

KONA COMMUNITY HOSPITAL

Surgery Storage

Kealahou, Island of Hawaii, Hawaii

HAWAII HEALTH SYSTEMS
Kona Community Hospital
79-1019 Haukapila Street
Kealahou, HI 96750

SPECIFICATIONS

CONSTRUCTION SUBMITTAL

SEPTEMBER 2020

KONA COMMUNITY HOSPITAL
Surgery Storage
Kealahakua, Island of Hawaii, Hawaii

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DIVISION 1 - GENRAL REQUIREMENTS

SECTION 01100 - SUMMARY OF WORK

PART 1 - General

1.01 SECTION INCLUDES

- A. Contract description.
- B. Contract use of premises.
- C. WEST HAWAII FACILITIES DIRECTOR (WHFD) AND/OR PROJECT MANAGER furnished/WHFD AND/OR PROJECT MANAGER installed products.
- D. WHFD AND/OR PROJECT MANAGER furnished/contractor installed products.
- E. Hospital occupancy.

1.02 CONTRACT DESCRIPTION

- A. HVAC replacement for the existing Outpatient Services, at the Kona Community Hospital.
- B. The Work of the contract generally consists of the following:
 - 1. Selective demolition within interior of existing hospital
 - 2. Selective demolition and removal of non-structural and structural elements of existing hospital.
 - 3. Renovation of the existing Outpatient Services HVAC system, including:
 - a. Affected acoustic ceiling and adjacent interior finishes
 - b. Sawcutting & patching for existing and new duct openings in concrete walls.
 - c. Alteration of associated electrical, lighting & fire sprinkler systems.

1.03 CONTRACTOR USE OF PREMISES

- A. Limit the use of premises to allow for continued Hospital occupancy.
- B. Emergency Building Exits During Construction: Must remain open and unblocked at all times. Maintain access for staff, patients, and public. Egress must be maintained and way finding signage during construction.
- C. Construction Operations: Limited to areas noted on Drawings.
- D. Staging and Parking

1. Staging area and limited contractor employee parking will be made available on site. Contractor and vendor parking is designated. Any new parking arrangements require prior approval by the WHFD AND/OR PROJECT MANAGER.
- E. Time Restrictions for Performing Work:
1. General 6:00 am to 2:30 pm. Coordinate w/ WHFD AND/OR PROJECT MANAGER, work necessary outside these normal operating hours. Submit written notice a minimum three days in advance.
- F. Cooperate with Hospital to minimize conflict and to facilitate Hospital's operations. Coordinate operations with WHFD AND/OR PROJECT MANAGER.
- G. Access to adjacent floors must be approved in advance by the WHFD AND/OR PROJECT MANAGER. Submit written notice not less than seven days in advance of intended work on adjacent floors.
- H. Do not close or obstruct roadways without first consulting with the WHFD AND/OR PROJECT MANAGER. Conduct operations with minimum interference to public or private roadways.
- I. Maintain vital services (as defined by the WHFD AND/OR PROJECT MANAGER) with the minimum of interruption. Outages and interruptions must be approved in advance by the WHFD AND/OR PROJECT MANAGER. Submit written notices of outages and interruptions not less than seven days in advance.
- J. Contractor's personnel:
1. It is preferred that contractors park off site and carpool to hospital.
 2. Contractor's personnel may use the hospital cafeteria.
 3. Smoking is not permitted anywhere on KHC property. Consumption of food and beverages will not be permitted on the premises except in designated areas.
 4. Playing of radios will not be permitted.
 5. Shall be properly attired for work. (No tank tops, cut-off jeans, slippers, etc.)
 6. Shall conduct themselves with decorum and courtesy toward staff, patients, and public.
 7. Shall not use loud and offensive language.
 8. Shall read and sign the Contractor's Guidelines Handbook.
- K. Construction Zone Accessibility Requirements
1. General: Hawaii Revised Statutes (HRS) 103-05 requires this project to conform to the requirements of the Americans with Disabilities Act Accessibility Guidelines (ADAAG).

2. Ensure accessible routes to emergency entrances and exits to and from accessible parking public pedestrian routes during the construction period as required by ADAAG 4.1.1(4).
3. Temporary buildings and facilities that are not of permanent construction but are extensively used or are essential for public use for a period of time shall be accessible. Egress must be maintained and way finding signage during construction.
4. Provide temporary safe pedestrian passageway around a construction site.
 - a. Areas that are used only as work areas shall be designed and constructed so that individuals with disabilities can approach, enter, and exit the areas.
 - b. These guidelines do not require that any areas used only as work areas be constructed to permit maneuvering within the work area or be constructed or equipped (i.e., with racks or shelves) to be accessible.
 - c. Follow OSHA guidelines concerning scaffolding and debris and dust protection.

1.04 WHFD AND/OR PROJECT MANAGER FURNISHED/WHFD AND/OR PROJECT MANAGER INSTALLED PRODUCTS

- A. Items noted "OFOI" (WHFD AND/OR PROJECT MANAGER Furnished/WHFD AND/OR PROJECT MANAGER Installed) will be furnished and installed by the WHFD AND/OR PROJECT MANAGER, including but not limited to:
 1. Medical equipment.
- B. Hospital's Responsibilities:
 1. Arrange for and deliver Hospital reviewed shop drawings, product, data and samples, to Contractor.
 2. Upon delivery, inspect products jointly with Contractor.
- C. Contractor's Responsibilities:
 1. Review WHFD AND/OR PROJECT MANAGER's provided shop drawings, product data, and samples.
 2. Provide any necessary utility roughs and backing, and install in accordance with manufacturer's instructions.
 3. Arrange and pay for product delivery to site.
 4. Submit claims for transportation damage and replace damaged, defective or deficient items.
 5. Arrange for manufacturers' warranties, inspections and service.

1.05 HOSPITAL OCCUPANCY

- A. The Hospital will remain operational during entire period of construction for the conduct of normal operations.
- B. The Contractor is to coordinate the work and details within each phase, to minimize disruption to WHFD AND/OR PROJECT MANAGER's operation. Advanced notification of a minimum of one week for disruption due to noise and other construction activity is required as well as posting of signage in advance to advise occupants of such disruption.
- C. Provide dust and noise barriers where specified under other portions of the contract documents. Follow ICRA procedures during construction, i.e., Policy #125-54 as attached. Walk off mats at site entrance shall be changed as needed. HEPA filtration units are to be utilized 24 hours per day throughout the construction process. Complete ISLM check sheet daily.
- D. Schedule the Work, and cooperate with Hospital to minimize conflict with work involving dust and noise and odor.

PART 2 - Products (Not Used)

PART 3 - Execution (Not Used)

END OF SECTION 01100

SECTION 01120 - ALTERATION PROJECT PROCEDURES

PART 1 - Products

1.01 SALVAGED MATERIALS

- A. Salvage sufficient quantities of cut or removed material to replace damaged work of existing construction, when materials not readily obtainable on current market.
- B. Incorporate salvaged or used material only as indicated or with permission of the Hospital.

1.02 PRODUCTS FOR PATCHING AND EXTENDING WORK

- A. New Materials: Match existing products and work for patching and extending work.
- B. Type and Quality of Existing Products: Determine by inspection and testing products where necessary, referring to existing Work as a standard.

PART 2 - Execution

2.01 EXAMINATION

- A. Verify that demolition is complete, and areas are ready for installation of new Work.
- B. Beginning of restoration Work means acceptance of existing conditions.

2.02 PREPARATION

- A. Cut, move or remove items as necessary for access to alterations and renovation Work. Replace and restore at completion.
- B. Remove unsuitable material not marked for salvage, such as rotted wood, corroded metals, and deteriorated masonry and concrete. Replace materials as specific for finished Work.
- C. Remove debris and abandoned items from area and from concealed spaces.
- D. Prepare surface and remove surface finishes to provide for proper installation of new work and finishes.
- E. Close openings in exterior surfaces to protect existing work and salvage items from weather and extremes of temperature and humidity. Insulate duct work and piping to prevent condensation in exposed areas.
- F. Do not demolish, chip, or penetrate existing structural members without the expressed approval of the Prime Consultant.
- G. Perform cutting and removal work to remove minimum necessary, and in a manner to avoid damage to adjacent work and provide proper surfaces to receive installation of repair and new Work.

2.03 INSTALLATION

- A. Coordinate work of alterations and renovations to expedite completion and to accommodate Owner occupancy.
- B. Project areas and Finishes: Complete in all respects including operational, carpentry, casework, mechanical and electrical work.
- C. Remove, cut, and patch Work in a manner to minimize damage and to provide a means of restoring Products and finishes to original or specified condition as appropriate.
- D. Refinish visible existing surfaces to remain in renovated rooms and spaces, to specified condition for each material, with a neat transition to adjacent finishes.
- E. In addition to specified replacement of equipment and fixtures, restore existing plumbing, ventilation, air conditioning, air balancing and electrical systems to full operational condition.

2.04 TRANSITIONS

- A. Where new Work abuts or aligns with existing, perform a smooth and even transition. Patched Work to match existing adjacent Work in texture and appearance.
- B. Cut finish surfaces such as masonry, tile, plaster, or metals by methods to terminate surfaces in a straight line at a natural point of division.
- C. When finished surfaces are cut so that a smooth transition with new Work is possible, terminate existing surface along a straight line at a natural line of division. Provide trim appropriate to finished surface subject to approval of Hospital's Representative.

2.05 ADJUSTMENTS

- A. Where removal of partitions or walls result in adjacent spaces becoming one, rework floors, walls and ceiling to a smooth plane without breaks, steps or bulkheads.
- B. Where a change of plane ¼ inch or more occurs, submit recommendation for providing a smooth transition for the WHFD AND/OR PROJECT MANAGER review.
- C. Trim existing doors as necessary to clear new floor finish. Refinish trim as required.
- D. At penetrations of fire-rated wall, ceiling or floor construction, completely seal voids with fire rated, fire resistant material, full thickness of the construction element.

2.06 REPAIR OF DAMAGED SURFACES

- A. Patch or replace portions of existing surfaces which are damaged, lifted, discolored, or showing other imperfections.
- B. Repair substrate prior to patching finish.

2.07 FINISHES

- A. Finish surfaces as specified in individual Product Sections.
- B. Finish patches to product uniform finish and texture over entire area. When finish cannot be matched, refinish entire surface to nearest intersection with written approval of the WHFD AND/OR PROJECT MANAGER.

2.08 CLEANING

- A. In addition to cleaning as specified in this specifications. Wet mop owner-occupied areas daily utilizing hospital's EPA approved disinfectant. Remove and replace soiled walk off (sticky) mats daily.
- B. Clean spillage, over-spray, and dust in Owner- occupied areas immediately.

PART 3 - Execution (Not Used)

END OF SECTION 01120

SECTION 01260 - CONTRACT CONSIDERATIONS

PART 1 - General

1.01 SECTION INCLUDES

- A. Schedule of values.
- B. Application for payment.
- C. Change procedures.

1.02 RELATED SECTIONS

- A. Section 01100- SUMMARY OF WORK: for allowances.

1.03 SCHEDULE OF VALUES

- A. Submit a printed schedule of AIA Form G703- Application and Certificate for Payment Continuation Sheet. Contractor's standard form or electronic media printout will be acceptable.
- B. Submit Schedule of Values in duplicate within 15 days after date of Owner Contractor Agreement.
- C. Format: Utilize the Table of Contents of this Project Manual. Identify each line item with number and title of the major specification Section. Identify site mobilization and bonds and insurance.
- D. Include in each line item, the amount of Allowances specified in this section. For unit cost Allowances, identify quantities taken from Contract Documents multiplied by the unit cost to achieve the total for the item.
- E. Include within each line item, a direct proportional amount of Contractor's overhead and profit.
- F. Revise schedule to list approved Change Orders, with each Application For Payment.

1.04 APPLICATIONS FOR PAYMENT

- A. Submit each application electronically on AIA Form G702- Application and Certificate for Payment and AIA G703- Continuation Sheet or Contractor's own invoice with all appropriate information. Contractor's electronic media printout will be acceptable.
- B. Content and Format: Utilize Schedule of Values for listing items in Application for Payment.
- C. Payment Period: Invoice to be submitted to Hospital Technical Representative for the preceding month's work by the 5th day of the month that follows. (The State of Hawaii does its best to pay within 30 days).

D. Waiver of Liens: Provide unconditional waiver of liens. Use contractor's form.

1.05 CHANGE PROCEDURES

A. The following documents will be used. Sample forms are attached.

B. Request for Information: Standard Contractor form. A request for information shall be used by the Contractor to the Prime Consultant to request solutions to problems which are discovered during construction, to request drawings and cost and/or schedule impacts in the Request for Information.

C. Instruction Notice: Attachment 1, standard form.

1. Instruction Notice will be issued by the Prime Consultant for instructions to the Contractor which do not involve a change in the Contract Sum or construction period.
2. Instruction Notice authorizes the Contractor to proceed at once with the instruction included therein.
3. Instruction Notice which does affect the Contract Sum or construction period must have written authorization by the Owner's Project Manager. Such instruction shall have the note "Change Order to Follow" and then be followed with a Quotation Request, cross referenced to the Field Order.
4. Instruction Notice will be distributed as follows:
 - a. Two copies to Contractor
 - b. One copy to the Prime Consultant
 - c. One copy to each appropriate Consultant
 - d. One copy to WHFD AND/OR PROJECT MANAGER

D. Quotation Requests: Attachment 2, standard Prime Consultant form.

1. Proposed changes to the Contract will be initiated by the Prime Consultant in the form of a Quotation Request.
2. A Quotation Request, indicating the party suggesting the change, will clearly describe the proposed Contract variation, accompanied by the required drawings, if necessary.
3. Construction work shall not proceed on the strength of a Quotation Request only.
4. Quotation Requests will be distributed as follows:
 - a. Two copies to Contractor.
 - b. One copy to Prime Consultant

- c. One copy to each appropriate Consultant
- d. One copy to Owner's Project Management
- 5. The Contractor shall respond to the Quotation Request within the time stated on the form.

E. Change Proposal. Standard Contract Form.

- 1. This form shall be issued by the Contractor for any claims he may have and in response to a Quotation Request.
- 2. The Change proposal shall include a description of the work and the requested change to the Contract sum and construction time.
- 3. All supporting documents, materials and subcontract quotations, time sheets, labor estimates, etc., shall be itemized and attached to the Change Proposal as necessary for proper checking by the Prime Consultant, Consultants and Owner's Project Manager.
- 4. Change proposals, if acceptable, will be signed by the WHFD AND/OR PROJECT MANAGER and Prime Consultant with one executed copy returned to Contractor. The Contractor shall thus have the authority to proceed with the work and Change Order will follow.

F. Change Order. Attachment 3, standard form.

- 1. This document is issued to the Contractor as an instruction for him to make a change to the work of the contract Documents.
- 2. Change Order documents are prepared by the Prime Consultant and countersigned by the Owner and Contractor.
- 3. Approved Change orders record the following information:
 - a. Cross-reference to Change Proposal.
 - b. Summarized description of change in work required.
 - c. Change in completion date.
 - d. Change in Contract sum.
 - e. Identification of party/individual initiating change.

G. Record of Variations: Variations in construction from the plans and specifications shall be recorded by the Contractor as required in Division 1. These variations shall be brought to the attention of the Prime Consultant and WHFD AND/OR PROJECT MANAGER by the Contractor.

H. Timeliness of Processing: Instruction notices, Quotation Requests and Change Proposals will be processed and one copy provided the WHFD AND/OR PROJECT MANAGER the same day the document is prepared.

- I. Time and Material Change Order: Submit itemized account and supporting data after completion of change, within time limits indicated in the Conditions of the Contract Time as provided in the Contract Documents.
- J. Maintained detailed records of work done on Time and Material basis. Provide full information required for evaluation of proposed changes, and to substantiate costs for changes in the Work.

PART 2 - Products (Not Used)

PART 3 - Execution (Not Used)

END OF SECTION 01260

OPTIONAL

INSTRUCTION NOTICE

INSTRUCTION NOTICE NO:

DATE:

PROJECT NO:

PROJECT: Kona Community Hospital
Outpatient Services

CONTRACTOR:

Reference:

- ☐ **Specifications:**
- ☐ **Drawings:**
- ☐ **Other:**

YOU ARE HEREBY DIRECTED TO PROMPTLY EXECUTE THIS INSTRUCTION NOTICE WHICH REPRESENTS THE CONTRACT DOCUMENTS OR ORDERS MINOR CHANGES IN THE WORK.

If you consider that a change in Contract Sum or Contract Time is required, submit your itemized proposal to the Prime Consultant immediately and before proceeding with the work. If your proposal is found to be satisfactory and in proper order, this Instruction Notice will be superseded by a Change Order.

COPIES TO:

- ☐ **WHFD AND/OR PROJECT MANAGER**
- ☐ **Contractor**
- ☐ **Prime Consultant**
- ☐ **Structural**
- ☐ **Mechanical**
- ☐ **Electrical**
- ☐ **Civil**
- ☐ **Landscape**
- ☐ **Others**

Attachment 1

OPTIONAL

QUOTATION REQUEST

QUOTATION REQUEST NO:

DATE:

PROJECT NO:

PROJECT: Kona Community Hospital
Outpatient Services

CONTRACTOR:

Submit a fully itemized quotation for the inclusion of the following changes into the contract. This is not a Change Order, a Construction Change Directive, nor an Instruction to proceed with the work herein.

REQUEST ORIGINATED BY:

DATE QUOTATION REQUIRED BY:

COPIES TO:

- ☐ **WHFD AND/OR PROJECT MANAGER**
- ☐ **Contractor**
- ☐ **Others**

CHANGE ORDER

DATE:

PROJECT:

CONTRACTOR:

Kona Community Hospital

Outpatient Services

CHANGE ORDER NO:

PROJECT NO:

Original Contract Sum was:
Net changes by previously authorized Change Orders: \$
Contract Sum prior to this Change Order was: \$
Contract sum will be (increased) (decreased) (unchanged) by this Change Order \$
New Contract Sum including this Change Order will be: \$
The Contract Time will be (increased) (decreased) (unchanged) by days
The date of Substantial Completion as of the date of this Change Order is:

PRIME CONSULTANT:

WHFD

AND/OR

PROJECT

MANAGER:

CONTRACTOR:

By: _____

Date: _____

Approved by: _____

Date: _____

Accepted by: _____

Date: _____

SECTION 01290 - PAYMENT PROCEDURES

PART 1 - Products

1.01 GENERAL CONDITIONS

- A. As specified in Division 1.

1.02 RELATED SELECTIONS

- A. Section 01260- CONTRACT CONSIDERATIONS for administrative procedures for handling changes to the Contract.

1.03 DEFINITIONS

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

1.04 SCHEDULE OF VALUES

- A. Coordination: Coordinate preparation of the schedule of values with preparation of Contractor's construction schedule.
 - 1. Coordinate line items in the schedule of values with other required administrative forms and schedules, including the following:
 - a. Application for Payment forms with continuation sheets.
 - b. Submittal schedule.
 - c. Items required to be indicated as separate activities in Contractor's construction schedule.
 - 2. Submit the schedule of values to the Prime Consultant through the Hospital's Construction Management Representative at earliest possible date, but no later than seven days before the date scheduled for submittal of initial Applications for Payment.
- B. Format and Content: Use Project Manual table of contents as a guide to establish line items for the schedule of values. Provide at least one line item for each Specification Section.
 - 1. Identification: include the following Project identification on the schedule of values:
 - a. Project name and location.
 - b. Name of Prime Consultant.
 - c. Prime Consultant's project number.
 - d. Contractor's name and address.

- e. Date if submittal.
- 2. Arrange schedule of values consistent with format of AIA Document G703.
- 3. Arrange the schedule of values in tabular form with separate columns to indicate the following for each items listed:
 - a. Related Specification Section or Division.
 - b. Description of the Work
 - c. Name of subcontractor
 - d. Name of manufacturer or fabricator.
 - e. Name of supplier.
 - f. Change Orders (numbers) that affected value.
 - g. Dollar value of the following, as percentage of the Contract Sum to nearest on-hundredth percent, adjusted to total 100 percent.
 - 1) Labor
 - 2) Materials
 - 3) Equipment
- 4. Provide a breakdown of the Contract Sum in enough detail to facilitate continued evaluation of Applications for Payment and progress reports. Coordinate with Project Manual table of contents. Provide multiple line items for principal subcontract amounts in excess of two percent of the Contract Sum.
 - a. Include separate line items under Contractor and principal subcontracts for Project closeout requirements in an amount totaling two percent of the Contract Sum and subcontract amount.
- 5. Round amounts to nearest whole dollar; total shall equal the Contract Sum.
- 6. Provide separate line item in the schedule of values for each part of the Work where Applications for Payment may include materials or equipment purchased or fabricated and stored, but not yet installed.
 - a. Differentiate between items stored on-site and items stored off-site. If required, include evidence of insurance.
- 7. Provide separate line items in the schedule of values for initial cost of materials, for each subsequent stage of completion, and for total installed value of that part of the Work.

8. Each item in the schedule of values and Application for Payments shall be complete. Include total cost and proportionate share of general overhead and profit for each item.
 - a. Temporary facilities and other major cost items that are not direct cost of actual work-in-place may be shown either as separate line items in the schedule of values or distributed as general overhead expense, at Contractor's option.
9. Schedule Updating: Update and resubmit the schedule of values before the next Applications for Payment when Change Orders or Construction Change Directives result in a change in the Contract Sum.

1.05 APPLICATIONS FOR PAYMENT

- A. Each Application for Payment following the initial Application for Payment shall be consistent with previous applications and payments as approved by the Hospital Construction Project Manager.
 1. Initial Application for Payment, Application for Payment at time of Substantial Completion, and final Application for Payment involve additional requirements.
- B. Payment Application Times: Each progress payment shall be submitted monthly.
- C. Payment Application Times: Submit Application for Payment to the Prime Consultant by the 5th day of the month. The period covered by each Application for Payment is one month, ending on the last day of the month.
- D. Application for Payment Forms: Use AIA G702 and Document AIA G703 or Contractor's own form as a form for Application for Payment.
- E. Application Preparation: Complete every entry on form. Contract number must be on every application for payment. The Prime Consultant will return incomplete applications, including those without the contract number, without action.
 1. Entries shall match data on the schedule of values and Contractor's construction schedule. Use updated schedules if revisions were made.
 2. Include amounts for work completed following previous Application for Payment, whether or not payment has been received. Include only amounts for work completed at time of Application for Payment.
 3. Include amounts of Change Orders and Construction Change Directives issued before last day of construction period covered by application.
 4. Indicate separate amounts for work being carried out under Owner-requested project acceleration.
- F. Stored Materials: Include in Application for Payment amounts applied for materials or equipment purchased or fabricated and stored, but not yet installed. Differentiate between items stored on-site and items stored off-site.

1. Provide supporting documentation that verifies amount requested, such as paid invoices. Match amount requested with amounts indicated on documentation; do not include overhead and profit on stored materials.
- G. Transmittal: submit signed Application for Payment to Hospital Construction Project Manager (electronically or by hand delivery). Include waivers of lien and similar attachments of required.
- H. Waivers of Mechanic's Lien: With each Application for Payment, submit waivers of mechanic's lien from entities lawfully entitled to file a mechanic's lien arising out of the contract and related to the Work covered by the payment.
1. Submit partial waivers on each item for amount requested in previous application, after deduction for retainage, on each item.
 2. When application shows completion of an item, submit conditional final or full waivers.
 3. WHFD AND/OR PROJECT MANAGER reserves the right to designate which entities involved in the Work must submit waivers.
 4. Waiver forms: Submit executed waivers of lien on forms acceptable to Owner.
- I. Waiver of Mechanic's Lien: With each Application for Payment, submit waivers of mechanic's lien from subcontractors, sub-contractors, and suppliers for construction period covered by the previous application.
1. Submit partial waivers on each item for amount requested in previous application, after deduction for retainage, on each item.
 2. When an application shows completion of an item, submit conditional final or full waivers.
 3. WHFD AND/OR PROJECT MANAGER reserves the right to designate which entities involved in the Work must submit waivers.
 4. Submit final Application for Payment with or proceeded by conditional final waivers from every entity involved with performance of the work covered by the application who is lawfully entitled to a lien.
 5. Waiver forms: Submit executed waivers of lien forms, acceptable to Owner.
- J. Initial Application for Payment: Administrative actions and submittals that must precede or coincide with submittal of first Application for Payment include the following:
1. List of subcontractors.
 2. Schedule of values.
 3. Contractor's construction schedule (preliminary if not final).

4. Products list (preliminary if not final).
 5. Schedule of unit prices.
 6. Submittal schedule (preliminary of not final).
 7. List of Contractor's staff assignments.
 8. List of Contractor's principal's consultants.
 9. Copies of building permits.
 10. Copies of authorizations and licenses from authorities having jurisdiction for performance of the Work.
 11. Initial progress report.
 12. Report of preconstruction conference.
 13. Certificates of insurance and insurance policies.
 14. Performance and payment bonds.
 15. Data needed to acquire Owner's insurance.
- K. Application for Payment at Substantial Completion: After Prime Consultant issues the Certificate of Substantial Completion, submit an Application for Payment showing 100 percent completion for portion of the Work claimed as substantially complete.
1. Include documentation supporting claim that the Work is substantially complete and a statement showing an accounting of changes to the Contract sum.
 2. This application shall reflect Certificate(s) of Substantial Completion issued previously for Owner occupancy of designated portions of the Work.
- L. Final Payment Application: After completing Project closeout requirements, submit final Application for Payment with releases and supporting documentation not previously submitted and accepted, including, but not limited to, the following:
1. Evidence of completion of Project closeout requirements.
 2. Insurance certificates for products and completed operations where required and proof that taxes, fees, and similar obligations were paid.
 3. Updated final statement, accounting for final changes to the Contract Sum.
 4. AIA Document G706, "Contractor's Affidavit of Payment of Debts and Claims".
 5. AIA Document G706A, "Contractor's Affidavit of Releases of Liens".

6. AIA Document G707, "Consent of Surety to Final Payment".
7. Evidence that claims have been settled.
8. Final liquidated damages settlement statement.
9. Alternate forms may be utilized with approval from the WHFD AND/OR PROJECT MANAGER & Contracts Manager

PART 2 - Products (Not Used)

PART 3 - Execution (Not Used)

END OF SECTION 01290

SECTION 01310 - PROJECT MANAGEMENT AND COORDINATION

PART 1 - General

1.01 SECTION INCLUDES

- A. General Coordination procedures
- B. Coordination drawings.
- C. Requests for information (RFI's)
- D. Project Web site.
- E. Project Meetings.

1.02 RELATED SECTIONS

- A. Section 01770 "CLOSEOUT PROCEDURES" for coordinating closeout of the Contract.

1.03 DEFINITIONS

- A. RFI: (Request for Information), the Prime Consultant for seeking information required by or clarifications of the Contract Documents.

1.04 INFORMATION SUBMITTALS

- A. Subcontract List: Prepare a written summary (provided herein as Attachment 4) identifying individuals or firms proposed for each portion of the Work, including those who are to furnish products or equipment fabricated to a special design. Included the following information in tabular form:
 - 1. Name, address and telephone number of company performing subcontract or supplying products.
 - 2. The particular work to be performed by subcontractor.
- B. Key personnel Names: Within 7 days of starting construction operations, submit a list of key personnel assignments, including superintendent and other personnel in attendance at Project site. Identify individuals and their duties and responsibilities; list addresses and telephone numbers, including home, office and cellular telephone numbers and e-mail addresses. Provide names, addresses and telephone numbers of individuals assigned as alternates in the absence of individuals assigned to Project.
 - 1. Post copies of list in project meeting room, in temporary field office and by each temporary telephone. Keep list current at all times.

1.05 GENERAL COORDINATION PROCEDURES

- A. Coordination: Coordinate construction operations included in different Sections of the Specifications to ensure efficient and orderly installation of each part of the

Work. Coordinate construction operations, included in different Sections that depend on each other for proper installation, connection, and operation.

1. Schedule construction operations in sequence required to obtain the best results where installation of one part of the Work depends on installation of other components, before or after its own installation.
 2. Coordinate installation of different components to ensure maximum performance and accessibility for required maintenance, service, and repair.
 3. Make adequate provisions to accommodate items scheduled for later installation.
- B. Coordination: Each contractor shall coordinate its construction operations with those of other contractors and entities to ensure efficient and orderly installation of each part of the Work. Each contractor shall coordinate its operations with operations, included in different Sections that depend on each other for proper installation, connection, and operations.
1. Schedule construction operations in sequence required to obtain the best results where installation of one part of the Work depends on installation of other components, before or after its own installation.
 2. Coordinate installation of different components with other contractors to ensure maximum performance and accessibility for required maintenance, service, and repair.
 3. Make adequate provisions to accommodate items scheduled for later installation.
- C. Prepare memoranda for distribution to each party involved, outlining special procedures required for coordination. Include such items as required notices, reports and list of attendees at meetings.
1. Prepare similar memoranda for Owner and separate contractors of coordination of their Work is required.
- D. Administrative Procedures: Coordinate scheduling and timing of required administrative procedures with other construction activities and (activities of other contractors) to avoid conflicts and to ensure orderly progress of the Work. Such administrative activities include, but are not limited to, the following:
1. Preparation of Contractor's construction schedule.
 2. Preparation of the schedule of values.
 3. Installation and removal of temporary facilities and controls.
 4. Delivery and processing of submittals.
 5. Progress meetings.
 6. Pre-installation of conferences.

7. Project closeout activities.
 8. Startup and adjustment of systems.
- E. Conservation: Coordinate construction activities to ensure that operations are carried out with consideration given to conservation of energy, water, and materials. Coordinate use of temporary utilities to minimize waste.
1. Salvage materials and equipment involved in performance of but not actually incorporated into, the Work. See other Sections for disposition of salvaged materials that are designed as Owner's property.

1.06 COORDINATION DRAWINGS

- A. Coordination Drawings, General: Prepare coordination drawings according to requirements in individual Sections, and additionally where installation is not completely shown on Shop Drawings, where limited space availability necessitates coordination, or if coordination is required to facilitate integration of products and materials fabricated or installed by more than one entity.
1. Content: Project-specific information, drawn accurately to a scale large enough to indicate and resolve conflicts. Do not base coordination drawings on standard printed data. Include the following information, as applicable:
 - a. Use applicable Drawings as a basis for preparation of coordination drawings. Prepare sections, elevations, and details as needed to describe relationship of various systems and components.
 - b. Coordinate the addition of trade-specific information to the coordination drawings by multiple contracts in a sequence that best provides for coordination of the information and resolution of conflicts between installed components before submitting for review.
 - c. Indicate functional and spatial relationships of components of architectural, structural, civil, mechanical, and electrical systems.
 - d. Indicate space requirements for routine maintenance and for anticipated replacement of components during the life of the installation.
 - e. Show location and size of access doors required for access to concealed dampers, valves, and other controls.
 - f. Indicate required installation sequences.
 - g. Indicate dimensions show in the Drawings. Specifically note dimensions that appear to be in conflict with submitted equipment and minimum clearance requirements. Provide alternate sketches to Prime Consultant indicating proposed resolution of such conflicts. Minor dimensions changes and difficulty installations will not be considered changes to the Contract.

- B. Coordinating Drawing Organization: Organize coordination drawings as follows:

1. Floor Plans and Reflected Ceiling Plans: Show architectural and structural elements and mechanical, plumbing, fire-protection, fire-alarm and electrical work. Show locations of visible ceiling-mounted devices relative to acoustical ceiling grid. Supplement plan drawings with section drawings where required to adequately represent the Work.
2. Plenum Space: indicate subframing for support of ceiling and wall systems, mechanical and electrical equipment, and related work. Locate components within ceiling plenum to accommodate layout of light fixtures indicated on Drawings. Indicate areas conflict between light fixtures and other components. All work to be seismically anchored utilizing TOLCO system.
3. Mechanical rooms: Provide coordination drawings for mechanical rooms showing plans and elevations of mechanical, plumbing, fire-protection, fire-alarm, and electrical equipment.
4. Structural Penetrations: Indicate penetrations and openings required for all disciplines.
5. Slab Edge and Embedded items: Indicate slab edge locations and sizes and locations of embedded items for metal fabrications, sleeves, anchor bolts, bearing plates, angles, door floor closers, slab depressions for floor finishes, curbs and housekeeping pads, and similar items.
6. Mechanical and Plumbing Work: Show the following:
 - a. Sizes and bottom elevations of ductwork, piping, and conduit runs, including insulation, bracing, flanges and support systems. All work to be seismically anchored using TOLCO system.
 - b. Dimensions of major components, such as dampers, valves, diffusers, access doors, cleanouts and electrical distribution equipment.
 - c. Fire –rated enclosures around ductwork.
7. Electrical Work: Show the following:
 - a. Runs of vertical and horizontal conduit 1-1/4 inches (32 mm) in diameter and larger.
 - b. Light fixture, exit light, emergency battery pack, smoke detector, and other fire-alarm locations.
 - c. Panel board, switch board, switchgear, transformer, busway, generator, and motor control center locations.
 - d. Location of pull boxes and junction boxes, dimensioned from column center lines.
8. Fire-Protection System: Show the following:

- a. Locations of standpipes, main piping, branch lines, pipe drops and sprinkler heads.
9. Review: Prime Consultant will review coordination drawings to confirm that the Work is being coordinated, but not for the details of the coordination, which are Contractor's responsibility. If Prime Consultant determines that coordination drawings are not being prepared in sufficient scope or details, or are otherwise deficient, Prime Consultant will so inform Contractor, who shall make changes as direct and resubmit.
10. Coordination Drawing Prints: Prepare coordination drawing prints according to requirements on Section 013300 "Submittal Procedures".
- C. Coordination Digital Data Files: Prepare coordination digital data files according to the following requirements:
 1. File Preparation Format: Same digital data software program, version, and operating system as original Drawings.
 2. File Submittal Format: Submit or post coordination drawing files using Portable Data File (PDF) format.
 3. Prime Consultant will furnish Contractor one set of digital data files of Drawings for use in preparing coordinated digital data files.
 - a. Digital Data Software Program: Drawings are available in AutoCAD 2010.
 - b. Contractor shall execute a data licensing agreement in the form of Agreement form acceptable to WHFD AND/OR PROJECT MANAGER and Prime Consultant, if required by either party.

1.07 REQUESTS FOR INFORMATION (RFI'S)

- A. General: Immediately of discovery of the need for additional information or interpretation of the Contract Documents, Contractor shall prepare and submit an RFI in the form specified to WHFD AND/OR PROJECT MANAGER.
 1. All RFIs must be submitted directly by the Contractor of record. Prime Consultant will return RFI submitted to Prime Consultant by other entities controlled by Contractor with no response.
 2. Coordinate and submit RFIs in a prompt manner so as to avoid delays in Contractor's work or work of subcontractors.
- B. Content of the RFI: Include a detailed, legible description of item needing information or interpretation and the following:
 1. Project name.
 2. Project number.
 3. Date.

4. Name of Contractor.
 5. Name of Project Engineer.
 6. RFI number, number sequentially.
 7. RFI subject.
 8. Specification Section number and title and related paragraphs, as appropriate.
 9. Drawing number and detail references, as appropriate.
 10. Field dimensions and conditions, as appropriate.
 11. Contractor's suggested resolution. If Contractor's suggested resolution impacts the Contract Time or the Contract Sum, Contractor shall state impact in the RFI.
 12. Contractor's signature.
 13. Attachments: Include sketches, description, measures, photos, Product Data, Shop Drawings, coordination drawings, and other information necessary to fully describe items needing interpretation.
 - a. Include dimensions, thickness, structural grid references, and details of affected materials, assemblies, and attachments on attached sketches.
 14. Response turnaround time needed.
- C. RFI Forms: Contractor's form
1. Attachment shall be electronic files preferably in Adobe Acrobat PDF format.
- D. Project Prime Consultant's Action: Project Prime Consultant will review each RFI, determine action required and respond within requested response time, typically 3 working days unless quicker response is needed as to not delay the project.
1. The following Contract-generated RFIs will be returned without action:
 - a. Requests for approval of submittals.
 - b. Requests for approval of substitutions.
 - c. Requests for approval of Contractor's means and methods.
 - d. Requests for coordination information already indicated in the Contract Documents.
 - e. Requests for adjustment in the Contract Time or Contract Sum.
 - f. Requests for interpretation of Prime Consultant's actions on submittals.

- g. Incomplete RFIs or inaccurately prepared RFIs.
- 2. The Prime Consultant's action may include a request for additional information, in which case the time for response will date from time of receipt of additional information.
- 3. The Project Prime Consultant's action on RFIs that may result in a change to the Contract Time or the Contract sum may be eligible for Contractor to submit Change Proposal according to Section 012600 "Contract Modification Procedures".
 - a. If Contractor believes the RFI response warrants change in the Contract Time or the Contract Sum, notify the WHFD AND/OR PROJECT MANAGER in writing within 3 days of receipt of the RFI response.
- E. RFI Log: Prepare, maintain, and submit a tabular log of RFIs organized by the RFI number. Submit log weekly to Prime Consultant.
 - 1. Project name.
 - 2. Name and address of Contractor.
 - 3. Name and address of Project Prime Consultant.
 - 4. RFI numbering including RFIs that were returned without action or withdrawn.
 - 5. RFI description.
 - 6. Date when the RFI was submitted.
 - 7. Date when the Prime Consultant's response was received.

1.08 PROJECT MEETINGS

- A. General: Schedule and conduct meetings and conferences at Project site unless otherwise indicated
 - 1. Attendees: Inform participants and others involved, and individuals whose presence is required, of date and time of each meeting. Notify WHFD AND/OR PROJECT MANAGER and Prime Consultant of scheduled meeting dates and times. It is preferred that a standing meeting day/time is planned at the commencement of the project.
 - 2. Agenda: Contractor shall prepare the meeting agenda. Distribute the agenda to all invited attendees.
 - 3. Sign in Sheet: Furnish and supply a copy of completed sheet to KCH.
 - 4. Minutes: Entity responsible for conducting meeting will record significant discussions and agreements achieved. Distribute the meeting minutes to all meeting attendees within three business days of the meeting.

B. Preconstruction Conference: the WHFD AND/OR PROJECT MANAGER will schedule and conduct a preconstruction conference before starting construction, at a time convenient to the Hospital, Contractor, and Project Prime Consultant, but no later than 15 days after execution of the Agreement.

1. Conduct the conference to review responsibilities and personnel assignments.
2. Attendees: Authorized representatives of WHFD AND/OR PROJECT MANAGER, the Prime Consultant and their consultants; Contractor and its superintendent; major subcontractors; suppliers and other concerned parties. Participants at the conference shall be familiar with Project and authorized to conclude matters relating to the Work.
3. Agenda: Discuss items of significance that could affect progress, including the following:
 - a. Tentative construction schedule.
 - b. Critical work sequencing and long-lead items.
 - c. Designation of key personnel and their duties.
 - d. Lines of communications.
 - e. Procedures for processing field decisions and Change Orders.
 - f. Procedures for RFIs
 - g. Procedures for testing and inspecting.
 - h. Procedures for processing Application for Payment.
 - i. Distribution of the Contract Documents.
 - j. Submittal procedures.
 - k. Use of the premises.
 - l. Work restrictions.
 - m. Working hours.
 - n. Owner's occupancy requirements.
 - o. Responsibility for temporary facilities and controls.
 - p. Procedures for moisture and mold
 - q. Procedures for disruption and shutdowns.
 - r. Parking availability.

- s. Office, work, and storage areas.
 - t. Equipment deliveries and properties.
 - u. Security.
4. Minutes: The Contractor will be responsible for conduction meeting, will record and distribute meeting minutes.
- C. Preinstall Conferences: Conduct a preinstallation conference at Project Site before each construction activity that requires coordination with other construction.
- 1. Attendees: Installer and representatives of manufacturers and fabricators involved in or affected by the installation and its coordination or integration with other materials and installation that have preceded or will follow, shall attend the meeting. Advise the WHFD AND/OR PROJECT MANAGER, Project Prime Consultant of scheduled meeting dates.
 - 2. Agenda: Review progress of other construction activities and preparations for the particular activity under consideration, including requirements to the following:
 - a. Contract Documents.
 - b. Options.
 - c. Related RFIs.
 - d. Related Change Orders.
 - e. Purchases.
 - f. Deliveries.
 - g. Submittals.
 - h. Possible conflicts.
 - i. Compatibility requirements.
 - j. Time schedules.
 - k. Weather limitations.
 - l. Manufacturer's written instructions.
 - m. Warranty requirements.
 - n. Compatibility of materials.
 - o. Acceptability of substrates.

- p. Temporary facilities and controls.
 - q. Space and access limitations.
 - r. Regulations of authorities having jurisdiction.
 - s. Testing and inspecting requirements.
 - t. Installation procedures.
 - u. Coordination with other work.
 - v. Required performance results.
 - w. Protection of adjacent work.
 - x. Protection of construction and personnel.
3. Record significant conference discussions, agreement, and disagreements, including required corrective measures and actions.
 4. Reporting: Distribute minutes of the meeting to each party present and to other parties requiring information.
 5. Do not proceed with installation if the conference cannot be successfully concluded. Initiate whatever actions are necessary to resolve impediments to performance of the Work and reconvene the conference at earliest feasible date

D. Progress Meetings: Conduct progress meetings at weekly intervals.

1. Coordinate dates of meetings with preparation of payment requests.
2. Attendees: Representatives of the WHFD AND/OR PROJECT MANAGER, and the Contractor. The Project Prime Consultant may call in by telephone, but once a month, attend the meeting site. The Prime Consultantural consultants and Contractor's subcontractors may attend upon request.
3. Agenda: Review and correct or approve minutes of previous progress meeting. Review other items of significance that could affect progress. Include topics for discussion as appropriate to status of Project.
 - a. Contractor's Construction Schedule: Review progress since the last meeting. Determine whether each activity is on time, ahead of schedule or behind schedule, in relation to Contractor's construction schedule. Determine how construction behind schedule will be expedited; secure commitments from parties involved to do so. Discuss whether schedule revisions are required to ensure that current and subsequent activities will be completed within the Contract Time.

- 1) Review schedule for next period

- b. Review present and future needs of each entity present, including the following:
 - 1) Interface requirements.
 - 2) Sequence of operations.
 - 3) Owner operation issues/security.
 - 4) Status of submittals.
 - 5) Deliveries.
 - 6) Off-site fabrication.
 - 7) Access
 - 8) Temporary facilities and controls.
 - 9) Status of RFIs.
 - 10) Status of proposed requests.
 - 11) Pending changes.
 - 12) Status of change Orders.
 - 13) Pending claims and disputes.
- 4. Minutes: The Contractor that is responsible for conducting the meeting will record and distribute the meeting minutes to each party present and to parties requiring information.
 - a. Schedule Updating: Revise Contractor's construction schedule after each progress meeting where revisions to the schedule have been made recognized. Issue revised schedule concurrently with the report of each meeting.

PART 2 - Products (Not Used)

PART 3 - Execution (Not Used)

END OF SECTION 01310

SECTION 01330 – SUBMITTAL PROCEDURES

PART 1 - General

1.01 SECTION INCLUDES

- A. Submittal procedures.
- B. Construction progress schedules.
- C. Proposed Products list.
- D. Shop Drawings.
- E. Product Data.
- F. Samples.
- G. Manufacturer's installation instructions.
- H. Manufacturer's certificates.

1.02 RELATED SECTIONS

- A. Section 01400- QUALITY REQUIREMENTS: Manufacturer's field services and reports.

1.03 DEFINITIONS

- A. Action Submittals: Written and graphic information that requires Prime Consultant's responsive action.
- B. Informational Submittals: Written information that does not require Prime Consultant's approval. Submittals may be rejected for not complying with requirements.

1.04 SUBMITTAL PROCEDURES

- A. Transmit each submittal with AIA Form G810 or project Prime Consultant's accepted transmittal form.
 - 1. Identify whether submittal is an action submittal or informational submittal.
 - 2. Submit the number of duplicate documents and samples schedule in Part 3 below.
- B. Sequentially number the transmittal form. Reverse submittals with original number and a sequential alphabetical suffix.
- C. Identify Project Contractor, Subcontractor or supplier, pertinent drawing and detail number, and specification section number, as appropriate.

- D. Apply Contractor's wax seal, signed or initialed certifying that review, verification of Products required, field dimensions, adjacent construction Work, and coordination of information, is in accordance with the requirements of the Work and Contract Documents.
- E. Schedule submittals to expedite the Project, and deliver to Prime Consultant at business address. Coordinate submission of related items.
- F. For each submittal for review, allow 5 days excluding delivery time and from the contractor.
- G. Identify variations from Contract Documents and Product of system limitations which may be detrimental o successful performance of the completed Work.
- H. Submit all items relating to color selection at one time. Color selections will not be made until all color related submittals have been received.
- I. Provide space for Contractor, Project Prime Consultant, and Consultants review stamps or initials.
- J. Review and Resubmission of Submittals
 - 1. The Project Prime Consultant will review the submittal and stamp or initial it with indication of action as appropriate. Project Prime Consultant will retain one copy or and furnish one copy to Contractor. Consultants will retain one copy.
 - 2. Submittals returned marked "resubmit" or "rejected". Make corrections and resubmit.
 - a. Direct specific attention on resubmittals to revision other than those requested by the Project Prime Consultant on previous submittals.
 - b. Make shop drawing corrections on the original drawing and print.
 - 3. Submittals returned with markings or comments and marked "confirm". Submit a letter indicating acceptance of comments and stating that Contractor will comply with marks and comments.
 - 4. Submittals returned marked "No Exceptions Taken". Submit number of copies mechanical and electrical items with Contractor.
- K. Distribute copies of reviewed submittals as appropriate. Instruct parties to promptly report any inability to comply with provisions.
- L. Submittal is not requested will not be recognized or processed.

1.05 CONSTRUCTION PROGRESS SCHEDULES

- A. Submit as part of the Monthly Report required by the Owner-Contractor Agreement.

1.06 PROPOSED PRODUCTS LIST

- A. Submit list of major products proposed for use, with name of manufacturer, trade name, and model number of each product.
- B. For products specified only by reference standards, give manufacturer, trade name, model or catalog designation, and reference standards.

