



SHELBY COUNTY GOVERNMENT BOILER MODIFICATIONS BID PACKAGES# 1, 2 & 3

BP#1 - 140 ADAMS AVENUE - COURTHOUSE

BP#2 - 201 POPLAR - CRIMINAL JUSTICE CENTER

**BP#3 - ADDITIONAL BUILDING AUTOMATION
MONITORING**

MEMPHIS, TN 38103

RFP #14-009-14

06SEP13

PROJECT MANUAL

MEDFAC

ENGINEERING LLC

1209 DOVECREST ROAD

MEMPHIS, TN 38134-7625

Project No 12077

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Shelby County Tennessee

Mark Luttrell, Jr. Mayor

Request for Proposal

Shelby County Government

Purchasing Department

160 N. Main, Suite 550
Memphis, TN 38103

Issued: September 19, 2013

Due: October 16, 2013 no later than 4:00 P.M. (Central Standard Time)

RFP # 14-009-14

BOILER MODIFICATION

SHELBY COUNTY GOVERNMENT

Shelby County Government is soliciting written proposals on a competitive basis for Construction Services for Boiler Modification, Shelby County Courthouse, 140 Adams Avenue, Memphis, Tennessee 38103, Shelby County Criminal Justice Center, 201 Poplar Avenue, Memphis, Tennessee 38103 and Additional Building Automation Monitoring. Information regarding this RFP is located on the County's website at www.shelbycountyttn.gov. At the top of the home page, click on the links "Department," "P" for the Purchasing Department and "Bids" to locate the name of the above-described RFP. Copies of the project manual and drawing are posted at this location and can be downloaded at no cost to prospective bidders.

A **Mandatory** pre-bid conference will be held at 11:00 AM, Thursday, October 3, 2013 at Shelby County Criminal Justice Center, 201 Poplar Avenue, Auditorium, 1st Floor Lobby, Memphis, Tennessee 38103. **PLEASE BE ON TIME, ONCE THE PRE-BID CONFERENCE STARTS LATE ARRIVALS WILL NOT BE ALLOWED TO ATTEND.**

The proposal, as submitted, should include all estimated costs related to the services requested by the RFP specifications. If selected, your proposal will be the basis for negotiating a contract with Shelby County Government. Your proposal must be received in the Shelby County Purchasing Department **no later than 4:00 p.m. on Wednesday, October 16, 2013.** Proposals should be addressed to:

**Nelson Fowler, Manager A
Shelby County Government
Purchasing Department
160 N. Main St., Suite 550
Memphis, TN 38103**

The package containing an original (clearly identified as original) five (5) copies and a digital CD of your proposal must be sealed and marked with the Proposer's name and "CONFIDENTIAL, "BOILER MODIFICATION, SHELBY COUNTY GOVERNMENT RFP # 14-009-14" noted on the outside.

Sincerely,

**Nelson Fowler, Manager A
Shelby County Government
Purchasing Department**

Cc: Diep Tran, Support Services

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Note: Please make sure you pay close attention to Sections: I- IX .These sections will clearly outline what information is required to properly respond and prepare your RFP response.

Please download all of the additional information and attachments that accompany this RFP.

I. INTRODUCTION

Shelby County Government (the “County”), is seeking proposals from interested and qualified Contractors to submit proposals for Boiler Modification, Shelby County Courthouse, 140 Adams Avenue, Shelby County Criminal Justice Center, 201 Poplar Avenue and Additional Building Automation Monitoring. This Request for Proposal (“RFP”) is being released to invite interested and qualified firms to prepare and submit proposals in accordance with instructions provided where the successful candidate will be selected and invited to enter into a contractual relationship with Shelby County for the Services outlined in this RFP.

II. MINIMUM PROPOSERS REQUIREMENT

All Proposers must:

1. **Prime** and **LOSB** contractors must **apply** and **qualify** for an Equal Opportunity Compliance (EOC) certification number through our EOC Administration prior to submitting your response.
All bidders must submit a Bid Bond in the amount of 5% of their bid. This bond must be submitted with your bid.
2. The successful contractor must submit a performance/labor material bond, separate bonds each in the amount of 100% of the amount of the contract.
3. The successful contractor must submit a certificate of Insurance for the amount references in our specifications.
4. Have all appropriate licenses and certifications required in the State of Tennessee to perform the Services.
5. Meet all other requirements such as LOSB and performance requirements for Services in accordance with the provisions of this RFP.
6. Must attend our prebid conference.
7. Adhere to all Title VI requirements and provide proof/documentation.
8. A written statement of compliance to Title VI must be provided with your response.
9. Also, see page 28 for forms to be submitted with your bid.
10. Independent contractors (sole proprietors) must adhere to State of Tennessee Public Chapter No. 436, know as the “Tennessee Lawful Employment Act (effective date of 1/1/2012). Proof and documentation of employment eligibility must be included with the proposal.

Please Note: As a part of doing business with Shelby County, each individual, company, or organization is required to obtain an “Equal Opportunity Compliance” certification number prior to submitting your response.

You can access the online applications to receive the numbers indicated above at www.shelbycountyttn.gov. To obtain a vendor number and an EOC number, please follow the instructions below:

Vendor Number (Purchasing Department)

At the top of the home page, click on the links “Department”, “P” for the Purchasing Department and “Conducting Business with Shelby County”. The “Vendor Registration” link is at the bottom of the drop down box. Please download the application instructions and read thoroughly prior to accessing the application. (*Applications for a vendor number are accepted online only.*)

Equal Opportunity Compliance (EOC) Number (EOC Administration Office)

At the top of the home page, click on the links “Department”, “E” for the Equal Opportunity Compliance and “Contract Compliance Program”. The “Contract Compliance Packet” link is in the middle of the page. Please print the packet and mail or fax the completed packet to the EOC office. The mailing address is 160 N. Main Street, Suite 501, Memphis, TN 38103. The fax number is 901-222-1101.

Note: Because of the length of time it takes to apply and receive an EOC number, vendors who apply prior to the RFP being due, bid will be accepted pending EOC approval of their application.

If you have any questions regarding the application, you may contact Purchasing at (901)222-2250 or the EOC Administration at (901) 222-1100.

III. CORRESPONDENCE

All correspondence, proposals, and questions concerning the RFP are to be submitted to:

**Nelson Fowler, Manager A
Shelby County Government
160 N. Main St. Suite 550
Memphis, TN. 38103**

Respondents requesting additional information or clarification are to contact Nelson Fowler in writing at nelson.fowler@shelbycountyttn.gov or at the address listed above. Questions should reference the section of the RFP to which the question pertains and all contact information for the person submitting the questions. ***IN ORDER TO PREVENT AN UNFAIR ADVANTAGE TO ANY RESPONDENT, VERBAL QUESTIONS WILL NOT BE ANSWERED. The deadline for submitting questions will be Friday, October 11, 2013 by 12:00 p.m. (CST).*** These guidelines for communication have been established to ensure a fair and equitable process for all respondents.

Note: Individual vendor questions will be answered by e-mail as received before the cut-off date. All written questions submitted by the deadline indicated above will be answered and posted on the County’s website at www.shelbycountyttn.gov within forty eight (48) hours of the above cut-off date.

Please be aware that contact with any other personnel (other than the person clearly identified in this document) within Shelby County regarding this RFP may disqualify your company from further consideration.

IV. PROPOSAL SUBMISSION & DEADLINE

All proposals must be received at the address listed above no later than **Wednesday, October 16, 2013 @ 4:00 p.m. (CST)**. Facsimile or e-mailed proposals will not be accepted since they do not contain original signatures. Postmarks will not be accepted in lieu of actual receipt. Late or incomplete proposals may not be opened and considered.

V. PROPOSAL TIMELINE

Shelby County reserves the right to modify this timeline at any time. If the due date for proposals is changed, all prospective proposers shall be notified.

Request for Proposals Released	Wednesday, September 18, 2013
Mandatory Pre-bid (if applicable)	Thursday, October 3, 2013 at 11:00 AM
Proposal Due Date	Wednesday, October 16, 2013
Notification of Award	November 2013
Services to Commence	Upon Execution of the Contract

The County may reproduce any of the proposer’s proposal and supporting documents for internal use or for any other purpose required by law.

VI. PROPOSAL CONDITIONS

a. Contingencies

This RFP does not commit the County to award a contract. The County reserves the right to accept or reject any or all proposals if the County determines it is in the best interest of the County to do so. The County will notify all proposers, in writing, if the County rejects all proposals.

b. Modifications

The County reserves the right to issue addenda or amendments to this RFP.

c. Proposal Submission

To be considered, all proposals must be submitted in the manner set forth in this RFP. It is the proposer’s responsibility to ensure that its proposals arrive on or before the specified time.

d. Incurred Costs

This RFP does not commit the County to pay any costs incurred in the preparation of a proposal in response to this RFP and Proposers agree that all costs incurred in developing this RFP are the Proposer's responsibility.

e. Final Authority

The final authority to award a contract rests solely with the Shelby County Purchasing Department.

f. Proposal Validity

Proposals submitted hereunder will be firm for at least ninety (90) calendar days from the due date unless otherwise qualified.

g. Disclosure of Proposal Contents

Proposer understands and acknowledges that the County is a governmental entity subject to the laws of the State of Tennessee and that any reports, data, or other information supplied to the County is subject to being disclosed as a public record in accordance with the laws of the State of Tennessee. All proposals and other materials submitted become the property of Shelby County Government.

h. Prevailing Wage Ordinance

Prevailing Wage – Any firm, individual, partnership or corporation awarded a contract by the COUNTY for the construction of, improvement, enlargement, alteration or replacement of a public work or project in excess of \$500,000 and any subcontractors of such public work or project in excess of \$100,000 (“Recipient”) shall be required to pay local prevailing wages and benefits for laborers, mechanics, or other listed classifications as defined by the Tennessee Department of Labor. The prevailing wage rate shall be the most current State of Tennessee prevailing wage established by the Tennessee Department of Labor For Region 1 (Shelby County). The benefit rates shall be the most current rates described in the published schedule by the Memphis and West Tennessee Building and Construction Trades Council, except as otherwise provided in the Shelby County Code of Ordinances. The applicable rate shall be determined at the time that the project is awarded. In instances where Prevailing wage applies, Prevailing Wage will override the Living Wage requirement.

i. Non-Discrimination and Title VI

The contractor hereby agrees, warrants, and assures compliance with the provisions of Title VI and VII of the Civil Rights Act of 1964 and all other federal statutory laws which provide in whole or in part that no person shall be excluded from participation or be denied benefits of or be otherwise subjected to discrimination in the performance of

this Contract or in the employment practices of the contractor on the grounds of handicap and/or disability, age, race, color, religion, sex, national origin, or any other classification protected by federal, Tennessee State Constitutional or statutory law. The contractor shall upon request show proof of such non-discrimination and shall post in conspicuous places available to all employees and applicants notices of non-discrimination.

Any recipient entity shall be subject to the requirements of Title VI of the Civil Rights Act of 1964, 42 U.S.C. 2000d et seq., and regulations promulgated pursuant thereto. It shall develop a Title VI implementation plan with participation by protected beneficiaries as may be required by such law or regulations. To the extent applicable, such plan shall include Title VI implementation plans sub recipients of federal funds through the entity. The contractor shall produce the plan upon request of Shelby County Government. Failure to provide same shall constitute a material breach of contract.

j.

**SHELBY COUNTY GOVERNMENT
LOCALLY OWNED SMALL BUSINESS (LOSB) PROGRAM
FOR CONSTRUCTION SERVICES**

**BOILER MODIFICATION
SHELBY COUNTY GOVERNMENT**

General

Shelby County Government is committed to a policy of non-discrimination pursuant to the Equal Protection provisions of the United States Constitution. It is further the policy of Shelby County that it's purchasing and contracting practices encourage the use of Locally-Owned Small Businesses (LOSB's) in all solicitations. In furtherance of these policy objectives, Shelby County seeks to afford all citizens equal opportunities to do business on county contracts and to ensure that all bidders, proposers, or Contractors doing business with Shelby County provide to LOSB's, maximum practicable opportunities, commensurate with availability, price and capabilities required, to participate on contracts which are paid for, in whole or in part, with monetary appropriations from Shelby County.

Shelby County seeks to prevent discrimination against any person or business in pursuit of these opportunities on the basis of race or gender. Shelby County will conduct its contracting and purchasing programs so as to discourage any discrimination and will actively seek to resolve all claims of discrimination brought against Shelby County or any Contractors involved in such contracting and purchasing programs.

Shelby County has determined that 20% of the contract shall be contracted with LOSB's vendors. For assistance and information regarding LOSB participation, Bidders shall contact:

Ms. Carolyn Griffin
Office of Equal Opportunity Compliance
Board of Commissioners of Shelby County
160 North Main Street, Suite 501
Memphis, Tennessee 38103
Phone: 901-222-1100
Fax: 901-222-1101
E-mail: carolyn.griffin@shelbycountyttn.gov

Definitions

The definitions used in this document are as follows:

1. **“Bidder”** or **“Proposer”** means any person, firm, partnership, association, or joint venture seeking to be awarded a contract or subcontract to provide goods, commodities or services.
2. **“Certification”** or **“Certified”** means a Business that is certified by Shelby County Government under the LOSB program.
3. **“Commercially useful function”** means being responsible for the management and performance of a distinct element of the total work.
4. **“Contractor”** shall mean any person or business enterprise that submits a bid or proposal to provide labor, goods, or services to Shelby County by contract for profit in the area of construction or construction-related activities; and, any person or firm who supplies or provides labor, goods, or services to Shelby County by contract for profit.
5. **“Efforts to Achieve LOSB Participation”** means that the Contractor will solicit LOSB Participation with respect to the procurement and will consider all sub-bids and quotations received from LOSB’s. When a subcontract is not awarded to the LOSB, the Contractor must document the reason(s) the award was not made and substantiate that documentation in writing pursuant to the provisions of this Program.
6. **“Locally Owned Small Business (LOS B)”** means a business whose home office is located in Shelby County, whose annual revenues do not exceed \$3,000,000 and who has been certified by Shelby County Office of Equal Opportunity Compliance.
7. **“Non-LOS B”** means a business, which is not certified as a LOSB.
8. **“Unavailable”** means either that: (1) there is no LOSB providing goods or services requested; or, (2) no LOSB submitted a bid.

Requirements and Compliance

All firms or entities seeking to become Contractors as outlined herein are required to make good faith efforts to achieve LOSB participation when submitting a proposal or bidding on Shelby County procurements. Bidders and proposers shall not discriminate on the basis of race or gender when soliciting bids in the performance of Shelby County’s procurements. Discrimination complaints brought to the attention of Shelby County Office of Equal Opportunity Compliance (or its designee) will be reviewed and investigated to the extent necessary to determine the validity of such complaints and what actions, if any, should be taken by Shelby County.

Policies and Procedures

Shelby County may adopt policies and procedures as necessary to carry out and implement its powers and duties with regard to the LOSB Program. It is the goal of Shelby County to encourage participation by LOSB’s and to adopt rules and regulations which achieve to the greatest extent possible a level of participation by LOSB’s taking into account the total number of all Contractors and suppliers. Therefore, Shelby County will review each procurement request to determine the maximum potential for utilization of LOSB’s. This review is based on the availability of qualified LOSB’s providing goods or services as it

relates to the scope of the bid or procurement process. The following procedures may be utilized during the procurement process.

1. Pre-Bid Activity

a. Bid Language

Shelby County may insert language into each bid specification describing the LOSB Program to assure that all prospective bidders are aware of the requirements to make efforts to utilize LOSB's.

b. Notification

Shelby County may provide written notification to Contractors and LOSB's regarding: pre-bid conferences; technical assistance to LOSB's; LOSB Program procedures and required documentation; and, provide a list of LOSB's who have expressed an interest in competing for the bid or in performing as a subcontractor.

2. Contractor's Responsibilities

a. Efforts to Achieve LOSB Participation

All entities seeking to become Contractors are required to make efforts to achieve maximum LOSB participation, as outlined in this LOSB Program, when submitting a response to a bid or negotiated proposal in response to a Shelby County procurement opportunity. Such Efforts should be documented on **LOSB Form "A."**

b. Utilization

Contractors are required to utilize legitimate LOSB's in order to receive credit for the utilization of a LOSB. Contractors must document all LOSB's to be utilized, the percentage of utilization and the intended scope of work. Such information should be submitted on **LOSB Form "B."** This documentation must be submitted with the bid or negotiated proposal document.

c. Commercially Useful Functions

All LOSB's identified on **LOSB Form "C"** or **LOSB Form "D"** shall perform a Commercially Useful Function.

d. Unavailability

If a potential Contractor's efforts to obtain LOSB participation are unsuccessful due to the unavailability of a LOSB, the Contractor will submit a statement of unavailability. **LOSB Form "A."**

e. Pre-Work Conference

Any Contractor who is the successful bidder shall be required to attend a conference with Shelby County prior to beginning the work. The primary purpose of this conference is to review the project scope and review LOSB participation as outlined in **LOSB Form "B."** Shelby County will also review the Statement of Intent to Perform as a Subcontractor or Provide Supplies or Services as documented on **LOSB Form "C."**

f. Post-Award Change

Any Contractor who determines that a LOSB identified on **LOS Form “B”** cannot perform shall request approval from Shelby County to contract with an alternate subcontractor pursuant to this LOSB Program. Such request will be reviewed and approved only after adequate documentation for the proposed change is presented.

g. **LOS Certification**

Each month the Contractor shall submit **LOS Form “D”** certifying all payments made to LOSB’s.

3. LOSB Responsibilities

a. **Commercially Useful Function**

It is the responsibility of each LOSB providing subcontracted goods and/or services to submit **LOS Form “C”** certifying that it is performing the work and that it is a Commercially Useful Function.

Written Agreement

Shelby County policies and procedures on LOSB participation are designed to create contractual relationships between Contractors and LOSB’s. Therefore, a Contractor may utilize the services of a LOSB in estimating and satisfying the scope of work, provided that a written contract/agreement is executed between the Contractor and the LOSB.

Certification

To ensure that the ownership and control over decision-making and day-to-day operations of a Certified LOSB is legitimate, Shelby County reserves the right to verify the ownership and control of each LOSB utilized.

Monitoring LOSB Utilization

Shelby County intends to monitor and enforce this LOSB Program. Shelby County reserves the right to conduct random audits of each of its Contractor’s LOSB’s. Shelby County reserves the right to reevaluate a LOSB’s certification at any time.

Efforts to Achieve LOSB Participation

The Contractor shall consider all bids and/or quotations received from LOSB’s. When a subcontract is not awarded by a Contractor to any of the competing LOSB’s, the Contractor must document the reason(s) the award was not made to the LOSB’s. It is the responsibility of the Contractor to prove that it employed Efforts to Achieve LOSB participation. Evidence supporting the Contractor’s Efforts must be documented on **LOS Form “A,”** which must include, but is not limited to, the following:

1. Contractor must submit proof that it solicited LOSB participation through reasonable and available means including, but not limited to:

- a. Written notices to LOSB's who have the capability to perform the work of the contract or provide the service;
 - b. Direct mailing, electronic mailing, facsimile or telephone requests.
2. Contractor must submit proof that it provided interested LOSB's with adequate information about plans, requirements and specifications of the contract in a timely manner to assist them in responding to a solicitation.
3. Contractor must submit proof that it made Efforts to Achieve LOSB Participation including, but not limited to, proof that it made opportunities available to LOSB suppliers and identified opportunities commensurate with opportunities made available and identified to Non LOSB's. Such proof will include the names of businesses, contact person(s), addresses, telephone numbers, and, a description of the specifications for the work selected for subcontracting.
4. Contractor must submit proof that it allowed LOSB's the opportunity to review bid specifications, blue prints and all other bid related items at no charge. The Contractor must allow sufficient time for review prior to the bid deadline.
5. Contractor must submit proof that it made Efforts to Achieve LOSB Participation by not rejecting a LOSB as unqualified or unacceptable without sound reasons based on a thorough investigation of their capabilities. Contractor must submit proof of the basis for rejecting any LOSB deemed unqualified or unacceptable by the Contractor. The Contractor will not impose unrealistic conditions of performance on LOSB's seeking subcontracting opportunities.

The Contractor must fully cooperate with Shelby County in its post-contract award LOSB Program audit and compliance efforts.

Substitution of LOSB's after Contract Award

In order to make a substitution of a LOSB, a Contractor must make a request to Shelby County. This request must be submitted in writing to Shelby County. Shelby County reserves the right to approve any substitution of a LOSB. The Contractor has the responsibility to provide Shelby County with a reasonable basis for the substitution. If the Contractor desires to substitute the LOSB with a Non-LOSB, then the Contractor must comply with the Effort to Achieve LOSB Participation provisions set forth herein.

Noncompliance with LOSB Program

Any of the following reasons, individually or collectively, may result in suspension from bidding, prohibition from contracting, or cancellation of contracts:

1. The failure to perform according to contract provisions relating to this LOSB Program;
2. Violation of, circumvention of, or failure to comply with the LOSB Program; and/or,
3. Other reasons deemed appropriate by Shelby County.

Questions and Information

Questions regarding this LOSB Program and requests for information should be directed to:

Ms. Carolyn Griffin
Office of Equal Opportunity Compliance
Board of Commissioners of Shelby County
160 North Main Street, Suite 501
Memphis, Tennessee 38103
Phone: 901-222-1100
Fax: 901-222-1101
E-mail: carolyn.griffin@shelbycountytg.gov

Construction

This LOSB Program is consistent with Shelby County Policies and Procedures. Wherever conflicts exist, the provision in the Shelby County Policies and Procedures will prevail.

LOSB Program Forms Description

- **LOS Form A -- Certification of Efforts**

Contractors are required to submit **LOS Form "A"** with proposals as evidence and documentation of efforts that have been made to contact LOSB's for participation as subcontractors, joint venture partners, or suppliers of goods and services. Contractors are required to contact LOSB's and solicit quotes for goods and services. All responses to the Contractor's solicitation should be recorded and reported.

- **LOS B Form B -- LOS B Utilization Plan**

A Contractor is required to submit **LOS B Form "B"** with its Proposal in order to identify all LOSB's they propose to utilize in providing the goods and services included in the Proposal. Contractors may only include a proposed provider of goods or services on **LOS B Form "B,"** if the entity is a legitimate LOSB. Additionally, if such entity will provide services, Contractors may only list LOSB's on **LOS B Form "B"** if the entity will perform a Commercially Useful Function. The Successful Contractor will be required to finalize and submit **LOS B Form "B"** prior to award of a contract. **LOS B Form "B"** will be incorporated into the contract and will become a contractual obligation of the Successful Contractor. **LOS B Form "B"** shall not be changed or altered after award of a contract without approval from Shelby County. The Contractor is required to provide written notice describing the reasons for any proposed change to Shelby County and to obtain approval from Shelby County of any changes to **LOS B Form "B."**

- **LOS B Form C --Statement of Intent to Perform as a Subcontractor or Provide Supplies or Services**

Contractors are required to have each subcontracted LOSB providing services complete **LOS B Form "C"** certifying that it is performing the work and that it is a Commercially Useful Function.

- **LOS B Form D -- Statement of Payments to LOSB's**

Contractors are required to record and maintain information regarding the utilization of LOSB's and all other information during the performance of awarded contracts. This information shall be recorded and maintained on **LOS B Form "D."** The form is required to be submitted to Shelby County each month. **LOS B Form "D"** must be completed in its entirety with information regarding the types of goods purchased from LOSB's or the types of services rendered by LOSB's and dollars amounts paid for their goods or services.

**Shelby County
LOS B Program**

LOS B FORM A

CERTIFICATION OF EFFORTS TO ACHIEVE LOS B PARTICIPATION

(To Be Submitted with the Bid/Proposal)

Company Name: _____

Bid No.: _____

I certify that the following efforts were made to achieve LOS B participation:

YES NO

A	Provided written notices to LOS B's who have the capability to perform the work of the contract or provide the service		
B	Direct mailing, electronic mailing, facsimile or telephone requests		
C	Provided interested LOS B's with adequate information about plans, requirements and specifications of the contract in a timely manner to assist them in responding to a solicitation		
D	Allowed LOS B's the opportunity to review bid specifications, blue prints and all other bid/RFP related items at no charge, and allowed sufficient time for review prior to the bid deadline		
E	Acted in good faith with interested LOS B's, and did not reject LOS B's as unqualified or unacceptable without sound reasons based on a thorough investigation of their capabilities		
F	Did not impose unrealistic conditions of performance on LOS B's seeking subcontracting opportunities		

Additionally, I contacted the referenced LOS B's and requested a bid/proposal. The responses I received were as follows:

Name and Address of LOS B	Type of Work And Contract Items, Supplies or Services to be Performed	Response	Reason for Not Accepting Bid/Proposal

(If additional space is required, this form may be duplicated)

If applicable, please complete the following:

I hereby certify that LOSB's were "Unavailable" as defined in the LOSB Program to submit bids to provide goods and services for this RFP/Bid's purpose.

Reasons for the "Unavailability":

Submitted by:

Authorized Representative Signature

Title

Date

**Shelby County
LOSB Program**

LOSB FORM B

LOSB UTILIZATION PLAN
(To Be Submitted with the Bid/Proposal)

Company: _____
Bid No.: _____

I, _____, do certify that on the following procurement opportunity,

(Contractor)
_____, the following LOSB's will be utilized as sub-contractors, suppliers,
(Opportunity)
or to provide professional services:

Name	Description of Work	Contract Value	LOSB Number

(If additional space is needed this form may be duplicated)

TOTAL CONTRACT VALUE: _____

TOTAL % OF LOSB PARTICIPATION: _____

The successful bidder/proposer is required to finalize and submit this form prior to award of a contract. Joint Venture Agreements, partnering agreements and all pertinent information must be presented prior to contract award. This information will be incorporated into the contract and will become a contractual obligation of the successful bidder/proposer. The finalized LOSB Form B shall not be changed or altered after award of a contract without approval from Shelby County. The successful bidder/proposer is required to provide written notice describing the reasons for the change to Shelby County to obtain approval of any changes to LOSB Form B.

Submitted by:

Authorized Representative Signature

Title

Date

**Shelby County
LOS B Program
LOS B FORM C**

**STATEMENT OF INTENT TO PERFORM AS A SUBCONTRACTOR OR
PROVIDE SUPPLIES OR SERVICES
(To Be Submitted Prior to Contract Award)**

Company Name: _____
Bid No.: _____

I, _____, intend to provide supplies or services in connection with the
(Subcontractor/Provider)
above **bid/proposal** request as a LOSB.

I am prepared to perform a “**Commercially Useful Function**” in connection with the above project.

The following are the work items to be performed:

at the following price: \$ _____.

If applicable, please complete the following:

I have or will enter into a formal agreement with _____ for the above-
(Company)
described scope of work, supplies, or services conditioned upon the execution of a contract
with Shelby County.

I hereby certify that this statement is true and correct:

Business Information: Submitted by:

Business: _____

Authorized Representative (Print)

Address: _____

Title _____

Authorized Representative’s Signature

Phone: _____

Date _____
Facsimile: _____

**Shelby County
 LOSB Program**

LOS B FORM D

STATEMENT OF PAYMENTS TO LOSB'S
 (To Be Submitted Monthly and with Final Payment Request)

Company Name: _____

Name/Contract No.: _____

Payment Request Number: _____

Name of Firm	Description of work	Total Amount Due This Month	Total Dollars Paid To Date	% of Contract Completed	Start Date of Contract	End Date of Contract

(If additional space is needed this form may be duplicated)

I hereby certify that this statement is true and that above payments have been made.

Business Information:

Submitted by:

Business: _____

 Authorized Representative (Print)

Address: _____

 Title

 Authorized Representative's Signature

Phone: _____

Date
Facsimile: _____

LOCALLY OWNED SMALL BUSINESS PURCHASING PROGRAM
RULES AND REGULATIONS:

(i) The Administrator of Purchasing in conjunction with the Administrator of EOC shall identify certain goods and services required by the County to be set aside for special purchasing procedures for locally owned small businesses.

(ii) Only certified locally owned small businesses will be allowed to submit competitive bids on the goods or services identified under paragraph (i) above.

(iii) The Administrator of Purchasing shall, in conjunction with the Administrator of EOC, annually review the Shelby County Capital Improvement Program to determine those projects with a construction cost of \$250,000 or more. Contracts amounting to at least ten (10%) of the construction costs of such project shall be awarded to locally owned small businesses as defined herein, except as set forth in sub-paragraph (vi) of this section, either as part of the conditions of the solicitation for general contractors bidding on these projects, or as separate bids issued by the County for subcontracts that may be assigned to general contractors.

(iv) After adhering to all other bidding and purchasing requirements of the County, not inconsistent with this part, if no bids are received from locally owned small businesses, then the County may solicit bids for the goods or services from all other sources.

(v) On all purchases and/or contracts entered into by the County, the Purchasing Administrator or his or her designee shall have the right to negotiate with any supplier of goods or services to the County for the inclusion of locally owned small business subcontractors and/or suppliers in the contract award.

(vi) Failure by a supplier or contractor to include locally owned small business sub-contractors or suppliers in its bid or contract may be grounds for rejection of said bid or contract unless the supplier or contractor can show documented evidence of good cause why none were included.

(vii) Any locally owned small business awarded a contract or purchase order under this section shall not sublet, subcontract, or assign any work or services awarded to it without the prior written consent of the Mayor or the Purchasing Administrator.

(viii) As to those purchases below the requirement for a formal bid solicitation

(currently, under \$15,000) and not included in the locally owned small business set aside, the Administrator of Purchasing shall determine if any locally owned small business offers that product or service. If so, at least one such eligible locally owned small business should be included in the vendors contacted for an opportunity to bid, and the Administrator of Purchasing may, at his discretion, designate in a purchase order the purchase of such goods and services from the identified locally owned small business.

(ix) In those situations where a locally owned small business as defined herein, engages in open competitive bidding for County contracts, the Administrator of Purchasing shall provide for a preference for the locally owned small business where responsibility and quality are equal. Said preferences shall not exceed five percent (5%) of the lowest possible bidder meeting specifications. The preference shall be applied on a sliding scale in the following manner:

- a. A preference of up to five percent (5%) shall be allowed for contracts up to \$500,000.00;
- b. A preference of up to three and five-tenths percent (3.5%) shall be allowed for contracts up to \$750,000.00;
- c. A preference of two and one-half percent (2.5%) shall be allowed for contracts up to \$1,000,000.00;
- d. A preference of two percent (2%) shall be allowed for contracts that exceed \$1,000,000.00.

(x) For construction contracts over \$2,000,000.00, the Administrator of Purchasing shall provide for a preference of two percent (2%) to general contractors meeting the requirements of Section 1, Subparagraph B, if fifty percent (50%) or more of the total work comprising the bid has been or will be awarded to certified locally owned small businesses. The fifty percent subcontracting threshold must be met prior to contract execution.

(xi) The Administrator of Purchasing may divide a single bid package for any purchase of goods and services into two or more smaller bid packages in any case that the Administrator of Purchasing reasonably believes that the smaller bid packages will result in a greater number of bids by locally owned small businesses.

(xii) The Administrator of Purchasing, upon approval of the County Mayor, may establish special insurance and bonding requirements for certified locally owned small businesses so long as they are not in conflict with the laws of the State of Tennessee.

(xiii) The Administrator of Purchasing, with the approval of the County Mayor, shall adopt and promulgate, and may from time to time, amend rules and regulations not inconsistent with the provisions of this ordinance, governing the purchase of goods and services from locally owned small business concerns to effectuate and implement the Locally Owned Small Business Purchasing Program within the intent of this ordinance.

(xiv) The Administrator of EOC shall, in conjunction with the Administrator of Purchasing, provide a written quarterly report to the Mayor and Board of Commissioners which shall include a summary of the purchases selected for this program, a listing of the contracts awarded to locally owned small businesses for the period, and the dollar amounts of each such contract, and the percentage which such contracts bear to the total amount of purchases for the period.

k.

DRUG-FREE WORKPLACE AFFIDAVIT

STATE OF _____

COUNTY OF _____

The undersigned, principal officer of _____, an employer of five (5) or i employees contracting with _____ County government to provide construction services states under oath as follows:

- 1. The undersigned is a principal officer of _____ (hereinafter referred to as the “Company”), and is duly authorized to execute this Affidavit on behalf of the Company.
- 2. The Company submits this Affidavit pursuant to T.C.A. § 50-9-113, which requires each employer with no less than five (5) employees receiving pay who contracts with the state or any local government to provide construction services to submit an affidavit stating that such employer has a drug-free workplace program that complies with Title 50, Chapter 9, of the *Tennessee Code Annotated*.
- 4. The Company is in compliance with T.C.A.~ 50-9-113. Further affiant saith not.

Principal Officer

STATE OF _____

COUNTY OF _____

Before inc personally appeared _____ with whom I am personally acquainted (or proved to me on the basis of satisfactory evidence), and who acknowledged that such person executed the foregoing affidavit for the purposes therein contained.

Witness my hand and seal at office this _____ day of _____ 20

Notary Public

My commission expires:

1.

GRATUITY DISCLOSURE FORM

Shelby County Ethics Commission

INSTRUCTIONS: This form is for all persons receiving any Shelby County Government contract, land use approval or financial grant money to report any gratuity that has been given, directly or indirectly, to any elected official, employee or appointee (including their spouses and immediate family members) who is involved in the decision regarding the contract, land use approval, or financial grant of money.

1. **NAME**

2. **DATE OF GRATUITY**

3. **NATURE AND PURPOSE OF THE GRATUITY**

4. **NAME OF THE OFFICIAL, EMPLOYEE, APPOINTEE, OR FAMILY MEMBER WHO RECEIVED THE GRATUITY**

5. **NAME OF THE PERSON OR ENTITY THAT PROVIDED THE GRATUITY**

6. **ADDRESS OF THE PERSON OR ENTITY THAT PROVIDED THE GRATUITY**

7. DESCRIPTION OF THE GRATUITY

8. COST OF THE GRATUITY (If cost is unknown and not reasonably discernible by the person giving the gratuity, then the person giving the gratuity shall report a good faith estimate of the cost of the gratuity.)

9. The information contained in this Gratuity Disclosure Form, and any supporting documentation or materials referenced herein or submitted herewith, is true and correct to the best of my knowledge, information and belief and affirm that I have not given, directly or indirectly, any gratuity to any elected official, employee or appointee (including spouse and immediate family members) that has not been disclosed and I affirm that I have not violated the provisions of the Shelby County Government Code of Ethics.

Signature

Date

Print Name

A copy of your completed form will be placed on the Shelby County Internet website.

m.

FORMS TO BE SUBMITTED

LOSB FORM A: MUST BE COMPLETED AND SUBMITTED IN YOUR BID ENVELOPE

LOSB FORM B: MUST BE COMPLETED, SUBMITTED WITH YOUR BID DOCUMENTING ALL LOSB'S TO BE UTILIZED, THE PERCENTAGE OF UTILIZATION AND THE INTENDED SCOPE OF THE WORK.

DRUG FREE WORKPLACE AFFIDAVIT - MUST BE COMPLETED AND SUBMITTED WITH YOUR BID.

GRATUITY DISCLOSURE FORM - MUST BE COMPLETED AND SUBMITTED WITH YOUR BID.

BID BOND- ALL BIDS MUST BE ACCOMPANIED BY A BANK CERTIFIED CHECK OF BANK DRAFT, LETTER OF CREDIT ISSUED BY ANY NATIONAL BANK OR APPROVED BID BOND FOR NOT LESS THAN 5% (PERCENT) OF THE AMOUNT OF THE BID. ALL PROPOSAL GUARANTEES SHALL BE MADE OUT TO THE COUNTY OF SHELBY.

NOTE: LOSB FORM C AND D WILL BE SUBMITTED BY THE SUCCESSFUL CONTRACTOR.

LOSB FORM C- MUST BE COMPLETED AND SUBMITTED BY EACH LOSB PROVIDING SUBCONTRACTED GOODS AND OR SERVICES CERTIFYING THAT THEY ARE PERFORMING THE WORK AND THAT IT IS A COMMERCIALY USEFUL FUNCTION.

LOSB FORM D-MUST BE COMPLETED AND SUBMITTED BY THE SUCCESSFUL CONTRACTOR EACH MONTH CERTIFYING ALL PAYMENTS MADE TO LOSB'S.

FAILURE TO SUBMIT THE REQUIRED FORMS MAY RESULT IN YOUR BID BEING REJECTED AS BEING IN NON-COMPLIANCE WITH BID REQUIREMENTS.

VII. NOTICE TO BIDDERS

Time and Place of Opening of Bids:

Request For Proposals (RFP's) for the improvements described herein will be received at **THE OFFICE OF THE SHELBY COUNTY ADMINISTRATOR OF PURCHASING, ROOM 550, SHELBY COUNTY ADMINISTRATION BUILDING, 160 NORTH MAIN, MEMPHIS, TENNESSEE 38103, at 4:00 pm, Wednesday, October 16, 2013.**

NOTE: There will not be a public bid opening for this project.

Description of Work:

- a. The proposed work is officially known as: Boiler Modification, Shelby County Government

Pre-Bid Meeting:

Bidders are encouraged to attend a **Mandatory** pre-bid meeting to be held on **Thursday, October 3, 2013 at 11:00 am**, at the Shelby County Criminal Justice Center, 201 Poplar, Auditorium, 1st Floor Lobby, Memphis, Tennessee 38103.

Instruction to Bidders:

- (a) The RFP can be downloaded from The Shelby county Government website locates at www.shelbycountyttn.gov and click the link "Department" at the top, then P for the Purchasing Department, then click on the link "Bids."
- (b) All bids must be accompanied by a bank cashier's check or bank draft, letter of credit issued by any national bank or certificate of deposit therein, duly assigned, or certified check or approved bid bond for not less than five (5) percent of the amount of the bid. All proposal guarantees shall be made out to the COUNTY OF SHELBY.
- (c) All bidders must be licensed by the Tennessee State Board of Licensing
- (d) General Contractors Evidence of this license must appear on the title page of the Proposal in the space provided, and also on the exterior of the sealed envelope. The envelope enclosing each bid must show the Contractor's name, license number, expiration date thereof, and license classification of the

contractor(s) bidding for the prime contract and for the masonry, electrical, plumbing, heating, ventilation, and air conditioning subcontracts in accordance with TCA 62-6-119. Lacking all of this information, the bid shall be rejected and returned to the bidder unopened.

EOC Requirements:

As a condition precedent to bidding, bidders shall have received a current “Equal Opportunity Compliance Eligibility Number” which must be attached to each bid submission. To receive an E.O.C. Eligibility Number, specific information must be received by the E.O.C. Department at least 48 hours prior to the bid opening. To verify your E.O.C. Number or to receive information for obtaining a number, contact the E.O.C. Department, **901-222-1100**.

Use of Locally Owned Small Business (LOSB) participation on County projects is mandatory.

Bidders are encouraged to contact County-certified LOSB firms from the listing that can be obtained from Shelby County EOC department. Bidders may also provide the names of firms they believe would qualify as LOSB firms, by notifying the E.O.C. Department and filing the required forms at least five (5) working days prior to the bid opening

A Locally Owned Small Business is defined as a sole proprietorship, corporation, partnership, or joint venture located within Shelby County and at least 51% owned, operated and managed by a Shelby County resident and having an average annual sale of \$5,000,000.00 or less over the past three (3) years.

Rejection of Bids:

The **COUNTY OF SHELBY** reserves the right to reject any and all proposals and to waive technicalities in any proposal.

BY ORDER OF: CLIFTON DAVIS

**PURCHASING
ADMINISTRATOR
SHELBY COUNTY
GOVERNMENT**

_____, 2013

PROPOSAL - RFP #14-009-14

(COPY THIS PROPOSAL AND USE AS YOUR BID FORM)

In compliance with your Invitation for Bids for:

Shelby County Government - Boiler Modifications

Project Location: 140 Adams - Bid Package #1
201 Poplar - Bid Package #2
201 Poplar & 160 N Main - Bid Package #3
Memphis, TN 38103

The undersigned bidder: (Check one)

- a corporation organized and existing under Tennessee laws;
- a partnership consisting of _____;
- an individual trading as _____;

of the City of _____ having examined the attached Contract Documents and being fully advised as to the extent and character of the work to be performed, and the equipment to be furnished, proposes to furnish and pay for all labor, tools, material, utility fees, plant, federal, state and local taxes and equipment necessary for implementation of the Contract requirements.

The bid amount shall incorporate an allowance for unidentified work as a contingency. Contingency funds may only be applied toward work that is not identified by the contract documents and is approved by the Owner. Any unused funds will be deducted from the contract by deductive change order at contract close-out.

- \$38,000 Contingency allowance Bid Package #1
- \$42,000 Contingency allowance Bid Package #2
- \$ 1,500 Contingency allowance Bid Package #3

The undersigned Bidder further proposes to perform all work as selected by the Owner and furnish and pay for all equipment in accordance with the Contract Documents, within the time limit specified, for the following Bid Package if awarded by the Owner:

BID PACKAGE #1 - 140 Adams - Courthouse

in figures \$ _____

in words _____

BID PACKAGE #2 - 201 Poplar - Criminal Justice Center

in figures \$ _____

in words _____

BID PACKAGE #3 - Additional Building Automation Monitoring

in figures \$ _____

in words _____

The undersigned Bidder, pursuant to the rights reserved by the Owner, under Legal Notice to Bidders as to rejection of bids and under Instructions to Bidders as to award of Contract, agrees to accept the award of said Contract and hereby agrees to enter into a Contract within 7 days after due notification from the Owner of award of the Contract, and further agrees to furnish all labor, tools, materials, plant, and equipment, perform all services and comply with all terms and conditions established by the Contract Documents.

The Bidder agrees that if he is awarded this Contract, he will commence construction within 14 calendar days after receipt of signed contract and will be **substantially complete with all work within 24 weeks** from the date of the contract award, at which time the Owner will have full beneficial use of all heating systems in this building. Final Closeout shall occur within 4 weeks of substantial completion or the liquidated damages shall be reinstated until the project is fully completed and all documentation and programming is approved and accepted by the Owner. 6 weeks will be added to the above if both Bid Packages #1 & #2 are awarded simultaneously. No additional time is associated with the award of Bid Package #3.

Should the Contractor neglect, refuse, or fail to complete the work within the time specified, after all extensions of time granted by the Owner have been added, then in that event the Owner shall have and is hereby given the right to deduct and retain out of such monies which may then be due, or which may become due and payable to the Contractor for the work to be done under this Contract, an agreed upon sum equal to **Three Hundred Dollars (\$300.00) per calendar day for each and every day that the work is delayed in its completion beyond the specified time.** The said **\$300.00 per day** shall be held by the Owner under a mutual understanding between the Contractor, Contractor's Surety and the Owner. If necessary the Owner shall collect any monies directly from the Contractor or the Contractor's Surety.

Enclosed herewith is a (Certified Check) (Cashier's Check) or a solvent bank (5% Bidder's

Bond) in the amount of _____ DOLLARS (\$_____), made payable to the Owner as a guarantee of good faith and which the undersigned hereby agrees shall be retained as liquidated damages by the Owner should the Contractor fail to furnish a Performance Bond written by good solvent in a surety company doing business in the State of Tennessee and acceptable to the Owner. The Performance Bond shall be in an amount equal to the gross amount of said Contract, and the Performance Bond shall be made and Contract shall be signed within 2 weeks after date of due notification from the Owner of award of the Contract, and the check shall be returned to the undersigned upon the signing of the Contract and delivery of the required number of copies of approved Performance/Payment Bond to the Owner.

In submitting this bid, it is understood that the right is reserved by the Owner to reject any and all bids and it is understood that this bid may not be withdrawn for a period of 120 days after the scheduled time for receipt of bids.

The undersigned declares that _____ is the only person, firm or corporation interested in this proposal, and that no other person, firm or corporation than the one herein named has any interest herein or in the Contract proposed to be taken; that it is made without any connection with any person, firm or corporation making proposal for the same work, and that it is in all respects fair as to the work bid upon and without collusion or fraud; also that no officer or employee of Shelby County Government who is excluded by law from participating therein, is directly or indirectly interested herein, or in furnishing of the supplies or doing the work to which it relates, or in furnishing surety, or in any portion of the profits thereof.

Receipt of the following addenda is hereby acknowledged: _____.
(Insert numbers of all addenda received; if no addenda received, insert "None").

Bidder _____
Signature Printed Name

Business address

Full name and residence of all persons interested in the foregoing as principals are:

(Name) (Address)

(Name) (Address)

(Name of President if a Corporation) (Name of Secretary if a Corporation)

END OF SECTION

THE AMERICAN INSTITUTE OF ARCHITECTS

AIA Document A310

Bid Bond

KNOW ALL MEN BY THESE PRESENTS, that we

(Here insert full name and address or legal title of Contractor>

as Principal, hereinafter called the Principal, and

(Here insert full name and address or legal title of Surety>

a corporation duly organized under the laws of the State of
as Surety, hereinafter called the Surety, are held and firmly bound unto

(Here insert full name and address or legal title of Owner)

as Obligee, hereinafter called the Obligee, in the sum of

Dollars (\$ _____),

for the payment of which sum well and truly to be made, the said Principal and the said Surety, bind ourselves, our heirs, executors, administrators, successors and assigns, jointly and severally, firmly by these presents.

WHEREAS, the Principal has submitted a bid for

(Here insert full name, address and description of project)

NOW, THEREFORE, if the Obligee shall accept the bid of the Principal and the Principal shall enter into a Contract with the Obligee in accordance with the terms of such bid, and give such bond or bonds as may be specified in the bidding or Contract Documents with good and sufficient surety for the faithful performance of such Contract and for the prompt payment of labor and material furnished in the prosecution thereof, or in the event of the failure of the Principal to enter such Contract and give such bond or bonds, if the Principal shall pay to the Obligee the difference not to exceed the penalty hereof between the amount specified in said bid and such larger amount for which the Obligee may in good faith contract with another party to perform the Work covered by said bid, then this obligation shall be null and void, otherwise to remain in full force and effect.

Signed and sealed this

day of

19

(Principal)

(Seal)

(Witness)

(Title)
(Surety)

(Seal)

(Witness)

(Title)

Performance Bond



KNOW ALL MEN BY THESE PRESENTS: that

(Here insert full name and address or legal title of Contractor)

as Principal, hereinafter called Contractor, and,

(Here insert full name and address or legal title of Surety)

as Surety, hereinafter called Surety, are held and firmly bound unto

(Here insert full name and address or legal title of Owner)

as Obligee, hereinafter called Owner, in the amount of

Dollars (\$ _____),

for the payment whereof Contractor and Surety bind themselves, their heirs, executors, administrators, successors and assigns, jointly and severally, firmly by these presents.

WHEREAS,

Contractor has by written agreement dated _____
(Here insert full name, address and description of project)

19 _____ entered into a contract with Owner for

in accordance with Drawings and Specifications prepared by

(Here insert full name and address or legal title of Architect)

which contract is by reference made a part hereof, and is hereinafter referred to as the Contract.

PERFORMANCE BOND

NOW, THEREFORE, THE CONDITION OF THIS OBLIGATION is such that, if Contractor shall promptly and faithfully perform said Contract, then this obligation shall be null and void; otherwise it shall remain in full force and effect.

The Surety hereby waives notice of any alteration or extension of time made by the Owner.

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

1) Complete the Contract in accordance with its terms and conditions, or

2) Obtain a bid or bids for completing the Contract in accordance with its terms and conditions, and upon determination by Surety of the lowest responsible bidder, or, if the Owner elects, upon determination by the Owner and the Surety jointly of the lowest responsible bidder, arrange for a contract between such bidder and Owner, and make available as Work progresses (even though there should be a default or a succession of

defaults under the contract or contracts of completion arranged under this paragraph) sufficient funds to pay the cost of completion less the balance of the contract price; but not exceeding, including other costs and damages for which the Surety may be liable hereunder, the amount set forth in the first paragraph hereof. The term "balance of the contract price," as used in this paragraph, shall mean the total amount payable by Owner to Contractor under the Contract and any amendments thereto, less the amount properly paid by Owner to Contractor.

