage a qualified testing agency to perform tests and inspections.

C. Bolted Connections: Inspect bolted connections according to RCSC's "Specification for Structural Joints Using ASTM A 325 or A 490 Bolts."

D. Welded Connections: Visually inspect field welds according to AWS D1.1/D1.1M.

1. In addition to visual inspection, test and inspect field welds according to AWS D1.1/D1.1M and the following inspection procedures, at testing agency's option:

a. Liquid Penetrant Inspection: ASTM E 165.
b. Magnetic Particle Inspection: ASTM E 709; performed on root pass and on finished weld. Cracks or zones of incomplete fusion or penetration are not accepted.
c. Ultrasonic Inspection: ASTM E 164.
d. Radiographic Inspection: ASTM E 94.

E. In addition to visual inspection, test and inspect field-welded shear connectors according to requirements in AWS D1.1/D1.1M for stud welding and as follows:

1. Perform bend tests if visual inspections reveal either a less-than-continuous 360-degree flash or welding repairs to any shear connector.
2. Conduct tests according to requirements in AWS D1.1/D1.1M on additional shear connectors if weld fracture occurs on shear connectors already tested.

3.6 REPAIRS AND PROTECTION

A. Galvanized Surfaces: Clean areas where galvanizing is damaged or missing and repair galvanizing to comply with ASTM A 780/A 780M.

END OF SECTION