1.07 SHOP DRAWINGS

- A. Present in a clear and thorough manner, accurately and at a scale sufficient to show pertinent aspects. Indicate fabrication, layout, anchorage and installation details.
- B. Title each drawing. Identify details by reference to Contract Drawing and detail numbers.
- C. Indicate special utility and electrical characteristics, utility connection requirements, and location of utility outlets for service for functional equipment and appliances.
- D. Drawing Size: Minimum 8-1/2 inches by 11 inches and maximum 30 inches by 42 inches.
- E. Shop Drawings: Submit review. After review, produce copies and distribute in accordance with the SUBMITTAL PROCEDURES article above.

1.08 PRODUCT DATA

- A. Clearly mark each copy to identify each applicable product, model, option, and pertinent data for the products or systems to be provided. Supplement manufacturers' standard data to provide information unique to this Project. Highlighting will not be acceptable.
- B. Indicate Product utility and electrical characteristics, utility connection requirements, and location of utility outlets for service for functional equipment and appliances.
- C. After review distribute in accordance with the Submittal Procedures article above.

1.09 SAMPLES

- A. Submit samples to illustrate functional and aesthetic characteristics of the Product, with integral parts and attachment devices. Coordinate sample submittals for interfacing work.
- B. Submit samples of finishes from the full range of manufacturers' standard colors, textures, and patterns for Prime Consultant selection.
 - 1. Provide custom color samples where requested.
- C. Reviewed samples which may be used in the Work are indicated in individual specification sections.

PART 2 - Products (Not Used)

PART 3 - Execution

3.01 SCHEDULE OF SUBMITTALS

- A. Product Data, Schedules, Shop Drawings and Other Printed Materials: Submit the number of copies which the Contractor requires, plus copies for the following:
 - 1. One copy: Project Prime Consultant.
 - 2. One copy: WHFD AND/OR PROJECT MANAGER.
 - 3. One copy: Hospital Construction Project Manager.
 - 4. Copies as required from consultants.
- B. Samples: Submit the number of samples which the Contractor requires plus one for WHFD AND/OR PROJECT MANAGER and Contracts Manager.

END OF SECTION 01330

SECTION 01400 - QUALITY REQUIREMENTS

PART 1 - General

1.01 SECTION INCLUDES

- A. Quality assurance and control of installation.
- B. Reference.
- C. Inspection and testing laboratory services.
- D. Special inspections.
- E. Manufacturers' field services and reports.

1.02 RELATED SECTIONS

- A. Section 01300 – SUBMITTAL PROCEDURES: Submissions of Manufacturers' Instruction and Certificates.
- B. Section 01600 – PRODUCT REQUIREMENTS: Requirements for material and product quality.

1.03 QUALITY ASSURANCE/CONTROL OF INSTALLATION

- A. Monitor quality control over suppliers, manufacturers, Products, services, site conditions, and workmanship, to produce Work of specified quality.
- B. Comply fully with manufacturers' instructions, including each step-in sequence.
- C. Should manufacturers' instructions conflict with Contract Documents, request clarification from Prime Consultant before proceeding.
- D. Comply with specified standards as a minimum quality for the Work except when more stringent tolerances, codes, or specified requirements indicate higher standards or more precise workmanship.
- E. Perform work by persons qualified to produce workmanship of specified quality.
- F. Secure Products in place with positive anchorage devices designed and sized to withstand stresses, vibration, physical distortion or disfigurement.

1.04 REFERENCES

- A. Conform to reference standard by date of issue current on date for receiving bids.
- B. Obtain copies of standards when required by Contract Documents.
- C. Should specified reference standards conflict with Contract Documents, request clarification from Prime Consultant before proceeding.

- D. The contractual relationship of the parties to the Contract shall not be altered from the Contract Documents by mention or inference otherwise in any reference document.

1.05 INSPECTION AND TESTING LABORATORY SERVICES

- A. When the individual specifications sections require it, the Contractor shall appoint, employ, and pay for services of an independent firm to perform inspection and testing. Seismic testing will need to be performed by a special inspector. Contractor to coordinate inspection, but KCH will pay for said inspection directly. TAB to be arranged and paid for by the contractor at substantial completion or other date agreed upon by all parties.
- B. Services will be performed in accordance with requirements of governing authorities and with specified standards.
- C. Reports will be submitted by the independent firm to the Prime Consultant, in duplicate, indicating observations and results of tests and indicating compliance or non-compliance with Contract Documents.
- D. Cooperate with independent firm; furnish samples of materials, design mix, equipment, tools, storage and assistance as requested.
 - 1. Notify WHFD AND/OR PROJECT MANAGER and independent firm 24 hours prior to expected time for operations required services.
 - 2. Make arrangements with independent firm and pay for additional samples and tests required for Contractor's use.
- E. Retesting required because of non-conformance to specified requirements shall be performed by the same independent firm on instructions by WHFD AND/OR PROJECT MANAGER and shall be paid by the Contractor.

1.06 SPECIAL INSPECTIONS

- A. Owner will employ Special Inspectors acceptable to Hawaii County to perform inspection on various elements of the work as required by Building Code as locally adopted. During the course of the work under inspection, each Special Inspector will submit detailed reports relative to progress and conditions of the work including deviations from specified requirements and stipulating dates, times, and locations. Special inspector will submit a final report to the County. Contractor must cooperate fully with Special Inspectors.

1.07 MANUFACTURER'S FIELD SERVICES AND REPORTS

- A. Submit qualification of observer to the WHFD AND/OR PROJECT MANAGER 30 days in advance of required observations. Observer subject to approval of the Prime Consultant and the WHFD AND/OR PROJECT MANAGER.
- B. When specified in individual specification Sections, require material or Product suppliers or manufacturers to provide qualified staff personnel to observe site

conditions, conditions of surfaces and installation, quality of workmanship, start-up of equipment or to test, adjust, and balance of equipment as applicable, and to initiate instruction when necessary.

- C. Individuals to report observations and site decisions or instructions given to applicators or installers that are supplemental or contrary to manufacturer's written constructions.
- D. Submit two (2) copies of report written by representative, both to the Owner and to the Project Engineer listing observations and recommendations, within five (5) days of observation.

PART 2 - Products (Not Used)

PART 3 - Execution (Not Used)

END OF SECTION 01400

SECTION 01500 - TEMPORARY FACILITIES AND CONTROLS

PART 1 - General

1.01 SECTION INCLUDES

- A. Requirements for temporary facilities and controls, including temporary utilities, support facilities, and security and protection facilities.
- B. Temporary utilities may include, but not limited to, the following:
 - 1. Sewers and drainage
 - 2. Water service and distribution
 - 3. Sanitary facilities, including toilets, wash facilities and drinking water facilities.
 - 4. Electric power service
 - 5. Lighting
 - 6. Telephone service.
- C. Support facilities include, but are not limited to, the following:
 - 1. Project identification and temporary signs.
 - 2. Construction aids and miscellaneous services and facilities.
- D. Security and protection facilities may include, but are not limited to, the following:
 - 1. Environmental protection.
 - 2. Stormwater control.
 - 3. Tree and plant protection.
 - 4. Pest control
 - 5. Site enclosure fence.
 - 6. Security enclosure and lockup.
 - 7. Barricade, warning signs, and lights.
 - 8. Fire protection.

1.02 RELATED DOCUMENTS

- A. Refer to Drawings for additional requirements for temporary protection.

1.03 RELATED SECTIONS

- A. Section 01330 SUBMITTAL PROCEDURES for procedures for submitting copies of implementation and termination schedule and utility reports.

1.04 USE CHARGES

- A. General: Cost or use charges for temporary facilities will be paid by the Contractor. Employ means and methods for conservation.
 - 1. Temporary electricity.
 - 2. Temporary water.

1.05 PROJECT CONDITIONS

- A. Temporary Utilities: At earliest feasible time and when acceptable to WHFD AND/OR PROJECT MANAGER, change over from use of temporary service to use of permanent service.
 - 1. Temporary Use of Permanent Facilities: Installer of each permanent service shall assume responsibility for operation, maintenance, and protection of each permanent service during its use as a construction facility before Owner's acceptance, regardless of previously assigned responsibilities.
- B. Conditions of Use: The following conditions apply to use of temporary services and facilities by all parties engaged in the Work:
 - 1. Keep temporary services and facilities clean and neat.
 - 2. Relocate temporary services and facilities as required by progress of the Work.

PART 2 - Products

2.01 MATERIALS

- A. Tarpaulins: Fire-resistive labeled with flame-spread rating of 15 or less.
- B. Water: Potable

2.02 EQUIPMENT

- A. Fire Extinguishers: Hospital will provide fire extinguishers. Hand carried, portable, UL rated. Provide class and extinguishing agents as indicated or a combination of extinguishers of NFPA-recommended classes for exposures.
 - 1. Comply with NFPA 10 and NFPA 241 for classification, extinguishing agent, and size required by location and class of fire exposure.
- B. Self-Contained Toilet units, if necessary Single occupant units of chemical, aerated recirculation or combustion type; vented; fully enclosed with a glass-fiber-reinforced polyester shell or similar non-absorbent material.

- C. Electrical Outlets: Properly configured, NEMA-polarized outlets to prevent insertion of 110 to 120V plugs into higher-voltage outlets; equipped with ground-fault circuit interrupters, reset button, and pilot light.
- D. Power Distribution System Circuits: Where permitted and overhead and exposed for surveillance, wiring circuits, not exceeding 125-V AC, 20-A rating, and lighting circuits may be nonmetallic sheathed cable.

PART 3 - Execution

3.01 INSTALLATION, GENERAL

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

3.02 TEMPORARY UTILITY INSTALLATION

- A. General: Engage appropriate local utility company to install temporary service or connect to serve connections provided under the Work of the Project. Where utility company provides only part of the service, provide the remainder with matching, compatible materials and equipment. Comply with utility company recommendations.
 - 1. Provide adequate capacity at each stage of construction. Before temporary utility is available, provide trucked-in services.
 - 2. Obtain easements to bring temporary utilities to Project site where Owner's easements cannot be used for that purpose.
 - 3. Install 50 amp 125/250v job box, if necessary.
 - 4. Sewers and Drainage: If sewers are available, provide temporary connections to remove effluent that can be discharged lawfully.
- B. Water Service: Connect to existing water source for construction operations.
- C. Sanitary Facilities: Existing designated facilities may be used during construction operations. Maintain daily in clean and sanitary condition,
- D. Electric Power Service: Connect to existing power service. Power consumption shall not disrupt hospital's need for continuous service.
- E. Lighting: Provide temporary lighting with local switching that provides adequate illumination for construction operations and traffic conditions.

3.03 SUPPORT FACILITIES INSTALLATION

- A. Environmental Protection: Provide protection, operate temporary facilities, and conduct construction in ways and by methods that comply with environmental regulation and that minimize possible air, waterway, and subsoil contamination or pollution or other undesirable effects.
 - 1. Cooperate and comply with hospital's Environmental Management Plan.
- B. Noise Control:
 - 1. Obtain noise permit or permit as required by Chapter 43 State of Hawaii Department of Health regulations.
 - 2. muffle internal combustion engine powered equipment to minimize noise and properly maintain to reduce noise to acceptable levels.
 - 3. Blasting and use of explosives will be not permitted.
 - 4. Activities of severe and prolonged noise and vibration must be approved in advance by WHFD AND/OR PROJECT MANAGER. Submit written notice not less than seven days in advance of intended noise producing activity.
- C. Dust Control:
 - 1. Keep dust within acceptable levels at all times, including non-working hours, weekends and holidays, in conformance with Chapter 31 – Air Pollution of State Departments of Health, Public Health Regulations, latest editions.
 - 2. Only wet grinding or cutting of concrete will be allowed on exterior surfaces.
 - 3. Mechanical dry sweeping not permitted. Vacuuming, wet mopping, approved limited dry hand, wet or damp sweeping is acceptable utilizing the hospital's EPA approved disinfectant.
 - 4. During loading operations, water down debris and waste materials to allay dust.
 - 5. Air scrubbers utilized for dust control costs incurred are the responsibility of the Contractor.
 - 6. Use wet/sticky mats at all entrances to work area to control dust. Replace daily at a minimum.
 - 7. The Contractor is responsible for damage claims.
 - 8. ICRA – during construction/renovation – KCH Policy 125.54 must be adhered to.
- D. Hazardous materials:
 - 1. Asbestos, urea formaldehyde and other hazardous materials are not expected but may be present in the existing structures subject to alteration.

Observe the applicable requirements of Hawaii Occupational Safety and health Standards and the Environmental Protection Agency.

2. If the presence of toxic substances is determined, notify the WHFD AND/OR PROJECT MANAGER immediately to determine the next course of action.
 3. Do not begin demolition when toxic substances are present until occupants of the building are moved to other facilities or are separated from the exposure by assured means.
 4. In removing and disposing of toxic substances, observe the following requirements:
 - a. Provide air-tight compartments within which the toxic substances may be removed.
 - b. In lieu of air-tight compartments, provide competent controlled misting or dust settling agent.
 - c. Place toxic substances in properly labeled sacks of at least 8 mil polypropylene.
 5. Must adhere to KCH Hazmat Material and Waste Management Program Policy 122-6 and Clean up of Spills, Hazardous and Infectious Policy 122-6-2. (If any differences are discovered between RFP and KCH policies, KCH policies shall prevail.)
- E. Temporary Fire Protection: Until fire-protection needs are supplied by permanent facilities, install and maintain temporary fire-protection facilities of types needed to protect against reasonably predictable and controllable fire losses. Comply with NFPA 241.
1. Hospital will provide fire extinguishers.
 - a. Field Offices: Class A stored-pressure water-type extinguishers.
 - b. Locate fire extinguishers where convenient and effective for their intended purpose; provide not less than one extinguisher on each floor at or near each usable stairwell.
 2. Store combustible materials in containers in fire-safe locations.
 3. Maintain unobstructed access to fire extinguishers, fire hydrants, temporary fire-protection facilities, stairways, and other access routes for firefighting. Prohibit smoking in hazardous fire-exposed areas.
 4. Supervise welding operations, and similar sources of fire ignition.
 5. Permanent Fire Protection: At earliest feasible date in each area of Project, complete installation of permanent fire-protection facility, including connected services, and place into operation and use. Instruct key personnel on use of facilities.

6. Develop and supervise an overall fire-prevention and first-aid fire-protection program for personnel at Project site. Review needs with local fire department and establish procedure to be followed. Instruct personnel in methods and procedures. Post warnings and information.

F. BARRIERS

1. Follow ICRA. Provide barriers to prevent unauthorized entry to construction areas, to allow for hospital's use of premises, and to protect existing facilities and adjacent properties from damage from construction operations.
2. Provide barricades and covered walkways required by governing authorities.
3. Protect non-owned vehicular traffic, store materials, site and structures from damage.
4. Barriers that will be used on project are to be approved by the project manager before starting work.

G. INTERIOR ENCLOSURES

1. Provide temporary partitions as required to separate work areas from hospital occupied areas, to prevent penetration of dust and moisture into hospital occupied areas, and to prevent damage to existing materials and equipment.
2. Construction: Framing and sheet materials must be noncombustible, with closed joints and sealed edges at intersections with existing surfaces and all other areas to provide a smoke tight area; STC rating of 35 in accordance with ASTM E90 and maximum Flame Spread Rating of 75 in accordance with ASTM E84. This information must be posted on the containment.
3. Paint surfaces exposed to view from hospital occupied areas.
4. Enclosures that will be used on the project are to be approved by the WHFD AND/OR PROJECT MANAGER before starting work.

H. INFECTION CONTROL

1. Provide protection, operate temporary facilities, and conduct construction in ways and by methods that comply with hospital's infection control regulation and minimize undesirable effects.
 - a. For ICRA. Cooperate and comply with Owner's Infection Control Plan (KCH Infection Control, Policy 125-54, to be adhered to during construction and renovation.).

3.04 OPERATION, TERMINATION, AND REMOVAL

- A. Supervision: Enforce strict discipline in use of temporary facilities. To minimize waste and abuse, limit availability of temporary facilities to essential and intended use.

B. Maintenance: Maintain facilities in good operating condition until removal.

1. Maintain operation of temporary enclosures, cooling, humidity control, ventilation, and similar facilities on a 24-hour basis where required to achieve indicated results and to avoid possibility of damage.

END OF SECTION 01500

SECTION 01600 - PROJECT REQUIREMENTS

PART 1 - General

1.01 SECTION INCLUDES

- A. Selection of products for use in project
- B. Product delivery, storage, and handling
- C. Manufacturers standard warranties on products; special warranties
- D. Product substitutions
- E. Comparable products

1.02 DEFINITIONS

- A. Products: Items purchased for incorporating into the Work, whether purchased for Project or taken from previously purchased stock. The term "product" includes the terms "material," "equipment," "system," and terms of similar intent.
 - 1. Named Products: Items identified by manufacturer's product name, including make or model number or other designation, shown or listed in manufacturer's published product literature that is current as of date of the Contract Documents.
 - 2. New Products: Items that have not previously been incorporated into another project or facility, except that products consisting of recycled- content materials are allowed, unless explicitly stated otherwise. Products salvaged or recycled from other projects are not considered new products.
 - 3. Comparable Product: Product that is demonstrated and approved through submittal process, or where indicated as a product substitution, to have the indicated qualities related to type, function, dimension, in-service performance, physical properties, appearance, and other characteristics that equal or exceed those of specified product.
- B. Substitutions: Changes in products, materials, equipment, and methods of construction from those required by the Contract Documents and proposed by Contractor.
- C. Basis-of-Design Product Specification: Where a specific manufacturer's product is named and accompanied by the words "basis of design." including make or model number or other designation, to establish the significant qualities related to type, function, dimension, in-service performance, physical properties, appearance, and other characteristics for purposes of evaluating comparable products of other named manufacturers.
- D. Manufacturer's Warranty: Preprinted written warranty published by individual manufacturer for a particular product and specifically endorsed by manufacturer to Hospital.

- E. Special Warranty: Written warranty required by or incorporated into the Contract Documents, either to extend time limit provided by manufacturer's warranty or to provide more rights for Hospital.

1.03 SUBMITTALS

- A. Product List: Submit a list, in tabular form (preferably in Microsoft Excel), showing specified products. Include generic names of products required. Include manufacturer's name and proprietary product names for each product.

1. Coordinate product list with Contractor's Construction Schedule and the Submittals Schedule.
2. Form: Tabulate information for each product under the following column headings:
 - a. Specification Section number and title.
 - b. Generic name used in the Contract Documents.
 - c. Proprietary name, model number, and similar designations.
 - d. Manufacturer's name and address.
 - e. Supplier's name and address.
 - f. Installer's name and address.
 - g. Projected delivery date or time span of delivery period.
 - h. Identification of items that require early submittal approval for scheduled delivery date.
3. Initial Submittal: Within 20 days after date of commencement of the Work, submit electronically the initial product list. Include a written explanation for omissions of data and for variations from Contract requirements.
 - a. At Contractor's option, initial submittal may be limited to product selections and designations that must be established early in Contract period.
4. Completed List: Within 30 days after date of commencement of the Work, submit electronically the completed product list. Include a written explanation for omissions of data and for variations from Contract requirements.
5. Project Prime Consultant's or WHFD AND/OR PROJECT MANAGER's Action: The Project Prime Consultant or WHFD AND/OR PROJECT MANAGER will respond in writing to Contractor within 15 days of receipt of completed product list. The Project Prime Consultant's or WHFD AND/OR PROJECT MANAGER's response will include a list of unacceptable product selections and a brief explanation of reasons for this action. Project Prime Consultants or WHFD AND/OR PROJECT MANAGERS response, or lack of

response, does not constitute a waiver of requirement that products comply with the Contract Documents.

- B. Basis-of-Design Product Specification Submittal: Comply with requirements in Division 1 Section "Submittal Procedures." Show compliance with requirements.

1.04 QUALITY ASSURANCE

- A. Compatibility of Options: If Contractor is given option of selecting between two or more products for use on Project, product selected shall be compatible with products previously selected.
 - 1. Each contractor is responsible for providing products and construction methods compatible with products and construction methods of other contractors.
 - 2. If a dispute arises between contractors over concurrently selectable but incompatible products, the WHFD AND/OR PROJECT MANAGER will determine which products shall be used.

1.05 PRODUCT DELIVERY, STORAGE, AND HANDLING

- A. Deliver, store, and handle products using means and methods that will prevent damage, deterioration, and loss, including theft. Comply with manufacturers written instructions.
 - 1. Schedule delivery to minimize storage at Project site and to prevent overcrowding of construction spaces. Long term storage onsite is not permitted unless approved by WHFD AND/OR PROJECT MANAGER.
 - 2. Coordinate delivery with installation time to ensure minimum holding time for items that are flammable, hazardous, easily damaged, or sensitive to deterioration, theft, and other losses.
 - 3. Deliver products to Project site in an undamaged condition in manufacturer's original sealed container or other packaging system, complete with labels and instructions for handling, storing, unpacking, protecting, and installing.
 - 4. Inspect products on delivery to ensure compliance with the Contract Documents and to ensure that products are undamaged and properly protected.
 - 5. Store products to allow for inspection and measurement of quantity or counting of units.
 - 6. Store materials in a manner that will not endanger Project structure.
 - 7. Store products that are subject to damage by the elements, under cover in a weathertight enclosure above ground, with ventilation adequate to prevent condensation.
 - 8. Comply with product manufacturer's written instructions for temperature, humidity, ventilation, and weather-protection requirements for storage.

9. Protect stored products from damage
- B. Storage: Provide a secure location and enclosure at Project site for temporary storage of materials and equipment. Coordinate location with WHFD AND/OR PROJECT MANAGER. Long term storage onsite is not permitted unless approved by WHFD AND/OR PROJECT MANAGER.

1.06 PRODUCT WARRANTIES

- A. Warranties specified in other Sections shall be in addition to, and run concurrent with, other warranties required by the Contract Documents. Manufacturer's disclaimers and limitations on product warranties do not relieve Contractor of obligations under requirements of the Contract Documents.
- B. Special Warranties: Prepare a written document that contains appropriate terms and identification, ready for execution. Submit a draft for approval before final execution.
 1. Manufacturer's Standard Form: Modified to include Project-specific information and properly executed.
 2. Specified Form: Forms are included with the Specifications. Prepare a written document using appropriate form properly executed.
 3. Refer to Divisions 2 through 16 Sections for specific content requirements and particular requirements for submitting special warranties.
- C. Submittal Time: Comply with requirements in Division 1 Section "Closeout Procedures."

PART 2 - Products

2.01 PRODUCT OPTIONS

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

5. Descriptive, performance, and reference standard requirements in the Specifications establish salient characteristics” of products.
 6. Or Equal: Where products are specified by name and accompanied by the term “or equal” or “or approved equal” or “or approved,” comply with provisions in “Comparable Products” Article to obtain approval for use of an unnamed product.
- B. Product Selection Procedures: Procedures for product selection include the following:
1. Product: Where Specification paragraphs or subparagraphs titled “Product” name a single product and manufacturer, provide the product named.
 - a. Substitutions may be considered, unless otherwise indicated.
 2. Manufacturer/Source: Where Specification paragraphs or subparagraphs titled “Manufacturer” or “Source” name single manufacturers or sources, provide a product by the manufacturer or from the source named that complies with requirements.
 - a. Substitutions may be considered, unless otherwise indicated.
 3. Products: Where Specification paragraphs or subparagraphs titled “Products” introduce a list of names of both products and manufacturers, provide one of the products listed that complies with requirements.
 - a. Substitutions may be considered, unless otherwise indicated.
 4. Manufacturers: Where Specification paragraphs or subparagraphs titled “Manufacturers” introduce a list of manufacturers’ names, provide a product by one of the manufacturers listed that complies with requirements.
 - a. Substitutions may be considered, unless otherwise indicated.
 5. Available Products: Where Specification paragraphs or subparagraphs titled “Available Products” introduce a list of names of both products and manufacturers, provide one of the products listed or another product that complies with requirements. Comply with provisions in “Comparable Products” Article to obtain approval for use of an unnamed product.
 6. Available Manufacturers: Where Specification paragraphs or subparagraphs titled “Available Manufacturers” introduce a list of manufacturer names, provide a product by one of the manufacturers listed or another manufacturer that complies with requirements. Comply with provisions in “Comparable Products” Article to obtain approval for use of an unnamed product.
 7. Product Options: Where Specification paragraphs titled “Product Options” indicate that size, profiles, and dimensional requirements on Drawings are based on a specific product or system, provide either the specific product or system indicated or a comparable product or system by another manufacturer. Comply with provisions in “Product Substitutions” Article.

8. Basis-of-Design Products: Where Specification paragraphs or subparagraphs titled "Basis-of-Design Product[s]" are included and also introduce or refer to a list of manufacturers' names, provide either the specified product or a comparable product by one of the other named manufacturers. Drawings and Specifications indicate sizes, profiles, dimensions, and other characteristics that are based on the product named. Comply with provisions in "Comparable Products" Article to obtain approval for use of an unnamed product.
 - a. Substitutions may be considered, unless otherwise indicated.
9. Visual Matching Specification: Where Specifications require matching an established Sample, select a product (and manufacturer) that complies with requirements and matches Prime Consultant's sample. WHFD AND/OR PROJECT MANAGER's or Contract Manager's decision will be final on whether a proposed product matches satisfactorily.
 - a. If no product available within specified category matches satisfactorily and complies with other specified requirements, comply with provisions of the Contract Documents on "substitutions" for selection of a matching product.
10. Visual Selection Specification: Where Specifications include the phrase "as selected from manufacturer's colors, patterns, textures" or a similar phrase, select a product (and manufacturer) that complies with other specified requirements.
 - a. Standard Range: Where Specifications include the phrase "standard range of colors, patterns, textures" or similar phrase, WHFD AND/OR PROJECT MANAGER and Contracts Manager will select color, pattern, or texture from manufacturer's product line that does not include premium items.
 - b. Full Range: Where Specifications include the phrase "full range of colors, patterns, textures or similar phrase. WHFD AND/OR PROJECT MANAGER and Contracts Manager will select color, pattern, or texture from manufacturer's product line that includes both standard and premium items.
11. Allowances: Refer to individual Specification Sections and "Allowance" provisions in Division I for allowances that control product selection and for procedures required for processing such selections.

2.02 PRODUCT SUBSTITUTIONS

- A. Follow the procedures as described in Hawaii Health Systems Corporation General Conditions for Construction.

2.03 COMPARABLE PRODUCTS

- A. Where products or manufacturers are specified by name, submit the following, in addition to other required submittals, to obtain approval of an unnamed product:

1. Evidence that the proposed product does not require extensive revisions to the Contract Documents, that it is consistent with the Contract Documents and will produce the indicated results, and that it is compatible with other portions of the Work.
2. Detailed comparison of significant qualities of proposed product with those named in the Specifications. Significant qualities include attributes such as performance, weight, size, durability, visual effect, and specific features and requirements indicated.
3. Evidence that proposed product provides specified warranty.
4. List of similar installations for completed projects with project names and addresses and names and addresses of Prime Consultants and owners, if requested.
5. Samples, if requested.

PART 3 - Execution (Not Used)

END OF SECTION 01600

SECTION 01730 – EXECUTION

PART 1 - General

1.01 SECTION INCLUDES

- A. Construction layout.
- B. Field engineering and surveying.
- C. Progress cleaning.

1.02 RELATED SECTIONS

- A. Section 01330 "SUBMITTAL PROCEDURES" for submitting surveys.

PART 2 - Products (Not Used)

PART 3 - Execution

3.01 EXAMINATION

- A. Acceptance of Conditions: Examine substrates, areas, and conditions, with General Contractor and Subcontractor present where indicated, for compliance with requirements for installation tolerances and other conditions affecting performance. Record observations.
 - 1. Written Report: Where a written report listing conditions detrimental to performance of the Work is required by other Sections, include the following:
 - a. Description of the Work.
 - b. List of detrimental conditions, including substrates.
 - c. List of unacceptable installation tolerances.
 - d. Recommended corrections.
 - 2. Verify compatibility with and suitability of substrates, including compatibility with existing finishes or primers.
 - 3. Examine roughing-in for mechanical and electrical systems to verify actual locations of connections before equipment and fixture installation.
 - 4. Examine walls, floors, and roofs for suitable conditions where products and systems are to be installed.
 - 5. Proceed with installation only after unsatisfactory conditions have been corrected. Proceeding with the Work indicates acceptance of surfaces and conditions.

3.02 PREPARATION

- A. Existing Utility Information: Furnish information to local utility that is necessary to adjust, move, or relocate existing utility structures, utility poles, lines, services, or other utility appurtenances located in or affected by construction. Coordinate with authorities having jurisdiction.
- B. Field Measurements: Take field measurements as required to fit the Work properly. Recheck measurements before installing each product. Where portions of the Work are indicated to fit to other construction, verify dimensions of other construction by field measurements before fabrication. Coordinate fabrication schedule with construction progress to avoid delaying the Work.
- C. Space Requirements: Verify space requirements and dimensions of Items shown diagrammatically on Drawings.
- D. Review of Contract Documents and Field Conditions: Immediately on discovery of the need for clarification of the Contract Documents, submit a request for information to Prime Consultant. Include a detailed description of problem encountered, together with recommendations for changing the Contract Documents.

3.03 PROGRESS CLEANING

- A. General: Clean Project site and work areas daily, including common areas. Coordinate progress cleaning for joint-use areas where more than one installer has worked. Enforce requirements strictly. Dispose of materials lawfully.
 - 1. Comply with requirements in NFPA 241 for removal of combustible waste materials and debris.
 - 2. Do not hold materials more than 7 days during normal weather or 3 days if the temperature is expected to rise above 80 deg F.
- B. Site: Maintain Project site free of waste materials and debris.
- C. Work Areas: Clean areas where work is in progress to the level of cleanliness necessary for proper execution of the Work.
 - 1. Remove liquid spills promptly.
 - 2. Where dust would impair proper execution of the Work, wet mop or vacuum the entire work area, as appropriate, utilizing the hospital's EPA approved disinfectant.
- D. Waste Disposal: Burying or burning waste materials on-site will not be permitted. Washing waste materials down sewers or into waterways will not be permitted.
- E. Limiting Exposures: Supervise construction operations to assure that no part of the construction, completed or in progress, is subject to harmful, dangerous, damaging, or otherwise deleterious exposure during the construction period.

END OF SECTION 01730

SECTION 01732 - CUTTING AND PATCHING

PART 1 - General

1.01 SECTION INCLUDES

- A. Requirements and limitations for cutting and patching of Work.

1.02 RELATED SECTIONS

- A. Section 01100 SUMMARY: Work by Owner or by separate contractors.
- B. Section 01120 ALTERATION PROJECT PROCEDURES: Cutting and patching for alterations work.
- C. Section 01330— SUBMITTAL PROCEDURES.
- D. Section 01600— MATERIAL REQUIREMENTS: Product Options and Substitutions.
- E. Individual Product Specification Sections:
 - 1. Cutting and patching incidental to work of the Section.
 - 2. Advance notification to other Sections of openings required in work of those Sections.
 - 3. Limitations on cutting structural members.

1.03 SUBMITTALS

- A. Submit written request in advance of cutting or alteration which affects:
 - 1. Structural integrity of any element of Project.
 - 2. Efficiency, maintenance, or safety of any operational element.
- B. Include in request:
 - 1. Identification of Project.
 - 2. Location and description of affected work.
 - 3. Necessity for cutting or alteration.
 - 4. Description of proposed work, and products to be used.
 - 5. Alternatives to cutting and patching.
 - 6. Effect on work of Hospital or separate contractor.
 - 7. Written permission of affected separate contractor.

8. Date and time work will be executed.

PART 2 - Products

2.01 MATERIALS

- A. Primary Products: Those required for original installation.

PART 3 - Execution

3.01 EXAMINATION

- A. Inspect existing conditions prior to commencing Work, including elements subject to damage or movement during cutting and patching.
- B. After uncovering existing work, inspect conditions affecting performance of work.
- C. Beginning of cutting or patching means acceptance of existing conditions.

3.02 PREPARATION

- A. Provide temporary supports to ensure structural integrity of the Work. Provide devices and methods to protect other portions of Project from damage.
- B. Provide protection from elements for areas that may be exposed by uncovering work.
- C. Maintain excavations free of water.

3.03 CUTTING AND PATCHING

- A. Execute cutting, fitting, and patching to complete work.
- B. Fit products together, to integrate with other work.
- C. Uncover work to install ill-timed work.
- D. Remove and replace defective or non-conforming work.
- E. Remove samples of installed work for testing when requested.
- F. Provide openings in the work for penetration of mechanical and electrical work.

3.04 PERFORMANCE

- A. Execute work by methods to avoid damage to other Work, and which will provide appropriate surfaces to receive patching and finishing.
- B. Cut rigid materials using masonry saw or core drill. Pneumatic tools are allowed with WHFD's prior approval.
- C. Restore work with new products in accordance with requirements of Contract Documents.

- D. Fit work air tight to pipes, sleeves, ducts, conduit, and other penetrations through surfaces.
- E. At penetrations of fire rated walls, partitions, ceiling, or floor construction, completely seal voids, fire stopping, to full thickness of the penetrated element. Use red 3M fire caulk only.
- F. Refinish surfaces to match adjacent finish. For continuous surfaces, refinish to nearest intersection or natural break. For an assembly, refinish entire unit.

END OF SECTION 01732

SECTION 01770 - CLOSEOUT PROCEDURES

PART 1 - General

1.01 SECTION INCLUDES

- A. Administrative and procedural requirements for contract closeout, including, but not limited to, the following:
 - 1. Inspection procedures.
 - 2. Warranties.
 - 3. Final cleaning.

1.02 RELATED SECTIONS

- A. Section 01260 CONTRACT CONSIDERATIONS for requirements for Applications for Payment for Substantial and Final Completion.
- B. Section 01730 EXECUTION for progress cleaning of Project site.
- C. Sections for specific closeout and special cleaning requirements for the Work in those Sections.

1.03 SUBSTANTIAL COMPLETION

- A. Preliminary Procedures: Before requesting inspection for determining date of Substantial Completion, complete the following. List items below that are incomplete in request.
 - 1. Prepare a list of items to be completed and corrected (punch list), the value of items on the list, and reasons why the Work is not complete.
 - 2. Advise Hospital Risk Manager of pending insurance changeover requirements, if necessary.
 - 3. Obtain and submit releases permitting Hospital unrestricted use of the Work and access to services and utilities. Include occupancy permits, operating certificates, and similar releases.
 - 4. Prepare and submit Project Record Documents, operation and maintenance manuals, Final Completion construction photographs, damage or settlement surveys, property surveys, and similar final record information.
 - 5. Complete startup testing of systems.
 - 6. Submit test/adjust/balance, including TAB, records.
 - 7. Terminate and remove temporary facilities from Project site, along with mockups, construction tools, and similar elements.

8. Advise WHFD of changeover in heat and other utilities.
 9. Submit changeover information related to Hospital's occupancy, use, operation, and maintenance.
 10. Complete final cleaning requirements, including touchup painting.
 11. Touch up and otherwise repair and restore marred exposed finishes to eliminate visual defects.
- B. Inspection: Submit a written request for inspection for Substantial Completion. On receipt of request, the WHFD will either proceed with inspection or notify Contractor of unfulfilled requirements. The will prepare the Certificate of Substantial Completion after inspection or will notify Contractor of Items, either on Contractor's list or additional items identified by the Prime Consultant that must be completed or corrected before certificate will be issued.
1. Re-inspection: Request re-inspection when the Work identified in previous inspections as incomplete is completed or corrected.
 2. Results of completed inspection will form the basis of requirements for Final Completion.

1.04 FINAL COMPLETION

- A. Preliminary Procedures: Before requesting final inspection for determining date of Final Completion, complete the following:
1. Submit a final Application for Payment according to Division 1 Section Payment Procedures.
 2. Submit specific warranties, workmanship bonds, maintenance service agreements, final certifications, and similar documents. To be submitted in 3 ring binder.
 3. Deliver tools, spare parts, extra materials, and similar items to location designated by WHFD. Label with manufacturer's name and model number where applicable.
 4. Make final changeover of permanent locks and deliver keys to WHFD. Advise Hospital's personnel of changeover n security provisions.
 5. Submit copy of WHFD's Substantial Completion inspection list of items to be completed or corrected. The copy of the list shall state that each item has been completed or otherwise resolved for acceptance.
 6. Submit evidence of final, continuing insurance coverage complying with insurance requirements.
 7. Submit pest-control final inspection report and warranty.

8. Instruct Hospital's personnel in operation, adjustment, and maintenance of products, equipment, and systems. Document attendance and discussion topics presented to WHFD's personnel.
- B. Inspection: Submit a written request for final inspection for acceptance. On receipt of request, the Prime Consultant and WHFD will either proceed with inspection or notify Contractor of unfulfilled requirements.
 1. Reinspection: Request reinspection when the Work identified in previous inspections as incomplete is completed or corrected.

1.05 LIST OF INCOMPLETE ITEMS (PUNCH LIST)

- A. Preparation: Submit electronic copy of punch list. Include name and identification of each space and area affected by construction operations for incomplete items and items needing correction including, if necessary, areas disturbed by Contractor that are outside the limits of construction. Use Contractor's form.
 1. Organize list of spaces in sequential order, starting with exterior areas first and proceeding from lowest floor to highest floor.
 2. Organize items applying to each space by major element, including categories for ceiling, individual walls, floors, equipment, and building systems.
 3. Include the following information at the top of each page:
 - a. Project name.
 - b. Date.
 - c. Name of Contractor.
 - d. Page number.

1.06 WARRANTIES

- A. Submittal Time: Submit written warranties on request of WHFD for designated portions of the Work where commencement of warranties other than date of Substantial Completion is indicated.
- B. Partial Occupancy: Submit properly executed warranties within 10 days of completion of designated portions of the Work that are completed and occupied or used by Owner during construction period by separate agreement with Contractor.
- C. Organize warranty documents into an orderly sequence based on the table of contents of the Project Manual.
 1. Bind warranties and bonds in heavy-duty, 3-ring, vinyl-covered, loose-leaf binders, thickness as necessary to accommodate contents, and sized to receive 8-1/2-by-11 1-inch paper.

2. Provide heavy paper dividers with plastic-covered tabs for each separate warranty. Mark tab to identify the product or installation. Provide a typed description of the product or installation, including the name of the product and the name, address, and telephone number of Installer.
- D. Provide additional copies of each warranty to include in operation and maintenance manuals.

PART 2 - Products

2.01 MATERIALS

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

PART 3 - Execution

3.01 FINAL CLEANING

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

disturbing natural weathering of exterior surfaces. Restore reflective surfaces to their original condition.

- f. Remove debris and surface dust from limited access spaces, including roofs, plenums, shafts, trenches, equipment vaults, manholes, attics, and similar spaces.
- g. Sweep concrete floors broom clean in unoccupied spaces. Mop using quaternary ammonium disinfectants.
- h. Vacuum carpet and similar soft surfaces, removing debris and excess nap; shampoo if visible soil or stains remain.
- i. Clean transparent materials, including mirrors and glass in doors and windows, Remove glazing compounds and other noticeable, vision-obscuring materials. Replace chipped or broken glass and other damaged transparent materials. Polish mirrors and glass, taking care not to scratch surfaces.
- j. Remove labels that are not permanent.
- k. Touch up and otherwise repair and restore marred, exposed finishes and surfaces. Replace finishes and surfaces that cannot be satisfactorily repaired or restored or that already show evidence of repair or restoration.
 - 1) Do not paint over "UL" and similar labels on door and window frames, including mechanical and electrical nameplates.
- l. Wipe surfaces of mechanical and electrical equipment, elevator equipment, and similar equipment. Remove excess lubrication, paint and mortar droppings, and other foreign substances.
- m. Replace parts subject to unusual operating conditions.
- n. Clean plumbing fixtures to a sanitary condition, free of stains, including stains resulting from water exposure.
- o. Replace disposable air filters and clean permanent air filters. Clean exposed surfaces of diffusers, registers, and grills.
- p. Clean ducts, blowers, and coils if units were operated without filters during construction.
- q. Clean light fixtures, lamps, globes, and reflectors to function with full efficiency. Replace burned-out bulbs, and those noticeably dimmed by hours of use, and defective and noisy starters in fluorescent and mercury vapor fixtures to comply with requirements for new fixtures.
- r. Leave Project clean and ready for occupancy.

C. Pest Control: To be determined by WHFD.

- D. Comply with safety standards for cleaning. Do not burn waste materials. Do not bury debris or excess materials on Hospital's property. Do not discharge volatile, harmful or dangerous materials into drainage systems. Remove waste materials from Project site and dispose of lawfully. Follow County of Hawaii waste guidelines.

END OF SECTION 01770

SECTION 01783 - PROJECT RECORD DOCUMENTS

PART 1 - General

1.01 SECTION INCLUDES

- A. Administrative and procedural requirements for Project Record Documents, including the following:
 - 1. Record Drawings.
 - 2. Record Specifications.
 - 3. Record Product Data.

1.02 RELATED SECTIONS

- A. Section 01770 CLOSEOUT PROCEDURES for general closeout procedures.
- B. Related sections of the work in this Specification for Project Record Documents.

1.03 SUBMITTALS

- A. Record Drawings: Comply with the following:
 - 1. Number of Copies: Submit copies of Record Drawings as follows:
 - a. Initial Submittal: Submit one set of plots from corrected Record CAD Drawings and one set of marked-up Record Prints. Prime Consultant will initial and date each plot and mark whether general scope of changes, additional information recorded, and quality of drafting are acceptable. Prime Consultant will return plots and prints for organizing into sets, printing, binding, and final submittal.
 - b. Final Submittal: Submit one set of marked-up Record Prints, two sets of Record CAD Drawing files, two copies of Record CAD Drawing plots. Plot and print each Drawing, whether or not changes and additional information were recorded.
 - 1) E-mail: ACAD and PDF formats
 - c. Record Specifications: Submit one electronic copy of Project's Specifications, including addenda and contract modifications.

PART 2 - Products

2.01 RECORD DRAWINGS

- A. Record Prints: Maintain one set of black-line prints of the Contract Drawings and Shop Drawings.
 - 1. Preparation: Mark Record Prints to show the actual installation where installation varies from that shown originally. Require individual or entity who

obtained record data, whether individual or entity is Installer, subcontractor, or similar entity, to prepare the marked-up Record Prints.

- a. Give particular attention to information on concealed elements that would be difficult to identify or measure and record later. Accurately record information in an understandable drawing technique.
 - b. Record data as soon as possible after obtaining it. Record and check the markup before enclosing concealed installations.
2. Content: Types of items requiring marking include, but are not limited to, the following:
 - a. Dimensional changes to Drawings.
 - b. Revisions to details shown on Drawings.
 - c. Depths of foundations below first floor.
 - d. Locations and depths of underground utilities.
 - e. Revisions to routing of piping and conduits.
 - f. Revisions to electrical circuitry.
 - g. Actual equipment locations.
 - h. Duct size and routing.
 - i. Locations of concealed internal utilities.
 - j. Changes made by Change Order or Construction Change Directive.
 - k. Changes made following Prime Consultant's written orders.
 - l. Details not on the original Contract Drawings.
 - m. Field records for variable and concealed conditions.
 - n. Record information on the Work that is shown only schematically.
3. Mark the Contract Drawings or Shop Drawings, whichever is most capable of showing actual physical conditions, completely and accurately. If Shop Drawings are marked, show cross-reference on the Contract Drawings.
4. Mark record sets with erasable, red-colored pencil. Use other colors to distinguish between changes for different categories of the Work at same location.
5. Mark important additional information that was either shown schematically or omitted from original Drawings.

6. Note Construction Change Directive numbers, alternate numbers, Change Order numbers, and similar identification, where applicable.
- B. Record CAD Drawings: Prepare a full set of corrected CAD Drawings of the Contract Drawings, as follows:
1. Format: Same CAD program, version, and operating system as the original Contract Drawings. PDF format also.
 2. Incorporate changes and additional information previously marked on Record Prints. Delete, redraw, and add details and notations where applicable.
 3. Refer instances of uncertainty to Prime Consultant through Owners Project Manager for resolution.
 4. The Contractor is free to negotiate a fee with the Prime Consultant, for the CAD Drawings of the Contract Drawings for use in recording Information.
- C. Format: Identify and date each Record Drawing; include the designation "PROJECT RECORD DRAWING" in a prominent location.
1. Record Prints: Organize Record Prints into manageable sets. Bind each set with durable paper cover sheets. Include identification on cover sheets.
 2. Record CAD Drawings: Organize CAD information into separate electronic files that correspond to each sheet of the Contract Drawings. Name each file with the sheet identification. Include identification in each CAD file. PDF format also.
 3. Identification: As follows:
 - a. Project name.
 - b. Date.
 - c. Designation "PROJECT RECORD DRAWINGS."
 - d. Name of Contractor.

2.02 RECORD SPECIFICATIONS

- A. Preparation: Mark Specifications to indicate the actual product installation where installation varies from that indicated in Specifications, addenda, and contract modifications.
1. Give particular attention to information on concealed products and installations that cannot be readily identified and recorded later.
 2. Mark copy with the proprietary name and model number of products, materials, and equipment furnished, including substitutions and product options selected.

3. Record the name of manufacturer, supplier, Installer, and other information necessary to provide a record of selections made.
4. For each principal product, indicate whether Record Product Data has been submitted in operation and maintenance manuals instead of submitted as Record Product Data.
5. Note related Change Orders, Record Product Data, and Record Drawings where applicable.

2.03 RECORD PRODUCT DATA

- A. Preparation: Mark Product Data to indicate the actual product installation where installation varies substantially from that indicated in Product Data submittal.
 1. Give particular attention to information on concealed products and installations that cannot be readily identified and recorded later.
 2. Include significant changes in the product delivered to Project site and changes in manufacturer's written instructions for installation.
 3. Note related Change Orders. Record Specifications, and Record Drawings where applicable.

2.04 MISCELLANEOUS RECORD SUBMITTALS

- A. Assemble miscellaneous records required by other Specification Sections for miscellaneous record keeping and submittal in connection with actual performance of the Work. Bind or file miscellaneous records and identify each, ready for continued use and reference.

PART 3 - Execution

3.01 RECORDING AND MAINTENANCE

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

END OF SECTION 01783

DIVISION 2 - SITE WORK

SECTION 02221 - MINOR DEMOLITION FOR REMODELING

PART 1 - General

1.01 SECTION INCLUDES

- A. Removal of designated building equipment and fixtures.
- B. Removal of designated construction.
- C. Identification of utilities.
- D. Refer to items as indicated.