Any suit under this bond must be instituted before the expiration of two (2) years from the date on which final payment under the Contract falls due.

No right of action shall accrue on this bond to or for the use of any person or corporation other than the Owner named herein or the heirs, executors, administrators or successors of the Owner.

Signed and sealed this

day of

19

THE AMERICAN INSTITUTE OF ARCHITECTS



AIA Document A311

Labor and Material Payment Bond

THIS BOND IS ISSUED SIMULTANEOUSLY WITH PERFORMANCE BOND IN FAVOR OF THE OWNER CONDITIONED ON THE FULL AND FAITHFUL PERFORMANCE OF THE CONTRACT

KNOW ALL MEN BY THESE PRESENTS: that _____ (Here insert full name and address or legal title or contractor)

as Principal, hereinafter called Principal, and, _____ (Here insert full name and address or legal title of Surety)

as Surety, hereinafter called Surety, are held and firmly bound unto _____ (Here insert full name and address or legal title of Owner)

as Obligee, hereinafter called Owner, for the use and benefit of claimants as hereinbelow defined, in the

amount of _____ (Here insert a sum equal to at least one-half of the contract price)

Dollars (\$

for the payment whereof Principal and Surety bind themselves, their heirs, executors, administrators, successors and assigns, jointly and severally, firmly by these presents.

WHEREAS,

Principal has by written agreement dated _____ 19 _____ entered into a contract with Owner for _____ (Here insert full name, address and description of project)

in accordance with Drawings and Specifications prepared by _____ (Here insert full name and address or legal title of Architect)

which contract is by reference made a part hereof, and is hereinafter referred to as the Contract.

LABOR AND MATERIAL PAYMENT BOND

NOW, THEREFORE, THE CONDITION OF THIS OBLIGATION is such that, if Principal shall promptly make payment to all claimants as hereinafter defined, for all labor and material used or reasonably required for use in the performance of the Contract, then this obligation shall be void; otherwise it shall remain in full force and effect, subject, however, to the following conditions:

1. A claimant is defined as one having a direct contract with the Principal or with a Subcontractor of the Principal for labor, material, or both, used or reasonably required for use in the performance of the Contract, labor and material being construed to include that part of water, gas, power, light, heat, oil, gasoline, telephone service or rental of equipment directly applicable to the Contract.

2. The above named Principal and Surety hereby jointly and severally agree with the Owner that every claimant as herein defined, who has not been paid in full before the expiration of a period of ninety (90) days after the date on which the last of such claimants work or labor was done or performed, or materials were furnished by such claimant, may sue on this bond for the use of such claimant, prosecute the suit to final judgment for such sum or sums as may be justly due claimant, and have execution thereon. The Owner shall not be liable for the payment of any costs or expenses of any such suit.

3. No suit or action shall be commenced hereunder by any claimant:

a) Unless claimant, other than one having a direct contract with the Principal, shall have given written notice to any two of the following: the Principal, the Owner, or the Surety above named, within ninety (90) days after such claimant did or performed the last of the work or labor, or furnished the last of the materials for which said claim is made, stating with substantial

Signed and sealed this

(Winc-s)
(Vvilms)

day of

accuracy the amount claimed and the name of the party to whom the materials were furnished, or for whom the work or labor was done or performed. Such notice shall be served by mailing the same by registered mail or certified mail, postage prepaid, in an envelope addressed to the Principal, Owner or Surety, at any place where an office is regularly maintained for the transaction of business, or served in any manner in which legal process may be served in the state in which the aforesaid project is located, save that such service need not be made by a public officer.

b) After the expiration of one (1) year following the date on which Principal ceased Work on said Contract, it being understood, however, that if any limitation embodied in this bond is prohibited by any law controlling the construction hereof such limitation shall be deemed to be amended so as to be equal to the minimum period of limitation permitted by such law.

c) Other than in a state court of competent jurisdiction in and for the county or other political subdivision of the state in which the Project, or any part thereof, is situated, or in the United States District Court for the district in which the Project, or any part thereof, is situated, and not elsewhere.

4. The amount of this bond shall be reduced by and to the extent of any payment or payments made in good faith hereunder, inclusive of the payment by Surety of mechanics' liens which may be filed of record against said improvement, whether or not claim for the amount of such lien be presented under and against this bond.

	19
<i>(Principal)</i>	
<i>(Tillt)</i>	
<i>(Surt'ty)</i>	(Seal)

**SHELBY COUNTY GENERAL CONDITIONS OF THE
CONTRACT FOR CONSTRUCTION**

Rev. 5/24/99

constcnd.doc

**GENERAL CONDITIONS OF THE
CONTRACT FOR CONSTRUCTION**

**ARTICLE I
CONTRACT DOCUMENTS**

1.1 Definitions

1.1.1 The Contract Documents

The Contract Documents consist of the Owner-Contractor Agreement, the conditions of the Contract (General, Supplementary and other conditions), the Drawings, the Specifications, and all Addenda issued prior to and all modifications issued after execution of the Contract. A Modification is (1) a written amendment to the Contract signed by both parties, (2) a Change Order, (3) a written interpretation issued by the Engineer pursuant to Subparagraph 2.2.8, or (4) a written order for a minor change in the Work issued by the Engineer pursuant to Paragraph 12.3. The Contract Documents include Bidding Documents such as the Advertisement or invitation to Bid, the Instructions to Bidders, sample forms, the Contractor Bid, or portions of Addenda relating to any of these, and other documents specifically enumerated in the Owner-Contractor Agreement.

1.1.2 The Contract

The Contract Documents form the Contract for Construction. This Contract represents the entire and integrated agreement between the parties hereto and supersedes all prior negotiations, representations, or agreements, either written or oral. The Contract may be amended or modified only by a Modification as defined in Subparagraph 1.1.1. The Contract Documents shall not be construed to create any contractual relationship of any kind between the Engineer and the Contractor, but the Engineer shall be entitled to performance of obligations intended for his benefit, and to enforcement thereof. Nothing contained in the Contract Documents shall create any contractual relationship between the Owner or the Engineer or any Subcontractor or sub-subcontractor.

1.1.3 The Work

The Work comprises the completed construction required by the contract Documents and includes all labor necessary to produce such construction, and all materials and equipment incorporated or to be incorporated in such construction.

Initial _____

1.1.4 The Project

The Project is the total construction of which the Work performed under these Contract Documents may be the whole or a part.

1.2 Execution Correlation and Intent

1.2.1 The Contract Documents shall be signed in not less than four originals by the Owner and Contractor. If either Owner or Contractor or both do not sign the Conditions of the Contract, Drawings, Specifications, or any of the other Contract Documents, the Engineer shall identify such Documents.

1.2.2 By executing the Contract, the Contractor represents that he has visited the site, familiarized himself with the local conditions under which the Work is to be performed, and correlated his observations with the requirements of the Contract Documents.

1.2.3 The intent of the Contract Documents is to include all items necessary for the proper execution and completion of the Work. The Contract Documents are complementary, and what is required by any one shall be as binding as if required by all. Work not specifically set forth in the Contract Documents will not be required unless it is consistent with work that is specifically set forth in the Contract Documents or is reasonably inferable from the Contract Documents as being necessary to produce the intended results. Words and abbreviations, which have well-known technical or trade meanings, are used in the Contract Documents in accordance with such recognized meanings.

1.2.4 The organization of the Specifications into divisions, sections, and articles, and the arrangement of Drawings shall not control the Contractor in dividing the Work among Sub-contractors or in establishing the extent of Work to be performed by any trade.

1.3 Ownership and Use of Documents

1.3.1 All Drawings, Specifications and copies thereof furnished by the Engineer are the property of the Owner. They are to be used only with respect to this Project and are not to be used on any other project. With the exception of one contract set for each party to the Contract, such documents are to be returned or suitably accounted for to the Engineer on request at the completion of the Work. Submission or distribution to meet official regulatory requirements or for other purposes in connection with the Project is not to be construed as publication in derogation of the Engineer's common law copyright or other reserved rights. The Engineer will furnish, free of charge, to

Initial _____

the Contractor sufficient sets of Contract Documents to execute the Work not to exceed ten (10). The Contractor may purchase additional sets by paying reproduction costs.

ARTICLE II
ENGINEER

2.1 **Definition**

2.1.1 The Engineer is the person lawfully licensed to practice Engineering, or any entity lawfully practicing Engineering identified as such in the Owner-Contractor Agreement, and is referred to throughout the Contract Documents as if singular in number and masculine in gender. The term Engineer means the Engineer or his authorized representative.

2.2 **Administration of the Contract**

2.2.1 The Engineer will provide administration of the Contract as hereinafter described.

2.2.2 The Engineer will be the Owner's representative during construction and until final payment is due. The Engineer will advise and consult with the Owner. The Owner's instructions to the Contractor shall be forwarded through the Engineer. The Engineer will have authority to act on behalf of the Owner only to the extent provided in the Contract Documents, unless otherwise modified by written instrument signed by the Owner.

2.2.3 The Engineer will visit the site at intervals appropriate to the stage of construction to familiarize himself generally with the progress and quality of the Work and to determine in general if the Work is proceeding in accordance with the Contract Documents. On the basis of his on-site observations as an Engineer, he will keep the Owner informed of the progress of the Work, and will endeavor to guard the Owner against defects and deficiencies in the Work of the Contractor.

2.2.4 The Engineer will not be responsible for and will not have control or charge of construction means, methods, techniques or procedures, or for safety precautions and programs in connection with the Work, and he will not be responsible for the Contractor's failure to carry out the Work in accordance with the Contract Documents. The Engineer will not be responsible for or have control or charge over the acts or omissions of the Contractor, Subcontractors, or any of their agents or employees, or any other persons performing any of the Work.

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2.2.5 The Engineer shall at all times have access to the Work wherever it is in preparation and progress. The Contractor shall provide facilities for such access so the Engineer may perform his functions under the contract documents.

2.2.6 Based on the Engineer's observations and an evaluation of the Contractor's Applications for Payment, the Engineer will determine the amounts owing to the Contractor and will issue Certificates for Payment in such amounts as provided in Paragraph 9.4.

2.2.7 The Engineer will render interpretations necessary for the proper execution or progress of the Work, with reasonable promptness and in accordance with any time limit agreed upon so as to cause no delay the Project. Either party to the Contract may make written request to the Engineer for such interpretations.

2.2.8 All interpretations and decisions of the Engineer shall be consistent with the intent of and reasonably inferable from the Contract Documents and will be in writing or in the form of drawings.

2.2.9 The Engineer's decision in matters relating to artistic effect will be final if consistent with the intent of the Contract Documents. The Engineer shall rule on all claims and disputes that relate to the interpretation of the Contract Documents.

2.2.10 The Engineer will have authority to reject Work which does not conform to the Contract Documents. Whenever, in his opinion, he considers it necessary or advisable for the implementation of the intent of the Contract Documents, he will have authority to require special inspection or testing of the Work in accordance with Subparagraph 7.7.2 whether or not such Work is then fabricated, installed or completed. In the event the Engineer determines that any Work deleted by the Contractor should have been performed by the Contractor under the Contract Documents, he shall issue a final determination that the Contractor shall proceed with the Work as directed by the Engineer, and the Contractor shall proceed with the Work even if he is in disagreement with the decision of the Engineer.

2.2.11 The Engineer will review and approve or take other appropriate action under Contractor's submittals such as Shop Drawings, Product Data, and Samples, but only for conformance with the design concept of the Work and with the information given in the Contract Documents. Such action shall be taken with reasonable promptness so as to cause no delay. The Engineer's approval of a specific item shall not indicate approval of an assembly of which the item is a component.

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2.2.12 The Engineer will prepare Change Orders in accordance with Article 12 and will have the authority to order minor changes in the Work as provided in Subparagraph 12.3.

2.2.13 The Engineer will conduct inspections to determine the dates of Substantial Completion and completion will receive and forward to the Owner for the Owner's review written warranties and related documents required by the Contract and assembled by the Contractor, and will issue a Final Certificate for Payment upon compliance with the requirements of Paragraph 9.8.

ARTICLE III

OWNER

3.1 Definition

3.1.1 The Owner is the person or entity identified as such in the Owner-Contractor Agreement and is referred to throughout the Contract Documents as if singular in number and masculine in gender. The term Owner means the Owner, or his authorized representative.

3.2 Information and Services Required of the Owner

3.2.1 The Owner or Engineer shall furnish all surveys describing the physical characteristics, legal limitations and utility locations for the site of the Project, and a legal description of the site.

3.2.2 Except as provided in Subparagraph 4.7.1, the Owner shall secure and pay for necessary approvals, easements, assessments and charges required for the construction, use or occupancy of permanent structures or for permanent changes in existing facilities.

3.2.3 Information or services under the Owner's control shall be furnished by the Owner with reasonable promptness to avoid delay in the orderly progress of the Work.

3.2.4 Unless otherwise provided in the Contract Documents, the Contractor will be furnished, free of charge, all copies of Drawings and Specifications reasonably necessary for the execution of the Work.

3.2.5 The foregoing are in addition to other duties and responsibilities of the Owner enumerated herein and especially those in respect to Work by Owner or by Separate Contractors, Payments and Completion and Insurance in Article 6, 9 and 11, respectively.

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3.3 Owner's Right to Stop the Work

3.3.1 If the Contractor fails to correct defective Work as required by Paragraph 13.2 or persistently fails to carry out the Work in accordance with the Contract Documents, the Owner may order the Contractor to stop the Work, or any portion thereof, until the cause for such order has been eliminated; however, this right of the Owner to stop the Work shall not give rise to any duty on the part of the Owner to exercise this right for the benefit of the Contractor or any other person or entity. Any such order to the Contractor shall be in writing.

3.4 Owner's Right to Carry Out the Work

3.4.1 If the Contractor defaults or neglects to carry out the Work in accordance with the Contract Documents and fails within two (2) days after receipt of written notice from the Owner to commence and continue correction of such default or neglect with diligence and promptness, the Owner may, without prejudice to any other remedy it may have, make good and correct such deficiencies with its own forces or with the forces of another contractor. In such case, an appropriate Change Order shall be issued deducting from the payments then or thereafter due the Contractor the cost of correcting such deficiencies, including compensation for the Engineer's additional services made necessary by such default, neglect, or failure. If the payments then or thereafter due the Contractor are not sufficient to cover such amount, the Contractor shall pay the difference to the Owner.

3.4.2 The Owner shall have access to the Project at all times.

ARTICLE IV
CONTRACTOR

4.1 Definition

4.1.1 The Contractor is the person or entity identified as such in the Owner-Contractor Agreement and is referred to throughout the Contract Documents as if singular in number and masculine in gender. The term Contractor means the Contractor or his authorized representative.

4.2 Review of Contract Documents

4.2.1 The Contractor shall carefully study and compare the Contract Documents and shall at once report to the Engineer any error, inconsistency or omission he may discover.

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4.3 Supervision and Construction Procedures

4.3.1 The Contractor shall supervise and direct the Work, using his best skill and attention. He shall be solely responsible for all construction means, methods, techniques, sequences and procedures and for coordinating all portions of the Work under the Contract.

4.3.2 The Contractor shall be responsible to the Owner for the acts and omissions of his employees, Subcontractors and their agents and employees, and other persons performing any of the Work under a contract with the Contractor.

4.3.3 The Contractor shall not be relieved from his obligations to perform the Work in accordance with the Contract Documents either by the activities or duties of the Engineer in his administration of the Contract, or by inspection, tests or approvals required or performed under Paragraph 7.7 by persons other than the Contractor.

4.4 Labor and Materials

4.4.1 Unless otherwise provided in the Contract Documents, the Contractor shall provide and pay for all labor, materials, equipment, tools, construction equipment and machinery, water, heat, utilities, transportation, and other facilities and services necessary for the proper execution and completion of the Work, whether temporary or permanent and whether or not incorporated or to be incorporated in the Work.

4.4.2 The Contractor shall at all times enforce strict discipline and good order among his employees and shall not employ on the Work any unfit person or anyone not skilled in the task assigned to him.

4.4.3 When a material, equipment or system is specified or approved in an addendum, by the name of one or more manufacturers, such material, equipment, or system shall form the basis of the contract. If Contractor desires to use another material, equipment, or system in lieu thereof, he shall request approval in writing and shall submit samples and data as required for the Engineer's consideration. The Engineer and Owner will be the final judge for the acceptance or the substitution. No Substitution shall be made without authority in writing from the Engineer.

4.4.4 By making requests for substitutions based on Subparagraph 4.4.3 above, the Contractor:

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- .1 represents that he has personally investigated the proposed substitute product and determined that it is equal or superior in all respects to that specified;
- .2 represents that he will provide the same warranty for the substitute that is required by the Contract Documents for that specified.
- .3 certifies that the cost data presented is complete and includes all related costs and excludes the Engineer's redesign costs, and waives all claims for additional costs related to the substitution which subsequently became apparent; and
- .4 will coordinate the installation of the accepted substitute, making such changes at no additional cost to Owner as may be required for the Work to be complete in all respects.

4.4.5 The General Contractor shall disclose the existence and extent of financial interests, whether direct or indirect, he has in subcontractors and material suppliers which he may propose for this Project.

4.5 Warranty

4.5.1 The Contractor warrants to the Owner and the Engineer that all materials and equipment furnished under this Contract will be new unless otherwise specified, and all Work will be of good quality, free from faults and defects and in conformance with the Contract Documents. All Work not conforming to these requirements, including substitutions not properly approved and requirements including substitutions not properly approved and authorized, may be considered defective. If required by the Engineer, the Contractor shall furnish satisfactory evidence. This warranty is not limited by the provisions of Paragraph 13.2.

4.6 Taxes

4.6.1 The Contractor shall pay all sales, consumer, use and other similar taxes for the Work or portions thereof provided by the Contractor which are legally enacted at the time bids are received, whether or not yet effective.

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4.7 Permits, Fees and Notices

4.7.1 Unless otherwise provided in the Contract Documents, the Contractor shall secure and pay for the building permit and for all other permits and governmental fees, licenses and inspections necessary for the proper execution of the Contract.

4.7.2 The Contractor shall give all notices and comply with all laws, ordinances, rules, regulations and lawful orders of any public authority bearing on the performance of the Work.

4.7.3 If the Contractor performs any Work knowing it to be contrary to such laws, ordinances, rules and regulations, and without such notice to the Engineer, he shall assume full responsibility therefore and shall bear all costs attributable thereto.

4.8 Allowances and Owner Furnished Equipment, Fixtures or Labor

4.8.1 The Contractor shall include in the Contract Sum all allowances stated in the Contract Documents. Items covered by these allowances shall be supplied for such amounts and by such persons as the Owner may direct, but the Contractor will not be required to employ persons against whom he makes a reasonable objection.

4.8.2 Unless otherwise provided in the Contract Documents:

- .1 these allowances shall cover the cost to the Contractor, less any applicable trade discount, of the materials and equipment required by the allowance delivered at the site, and applicable taxes;
- .2 the Contractor's costs for unloading and handling on the site, labor, installation costs, overhead, profit and other expenses contemplated for the original allowance shall be included in the Contract Sum and not in the allowance;
- .3 whenever the cost is more than or less than the allowance, the Contract Sum shall be adjusted accordingly by Change Order, the amount of which will recognize changes, if any, in handling costs on the site, labor, installation costs, overhead, profit and other expenses.

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4.8.3 The Owner may directly furnish any or all of the equipment, fixtures or labor required for the Project. In the event the Owner elects to do so, the Contract Price for such equipment, fixtures or labor will be reduced by the amount for equipment of labor being furnished by Owner. A Change Order reducing the Contract Price for that item of work shall be executed by Owner and Contractor to reflect a reduction in the Contract Price for that item, equipment, fixtures or work that the Owner is to furnish. The Contractor shall assume responsibility for and be fully responsible for the care, custody and control of all Owner furnished equipment and/or fixtures once said equipment or fixtures arrive on the job site or in any approved off site storage facility.

4.9 Superintendent

4.9.1 The Contractor shall employ a competent superintendent and necessary assistants who shall be in attendance at the Project site during the progress of the Work. The superintendent shall represent the Contractor and all communications given to the superintendent shall be as binding as if given to the Contractor and shall be confirmed in writing.

4.10 Documents and Samples at the Site

4.10.1 The Contractor shall maintain at the site for the Owner, one record copy of all Drawings, Specifications, Addenda, Change Orders and other Modifications, in good order and marked currently to record all changes made during construction and approved Shop Drawings, Product Data and Samples. These shall be available to the Engineer and shall be delivered to him for the Owner upon completion of the Work.

4.11 Shop Drawings, Product Data and Samples

4.11.1 Shop Drawings are drawings, diagrams, schedules and other data specifically prepared for the Work by the Contractor or any Subcontractor, manufacturer, supplier or distributor to illustrate some portion of the Work.

4.11.2 Product Data are illustrations, standard schedules, performance charts, instructions, brochures, diagrams and other information furnished by the Contractor to illustrate a material, product or system for some portion of the Work.

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4.11.3 Samples are physical examples which illustrate materials, equipment or workmanship and establish standards by which the Work will be judged.

4.11.4 The Contractor shall review, approve and submit, with reasonable promptness and in such sequence as to cause no delay in the Work or in the work of the Owner or any separate contractor, all Shop Drawings, Product Data and Samples required by the Contract Documents.

4.11.5 By approving and submitting Shop Drawings, Product Data and Samples, the Contractor represents that he has determined and verified all materials, field measurements, and field construction criteria related thereto, or will do so, and that he has checked and coordinated the information contained within such submittals with the requirements of the Work and the Contract Documents.

4.11.6 The Contractor shall not be relieved of responsibility for any deviation from the requirements of the Contract Documents by the Engineer's approval of Shop Drawings, Product Data or Samples under Subparagraph 2.2.11, unless the Contractor has specifically informed the Engineer in writing of such deviation at the time of submission and the Engineer has given written approval to the specific deviation. The Contractor shall not be relieved from responsibility for errors or omissions in the Shop Drawings, Product Data, or Samples by the Engineer's approval thereof.

4.11.7 The Contractor shall direct specific attention, in writing or on resubmitted Shop Drawings, Product Data or Samples, to revisions other than those requested by the Engineer on previous submittals.

4.11.8 No portion of the Work requiring submission of a Shop Drawing, Product Data or Sample shall be commenced until the submittal has been approved by the Engineer as provided in Subparagraph 2.2.11. All such portions of the Work shall be in accordance with approved submittals.

4.12 Use of Site

4.12.1 The Contractor shall confine operations at the site to areas permitted by law, ordinance, permits and the Contract Documents and shall not unreasonably encumber the site with any materials or equipment.

4.13 Cutting and Patching of Work

4.13.1 The Contractor shall be responsible for all cutting,

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fitting or patching that may be required to complete the Work or to make its several parts fit together properly.

4.13.2 The Contractor shall not damage or endanger any portion of the Work or the work of the Owner or any separate contractors by cutting, patching or otherwise altering any work, or by excavation.

The Contractor shall not cut or otherwise alter the work of the Owner or any separate contractor except with the written consent of the Owner. The Contractor shall not unreasonably withhold from the Owner his consent to cutting or otherwise altering the Work.

4.14 Cleaning Up

4.14.1 The Contractor at all times shall keep the premises free from accumulation of waste materials or rubbish caused by his operations. At the completion of the Work he shall remove all his waste materials and rubbish from and about the project as well as all his tools, construction equipment, machinery and surplus materials.

4.14.2 If the Contractor fails to clean up at the completion of the Work, the Owner may do so as provided in Paragraph 3.4 and the cost thereof will be charged to the Contractor.

4.15 Royalties, Patents and Records

4.15.1 The Contractor shall pay all royalties and license fees. He shall defend all suits and claims for infringement of any patent rights and shall save Owner and Engineer harmless from loss on account thereof.

4.15.2 The Contractor shall not discriminate against any subcontractor, employee or applicant for employment on the grounds of race, color, national origin or sex.

4.15.3 The Contractor and all subcontractors under the general contract shall maintain copies of every sub-payroll period for the life of the construction contract and for a period of three (3) years after final release and payment is made by the Owner to the Contractor.

4.15.4 Each Contractor request for payment, including final payment and each partial payment, if permitted by the contract, shall contain a certification by the Contractor that performance by the Contractor and his subcontractor for the period of work covered by the payment request has been in accordance with the contract clauses and requirements with respect to nondiscrimination.

4.15.5 Representatives of Shelby County, as designated by the Mayor, shall have the right to inspect the Contractor's facilities and payroll records during the term of the construction contract and for a period of three (3) years after final release and final payment by the Owner for the purposes of verifying nondiscrimination in employment.

4.15.6 The Contractor shall incorporate the same requirements set forth in Subparagraph 5.3.1 in all Subcontracts awarded by him with the further requirement that each Subcontract include identical requirements to be included in any lower tier Subcontracts together with the requirement to include it in any further subcontracts that might be made.

4.16 Indemnification

4.16.1 (a) By executing this Agreement, the Contractor assumes the entire responsibility and liability for any and all claims, damage or injury of any kind or nature (including death) to all persons, whether employees of the Contractor or otherwise, and to all property (including but not limited to the replacement cost and loss of use of property), caused by, resulting from, arising out of, or occurring in connection with the performance of the Work by the Contractor, its agents, servants, employees, or subcontractors or anyone directly or indirectly employed by any of them for whose acts any of them may be liable.

(b) If any claim is made against the Owner for any damage, injury, death, or loss, whether such claim is based upon the Contractor's or its agents' servants' employees' or subcontractors' alleged active or passive negligence or participation in the wrong, or upon any alleged active or passive negligence or participation in the wrong, or upon any alleged breach of any statutory duty or obligation on the part of the Contractor, its agents, servants, employees or subcontractors, or in any other instance for which the Contractor has assumed responsibility in this Agreement, the Contractor shall indemnify, defend, and hold harmless the Owner, its officers, directors, agents, servants and employees from and against any and all loss, expense, judgment, damage or injury (including attorney's fees and expenses) that the Owner or its officers, directors, agents, servants or employees may sustain as the result of any such claim.

The Contractor shall assume on behalf of the Owner, its officers, directors, agents, servants and employees the defense of any action at law or in equity which may be brought against any of them upon any such claim, and shall pay on behalf of them the amount of any judgment with any costs or expenses incurred by any of them in connection with such claim.

4.16.2 Labor Indemnity

4.16.2.1 The Contractor shall indemnify, defend and hold harmless the Owner from any and all administrative and judicial actions (including reasonable attorney's fees related to any such action) incurred by the Owner in connection with any labor related activity arising from the performance of the Work of the Contractor. As used in this Agreement, "labor related activity" includes, but is not limited to strikes, walkouts, informational or organizational picketing, use of placards, distribution of handouts, leaflets or in the vicinity of any facility where the Owner conducts business. The Owner shall advise the contractor if any labor related activity occurs and the Contractor shall arrange for the legal representation necessary to protect the Owner, provided such representation is previously approved by the Owner.

4.16.3 Attorney's Fees

4.16.3.1 In the event it becomes necessary for Owner to employ an attorney to enforce any provision of this Agreement, then the Contractor shall be liable for all attorney's fees and litigation expense of Owner.

4.17 Progress Schedule

4.17.1 The Contractor shall, within five (5) days from receipt of the Notice to Proceed, prepare and submit for the Owner and Engineer an estimated project schedule for the Work. The Progress Schedule shall be updated each month to reflect actual progress made and to forecast future progress of the Work. The Progress Schedule shall be related to the entire Project as provided by the contract Documents and shall provide for expeditious and practicable execution of the Work. The Owner reserves the right to reasonably reschedule the Work or the sequence of activities of the contractor for no additional compensation should it deem rescheduling to be in its best interest.

ARTICLE V
SUBCONTRACTORS**5.1 Definition**

5.1.1 A Subcontractor is a person or entity who has a direct contract with the Contractor to perform any of the Work at the site. The term Subcontractor is referred to throughout the Contract Documents as if singular in number and masculine in gender and means a Subcontractor or his authorized representative. The term Subcontractor does not include any separate contractor or his subcontractor.

5.1.2 A Sub-subcontractor is a person or entity who has a direct or indirect contract with a Subcontractor to perform any of the Work at the site. The term Sub-subcontractor is referred to throughout the Contract Documents as if singular in number and masculine in gender and means a Sub-subcontractor or an authorized representative thereof.

5.2 **Award of Subcontracts and Other Contracts for Portions of the Work**

5.2.1 Unless otherwise required by the Contract Documents or Bidding Documents, the Contractor, as soon as practicable after the award of the Contract, shall furnish to the Owner and the Engineer in writing the names of the persons or entities (including those who are to furnish materials or equipment fabricated to a special design) proposed for each of the principal portions of the Work. The Engineer will promptly reply to the Contractor in writing stating whether or not the Owner or the Engineer, after due investigation, has reasonable objection to any such proposed person or entity. Failure of the Owner or Engineer to reply promptly shall constitute notice of no reasonable objection. No work shall be commenced until approval of all such Subcontractors has been given in writing by the Owner. If required, the Contractor shall furnish evidence satisfactory to the Owner, showing each proposed Subcontractor is competent to execute the Work covered by the Subcontract.

5.2.2 The Contractor shall not contract with any such proposed person or entity to whom the Owner or the Engineer has made reasonable objection under the provisions of Subparagraph 5.2.1. The Contractor shall not be required to contract with anyone to whom he has a reasonable objection.

5.2.3 If the Owner or the Engineer has reasonable objection to any such proposed person or entity, the Contractor shall submit a substitute to whom the Owner or the Engineer has no reasonable objection. Such substitution shall in no way affect the Contract Sum.

5.2.4 The Contractor shall make no substitution for any Subcontractor, person or entity previously selected if the Owner or Engineer makes reasonable objection to such substitution.

5.2.5 The Contractor shall submit a status report with regard to Subcontractors identified on Exhibit C, which forms a part of the Contract Documents, as to any change in the subcontractors identified thereon and the reasons for same, the dollars paid to the prior subcontractor and the amount of the new subcontract.

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THIS REPORT SHALL BE SUBMITTED TO CONTRACTS ADMINISTRATION OF SHELBY COUNTY GOVERNMENT, 160 N. Main St., Suite 1109, Memphis, Tennessee, 38103.

5.3 Subcontractual Relations

5.3.1 By an appropriate agreement, the Contractor shall require each Subcontractor, to the extent of the Work to be performed by the Subcontractor, to be bound to the Contractor by the terms of the Contract Documents, and to assume toward the Contractor all the obligations and responsibilities which the Contractor, by these Documents, assumes toward the Owner and the Engineer. Said agreement shall preserve and protect the rights of the Owner and the Engineer under the Contract Documents with respect to the Work to be performed by the Subcontractor so that the subcontracting thereof will not prejudice such rights, and shall allow to the Subcontractor, unless specifically provided otherwise in the Contractor-Subcontractor agreement, the benefit of all rights, remedies and redress against the Contractor that the Contractor, by these Documents, has against the Owner. Where appropriate, the Contractor shall require each Subcontractor to enter into similar agreements with his Sub-subcontractors. The Contractor shall make available to each proposed Subcontractor, prior to the execution of the Subcontract, copies of the Contract Documents to which the Subcontractor will be bound by the Paragraph 5.3, and identify to the Subcontractor any terms and conditions of the proposed subcontract which may be at variance with the Contract Documents. Each Subcontractor shall similarly make copies of such Documents available to any Sub-subcontractors.

ARTICLE VI WORK BY OWNER OR BY SEPARATE CONTRACTORS

6.1 Owner's Right to Perform Work and to Award Separate Contracts

6.1.1 The Owner reserves the right to perform work related to the Project with his own forces, and to award separate contracts in connection with other portions of the Project or other work on the site under these or similar Conditions of the Contract.

6.1.2 When separate contracts are awarded for different portions of the Project or other work on the site, the term Contractor in the Contract Documents in each case shall mean the Contractor who executes each separate Owner-Contractor Agreement.

6.2 Mutual Responsibility

6.2.1 The Contractor shall afford the Owner and separate contractor's reasonable opportunity for the introduction and storage of their materials and equipment and the execution of their work, and shall connect and coordinate his Work with theirs as required by the Contract Documents.

6.2.2 If any part of the Contractor's Work depends on proper execution or results in the work of the Owner or any separate contractor, the Contractor shall, prior to proceeding with the Work, promptly report to the Engineer any apparent discrepancies or defects in such other work that render it unsuitable for such proper execution and results. Failure of the Contractor to so report shall constitute an acceptance of the Owner's or separate contractor's work as fit and proper to receive his Work.

6.2.3 Should the Contractor wrongfully cause damage to the work or property of the Owner or to other work on the site, the Contractor shall promptly remedy such damage as provided in Subparagraph 10.2.5.

6.2.4 Should the Contractor wrongfully cause damage to the work or property of any separate contractor, the Contractor shall upon due notice promptly attempt to settle with such other contractor by agreement, or otherwise to resolve the dispute. If such separate contractor sues the Owner on account of any damage alleged to have been caused by the Contractor, the Owner shall notify the Contractor who shall defend such proceedings, and if any judgment or award against Owner arises there from, the Contractor shall pay or satisfy it and shall reimburse the Owner for all Attorney's fees and Court costs which the Owner has incurred.

6.3 Owner's Right to Clean Up

6.3.1 If a dispute arises between the Contractor and separate contractors as to their responsibility for cleaning up as required by Paragraph 4.14, the Owner may clean up and charge the cost thereof to the contractors responsible therefore as the Owner shall determine to be just.

**ARTICLE VII
MISCELLANEOUS PROVISIONS**

7.1 GENERAL COMPLIANCE WITH LAWS

7.1.1 If required, the Contractor certifies that it is

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qualified or will take steps necessary to qualify to do business in the State of Tennessee and that it will take such action as, from time to time, may be necessary to remain so qualified and it shall obtain, at its expense all licenses, permits, insurance, and governmental approvals, if any, necessary to the performance of its obligations under this Agreement.

7.1.2 The Contractor is assumed to be familiar with and agrees that at all times it will observe and comply with all federal, state, and local laws, ordinances, and regulations in any manner affecting the conduct of the work. The preceding shall include, but is not limited to, compliance with all Equal Employment Opportunity laws, the Fair Labor Standards Act, Occupational Safety and Health Administration (OSHA) requirements, and the Americans with Disabilities Act (ADA).

7.1.3 This Contract will be interpreted in accordance with the laws of the State of Tennessee. By execution of this contract the Contractor agrees that all actions, whether sounding in contract or in tort, relating to the validity, construction, interpretation and enforcement of this contract will be instituted and litigated in the courts of the State of Tennessee, located in Shelby County, Tennessee, and in no other. In accordance herewith, the parties to this contract submit to the jurisdiction of the courts of the State of Tennessee located in Shelby County, Tennessee.

7.2 Successors and Assigns

7.2.1 This Agreement (including without limitation, all obligations imposed by the Contract Documents) shall be binding upon and shall inure to the benefit of the parties successors, assigns and legal representative. The Contract shall not be assigned or sublet in whole or in part by the Contractor without the written consent of the Owner, nor shall the Contractor assign any monies due or to become due to him hereunder, without the previous written consent of the Owner.

7.3 Written Notice

7.3.1 Written notice shall be deemed to have been duly served if delivered in person to the individual or member of the firm, entity or to an officer of the corporation for whom it was intended, or if delivered at or sent by registered or certified mail to the last business address known to him who gives the notice.

7.4 Claims for Damages

7.4.1 Should either party to the Contract suffer injury or damage to person or property because of any act or omission of the other party, or of any of his employees, agents or others for whose acts he is legally liable, claim shall be made in writing to such other party within a reasonable time after the first observance of such injury or damage.

7.5 Performance Bond and Labor and Material Payment Bond

7.5.1 The Contractor shall furnish and keep in force throughout the performance of the Work a separate performance bond and separate labor and material payment bond, each in the amount of the total of the Contract (as the same may be modified from time to time) conditioned upon the faithful performance of the Work by the Contractor and payment of all obligations arising in connection with the Work by the Contractor. Said bonds shall also guarantee to the Owner that the Work shall be free of all liens upon the property of the Owner. The bonds shall name the Owner as obligee and shall be with such Surety authorized to do business in the State of Tennessee and in such form and manner as approved by Owner. Said Bond shall be subject to final approval of the Shelby County Risk Management Department. Said bonds shall be furnished to the Owner prior to the commencement of the Work, or upon written request by Owner to Contractor after the Work has commenced.

7.6 Rights and Remedies

7.6.1 The duties and obligations imposed by the Contract Documents and the rights and remedies available there under shall be in addition to and not a limitation of any duties, obligations, rights and remedies otherwise imposed or available by law.

7.6.2 No action or failure to act by the Owner, Engineer, or Contractor shall constitute a waiver of any right or duty afforded any of them under the Contract, nor shall any such action or failure to act constitute an approval of or acquiescence in any breach there under, except as may be specifically agreed in writing.

7.7 Tests

7.7.1 If the Contract Documents, laws, ordinances, rules, regulations or orders of any public authority having jurisdiction require any portion of the Work to be inspected, tested or

approved, the Contractor shall give the Engineer timely notice of its readiness so the Engineer may observe such inspection, testing

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or approval. The Contractor shall bear all costs of such inspections, tests or approvals conducted by public authorities. Unless otherwise provided, the Owner shall bear all costs of other inspections or tests.

7.7.2 If the Engineer determines that any Work requires special inspection, testing or approval which Subparagraph 7.7.1 does not include, he will, upon written authorization from the Owner, instruct the Contractor to order such special inspection, testing or approval, and the Contractor shall give notice as provided in Subparagraph 7.7.1. If such special inspection or testing reveals a failure of the Work to comply with the requirements of the Contract Documents, the Contractor shall bear all costs thereof, including compensation for the Engineer's additional services and/or correction of the defective Work made necessary by such a failure; otherwise, the Owner shall bear such costs, and an appropriate Change Order shall be issued.

7.7.3 Required certificates of inspection, testing or approval shall be secured by the Contractor and promptly delivered by him to the Engineer.

7.7.4 If the Engineer is to observe the inspection, tests or approvals required by the Contract Documents, he will do so promptly where practicable, at the source of supply.

ARTICLE VIII

TIME

8.1 Definitions

8.1.1 Unless otherwise provided, the Contract time is the period of time allotted in the Contract Documents for Substantial Completion of the Work as defined in Subparagraph 8.1.3, including authorized adjustments thereto.

8.1.2 The date of commencement of the Work is the date established in a notice to proceed. If there is no notice to proceed, it shall be the date of the Owner-Contractor Agreement or such other date as may be established therein.

8.1.3 The date of Substantial Completion of the Work or designated portion thereof is the Date certified by the Engineer when construction is sufficiently complete, in accordance with the contract Documents, so the Owner can occupy or utilize the Work or

designated portion thereof for the use for which it is intended.

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8.1.4 The term day as used in the Contract Documents shall mean calendar day unless otherwise specifically designated.

8.2 Progress and Completion

8.2.1 All time limits stated in the Contract Documents are of the essence of the Contract.

8.2.2 The Contractor shall begin the Work on the date of commencement as defined in Subparagraph 8.1.2. He shall carry the work forward expeditiously with adequate forces and shall achieve Substantial Completion within the Contract Time.

8.3 Delays and Extensions of Time

8.3.1 The Contractor shall proceed with each and every part of this Agreement in a prompt and diligent manner. The Contractor, without additional compensation, shall perform the Work at such times, in such order and in such manner as the Owner may direct. The Contractor shall commence, continue and complete its performance of the Project so as not to delay Owner or other separate contractors of the Owner or subcontractors completion of the Work or any portions thereof, and so as to insure completion as directed by Owner. Any time specified for the completion of the Work, or portion thereof, is a material provision of this Agreement, and time is of the essence. The Contractor shall furnish sufficient forces to assure proper performance of its Work in strict compliance with all performance or progress schedules for the Project.

8.3.2 The Contractor shall, from time to time, on written demand of Owner, give adequate evidence to Owner to substantiate the planned performance and progress of the Work and the various parts thereof. The Contractor shall promptly increase its work force, accelerate its performance, work overtime, work Saturdays, Sundays and holidays, all without additional compensation, if in the opinion of the Owner, such work is necessary to maintain proper progress. The Contractor will fully cooperate and coordinate its work with any other separate contractors of Owner or subcontractors at the Project. The Contractor shall bear the costs of all damages done to other separate contractors of Owner or subcontractors and shall be responsible for any damages caused by or resulting from acts or omissions of the Contractor in failing to make proper progress. The liability of the Contractor shall not be deemed waived by any assent or acquiescence by Owner to the Contractor late performance. Owner shall be entitled to terminate this

Agreement due to late or threatened late performance, upon seven (7) days notice to proceed and Contractors failure to do so.

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8.3.3 In the event any subcontractor should damage the Contractor, the Contractor shall neither seek nor be entitled to any compensation from Owner, but will seek its damages directly from such subcontractor. Should the Contractor's performance, in whole or part, be disrupted, interfered with or delayed, or be suspended in the commencement, prosecution or completion, for reasons beyond the Contractor's control and without its fault or negligence, the Contractor shall be entitled to an extension of time in which to complete its Work; but only if it shall have notified the Owner, in writing, of the cause of delay within five (5) days of the occurrence of the event. The Contractor and Owner agree that the Contractor shall not be entitled to any money damages regardless of fault as a result of any delay, acceleration, disruption, interference, suspension, or other event affecting the Contractor or the Contractor's performance.

ARTICLE IX PAYMENTS AND COMPLETION

9.1 Contract Sum

9.1.1 The Contract Sum is stated in the Owner-Contractor Agreement and, including authorized adjustments thereto, is the total amount payable by the Owner to the Contractor for the performance of the Work under the Contract Documents.

9.2 Schedule of Values

9.2.1 Before the first Application for Payment, the Contractor shall submit to the Engineer a schedule of values allocated to the various portions of the Work, prepared in such form and supported by such data to substantiate its accuracy as the Engineer may require. This schedule, unless objected to by the Engineer, shall be used only as a basis for the Contractor's Applications for Payment.

9.3 Applications for Payment

9.3.1 At least ten days before the date of each progress payment established in the Owner-Contractor Agreement, the Contractor shall submit to the Engineer an itemized Application for Payment, notarized if required, supported by such data substantiating the Contractor's right to payment as the Owner or the Engineer may require, and reflecting retain age, if any, as provided elsewhere in the Contract Documents. The Contractor shall

indicate on each Application for Payment the dollar amount and percentage due Subcontractors.

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Progress payments (monthly) will be made based upon Applications for Payment submitted to the Engineer by the Contractor and Certificates for Payment issued by the Engineer as follows:

On or before the 10th day of each month, 95% of the proportion of the Contract Sum properly allocable to labor, materials and equipment incorporated in the Work, up to the first day of that month, less the aggregate of previous payments in each case. Payments will be less such retainage as the Engineer shall determine for all incomplete work and unsettled claims.

9.3.1.1 Until final payment, the Owner will pay 95% of the amount due the Contractor on account of progress payments. If the manner of completion of the Work and its progress are and remain satisfactory to the Owner, it may, in its sole discretion, for each Work category shown to be 50% or more complete in the Application for Payment, without reduction of previous retainage, on presentation by the Contractor with Consent of Surety for each application, certify any remaining progress payments for each Work category to be paid in full.

9.3.1.2 The full Contract retainage may be reinstated at any time in the sole discretion of the Owner.

9.3.2 Unless otherwise provided in the Contract Documents, payments will be made on account of materials or equipment not incorporated in the Work but delivered and suitably stored at the site and, if approved in advance by the Owner, payments may similarly be made for materials or equipment suitably stored at some other location agreed upon in writing. Payments for materials or equipment stored on or off the site shall be conditioned upon submission by the Contractor of bills of sale or such other procedures satisfactory to the Owner to establish the Owner's title to such materials or equipment or otherwise protect the Owner's interest, including applicable insurance and transportation to the site for those materials and equipment stored off the site.

9.3.3 The Contractor warrants that title to all Work, materials and equipment covered by an Application for Payment will pass to the Owner either by incorporation in the construction or upon the receipt of payment by the Contractor, whichever occurs first, free and clear of all liens, claims, security interests or encumbrances, hereinafter referred to in the Article IX as "liens" and that no Work, materials or equipment covered by an Application for Payment will have been acquired by the Contractor, or by any other persons performing Work at the site or furnishing materials and equipment for the Project, subject to an agreement under which an interest

therein or an encumbrance thereon is retained by the seller or otherwise imposed by the Contractor or such other person.

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9.3.4 The Contractor shall submit a report with each Application for Payment which sets forth all subcontractors performing work during that reporting period, the dollar amount paid to the subcontractor, etc. on the form provided by Shelby County Government.

9.4 Certificate for Payment

9.4.1 The Engineer will, within seven (7) days after the receipt of the Contractor's Application for Payment, issue a Certificate for Payment to the Owner for such amount as the Engineer determines is properly due.

9.4.2 The issuance of a Certificate of Payment will constitute a representation by the Engineer to the Owner, based on his observations at the site as provided in Subparagraph 2.2.3 and the data comprising the Application for Payment, that the Work has progressed to the point indicated; that, to the best of his knowledge, information and belief, the quality of the Work is in accordance with the Contract Documents (subject to an evaluation of the Work for conformance with the Contract Documents upon Substantial Completion, to the results of any subsequent tests required by or performed under the Contract Documents, to minor deviations from the Contract Documents correctable prior to completion, and any specific qualifications stated in his Certificate); and that the Contractor is entitled to payment in the amount certified.

9.5 Progress Payments

9.5.1 The Contractor shall promptly pay each Subcontractor, upon receipt of payment from the Owner, out of the amount paid to the Contractor on account of such Subcontractor's Work, the amount to which said Subcontractor is entitled, reflecting the percentage actually retained, if any, from payments to the Contractor on account of such Subcontractor's Work. The Contractor shall, by an appropriate agreement with each Subcontractor, require each Subcontractor to make payments to his Sub-subcontractors in similar manner.

9.6 Payments Withheld

9.6.1 The Engineer may decline to certify payments and may withhold his Certificate in whole or in part, to the extent necessary to protect the Owner, if in his opinion he is unable to

make representations to the Owner as provided in Subparagraph 9.4.2. The Engineer may also decline to certify payment or,

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because of subsequently discovered evidence or subsequent observations, he may nullify the whole or any part of any Certificate for Payment previously issued, to such extent as may be necessary in his opinion to protect the Owner from loss because of:

- .1 defective Work not remedied;
- .2 third party claims filed or reasonable evidence indicating probable filing of such claims;
- .3 failure of the Contractor to make payments properly to Subcontractors or for labor, materials or equipment;
- .4 reasonable evidence that the Work cannot be completed for the unpaid balance of the Contract Sum;
- .5 damage to the Owner or another contractor;
- .6 reasonable evidence that the Work will not be completed within the Contract Time; or
- .7 persistent failure to carry out the Work in accordance with the Contract Documents.

9.6.2 When the above grounds in Subparagraph 9.6.1 are removed, payment shall be made, without interest, for any amounts previously withheld.

9.7 Substantial Completion

9.7.1 When the Contractor considers that the Work, or a designated portion thereof which is acceptable to the Owner, is substantially complete as defined in Subparagraph 8.1.3, the Contractor shall prepare for submission to the Engineer a list of items to be completed or corrected. The failure to include any items on such list does not alter the responsibility of the Contractor to complete all Work in accordance with the Contract Documents. When the Engineer on the basis of an inspection determines that the Work or designated portion thereof is substantially complete, he will then prepare a Certificate of Substantial Completion which shall establish the Date of Substantial Completion, shall state the responsibilities of the Owner and the Contractor for security, maintenance, heat, utilities, damage to the Work and insurance, and shall fix the time

within which the Contractor shall complete the items listed therein. Warranties required by the Contract Documents shall

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commence on the Date of Substantial Completion of the Work or designated portion thereof unless otherwise provided in the Certificate of Substantial Completion.

9.7.2 Upon Substantial Completion of the Work or designated portion thereof and upon application by the Contractor and certification by the Engineer, the Owner shall make payment, reflecting adjustment in retainage, if any, for such Work or portion thereof, as provided in the Contract Documents. Payment by the Owner upon application by the Contractor and certification by the Engineer for Substantial Completion does not waive any claims the Owner may have against the Contractor.

9.8 Final Completion and Final Payment

9.8.1 Upon receipt of written notice that the Work is ready for final inspection and acceptance and upon receipt of a final Application for Payment, the Engineer will promptly make such inspection and, when he finds the Work acceptable under the Contract Documents and the Contract fully performed, he will promptly issue a final Certificate for Payment stating that to the best of his knowledge, information and belief, and on the basis of his observations and inspections, the Work has been completed in accordance with the terms and conditions of the Contract documents and that the entire balance found to be due the Contractor, and noted in said final Certificate, is due and payable. The Engineer's final Certificate for Payment will constitute a further representation that the conditions precedent to the Contractor being entitled to final payment as set forth in Subparagraph 9.7.2 have been fulfilled.

9.8.2 Neither the final payment nor the remaining retained percentage shall become due until the Contractor submits to the Engineer (1) an affidavit that all payrolls, bills for materials and equipment, and other indebtedness connected with the Work for which the Owner or his property might in any way be responsible, have been paid or otherwise satisfied, (2) consent of surety to final payment and (3) if required by the Owner, other data establishing payment or satisfaction of all such obligations, such as receipts, releases and waivers of claims, encumbrances and/or alleged liens arising out of the Contract, to the extent and in such form as may be designated by the Owner. If any Subcontractor refuses to furnish a release or waiver required by the Owner, the Contractor may furnish a bond satisfactory to the Owner to indemnify him against such lien. If any such lien remains unsatisfied after all payments are made, the Contractor shall

refund to the Owner all monies that the latter may be compelled to pay in discharging such lien, including all costs and reasonable attorney's fees.

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9.8.3 The acceptance of final payment shall constitute a waiver of all claims by the Contractor except those previously made in writing and identified by the Contractor as unsettled at the time of the final Application for Payment.

ARTICLE X
PROTECTION OF PERSONS AND PROPERTY

10.1 Safety Precautions and Programs

10.1.1 The Contractor shall be responsible for initiating, maintaining and supervising all safety precautions and programs in connection with the Work.

10.2 Safety of Persons and Property

10.2.1 The Contractor shall take all reasonable precautions for the safety of, and shall provide all reasonable protection to prevent damage, injury or loss to:

- .1 all employees on the Work and all other persons who may be affected thereby;
- .2 all the Work and all materials and equipment to be incorporated therein, whether in storage on or off the site, under the care, custody or control of the Contractor or any of his Subcontractors or Sub-subcontractors; and
- .3 other property at the site or adjacent thereto, including trees, shrubs, lawns, walks, pavements, roadways, structures and utilities not designated for removal, relocation or replacement in the course of construction.

10.2.2 The Contractor shall give all notices and comply with all applicable laws, ordinances, rules, regulations and lawful orders of any public authority bearing on the safety of persons or property or their protection from damage, injury or loss.

10.2.3 The Contractor shall erect and maintain, as required by existing conditions and progress of the Work, all reasonable safeguards for safety and protection, including posting danger signs and other warnings against hazards, promulgating safety

regulations and notifying owners and users of adjacent utilities. Pavements, sidewalks, alleys, adjacent buildings not included in this Contract, which may be damaged, shall be repaired and/or replaced immediately and in a manner satisfactory to the Engineer, Shelby County and/or other governing officials.

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10.2.4 When the use or storage of explosives or other hazardous materials or equipment is necessary for the execution of the Work, the Contractor shall exercise the utmost care and shall carry on such activities under the supervision of properly qualified personnel.

10.2.5 The Contractor shall promptly remedy all damage or loss (other than damage or loss insured under Paragraph 11.3) to any property referred to in Clauses 10.2.1.2 and 10.2.1.3 caused in whole or in part by the Contractor, Subcontractor, or any Sub-subcontractor, or anyone directly or indirectly employed by any of them, or by anyone for whose acts the Contractor may be liable or responsible. The foregoing obligations of the Contractor are in addition to his obligations under Paragraph 4.16.

10.2.6 The Contractor shall designate a responsible member of his organization at the site whose duty shall be the prevention of accidents. This person shall be the Contractor's superintendent unless otherwise designated by the Contractor in writing to the Owner and the Engineer.

10.2.7 The Contractor shall not load or permit any part of the Work to be loaded so as to endanger its safety.

10.3 Emergencies

10.3.1 In any emergency affecting the safety of persons or property, the Contractor shall act, at his discretion, to prevent threatened damage, injury or loss. Any additional compensation or extension of time claimed by the Contractor on account of emergency work shall be determined as provided in Article XII for Changes in the Work.

10.3.2 Whenever the Contractor has not taken sufficient precautions for the safety of the public or the protection of work to be performed under this Project, or adjacent structures or property which may be injured by processes of construction, demolition and/or site clearance on account of such neglect, and whenever an emergency shall arise and immediate action shall be considered necessary in order to protect public or private, persons or property interest, then the Engineer and/or the Owner shall so instruct the Contractor.

10.3.3 If correction is not made in due time or if conditions such as lack of time prevent instructions to Contractor, then the

Owner, without notice to the Contractor, may provide reasonable, suitable protection by causing such Work to be done and material to be furnished and placed as the Engineer and Owner may consider necessary and adequate. The cost and expense of such work and

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material so furnished shall be borne by the Contractor and, if the same shall not be paid on presentation of the bills thereof, such costs shall be deducted from any amounts due or to become due the Contractor. The performance of such emergency work under the direction of the Owner and/or Engineer shall in no way relieve the Contractor of the responsibility for damages which may occur during or after such performance.

10.3.4 None of the foregoing shall make the Owner and/or Engineer responsible for foreseeing and protecting against emergency.

ARTICLE XI
INSURANCE

11.1 Contractor Liability Insurance

11.1.1 The Contractor shall purchase and maintain, in a company or companies licensed to do business in the State of Tennessee, such insurance as will protect the Owner from claims set forth below which may arise out of or result from the Contractor's operations under the Contract, whether such operations be by himself or by any Subcontractor or by anyone directly or indirectly employed by any of them, or by anyone for whose acts the Contractor or Subcontractor may be liable:

- .1 claims under workers' compensation, disability benefits, and other similar employee benefit acts;
- .2 claims for damages because of bodily injury, occupational sickness or disease, or death of his employees;
- .3 claims for damages because of bodily injury, sickness or disease, or death of any person other than his employees;
- .4 claims for damages insured by personal injury liability coverage which are sustained (1) by any person as a result of an offense directly or indirectly related to the employment of such person by the Contractor, or (2) by any other person;
- .5 claims for damages, other than the Work itself, because of injury to or destruction of tangible

property, including loss of use resulting there from; and

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- .6 claims for damages because of bodily injury or death of any person or property damage arising out of the ownership, maintenance, or use of any motor vehicle.

11.1.2 The insurance required by Subparagraph 11.1.1 shall be written for not less than any limits of liability specified in the Contract Documents, section III, paragraph 31, or required by law, whichever is greater.

11.1.3 The insurance required by Subparagraph 11.1.1 shall include contractual liability insurance applicable to the Contractors obligations under Paragraph 4.16.

11.1.4 All insurance policies maintained by the Contractor shall provide that insurance as applying to the Owner shall be primary and non-contributing irrespective of such insurance as the Owner may maintain in its own name and on its own behalf.

11.1.5 Certificates of Insurance acceptable to the Owner shall be filed with the Owner at the time of submittal of the Contract Documents to the Owner for execution. These certificates shall contain a provision that coverage's afforded under the policies will not be canceled until at least thirty-(30) days prior written notice has been given to the Owner. The Contractor shall immediately notify Shelby County Government, Contract Administration, 160 N. Main Street, Suite 550, Memphis, Tennessee 38103 of cancellation or changes in any of the insurance coverage required. Upon request of the Owner, certified copies of any of the required insurance policies may be requested from the Contractor or Contractor's insurance company, agency, or broker.

11.2 Owners Liability Insurance

11.2.1 The Owner shall at its discretion, purchase liability insurance or maintain a self-insured liability program.

11.3 Property Insurance

11.3.1 The General Contractor shall be responsible for all risk

insurance for physical loss or damage for the project during construction until the project is accepted by the Owner at which time the Owner will provide the property coverage.

11.3.2 The Contractor shall pay each Subcontractor a just share of any insurance monies received by the Contractor, and by appropriate agreement, written where legally required for validity, shall require such Subcontractor to make payments to his Sub-subcontractors in similar manner.

11.3.3 The Contractor or his insurance agent, broker or insurance company shall furnish to Owner a copy of all policies with the Contactor within five days of request.

11.3.4 If the Owner requests in writing that insurance for risks other than those described in Subparagraphs 11.3 and 11.3.2 or 11.3.3 or other special hazards to be included in the property insurance policy, the Contractor shall, if possible, include such insurance, and the cost thereof shall, if possible, include such insurance, and the cost thereof shall be charged to the Contractor by appropriate Change Order. Initial_____

ARTICLE XII
CHANGES IN THE WORK

12.1 Change Orders

12.1.1 A Change Order is a written order to the Contractor signed by the Owner issued after execution of the Contract, authorizing a change in the Work or an adjustment in the Contract Sum or the Contract Time. The Contract Sum and the Contract Time may be changed only by Change Order. A Change Order signed by the Contractor indicates his agreement therewith, including the adjustment in the Contract Sum or the Contract Time. The Contractor by execution of the Change Order waives any further claims or damages in any manner whatsoever for the changes set forth in the Change Order.

12.1.2 The Owner, without invalidating the Contract, may order changes in the Work within the general scope of the Contract consisting of additions, deletions or other revisions, the Contract Sum and the Contract Time being adjusted accordingly. All such changes in the Work shall be authorized by Change Order, and shall be performed under the applicable conditions of the Contract Documents.

12.1.3 The cost or credit to the Owner resulting from a change in the Work shall be determined in one or more of the following ways:

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- .1 by lump sum properly itemized on the form furnished by the Owner which shall show the actual verified cost of the work, plus ten percent overhead and five percent profit; if the work is performed by a Subcontractor, the General Contractor is allowed an additional five percent;
- .2 by unit prices stated in the Contract Documents or subsequently agreed upon;
- .3 by cost to be determined in a manner agreed upon by the parties and a mutually acceptable fixed or percentage fee; or
- .4 by the method provided in Subparagraph 11.1.4.

12.1.4 If none of the methods set forth in Clauses 12.1.3.1, 12.1.3.2, or 12.1.3.3 is agreed upon, the Contractor, provided he receives a written order signed by the Owner, shall promptly proceed with the Work involved. The cost of such Work shall then be determined by the Engineer on the basis of the reasonable expenditures and savings of those performing the Work attributable to the change, including, in the case of an increase in the Contract Sum, a reasonable allowance for overhead and profit, which shall be defined as ten percent overhead and five percent profit with an additional five percent going to the General Contractor when the work is performed by a Subcontractor. In such case, and also under Clauses 12.1.3.3 and 12.1.3.4 above, the Contractor shall keep and present, in such form as the Engineer may prescribe, an itemized accounting together with appropriate supporting data for inclusion in a Change Order. Unless otherwise provided in the Contract Documents, cost shall be limited to the following: cost of labor, including social security, old age and unemployment insurance and fringe benefits required by agreement or custom; workers' or workmen compensation insurance; bond premiums, rental value of equipment and machinery; and the additional costs of supervision and field office personnel directly attributable to the change. Pending final determination of cost to the Owner, payments on account shall be made on the Engineer's Certificate for Payment. The amount of credit to be allowed by the Contractor to the Owner for any deletion or change which results in a net decrease in the Contract Sum will be the amount of the actual net cost as confirmed by the Engineer. When both additions and credits covering related Work or substitutions are involved in any one change, the allowance for overhead and profit shall be figured on the basis of the net increase, if any, with respect to that change.

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12.2 Concealed Conditions

12.2.1 Should concealed conditions encountered in the performance of the Work below the surface of the ground or should concealed or unknown conditions in an existing structure be at variance with the conditions indicated by the Contract Documents, or should unknown physical conditions below the surface of the ground or should concealed or unknown conditions in an existing structure of an unusual nature, differing materially from those ordinarily encountered and generally recognized as inherent in work of the character provided for in this Contract, be encountered, Contractor, subject to approval by the Engineer, shall be entitled to a time extension for only the period that the Contractor's performance is extended due to the unforeseen conditions.

12.3 Minor Changes in the Work

12.3.1 The Engineer will have authority to order minor changes in the Work not involving an adjustment in the Contract Sum or an extension of the Contract Time and not inconsistent with the intent of the Contract Documents. Such Changes shall be effected by written order, and shall be binding on the Owner and the Contractor. The Contractor shall carry out such written orders promptly.

ARTICLE XIII
UNCOVERING AND CORRECTION OF WORK

13.1 Uncovering of Work

13.1.1 If any portion of the Work should be covered contrary to the request of the Engineer or to requirements specifically expressed in the Contract Documents, it must, if required in writing by the Engineer, be uncovered for his observation and shall be replaced at the Contractor's expense.

13.1.2 If any other portion of the Work has been covered which the Engineer has not specifically requested to observe prior to being covered, the Engineer may request to see such Work and it shall be uncovered by the Contractor. If such Work is found in accordance with the Contract Documents, the cost of uncovering and replacement shall, by appropriate Change Order, be charged to the Owner. If such Work is found not in accordance with the Contract Documents, the Contractor shall pay such costs. If the Work to be uncovered by the Contractor should have been inspected by the Engineer prior to being covered, and the Work is found to be in accordance with the Contract Documents, the cost of the uncovering and recovering of the Work shall be borne by the Engineer.

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13.2 Correction of Work

13.2.1 The Contractor shall promptly correct all Work rejected by the Engineer as defective or as failing to conform to the Contract Documents whether observed before or after Substantial Completion and whether or not fabricated, installed or completed. The Contractor shall bear all costs of correcting such rejected Work, including compensation for the Engineer's additional services made necessary thereby.

13.2.2 If, within one year after the Date of Substantial Completion of the Work or designated portion thereof, within one year after acceptance by the Owner of designated equipment or within such longer period of time as may be prescribed by law or by the term of any applicable special warranty required by the Contract Documents, any of the Work is found to be defective or not

in accordance with the Contract Documents, the Contractor shall correct it promptly after receipt of a written notice from the Owner to do so. This obligation shall survive termination of the Contract. The Owner shall give such notice promptly after discovery of the condition.

13.2.3 The Contractor shall remove from the site all portions of the Work which are defective or non-conforming, unless removal is waived by the Owner.

13.2.4 If the Contractor fails to correct defective or non-conforming Work as provided in Subparagraphs 4.5.1, 13.2.1 and 13.2.2, the Owner may correct it in accordance with Paragraph 3.4.

13.2.5 If the Contractor does not proceed with the correction of such defective or non-conforming Work within a reasonable time fixed by written notice from the Engineer, the Owner may remove it and store the materials or equipment at the expense of the Contractor. If the Contractor does not pay the cost of such removal and storage within ten days thereafter, the Owner may, upon ten additional days' written notice, sell such Work at auction or a private sale and shall account for the net proceeds thereof, after deducting all the costs that should have been borne by the Contractor, including compensation for the Engineer's additional services made necessary thereby. If such proceeds of sale do not cover all costs which the Contractor should have borne, the difference shall be charged to the Contractor and an appropriate Change Order shall be issued. If the payments then or thereafter due the Contractor are not sufficient to cover such amount, the Contractor shall pay the difference to the Owner.

13.2.6 The Contractor shall bear the cost of making good all work of the Owner or separate contractors destroyed or damaged by such correction or removal.

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13.2.7 Nothing contained in Paragraph 13.2 shall be construed to establish a period of limitation with respect to any other obligation which the Contractor might have under the Contract Documents, including Paragraph 4.5 hereof. The establishment of the time period of one year after the Date of Substantial Completion or such longer period of time as may be prescribed by law or by the terms of any warranty required by the Contract Documents relates only to the specific obligation of the Contractor to correct the Work, and has no relationship to the time within which his obligation to comply with the Contract Documents may be sought to be enforced, nor to the time within which proceedings may be commenced to establish the Contractor's liability with respect to his obligations other than specifically to correct the Work.

13.3 Acceptance of Defective or Non-Conforming Work

13.3.1 If the Owner prefers to accept defective or non-conforming Work, he may do so instead of requiring its removal and correction, in which case a Change Order will be issued to reflect a reduction in the Contract Sum where appropriate and equitable. Such adjustment shall be effective whether or not final payment has been made.

ARTICLE XIV
TERMINATION OF THE CONTRACT

14.1 Termination for Default

14.1.1 Should the Contractor fail to perform in strict accordance with this Agreement, where or as Owner may so direct, or should the Contractor become insolvent, unable to or fail to pay its obligations as they mature or, in any other respect fail in the opinion of the Owner, to properly prosecute and perform any part of its work, fail to exert its best performance efforts, be involved in labor disputes, or be terminated under any other contract with Owner, then the Contractor may be deemed by Owner to have materially breached and to have defaulted in its obligations under this Agreement. In case of a breach and default, the Owner, at its discretion, may terminate this Agreement, or any part thereof, by giving five (5) days written notice thereof to the Contractor. In case of such termination, Owner may use any and all materials, equipment, tools or chattels furnished by or belonging to the Contractor either at or for the Project.

14.1.2 The Contractor, on termination, will be deemed to have offered to Owner an assignment of all of its subcontracts and purchase orders relating to this Project. Owner may, at its discretion, do whatever is necessary to assure performance of any

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terminated work and to take such action, if necessary, in the Contractor's name. Owner may withhold from Contractor any monies due or to become due under this or any other contract between the Contractor and Owner, to offset the damages incurred or possibly incurred as a result of the breach and default by the Contractor. In case of a breach, or in the event Owner is required to retain the services of an attorney to enforce any provisions of this Agreement, then the Contractor and its surety company shall be liable to Owner for any and all additional costs, expenses, attorney's fees and other damages, both liquidated and unliquidated, which directly or indirectly result from the Contractor's breach, threatened breach, default or lack of performance of any term or condition of this Agreement.

14.1.3 If the unpaid balance of the Contract Sum exceeds the costs of finishing the Work, including compensation for the

Engineer□additional services made necessary thereby, such excess shall be paid to the Contractor. If such costs exceed the unpaid balance, the Contractor shall pay the difference to the Owner. The amount to be paid to the Contractor or to the Owner, as the case may be, shall be certified by the Engineer, upon application, in the manner provided in Paragraph 9.4, and this obligation for payment shall survive the termination of this Contract.

14.2 Termination for Convenience

14.2.1 Owner, by written notice, shall have the right to terminate and cancel this Agreement, without the Contractor being at fault, for any cause or for its own convenience, and require the Contractor to immediately stop work. In such event, Owner shall pay the Contractor for that Work actually performed and materials furnished in an amount proportionate to the Contract price. Owner shall not be liable to the Contractor for any other costs, including prospective profits on Work not performed.

ARTICLE XV RIGHT TO OCCUPY BY OWNER

15.1 Early Occupancy by Owner

15.1.1 The Owner has the right to occupy or use ahead of schedule all or any substantially completed or partially completed portion of the Work when such occupancy and use are in its best interest, notwithstanding the time of completion for all of the Work. If occupancy or use increases the cost of the Work (other than for corrections which are the responsibility of the Contractor) and/or as a result of the Owner exercising its rights

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herein, the contractor shall be entitled to extra costs and extensions of time, or both. Claims for such extra costs and extensions of time, to be valid, shall be made in writing to the Owner within seven (7) calendar days of the notification of Owner to the Contractor of its intent to so occupy or use.

15.2 Corrections after Occupancy

15.2.1 After the Owner has taken occupancy of all or any substantially completed portion of the Work, the Contractor shall not disrupt the use and occupancy of the Owner to make corrections in the Work but shall, at the discretion of the Owner, make such corrections at the expense of the Contractor after normal working hours.

15.3 Heating, Ventilating and Air-Conditioning Systems

15.3.1 The Owner may require the use and operation of any completed heating, ventilating and air-conditioning equipment at the time it occupies or uses any substantially completed portion of the Work. In such event, the Owner may require the Contractor to operate such equipment and will pay the Contractor the cost of such utilities required for the use and occupancy of the Owner, but the Contractor shall be responsible for such equipment and for its careful and proper operation. At any time, the Owner may assume the care and maintenance of any portion of the Work which it is occupying and using for the operation of any such equipment, but in each case, the Contractor shall not be relieved of its responsibility for the full completion of the Work and the protection of its tools, materials and equipment.

ARTICLE XVI
REGULATIONS

16.1 Nondiscrimination in Employment

16.1.1 During the performance of this Contractual Agreement, the contracting party agrees as follows: The CONTRACTOR agrees that no person on the grounds of handicap, age, race, color, religion, sex, or national origin, shall be excluded from participation in, or be denied benefits of, or be otherwise subject to discrimination in the performance of this contract, or in the employment practices of the CONTRACTOR. The CONTRACTOR shall upon request show proof of such non-discrimination, and shall post in conspicuous places available to all employees and applicants notices of non-discrimination.

16.2 [RESERVED]

Initial _____

16.3 Maintenance and Records

16.3.1 The Contractor and all Subcontractors under the General Contract shall maintain copies of every subcontract awarded and their own payrolls, for each weekly payroll period during the term of the Construction Contract and for a period of one (1) year after release and payment is made by Owner to the Contractor.

16.4 Owner's Right of Inspection

16.4.1 Representative of the Owner, as designated by the County Mayor, shall have the right to inspect the Contractor's facilities and payroll records during the life of the Construction Contract for a period of one (1) year after final release and final payment

by the Owner for the purpose of verifying nondiscrimination in employment.

**ARTICLE XVII
PROCEDURE FOR INSTALLATION OR
REMOVAL OF FIBERGLASS INSULATION**

The following procedures should be adhered to when disturbing, installing or removing fiberglass insulation. These procedures are established to minimize employee exposure to the adverse health affects of fiberglass exposure.

The below procedures are the minimal requirements for handling fiberglass in Shelby County Facilities. Mandates by code or law must be adhered to.

17.1 Installation, Removal, or Disturbance of Fiberglass Insulation

17.1.1 Install in well ventilated areas and avoid breathing dust.

17.1.2 Wear loose, comfortable clothing and long-sleeved shirts to minimize skin contact.

17.1.3 Handle carefully to minimize airborne dust.

17.1.4 If high dust levels are anticipated during installation, such as with power tools, use appropriate NIOSH approved dust respirator.

17.1.5 All power cutting tools must be equipped with dust collectors.

Initial _____

17.2 Exposure

17.2.1 After use, wash with warm water and mild soap. Do not scratch or rub skin if it becomes irritated. Utilize running water.

17.2.2 Wash work clothes separately, and then rinses the washer.

17.2.3 Eye exposure: Flush with flowing water for at least 15 minutes. If symptoms persist, seek immediate medical attention.

17.3 Work Site Environment

17.3.1 Insure area is free of obvious partials through proper cleanup procedures. Use of vacuum with proper filters, or wet cleanup is acceptable. (This includes office furniture, floors and walls.)

17.3.2 Initially there may be a potential adverse impact on indoor air quality within the general work area during the installation process. Notify building manager or other appropriate person that it will be necessary to establish and maintain adequate ventilation of the work area, without causing the entry of contaminants to other parts of the building. Persons who are sensitive to odors and/or chemicals should be advised to avoid the work area during this process.

17.3.3 Exposure to employees should be kept to a minimum.

17.3.4 Disturbance of ceiling tiles where fiberglass insulation exists requires the same procedures as if installation or removal was taking place.

BY THE SIGNING OF THIS DOCUMENT AND INITIALING EACH PAGE HEREOF, THE CONTRACTOR CERTIFIES THAT HE HAS READ AND UNDERSTANDS ALL OF THE ABOVE AND AGREES TO ABIDE BY THESE GENERAL CONSTRUCTION CONDITIONS.

CONTRACTOR

BY: _____

TITLE: _____

DATE: _____

THIS IS A DRAFT ONLY!! ORIGINAL DOCUMENTS IN EXECUTED FORM ARE REQUIRED PRIOR TO COUNTY SIGNATURE. IT IS A MANDATORY REQUIREMENT THAT ALL DOCUMENTS WHICH ARE REQUIRED TO BE ATTACHED TO THIS AGREEMENT BE ATTACHED BEFORE SUBMITTAL TO SHELBY COUNTY FOR SIGNATURE. IF NOT, THE AGREEMENT WILL BE RETURNED FOR COMPLETION.

COUNTY/CONTRACTOR AGREEMENT

OWNER: SHELBY COUNTY GOVERNMENT
160 N. MAIN ST.
MEMPHIS, TN 38103

CONTRACTOR:

**ARCHITECT/
ENGINEER:**

THIS CONTRACT made and entered into this _____ day of _____, 20___, by and between SHELBY COUNTY GOVERNMENT, through its governing body and authorized representative, party of the first part, hereinafter referred to as "COUNTY," and _____, party of the second part, hereinafter referred to as "CONTRACTOR."

WITNESSETH

WHEREAS, the COUNTY issued Sealed Bid No. _____ for _____, hereinafter in this Contract referred to as "PROJECT".

WHEREAS, the said CONTRACTOR submitted a bid/proposal in accordance with bid specifications, a copy of which is attached hereto as Exhibit "A" and incorporated herein by reference, which bid was accepted by COUNTY.

NOW, THEREFORE, CONTRACTOR agrees and undertakes to (describe work to

be done) in accordance with the Bid Specifications which are on file in the Shelby County Purchasing Department and which are incorporated herein by reference, and at the price quoted for said PROJECT by CONTRACTOR. Further, the parties agree that they will be governed by the Shelby County General Conditions of the Contract for work to be performed. The Contractor acknowledges that it has read and is familiar with the contents of said General Conditions, agrees to be bound thereby and has executed a copy of same at the place indicated thereon. A copy of said General Conditions is attached hereto as Exhibit "B" and incorporated fully herein by reference.

SECTION 1. CONTRACTOR'S RESPONSIBILITIES

1. CONTRACTOR shall perform all necessary work required by the contract documents for the satisfactory completion in full of the PROJECT.
2. CONTRACTOR shall coordinate all work with COUNTY through _____. Work shall be scheduled on a regular basis in as timely and orderly a manner as possible.
3. The CONTRACTOR shall give a Performance Bond and Labor and Material Bond, each equal to 100% of the amount of the Contract, with surety to be approved by the COUNTY, conditioned upon the full and faithful performance of all the terms and conditions of the Contract with special reference to paying in full in lawful money of the United States, all just and valid claims for material and labor entered into for the said work covered by this Contract. That further, this Contract shall not take effect until these Bonds have been executed and approved by the County.
4. The CONTRACTOR further agrees to provide insurance coverage of the type and in the amounts as required in section III, Specific Provision, paragraph 31.
5. The COUNTY shall pay the CONTRACTOR for the performance of the Contract _____ (\$)Dollars, subject to additions and deductions as provided in the contract documents.
6. The CONTRACTOR shall execute the entire work described in the Contract Documents, except to the extent specifically indicated in the Contract Documents to be the responsibility of others, within _____ (__) calendar days from the actual start date as specified in the written "Notice to Proceed."
7. All work by CONTRACTOR is to be performed in a manner satisfactory to COUNTY, and in accordance with the established customs, practices and procedures of

COUNTY. CONTRACTOR is to periodically request sufficient conferences to insure that the work is being done by CONTRACTOR in a satisfactory manner in accordance with the wishes of COUNTY.

SECTION II. METHOD OF PAYMENT

1. CONTRACTOR shall provide an Application for Payment to be received by the Architect/Engineer not later than the 25th day of each month. COUNTY shall make payment to the CONTRACTOR not later than the 20th day of the following month. If an Application for Payment is received by the Architect/Engineer after the application date fixed above, payment shall be made by COUNTY not later than forty-five (45) days after receipt of the Application for Payment. If the CONTRACTOR submits an incorrect Application for Payment, payment date will be extended thirty (30) days from the date of correction.
2. Application for payment shall indicate the percentage of completion of each portion of the work as of the end of the period covered by the Application for Payment.
3. Subject to the provisions of the Contract Documents, the amount of each progress payment shall be computed as follows:
 - a. Take that portion of the contract sum properly allocable to completed work as determined by multiplying the percentage completion of each portion of the work by the total Contract Sum less retainage of five (5%) percent;
 - b. Add that portion of the Contract Sum properly allocable to materials and equipment delivered and suitably stored at the site for subsequent incorporation in the completed construction (or, if approved in advance by COUNTY, suitably stored off the site at a location agreed upon in writing), less retainage of five (5%) percent;
 - c. Subtract the aggregate of previous payments made by the COUNTY; and
 - d. Subtract amounts, if any, for which the Architect/ Engineer has withheld or nullified a Certificate of Payment as provided in the General Conditions to Construction Contracts.
4. When all work embraced in this Contract has been fully and completely performed on the part of the CONTRACTOR, and accepted by the COUNTY, there shall be a statement by CONTRACTOR of the work done according to the terms herein, and the balance appearing to be due the CONTRACTOR out of funds applicable for payment for this work, excepting there from any sum that may be lawfully retained under the provisions of this Contract, Specifications, and General Conditions to

Construction Contracts and all such funds as may be due the COUNTY.

5. The COUNTY shall have the right, at its option, to discharge the CONTRACTOR for any breach of any provision of this Contract, and such discharge shall not affect the right of the COUNTY against sureties on the Bonds provided.
6. It is further mutually agreed between the parties hereto that if at any time after the execution of this Contract and the Surety Bonds attached hereto for its faithful performance, the COUNTY shall deem the surety or sureties upon such bond inadequate to cover the performance of the work, the CONTRACTOR shall, at its expense, within five (5) days after the receipt of notice from the COUNTY so to do, furnish as additional bond or bonds, in satisfactory amount to the COUNTY. In such event, no further payment to the CONTRACTOR shall be deemed due under this Contract until such new or additional security for the faithful performance of the work shall be furnished in manner and form satisfactory to the COUNTY.
7. CONTRACTOR further agrees to provide COUNTY an amount equal to _____ (\$) Dollars per day for liquidated damages for each consecutive calendar day required for the completion of the contract beyond the time stipulated. **(NOTE: If this paragraph is inapplicable, then N/A [not applicable] should be inserted in the applicable space.)**
8. Other contract provisions, including but not limited to insurance provisions may be required to enter into a contract with Shelby County Government.

SECTION III. SPECIFIC PROVISIONS

The parties further agree as follows:

1. CONTROL

All Services by the CONTRACTOR will be performed in a manner satisfactory to the COUNTY, and in accordance with the generally accepted business practices and procedures of the COUNTY.

2. CONTRACTOR'S PERSONNEL

The CONTRACTOR certifies that it presently has adequate qualified personnel to perform all Services required under this Contract. All work performed during the Term of this Contract will be supervised by the CONTRACTOR. The CONTRACTOR further certifies that all of its employees assigned to serve the

COUNTY have such knowledge and experience as required to perform the duties assigned to them. Any employee of the CONTRACTOR who, in the opinion of the COUNTY, is incompetent, or whose conduct becomes detrimental to the work, shall immediately be removed from association with the Services under this Contract.

3. INDEPENDENT STATUS

- a. Nothing in this Contract shall be deemed to represent that the CONTRACTOR, or any of the Contractor's employees or agents, are the agents, representatives, or employees of the COUNTY. The CONTRACTOR will be an independent CONTRACTOR over the details and means for performing the Services under this Contract. Anything in this Contract which may appear to give the COUNTY the right to direct the CONTRACTOR as to the details of the performance of the Services under this Contract or to exercise a measure of control over the CONTRACTOR is solely for purposes of compliance with local, state and federal regulations and means that the CONTRACTOR will follow the desires of the COUNTY only as to the intended results of the scope of this Contract.
- b. It is further expressly agreed and understood by CONTRACTOR that neither it nor its employees or agents are entitled to any benefits which normally accrue to employees of the COUNTY; that CONTRACTOR has been retained by the COUNTY to perform the Services specified herein (not hired) and that the remuneration specified herein is considered fees for the Services performed (not wages) and that invoices submitted to the COUNTY by CONTRACTOR for the Services performed shall be on the Contractor's letterhead.

4. REPORTS

CONTRACTOR shall prepare and submit quarterly reports of its activities, funded under this Contract, to the originating department and the Contract Administration Department of the COUNTY. The reports shall include an itemization of the use of County's funds, inclusive of specific Services delivered. Any such reports provided to the COUNTY shall be prepared with the understanding that the COUNTY may make such reports available to the public. The quarterly reports and all books of account and financial records that are specific to the work performed in accordance with this Contract may be subject to audit by the Director of the Division of Administration and Finance of the COUNTY. The COUNTY shall have the right to withhold future disbursement of funds under this Contract and any future Contracts until this provision has been met.

5. TERMINATION OR ABANDONMENT

- a. It shall be cause for the immediate termination of this Contract if, after its

execution, the COUNTY determines that:

- i) Either the CONTRACTOR or any of its principals, partners or corporate officers, if a corporation, including the corporation itself, has plead nolo contendere, or has plead or been found guilty of a criminal violation, whether state or federal, involving, but not limited to, governmental sales or purchases, including but not limited to the rigging of bids, price fixing, or any other collusive and illegal activity pertaining to bidding and governmental contracting; or
 - ii) CONTRACTOR has subcontracted, assigned, delegated, transferred its rights, obligations or interests under this Contract without the County's consent or approval; or
 - iii) CONTRACTOR has filed bankruptcy, become insolvent or made an assignment for the benefit of creditors, or a receiver, or similar officer has been appointed to take charge of all or part of CONTRACTOR assets.
- b. The COUNTY may terminate the Contract upon five (5) days written notice by the COUNTY or its authorized agent to the CONTRACTOR for Contractor's failure to provide the Services specified under this Contract.
 - c. This Contract may be terminated by either party by giving thirty (30) days written notice to the other, before the effective date of termination (the "Termination Date"). In the event of such termination, the CONTRACTOR shall be paid for all Services rendered prior to the Termination Date, provided the CONTRACTOR shall have delivered to COUNTY such statements, accounts, reports and other materials as required under this Contract; however, CONTRACTOR shall not be compensated for any anticipatory profits that have not been earned as of the date of the Termination Date. All Services completed by CONTRACTOR prior to the Termination Date shall be documented and tangible work documents shall be transferred to and become the sole property of the COUNTY prior to payment for the Services rendered.
 - d. Notwithstanding the above or any section herein to the contrary, CONTRACTOR shall not be relieved of liability to the COUNTY for damages sustained by the COUNTY by virtue of any breach of the Contract by CONTRACTOR and the COUNTY may withhold any payments to CONTRACTOR for the purpose of setoff until such time as the exact amount of damages due the COUNTY from CONTRACTOR is determined.

6. COMPENSATION FOR CORRECTIONS

No compensation shall be due or payable to CONTRACTOR pursuant to this Contract for any Contractor's Services performed by the CONTRACTOR in connection with effecting of corrections to the design of the Services, when such corrections are required as a direct result of negligence by the CONTRACTOR to properly fulfill any of his obligations as set forth in this Contract.

7. SUBCONTRACTING, ASSIGNMENT OR TRANSFER

- a. Any subcontracting, assignment, delegation or transfer of all or part of the rights, responsibilities, or interest of either party to this Contract is prohibited unless by written consent of the other party. No subcontracting, assignment, delegation or transfer shall relieve the CONTRACTOR from performance of the Services under this Contract. The COUNTY shall not be responsible for the fulfillment of the Contractor's obligations to its transferors or subcontractors.
- b. Upon the request of the other party, the subcontracting, assigning, delegating or transferring party shall provide all documents evidencing the subcontract, assignment, delegation or transfer.

8. CONFLICT OF INTEREST

The CONTRACTOR covenants that it has no public or private interest, and will not acquire directly or indirectly any interest, which would conflict in any manner with the performance of the Services. The CONTRACTOR warrants that no part of the total Contract Fee shall be paid directly or indirectly to any officer or employee of the COUNTY as wages, compensation, or gifts in exchange for acting as officer, agent, employee, subcontractor or consultant to the CONTRACTOR in connection with any work contemplated or performed relative to this Contract.

9. CONTINGENT FEES

The CONTRACTOR warrants that it has not employed or retained any company or person other than a bona fide employee working solely for the CONTRACTOR, to solicit or secure this Contract, and that it has not paid or agreed to pay any company or person, other than a bona fide employee working solely for the CONTRACTOR any fee, commission, percentage, brokerage fee, gift, or any other consideration contingent upon or resulting from the award or making of this Contract. For breach or violation of this warranty, the COUNTY will have the right to recover the full amount of such fee, commission, percentage, brokerage fee, gift, or other consideration.

10. EMPLOYMENT OF COUNTY WORKERS

The CONTRACTOR will not engage, on a full, part-time, or any other basis during the Term of the Contract, any professional or technical personnel who are or have been at any time during the Term of the Contract in the employ of the COUNTY.

11. ACCESS TO RECORDS

During all phases of the work and Services to be provided hereunder, CONTRACTOR agrees to permit duly authorized agents and employees of the COUNTY to enter Contractor's offices for the purpose of inspections, reviews, and audits during normal working hours. Reviews may also be accomplished at meetings that are arranged at mutually agreeable times and places. The CONTRACTOR will maintain all books, documents, papers, accounting records, and other evidence pertaining to the Fee paid under this Contract and make such materials available at their offices at all reasonable times during the Term of this Contract and for three (3) years from the date of payment under this Contract for inspection by the COUNTY or by any other governmental entity or agency participating in the funding of this Contract, or any authorized agents thereof. Copies of said records shall be furnished to the COUNTY upon request.

12. ARBITRATION

Any dispute concerning a question of fact in connection with the work not disposed of by agreement between the CONTRACTOR and the COUNTY will be referred to the Shelby County Contract Administrator or its duly authorized representative, whose decision regarding same will be final.

13. RESPONSIBILITIES FOR CLAIMS AND LIABILITIES

- a. CONTRACTOR shall indemnify, defend, save and hold harmless the COUNTY, and its elected officials, officers, employees, agents, assigns, and instrumentalities from and against any and all claims, liability, losses or damages—including but not limited to Title VII and 42 USC 1983 prohibited acts—arising out of or resulting from any conduct; whether actions or omissions; whether intentional, unintentional, or negligent; whether legal or illegal; or otherwise that occur in connection with or in breach of this Contract or in the performance of the Services hereunder, whether performed by the CONTRACTOR its subcontractors, agents, employees or assigns. This indemnification shall survive the termination or conclusion of this Contract.
- b. CONTRACTOR expressly understands and agrees that any insurance protection required by this Contract or otherwise provided by the CONTRACTOR shall in no way limit the responsibility to indemnify, defend, save and hold harmless the COUNTY or its elected officials, officers, employees, agents, assigns, and instrumentalities as herein provided.

- c. The COUNTY has no obligation to provide legal counsel or defense to CONTRACTOR or its subcontractors in the event that a suit, claim or action of any character is brought by any person not a party to this agreement against CONTRACTOR as a result of or relating to performance of the Services under this Contract.
- d. Except as expressly provided herein, the COUNTY has no obligation for the payment of any judgment or the settlement of any claims against CONTRACTOR as a result of or relating to performance of the Services under this Contract.
- e. CONTRACTOR shall immediately notify the COUNTY of any claim or suit made or filed against CONTRACTOR or its subcontractors regarding any matter resulting from or relating to Contractor's performance of the Services under this Contract and will cooperate, assist and consult with the COUNTY in the defense or investigation thereof.

14. GENERAL COMPLIANCE WITH LAWS

- a. The CONTRACTOR certifies that it is qualified or will take steps necessary to qualify to do business in the State of Tennessee and that it will take such action as, from time to time, may be necessary to remain so qualified and it shall obtain, at its expense all licenses, permits, insurance, and governmental approvals, if any, necessary to the performance of the Services under this Contract.
- b. The CONTRACTOR is assumed to be familiar with and agrees that at all times it will observe and comply with all federal, state, and local laws, ordinances, and regulations in any manner affecting the performance of the Services. The preceding shall include, but is not limited to, compliance with all Equal Employment Opportunity laws, the Fair Labor Standards Act, Occupational Safety and Health Administration (OSHA) requirements, and the Americans with Disabilities Act (ADA).
- c. This Contract will be interpreted in accordance with the laws of the State of Tennessee. By execution of this Contract, the CONTRACTOR agrees that all actions, whether sounding in contract or in tort, relating to the validity, construction, interpretation and enforcement of this Contract will be instituted and litigated in the courts of the State of Tennessee, located in Shelby County, Tennessee, and in no other. In accordance herewith, the parties to this Contract submit to the jurisdiction of the courts of the State of Tennessee located in Shelby County, Tennessee.

15. NON-DISCRIMINATION

The CONTRACTOR hereby agrees, warrants, and assures compliance with the provisions of Title VI and VII of the Civil Rights Act of 1964 and all other federal statutory laws which provide in whole or in part that no person shall be excluded from participation or be denied benefits of or be otherwise subjected to discrimination in the performance of this Contract or in the employment practices of the CONTRACTOR on the grounds of handicap and/or disability, age, race, color, religion, sex, national origin, or any other classification protected by federal, Tennessee State Constitutional or statutory law. The CONTRACTOR shall upon request show proof of such non-discrimination and shall post in conspicuous places available to all employees and applicants notices of non-discrimination.

16. ENTIRE AGREEMENT

This Contract represents the entire and integrated agreement between the parties and supersedes all prior negotiations, representations or agreements, whether oral or written.

17. AMENDMENT

This Contract may be modified or amended only by written instrument signed by both parties.

18. SEVERABILITY

If any provision of this Contract is held to be unlawful, invalid or unenforceable under any present or future laws, such provision shall be fully severable; and this Contract shall then be construed and enforced as if such unlawful, invalid or unenforceable provision had not been a part hereof. The remaining provisions of this Contract shall remain in full force and effect and shall not be affected by such unlawful, invalid or unenforceable provision or by its severance here from. Furthermore, in lieu of such unlawful, invalid, or unenforceable provision, there shall be added automatically as a part of this Contract a legal, valid and enforceable provision as similar in terms to such unlawful, invalid or unenforceable provision as possible.

19. NO WAIVER OF CONTRACTUAL RIGHT

No waiver of any term, condition, default, or breach of this Contract, or of any document executed pursuant hereto, shall be effective unless in writing and executed by the party making such waiver; and no such waiver shall operate as a waiver of either (a) such term, condition, default, or breach on any other occasion or (b) any other term, condition, default, or breach of this Contract or of such document. No delay or failure to enforce any provision in this Contract or in any document executed pursuant hereto shall operate as a waiver of such provision or any other provision herein or in any document related hereto. The enforcement by any party of any right or remedy it may have under this Contract or applicable law

shall not be deemed an election of remedies or otherwise prevent such party from enforcement of one or more other remedies at any time.

20. MATTER TO BE DISREGARDED

This title of the several sections, subsections, and paragraphs set forth in this Contract are inserted for convenience of reference only and shall be disregarded in construing or interpreting any of the provisions of this Contract.

21. SUBJECT TO FUNDING

This Contract is subject to annual appropriations of funds by the Shelby County Government. In the event sufficient funds for this Contract are not appropriated by Shelby County Government for any of its fiscal period during the Term hereof, then this Contract will be terminated. In the event of such termination, the CONTRACTOR shall be entitled to receive just and equitable compensation for any satisfactory work performed as of the Termination Date.

22. TRAVEL EXPENSES (If Applicable)

All travel expenses payable under this Contract shall be in accordance with the County Travel Policy and Procedures. This includes advance written travel authorization, submission of travel claims, documentation requirements, and reimbursement rates. No travel advances will be made by the County.

23. PERFORMANCE AND LABOR AND MATERIALS BONDS

CONTRACTOR will provide COUNTY within ten (10) days from inception date of this Contract a Performance and Labor and Materials Bond each in the amount of 100% of the Contract price for each year that this contract is in effect. Said Bonds may be pro-rated for the initial year in the event that this period of time is less than a full twelve (12) month period.

24. NON-LIABILITY FOR CONTRACTOR EMPLOYEE TAXES

Neither CONTRACTOR nor its personnel are County's employees, and COUNTY shall not take any action or provide Contractor's personnel with any benefits and shall have no liability for the following:

- a. Withholding FICA (Social Security) from Contractor's payments;
- b. Making state or federal unemployment insurance contributions on behalf of CONTRACTOR or its personnel;
- c. Withholding state and federal income tax from payment to CONTRACTOR;

- d. Making disability insurance contributions on behalf of CONTRACTOR;
- e. Obtaining workers' compensation insurance on behalf of CONTRACTOR or Contractor's personnel.

25. INCORPORATION OF OTHER DOCUMENTS

- a. CONTRACTOR shall provide Services pursuant to this Contract in accordance with the terms and conditions set forth within the Shelby County Request for Proposals/Bids as well as the Response of CONTRACTOR thereto, all of which are maintained on file within the Shelby County Purchasing Department and incorporated herein by reference.
- b. It is understood and agreed between the parties that in the event of a variance between the terms and conditions of this Contract and any amendment thereto and the terms and conditions contained either within the Request for Proposals/Bids or the Response thereto, the terms and conditions of this Contract as well as any amendment shall take precedence and control the relationship and understanding of the parties.

26. CONTRACTING WITH LOCALLY OWNED SMALL BUSINESSES

The CONTRACTOR shall take affirmative action to assure that Locally Owned Small Businesses that have been certified by the COUNTY are utilized when possible as sources of supplies and equipment, construction and services.

27. RIGHT TO REQUEST REMOVAL OF Contractor's EMPLOYEES

The COUNTY may interview the personnel CONTRACTOR assigns to County's work. COUNTY shall have the right, at any time, to request removal of any employee(s) of CONTRACTOR, whom COUNTY deems to be unsatisfactory for any reason. Upon such request, CONTRACTOR shall use all reasonable efforts to promptly replace such employee(s) with substitute employee(s) having appropriate skills and training.

28. INCORPORATION OF WHEREAS CLAUSES

The foregoing whereas clauses are hereby incorporated into this Contract and made a part hereof.

29. DISCLOSURE OF REPORTS, DATA OR OTHER INFORMATION

Notwithstanding anything to the contrary contained herein or within any other document supplied to COUNTY by CONTRACTOR, CONTRACTOR understands

and acknowledges that COUNTY is a governmental entity subject to the laws of the State of Tennessee and that any reports, data or other information supplied to COUNTY by CONTRACTOR due to Services performed pursuant to this Contract is subject to being disclosed as a public record in accordance with the laws of the State of Tennessee.

30. ORGANIZATION STATUS AND AUTHORITY

- a. CONTRACTOR represents and warrants that it is a corporation, limited liability company, partnership, or other entity duly organized, validly existing and in good standing under the laws of the state of Tennessee; it has the power and authority to own its properties and assets and is duly qualified to carry on its business in every jurisdiction wherein such qualification is necessary.
- b. The execution, delivery and performance of this Contract by the CONTRACTOR has been duly authorized by all requisite action and will not violate any provision of law, any order of any court or other agency of government, the organizational documents of CONTRACTOR, any provision of any indenture, agreement or other instrument to which CONTRACTOR is a party, or by which Contractor's respective properties or assets are bound, or be in conflict with, result in a breach of, or constitute (with due notice or lapse of time or both) a default under any such indenture, agreement or other instrument, or result in the creation or imposition of any lien , charge or encumbrance of any nature whatsoever upon any of the properties or assets.