1.02 RELATED SECTIONS

- A. Section 01713 ALTERATION PROJECT PROCEDURES
- B. Section 01500 CONSTRUCTION FACILITIES AND TEMPORARY CONTROLS: Temporary enclosures, Security at Owner occupied areas, and Cleanup during construction.
- C. Section 01700 CONTRACT CLOSEOUT: Project record documents.

1.03 REGULATORY REQUIREMENTS

- A. Conform to applicable code for demolition work, ICRA, safety of structure, dust control, noise control, and pollution control.
- B. Obtain required permits from authorities.
- C. Notify affected utility companies before starting work and comply with their requirements.
- D. Do not dose or obstruct egress width to exits.
- E. Do not disable or disrupt building fire or life safety systems without two weeks prior written notice to the WHFD.
- F. Conform to procedures applicable when discovering hazardous or contaminated materials.

PART 2 - Products (Not Used)

PART 3 - Execution

3.01 PREPARATION

- A. Provide, erect, and maintain temporary barriers and partitions as specified in Section 01500.

- B. Erect and maintain weatherproof closures for exterior openings.
- C. Erect and maintain temporary partitions to prevent spread of dust, odors and noise to permit continued hospital occupancy as specified in Section 01100 and ICRA.
- D. Protect existing materials and systems which are not to be demolished.
- E. Prevent movement of structure; provide required bracing and shoring.
- F. Mark location of utilities.

3.02 DEMOLITION REQUIREMENTS

- A. Conduct demolition to minimize interference with adjacent and occupied building areas.
- B. Provide structural shoring per instructions on structural drawings.
- C. Where coring of slabs and walls is required make provisions to clear floor below and catch core in a safe manner. Locate existing reinforcing in slabs and walls before coring and avoid cutting steel. Relocate hole as necessary to avoid steel.
- D. Cease operations immediately if structure appears to be in danger. Notify Prime Consultant/WHFD AND/OR PROJECT MANAGER. Do not resume operations until directed.
- E. Maintain protected egress and access to the Work.

3.03 DEMOLITION

- A. Disconnect remove or cap and identify designated utilities within demolition areas as indicated.
- B. Demolish in an orderly and careful manner. Protect existing supporting structural members.
- C. Except where noted otherwise, remove demolished materials from site following County of Hawaii waste disposal guidelines. Do not burn or bury materials on site.
- D. Remove demolished materials from site as work progresses. Upon completion of work, leave areas in clean condition.
- E. Remove temporary Work.

3.04 SALVAGE MATERIALS

- A. Coordinate with the WHFD, items for salvage. The WHFD may elect to salvage items before construction begins. If they so elect, then provide the WHFD two weeks advance notice before work is to begin.

END OF SECTION 02221

SECTION 03300 - CAST-IN-PLACE CONCRETE

PART 1 - General

1.01 SUMMARY

- A. Section includes cast-in-place concrete, including formwork, reinforcement, concrete materials, mix design, placement procedures, and finishes.

1.02 DEFINITIONS

- A. Cementitious Materials: Portland cement alone or in combination with one or more of blended hydraulic cement, fly ash and other pozzolans, ground granulated blast-furnace slag, and silica fume.

1.03 RELATED SECTIONS

- A. SECTION 07531 - SINGLE PLY TPO MEMBRANE ROOFING

PART 2 - Products

2.01 FORM-FACING MATERIALS

- A. Smooth-Formed Finished Concrete: Comply with ACI 347R. Provide new or good finish form-facing panels that will provide continuous, true, and smooth concrete surfaces. Furnish in largest practicable sizes to minimize number of joints.
- B. Rough-Formed Finished Concrete: Plywood, lumber, metal, or another approved material. Provide lumber dressed on at least two edges and one side for tight fit.
- C. Form-Release Agent: Commercially formulated form-release agent that will not bond with, stain, or adversely affect concrete surfaces and will not impair subsequent treatments of concrete surfaces. Form oils or waxes shall not be used for concrete surfaces intended to be painted.
 - 1. Formulate form-release agent with rust inhibitor for steel form-facing materials.

2.02 STEEL REINFORCEMENT

- A. Reinforcing Bars: ASTM A 615/A 615M, Grade 60, deformed, unless otherwise noted on the drawings.
- B. Plain-Steel Wire: ASTM A 82 galvanized, as drawn.

2.03 REINFORCEMENT ACCESSORIES

- A. Bar Supports: Bolsters, chairs, spacers, and other devices for spacing, supporting, and fastening reinforcing bars and welded wire fabric in place that will not puncture the vapor retarder. Use plastic straps or brightly colored tie wires to secure reinforcing. Manufacture bar supports according to CRSI's "Manual of Standard Practice" from steel wire, plastic, or precast concrete or fiber-reinforced concrete of greater compressive strength than concrete, and as follows:
- B. Joint Dowel Bars: Plain-steel bars, ASTM A 615/A 615M, Grade 60. Cut bars true to length with ends square and free of burrs.

2.04 CONCRETE MATERIALS

- A. Portland Cement: ASTM C 150, Type I or II.

- B. Pozzolans
 - 1. Fly Ash: ASTM C 618, Class C or F.
 - 2. Blended Hydraulic Cement: ASTM C595M.
 - 3. Ground Granulated Blast-Furnace Slag: ASTM C 989, Grade 100 or 120.
- C. Blended Hydraulic Cement: ASTM C 595M; Type IS - portland blast-furnace slag cement, Type IP - portland/pozzolan cement, Type I (PM) - pozzolan-modified portland cement, or Type I (SM) - slag-modified portland cement.
- D. Normal-Weight Aggregate: ASTM C 33, uniformly graded, and as follows:
 - 1. Class: Moderate weathering region, but not less than 3M.
 - 4. Aggregate Size: No. 67 (3/4 inch to No. 4).
- E. Size of Coarse Aggregate: Except when otherwise specified or permitted, maximum size of coarse aggregate shall not exceed three-fourths of the minimum clear spacing between reinforcing bars (or bundled bars), one-fifth of the narrowest dimension between the sides of forms, or one-third of the thickness of slabs or toppings.
- F. Water: Potable and complying with ASTM C 94 or non potable meeting ASTM C-94 Acceptance Criteria for Questionable Water Supply. Use only potable water for job site mixing.

2.05 ADMIXTURES

- A. General: Admixtures certified by manufacturer to contain not more than 0.1 percent water-soluble chloride ions by mass of cementitious material and to be compatible with other admixtures and cementitious materials. Do not use admixtures containing calcium chloride.
- B. Air-Entraining Admixture: ASTM C 260.
- C. Water-Reducing Admixture: ASTM C 494, Type A.
- D. High-Range, Water-Reducing Admixture: ASTM C 494, Type F.
- E. Water-Reducing and Accelerating Admixture: ASTM C 494, Type E.
- F. Water-Reducing and Retarding Admixture: ASTM C 494, Type D.

2.06 CURING MATERIALS AND EVAPORATION RETARDERS

- A. Evaporation Retarder: Waterborne, monomolecular film forming, manufactured for application to fresh concrete.
- B. Absorptive Cover: AASHTO M 182, Class 2, burlap cloth made from jute or kenaf, weighing approximately 9 oz./sq. yd. dry.
- C. Moisture-Retaining Cover: ASTM C 171, polyethylene film or white burlap-polyethylene sheet.

D. Water: Potable.

2.07 RELATED MATERIALS

A. Epoxy-Bonding Adhesive: ASTM C 881, two-component epoxy resin, capable of humid curing and bonding to damp surfaces, of class and grade to suit requirements, and as follows:

1. Types IV and V, load bearing, for bonding hardened or freshly mixed concrete to hardened concrete.

2.08 CONCRETE MIXES

A. Prepare design mixes for each type and strength of concrete determined by either laboratory trial mix or field test data bases, as follows:

1. Proportion normal-weight concrete according to ACI 211.1 and ACI 301.

B. Roof Curbs: Proportion normal-weight concrete mix as follows:

1. Compressive Strength (28 Days): 3000 psi.

C. Cementitious Materials: Limit percentage, by weight, of cementitious materials other than portland cement in concrete as follows:

1. Fly Ash: 25 percent.
2. Combined Fly Ash and Pozzolan: 25 percent.
3. Ground Granulated Blast-Furnace Slag: 50 percent.
4. Combined Fly Ash or Pozzolan and Ground Granulated Blast-Furnace Slag: 50 percent portland cement minimum, with fly ash or pozzolan not exceeding 25 percent.
5. Silica Fume: 10 percent.
6. Combined Fly Ash, Pozzolans, and Silica Fume: 35 percent with fly ash or pozzolans not exceeding 25 percent and silica fume not exceeding 10 percent.
7. Combined Fly Ash or Pozzolans, Ground Granulated Blast-Furnace Slag, and Silica Fume: 50 percent portland cement minimum, with fly ash or pozzolans not exceeding 25 percent and silica fume not exceeding 10 percent.

D. Do not add air entrainment to concrete of trowel-finished interior floors and suspended slabs. Do not allow entrapped air content to exceed 3 percent.

2.09 FABRICATING REINFORCEMENT

A. Fabricate steel reinforcement according to CRSI's "Manual of Standard Practice."

2.10 CONCRETE MIXING

A. Ready-Mixed Concrete: Measure, batch, mix, and deliver concrete according to ASTM C 94, and ASTM C 1116 and furnish batch ticket information. Batch ticket information shall include design mix reference, water that can be added at the jobsite, and admixtures. Discharge concrete into its final position within 90 minutes after introduction of batch water to the cement. If a retarder admixture is used, the discharge time limit of 90 minutes may be increased by the time specified for retardation by the admixture manufacturer or the concrete supplier.

Mix concrete a minimum of one minute at mixing speed immediately prior to discharge.

PART 3 - Execution

3.01 FORMWORK

- A. Design, erect, shore, brace, and maintain formwork, according to ACI 301, to support vertical, lateral, static, and dynamic loads, and construction loads that might be applied, until concrete structure can support such loads.
- B. Construct formwork so concrete members and structures are of size, shape, alignment, elevation, and position indicated, within tolerance limits of ACI 117.
- C. Limit concrete surface irregularities, designated by ACI 347R as abrupt or gradual, as follows:
 - 1. Class C, 1/2 inch.
 - 2. Class D, 1 inch.
- D. Construct forms to prevent loss of concrete mortar.
- E. Fabricate forms for easy removal without hammering or prying against concrete surfaces. Provide crush or wrecking plates where stripping may damage cast concrete surfaces. Kerf wood inserts for forming keyways, reglets, recesses, and the like, for easy removal.
 - 1. Do not use rust-stained steel form-facing material.
- F. Set edge forms, bulkheads, and intermediate screed strips for slabs to achieve required elevations and slopes in finished concrete surfaces. Provide and secure units to support screed strips; use strike-off templates or compacting-type screeds.
- G. Chamfer exterior corners and edges of permanently exposed concrete. Chamfer not required for footings or footing piers.
- H. Clean forms and adjacent surfaces to receive concrete. Remove chips, wood, sawdust, dirt, and other debris just before placing concrete.
- I. Retighten forms and bracing before placing concrete, as required, to prevent mortar leaks and maintain proper alignment.
- J. Coat contact surfaces of forms with form-release agent, according to manufacturer's written instructions, before placing reinforcement.

3.02 EMBEDDED ITEMS

- A. Place and secure anchorage devices and other embedded items required for adjoining work that is attached to or supported by cast-in-place concrete. Use Setting Drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
 - 1. Install anchor bolts, accurately located, to elevations required.

- 2.. Install inserts, post base, tie-down straps, hangers, metal ties, nailing strips, blocking, grounds and other fastening devices needed for attachment of other work.

3.03 REMOVING AND REUSING FORMS

- A. General: Formwork, for sides of beams, walls, columns, and similar parts of the Work, that does not support weight of concrete may be removed after cumulatively curing at not less than 50 deg F (10 deg C) for 24 hours after placing concrete provided concrete is hard enough to not be damaged by form-removal operations and provided curing and protection operations are maintained. The 24 hour period may be reduced to 12 hours in compliance with ACI 347R with prior approval from the WHFD.
- B. Clean and repair surfaces of forms to be reused in the Work. Split, frayed, delaminated, or otherwise damaged form-facing material will not be acceptable for exposed surfaces. Apply new form-release agent.
- C. When forms are reused, clean surfaces, remove fins and laitance, and tighten to close joints. Align and secure joints to avoid offsets. Do not use patched forms for exposed concrete surfaces unless approved by WHFD.

3.04 STEEL REINFORCEMENT

- A. General: Comply with CRSI's "Manual of Standard Practice" for placing reinforcement.
- B. Clean reinforcement of loose rust and mill scale, earth, ice, and other foreign materials.

3.05 CONCRETE PLACEMENT

- A. Before placing concrete, verify that installation of formwork, reinforcement, and embedded items is complete and that required inspections have been performed. Provide one day notification for each scheduled pour.
- B. Do not add water to concrete during delivery, at Project site, or during placement, unless approved by WHFD.
- C. Convey concrete from mixer to the place of final deposit rapidly by methods that prevent segregation or loss of ingredients and will insure the required quality of concrete.
- D. Deposit concrete continuously or in layers of such thickness that no new concrete will be placed on concrete that has hardened enough to cause seams or planes of weakness. If a section cannot be placed continuously, provide construction joints as specified. Deposit concrete to avoid segregation.
- E. Deposit concrete in forms in horizontal layers with proper consolidation into previous layers and in a manner to avoid inclined construction joints. Place each layer while preceding layer is still plastic, to avoid cold joints.
 1. Consolidate placed concrete with mechanical vibrating equipment. Use equipment and procedures for consolidating concrete recommended by ACI 309R.

2. Do not use vibrators to transport concrete inside forms. Insert and withdraw vibrators vertically at uniformly spaced locations no farther than the visible effectiveness of the vibrator. Place vibrators to rapidly penetrate placed layer and at least 6 inches into preceding layer. Do not insert vibrators into lower layers of concrete that have begun to lose plasticity. At each insertion, limit duration of vibration to time necessary to consolidate concrete and complete embedment of reinforcement and other embedded items without causing mix constituents to segregate.

3.06 FINISHING FORMED SURFACES

- A. Rough-Formed Finish: As-cast concrete texture imparted by form-facing material with tie holes and defective areas repaired and patched. Remove fins and other projections exceeding ACI 347R limits for class of surface specified.

3.07 MISCELLANEOUS CONCRETE ITEMS

- A. Filling In: Fill in holes and openings left in concrete structures, unless otherwise indicated, after work of other trades is in place. Mix, place, and cure concrete, as specified, to blend with in-place construction. Provide other miscellaneous concrete filling indicated or required to complete Work.

END OF SECTION 03300

DIVISION 7 - THERMAL AND MOISTURE PROTECTION

SECTION 07531 - SINGLE-PLY TPO MEMBRANE ROOFING

PART 1 - General

1.01 SUMMARY

- A. This section includes single-ply TPO membrane roofing system over concrete curb, installed over existing single ply roofing membrane.
- B. Type of flashing system specified in this section utilizing single-ply roofing membranes includes totally adhered system conforming to uplift requirements.
- C. Single-ply roofing membrane includes white thermoplastic alloy (TPO).
- D. Related Work Describe Elsewhere:
 - 1. Coordinate installation of metal flashing, counterflashing, etc. with SECTION 07600 - FLASHING AND SHEET METAL.

1.02 QUALITY ASSURANCE

- A. The Roofing Contractor shall be an approved and experienced applicator of the manufacturer whose roofing system that is proposed for application and the workers shall have been instructed by that roofing system manufacturer in the proper application of the system.
- C. Should the Manufacturer's warranty requirements necessitate different drawings and details, including the use of cover board, which exceed the requirements of those shown or specified, provide shop drawings and field adjustments at no cost to the WHFD.
- D. UL Listing: Provide labeled materials that have been tested and listed by UL in "Building Materials Directory" or by other nationally recognized testing laboratory for application indicated, with "Class A" or "Class B" rated materials/system for roof slopes shown.
- E. FM Listing: Manufactured products standard with the manufacturer for adherence to substrate and minimum 1-90 uplift.
- F. VOC content of adhesives shall be less than the current VOC content limits of the South Coast Air Quality Management District Rule 1168, "Adhesive and Sealant Application"

1.03 SUBMITTALS

- A. Submit in accordance with SECTION 01330 - SUBMITTAL PROCEDURES.
- B. Manufacturer's Data: Submit complete sets of the following information for the roofing system proposed for use. Submittals shall be marked-up as necessary to clearly identify the item being submitted and its conformance to the requirements of

these specifications.

1. Manufacturer's material product data and Material Safety Data Sheets (MSDS) for the following items:
 - a. TPO Sheet Membrane Flashing.
 - b. Fasteners, of required length(s).
 - c. Bonding Adhesive.
 2. Detailed installation drawings and specifications for the proposed roofing system/assembly.
 3. Test report from a nationally recognized testing laboratory (Warnock Hersey, Factory Mutual, or Underwriters Laboratories) indicating that the proposed roofing system has a fire classification rating of Class A or Class B. The test report shall also indicate the maximum roof slope permitted for the proposed assembly.
 4. Where required, Factory Mutual or UL approval for the proposed roofing system.
- C. Shop Drawings: Submit complete sets of shop drawings detailing all roofing conditions.
- D. Warranties as noted under item entitled "WARRANTIES" hereinbelow.

1.04 WARRANTIES

- A. Manufacturer's Warranty: Roofing manufacturer warranty without monetary limitation, in which roof manufacturer agrees to repair or replace components of roofing system that fail in materials or workmanship within the specified warranty period. Failure includes roof leaks and materials and adhesion failure due to wind conditions.
- B. Manufacturer's warranty includes roofing base flashings, roofing membrane accessories, fasteners, and other components of the roofing system.
1. Warranty Period: 15 years from the Project Acceptance Date.
 2. Warranty shall state the Manufacturer's acceptance that the roof was installed in accordance with the contract requirements and that the State's personnel were properly instructed in the maintenance procedures.
 3. In the event of a failure, WHFD and/or Project Manager, Contractor, Roofing Installer, and Manufacturer shall mutually agree and determine roof/flashings system failures and remedies.
 4. The Surety will not be held liable beyond 2 years of the Project Acceptance Date.
- D. Project Warranty: Submit Contractor's warranty covering work of this section, including all components of roof system such as roofing membrane, base flashing, roofing membrane accessories, and fasteners, for the following warranty period and

conditions:

1. Warranty Period: Two years from the Project Acceptance Date.
2. Warranty shall cover repairs or replacement of damages to the building and its finishes due to leaks.

1.05 PRODUCT HANDLING

- A. Delivery of Materials: All roofing materials shall be delivered to the site in the original unbroken manufacturer's wrapping material and containers with the original labels thereon intact. If any unlabeled materials are to be used, a properly attested certificate from the manufacturer stating that such materials comply with the requirements of the Contract Documents shall be furnished to the WHFD and/or Project Manager Officer prior to installation.
- B. Storage of Materials at Job Site:
 1. Except when placed on roof decks immediately prior to installation, roofing materials shall be stored above the supporting surfaces, such as on pallets.
 2. Roll goods and any other materials which either absorb or are adversely affected by moisture shall be kept dry. Wet materials and/or materials which appear to have been deteriorated after getting wet shall not be permitted to be used on the job and shall be promptly removed.
 3. Materials containing solvents shall be stored in a dry, cool area with proper fire and safety precautions. Store liquid materials in their original undamaged containers in a clean, dry, protected location and within the temperature range required by roofing manufacturer. Protect stored liquid material from direct sunlight.
 4. Roll goods shall be stored on end.
 5. If stored on other than the ground, all materials shall be distributed so that their resultant weight does not exceed the design live load on the deck (normally 20 pounds per square foot on roofs and 40 pounds per square foot on floors).
 7. Store membrane in the original undisturbed plastic wrap in a cool, shaded area and cover with light-colored, breathable tarpaulins, in a manner to protect it from damage. Membrane that has been exposed to the elements for approximately 7 days must be prepared with Splice Wash prior to hot air welding.

1.06 CAUTIONS AND WARNINGS

- A. Oil, grease, mineral solvents, or live steam may be deleterious to certain membrane materials. The Contractor shall apprise the WHFD and/or Project Manager Officer of and seek the advice of the roofing system manufacturer if such conditions are noted on the site.
- B. Vapors from bonding adhesives and lap sealants may be harmful if breathed in. They may also be flammable. The Contractor shall consult container labels and material safety data sheets for specific information on the products being used.

- C. Provide rubber gloves, goggles or face shields, rubber boots, protective clothing, and other protective items required or recommended by membrane manufacturer. Ensure that workers are instructed in use of protective items and safety procedures.

PART 2 - Products

2.01 GENERAL

- A. Performance: Provide roofing and flashing materials recognized to be of generic type indicated and tested to show compliance with indicated performances, or provide other similar materials certified in writing by manufacturer to be equal to, or better than, materials specified in every significant respect, and acceptable to the WHFD and/or Project Manager Officer.
- B. Compatibility: Provide products that are recommended by manufacturers to be fully compatible with existing roofing membrane, indicated substrates, or provide separation materials as required to eliminate contact between incompatible materials.

2.02 TPO MEMBRANE FLASHING

- A. General: Thermoplastic alloy formed into uniform, flexible sheets conforming to ASTM D 6878.
 - 1. Scrim reinforced, fleece back as required.
 - 2. Thickness: 60 mils, nominal.
 - 3. Exposed Face Color: White, to match existing single ply roofing.
- B. Fully Adhered TPO Membrane Flashing: Manufacturer's standard installation.
- C. Acceptable Manufacturer: Firestone UltraPly TPO, Carlisle Sure-Weld, GAF Everguard, GenFlex, JohnsManville Ultraguard, Mulehide, or approved equal.

2.03 AUXILIARY MATERIALS

- A. General: Furnish auxiliary materials recommended by roofing system manufacturer for intended use and compatible with TPO roofing.
- B. Bonding Adhesive: Manufacturer's standard bonding adhesive.
- C. Sealers and Sealants: As recommended by the manufacturer.
- D. Metal Termination Bars: Manufacturer's standard aluminum bars, approximately 1-inch wide, roll formed and prepunched.
- E. Fasteners and Plates: Factory-coated steel fasteners and metal or plastic discs of appropriate type and lengths, designed for fastening system components to substrates as approved by Factory Mutual as a component of the roofing system, and acceptable to roofing system manufacturer. Exposed fasteners shall be stainless steel.

- F. Miscellaneous Accessories: Provide preformed inside and outside corner sheet flashings, and other accessories recommended by roofing system manufacturer for intended use. Provide products which are recommended by membrane manufacturer to be fully compatible with indicated substrates, or provide separation materials as required to eliminate contact between incompatible materials.
- G. Pourable Sealer: Two-component, solvent free, polyurethane based sealant as furnished by membrane manufacturer to fill and seal pipe penetrations; to create a temporary seal of membrane to substrate when work is interrupted.
- H. Recovery Board: ½ inch thick glass-mat, water-resistant gypsum substrate, meeting ASTM C 1177/C 1177M, Dens-Deck Prime or approved equal.
Products made with Cellulose may be submitted for approval, provided that products have passed termite testing by a recognized lab conducting such test.

PART 3 - Execution

3.01 INSPECTION OF SURFACES

- A. Before the work under this section is started, the Roofer, together with the Manufacturer's Technical Representative or their independent roofing auditor/inspector (where applicable) and the Contractor shall meet at the job-site to examine all surfaces on which roofing will be placed and all adjoining work which will affect or be affected by the roofing work. All unacceptable areas and/or conditions such as those listed in item entitled "APPLICATION" hereinbelow shall be corrected by the contractor and verified and accepted by the Roofer and the Manufacturer's Technical Representative or their independent roofing auditor/inspector prior to start of the work.
- B. Fill Voids: All surface voids, of the immediate substrate, greater than 1/4-inch wide shall be properly filled with an acceptable fill material.

3.02 APPLICATION

- A. General:
 - 1. Workmanship: The Roofer shall have a responsible foreman on the job during roofing operations who shall ensure that all work is done in accordance with the plans and specifications.
 - 2. No roofing shall be installed during precipitation and shall not be started in the event there is a possibility of precipitation during application.
 - 3. No roofing shall be started without notice of the WHFD and/or Project Manager Officer or their representative. The Contractor shall call the WHFD and/or Project Manager Officer to give at least one day (24 hours minimum) advance notice of the starting of roofing operations.
 - 4. The application of roofing shall be as specified or as shown in the plans.
 - 5. Absolutely no roofing shall be applied to damp surfaces or before the deck and the work in connection therewith have met the following conditions:

- a. Concrete shall be cured (minimum 7 days) and dry, smooth, free from loose materials, properly graded to outlets, and swept clean. All sharp projections and lumpy places shall have been removed.
 - b. Fill in and build up all potential ponding areas of substrate as recommended by the manufacturer to provide positive drainage.
- B. Flashing Installation:
1. Install sheet flashings and preformed flashing accessories and fasten to substrates in accordance with roof system manufacturer's written instructions.
 2. Terminate and seal top of sheet flashings and mechanically anchor to substrate with fasteners and fastening plates spaced at 12 inches on center or through termination bars, as detailed.

3.03 FIELD QUALITY CONTROL

- A. Final Roof Inspection: Arrange for roofing system manufacturer's authorized representative to inspect roofing installation on completion. Notify the WHFD and/or Project Manager Officer 48 hours in advance of the date and time of inspection.
- B. Correct deficiencies in or remove roofing that does not comply with requirements, repair substrates, reinstall roofing, and repair sheet flashings to a condition free of damage and deterioration at the time of Substantial Completion and according to warranty requirements.

3.04 PROTECTION AND CLEANING

- A. Protection:
1. Any work or materials damaged during the handling of roofing materials shall be restored to their original (undamaged) condition or replaced.
 2. The work of other trades shall not be marred or injured. Daubed or splashed surfaces shall be removed and the surface or finish restored to its original finish and appearance.
 3. Contractor shall have on hand at the roof appropriate weather protection materials to protect the substrate during inclement weather.
 4. Protect interior spaces from weather and any debris caused by work.
 5. Seal off interior spaces from all vapors generated by work.
- B. Cleaning:
1. Debris from roofing work shall be removed from the premises and disposed of at the end of each working day and upon completion of the work to the satisfaction of the WHFD and/or Project Manager Officer. The roof shall be left in good, clean condition.

END OF SECTION

SECTION 07600 - FLASHING AND SHEET METAL

PART 1 - GENERAL

1.01 SUMMARY

- A. Provide all labor, materials and equipment necessary to fabricate and install flashing, counterflashing, metal edging, and other related work as shown on drawings and as specified herein.

1.02 RELATED SECTIONS

- A. SECTION 07531 - SINGLE-PLY TPO MEMBRANE ROOFING

1.03 SUBMITTALS

- A. Manufacturer's Data: Submit manufacturer's product data on all manufactured items.
- B. Shop Drawings: Submit shop drawings with reference made to detail numbers on the contract drawings to the WHFD for approval. Contract drawings are general in nature. Furnish additional details for all the similar and unusual conditions necessary to fabricate the flashing and sheet metal work. Shop drawings shall show all fasteners and relationship to adjacent work. No fabrication will be permitted before approval is secured. Tracing or reproducing drawing details is unacceptable.
- C. Warranty: Submit warranty as stipulated in item entitled "WARRANTY" hereinbelow.

1.04 QUALITY ASSURANCE

- A. All sheet metal fabrications shall conform to State and local codes, SMACNA (latest edition) and industry standards.
- B. All roof penetrations shall be installed weathertight in such a manner to maintain integrity of the roofing.
- C. Fastening and cleating shall withstand all positive and negative wind pressures.

1.05 STORAGE AND HANDLING

- A. All materials shall be stored in such a manner as to afford adequate protection. Damaged materials shall not be used and shall be removed from the site.

1.06 WARRANTY

- A. The warranty provisions and number of years for the warrantee by this article shall take precedence over the standard provisions in the GENERAL CONDITIONS.
- B. Project Warranty: Submit Contractor's warranty, signed jointly by Installer covering

work of this section, including all components of flashing system such as panels, base flashing, roofing accessories, fasteners, curbs, collar flashing, and other products, for the following warranty period and conditions:

1. Warranty Period: Two years from the Project Acceptance Date.
2. Warranty shall cover repairs or replacement of damages to the building and its finishes due to leaks.

PART 2 - PRODUCTS

2.01 MATERIALS

- A. Galvanized Steel: Minimum 24 gauge galvanized sheet metal, ASTM A 653/A 653M, G90 hot-dip galvanized, mill phosphatized where indicated for painting.
- B. Nails and Fasteners: Use the same metal or a metal compatible with the item. Use stainless steel fasteners to fasten dissimilar metals.
- C. Bituminous Paint: Cold-applied asphalt mastic complying with SSPC-Paint 12 but containing no asbestos fibers, or cold-applied asphalt emulsion complying with ASTM D 1187.

PART 3 - EXECUTION

3.01 INSTALLATION AND WORKMANSHIP

- A. Surface to which sheet metal is to be applied shall be even, smooth, sound, thoroughly clean and dry, and free from defects that might affect the application. Report any unsatisfactory surfaces to the WHFD. In the absence of such a report, the Contractor shall be held responsible for the finished product.
- B. All accessories or other items essential for the completeness of the sheet metal installation, though not specifically indicated on the drawings or specified, shall be provided. All such items unless otherwise indicated on the drawings or specified, shall be of the same kind of materials as the item to be applied. Nails, screws, rivets, and bolts shall be of the type best suited for the purpose intended and shall be of a composition that is compatible with the metal to which it will contact.
- C. Except as otherwise indicated on the drawings or specified, the workmanship of sheet metal work, method of forming joints, anchoring, cleating, provisions for expansion, etc., shall conform to the standards details and recommendations of the Sheet Metal and Air Conditioning Contractors National Association's "Architectural Sheet Metal Manual", and shall be subject to the approval of the WHFD. Exposed edges shall be folded back neatly to form a minimum 1/2-inch hem on the concealed side. Fabricate for waterproof and weather-resistant performance, with expansion provisions for running work, sufficient to permanently prevent leakage, damage, or deterioration of the work.

- E. Seams: Straight and uniform in width and height with no sealants showing on the face.
1. Flat-lock Seams: Finish not less than 3/4-inch wide.
 2. Lap Seams: Finish soldered seams not less than one-inch wide. Overlap seams not soldered, not less than 3-inches.
 3. Loose-lock Expansion Seams: Not less than 3-inches wide, and shall provide minimum one-inch movement within the joint. Joint shall be completely filled with exterior sealant, applied at not less than 1/8-inch thick bed.
 4. Flat Seams: Make seams in the direction of the flow.
- G. All sheet metal work shall be watertight and wind-tight in compliance with the purpose intended for the items indicated on the drawings or specified herein. Sheet metal shall be held firmly in place and shall not rattle.
- H. Cleating: Cleats for sheet metal work shall be provided where required, continuous, unless otherwise indicated on the drawings. Cleats shall be of the same material and weight as the metal being installed. Hook cleating with 3/4-inch minimum hem on concealed side of flashing.
- I. Protection from Contact of Dissimilar Materials: Surfaces in contact with dissimilar metal shall be painted with heavy-bodied bituminous paint or shall be separated by means of moisture-proof building felts.

3.02 PROTECTION

- A. Protect all sheet metal work until final acceptance of the building.

3.03 CLEAN UP

- A. Clean all exposed sheet metal work at completion of installation. Grease and oil films, handling marks, contamination from steel wool, fittings and drilling debris shall be removed, and the work scrubbed clean. All exposed metal surfaces shall be free of dents, creases, waves, scratch marks, and solder or weld marks.
- B. At completion of the work, clean up and remove all rubbish and debris from the premises which resulted from this work.

END OF SECTION

SECTION 07840 – FIRESTOPPING

PART 1 - General

1.01 SUMMARY

- A. Firestopping shall consist of furnishing and installing tested and listed firestop systems, a combination of materials or devices to form an effective barrier against the spread of flame, smoke and gases, and maintain the integrity of fire resistance rated walls, partitions, floors, and ceiling-floor assemblies, including through-penetrations and construction joints and gaps. Through-penetrations include the annular space around pipes, tubes, conduit, wires, cables and vents. Construction joints include those used to accommodate expansion, contraction, wind, or seismic movement; firestopping material shall not interfere with the required movement of the joint.

1.02 SUBMITTALS

- A. Submit in accordance with SECTION 01330 - SUBMITTAL PROCEDURES.
- B. Manufacturer's Data: Submit copies of manufacturer's product data and specifications for type of sealant required. Data shall indicate product characteristics, typical uses, performance and limitation criteria, shelf life, and test data.
- C. Shop Drawings: Submit detail drawings, including manufacturer's typical details conforming to UL Fire Resistance Directory or other details certified by another nationally recognized testing laboratory, installation instructions or UL listing details for a firestopping assembly in lieu of fire-test data or report. For those firestop applications for which no UL tested system is available through a manufacturer, a manufacturer's engineering judgement, derived from similar UL system designs or other tests, shall be submitted for review and approval prior to installation. Submittal shall indicate the firestopping material to be provided for each type of application. When more than a total of 5 penetrations and/or construction joints are to receive firestopping, provide drawings that indicate location, "F" and "T" ratings, and type of application.
- D. Material Safety Data Sheets (MSDS): Submit MSDS for each firestop product.
- E. UL Tested Systems: Submit drawings showing typical installation details for the methods of installation. Indicate which firestop materials will be used and thickness for different hourly ratings and steel thickness.
- F. Engineering Judgments: Submit manufacturer's drawings for all non-standard applications where no UL tested system exists. All drawings must indicate the "Tested" UL system upon which the judgment is based so as to assess the relevance of the judgment to some known performance.
- G. Installation Procedures: Submit manufacturer's installation procedures for each type of product.

- H. Approved Applicator: Submit document from manufacturer wherein manufacturer recognizes the installer as qualified and submit a list of past projects to demonstrate experience and capability to perform intended work.
- I. Color Samples: Submit sets of color finish samples of sealants that will be exposed in finish spaces.
- J. Upon completion, installer shall provide written certification and report that materials were installed in accordance with the manufacturer's installation instructions and details and by UL number.

1.03 QUALITY ASSURANCE

A. Workmanship: The Contractor shall engage an experienced Installer who is:

- 1. FM Research approved in accordance with FM AS 4991, "Approval of Firestop Contractors", or
- 2. Certified, licensed, or otherwise qualified by the firestopping manufacturer as having the necessary staff, training, and a minimum of 3 years experience in the installation of manufacturer's products per specified requirements. A manufacturer's willingness to sell its firestopping products to the Contractor or to an installer engaged by the Contractor does not in itself confer qualification on the buyer. The Installer shall have been trained by a direct representative of the manufacturer (not distributor or agent) in the proper selection and installation procedures.

B. Regulatory Requirements:

- 1. Firestop systems shall be installed in all openings and around all penetrating elements or devices as required by these Contract Documents, and as required by applicable design, building and construction codes, subject to the interpretation of the authority having jurisdiction.
- 2. Firestop materials shall have the approval of the authority having jurisdiction.

C. Certification:

- 1. The performance of the firestop designs shall have been demonstrated by third party testing in accordance with the applicable reference standards. Evidence of third-party acceptance shall include labeling or listing by an acceptable agency.
- 2. Manufactured assemblies and material formulations shall be prepared under a third party monitored Quality Control Program, e.g., U.L. Followup Service.
- 3. Contractor shall certify compliance with the provisions of this section.
- 4. Provide third party inspection of installed firestopping under field quality control.

- D. Finish: Exposed surfaces of the firestop shall be finished to the standard of the adjacent faces of the partition being penetrated.
- E. Compatibility: Firestop materials and installations shall be compatible and tested for a complete, UL listed firestopping system.

1.04 DELIVERY, STORAGE, AND HANDLING

- A. Deliver materials in the original unopened packages or containers showing name of the manufacturer and the brand name. Store materials off the ground and protect from damage and exposure to elements. Remove damaged and deteriorated materials from the site.
- B. All firestop materials shall be installed prior to expiration of shelf life.

PART 2 - Products

2.01 FIRESTOPPING

- A. Materials: Provide asbestos-free firestopping material capable of maintaining an effective barrier against flame, gases, and temperature. Provide noncombustible firestopping that is non-toxic to human beings during installation or during fire conditions. Devices and equipment for firestopping service shall be listed in the UL Fire Resistance Directory or FM P7825a "Approval Guide Fire Protection" and approved for use with applicable construction, and penetrating items.
- B. Fire Hazard Classification: Material shall have a flame spread of 25 or less, a smoke developed rating of 50 or less, and a fuel contribution of 50 or less when tested in accordance with the procedures of ASTM E 84, "Surface Burning Characteristics of Building Materials", UL 723, "Surface Burning Characteristics of Building Materials", or UL listed and accepted.
- C. Fire Resistance and Hose Stream Tests: Firestopping materials shall be rated "F" and "T" in accordance with ASTM E 814, "Fire Tests of Through-Penetration Fire Stops", or UL 1479, "Fire Tests of Through-Penetration Firestops", except that the "T" rating may be based on thermocouples placed one-inch from a penetrating item in lieu of direct attachment to penetrating items. Rating periods shall conform to the following: Time-rated wall or ceiling assemblies shall be rated at minimum one and two hour unless rated otherwise, but not less than the construction in which they occur.
- D. Nontoxicity: Firestopping materials shall be non-toxic to human beings during installation and during fire conditions.
- E. Construction Joints and Gaps: Construction joints and gaps shall be provided with firestopping materials and systems that have been tested in accordance with ASTM E 119, "Fire Tests of Building Construction and Materials", ASTM E 1966, "Fire-Resistive Joint Systems", or UL 2079, "Tests for Fire Resistance of Building Joint Systems", to meet the required fire resistance rating. Systems installed at construction joints shall meet the cycling requirements of ASTM E 1399, "Cyclic

Movement and Measuring the Minimum and Maximum Joint Widths of Architectural Joint Systems", or UL 2079.

PART 3 - Execution

3.01 FIRESTOPPING LOCATIONS

- A. Provide firestopping in the following locations, including but not limited to:
 - 1. Around duct, cable, conduit, piping and their supports that penetrate through time-rated assemblies.
 - 2. Around openings between surfaces of time-rated assemblies.
 - 3. Around openings and penetrations in enclosures with time-rated fire doors.
 - 4. Other locations required and/or indicated to complete fire rated assembly.

3.02 PREPARATION

- A. Coordination: The specified work shall be coordinated with other trades. Firestopping materials, at penetrations of pipes and ducts, shall be applied prior to insulating, unless insulation meets requirements specified for firestopping. Firestopping materials at building joints and construction gaps shall be applied prior to completion of enclosing walls or assemblies. Cast-in-place firestop devices shall be located and installed in place before concrete placement. Pipe, conduit or cable bundles shall be installed through cast-in-place device after concrete placement but before area is concealed or made inaccessible.
- B. Surface Preparation: Remove dirt, grease, oil, loose materials, rust, or other substances that may affect proper fitting or the required fire resistance from surfaces in contact with firestopping materials, unless otherwise directed by the manufacturer's instructions.
- C. Verify that environmental conditions are safe and suitable for installation of firestopping products.
- D. Verify that all pipe, conduit, cable, and other items which penetrate fire-rated construction have been permanently installed prior to installation of firestopping.

3.03 INSTALLATION

- A. Firestopping material shall completely fill void spaces regardless of geometric configuration, subject to tolerance established by the manufacturer. Firestopping systems for filling floor voids 4-inches or more in any direction shall be capable of supporting the same load as the floor is designed to support or shall be protected by a permanent barrier to prevent loading or traffic in the firestopped area. Firestopping shall be installed in accordance with manufacturer's written instructions.

1. Filling of Voids: Completely fill voids at the surface; the depth of the material shall be as approved by UL.
2. Insulated Pipes and Ducts: Thermal insulation shall be cut and removed where pipes or ducts pass through firestopping, unless insulation meets requirements specified for firestopping. Thermal insulation shall be replaced with a material having equal thermal insulating and firestopping characteristics.
3. Electrical and Data Cables or Conduits: Firestopping at penetrations shall comply with the requirements of NFPA 70, "National Electrical Code" and be sealed with re-enterable firestopping materials that do not cure over time. Firestopping shall be modular devices, containing built-in self-sealing intumescent inserts. Firestopping devices shall allow for cable moves, adds, or changes without the need to remove or replace any firestop materials.\
4. When required to properly contain firestopping materials within openings, damming or packing materials may be utilized. Combustible damming material must be removed after appropriate curing. Non-combustible damming materials may be left as a permanent component of the firestop system.
5. Provide firestopping manufacturer's labeling for all firestopping installation locations.

3.04 FIELD QUALITY CONTROL

- A. Contractor shall have independent third party inspection service to inspect and approve all firestopping installations.
- B. To ensure proper installation, firestopped areas shall not be covered or enclosed until inspection is complete and approval has been received.
- C. Submit written reports indicating locations of and types of penetrations and types of firestopping used at each location; type shall be recorded by UL listed printed numbers.

3.05 CLEAN UP

- A. Remove spilled and excess materials adjacent to firestopping without damaging adjacent surfaces.
- B. Leave finished work in neat, clean condition with no evidence of spill-overs or damage to adjacent surfaces.

END OF SECTION 07840

DIVISION - FINISHES

SECTION 09250 – GYPSUM WALLBOARD

PART 1 - General

1.01 SUMMARY

- A. Complete all gypsum wallboard work as indicated or required by the drawings and as specified herein. Work shall include, but not be limited to, the following:
 - 1. Gypsum wallboard on metal framing and furring.
 - 2. Metal stud framing for wallboard.

1.02 QUALITY ASSURANCE

- A. Fire Resistive Design: The construction shall comply with the applicable provisions of the International Building Code, including all local amendments thereto and shall have been tested according to ASTM E 119 by an independent testing and inspecting agency acceptable to the authorities having jurisdiction. Installation and materials shall be in strict accordance with the above mentioned code. The Fire Resistant Design shall be as indicated from UL's "Fire Resistance Directory", FM's "Approval Guide, Building Products", GA-600 "Fire Resistance Design Manual", or as listed otherwise.
- B. Industry Standard: Comply with applicable requirements of GA 216 "Application and Finishing of Gypsum Board" and GA 214, "Recommended Specification: Levels of Gypsum Board Finish" by the Gypsum Association, except where more detailed or more stringent requirements are indicated, including the recommendations of the manufacturer.
- C. Transverse Loading: The non-load bearing metal framing shall be capable of carrying a transverse load of 5 psf without exceeding the allowable stress or a deflection of U360. Increase stud gauge, decrease stud spacing, or provide hidden from view lateral bracing to comply with these requirements at no additional cost to the State.
- D. Gypsum Board Terminology: Refer to ASTM C 11, "Terminology Relating to Gypsum and Related Building Materials and Systems", for definition of terms for gypsum board assemblies not defined in this section or in referenced standards.
- E. VOC content of adhesives shall be less than the current VOC content limits of the South Coast Air Quality Management District Rule 1168, "Adhesive and Sealant Application".
- F. Impact Resistance: ASTM C 1629 - Standard Classification for Abuse Resistant Nondecorated Interior Gypsum Panel Products and Fiber reinforced Cement Panels.

1.03 SUBMITTALS

- A. Submit in accordance with SECTION 01330 - SUBMITTAL PROCEDURES.
- B. Manufacturer's Data: Material description and manufacturer's recommended installation procedures for each material.
- C. Shop Drawings: Submit shop drawings indicating fabrications and location of control and expansion joints, including plans, elevations, sections, details, and attachment to adjoining work. Submit setting drawings for backing plates and anchors.
- D. Material Safety Data Sheets (MSDS): Submit MSDS for each product.

1.04 PRODUCT HANDLING

- A. Deliver gypsum wallboard materials in sealed containers and bundles, fully identified with manufacturer's name, brand, type and grade; store in a dry well ventilated space, protected from the weather, under cover and off the ground. Stack gypsum panels flat to prevent sagging. Joint materials shall be stored in accordance with manufacturer's printed instructions. Damaged or deteriorated materials shall be removed from jobsite.
- B. Environmental Limitations: Comply with ASTM C 840 requirements or gypsum board manufacturer's written recommendations, whichever are more stringent.

1.05 SAFETY PRECAUTIONS

- A. Respirators and Other Concerns: Comply with OSHA 29 CFR 1910.134, "Respiratory Protection", ASTM C 930, "Potential Health and Safety Concerns Associated with Thermal Insulation Materials and Accessories", and other Federal, State, and local regulations governing safety. Provide workers with dust/mist respirators, training in their use, and protective clothing as approved by the National Institute for Occupational Safety and Health (NIOSH)/Mine Safety and Health Administration (MSHA) when installing insulation or sanding joint compound.
- B. Open Flame: Do not allow open flames or sources of ignition during installation of blanket insulation.

PART 2 - Products

2.01 MATERIALS

- A. General: Provide panels in maximum lengths and widths available that will minimize joints and correspond with the applicable support system.
- B. Gypsum Wallboard: ASTM C 1396/C 1396M "Gypsum Board", 5/8-inch thick, tapered edge type, 48-inches wide, Type "X" (Special Fire Retardant).
- C. Water Resistant Board: ASTM C 1396/C 1396M, Type "WR-X" (Special Fire Retardant) water-resistant backing board, 5/8-inch thick unless indicated otherwise, with tapered edges, 48-inches wide, unless indicated otherwise (for walls only).