31. INSURANCE REQUIREMENTS

- a. The CONTRACTOR shall purchase and maintain, in a company or companies licensed to do business in the State of Tennessee, such insurance as will protect the County from claims which may arise out of or result from the Contractor's operations under the Contract, whether such operations are performed by himself or by any subcontractors or by anyone directly or indirectly employed by any of them, or by anyone for whose acts the CONTRACTOR or subcontractor may be liable.
- b. The insurance required shall be written for not less than any limits of liability specified or required by law, whichever is greater. Shelby County Government, its elected officials, appointees and employees will be named as additional insured. All policies will provide for thirty (30) days written notice to COUNTY of cancellation or material change in coverage provided. The Contractor shall immediately notify Shelby county Government, Contract Administration, 160 N. Main Street, Suite 550, Memphis, Tennessee of cancellation or changes in any of the insurance coverage required. The CONTRACTOR will maintain throughout the life of this Contract insurance,

through insurers rated A- or better by A.M. Best, in the following minimum requirements:

- i) Commercial General Liability Insurance- \$1,000,000.00 limit per occurrence for bodily injury and property damage/\$1,000,000.00 personal and advertising injury/\$2,000,000.00 General Aggregate/\$2,000,000.00 Products-Completed Operations Aggregate. Shelby County Government, its elected officials, appointees, employees, volunteers, and members of boards, agencies, and commissions will be listed as additional insured regarding operations under this program. The insurance shall include coverage for the following:

- a) Premises/Operations
- b) Products/Completed Operations
- c) Personal Injury
- d) XCU coverage, where applicable
- e) Contractual Liability
- f) Independent Contractors
- g) Broad Form Property Damage
- h) When contract is awarded, the Contractor will be

required to provide the County with a copy of the additional insured endorsement.

- ii) Business Automobile Liability Insurance - \$1,000,000.00 each accident for bodily injury and property damage. Coverage is to be provided on all:

- a) Owned/Leased Autos
- b) Non-owned Autos
- c) Hired Autos

- iii) Workers Compensation and Employer's liability Insurance – All owners, sole proprietors, partners, and officers will elect to be covered by workers compensation coverage, regardless of requirement by Tennessee state status. Policy is to be specifically endorsed to include these individuals for coverage. Coverage is to include:

- a. Employers Liability Coverage for \$1,000,000 per accident;
- b. Employers Liability Disease each employee \$1,000,000; and
- c. Employers Liability Disease Policy Limit \$1,000,000

Note: The Contractor's workers compensation policy will include the following endorsement: WAIVER OF OUR RIGHT TO RECOVER FROM OTHERS ENDORSEMENT: (form WC 00 03 13) A completed copy of this form will be included in documents provided to Shelby County Government by Provider's insurance company.

- iv) Builders Risk Insurance or Installation Floater (as applicable) for project. – All risk coverage in the amount of replacement cost of the structure/equipment, which is to be built or installed.
- c. CONTRACTOR shall provide County with a current copy of the Certificate of Insurance at the time of contracting and shall maintain said insurance during the entire Contract period as well as provide renewal copies on each anniversary date. The certificate holder is to read:

Shelby County Government
Purchasing Department
160 N. Main, Suite 550
Memphis, TN 38103

- d. Self insured retentions or deductibles of \$25,000 or over per loss or claims must be reviewed and agreed to by Shelby County Government prior to commencement of work under this program.

All policies will provide for 30 day written notice to Shelby County of cancellation of coverage provided. Ten (10) days notice applicable to non-payment of premium. If insurer is not required by the policy terms and conditions to provide written notice of cancellation to Shelby County, the Contractor//Contractor will provide immediate notice to Shelby County.

32. NOTICE

Any notices required or permitted to be given under the provisions of this Contract shall be effective only if in writing and delivered either in person to the County's authorized agent or by First Class or U.S. Mail to the addresses set forth in the Contract, or to such other person or address as either party may designate in writing and deliver as herein provided.

33. HIPAA (If applicable)

CONTRACTOR warrants to the COUNTY and State that it is familiar with the requirements of the Health Insurance Portability and Accountability Act of 1996 (HIPAA) and its accompanying regulations, and will comply with all applicable

HIPAA requirements in the course of this Contract. CONTRACTOR warrants that it will cooperate with the COUNTY and State in the course of performance of the Contract so that all parties will be in compliance with HIPAA, including cooperation and coordination with COUNTY and State privacy officials and other compliance officers required by HIPAA and its regulations. CONTRACTOR will sign any documents that are reasonably necessary to keep the State and the COUNTY in compliance with HIPAA, including, but not limited to, business associate agreements.

It is agreed that the following documents are made a part of and incorporated fully into this construction Contract:

1. Performance Bond
2. Labor and Material Bond
3. Insurance Certificate
4. Bid Specifications (SB #_____, _____)
5. Contractor's Bid/Proposal (Exhibit "A")
6. General Conditions to Contract (Exhibit "B")
7. List of subcontractors who will be performing work on project with attached required information per Exhibit "C"

NOTE: THE ABOVE DOCUMENTS MUST BE ATTACHED BEFORE EXECUTION OF THIS AGREEMENT BY SHELBY COUNTY.

**SECTION 01010
SUMMARY OF WORK**

PART 1 GENERAL**1.01 SECTION INCLUDES**

- A. Contractor use of site.
- B. Owner occupancy.
- C. Abbreviated Summary of Work.
- D. General Contractor Requirements and Drawing Notes.
- E. Progress Meetings

1.02 CONTRACTOR USE OF SITE

- A. Limit use of site to allow:
 - 1. Owner occupancy and nearly normal use of the facilities during the construction. Avoid noise levels and disruption that interrupt normal business/court activities. Disruptive work must be done when the space that will be affected is unoccupied. Interruptions in the space heating system are to be performed when ambient conditions are above 60F 20 hours of every day service is interrupted. Interruptions to the domestic water service are to be performed at the time that has the least impact on users. This time may be after 8 PM until 6 AM 7 days a week in the case of the jail areas. Keep occupant's work areas free from excess noise, vibration, fumes and construction dust. Protect the office equipment, computers and other electronic equipment free of dust 100% of the time during all work activities.
 - 2. Office hours vary through the facility with occupancy beginning about 07:00 and ending about 18:00 Monday through Friday. The upper floors have some continuous occupancy in the court building of 201 Poplar and the jail side of 201 Poplar has continuous occupancy. The Courthouse at 140 Adams is effectively unoccupied nights and weekends. Work in support of this project is allowed in the occupied areas provided the contractor erects dust partitions to separate construction activities from the public and SCG employees.

Upon reasonable notification from Contractor the Owner will arrange for after hours access to facilities as needed to comply with requirement for nearly normal use of facility. It is specifically identified that work which causes plumbing, HVAC or electrical service interruptions as well as any work that is disruptive in occupied office areas, court/jury areas and corridors will need to be performed after hours.
- B. Temporary Office & Toilet Accommodations:
 - 1. The Owner will not provide office facilities, but will allow the Contractor to use any area in the renovated area for an office. If required the Prime Contractor shall provide a portable building / trailer as necessary during the period of construction for a job office. The Contractor is responsible for his own

telephone.

2. The Prime Contractor shall furnish, install, and maintain ample toilet facilities for the workers. The Owner will allow use of toilets provided there is no unusual soiling or excessive cleaning made necessary due to Contractor use. If required by the Owner the Contractor will provide outdoor toilets placed where directed and shall be installed and maintained as required by the local building department and health ordinances. Contractor shall also provide any necessary enclosures/bases to accommodate the toilets.

C. Temporary Light and Power

1. The Prime Contractor shall make all necessary connections for temporary electric service and shall provide all temporary fixtures and electrical devices. The Owner will pay for 120 VAC single phase electrical power used by the Contractor. Power for electric welders is available from the building electrical service; the Contractor is to request direction from the Owner on where they may connect for service to the welding machines. The Contractor is responsible for providing power to serve any special equipment needs during the implementation of this work.

D. Water for Construction:

1. The Owner will pay for water required for construction purposes. The Contractor shall provide and run the necessary lines and meters for construction use.

E. Signage:

1. The Contractor is not allowed to erect signage without the written consent of the Owner.

F. Utilities Service Work:

1. The Owner will pay directly to the local utility any cost involved in work performed by the local utility in connection with supplying gas or electric service, rerouting gas and electric service, furnishing metering equipment, furnishing and installation of transformers and gas meters. Coordinate with local utility concerning the extent of services they are providing and include the balance of services needed for a complete installation as a part of the Contract requirements.

G. Drug Free Workplace

1. The contractor shall maintain a "drug free workplace" policy. Provide documentation of this policy.

1.03 OWNER OCCUPANCY

- A. Cooperate with Owner to minimize conflict, and to facilitate Owner's operations. Except for special reasons the Owner will not fully vacate the site to accommodate the construction. Refer to the drawings and Summary of Work for any special phasing requirements.

- B. Schedule the Work to accommodate this requirement. Work in areas as the occupants will permit. This will require some work outside of normal business hours. There will be no change in the Contract amount due to this requirement.
- C. Construct and maintain substantial barricades for the protection of all persons around the building site as required. Place barricades around open trenches with warning tape between barricades to warn pedestrians of danger. Provide plywood walkways over cuts through sidewalks.
- D. Provide temporary heating as required for the proper protection, curing and drying of all work and for freeze protection.

1.04 ABBREVIATED SUMMARY

- A. Briefly without force and effect on the Contract Documents the Work can be described as follows:

Bid Package #1 - Courthouse - 140 Adams

Replace the boilers and steam heating system to the maximum extent practical using high efficiency modular hydronic boilers. Reuse radiators and associated steam piping. Provide a small high efficiency boiler to serve the radiators. Provide new boilers, pumps and piping to serve the HVAC systems throughout the building using variable flow.

Bid Package #2 - Criminal Justice Center - 201 Poplar

Provide high efficiency modular hydronic boilers with system modifications necessary to replace the existing steam boilers. Retain steam boilers for operation only on fuel oil for emergency use. Convert the domestic water heaters for heating operation using HVAC heating water. Provide new boilers, pumps and piping to serve the HVAC systems throughout the building using variable flow.

Bid Package #3 -Additional Building Automation Monitoring -Section 15950 will integrate the Building Automation System at the Regional Forensics Center so that it is monitored and Controlled from the County's existing remote monitoring locations at 160 N Main and 201 Poplar.

1.05 GENERAL REQUIREMENTS AND DRAWING NOTES

- A. The drawings are diagrammatic and show general layouts for bidding purposes only. It is the responsibility of the Contractor to prepare detailed shop drawings and/or to confirm space allocations.
- B. Remove and/or re-route existing utilities interfering with new work as required to allow installation of new work. Repair any damage to utilities, structure or other that results from any excavation, trenching or similar activity at no additional cost.
- C. Existing conditions are based on owner supplied information and limited field verification. Verify existing conditions, sizes, locations of services and equipment prior to pricing, fabrication, or actual construction. Allow for variances in the bid price.
- D. Remove duct/piping/raceway serving equipment noted as removed under this project.

- Cap at existing mains leaving no excess duct, raceway or piping.
- E. Relocate existing services contained within or concealed by building components/structure removed under this project. Conceal relocated services.
 - F. Repair to the satisfaction of the Owner any damage, alterations or soiling of the Owner's or occupants property. To verify and document the existing conditions the contractor shall make a video record of all areas where work will occur. The Owner will accompany the contractor during video recording and make appropriate comments to establish existing conditions. The contractor shall make a copy for the Owner, the Engineer and retain a copy.
 - G. Refer to architectural and structural drawings, if available, for building dimensions, details, elevations and exact locations of equipment.
 - H. Verify all equipment connections and service requirements with respective manufacturer prior to rough-in.
 - I. Conform to manufacturer's recommendations, the latest edition of the plumbing code, gas code, mechanical code, national electrical code, life safety code, local building codes and state regulations having jurisdiction.
 - J. Adjust layout and configuration of new work to reduce installation costs, comply with codes and avoid conflicts with other work. Provide drawings to detail the proposed rearrangement and submit a request to the engineer explaining the reason for rearrangement. Written approval from the engineer is required prior to implementation.
 - K. Saw-cut or core drill concrete, asphalt and other masonry removed under this project. Protect spaces and equipment from dust and water. Under no circumstance are beams, columns or thickened slabs to be cut or core drilled without written instructions from the Engineer on reinforcing requirements prior to any work.
 - L. Coordinate electrical requirements of new work with DIV 16 prior to ordering. New equipment shall be UL listed and NEMA approved.
 - M. Review the drawings associated with other trades to coordinate work with these other trades. Avoid interference with architectural features, beams, footings, windows, etc. Notify engineer of any conflicts.
 - N. Sleeve penetrations of new work through all fire rated separations. Seal floor sleeves and weather exposed wall sleeves to prevent water seepage. Firestop around sleeves in fire rated partitions.
 - O. Seal penetrations of new work through all smoke rated partitions to prevent passage of smoke.
 - P. Use manufactured pipe hangers, threaded rods, structural HRS, concrete inserts and clamps in conjunction with the building structural members to support piping and equipment from the walls and overhead. Do not use band iron, metal or wire strapping for pipe or equipment support.
 - Q. Secure pipe and equipment and provide shock arrestors to prevent pipe movement

and water hammer.

- R. Provide removable doors for access to and servicing of: valves, adjustable &/or replaceable components, coils, filters, moving assemblies, lubrication points, fire/smoke dampers, and shokstops.
- S. Any portions of the work of this contract that may require a shutdown of the existing mechanical and electrical systems shall be scheduled with owner to achieve an acceptable time for this work.
- V. Upon completion of the work covered by this contract, furnish the owner with one (1) set of reproducible "as-built" drawings and set of computer diskettes with CAD (computer aided drafting) "as-built" drawing data files which show all work installed under this contract. Pay particularly close attention to locations of new underground or concealed work and any existing underground utilities or abnormal subsurface conditions uncovered during excavations. Engineer will furnish diskettes of floor plans that form the Construction drawings.
- W. All work must be done in a manner so that facility functions are not interrupted.
- X. The Basement of 140 Adams has equipment, duct and piping that will be disturbed or demolished under this project and is believed to contain asbestos. See Section 028211 for associated testing, handling and removal requirements.
- Y. If the Contractor is suspect of any materials in the area of this contract that his personnel must be exposed to in the performance of this project he should bring such concerns, in writing, to the owner prior to signing the construction contract.
- Z. All equipment that is removed or functionally abandoned as a part of this contract shall be relocated or disposed of as directed by the Owner. Stockpile this equipment in a location as directed by Owner. After Owner review of equipment, and written summary of equipment he wishes to keep, dispose of all unwanted equipment.
- AA. Broom clean area disturbed by work on this project on a daily basis. Keep corridors and walkways clear. Do not block exits. Debris to be hauled away from site on a weekly basis. Provide dust barriers, sticky walk-off mats and maintain the construction area at a negative pressure to contain dust and debris within the renovated area.
- BB. Provide 10% spare lamps for all new lighting fixtures installed under this project.
- CC. Provide cover plates and/or restore to original condition any wall, ceiling, or floor surface exposed by work under this project. Cover plates may be used on abandoned device boxes recessed in wall. Where used they shall be brushed stainless steel with smooth rounded edges.
- DD. All terminations of control wiring are to be "crimped spade" or "wire looped around screw" connections to match the requirements of the connected device. Provide a tight connection of the conductors at controlled devices with sufficient slack to allow easy removal and replacement of devices while protecting terminations from being pulled loose.
- EE. Conceal control wiring to thermostats, temperature sensors and other devices in wall cavities or above the ceilings wherever possible. When wall or ceiling construction in

finished spaces prohibits internal routing provide surface mounted EMT raceway. Provide wall boxes or wall plates as appropriate to facilitate raceway connection. Overall dimension (normal to wall or ceiling) of the control assembly, wall box (if reqd), and mounting hardware shall be less than 3 inches.

- FF. Color selections - painting: the prime contractor will assemble all colors and/or color charts or cards for all items requiring paint for approval by the Owner.
- GG. Allow for four 2 hour sessions of training of the building engineers on the operation and maintenance of the newly installed systems.
- HH. Start up of equipment shall only be performed in the Owner's presence. The manufacturer's representative shall oversee the contractor in the actual start-up.
- II. Provide identification badges for all construction personnel other than delivery drivers. Where uniforms with unique identification is worn the badges are not required.

1.06 PROGRESS MEETINGS

- A. A job site meeting with all actively involved subcontractors will be held every two weeks. The prime Contractor shall make an audio record, keep written minutes of these meetings and distribute typed summaries of the minutes to all involved parties

PART 2 PRODUCTS \\Not Used
PART 3 EXECUTION \\Not Used

END OF SECTION

**SECTION 01045
CUTTING AND PATCHING**

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. All cutting, fitting and patching required to complete the Work.
 - 1. Make its several parts fit together properly.
 - 2. Uncover portions of the Work to provide for installation of ill timed work.
 - 3. Remove and replace defective work.
 - 4. Remove and replace work not conforming to Contract Documents.
 - 5. Remove samples of installed work where specified for testing.
 - 6. Provide access and penetrations of nonstructural surfaces for installation of piping, conduit, and ductwork.
 - 7. Patch openings to accommodate removal/installation of equipment, louvers, vents and similar items.

PART 2 PRODUCTS

2.01 MATERIALS

- A. All structural steel members required for the completion of work are to be A-36 Hot Rolled Steel (HRS), or strut. All members to be electroplated or hot dipped galvanized. In concealed locations structural steel may be factory painted or primed and painted. All damp, outdoor or weather exposed locations shall be hot dipped of factory electroplate galvanized steel.

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. Report unsatisfactory conditions to the Owner's Representative in writing and do not proceed if conditions are unsatisfactory.

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 which may be exposed by uncovering work.

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, plumbing and electrical work.
- G. Patching is to restore the finished surfaces to match adjacent undisturbed work. Painting is to extend edge to edge. Marble, limestone and terrazzo are to be matched using equal materials that are available and that matches existing as closely as possible, include taking samples to large distributors and matching the marble, limestone and terrazzo; color/texture match grout exactly, submit samples for Owner approval prior to ordering.

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. Employ original installer to perform patching for roof membrane penetrations, weather exposed and moisture resistant elements. Match materials and methods of existing roof construction to the extent possible without degrading roof integrity. Enhance method of repair to roof system when approved and requested by the Owner's representative in writing. e.g. hot patch vs cold patch. Request the name of the roofer that installed this roof.
- C. Cut rigid materials using masonry saw or core drill. Pneumatic tools not allowed without prior approval.
- D. Restore damaged work in accordance with similar new work in accordance with requirements of Contract Documents.
- E. Fit work air tight to pipes, sleeves, ducts, conduit, and other penetrations through surfaces.
- F. At penetrations of fire rated walls, partitions, ceiling, or floor construction, completely seal voids with fire resistant material to full thickness of the penetrated element and caulk surface with intumescent caulk 3M brand CP25 or equal by Dow Corning. Firestop around insulated piping using UL rated assemblies. Sleeve penetrations of masonry walls with insulated pipes.
- G. Refinish surfaces to match adjacent finish. For continuous surfaces, refinish to nearest intersection or natural break. For an assembly, refinish entire unit.
- H. All patches of concrete to be made using materials and methods indicated in the drawings. Minimum methods if not specifically indicated as follows: Dowel in all patches of concrete with #4 deformed bar 12" OC full perimeter of patch, centered in the existing slab with 3" of embedment. Reinforce patch with #4 12" OCEW. Concrete to be a minimum of 6" thick, 4000 PSI at 28 day compressive strength. Holes 3"-12" dia to have two #3 bars forming an "X" and smaller holes may be patch with non-shrink grout using a hammer drill to roughen the sides of the opening.

END OF SECTION

SECTION 01300

SUBMITTALS

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. Manufacturers' instructions.
- G. Manufacturers' certificates and warranties.

1.02 RELATED SECTIONS

- A. Section 01700 - Contract Closeout: Contract warranty, manufacturer's certificates, and closeout submittals.

1.03 SUBMITTAL PROCEDURES

- A. Transmit each submittal with Architect/Engineer accepted transmittal form. Submit the number required by the Contractor, plus five copies (two to be retained by the Architect/Engineer/Owner and three to be bound into the O&M Manuals).
- B. Identify Project, Contractor, SubContractor or supplier; pertinent Drawing sheet and detail number(s), and specification Section number, as appropriate.
- C. Apply Contractor's stamp, 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.
- D. Schedule submittals to expedite the Project, and deliver as a single bound electronic media package to Owner's Representative, MEDFAC Engineering LLC, 1209 Dovecrest, Memphis, TN 38134-7625.
- E. Identify variations from Contract Documents and Product or system limitations which may be detrimental to successful performance of the completed Work.
- F. Provide space for Contractor and Architect/Engineer review stamps.

- G. Revise and resubmit submittals as required, identify all changes made since previous submittal.
- H. Distribute copies of reviewed submittals to concerned parties. Instruct parties to promptly report any inability to comply with provisions.

1.04 CONSTRUCTION PROGRESS SCHEDULES

- A. Submit initial progress schedule in duplicate within 14 days after date established in Notice to Proceed for Owner's Representative review.
- B. Revise and resubmit as required.
- C. Submit revised schedules with each Application for Payment, identifying changes since previous version.
- D. Indicate estimated percentage of completion for each item of Work at each submission.

1.05 PROPOSED PRODUCTS LIST

- A. Within 14 days after date of Contract signing, submit complete list of major products proposed for use, with name of manufacturer, trade name, and model number or each product.
- B. For products specified only by reference standards, give manufacturer, trade name, model or catalog designation, and reference standards.

1.06 SHOP DRAWINGS

- A. Submit in the form of one reproducible transparency.
- B. After review, reproduce and distribute in accordance with Article on Procedures above and for Record Documents described in Section 01700 - Contract Closeout.

1.07 PRODUCT DATA

- A. Submit the number of copies which the Contractor requires, plus five (two to be retained by the Architect/Engineer/Owner and three to be bound into the O&M Manuals).
- B. Mark each copy to identify applicable products, models, options, and other data. Supplement manufacturers' standard data to provide information unique to this Project. Include a copy of all warranties with all equipment.
- C. After review, distribute in accordance with Article on Procedures above and provide copies for Record Documents described in Section 01700 - Contract Closeout.

1.08 MANUFACTURER'S INSTRUCTIONS

- A. Submit manufacturers' printed instructions for delivery, storage, assembly, installation, start-up, adjusting, and finishing, in quantities specified for Product Data.
- B. Identify conflicts between manufacturers' instructions and Contract Documents.

1.09 MANUFACTURER'S CERTIFICATES

- A. When specified in individual specification Sections, submit manufacturers' certificate to Architect/Engineer for review, in quantities specified for Product Data.
- B. Certificates may be recent or previous test results on material or Product, but must be acceptable to Architect/Engineer.

1.10 MATERIAL SAFETY DATA SHEETS, MSDS.

- A. Material Safety Data Sheets are required as a part of the submittal for all equipment and materials that could conceivably contain asbestos. Example are mastics, floor tile, sealants, insulation, gypsum board and any other item that the Owner requests MSDS on.

PART 2 PRODUCTS \\Not Used
PART 3 EXECUTION \\Not used

END OF SECTION

**SECTION 01600
MATERIAL AND EQUIPMENT**

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Products.
- B. Transportation and handling.
- C. Storage and protection.
- D. Product options.
- E. Substitutions.
- F. Demolished and abandoned equipment.

1.02 PRODUCTS

- A. Products: Means new material, machinery, components, equipment, fixtures, and systems forming the Work. Does not include machinery and equipment used for preparation, fabrication, conveying and erection of the Work. Products may also include existing materials or components required for reuse.
- B. Do not use materials and equipment removed from existing premises, unless specifically permitted by the Contract Documents.
- C. Provide interchangeable components of the same manufacturer, for similar components.

1.03 TRANSPORTATION AND HANDLING

- A. Transport and handle Products in accordance with manufacturer's instructions.
- B. Promptly inspect shipments to assure that Products comply with requirements, quantities are correct, and Products are undamaged.
- C. Provide equipment and personnel to handle Products by methods to prevent soiling, disfigurement, or damage.

1.04 STORAGE AND PROTECTION

- A. Store and protect Products in accordance with manufacturer's instructions, with seals and labels intact and legible. Store sensitive Products in weather-tight, climate controlled enclosures.
- B. Arrange storage of Products to permit access for inspection. Periodically inspect to assure Products are undamaged and are maintained under specified conditions.

1.05 PRODUCT OPTIONS

- A. Products Specified by Reference Standards or by Description Only: Any Product meeting those standards or description.
- B. Products Specified by Naming One or More Manufacturers: Products of manufacturers named and meeting specifications, no options or substitutions allowed.
- C. Products Specified by Naming One or More Manufacturers with a Provision for Substitutions: Submit a request for substitution for any manufacturer not named.

1.06 SUBSTITUTIONS

- A. Architect/Engineer will consider requests for Substitutions only within 14 days after date of Contract signing.
- B. Substitutions may be considered when a Product becomes unavailable through no fault of the Contractor.
- C. Document each request with complete data substantiating compliance of proposed Substitution with Contract Documents.
- D. A request constitutes a representation that the Contractor:
 - 1. Has investigated proposed Product and determined that it meets or exceeds the quality level of the specified Product.
 - 2. Will provide the same warranty for the Substitution as for the specified Product.
 - 3. Will coordinate installation and make changes to other Work which may be required for the Work to be complete with no additional cost to Owner.
 - 4. Waives claims for additional costs or time extension which may subsequently become apparent.
 - 5. Will reimburse Owner for review or redesign services associated with re-approval by authorities.
- E. Substitutions will not be considered when they are indicated or implied on shop drawing or product data submittals, without separate written request, or when acceptance will require revision to the Contract Documents.
- F. Substitution Submittal Procedure:
 - 1. Submit six copies of request for Substitution for consideration. Limit each request to one proposed Substitution.
 - 2. Submit shop drawings, Product data, and certified test results attesting to the proposed Product equivalence.
 - 3. The Architect/Engineer will notify Contractor, in writing, of decision to accept or reject request.

1.07 Demolished and Abandoned Equipment

- A. All equipment that is removed or functionally abandoned as a part of this Contract shall be relocated or disposed of as directed by Owner. Stockpile this equipment in a location as directed by Owner. After Owner review of equipment, and written summary of equipment he wishes to keep, dispose of all unwanted equipment.

PART 2 PRODUCTS \\Not Used
PART 3 EXECUTION \\Not used

END OF SECTION

**SECTION 01700
CONTRACT CLOSEOUT**

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Closeout Procedures.
- B. Final Cleaning.
- C. Adjusting.
- D. Project Record Documents.
- E. Operation and Maintenance Data.
- F. Warranties.

1.02 CLOSEOUT PROCEDURES

- A. Submit written certification that Contract Documents have been reviewed, Work has been inspected, and that Work is complete in accordance with Contract Documents and ready for Architect/Engineer's inspection. If the project is not ready for inspection by Architect/Engineer, the Contractor will be billed at \$150/hour for Architect/Engineer time that is spent on travel and observations of areas/items that are not complete and ready for review.
- B. Provide completed and signed Use and Occupancy certificate to Owner, copy to Architect/Engineer, that are required by governing authorities.
- C. Submit final Application for Payment identifying total adjusted Contract Sum, previous payments, and sum remaining due.
- D. Owner will occupy and have use of all portions of the building.

1.03 FINAL CLEANING

- A. In addition to daily broom cleaning, Contractor will provide final cleaning prior to acceptance of each area for beneficial use. Final cleaning will be performed by the Contractor only once. All cleaning operations by the Owner, made necessary by work in the area by the Contractor will be deducted from the Contract amount at the rate of \$50.00/hour for cleaning by Owner required because of unsatisfactory cleaning work by the Contractor.
- B. Remove waste and surplus materials, rubbish, and construction facilities from the site. Above ceiling locations are included in this description of "site". Cleaning and disposal practices must comply with all codes, ordinances, regulations and anti-pollution laws.

- C. Building Finished Surfaces:
 - 1. Remove grease, mastic, adhesives, dust, dirt, stains, labels, fingerprints, and other foreign matter from sight-exposed interior and exterior surfaces, including windows and mirrors. Wipe down all finished surfaces to remove all traces of dust and soiling.
- D. Contractor Inspection:
 - 1. Prior to Owner's inspection, conduct an inspection of the entire work area to ensure that it is clean.

1.04 ADJUSTING

- A. Adjust operating Products and equipment to ensure smooth and unhindered operation in accordance with Contract Documents.

1.05 PROJECT RECORD DOCUMENTS

- A. Maintain on site, one set of the following record documents; record actual revisions to the Work:
 - 1. Contract Drawings.
 - 2. Specifications.
 - 3. Addenda.
 - 4. Change Orders and other Modifications to the Contract.
 - 5. Reviewed shop drawings, product data, and samples.
- B. Store Record Documents separate from documents used for construction.
- C. Record any and all new information relevant to the documents concurrent with construction progress on the record documents, neatly detailing any changes.
- D. Specifications: Legibly mark and record at each Product section description of actual Products installed, including the following:
 - 1. Manufacturer's name and product model and number.
 - 2. Product substitutions or alternates utilized.
 - 3. Changes made by Addenda and Modifications.

1.06 WARRANTIES

- A. Execute and assemble documents from SubContractors, suppliers, and manufacturers.
- B. Provide Table of Contents and assemble in binder with durable cover.
- C. Submit prior to final Application for Payment.
- D. A minimum of 12 months material and labor warranty shall be provided for the work that is performed and all systems/components that are installed. Refer to the individual specification sections for more extended warranty requirements.

PART 2 PRODUCTS \\Not used
PART 3 EXECUTION \\Not used

END OF SECTION

SECTION 028211
NEGATIVE PRESSURE ENCLOSURE ASBESTOS ABATEMENT SPECIFICATIONS

PART 1 - GENERAL**1.1 SUMMARY OF THE WORK****1.1.1 CONTRACT DOCUMENTS AND RELATED REQUIREMENTS**

Drawings, general provisions of the contract, including general and supplementary conditions and other Division 01 specifications, shall apply to the work of this section. The contract documents show the work to be done under the contract and related requirements and conditions impacting the project. Related requirements and conditions include applicable codes and regulations, notices and permits, existing site conditions and restrictions on use of the site, requirements for partial Owner occupancy during the work, coordination with other work and the phasing of the work. In the event a conflict is discovered by the Contractor in the contract documents and/or requirements or codes, the conflict must be brought to the immediate attention of the Owner for resolution. Whenever there is a conflict or overlap in the requirements, the most stringent shall apply. Any actions taken by the Contractor without obtaining guidance from the Architect shall become the sole risk and responsibility of the Contractor. All costs incurred due to such action are also the responsibility of the Contractor.

1.1.2 EXTENT OF WORK

- A. Where PACM has been examined and found to contain in excess of 1% asbestos using recognized and approved methods then that material is to be removed as ACM in accordance with all applicable rules and regulations. The quantities are not tabulated and the Contractor is to perform a field evaluation to determine the quantities prior to bid. Nothing in this section may be interpreted as limiting the extent of work otherwise required by this contract and related documents.
- B. Remove, clean-up and dispose of asbestos containing materials (ACM) and asbestos/waste contaminated elements in all renovated spaces including equipment rooms.
- C. These specifications provide general guidance to personnel given the task of designing and executing a Class I negative pressure enclosure asbestos abatement project. Each abatement project is a unique situation and therefore must be tailored for that project. This specification incorporates current regulatory requirements and current best abatement practices, procedures and technology. The Industrial Hygiene Professionals may provide additional requirements or deletions that, in their professional judgment, will ensure a safe and effective approach to a specific abatement project while maintaining compliance with applicable regulations and OWNER policy. Any changes must be submitted to the Owner for their review and approval.
- D. These specifications do not supersede any other aspect of the construction document and are to be used in conjunction selective demolition criteria; and general construction provisions.
- E. A survey of the building materials has not been performed by the County and the Contractor is to assume that all piping elbows and fitting covers, all insulation that has an aluminum jacket, the two boilers that are demolished as well as all breeching which are indicated as being demolished in the Basement level of 140 Adams should be treated as if it contains insulation materials and gasketing that is ACM. Assume the worst case regarding its condition relative to handling requirements. Contractors are allowed to take samples for testing at any time provided the person collecting samples is properly trained and certified, licensed and insured to perform this procedure.
- F. Where the abatement is limited to non-friable asbestos products in good condition such as transite board, roofing, flooring and cove base constituting a Class II asbestos abatement then the requirements are reduced as noted herein.

1.1.3 RELATED WORK

- A. Section 024100, DEMOLITION.
- B. Division 15, MECHANICAL, PLUMBING and FIRE PROTECTION.
- C. DIVISION 16 ELECTRICAL

1.1.4 TASKS

- A. Pre-abatement activities including pre-abatement meeting(s), inspection(s), notifications, permits, submittal approvals, regulated area preparations, emergency procedures arrangements, and standard operating procedures for asbestos abatement work.
- B. Abatement activities including removal, enclosure, clean-up and disposal of ACM waste, recordkeeping, security, monitoring, and inspections.
- C. Cleaning and decontamination activities including final visual inspection, air monitoring and certification of decontamination.

1.1.5 CONTRACTORS USE OF PREMISES

- A. The Contractor and Contractor's personnel shall cooperate fully with the OWNER representative/consultant to facilitate efficient use of buildings and areas within buildings. The Contractor shall perform the work in accordance with the OWNER specifications, drawings, phasing plan and in compliance with any/all applicable Federal, State and Local regulations and requirements.
- B. The Contractor shall use the existing facilities in the building strictly within the limits indicated in contract documents as well as the approved OWNER Design and Construction Procedures. OWNER Design and Construction Procedures drawings of partially occupied buildings will show the limits of regulated areas; the placement of decontamination facilities; the temporary location of bagged waste ACM; the path of transport to outside the building; and the temporary waste storage area for each building/regulated area. Any variation from the arrangements shown on drawings shall be secured in writing from the OWNER representative through the pre-abatement plan of action. The following limitations of use shall apply to existing facilities shown on drawings:

1.2 STOP ASBESTOS REMOVAL

If the Owner, their field representative; or their separately employed Industrial Hygienist presents a verbal **Stop Asbestos Removal Order**, the Contractor/Personnel shall immediately stop all asbestos removal and maintain HEPA filtered negative pressure air flow in the containment and adequately wet any exposed ACM. If a verbal Stop Asbestos Removal Order is issued, the OWNER shall follow-up with a written order to the Contractor as soon as it is practicable. The Contractor shall not resume any asbestos removal activity until authorized to do so in writing by the OWNER. A stop asbestos removal order may be issued at any time the OWNER determines abatement conditions/activities are not within OWNER specification, regulatory requirements or that an imminent hazard exists to human health or the environment. Work stoppage will continue until conditions have been corrected to the satisfaction of the OWNER. Standby time and costs for corrective actions will be borne by the Contractor, including the Industrial Hygienist's time. The occurrence of any of the following events shall be reported immediately by the Contractor's competent person to the OWNER Contracting Office or field representative using the most expeditious means (e.g., verbal or telephonic), followed up with written notification to the as soon as practical. The Contractor shall immediately stop asbestos removal/disturbance activities and initiate fiber reduction activities:

- A. Airborne PCM analysis results equal to or greater than 0.01 f/cc outside a regulated area or >0.05 f/cc inside a regulated area;
- B. breach or break in regulated area containment barrier(s);
- C. less than -0.02" WCG pressure in the regulated area;
- D. serious injury/death at the site;
- E. fire/safety emergency at the site;
- F. respiratory protection system failure;
- G. power failure or loss of wetting agent; or

H. any visible emissions observed outside the regulated area.

1.3 DEFINITIONS

1.4.1 GENERAL

Definitions and explanations here are neither complete nor exclusive of all terms used in the contract documents, but are general for the work to the extent they are not stated more explicitly in another element of the contract documents. Documents must be recognized as diagrammatic in nature and not completely descriptive of the requirements indicated therein.

1.4.2 GLOSSARY

Abatement - Procedures to control fiber release from asbestos-containing materials. Includes removal, encapsulation, enclosure, demolition, and renovation activities related to asbestos containing materials (ACM).

Aerosol - Solid or liquid particulate suspended in air.

Adequately wet - Sufficiently mixed or penetrated with liquid to prevent the release of particulates. If visible emissions are observed coming from the ACM, then that material has not been adequately wetted.

Aggressive method - Removal or disturbance of building material by sanding, abrading, grinding, or other method that breaks, crumbles, or disintegrates intact ACM.

Aggressive sampling - EPA AHERA defined clearance sampling method using air moving equipment such as fans and leaf blowers to aggressively disturb and maintain in the air residual fibers after abatement.

AHERA - Asbestos Hazard Emergency Response Act. Asbestos regulations for schools issued in 1987.

Aircell - Pipe or duct insulation made of corrugated cardboard which contains asbestos.

Air monitoring - The process of measuring the fiber content of a known volume of air collected over a specified period of time. The NIOSH 7400 Method, Issue 2 is used to determine the fiber levels in air. For personal samples and clearance air testing using Phase Contrast Microscopy (PCM) analysis. NIOSH Method 7402 can be used when it is necessary to confirm fibers counted by PCM as being asbestos. The AHERA TEM analysis may be used for background, area samples and clearance samples when required by this specification, or at the discretion of the CPH/CIH as appropriate.

Air sample filter - The filter used to collect fibers which are then counted. The filter is made of mixed cellulose ester membrane for PCM (Phase Contrast Microscopy) and polycarbonate for TEM (Transmission Electron Microscopy)

Amended water - Water to which a surfactant (wetting agent) has been added to increase the penetrating ability of the liquid.

Asbestos - Includes chrysotile, amosite, crocidolite, tremolite asbestos, anthophyllite asbestos, actinolite asbestos, and any of these minerals that have been chemically treated or altered. Asbestos also includes PACM, as defined below.

Asbestos Hazard Abatement Plan (AHAP) - Asbestos work procedures required to be submitted by the contractor before work begins.

Asbestos-containing material (ACM) - Any material containing more than one percent of asbestos.

Asbestos contaminated elements (ACE) - Building elements such as ceilings, walls, lights, or ductwork that are contaminated with asbestos.

Asbestos-contaminated soil (ACS) - Soil found in the work area or in adjacent areas such as crawlspaces or pipe tunnels which is contaminated with asbestos-containing material debris and cannot be easily separated from the material.

Asbestos-containing waste (ACW) material - Asbestos-containing material or asbestos contaminated objects requiring disposal.

Asbestos Project Monitor - Any person conducting asbestos abatement clearance inspections and clearance air sampling be licensed as an asbestos project monitor competent and duly certified to perform this role.

Asbestos waste decontamination facility - A system consisting of drum/bag washing facilities and a temporary storage area for cleaned containers of asbestos waste. Used as the exit for waste and equipment leaving the regulated area. In an emergency, it may be used to evacuate personnel.

Authorized person - Any person authorized by the OWNER, the Contractor, or government agency and required by work duties to be present in regulated areas.

Authorized visitor - Any person approved by the OWNER; the contractor; or any government agency representative having jurisdiction over the regulated area (e.g., OSHA, Federal and State EPA).

Barrier - Any surface that isolates the regulated area and inhibits fiber migration from the regulated area.

Containment Barrier - An airtight barrier consisting of walls, floors, and/or ceilings of sealed plastic sheeting which surrounds and seals the outer perimeter of the regulated area.

Critical Barrier - The barrier responsible for isolating the regulated area from adjacent spaces, typically constructed of plastic sheeting secured in place at openings such as doors, windows, or any other opening into the regulated area.

Primary Barrier - Plastic barriers placed over critical barriers and exposed directly to abatement work.

Secondary Barrier - Any additional plastic barriers used to isolate and provide protection from debris during abatement work.

Breathing zone - The hemisphere forward of the shoulders with a radius of about 150 - 225 mm (6 - 9 inches) from the worker's nose.

Bridging encapsulant - An encapsulant that forms a layer on the surface of the ACM.

Building/facility Owner - The legal entity, including a lessee, which exercises control over management and recordkeeping functions relating to a building and/or facility in which asbestos activities take place.

Bulk testing - The collection and analysis of suspect asbestos containing materials.

Certified Industrial Hygienist (CIH) - A person certified in the comprehensive practice of industrial hygiene by the American Board of Industrial Hygiene.

Class I asbestos work - Activities involving the removal of Thermal System Insulation (TSI) and surfacing ACM and Presumed Asbestos Containing Material (PACM).

Class II asbestos work - Activities involving the removal of ACM which is not thermal system insulation or surfacing material. This includes, but is not limited to, the removal of asbestos-containing wallboard, floor tile and sheeting, roofing and siding shingles, and construction mastic.

Clean room/Changing room - An uncontaminated room having facilities for the storage of employee's street clothing and uncontaminated materials and equipment.

Clearance sample - The final air sample taken after all asbestos work has been done and visually inspected. Performed by the Contractor's Industrial Hygiene Professional/Certified Industrial Hygienist (CPIH/CIH).

Closely resemble - The major workplace conditions which have contributed to the levels of historic asbestos exposure, are no more protective than conditions of the current workplace.

Competent person - In addition to the definition in 29 CFR 1926.32(f), one who is capable of identifying existing asbestos hazards in the workplace and selecting the appropriate control strategy for asbestos exposure, who has the authority to take prompt corrective measures to eliminate them, as specified in 29 CFR 1926.32(f); in addition, for Class I and II work who is specially trained in a training course which meets the criteria of EPA's Model Accreditation Plan (40 CFR 763) for supervisor.

Contractor's Professional Industrial Hygienist (CPIH/CIH) - The asbestos abatement contractor's industrial hygienist. The industrial hygienist must meet the qualification requirements of a PIH and shall be a certified industrial hygienist (CIH).

Count - Refers to the fiber count or the average number of fibers greater than five microns in length with a length-to-width (aspect) ratio of at least 3 to 1, per cubic centimeter of air.

Crawlspace - An area which can be found either in or adjacent to the work area. This area has limited access and egress and may contain asbestos materials and/or asbestos contaminated soil.

Decontamination area/unit - An enclosed area adjacent to and connected to the regulated area and consisting of an equipment room, shower room, and clean room, which is used for the decontamination of workers, materials, and equipment that are contaminated with asbestos.

Demolition - The wrecking or taking out of any load-supporting structural member and any related razing, removing, or stripping of asbestos products.

OWNER Total – means a building or substantial part of the building is completely removed, torn or knocked down, bulldozed, flattened, or razed, including removal of building debris.

Disposal bag - Typically 6 mil thick sift-proof, dustproof, leak-tight container used to package and transport asbestos waste from regulated areas to the approved landfill. Each bag/container must be labeled/marked in accordance with EPA, OSHA and DOT requirements.

Disturbance - Activities that disrupt the matrix of ACM or PACM, crumble or pulverize ACM or PACM, or generate visible debris from ACM or PACM. Disturbance includes cutting away small amounts of ACM or PACM, no greater than the amount that can be contained in one standard sized glove bag or waste bag in order to access a building component. In no event shall the amount of ACM or PACM so disturbed exceed that which can be contained in one glove bag or disposal bag which shall not exceed 60 inches in length or width.

Drum - A rigid, impermeable container made of cardboard fiber, plastic, or metal which can be sealed in order to be sift-proof, dustproof, and leak-tight.

Employee exposure - The exposure to airborne asbestos that would occur if the employee were not wearing respiratory protection equipment.

Encapsulant - A material that surrounds or embeds asbestos fibers in an adhesive matrix and prevents the release of fibers.

Encapsulation - Treating ACM with an encapsulant.

Enclosure - The construction of an air tight, impermeable, permanent barrier around ACM to control the release of asbestos fibers from the material and also eliminate access to the material.

Equipment room - A contaminated room located within the decontamination area that is supplied with impermeable bags or containers for the disposal of contaminated protective clothing and equipment.

Fiber - A particulate form of asbestos, 5 microns or longer, with a length to width (aspect) ratio of at least 3 to 1.

Fibers per cubic centimeter (f/cc) - Abbreviation for fibers per cubic centimeter, used to describe the level of asbestos fibers in air.

Filter - Media used in respirators, vacuums, or other machines to remove particulate from air.

Firestopping - Material used to close the open parts of a structure in order to prevent a fire from spreading.

Friable asbestos containing material - Any material containing more than one (1) percent or asbestos as determined using the method specified in appendix A, Subpart F, 40 CFR 763, section 1, Polarized Light Microscopy, that, when dry, can be crumbled, pulverized, or reduced to powder by hand pressure.

Glovebag - Not more than a 60 x 60 inch impervious plastic bag-like enclosure affixed around an asbestos-containing material, with glove-like appendages through which materials and tools may be handled.

High efficiency particulate air (HEPA) filter – An ASHRAE MERV 17 filter capable of trapping and retaining at least 99.97 percent of all mono-dispersed particles of 0.3 micrometers in diameter.

HEPA Vacuum - Vacuum collection equipment equipped with a HEPA filter system capable of collecting and retaining asbestos fibers.

Homogeneous area - An area of surfacing, thermal system insulation or miscellaneous ACM that is uniform in color, texture and date of application.

HVAC - Heating, Ventilation and Air Conditioning

Industrial hygienist (IH) - A professional qualified by education, training, and experience to anticipate, recognize, evaluate and develop controls for occupational health hazards. Meets definition requirements of the American Industrial Hygiene Association (AIHA).

Industrial hygienist technician (IH Technician) - A person working under the direction of an IH or CIH who has special training, experience, certifications and licenses required for the industrial hygiene work assigned. Some states require that an industrial hygienist technician conducting

asbestos abatement clearance inspection and clearance air sampling be licensed as an asbestos project monitor.

Intact - The ACM has not crumbled, been pulverized, or otherwise deteriorated so that the asbestos is no longer likely to be bound with its matrix.

Lockdown - Applying encapsulant, after a final visual inspection, on all abated surfaces at the conclusion of ACM removal prior to removal of critical barriers.

National Emission Standards for Hazardous Air Pollutants (NESHAP) - EPA's rule to control emissions of asbestos to the environment (40 CFR part 61, Subpart M).

Negative initial exposure assessment - A demonstration by the employer which complies with the criteria in 29 CFR 1926.1101 (f)(2)(iii), that employee exposure during an operation is expected to be consistently below the PEL.

Negative pressure - Air pressure which is lower than the surrounding area, created by exhausting air from a sealed regulated area through HEPA equipped filtration units. OSHA requires maintaining -0.02" water column gauge inside the negative pressure enclosure.

Negative pressure respirator - A respirator in which the air pressure inside the facepiece is negative during inhalation relative to the air pressure outside the respirator facepiece.

Non-friable ACM - Material that contains more than 1 percent asbestos but cannot be crumbled, pulverized, or reduced to powder by hand pressure.

Organic vapor cartridge - The type of cartridge used on air purifying respirators to remove organic vapor hazardous air contaminants.

Outside air - The air outside buildings and structures, including, but not limited to, the air under a bridge or in an open ferry dock.

Owner/operator - Any person who owns, leases, operates, controls, or supervises the facility being demolished or renovated or any person who owns, leases, operates, controls, or supervises the demolition or renovation operation, or both.

Owner's Industrial Hygienist - The County's Professional Industrial Hygienist must meet the qualifications of a PIH, and may be a Certified Industrial Hygienist (CIH).

OWNER Representative - The OWNER official responsible for on-going project work.

Penetrating encapsulant - Encapsulant that is absorbed into the ACM matrix without leaving a surface layer.

Personal sampling/monitoring - Representative air samples obtained in the breathing zone for one or workers within the regulated area using a filter cassette and a calibrated air sampling pump to determine asbestos exposure.

Permissible exposure limit (PEL) - The level of exposure OSHA allows for an 8 hour time weighted average. For asbestos fibers, the eight (8) hour time weighted average PEL is 0.1 fibers per cubic centimeter (0.1 f/cc) of air and the 30-minute Excursion Limit is 1.0 fibers per cubic centimeter (1 f/cc).

Personal protective equipment (PPE) - equipment designed to protect user from injury and/or specific job hazard. Such equipment may include protective clothing, hard hats, safety glasses, and respirators.

Pipe tunnel - An area, typically located adjacent to mechanical spaces or boiler rooms in which the pipes servicing the heating system in the building are routed to allow the pipes to access heating elements. These areas may contain asbestos pipe insulation, asbestos fittings, or asbestos-contaminated soil.

Polarized light microscopy (PLM) - Light microscopy using dispersion staining techniques and refractive indices to identify and quantify the type(s) of asbestos present in a bulk sample.

Polyethylene sheeting - Strong plastic barrier material 4 to 6 mils thick, semi-transparent, flame retardant per NFPA 241.

Positive/negative fit check - A method of verifying the seal of a facepiece respirator by temporarily occluding the filters and breathing in (inhaling) and then temporarily occluding the exhalation Ownerlve and breathing out (exhaling) while checking for inward or outward leakage of the respirator respectively.

Presumed ACM (PACM) - Thermal system insulation, surfacing, and flooring material installed in buildings prior to 1981. If the building Owner has actual knowledge, or should have known through the exercise of due diligence that other materials are ACM, they too must be treated as PACM. The designation of PACM may be rebutted pursuant to 29 CFR 1926.1101 (b).

Professional IH - An IH who meets the definition requirements of AIHA; meets the definition requirements of OSHA as a "Competent Person" at 29 CFR 1926.1101 (b); has completed two specialized EPA approved courses on management and supervision of asbestos abatement projects; has formal training in respiratory protection and waste disposal; and has a minimum of four projects of similar complexity with this project of which at least three projects serving as the supervisory IH. The PIH may be either the Owner's Industrial Hygienist or Contractor's (CPIH/CIH).

Project designer - A person who has successfully completed the training requirements for an asbestos abatement project designer as required by 40 CFR 763 Appendix C, Part I; (B)(5).

Assigned protection factor - A value assigned by OSHA/NIOSH to indicate the expected protection provided by each respirator class, when the respirator is properly selected and worn correctly. The number indicates the reduction of exposure level from outside to inside the respirator facepiece.

Qualitative fit test (QLFT) - A fit test using a challenge material that can be sensed by the wearer if leakage in the respirator occurs.

Quantitative fit test (QNFT) - A fit test using a challenge material which is quantified outside and inside the respirator thus allowing the determination of the actual fit factor.

Regulated area - An area established by the employer to demarcate where Class I, II, III asbestos work is conducted, and any adjoining area where debris and waste from such asbestos work may accumulate; and a work area within which airborne concentrations of asbestos exceed, or there is a reasonable possibility they may exceed the PEL.

Regulated ACM (RACM) - Friable ACM; Category I non-friable ACM that has become friable; Category I non-friable ACM that will be or has been subjected to sanding, grinding, cutting, or abrading or; Category II non-friable ACM that has a high probability of becoming or has become crumbled, pulverized, or reduced to powder by the forces expected to act on the material in the course of the demolition or renovation operation.

Removal - All operations where ACM, PACM and/or RACM is taken out or stripped from structures or substrates, including demolition operations.

Renovation - Altering a facility or one or more facility components in any way, including the stripping or removal of asbestos from a facility component which does not involve demolition activity.

Repair - Overhauling, rebuilding, reconstructing, or reconditioning of structures or substrates, including encapsulation or other repair of ACM or PACM attached to structures or substrates.

Shower room - The portion of the PDF where personnel shower before leaving the regulated area.

Supplied air respirator (SAR) - A respiratory protection system that supplies minimum Grade D respirable air per ANSI/Compressed Gas Association Commodity Specification for Air, G-7.1-1989.

Surfacing ACM - A material containing more than 1 percent asbestos that is sprayed, troweled on or otherwise applied to surfaces for acoustical, fireproofing and other purposes.

Surfactant - A chemical added to water to decrease water's surface tension thus making it more penetrating into ACM.

Thermal system ACM - A material containing more than 1 percent asbestos applied to pipes, fittings, boilers, breeching, tanks, ducts, or other structural components to prevent heat loss or gain.

Transmission electron microscopy (TEM) - A microscopy method that can identify and count asbestos fibers.

Visible emissions - Any emissions, which are visually detectable without the aid of instruments, coming from ACM/PACM/RACM/ACS or ACM waste material.

Waste/Equipment decontamination facility (W/EDF) - The area in which equipment is decontaminated before removal from the regulated area.

Waste generator - Any Owner or operator whose act or process produces asbestos-containing waste material.

Waste shipment record - The shipping document, required to be originated and signed by the waste generator, used to track and substantiate the disposition of asbestos-containing waste material.

Wet cleaning - The process of thoroughly eliminating, by wet methods, any asbestos contamination from surfaces or objects.

1.4.3 REFERENCED STANDARDS ORGANIZATIONS

The following acronyms or abbreviations as referenced in contract/specification documents are defined to mean the associated names. Names and addresses may be subject to change.

- A. OWNER – Shelby County Government
160 N Main St.
Memphis, TN 38103

- B. AIHA American Industrial Hygiene Association
2700 Prosperity Avenue, Suite 250
Fairfax, OWNER 22031
703-849-8888

- C. ANSI American National Standards Institute
1430 Broadway
New York, NY 10018
212-354-3300

- D. ASTM American Society for Testing and Materials
1916 Race St.
Philadelphia, PA 19103
215-299-5400

- E. CFR Code of Federal Regulations
Government Printing Office
Washington, DC 20420

- F. CGA Compressed Gas Association
1235 Jefferson Davis Highway
Arlington, OWNER 22202
703-979-0900

- G. CS Commercial Standard of the National Institute of Standards and Technology (NIST)
U. S. Department of Commerce
Government Printing Office
Washington, DC 20420

- H. EPA Environmental Protection Agency
401 M St., SW
Washington, DC 20460
202-382-3949

- I. MIL-STD Military Standards/Standardization Division
Office of the Assistant Secretary of Defense
Washington, DC 20420

- J. NIST National Institute for Standards and Technology
U. S. Department of Commerce
Gaithersburg, MD 20234
301-921-1000

- K. NEC National Electrical Code (by NFPA)

- L. NEMA National Electrical Manufacturer's Association
2101 L Street, N.W.
Washington, DC 20037

- M. NFPA National Fire Protection Association
1 Batterymarch Park
P.O. Box 9101
Quincy, MA 02269-9101
800-344-3555

- N. NIOSH National Institutes for Occupational Safety and Health
4676 Columbia Parkway
Cincinnati, OH 45226
513-533-8236

- O. OSHA Occupational Safety and Health Administration
U.S. Department of Labor
Government Printing Office
Washington, DC 20402

- P. UL Underwriters Laboratory
333 Pfingsten Rd.
Northbrook, IL 60062
312-272-8800

1.5 APPLICABLE CODES AND REGULATIONS

1.5.1 GENERAL APPLICABILITY OF CODES, REGULATIONS, AND STANDARDS

- A. All work under this contract shall be done in strict accordance with all applicable Federal, State, and local regulations, standards and codes governing asbestos abatement, and any other trade work done in conjunction with the abatement. All applicable codes, regulations and standards are adopted into this specification and will have the same force and effect as this specification.
- B. The most recent edition of any relevant regulation, standard, document or code shall be in effect. Where conflict among the requirements or with these specifications exists, the most stringent requirement(s) shall be utilized.
- C. Copies of all standards, regulations, codes and other applicable documents, including this specification and those listed in Section 1.5 shall be available at the worksite in the clean change area of the worker decontamination system.

1.5.2 ASBESTOS ABATEMENT CONTRACTOR RESPONSIBILITY

The Asbestos Abatement Contractor (Contractor) shall assume full responsibility and liability for compliance with all applicable Federal, State and Local regulations related to any and all aspects of the asbestos abatement project. The Contractor is responsible for providing and maintaining training, accreditations, medical exams, medical records, personal protective equipment (PPE) including respiratory protection including respirator fit testing, as required by applicable Federal, State and Local regulations. The Contractor shall hold the OWNER, Architect, Engineer and Owner's consultants harmless for any Contractor's failure to comply with any applicable work, packaging, transporting, disposal, safety, health, or environmental requirement on the part of himself, his employees, or his subcontractors. The Contractor will incur all costs of the CPIH/CIH, including all sampling/analytical costs to assure compliance with OSHA/EPA/State requirements related to failure to comply with the regulations applicable to the work.

1.5.3 FEDERAL REQUIREMENTS

Federal requirements which govern of asbestos abatement include, but are not limited to, the following regulations.

- A. Occupational Safety and Health Administration (**OSHA**)
 - 1. Title 29 CFR 1926.1101 - Construction Standard for Asbestos
 - 2. Title 29 CFR 1910 Subpart I - Personal Protective Equipment
 - 3. Title 29 CFR 1910.134 - Respiratory Protection
 - 4. Title 29 CFR 1926 - Construction Industry Standards
 - 5. Title 29 CFR 1910.1020 - Access to Employee Exposure and Medical Records
 - 6. Title 29 CFR 1910.1200 - Hazard Communication
 - 7. Title 29 CFR 1910 Subpart K - Medical and First Aid
- B. Environmental Protection Agency (**EPA**):
 - 1. 40 CFR 61 Subpart A and M (Revised Subpart B) - National Emission Standard for Hazardous Air Pollutants - Asbestos.
 - 2. 40 CFR 763.80 - Asbestos Hazard Emergency Response Act (AHERA)
- C. Department of Transportation (**DOT**)
 - Title 49 CFR 100 - 185 – Transportation

1.5.4 STATE REQUIREMENTS

State requirements that apply to the asbestos abatement work, disposal, clearance, etc., are deferred to the Shelby County Health Department.

1.5.5 LOCAL REQUIREMENTS

If local requirements are more stringent than federal or state standards, the local standards are to be followed. A separate permit is required by the Shelby County Pollution Control section.

1.5.6 STANDARDS

- A. Standards which govern asbestos abatement activities include, but are not limited to, the following:
 - 1. American National Standards Institute (ANSI) Z9.2-79 - Fundamentals Governing the Design and Operation of Local Exhaust Systems and ANSI Z88.2 - Practices for Respiratory Protection.
 - 2. Underwriters Laboratories (UL) 586-90 - UL Standard for Safety of HEPA Filter Units, 7th Edition.
- B. Standards which govern encapsulation work include, but are not limited to the following:
 - 1. American Society for Testing and Materials (ASTM)
- C. Standards which govern the fire and safety concerns in abatement work include, but are not limited to, the following:
 - 1. National Fire Protection Association (NFPA) 241 - Standard for Safeguarding Construction, Alteration, and Demolition Operations.
 - 2. NFPA 701 - Standard Methods for Fire Tests for Flame Resistant Textiles and Film.
 - 3. NFPA 101 - Life Safety Code

1.5.7 EPA GUIDANCE DOCUMENTS

- A. EPA guidance documents which discuss asbestos abatement work activities are listed below. These documents are made part of this section by reference. EPA publications can be ordered from (800) 424-9065.
- B. Guidance for Controlling ACM in Buildings (Purple Book) EPA 560/5-85-024
- C. Asbestos Waste Management Guidance EPA 530-SW-85-007
- D. A Guide to Respiratory Protection for the Asbestos Abatement Industry EPA-560-OPTS-86-001
- E. Guide to Managing Asbestos in Place (Green Book) TS 799 20T July 1990

1.5.8 NOTICES

- A. State and Local agencies: Send written notification as required by state and local regulations including the local fire department prior to beginning any work on ACM as follows:
- B. Copies of notifications shall be submitted to the OWNER for the facility's records in the same time frame notification are given to EPA, State, and Local authorities.

1.5.9 PERMITS/LICENSES

- A. The contractor shall apply for and have all required permits and licenses to perform asbestos abatement work as required by Federal, State, and Local regulations.

1.5.10 POSTING AND FILING OF REGULATIONS

- A. Maintain two (2) copies of applicable federal, state, and local regulations. Post one copy of each in the clean room at the regulated area where workers will have daily access to the regulations and keep another copy in the Contractor's office.

1.5.11 OWNER RESPONSIBILITIES

Prior to commencement of work:

- A. Notify occupants adjacent to regulated areas of project dates and requirements for relocation, if needed. Arrangements must be made prior to starting work for relocation of desks, files, equipment and personal possessions to avoid unauthorized access into the regulated area. **Note: Notification of adjacent personnel is required by OSHA in 29 CFR 1926.1101 (k) to prevent unnecessary or unauthorized access to the regulated area.**
- B. Obtain from the Contractor results of background air sampling; including location of samples, person who collected the samples, equipment utilized, calibration data and method of analysis. During abatement, collect from the Contractor, results of bulk material analysis and air sampling data collected during the course of the abatement. This information shall be kept in a duplicate filing system by the Contractor and shall not release the Contractor from any responsibility for additional OSHA compliance.

1.5.12 EMERGENCY ACTION PLAN AND ARRANGEMENTS

- A. An Emergency Action Plan shall be developed by the Contractor prior to commencing abatement activities and shall be agreed to by the Contractor and the OWNER. The Plan shall meet the requirements of 29 CFR 1910.38 (a);(b). Make revisions as required by the Owner before submitting a final plan.
- B. Emergency procedures shall be in written form and prominently posted in the clean room and equipment room of the decontamination unit. Everyone, prior to entering the regulated area, must read and sign these procedures to acknowledge understanding of the regulated area layout, location of emergency exits and emergency procedures.
- C. Emergency planning shall include written notification of police, fire, and emergency medical personnel of planned abatement activities; work schedule; layout of regulated area; and access to the regulated area, particularly barriers that may affect response capabilities.
- D. Emergency planning shall include consideration of fire, explosion, hazardous atmospheres, electrical hazards, slips/trips and falls, confined spaces, and heat stress illness. Written procedures for response to emergency situations shall be developed and employee training in procedures shall be provided.
- E. Employees shall be trained in regulated area/site evacuation procedures in the event of workplace emergencies.
 - 1. For non life-threatening situations - employees injured or otherwise incapacitated shall decontaminate following normal procedures with assistance from fellow workers, if necessary, before exiting the regulated area to obtain proper medical treatment.

2. For life-threatening injury or illness, worker decontamination shall take least priority after measures to stabilize the injured worker, remove them from the regulated area, and secure proper medical treatment.
- F. Telephone numbers of any/all emergency response personnel shall be prominently posted in the clean room, along with the location of the nearest telephone.
- G. The Contractor shall provide verification of first aid/CPR training for personnel responsible for providing first aid/CPR. OSHA requires medical assistance within 3-4 minutes of a life-threatening injury/illness. Bloodborne Pathogen training shall also be verified for those personnel required to provide first aid/CPR.
- H. The Emergency Action Plan shall provide for a Contingency Plan in the event that an incident occurs that may require the modification of the standard operating procedures during abatement. Such incidents include, but are not limited to, fire; accident; power failure; negative pressure failure; and supplied air system failure. The Contractor shall detail procedures to be followed in the event of an incident assuring that asbestos abatement work is stopped and wetting is continued until correction of the problem.

1.5.13 PRE-CONSTRUCTION MEETING

Prior to commencing the work, the Contractor shall meet with the Owner's Certified Industrial Hygienist (CIH) to present and review, as appropriate, the items following this paragraph. The Contractor's Competent Person(s) who will be on-site shall participate in the pre-start meeting. The pre-start meeting is to discuss and determine procedures to be used during the project. At this meeting, the Contractor shall provide:

- A. Proof of Contractor licensing and evidence that all local permits are in place.
- B. Proof the Competent Person(s) is trained and accredited and approved for working in this State. Verification of the experience of the Competent Person(s) shall also be presented.
- C. A list of all workers who will participate in the project, including experience and verification of training and accreditation.
- D. A list of and verification of training for all personnel who have current first-aid/CPR training. A minimum of one person per shift must have adequate training.
- E. Current medical written opinions for all personnel working on-site meeting the requirements of 29 CFR 1926.1101 (m).
- F. Current fit-tests for all personnel wearing respirators on-site meeting the requirements of 29 CFR 1926.1101 (h) and Appendix C.
- G. A copy of the Contractor's Asbestos Hazard Abatement Plan. In these procedures, the following information must be detailed, specific for this project.
 1. Regulated area preparation procedures;
 2. Notification requirements procedure of Contractor as required in 29 CFR 1926.1101 (d);
 3. Decontamination area set-up/layout and decontamination procedures for employees;
 4. Abatement methods/procedures and equipment to be used;
 5. Personal protective equipment to be used;
- H. At this meeting the Contractor shall provide all submittals as required.
- I. Procedures for handling, packaging and disposal of asbestos waste.
- J. Emergency Action Plan and Contingency Plan Procedures.

1.6 PROJECT COORDINATION

The following are the minimum administrative and supervisory personnel necessary for coordination of the work.

1.6.1 PERSONNEL

- A. Administrative and supervisory personnel shall consist of a qualified Competent Person(s) as defined by OSHA in the Construction Standards and the Asbestos Construction Standard; Contractor Professional Industrial Hygienist and Industrial Hygiene Technicians. These

employees are the Contractor's representatives responsible for compliance with these specifications and all other applicable requirements.

- B. Non-supervisory personnel shall consist of an adequate number of qualified personnel to meet the schedule requirements of the project. Personnel shall meet required qualifications. Personnel utilized on-site shall be pre-approved by the OWNER representative. A request for approval shall be submitted for any person to be employed during the project giving the person's name; social security number; qualifications; accreditation card with color picture; Certificate of Worker's Acknowledgment; and Affidavit of Medical Surveillance and Respiratory Protection and current Respirator Fit Test.
- C. Minimum qualifications for Contractor and assigned personnel are:
1. The Contractor has conducted within the last three (3) years, three (3) projects of similar complexity and dollar value as this project; has not been cited and penalized for serious violations of federal or state EPA, TOSHA or OSHA asbestos regulations in the past three (3) years; has adequate liability/occurrence insurance for asbestos work as required by the state; is licensed in applicable states; has adequate and qualified personnel available to complete the work; has comprehensive standard operating procedures for asbestos work; has adequate materials, equipment and supplies to perform the work.
 2. The Competent Person has four (4) years of abatement experience of which two (2) years were as the Competent Person on the project; meets the OSHA definition of a Competent Person; has been the Competent Person on two (2) projects of similar size and complexity as this project within the past three (3) years; has completed EPA AHERA/OSHA/State/Local training requirements/accreditation(s) and refreshers; and has all required OSHA documentation related to medical and respiratory protection.
 3. The Contractor Professional Industrial Hygienist/CIH (CPIH/CIH) shall have five (5) years of monitoring experience and supervision of asbestos abatement projects; has participated as senior IH on five (5) abatement projects, three (3) of which are similar in size and complexity as this project; has developed at least one complete standard operating procedure for asbestos abatement; has trained abatement personnel for three (3) years; has specialized EPA AHERA/OSHA training in asbestos abatement management, respiratory protection, waste disposal and asbestos inspection; has completed the NIOSH 582 Course or equivalent, Contractor/Supervisor course; and has appropriate medical/respiratory protection records/documentation.
 4. The Abatement Personnel shall have completed the EPA AHERA/OSHA abatement worker course; have training on the standard operating procedures of the Contractor; has one year of asbestos abatement experience within the past three (3) years of similar size and complexity; has applicable medical and respiratory protection documentation; has certificate of training/current refresher and State accreditation/license.

All personnel should be in compliance with OSHA construction safety training as applicable and submit certification.

1.7 RESPIRATORY PROTECTION

1.7.1 GENERAL - RESPIRATORY PROTECTION PROGRAM

The Contractor shall develop and implement a written Respiratory Protection Program (RPP) which is in compliance with the January 8, 1998 OSHA requirements found at 29 CFR 1926.1101 and 29 CFR 1910.Subpart I;134. ANSI Standard Z88.2-1992 provides excellent guidance for developing a respiratory protection program. All respirators used must be NIOSH approved for asbestos abatement activities. The written RPP shall, at a minimum, contain the basic requirements found at 29 CFR 1910.134 (c)(1)(i - ix) - Respiratory Protection Program.

1.7.2 RESPIRATORY PROTECTION PROGRAM COORDINATOR

The Respiratory Protection Program Coordinator (RPPC) must be identified and shall have two (2) years experience coordinating RPP of similar size and complexity. The RPPC must submit a signed statement attesting to the fact that the program meets the above requirements.

1.7.3 SELECTION AND USE OF RESPIRATORS

The procedure for the selection and use of respirators must be submitted to the OWNER as part of the Contractor's qualifications. The procedure must be written clearly enough for workers to understand. A copy of the Respiratory Protection Program must be available in the clean room of the decontamination unit for reference by employees or authorized visitors.

1.7.4 MINIMUM RESPIRATORY PROTECTION

Minimum respiratory protection shall be a full face powered air purifying respirator when fiber levels are maintained consistently at or below 0.5 f/cc. A higher level of respiratory protection may be provided or required, depending on fiber levels. Respirator selection shall meet the requirements of 29 CFR 1926.1101 (h); Table 1, except as indicated in this paragraph. Abatement personnel must have a respirator for their exclusive use.

1.7.5 MEDICAL WRITTEN OPINION

No employee shall be allowed to wear a respirator unless a physician or other licensed health care professional has provided a written determination they are medically qualified to wear the class of respirator to be used on the project while wearing whole body impermeable garments and subjected to heat or cold stress.

1.7.6 RESPIRATOR FIT TEST

All personnel wearing respirators shall have a current qualitative/quantitative fit test which was conducted in accordance with 29 CFR 1910.134 (f) and Appendix A. Quantitative fit tests shall be done for PAPRs which have been put into a motor/blower failure mode.

1.7.7 RESPIRATOR FIT CHECK

The Competent Person shall assure that the positive/negative pressure user seal check is done each time the respirator is donned by an employee. Head coverings must cover respirator head straps. Any situation that prevents an effective facepiece to face seal as evidenced by failure of a user seal check shall preclude that person from wearing a respirator inside the regulated area until resolution of the problem.

1.7.8 MAINTENANCE AND CARE OF RESPIRATORS

The Respiratory Protection Program Coordinator shall submit evidence and documentation showing compliance with 29 CFR 1910.134 (h) Maintenance and Care of Respirators.

1.8 WORKER PROTECTION

1.8.1 TRAINING OF ABATEMENT PERSONNEL

Prior to beginning any abatement activity, all personnel shall be trained in accordance with OSHA 29 CFR 1926.1101 (k)(9) and any additional State/Local requirements. Training must include, at a minimum, the elements listed at 29 CFR 1926.1101 (k)(9)(viii). Training shall have been conducted by a third party, EPA/State approved trainer meeting the requirements of EPA 40 CFR 763 Appendix C (AHERA MAP). Initial training certificates and current refresher and accreditation proof must be submitted for each person working at the site.

1.8.2 MEDICAL EXAMINATIONS

Medical examinations meeting the requirements of 29 CFR 1926.1101 (m) shall be provided for all personnel working in the regulated area, regardless of exposure levels. A current physician's written opinion as required by 29 CFR 1926.1101 (m)(4) shall be provided for each person and shall include in the medical opinion the person has been evaluated for working in a heat and

cold stress environment while wearing personal protective equipment (PPE) and is able to perform the work without risk of material health impairment.

1.8.3 REGULATED AREA ENTRY PROCEDURE

The Competent Person shall ensure that each time workers enter the regulated area; they remove ALL street clothes in the clean room of the decontamination unit and put on new disposable coveralls, head coverings, a clean respirator, and then proceed through the shower room to the equipment room where they put on non-disposable required personal protective equipment.

1.8.4 DECONTAMINATION PROCEDURE

The Competent Person shall require all personnel to adhere to following decontamination procedures whenever they leave the regulated area.

- A. When exiting the regulated area, remove disposable coveralls, and ALL other clothes, disposable head coverings, and foot coverings or boots in the equipment room.
- B. Still wearing the respirator and completely naked, proceed to the shower. Showering is MANDATORY. Care must be taken to follow reasonable procedures in removing the respirator to avoid inhaling asbestos fibers while showering. The following procedure is required as a minimum:
 1. Thoroughly wet body including hair and face. If using a PAPR hold blower above head to keep filters dry.
 2. With respirator still in place, thoroughly decontaminate body, hair, respirator face piece, and all other parts of the respirator except the blower and battery pack on a PAPR. Pay particular attention to cleaning the seal between the face and respirator facepiece and under the respirator straps.
 3. Take a deep breath, hold it and/or exhale slowly, completely wetting hair, face, and respirator. While still holding breath, remove the respirator and hold it away from the face before starting to breathe.
- C. Carefully decontaminate the facepiece of the respirator inside and out. If using a PAPR, shut down using the following sequence: a) first cap inlets to filters; b) turn blower off to keep debris collected on the inlet side of the filter from dislodging and contaminating the outside of the unit; c) thoroughly decontaminate blower and hoses; d) carefully decontaminate battery pack with a wet rag being cautious of getting water in the battery pack thus preventing destruction.
- D. Shower and wash body completely with soap and water. Rinse thoroughly.
- E. Rinse shower room walls and floor to drain prior to exiting.
- F. Proceed from shower to clean room; dry off and change into street clothes or into new disposable work clothing.

1.8.5 REGULATED AREA REQUIREMENTS

The Competent Person shall meet all requirements of 29 CFR 1926.1101 (o) and assure that all requirements for regulated areas at 29 CFR 1926.1101 (e) are met. All personnel in the regulated area shall not be allowed to eat, drink, smoke, chew tobacco or gum, apply cosmetics, or in any way interfere with the fit of their respirator.

1.9 DECONTAMINATION FACILITIES

1.9.1 DESCRIPTION

Provide each regulated area with separate personnel decontamination facilities (PDF) and waste/equipment decontamination facilities (W/EDF). Ensure that the PDF are the only means of ingress and egress to the regulated area and that all equipment, bagged waste, and other material exit the regulated area only through the W/EDF.

1.9.2 GENERAL REQUIREMENTS

All personnel entering or exiting a regulated area must go through the PDF and shall follow the requirements at 29 CFR 1926.1101 (j)(1) and these specifications. All waste, equipment and contaminated materials must exit the regulated area through the W/EDF and be decontaminated in accordance with these specifications. Walls and ceilings of the PDF and W/EDF must be constructed of a minimum of 3 layers of 6 mil opaque fire retardant polyethylene sheeting and be securely attached to existing building components and/or an adequate temporary framework. A minimum of 3 layers of 6 mil poly shall also be used to cover the floor under the PDF and W/EDF units. Construct doors so that they overlap and secure to adjacent surfaces. Weight inner doorway sheets with layers of duct tape so that they close quickly after release. Put arrows on sheets so they show direction of travel and overlap. If the building adjacent area is occupied, construct a solid barrier on the occupied side(s) to protect the sheeting and reduce potential for non-authorized personnel entering the regulated area.

1.9.3 TEMPORARY FACILITIES TO THE PDF AND W/EDF

The Competent Person shall provide temporary water service connections to the PDF and W/EDF. Backflow prevention must be provided at the point of connection to the OWNER system. Water supply must be of adequate pressure and meet requirements of 29 CFR 1910.141(d)(3). Provide adequate temporary overhead electric power with ground fault circuit interruption (GFCI) protection. Provide a sub-panel equipped with GFCI protection for all temporary power in the clean room. Provide adequate lighting to provide a minimum of 50 foot candles in the PDF and W/EDF. Provide temporary heat, if needed, to maintain 70°F throughout the PDF and W/EDF.

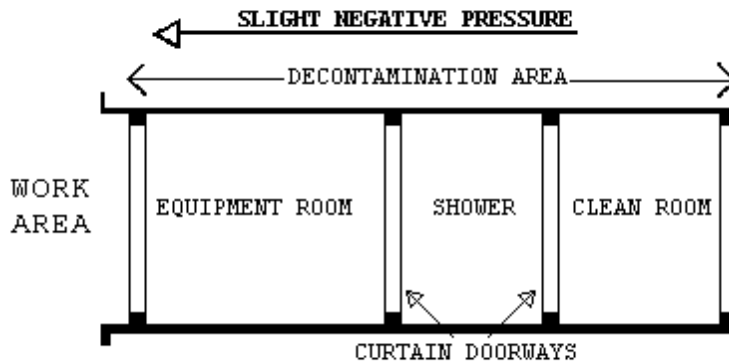
1.9.4 PERSONNEL DECONTAMINATION FACILITY (PDF)

The Competent Person shall provide a PDF consisting of shower room which is contiguous to a clean room and equipment room which is connected to the regulated area. The PDF must be sized to accommodate the number of personnel scheduled for the project. The shower room, located in the center of the PDF, shall be fitted with as many portable showers as necessary to insure all employees can complete the entire decontamination procedure within 15 minutes. The PDF shall be constructed of opaque poly for privacy. The PDF shall be constructed to eliminate any parallel routes of egress without showering.

1. Clean Room: The clean room must be physically and visually separated from the rest of the building to protect the privacy of personnel changing clothes. The clean room shall be constructed of at least 3 layers of 6 mil opaque fire retardant poly to provide an air tight room. Provide a minimum of 2 - 900 mm (3 foot) wide 6 mil poly opaque fire retardant doorways. One doorway shall be the entry from outside the PDF and the second doorway shall be to the shower room of the PDF. The floor of the clean room shall be maintained in a clean, dry condition. Shower overflow shall not be allowed into the clean room. Provide 1 storage locker per person. A portable fire extinguisher, minimum 10 pounds capacity, Type ABC, shall be provided in accordance with OSHA and NFPA Standard 10. All persons entering the regulated area shall remove all street clothing in the clean room and dress in disposable protective clothing and respiratory protection. Any person entering the clean room does so either from the outside with street clothing on or is coming from the shower room completely naked and thoroughly washed. Females required to enter the regulated area shall be ensured of their privacy throughout the entry/exit process by posting guards at both entry points to the PDF so no male can enter or exit the PDF during her stay in the PDF.
2. Shower Room: The Competent Person shall assure that the shower room is a completely water tight compartment to be used for the movement of all personnel from the clean room to the equipment room and for the showering of all personnel going from the equipment room to the clean room. Each shower shall be constructed so water runs down the walls of the shower and into a drip pan. Install a freely draining smooth floor on top of the shower pan. The shower room shall be separated from the rest of the building and from the clean room and equipment room using air tight walls made from at least 3 layers of 6 mil opaque fire retardant poly. The shower shall be equipped with a shower head and controls, hot and cold

water, drainage, soap dish and continuous supply of soap, and shall be maintained in a sanitary condition throughout its use. The controls shall be arranged so an individual can shower without assistance. Provide a flexible hose shower head, hose bibs and all other items shown on Shower Schematic. Waste water will be pumped to a drain after being filtered through a minimum of a 100 micron sock in the shower drain; a 20 micron filter; and a final 5 micron filter. Filters will be changed a minimum of daily or more often as needed. Filter changes must be done in the shower to prevent loss of contaminated water. Hose down all shower surfaces after each shift and clean any debris from the shower pan. Residue is to be disposed of as asbestos waste.

3. Equipment Room: The Competent Person shall provide an equipment room which shall be an air tight compartment for the storage of work equipment/tools, reusable personal protective equipment, except for a respirator and for use as a gross decontamination area for personnel exiting the regulated area. The equipment room shall be separated from the regulated area by a minimum 3 foot wide door made with 2 layers of 6 mil opaque fire retardant poly. The equipment room shall be separated from the regulated area, the shower room and the rest of the building by air tight walls and ceiling constructed of a minimum of 3 layers of 6 mil opaque fire retardant poly. Damp wipe all surfaces of the equipment room after each shift change. Provide an additional loose layer of 6 mil fire retardant poly per shift change and remove this layer after each shift. If needed, provide a temporary electrical sub-panel equipped with GFCI in the equipment room to accommodate any equipment required in the regulated area.
4. The PDF shall be as follows: Clean room at the entrance followed by a shower room followed by an equipment room leading to the regulated area. Each doorway in the PDF shall be a minimum of 2 layers of 6 mil opaque fire retardant poly.

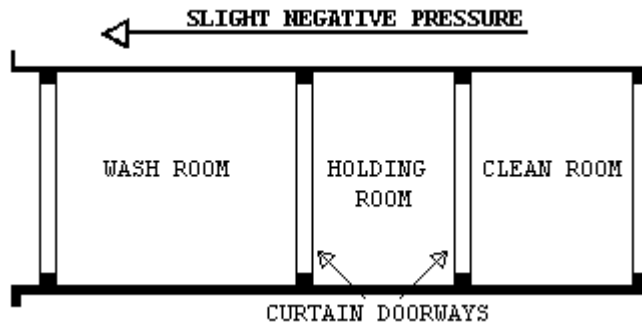


1.9.5 WASTE/EQUIPMENT DECONTAMINATION FACILITY (W/EDF)

The Competent Person shall provide an W/EDF consisting of a wash room, holding room, and clean room for removal of waste, equipment and contaminated material from the regulated area. Personnel shall not enter or exit the W/EDF except in the event of an emergency. Clean debris and residue in the W/EDF daily. All surfaces in the W/EDF shall be wiped/hosed down after each shift and all debris shall be cleaned from the shower pan. The W/EDF shall consist of the following:

1. Wash Down Station: Provide an enclosed shower unit in the regulated area just outside the Wash Room as an equipment bag and container cleaning station.
2. Wash Room: Provide a wash room for cleaning of bagged or containerized asbestos containing waste materials passed from the regulated area. Construct the wash room using 50 x 100 mm (2" x 4") wood framing and 3 layers of 6 mil fire retardant poly. Locate the wash room so that packaged materials, after being wiped clean, can be passed to the Holding Room. Doorways in the wash room shall be constructed of 2 layers of 6 mil fire retardant poly.

3. Holding Room: Provide a holding room as a drop location for bagged materials passed from the wash room. Construct the holding room using 50 x 100 mm (2" x 4") wood framing and 3 layers of 6 mil fire retardant poly. The holding room shall be located so that bagged material cannot be passed from the wash room to the clean room unless it goes through the holding room. Doorways in the holding room shall be constructed of 2 layers of 6 mil fire retardant poly.
4. Clean Room: Provide a clean room to isolate the holding room from the exterior of the regulated area. Construct the clean room using 2 x 4 wood framing and 2 layers of 6 mil fire retardant poly. The clean room shall be located so as to provide access to the holding room from the building exterior. Doorways to the clean room shall be constructed of 2 layers of 6 mil fire retardant poly. When a negative pressure differential system is used, a rigid enclosure separation between the W/EDF clean room and the adjacent areas shall be provided.
5. The W/EDF shall be as follows: Wash Room leading to a Holding Room followed by a Clean Room leading to outside the regulated area. See diagram.



1.9.6 WASTE/EQUIPMENT DECONTAMINATION PROCEDURES

At the washdown station in the regulated area, thoroughly wet clean contaminated equipment and/or sealed polyethylene bags and pass into Wash Room after visual inspection. When passing anything into the Wash Room, close all doorways of the W/EDF, other than the doorway between the washdown station and the Wash Room. Keep all outside personnel clear of the W/EDF. Once inside the Wash Room, wet clean the equipment and/or bags. After cleaning and inspection, pass items into the Holding Room. Close all doorways except the doorway between the Holding Room and the Clean Room. Workers from the Clean Room/Exterior shall enter the Holding Room and remove the decontaminated/cleaned equipment/bags for removal and disposal. These personnel will not be required to wear PPE. At no time shall personnel from the clean side be allowed to enter the Wash Room.

PART 2 - PRODUCTS, MATERIALS AND EQUIPMENT

2.1 MATERIALS AND EQUIPMENT

2.1.1 GENERAL REQUIREMENTS

Prior to the start of work, the contractor shall provide and maintain a sufficient quantity of materials and equipment to assure continuous and efficient work throughout the duration of the project. Work shall not start unless the following items have been delivered to the site and the CPIH/CIH has submitted verification to the OWNER's representative.

- A. All materials shall be delivered in their original package, container or bundle bearing the name of the manufacturer and the brand name (where applicable).
- B. Store all materials subject to damage off the ground, away from wet or damp surfaces and under cover sufficient enough to prevent damage or contamination. Flammable and combustible materials cannot be stored inside buildings. Replacement materials shall be stored outside of the regulated area until abatement is completed.

- C. The Contractor shall not block or hinder use of buildings by patients, staff, and visitors to the OWNER in partially occupied buildings by placing materials/equipment in any unauthorized location.
- D. The Competent Person shall inspect for damaged, deteriorating or previously used materials. Such materials shall not be used and shall be removed from the worksite and disposed of properly.
- E. Polyethylene sheeting for walls in the regulated area shall be a minimum of 4-mils. For floors and all other uses, sheeting of at least 6-mil shall be used in widths selected to minimize the frequency of joints. Fire retardant poly shall be used throughout.
- F. The method of attaching polyethylene sheeting shall be agreed upon in advance by the Contractor and the OWNER and selected to minimize damage to equipment and surfaces. Method of attachment may include any combination of moisture resistant duct tape furring strips, spray glue, staples, nails, screws, lumber and plywood for enclosures or other effective procedures capable of sealing polyethylene to dissimilar finished or unfinished surfaces under both wet and dry conditions.
- G. Polyethylene sheeting utilized for the PDF shall be opaque white or black in color, 6 mil fire retardant poly.
- H. Installation and plumbing hardware, showers, hoses, drain pans, sump pumps and waste water filtration system shall be provided by the Contractor.
- I. An adequate number of HEPA Vacuums, scrapers, sprayers, nylon brushes, brooms, disposable mops, rags, sponges, staple guns, shovels, ladders and scaffolding of suitable height and length as well as meeting OSHA requirements, fall protection devices, water hose to reach all areas in the regulated area, airless spray equipment, and any other tools, materials or equipment required to conduct the abatement project. All electrically operated hand tools, equipment, electric cords shall be connected to GFCI protection.
- J. Special protection for objects in the regulated area shall be detailed (e.g., plywood over carpeting or hardwood floors to prevent damage from scaffolds, water and falling material).
- K. Disposal bags – 2 layers of 6 mil poly for asbestos waste shall be pre-printed with labels, markings and address as required by OSHA, EPA and DOT regulations.
- L. The OWNER shall be provided an advance copy of the MSDS as required for all hazardous chemicals under OSHA 29 CFR 1910.1200 - Hazard Communication in the pre-start meeting submittal. Chlorinated compounds shall not be used with any spray adhesive, mastic remover or other product. Appropriate encapsulant(s) shall be provided.
- M. OSHA DANGER demarcation signs, as many and as required by OSHA 29 CFR 1926.1101(k)(7) shall be provided and placed by the Competent Person. All other posters and notices required by Federal and State regulations shall be posted in the Clean Room.
- N. Adequate and appropriate PPE for the project and number of personnel/shifts shall be provided. All personal protective equipment issued must be based on a written hazard assessment conducted under 29 CFR 1910.132(d).

2.2 MONITORING, INSPECTION AND TESTING

2.2.1 GENERAL

- A. Perform throughout abatement work monitoring, inspection and testing inside and around the regulated area in accordance with the OSHA requirements and these specifications. OSHA requires that the employee exposure to asbestos must not exceed 0.1 fiber per cubic centimeter (f/cc) of air, averaged over an 8-hour work shift. The CPIH/CIH is responsible for and shall inspect and oversee the performance of the Contractor IH Technician. The IH Technician shall continuously inspect and monitor conditions inside the regulated area to ensure compliance with these specifications. In addition, the CPIH/CIH shall personally manage air sample collection, analysis, and evaluation for personnel, regulated area, and adjacent area samples to satisfy OSHA requirements. Additional inspection and testing requirements are also indicated in other parts of this specification.
- B. The Contractor provide the services of a professional industrial hygienist (CPIH/CIH) to perform various services on behalf of the OWNER. The CPIH/CIH will perform the necessary monitoring, inspection, testing, and other support services to ensure that OWNER's employees, and visitors

as well as Contractor's employees working outside of the regulated areas will not be adversely affected by the abatement work, and that the abatement work proceeds in accordance with these specifications, that the abated areas or abated buildings have been successfully decontaminated. The work of the CPIH/CIH in no way relieves the Contractor from their responsibility to perform the work in accordance with contract/specification requirements, to perform continuous inspection, monitoring and testing for the safety of their employees, and to perform other such services as specified. The cost of the CPIH/CIH and their services will be borne by the Contractor.

- C. If fibers counted by the CPIH/CIH during abatement work, either inside or outside the regulated area, utilizing the NIOSH 7400 air monitoring method, exceed the specified respective limits, the Contractor shall stop work. The Contractor shall immediately confirm the results by analysis of the samples by TEM. Confirmation sampling and analysis will be the responsibility of the CPIH. The Owner may bring in an independent CIH at any time to review the work of the Contractor. An agreement between the CPIH/CIH and the Owner's independent consultant shall be reached on the exact details of the monitoring and confirmation effort, including such things as the number of samples, location, collection, quality control on-site, analytical laboratory, interpretation of results and any follow-up actions. This written agreement shall be co-signed by the CIH's and delivered to the OWNER's representative.

2.2.2 SCOPE OF SERVICES OF THE CPIH/CIH

- A. The purpose of the work of the CPIH/CIH is to: assure quality; adherence to the specification; resolve problems; prevent the spread of contamination beyond the regulated area; and assure clearance at the end of the project. In addition, their work includes performing the final inspection and testing to determine whether the regulated area or building has been adequately decontaminated. All air monitoring is to be done utilizing PCM/TEM. The CPIH/CIH will perform the following tasks:
 - 1. Task 1: Establish background levels before abatement begins by collecting background samples. Retain samples for possible TEM analysis.
 - 2. Task 2: Perform continuous air monitoring, inspection, and testing outside the regulated area during actual abatement work to detect any faults in the regulated area isolation and any adverse impact on the surroundings from regulated area activities.
 - 3. Task 3: Perform unannounced visits to spot check overall compliance of work with contract/specifications. These visits may include any inspection, monitoring, and testing inside and outside the regulated area and all aspects of the operation except personnel monitoring.
 - 4. Task 4: Provide support to the OWNER representative such as evaluation of submittals from the Contractor, resolution of conflicts, interpret data, etc.
 - 5. Task 5: Perform, in the presence of the OWNER representative, final inspection and testing of a decontaminated regulated area at the conclusion of the abatement to certify compliance with all regulations and OWNER requirements/specifications.
 - 6. Task 6: Issue certificate of decontamination for each regulated area and project report.
- B. All documentation, inspection results and testing results generated by the CPIH/CIH will be available to the Owner's independent CIH for information and consideration. The Contractor shall cooperate with and support the CPIH/CIH for efficient and smooth performance of their work.
- C. The monitoring and inspection results of the CPIH/CIH will be used by the OWNER to issue any Stop Removal orders to the Contractor during abatement work and to accept or reject a regulated area or building as decontaminated.

2.2.3 MONITORING, INSPECTION AND TESTING BY CONTRACTOR

The Contractor's CPIH/CIH is responsible for managing all monitoring, inspections, and testing required by these specifications, as well as any and all regulatory requirements adopted by these specifications. The CPIH/CIH is responsible for the continuous monitoring of all subsystems and procedures which could affect the health and safety of any workers, employees or visitors to the project. Safety and health conditions and the provision of those conditions inside the regulated area for all persons entering the regulated area is the exclusive responsibility of the

Contractor/Competent Person. The person performing the personnel and area air monitoring inside the regulated area shall be an IH Technician, who shall be trained and shall have specialized field experience in sampling and analysis. The IH Technician shall have successfully completed a NIOSH 582 Course or equivalent and provide documentation. The IH Technician shall participate in the AIHA Asbestos Analysis Registry or participate in the Proficiency Analytic Testing program of AIHA for fiber counting quality control assurance. The IH Technician shall also be an accredited EPA AHERA Supervisor or Abatement Worker and Building Inspector. The IH Technician shall have participated in five abatement projects collecting personal and area samples as well as responsibility for documentation on substantially similar projects in size and scope. The analytic laboratory used by the Contractor to analyze the samples shall be AIHA accredited for asbestos PAT and approved by the OWNER prior to start of the project. A daily log shall be maintained by the CPIH/CIH or IH Technician, documenting all OSHA requirements for air personal monitoring for asbestos in 29 CFR 1926.1101(f), (g) and Appendix A. This log shall be made available to the OWNER representative and the CPIH/CIH upon request. The log will contain, at a minimum, information on personnel or area samples, other persons represented by the sample, the date of sample collection, start and stop times for sampling, sample volume, flow rate, and fibers/cc. The CPIH/CIH shall collect and analyze samples for each representative job being done in the regulated area, i.e., removal, wetting, clean-up, and load-out. No fewer than two personal samples per shift shall be collected and one area sample per 1,000 square feet of regulated area where abatement is taking place and one sample per shift in the clean room area shall be collected. In addition to the continuous monitoring required, the CPIH/CIH will perform inspection and testing at the final stages of abatement for each regulated area as specified in the CPIH/CIH responsibilities. Additionally, the CPIH/CIH will monitor and record pressure readings within the containment daily with a minimum of two readings at the beginning and at the end of a shift, and submit the data in the daily report.

2.3 ASBESTOS HAZARD ABATEMENT PLAN

The Contractor shall have established an Asbestos Hazard Abatement Plan (AHAP) in printed form and loose leaf folder consisting of simplified text, diagrams, sketches, and pictures that establish and explain clearly the procedures to be followed during all phases of the work by the Contractor's personnel. The AHAP must be modified as needed to address specific requirements of this project and the specifications. The AHAP shall be submitted for review and approval to the OWNER prior to the start of any abatement work. The minimum topics and areas to be covered by the AHAPs are:

- A. Minimum Personnel Qualifications
- B. Emergency Action Plan/Contingency Plans and Arrangements
- C. Security and Safety Procedures
- D. Respiratory Protection/Personal Protective Equipment Program and Training
- E. Medical Surveillance Program and Recordkeeping
- F. Regulated Area Requirements - Containment Barriers/Isolation of Regulated Area
- G. Decontamination Facilities and Entry/Exit Procedures (PDF and W/EDF)
- H. Negative Pressure Systems Requirements
- I. Monitoring, Inspections, and Testing
- J. Removal Procedures for ACM
- K. Removal of Contaminated Soil (if applicable)
- L. Encapsulation Procedures for ACM
- M. Disposal of ACM waste/equipment
- N. Regulated Area Decontamination/Clean-up
- O. Regulated Area Visual and Air Clearance
- P. Project Completion/Closeout

2.4 SUBMITTALS

2.4.1 PRE-START MEETING SUBMITTALS

Submit to the OWNER a minimum of 14 days prior to the pre-start meeting the following for review and approval. Meeting this requirement is a prerequisite for the pre-start meeting for this project:

- A. Submit a detailed work schedule for the entire project reflecting contract documents and the phasing/schedule requirements from the CPM chart.
- B. Submit a staff organization chart showing all personnel who will be working on the project and their capacity/function. Provide their qualifications, training, accreditations, and licenses, as appropriate. Provide a copy of the "Certificate of Worker's Acknowledgment" and the "Affidavit of Medical Surveillance and Respiratory Protection" for each person.
- C. Submit Asbestos Hazard Abatement Plan developed specifically for this project, incorporating the requirements of the specifications, prepared, signed and dated by the CPIH/CIH.
- D. Submit the specifics of the materials and equipment to be used for this project with manufacturer names, model numbers, performance characteristics, pictures/diagrams, and number available for the following:
 1. Supplied air system, negative air machines, HEPA Vacuums, air monitoring pumps, calibration devices, pressure differential monitoring device and emergency power generating system.
 2. Waste water filtration system, shower system, containment barriers.
 3. Encapsulants, surfactants, hand held sprayers, airless sprayers, glovebags, and fire extinguishers.
 4. Respirators, protective clothing, personal protective equipment.
 5. Fire safety equipment to be used in the regulated area.
- E. Submit the name, location, and phone number of the approved landfill; proof/verification the landfill is approved for ACM disposal; the landfill's requirements for ACM waste; the type of vehicle to be used for transportation; and name, address, and phone number of subcontractor, if used. Proof of asbestos training for transportation personnel shall be provided.
- F. Submit required notifications and arrangements made with regulatory agencies having regulatory jurisdiction and the specific contingency/emergency arrangements made with local health, fire, ambulance, hospital authorities and any other notifications/arrangements.
- G. Submit the name, location and verification of the laboratory and/or personnel to be used for analysis of air and/or bulk samples. Personal air monitoring must be done in accordance with OSHA 29 CFR 1926.1101(f) and Appendix A. Area or clearance air monitoring shall be conducted in accordance with EPA AHERA protocols.
- H. Submit qualifications verification: Submit the following evidence of qualifications. Make sure that all references are current and verifiable by providing current phone numbers and documentation.
 1. Asbestos Abatement Company: Project experience within the past 3 years; listing projects first most similar to this project: Project Name; Type of Abatement; Duration; Cost; Reference Name/Phone Number; Final Clearance; Completion Date
 2. List of project(s) halted by Owner, A/E, IH, regulatory agency in the last 3 years: Project Name; Reason; Date; Reference Name/Number; Resolution
 3. List asbestos regulatory citations (e.g., OSHA), notices of violations (e.g., Federal and state EPA), penalties, and legal actions taken against the company including and of the company's officers (including damages paid) in the last 3 years. Provide copies and all information needed for verification.
- I. Submit information on personnel: Provide a resume; address each item completely; copies of certificates, accreditations, and licenses. Submit an affidavit signed by the CPIH/CIH stating that all personnel submitted below have medical records in accordance with OSHA 29 CFR 1926.1101(m) and 29 CFR 1910.20 and that the company has implemented a medical surveillance program and written respiratory protection program, and maintains recordkeeping in accordance with the above regulations. Submit the phone number and doctor/clinic/hospital used for medical evaluations.
 1. CPIH/CIH and IH Technician: Name; years of abatement experience; list of projects similar to this one; certificates, licenses, accreditations for proof of AHERA/OSHA specialized asbestos

- training; professional affiliations; number of workers trained; samples of training materials; samples of AHAPs developed; medical opinion; and current respirator fit test.
2. Competent Person(s)/Supervisor(s): Number; names; social security numbers; years of abatement experience as Competent Person/Supervisor; list of similar projects in size/complexity as Competent Person/Supervisor; as a worker; certificates, licenses, accreditations; proof of AHERA/OSHA specialized asbestos training; maximum number of personnel supervised on a project; medical opinion (asbestos surveillance and respirator use); and current respirator fit test.
 3. Workers: Numbers; names; social security numbers; years of abatement experience; certificates, licenses, accreditations; training courses in asbestos abatement and respiratory protection; medical opinion (asbestos surveillance and respirator use); and current respirator fit test.
- J. Submit copies of State license for asbestos abatement; copy of insurance policy, including exclusions with a letter from agent stating in plain language the coverage provided and the fact that asbestos abatement activities are covered by the policy; copy of AHAPs incorporating the requirements of this specification; information on who provides your training, how often; who provides medical surveillance, how often; who performs and how is personal air monitoring of abatement workers conducted; a list of references of independent laboratories/IH's familiar with your air monitoring and standard operating procedures; and copies of monitoring results of the five referenced projects listed and analytical method(s) used.
 - K. Rented equipment must be decontaminated prior to returning to the rental agency.
 - L. Submit, before the start of work, the manufacturer's technical data for all types of encapsulants, all MSDS and application instructions.