- D. Wallboard Fasteners: ASTM C 1002 "Steel Self-Piercing Tapping Screws for the Application of Gypsum Panel Products or Metal Plaster Bases to Wood Studs or Steel Studs", standard bugle head self-drilling, self-tapping corrosive-resistant drywall screws. Screws used in fire-resistive rated construction shall be of type approved for use by governing building code. Screws for structural studs shall conform to ASTM C 954 "Steel Drill Screws for the Application of Gypsum Panel Products or Metal Plaster Bases to Steel Studs from 0.033-inch (0.84 mm) to 0.112-inch (2.84 mm) in Thickness". Fasteners for cementitious backer board shall have a polymer coating.
- E. Reinforced Tape and Cement: ASTM C 475/C 475M "Joint Compound and Joint Tape for Finishing Gypsum Board", materials for treating joints and fastener heads shall be as manufactured or recommended by the Manufacturer of the wallboard used. Provide "setting" type joint compound and fiberglass tape that is unaffected by humidity for water resistant board.
- F. Non-Load Bearing Studs: Comply with ASTM C 754 for conditions indicated. ASTM C 645 "Nonstructural Steel Framing Members", studs shall be 1-5/8, 2-1/2, 3-5/8, and 6-inch unless indicated otherwise on the drawings. Studs shall be rolled formed channel of 25, 22, and 20 gauge galvanized steel, ASTM A 653/A 653M "Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process", G60 coating. Dietrich UltraSTEEL EQ gauges for equal structural and composite limiting height studs are acceptable. Provide holes and notches for conduit or electrical wiring. Provide minimum 20 gauge at ceramic tile partitions.
- G. Tracks: Metal floor and ceiling tracks shall be rolled formed channel of gauge electro-zinc plated steel of same gauge as stud with width dimensions suitable to corresponding stud sizes indicated on the drawings.
- H. Deep-Leg Deflection Track: ASTM C 645 top runner with 2-inch deep flanges.
- I. Furring Channels: ASTM C 645, hat-shaped, 7/8-inch deep, hot-dipped galvanized, 25 gauge.
- J. Wallboard Accessories: ASTM C 1047 "Accessories for Gypsum Wallboard and Gypsum Veneer Base", Vinyl Corp., Plastic Components Inc., Vinyl Tech or approved equal.
 - 1. Standard Corner Bead: Vinyl Corp. Corner Bead CB 125 at all outside corners of wall, ceiling, and soffit as indicated.
 - 2. Casing Trim: Vinyl Corp. "L" Bead SB 50 or 58, "J" Bead MJB 50 or 58, as applicable, or approved equal as indicated.
 - 3. Other Accessories: As indicated or necessary for complete installation.
 - 4. All accessories shall be vinyl, PVC, or approved equal.
- K. Joint Treatment Materials: ASTM C 475/C 475M; type recommended by manufacturer for the application indicated, except as otherwise noted. Perforated tape, and joint and topping compound, or "all-purpose" compound.

PART 3 - Execution

3.01 EXAMINATION

- A. Examine substrates to which drywall construction attaches or abuts, preset hollow metal frames, and structural framing, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of drywall construction. Do not proceed with installation until unsatisfactory conditions have been corrected.

3.02 INSTALLATION

- A. General: Comply with ASTM C 840 "Application and Finishing of Gypsum Board", Gypsum Association GA 216 and ASTM C 754 as applicable to the type of substrate and drywall support system indicated.
- B. Tolerances:
 - 1. Maximum variation of finish surface from true flatness shall be 1/8-inch in 10-feet in any direction unless specified otherwise.
 - 2. Maximum variation of plumbness of wall shall be 1/8-inch in 10-feet of height.
 - 3. Maximum variation from true position shall be 1/8-inch.
- C. Gypsum Wallboard, General:
 - 1. Locate exposed end-butt joints as far from center of walls and ceilings as possible.
 - 2. Install exposed gypsum board with face side out. Do not install imperfect, damaged or damp boards. Butt boards together for a light contact at edges and ends with not more than 1/16-inch open space between boards. Do not force into place.
 - 3. Locate either edge or end joints over supports, except in horizontal applications or where intermediate supports or gypsum board back-blocking is provided behind end joints. Position boards so that both tapered edge joints abut, and mill-cut or field-cut end joints abut. Do not place tapered edges against cut edges or ends. Stagger vertical joints over different studs on opposite sides of partitions. Do not make joints other than control joints at corners of framed openings.
 - 4. Attach gypsum panels to steel studs so leading edge or end of each panel is attached to open (unsupported) edges of stud flanges first.
 - 5. Attach gypsum board to framing and blocking as required for additional support at openings and cutouts.
 - 6. Cover both faces of stud partition framing with gypsum board in concealed spaces (above ceilings, etc.), except in chase walls which are properly

braced internally. Except where concealed application is required for sound, fire, air or smoke ratings, coverage may be accomplished with scraps of not less than 8 square foot area, and may be limited to not less than 75 percent of full coverage.

7. Isolate perimeter of non-load-bearing drywall partitions at structural abutments. Provide 1/4-inch to 3/8-inch space and trim edge with J-type semi-finishing edge trim. Seal joints with acoustical sealant. Do not fasten drywall directly to stud system runner tracks.
8. Space fasteners in gypsum boards in accordance with referenced standards and manufacturer's recommendations, except as otherwise indicated.

D. Methods of Gypsum Wallboard Application:

1. Single-Layer Application:

- a. On partitions/walls higher than 8'-1", apply gypsum board vertically (parallel), unless otherwise indicated, and provide sheet lengths which will minimize end joints.
 - b. On partitions/walls 8'-1" or less in height apply gypsum board horizontally (perpendicular); use maximum length sheets possible to minimize end joints.
2. Single-Layer Fastening Method: Apply gypsum boards to supports by fastening with screws, spaced not to exceed 16-inch centers for walls and 12-inch centers for ceilings.
 3. Gypsum wallboard construction for fire rated assemblies shall be in accordance with the design number indicated or if not indicated in accordance with the International Building Code.

E. Installation of Trim Accessories:

1. General: Where feasible, use the same fasteners to anchor trim accessory flanges as required to fasten gypsum board to the supports. Otherwise, attach trim in accordance with manufacturer's instructions and recommendations.
2. Install corner beads at external corners.
3. Install edge trim whenever edge of gypsum board would otherwise be exposed or semi-exposed. Provide type with face flange to receive joint compound except where semi-finishing type is indicated. Install L-type trim where work is tightly abutted to other work, and install special kerf-type where other work is kerfed to receive long leg of L-type trim. Install U-type trim where edge is exposed, revealed, gasketed, or sealant-filled (including expansion joints).
4. Install J or LC-type semi-finishing trim where indicated.

5. Install control joints where indicated or necessary in large ceiling and wall expanses. Use door header to ceiling or floor to ceiling in long partitions and wall furring runs and from wall to wall in large ceiling areas. Where joint will be conspicuous, obtain approval prior to installation.

3.03 DRYWALL FINISHING

- A. General: Apply treatment at gypsum board joints (both directions), flanges of trim accessories, penetrations, fasteners heads, surface defects and elsewhere in accordance with ASTM C 840 and Gypsum Association GA 216 and GA 214 as required to prepare work for decoration. Prefill open joints, rounded or beveled edges, and damaged surfaces using type of compound recommended by manufacturer.
 1. Apply joint tape at joints between gypsum boards, except where a trim accessory is indicated that does not require tape.
 2. Apply joint compound in 3 coats (not including prefill of openings in base), and sand between last 2 coats and after last coat. Fastener heads, dents, gouges, and cut-outs shall be filled with joint compound and sanded.
 3. Accessories at exposed joints, edges, corners, openings, and similar locations shall be taped, floated with joint compound, and sanded in accordance with manufacturer's instructions and MSDS to produce surfaces ready for gypsum board finishes.
 4. Treatment for water-resistant gypsum wallboard shall be as recommended by the gypsum wallboard manufacturer.
- B. Finish interior gypsum wallboard by applying the following levels of gypsum board finish in accordance with GA-214.
 1. Level 1: For ceiling plenum areas and other concealed areas embed tape in joint compound.

3.04 BACKING PLATES AND ANCHORS

- A. Backing plates and anchors or blocking which are to be attached to studs or furring for anchoring items and work indicated on the drawings or specified in other sections shall be installed and secured. Plates and anchors shall be welded or fastened in place in accordance with approved setting drawings.

3.05 CLEANING AND REPAIRING

- A. After installation and before painting, correct surface damage and defects. Leave surface clean and smooth, satisfactory to the painter. No painting shall be done over gypsum board work until the joints are thoroughly dry. Joints and fastenings are to be invisible after painting.
- B. Remove all drywall materials from electrical boxes, hardware, fixtures, flooring, and similar items and surfaces not intended to receive drywall materials.

END OF SECTION 09250

DIVISION 15 - MECHANICAL

SECTION 15000 - GENERAL MECHANICAL REQUIREMENTS

PART 1 - GENERAL

1.01 GENERAL CONDITIONS

- A. As specified in Section 00700.

1.02 GENERAL REQUIREMENTS

- A. These general mechanical requirements govern work specified under all sections of Division 15 MECHANICAL.
- B. The Contractor shall furnish all labor, materials, tools and equipment and perform all work and services necessary for a complete and properly operating mechanical equipment and systems, as shown on drawings and as specified, in accordance with provisions of the Contract Documents and completely coordinated with work of all other trades.
- C. The Contractor shall completely examine the Contract Documents and shall report to the WHFD AND/OR PROJECT MANAGER any error, inconsistency or omission he discovers.
- D. Furnish and install all supplementary or miscellaneous items, details, appurtenances and devices incidental to or necessary for a sound, secure and complete mechanical system where work required is not specifically indicated.
- E. Drawings and specifications shall be taken together. Provide work specified and not indicated or work indicated and not specified as though mentioned in both.
- F. The Contractor shall warrant that all materials and equipment furnished under this Contract will be new and that all work will be of good quality, free from faults and defects and in conformance with Contract Documents for a guaranteed period of one year after the date of acceptance as specified.
- G. The Contractor shall maintain at the site one (1) copy of all Drawings, Specifications, Addenda, approved Shop Drawings, Change Orders and other modifications, in good order and marked (in red) to record all changes made during construction. These shall be made available to the WHFD AND/OR PROJECT MANAGER.
- H. The Contractor at all times shall keep the premises free from accumulation of waste materials or rubbish caused by its operations. At the completion of the work, he shall remove all its waste materials and rubbish from and about the project as well as all its tools, construction equipment, machinery and surplus materials and shall clean all new equipment and accessories.
- I. The Contractor shall give the WHFD AND/OR PROJECT MANAGER timely notice of its readiness for testing any work including the data arranged so the WHFD AND/OR PROJECT MANAGER may observe such testing. The Contractor shall bear all cost of such tests.

- J. The WHFD AND/OR PROJECT MANAGER shall have the right to accept or reject material, equipment, and/or workmanship and determine when the Contractor has complied with the contract documents.

1.03 INSPECTION OF SITE

- A. The Contractor shall visit the site and examine the conditions affecting its work before submitting its proposal. The submission of the proposal shall be considered evidence that the Contractor has visited the site and no extra payments will be allowed to the Contractor on account of extra work made necessary by its failure to visit the site. If there are any questions or discrepancies in the design, the Contractor shall bring it to the attention of the WHFD AND/OR PROJECT MANAGER before submitting its proposal.

1.04 SUBMITTALS

- A. Submit 6 copies of shop drawings, manufacturer's data and certificates for equipment, materials and finish and pertinent details for each system and have them approved before procurement, fabrication or delivery of the items to the job site. Partial submittals will not be acceptable and will be returned without review. Submittals shall include the manufacturer's name, trade name, catalog model or number, nameplate data, size, layout dimensions, capacity, project specification and paragraph reference, applicable industry and technical society publication references and other information necessary to establish contract compliance of each item the Contractor proposed to furnish.
 - 1. Shop Drawings: Drawings shall be a minimum of 24 inches by 36 inches in size, except as specified otherwise. Drawings shall include floor plans, sectional views, wiring diagrams and installation details of equipment; and equipment spaces identifying and indicating proposed location, layout and arrangement of items of equipment, control panels, accessories, piping and other items that must be shown to assure a coordinated installation. Wiring diagrams shall identify circuit terminals and indicate the internal wiring for each item of equipment and interconnection between each type of equipment. Drawings shall indicate adequate clearance for operation, maintenance and replacement of operating equipment devices. If equipment is disapproved, drawings shall be revised to show acceptable equipment and be resubmitted.
 - a. The Contractor shall review, stamp with its approval and submit, all Shop Drawings required by the Contract Documents or subsequently by the WHFD AND/OR PROJECT MANAGER as covered by modifications. At the time of submission, the Contractor shall inform the WHFD AND/OR PROJECT MANAGER in writing of any deviation in the Shop Drawings from the requirements of the Contract Documents. By approving and submitting Shop Drawings, the Contractor certifies that he has determined and verified all field measurements and obstructions, field construction criteria, materials, catalog numbers and similar data, that he has checked and coordinated each Shop Drawing with the requirements of the work and of the Contract Documents and that all equipment fits within designated spaces.

2. **Manufacturer's Data:** Submittals for each manufactured item shall be manufacturer's descriptive literature of cataloged products, equipment drawings, diagrams, performance and characteristic curves and catalog cuts.
3. **Standards Compliance:** When materials or equipment must conform to the standards of organizations such as the American National Standards Institute (ANSI), American Society for Testing and Materials (ASTM), National Electrical Manufacturers Association (NEMA) and Underwriters Laboratories (UL), proof of such conformance shall be submitted to the WHFD AND/OR PROJECT MANAGER for approval. If an organization uses a label or listing to indicate compliance with a particular standard, the label or listing will be acceptable evidence, unless otherwise specified in the individual sections. In lieu of the label or listing, the Contractor shall submit a certificate from an independent testing organization, which is competent to perform acceptable test and is approved by the WHFD AND/OR PROJECT MANAGER. The certificate shall state that the item has been tested in accordance with the specified organization's test methods and that the item conforms to the specified organization's standard. For materials and equipment whose compliance with organizational standards or specifications is not regulated by an organization using its own listing or label as proof of compliance, a certificate of compliance from the manufacturer shall be submitted for approval. The certificate shall identify the manufacturer, the product and the referenced standard and shall simply state that the manufacturer certifies that the product conforms to all requirements of the project specification and of the referenced standards listed.
4. **Certified Test Reports:** Before delivery of materials and equipment, certified copies of all test reports specified in the individual section shall be submitted for approval.
5. **Certificates of Conformance or Compliance:** Submit certification from the manufacturer attesting that materials and equipment to be furnished for this project comply with the requirements of this specification and of the reference publications. Pre-printed certifications will not be acceptable; certifications shall be in the original. The certification shall not contain statements that could be interpreted to imply that the product does not meet all requirements specified, such as "as good as"; "achieve the same end use and result as materials formulated in accordance with the referenced publication", "equal or exceed the service and performance of the specified material". The certification shall simply state that the product conforms to the requirements specified.
6. **"Field Posted As-Built" Drawings:** Keep at the job site a complete, accurate record of all approved deviations from the contract drawings, shop drawings and specifications. Keep these changes on prints of the drawings affected and turn over one (1) set to the WHFD AND/OR PROJECT MANAGER at the completion of the project.
7. **Balancing Report and Maintenance Manuals:** After installation, the new system shall be tested, balanced and adjusted by an NEBB Certified Testing and Balancing Company. Contractor to submit 4 sets of certification, certification shall be current at time of testing and balancing. Submit 4 copies

of the balancing report, and operating and maintenance manuals for approval before final inspection.

8. Operation and Maintenance Manual

- a. Submit (5) hard bound copies and (2) compact discs of the Operating and Maintenance Manual on all equipment and the system as a whole. The manual shall identify project name and number, contractor, consultant, date and all equipment provided, It shall include the equipment manufacturer's name, model and serial number, tag no., capacity, quantity of units, their location and area (room) served and shall include the manufacturer's operation and maintenance manuals including control and wiring diagrams and source of service and replacement parts. When standard manufactures' brochures are used, adequately indicate (highlight, arrow, etc.) the project related information and delete (X or cross-out) the non applicable information.
- b. Distribution of submittal:
- c. (5) hard bound copies: WHFD AND/OR PROJECT MANAGER
- d. (2) Compact Discs: WHFD AND/OR PROJECT MANAGER

9. Maintenance Service Contract

- a. The Maintenance Service Contract shall be submitted along with the Operations and Maintenance Manual on/or before the Project Acceptance Date. Refer to Part 3 Paragraph titled "One Year Guarantee and Maintenance Service Contract" for additional information.
- b. Note to Contractor: Equipment specified shall have either replacement parts which are locally stocked and an in-state service organization able to provide the necessary repair and maintenance service.
- c. Distribution of Submittal:
- d. (7) Copies: WHFD AND/OR PROJECT MANAGER

1.05 LAWS, REGULATIONS AND CODES

- A. All work shall be in accordance with government laws, ordinances, rules and regulations and orders.
- B. The following shall govern where applicable; the Plumbing Code of the County of Hawaii, the Building Code of the County of Hawaii, State of Hawaii Department of Health Regulations, U.S. Department of H.E.W., Applicable National Fire Protection Association Standards, OSHA, Rules and Regulations, County of Hawaii Energy Code and all other codes and standards referenced in these specifications. Where requirements differ in these code and standards, the more stringent shall apply.

1.06 TRADE NAME

- A. Mentioning of a trade name in the plans and specifications indicates that the Manufacturer is acceptable to the WHFD AND/OR PROJECT MANAGER. However, certain specified construction and details may not be regularly included in the manufacturer's catalogued product. The Mechanical Contractor shall provide the material or equipment complete as specified.

1.07 PERMITS AND INSPECTIONS

- A. Applications for permits will be done by the contractor; the Contractor shall pay for all necessary licenses, permits and fees.
- B. The Mechanical Contractor shall apply and pay for all necessary inspections required by any public authority having jurisdiction.

1.08 DISCREPANCIES

- A. The Drawings and Specifications are intended to be cooperative. Any materials, equipment or system related to this section and exhibited on the Architectural, Structural, Electrical or Mechanical Drawings but not mentioned in the Specifications are to be executed to the intent and meaning thereof, as if it were both mentioned in the Specifications and set forth on the Drawings.
- B. In case of differences between the Drawings and Specifications, the Specifications shall govern first, and then the Drawings. Large scale details shall take precedence over small scale Drawings as to the shape and details of construction. Specifications shall govern as to materials.
- C. Drawings and Specifications are intended to be fully cooperative and to agree, but should any discrepancy or apparent difference occur between Drawings and Specifications or should error occur in the work of others affecting the work, the Contractors shall notify the WHFD AND/OR PROJECT MANAGER at once. If the Contractor proceeds with the work affected without instructions from the WHFD AND/OR PROJECT MANAGER, he shall make good any resultant damage or defect. All interpretations of Drawings and specifications shall be clarified by the WHFD AND/OR PROJECT MANAGER.

1.09 WORKMANSHIP AND MATERIALS

- A. Workmanship shall be of the best quality and none but competent mechanics skilled in their trades shall be employed. The Contractor shall furnish the services of an experienced superintendent, who will be constantly in charge of the erection of the work, until completed and accepted.
- B. Unless otherwise hereinafter specified, each article of its kind shall be the standard product of a single manufacturer.
- C. Whenever the words "or approved equal" or other words of similar intent or meaning are used, implying that judgment is to be exercised, it is understood that it is the judgment of the WHFD AND/OR PROJECT MANAGER that is referred to.

- D. The WHFD AND/OR PROJECT MANAGER shall have the right to accept or reject material, equipment and/or workmanship and determine when the Contractor has complied with the requirements herein specified.
- E. All manufactured materials shall be delivered and stored in their original containers. Equipment shall be clearly marked or stamped with the manufacturer's name and rating. Equipment and materials shall be carefully handled, properly stored and adequately protected to prevent damage before and during installation, in accordance with the manufacturer's recommendations and as approved by the WHFD AND/OR PROJECT MANAGER. Damaged or defective items, in the opinion of the WHFD AND/OR PROJECT MANAGER, shall be replaced.
- F. Reference to standards is intended to be the latest revision of the standard specified.

1.10 MANUFACTURER'S RECOMMENDATIONS

- A. Equipment installed under this Division of the Specifications shall be installed according to manufacturer's recommendations, unless otherwise shown on the drawings or herein specified. Where installation procedures or any part thereof are required to be in accordance with the recommendations of the manufacturer of the material being installed, printed copies of these recommendations shall be furnished to the WHFD AND/OR PROJECT MANAGER, prior to installation. Installation of the item will not be allowed to proceed until the recommendations are received. Failure to furnish these recommendations can be cause of rejection of the material.

1.11 OPENINGS, CUTTING AND REPAIRING

- A. The Mechanical Contractor shall cooperate with the work to be done under other sections in providing information as to openings required in walls and slabs for all piping including sleeves where required.
- B. Any drilling or cutting required for the performance of work under this Section shall be the responsibility of this Contractor and the cost shall be borne by him.
- C. Holes in Concrete: The Mechanical Contractor shall pay all costs for cutting holes. All holes through existing concrete shall be either core drilled or saw cut. All holes required shall have the approval of the WHFD AND/OR PROJECT MANAGER prior to cutting and drilling.
- D. It shall be the responsibility of this Contractor to ascertain that all openings are properly located.

1.12 ELECTRICAL WORK

- A. All power wiring, including final hook-up to all mechanical equipment will be provided. Control devices required on the power wiring shall be provided by the Mechanical Contractor, to be wired by the Electrical Contractor.

- B. The Mechanical Contractor shall furnish all starters for installation by the Electrical Contractor. The Mechanical Contractor shall turn over these items to the Electrical Contractor at the site after receipt of notice from the Electrical Contractor that he is ready to install said items.

PART 2 - PRODUCTS

2.01 MATERIALS

- A. As specified in all sections of Division 15 - Mechanical.
- B. Provide components and equipment that are "standard products" of a manufacturer regularly engaged in the manufacturing of products that are of a similar material, design and workmanship. "Standard products" is defined as being in satisfactory commercial or industrial use for 2 years before bid opening, including applications of components and equipment under similar circumstances and of similar size, satisfactorily completed by a product that is sold on the commercial market through advertisements, manufacturers' catalogs, or brochures. Where two or more items of the same class of equipment are required, these items shall be products of a single manufacturer, however, the component parts of the items need not be the products of the same manufacturer. Each item of equipment shall have the manufacturer's name, address, model number and serial number on the nameplate.

2.02 SALT CORROSION PROTECTION

- A. Provide salt corrosion protection for all air cooled condensing units, fan coil units, supply and exhaust fans and housings. All outdoor coils shall be coated with Blygold PoluAl XT or approved equal and all outdoor housings and fans of outdoor mounted equipment shall be coated with PSX 700, or approved equal.

2.03 SUBSTITUTIONS

- A. The material, products and equipment described in these specifications establish a standard of required function, quality, dimension, capacity, and appearance to be met by any proposed substitution.
- B. Specific product listings in these specifications shall not preclude alternate product selections of comparable or superior quality. The Contractor may make reasonable substitutions, provided that these are submitted to the WHFD AND/OR PROJECT MANAGER for acceptance prior to bid in accordance with Division 1 Specifications. The Contractor shall be responsible for design changes to accommodate the substituted product, at no additional costs to the Hospital.

PART 3 - EXECUTION

3.01 EQUIPMENT

A. MECHANICAL EQUIPMENT, FIXTURES AND ACCESSORIES

1. All mechanical equipment, accessories, plumbing fixtures and plumbing accessories shall be purchased by a Hawaii based manufacturer's representative who is factory authorized to furnish these items in the State of Hawaii. The manufacturer's representative shall be knowledgeable in the operation and functioning of the items furnished by him and must meet the following conditions:
 - a. The manufacturer's representative shall furnish recommendations on the installation and operation of the items furnished in a capacity conforming to that of the actual manufacturer.
 - b. The manufacturer's representative shall stock a reasonable amount of replacement parts locally.
 - c. The manufacturer's representative shall have the ability to provide warranty replacement parts for equipment in a timely fashion to reduce the down time of equipment.

B. MAINTENANCE SERVICE CONTRACTOR

1. The maintenance service contractor shall have a local office, staffed with competent and qualified field service personnel. The personnel shall be certified by the manufacturer to perform service and maintenance tasks on all equipment in accordance with the one year maintenance service contract and the terms and conditions of all equipment manufacturers' warranties and recommendations. Field service personnel shall be fully capable of providing technical assistance instruction, routine maintenance and emergency maintenance service on all system equipment components.

C. TROUBLE CALLS: Emergency service and repairs required between regular service calls shall be rendered within 24 hours after the Contractor is notified, non-work days excluded.

1. The Contractor shall call the Hospital, the next working day after being notified of the problem and report the status of repairs.

D. MANUFACTURERS REPRESENTATIVE

1. Air conditioning equipment to be considered for bid purposes shall be purchased from a manufacturer's sales and service representative located in the State of Hawaii that has locally stocked spare parts and support of a service organization within the State of Hawaii which has serviced manufacturer's unit of comparable type, size and capacity as those specified. The manufacturer must have other units of comparable type, size and capacity installed and operating satisfactorily in the State of Hawaii for a minimum of two years prior to bid opening. The Contractor shall provide a list

of locations in Hawaii with addresses and telephone numbers when requested by the WHFD AND/OR PROJECT MANAGER.

E. MECHANICAL EQUIPMENT

1. The mechanical equipment supplier shall maintain a local support office within the State of Hawaii, staffed with factory trained representatives or staff, capable of providing instruction on operation and installation of all system components.
2. The control system supplier shall maintain a local support office within the State of Hawaii, staffed with factory trained representatives or staff, capable of providing instruction on operation, installation and trouble shooting of all system components.
3. Provide competent and qualified manufacturer's factory-trained and certified field service personnel on-site to be responsible for execution of all diagnostic testing in accordance with equipment manufacturer's installation and start-up certification requirements and warranty terms and conditions.
4. The Contractor shall provide manufacturer's representative and/or service technicians for any field modifications to equipment. The Contractor shall ensure that any modifications to equipment will not invalidate the manufacturer's warranties.

3.02 PIPING IDENTIFICATION

- A. Identification of all pipe lines shall be by means of colored, waterproof, all temperature, self-adhering labels and directional arrow.
- B. At Contractor's option, each and every system may be identified by painting with contrasting colors, using 3/4" high minimum stencil letters. Painting shall be done by the Mechanical Contractor.
- C. All exposed pipes, whether insulated or not shall be identified. Labels may be omitted from piping where the use is obvious, due to its connection to equipment and where the appearance would be objectionable in finished rooms, as approved by the WHFD AND/OR PROJECT MANAGER.
- D. Identification labels shall be placed as follows:
 1. Near each valve and branch connection.
 2. Wherever piping merges or disappears from view from the floor of the room in which it is installed.
 3. Labels shall not be more than 50 feet apart.

3.03 VALVE INDEX

- A. The Mechanical Contractor shall provide brass or plastic tags on all valves with letters stamped or engraved thereon designating service of each valve.

3.04 FIELD TEST

- A. The Mechanical Contractor shall perform all tests of the installed work and shall provide all services, labor, equipment, materials and instruments needed for the tests. During pressure tests, all items in the system to be tested, not designed for test pressures shall be removed or isolated from the system and shall be reconnected or unblocked after tests are completed. Should operating tests require the presence of manufacturers' representatives, the Mechanical Contractor shall cooperate with them and shall place at their disposal all assistance, materials and services required to perform such test. The Mechanical Contractor shall certify in writing that all work has passed all required tests.

3.05 POSTED OPERATING INSTRUCTION

- A. Furnish approved operating instructions for each principal item of equipment for the use of the operation and maintenance personnel. The operating instructions shall include wiring diagrams, control diagrams and control sequence for each principal item of equipment. Operating instruction shall be printed or engraved and shall be framed under glass or in approved laminated plastic and posted where directed by the WHFD AND/OR PROJECT MANAGER. Operating instructions shall be attached to or posted adjacent to each principal item of equipment including start up, procedure in the event of equipment failure and other items of instruction as recommended by the manufacturer of each item of equipment. Operating instructions exposed to the weather shall be made of weather-resistant materials or shall be suitably enclosed to be weather protected. Operating instructions shall not fade when exposed to sunlight and shall be secured to prevent easy removal or peeling.

3.06 INSTRUCTION TO MAINTENANCE PERSONNEL

- A. The Contractor shall furnish the services of competent instructors who will give full instruction to the designated personnel in the adjustment, operation and maintenance, including pertinent safety requirements, of the equipment or system specified. Each instructor shall be thoroughly familiar with all parts of the installation and shall be trained in operating theory as well as practical operation and maintenance work. Instruction shall be given during the first regular work week after the equipment or system has been accepted and turned over to the County for regular operation. When significant changes or modifications in the equipment or systems are made under the term of the contract, additional instruction shall be provided to acquaint the operating personnel with the changes or modifications.

3.07 SAFETY REQUIREMENTS

- A. Belts, pulleys, chains, gears, couplings, projecting setscrews, keys and other rotating parts located so that any person can come in close proximity thereto shall be fully enclosed or properly guarded. High temperature equipment and piping so located as to endanger personnel or create a fire hazard shall be properly guarded or covered with insulation of a type as specified herein. Items such as catwalks, ladders and guardrails shall be provided where required for safe operation and maintenance of equipment.

3.08 INSPECTIONS

- A. All work and materials are subject to field observation at any and all times by the WHFD AND/OR PROJECT MANAGER.
- B. Contractor shall notify the WHFD AND/OR PROJECT MANAGER a minimum of two days prior to testing any piping or ducting systems which must be witnessed and approved before they are covered up or enclosed. Should the Contractor fail to notify the WHFD AND/OR PROJECT MANAGER at the times prescribed, it shall then be the Contractor's responsibility to make duct work accessible, expose any concealed lines, or demonstrate the acceptability of any part of the system. Any extra cost caused by the removal of such work shall be borne by the Contractor.
- C. If the WHFD AND/OR PROJECT MANAGER finds any material or work not conforming to these Specifications, Contractor within three days of being notified shall remove said materials from the premises and replace with approved material, at no cost to the Hospital.

3.09 FINAL INSPECTION

- A. Final inspection shall be requested by the Contractor only after submittal of all required certificates. No final inspection will be made until all moving parts of equipment are properly guarded, all controls and safety devices tested and operative, all painting required done and the site cleaned up.

3.10 ONE YEAR GUARANTEE AND MAINTENANCE SERVICE CONTRACT

- A. In addition to the Guaranty on material and workmanship, the installer shall submit the Maintenance Service Contract, countersigned by the Contractor, that will validate said Guaranty.
- B. The Guarantee and maintenance services shall extend for a period of one year commencing after 30 consecutive days of trouble-free operation after the Project Acceptance Date, and shall include all labor, materials, equipment and parts necessary to service the complete system, in accordance with the attached Schedule of Maintenance Service, so as to assure proper operation and function of the system. All costs for the periodic maintenance, including emergency calls, shall be borne by the Contractor. This maintenance period and the Guaranty period shall run concurrently (same start and end dates).
 - 1. Trouble-free operation is defined as a non-disabling condition or a non recurring failure or disruption and the following:
 - a. The system shall be free of all discrepancies, contamination and debris which require correction in excess of those described for the monthly service which is included in the Schedule of Maintenance.
 - b. The system is maintaining operational conditions and other parameters measured during acceptance tests.
- C. The Installer shall include a listing of the following items along with the Maintenance Service Contract:

1. Name of the servicing contractor.
2. Mechanical system acceptance date.
3. Service contract expiration date.
4. Monthly inspection schedule for the maintenance period.
5. Itemized listing of the equipment covered under the service contract, including a description of the equipment identified, its serial number(s) and manufacturer's name(s).

3.11 SCHEDULE OF MAINTENANCE SERVICE

A. All services performed by the Contractor shall include applicable items listed but shall not be limited to the following maintenance tasks:

1. Air Handling Unit

a. Monthly Service

- 1) Clean and clear all drip pans and flush all related condensate drain lines with nitrogen. (Contractor may be liable for water damage due to clogged drains). Install pan tablets if necessary to control algae.
- 2) Change all disposable air filters at least once a month or per manufacturer's recommendation.
- 3) Lubricate and oil all fan and motor bearings and connections of dampers and vanes.
- 4) Check all drives for wear; adjust belt tension. Replace belt as required.
- 5) Operate equipment to check for proper operation, unusual noise and vibration; adjust or repair all equipment and controls as required; clean-up all equipment.
- 6) Check time clock for proper operation and time settings.
- 7) Certify performance of monthly services and that all discrepancies are reported and corrected.

b. Annual Service:

- 1) Adjust alignment of bearings and sheaves; lubricate fan and motor bearings. Replace worn or noisy bearings and sheaves.
- 2) Clean cooling coils of dirt accumulation using nitrogen, high pressure air/water, and steam or chemical coil cleaner solution.
- 3) Check pressure and temperature differential across cooling coils and log readings. Check drains.
- 4) Clean supply and return air grilles, registers and diffusers and fresh air intake grilles and dampers and repair or replace deteriorated screens.
- 5) Clean all fan wheels and interior and exterior of equipment housings.
- 6) Secure all loose housing, seal leaks and touch-up paint after cleaning all rust.
- 7) Check and calibrate all pneumatic and/or electric temperature controls.
- 8) Certify performance of annual service and correct and report all discrepancies.

2. Ventilation Fans (Exhaust)
 - a. Quarterly Service
 - 1) Check back-draft dampers for proper operation; lubricate linkage for free movement.
 - 2) Lubricate fan motors and bearings.
 - 3) Check belt wear and tension; adjust or replace as needed.
 - 4) Check sheaves for wear, replace as needed.
 - 5) Check fan collar, bearings and shaft for wear, repair or replace as needed.
 - 6) Remove and wash intake grille.
 - 7) Certify performance of quarterly fan maintenance service and correct and report all discrepancies.
 - b. Semi-Annual Service
 - 1) Check and clean fan wheels and housings of dust, dirt, and grease.
 - 2) Remove and wash all intake grilles and dampers and repair or replace deteriorated bird screens.
 - 3) Certify performance of semi-annual fan maintenance service and correct and report all discrepancies.
3. Temperature Controls
 - a. Quarterly Service
 - 1) Check control devices for proper operation, sticking stems, and calibration; repair/replace weak or broken springs and all other parts.
 - 2) Check automatic dampers for tightness in closing, bent blades and defective linkage; lubricate connections for free movement and repair as required.
 - 3) Adjust thermostat to maintain 72 degrees F(adj.) room temperature.
 - 4) Certify performance of quarterly maintenance service and that all discrepancies are reported and corrected.
 - 5) Notify WHFD AND/OR PROJECT MANAGER of any dangerous conditions, improper storage of furniture, material and supplies which impacts your work within rooms and enclosures, including vandalism.
- B. WORK SCHEDULE: All maintenance work shall be performed between the hours of 7:30 a.m. and 4:00 p.m. on normal working days, Monday through Friday, excluding Holidays.
- C. TROUBLE CALLS: Emergency service and repairs required between regular service calls shall be rendered within 24 hours after the Contractor is notified, non-work days excluded.
- D. MAINTENANCE REPORT
 1. Maintenance Report
 - a. Submit to the WHFD AND/OR PROJECT MANAGER a Service Maintenance Report using the form found at the end of this section. This form shall include the following:
 - 1) Date maintenance service was performed.

- 2) The name of the mechanic who performed said maintenance.
- 3) The type and cost (labor, materials, parts and equipment) of repair work performed on the unit, if any.
- 4) Documents and other data pertaining to the maintenance performed.
- 5) It will be the responsibility of the Contractor to maintain the report/ checklist by recording the above noted data after each scheduled maintenance and emergency repairs, and have the checklist available for inspection at the building site.
- 6) The report shall be sufficiently detailed to properly reflect the past maintenance history of the equipment. Reports shall be certified by a representative of the facility being served and shall be submitted to the WHFD AND/OR PROJECT MANAGER at the completion of the service contract.

3.12 CLEANUP AND WORK PRACTICES

- A. The Contractor shall keep the job site free of debris, litter, discarded parts, etc. and shall clean all oil drippings during the daily progress of work. The Contractor shall remove all tools, parts and equipment from the service areas upon completion of the work.
- B. The Contractor shall exercise caution during the progress of its maintenance and repair work to prevent damage to the ceilings, roofing and other building structure. The Contractor shall restore all damages, caused by its negligence, to its original condition at its own expense.

SERVICE MAINTENANCE REPORT

DATE: _____

SHEET NO: _____

1. Name of Facility and Location: _____

2. Submitted By: _____

3. Date of Service Call: _____

4. Name of Person(s) Making Call: _____

5. Time In _____: Time Out _____: At Site

6. Person(s) Contacted: _____

7. Nature of Service Call: (Routine Maintenance or Emergency, Explain)

8. Equipment Readings and Maintenance Performed:
(List all items serviced: Identify – 8a, 8b, 8c, ..., etc.)

Example of Operational Performance Tests:

Facility:

Date:

A/C Equipment Description and Information:

Qty	Tag	Equipment	Manufa ct.	Model No.	Capacit y	Chw Dx	or Area Serv.	Location
*1	AH U	Air Handling unit	Carrier	39LD110 1	19 Tons	Chw	Library	Mech Rm

Remarks:

*Sample

TEST DATA:

Chillers

Chilled Water Supply Temperature Tchws
 Chilled Water Return Temperature Tchwr
 Chilled Water Pump Discharge Pressure Pchwpd
 Chilled Water Pump Suction Pressure Pchwps
 Chilled Water Pump Static pressure Pchwpo

1	2

Compressors

Capacity Reduction

Full Load

75%

50%

25%

1	2	3
RLA	Ref Press	RLA
Ref Press	Ref Press	Ref Press

Air Handling Units (AHUs)

Supply Air Temperature Tsa
 Return Air Temperature Tra
 Differential Air Pressure Pd
 Chilled Water Supply Temperature Tchws
 Chilled Water Return Temperature Tchwr
 Chilled Water Supply Pressure Pchws
 Chilled Water Return Pressure Pchwr

1	2	3	4	5

END OF SECTION 15000

SECTION 15250 - INSULATION OF MECHANICAL SYSTEMS

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

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

1.02 GENERAL REQUIREMENTS

- A. Section 15000, "General Mechanical Requirements", with the additions and modifications specified herein, applies to this section.
 - 1. Manufacturer's Stamp or Label: Every package or standard container of insulation, jackets, cements, adhesives and coatings delivered to the project site for use must have the manufacturer's stamp or label attached giving name of manufacturer, brand and description of material. Insulation packages and containers shall be marked "asbestos-free".
 - 2. Fire Resistance: Insulation, adhesives, vapor-barrier materials and other accessories, except as specified herein, shall be noncombustible. The materials shall have a flame-spread rating not more than 25 and a smoke-developed rating not more than 50 in accordance with NFPA 255, ASTM E 84-80 or UL 723.
 - a. Materials Tests: Test factory-applied materials assembled. Field-applied materials may be tested individually. Use no fugitive or corrosive treatments to impart flame resistance. UL label or satisfactory certified test report from an approved testing laboratory will be required to indicate that fire hazard ratings for materials proposed for use do not exceed those specified. Flame-proofing treatments subject to deterioration due to effects of moisture or high humidity are not acceptable.
 - b. Materials Exempt from Fire-Resistant Rating:
 - 1) Nylon anchors
 - 2) Treated wood inserts

1.03 SUBMITTALS

- A. The items for which the submittal requirements of Section 15000, "General Mechanical Requirements", apply are as follows:
 - 1. Manufacturer's Data:
 - a. Insulation
 - b. Jackets
 - c. Vapor-barrier materials
 - d. Accessory-materials
 - 2. Standards Compliance: Standards compliance labels are required on each container or package:

- a. Insulation
- b. Jackets
- c. Vapor-barrier materials
- d. Accessory materials

1.04 DEFINITIONS

- A. Finished Spaces: Habitation or occupancy spaces where rough surfaces are plastered, paneled or otherwise treated to provide a pleasing appearance.
- B. Unfinished Spaces: Storage or work areas where appearance is not a factor, unexcavated spaces, crawl spaces, etc.
- C. Concealed Spaces: Spaces between a ceiling and floor construction above or between double walls or furred-in areas; pipe and duct shafts, etc.
- D. Exposed: Open to view inside the building. For example, pipe run through a room and not covered by other construction, is exposed.
- E. Fugitive Treatments: Treatment of materials subject to deterioration due to aging, moisture, high humidity, oxygen, ozone and heat. Fugitive means entrapped materials that can cause deterioration e.g., solvents, water vapor, etc.
- F. Outside: Open to view beyond the exterior side of walls, above the roof and unexcavated or crawl spaces, above or beneath pier floors, in tunnels or exposed on all sides in trenches connected or not connected to an exterior portion of a building.

1.05 PIPING REQUIRING INSULATION

- A. Cold Water Piping
- B. Hot Water Piping.
- C. Condensate Drain Piping
- D. Chilled Water Piping

PART 2 - PRODUCTS

2.01 MATERIALS

- A. Asbestos Prohibition: No asbestos containing materials or equipment shall be used under this section. The Contractor shall ensure that all materials and equipment incorporated in this project are asbestos free.

2.02 PIPING INSULATION

- A. Insulation exterior shall be cleanable, grease resistant, non-flaking and non-peeling. Pipe insulation shall conform to the referenced publications and the specified temperature ranges and densities in pounds per cubic foot (pcf).

Insulation for fittings and flanges shall be pre-molded, pre-cut or job-fabricated insulation of the same thickness and conductivity as used on adjacent piping.

1. Interior Cold Water Piping: All interior cold water piping shall be insulated with Rubatex or equal.
2. Interior Hot Water Piping: hot water piping shall be insulated with fiberglass insulation with insulation jacket.
3. Exterior Hot Water Piping: hot water piping shall be insulated with Pittsburgh Corning Foamglas insulation and finish with Johns Manville, Zeston 2000 PVC Jacket, 0.2 mils thick, or approved equal.
4. Condensate Drain Piping: All interior condensate drain piping shall be insulated with Rubatex or equal.
5. Chilled Water Piping Insulation (Supply and Return): All chilled water piping shall be insulated with Pittsburgh Corning Foamglas insulation. See Table 1 for insulation thickness requirements. Exterior chilled water piping shall be finished with Johns Manville, Zeston 2000 PVC Jacket, 0.2 mils thick, or approved equal.

2.03 DUCT INSULATION

- A. All supply air and return duct work shall be wrapped with duct wrap with vapor barrier. Owens Corning Fiberglas duct wrap with Foil-Scrim-Kraft facing or TVM Building Products reflective duct insulation with double layer of polyethylene bubbles, sandwiched between two layers of highly reflective aluminum sheets.
- B. All air devices shall be fully insulated such that no metal portions of the diffuser are exposed in unconditioned areas. Provide molded fiberglass insulation diffuser blanket for 24"x24" lay-in modules. Diffuser blanket shall have foil back vapor barrier with 6.0 R-value.

2.04 INSULATION JACKETS

- A. Vapor-Barrier Material: Material shall be resistant to flame and moisture penetration and not support mold growth. Provide vapor-barrier material on insulation in exposed locations with a white surface suitable for painting without sizing. Perm rating of .01.

2.05 ADHESIVES, SEALANTS AND COMPOUNDS

- A. Shall be compatible with materials to which applied and suitable for the service.
 1. Vapor-Barrier and Jacket Adhesive: Fire resistant type. Foster Products or approved equal.
 2. Lagging Adhesive: Fire resistant type. Foster Products or approved equal.
 3. Mineral Fiber Insulation Cement: ASTM C 195, thermal conductivity 0.85 max. at 200 degrees F mean when tested per ASTM C 177.

4. Bedding Compound and Joint Sealer: Fire resistant type. Foster Products or approved equal.
5. Vapor-Barrier Coating: Fire resistant type. Perm rating of .05. Foster Products or approved equal.

2.06 ACCESSORIES

- A. Staples: Corrosion-resistant outside-clinch type.
- B. Anchor Pins: Provide anchor pins and speed washers recommended by the insulation manufacturer.
- C. Glass Cloth and Tape: Textile Glass.
- D. Vapor-Barrier Material Tape: Pressure-Sensitive adhesive backed. Arno or approved equal.

PART 3 - EXECUTION

3.01 INSTALLATION

- A. Install insulation system in accordance with manufacturer's recommendations using tradesman skilled in this trade and approved by the insulation manufacturer. Provide insulation products with a composite (insulation, jacket and adhesive) fire and smoke hazard rating as tested under ASTM E84, NFPA 255 and UL 723, not exceeding a flame spread of 25 and smoke developed of 50.
- B. Pipe Insulation Thickness: Insulation thickness shall conform to Table 1 and IECC 2015.

Fluid operating Temperature Range and Usage (degree F)	Insulation Conductivity		Nominal Pipe or tube size (inches)				
	Conductivity (BTU* in)/(h*ft^2*degree F)	Mean Rating Temperature, (degree F)	< 1	1 to < 1.5	1.5 to < 4	4 to < 8	<= 8
>350	0.32-0.34	250	4.5	5.0	5.0	5.0	5.0
251-350	0.29-0.32	200	3.0	4.0	4.5	4.5	4.5
201-250	0.27-0.30	150	2.5	2.5	2.5	3.0	3.0
141-200	0.25-0.29	125	1.5	1.5	2.0	2.0	2.0
105-140	0.21-0.28	100	1.0	1.0	1.5	1.5	1.5
40-60	0.21-0.27	75	0.5	0.5	1.0	1.0	1.0
<40	0.20-0.26	50	0.5	1.0	1.0	1.0	1.5

Table 1.

1. For insulation outside the stated conductivity range, the minimum thickness (T) shall be determined as follows:

a. $T = r [(1 + t/r)*K/k-1]$ where:

- 1) T = minimum insulation thickness
 - 2) r = actual outside radius of pipe
 - 3) t = insulation thickness listed in the table for applicable fluid temperature and pipe size
 - 4) K = conductivity of alternate material at mean rating temperature indicated for the applicable fluid temperature ($\text{Btu} \cdot \text{in} / \text{h} \cdot \text{ft}^2 \cdot \text{degree F}$)
 - 5) k = the upper value of the conductivity range listed in the table for the applicable fluid temperature.
- C. Expansion Clearances: At points where pipe will move during expansion and contraction (expansion joints, Z-bends, expansion loops and ells), clearances between the pipe and encased insulation shall be sized to permit full pipe movement without cracking or damaging insulation and jacket.
- D. Duct work and Duct work Accessories: Provide field-applied insulation to exterior of supply ducts, return ducts, and casings of HVAC units. Ensure full range of motion of equipment actuators. Modify insulation to avoid obstruction with valve handles, safety relief, and other such items. Install insulation with jackets drawn tight and cement down on longitudinal and end laps. Do not use scrap pieces where a full length section will fit.

3.02 FIELD INSPECTION

- A. Visually inspect to insure that materials used conform with specifications. Inspect installation progressively for compliance with requirements.

3.03 ONE YEAR GUARANTEE

- A. The Contractor shall warrant that all materials and equipment furnished under this section will be new and that all work will be of good quality, free from faults and defects and in conformance with Contract Documents for a guaranteed period of one year after the date of acceptance as specified.