2.4.2 SUBMITTALS DURING ABATEMENT

- A. The Competent Person shall maintain and submit a daily log at the regulated area documenting the dates and times of the following: purpose, attendees and summary of meetings; all personnel entering/exiting the regulated area; document and discuss the resolution of unusual events such as barrier breeching, equipment failures, emergencies, and any cause for stopping work; and representative air monitoring and results/TWA's/EL's. Submit this information daily to the CPIH/CIH.
- B. The CPIH/CIH shall document and maintain the inspection and approval of the regulated area preparation prior to start of work and daily during work.
 1. Removal of any poly barriers.
 2. Visual inspection/testing by the CPIH/CIH or IH Technician prior to application of lockdown encapsulant.
 3. Packaging and removal of ACM waste from regulated area.
 4. Disposal of ACM waste materials; copies of Waste Shipment Records/landfill receipts to the OWNER's representative on a weekly basis.

2.4.3 SUBMITTALS AT COMPLETION OF ABATEMENT

The CPIH/CIH shall submit a project report consisting of the daily log book requirements and documentation of events during the abatement project including Waste Shipment Records signed by the landfill's agent. It will also include information on the containment and transportation of waste from the containment with applicable Chain of Custody forms. The report shall include a certificate of completion, signed and dated by the CPIH/CIH. All clearance and perimeter area samples must be submitted. The OWNER's Representative will retain the abatement report after completion of the project and provide copies of the abatement report to OWNER.

PART 3 - EXECUTION

3.1 REGULATED AREA PREPARATIONS

3.1.1 SITE SECURITY

- A. Regulated area access is to be restricted only to authorized, trained/accredited and protected personnel. These may include the Contractor's employees, employees of Subcontractors, OWNER employees and representatives, State and local inspectors, and any other designated individuals. A list of authorized personnel shall be established prior to commencing the project and be posted in the clean room of the decontamination unit.
- B. Entry into the regulated area by unauthorized individuals shall be reported immediately to the Competent Person by anyone observing the entry. The Competent Person shall immediately require any unauthorized person to leave the regulated area and then notify the OWNER or OWNER's Representative using the most expeditious means.
- C. A log book shall be maintained in the clean room of the decontamination unit. Anyone who enters the regulated area must record their name, affiliation, time in, and time out for each entry.
- D. Access to the regulated area shall be through a single decontamination unit. All other access (doors, windows, hallways, etc.) shall be sealed or locked to prevent entry to or exit from the regulated area. The only exceptions for this requirement are the waste/equipment load-out area which shall be sealed except during the removal of containerized asbestos waste from the regulated area, and emergency exits. Emergency exits shall not be locked from the inside; however, they shall be sealed with poly sheeting and taped until needed. In any situation where exposure to high temperatures which may result in a flame hazard, fire retardant poly sheeting must be used.
- E. The Contractor's Competent Person shall control site security during abatement operations in order to isolate work in progress and protect adjacent personnel. A 24 hour security system shall be provided at the entrance to the regulated area to assure that all entrants are logged in/out and that only authorized personnel are allowed entrance.
- F. The Contractor will have the OWNER's assistance in notifying adjacent personnel of the presence, location and quantity of ACM in the regulated area and enforcement of restricted access by the OWNER's employees.
- G. The regulated area shall be locked during non-working hours and secured by OWNER Representative or Competent Person. The OWNER Police should be informed of asbestos abatement regulated areas to provide security checks during facility rounds and emergency response.

3.1.2. SIGNAGE AND POWER MANAGEMENT

- A. Post OSHA DANGER signs meeting the specifications of OSHA 29 CFR 1926.1101 at any location and approaches to the regulated area where airborne concentrations of asbestos may exceed the PEL. Signs shall be posted at a distance sufficiently far enough away from the regulated area to permit any personnel to read the sign and take the necessary measures to avoid exposure. Additional signs will be posted following construction of the regulated area enclosure.
- B. Shut down and lock out/tag out electric power to the regulated area. Provide temporary power and lighting. Insure safe installation including GFCI of temporary power sources and equipment by compliance with all applicable electrical code and OSHA requirements for temporary electrical systems. Electricity shall be provided by the OWNER.
- C. Shut down and lock out/tag out heating, cooling, and air conditioning system (HVAC) components that are in, supply or pass through the regulated area. Investigate the regulated area and agree on pre-abatement condition with the OWNER's representative. Seal all intake and exhaust vents in the regulated area with duct tape and 2 layers of 6-mil poly. Also, seal any seams in system components that pass through the regulated area. Remove all contaminated HVAC system filters and place in labeled 6-mil polyethylene disposal bags for staging and eventual disposal as asbestos waste.

3.1.3 NEGATIVE PRESSURE FILTRATION SYSTEM

The Contractor shall provide enough HEPA negative air machines to effect $> - 0.02$ " WCG pressure. The Competent Person shall determine the number of units needed for the regulated area by dividing the cubic feet in the regulated area by 15 and then dividing that result by the cubic feet per minute (CFM) for each unit to determine the number of units needed to effect $> - 0.02$ " WCG pressure. Provide a standby unit in the event of machine failure and/or emergency in an adjacent area.

NIOSH has done extensive studies and has determined that negative air machines typically operate at ~50% efficiency. The contractor shall consider this in their determination of number of units needed to provide $> - 0.02$ " WCG pressure. The contractor shall use double the number of machines, based on their calculations, or submit proof their machines operate at stated capacities, at a 2" pressure drop across the filters.

3.1.3.1 DESIGN AND LAYOUT

- A. Before start of work submit the design and layout of the regulated area and the negative air machines. The submittal shall indicate the number of, location of and size of negative air machines. The point(s) of exhaust, air flow within the regulated area, anticipated negative pressure differential, and supporting calculations for sizing shall be provided. In addition, submit the following:
 - 1. Method of supplying power to the units and designation/location of the panels.
 - 2. Description of testing method(s) for correct air volume and pressure differential.
 - 3. If auxiliary power supply is to be provided for the negative air machines, provide a schematic diagram of the power supply and manufacturer's data on the generator and switch.

3.1.3.2 NEGATIVE AIR MACHINES (HEPA UNITS)

- A. Negative Air Machine Cabinet: The cabinet shall be constructed of steel or other durable material capable of withstanding potential damage from rough handling and transportation. The width of the cabinet shall be less than 30" in order to fit in standard doorways. The cabinet must be factory sealed to prevent asbestos fibers from being released during use, transport, or maintenance. Any access to and replacement of filters shall be from the inlet end. The unit must be on casters or wheels.
- B. Negative Air Machine Fan: The rating capacity of the fan must indicate the CFM under actual operating conditions. Manufacturer's typically use "free-air" (no resistance) conditions when rating fans. The fan must be a centrifugal type fan.
- C. Negative Air Machine Final Filter: The final filter shall be a HEPA filter. The filter media must be completely sealed on all edges within a structurally rigid frame. The filter shall align with a continuous flexible gasket material in the negative air machine housing to form an air tight seal. Each HEPA filter shall be certified by the manufacturer to have an efficiency of not less than 99.97%. Testing shall have been done in accordance with Military Standard MIL-STD-282 and Army Instruction Manual 136-300-175A. Each filter must bear a UL586 label to indicate ability to perform under specified conditions. Each filter shall be marked with the name of the manufacturer, serial number, air flow rating, efficiency and resistance, and the direction of test air flow.
- D. Negative Air Machine Pre-filters: The pre-filters, which protect the final HEPA filter by removing larger particles, are required to prolong the operating life of the HEPA filter. Two stages of pre-filtration are required. A first stage pre-filter shall be a low efficiency type for particles 10 μm or larger. A second stage pre-filter shall have a medium efficiency effective for particles down to 5 μm or larger. Pre-filters shall be installed either on or in the intake opening of the NAM and the second stage filter must be held in place with a special housing or clamps.

- E. Negative Air Machine Instrumentation: Each unit must be equipped with a gauge to measure the pressure drop across the filters and to indicate when filters have become loaded and need to be changed. A table indicating the cfm for Owner's pressure readings on the gauge shall be affixed near the gauge for reference or the reading shall indicate at what point the filters shall be changed, noting cfm delivery. The unit must have an elapsed time meter to show total hours of operation.
- F. Negative Air Machine Safety and Warning Devices: An electrical/ mechanical lockout must be provided to prevent the fan from being operated without a HEPA filter. Units must be equipped with an automatic shutdown device to stop the fan in the event of a rupture in the HEPA filter or blockage in the discharge of the fan. Warning lights are required to indicate normal operation; too high a pressure drop across filters; or too low of a pressure drop across filters.
- G. Negative Air Machine Electrical: All electrical components shall be approved by the National Electrical Manufacturer's Association (NEMA) and Underwriters Laboratories (UL). Each unit must be provided with overload protection and the motor, fan, fan housing, and cabinet must be grounded.
- H. It is essential that replacement HEPA filters be tested using an "in-line" testing method, to ensure the seal around the periphery was not damaged during replacement. Damage to the outer HEPA filter seal could allow contaminated air to bypass the HEPA filter and be discharged to an inappropriate location. Contractor will provide written documentation of test results for negative air machine units with HEPA filters changed by the contractor or documentation when changed and tested by the contractor filters

3.1.3.3 PRESSURE DIFFERENTIAL

The fully operational negative air system within the regulated area shall continuously maintain a pressure differential of -0.02" water column gauge. Before any disturbance of any asbestos material, this shall be demonstrated to the OWNER by use of a pressure differential meter/manometer as required by OSHA 29 CFR 1926.1101(e)(5)(i). The Competent Person shall be responsible for providing, maintaining, and documenting the negative pressure and air changes as required by OSHA and this specification.

3.1.3.4 MONITORING

The pressure differential shall be continuously monitored and recorded between the regulated area and the area outside the regulated area with a monitoring device that incorporates a strip chart recorder. The strip chart recorder shall become part of the project log and shall indicate at least -0.02" water column gauge for the duration of the project.

3.1.3.6 SUPPLEMENTAL MAKE-UP AIR INLETS

Provide, as needed for proper air flow in the regulated area, in a location approved by the OWNER, openings in the plastic sheeting to allow outside air to flow into the regulated area. Auxiliary makeup air inlets must be located as far from the negative air machines as possible, off the floor near the ceiling, and away from the barriers that separate the regulated area from the occupied clean areas. Cover the inlets with weighted flaps which will seal in the event of failure of the negative pressure system.

3.1.3.7 TESTING THE SYSTEM

The negative pressure system must be tested before any ACM is disturbed in any way. After the regulated area has been completely prepared, the decontamination units set up, and the negative air machines installed, start the units up one at a time. Demonstrate and document the operation and testing of the negative pressure system to the OWNER using smoke tubes and a negative pressure gauge.

Verification and documentation of adequate negative pressure differential across each barrier must be done at the start of each work shift.

3.1.3.8 DEMONSTRATION OF THE NEGATIVE PRESSURE FILTRATION SYSTEM

The demonstration of the operation of the negative pressure system to the OWNER shall include, but not be limited to, the following:

- A. Plastic barriers and sheeting move lightly in toward the regulated area.
- B. Curtains of the decontamination units move in toward regulated area.
- C. There is a noticeable movement of air through the decontamination units. Use the smoke tube to demonstrate air movement from the clean room to the shower room to the equipment room to the regulated area.
- D. Use smoke tubes to demonstrate air is moving across all areas in which work is to be done. Use a differential pressure gauge to indicate a negative pressure of at least -0.02" across every barrier separating the regulated area from the rest of the building. Modify the system as necessary to meet the above requirements.

3.1.3.9 USE OF THE NEGATIVE PRESSURE FILTRATION SYSTEM DURING ABATEMENT OPERATIONS

- A. Start units before beginning any disturbance of ACM occurs. After work begins, the units shall run continuously, maintaining 4 actual air changes per hour at a negative pressure differential of -0.02" water column gauge, for the duration of the work until a final visual clearance and final air clearance has been successfully completed.
No negative air units shall be shut down at any time unless authorized by the OWNER, verbally and in writing.
- B. Pre-cleaning of ACM contaminated items shall be performed after the enclosure has been erected and negative pressure has been established in the work area. After items have been pre-cleaned and decontaminated, they may be removed from the work area for storage until the completion of abatement in the work area.
- C. Abatement work shall begin at a location farthest from the units and proceed towards them. If an electric failure occurs, the Competent Person shall stop all abatement work and immediately begin wetting all exposed asbestos materials for the duration of the power outage. Abatement work shall not resume until power is restored and all units are operating properly again.
- D. The negative air machines shall continue to run after all work is completed and until a final visual clearance and a final air clearance has been successfully completed for that regulated area.

3.1.3.10 DISMANTLING THE SYSTEM

After completion of the final visual and final air clearance has been obtained by the CPIH/CIH, the units may be shut down. The unit exterior surfaces shall have been completely decontaminated; pre-filters are not to be removed and the units inlet/outlet sealed with 2 layers of 6 mil poly immediately after shut down. No filter removal shall occur at the OWNER site following successful completion of site clearance. OSHA/EPA/DOT asbestos shall be attached to the units.

3.1.4 CONTAINMENT BARRIERS AND COVERINGS IN THE REGULATED AREA

3.1.4.1 GENERAL

Seal off the perimeter to the regulated area to completely isolate the regulated area from adjacent spaces. All surfaces in the regulated area must be covered to prevent contamination and to facilitate clean-up. Should adjacent areas become contaminated as a result of the work, shall immediately stop work and clean up the

contamination at no additional cost to the OWNER. Provide firestopping and identify all fire barrier penetrations due to abatement work as specified in Section 3.1.4.8; FIRESTOPPING.

3.1.4.2 PREPARATION PRIOR TO SEALING THE REGULATED AREA

Place all tools, scaffolding, materials and equipment needed for working in the regulated area prior to erecting any plastic sheeting. All uncontaminated removable furniture, equipment and/or supplies shall be removed by the OWNER from the regulated area before commencing work. Any objects remaining in the regulated area shall be completely covered with 2 layers of 6-mil fire retardant poly sheeting and secured with duct tape. Lock out and tag out any HVAC/electrical systems in the regulated area.

3.1.4.3 CONTROLLING ACCESS TO THE REGULATED AREA

Access to the regulated area is allowed only through the personnel decontamination facility (PDF). All other means of access shall be eliminated and OSHA DANGER demarcation signs posted as required by OSHA. If the regulated area is adjacent to, or within view of an occupied area, provide a visual barrier of 6 mil opaque fire retardant poly to prevent building occupant observation. If the adjacent area is accessible to the public, the barrier must be solid and capable of withstanding the negative pressure.

3.1.4.4 CRITICAL BARRIERS

Completely separate any operations in the regulated area from adjacent areas using 2 layers of 6 mil fire retardant poly and duct tape. Individually seal with 2 layers of 6 mil poly and duct tape all HVAC openings into the regulated area. Individually seal all lighting fixtures, clocks, doors, windows, convectors, speakers, or any other objects/openings in the regulated area. Heat must be shut off and any objects covered with poly.

3.1.4.5 PRIMARY BARRIERS

- A. Cover the regulated area with two layers of 6 mil fire retardant poly on the floors and two layers of 4 mil, fire retardant poly on the walls, unless otherwise directed in writing by the OWNER's representative. Floor layers must form a right angle with the wall and turn up the wall at least 300 mm (12"). Seams must overlap at least 1800 mm (6') and must be spray glued and taped. Install sheeting so that layers can be removed independently from each other. Carpeting shall be covered with three layers of 6 mil poly. Corrugated cardboard sheets must be placed between the bottom and middle layers of poly. Mechanically support and seal with duct tape and glue all wall layers.
- B. If stairs and ramps are covered with 6 mil plastic, two layers must be used. Provide 3/4" exterior grade plywood treads held in place with duct tape on the plastic. Do not cover rungs or rails with any isolation materials.

3.1.4.6 SECONDARY BARRIERS

A loose layer of 6 mil shall be used as a drop cloth to protect the primary layers from debris generated during the abatement. This layer shall be replaced as needed during the work and at a minimum once per work day.

3.1.4.7 EXTENSION OF THE REGULATED AREA

If the enclosure of the regulated area is breached in any way that could allow contamination to occur, the affected area shall be included in the regulated area and constructed as per this section. Decontamination measures must be started immediately and continue until air monitoring indicates background levels are met.

3.1.4.8 FIRESTOPPING

- A. Through penetrations caused by cables, cable trays, pipes, sleeves, conduits, etc. must be firestopped with a fire-rated firestop system providing an air tight seal. Provide short lengths of insulation in accordance with Section 15260 and provide a UL listed firestopping at the penetrations to maintain the rating of the wall or floor, typically a 2 hour fire rating.
- B. Firestop materials shall be equal to the wall or floor penetrated. The contractor shall list all areas of penetration, the type of sealant used, and whether or not the location is fire rated.
- C. Any visible openings whether or not caused by a penetration shall be reported by the Contractor to the OWNER Representative for a sealant system determination. Firestops shall meet ASTM E814 and UL 1479 requirements for the opening size, penetrant, and fire rating needed.

3.1.5 SANITARY FACILITIES

The Contractor shall provide sanitary facilities for abatement personnel and maintain them in a clean and sanitary condition throughout the abatement project.

3.1.6 PERSONAL PROTECTIVE EQUIPMENT

Provide whole body clothing, head coverings, gloves and foot coverings and any other personal protective equipment as determined by conducting the hazard assessment required by OSHA at 29 CFR 1910.132 (d). The Competent Person shall ensure the integrity of personal protective equipment worn for the duration of the project. Duct tape shall be used to secure all suit sleeves to wrists and to secure foot coverings at the ankle.

3.1.7 PRE-CLEANING

The OWNER will provide water for abatement purposes. The Contractor shall connect to the existing system. The service to the shower(s) shall be supplied with backflow prevention.

Pre-cleaning of ACM contaminated items shall be performed after the enclosure has been erected and negative pressure has been established in the work area. All workers performing pre-cleaning activities must don appropriate personal protective equipment (PPE), as specified throughout this document and as approved in the Contractor's work plan. After items have been pre-cleaned and decontaminated, they may be removed from the work area for storage until the completion of abatement in the work area.

Pre-clean all movable objects within the regulated area using a HEPA filtered Vacuum and/or wet cleaning methods as appropriate. After cleaning, these objects shall be removed from the regulated area and carefully stored in an uncontaminated location. Fabric items and carpeting should be disposed of as asbestos contaminated waste if in the regulated area. If ACM floor tile or mastic is attached to the then that section of the carpet will be disposed of as asbestos waste.

Pre-clean all surfaces in the regulated area using HEPA filtered Vacuums and/or wet cleaning methods as appropriate. Do not use any methods that would raise dust such as dry sweeping or

vacuuming with equipment not equipped with HEPA filters. Do not disturb asbestos-containing materials during this pre-cleaning phase.

3.1.8 PRE-ABATEMENT ACTIVITIES

3.1.8.1 PRE-ABATEMENT MEETING

The OWNER representative, upon receipt, review, and substantial approval of all pre-abatement submittals and verification by the CPIH/CIH that all materials and equipment required for the project are on the site, will arrange for a pre-abatement meeting between the Contractor, the CPIH/CIH, Competent Person(s), the OWNER representative(s), and any industrial hygienists employed by the Owner. The purpose of the meeting is to discuss any aspect of the submittals needing clarification or amplification and to discuss any aspect of the project execution and the sequence of the operation. The Contractor shall be prepared to provide any supplemental information/documentation to the OWNER and their representatives regarding any submittals, documentation, materials or equipment. Upon satisfactory resolution of any outstanding issues, the OWNER's representative will issue a written order to proceed to the Contractor. No abatement work of any kind described in the following provisions shall be initiated prior to the OWNER written order to proceed.

3.1.8.2 PRE-ABATEMENT CONSTRUCTION AND OPERATIONS

- A. Perform all preparatory work for the first regulated area in accordance with the approved work schedule and with this specification.
- B. Upon completion of all preparatory work, the CPIH/CIH will inspect the work and systems and will notify the OWNER's representative when the work is completed in accordance with this specification. The OWNER's representative may inspect the regulated area and the systems with the Owner's independent industrial hygienist and may require that upon satisfactory inspection, the Contractor's employees perform all major aspects of the approved AHAP(s), especially worker protection, respiratory systems, contingency plans, decontamination procedures, and monitoring to demonstrate satisfactory operation. The operational systems for respiratory protection and the negative pressure system shall be demonstrated for proper performance.
- C. The CPIH/CIH shall document the pre-abatement activities described above and deliver a copy to the OWNER's representative.
- D. Upon satisfactory inspection of the installation of and operation of systems the OWNER's representative will notify the Contractor in writing to proceed with the asbestos abatement work in accordance with this specification and all applicable regulations.

3.1.8.3 PRE-ABATEMENT INSPECTIONS AND PREPARATIONS

Before any work begins on the construction of the regulated area, the Contractor will:

- A. Conduct a space-by-space inspection with an authorized OWNER representative and prepare a written inventory of all existing damage in those spaces where asbestos abatement will occur. Still or video photography may be used to supplement the written damage inventory. Document will be signed and certified as accurate by both parties.
- B. The OWNER's Representative, the Contractor, and the CPIH/CIH must be aware of any materials that are PACM and take action to sample and expedite analysis for any materials that are suspect PACM and to take samples, particularly for areas that are not accessible until demolition is performed. Ensure the following areas are inspected on the project: lay-in ceilings concealing ACM; ACM behind walls/windows from previous renovations; inside utility chases/walls; transite piping/ductwork/sheets; concealed roofing materials; below induction unit

enclosures; concealed piping; flooring/mastic covered by carpeting/new flooring; exterior insulated wall panels; on underground fuel tanks; and steam line trench coverings.

- C. Note that there are multiple layers of flooring, ceilings and wallboard that must be removed as old ceiling system materials are concealed above the existing system, likewise multiple layers of flooring and wallboard are concealing older layers of same. This is to be expected and anticipated by the Contractor as a part of their Bid.
- D. If present and required, remove and dispose of carpeting from floors in the regulated area.
- E. Inspect existing firestopping in the regulated area. Correct as needed.
- F. Where the Owner's asbestos survey reveals ACM in any component that is sampled then all similar areas on that floor are to be considered homogenous. Where the Contractor can clearly document a lesser ACM concentration then the Abatement plan may be adjusted to suit the documented concentrations.

3.2 REMOVAL OF ACM

3.2.1 WETTING ACM

- A. Use amended water for the wetting of ACM prior to removal. The Competent Person shall assure the wetting of ACM meets the definition of "adequately wet" in the EPA NESHAP regulation and OSHA's "wet methods" for the duration of the project. A removal encapsulant may be used instead of amended water with written approval of the OWNER's representative.
- B. Amended Water: Provide water to which a surfactant has been added shall be used to wet the ACM and reduce the potential for fiber release during disturbance of ACM. The mixture must be equal to or greater than the wetting provided by water amended by a surfactant consisting one ounce of 50% polyoxyethylene ester and 50% polyoxyethylene ether mixed with 5 gallons (19L) of water.
- C. Removal Encapsulant: When authorized by OWNER, provide a penetrating encapsulant designed specifically for the removal of ACM. The material must, when used, result in adequate wetting of the ACM and retard fiber release during removal.

3.2.2 SECONDARY BARRIER AND WALKWAYS

- A. Install as a drop cloth a 6 mil poly sheet at the beginning of each work shift where removal is to be done during that shift. Completely cover floors and any walls within 10 feet (3 meters) of the area where work is to done. Secure the secondary barrier with duct tape to prevent it from moving or debris from getting behind it. Remove the secondary barrier at the end of the shift or as work in the area is completed. Keep residue on the secondary barrier wetted. When removing, fold inward to prevent spillage and place in a disposal bag.
- B. Install walkways using 6 mil black poly between the regulated area and the decontamination facilities (PDF and W/EDF) to protect the primary layers from contamination and damage. Install the walkways at the beginning of each shift and remove at the end of each shift.

3.2.3 WET REMOVAL OF ACM

- A. Adequately and thoroughly wet the ACM to be removed prior to removal with amended water or when authorized by OWNER, removal encapsulant to reduce/prevent fiber release to the air. Adequate time (at a minimum two hours) must be allowed for the amended water or removal encapsulant to saturate the ACM. Abatement personnel must not disturb dry ACM. Use a fine spray of amended water or removal encapsulant. Saturate the material sufficiently to wet to the substrate without causing excessive dripping. The material must be sprayed repeatedly/continuously during the removal process in order to maintain adequately wet conditions. Removal encapsulants must be applied in accordance with the manufacturer's written instructions. Perforate or carefully separate, using wet methods, an outer covering that is painted or jacketed in order to allow penetration and wetting of the material. Where necessary, carefully

remove covering while wetting to minimize fiber release. **In no event shall dry removal occur except when authorized in writing by the OWNER when a greater safety hazard (e.g., electricity) is present.**

- B. If ACM does not wet well with amended water due to composition, coating or jacketing, remove as follows:
1. Mist work area continuously with amended water whenever necessary to reduce airborne fiber levels.
 2. Remove saturated ACM in small sections. Do not allow material to dry out. As material is removed, bag material, while still wet into disposal bags. Twist the bag neck tightly, bend over (gooseneck) and seal with a minimum of three tight wraps of duct tape. Clean /decontaminate the outside of the bag of any residue and move to washdown station adjacent to W/EDF.
 3. Fireproofing or Architectural Finish on Scratch Coat: Spray with a fine mist of amended water or removal encapsulant. Allow time for saturation to the substrate. Do not over saturate causing excess dripping. Scrape material from substrate. Remove material in manageable quantities and control falling to staging or floor. If the falling distance is over 20 feet (6M), use a drop chute to contain material through descent. Remove residue remaining on the scratch coat after scraping is done using a stiff bristle hand brush. If a removal encapsulant is used, remove residue completely before the encapsulant dries. Periodically re-wet the substrate with amended water as needed to prevent drying of the material before the residue is removed from the substrate.
 4. Fireproofing or Architectural Finish on Wire Lath: Spray with a fine mist of amended water or removal encapsulant. Allow time to completely saturate the material. Do not over saturate causing excess dripping. If the surface has been painted or otherwise coated, cut small holes as needed and apply amended water or removal encapsulant from above. Cut saturated wire lath into 2' x 6' (50mm x 150mm) sections and cut hanger wires. Roll up complete with ACM, cover in burlap and hand place in disposal bag. Do not drop to floor. After removal of lath/ACM, remove any overspray on decking and structure using stiff bristle nylon brushes. Depending on hardness of overspray, scrapers may be needed for removal.
 5. Pipe/Tank/Vessel/Boiler Insulation: Remove the outer layer of wrap while spraying with amended water in order to saturate the ACM. Spray ACM with a fine mist of amended water or removal encapsulant. Allow time to saturate the material to the substrate. Cut bands holding pre-formed pipe insulation sections. Slit jacketing at the seams, remove and hand place in a disposal bag. Do not allow dropping to the floor. Remove molded fitting insulation/mud in large pieces and hand place in a disposal bag. Remove any residue on pipe or fitting with a stiff bristle nylon brush. In locations where pipe fitting insulation is removed from fibrous glass or other non-asbestos insulated straight runs of pipe, remove fibrous material at least 6" from the point it contacts the ACM.

3.3 REMOVAL OF CLASS II FLOORING, ROOFING, AND TRANSITE MATERIALS:

3.3.1 GENERAL

All applicable requirements of OSHA, EPA, and DOT shall be followed during Class II work. Keep materials intact; do not disturb; wet while working with it; wrap as soon as possible with 2 layers of 6 mil plastic for disposal.

3.3.2 REMOVAL OF FLOORING MATERIALS:

- A. All requirements of OSHA Flooring agreement provisions shall be followed:
1. The Contractor shall provide enough HEPA negative air machines to effect > - 0.02" WCG pressure. Provide a standby unit in the event of machine failure and/or emergency in an adjacent area. The contractor shall use double the number of machines, based on their calculations, or submit proof their machines operate at stated capacities, at a 2" pressure drop across the filters.
 2. Flooring shall be removed intact, as much as possible. Do not rip or tear flooring.
 3. Mechanical chipping or sanding is not allowed.

4. Flooring shall be removed with an infra-red heating unit operated by trained personnel following the manufacturer's instructions.
5. Wet clean and HEPA vacuum the floor before and after removal of flooring.
6. Place a 6 mil poly layer 4' by 10' adjacent to the regulated area for use as a decontaminated area. All waste must be contained in the regulated area.
7. Package all waste in 6 mil poly lined fiberboard drums.

3.3.3 REMOVAL OF MASTIC

- A. All chemical mastic removers must be low in volatile organic compound (VOC) content, have a flash point greater than 200° Fahrenheit, contain no chlorinated solvents, and comply with California Air Resources Board (CARB) thresholds for VOCs (effective January 1, 2010).
- B. A negative air machine as required under flooring removal shall be provided.
- C. Follow all manufacturers' instructions in the use of the mastic removal material.
- D. Package all waste in 6 mil poly lined fiberboard drums.
- E. Prior to application of any liquid material, check the floor for penetrations and seal before removing mastic.

3.4 LOCKDOWN ENCAPSULATION

3.4.1 GENERAL

Lockdown encapsulation is an integral part of the ACM removal. At the conclusion of ACM removal and before removal of the primary barriers, the contractor shall encapsulate all surfaces with a bridging encapsulant.

3.4.2 DELIVERY AND STORAGE

Deliver materials to the job site in original, new and unopened containers bearing the manufacturer's name and label as well as the following information: name of material, manufacturer's stock number, date of manufacture, thinning instructions, application instructions and the MSDS for the material.

3.4.3 WORKER PROTECTION

Before beginning work with any material for which an MSDS has been submitted, provide workers with any required personal protective equipment. The required personal protective equipment shall be used whenever exposure to the material might occur. In addition to OSHA/specification requirements for respiratory protection, a paint pre-filter and an organic vapor cartridge, at a minimum, shall be used in addition to the HEPA filter when an organic solvent based encapsulant is used. The CPHI/CIH shall be responsible for provision of adequate respiratory protection. Note: Flammable and combustible encapsulants shall not be used, unless authorized in writing by the OWNER.

3.4.4 ENCAPSULATION OF SCRATCH COAT PLASTER OR PIPING

- A. Apply two coats of lockdown encapsulant to the scratch coat plaster or piping after all ACM has been removed. Apply in strict accordance with the manufacturer's instructions. Any deviation from the instructions must be approved by the OWNER's representative in writing prior to commencing the work.
- B. Apply the lockdown encapsulant with an airless sprayer at a pressure and using a nozzle orifice as recommended by the manufacturer. Apply the first coat while the scratch coat is still damp from the asbestos removal process, after passing the visual inspection. If the surface has been allowed to dry, wet wipe or HEPA Vacuum prior to spraying with encapsulant. Apply a second coat over the first coat in strict conformance with the manufacturer's instructions. Color the lockdown encapsulant and contrast the color in the second coat so that visual confirmation of completeness and uniform coverage of each coat is possible. Adhere to the manufacturer's

instructions for coloring. At the completion of the encapsulation, the surface must be a uniform third color produced by the mixture.

3.4.5 SEALING EXPOSED EDGES

Seal edges of ACM exposed by removal work which is inaccessible, such as a sleeve, wall penetration, etc., with two coats of bridging encapsulant. Prior to sealing, permit the exposed edges to dry completely to permit penetration of the bridging encapsulant. Apply in accordance with 3.3.4 (B).

3.5 DISPOSAL OF ACM WASTE MATERIALS

3.5.1 GENERAL

Dispose of waste ACM and debris which is packaged in accordance with these specifications, OSHA, EPA and DOT. The landfill requirements for packaging must also be met. Transport will be in compliance with 49 CFR 100–185 regulations. Disposal shall be done at an approved landfill. Disposal of non-friable ACM shall be done in accordance with applicable regulations.

3.5.2 PROCEDURES

- A. The OWNER must be notified at least 24 hours in advance of any waste removed from the containment.
- B. Asbestos waste shall be packaged and moved through the W/EDF into a covered transport container in accordance with procedures in this specification. Waste shall be double-bagged and wetted with amended water prior to disposal. Wetted waste can be very heavy. Bags shall not be overfilled. Bags shall be securely sealed to prevent accidental opening and/or leakage. The top shall be tightly twisted and goose necked prior to tightly sealing with at least three wraps of duct tape. Ensure that unauthorized persons do not have access to the waste material once it is outside the regulated area. All transport containers must be covered at all times when not in use. NESHAP signs must be on containers during loading and unloading. Material shall not be transported in open vehicles. If drums are used for packaging, the drums shall be labeled properly and shall not be re-used.
- C. Waste Load Out: Waste load out shall be done in accordance with the procedures in W/EDF Decontamination Procedures. Sealed waste bags shall be decontaminated on exterior surfaces by wet cleaning and/or HEPA Vacuuming before being placed in the second waste bag and sealed, which then must also be wet wiped or HEPA Vacuumed.
- D. Asbestos waste with sharp edged components, i.e., nails, screws, lath, strapping, tin sheeting, jacketing, metal mesh, etc., which might tear poly bags shall be wrapped securely in burlap before packaging and, if needed, use a poly lined fiber drum as the second container, prior to disposal.

3.6 PROJECT DECONTAMINATION

3.6.1 GENERAL

- A. The entire work related to project decontamination shall be performed under the close supervision and monitoring of the CPIH/CIH.
- B. If the asbestos abatement work is in an area which was contaminated prior to the start of abatement, the decontamination will be done by cleaning the primary barrier poly prior to its removal and cleanings of the surfaces of the regulated area after the primary barrier removal.
- C. If the asbestos abatement work is in an area which was uncontaminated prior to the start of abatement, the decontamination will be done by cleaning the primary barrier poly prior to its removal, thus preventing contamination of the building when the regulated area critical barriers are removed.

3.6.2 REGULATED AREA CLEARANCE

Clearance air testing and other requirements which must be met before release of the Contractor and re-occupancy of the regulated area space are specified in Final Testing Procedures.

3.6.3 WORK DESCRIPTION

Decontamination includes the clearance air testing in the regulated area and the decontamination and removal of the enclosures/facilities installed prior to the abatement work including primary/critical barriers, PDF and W/EDF facilities, and negative pressure systems.

3.6.4 PRE-DECONTAMINATION CONDITIONS

- A. Before decontamination starts, all ACM waste from the regulated area shall be collected and removed, and the loose 6 mil layer of poly removed while being adequately wetted with amended water and disposed of along with any gross debris generated by the work.
- B. At the start of decontamination, the following shall be in place:
 1. Primary barriers consisting of 2 layers of 6 mil poly on the floor and 4 mil poly on the walls.
 2. Critical barriers consisting of 2 layers of 6 mil poly which is the sole barrier between the regulated area and openings to the rest of the building or outside.
 4. Decontamination facilities for personnel and equipment in operating condition and the negative pressure system in operation.

3.6.5 FIRST CLEANING

Carry out a first cleaning of all surfaces of the regulated area including items of remaining poly sheeting, tools, scaffolding, ladders/staging by wet methods and/or HEPA Vacuuming. Do not use dry dusting/sweeping/air blowing methods. Use each surface of a wetted cleaning cloth one time only and then dispose of as contaminated waste. Continue this cleaning until there is no visible residue from abated surfaces or poly or other surfaces. Remove all filters in the air handling system and dispose of as ACM waste in accordance with these specifications. The negative pressure system shall remain in operation during this time. Additional cleaning(s) may be needed as determined by the Owner.

3.6.6 PRE-CLEARANCE INSPECTION AND TESTING

The CPIH/CIH and Owner's representative will perform a thorough and detailed visual inspection at the end of the cleaning to determine whether there is any visible residue in the regulated area. If the visual inspection is acceptable, the CPIH/CIH will perform pre-clearance sampling using aggressive clearance as detailed in 40 CFR 763 Subpart E (AHERA) Appendix A (III)(B)(7)(d). If the sampling results show values below 0.01 f/cc, then the Contractor shall notify the OWNER's representative of the results with a brief report from the CPIH/CIH documenting the inspection and sampling results and a statement verifying that the regulated area is ready for lockdown encapsulation. The OWNER reserves the right to utilize their own Industrial Hygienist to perform a pre-clearance inspection and testing for verification.

3.6.7 LOCKDOWN ENCAPSULATION OF ABATED SURFACES

With the express written permission of the OWNER's representative, perform lockdown encapsulation of all surfaces from which asbestos was abated in accordance with the procedures in this specification. Negative pressure shall be maintained in the regulated area during the lockdown application.

3.7 FINAL VISUAL INSPECTION AND AIR CLEARANCE TESTING

3.7.1 GENERAL

Notify the OWNER representative 24 hours in advance for the performance of the final visual inspection and testing. The final visual inspection and testing will be performed by the CPIH/CIH

starting after the final cleaning. The OWNER reserves the right to utilize their own Industrial Hygienist to perform a final inspection and testing for verification.

3.7.2 FINAL VISUAL INSPECTION

Final visual inspection will include the entire regulated area, the PDF, all poly sheeting, seals over HVAC openings, doorways, windows, and any other openings. If any debris, residue, dust or any other suspect material is detected, the final cleaning shall be repeated at no cost to the OWNER. Dust/material samples may be collected and analyzed at no cost to the OWNER at the discretion of the Owner's Industrial Hygienist to confirm visual findings. When the regulated area is visually clean the final testing can be done.

3.7.3 FINAL AIR CLEARANCE TESTING

- A. After an acceptable final visual inspection by the CPIH/CIH and OWNER Representative, the CPIH/CIH will perform the final clearance testing. Air samples will be collected and analyzed in accordance with procedures for AHERA in this specification. If work is less than 260 lf/160 sf/35 cf, 5 PCM samples shall be collected for clearance and a minimum of one field blank. If work is equal to or more than 260 lf/160 sf/35 cf, AHERA TEM sampling shall be performed for clearance. TEM analysis shall be done in accordance with procedures for EPA AHERA in this specification. If the release criteria are not met, the Contractor shall repeat the final cleaning and continue decontamination procedures until clearance is achieved. All inspection and testing costs will be borne by the Contractor.
- B. If release criteria are met, proceed to perform the abatement closeout and to issue the certificate of completion in accordance with these specifications.

3.7.4 FINAL AIR CLEARANCE PROCEDURES

- A. Contractor's Release Criteria: Work in a regulated area is complete when the regulated area is visually clean and airborne fiber levels have been reduced to or below 0.01 f/cc as measured by the AHERA PCM protocol, or 70 AHERA structures per square millimeter (s/mm²) by AHERA TEM.
- B. Air Monitoring and Final Clearance Sampling: To determine if the eleOwnerted airborne fiber counts encountered during abatement operations have been reduced to the specified level, the CPIH/CIH will secure samples and analyze them according to the following procedures:
 1. Fibers Counted: "Fibers" referred to in this section shall be either all fibers regardless of composition as counted in the NIOSH 7400 PCM method or asbestos fibers counted using the AHERA TEM method.
 2. Aggressive Sampling: All final air testing samples shall be collected using aggressive sampling techniques. Samples will be collected on 0.8 μ MCE filters for PCM analysis and 0.45 μ Polycarbonate filters for TEM. A minimum of 1200 Liters of using calibrated pumps shall be collected for clearance samples. Before pumps are started, initiate aggressive air mixing sampling as detailed in 40 CFR 763 Subpart E (AHERA) Appendix A (III)(B)(7)(d). Air samples will be collected in areas subject to normal air circulation away from corners, obstructed locations, and locations near windows, doors, or vents. After air sampling pumps have been shut off, circulating fans shall be shut off. The negative pressure system shall continue to operate.

3.7.5 CLEARANCE SAMPLING USING PCM – LESS THAN 260LF/160SF:

- A. The CPIH/CIH will perform clearance samples as indicated by the specification.
- B. The NIOSH 7400 PCM method will be used for clearance sampling with a minimum collection volume of 1200 Liters of air. A minimum of 5 PCM clearance samples shall be collected. All samples must be equal to or less than 0.01 f/cc to clear the regulated area.

3.7.6 CLEARANCE SAMPLING USING TEM – EQUAL TO OR MORE THAN 260LF/160SF: TEM

- A. Clearance requires 13 samples be collected; 5 inside the regulated area; 5 outside the regulated area; and 3 field blanks.

- B. The TEM method will be used for clearance sampling with a minimum collection volume of 1200 Liters of air. A minimum of 13 clearance samples shall be collected. All samples must be equal to or less than 70 AHERA structures per square millimeter (s/mm²) AHERA TEM.

3.7.7 LABORATORY TESTING OF PCM CLEARANCE SAMPLES

The services of an AIHA accredited laboratory will be employed by the Contractor to perform analysis for the PCM air samples. The accredited laboratory shall be successfully participating in the AIHA Proficiency Analytical Testing (PAT) program. Samples will be sent daily by the CPIH/CIH so that verbal/faxed reports can be received within 24 hours. A complete record, certified by the laboratory, of all air monitoring tests and results will be furnished to the OWNER's representative and the Contractor.

3.7.8 LABORATORY TESTING OF TEM SAMPLES

Samples shall be sent by the CPIH/CIH to a NIST accredited laboratory for analysis by TEM. The laboratory shall be successfully participating in the NIST Airborne Asbestos Analysis (TEM) program. Verbal/faxed results from the laboratory shall be available within 24 hours after receipt of the samples. A complete record, certified by the laboratory, of all TEM results shall be furnished to the OWNER's representative and the Contractor.

3.7.9 LABORATORY TESTING OF BULK SAMPLES

Samples shall be sent by the CPIH/CIH to a NIST accredited laboratory for analysis by PLM. The laboratory shall be successfully participating in the NIST Bulk Asbestos Analysis (PLM) program. Verbal/faxed results from the laboratory shall be available within 24 hours after receipt of the samples. A complete record, certified by the laboratory, of all TEM results shall be furnished to the OWNER's representative and the Contractor.

3.8 ABATEMENT CLOSEOUT AND CERTIFICATE OF COMPLIANCE

3.8.1 COMPLETION OF ABATEMENT WORK

After thorough decontamination, seal negative air machines with 2 layers of 6 mil poly and duct tape to form a tight seal at the intake/outlet ends before removal from the regulated area. Complete asbestos abatement work upon meeting the regulated area visual and air clearance criteria and fulfilling the following:

- A. Remove all equipment and materials from the project area.
- B. Dispose of all packaged ACM waste as required.
- C. Repair or replace all interior finishes damaged during the abatement work, as required.
- D. Fulfill other project closeout requirements as required in this specification.

3.8.2 CERTIFICATE OF COMPLETION BY CONTRACTOR

The CPIH/CIH shall complete and sign the "Certificate of Completion" in at the completion of the abatement and decontamination of the regulated area.

3.8.4 RE-INSULATION

If required as part of the contract, replace all asbestos containing insulation/fire-proofing with suitable non-asbestos material. Provide MSDS's for all replacement materials in advance of installation for OWNER approval. Refer to Section 15260 INSULATION for piping and duct insulation. Reinsulation is required to be performed under the mechanical and plumbing SubContractor's scope of work. Fireproofing on the building structure that is removed by this section is to be replaced by this section. Allow for 1 hour protection of roof beams and joists, allow for 2 hour protection on floor beams and joists.

ATTACHMENT #1

CERTIFICATE OF COMPLETION

DATE: _____ OWNER Project #: _____

PROJECT NAME: _____ Abatement Contractor: _____

OWNER ADDRESS: _____

1. I certify that I have personally inspected, monitored and supervised the abatement work of (specify regulated area or Building):
which took place from / / to / /
2. That throughout the work all applicable requirements/regulations and the OWNER's specifications were met.
3. That any person who entered the regulated area was protected with the appropriate personal protective equipment and respirator and that they followed the proper entry and exit procedures and the proper operating procedures for the duration of the work.
4. That all employees of the Abatement Contractor engaged in this work were trained in respiratory protection, were experienced with abatement work, had proper medical surveillance documentation, were fit-tested for their respirator, and were not exposed at any time during the work to asbestos without the benefit of appropriate respiratory protection.
5. That I performed and supervised all inspection and testing specified and required by applicable regulations and OWNER specifications.
6. That the conditions inside the regulated area were always maintained in a safe and healthy condition and the maximum fiber count never exceeded 0.5 f/cc, except as described below.
7. That all abatement work was done in accordance with OSHA requirements and the manufacturer's recommendations.

CPIH/CIH Signature/Date: _____

CPIH/CIH Print Name: _____

Abatement Contractor Signature/Date: _____

Abatement Contractor Print Name: _____

ATTACHMENT #2

CERTIFICATE OF WORKER'S ACKNOWLEDGMENT

PROJECT NAME: _____ DATE: _____

PROJECT ADDRESS: _____

ABATEMENT CONTRACTOR'S NAME: _____

WORKING WITH ASBESTOS CAN BE HAZARDOUS TO YOUR HEALTH. INHALING ASBESTOS HAS BEEN LINKED WITH OWNERRIOUS TYPES OF CANCERS. IF YOU SMOKE AND INHALE ASBESTOS FIBERS, YOUR CHANCES OF DEVELOPING LUNG CANCER IS GREATER THAN THAT OF THE NON-SMOKING PUBLIC.

Your employer's contract with the Owner for the above project requires that: You must be supplied with the proper personal protective equipment including an adequate respirator and be trained in its use. You must be trained in safe and healthy work practices and in the use of the equipment found at an asbestos abatement project. You must receive/have a current medical examination for working with asbestos. These things shall be provided at no cost to you. By signing this certificate you are indicating to the Owner that your employer has met these obligations.

RESPIRATORY PROTECTION: I have been trained in the proper use of respirators and have been informed of the type of respirator to be used on the above indicated project. I have a copy of the written Respiratory Protection Program issued by my employer. I have been provided for my exclusive use, at no cost, with a respirator to be used on the above indicated project.

TRAINING COURSE: I have been trained by a third party, State/EPA accredited trainer in the requirements for an AHERA/OSHA Asbestos Abatement Worker training course, 32 hours minimum duration. I currently have a Ownerlid State accreditation certificate. The topics covered in the course include, as a minimum, the following:

- Physical Characteristics and Background Information on Asbestos
- Potential Health Effects Related to Exposure to Asbestos
- Employee Personal Protective Equipment
- Establishment of a Respiratory Protection Program
- State of the Art Work Practices
- Personal Hygiene
- Additional Safety Hazards
- Medical Monitoring
- Air Monitoring
- Relevant Federal, State and Local Regulatory Requirements, Procedures, and Standards
- Asbestos Waste Disposal

MEDICAL EXAMINATION: I have had a medical examination within the past 12 months which was paid for by my employer. This examination included: health history, occupational history, pulmonary function test, and may have included a chest x-ray evaluation. The physician issued a positive written opinion after the examination.

Signature: _____

Printed Name: _____

Social Security Number: _____

Witness: _____

ATTACHMENT #3

AFFIDAVIT OF MEDICAL SURVEILLANCE, RESPIRATORY PROTECTION AND TRAINING/ACCREDITATION

OWNER PROJECT NAME AND NUMBER: _____

OWNER MEDICAL FACILITY: _____

ABATEMENT CONTRACTOR'S NAME AND ADDRESS: _____

1. I verify that the following individual

Name: _____ Social Security Number: _____

who is proposed to be employed in asbestos abatement work associated with the above project by the named Abatement Contractor, is included in a medical surveillance program in accordance with 29 CFR 1926.1101(m), and that complete records of the medical surveillance program as required by 29 CFR 1926.1101(m)(n) and 29 CFR 1910.20 are kept at the offices of the Abatement Contractor at the following address.

Address: _____

2. I verify that this individual has been trained, fit-tested and instructed in the use of all appropriate respiratory protection systems and that the person is capable of working in safe and healthy manner as expected and required in the expected work environment of this project.

3. I verify that this individual has been trained as required by 29 CFR 1926.1101(k). This individual has also obtained a valid State accreditation certificate. Documentation will be kept on-site.

4. I verify that I meet the minimum qualifications criteria of the OWNER specifications for a CPIH.

Signature of CPIH/CIH: _____ Date: _____

Printed Name of CPIH/CIH: _____

Signature of Contractor: _____ Date: _____

Printed Name of Contractor: _____

ATTACHMENT #4

ABATEMENT CONTRACTOR/COMPETENT PERSON(S) REVIEW AND ACCEPTANCE OF THE OWNER'S ASBESTOS SPECIFICATIONS

OWNER Project Location: _____

OWNER Project #: _____

OWNER Project Description: _____

This form shall be signed by the Asbestos Abatement Contractor Owner and the Asbestos Abatement Contractor's Competent Person(s) prior to any start of work at the OWNER related to this Specification. If the Asbestos Abatement Contractor's/Competent Person(s) has not signed this form, they shall not be allowed to work on-site.

I, the undersigned, have read OWNER's Asbestos Specification regarding the asbestos abatement requirements. I understand the requirements of the OWNER's Asbestos Specification and agree to follow these requirements as well as all required rules and regulations of OSHA/EPA/DOT and State/Local requirements. I have been given ample opportunity to read the OWNER's Asbestos Specification and have been given an opportunity to ask any questions regarding the content and have received a response related to those questions. I do not have any further questions regarding the content, intent and requirements of the OWNER's Asbestos Specification.

At the conclusion of the asbestos abatement, I will certify that all asbestos abatement work was done in accordance with the OWNER's Asbestos Specification and all ACM was removed properly and no fibrous residue remains on any abated surfaces.

Abatement Contractor Owner's Signature _____ Date _____

Abatement Contractor Competent Person(s) _____ Date _____

END OF SECTION

SECTION 15010
BASIC MECHANICAL REQUIREMENTS

PART 1 - GENERAL

1.01 DIVISION 15000 INDEX

DIVISION 15 - MECHANICAL

Section

- 15010 - Basic Mechanical Requirements
- 15140 - Supports and Anchors (including Seismic Restraints)
- 15170 - Electric Motors and Starters
- 15171 - Variable Frequency Drives
- 15190 - Mechanical Identification
- 15242 - Vibration Isolation
- 15250 - Insulation
- 15300 - Fire Protection
- 15410 - Plumbing Piping
- 15450 - Plumbing Equipment
- 15510 - Hydronic Piping
- 15515 - Hydronic Piping Accessories
- 15520 - Steam and Condensate Piping
- 15525 - Steam and Condensate Piping Accessories
- 15540 - HVAC Pumps
- 15555 - Steam Boilers
- 15565 - Fire Tube Condensing Boiler
- 15890 - Ductwork
- 15910 - Ductwork Accessories
- 15950 - Control Systems
- 15969 - Thermometers, Gauges and Instrumentation
- 15990 - Testing, Adjusting & Balancing

1.02 SECTION INCLUDES

Comply with all Division 1 Specifications. When Division 15 sections are more stringent, they take precedence. All Division 15 sections are bound by these requirements. In case of conflict, obtain a decision from the Architect/Engineer.

- A. Work Included.
- B. Related Work.
- C. Equipment/Items furnished by others and Installed by Division 15.
- D. Items to be furnished for Installation by Division 16
- E. Job and Job Site Conditions.
- F. Intent.
- G. Deviations.
- H. Quality Assurance.
- I. Codes and Standards.
- J. Coordination.
- K. Submittals.
- L. Dust Control
- M. Record Drawings.
- N. Final Cleaning.

- O. Operating and Maintenance Manuals.
- P. Warranties.

1.03 WORK INCLUDED

- A. All labor, materials, tools, and services for complete installation of mechanical, fire protection and plumbing equipment and systems contained in the Contract Documents.

Significant integration with existing systems is required under this project. Allow for the time and investigation to identify systems and components that are affected by these connections even though they are outside of the construction area and protect these systems from service interruption and damage. Maintain these components, keeping them in service throughout construction and include them in the permanent construction.

A major part of this project involves coordination with and support of Hitachi Proton Therapy Equipment, PTE. There is an extensive Equipment Building Interface, EBI, set of documents that establish the requirements of the building and its respective systems to support the PTE. At the time Construction Documents were completed the EBI documents were not finalized and the Contractor must comply with the most current EBI documents as equipment is installed. Refer to the EBI for all locations of service connections and coordinate with the Hitachi drawings in determining where to place work such that interference with Hitachi is avoided and service clearances are maintained. The EBI documents supercede the Construction Documents in establishing Contractor requirements, dimensions, interface points and defining the water quality, flow rates, pressures and temperatures as they relate to the PTE. Compare the most current EBI documents to the Construction Documents and bring any deviations to the attention of the Engineer via RFI process.

- B. Principal features of the work included are:
 - 1. A complete cooling, heating, ventilating, and exhaust system throughout the new and renovated areas while maintaining HVAC service to the adjacent areas that are not renovated.
 - 2. Duct, air distribution, AHU, terminal units and additions to provide air supply and exhaust to support the requirements of the new areas.
 - 3. Hydronic, compressed air, steam, condensate piping and accessories to serve the coils, utility piping, humidifier and equipment throughout the new and renovated space. Associated firestopping, piping insulation, supports, vibration isolation, identification, and penetrations.
 - 4. Control systems (Furnished as a Separate Contract to the General Contractor) All HVAC, medical gas secondary monitoring, domestic water heater and radiation monitoring/search/crash controls with integration and mapping into the existing Building Automation System.
 - 5. Roof, wall and floor penetrations and supports for HVAC equipment, piping and drain systems associated with equipment and piping installed or modified under

this Division 15. Cutting and patching for mechanical work. Providing all support steel, strut, bases, watertight seals and seismic restraints for mechanical work.

6. Plumbing fixtures, equipment, plumbing system demolition, additions and modifications to support the new and renovated space and equipment added under this project. RPBP, pumping stations, wetwells, valve boxes, capping and relocating piping, medical gas and vacuum piping, alarms and accessories, lab gas, lab vacuum piping and accessories, supports, penetrations, identification and insulation.
7. Identifying with adhesive labels all Division 15 piping, duct, components, valves and equipment whether concealed or exposed, new, renovated or relocated.
8. Testing and balancing of mechanical systems. Correct deficiencies identified by testing and balancing Contractor.
9. Preparation and submittal of maintenance manuals, shop drawings, product data, and samples. Factory start-up of all equipment and Owner training.
10. Maintaining a record set of drawings, marking them to indicate locations of concealed items, and deviations made to suit conditions and production of mechanical as-built drawings.
11. Preparation of surfaces for painting, mechanical duct and piping and associated coverings, penetration patches and supports in locations where noted.
12. Automatic sprinkler protection of the new, renovated and affected areas to comply with applicable codes and requirements of all Authorities Having Jurisdiction over this project.
13. Temporary ducting, valves, caps, piping and insulation as needed to accommodate the phased installation of the work and partial use and occupancy that must be accommodated throughout the course of this project. This work is not specifically indicated on the plans, but plumbing systems, HVAC, and fire protection systems suitable for the use of the space must be maintained via permanent or temporary means for all occupied areas.
14. Seismic restraints and seismic restraint design by an engineer licensed in the state where the work is installed for every item installed by Division 15.

1.04 RELATED WORK

- | | | |
|----|--------------|---------------------------------|
| A. | Division 1: | General Requirements |
| B. | Division 3: | Concrete |
| C. | Division 5: | Metals |
| D. | Division 7: | Thermal and Moisture Protection |
| E. | Division 9: | Finishes |
| F. | Division 16: | Electrical |

1.05 EQUIPMENT/ITEMS SUPPLIED BY OTHERS AND INSTALLED BY DIVISION 15.

- A. Certain items are new items, Owner Supplied Contractor Installed, OSCI. These items are required to be inspected, unloaded, stored, installed and/or connected by the Contractor as part of the work of this Contract. Owner supplied items may be furnished directly by the Owner or may be furnished by Contractors under separate contracts with the Owner.

The following items are furnished by others, and shall be received, unloaded, placed and connected by the Division 15 Contractor:

- a. Duct smoke detectors, furnished by Div 16.
 - b. Fume Hoods.
 - c. Grossing Sinks.
 - d. Surgery ceiling air distribution / boom support / lighting. Furnished and installed by GC, duct and piping connections as well as sealing by DIV15.
 - e. Headwalls and booms with medical gas inlets / outlets.
 - f. Integral sinks furnished with various countertops as scheduled.
- B. Responsibilities of party furnishing equipment:
1. Arrange for and deliver necessary shop drawings, product data and samples to the Contractor.
 2. Arrange and pay for Product delivery to the site, in accordance with the construction schedule.
 3. Deliver supplier's bill of materials to Contractor, when required.
 4. Inspect deliveries jointly with Contractor.
 5. Submit claims for transportation damage.
 6. Arrange for replacement of damaged, defective, or missing items.
 7. Provide manufacturer's warranties, service and start-up.
- C. Contractor's Responsibilities:
1. Designate delivery date for each Product in the Construction Schedule.
 2. Review shop drawings, product data and samples. Submit to Architect/Engineer with notification of any discrepancies or problems anticipated in the use of the product.
 3. Handle products at the site, including unloading, uncrating, storage and protection of the items from damage. Contractor agrees to assume full responsibility for, and insure all such items upon delivery.
 4. Assemble, install, connect, adjust and finish Products, as stipulated in the respective Section of Specifications.
 5. Repair or replace items damaged by Contractor.
 6. Coordinate with Vendor and include warranty and O&M information in close out documents.
 7. Coordinate any start-up, servicing and Vendor inspections to assure installation is in accordance with manufacturers' recommendations.

1.06 ITEMS TO BE FURNISHED FOR INSTALLATION BY DIVISION 16

- A. The following items are mentioned here to make the Division 16 Contractor aware of the connection requirement since these requirements might be confusing or difficult to interpret elsewhere. This in no way relieves the Division 16 Contractor from his requirements delineated elsewhere.
1. Remote HVAC Control devices, 120V/1Ph.
 2. Interlocks between motorized dampers and fans, 120V/1Ph.
 3. VFDs are furnished and installed on strut racks or stands by DIV15. All wiring is by DIV16.
 4. Medical gas alarm panels and associated pressure sensors.

1.07 JOB AND JOB SITE CONDITIONS

- A. Contractor use of Site:
 - 1. Limit use of site to cause as little interference or interruption of existing utilities and services as possible.
 - 2. Schedule work which will cause interference or interruption in advance with the Owner, General Contractor, G.C., authorities having jurisdiction, and all affected trades.
 - 3. Parking area for Contractor's trucks is allowed only in areas designated by the Owner. Arrangements will be made for delivery of materials and removal of debris in locations designated by the Owner.
 - 4. Remove all boxes and large debris and place in dumpster on a daily basis. Keep corridors and walkways clear. Do not block exits. Broom cleaning is required on a daily basis.
- B. Safety:
 - 1. Erect substantial barricades, trench and floor opening coverings, and/or fencing sufficient to prevent injury to persons or damage to property. Construct to prevent entry of unauthorized persons.
 - a. Construct dust curtains, barriers, barricades, etc., as required to maintain safe working conditions using non combustible materials.
 - 2. All temporary works required by the Contractor to fulfill his Contract shall at all times comply with local and governing codes and laws and furnish protection to workmen and the public.
 - a. Shore all trenches and ventilate all confined spaces as required by governing codes. Use only trained and certified personnel to perform work in trenches and confined spaces.
 - 3. Do not block or obstruct building entrances or exits.
 - 4. Provide temporary lifting and hoisting devices and equipment as required to distribute materials and equipment to various locations.
 - 5. Provide temporary heating as required for the proper protection and drying of all work and for freeze protection of HVAC and plumbing piping.
- C. Material Storage: Contractor and subContractors shall provide and maintain adequate protection and security for materials stored on site. Provide/construct in area only as directed by the Owner.
 - 1. Provide suitable and sufficient enclosed and covered spaces, with raised flooring, to protect materials and equipment subject to damage by weather or construction.
 - 2. Provide sheds, as necessary, to suitable store materials and equipment needing limited protection.
- D. Electricity, Natural Gas, and Water for Construction: The Contractor shall pay for electricity, natural gas, and water required for construction purposes. The Contractor shall provide and run the necessary lines, temporary services, standpipes, hoses, extension cords, etc. for construction use.
- E. Signage: The Contractor is not allowed to erect signage without the written consent of the Owner.
- F. Examine the Contract Documents to determine how other work will affect the execution of mechanical work. Coordinate with affected trades and schedule work as necessary to avoid construction delays.

- G. Determine sizes and verify locations of all existing utilities on or near site.
- H. Make arrangements for and pay for all utility connections.
- I. Make arrangements for and pay for all necessary permits, licenses and inspections.

1.08 INTENT

- A. The Contract Documents (drawings, specifications and any addenda) describe the work of this project. Any item mentioned in one part shall be as binding as though mentioned in all.
- B. The Contract Documents form a guide for a complete mechanical installation. Where an item is reasonably necessary for a complete system, but not specifically mentioned, such as runout piping, duct hangers or transitions, offsets, drains, wiring, interlocks, linkages, disconnects, starters, etc., provide same at no additional cost.
- C. Mechanical layouts indicated on drawings are diagrammatical only. Exact locations of ducts, pipes, and equipment shall be governed by field verification of available space, the drawings of related trades, and adjustments to assure that the new work will fit in available space while maintaining all required service accessibility. Field coordination drawings are encouraged to prevent conflicts. Coordination drawings are required for equipment rooms, outdoor equipment sites and all congested areas to verify the available space and resolve conflicts with other trades. Architect/Engineer reserves the right to make reasonable changes in location of mechanical equipment and appurtenances without affecting the Contract cost.
- D. It is the intent of these specifications and the Contract Documents that each and every fixture, piece of equipment, appliance, and any other related articles shown on the drawings or specified herein, as required for proper completion of the work, shall be completely installed, connected, wired, and made satisfactorily operable for the use and service for which it was intended. The manufacturer or vendor of any fixture, equipment or appliance shall see to it that all connections, whether mechanical or wired, are properly built-in or attached to the article when or before it reaches the job site so it will operate. Notwithstanding any omission or failure on the part of suppliers to provide suitable connections, it is the responsibility of the Contractor to install and connect such articles.

1.09 DEVIATIONS

- A. No deviations from Contract Documents is allowed without full knowledge and written consent of Architect/Engineer.
- B. Should Contractor find during progress of work, that in his judgement, existing conditions warrant a modification of any particular requirement desirable he shall report such item with any applicable recommendation promptly to the Architect/Engineer for decision or instructions.

1.10 QUALITY ASSURANCE AND COMMISSIONING

- A. Comply with applicable local, state and federal codes and requirements of officials having jurisdiction.

- B. Comply with applicable requirements of recognized industry associations which promulgate standards for the various trades. (See individual Sections of Division 15.)
- C. Employ only skilled and experienced mechanics for this work. Employ competent, qualified mechanics with minimum 15 years of experience to supervise the work.
- D. Section 01810 "General Commissioning Requirements" requires the engagement of a Commissioning Agent to document the completion of the Fire Suppression, Fire Alarm, Plumbing, Medical Gas, HVAC and Electrical systems for the project. Comply with the requirements of Section 01810 as a Commissioning Team member for the commissioning of the various building systems.

1.11 CODES AND STANDARDS

- A. Perform work specified in Division 15 in accordance with codes and standards listed below, and such standards that may be specified in other Sections. When these specifications are more stringent, they take precedence. In case of conflict, obtain a decision from the Architect/Engineer. The most current edition of the following codes shall apply except the building codes shall be the set enforced at the time construction documents are released for bid. Refer to the complete document set for applicable editions of each code.
 - 1. NFPA 90A: Air Conditioning and Ventilation Systems.
 - 2. NFPA 101: Life Safety Code.
 - 3. International Building Code.
 - 4. International Mechanical Code.
 - 5. International Plumbing Code.
 - 6. International Gas Code.
 - 7. International Fire Code.
 - 8. North Carolina Accessibility Code with 2004 Amendments
 - 9. State Energy Code.
 - 10. AGA: American Gas Association.
 - 11. ANSI: American National Standards Institute.
 - 12. ARI: American Refrigeration Institute.
 - 13. ASHRAE: American Society of Heating Refrigeration and Air Conditioning Engineers.
 - 14. ASME: American Society for Mechanical Engineers.
 - 15. ASTM: American Society for Testing and Materials.
 - 16. AWWA: American Water Works Association.
 - 17. ADA: Federal Register, Vol 56, No. 144, Rules and Regulations.
 - 18. MSS: Manufacturer's Standardization Society of the Valve and Fitting Industry.
 - 19. NEMA: National Electrical Manufacturers' Association.
 - 20. NFPA: National Fire Protection Association.
 - 21. SMACNA: Sheet Metal and Air Conditioning Contractors' National Association.
 - 22. UL: Underwriters' Laboratories, Inc.
 - 23. National Association of Corrosion Engineers Standard RP-01-69 and RP-02-85 for Recommended Practice.

1.12 COORDINATION

Employ and pay for services of a person or firm technically qualified and experienced in
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field of coordination for the type of work required for this Project.

- A. Coordinate work of Divisions 15 with work of Division 16 and other affected Divisions. Check compatibility with equipment, electrical characteristics, and operational control requirements.
- B. Visit site and be informed of conditions under which work must be performed. Check field dimensions and clearances and relationship to available space and anchors. No subsequent allowance will be made because of error or failure to obtain necessary information to completely estimate and perform all work involved.
- C. Immediately after notification of contract award meet with affected trades, review shop drawings, product data, and samples for compliance with Contract Documents and for coordination among work of all sections of the Project Manual. Coordination drawings are required for equipment rooms and areas congested with equipment in order to organize installation of Products, for the efficient use of available space, to properly sequence the installation and to identify potential conflicts.
 - 1. Coordination drawings shall be 1/8" scale on 30"x42" paper as a minimum. AutoCAD *.dwg drawing format and pdfs are required for all drawing submissions. In congested areas where drawing clarity will be questionable increase the drawing scale to 1/4 " and provide sections and elevations. Note above finish floor elevation (AFF) of pipes, ducts, etc. in plan view drawings. Drafting and lettering shall be located to maximize the readability of the drawings.
 - 2. When drawings are complete transmit to General Contractor for review and approval, then transmit to Architect/Engineer.
 - 3. Submit coordination drawings after submittal review is complete, but before any work is begun in the equipment rooms. Revise and resubmit package as required, identify all changes made since previous submittal.
 - 4. After Architect/Engineer review of original and revised documents, reproduce, and distribute one copy to each to the affected trades plus four for the General Contractor, Owner, Architect and Engineer.
 - 5. Coordination documents will form a part of the "As-Built" document set. Division 15 shall maintain documents for the duration of the Work, recording changes due to site instructions, modifications, or adjustments including Architectural. Submit As-Built Coordination documents to Owner with claim for final Application for Payment.
 - 6. Store original coordination documents separate from construction documents.
- E. Carefully examine specifications and drawings to be thoroughly familiar with items which require fire protection, plumbing, HVAC connections, control interface, structural support, painting and coordination.
- F. Notify other tradesmen of any deviations or special conditions necessary for installation of work. Resolve interferences between work of various Contractors prior to installation. If necessary, remove and properly reinstall, without additional cost to the Owner, work not installed in accordance with specifications and drawings and without proper coordination. Architect/Engineer shall be the mediating authority in deviation and disputes arising on the project.
- G. Where conflicts exist between Contract Documents, Contractor shall refer such conflict to the Architect/Engineer for decision before proceeding with work.
- H. Equipment shall be installed in accordance with manufacturer's recommendations. Where conflicts occur between manufacturer's recommendations and Contract

Documents, refer such conflicts to Architect/Engineer for decision before proceeding with work.

- I. Insofar as it is possible to determine in advance, advise masonry tradesmen to leave proper chases and openings. Provide dimensioned drawings identifying the location of sleeves as well as the diameter and material type for placement during concrete forming. Place all outlets, anchors, sleeves, and supports prior to pouring concrete or installation of masonry work. Should Contractor neglect doing this, and cutting and/or patching required to be done is at this Contractor's expense.
- J. Section 15140 defines seismic restraint, support and anchoring requirements that apply to all work under Division 15 unless more stringent requirements are indicated elsewhere or by manufacturer's recommendations.

1.13 SUBMITTALS

- A. Apply Contractor's stamp, 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. All submittals shall initially be submitted electronically with paper submittals provided for use in the field once they are approved.
- B. The purpose of shop drawing submittals by the Contract Documents is to demonstrate to the Architect/Engineer that the Contractor understands the design concept and that he demonstrates his understanding by indicating the type of equipment and materials he intends to furnish and install and by detailing the fabrication and installation methods to be used.
- C. Deviations from the specifications and drawings shall be noted on the shop drawing or equipment brochure. If none are noted it shall be assumed the material fully meets the specified requirements.
- D. If deviations, discrepancies, or conflicts between shop drawing or equipment brochures and the Contract Documents are discovered either prior to or after shop drawing submittals are processed, the Contract Documents shall control and shall be followed.
- E. Shop Drawings: Submit copy of shop drawings in Autocad *.dwg format as well as *.pdf format, including:
 1. Automatic temperature control system.
 2. Layouts of equipment rooms.
 3. Duct, Piping, and other work located in congested areas.
- F. Brochures: Submit one copy to the Engineer for approval. The Engineer will issue his comments. Upon submittal approval by the Engineer prepare the number of copies specified under Division 1, but not less than 10, and distribute accordingly, manufacturer's brochures including:
 1. Identify Project, Contractor, SubContractor or supplier; pertinent Drawing sheet and detail number(s), and specification Section number, as appropriate.
 2. Complete descriptions.
 3. Illustrations.
 4. Rating data, accessories, dimensional data, and features as scheduled on drawings and specified herein. Highlight data specific to this project with red or yellow

- markings so that the unit submitted is clearly identified.
5. Capacities stated in the terms specified.
 6. When specified submit manufacturers' printed instructions for delivery, storage, assembly, installation, start-up, adjusting, and finishing.
 7. When specified provide manufacturers' certificate of performance. Certificates may be recent or previous certified test results on material or Product, but must be acceptable to Architect/Engineer.
 8. Clearly and completely cross out any features, items, dimensions, options, accessories and descriptions that are not included or pertinent to the equipment offered on this project.
- G. Schedule submittal to expedite the Project, and deliver to the prime Contractor for review and distribution.
- H. Provide space for Contractor and Architect/Engineer review stamps.
- I. Revise and resubmit submittal as required, identify all changes made since previous submittal.
- J. Distribute copies of reviewed submittal to concerned parties. Instruct parties to promptly report any inability to comply with provisions.
- K. Submit Construction Progress Schedule for Architect/Engineers review.
1. Revise and resubmit as required.
 2. Submit revised schedules with each Application for Payment, identifying changes since previous version.
 3. Indicate estimated percentage of completion for each item of Work at each submission.

1.14 DUST CONTROL

- A. Provide duct, filters, fans, room pressurization monitoring as indicated. The General Contractor provides all physical barriers to separate construction areas from adjacent spaces. These barriers are typically flame retardant plastic sheeting for short term separations and are metal stud and gypsum board for barriers that are required for more than 10 calendar days.
1. The pressurization sensor is a ball in tube device that will display a red ball on the clean side if the construction area is not pressurized to a negative 0.01" WC relative to the non-construction side. ADI model #ADI-69-V-N, ph# 888.334.4545.
 2. Where filters are indicated connected to an existing exhaust system than temporary saddle in a 24/12 tap with MBD and fabricate a track to hold two 24x24x2" filter on each side of the tap. Install a 30% pleated filters and balance to achieve a negative construction area pressurization -0.02"WC. Patch duct to match existing when construction is complete.
 3. Where a filter fan is shown provide a 1900/1200 CFM HEPA-AIRE #H2000LA negative air machine with two speeds, 1 HP 120/1 motor, casters, local filter alarm, pleated prefilter, minimum of 30% efficiency, final 12" thick HEPA filter 99.997% effective at capturing 0.3 micron particulate and rate for 2000 CFM at 1.85" WC pressure loss, 12 round discharge collar with flexible duct and discharge grille or alternate connector as needed to connect the unit to a location where air can be discharged. Spaces exceeding 2000 SF will require one filter-fan for each additional 2000 SF or fraction thereof. Maintain filters in good serviceable condition at all times.

4. Large areas are subject to BAS monitoring of the space pressurization and these applications will be addressed as a part of Section 15950.

1.15 RECORD DRAWINGS

- A. Keep a record set of Contract Drawings, Specifications, Addenda, Change Orders and other Modifications to the Contract, and Reviewed shop drawings, product data, and samples at the job site exclusively for recording deviations from those drawings which are necessary because of job conditions. Label each document "Project Record". Store Record Documents separate from documents used for construction. Record locations and depths of buried and concealed piping, utilities, and appurtenances by indicating top depths and the distances from fixed, easily identifiable objects such as structural or exterior building walls or columns. Where pipes, utilities, and appurtenances are concealed in walls, indicate distances from building corners or other building features not likely to be disturbed by future alterations. Mark deviations in colored pencils so that work of various systems can be easily identified. Deliver this set to the G.C. after deviations are recorded on vellums as described herein.
- B. Specifications: Legibly mark and record at each Product section description of actual Products installed, including the following:
 1. Manufacturer's name and product model and number.
 2. Product substitutions or alternates utilized.
 3. Changes made by Change Order, Addenda, and Modifications.
- C. Record Documents and Shop Drawings: Legibly mark each item to record actual construction including:
 1. Field changes of dimension and detail.
 2. Details not on original Contract Drawings.
- D. When work is completed, record all deviations on magnetic media CAD drawings, delete Architect/Engineer seal from all documents, add the notation "As-built" on each sheet, and submit reproducible vellums as well as electronic media copies of completed record "as-built" drawings to Prime Contractor for review and approval.
- E. Forward final approved vellum tracings and electronic files to the Architect/Engineer for approval with final application for payment. Revise the files as required by Architect/Engineer and resubmit where any deviations are not included.

1.16 FINAL CLEANING

- A. In addition to daily broom cleaning, Contractor will provide final cleaning prior to acceptance of systems for beneficial use.
- B. Remove waste and surplus materials, rubbish, and construction facilities from the site. Cleaning and disposal practices must comply with all codes, ordinances, regulations and anti-pollution laws.
- C. Building Finished Surfaces and Equipment:
 1. Remove grease, mastic, adhesives, dust, dirt, stains, labels, fingerprints, and other foreign matter from sight-exposed interior and exterior surfaces.
- D. HVAC and Plumbing Systems:
 1. Clean AHU coils and replace air filters if units are operated prior to acceptance of

- systems by Owner for beneficial use.
2. Remove start-up strainers, clean all debris from strainers and leave normal strainer screen in place. Resecure all components and insulation. Deliver start-up strainer screens to Owner.
 3. Replace all prefilter air filters and terminal unit air filters at the completion of construction.
 4. Clean ducts, fans, and coils if units were operated during construction.
 5. Clean plumbing fixtures inside and out.
 6. Check aerators and washers, and clean off debris.
 7. Touch-up paint or strip and repaint equipment that has factory finished marred by construction activity. The Architect/Engineer will render final decision on which equipment requires touch-up/repainting and will decide when the finish is equivalent to new equipment.
- E. Clean interior and exterior of Variable Frequency Drives, motor controllers and starters to remove construction dust and debris.
- F. Contractor Inspection: Prior to Owner's inspection, conduct an inspection of the entire work area to ensure that it is clean.

1.17 OPERATING AND MAINTENANCE MANUALS

- A. Three sets of the following data are required in paper as well as a *.pdf copy:
1. Operating and maintenance instructions.
 2. Spare parts lists.
 3. Copies of approved submittal data.
 4. Equipment warranties.
 5. List showing company name, address, telephone number and local person to contact for service on equipment and systems.
- B. Arrange each set of data in an orderly way with section tabs, and bind each set in a premium quality three-post, hard cover binder.
1. Prepare binder covers with printed title "OPERATION AND MAINTENANCE INSTRUCTIONS", title of project.
 2. Contents: Prepare a Table of Contents for each volume, with each Product or system description identified.
 3. Part 1: Directory, listing names, addresses, and telephone numbers of Architect/Engineer, Contractor, SubContractors, and major equipment suppliers.
 4. Part 2: Operation and maintenance instructions. Including the following:
 - a. Significant design criteria.
 - b. List of equipment.
 - c. Parts list for each component.
 - d. Operating instructions.
 - e. Maintenance instructions for equipment and systems.
 - f. Maintenance instructions for finishes, including recommended cleaning methods and materials and special precautions identifying detrimental agents.
 5. Part 3: Project documents and certificates, including the following:
 - a. Shop drawings and product data.
 - b. Certificates.
 - c. Photocopies of warranties, and bonds.
- C. Submit one copy of completed volumes in final form 7 days prior to final inspection. This copy will be returned after final inspection, with Architect/Engineer comments.

Revise content of documents as required prior to final payment application.

- D. Submit final volumes revised, within 7 days after final inspection.

1.18 WARRANTIES

- A. Execute and assemble documents from SubContractors, suppliers, and manufacturers.
- B. Provide Table of Contents and assemble in 3-ring premium quality binder.
- C. Submit prior to final Application for Payment.
- D. For items of Work delayed beyond date of Substantial Completion, provide updated submittal within 7 days after acceptance, listing date of acceptance as start of warranty period.
- E. A minimum of one year parts and labor warranty from the date of substantial completion is to be provided for the systems installed. Where additional warranty requirements are noted the more stringent shall apply. Where existing systems are affected by this project they are to be included in the one year warranty until proven that any problem they experience is not directly caused by modifications made during this project.
- F. The following equipment is subject to extended parts only warranties.
 - 1. Refer to the individual specification sections

1.19 CONTRACT CLOSEOUT:

- A. Submit written certification that Contract Documents have been reviewed, Work has been inspected, and that Work is complete in accordance with Contract Documents and ready for Architect/Engineer's inspection.
- B. Should the Architect/Engineer perform reinspection due to failure of the Work to comply with the claims of status of completion made by the Contractor:
 - 1. The Contractor will compensate the Architect/Engineer for such additional services at the rate of \$150/hour, including travel to and from job site.
 - 2. Such compensation will be made direct from the Contractor to the Architect/Engineer.
- B. Submit final inspection tag to prime Contractor.
- C. Submit final Application for Payment identifying total adjusted Contract Sum, previous payments, and sum remaining due.
- D. Owner will occupy and have use of all portions of the building.

PART 2 - PRODUCTS

2.01 SECTION INCLUDES

Comply with all Division 1 Specifications. When Division 15 specifications sections are more stringent, they take precedence. In case of conflict, obtain a decision from the

Architect/Engineer.

- A. Materials and Equipment.
- B. Transportation and Handling.
- C. Storage and Protection.
- D. Demolished and Abandoned Equipment.
- E. Basic Materials / Methods.

2.02 MATERIALS AND EQUIPMENT - GENERAL

- A. Within the Contract Documents relating to mechanical work, manufacturers' names, catalog numbers, and other proprietary references to materials and equipment are made. Such references are made to establish the standards of quality and type required and not to limit competition. Most known or acceptable manufacturers of competitive products are listed in applicable sections as "approved equals". Reasonable requests for substitution or additions to "approved equals" will be considered, but the Architect/Engineer in concert with the Owner will be the sole judge of acceptability of items proposed as substitutes.
- B. Materials and equipment used in carrying out these specifications are to be of domestic manufacture (unless specified to be of a foreign manufacturer), shall bear UL or other recognized testing laboratory label when such labels are available. Contractor may submit for Architect/Engineer approval foreign manufactured material or equipment, including necessary product information, evidence of successful experience with use of product in U.S., and a list of institutions with individual in charge to contact as a reference.
- C. Use specified or "approved equal" items as a basis for bidding.
 - 1. Architect/Engineer will consider requests for Substitutions prior to bid and within 14 days after date established in Notice to Proceed.
 - 2. Substitutions may be considered when a Product becomes unavailable through no fault of the Contractor.
 - 3. Document each request with complete data substantiating compliance of proposed Substitution with Contract Documents.
 - 4. A request constitutes a representation that the Contractor:
 - a. Has investigated proposed Product and determined that it meets or exceeds the quality level of the specified Product.
 - b. Will provide the same warranty for the Substitution as for the specified Product.
 - c. Will coordinate installation and make changes to other Work which may be required for the Work to be complete with no additional cost to Owner.
 - d. Waives claims for additional costs or time extension which may subsequently become apparent.
 - e. Will reimburse Owner for review or redesign services associated with re-approval by authorities.
 - 5. Substitutions will not be considered when they are indicated or implied on shop drawing or product data submittal, without separate written request, or when acceptance will require revision to the Contract Documents.
 - 6. Substitution Submittal Procedure:
 - a. Submit ten copies of the request for Substitution for consideration. Limit each request to one proposed Substitution.
 - b. Submit shop drawings, Product data, and certified test results attesting to the proposed Product equivalence.
 - c. The Architect/Engineer will notify Contractor, in writing, of decision to accept or

reject request.

- D. Products: Means new material, machinery, components, equipment, fixtures, and systems forming the Work. Does not include machinery and equipment used for preparation, fabrication, conveying and erection of the Work. Products may also include existing materials or components required for reuse.
- E. Do not use materials and equipment removed from existing premises, unless specifically permitted by the Contract Documents.
- F. Provide interchangeable components of the same manufacturer, for similar components.

2.03 TRANSPORTATION AND HANDLING

- A. Transport and handle Products in accordance with manufacturer's instructions.
- B. Promptly inspect shipments to assure that Products comply with requirements, quantities are correct, and Products are undamaged.
- C. Provide equipment and personnel to handle Products by methods to prevent soiling, disfigurement, or damage.

2.04 STORAGE AND PROTECTION

- A. Insofar as possible, deliver items in manufacturer's original unopened packaging. Store and protect Products in accordance with manufacturer's instructions, with seals and labels intact and legible. Where that is not practical, provide cover and shielding for all items with protective materials to keep them from being damaged. Store sensitive Products in weather-tight, climate controlled enclosures. Use care in loading, transporting, unloading, and storing to keep items from being damaged.
- B. Arrange storage of Products to permit access for inspection. Periodically inspect to assure Products are undamaged and are maintained under specified conditions.
- C. Protect nameplates on motors, pumps, pressure vessels and similar equipment. Do not paint or insulate over nameplate data.
- D. Protect plumbing fixtures and brass or chromium plated trim, valves and piping from damage. Cover fixtures during work of finishing trades.
- E. Keep dirt and debris out of pipes and ducts.
- F. Repair, restore, and replace damaged items.
- G. Cover factory finished equipment during work of finishing trades, e.g., fan coils, fin tubes, etc.

2.05 DEMOLISHED AND ABANDONED EQUIPMENT

- A. All equipment that is removed or functionally abandoned as a part of this contract shall be relocated or disposed of as directed by Owner. Stockpile this equipment in a location as directed by Owner. Take precautions to protect equipment from damage,

freezing, corrosion or other adverse conditions which would have a negative effect on the equipment. Repair any damage to equipment caused by the Contractor failing to take the aforementioned precautions. After Owner review of equipment, and written summary of equipment he wishes to keep, dispose of all unwanted equipment.

- B. The following items are specifically identified as to be turned over to the Owner:
1. Tube station.

2.06 BASIC MATERIALS/METHODS

- A. Structural steel for supports: ASTM A36 for shapes and plates; ASTM A500, Grade B for tubing; ASTM A53 Grade B for structural piping.
1. Galvanized members to be used in weather exposed areas, in fan plenums or areas of high humidity or condensation.
 2. Furnish all other members with shop coat of red primer.
 3. Shop fabricate for field assembly using bolts.
 4. Minimize field welding.
 5. Retouch primer, galvanized finish after field welding, cutting, drilling or scratching.
 6. ASTM A325 Bolts.
 7. Wedge expansion anchors equal to Hilti KB-TZ or Hilti KH-EZ screw anchor.
- B. Rain hoods and counter flashings:
1. Stainless steel: Minimum 20 gauge.
 2. Sheet copper: 24 OZ/SF.
 3. Sheet lead: 6 LBS/SF minimum.
 4. Sheet Aluminum: 0.050" minimum
- C. Access doors, panels and frames: Style and type as required for material in which installed.
1. Size: 16"x16" minimum, as indicated, or as required to allow inspection, service and removal of items served.
 2. 14 gauge minimum sheet metal for doors, 16 gauge frames of cadmium-plated or galvanized construction. Doors shall have expanded plaster rings where located in plaster walls or flanged finish where located in drywall or block construction.
 3. Panels shall have spring hinges with screwdriver locks in non-public areas. Key lock, keyed alike, for panels in public areas.
 4. Prime painted or rust inhibitive paint finish.
 5. UL labeled when in fire-rated construction, 1.5 hour rating.
 6. Provide in walls, floors, and ceilings to permit access to all equipment and piping requiring service or adjustment. Examples of such equipment needing access are fire and/or smoke dampers, valves, shock arrestors, air vents, drains and equipment needing periodic or replacement maintenance.
 7. Division 15 is responsible for purchase and location of access panels. Engage service of Trade Contractor responsible for building system in which panels are to be installed.
 8. Approved manufactures are Inland-Milcor, Bilco, or Miami Carey. Use panels equal to Milcor Style M for masonry and drywall construction. Equal to Milcor Style K for plastered masonry walls and ceilings. Stainless steel panels shall be used in ceramic tile, glazed structural tile or in locations noted on plans.

PART 3 - EXECUTION

3.01 SECTION INCLUDES

Comply with all Division 1 Specifications. When Division 15 specifications sections are more stringent, they take precedence. In case of conflict, obtain a decision from the Architect/Engineer.

- A. Locations.
- B. Excavating and Backfilling.
- C. Cutting and Patching.
- D. Counterflashing
- E. Connection to Equipment Furnished by Owner.
- F. Firestopping
- G. Service of Systems.
- H. Acceptance of Systems.

3.02 LOCATIONS

- A. Mechanical layouts indicated on drawings are diagrammatical. Exact locations of ducts, pipes, and equipment may vary because of conflicts with work of other trades and equipment manufacturer deviations. Work out conflicts where relocations will not affect operation or appearance of systems. Where conflicts cannot be worked out between trades, Architect/Engineer will decide. Architect/Engineer reserves the right to make reasonable changes in locations without additional cost.
- B. Locate equipment requiring periodic servicing so that it is readily accessible. Don't back up service sides to walls, nor place it too close to other equipment to make service difficult or impractical. Where equipment is above an accessible ceiling locate equipment within 18" of the ceiling so that it may be reasonably service from a standing position on a ladder.
- C. Protect service personnel from contact with sharp edges by installing protective caps and covers where suspended equipment, piping, ductwork, bracing or associated supports are less than 76" above the floor or any other walking surface. Install caps on the bottom of all threaded rod, place plastic covers over all cut strut, wrap elastomeric insulation over edges of structural steel and glue in place. Use products similar to MacMaster Carr #3312T58 - 1-5/8" strut cover, # 9753K16 - 3/8" threaded rod cover and armacell AP self adhesive insulation tape or Engineer approved equivalent providing protection against accidental contact that could cause injury to service personnel.

3.03 EXCAVATING AND BACKFILLING

- A. Provide trenching, excavating, and backfilling necessary for performance of mechanical work.
- B. Trenching and excavation to be unclassified. No extra will be paid in the event that rock is encountered. The Contractor shall be responsible for the repair of concealed cables, electrical, piping or plumbing that is damaged as a result of excavation.
- C. Provide sheathing, shoring, dewatering, and cleaning necessary to keep trenches and their grades in proper condition for work to be carried on. Comply with all regulations regarding shoring and workers in trenches. Submit shop drawings of shoring to Architect/Engineer for review where trench depth exceeds 84" depth.
- D. Depth of excavation to provide a minimum of 24" cover above top of pipe. Excavation

to be carried to a depth of at least 6" below bottom of pipe elevation. Fill below pipe (6"), around pipe, and a minimum of 12" above pipe with Class "B" crushed stone tamped firm and even. Use several layers of backfill, none over 9" deep, compact each layer to 95% Standard Proctor (relative compaction) Separate top soil during excavation. Final layer of backfill (12" minimum) to be top soil. Trenches to be at least 18" wider than pipe with batterboards placed every 25'. Backfilling shall be done to exclude use of rock or stone above Class "B" crushed stone. In no case shall backfilling contain large rocks, tree roots, organic materials, trash or debris. Backfilling should carefully restore surface to its original condition.

- E. Piping through or under foundation walls must be sleeved with fabricated water stop seal welded to schedule 40 pipe and cast in the wall during construction.
- F. Where finished surface is asphaltic pavement or concrete the finished surface shall match adjacent surface and a minimum of 6" concrete shall provide a base for the finished surface. Finished surface shall be by others unless work of Division 15 should occur after the finished surface is in place or if Division 15 work disturbs existing finished surfaces.

3.04 CUTTING AND PATCHING

- A. Includes all cutting, fitting and patching, including attendant excavation, backfill and shoring required to complete the work or to:
 - 1. Make its several parts fit together properly.
 - 2. Uncover portions of the work to provide for installation of ill-timed work.
 - 3. Remove and replace defective work.
 - 4. Remove and replace work not conforming to requirements of Contract Documents.
 - 5. Remove samples of installed work as specified for testing.
 - 6. Provide routine penetrations of non-structural surfaces for installation of piping, ductwork and electrical conduit.
 - 7. Restore surfaces and voids, patch openings and conceal old surfaces left by or uncovered by demolition.
- B. Submit a written request to Architect/Engineer well in advance of executing any cutting or alteration which affects:
 - 1. The work of the Owner or any separate Contractor.
 - 2. The structural value or integrity of any element of the Project.
 - 3. The integrity or effectiveness of weather-exposed or moisture-resistant elements or systems.
 - 4. The efficiency, operational life, maintenance or safety of operational elements.
 - 5. The visual qualities of sight-exposed elements.
 - 6. The temperature of a beam or column. (In general the beam flanges are not to be welded to for attachment of mechanical supports)
- C. Inspect existing conditions of the Project, including elements subject to damage or to movement during cutting and patching.
 - 1. After uncovering work, inspect the conditions affecting the installation of products, or performance of the work.
 - 2. Report any unsatisfactory or questionable conditions to the Architect/Engineer in writing; do not proceed with the work until the Architect/Engineer has provided further instructions.
 - 3. Provide adequate temporary support as necessary to assure the structural value or integrity of the affected portion of the work.

4. Provide devices and methods to protect other portions of the Project from damage.
 5. Provide protection from the elements for that portion of the Project which may be exposed by cutting and patching work, and maintain excavations free from water.
- D. Execute cutting and demolition by methods which will prevent damage to other work, and will provide proper surfaces to receive installation of repairs.
 - E. Execute excavation and backfilling by methods which will prevent settlement or damage to other work.
 - F. Employ the original Installer or Fabricator to perform cutting and patching for weather-exposed or moisture-resistant elements and sight-exposed finished surfaces.
 - G. Execute fitting and adjustment of products to provide a finished installation to comply with specified products, functions, tolerances and finishes.
 - H. Restore work which has been cut or removed; install new products to provide completed work in accord with requirements of Contract Documents.
 - I. Fit work airtight to pipes, sleeves, ducts conduit and other penetrations through surfaces.
 - J. Correct unnecessary damage, restore structural integrity and finish surfaces caused due to installation of mechanical work.

3.05 COUNTERFLASHING

- A. Counterflash ducts, pipes, curbs, equipment supports, etc., where penetration of roofs and outside walls occur.

3.06 CONNECTION TO EQUIPMENT FURNISHED BY OWNER (OTHERS)

- A. Connect or install equipment shown on mechanical drawings that requires plumbing and/or mechanical hookups.
- B. Rough-in piping and connect equipment. Obtain drawings from the equipment manufacturer which details all rough-in requirements.
- C. Provide piping, shutoff valves, drains, vents, traps, unions, dirt legs, caps, etc., required for a complete installation.
- D. Operating valves and controls which are an integral part of Owner furnished equipment are furnished with the equipment..
- E. Rough-in of utilities which conflict with approved shop drawings must be changed at no expense to the Owner.

3.07 SERVICE OF SYSTEMS

- A. If equipment is placed in service prior to acceptance of the project by Owner, operate equipment strictly in accordance with manufacturer's instructions.
 1. Employ competent, qualified personnel in operation of the equipment.
 2. Provide for proper operation and cleanliness.
 3. Install new filters and clean strainers in systems before turning them over to Owner. Clean interior of duct/pipe and coil air side if soiling has occurred.

4. If Architect/Engineer directs it, open up equipment for inspections, close equipment, and operate equipment in his presence for as long as he determines it is necessary.
 5. Do not use permanent HVAC equipment during periods where other trades are generating airborne dust.
- B. Lubricate equipment and perform such other maintenance as required to place it in first class operating condition.
- C. Adjust operating products and equipment to ensure smooth and unhindered operation in accordance with Contract Documents.

3.08 FIRESTOPPING

- A. Firestop all fire rated assemblies in full accordance with NFPA and UL listed assemblies and industry standards.
1. Maintain protective rating of partitions penetrated by duct using fire or fire/smoke dampers.
 2. Maintain protective rating of partitions penetrated by piping using sleeve assemblies with intumescent caulk or similar characteristics.