END OF SECTION 15250

SECTION 15700 - HYDRONIC PIPING, EQUIPMENT, AND ACCESSORIES

PART 1 - GENERAL

1.01 GENERAL CONDITIONS

- A. Section 15000, "General Mechanical Requirements", applies to this section with additions and modifications specified herein. The piping systems as specified in this section include chilled water; tubing flanges; bolting; gaskets; valves; fittings; pressure containing assemblies; flow measuring equipment and flow control equipment.

1.02 SUBMITTALS

- A. Manufacturer's Literature and Data:

- 1. Piping and Fittings, Gaskets, Valves and Piping Accessories
 - 2. Hangers and Supports

- B. Operation and Maintenance Manuals:

- 1. Piping Diagrams and Codes

- C. Certified Laboratory Test Reports:

- 1. Valves

- D. Shop Drawings:

- 1. Piping Installation

- E. Welding:

- 1. Welding Procedure: Before any welding is performed, submit three copies of this welding procedure specification for all metals included in the work, together with proof of its qualifications as outlined in ANSI B31.1.
 - 2. Performance Qualification Record: Before any welder or operator performs any welding the Contractor shall submit to the Owners Representative three copies of the Welder's Performance Qualification Record in conformance with ANSI B31.1 showing that the welder was tested under the approved procedure specification submitted by the Contractor. In addition the Contractor shall submit each welder's assigned number, letter or symbol which shall be used to identify the work of the welder which shall be affixed immediately upon completion of the weld. Welders making defective welds after passing a qualification test shall be required to take a re-qualification test. Welders failing the re qualification tests will not be permitted to work under this contract.
 - 3. Previous Qualifications: Welding procedures, welders and welding operators previously qualified by test may be accepted for this contract without re qualification subject to approval provided that all the conditions specified in ANSI B31.1 are met before a procedure can be used.

- F. Brazing: Brazing Procedure: Before any brazing is performed, submit three copies of this brazing procedure specification for all metals included in the work, together with proof of its qualifications as outlined in ANSI/AWS B2.2.

1.03 CORROSION PREVENTION OF FERROUS METALS

- A. Expose for 125 hours in a salt spray fog test, except equipment located outdoors shall withstand 500 hours. The salt spray fog test shall be in accordance with ASTM B117 using a 5 parts by weight (plus or minus 1) of sodium chloride in 95 parts of distilled water or water containing not more than 200 parts per million of total solid sodium chloride solution. Immediately after completion of the test the coating shall show no signs of blistering, wrinkling or cracking, no loss of adhesion and the specimen shall show no signs of rust creepage beyond 1/8 inch on either side of the scratch mark. The film thickness of the factory coating or paint system applied on the equipment shall not be less than the film thickness used as the test specimen.

1.04 ROTATING EQUIPMENT SAFETY

- A. Couplings, Motor Shafts, Gears and other exposed rotating or rapidly moving parts shall be fully guarded in accordance with OSHA 1910.219. The guards shall be cast iron or expanded metal. Guard parts shall be rigid and suitably secured and shall be readily removable without disassembling the guarded unit.

1.05 WELDING AND CUTTING

- A. ANSI Z49.1.

PART 2 - PRODUCTS

2.01 WATER PIPING, FITTINGS AND ACCESSORIES

- A. Materials and dimensions in accordance with ANSI B31.1 Water Piping Systems as used in this paragraph include chilled water piping systems. Piping systems shall be compatible with system fluids and capable of withstanding the operating pressures and temperatures.
 - 1. Chilled Water Piping:
 - a. Provide seamless Schedule 40 black steel pipe conforming to ASTM A53. Fittings shall be butt-weld wrought carbon steel conforming to ASRM A234 and ASME B16.9, or flanged type conforming to ANSI B16.5. Convolute steel flanges conforming to ASME Code Section 8 may be used in lieu of ANSI B16.5 flanges.
 - b. At Contractor's option, provide Type "K" hard-drawn copper tube, ASTM B-88, with brazed joints for the pipe size 3 inches and smaller. Copper fittings shall be wrought copper solder-type conforming to ANSI B16.22. Joints for solder-type fittings shall be brazed using Canfield Sil-Can 15 silver brazing alloy conforming to AWS CcuP-2 and Sil-Can "White Cream" brazing flux. Install copper tube and fittings in accordance with CDA (Copper Development Association) 404/O-RR guidelines.

2. Flanges: The raised faces shall be removed when used with flanges having a flat face.
 - a. Steel Flanges: ANSI B16.5 forged steel, welding type conforming to ASME Code Section 8. Do not use convoluted flanges. Stockham, Walworth or approved equal.
3. End Connections: Steel Piping: Steel piping 2 1/2 inches and larger shall be flanged or butt welded.
 - a. Bolting of Flanges: Material used for bolts and studs shall conform to ASTM A307, Grade B and material for nuts shall conform to ASTM A194, Grade 2. Dimensions of bolts, studs and nuts shall conform to ANSI B18.2.1 and ANSI B18.3.2 with threads conforming to ANSI B1.1 coarse type with Class 2A fit for bolts and studs and Class 2B for nuts. Bolts or studs shall extend completely through the nuts and may have reduced shanks of a diameter not less than the diameter at root of threads. Carbon steel bolts shall have American Standard regular square or heavy hexagon heads and shall have American Standard heavy semi-finished hexagonal nuts.
 - b. Gaskets: ASTM D 2000, fluorinated elastomers, suitable for the pressure and temperature ranges encountered and compatible with grooves in flange faces.
 - c. Butt Weld Joints: Shall conform to ANSI B31.1. The use of backing rings shall conform to ANSI B31.1. Ferrous rings shall be of good welding quality and shall not exceed 0.05 percent sulfur; for alloy pipe, backing rings shall be of material compatible with the chemical composition of the parts to be welded and preferably of the same composition. Backing rings shall be of the continuous machined or split band type.
 - d. Socket Weld Joints: Shall conform to ANSI B31.1.
 - e. All connections to mechanical equipment shall be flanged connections.
4. Valves: Gate, Special and Related Equipment shall conform to the following paragraphs. End connections shall conform to paragraph "End Connections". Valves shall have rising stems and shall open when turned counterclockwise.
 - a. Ball Valves: Use full port ball valves with threaded/flanged ends for isolation/shutoff. Provide stem extensions, as necessary, to accommodate piping insulation. Operating pressure shall not exceed 80% of the valve pressure class. Use 600 WOG – 150 SWP class, forged brass, ball valves with threaded ends.
 - b. Drain Valves: Shall be gate valves, bronze, 150 pound class. Shall not be smaller than 3/4 inch nominal pipe size, shall have threaded ends and shall be provided with hose nipple adapters for connecting a hose to lead to a convenient floor drain. The valves shall be manually operated. Stockham, Nibco, or approved equal. Provide at low points on system whether shown on drawings or not.

- c. Air Vent Valves: Shall be Manually Operated General Service Type and Automatic Type. The automatic type air vent valves shall be of the ball float type. The valves shall be provided with cast iron bodies, 300 series corrosion resistant steel float, linkage and removable seat of hardened corrosion resistant steel. Manual vent valves shall be gate valves, bronze, 150 pound class. Valves shall be suitable for hot or cold water service and 125 psi working pressure. The valves shall be 3/4 inch pipe size for water mains and 1/2 inch pipe size, minimum, for all other applications. Air vent valves shall be provided at all high points in the water piping system or as indicated.
 - d. Check Valve:
 - 1) Cast Iron Check Valves 2 1/2 Inches and Larger: Valves shall be Class 150 with bronze trim. Provide non slam, eccentric disc type for centrifugal pump discharge service.
 - 2) Check valve 2-inches and smaller: Valves shall be of Class 125, thread or solder ends, body and caps shall be of ASTM B-62 cast iron bronze composition swing type disc.
5. Miscellaneous Components for Piping System:
- a. Flexible Connector: Shall be for water service and shall be flanged neoprene type with braided stainless steel outer casing and bolted steel control rods. Materials shall be of the type recommended by the manufacturer for use with chilled water. Mason or approved equal.
 - b. Y-Type Strainer: Bronze body, 20 mesh stainless steel screen, 125 psi working pressure. Provide with blow-off valve. Mueller Steam Specialty Co. or approved equal.
6. Dielectric Insulating Fittings.
- a. Insulating unions or flanges shall be provided at locations described herein unless noted otherwise.
 - b. A shutoff valve shall be provided locally, upstream of dielectric insulating fittings, so that repairs can be made easily on these fittings.
 - c. Locations requiring insulating couplings or flanges are as follows:
 - 1) At connection points where copper water lines connect to steel domestic water heater tanks.
 - 2) At points in water lines where ferrous and other dissimilar metallic pipes are connected together.
 - 3) In metallic water and gas service connections into each building within 5 feet of the building wall. Install adjacent to the shutoff valve or cock, and aboveground where possible.

- 4) Where steel or cast iron pipe in the ground connects to copper or brass piping above the ground, the transition from steel or cast iron pipe to the copper or brass pipe shall be made aboveground in an accessible location.
 - 5) Where copper or brass piping is connected to steel or cast iron piping and the connection is buried in the ground, the connection shall be covered with a protective coal tar tape wrap extending outward at least 5 feet on pipes, from the point of connection. The tape shall be Protecto Wrap No. 200, or equal. A primer, specifically designed for use with the tape, shall be used. The piping shall be thoroughly cleaned before tape or primer is applied.
- B. Materials and dimensions in accordance with ANSI B31.1 Water Piping Systems as used in this paragraph include salt water piping systems. Piping systems shall be compatible with system fluids and capable of withstanding the operating pressures and temperatures.
1. All PVC Schedule 80 pipe and fittings shall be produced by Spears® Manufacturing Company from PVC Type I cell classification 12454, conforming to ASTM Standard D 1784, or approved equal. All PVC injection molded Schedule 80 fittings and extruded pipe shall be Certified for potable water service by NSF International. All Schedule 80 fittings shall be manufactured in strict compliance to ASTM D 2467 and Schedule 80 pipe shall be manufactured in strict compliance to ASTM D 1785. All fabricated fittings shall be produced in accordance with Spears® General Specifications for Fabricated Fittings. All PVC flanges shall be designed and manufactured to meet CL150 bolt pattern per ANSI Standard B16.5 and rated for a maximum internal pressure of 150 psi, non-shock at 73° F.
 2. Ball Valves: Utility sealed unit type constructed from PVC Type I, ASTM D 1784 Cell Classification 12454 or CPVC Type IV, ASTM D 1784 Cell Classification 23447. All O-rings shall be EPDM. All valves shall have Safe-T-Shear® stem and removable Polypropylene handle. All valves shall be certified by NSF International for use in potable water service. All valves shall be pressure rated at 150 psi for water at 73° F, as manufactured by Spears® Manufacturing Company, or approved equal.

2.02 THERMOMETERS

- A. Seven inch aluminum case, Well Threaded and Seal Welded or Seal Brazed, Range 0 degrees to 100 degrees F., Standard Stem, Adjustable angle. Scale and temperature ranges shall be suitable for the intended service. Thermometers shall be of the organic liquid type as approved. Terice, Marshalltown or approved equal. Where installed on salt water piping, provide corrosion resistant thermometers constructed of 316 Stainless Steel, Weiss Instruments or approved equal.

2.03 PRESSURE GAUGES

- A. Aluminum case, 4 1/2 inch dial size for water. The scale ranges, graduations, figure intervals and type of mounting shall be selected specifically for the intended service. The gauge shall be of a design that is readable from the floor.

For pumps, provide compound type gauges as indicated on the drawings. Trerice, Marshalltown or approved equal. Where installed on salt water piping, provide corrosion resistant pressure gauges constructed of 316 Stainless Steel, Weiss Instruments or approved equal.

PART 3 - EXECUTION

3.01 INSTALLATION

- A. Install piping and piping components to insure proper and efficient operation of the equipment and controls and in accordance with manufacturer's printed instructions. Proper supports for the mounting of vibration isolators, stands, guides, anchors, clamps and brackets shall be provided. Piping connections to equipment shall be arranged so that removal of equipment or components of equipment can be accomplished with the least amount of disassembly or removal of the piping system. Piping connected to equipment with vibration isolators shall be provided with flexible connections which shall conform to vibration and sound isolation requirements for the system. Electric isolation shall be provided between dissimilar metals to reduce the rate of galvanic corrosion.

- 1. Water Piping: Air vents shall be provided at high points and drains at low points in the chilled water system.

3.02 PIPING SYSTEMS

- A. Cut to the measurements established at the site and work into place without springing or forcing. Install piping with line flexibility included to absorb the expansion and contraction due to temperature changes of the piping systems. Piping line flexibility shall be achieved by the use of pipe bends or loops or bellows type expansion joints. Where piping shall pass through the structure of the building the pipe joints shall not be concealed but shall be located where they are accessible for inspection.

- 1. Flanged Joints: Faced true, square, tight and used where necessary for normal maintenance. Mate with valves and various equipment connections. Select gaskets, packing and thread compounds for suitability with the particular fluid with which they shall be in contact.
 - 2. Reducing Fittings: Shall be used to connect changes of sizes in piping lines. Branch connections shall be made with tees except that factory made forged steel welding branch outlets or nozzles having integral reinforcements and conforming to ANSI B31.1 may be used if the nominal diameter of the piping system branch does not exceed one nominal pipe size less than the nominal size of the piping segment which contains the fitting.
 - 3. Dielectric Unions or Flanges: Provide between ferrous and non ferrous piping, equipment and fittings; except that bronze valves and fittings may be used without dielectric couplings for ferrous to ferrous or non ferrous connections. Flanges and unions shall conform to the requirements of ANSI B16.10 Standard.
 - 4. Piping System Supports: Factory-fabricated by Elcen, Fee and Mason, Grinnell, or Unistrut; no chains or straps permitted. Provide concrete inserts,

beam clamps, channel framing hanger rods and accessories required for proper pipe support. Concrete inserts must be used at all pre-stressed planks.

5. Ramset or explosive type anchors are not permitted. Support steel and copper pipe at maximum spacing of 6 feet for pipes 1-1/2 inches and smaller, 10 feet for pipes 2 inches through 4 inches and 15 feet for pipes larger than 4 inches. Support vertical piping with hanger at base of riser and with pipe clamp at each floor. On vertical chilled water risers, clamps shall be mounted 2" above finished slab with steel rod supports. At each support point on insulated piping, provide Pittsburgh Corning Foamglass insulation around pipe with 18-gage sheet metal jacket each two pipe diameters in length. Pipe hangers shall be steel clevis hanger with adjustable hanger rod; 3/8-inch for pipe 2 inches and smaller, 1/2-inch for pipe 2-1/2 inches through 3-1/2 inches and 5/8-inch for pipe 4 inches and larger. Groups of lines may be supported from steel channel with pipe clamp.
6. Pipe Guides: Shall be spider type, cylindrical type or hold down slide type utilizing factory bonded graphite, teflon or oil impregnated metal matched surfaces. Teflon or oil impregnated matched surfaces shall be protected and cleaned prior to start up.
7. Condensate Drain Piping Systems: Slope lines at 1/4-inch per foot unless otherwise directed. Provide a water seal with water column 1-inch greater than the total static pressure of the fan in inches of water. Terminate condensate drain over nearest plumbing drain when not otherwise indicated. See insulation specified hereinafter.
8. Flexible Connections: Install flexible pipe connectors or couplings on piping connected to equipment. The material used and the configuration shall be suitable for pressure, temperature and circulating medium. The flexible section shall have flanged ends and shall be suitable for the service intended. The flexible section may be reinforced with metal retaining rings, with built-in braided wire reinforcement and restriction bolts or with wire braid cover suitable for the service intended.

3.03 CHILLED WATER PIPING

- A. Fabrication and Assembly of Piping and Components: Welding shall conform to ANSI B31.1 and as specified herein. Provide drain valves at low points of piping system and automatic air vent valves at high points where air pockets would occur. All piping shall follow the general arrangement shown, cut accurately to measurements established for the work by the Contractor and worked into place without springing or forcing, except where cold springing is indicated. Provide adequate clearance from walls and roofs to permit the welding of joints and re-roofing work; at least 6 inches for pipe sizes 4 inches and less, 10 inches for pipe sizes over 4 inches and in corners provide sufficient clearance to permit the welder to work between the pipe and one wall. Provision for expansion and contraction of pipe lines shall be made. Changes in size of water lines shall be made with reducing fittings. Protect materials and equipment from the weather. Use flanged joints only where necessary for normal maintenance and where required to match valves and equipment. Install joints so that flange faces bear uniformly on gaskets. All gaskets, packing and thread compounds shall be

suitable for the service. Long radius ells shall be used wherever possible to reduce pressure drops.

- B. Do not miter pipe to form elbows or notch straight runs to form full sized tees or any similar construction. All branch connections shall be made with welding tees except factory made forged welding branch outlets or nozzles having integral reinforcements conforming to ANSI B31.1 may be used, provided the nominal diameter of the branch is at least one pipe size less than the nominal diameter of the run. All piping shall be run essentially as indicated, avoid interference with other piping, conduit or equipment. Except where specifically shown otherwise, run vertical piping plumb and straight and parallel to walls. Trapping of lines shall not be permitted except as otherwise indicated. Provide sleeves of suitable size for all lines passing through building structure. Piping connected to equipment shall be installed to provide flexibility for thermal stresses and for vibration, and shall be adequately supported and anchored so that strain from weight and thermal movement of piping is not imposed on the equipment. Each section of pipe, fittings and valves shall be thoroughly cleaned and positively free of all foreign matter before erection. Prior to erection, each piece of pipe shall be held in an inclined position and thoroughly tapped to loose sand, mill scale and foreign matter. Before all final connections are made to apparatus, wash the interior of all piping thoroughly with water. Blow out piping with compressed air to remove rust chips, oil and debris. Plug or cap open ends of mains during all shutdown periods. Lines shall not be left open at any place where foreign matter might accidentally enter pipe.

1. Valves: Install at equipment to allow maintenance or isolation, and to establish proper and sequential operation of the complete system.
2. Air Vent Valves: Provide at high points in water piping. Isolate valves and pipe to run off into the nearest floor drain.
3. Access Doors: Provide where required, whether shown on drawings or not, for adequate access to controls and equipment. Where installed in fire rated ceilings or walls, provide fire rated access panels to preserve the fire rating of the assembly.

3.04 CLEANING OF SYSTEMS

- A. When installations of the various components of the piping systems are completed, they shall be cleaned with water before final closing. All piping and components shall be cleaned free of scale and thoroughly flushed of all foreign matter. All strainers and valves shall be thoroughly cleaned. Equipment shall be wiped clean, with all traces of oil, dust, dirt or paint spots removed. The Contractor shall maintain the system in this clean condition until final approval. Piping and equipment shall be cleaned and painted.
1. Safety Procedure: Ventilate work area and avoid skin contact. Solvent resistant gloves shall be used. Observe precautions and warnings on the manufacturer's product labels.

3.05 IDENTIFICATION OF PIPING

- A. Conform to Section 15000, "General Mechanical Requirements" and as specified herein. Spacing of identification marking on runs shall not exceed 50 feet. Tag equipment, gauges, thermometers, valves and controllers. Tags shall be of brass or approved nonferrous material and shall be securely mounted or attached.

3.06 FIELD INSPECTIONS

- A. Prior to initial operation the piping systems will be examined and inspected for conformance to plans and specifications and ANSI Code B31.1 for chilled water and condenser water piping. Equipment, material or work rejected because of defects or non-conformance with plans, specifications and ANSI Codes for pressure piping shall be corrected by the Contractor as directed.

3.07 FIELD TESTS

- A. After completion of the piping installation and prior to initial operation, tests shall be conducted on the piping system. Furnish materials and equipment required for tests. Defects disclosed by the test shall be corrected by the Contractor. Test after installation and prior to acceptance, shall be performed in the presence of the Owners Representative and shall be subject to its approval.
 - 1. Chilled Water Piping: Hydrostatically test in accordance with the requirements of ANSI B31.1. Test piping system at one and one-half times system pressure but at least 100 psig with water not exceeding 100 degrees F. Before tests, remove or isolate gauges, traps and other apparatus in the piping system which may be damaged. Repair leaks by tightening, re-welding joints or renewing pipe or fittings. Caulking of joints will not be permitted. Install a calibrated test pressure gauge in the system to observe loss in pressure. The required test pressure shall be maintained for a sufficient amount of time to enable an inspection to be made of joints and connections. Defects disclosed by the test shall be corrected by the Contractor.

3.08 START-UP AND OPERATIONAL TESTS

- A. The chilled water systems shall be started up and initially operated. During this time, the various strainers shall be periodically cleaned until no further accumulation of foreign material occurs. Adjust safety and automatic control instruments as necessary to place them in required operation and sequence.

END OF SECTION 15700

SECTION 15800 - AIR CONDITIONING AND VENTILATION

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
- B. Section 15000, "General Mechanical Requirements", applies to this section with the additions and modifications specified herein.

1.02 WORK SPECIFIED IN THIS SECTION

- A. Provide complete and operating air conditioning and ventilating system. "Provide" shall mean "furnish and install" when used herein.
 - 1. Electrical: Provide all temperature, pressure, flow, and indicating controls for this work. Mount control devices and provide control wiring and conduit. Furnish motor starters for equipment under this section.

1.03 RELATED WORK SPECIFIED IN OTHER SECTIONS

- A. Electrical: Mounting of starters and providing of fused or non-fused disconnect switches, circuit protection, and power wiring conduit are under DIVISION 16 ELECTRICAL.
- B. Excavation, trenching, and backfilling are under DIVISION 2 SITE-WORK.
- C. Concrete bases and supports are under DIVISION 3 CONCRETE.
- D. Painting of this work is under DIVISION 9 FINISHES, unless otherwise indicated hereinafter.

1.04 QUALITY ASSURANCE

- A. Comply with all the requirements of the County of Hawaii and State of Hawaii.
- B. Obtain and pay for all fees, permits, licenses, assessments, and inspections required for this work.
- C. Unless specified under the General Provisions of the approved Construction contract, substitutions of another manufacturer's product for equipment specified hereinafter and for items with "or equal" after the brand name requires written permission by the WHFD AND/OR PROJECT MANAGER substitution deadline. No substitution will be considered after the bid opening.
- D. Comply with the recommendations and requirements of the Codes and Standards listed hereinafter in addition to detailed requirements of this specification.

1. American Society of Heating, Refrigerating, and Air Conditioning Engineers (ASHRAE):
 - a. Handbook, Applications (Current Edition)
 - b. Handbook, Systems and Equipment – (Current Edition)
 - c. Safety Standard for Refrigeration Systems – (Current Edition)
 - d. 62.1 Standards for Ventilation and Indoor Air Quality
2. National Fire Protection Association (NFPA) Standards (Current Editions):
 - a. Air Conditioning and Ventilating Systems
 - b. Standard for Ventilation Control and Fire Protection of Commercial Cooking Operations
 - c. National Electric Code
3. Air Conditioning, Heating, and Refrigeration Institute (AHRI) Standards (Current Editions):
 - a. Forced-Circulation Air Cooling and Heating Coils.
 - b. Sound Rating of Ducted Air Moving and Conditioning Equipment
4. Air Moving and Control Association (AMCA) Standards (Current Editions):
 - a. Laboratory Methods of Testing Fans for Certified Aerodynamic Performance Rating
 - b. Reverberant Room Method for Sound Testing of Fans
5. American Society of Mechanical Engineers (ASME) (Current Edition):
 - a. Boiler and Pressure Vessel Code
6. Sheet Metal and Air Conditioning Contractors National Association (SMACNA):
 - a. Duct Construction Standards – Metal and Flexible, 1995.
7. Hawai'i State Department of Health (Current Editions):
 - a. Title 11, Chapter 11 – Sanitation
 - b. Title 11, Chapter 39 – Air Conditioning and Ventilation
8. International Building Code, with County of Hawai'i Amendments – 2012
9. International Energy Conservation Code (IECC), with County of Hawai'i Amendments – 2015

1.05 SUBMITTALS

- A. Submit under provisions of 01300 - SUBMITTALS. Submit six copies of each submittal required hereinafter.
- B. Equipment Submittals: Before beginning work, submit for review manufacturer certified literature showing ratings and dimensions of equipment and of a list indicating all materials and items that are of a different manufacturer or model than those specified. Include equipment wiring diagrams.
- C. Shop Drawings: After review of equipment, submit for review and approval dimensioned installation shop drawings to scale showing details where space requirement presents problems; proposed departures from the Contract Documents due to field conditions, requirements for concrete work, access panels, inserts in slabs, and openings in structure.
- D. As-Built Drawings: Record changes from the contract drawings of all concealed piping, duct work and equipment. Indicate location of isolating valves, dampers, and items requiring maintenance or inspection. Submit as-built drawings in accordance with Section 01300 - Submittals.
- E. Operation and Maintenance Manuals: Furnish operating and maintenance manuals on all equipment and the system as a whole and in accordance with Section 15000 - General Mechanical Requirements.
- F. Certificates: The Hospital will have the right to require a written certificate, dated and signed by a responsible employee of the Contractor, evidencing the performance of any portion of the work, or any testing; as a condition precedent to the acceptance of any work or the result of any test. Whenever a regulatory agency performs inspections or tests of any portion of the work, a certificate shall be furnished by the Contractor that the inspection or test was satisfactorily passed.
- G. Commissioning Submittals:
 - 1. Commissioning Plan
 - 2. Test Checklists and Report Forms.
 - 3. Certificates of Readiness
 - 4. Test and Inspection Reports
 - 5. Corrective Action Documents
 - 6. Commissioning Report
 - 7. System Manual

1.06 PRODUCT DELIVERY, STORAGE, AND HANDLING

- A. Furnish new equipment, material, and accessories bearing the manufacturer's identification. Coordinate deliveries to avoid interferences or construction delays.

Protect products during delivery, storage, installation and the remainder of the construction period after installation.

1.07 GUARANTEE

- A. All work in this section shall be guaranteed for a period of one year from the date of acceptance of the work as a whole by the County and as indicated in Section 15000. Correction of undue noise or vibration is included in the guarantee.
- B. Normal maintenance requirements are not included in this guarantee. Should any equipment or material fail within this period, the Contractor shall be responsible for any damage to any part of the premises caused by leaks in piping or equipment for a period of one year after final acceptance of the work as a whole by the Hospital.

PART 2 - PRODUCTS

2.01 GENERAL

- A. Asbestos Prohibition: No asbestos containing materials or equipment shall be used under this section. The Contractor shall ensure that all materials and equipment incorporated in the project as asbestos-free.

2.02 SALT CORROSION PROTECTION

- A. See Section 15000 – General Mechanical Requirements for details.

2.03 EQUIPMENT

- A. Capacities and characteristics of equipment are indicated on the drawings. See electrical drawings for all voltage and phase requirements of all equipment furnished under this work. Provide combination magnetic across the line starter and circuit breaker for each motor of mechanical equipment unless the equipment is factory wired to a single power connection or unless otherwise indicated herein-after. Provide NEMA 3R weatherproof starters with fiberglass enclosure for the outdoor installation. Provide vibration isolators as indicated hereinafter.

EQUIPMENT	ISOLATOR DESCRIPTION	MINIMUM STATIC DEFLECTION
Air Handling Units Spring Isolators	Vertically Restrained	1.00"
Air Cooled Condensing Units	Vertically Restrained Spring Isolators	1.00"
Exhaust Fan Hangers	Vertical Spring Isolator	1.00"

- B. *Isolator mounting location shall be in accordance with manufacturer's dimensioned drawings. Isolators shall be sized to provide specified static deflection from manufacturer's published loading information at each mounting point, based on operating weight.

2.04 AIR HANDLING UNIT

A. General:

- 1. Factory-assembled, horizontal return air, horizontal discharge air, draw-thru type air handler / fan coil unit suitable for concealed or exposed installation in four pipe configuration.
- 2. Unit shall be completed with water coil(s); fan(s); motor; belt drive; double sloped IAQ drain pan.

B. Construction and Components:

- 1. Construction: shall be galvanized or galvanized steel, painted with baked on polyurethane based powder coating with textured finish.
- 2. Insulation: Cabinet to be lined with choice of insulation.
 - a. Units shall be equipped with 1-in. thick, 1.5-lbs/ft³, Exact-O-Kote® IAQ insulation containing an EPA-registered immobilized antimicrobial agent tested in accordance with ASTM G21 and G22. Physical Properties:
 - 1) Temperature Limit: 250°F (121°C)
 - 2) Fire Hazard Classification: 25/50 (per ASTM E 84 and UL 723 and CAN/ULC S102-M88). Meets NFPA 90A and 90B.
 - 3) Maximum Air Velocity: 5,000 fpm (1,500 mpm). Exact-O-Kote® is tested at two and one-half times (12,500 fpm) (3,800 mpm) the maximum recommended service velocity. It meets the requirements of UL 181.
 - 4) ASTM C 1071: Exact-O-Kote® has been tested and conforms to the physical properties and requirements of ASTM C 1071.
- 3. Piping and Drain Pans: Cabinet to be equipped with choice of drain pan:
 - a. Construction:
 - 1) Piping penetrations through the cabinet will be isolated with rubber/plastic grommets or bushings.
 - 2) Drain pan will be serviceable from same end as Cooling Coil piping connections unless specified otherwise.
 - 3) When specified, metal pans will be treated externally with antimicrobial (as available)/ anti-condensation agent.

- 4) Type 304 stainless steel drain-pan shall be double-sloped for IAQ
Type 304 stainless steel drain-pan, treated externally with
antimicrobial (as available)/ anti-condensation agent, with ¾-in FPT
connection for use with ¾-in PVCx3/4-in MPT adapter.
- 4. Duct Connections: Supply and return duct connections shall be approx. one
inch long
- 5. Fans: Units shall be equipped with:
 - a. Belt-driven, double-width fan wheels shall have forward-curved blades
and be statically and dynamically balanced.
 - b. Fan drive shall consist of variable-pitch motor pulley, fixed-pitch fan pulley
and V-belt.
 - c. Fans and scrolls shall be of galvanized steel.
 - d. Removable side panels shall be provided for access to the fan/motor
assembly.
- 6. Coils: Unit shall be equipped with a standard capacity (3) or (4)-row CW/HW
or DX coil for installation in a 2-pipe system. Additional coils shall be
provided for installation in a 4-pipe system.
 - a. Coils shall have a working pressure of 400 psig at 200 F
 - b. Aluminum fins bonded to the tubes by mechanical expansion
 - c. Provide end plates and coil baffles of
 - d. 20ga SS304 stainless steel with extruded holes mechanically bonded to
tubes
 - e. Hydronic coils
 - 1) Equipped with manual air vent.
 - 2) 3/8" o.d. copper tubes
 - f. Operating Characteristics:
 - 1) A two coil unit installed in a 4-pipe system shall be capable of
providing sequenced heating and cooling as determined by the
controls provided by others.
 - g. Coil Arrangement Offering
 - 1) 6 row cooling, Up to 4 pipe reheat, 10 row max
- 7. Motor(s):

- a. General: Follow manufacturer guidelines for fan motor brake horsepower. Specifier to select from available motor options per current manufacturer catalog / software.
 - b. Types: Fan motors shall be open, drip-proof, single-speed, 60 Hz
 - c. See drawings for electrical requirements.
 - d. Motor mounted on base with tension adjustment feature.
 - e. Motor bearings will be permanently lubricated type.
 - f. Motor mounting shall be mounted on same hand as cooling coil connections unless specified differently.
8. Blowers:
- a. Statically and dynamically balanced for specified performance.
 - b. Provide ball bearing type bearings, permanently lubricated and sealed for life.
 - c. Bearings isolated from blower housing with elastomer mounts.
 - d. Blower housing isolated from cabinet by elastomer separator.
 - e. Provide wheel as appropriate to application
 - f. Forward curved
9. Drive System:
- a. Equip with variable pitch drive pulley, fixed diameter driven sheave and keyed shaft.
10. Filters: See drawings for details.

2.05 VARIABLE FREQUENCY DRIVE

A. Variable Frequency Drives Acceptable Manufacturers

- 1. Franklin Control Systems P-Series, Q-link not acceptable.
- 2. Eaton

B. General Design

- a. All VFD's must be solid state, utilizing PWM control with energy optimizing control algorithms for lower operating temperature.
- b. VFD's shall be current rated, with each model capable of operating on voltages of 200~480 VAC +/- 10%, 3 Phase.

- c. VFD's shall be suitable for use on a circuit capable of delivering not more than 100,000 rms symmetrical amperes, 480 V per UL 61800-5-2 guidelines, without the use of external fused protection. Manufacturer's short circuit testing shall be performed at full rated capacity of 100,000 Amps.
 - d. The VFD must be minimum UL Type 1 for indoor applications, and UL Type 3R for outdoor applications.
 - e. VFD must utilize R3Filtering or equivalent to reduce harmonics on the line side of the VFD. Harmonic mitigation shall reduce THDi to 35% or less without the use of external reactors or filters.
 - f. With cover removed, VFD shall have a minimum IP20 (finger safe) rating, with high voltage terminals protected from contact with the installer/operator.
 - g. Circuit boards shall be conformal coated to protect against dust and corrosion.
 - h. VFD cooling fans shall be easily replaceable without the use of special tools, or removal of the VFD from the wall. Cooling fans shall also be replaceable without removal of circuit boards, field wiring, and factory wiring. Cooling fans shall only run when needed based on the internal temperature of the VFD.
 - i. Programming of the VFD shall be HVAC specific, with guides that walk the operator through the start-up procedure with access to troubleshooting info through the display.
 - j. All VFD shall include two independent analog inputs as standard, programmable for 0 –10VDC or 4-20mA. Both analog inputs shall be utilized as speed references, or as PID inputs. The analog inputs shall be programmed as an individual reference at a time, or as a combined reference together.
 - k. There shall be a minimum of (2) configurable digital inputs, and (2) configurable voltage inputs. Digital inputs shall be configurable as normally open or normally closed, and be rated up to 8mA at 24 VDC. Voltage inputs shall be capable of interfacing with 12-240V, 8mA max.
 - l. There shall be a minimum of (1) relay outputs rated up to 1 amp at 240 VAC normally open contact. Relay shall be configurable for Fault, Run and status. 240V 1A maximum rating.
2. AC Line Reactors And DC Filters
- a. Provide ac line reactor to reduce harmonics.
 - b. Provide dc filters when cable lengths are greater than 20'.
3. Keypad

- a. The VFD display shall be a backlit, full color OLED display. The VFD shall display information in complete English words (alpha-numeric codes are not acceptable unless accompanied by complete English descriptions on the display). Faults shall also be written in complete English words.
 - b. The VFD shall have dedicated HOA buttons, and LED indicator lights to clearly designate HOA position.
 - c. The VFD display shall clearly indicate the operational state of the VFD, in addition to running values on the home (default) screen. This shall include at minimum:
 - 1) Run status
 - 2) Fault status
 - 3) Forward/Reverse
 - 4) Speed in Hz or RPM
 - 5) Running current
 - 6) Average RMS voltage
 - 7) Run source (Terminal, Keypad, HOA, Communications)
 - 8) Min/Max Speed
 - 9) PID set point, and min/max units when running in PID mode
 - d. VFD keypad shall be capable of passcode protection.
4. Electrical Ratings
- a. Voltage: Input 200~480 VAC +/- 10%, 3 phase, 48-63Hz
 - b. Output Frequency: 0-400 Hz
 - c. Power factor: $\geq .99$
 - d. Efficiency: $\geq 98\%$, full load
 - e. Overload capacity: 110% for 60s @ 40°C, 83% for 30s @ 50°C
 - f. Carrier Frequency: 2kHz - 10kHz, 0.1kHz resolution, Default 2.5kHz
 - g. Harmonics: R3Filtering $\leq 35\%$ THDi, without external reactors or filters
 - h. EMI/RFI: VFD's shall include EMI/RFI filters acceptable for the 1st Environment (Category C2), compliant to EN 61800-3 Radiated and Conducted Emissions

5. Environmental Ratings

- a. Temperature
 - 1) Operating Temperature: -10 to 40°C
 - 2) Storage Temperature: -20 to 65°C
 - b. Altitude
 - 1) Max 1000m above sea level
 - 2) De-rate 1% per 100m from 1000-2000m and 2% per 100m from 2000-3000m
 - c. Humidity: 95% relative humidity, non-condensing
 - d. Enclosures
 - 1) UL Type 1 minimum for indoor mounting locations
 - 2) UL Type 3R minimum for outdoor mounting locations
 - 3) VFD shall be IP20 (finger safe) with cover removed
6. Standard Features
- a. VFD shall provide start-up report in PDF format that details all running values, and settings. All settings that have been changed from factory default shall be highlighted in the report such that changes are easily distinguishable.
 - b. The VFD shall incorporate a real-time clock with battery back-up allowing faults and setting changes to be logged with real time and date. The battery shall replaceable without removal of factory wiring or circuit boards. Battery shall have a minimum life span of 10 years under normal operating conditions.
 - c. All programming shall be HVAC specific, with common HVAC applications available to expedite the start-up process by automatically adjusting parameters according to the application selected.
 - d. All VFD must have a motor preheat function to prevent moisture accumulation in an idle motor.
 - e. All VFD must be capable of maintaining a set point via microprocessor based PID control on closed loop systems utilizing external 4-10mA, or 0-10V analog transmitters. VFD's must be capable of providing auxiliary power up to 0.5 amp at 24 VDC for external transmitters. PID set points shall be adjustable via the VFD keypad, communication protocols. Digital inputs shall be programmable to switch between pre-configured user defined set points.

- f. PID: Control action, proportional plus integral derivative.
- g. All VFD display units shall be selectable, and shall automatically adjust based on Applications selected at start up. VFD shall be capable of displaying PSI, Degrees F/C, inWC, Bar, mBar, Pa, kPa.
- h. VFD's shall have sleep and wake functions to save energy when set point is met in PID mode, and there is no additional demand on the system.
- i. Sleep boost functionality shall be used on PID controlled pressurized water systems to ensure the drive doesn't start and stop too frequently when at or near the desired pressure set point .
- j. The VFD shall provide frequency setting resolution of 0.01 Hz when its Digital Reference is utilized below 100 Hz and 0.1 Hz over 100 Hz. The VFD shall provide frequency setting resolution of 0.03 Hz / 60 Hz when Analog Reference is utilized.
- k. The VFD shall have the ability to automatically restart after an over-current, over-voltage, under-voltage, or loss of input signal protective trip. The number of restart attempts, trial time, and time between reset attempts shall be programmable.
- l. The VFD shall be capable of both Automatic and Manual Torque Boost function to overcome sudden fluctuation of the load.
- m. The VFD shall be capable of starting into a rotating load (forward or reverse) and accelerate or decelerate to set-point without safety tripping or component damage (flying start).
- n. All VFD shall have 1 analog output (0-10VDC) which can be programmed to function as one of the following: Output Frequency, Output Current, and DC Bus Voltage. Default is set to Output Frequency.
- o. If the input reference (4-20mA or 0-10V) is lost, the VFD shall give the user the option of either (1) stopping and automatically reset once a signal restored (2) displaying a fault, (3) holding the VFD speed based on the last good reference received 1 second prior to losing the signal. The drive shall be programmable to signal this condition via a keypad warning, relay output and/or over the serial communication bus.
- p. The customer terminal strip shall be isolated from the line and ground.
- q. The VFD shall have dedicated damper control terminals capable of providing up to 1 amp, 24VDC to open a damper actuator, and ensure end switch closure with normally open dry contact. To ensure proper damper functionality a damper time delay shall be programmable. The VFD shall fault in the event that the damper fails to make contact with the end switch within the user defined time delay. Use of external relays and CPT's is prohibited unless damper loads exceed 1 Amp max.
- r. The Maximum current limit shall be fixed at 150% (minimum, instantaneous) of the VFD normal duty current rating.

- s. The VFD shall be capable of 3 preset speeds that are activated via Digital Input Terminals.
- t. The VFD shall provide from 1 to 6000 seconds of Acceleration and Deceleration time setting parameters.
- u. The VFD shall be optimized for various levels of carrier frequency programmable from 2 to 10 kHz to reduce motor noise and to provide high system efficiency.
- v. VFD's shall have a minimum of 3 critical lockout skip frequency ranges. Low and high frequency settings shall be programmable for each lockout skip frequency range.
- w. VFD's shall be capable of recording minimum of 100 faults and 25 setting changes with true time and date stamping. Faults and settings shall be downloadable in PDF format.
- x. VFD's shall allow settings to be stored as configuration templates in manufacturer provided mobile application. Configuration templates shall be capable of being uploaded into un-configured VFD's to expedite the start-up process.
- y. The VFD shall have the following protection features. In the case of a protective trip, the drive shall stop and announce the fault condition. Options shall be available for faults to auto reset and retry with adjustable time delay. When VFD's are in fault conditions, display shall clearly indicate the name of the fault in plain English. Fault codes are not acceptable. The display shall also clearly indicate if the VFD is awaiting an automatic restart by counting down time until next restart.
 - 1) Motor overload
 - 2) Motor overcurrent
 - 3) VFD overcurrent
 - 4) VFD short circuit
 - 5) Overvoltage
 - 6) Undervoltage
 - 7) Input phase open
 - 8) Output phase open
 - 9) No motor
 - 10) Ground Fault
- z. The VFD shall have the following faults to ensure desired operation

- 1) BMS communication loss
 - 2) Speed signal loss
 - 3) Transducer failure
- aa. All VFD shall be capable of configuring digital inputs or voltage inputs for dedicated shutdown, or fireman's override functionality under the following premise.
- 1) Shutdown
 - a) When configured for shutdown, the digital input or voltage input terminal shall override all other commands and stop the VFD in any mode. This condition shall be stored in the VFD fault log.
 - 2) Fireman's Override
 - a) When configured for Fireman's Override, the digital input or voltage input terminal shall override all other commands and run the VFD at user defined preset speed until the terminal is deactivated. During a Fireman's override condition, all non-critical faults shall be ignored, and VFD shall "run to destruct" if configured terminal is not deactivated. Once the override signal is removed the VFD shall automatically return to normal operation.

7. Communications

- a. All VFD's must have RS-485 ports as standard. The following BAS communication protocols shall be native to the VFD, without the need for option boards:
 - 1) BACnet MS/TP
 - 2) Modbus TCP
- b. Serial communications shall include the following capabilities; start/stop and speed control, monitoring of all running values, fault and alarm indication, fault detail, power consumption data, I/O configuration and status, VFD firmware and hardware identification, configuration of startup parameters, and configuration of protective functions.
- c. VFD's must be accompanied by wireless mobile application to assist with start-up, troubleshooting, uploading/downloading of parameters, firmware updates, reporting, and fault logging. Application to be provided at no additional charge.
- d. Minimum 128-bit AES encryption shall be used for any wireless communication.

8. Bypass

- a. VFD Bypass shall be integral to the VFD, and provide the same level of protection as the base VFD unit when in Bypass mode. Thermal overload protection is not acceptable.
- b. VFD Bypass shall not have a separate set of customer control terminals. A single set of control terminals shall be provided, with electrical isolation and control logic isolation to ensure bypass operation is unaffected in the event of VFD failure.
- c. VFD shall have the ability to automatically switch to bypass mode in the event of a VFD fault. For protective functions with automatic restart enabled, the VFD shall attempt to restart in VFD mode prior to switching to bypass. Auto-bypass functionality shall be user selectable.
- d. Bypass shall maintain BACnet or Modbus communication when in bypass mode, and in the event of VFD failure.
- e. Bypass shall have the following SmartStart protection features to ensure smooth across the line operation when in bypass mode:
 - 1) Stall prevention
 - 2) Locked rotor
 - 3) Max time to start
- f. Bypass shall be capable of monitoring current. Thermal overload protection is not acceptable.
- g. VFD bypass shall maintain control by monitoring the VFD's analog input. This will control the bypass in an on or off state to maintain desired setpoint/process output.

2.06 VARIABLE AIR VOLUME TERMINAL UNITS

- A. General: Factory-assembled, externally powered, variable air volume control terminal. Unit shall be complete with a damper assembly, flow sensor, externally mounted volume controller, collars for duct connection and all required features. Control box shall be clearly marked with an identification label that lists such information as nominal cfm, maximum and minimum factory-set airflow limits, coil type and coil hand, where applicable.
- B. Unit Cabinet:
 - 1. Constructed of 22-gage galvanized steel with round, rectangular or flat oval inlet collar and rectangular discharge with slip and drive connection.
 - 2. Insulated with 1 inch thick, 1.5-lb equivalent density mat-faced insulation. The insulation shall meet UL 181 and NFPA 90A. It shall be enclosed between the unit's zinc coated sheet metal casing and a non-perforated internal zinc-coated sheet metal cover, which extends over the fiberglass insulation, as well as the cut edges of the material.

C. Damper Assembly: The damper assembly shall be composed of multiple 16-gage damper blades located in a 16-gage damper frame, utilizing steel damper linkages and mounted on nylon self lubricating blade bearings. Dampers shall have an open cell foam damper seal affixed to the blade, providing a maximum of 2% of the maximum rated capacity with dampers closed with an inlet pressure of 3 in. wg. Damper assembly will consist of either 4 or 6 blades with a 90 degree travel, and shall provide uniform air delivery over the entire face of the unit at all flows.

D. Controls:

1. Units shall have electronic controls capable of maintaining required airflow set-points +/- 5% of the unit's capacity at any inlet pressure up to 6 in. wg. The controller shall be capable of resetting between factory or field-set maximum and minimum (>350 fpm inlet duct velocity) set points to satisfy the room thermostat demand.
2. The unit shall be equipped with a double ended amplified linear averaging flow probe located horizontally across the inlet. The probe shall have capped ports at the end opposite to the controller connection for flow verification in the field against provided flow/pressure charts. The sensor will provide a differential pressure signal amplified to equal 3 times the velocity pressure with an accuracy of +/- 10% throughout the range of 350 to 2600 fpm inlet duct velocity.

E. Special Features:

1. Hot Water Heating Coil:
 - a. Coil shall be mounted in a minimum 20-ga. galvanized steel casing with slip and drive discharge connections and factory mounted on the base unit as shown on the equipment drawings.
 - b. Coils shall have:
 - 1) Aluminum fins (10 ft per in.) bonded to the copper tubes by mechanical expansion.
 - 2) Number of coil rows and circuits shall be selected to provide performance as required by the plans.
 - 3) Up to 4 rows as shown on equipment drawings or designed on the equipment schedule. Right or left-hand fittings with sweat connection sizes as indicated on equipment drawings.
2. Sound Attenuator: The sound attenuator section shall consist of a continuous extension of the standard zinc coated steel casing.
3. Control Transformers:
 - a. Electric heat units shall include a factory supplied, mounted and wired control transformer inside the electric heat enclosure for electronic control applications.

- b. Non-electric heat units, with electronic controls, shall be provided with a factory supplied, mounted, and wired control transformer, mounted inside the control enclosure.
- 4. Hanger Brackets: Shall be field-installed for use with ceiling installation of the terminal unit.
- 5. Non-Fused Disconnect: Non-fused switch shall provide unit power shutoff. Shall be accessible from outside the unit and shall provide power off lockout capability.

2.07 UV LAMPS

A. UV lamps shall be Totaline Germicidal Purification UV Dual Lamps.

- 1. Non ozonating lamp.
- 2. Dual 36 watt-254 nanometer UVC lamps.
- 3. Anodized aluminum parabolic reflectors.
- 4. Lamps shall have a minimum 9000 Life-Hours.
- 5. 24/120 Volt operation
- 6. Magnetic mounting base
- 7. Extended range ballast
- 8. Delta plate option

2.08 DRAIN PAN WATER SWITCH

- ### A. Provide electronic water switch in secondary drain pans where indicated on drawings. Switch shall sense the presence of water and shut down associated equipment upon moisture detection. Switch shall be configured as fail-safe, and be rated for capacity of 250v 5 amps (max). Switch shall be provided by the mechanical contractor and wired by the electrical contractor. Wire per manufacturer's instructions, test switch after performance verification of air conditioning system to ensure proper operation.

2.09 VALVES

- ### A. Safety Relief Valves: Provide bodies of forged brass with nonferrous, corrosion resistant internal working parts or high strength, cast iron bodies conforming to ASTM A126, Grade B with corrosion resistant internal working parts. Brass Bodies shall have brazing connections. Cast iron body valves shall have flanged connections. Set valves in accordance with ASHRAE 15.
- ### B. Control Valves:
- 1. 2-way characterized control valve with stainless steel ball and stem.

2. Spring return control damper actuators shall be direct coupled type which require no crank arm and linkage and be capable of direct mounting to a jackshaft up to a 1.05" diameter. The actuator must provide proportional damper control in response to a 2 to 10 VDC or, with the addition of a 500Ω resistor, a 4 to 20 mA control input from an electronic controller or positioner. The actuators must be designed so that they may be used for either clockwise or counterclockwise fail-safe operation. Actuators shall use a brushless DC motor controlled by a microprocessor and be protected from overload at all angles of rotation. Run time shall be constant, and independent of torque. A 2 to 10 VDC feedback signal shall be provided for position feedback. Actuators shall be cULus Approved and have a 5 year warranty, and be manufactured under ISO 9001 International Quality Control Standards. Actuators shall be as manufactured by Belimo.

2.10 CONDENSATE DRAIN PIPING

- A. Condensate drain piping shall be Schedule 80 PVC pipe and drainage pattern fittings with solvent welded joints. Provide seal trap at connection to unit and size according to system static pressure. Provide cleanouts at every change in direction of the condensate piping. All interior condensate drain piping shall be insulated per Section 15250 – Insulation of Mechanical System.

2.11 DUCT WORK AND ASSOCIATED SHEET METAL WORK

- A. All low velocity ducts shall be galvanized steel with gages and construction in accordance with SMACNA Duct Construction Standards – 2005. Use of duct board will not be approved.
- B. All high velocity ducts shall be galvanized steel with gages and construction in accordance with SMACNA Duct Construction Standards – 2005. Use of duct board will not be approved.
- C. Splitter damper shall be adjustable with locking quadrant.
- D. Flexible connections shall be U/L approved neoprene-coated glass fabric cloth.
- E. Flexible duct shall be U/L labeled with 1 inch thick fiberglass insulation and externally insulated.
- F. All sheet metal duct work shall be sealed at all joints and made air tight by applying an approved sealant compound around all joints per the manufacturer's recommendations.

2.12 AIR DISTRIBUTION DEVICES

- A. All aluminum construction for face plates, frames and grilles:
 1. Ceiling Diffusers:
 - a. All aluminum construction, square surface mount. Finish to be determined by WHFD AND/OR PROJECT MANAGER. Provide lay-in diffuser where indicated on plan. Titus TDC-AA or approved equal. Provide lay-in register where indicated on plan.

- b. All aluminum construction, square surface mount. Finish to be determined by WHFD AND/OR PROJECT MANAGER. Provide lay-in diffuser where indicated on plan. Titus 300FS or approved equal. Provide lay-in register where indicated on plan.
- 2. Return Air Registers:
 - a. All aluminum construction, square surface-mounted with opposed-blade volume damper. Finish to be determined by WHFD AND/OR PROJECT MANAGER. Provide lay-in register where indicated on plan. Titus 350FL-AA or approved equal.
- 3. Volume Dampers: All aluminum construction with locking device. Contractor shall provide access doors at all volume damper locations to provide for adjustments during balancing of the air conditioning system. Where installed in fire rated assemblies, access doors shall be rated to preserve the fire rating of the assembly. Ruskins or equal.
- 4. Exhaust Registers/Wall Registers: All aluminum construction, surface-mounted with opposed-blade volume damper. Finish to be determined by WHFD AND/OR PROJECT MANAGER. Titus 350 or approved equal.
- 5. Backdraft Dampers: All aluminum construction, counter weighted and field adjusted to provide positive seal against reverse flow or air conditioned air. Ruskins or approved equal.
- B. Fire Dampers: Shall be UL555 rated, dynamic type, and constructed of galvanized steel. Fire dampers shall have 1-1/2 hour rating for fire rated assemblies of less than 3 hours and 3 hour rating for fire rated assemblies of 3 hours or more. Provide air tight duct access panels as required for routine maintenance of the fire dampers. Temperature rating of the fire damper shall be 165°F.
- C. Fire Smoke Dampers: Combination fire smoke dampers meeting or exceeding the following specifications shall be furnished and installed at locations shown on plans or as described in schedules. Combination fire smoke dampers shall be produced in an ISO 9001 certified factory and shall be warranted to be free from defects in material and workmanship for a period of 5 years after date of shipment. Dampers shall meet the requirements of NFPA 80, 90A, 92A, 92B, 101 and 105 and shall have a fire rating of 1.5 hours in accordance with the latest edition of UL555 and shall be classified as Leakage Class II Smoke Dampers in accordance with the latest version of UL555S.
 - 1. Damper frame (when size permits) shall be minimum 16 gauge galvanized steel formed into a structural hat channel superior to 13 gauge channel frame. Damper blades shall be single piece airfoil shaped with 14 gauge equivalent strength and shall run vertically within the frame. Blade edge seals shall be inflatable silicone mechanically locked into blade edge. Jamb seals shall be stainless steel compression type. Bearings shall be stainless steel, permanently lubricated sleeve type turning in an extruded hole in the frame for maximum life.

2. Combination fire smoke dampers and their actuators shall be qualified in accordance with UL555S to an elevated temperature of 250°F (121°C) or 350°F (177°C) depending upon the actuator. Appropriate electric or pneumatic actuators (specifier select one) shall be installed by the damper manufacturer at time of damper fabrication. Electric actuators, factory installed on dampers, shall have been tested for prolonged periods of holding (minimum 1 year) with no evidence of reduced spring return performance. Each damper shall be rated for leakage and airflow in either direction through the damper. Ruskin FSD or approved equal.

2.13 MOTORIZED DAMPERS

- A. All aluminum construction with opposed blades. Actuator shall be powered by 24 Vdc input with modulating control signal, 0-10 Vdc or 4-20 mAdc. Actuator shall be externally mounted. Return air dampers shall spring return to open position, Outside Supply Air (OA) dampers shall spring return to closed position.

2.14 HEPA FILTER AND HOUSING

A. General

1. HEPA filters shall be TRI-PURE 2000 High Capacity HEPA Filters as manufactured by Tri-Dim.
2. Filter sizes, efficiencies and capacities shall be as scheduled on the drawings.

B. Filter Construction

1. Filters shall be constructed with twelve 1" pleated media packs arranged in a V-bank configuration. The media packs shall be formed by pleating wet laid micro fiberglass media with continuous beads of a cured, nonvolatile adhesive.
2. The filter frame shall be 20 ga. stainless steel and shall consist of eight C-channel supports attached without the use of mechanical fasteners. The media packs shall be sealed around the entire periphery to the frame with two-component polyurethane.

C. Performance

1. The minimum filter efficiency shall be 99.99% at 0.30 µm when tested with polydisperse DOP aerosol at the rated airflow.
2. The maximum pressure drop shall be 0.25" w.g. at 250 FPM.

D. Filter Housings

1. Side access HEPA filter housings shall be Tri-Lock GS/FS HEPA Housing as manufactured by Tri-Dim.
2. Unit shall be a factory-assembled air-tight housing with upstream and downstream outwardly-turned flanges for installation in the ductwork.

3. Housings shall be suitable for operation + 8 in. w.g. internal static pressure.

E. Filter Housing Construction

1. Housing construction shall be of stainless steel. Metal-to-metal joints shall be welded. Prefilter tracks, if required, shall be stainless steel and incorporate a pile gasket to ensure sealing of the filter to the track.
2. Each HEPA filter shall be secured in place with four spring-loaded swing-arm assemblies to provide positive sealing of the HEPA filter to the mounting surface.
3. Access doors shall be hinged/removable and shall have continuous neoprene gasketing on the perimeter. They shall be equipped with positive pressure adjustable latches with easy-grip knobs.

2.15 MERV 14 FILTER HOUSING

- A. Filter sizes, efficiencies and capacities shall be as scheduled on the drawings.
- B. Welded, flat filter bank. Stainless steel construction
- C. Positive-tension door locks
- D. Two doors, one on each side.
- E. Perimeter gasketing around door
- F. Perform up to +/- 3" W.G.
- G. Static ports

2.16 OCCUPANCY SENSORS

- A. The Dual Technology sensor shall be capable of detecting presence in the control area by detecting doppler shifts in transmitted ultrasound and passive infrared heat changes.
- B. Sensors shall use patent pending ultrasonic diffusion technology that spreads coverage to a wider area.
- C. Sensor shall utilize Dual Sensing Verification Principle for coordination between ultrasonic and PIR technologies. Detection verification of both technologies must occur in order to activate lighting systems. Upon verification, detection by either shall hold lighting on.
- D. Sensor shall have a retrigger feature in which detection by either technology shall retrigger the lighting system on within 5 seconds of being switched off.
- E. Sensors shall be ceiling mounted with a flat, unobtrusive appearance and provide 360° coverage.

- F. Ultrasonic sensing shall be volumetric in coverage with a frequency of 40 KHz. It shall utilize Advanced Signal Processing that automatically adjusts the detection threshold dynamically to compensate for changing levels of activity and airflow throughout controlled space.
- G. To avoid false ON activations and to provide immunity to RFI and EMI, Detection Signature Analysis shall be used to examine the frequency, duration, and amplitude of a signal, to respond only to those signals caused by human motion.
- H. The PIR technology shall utilize a temperature compensated, dual element sensor and a multi-element Fresnel lens. The lens shall be Poly IR4 material to offer superior performance in the infrared wavelengths and filter short wavelength IR, such as those emitted by the sun and other visible light sources. The lens shall have grooves facing in to avoid dust and residue build up which affects IR reception.
- I. Sensors shall operate at 24 VDC/VAC and halfwave rectified and utilize a Watt Stopper power pack.
- J. Sensors shall utilize SmartSet™ technology to optimize time delay and sensitivity settings to fit occupant usage patterns. The use of SmartSet shall be selectable with a DIP switch.
- K. Sensors shall have a time delay that is adjusted automatically (with the SmartSet setting) or shall have a fixed time delay of 5 to 30 minutes, set by DIP switch.
- L. Sensors shall feature a walk-through mode, where lights turn off 3 minutes after the area is initially occupied if no motion is detected after the first 30 seconds.
- M. The sensors shall have a built-in light level sensor that works from 10 to 300 foot candles.
- N. The sensors shall have a manual on function that is facilitated by installing a momentary switch.
- O. Sensors shall have eight occupancy logic options that give the ability to customize control to meet application needs.
- P. The sensors shall feature terminal style wiring, which makes installation easier.
- Q. DT-300 sensor shall have an additional single-pole, double throw isolated relay with normally open, normally closed and common outputs. The isolated relay is for use with HVAC control, data logging, and other control options.
- R. Each sensing technology shall have an LED indicator that remains active at all times in order to verify detection within the area to be controlled. The LED can be disabled for applications that require less sensor visibility.
- S. To ensure quality and reliability, sensor shall be manufactured by an ISO 9002 certified manufacturing facility and shall have a defect rate of less than 1/3 of 1%.
- T. Sensors shall have standard 5 year warranty and shall be UL and CUL listed.

2.17 VELOCITY SENSORS

A. General

1. Provide one Airflow Measuring Device (AMD) for each measurement location provided on the plans, schedules and/or control diagrams to determine the average airflow rate at each measurement location.
2. Each AMD shall be provided with one sensor probe with a maximum of two sensor nodes and an integral microprocessor-based electronic transmitter.
 - a. Devices that have electronic signal processing components in the sensor probe are not acceptable.
3. Airflow measurement shall determine the average actual airflow rate.
4. Temperature output shall provide the velocity weighted average temperature from multiple sensing nodes.

B. Sensor Probes

1. Sensor probes shall be constructed of 6063 extruded aluminum alloy tube.
2. Sensor probe mounting brackets shall be constructed of 304 stainless steel.
3. Probe internal wiring between the connecting cable and sensor nodes shall be Kynar coated copper.
 - a. PVC jacketed internal wiring is not acceptable.
4. Probe internal wiring connections shall consist of solder joints and spot welds.
 - a. Connectors of any type within the probe are not acceptable.
 - b. Printed circuit boards within the probe are not acceptable.
5. Each sensor node shall be provided with two bead-in-glass, hermetically sealed thermistors potted in a marine grade waterproof epoxy.
 - a. Devices that use epoxy or glass encapsulated chip thermistors are not acceptable.
6. Each thermistor shall be individually calibrated at a minimum of 3 temperatures to NIST-traceable temperature standards.
7. Each sensor node shall be calibrated to volumetric standards at a minimum of 7 calibration points.

8. The number of independent sensor nodes provided shall be as follows:

<u>a. Diameter - in [mm]</u>	<u># Sensor Nodes</u>
4 [101.6]	1
≥ 5 & ≤ 16 [≥ 127 & ≤ 406.4]	2

C. Transmitter

1. An integral microprocessor-based transmitter shall be provided for each measurement location, with simple DIP switch user interface for set up.
2. All printed circuit board interconnects and test points shall be gold plated.
3. All printed circuit boards shall be electroless nickel immersion gold (ENIG) plated.
4. The transmitter shall be capable of determining the average airflow rate and average velocity-weighted temperature of the sensor nodes in the array.
5. The transmitter shall be capable of identifying an AMD malfunction and ignore any sensor node that is in a fault condition.
6. The transmitter shall be provided with one of the following:
 - a. Two scalable, protected and field selectable analog output signals (0-5/1-5 VDC or 0-10/2-10 VDC, AO1= Airflow, AO2= Temperature)
 - b. One non-isolated RS-485 network connection (field selectable BACnet MS/TP or Modbus RTU). Provide individual 24 VAC transformers at each network transmitter requiring isolated RS-485 connection.
7. The transmitter shall provide a sensor diagnostic system on board, with system status alarm (trouble indication), with visual indication of LED on the circuit board.
8. Network communications shall provide the average airflow rate, temperatures, individual sensor node airflow rates and individual sensor node temperatures.
9. The transmitter shall be powered by 24 VAC (22.8 to 26.4 under load) @5 V-A.
10. The transmitter shall use a "watchdog" timer circuit to ensure continuous operation in the event of brown-out and/or power failure.

D. Performance and calibration

1. Each sensing node shall have an airflow accuracy of $\pm 3\%$ of reading (typical) $\pm 4\%$ max. from 0 to 3,000 FPM (15.24 m/s) over a temperature range of 0° F to 160° F (-18° to 71° C). Airflow accuracy shall be maintained at lower operating temperatures of -20° F to 160° F (-29° C to 71° C) but the velocity range shall be limited to 0 – 2,000 FPM (10.2 m/s).

- a. Accuracy shall include the combined uncertainty of the sensor nodes and transmitter.
 - b. Devices whose overall performance at the host controller input terminals is the combined accuracy of the transmitter and sensor probes shall demonstrate that the total accuracy meets the performance requirements of this specification throughout the measurement range.
- 2. Each sensor node shall be factory calibrated at a minimum of 7 airflow rates including zero (still air), to NIST Traceable standards.
- 3. Each thermistor shall be individually calibrated at a minimum of 3 temperatures to standards that are traceable to the National Institute of Standards and Technology (NIST).
- 4. Each sensing node shall have a temperature accuracy of $\pm 0.15^{\circ}\text{F}$ ($\pm 0.08^{\circ}\text{C}$) over a calibrated range of -20°F to 160°F (-28.9°C to 71.1°C).
- 5. Minimum calibrated and operating temperature range for the sensor probes shall be -20°F to 160°F (-28.9°C to 71.1°C).
- 6. Operating temperature range for the transmitter shall be -20°F to 120°F (-28.9°C to 48.9°C).
- E. Listings and Certifications
 - a. The AMD shall be UL 60730-1 and 60730-2-9 Listed as an assembly and subscribed to the UL Follow-up Services.
 - b. Devices claiming compliance with the UL Listing based on individual UL component listings are not acceptable.

2.18 NETWORK THERMOSTAT AND RH SENSOR

- A. Compatible with existing Delta Controls network.
- B. Built-in $10\text{k}\frac{1}{2}$ thermistor.
- C. Built-in humidity sensor
- D. LINKnet communications.
- E. Programmable 3-value, 96 segment, LCD display (via GCL+ over LINKnet) with optional backlighting
- F. 4 Programmable Buttons (via GCL+ over LINKnet)
- G. Optional buttons for fan speed control when used with Delta Fan Coil Controllers (DFC's)
- H. Service port
- I. LCD

1. 3-value and various icons (96 total segments) with optional backlighting
- J. Push Buttons
1. 4 stylized momentary push buttons
- K. Temperature Sensor
1. Thermistor Input – 10k $\frac{1}{2}$ @ 77°F (25°C)
 2. Accuracy of +/- 0.36°F from 32° - 158°F (+/- 0.2°C from 0 - 70°C)
 3. Display Resolution of 0.1 °
 4. Stability of 0.24 °F over 5 years (0.13 °C)
- L. Humidity Sensor
1. Accuracy of +/- 3%RH from 20% -80% RH (linearized accuracy of +/- 3% to +/- 5% from 0-20% and 80-100% RH)
 2. Display Resolution of 0.1%
 3. Stability of < 0.5% RH/yr (typical)
- M. Technology
1. 8-bit processor with internal A/D, Flash, and RAM
- N. Device Address
1. Set via DIP switches
- O. Communications Port
1. Delta LINKnet @ 76800 bps
 2. (maximum 12 devices, depending on the controller, with no more than 2 DFM devices per LINKnet segment)
- P. Connectors
1. Screw-type terminal connectors
- Q. Wiring Class
1. Class 2
- R. Power
1. 24V AC

- 2. 5 VA
- S. Ambient
 - 1. 32° to 131°F (0° to 55°C)
 - 2. 10 to 90% RH (non-condensing)
- T. Compliance
 - 1. CE
 - 2. FCC
- U. Listings
 - 1. UL 916 Listed

2.19 ROOM PRESSURE MONITOR

- A. Supply Voltage
 - 1. 24 Vac/dc $\pm 10\%$, 70 mA max
- B. Signal Output
 - 1. (Volts, Current, Switch)
- C. Voltage
 - 1. (3w) 0 to (5,10) VDC @2 K Ω min
- D. Current
 - 1. (3w) 4-20mA sourcing, 750 Ω max
- E. Alarm Relay
 - 1. SPST N.O., 2A @120VAC or 30 VDC
- F. ALM. Limits
 - 1. Adjustable High & Low pressure limits
- G. ALM. Delay
 - 1. Selectable 0-10 minutes
- H. Setpoint (SP)
 - 1. Adjust Local Set on touch screen for alarm relay

- I. Control Type
 - 1. Single room differential pressure monitor
- J. Communication
 - 1. BACnet MS/TP
- K. Field Interface Devices
 - 1. RPS SS room pressure probe
- L. Display/Audible
 - 1. Red LED for alarm
- M. Display 3-1/2 digit backlit LCD, 0.45"H, (WC or Pa)
- N. Audible (Internal) 85 dB buzzer w/silence button, (Selectable volume)
- O. Audible Output
 - 1. 24VDC @20mA max
- P. Accuracy
 - 1. Auto zero internal push button
 - a. $\pm 1\%$ F.S. from ($\pm 1"$ to $\pm 0.25"$) WC
 - b. $\pm 2\%$ F.S. at $\pm 0.125"$ WC
- Q. Resolution
 - 1. Averaging from 1-60 sec., menu selectable (5s default)
- R. Sensor Type
 - 1. ASIC silicon sensor
- S. Normal Measurement
 - 1. Low Range Field Selectable
 - a. $\pm 0.25"$ or $\pm 0.125"$ WC, (± 60 Pa or ± 30 Pa)
- T. Overpressure (Burst)
 - 1. 200"WC (49.8 kPa)
- U. Max Operating Pressure (Proof)

1. 100"WC (24.9 kPa)

V. Operating Temperature

1. 32° to 140°F (0° to 60°C)

W. Operating Humidity

1. 10-90% RH non-condensing

X. Wetted Parts

1. Silicone

Y. Media Compatibility

1. Inert dry air

Z. Process Connection

1. Two-1/8" ID ports w/Adapters, for 1/4" OD tubing

AA.Wiring Terminations

1. 5-8 Terminals (14-22 AWG)

BB.Mounting

1. Slotted back plate for surface or BB wall mount

CC. Enclosure Rating

1. NEMA 1 (IP30), White ABS plastic

DD. Dimensions: 3.3"W x 4.7"H x 1.15"D, (8.4 x 11.9 x 2.9 cm)

EE.Weight

1. 0.25 lb (0.11 kg)

FF.Approvals

1. CE, RoHS

GG. Warranty

1. 1 year

PART 3 - EXECUTION

3.01 PREPARATION

- A. Visit the work-site and become fully aware of all existing conditions. Investigate the Contract Documents and make proper provisions to avoid interferences or construction delays. Determine the exact route of each duct and pipe.
- B. Make offsets and changes in shape or direction required to maintain proper headroom and pitch or to accommodate the structure and the work of other trades. When changing the shape of duct work, provide ducts having the same friction loss as the size of the duct shown on the Contract Documents. Furnish other trades with information to properly locate and size openings in the structure required for the work under this Section. Furnish anchor bolts, sleeves, inserts and supports required for the work under this section. Provide access panels for concealed items provided under this section that require maintenance, adjustment or inspection. Where installed in fire rated assemblies, access doors shall be rated to preserve the fire rating of the assembly.

3.02 INSTALLATION REQUIREMENTS

- A. Perform work using personnel skilled in the trade involved. Provide competent supervision. Furnish new equipment, materials and accessories bearing the manufacturer's identification and conforming to the recognized commercial standards. Provide OSHA approved guard all around exposed moving machinery parts and around high-temperature equipment and materials. When exposed to weather, provide a protective enclosure around electrical equipment, controls and other items that are not satisfactorily protected. No piping, electrical conduit, ceiling supports or similar items shall be supported from air conditioning equipment or duct work.

3.03 EQUIPMENT INSTALLATION

- A. Install equipment in the space allotted with sufficient clearance for proper operation and maintenance, and with sufficient head clearance according to the building code. Where equipment differs in arrangement or connections from those shown, provide all required changes in piping, supports and appurtenances. Provide equipment accessories necessary for proper operation and support. Concrete equipment bases and supports are under DIVISION 3 CONCRETE. Direct trade providing concrete in the proper locations, dimensions, load carrying capacity and anchor bolt locations. Concrete pads shall be not less than 6 inches above adjacent surfaces and shall extend 6 inches beyond the base of the equipment. Provide vibration isolators for all mechanical equipment as indicated hereinbefore. Secure floor-mount isolators to base and to equipment. Provide concrete inserts at all pre-stressed planks for hanger rods and coordinate with pre-stressed plank contractor for insert location.

3.04 CONDENSATE DRAIN PIPING SYSTEM

- A. Slope lines at 1/4-inch per foot unless otherwise directed. Provide a water seal with water column 1-inch greater than the total static pressure of the fan in inches of water. Terminate condensate drain over nearest plumbing drain when not otherwise indicated. See insulation specified in Section 15250 Insulation of Mechanical Systems.

3.05 PIPING SYSTEM SUPPORTS

- A. Pipe Supports: Factory-fabricated by Elcen, Fee and Mason, Grinnell, or Unistrut. Provide concrete inserts, beam clamps, channel framing, hanger rods and accessories required for proper pipe support. Ramset or explosive type anchors are not permitted. Support copper pipe at maximum spacing of 6 feet for pipes 1-1/2 inches and smaller. Support vertical piping with hanger at base of riser and with pipe clamp at each floor. At each support point on insulated piping, provide Owens-Corning Kaylo Pipe Insulation around pipe with 18-gage sheet metal jacket each two pipe diameters in length.

3.06 SHEET METAL DUCT WORK

- A. Construct in accordance with the SMACNA Duct Manual for Low Velocity Systems, 4th edition. Provide curved elbows with inside radius equal to the duct width. At Contractor's option, 90-degree elbows may be square with factory-fabricated airfoil turning vanes. Provide factory-fabricated adjustable air extractors in straight branch duct tap-ins or use radius tap-ins. provide adjustable air extractors at supply air registers and diffuser tap ins. Provide splitter dampers at all splits in the duct runs constructed in accordance with Plate 29, Fig. A of SMACNA Duct Manual. Provide dampers where indicated with opposed blades and locking quadrant. Provide flexible duct connections at inlet and outlet of all air moving devices. Seal watertight all duct work exposed to weather, and cross-break to shed water. Provide stiffeners as required to assure no water puddling.
 - 1. Contractor is to provide volume dampers at all duct locations for proper balancing of the HVAC system and as indicated on the drawings. All volume dampers are to be made accessible for adjustment. Provide access doors as required. Where installed in fire rated assemblies, access doors shall be rated to preserve the fire rating of the assembly.

3.07 ELECTRICAL

- A. Conform to the requirements of ANSI, CI, National Electrical Code, and to the requirements of DIVISION 16 ELECTRICAL of these specifications. Obtain equipment manufacturer's control wiring diagrams for the equipment furnished. Prepare a control and interlock wiring diagram for the complete system. Indicate terminal connection points to factory-wired equipment. Submit control diagram for review. Furnish motor starters for all electrically driven air conditioning and ventilating equipment, complete with circuit breaker, one overload relay per phase, 120-volt control circuit and horsepower rating. Provide NEMA 3R weatherproof starter with fiberglass enclosure for outdoor equipments.

3.08 BALANCE, ADJUST AND TEST

- A. See SECTION 15901 – TESTING, ADJUSTING, AND BALANCING (TAB) and drawings for requirements and details.

3.09 COMMISSIONING

A. Summary:

1. Optimize energy efficiencies and effectiveness of building systems.
2. Support quality management through verification of building components and systems performance.
3. Thoroughly test, operate, and demonstrate building systems.
4. Optimize operation and maintenance through comprehensive training, instruction, documentation of system performance, maintenance/parts manuals, and warranty documentation.

B. Systems to be Commissioned Include:

1. Air distribution/Exhaust Systems
2. Fume hoods and lab control valves
3. Air Conditioning and Ventilation Equipment

C. Commissioning Procedure/Responsibilities:

1. Contractor shall be the single point of contact, and provide coordination and responsibility for all construction and commissioning activities and requirements.
2. Responsible to Hospital to manage all subcontractors and to coordinate all schedules, activities, and resources required for successful completion of Project and commissioning thereof.
3. Subcontractors shall assign representatives with expertise and authority on their behalf and schedule them to participate in and perform commissioning team activities.
4. The commissioning process, actions, and documentation described herein shall be the responsibility of the General Contractor, however these responsibilities may be delegated to the subcontractor(s) as so determined by the Contractor. While a certified commissioning authority is not required under this project, the General Contractor may elect to employ such services of a commissioning authority, or assign an individual or subcontractor to facilitate and lead the commissioning process identified herein.

D. Commissioning Documentation:

1. Commissioning Plan: A document that describes schedules, allocation of resources, and documentation requirements of the commissioning process. This plan shall include:
 - a. Reviewed submittals, system manuals, control theory, diagrams and other documents and reports as necessary for describing components and operation of system(s).

- b. Identification of systems and equipment to be commissioned
 - c. Description of testing procedures along with identification of parties involved in performing and verifying tests.
 - d. Identification of items that must be completed before the next operation can proceed.
 - e. Description of requirements for operation and maintenance training, including required training materials.
 - f. Description of expected performance for systems, subsystems, equipment, and controls.
 - g. Identification of installed systems, subsystems, equipment, and controls, including design changes that occurred during construction phase.
 - h. Process and schedule for completing prestart and startup checklists for systems, subsystems, and equipment to be verified and tested.
2. Test Checklists: The Contractor shall develop checklists for each system, subsystem, or equipment. Test checklists provided by equipment manufacturer shall be deemed acceptable, but shall be modified as required to suite project specific systems and equipment. Checklists to be used shall be submitted for review and approval.
 3. Certificate of Readiness: Contractor shall provide a certificate identifying that the systems, subsystems, equipment, and associated controls are ready for testing.
 4. Test and Inspection Reports: Record test data, observations, and measurements on test checklists. Photographs, forms and other means appropriate for application will be included with data. Compile test and inspection reports and certificates, and include in systems manual and commissioning report.
 5. Corrective Action Documents: Document corrective action taken for systems and equipment that fail test. Include required modifications to systems and equipment and revisions to test procedures, if any. Retest systems and equipment requiring corrective action and document retest results.
 6. Commissioning Report: The contractor shall document results of commissioning process including unresolved issues and performance of systems, subsystems, and equipment. The commissioning report indicates whether installation and testing of systems, subsystems, and equipment have been completed. Commissioning report shall include:
 - a. Lists and explanations of substitutions, compromises, variances in contract documents, record of conditions, and if appropriate, recommendations for resolution. This report will be used to evaluate systems, subsystems and equipment, and will serve as future reference document during owner occupation and operation. It will describe

components and performance in comparison to requirements identified on contract documents.

- b. Commissioning Plan.
 - c. Completed testing checklists and reports.
 - d. Corrective Action Documents
7. Systems Manual: Provide (6) copies and (2) CD's of the system manual to the WHFD AND/OR PROJECT MANAGER upon completion of each document identified above.
- a. Project record documents as specified in Division 1 Specifications and Section 15000 – General Mechanical Requirements.
 - b. Commissioning Report
 - c. Operation and maintenance manuals.
 - d. Test, Adjust, and Balance Report.
 - e. Schedule of Maintenance Service.
 - f. Product Warranties and One Year Guarantee.

3.10 CLEAN-UP

- A. Cleanup the work provided under this section. Touch up with matching paint all damaged factory finishes.

3.11 PAINTING AND IDENTIFYING

- A. The items furnished under this section are to be painted and identified under DIVISION 9 FINISHES. Do not paint over nameplates or other identifying labels.
 - 1. Paint exposed black iron work including pipe, fittings, iron body valves, pipe hangers, etc. with two coats of oil-base enamel paint.
 - 2. Provide snap-around pipe markers, Westline or equal on all exposed piping. Black letters shall indicate the service and an arrow shall indicate the direction of flow. Markers shall be provided where pipes enter and leave each area and at not over 30 foot intervals within an area. Background color shall be yellow. Width of color band, size of legend letters, and position of legend shall conform to the requirements of ANSI A13.1, Scheme for the Identification of Piping System.
 - 3. Painting of exposed bare metal surfaces in finished areas shall be provided herein if it is not specified under DIVISION 9 FINISHES. Included in this work shall be bare metal register, louvers, access panels for mechanical equipment, control covers and thermostat covers, duct work, piping, hangers, etc. Refer to architectural finishing schedule for finish required. Prepare surface as required for oil-base enamel paint. Provide two final coats matching adjoining surface finish.

3.12 INSTRUCTIONS

- A. Instruct the Hospital in the proper operation and maintenance of the system. Review the maintenance manuals with the Hospital. Post starting and stopping instructions and control diagram adjacent to equipment, mounted in frame with glass cover plate. Submit a list of manufacturer's warranties for the equipment furnished.

3.13 CERTIFICATES

- A. The WHFD AND/OR PROJECT MANAGER shall have the right to require a written certificate, dated and signed by a responsible employee of the Contractor, evidencing the performance of any portion of the work, or any testing as a condition precedent to the acceptance of any work or the results of any test. Wherever a governmental authority performs inspections or tests of any portion of the work, a certificate shall be provided by the Contractor that the inspection or test was satisfactorily passed.

END OF SECTION 15800

SECTION 15901 – TESTING, ADJUSTING AND BALANCING (TAB)

PART 1 - GENERAL

1.01 GENERAL CONDITIONS

- A. As specified in Division 1 sections.

1.02 SCOPE

- A. Procure the services of an independent contractor qualified in TAB as defined in Chapter 34 of the 1995 ASHRAE Handbook - HVAC Application. The TAB work shall include the following:
 - 1. Air conditioning equipment.
 - 2. Ducts, duct outlets and duct inlets.
 - 3. Transfer ducts, openings, grilles and registers.
 - 4. Pipes, coils, and valves.
 - 5. Electrical measurements.
 - 6. Controls and control components.
 - 7. Sound and vibration measurements.

1.03 RELATED WORK SPECIFIED ELSEWHERE

- A. Division 16 – ELECTRICAL
- B. Section 15800 - AIR CONDITIONING AND VENTILATION
- C. Section 15950 - NETWORKED BUILDING CONTROLS.

1.04 GENERAL REQUIREMENTS:

- A. It is the intent of the plans and specifications to provide a complete installation. Should there be omissions or discrepancies in the plans and specifications such as dampers, gauges, and sensors that will inhibit the proper TAB process, the Contractor shall call the attention of the WHFD AND/OR PROJECT MANAGER to such omissions and discrepancies in advance of the date of bid opening so that the necessary corrections can be made. Otherwise the Contractor shall furnish and install the omissions or discrepancies as if the same were specified and provided for. A test report shall be provided at the completion of each phase.
 - 1. Standards:
 - a. All work shall be done in accordance with applicable ordinances and codes of the County of Hawaii and in accordance with State Department of Health regulations.

- b. Work shall comply with applicable regulations of the State of Hawaii, National Fire Protection association (NFPA) Pamphlet No. 90A, and American Society of Heating, Refrigerating and Air Conditioning WHFD AND/OR PROJECT MANAGER s (ASHRAE) Standard 111.
 - c. Applicable standard published by the National Environmental Balancing Bureau (NEBB) and/or the Associated Air Balance Council (AABC).
 - d. Contractor shall obtain all permits, licenses and certificates and pay for all fees.
2. Drawings and Specifications: The drawings and specifications are intended to cover the complete installation of systems to function as described. The omission of reference to any necessary item of labor or material shall not relieve the Contractor from providing such labor or material. Drawings do not attempt to show exact details of piping and ductwork.
- a. Contract Drawings: Mechanical plans are essentially diagrammatic, showing locations of ducts, and other mechanical equipment. Where locations are not dimensioned, they are approximate, Contractor shall study existing conditions and plan his work in the most logical manner.
 - b. Shop Drawings: As soon as practical, obtain a set of shop drawings and data submittals including the automatic control diagrams that have been reviewed by the WHFD AND/OR PROJECT MANAGER. Refer to section 15800, and coordinate with the Contractor to obtain all pertinent information on the mechanical systems.

1.05 DEFINITIONS

- A. Accuracy: The accuracy of an instrument is the capability of that instrument to indicate the true value of a measured quantity.
- B. Adjusting: Adjusting is the varying of system flows by partially closing balancing devices, such as dampers and valves, and varying fan speeds to achieve optimum system operating conditions within design and installation limitations.
- C. AHJ: The local governing Authority Having Jurisdiction over the installation.
- D. Balancing: Balancing is the methodical proportioning of air and hydronic flows through the system mains, branches, and terminal devices using acceptable procedures to achieve the specified airflow or hydronic flow within testing and design limitations.
- E. Calibrate: The act of comparing an instrument of unknown accuracy with a standard of known accuracy to detect, correlate, report, or eliminate by adjustment any variation in the accuracy of the tested instrument.
- F. Conformed Contract Documents: Current and complete documents.
- G. Deficiency: Deficiency is considered any circumstance that adversely affects the specified balance of a device or system.

- H. Environmental Systems: Environmental Systems are systems that primarily use a combination of mechanical equipment, airflow, water flow and electrical energy to provide heating, ventilating, air conditioning, humidification, and dehumidification for the purpose of human comfort or process control of temperature and humidity.
- I. May: The word may is used to indicate a course of action that is permissible as determined by the NEBB/AABC Firm.
- J. NEBB/AABC Certified TAB Firm: A NEBB/AABC Certified TAB Firm is a firm that has met and maintains all the requirements of the National Environmental Balancing Bureau for firm certification in Testing, Adjusting, and Balancing and is currently certified by NEBB/AABC. A NEBB/AABC Certified TAB Firm shall employ at least one NEBB/AABC Qualified TAB Supervisor in a full time management position.
- K. NEBB/AABC Certified TAB Report: The data presented in a NEBB/AABC Certified TAB Report accurately represents system measurements obtained in accordance with the current edition of the NEBB/AABC Procedural Standards for Testing, Adjusting, and Balancing of Environmental Systems. A NEBB/AABC Certified TAB Report does not necessarily guarantee that systems included are balanced to design flows. Any variances from design quantities, which exceed NEBB/AABC tolerances or contract document tolerances, are noted in the test-adjust-balance report project summary.
- L. NEBB/AABC Qualified TAB Supervisor: A NEBB/AABC Qualified TAB Supervisor is a full time employee of the firm in a management position who has successfully passed the supervisor level written and practical qualification examinations and maintains the Supervisor re-qualification requirements of NEBB/AABC.
- M. NEBB/AABC Qualified TAB Technician: A NEBB/AABC Qualified TAB Technician is a full time employee of the firm who has met the technician level experience requirements of NEBB/AABC and has successfully passed the technician level written and practical qualification examinations. A NEBB/AABC Qualified TAB Technician shall be supervised by a NEBB/AABC Qualified TAB Supervisor. (Supervision is not intended to infer constant oversight. A NEBB/AABC Qualified TAB Technician is capable of performing assigned tasks with periodic supervision.)
- N. Precision: Precision is the ability of an instrument to produce repeatable readings of the same quantity under the same conditions. The precision of an instrument refers to its ability to produce a tightly grouped set of values around the mean value of the measured quantity.
- O. Procedure: A Procedure is defined as a specific set of tasks to be accomplished to achieve the defined result.
- P. Range: Range is the upper and lower limits of an instrument's ability to measure the value of a quantity for which the instrument is calibrated.
- Q. Resolution: Resolution is the smallest change in a measured variable that an instrument can detect.

- R. Shaft Pressurization System: A type of smoke-control system that is intended to positively pressurize stair and / or elevator shafts with outdoor air by using fans to keep smoke from contaminating the shafts during an alarm condition.
- S. Shall: The word shall is used to indicate mandatory requirements strictly to be followed in order to conform to the standard and procedures and from which no deviation is permitted. Note: In the event unique circumstances prevent a required action from being fulfilled, a notation shall be included in the TAB report explaining the exception. For example, such notation could be one of the following: Not Available, Not Applicable, or Not Accessible. The simple notation "N/A" is not allowed.
- T. Should: The word should is used to indicate that a certain course of action is preferred but not necessarily required.
- U. Smoke-Control System: An engineered system that uses fans to produce airflow and pressure differences across barriers to limit smoke movement.
- V. Smoke-Control Zone: A space within a building that is enclosed by smoke barriers and is a part of a zoned smoke-control system.
- W. Stair Pressurization System: A type of smoke-control system that is intended to positively pressurize stair towers with outdoor air by using fans to keep smoke from contaminating the stair towers during an alarm condition.
- X. System Effect: A phenomenon that can create undesired or unpredicted conditions that cause reduced capacities in all or part of a system.
- Y. TAB Technician: A TAB Technician is an employee of a NEBB/AABC Certified TAB firm who assists a NEBB/AABC Qualified TAB Supervisor and / or a NEBB/AABC Qualified TAB Technician by performing TAB work in the field. (Supervision is not intended to infer constant oversight. A TAB Technician may be capable of performing assigned tasks without direct, full time supervision.)
- Z. Terminal: A point where the controlled medium, such as fluid or energy, enters or leaves the distribution system
- AA. Testing: Testing is the use of specialized and calibrated instruments to measure temperatures, pressures, rotational speeds, electrical characteristics, velocities, and air and hydronic quantities for an evaluation of flow conditions.
- BB. Testing, Adjusting, and Balancing (TAB): TAB is a systematic process or service applied to heating, ventilating and air-conditioning (HVAC) systems and other environmental systems to achieve and document air and hydronic flow rates. The standards and procedures for providing these services are referred to as "Testing, Adjusting, and Balancing" and are described in this document.

1.06 TAB FIRM QUALIFICATIONS

- A. The TAB Firm shall be NEBB/AABC Certified in Testing, Adjusting and Balancing of Air and Hydronic Systems.

1.07 SUBMITTALS

- A. Within 15 days after the "Notice to Proceed", the independent air balance agency shall submit 3 copies of documentation to confirm compliance with the following:
 - 1. The completion of five(s) project of similar size and scope of this project.
 - 2. The agency is a certified firm by the NEBB or the AABC and employs one or more qualified supervisor(s) as defined by the NEBB or AABC.
 - 3. All instruments and equipment used by the agency is accurately calibrated in accordance with the requirements of NEBB or AABC.
 - 4. Specimen copies of each of the report forms proposed for use on this project.
- B. At least 60 days prior to starting field work, submit 3 copies of:
 - 1. Shop drawings clearly showing the equipment, air devices and associated apparatus related to the report forms. Limit one entry to one line of the report form.
 - 2. A set of report forms filled out as to the design values and the installed equipment pressure drops, the required CFM for air terminals, and design parameters to be used in the TAB process.
 - 3. A complete list of instruments proposed to be used organized in appropriate categories, with data sheets for each. Show:
 - a. Manufacturer and model number.
 - b. Description and use when needed to further identify the instrument.
 - c. Size or capacity range.
 - d. Latest calibration date.
 - 4. WHFD AND/OR PROJECT MANAGER will review submittals for compliance with contract documents, and will return one set marked to indicate:
 - a. Discrepancies noted between data shown and contract documents.
 - b. Additional, or more accurate, instruments required.
 - c. Requests for re-calibration of specific instruments.

1.08 GUARANTEE

- A. Testing agency shall include an extended warranty of 90 days, after completion of test and balance work, during which time the WHFD AND/OR PROJECT MANAGER at his discretion may request a recheck, or resetting of any outlet or supply air fan, as listed in test report. The testing agency shall provide technicians to assist the WHFD AND/OR PROJECT MANAGER in making tests he may require during this period of time.

1.09 CONTRACTOR RESPONSIBILITY TO TAB AGENCY

- A. Provide the NEBB/AABC Certified TAB Firm with a conformed set of contract documents (drawings, specifications, and approved submittals), including all current approved change orders / contract modifications.
- B. Develop a project schedule with the input of the NEBB/AABC Certified TAB Firm that coordinates the work of other disciplines and provides adequate time in the construction process to allow successful completion of the TAB work.
- C. Notify the NEBB/AABC Certified TAB Firm of schedule changes.
- D. Ensure that the building enclosure is complete, including but not limited to, all structural components, windows and doors installed, door hardware complete, ceilings complete, stair, elevator and mechanical shafts complete, roof systems complete, all plenums sealed, etc.
- E. Ensure that all necessary mechanical work is complete. This includes, but is not limited to, duct leakage testing and hydrostatic testing. The piping systems should be flushed, filled, vented, and chemically treated. The duct systems and equipment have been cleaned.
- F. Complete the installation of permanent electrical power systems serving the HVAC equipment and systems. Such systems shall be properly installed in accordance with all applicable codes to ensure the safety of all construction personnel.
- G. Complete the installation of all HVAC equipment and systems to ensure safe operation.
- H. Perform the start up of all HVAC equipment and systems in accordance with the manufacturer's recommendations.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.01 JOB CONDITIONS & COORDINATION

- A. Prior to start of testing, adjusting and balancing, verify that the required "Job Conditions" are met:
 - 1. Systems installation is complete and in full operation.
 - 2. Outside conditions are within a reasonable range relative to design conditions.
 - 3. Lights are turned "on" when lighting is included in the cooling load.
 - 4. Special equipment such as computers, laboratory equipment, and electronic equipment are in full operation.

B. Coordination:

1. Coordinate services with the work of the various trades to ensure rapid completion of the services.
2. Promptly report to the Contractor and WHFD AND/OR PROJECT MANAGER any deficiencies noted during performance of services to allow immediate corrective action.

3.02 PROCEDURES FOR TESTING, ADJUSTING, AND BALANCING EXISTING SYSTEMS

- A. Perform TAB of existing systems to the extent indicated by the contract documents and the current edition of the NEBB/AABC TAB Standards.

3.03 ACCEPTANCE CRITERIA

- A. The systems will be considered balanced in accordance with NEBB/AABC TAB Standards when the following conditions are satisfied:
1. All measured airflow and hydronic flow quantities are within ± 10 percent of the design quantities unless there are reasons beyond the control of the NEBB/AABC Certified TAB Firm. Deficiencies shall be noted in the TAB report.
 2. There is at least one direct path with fully open dampers from the fan to an air inlet or outlet. Additionally, if a system contains branch dampers, there will be at least one wide-open path downstream of every adjusted branch damper.
 3. There is at least one direct path with fully open balancing valves from the pump discharge balancing valve (if present) to a terminal device. Additionally, if a system contains branch balancing valves, there will be at least one wide open path downstream of every adjusted branch balancing valve.

3.04 REPORTING

- A. Provide appropriate deficiency information to the construction team as TAB work progresses.
- B. Deficiency information shall be sufficient to facilitate contractor's dispatch of appropriate personnel to resolve items noted prior to final TAB work.

3.05 FINAL REPORT

- A. The final report shall be in accordance with the requirements of the current edition of the NEBB/AABC TAB Standards.

END OF SECTION 15901

SECTION 15950 - NETWORKED BUILDING CONTROLS

PART 1 - GENERAL

1.01 GENERAL CONDITIONS:

- A. As specified in Division 1 sections.

1.02 SECTION INCLUDES

- A. Scope of Work
- B. Related Section
- C. Description
- D. Approved Control System Contractor
- E. Quality Assurance
- F. System Performance
- G. Submittals
- H. Warranty
- I. Ownership of Proprietary Material

1.03 PRODUCTS INSTALLED BUT NOT FURNISHED UNDER THIS SECTION

- A. Control devices and systems to provide the functional requirements of these specifications and as shown on the drawings.
 - 1. Direct Digital Control (DDC) and hard-wired interface controls of Heating, Ventilating, and Air Conditioning (HVAC) equipment and systems with electronic positioning of valves and dampers.
 - 2. Electronic control of air handling units, and similar units for control of room conditions.
 - 3. Complete hard-wired HVAC controls and instrumentation for: air distribution systems including fan coil units, room temperature and humidity, exhaust systems for other special equipment, ventilating for mechanical and other utility spaces, and control wiring and piping.
- B. Connect the new DDC controls and electronic operators as indicated on the control diagrams and points list to the existing DDC system. All DDC control units shall be from American Control Inc, and shall communicate directly with the existing building control system serving The Kona Community Hospital (KCH) located at the Facilities Office.
- C. The successful controls bidder (controls contractor) will be responsible for all equipment and labor required to fully monitor and control the equipment as

shown and specified. The controls contractor will also be responsible for creating BACnet objects of all shown points and provide them to the ICS/Setpoint in the format acceptable to ICS/Setpoint

A separate contract will be generated to the ICS/Setpoint by the controls contractor for modifications and programming required to integrate the new work into the existing building management system system.

1.04 RELATED SECTIONS

- A. The General Conditions of the Contract, Supplementary Conditions, and General Requirements are a part of these Specifications and shall be used in conjunction with this Section as a part of the Contract Documents. Consult them for further instructions pertaining to this work. The Contractor is bound by the provisions of Division 0 and Division 1.
- B. Section 15000 – GENERAL MECHANICAL REQUIREMENTS
- C. Section 15800 – AIR CONDITIONING AND VENTILATION
- D. Section 15901 – TESTING, ADJUSTING, AND BALANCING (TAB)

1.05 DESCRIPTION

- A. General: The control system shall be as indicated on the drawings and described in the specifications.
- B. Direct Digital Control (DDC) technology shall be used to provide the functions necessary for control of mechanical systems on this project.
- C. The control system shall accommodate simultaneous multiple user operation. Access to the control system data should be limited only by operator password. Multiple users shall have access to all valid system data. An operator shall be able to log onto any workstation on the control system and have access to all appropriate data.
- D. The control system shall be designed such that each mechanical system will be able to operate under stand-alone control. As such, in the event of a network communication failure, or the loss of any other controller, the control system shall manual bypass switch to continue to independently operate under control.
- E. Communication between the control panels and all workstations shall be over a high-speed network. All nodes on this network shall be peers. The operator shall not have to know the panel identifier or location to view or control an object. Application Specific Controllers shall be constantly scanned by the network controllers to update point information and alarm information.
- F. The documentation is schematic in nature. The Contractor shall provide hardware and software necessary to implement the functions and sequences shown.

1.06 APPROVED CONTROL SYSTEM CONTRACTOR:

- A. Approved Control System Contractor for Kona Community Hospital is ICS/Setpoint:

1.07 QUALITY ASSURANCE

A. System Installer Qualifications

1. The Installer shall have an established working relationship with the Control System Manufacturer of not less than three years.
2. The Installer shall have successfully completed Control System Manufacturer's classes on the control system. The Installer shall present for review the certification of completed training, including the hours of instruction and course outlines upon request.
3. The installer shall provide 24-hour remote response in the event of a customer call.
4. The above list of manufacturers applies to operator workstation software, controller software, the custom application programming language, Building Controllers, Custom Application Controllers, and Application Specific Controllers. All other products specified herein (i.e., sensors, valves, dampers, and actuators) need not be manufactured by the above manufacturers.

- B. Codes and Standards: Meet requirements of all applicable standards and codes, except when more detailed or stringent requirements are indicated by the Contract Documents, including requirements of this Section.

1. National Electrical Code -- NFPA 70.
2. Federal Communications Commission -- Part J.
3. ASHRAE/ANSI 135-1995 (BACnet)

- C. All products used in this installation shall be new, currently under manufacture, and shall be applied in similar installations for a minimum of 2 years. This installation shall not be used as a test site for any new products unless explicitly approved by the WHFD AND/OR PROJECT MANAGER in writing prior to bid date. Spare parts shall be available for at least 5 years after completion of this contract.

1.08 SYSTEM PERFORMANCE

- A. Performance Standards: The system shall conform to the following:
- B. Graphic Display: The system shall display a graphic with a minimum of 20 dynamic points. All current data shall be displayed within 20 seconds of the request.

- C. Graphic Refresh: The system shall update all dynamic points with current data within 30 seconds.
- D. Object Command: The maximum time between the command of a binary object by the operator and the reaction by the device shall be 10 seconds. Analog objects shall start to adjust within 10 seconds.
- E. Object Scan: All changes of state and change of analog values shall be transmitted over the high-speed network such that any data used or displayed at a controller or workstation will be current, within the prior 60 seconds.
- F. Alarm Response Time: The maximum time from when an object goes into alarm to when it is annunciated at the workstation shall not exceed 45 seconds.
- G. Program Execution Frequency: Custom and standard applications shall be capable of running as often as once every 5 seconds. The Contractor shall be responsible for selecting execution times consistent with the mechanical process under control.
- H. Performance: Programmable Controllers shall be able to execute DDC PID control loops at a selectable frequency from at least once every 5 seconds. The controller shall scan and update the process value and output generated by this calculation at this same frequency.
- I. Multiple Alarm Annunciation: All workstations on the network shall receive alarms within 5 seconds of each other.
- J. Reporting Accuracy: Table 1 lists minimum acceptable reporting accuracies for all values reported by the specified system.

Table I -- Reporting Accuracy

Measured Variable	Reported Accuracy
Space temperature	$\pm 0.5^{\circ}\text{C}$ [$\pm 1^{\circ}\text{F}$]
Ducted air	$\pm 1.0^{\circ}\text{C}$ [$\pm 2^{\circ}\text{F}$]
Outside air	$\pm 1.0^{\circ}\text{C}$ [$\pm 2^{\circ}\text{F}$]
Water temperature	$\pm 0.5^{\circ}\text{C}$ [$\pm 1^{\circ}\text{F}$]
Delta-T	$\pm 0.15^{\circ}\text{C}$ [$\pm 0.25^{\circ}\text{F}$]
Relative humidity	$\pm 5\%$ RH
Water flow	$\pm 5\%$ of full scale
Air flow (terminal)	$\pm 10\%$ of reading *Note 1
Air flow (measuring stations)	$\pm 5\%$ of reading
Air pressure (ducts)	$\pm 25\text{ Pa}$ [± 0.1 "W.G.]

Air pressure (space)	±3 Pa [±0.01 "W.G.]
Electrical Power	5% of reading *Note 3
Carbon Dioxide (CO2)	± 50 PPM

Note 1: (10%-100% of scale) (cannot read accurately below 10%)

1.09 SUBMITTALS

- A. Contractor shall provide shop drawings and manufacturers' standard specification data sheets on all hardware and software to be provided. No work may begin on any segment of this project until the WHFD AND/OR PROJECT MANAGER and Hospital have reviewed submittals for conformity with the plan and specifications. Five (5) copies are required. All shop drawings shall be provided to the Hospital electronically as .dwg or .dxf file formats.
- B. Quantities of items submitted shall be reviewed by the WHFD AND/OR PROJECT MANAGER and Hospital. Such review shall not relieve the contractor from furnishing quantities required for completion.
- C. Provide the WHFD AND/OR PROJECT MANAGER and Hospital, any additional information or data which is deemed necessary to determine compliance with these specifications or which is deemed valuable in documenting the system to be installed.
- D. Submit the following within 60 days of contract award:
 1. A complete bill of materials of equipment to be used indicating quantity, manufacturer and model number.
 2. A schedule of all control valves including the valve size, model number (including pattern and connections), flow, CV, pressure rating, and location.
 3. A schedule of all control dampers. This shall include the damper size, pressure drop, manufacturer and model number.
 4. Provide manufacturers cut sheets for major system components. When manufacturer's cut sheets apply to a product series rather than a specific product, the data specifically applicable to the project shall be highlighted or clearly indicated by other means. Each submitted piece of literature and drawings shall clearly reference the specification and/or drawing that the submittal is being submitted to cover. Include:
 - a. Building Controllers
 - b. Custom Application Controllers
 - c. Application Specific Controllers
 - d. Operator Interface Computer
 - e. Portable Operator Workstation

- f. Auxiliary Control Devices
 - g. Proposed control system riser diagram showing system configuration, device locations, addresses, and cabling.
 - h. Detailed termination drawings showing all required field and factory terminations. Terminal numbers shall be clearly labeled.
 - i. Points list showing all system objects, and the proposed English language object names.
 - j. Sequence of operations for each system under control. This sequence shall be specific for the use of the Control System being provided for this project.
 - k. Provide a BACnet Product Implementation Conformance Statement (PICS) for each BACnet device type in the submittal.
 - l. Color prints of proposed graphics with a list of points for display.
- E. Project Record Documents: Upon completion of installation submit one (1) copy of record (as-built) documents. The documents shall be submitted for approval prior to final completion and include:
- 1. Project Record Drawings: These shall be as-built versions of the submittal shop drawings. One set of electronic media including CAD .DWG or .DXF drawing files shall also be provided.
 - 2. Testing and Commissioning Reports and Checklists.
 - 3. Operating and Maintenance (O&M) Manual: These shall be as built versions of the submittal product data. In addition to that required for the submittals, the O&M manual shall include:
 - a. Names, address and 24-hour telephone numbers of Contractors installing equipment, and the control systems and service representative of each.
 - b. Operators Manual with procedures of operating the control systems including logging on/off, alarm handling, producing point reports, trending data, overriding computer control, and changing set points 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. Engineering, Installation and Maintenance Manual(s) that explains how to design and install new points, panels, and other hardware; preventative maintenance and calibration procedures; how to debug hardware problems; and how to repair or replace hardware.
 - e. A listing and documentation of all custom software created using the programming language including the point database. One set of

magnetic media containing files of the software and database shall also be provided.

- f. One set of electronic media containing files of all color-graphic screens created for the project.
 - g. Complete original issue documentation, installation, and maintenance information for all third party hardware provided including computer equipment and sensors.
 - h. Complete original issue media for all software provided including operating systems, programming language, operator workstation software, and graphics software.
 - i. Licenses, Guarantee, and Warrantee documents for all equipment and systems.
 - j. Recommended preventive maintenance procedures for all system components including a schedule of tasks (inspection, cleaning, calibration, etc.) time between tasks, and task descriptions.
- F. Training Manuals: The Contractor shall provide a course outline and training manuals for all training classes at least six weeks prior to the first class. The Hospital reserves the right to modify any or all of the training course outline and training materials. Review and approval by Hospital and WHFD AND/OR PROJECT MANAGER and shall be completed at least 3 weeks prior to first class.

1.10 WARRANTY: Warrant all work as follows:

- A. Labor & materials for control system specified shall be warranted free from defects for a period of twelve (12) months after final completion acceptance by the Hospital. Control System failures during the warranty period shall be adjusted, repaired, or replaced at no charge or reduction in service to the Hospital. The Contractor shall respond to the Owner's request for warranty service within 24 hours during customary business hours.
- B. At the end of the final start-up/testing, if equipment and systems are operating satisfactorily to the Hospital and WHFD AND/OR PROJECT MANAGER, the Hospital shall sign certificates certifying that the control system's operation has been tested and accepted in accordance with the terms of this specification. The date of Hospital's acceptance shall be the start of warranty.
- C. Operator workstation software, project specific software, graphics, database, and firmware updates shall be provided to the Hospital at no charge during the warranty period.
- D. Written authorization by Hospital must, however, be granted prior to the installation of such changes.
- E. The system provider shall provide a web-accessible Users Network to give the Hospital access to question/answer forum, graphics library, user tips, upgrades, and training schedules.

1.11 OWNERSHIP OF PROPRIETARY MATERIAL

- A. All project developed hardware and software shall become the property of the Hospital. These include but are not limited to:
 - 1. Project graphic images
 - 2. Record drawings
 - 3. Project database
 - 4. Job-specific application programming code
 - 5. All documentation

PART 2 - PRODUCTS

2.01 SECTION INCLUDES

- A. Acceptable Manufacturers
- B. Operator Interface
- C. System Software
- D. Building Controllers
- E. Custom Application Controllers
- F. Application Specific Controllers
- G. Communications
- H. Input/Output Interface
- I. Auxiliary Control Devices

2.02 ACCEPTABLE MANUFACTURERS

- A. Acceptable systems are:
 - 1. Delta controls
- B. The Contractor shall use only listed manufacturer's products as shown in Section 1 of this division. When a product or component is referred to by manufacturer's name and/or model number, the Contractor shall use only that product.

2.03 OPERATOR INTERFACE

- A. Operator Interface: The existing system is Delta Controls enteliWEB.
- B. Integrate new work into the existing Web server and user workstations.

C. System Software:

1. Operating System: Furnish a commercially available, concurrent multi-tasking operating system. Acceptable operating systems are Windows 2000 Professional and Windows XP Professional.
2. System Graphics: The Operator Workstation software shall be graphically oriented. The system shall allow display of up to 10 graphic screens at once for comparison and monitoring of system status. Provide a method for the operator to easily move between graphic displays and change the size and location of graphic displays on the screen. The system graphics shall be able to be modified while on line. An operator with the proper password level shall be able to add, delete, or change dynamic points on a graphic. Dynamic points shall include analog and binary values, dynamic text, static text, and animation files. Graphics shall have the ability to show animation of equipment. Graphics shall be capable of launching other PC applications.
 - a. Custom Graphics: Custom graphic files shall be created with the use of commonly available graphics packages such as PC Paint. The graphics generation package shall create and modify graphics that are saved in industry standard formats such as PCX, BMP, GIF and JPEG. The graphics generation package shall also provide the capability of capturing or converting graphics from other programs such as Designer, or AutoCAD.
 - b. Graphics Library: Furnish a complete library of standard HVAC equipment such as chillers, boilers, air handlers, terminals, fan coils, and unit ventilators. This library shall also include standard symbols for other equipment including fans, pumps, coils, valves, piping, dampers, and ductwork. The library shall be furnished in a file format compatible with the graphics generation package program.
 - c. Engineering Units: Allow for selection of the desired engineering units (i.e. Inch Pound) in the system. Unit selection shall be able to be customized by locality to select the desired units for each measurement. Engineering units on this project shall be Standard Inch Pound.

D. System Applications: Each workstation shall provide operator interface and off-line storage of system information. Provide the following applications at each workstation.

1. Automatic System Database Save and Restore: Each workstation shall store on the hard disk a copy of the current database of each building controller. This database shall be updated whenever a change is made in any panel in the system. The storage of this data shall be automatic and not require operator intervention. In the event of a database loss in a building management panel, the first workstation to detect the loss shall automatically restore the database for that panel.
2. Manual Database Save and Restore: A system operator with the proper password clearance shall be able to archive the database from any system panel and store on magnetic media. The operator shall also be able to clear a

panel database and manually initiate a download of a specified database to any panel in the system.

3. System Configuration: The workstation software shall provide a graphical method of configuring the system. The user with proper security shall be able to add new devices, and assign modems to devices. This shall allow for future system changes or additions.
4. On-Line Help and Training: Provide a context sensitive, on line help system to assist the operator in operation and editing of the system. On-line 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. Provide an interactive tutorial CD, which will act as on-line training/help for the systems operator.
5. Security: Each operator shall be required to log on to the 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 logoff time shall be set per operator password. All system security data shall be stored in an encrypted format.
6. System Diagnostics: The system shall automatically monitor the operation of all workstations, printers, modems, network connections, building management panels, and controllers. The failure of any device shall be annunciated to the operator.
7. Alarm Processing: Any object in the system shall be configurable to alarm in and out of normal state. The operator shall be able to configure the alarm limits, warning limits, states, and reactions for each object in the system.
 - a. Alarm Reactions: The operator shall be able to determine what actions, if any, are to be taken, by object (or point), during an alarm. Actions shall include logging, printing, starting programs, displaying messages, dialing out to remote stations, paging, forwarding to an e-mail address, providing audible annunciation or displaying specific system graphics. Each of these actions shall be configurable by workstation and time of day. An object in alarm that has not been acknowledged within an operator specified time period shall be re-routed to an alternate operator specified alarm receipt device.
 - b. Binary Alarms: Each binary object shall be set to alarm based on the operator-specified state. Provide the capability to disable alarming when the associated equipment is turned off or is being serviced.
 - c. Analog Alarms: Each analog object shall have both high and low alarm limits and warning limits. Alarming must be able to be automatically and manually disabled.

8. Trend Logs: The operator shall be able to define a custom trend log for any data in the system. This definition shall include interval, start-time, and stop-time. Trend intervals of 1, 5, 15, 30, and 60 minutes as well as once a shift (8 hours), once a day, once a week, and once a month shall be selectable. All trends shall start based on the hour. Each trend shall accommodate up to 64 system objects. The system operator with proper password shall be able to determine how many samples are stored in each trend. Trend data shall be sampled and stored on the Building Controller panel and be archived on the hard disk. Trend data shall be able to be viewed and printed from the operator interface software. Trends must be viewable in a text-based format or graphically. They shall also be storable in a tab delimited ASCII format for use by other industry standard word processing and spreadsheet packages.
9. Dynamic Graphical Charting: The operator shall be able to select system values to be charted in real time. Up to three values at one time can be selected for each chart. The type of chart (bar, line, 3-D, etc.) shall be selectable.
10. Alarm and Event Log: The operator shall be able to view all logged system alarms and events from any location in the system. The operator shall be able to sort and filter alarms. Events shall be listed chronologically. An operator with the proper security level may acknowledge and clear alarms. All that have not been cleared by the operator shall be archived to the hard disk on the workstation.
11. Object and Property Status and Control: Provide a method for the operator with proper password protection to view, and edit if applicable, the status of any object and property in the system. These statuses shall be available by menu, on graphics, or through custom programs.
12. Clock Synchronization: The real time clocks in all building control panels and workstations shall be synchronized on command of an operator. The system shall also be able to automatically synchronize all system clocks; daily from any operator designated device in the system. The system shall automatically adjust for daylight savings and standard time if applicable.
13. Reports and Logs: Provide a reporting package that allows the operator to select, modify, or create reports. Each report shall be definable as to data content, format, interval, and date. Report data shall be archived on the hard disk for historical reporting. Provide the ability for the operator to obtain real time logs of designated lists of objects. Reports and logs shall be stored on the PC hard disk in a format that is readily accessible by other standard software applications including spreadsheets and word processing. Reports and logs shall be readily printed to the system printer. The operator shall be able to designate reports that shall be printed or stored to disk at selectable intervals.
 - a. Custom Reports: Provide the capability for the operator to easily define any system data into a daily, weekly, monthly, or annual report. These reports shall be time and date stamped and shall contain a report title and the name of the facility.

- b. Standard Reports: The following standard system reports shall be provided for this project. These reports shall be readily customized to the project by the Hospital.
 - 1) Schedule Report: Provide a summary of all schedules including Holiday and Exception schedules.
 - 2) Commissioning Report: Provide a one-time report that lists all equipment with the unit configuration and present operation.
 - 3) Tenant Override Reports: Provide a monthly report showing the daily total time in hours that each tenant has requested after hours HVAC and lighting services. Provide an annual summary report that shows the override usage on a monthly basis.
- E. Workstation Applications Editors: Each PC workstation shall support full screen editing of all system applications. Provide editors for each application at the PC workstation. The applications shall be downloaded and executed at the appropriate controller panels.
 - 1. Controller: Provide a full screen editor for each type controller and application that shall allow the operator with proper password to view and change the configuration, name, control parameters, and system set-points.
 - 2. Scheduling: An editor for the scheduling application shall be provided at each workstation. Provide a monthly calendar for each schedule. Exception schedules and holidays shall be shown clearly on the calendar. Provide a method for allowing several related objects to follow a schedule. The advance and delay time for each object shall be adjustable from this master schedule.
 - a. An operator with proper password level shall be able to modify the schedule. Schedules shall be able to be easily copied between objects and/or dates.
 - 3. Air System Equipment Coordination: Provide a full screen editor that allows equipment to be grouped for proper operation as specified in the sequence of operations. This shall include the coordination of VAV boxes with their associated Air Handling Equipment.
- F. Custom Application Programming: Provide the tools to create, modify, and debug custom application programming. The operator shall be able to create, edit, and download custom programs at the same time that all other system applications are operating. The system shall be fully operable while custom routines are edited, compiled, and downloaded.

2.04 SYSTEM SOFTWARE

- A. Furnish the following applications software for building and energy management. All software applications shall reside and run in the system controllers. Editing of applications shall occur at the operator workstation.

B. System Security:

1. User access shall be secured using individual security passwords and user names.
2. Passwords shall restrict the user to only the objects, applications, and system functions as assigned by the system manager.
3. User logon/logoff attempts shall be recorded.
4. The system shall protect itself from unauthorized use by automatically logging off following the last keystroke. The delay time shall be user definable.

C. Scheduling: Provide the capability to schedule each object or group of objects in the system. Each of these schedules shall include the capability for start, stop, optimal start, and optimal stop actions. Each schedule may consist of up to 10 events. When a group of objects are scheduled together, provide the capability to define advances and delays for each member. Each schedule shall consist of the following:

1. Weekly Schedule. Provide separate schedules for each day of the week.
2. Exception Schedules. Provide the ability for the operator to designate any day of the year as an exception schedule. This exception schedule shall override the standard schedule for that day. Exception schedules may be defined up to a year in advance. Once an exception schedule is executed it will be discarded and replaced by the standard schedule for that day of the week.
3. Holiday Schedules. Provide the capability for the operator to define up to [99] special or holiday schedules. These schedules may be placed on the scheduling calendar and will be repeated each year. The operator shall be able to define the length of each holiday period.
4. Optimal Start/Stop. The scheduling application outlined above shall support an optimal start/stop algorithm. This shall calculate the thermal characteristics of a zone and start the equipment prior to occupancy to achieve the desired space temperature at the specified occupancy time. The algorithm shall calculate separate sets of heating and cooling rates for zones that have been unoccupied for less than and greater than 24 hours. Provide the ability to modify the start/stop algorithm based on outdoor air temperature. Provide an early start limit in minutes to prevent the system from starting before an operator determined time limit.

D. Alarm Reporting: The operator shall be able to determine the action to be taken in the event of an alarm. Alarms shall be routed to the appropriate workstations based on time and other conditions. An alarm shall be able to start programs, be logged in the event log, printed, generate custom messages graphics.

E. Maintenance Management: The system shall monitor equipment status and generate maintenance messages based upon user designated run time, starts, and/or calendar date limits.

- F. PID Control: A PID (proportional-integral-derivative) algorithm with direct or reverse action and anti-wind-up shall be supplied. The algorithm shall calculate a time-varying analog value used to position an output or stage a series of outputs. The controlled variable, set-point, and PID gains shall be user-selectable. The set-point shall optionally be chosen to be a reset schedule.
- G. Timed Override: A standard application shall be utilized to enable/disable temperature control when a user selects on/cancel at the zone sensor, workstation, or the operator display. The amount of time that the override takes precedence will be selectable from the workstation.
- H. Staggered Start: This application shall prevent all controlled equipment from simultaneously restarting after a power outage. The order in which equipment (or groups of equipment) is started, along with the time delay between starts shall be user-selectable.
- I. System Calculations: Provide software to allow instantaneous power (e.g. KW), flow rates (e.g. L/s [GPM]) to be accumulated and converted to energy usage data. Provide an algorithm that calculates a sliding-window KW demand value. Provide an algorithm that calculates energy usage and weather data (heating and cooling degree days). These items shall all be available for daily, previous day, monthly and the previous month.
- J. Anti-Short Cycling: All binary output points shall be protected from short cycling. This feature shall allow minimum on-time and off-time to be selected.

2.05 BUILDING CONTROLLERS

- A. General: Provide Building Controllers to provide the performance specified in section 1 of this division. Each of these panels shall meet the following requirements.
 - 1. The Building Automation System shall be composed of one or more independent, stand-alone, microprocessor based Building Controllers to manage the global strategies described in System software section.
 - 2. The Building Controller shall have sufficient memory to support its operating system, database, and programming requirements.
 - 3. The controller shall provide a communications port for connection of the Portable Operators Terminal using Point to Point BACnet physical/data link layer protocol or a connection to the inter-network.
 - 4. The operating system of the Controller shall manage the input and output communications signals to allow distributed controllers to share real and virtual point information and allow central monitoring and alarms.
 - 5. Controllers that perform scheduling shall have a real time clock.
 - 6. Data shall be shared between networked Building Controllers.
 - 7. The Building Controller shall utilize industry recognized open standard protocols for communication to unit controllers.

8. The Building Controller shall continually check the status of its processor and memory circuits. If an abnormal operation is detected, the controller shall:
 - a. Assume a predetermined failure mode.
 - b. Generate an alarm notification.
 - c. Create a retrievable file of the state of all applicable memory locations at the time of the failure.
 - d. Automatically reset the Building Controller to return to a normal operating mode.
9. BACnet: The Building Controller shall use the Read (Initiate) and Write (Execute) Services as defined in these BIBBS:

DS-RP-A,B
DS-RPM-A,B
DS-WP-A,B
DS-WPM-B

- B. Communications: Each Building Controller shall reside on the Enterprise wide network, which is same high-speed network as the workstations. The Enterprise wide network will be provided by the Hospital and supports the Internet Protocol (IP). Local connections of the Building Controller shall be on ISO 8802-3 (Ethernet). Communications shall use Annex J of ASHRAE Standard 135-95. Each Building Controller shall also perform routing to a network of Custom Application and Application Specific Controllers.] Each Building Controller shall perform communications to a network of Custom Application and Application Specific Controllers using LonTalk FTT-10 and LonMark profiles.
- C. Environment: Controller hardware shall be suitable for the anticipated ambient conditions. Controller used in conditioned ambient shall be mounted in an enclosure, and shall be rated for operation at 0 C to 50 C [32 F to 120 F].
- D. Serviceability: Provide diagnostic LEDs for power, communications, and processor. All wiring connections shall be made to field removable, modular terminal strips or to a termination card connected by a ribbon cable. The primary logic board shall be removable without disconnecting field wiring.
- E. Memory: The Building Controller shall maintain all BIOS and programming information in the event of a power loss for at least 72 hours.
- F. Immunity to Power and Noise: Controller shall be able to operate at 90% to 110% of nominal voltage rating and shall perform an orderly shut-down below 80% nominal voltage.
- G. The Building Controller shall have a seven segment LED display on the main board that indicates the current operating mode of the controller.

2.06 CUSTOM APPLICATION CONTROLLERS

- A. General: Provide Custom Application Controllers to provide the performance specified in section 1 of this division. Each of these panels shall meet the following requirements.
 - 1. The Building Automation System shall be composed of one or more independent, stand-alone, microprocessor based Building Controllers to manage the local strategies described in System software section.
 - 2. The Controller shall have sufficient memory to support its operating system, database, and programming requirements.
 - 3. Controllers that perform scheduling shall have a real time clock.
 - 4. The operating system of the Controller shall manage the input and output communications signals to allow distributed controllers to share real and virtual point information and allow central monitoring and alarms.
 - 5. The Controller shall continually check the status of its processor and memory circuits. If an abnormal operation is detected, the controller shall:
 - a. Assume a predetermined failure mode.
 - b. Generate an alarm notification.
 - 6. Custom application controllers shall communicate using LonTalk. Controllers shall use FTT-10 transceivers. All communications shall be with the use of LonMark-approved SNVTs.
- B. Environment: Controller hardware shall be suitable for the anticipated ambient conditions.
 - 1. Controller used in conditioned ambient shall be mounted in NEMA 1 type enclosures, and shall be rated for operation at 0 C to 50 C [32 F to 120 F].
 - 2. Controllers used outdoors and/or in wet ambient shall be mounted within NEMA 4 type waterproof enclosures, and shall be rated for operation at -40 C to 70 C [-40 F to 158 F].
- C. Serviceability: Provide diagnostic LEDs for power, communications, and processor. All low voltage wiring connections shall be made such that the controller electronics can be removed and/or replaced without disconnection of field termination wiring.
- D. Memory: The Controller shall maintain all BIOS and programming information in the event of a power loss for at least 72 hours.
- E. Immunity to Power and Noise: Controller shall be able to operate at 90% to 110% of nominal voltage rating and shall perform an orderly shutdown below 80% nominal voltage.

2.07 APPLICATION SPECIFIC CONTROLLERS

- A. General: Application specific controllers (ASC) are microprocessor-based DDC controllers, which through hardware or firmware design are dedicated to control a specific piece of equipment. They are not fully user programmable, but are customized for operation within the confines of the equipment they are designed to serve.
 - 1. Each ASC shall be capable of stand-alone operation and shall continue to provide control functions without being connected to the network.
 - 2. Each ASC will contain sufficient I/O capacity to control the target system.
- B. Environment: The hardware shall be suitable for the anticipated ambient conditions.
 - 1. Controllers used outdoors and/or in wet ambient shall be mounted within NEMA 4 type waterproof enclosures, and shall be rated for operation at -40 F to 150 F.
 - 2. Controller used in conditioned ambient shall be mounted in NEMA 1 type rated enclosures. Controllers located where not to be disturbed by building activity (such as above ceiling grid), may be provided with plenum-rated enclosures and non-enclosed wiring connections for plenum cabling. All controllers shall be rated for operation at 32 F to 120 F.
- C. Serviceability: Provide diagnostic LEDs for power and communications. All wiring connections shall be clearly labeled and made to be field removable.
- D. Memory: The Application Specific Controller shall maintain all BIOS and programming information in the event of a power loss for at least 90 days.
- E. Immunity to Power and Noise: Controller shall be able to operate at 90% to 110% of nominal voltage rating and shall perform an orderly shutdown below 80%.
- F. Transformer: Power supply for the ASC must be rated at minimum of 125% of ASC power consumption, and shall be fused or current limiting type.
- G. Application Specific Controllers shall communicate using LonTalk. Controllers shall use FTT-10 transceivers. All communications shall follow LonMark profiles. ASCs which do not have a profile that applies must comply with LonMark standards, utilize SNVTs for all listed points, and be provided with a XIF file for self-documentation.

2.08 COMMUNICATIONS

- A. This project shall comprise a network utilizing BACnet for communications between Building Controllers and PC Workstations. LonTalk subnetworks shall be used for communications between Building Controllers, Custom Application Controllers and Application Specific Controllers.
- B. Each BACnet device shall operate on the BACnet physical/data link protocols specified for that device as defined earlier in this section

- C. The Hospital will provide all communication media, connectors, repeaters, hubs, and routers necessary for the inter-network. A 10BaseT jack will be provided adjacent to each Building Control Panel and PC Workstation for connection to this network.
- D. All Building Controllers shall have a communications port for connections with the operator interfaces. This may be either an RS-232 port for Point to Point
- E. Connection or a network interface node for connection to the Ethernet network.
- F. Remote operator interface via a 9600 or faster baud modem shall allow for communication with any and all controllers on this network as described in F below.
- G. Communications services over the internetwork shall result in operator interface and value passing that is transparent to the internetwork architecture as follows:
 - 1. Connection of an operator interface device to any one controller on the internetwork will allow the operator to interface with all other controllers as if that interface were directly connected to the other controllers. Data, status information, reports, system software, custom programs, etc., for all controllers shall be available for viewing and editing from any one controller on the internetwork.
 - 2. All database values (i.e., points, software variable, custom program variables) of any one controller shall be readable by any other controller on the internetwork. This value passing shall be automatically performed by a controller when a reference to a point name not located in that controller is entered into the controller's database. An operator/installer shall not be required to set up any communications services to perform internetwork value passing.
- H. The time clocks in all controllers shall be automatically synchronized daily.

2.09 INPUT/OUTPUT INTERFACE

- A. Hard-wired inputs and outputs may tie into the system through Building, Custom, or Application Specific Controllers.
- B. All input points and output points shall be protected such that shorting of the point to itself, another point, or ground will cause no damage to the controller. All input and output points shall be protected from voltage up to 24V of any duration, such that contact with this voltage will cause no damage to the controller.
- C. Binary inputs shall allow the monitoring of on/off signals from remote devices. The binary inputs shall provide a wetting current of at least 12 ma to be compatible with commonly available control devices.
- D. Pulse accumulation input points. This type of point shall conform to all the requirements of Binary Input points, and also accept up to 2 pulses per second for pulse accumulation, and shall be protected against effects of contact bounce and noise.

- E. Analog inputs shall allow the monitoring of low voltage (0-10 Vdc), current (4-20 ma), or resistance signals (thermistor, RTD). Analog inputs shall be compatible with, and field configurable to commonly available sensing devices.
- F. Binary outputs shall provide for on/off operation, or a pulsed low voltage signal for pulse width modulation control. Outputs shall be selectable for either normally open or normally closed operation.
- G. Analog outputs shall provide a modulating signal for the control of end devices. Outputs shall provide either a 0-10 Vdc or a 4-20 ma signal as required to provide proper control of the output device. Analog outputs on building or custom programmable controllers shall have status lights, a 2-position (auto/manual) switch, and manually adjustable potentiometer for manual override.

2.10 AUXILIARY CONTROL DEVICES

- A. Motorized dampers, unless otherwise specified elsewhere, shall be as follows:
 - 1. Damper frames shall be 16 gauge galvanized sheet metal or 1/8" extruded aluminum with reinforced corner bracing.
 - 2. 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.
 - 3. Damper shaft bearings shall be as recommended by manufacturer for application.
 - 4. All blade edges and top and bottom of the frame shall be provided with compressible seals. Side seals shall be compressible stainless steel. The blade seals shall provide for a maximum leakage rate of 10 CFM per square foot at 2.5" w.c. differential pressure.
 - 5. All leakage testing and pressure ratings will be based on AMCA Publication 500.
 - 6. Individual damper sections shall not be larger than 48" x 60". Provide a minimum of one damper actuator per section.
- B. Control dampers shall be parallel or opposed blade types as scheduled on drawings.
- C. Electronic 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 both clockwise or counter clockwise spring return operation. Linear actuators shall spring return to the retracted position.

4. Proportional actuators shall accept a 0-10 VDC or 0-20 ma control signal and provide a 2-10 VDC or 4-20 ma operating range.
5. All 24 VAC/DC 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 required 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 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 conduit 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 Underwriters Laboratories Standard 873 listed.
10. Actuators shall be designed for a minimum of 60,000 full stroke cycles at the actuator's rated torque.

D. Control Valves

1. Control valves shall be two-way type for modulating service as scheduled or 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.
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-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 5 psi, whichever is greater.

- 2) Valves 1/2" 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.
 - 3) 2-1/2" valves and larger shall be cast iron ANSI Class 125 with guided plug and Teflon packing.
- c. Water valves shall fail normally open or closed as scheduled on plans or as follows:
- 1) Chilled water control valves - normally closed.
 - 2) Other applications - as scheduled or as required by sequence of operation.
- d. Zone valves shall be sized to meet the control application and they shall maintain their last position in the event of a power failure.

2.11 AUXILIARY CONTROL DEVICES

A. Temperature Sensors

1. Temperature sensors shall be Resistance Temperature Device (RTD) or Thermistor.
2. Duct sensors shall be rigid or averaging as shown. Averaging sensors shall be a minimum of 5 feet in length.
3. Immersion sensors shall be provided with a separable stainless steel 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 on the drawings.
5. Provide matched temperature sensors for differential temperature measurement. Differential accuracy shall be within 0.2 F.
6. The space temperature, ICS/Setpoint, and override confirmation will be annunciated by a digital display for each zone sensor. The ICS/Setpoint will be selectable utilizing buttons.

B. Humidity Sensors

1. Duct and room sensors shall have a sensing range of 20% to 80% with accuracy of $\pm 5\%$ R.H.
2. Duct sensors shall be provided with a sampling chamber.
3. Outdoor air humidity sensors shall have a sensing range of 20% to 95% R.H. It shall be suitable for ambient conditions of -40 F to 170 F.

4. Humidity sensor's drift shall not exceed 1% of full scale per year.

C. Static Pressure Sensors

1. Sensor shall have linear output signal. Zero and span shall be field-adjustable.
2. Sensor sensing elements shall withstand continuous operating conditions plus or minus 50% greater than calibrated span without damage.
3. Water pressure sensor shall have stainless steel diaphragm construction, proof pressure of 150 psi minimum. Sensor shall be complete with 4-20 ma output, required mounting brackets, and block and bleed valves. Mount in location accessible for service.
4. Water differential pressure sensor shall have stainless steel diaphragm construction, proof pressure of 150 psi minimum. Over-range limit (DP) and maximum static pressure shall be 3,000 psi. Transmitter shall be complete with 4-20 ma output, required mounting brackets, and five-valve manifold. Mount in a location accessible for service.

D. Duct Smoke Detectors: Photoelectric type complying with UL 268A.

1. Detector address shall be accessible from fire-alarm control unit and shall be able to identify the detector's location within the system and its sensitivity setting.
2. Each sensor shall have multiple levels of detection sensitivity.
3. Sampling Tubes: Design and dimensions as recommended by manufacturer for specific duct size, air velocity, and installation conditions where applied.
4. Relay Fan Shutdown: Fully programmable relay rated to interrupt fan motor-control circuit.
5. Status:
 - 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% of rated motor current.
 - d. Current Switches: Self-powered, solid-state with adjustable trip current, selected to match current and system output requirements.
 - e. Electronic Valve/Damper Position Indicator: Visual scale indicating percent of travel and 2- to 10-V dc, feedback signal.
 - f. 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.

E. Low Limit Thermostats

1. Safety low limit thermostats shall be vapor pressure type with an element 20 feet minimum length. Element shall respond to the lowest temperature sensed by any one foot section.

2. Low limit shall be manual reset only.

F. Indoor Air Quality Sensors

1. Indoor air quality sensors shall measure both total percentage VOCs and CO2 in PPM. Sensors shall be duct or space mounted.

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 Type 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 Type enclosure, with scale range and differential suitable for intended application, or as specified.
4. Current sensing relays may be used for flow sensing or terminal devices.

H. Relays

1. Control relays shall be UL listed plug-in type with dust cover. 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 plus or minus 200% (minimum) from set-point shown on plans. Contact rating, configuration, and coil voltage suitable for application. Provide NEMA 1 Type enclosure when not installed in local control panel.

I. Transformers and Power Supplies

1. Control transformers shall be UL listed, Class 2 current-limiting type, or shall be furnished with over-current protection in both primary and secondary circuits for Class 2 service.
2. Unit output shall match the required output current and voltage requirements. Current output shall allow for a 50% safety factor. Output ripple shall be 3.0 mV maximum Peak-to-Peak. Regulation shall be 0.10% line and load combined, with 50 microsecond response time for 50% load changes. Unit shall have built-in over-voltage protection.
3. Unit shall operate between 0 C and 50 C.
4. Unit shall be UL recognized.
5. Current Switches: 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.

J. Local Control Panels

1. All indoor control cabinets shall be fully enclosed NEMA 1 Type construction with hinged door, key-lock latch, and 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 and main air gauge for control power sources to each local panel.

PART 3 - EXECUTION

3.01 SECTION INCLUDES

- A. Examination
- B. General Workmanship
- C. Wiring
- D. Fiber Optic Cable
- E. Installation of Sensors
- F. Flow Switch Installation
- G. Actuators
- H. Warning Labels
- I. Identification of Hardware and Wiring
- J. Controllers
- K. Cleaning
- L. Protection
- M. Training
- N. Field Quality Control
- O. Check-out, Start-up, and Testing
- P. Acceptance

3.02 EXAMINATION

- A. The project plans shall be thoroughly examined for control device and equipment locations, and any discrepancies, conflicts, or omissions shall be reported to the WHFD AND/OR PROJECT MANAGER for resolution before rough-in work is started.
- B. 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 WHFD AND/OR PROJECT MANAGER for resolution before rough-in work is started.

3.03 GENERAL WORKMANSHIP

- A. Install equipment, piping, wiring/conduit parallel to building lines (i.e. horizontal, vertical, and parallel to walls) wherever possible.
- B. Provide sufficient slack and flexible connections to allow for vibration of piping and equipment.
- C. Install all equipment in readily accessible location as defined by chapter 1 article 100 part A of the NEC. Control panels shall be attached to structural walls unless mounted in equipment enclosure specifically designed for that purpose. Panels shall be mounted to allow for unobstructed access for service.
- D. Verify integrity of all wiring to ensure continuity and freedom from shorts and grounds.
- E. 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.

3.04 WIRING

- A. All control and interlock wiring shall comply with the national and local electrical codes and Division 16 of these specifications. Where the requirements of this section differ with those in Division 16, the requirements of this section shall take precedence.
- B. Where Class 2 wires are in concealed and accessible locations including ceiling return air plenums, approved cables not in raceway may be used provided that:
 - 1. Circuits meet NEC Class 2 (current limited) requirements. (Low voltage power circuits shall be sub fused when required to meet Class 2 current limit.)
 - 2. All cables shall be UL listed for application, i.e., cables used in ceiling plenums shall be UL listed specifically for that purpose.
- C. Do not install Class 2 wiring in conduit containing Class 1 wiring. Boxes and panels containing high voltage may not be used for low voltage wiring except for the purpose of interfacing the two (e.g. relays and transformers).

- D. Where class 2 wiring is run exposed, wiring shall be run parallel along a surface or perpendicular to it, and bundled, using approved wire ties at no greater than 10 ft intervals. Such bundled cable shall be fastened to the structure, using specified fasteners, at 5 ft intervals or more often to achieve a neat and workmanlike result.
- E. All wire-to-device connections shall be made at a terminal blocks or terminal strip. All wire-to-wire connections shall be at a terminal block, or with a crimped connector. All wiring within enclosures shall be neatly bundled and anchored to permit access and prevent restriction to devices and terminals.
- F. Maximum allowable voltage for control wiring shall be 120V. If only higher voltages are available, the Control System Contractor shall provide step down transformers.
- G. All wiring shall be installed as continuous lengths, where possible. Any required splices shall be made only within an approved junction box or other approved protective device.
- H. Install plenum wiring in sleeves where it passes through walls and floors. Maintain fire rating at all penetrations in accordance with other sections of this specification and local codes.
- I. Size of conduit and size and type of wire shall be the design responsibility of the Control System Contractor, in keeping with the manufacturer's recommendation and NEC.
- J. Control and status relays are to be located in designated enclosures only. These relays may also be located within packaged equipment control panel enclosures. These relays shall not be located within Class 1 starter enclosures.
- K. Follow manufacturer's installation recommendations for all communication and network cabling. Network or communication cabling shall be run separately from other wiring.
- L. Adhere to Division 16 requirements for installation of raceway.
- M. This Contractor shall terminate all control and/or interlock wiring and shall maintain updated (as built) wiring diagrams with terminations identified at the job site.
- N. Flexible metal conduits and liquid tight, flexible metal conduits shall not exceed 3' in length and shall be supported at each end. Flexible metal conduit less than 1/2" electrical trade size shall not be used. In areas exposed to moisture, including chiller and boiler rooms, liquid tight, flexible metal conduits shall be used.

3.05 INSTALLATION OF SENSORS

- A. Install sensors in accordance with the manufacturer's recommendations.
- B. Mount sensors rigidly and adequate for the environment within which the sensor operates.

- C. Room temperature sensors shall be installed on concealed junction boxes properly supported by the wall framing.
- D. All wires attached to sensors shall be air sealed in their conduits or in the wall to stop air transmitted from other areas affecting sensor readings.
- E. Install duct static pressure tap with tube end facing directly down-stream of air flow.
- F. Sensors used in mixing plenums, and hot and cold decks shall be of the averaging type. Averaging sensors shall be installed in a serpentine manner horizontally across duct. Each bend shall be supported with a capillary clip.
- G. All pipe mounted temperature sensors shall be installed in wells. Install all liquid temperature sensors with heat conducting fluid in thermal wells.
- H. Wiring for space sensors shall be concealed in building walls. EMT conduit is acceptable within mechanical and service rooms.
- I. Install outdoor air temperature sensors on north wall complete with sun shield at designated location.

3.06 FLOW SWITCH INSTALLATION

- A. Install using a thread o let in steel pipe. In copper pipe use C x C x F Tee, no pipe extensions or substitutions allowed.
- B. Mount a minimum of 5 pipe diameters upstream and 5 pipe diameters downstream or 2 feet whichever is greater, from fittings and other obstructions.
- C. Install in accordance with manufacturers' instructions.
- D. Assure correct flow direction and alignment.
- E. Mount in horizontal piping flow switch on top of the pipe.

3.07 ACTUATORS

- A. Mount and link control damper actuators per manufacturer's instructions.
- B. To compress seals when spring return actuators are used on normally closed dampers, power actuator to approximately 5° open position, manually close the damper, and then tighten the linkage.
- C. Check operation of damper/actuator combination to confirm that actuator modulates damper smoothly throughout stroke to both open and closed positions.
- D. Valves - Actuators shall be mounted on valves with adapters approved by the actuator manufacturer. Actuators and adapters shall be mounted following manufacturer's recommendations.

3.08 WARNING LABELS

- A. Affix plastic labels on each starter and equipment automatically controlled through the Control System. Label shall indicate the following:

3.09 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.

3.10 CONTROLLERS

- A. Provide a separate Controller for each major piece of HVAC equipment. Points used for control loop reset such as outside air or space temperature are exempt from this requirement.
- B. Building Controllers and Custom Application Controllers shall be selected to provide a minimum of [15%] spare I/O point capacity for each point type found at each location. If input points are not universal, [15%] of each type is required. If outputs are not universal, [15%] of each type is required. A minimum of one spare is required for each type of point used.
- C. Future use of spare capacity shall require providing the field device, field wiring, points database definition, and custom software. No additional Controller boards or point modules shall be required to implement use of these spare points.

3.12 PROGRAMMING

- A. Provide sufficient internal memory for the specified control sequences and trend logging. There shall be a minimum of 25% of available memory free for future use.
- B. Point Naming: System point names shall be modular in design, allowing easy operator interface without the use of a written point index.
- C. Software Programming: Provide programming for the system as per specifications and adhere to the strategy algorithms provided. All other system programming necessary for the operation of the system but not specified in this document shall also be provided by the Control System Contractor. Imbed into the control program sufficient comment statements to clearly describe each section of the program. The comment statements shall reflect the language used in the sequence of operations.

- D. Operators' Interface

1. Standard Graphics: Provide graphics for each major piece of equipment and floor plan in the building. This includes each Air Handler and VAV Terminal. These standard graphics shall show all points dynamically as specified in the points list.
 2. The controls contractor shall provide all the labor necessary to install, initialize, start up, and trouble-shoot all operator interface software and their functions as described in this section. This includes any operating system software, the operator interface data base, and any third party software installation and integration required for successful operation of the operator interface.
 3. As part of this execution phase, the controls contractor will perform a complete test of the operator interface. Test duration shall be a minimum of 16 hours on-site. Tests shall be made in the presence of the Hospital or WHFD AND/OR PROJECT MANAGER.
- E. Demonstration: A complete demonstration and readout of the capabilities of the monitoring and control system shall be performed. The contractor shall dedicate a minimum of 16 hours on site with the Hospital and his representatives for a complete functional demonstration of all the system requirements. This demonstration constitutes a joint acceptance inspection, and permits acceptance of the delivered system for on line operation.

3.13 CLEANING

- A. This contractor shall clean up all debris resulting from his or her activities daily. The contractor shall remove all cartons, containers, crates, etc. under his control as soon as their contents have been removed. Waste shall be collected and placed in a location designated by the Construction Manager or General Contractor.
- B. At the completion of work in any area, the Contractor shall clean all of his/her work, equipment, etc., making it free from dust, dirt and debris, etc.
- C. At the completion of work, all equipment furnished under this Section shall be checked for paint damage, and any factory finished paint that has been damaged shall be repaired to match the adjacent areas. Any metal cabinet or enclosure that has been deformed shall be replaced with new material and repainted to match the adjacent areas.

3.14 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.

3.15 TRAINING

- A. Provide a minimum of 2 classroom training sessions, 8 hours each, throughout the contract period for personnel designated by the Hospital. Computer based training may be substituted for up to 4 hours of hands on training.
- B. Train the designated staff of WHFD AND/OR PROJECT MANAGER and Hospital to enable them to proficiently operate the system; create, modify and delete programming; add, remove and modify physical points for the system; add additional panels when required.
- C. These objectives will be divided into three logical groupings; participants may attend one or more of these, depending on level of knowledge required:
 - 1. Day-to-day Operators
 - 2. System Troubleshooter
 - 3. System Manager: parts
- D. Provide course outline and materials as per Part 1 of this Section. The instructor(s) shall provide one copy of training material per student.
- E. The instructor(s) shall be factory-trained instructors experienced in presenting this material.
- F. Classroom training shall be done using a network of working controllers representative of the installed hardware or at the customer's site.

3.16 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.

3.17 ACCEPTANCE

- A. The control systems will not be accepted as meeting the requirements of Completion until all tests described in this specification have been performed to the satisfaction of both the WHFD AND/OR PROJECT MANAGER and Hospital. Any tests that cannot be performed due to circumstances beyond the control of the Contractor may be exempt from the Completion requirements if stated as such in writing by the WHFD AND/OR PROJECT MANAGER. Such tests shall then be performed as part of the warranty.

END OF SECTION 15950

DIVISION 16 - ELECTRICAL

SECTION 16010 – BASIC ELECTRICAL REQUIREMENTS

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

Drawings and general provisions of Contract, including General and Supplementary Conditions and Division-1 Specification sections, apply to work of this section.

1.02 SUMMARY

- A. This section specifies the basic requirements for the electrical installations and includes requirements common to more than one section of Division 16. It expands and supplements the requirements specified in sections of Division 1.
- B. Standards of the organizations listed below but referred to in the various sections by basic designation only, form a part of this specification to the extent indicated by the reference thereto:
 - 1. American Society for Testing and Materials (ASTM).
 - 2. National Fire Protection Association (NFPA).
 - 3. American National Standards Institute (ANSI).
 - 4. Illuminating Engineering Society (IES).
 - 5. Institute of Electrical and Electronics Engineers (IEEE).
 - 6. Insulated Cable Engineers Association (ICEA).
 - 7. National Electrical Manufacturer's Association (NEMA).
 - 8. National Electrical Contractors' Association (NECA).
 - 9. Underwriters' Laboratories, Inc. (UL).
 - 10. Factory Mutual (FM).
 - 11. Federal Specifications (FS).
 - 12. National Electrical Code (NEC) with County of Hawaii Amendments.
 - 13. ANSI TIA/EIA Telecommunication Building Wiring Standards.
- C. References shall mean to the latest edition of the standard or those currently adopted by the State or County governing agencies.
- D. Conform to local ordinances and codes.

1.03 QUALITY ASSURANCE

- A. Verify final locations for rough-ins with field measurements and with the requirements of the actual equipment to be connected. Contractor shall coordinate with the appropriate supplier, vendor, or subcontractor regarding the exact and specific rough-in requirements for equipment actually supplied.
- B. Conduits, junction boxes, wireway, etc. required for low voltage/telecommunications, cabling shall be coordinated with telecommunications cabling divisions prior to rough-in.

1.04 ELECTRICAL INSTALLATIONS

- A. Coordinate electrical equipment and materials installation with other building components.
- B. Verify all dimensions by field measurement. Do not scale drawings.
- C. Arrange for chases, slots, and openings in other building components to allow for electrical installations.
- D. Sequence, coordinate, and integrate installations of electrical materials and equipment for efficient flow of the work.
- E. Coordinate the access panel requirements with General Contractor to accommodate the installation of electrical equipment and materials.
- F. Where mounting heights are not detailed or dimensioned, install electrical services and overhead equipment to provide the maximum headroom possible.
- G. Install electrical equipment to facilitate maintenance and repair or replacement of equipment components. As much as practical, connect equipment for ease of disconnecting, with minimum of interference with other installations.
- H. Coordinate the installation of electrical materials and equipment above ceilings with suspension system, mechanical equipment and systems, and structural components.
- I. Contractor shall review Mechanical and Architectural drawings prior to bid.
- J. Final connections to equipment shall be per manufacturer's approved wiring diagrams, details and instructions. It shall be the Contractor's responsibility to provide materials and equipment compatible with equipment actually supplied.
- K. It is the intent of these drawings and specifications to establish a standard of quality.
- L. Work shall be performed in a workmanlike manner to the satisfaction of the Hospital.
- M. Contractor shall verify and coordinate exact location of equipment to be furnished by others prior to rough-in.
- N. Contractor shall be responsible for replacing equipment which is damaged due to incorrect field wiring provided under this section or factory wiring in equipment provided under this division.
- O. Contractors shall visit site prior to bid and verify that conditions are as indicated. Contractor shall include in his bid, costs required to make his work meet existing conditions.
- P. Proposed substitutions of electrical equipment or request for "or equal" or approved equal" listing shall be submitted to the Hospital as specified under

Division 1.

- Q. Wire termination provisions for panelboards, circuit breakers, safety switches and all other electrical apparatus shall be listed as suitable for 75 degree C.
- R. Systems shall be complete, operable and ready for continuous operations. Lights, switches, receptacles, motors, etc., shall be connected and operable.
- S. Electrical equipment shall be located to maintain clear and level clearances outlined in NEC 110-26. Panelboards, switchboards, transformers, disconnects, switches, breakers, etc. shall be located to comply with NEC 110-26(a). Where the clearances outlined in NEC 110-26 cannot be obtained, the Contractor shall notify the engineer prior to performing any rough-in.
- T. Maintain separation between telecommunication conduits and electrical feeders, electronic ballasts, transformers, etc. to minimize electromagnetic compatibility issues.

1.05 ELECTRICAL SUBMITTALS

- A. Refer to Division 1 Specifications for submittal requirements.
- B. Data shall be submitted at one time in three ring binders and indexed as scheduled below. Partial submittals will not be accepted.
 - 1. 16060 – Grounding and Bonding
 - 2. 16073 – Hangers and Supports for Electrical Systems
 - 3. 16075 – Electrical Identification
 - 4. 16120 – Conductors and Cables
 - 5. 16130 – Raceways and Boxes
 - 6. 16410 – Enclosed Switches
- C. Submit shop drawings and product data grouped to include complete submittals of related systems, products and accessories in a single submittal.
- D. Identify products requiring color selections.
- E. Identify products for use on project.

1.06 PRODUCT OPTIONS AND SUBSTITUTIONS

Substitutions shall be made in accordance with Division 1 Specifications.

1.07 PRODUCT LISTING

- A. Prepare listing of major electrical equipment and materials for the project.
- B. Submit this listing as a part of the submittal requirement specified in the Division 1 Specifications.

1.08 NAMEPLATE DATA

- A. Provide permanent operational data nameplate on each item of power operated

equipment, indicating, manufacturer, product name, model number, serial number, capacity, operating and power characteristics, labels of tested compliances, and similar essential data. Locate nameplates in an accessible location.

1.09 DELIVERY, STORAGE AND HANDLING

- A. Deliver products to project properly identified with names, model numbers, types, compliance labels and similar information needed for distinct identification; adequately packaged and protected to prevent damage during shipment, storage and handling.
- B. Store equipment and materials at the site, unless off-site storage is authorized in writing. Contractor shall protect stored equipment and materials from damage and theft.
- C. Coordinate deliveries of electrical materials and equipment to minimize construction congestion. Limit each shipment of materials and equipment to the items and quantities needed for the smooth and efficient flow of installations.

1.10 RECORD DOCUMENTS

- A. Refer to the Division 1 Specifications for requirements. The following paragraphs supplement the requirements of Division 1.
- B. Mark drawings to indicate revisions to conduit size and location both exterior and interior, actual equipment locations, dimensioned to column lines; concealed equipment, dimensioned to column lines; distribution and branch electrical circuitry; fuse and circuit breaker size and arrangement support and hanger details; Change Orders; Addendums; concealed control system devices.
- C. Mark specifications to indicate approved substitutions; Change Orders; Addendums and equipment and materials used.

1.11 WARRANTIES

- A. Refer to the Division 1 Specifications for procedures and submittal requirements for warranties. Refer to individual equipment specifications for warranty requirements.
- B. Compile and assemble the warranties specified in Division 16, into a separated set of vinyl covered, three ring binders, tabulated and indexed for easy reference.
- C. Provide complete warranty information for each item to include product or equipment to include date of beginning of warranty or bond; duration of warranty or bond; and names, addresses and telephone numbers and procedures for filing a claim and obtaining warranty services.

1.12 CLEANING

- A. Refer to the Division 1 Specifications for general requirements for final cleaning.

PART 2 - PRODUCTS

Not Used

PART 3 - EXECUTION

Not Used

END OF SECTION

SECTION 16047- ELECTRICAL DEMOLITION

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to work specified in this section.

1.02 SUMMARY

- A. The extent of general building demolition work is shown on the drawings. Coordinate the required electrical work with the general demolition.
- B. Demolition includes removal and disposal of demolished materials, as shown on drawings and herein specified.
- C. Interior demolition includes complete wrecking of interior partitions, work above ceilings, finishes, and structures and removal and disposal of demolished materials, as shown on drawings and herein specified.
- D. The Owner shall have the option of retaining any items removed. The Contractor shall deliver these items to the Owner's designated storage area. Any items not retained by the Owner shall be disposed of off-site by the Contractor.

1.03 JOB CONDITIONS

- A. Condition of Structures: The Owner assumes no responsibility for actual condition of structures to be demolished.
- B. Conditions of the structure existing at time of inspection for bidding purposes will be maintained by Owner in so far as practicable. However, variations within structure may occur by Owner's removal and salvage operations prior to start of demolition work. The drawings are schematic and provided as an aid in bidding. The Contractor shall visit the site and determine the actual conditions prior to bidding.
- C. Partial Removal: Items of salvageable value to Contractor may be removed from structure as work progresses. Salvaged items must be transported from site as they are removed. Storage or sale of removed items on site will not be permitted.
- D. Traffic: Conduct demolition operations and removal of debris to ensure minimum interference with roads, streets, walks, occupied areas, and other adjacent occupied or used facilities.
- E. Protections: Ensure safe passage of persons around or through area of demolition. Conduct operations to prevent injury to adjacent buildings, structures, other facilities, and persons.

- F. Install temporary electrical services, lighting, etc. as required by the Owner or

authorities having jurisdiction.

- G. Damages: Promptly repair damages caused to adjacent facilities by demolition operations at no cost to Owner.
- H. Utility Services: Maintain existing utilities indicated to remain, keep in service, and protect against damage during demolition operations. Allow no interruption in service unless coordinated with Owner at least 24 hours in advance.
- I. Do not interrupt existing utilities serving occupied or used facilities, except when authorized in writing by authorities having jurisdiction. Provide temporary services during interruptions to existing utilities, as acceptable to governing authorities.
- J. Contractor will disconnect and seal utilities serving each structure to be demolished, or interior area to be demolished, prior to start of demolition work.
- K. If Contractor is required to disconnect utility services or other services to an occupied area, the Contractor shall provide temporary or alternative service to that area.

PART 2 – PRODUCTS

- A. Not Applicable

PART 3 - EXECUTION

3.01 DEMOLITION

- A. Remove all branch and feeder conduit and wire back to panelboards, where specified.
- B. Where walls, ceilings, or floors are to remain, remove devices and wire. Provide blank cover plate at outlet box.
- C. All items shown to remain active shall be furnished with necessary accessible junction boxes and all conduit and wire as required to maintain circuit continuity.
- D. All outlet boxes which must be removed due to demolition but which must remain active in order to maintain circuit continuity shall be relocated into ceilings or walls and shall be accessible.
- E. All material fixtures and equipment to be reused shall be removed and stored on site. Before reinstallation, all items are to be cleaned, tested, and prepared for re-use. Fixtures shall be re-lamped and new ballasts installed.

3.02 DISPOSAL OF DEMOLISHED MATERIAL

- A. General: Remove from site debris, rubbish, and other materials resulting from demolition operations. Apply all fees related to removal and pumping.
- B. Remove and dispose of interior demolition debris only.

- C. Burning of removed materials from demolished structures will not be permitted on site.
- D. Transport materials removed from demolished structures and dispose of offsite.

END OF SECTION

SECTION 16060- GROUNDING AND BONDING

PART 1 – GENERAL

1.01 RELATED DOCUMENTS

Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.02 SUMMARY

This Section includes methods and materials for grounding systems and equipment grounding requirements specified in this section ay be supplemented by special requirements of section described in other sections.

1.03 SUBMITTALS

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

1.04 QUALITY ASSURANCE

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

PART 2 - PRODUCTS

2.01 CONDUCTORS

- A. Insulated Conductors: Copper wire or cable insulated for 600V unless otherwise required by applicable Code or authorities having jurisdiction.
- B. Equipment Grounding Conductors: Insulated with green-colored insulation.

2.02 CONNECTORS

- A. Listed and labeled by a nationally recognized testing laboratory acceptable to authorities having jurisdiction for applications in which used, and for specific types, sizes, and combinations of conductors and other items connected.

PART 3 - EXECUTION

3.01 APPLICATIONS

- A. Conductors: Install solid conductor for No. 8 AWG and smaller, and stranded conductors for No. 6 AWG and larger, unless otherwise indicated.

3.02 EQUIPMENT GROUNDING

- A. Install insulated equipment grounding conductors with all feeders and branch circuits.

- B. Install insulated equipment grounding conductors with the following items, in addition to those required by NFPA 70:
 - 1. Feeders and branch circuits.
 - 2. Lighting circuits.
 - 3. Receptacle circuits.
 - 4. Single-phase motor and appliance branch circuits.
 - 5. Three-phase motor and appliance branch circuits.
 - 6. Flexible raceway runs.
 - 7. Armored and metal-clad cable runs.
- C. Air-Duct Equipment Circuits: Install insulated equipment grounding conductor to duct-mounted electrical devices operating at 120 V and more, including air cleaners, heaters, dampers, humidifiers, and other duct electrical equipment. Bond conductor to each unit and to air duct and connected metallic piping.

3.03 INSTALLATION

- A. Grounding Conductors: Route along shortest and straightest paths possible, unless otherwise indicated or required by Code. Avoid obstructing access or placing conductors where they may be subjected to strain, impact, or damage.
- B. Bonding Straps and Jumpers: Install in locations accessible for inspection and maintenance, except where routed through short lengths of conduit.
 - 1. Bonding to Equipment Mounted on Vibration Isolation Hangers and Supports: Install so vibration is not transmitted to rigidly mounted equipment.
- C. Bonding Interior Metal Ducts: Bond metal air ducts to equipment grounding conductors of associated fans, blowers, electric heaters, and air cleaners. Install bonding jumper to bond across flexible duct connections to achieve continuity.

END OF SECTION

SECTION 16073 – HANGERS & SUPPORTS FOR ELECTRICAL SYSTEMS

PART 1 – GENERAL

1.01 RELATED DOCUMENTS

Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.02 SUMMARY

- A. This Section includes the following:
 - 1. Hangers and supports for electrical equipment and systems.

1.03 DEFINITIONS

- A. EMT: Electrical metallic tubing.
- B. IMC: Intermediate metal conduit.
- C. RMC: Rigid metal conduit.

1.04 SUBMITTALS

- A. Product Data: For each support device.

1.05 QUALITY ASSURANCE

- A. Comply with NFPA 70.

PART 2 - PRODUCTS

2.01 SUPPORT, ANCHORAGE, AND ATTACHMENT COMPONENTS

- A. Raceway and Cable Supports: As described in NECA 1 and NECA 101.
- B. Conduit and Cable Support Devices: Steel and malleable-iron hangers, clamps, and associated fittings, designed for types and sizes of raceway or cable to be supported.
- C. Mounting, Anchoring, and Attachment Components: Items for fastening electrical items or their supports to building surfaces include the following:
 - 1. Powder-Actuated Fasteners: Threaded-steel stud, for use in hardened portland cement concrete, steel, or wood, with tension, shear, and pullout capacities appropriate for supported loads and building materials where used.
 - 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:A

- 1) Hilti Inc.
 - 2) ITW Ramset/Red Head; a division of Illinois Tool Works, Inc.
 - 3) MKT Fastening, LLC.
 - 4) Simpson Strong-Tie Co., Inc.; Masterset Fastening Systems Unit.
2. Mechanical-Expansion Anchors: Insert-wedge-type, zinc-coated steel, for use in hardened portland cement concrete with tension, shear, and pullout capacities appropriate for supported loads and building materials in which used.
- 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) Cooper B-Line, Inc.; a division of Cooper Industries.
 - 2) Empire Tool and Manufacturing Co., Inc.
 - 3) Hilti Inc.
 - 4) ITW Ramset/Red Head; a division of Illinois Tool Works, Inc.
 - 5) MKT Fastening, LLC.
3. Concrete Inserts: Steel or malleable-iron, slotted support system units similar to MSS Type 18; complying with MFMA-4 or MSS SP-58.
4. Clamps for Attachment to Steel Structural Elements: MSS SP-58, type suitable for attached structural element.
5. Through Bolts: Structural type, hex head, and high strength. Comply with ASTM A 325.
6. Toggle Bolts: All-steel springhead type.
7. Hanger Rods: Threaded steel.

PART 3 - EXECUTION

3.01 APPLICATION

- A. Comply with NECA 1, NECA 101 and manufacturer's instructions for application of hangers and supports for electrical equipment and systems except if requirements in this Section are stricter.
- B. Maximum Support Spacing and Minimum Hanger Rod Size for Raceway: Space supports for EMT, IMC, and RMC as required by NFPA 70. Minimum rod size shall be 1/4 inch (6 mm) in diameter.
- C. Spring-steel clamps designed for supporting single conduits without bolts may be used for 1-1/2-inch (38-mm) and smaller raceways serving branch circuits and communication systems above suspended ceilings and for fastening raceways to trapeze supports.
- D. Do not support raceway with wire or perforated pipe straps. Remove wire used for temporary supports. Do not attach raceway to ceiling support wires or other piping systems.

3.02 SUPPORT INSTALLATION

- A. Comply with NECA 1 and NECA 101 for installation requirements except as specified in this Article.
- B. Raceway Support Methods: In addition to methods described in NECA 1, EMT may be supported by openings through structure members, as permitted in NFPA 70.
- C. Strength of Support Assemblies: Where not indicated, select sizes of components so strength will be adequate to carry present and future static loads within specified loading limits. Minimum static design load used for strength determination shall be weight of supported components plus 200 lb (90 kg).
- D. Mounting and Anchorage of Surface-Mounted Equipment and Components: Anchor and fasten electrical items and their supports to building structural elements by the following methods unless otherwise indicated by code:
 - 1. To Wood: Fasten with lag screws or through bolts.
 - 2. To New Concrete: Bolt to pre-set concrete inserts or expansion anchors.
 - 3. To Masonry: Approved toggle-type bolts on hollow masonry units and expansion anchor fasteners or pre-set concrete inserts on solid masonry units.
 - 4. To Existing Concrete: Expansion anchor fasteners.
 - 5. To Steel: Welded threaded studs complying with AWS D1.1/D1.1M, with lock washers and nuts, Beam clamps (MSS Type 19, 21, 23, 25, or 27), complying with MSS SP-69.
 - 6. To Light Steel: Sheet metal screws.
 - 7. Items Mounted on Hollow Walls and Nonstructural Building Surfaces: Mount cabinets, panelboards, disconnect switches, control enclosures, pull and junction boxes, transformers, and other devices on slotted-channel racks attached to substrate by means that meet seismic-restraint strength and anchorage requirements.
- E. Drill holes for expansion anchors in concrete at locations and to depths that avoid reinforcing bars.
- F. Install surface-mounted cabinets and panelboards with minimum of four anchors.
- G. In wet and damp locations use steel channel supports to stand cabinets and panelboards one inch off wall.
- H. Use sheet metal channel to bridge studs above and below cabinets and panelboards recessed in hollow partitions.
- I. Do not fasten supports to pipes, ducts, mechanical equipment, and conduit.
- J. Do not use power-actuated anchors.

- K. Obtain permission from Owner before drilling or cutting structural members.

3.03 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 minimum dry film thickness of 2.0 mils (0.05 mm).
- B. Touchup: Comply with requirements in Division 9 painting Sections for cleaning and touchup painting of field welds, bolted connections, and abraded areas of shop paint on miscellaneous metal.
- C. Galvanized Surfaces: Clean welds, bolted connections, and abraded areas and apply galvanizing-repair paint to comply with ASTM A 780.

3.04 FIRESTOPPING

- A. Apply firestopping to cable and raceway penetrations of fire-rated floor and wall assemblies to achieve fire-resistance rating of the assembly.

3.05 DEMOLITION

- A. Protect existing electrical equipment and installations indicated to remain. If damaged or disturbed in the course of the Work, remove damaged portions and install new products of equal capacity, quality, and functionality.
- B. All abandoned wiring shall be removed in its entirety in accordance with the locally amended National Electrical Code, NFPA 70.
- C. Accessible Work: Remove exposed electrical equipment and installations, indicated to be demolished, in their entirety.
- D. Abandoned Work: Cut and remove buried raceway, indicated to be abandoned in place, 2 inches below the surface of adjacent construction. Cap raceways and patch surface to match existing finish.
- E. Remove demolished material from Project site.
- F. Remove, store, clean, reinstall, reconnect, and make operational components indicated for relocation.

END OF SECTION

SECTION 16075 - ELECTRICAL IDENTIFICATION

PART 1 – GENERAL

1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.02 SUMMARY

- A. This Section includes the following:
 - 1. Identification for raceways
 - 2. Identification for conductors.
 - 3. Equipment identification labels.

1.03 SUBMITTALS

- A. Product Data: For each electrical identification product indicated.

1.04 QUALITY ASSURANCE

- A. Comply with ANSI A13.1 and ANSI C2.
- B. Comply with NFPA 70.
- C. Comply with 29 CFR 1910.145.

1.05 COORDINATION

- A. Coordinate identification names, abbreviations, colors, and other features with requirements in the Contract Documents, Shop Drawings, manufacturer's wiring diagrams, and the Operation and Maintenance Manual, and with those required by codes, standards, and 29 CFR 1910.145. Use consistent designations throughout Project.
- B. Coordinate installation of identifying devices with completion of covering and painting of surfaces where devices are to be applied.
- C. Coordinate installation of identifying devices with location of access panels and doors.
- D. Install identifying devices before installing acoustical ceilings and similar concealment.

PART 2 – PRODUCTS

2.01 RACEWAY IDENTIFICATION MATERIALS

- A. Comply with ANSI A13.1 for minimum size of letters for legend and for minimum length of color field for each raceway and cable size.
- B. Color for Printed Legend:
 - 1. Power Circuits: Black letters on an orange field.
 - 2. Legend: Indicate system or service and voltage, if applicable.
- C. Self-Adhesive Vinyl Labels: Preprinted, flexible label laminated with a clear, weather- and chemical-resistant coating and matching wraparound adhesive tape for securing ends of legend label.
- D. Snap-Around Labels: Slit, pretensioned, flexible, preprinted, color-coded acrylic sleeves, with diameter sized to suit diameter of raceway or cable it identifies and to stay in place by gripping action.
- E. Snap-Around, Color-Coding Bands: Slit, pretensioned, flexible, solid-colored acrylic sleeves, 2 inches (50 mm) long, with diameter sized to suit diameter of raceway or cable it identifies and to stay in place by gripping action.
- F. Self-Adhesive Vinyl Tape: Colored, heavy duty, waterproof, fade resistant; 2 inches (50 mm) wide; compounded for outdoor use.

2.02 CONDUCTOR IDENTIFICATION MATERIALS

- A. Color-Coding Conductor Tape: Colored, self-adhesive vinyl tape not less than 3 mils (0.08 mm) thick by 1 to 2 inches (25 to 50 mm) wide.
- B. Marker Tapes: Vinyl or vinyl-cloth, self-adhesive wraparound type, with circuit identification legend machine printed by thermal transfer or equivalent process.
- C. Aluminum Wraparound Marker Labels: Cut from 0.014-inch- (0.35-mm-) thick aluminum sheet, with stamped, embossed, or scribed legend, and fitted with tabs and matching slots for permanently securing around wire or cable jacket or around groups of conductors.
- D. Metal Tags: Brass or aluminum, 2 by 2 by 0.05 inch (50 by 50 by 1.3 mm), with stamped legend, punched for use with self-locking nylon tie fastener.

2.03 EQUIPMENT IDENTIFICATION LABELS

- A. Engraved, Laminated Acrylic or Melamine Label: Punched or drilled for screw mounting. White letters on black face for normal power. White letters on red face for emergency power. Minimum letter height shall be 3/8 inch (10 mm).

2.04 MISCELLANEOUS IDENTIFICATION PRODUCTS

- A. Cable Ties: Fungus-inert, self-extinguishing, 1-piece, self-locking, Type 6/6 nylon cable ties.

1. Minimum Width: 3/16 inch (5 mm).
 2. Tensile Strength: 50 lb (22.6 kg), minimum.
 3. Temperature Range: Minus 40 to plus 185 deg F (Minus 40 to plus 85 deg C).
 4. Color: According to color-coding.
- B. Fasteners for Labels and Signs: Self-tapping, stainless-steel screws or stainless-steel machine screws with nuts and flat and lock washers.

PART 3 – EXECUTION

3.01 APPLICATION

- A. Accessible Raceways, 600 V or Less, for Service, Feeder, and Branch Circuits More Than: Identify with orange self-adhesive vinyl label, paint, or self-adhesive vinyl tape applied in bands.
- B. Accessible Raceways of Auxiliary Systems: Identify the following systems with color-coded, self-adhesive vinyl tape applied in bands or paint:
1. Color coding for raceways shall be as follows, verify exact requirements based on existing identification convention present at the facility:

Color		Minimum
<u>Service</u>	<u>Band</u>	<u>Band Width</u>
Power	Yellow	2"
Emergency Power	Red	2"
Life Safety/Fire Alarm	White	2"

- C. Branch-Circuit Conductor Identification: Where there are conductors for more than three branch circuits in same junction or pull box, use color-coding conductor tape. Identify each ungrounded conductor according to source and circuit number.
- D. Equipment Identification Labels: On each unit of equipment, install unique designation label that is consistent with wiring diagrams, schedules, and Operation and Maintenance Manual. Apply labels to disconnect switches and protection equipment, central or master units, control panels, control stations, terminal cabinets, and racks of each system. Systems include power, lighting, control, communication, signal, monitoring, and alarm systems unless equipment is provided with its own identification.
1. Labeling Instructions:
 - a. Indoor Equipment: Engraved, laminated acrylic or melamine label. Unless otherwise indicated, provide a single line of text with 1/2-inch- (13-mm-) high letters on 1-1/2-inch- (38-mm-) high label; where 2 lines of text are required, use labels 2 inches (50 mm) high.
 - b. Elevated Components: Increase sizes of labels and letters to those appropriate for viewing from the floor.
 2. Equipment to Be Labeled:
 - a. Panelboards, electrical cabinets, and enclosures.

- b. Access doors and panels for concealed electrical items.
- c. Disconnect switches.
- d. Enclosed circuit breakers.

3.02 INSTALLATION

- A. Verify identity of each item before installing identification products.
- B. Location: Install identification materials and devices at locations for most convenient viewing without interference with operation and maintenance of equipment.
- C. Apply identification devices to surfaces that require finish after completing finish work.
- D. Self-Adhesive Identification Products: Clean surfaces before application, using materials and methods recommended by manufacturer of identification device.
- E. Attach nonadhesive signs and plastic labels with screws and auxiliary hardware appropriate to the location and substrate.
- F. System Identification Color Banding for Raceways and Cables: Each color band shall completely encircle cable or conduit. Place adjacent bands of two-color markings in contact, side by side. Locate bands at changes in direction, at penetrations of walls and floors, at 50-foot (15-m) maximum intervals in straight runs, and at 25-foot (7.6-m) maximum intervals in congested areas.
- G. Color-Coding for Phase and Voltage Level Identification, 600 V and Less: Use the colors listed below for ungrounded service, feeder, and branch-circuit conductors.
 - 1. Color shall be factory applied or, for sizes larger than No. 10 AWG, field applied.
 - 2. Colors for 208/120-V Circuits:
 - a. Phase A: Black.
 - b. Phase B: Red.
 - c. Phase C: Blue.
 - d. Neutral: White
 - e. Ground: Green
 - 3. Colors for 480/277-V Circuits:
 - a. Phase A: Brown.
 - b. Phase B: Orange.
 - c. Phase C: Yellow.
 - d. Neutral: Gray
 - e. Ground: Green
 - 4. Field-Applied, Color-Coding Conductor Tape: Apply in half-lapped turns for a minimum distance of 6 inches (150 mm) from terminal points and in boxes where splices or taps are made. Apply last two turns of tape with no tension to prevent possible unwinding. Locate bands to avoid obscuring factory cable markings.

END OF SECTION

SECTION 16120 - CONDUCTORS & CABLES

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.02 SUMMARY

- A. This Section includes the following:
 - 1. Building wires and cables rated 600 V and less.
 - 2. Connectors, splices, and terminations rated 600 V and less.
 - 3. Sleeves and sleeve seals for cables.

1.03 DEFINITIONS

- A. EPDM: Ethylene-propylene-diene terpolymer rubber.
- B. NBR: Acrylonitrile-butadiene rubber.

1.04 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Field quality-control test reports.

1.05 QUALITY ASSURANCE

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- B. Comply with NFPA 70.

PART 2 - PRODUCTS

2.01 CONDUCTORS AND CABLES

- A. Copper Conductors: Comply with NEMA WC 70.
- B. Conductor Insulation: Comply with NEMA WC 70 for Types THHN-THWN XHHW and SO.

2.02 CONNECTORS AND SPLICES

Description: Factory-fabricated connectors and splices of size, ampacity rating, material, type, and class for application and service indicated.

PART 3 - EXECUTION

3.01 CONDUCTOR MATERIAL APPLICATIONS

- A. Feeders: Solid for No. 10 AWG and smaller; stranded for No. 8 AWG and larger, except as indicated below.
 - 1. Use standard conductors for control circuits.
 - 2. Use conductor not smaller than 14 AWG for control circuits.
 - 3. Use 10 AWG conductors for 20 ampere, 120 volt branch circuits longer than 75 feet (25 m).
 - 4. Use 10 AWG conductors for 20 ampere, 277 volt branch circuits longer than 200 feet (160 m).
- B. Branch Circuits: Copper. Minimum size #12 AWG; solid for No. 10 AWG and smaller; stranded for No. 8 AWG and larger.

3.02 CONDUCTOR INSULATION APPLICATIONS AND WIRING METHODS

- A. Feeders Concealed in Ceilings, Walls, Partitions, below raised floors and Crawlspace: Type THHN-THWN, single conductors in raceway

3.03 INSTALLATION OF CONDUCTORS AND CABLES

- A. Conceal cables in finished walls, ceilings, and floors, unless otherwise indicated.
- B. 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.
- C. Use pulling means, including fish tape, cable, rope, and basket-weave wire/cable grips, that will not damage cables or raceway.
- D. Support cables according to Division 16 Section "Hangers and Supports for Electrical Systems."
- E. Identify and color-code conductors and cables according to Division 16 Section "Electrical Identification."
- F. Use no wire smaller than 12 AWG for power and lighting circuits, and no wire smaller than 16 AWG for control wiring.
- G. Utilize 10 AWG conductor for 20 ampere, 120 volt branch circuit homeruns longer than 75 feet (23m), and for 20 ampere, 277 volt branch circuit homeruns longer than 200 feet (61m).

3.04 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 and UL 486B.
- B. Make splices and taps that are compatible with conductor material and that possess equivalent or better mechanical strength and insulation ratings than unspliced conductors.

3.05 FIRESTOPPING

- A. Apply firestopping to electrical penetrations of fire-rated floor and wall assemblies to restore original fire-resistance rating of assembly.

3.06 FIELD QUALITY CONTROL

- A. Tests and Inspections:
 - 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 visual and mechanical inspection and electrical test stated in NETA Acceptance Testing Specification. Certify compliance with test parameters.
- B. Remove and replace malfunctioning units and retest as specified above.

END OF SECTION

SECTION 16130 – RACEWAYS AND BOXES

PART 1 - GENERAL

1.01 SUMMARY

- A. This Section includes raceways, fittings, boxes and enclosures, for electrical wiring.

1.02 DEFINITIONS

- A. EMT: Electrical metallic tubing.
- B. FMC: Flexible metal conduit.
- C. IMC: Intermediate metal conduit.
- D. LFMC: Liquidtight flexible metal conduit.
- E. RGSC: Rigid galvanized steel conduit.
- F. RNC: Rigid nonmetallic conduit.

1.03 SUBMITTALS

- A. Product Data: For surface raceways, wireways and fittings, floor boxes, hinged-cover enclosures, and cabinets.
- B. Coordination Drawings: Conduit routing plans, drawn to scale, on which the following items are shown and coordinated with each other, based on input from installers of the items involved:
 - 1. Structural members in the paths of conduit groups with common supports.
 - 2. Plumbing items and architectural features in the paths of conduit groups with common supports.

1.04 QUALITY ASSURANCE

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- B. Comply with NFPA 70.

PART 2 - PRODUCTS

2.01 METAL CONDUIT AND TUBING

- A. Rigid Steel Conduit: ANSI C80.1.
- B. IMC: ANSI C80.6.
- C. EMT: ANSI C80.3.

- D. FMC: Zinc-coated steel.
- E. LFMC: Flexible steel conduit with PVC jacket.
- F. Fittings for Conduit (Including all Types and Flexible and Liquidtight), EMT, and Cable: NEMA FB 1; listed for type and size raceway with which used, and for application and environment in which installed.
 - a. Conduit Fittings for Hazardous (Classified) Locations: Comply with UL 886.
 - b. Fittings for EMT: Steel compression type.
 - c. Coating for Fittings for PVC-Coated Conduit: Minimum thickness, 0.040 inch (1 mm), with overlapping sleeves protecting threaded joints.
- G. Joint Compound for Rigid Steel Conduit or IMC: Listed for use in cable connector assemblies, and compounded for use to lubricate and protect threaded raceway joints from corrosion and enhance their conductivity.

2.03 METAL WIREWAYS

- A. Description: Sheet metal sized and shaped as indicated, NEMA 250, Type 1, unless otherwise indicated.
- B. Fittings and Accessories: Include 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.
- C. Wireway Covers: Screw-cover type or Flanged-and-gasketed type as required.
- D. Finish: Manufacturer's standard enamel finish.

2.04 BOXES

- A. Sheet Metal Outlet and Device Boxes: NEMA OS 1.
- B. Cast-Metal Outlet and Device Boxes: NEMA FB 1, ferrous alloy, Type FD, with gasketed cover.
- C. Small Sheet Metal Pull and Junction Boxes: NEMA OS 1.
- D. Cast-Metal Access, Pull, and Junction Boxes: NEMA FB 1, galvanized, cast iron with gasketed cover.

PART 3 - EXECUTION

3.01 RACEWAY APPLICATION

- A. Comply with the following indoor applications, 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 Physical Damage: Rigid galvanized steel conduit. Includes raceways in the following locations:
 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: Rigid galvanized steel conduit, IMC.
 7. Boxes and Enclosures: NEMA 250, Type 1, except use NEMA 250, Type 4, stainless steel in damp or wet locations.
- B. Minimum Raceway Size: 3/4-inch (24-mm) trade size for homeruns and conduits below grade or slab on grade.
- C. 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.
- D. All conduits larger than 1" shall be furnished with grounding type busing with equipment grounding conductor solidly connected at both ends.

3.02 INSTALLATION

- A. Comply with NECA 1 for installation requirements applicable to products specified in Part 2 except where requirements on Drawings or in this Article are stricter. Raceway and boxes located as shown on Drawings, and at other locations where required for splices, taps, wire pulling, equipment connections, and compliance with regulatory requirements. Raceway and boxes are shown in approximate locations unless dimensioned. Provide raceway as required to complete wiring system. Sizes shall meet or exceed NEC requirements. Raceway routing is shown for reference only. Route as required for a complete raceway system.
- B. Keep raceways at least 6 inches (150 mm) 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. Arrange stub-ups so curved portions of bends are not visible above the finished slab.
- E. Install no more than the equivalent of three 90-degree bends in any conduit run between boxes. Provide no more than the equivalent of two (2) 90 degree bends between boxes.
- F. Conceal conduit and EMT within finished walls, ceilings, and floors, unless otherwise indicated except as follows:

1. Any variance shall be obtained from the Contracting Officer.
- G. 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.
- H. Raceway Terminations at Locations Subject to Moisture or Vibration: Use insulating bushings to protect conductors, including conductors smaller than No. 4 AWG.
- I. Install raceway sealing fittings at suitable, approved, and accessible locations 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 at the following points:
 1. Where conduits pass from warm to cold locations, such as boundaries of refrigerated spaces.
 2. Where otherwise required by NFPA 70.
- J. Route raceways, concealed or exposed parallel and perpendicular to walls and building structural components.
- K. Flexible Conduit Connections: Use maximum of 72 inches (1830 mm) of flexible conduit for recessed and semi-recessed lighting fixtures, maximum 36 inches (915 mm) for connection to equipment subject to vibration, noise transmission, or movement; and for transformers and motors.
 1. Use LFMC in damp or wet locations.
- L. Avoid moisture traps; provide junction box with drain fitting at low points in conduit system.
- M. Cut conduit square using saw or pipecutter; de-burr cut ends.
- N. Bring conduit to shoulder of fittings; fasten securely.
- O. Use conduit hubs or sealing locknuts to fasten conduit to sheet metal boxes in damp and wet locations and to cast boxes.
- P. Use conduit bodies to make sharp changes in direction, as around beams. Use hydraulic one-shot bender to fabricate bends in metal conduit larger than 2-inch (50mm) trade size.

3.03 BOX APPLICATIONS

- A. Set wall mounted boxes at elevations to accommodate mounting heights indicated. Comply with ADA requirements.
- B. Orient boxes to accommodate wiring devices oriented as specified in Section 16140.
- C. Install pull boxes and junction boxes above accessible ceilings and in unfinished areas only.
- D. Inaccessible Ceiling Areas: Install outlet and junction boxes no more than 6 inches

(150mm) from ceiling access panel or from removable recessed luminaire.

- E. Locate flush mounting box in masonry wall to require cutting of masonry unit corner only. Coordinate masonry cutting to achieve neat opening.
- F. Do not install flush mounting box back-to-back in walls; provide minimum 6 inches (150 mm) separation. Provide minimum 24 inches (600 mm) separation in acoustic and fire rated walls.
- G. Secure flush mounting box to interior wall and partition studs. Accurately position to allow for surface finish thickness.
- H. Use stamped steel bridges to fasten flush mounting outlet box between studs.
- I. Use adjustable steel channel fasteners for hung ceiling outlet box.
- J. Do not fasten boxes to ceiling support wires or other piping systems.
- K. Support boxes independently of conduit.
- L. Use gang box where more than one device is mounted together. Do not use sectional box.
- M. Use gang box with plaster right for single device outlets.
- N. Do not use boxes smaller than 4-inches square.

3.04 FIRESTOPPING

- A. Apply firestopping to electrical penetrations of fire-rated floor and wall assemblies to restore original fire-resistance rating of assembly.

3.05 PROTECTION

- A. Provide final protection and maintain conditions that ensure coatings, finishes, and cabinets are without damage or deterioration at time of Substantial Completion.
 - 1. Repair damage to galvanized finishes with zinc-rich paint recommended by manufacturer.
 - 2. Repair damage to PVC or paint finishes with matching touchup coating recommended by manufacturer.
- B. Use suitable caps to protect installed conduit against entrance of dirt and moisture.

END OF SECTION

SECTION 16410 – ENCLOSED SWITCHES

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 1 Specification Sections, apply to this Section.

1.02 SUMMARY

- A. This Section includes the following individually mounted, enclosed switches and circuit breakers:
 - 1. Nonfusible switches.

1.03 DEFINITIONS

- A. GD: General duty.
- B. GFCI: Ground-fault circuit interrupter.
- C. HD: Heavy duty.
- D. RMS: Root mean square.
- E. SPDT: Single pole, double throw.

1.04 SUBMITTALS

- A. Product Data: For each type of enclosed switch, circuit breaker, accessory, and component indicated. Include dimensioned elevations, sections, weights, and manufacturers' technical data on features, performance, electrical characteristics, ratings, and finishes.
 - 1. Enclosure types and details for types other than NEMA 250, Type 1.
 - 2. Current and voltage ratings.
 - 3. Short-circuit current rating.
 - 4. UL listing for series rating of installed devices.
 - 5. Features, characteristics, ratings, and factory settings of individual overcurrent protective devices and auxiliary components.

1.05 QUALITY ASSURANCE

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- B. Comply with NFPA 70.
- C. 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.

1.06 PROJECT 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 (minus 30 deg C) and not exceeding 140 deg F (60 deg C).
 - 2. Altitude: Not exceeding 2500 feet (above sea level).

1.07 COORDINATION

- A. Coordinate layout and installation of switches, circuit breakers, and components with other construction, including conduit, piping, equipment, and adjacent surfaces. Maintain required workspace clearances and required clearances for equipment access doors and panels.

PART 2 - PRODUCTS

2.01 NONFUSIBLE SWITCHES

- A. Manufacturers:
 - 1. Eaton Corporation; Cutler-Hammer Products.
 - 2. General Electric Co.; Electrical Distribution & Control Division.
 - 3. Siemens Energy & Automation, Inc.
 - 4. Square D/Group Schneider.
- A. Nonfusible Switch, 600 A and Smaller: NEMA KS 1, Type HD, lockable handle with capability to accept two padlocks, and interlocked with cover in closed position.
- B. Accessories:
 - 1. Equipment Ground Kit: Internally mounted and labeled for copper and aluminum ground conductors.

2.02 ENCLOSURES

- A. NEMA AB 1 and NEMA KS 1 to meet environmental conditions of installed location.
 - 1. Outdoor Locations: NEMA 250, Type 4X.
 - 2. Kitchen Areas: NEMA 250, Type 4X, stainless steel.
 - 3. Other Wet or Damp Indoor Locations: NEMA 250, Type 4.
 - 4. Hazardous Areas Indicated on Drawings: NEMA 250, Type 7C.

PART 3 - EXECUTION

3.01 EXAMINATION

- A. Examine elements and surfaces to receive enclosed switches and circuit breakers for compliance with installation tolerances and other conditions affecting performance.

- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 INSTALLATION

- A. Comply with applicable portions of NECA 1, NEMA PB 1.1, and NEMA PB 2.1 for installation of enclosed switches and circuit breakers.
- B. Mount individual wall-mounting switches and circuit breakers with tops at uniform height, unless otherwise indicated.
- C. Comply with mounting and anchoring requirements specified in Division 16 Section "Hangers and Supports for Electrical Systems"
- D. Temporary Lifting Provisions: Remove temporary lifting eyes, channels, and brackets and temporary blocking of moving parts from enclosures and components.

3.03 IDENTIFICATION

- A. Identify field-installed conductors, interconnecting wiring, and components; provide warning signs as specified in Division 16 Section "Electrical Identification."
- B. Enclosure Nameplates: Label each enclosure with engraved metal or laminated-plastic nameplate as specified in Division 16 Section "Electrical Identification."

3.04 FIELD QUALITY CONTROL

- A. Prepare for acceptance testing as follows:
 - 1. Inspect mechanical and electrical connections.
 - 2. Verify switch and relay type and labeling verification.
 - 3. Verify rating of installed fuses.
 - 4. Inspect proper installation of type, size, quantity, and arrangement of mounting or anchorage devices complying with manufacturer's certification.

3.05 CLEANING

- A. On completion of installation, vacuum dirt and debris from interiors; do not use compressed air to assist in cleaning.
- B. Inspect exposed surfaces and repair damaged finishes.

END OF SECTION