3.09 ACCEPTANCE OF SYSTEMS

- A. Complete the following before requesting a final inspection:
1. Work required under this division of specifications except as permitted.
 2. System balancing.
 3. Control system checkout.
 4. Furnish required operating instructions and closeout documents.
 5. Owner will accept job on basis of tests and inspections. Division 15 Contractor is to furnish necessary mechanics, test & balance, and controls personnel to operate the system, make any necessary adjustments, and assist with final inspection.
 6. If directed by Owner/Architect/Engineer, expose concealed work to demonstrate that work has been properly performed and restore work at no charge.
 7. G.C. representative must be present and sign off on all testing. Notify Owner 48 hours prior to scheduled testing.

END OF SECTION

SECTION 15140 SUPPORTS AND ANCHORS

PART 1 GENERAL

1.01 WORK INCLUDED

- A. Pipe, duct, and equipment hangers, supports, and associated anchors including all structural members which are required to distribute the loads to the building structure.
- B. Equipment bases and supports.
- C. Sleeves and seals.
- D. Flashing and sealing equipment curbs, vents and supports to the building roof and exterior.
- E. Seismic restraints for Division 15 duct, piping and equipment.
- F. Anchors for attachment to aerated autoclaved concrete planks.
- G. Flexible piping connections, seismic connectors, expansion joints.
- H. Quality Assurance for seismic inspections.

1.02 RELATED WORK

- A. All of Division 15 Sections unless individual Section is more stringent.
- B. All work specified in this section shall comply with the provisions of Division 1 and Section 15010.

1.03 SUBMITTALS

- A. Submit shop drawings of trapeze and other equipment, piping and duct supports in accordance with Division 1 and 15010. Seismic restraints require detailed shop drawings of every style restraint that is applied as well as scaled plans that specify the location and type of every restraint. Prepared under the direction and control of a registered professional engineer actively licensed in the state where the project is located.

PART 2 PRODUCTS

2.01 PIPE HANGERS AND SUPPORTS

- A. Hangers for Pipe:
Items 1, 2 & 3 apply to piping with less than 0.60" expansion.

Allow: 2.40" per 100 straight L.F. for steam and condensate,
1.20" per 100 straight L.F. for expansion of heating water piping,
0.30" per 100 straight L.F. for other piping.
 - 1. Carbon steel, adjustable, clevis equal to B-Line B3100. For cast iron through 6", all other piping through 4".
 - 2. Malleable iron, hinged, split type equal to B-line B3198H. For all piping through 2".
 - 3. Steel pipe clamp with forged steel weldless eye nut equal to B-line B3144 & B3200. For all piping 4" or greater.
 - 4. Adjustable Yoke Roller Hanger: For piping subject to 0.60" or more axial growth due to expansion; equal to Bline B3110.
 - 5. Field fabricated supports shall be constructed from ASTM A36/A36M, steel

shapes selected for loads being supported. Weld steel according to AWS D-1.1.

- B. Wall Support for Pipe: Angle iron bracket with suspended hangers equal to B-line figure B3065, B3067.
- C. Vertical Support: steel riser clamp equal to B-line figure B3373.
 - 1. Supports for vertical riser piping in concealed areas shall utilize double bolt riser clamps, with each end having equal bearing on the building structure at each floor level.
 - 2. Supports for vertical riser piping at floor levels in exposed areas (such as fire protection standpipe in stairwells) shall be attached to the underside of the penetrated structure utilizing drilled anchors, two hanger rods (sized as specified), and socket clamp with washers.
 - 3. Two-hole rigid pipe clamps or four-hole socket clamps with washers may be used to support pipe directly from adequate structural members where floor-to-floor distance exceeds required vertical support spacing and lines are not subject to expansion and contraction.
- D. Floor Support for Pipe: Adjustable steel pipe saddle, locknut nipple, floor flange, and concrete pier or steel support equal to B-line figure B3093 & B3088.
- E. Shield for Insulated Piping for use with trapeze and Clevis Hangers: galvanized steel shield over insulation in 180 degree segments, locking tabs at hanger, minimum 12 inches long, minimum 18 Ga., equal to B-line figure B3151; with calcium silicate or foamglass insulation in 180 degree segments and same length as shield at all support points inside of insulation jacket. Comply with B-Line standard gauge, locking tabs and length for any shop fabricated shields.
- F. Copper Pipe Support: Copper plated or plastic encased steel in accordance with systems noted herein for steel piping. All copper or brass lines shall be isolated from ferrous metals with dielectric materials to prevent electrolytic action. Plastic tape is not an acceptable isolation material. All water piping shall be isolated from building components to prevent the transmission of sound. Support and positioning of piping shall be by means of engineered methods that comply with IAPMO PS 42-96. These shall be Hubbard Enterprises/Holdrite support systems, C & S Mfg. Corp. or Owner-approved equivalent. Supports within chases and partitions shall be corrosion resistant metal plate, clamps, angles or channels, and aligned with structure in the vertical or horizontal position. Plastic supports are only allowed when approved by the Owner. Horizontal supports within chases and partitions that are attached to studs shall be attached at both ends. Drywall shall not be relied upon to support any piping. Supports for plumbing fixture water service piping within chases and partitions may be attached to cast iron drain and vent pipe with approved brackets and pipe clamps.
- G. Saddle: Formed steel saddle for welding to bottom of pipe at support points. For use with pipe rollers only. Equal to B-line B3160 through B3165.
- H. Trapeze: Field or shop fabricated structural steel with Roller chair equal to B-line B3124 for hot piping, B3096 for other piping. Shop drawings required for typical

trapeze for Engineer approval.

2.02 HANGER RODS

- A. Steel Hanger Rods: galvanized steel continuous threaded, 3/8" minimum.

2.03 OVERHEAD FASTENERS

- A. Concrete Anchors: (Maximum size 1/2" when supporting loads from bottom of concrete floor.)
 1. A minimum safety factor of 4 based upon 3500 psi concrete is required for all overhead piping support systems.
 2. Wedge anchors equal to Hilti Kwik KB-TZ.
 3. Chemical anchors subject to the approval by the structural Engineer of Record on this project.
- B. Beam clamps:
 1. Formed steel C-clamp with locknut equal to Bline B3151L with 11 gauge retaining strap B3362. 3/8" through 1/2" hanger rods only.
 2. Forged steel equal to Bline B3291-B3298 for 7/8" through 1-1/4" hanger rods.
 3. Formed steel equal to Bline B3055 for 5/8" through 3/4" hanger rods.

2.04 FLASHING

- A. Counter Flashing: 24 gage galvanized steel, copper or aluminum.
- B. Lead Flashing: 4 lb/sq ft sheet lead for waterproofing; one lb/sq ft sheet lead for soundproofing.
- C. Flexible Flashing: 50 mil thick sheet butyl, EPDM or as required to be in compliance with roof system construction.
- D. Caps: Galvanized Steel, 20 gage minimum; 16 gage at fire resistant elements.

2.05 EQUIPMENT PADS

- A. Fabricate pads of 4000 psi concrete with 10 GA 6X6 welded wire reinforcement, #4 bar overlapped 12", offset 3" around the full perimeter of pad. "J" Bolts positioned for securing equipment to pad. Pad height as noted, or 5.5" if not noted. Vertical pumps that are installed on the slab on grade to have a thickened concrete pad, minimum 18"x18"x12" thick with perimeter #4 deformed bar reinforcement 2" from top and 2" from bottom and tied together with vertical bars 14" O.C.. All floor mounted equipment to be provided with a pad or Engineer approved structural steel support frame. Extend pad 6" beyond footprint of equipment. Chamfer top edge of pad 1" on all sides or tool top edge with a radius. Finish grout and rub for a smooth void free surface.
- B. Refer to drawings for any applicable details. All equipment requires bolting to pad or slab structure to resist movement during seismic activity. Dowel pads into slab with #4 dowel 6" long with equal embedment in pad and slab. One dowel per 5 square feet of pad with a minimum of 4 per pad.

2.06 Flexible/Expansion/Seismic Pipe Connectors

This section addresses multiple applications of piping connections where flexibility is required.

- A. Seismic Pipe Connectors: Stainless steel hose flexible connectors shall be corrugated, stainless steel tubing with stainless steel wire braid covering and ends welded to inner tubing. The hose connectors shall be rated at 200 psig minimum working pressure. The end connections for 2 inches and smaller shall be threaded steel pipe nipple. The end connections for 2-1/2 inches and larger shall be flanged steel. Where the piping system that it connects with is copper the corrugations and braid shall be bronze with a bronze braid up to 2", larger sizes may be stainless steel construction with copper sweat connections. Medical gas piping to be oxygen clean and sealed by the factory. Refer to details for additional criteria of lateral and axial movement requirements. Provide +/- 4" lateral and +/- 4" axial if not indicated otherwise comprised of 45 degree connectors on each end with a 90 degree connector in the center and two sections of braided corrugated hose connecting these fittings. Provide all anchors and guides where recommended by the manufacturer or as indicated in installation details.
- B. Flexible section shall match the seismic pipe connector, but shall be a single straight section of flexible hose joined by two straight sections of piping with threaded, flanged or brazed copper stubs for connection to the piping system. Refer to details for additional application requirements. Flexible pipe connections are applied at pumps, compressors, chillers, cooling towers and other equipment on spring isolators.
- C. Expansion connectors are restrained pipe guides with a corrugated stainless steel section that provides 2", 3" or 4" of expansion capability or as noted on the plans and limits extension by the confined sleeve, 250 PSI working pressure at 350F, weld ends. Provide all design, shop drawings, anchors, pipe guides and spring supports to limit pipe movement in shafts to 0.625" at any branch connection in shafts. Horizontal pipe runs require design, anchors, pipe guides and shop drawings to control and compensate for the growth of the piping. Piping elongation/contraction to be based on the following temperature change from installation to operation.
Flexicraft Mod EP or equal.
 - 1. Steam 275F
 - 2. Steam Condensate 150F
 - 3. Heating Water 100F
 - 4. Chilled Water 40F

2.07 SLEEVES

- A. Sleeves for Pipes through Non-fire Rated Floors or Walls: Form with 16 gage galvanized steel. Always required on insulated pipes through open cell masonry walls.
- B. Sleeves for Pipes through below grade Beams, Footings, and Potentially Walls: Schedule 40 or heavier galvanized steel pipe, full depth of structural member, provide a seal welded 2" waterstop near the center of the sleeve, Linkseal model WS or engineer approved equal.
- C. Sleeves for Pipes through Fire Rated and Fire Resistive Floors and Walls, and

Fireproofing: Prefabricated fire rated sleeves including seals, UL listed, or as detailed in the drawings. UL number required no exceptions. Cast iron sleeves or 16 gauge galv steel with spiral seams. Top of sleeve to extend 1" AFF.

- D. Sleeves for Ductwork: Form with galvanized steel, thickness per NFPA 90A.
- E. Stuffing and Fire Stopping Insulation: Glass fiber type, non-combustible, 3 PCF mineral wool safing, without binder rated for 2000F.
- F. Caulk:
 - 1. Silicone rubber, clear, on all surfaces that are exposed to weather, but not subject to painting.
 - 2. Acrylic latex, white, on all surfaces that receive paint.
 - 3. Firestopping, intumescent, volumetric expanding at temperatures in excess of 250F, UL classified and Factory Mutual approved. CP25 series as manufactured by 3M.

2.08 ROOF MOUNTED SUPPORTS

- A. Structural Steel - ASTM A36 Standard hot rolled galvanized steel.
- B. Flashing – Stainless steel, 18 gauge minimum.

2.09 SEISMIC RESTRAINTS

- A. Duct, Piping and equipment: Mason Industries, B-Line, Amber-Booth, Kinetics, Tolco or equal
- B. Obtain all seismic bracing and design from a single source vendor specializing in this type work. All duct and piping must be axially and longitudinally restrained to limit sway and prevent damage to other building components. Supports shall be designed to resist the S_{DS} and S_{D1} forces during a seismic event and be operable after the seismic event. Seismic forces are identified on the structural drawings and must be adjusted for the elevation above grade. Comply with ASCE/SEI 7-10, Chapter 13. An importance factor of 1.5 is assigned to the equipment serving Plaza / Sub Plaza / 6th floor spaces. Other Importance Factors are to comply with Chapter 13. All work is to be designed by a Tennessee registered engineer with an active license to practice engineering in Tennessee. Verify that the building structure at all points of attachment is capable of withstanding all imposed loading.
- C. Provide detailed calculations and AutoCAD drawings of all mechanical, plumbing and fire protection locating and detailing the seismic restraints. Items identified in 2.11 below represent a partial list of the equipment that must be restrained that is subject to special inspections. Where walkpaths are identified on the interstitial floor seismic restraints are to be excluded from that path. Where the installation details provided on the Contract Document provide the required seismic restraint then document that with calculations and indicate on the seismic restraint shop drawing to comply with supports as indicated on the Contract Documents.
- D. Sprinkler piping supports and restraints will be designed by the sprinkler contractor and furnished to the seismic restraint registered Engineer to certify that the system is designed in accordance with ASCE/SEI 7-10. Provide letter itemizing the sheet by sheet review and verifications that were performed. Where changes are necessary in the sprinkler shop drawings provide these requirements to the Sprinkler Contractor

and verify all corrections are made prior to certifying the shop drawings.

- E. Bolts securing rigidly mounted equipment require bolt isolation washers equal to type HG by Mason. Equipment 401 up to 1000 LBS receives a minimum of four at ½" x 4" anchors. Equipment 1001 up to 5000 LBS receives a minimum of four at ¾" x 6" anchors. Heavier equipment to be laterally braced and secured with an equivalent level of anchors. All anchors used for structural attachment of seismic restraints must be certified for seismic application by ICC Evaluation Service Reports and applied in full compliance with these reports.

2.10 AERATED AUTOCLAVED CONCRETE PLANK FASTENERS

- A. Manufacturer to be TOX or equal that specifically makes anchors for use in aerated autoclaved concrete. The PAVA-10/10 fastener or 10/20 fastener extended stud or the PAVI10 internal thread configuration is required to be applied for anchors in the aerated concrete plank.
- B. Through bolt the planks where the seismic load exceeds 250 pounds tension or shear per fastener.
- C. Galvanized boat nails, minimum 3" 10D may be applied to secure items to the ACC where there is no tensile force on the fastener.

2.11 SEISMIC RESTRAINTS - QUALITY ASSURANCE INSPECTIONS

- A. Special Inspections are required for each item that is listed below or any DIV15 installed item that weighs more than 250 pounds, if not specifically listed below. This is to insure that it is secured in accordance with the seismic restraints designed under this section. Comply with the requirements listed herein when the equipment is fully installed. Also perform interim inspections as needed to verify anchors are installed in accordance with their current ICC-ES data sheets for seismic tension and seismic shear in normal weight cracked concrete.
 - a. Pumps
 - b. Boilers, steam and hot water
 - c. Boiler stacks
 - d. Condensate return units
 - e. Piping supports for all piping 3" and larger
 - f. Piping supports for all piping in chases
 - g. Piping supports for natural gas piping, sprinkler piping
 - h. Duct exceeding 5 SF or 30" diameter in cross section on the first floor.
- B. The special inspection must be made by a degreed civil or mechanical engineer working under the direction and control of a licensed professional engineer with minimum of ten years of experience in the design of structural seismic restraints

2.12 Inserts:

- A. Cast-in-place concrete inserts shall comply with MSS-SP-69, U.L. and F.M. approved, and sized to suit threaded hanger rods.

- B. Inserts shall have malleable iron case with galvanized steel shell and expander plug for threaded connection with lateral adjustment, top slot for reinforcing rods, lugs for attaching to forms; size inserts to suit threaded hanger rods. Suitable concrete inserts for pipe and equipment hangers shall be set and properly located for all pipe and equipment to be suspended from concrete construction. If the inserts are later found not to be in the proper location for the placement of hangers, then drilled anchors shall be installed. Drilled anchors in concrete or masonry shall be submitted for the approval.
- C. Manufactured inserts for metal deck construction shall have legs custom fit to rest in form valleys.
- D. Shop fabricated inserts shall be submitted and approved by Owner prior to installation.
- E. Inserts shall be of a type that will not interfere with structural reinforcing and that will not displace excessive amounts of structural concrete.

PART 3 EXECUTION

3.01 PIPE HANGERS AND SUPPORTS

- A. Support horizontal piping as follows:

<u>PIPE SIZE</u>	<u>MAX. HANGER SPACING</u>	<u>HANGER DIAMETER</u>
Steel:		
1-1/4" & less	7'-0"	3/8"
1-1/2" to 3"	10'-0"	3/8"
4" to 6"	15'-0"	5/8"
8" to 12"	15'-0"	7/8"
Copper:		
1-1/4" & less	6'-0"	3/8"
1-1/2"-4"	10'-0"	3/8"
PVC, CPVC & Polypropylene		
2" & less	5'-0"	3/8"
3"	6'-0"	3/8"
4" or greater	7'-0"	3/8"
Cast, Ductile Iron & Glass		
2"-6" 10' lengths	10'-0"	3/8" up to 4" pipe 1/2" for 6" pipe
2"-6" 5' lengths	5'-0"	3/8"
8-10" 10' lengths	10'-0"	5/8"
12" 10' lengths	10'-0"	3/4"

- B. Install hangers to provide minimum 2 inch space between finished covering and adjacent work. Trapezoid piping may be tighter if necessary to conserve space.
- C. Place a hanger within 24 inches of each steel/copper horizontal elbow. Place a hanger within 12" of other piping horizontal elbow.
- D. Use hangers with 1-1/2 inch minimum vertical adjustment. Double nut hanger and all

mounting locations to prevent loosening of assembly.

- E. Support vertical piping at every floor. Support vertical cast iron pipe at each floor and at joints. Connect no-hub joints in vertical risers together with riser clamps and bolted plates.
- F. Where several pipes can be installed in parallel and at same elevation, provide multiple or trapeze hangers. Use back to back channel or tubular steel/strut to construct trapeze. Select structural components used for trapeze using a safety factor of four. Weld washers across the top to accept vertical adjusting rods of pipe supports.
- G. Support riser piping independently of connected horizontal piping.
- H. Piping supports will provide a rigid and secure piping system. Add supports of the configuration and style needed to achieve this requirement.
- I. PVC, CPVC and polypropylene piping supports must comply with spacing requirements as recommended by piping manufacturer based on the density and temperature of material and ambient conditions. Support spacing can generally be increased by providing continuous steel support between hangers.
- J. Add rigid supports, concrete kickers below grade and rod fitting to pipe at changes in direction of rain leaders where roof elevation is more than 30' above change in direction.
- K. Use welded support 1/2" taller than pipe insulation on piping greater than 2" that is supported by rollers.
- L. Install concrete anchors according to manufacturer's recommendations. Determine spacing and installation requirements subject to approval by Architect/Engineer. Install additional supports as directed by Architect/Engineer.
- M. All equipment, duct and piping installation and supports shall include fully engineered seismic restraints that comply with American Society of Civil Engineers Standard 7-10. Provide complete shop drawings and installation details certified and sealed by a licensed professional Engineer that has their primary area of practice in the design of seismic restraints with five years documented experience in this field. Areas where the renovation work does not include new duct or piping mains are not required to add seismic restraints to existing or new work. All new and existing natural gas, Oxygen, Nitrous Oxide and medical air piping and equipment within any area of renovation or new work is to be seismically restrained.

3.02 FLASHING

- A. Provide flashing and metal counter flashing where piping and ductwork penetrate outdoor or waterproofed walls, floors, and roofs. Match Architectural materials and appearance where possible.
- B. Provide curbs for mechanical roof installations 8 inches minimum high above roofing surface. Flash and counterflash with sheet metal or elastomeric materials as required to be in complete compliance with roof system; seal watertight.

3.03 SLEEVES

- A. Set sleeves in position in formwork. Provide reinforcing around sleeves. Install linkseal EPDM multilink seals between sleeve and piping, stainless steel fasteners are required, hand torque using a calibrated wrench.
- B. Extend sleeves through floors 1 inch above finished floor level. Cast in place or if retrofit then grout in place with an expansive waterstop grout full depth.
- C. Where piping or ductwork penetrates floor, ceiling, roof or wall, close off space between pipe or duct and adjacent work with stuffing or fire stopping insulation and caulk seal air tight. Provide close fitting metal collar or escutcheon covers on both sides of penetration.
- D. Install chrome plated escutcheons at finished surfaces.
- E. Where piping crosses walls and floors that exceed 36" thick these are radiation shielding walls and there shall be no sleeves. Allow for double lapped 20 mil PVC pipe wrap tape, IAPMO PS-37-90, for an installed tape thickness of 40 mil. Install in a continuous spiral using 2" wide tape and a 1" overlap including all fittings. 1" wide tape may be used at fittings. Position piping to provide 4" of space for concrete between all piping.

3.04 EQUIPMENT BASES AND SUPPORTS

- A. Install all floor mounted equipment on bases of steel reinforced concrete.
- B. Use templates, anchor bolts, and accessories for mounting and anchoring equipment. Obtain certified drawings from the equipment manufacturer prior to fabrication of curb or support steel.
- C. Construct supports of structural steel members. Brace and fasten with flanges bolted or welded to structure. Neatly chamfer and round all exposed corners of structural supports and grind to remove all burrs and slag. Do not weld to structural columns or beams without written permission from the Structural Engineer. Clamp and bolt to the structural steel wherever possible. Replace any fireproofing disturbed by attachment of mechanical work.
- D. Reinforce structural steel supports to the satisfaction of the Architect/Engineer to assure a rigid and structurally sound installation. Add isolation pads where directed by the Architect/Engineer to eliminate any excessive transmitted sound.
- E. Where noted on drawing finish paint exposed steel surfaces. Where painting is required all hangers and supports in finished areas receive surface prep, prime coat and one or two finish coats to provide a painted surface free of any thin spots. Refer to 15010, all steel supports require a rust preventing finish.
- F. Where attachment to steel building structure is not practical secure support steel to concrete building structure with expansion bolts equal to KW-TZ bolts 1/2" x 4" long minimum. Where other bolted connections are shown ASTM A325 fasteners are required. Provide number of fasteners required to equal capacity of threaded rod. All

attachments to building structure are subject to approval of the structural Engineer. Obtain structural Engineer's approval prior to ordering or installing supports. Touch up finish and fireproofing that is disturbed by connection to building structure.

- G. Seal around support connection at roof with plastic cement, replace insulation, restore roof membrane to match adjacent roof system. Flash and seal to match adjacent roof system
- H. Restore floor, wall, ceiling, roof, soil, sod, concrete, asphalt, shrubbery, trees etc. disturbed by installation of equipment.
- I. Provide 3.5" wide x 3.5" high concrete curb around all floor penetrations by piping or ductwork. Neatly finish and seal curb to floor using hot tar or Owner approved epoxy sealant.

3.05 SEISMIC BRACING

- A. Bracing shall conform to the requirements of local authorities or this section, whichever is more stringent.
- B. All pipe, duct, raceway, and equipment must be seismically restrained per 2009 International Building Code / ASCE 7-10. Only one inch and smaller pipe that is not conveying flammable or oxidizing media and is excluded from this requirement.
- C. Bracing is not required on the following:
 - 1. Piping (other than natural gas, compressed air, N₂O, O₂ and fuel oil) that is 1" and smaller.
- D. All duct and piping supports shall comply with seismic restraints as shown in the current "SMACNA - Seismic Restraint Manual, Guidelines For Mechanical Systems" or ASHRAE - A Practical Guide to Seismic Restraint for all duct and piping. Some details are shown and the Contractor is to follow these examples with any adjustments deemed necessary by the Engineer that certifies the seismic design.
- E. Locate lateral and transverse braces within 4" of hangers.
- F. Do not locate seismic bracing where it will interfere with expansion or contraction of duct or piping.
- G. Do not locate seismic bracing where it will interfere with vibration isolation of duct, piping or equipment. Restraints formed with rigid steel members will require a neoprene isolation washer in the anchor to prevent vibration transmission to the building structure.
- H. Refer to drawing notes for seismic design criteria. All components shall be selected and installed in accordance with the seismic restraint selection guides of Mason Industries, ASHRAE, SMACNA, Vibro-Acoustics, Amber-Booth or B-Line.
- I. Provide the services of a licensed structural Engineer to perform all calculations, design, inspect and certify the installation of all seismic restraints and flexible connections.

3.05 PIPING CAST IN CONCRETE OR FLOWABLE FILL

- A. Provide supports and bracing to provide piping rigidity that will withstand forces generated by concrete placement and vibration. Tie piping in place to resist flotation as well as other vertical and horizontal displacement. Field verify conditions and support from the rebar, or structural concrete providing added support as needed to insure the piping slope is maintained.

END OF SECTION

**SECTION 15170
ELECTRIC MOTORS AND STARTERS**

PART 1 - GENERAL

1.01 WORK INCLUDED

- A. All work specified in this section shall comply with the provisions of Section 15010.
- B. Provide and install electric motors furnished with equipment specified in this Division.
- C. Variable frequency drives and factory control panels integral to equipment shall be furnished under this Division and installed under Division 16.

1.02 RELATED WORK

- A. Division 16: Electrical
 - 1. DIV16 shall make all electrical connections.
 - 2. DIV 16 shall furnish and install motor starters which are not an integral part of mechanical equipment.
 - 3. DIV 16 shall install power factor correction capacitors

1.03 SUBMITTALS

- A. Submittal data is required for products under this section as separate items, if they will not be provided with appropriate equipment submittal. The data should be arranged in the form of a table noting: equipment tag, motor HP, voltage, phase, motor type and other applicable information.
- B. All motors shall be GE, Leeson, US Motor, Lincoln, Toshiba, Reliance or Marathon, premium efficiency.

PART 2 - PRODUCTS

2.01 MOTORS

- A. Electric motors shall be new NEMA Standard, sized and designed to operate at full load and full speed continuously without causing noise, vibration, or temperature rise in excess of their rating.
- B. Motors on belt driven equipment shall have slide rails with adjusting screws for belt tension adjustment. Motors in HVAC system air stream or exposed to the weather shall be weather protected, TEFC.
- C. Motor sound power levels shall not be greater than recommended in NEMA M61-12.49.
- D. Motors shall be provided with drive shafts long enough to extend completely through belt sheaves when sheaves are properly aligned or balanced.
- E. Motor characteristics shall be as follows:

1. 120V/1/60 Hz: Capacitor start, open drip-proof type, ball bearing, rated 40 degrees C continuous rise.
2. 480V/3/60 Hz: NEMA Design B, normal starting torque, single speed, squirrel cage type, open drip-proof, 1.15 service factor, insulation for rating of 65 degrees C continuous rise above 40 degrees C ambient, with ball bearings rated for minimum B-10 life of 100,000 hours and fitted with grease fittings and relief parts.
3. Motors in high humidity environments, within RTUs and outdoors shall be totally enclosed, fan cooled, TEFC.
4. NEMA premium efficiency shall exceed all requirements of the Energy Policy Act of 1992.
5. All motors under control of a variable frequency drive shall have class F insulation and comply with NEMA MG 1-1993, Section IV, Part 31.40.4.2 requirements for definite purpose inverter fed motors. Additionally these motors shall have a minimum CIV rating of 1600 volts at rated operating temperature.

PART 3 - EXECUTION

3.01 INSTALLATION

- A. Arrange and set motors.
- B. Employ the services of a skilled millwright to align motors on direct drive equipment. Provide Falk stainless steel shims where shims are required.
- C. Electrical Contractor to make connections and test motor for proper rotation/phasing. Comply with NEC Article 430.
- D. Division 16 shall mount and terminate capacitors on the load side of the motor disconnect. If a combination motor starter is the local disconnect connect capacitor between the contactor and overload relays. In all instances the capacitor shall be disconnected from the power source with the motor. Comply with NEC Article 460 - Capacitors.

3.02 ADJUSTMENTS

- A. All motors, together with driven equipment, shall be dynamically and statically balanced by equipment supplier, start-up representative, or this Contractor using approved balancing equipment such as IRD Mechanalysis MOD# 810 Vibration Analyzer.
- B. Imbalance shall be reduced to minimum specified by equipment manufacturers and to meet vibration and sound levels specified elsewhere in this Division.
- C. Complete equipment inspection form included in Vibration Isolation - Section 15242.

END OF SECTION

**SECTION 15171
VARIABLE FREQUENCY DRIVES (VFD's)**

PART 1 - GENERAL

1.1 WORK INCLUDED:

- A. Variable Frequency Drives
- B. All work specified in this Section shall comply with the provisions of Division 1 and Section 15010.

1.2 RELATED WORK AND REQUIREMENTS SPECIFIED ELSEWHERE:

- A. DIVISION 1 & DIVISION 16
- B. Related Work:
 - Section 15010 - Basic Mechanical Requirements
 - Section 15950 - Controls
 - Section 15990 - Testing and Balancing

1.3 SCOPE OF WORK:

- A. Provide all materials, labor, tools and equipment required for the proper support and installation of variable frequency drives as indicated on the plans, as specified herein, and as required for a complete and operational system.
- B. Everything necessary for a complete and satisfactory installation, including all parts, devices, bypasses, accessories, etc., required by applicable codes or that may be required to satisfactorily complete the installation of the variable frequency drives shall be provided by this Section.
- C. All field wiring is provided by Division 16.

1.4 SUBMITTALS AND SHOP DRAWINGS:

- A. Data on all materials shall be furnished whether the items are as specified or an equal material is proposed. See DIV01 for submittal requirements.
- B. Submittal shall show, as a minimum, the data as listed below. Equipment rejected in first submittal will be required to be furnished as specified. Substitutions will not be considered after original submittal has been reviewed.
 - 1. Name of manufacturer.
 - 2. Options.
 - 3. Location and use.
 - 4. Enclosure type and exterior dimensions.
 - 5. Capacity of equipment.
 - 6. Circuit diagram.
- D. If the submitted drive package differs in any respect from the requirements listed in this specification, then such differences shall be directly addressed. Each difference

(whether it exceeds or lacks the listed requirement) shall also be listed in the submittal, and cross-referenced to the appropriate paragraph in this specification. Documentation shall also be included which supports the proposed drive package's status as an "equal" with regard to each of the differences encountered. Compensating options and features not specified shall also be included.

1.5 APPLICABLE PUBLICATION:

- A. The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by the basic designation only.
- B. National Electrical Manufacturer's Association (NEMA) Publications:
 - 1. ICSI-1978 (Latest Revision) - General Standards for Industrial Control and Systems.
 - 2. ICS2-1978 (Latest Revision) - Standards for Industrial Control Devices Controllers and Assemblies.
 - 3. ICSF-1977 (Latest Revision) - Terminal Blocks for Industrial Control Equipment and Systems.
 - 4. ICS6-1978 (Latest Revision) - Enclosures for Industrial Controls and Systems.
- C. National Fire Protection Association (NFPA) Publication:
 - 1. 70 (Latest Revision) - National Electrical Code (NEC).
- D. Federal Communication Commission Rules, Part 15, Subpart J, Class A Equipment.
- E. Institute of Electronic and Electrical Engineers (IEEE) Standard 519-1981.

1.6 OPERATION AND MAINTENANCE MANUALS:

- A. As specified in Section 15010, provide the Owner with bound copies of operations and maintenance data covering the drive and rating. Manuals shall be indexed and tabbed thereby organizing data. Basic troubleshooting criteria for drive and rating shall also be included. Provide in these manuals the name and telephone number (s) of a factory trained and qualified service organization within a 50 mile radius of a facility capable of servicing and repairing the VFD drive units.

1.7 WARRANTY:

- A. The VFD manufacturer shall provide a three year warranty from date of final acceptance covering all defects in materials and workmanship pertinent to the VFD, bypass assembly and motor. In addition the Contractor shall warrant to the Owner all work performed under this contract to be free from defects in workmanship and materials for a period of one year from date of final acceptance. Warranty shall also include all parts, labor transportation and living expenses of factory personnel. Acceptance will not be given until all defects in all variable flow system components have been remedied, and each system successfully tested and run in its entirety. Defects arising during this period shall be promptly remedied by the Contractor at his own expense upon notice by the Owner.

1.8 ACCEPTABLE MANUFACTURERS:

- A. Yaskawa, Cutler Hammer, Square D, ABB, Danfoss.
- B. All drives shall be from a single manufacturer.

1.9 INSPECTION OF SITE:

- A. Prior to submitting bid, the Contractor shall visit the site of the proposed construction

and thoroughly acquaint himself with all existing facilities and working conditions to be encountered.

PART 2 - PRODUCTS

2.1 BASIC EQUIPMENT DESCRIPTION

- A. The VFD shall be a fully digital PWM using very large scale integration techniques (VSLI) as well as surface-mount technology for increased reliability. The VFD shall use a 16-bit microprocessor to allow stepless motor control from 0.1% to 110% of motor base speed.
- B. All programmable settings shall be held in non-volatile memory and shall not be affected by power outages, brownouts, power dips, etc. The VFD shall have initial programmable settings intact from the factory without the need of battery backup, etc. The VFD shall not need to be programmed at the job site prior to being able to run a motor, but shall be ready to run a motor as soon as power connections are made.
- C. Programming at the job site to accommodate specific local application requirements, such as frequency avoidance and preset speeds shall be available to the user.
- D. Complete efficiency versus load and speed ratings shall be readily available from the manufacturer. Multiple motor operation at the same frequency and speed shall be possible as long as the sum of the connected motor full load sine wave currents are less than or equal to 90% of the VFD maximum continuous current rating.
- E. All high voltage components within the enclosure shall be isolated with steel or polycarbonate covers.

2.2 CODES/STANDARDS

- A. VFD shall be UL listed.
- B. The controller and options shall comply with the applicable requirement of the latest standards of ANSI; NEMA ICS 1,2,3 and 6; National Electric Code NEC; NEPU-70; IEEE P598; FCC Part 15 Subpart J; CFR 47.

2.3 QUALITY ASSURANCE

- A. The VFD controller shall be subject to but not limited to the following quality assurance controls, procedures and tests.
 - 1. The manufacturer shall have been actively and continuously engaged in the production of VFD's for a period of at least 10 years and have equal experience in commercial HVAC applications.
 - 2. The VFD shall be subject to, but not limited to, the following quality assurance controls, procedures and tests:
Transistors and diodes shall be tested to assure correct function and highest reliability. These tests shall include elevated temperature functional, A-C and D-C parametric tests. Power transistor components shall be lot sample tested functionally and parametrically at 25 degrees C and 125 degrees C when received. Digital integrated circuits shall undergo functional and reliability tests. Tests shall include 168 hour burn-in screening at 145 degrees C according to MIL-STD-83B.
 - 3. Small semi-conductors shall be lot sampled for functional and D-C parameters at room and elevated temperatures when received.
 - 4. Electronic printed circuit board assemblies shall be tested for continuity of field

and correct components before they are functionally tested. The major complex circuits shall be temperature cycled for a nominal 24 hour period between 15 degrees C and 55 degrees C. These circuits shall be functionally tested using state-of-the-art computerized test systems.

5. Every VFD shall be functionally tested under motor load and must pass a heat run under motor load. In addition, every VFD shall be temperature cycled under constantly varying environmental and line conditions while the unit is cycling a motor under computer control. This test shall be running simultaneously while the temperature is cycled between 7 degrees C and 45 degrees C.
6. VFD shall have a minimum efficiency of 98% wire to wire at full load and no less than 95% efficiencies at part load.
7. The drive Mean Time Between Failure to be no less than 20 years using industry standard calculations of component and equipment reliability.

2.4 SERVICE

- A. The VFD manufacturer shall maintain and staff service centers and have the ability to test both the controller and the motor in these service centers.
 1. Start-up shall be included for each VFD provided.
 2. Factory trained service Engineers shall provide start-up service, including physical inspection of drive and connected wiring and final adjustments, to meet specified performance requirements.
- B. Training shall be available on site by start-up personnel and shall be in addition to the start-up service. Training shall include hands on sessions with two 2.5 hour hands on sessions with 4 sets of literature included. The training should fully address system concepts, basic troubleshooting all adjustments and component replacement.
- C. A reasonable supply of spare parts including PC boards and IGBTs must be kept available by the Vendor to meet ordinary repair requirements. 100% of all parts shall be available within 36 hours of notification Monday thru Friday.

2.5 BASIC FEATURES

The VFD shall have the following basic features:

- A. All VFD load ratings shall be at maximum 12 kHz carrier frequency. This may require an adjustment in the nominal HP rating of the drive. This selection is made to allow the drive to operate at higher switching frequency if necessary for motor noise reduction. Operators control shall be mounted on the door of the cabinet and consist of a membrane command center which allows manual stop/start, speed control, local/remote status indication, manual or automatic speed control selection, and run/jog selection. In addition, the command center will serve as a means to configure controller parameters such as Min Speed, Max Speed, Acceleration and Deceleration times, Volts/Hz ratio, Torque Boost, Slip Compensation, Overfrequency Limit and Current Limit. Potentiometers will not be allowed for these settings. The controller shall have an internal means of deactivating keypad parameter adjustments to eliminate unauthorized data entry.
- B. An interface to the BAS for two way communication and adjustment of drive remote resettable parameters. Verify communication protocol (BACnet / LonWorks / N2 / Modbus / EtherNet/IP) and provide the card or accessory that is required by Section 15950.

- C. A 3% DC bus reactor on all drives that are not provided with an optional input line reactor.
- D. An electronic overload circuit designed to protect an A-C motor operated by the VFD output from extended overload operation on an inverse time basis. This electronic overload shall be UL and NEC recognized as adequate motor protection. No additional hardware such as motor overload relays or motor thermostats shall be required.
- E. Automatic and manual torque boosts that are settable within the control to accelerate high inertia fan and pump loads. Adjustable D-C braking that is programmable from the command center settable in both amplitude and duration.
- F. An LCD display mounted on the door of the cabinet that digitally indicates:
 - 1. Frequency output
 - 2. Voltage output
 - 3. Current output
 - 4. Motor RPM
 - 5. Input kW
 - 6. Elapsed Time
 - 7. Time Stamped Fault Indication
- G. The capability of starting into a rotating load regardless of direction without the need of a time delay upon a start command.
- H. Relay contacts for remote indication of drive fault, motor running on inverter, and motor running in bypass if provided, for interwiring to other user supplied devices.
- I. An automatic restart circuit which is settable by number of restart attempts and time interval between restarts.
- J. Three critical frequency avoidance bands, which can be programmed in the field, enable the controller to avoid resonate frequencies of the driven equipment. Each critical frequency avoidance band shall have a bandwidth adjustable via keypad entry of up to 10 Hz.
- K. Eight programmable preset speeds which will force the VFD to a preset speed upon a user contact closure. This feature shall be set digitally by entering data via the door mounted membrane command center. These shall be utilized for user specified purge functions.
- L. The VFD shall have the capability of riding through power dips up to 10 seconds without a controller trip depending on load and operating condition. In this extended ride through, the drive shall use the energy generated by the rotating fan as a power source for all electronic circuits.
- M. Multiple Volts/Hz patterns settable in one Hz increments.
- N. Jog speed selection.
- O. RS232 Port for Configuration, Control and Monitoring.
- P. An isolated electrical follower capability shall enable the VFD to follow a 4-20mA or 0-10 volt D-C grounded or ungrounded speed signal.
- Q. An isolated 0-10 V or 4-20 mA output signals for computer controlled feedback signals shall be selectable for speed or current.
- R. For ultra-smooth acceleration and deceleration capabilities, the drive shall have a pre-programmed "S" curve ramp which can be activated locally.
- S. Flux Vector PWM operation with "trip free" circuitry to eliminate nuisance faults.
- T. IGBT transistors with a selectable carrier frequency between 4 and 12 KHz.
- U. A loss of load feature shall provide a dry contact closure that will annunciate an alarm at the BAS when connected load falls below any normal load level. This alarm point shall automatically be disabled on starting and stopping of the load to prevent nuisance trips of the alarm.
- V. A slip compensation circuit for accurate 1% speed regulation without the need of a

tachometer.

2.6 PROTECTIVE CIRCUITS AND FEATURES

The VFD shall include the following protective circuits and features:

- A. DV/DT and DI/DT protection for semiconductors.
- B. Instantaneous Electronic Trip for the following faults:
 - 1. Motor current exceeds 110% for longer than one minute of controller maximum sine wave current rating; 150% current overload capability for 1 second.
 - 2. Output phase-to-phase short circuit condition.
 - 3. Total ground fault under any operating condition.
 - 4. High input line voltage.
 - 5. Low input line voltage.
 - 6. Loss of input phase.
 - 7. External fault, (This protective circuit shall permit, by means of the terminal strip, wiring of remote N.C. safety contact such as high static, firestat, etc., to shut down the drive.)
- C. All live power equipment shall be covered by protective shields to ensure the safety of operating personnel.
- D. Metal oxide varistors.

2.7 ADJUSTMENTS:

The following adjustments shall be provided:

- A. Maximum frequency (15 to 400 Hz) with factory setting at 60 Hz.
- B. Minimum frequency (5 to 60 Hz) with factory setting at 6 Hz.
- C. Acceleration (0.1 to 360 seconds) factory set at 240 seconds.
- D. Deceleration (0.1 to 360 seconds) factory set at 240 seconds.
- E. Volts/Hertz ratio factory set for 460 volts at 60 Hz.
- F. Voltage offset or boost with factory setting at 100% torque.
- G. Current limit (50 to 100%) sine wave current rating factory set at 100%.

2.8 SERVICE CONDITIONS

The VFD shall be designed and constructed to operate within the following service conditions:

- A. Suitable for continuous operation at an ambient temperature of 0 degrees C to 40 degrees C. Elevation up to 3300 ft. altitude with a relative humidity to 95% non-condensing.
- B. A-C line variation of -15% to + 10% voltage and +/-2% frequency.

2.9 OPTIONS

The following options shall be included where scheduled:

- A. Refer to schedule and provide the bypass option if indicated. Bypass shall include a door interlocked, main power input disconnect providing positive shutdown of all power to both the bypass circuitry and the VFD. A separate motor starter shall not be needed for safe operation. A three contactor bypass shall isolate the input and output to the IGBT section and power the load using across the line power while maintaining the motor overload protective circuits. This option shall maintain all safety circuits while in the bypass mode.

- B. A 3% impedance input line reactor shall be provided to minimize drive harmonics on the A-C line and protect the drive from damaging electrical system transients.
- C. Input fused disconnect switch or circuit breaker shall provide protection for the input rectification circuit with interrupting rating of 50,000 AIC and lock-out padlock hasp.

PART 3 - EXECUTION

3.1 DELIVERY AND STORAGE:

- A. Equipment and materials shall be properly stored, adequately protected and carefully handled to prevent damage before, during and after installation. Equipment and materials shall be handled, stored and protected in accordance with the manufacturer's recommendations and as approved by the Owner. Any damage to existing construction or to new equipment or materials which occurs as a result of improper action or inaction by the Contractor shall be remedied to the satisfaction of the Owner at no additional cost to the Owner.

3.2 INSTALLATION:

- A. Location: VFD shall be located approximately where shown on plans. However, minor adjustments shall be made as required to avoid installation of the drive cabinet where the drive may be subject to extremes of heat or moisture. Care shall be exercised to avoid location of the drive close to (or under) steam or water lines of any type, heaters or any other types of heat producing equipment. The drives shall also not be located close to any existing equipment which may be sensitive to radio frequency or electromagnetic emissions produced by the drive. The drives shall not be located close to equipment which produces excessive vibration such as compressors of any type. Drives shall not be installed on any type of mechanical equipment. Maintain a service area in front of each drive that is 30" wide and 42" deep. Adjacent drives may share the 30" width. Refer to the NFPA 70 Art 110.26 for complete clearance requirements and coordinate with Division 16.
- B. Installations: Installation shall only be to building structure such as floors, columns, or concrete or steel structure per manufacturer's recommendations. Where installation of drive cabinets is to be on partitions of light construction (such as gypboard and studs) additional strut type bracing shall be provided. Cabinet anchoring devices shall be as approved by the Engineer. Where installation of drive is on floor, provide a strut stand to elevate the drive 6" above the floor. In many locations the VFDs will need to be installed on free standing strut stands that are rigidly anchored to the floor and adjacent building structure. See drawings for applicable details and allow for variations as needed to suit installation conditions.
- C. Connections: Electrical power and electrical control signal connections shall be made to the VFD drive via 24" lengths of flexible metal conduit sized per the NEC. Connectors for flexible metal conduit shall have an integral grounding lug for use with an external grounding jumper wire.
- D. Workmanship: All work shall be performed by skilled workmen under the supervision and guidance of a competent superintendent and shall present a neat and workmanlike appearance when complete.
- E. Cleanup: Areas involved in the installation of the VFD shall be kept reasonably clean and free of excessive amounts of rubbish and waste material shall be removed and the work site shall be left in clean condition.
- F. Clean the VFD interior prior to startup.

3.3 SERVICE AND STARTUP:

- A. Startup: The VFD manufacturer shall provide the services of factory trained service personnel to conduct thorough tests of the drive to assure proper operation of the drive under normal conditions. All such defects which are discovered as a result of these tests shall be remedied and the drive retested until no additional defects are discovered. Startup services and tests shall be conducted in the presence of the G.C.'s representative; and a tag shall be placed in the VFD drive noting the date of successful startup tests and the initials of personnel conducting and witnessing startup tests. The controls and all peripheral equipment shall be fully functional before final acceptance is provided.

- B. Training: The VFD manufacturer shall provide the training of Owner's personnel in basic troubleshooting of VFD drive. Training shall be on site and shall be a minimum duration of two hours in addition to system startup. Training shall occur only after successful startup of VFD system. The training shall consist of a two separate 2.5 hour hands-on session. The training shall include 4 sets of literature on VFD troubleshooting, operation and repair. In addition to on-site training the Vendor shall be available by phone for up to four hours of consultation.

END OF SECTION

**SECTION 15190
MECHANICAL IDENTIFICATION**

PART 1 GENERAL

1.01 WORK INCLUDED

- A. Identification of HVAC, plumbing, fire protection and gas piping, all equipment and accessories installed under Division 15.
- B. Include labeling of the pharmacy hoods as noted on the plans.
- C. Extent of identification includes all new work as well as existing work where the existing work is within the area of renovation and existing labeling is not in compliance with the requirements of this section.
- D. All work specified in this section shall comply with the provisions of Division 1 and Section 15010.

1.02 RELATED WORK

- A. Identification of electrical products provided by Division 15 and installed by other Divisions.
- B. Identification of products provided by the Owner and installed by Division 15.

1.03 REFERENCES

- A. ANSI/ASME A13.1 - Scheme for the Identification of Piping Systems.

1.04 SUBMITTALS

- A. Submit product data under provisions of Division 1 and Section 15010. Owner must provide written approval of submittal in addition to Architect/Engineer approval.
- B. Submit list of wording, symbols, stencil, letter size, paint samples and color coding for identification.

PART 2 PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

- A. Bradley, Seton, Lietz or equal.

2.02 MATERIALS

- A. Color/Size: Unless specified otherwise, conform with ANSI/ASME A13.1.
- B. Vinyl Equipment Nameplates: adhesive backed flexible plastic with black letters on white background. 3/4" tall letters on 1" tall background for small equipment such as terminal units. Large equipment such as floor mounted pumps, RTUs, water heaters, BCUs provide 3-1/2" tall letters on 6" wide labels, or for chillers, AHUs and similar provide 6" tall letters on 12" tall labels
- C. Plastic Tape Pipe Markers: Flexible, vinyl film tape with pressure sensitive adhesive

backing and printed markings minimum information indicating flow direction arrow and fluid being conveyed as noted for stencils above. Comply with color field and letter size/color noted below. Completely wrap each end of label with arrow tape with 180 degrees of tape overlap. Seton "Opti-Code Pipe Markers" or approved equal.

- D. Ceiling markers, adhesive backed flexible plastic with 3/8" tall black letters on 1/2" wide clear strip. Label to designate equipment and valves located above suspended ceilings. Include fan terminals, hydronic coils, flow sensors, isolation valves, fire dampers, smoke dampers, fire-smoke dampers, smoke detector, fan coil units, VAV terminals, HVAC controllers, control sensors of all types, sprinkler flow & tamper switches, speed controls and other equipment. e.g. HVAC VALVE, PLUMBING VALVE, FIRE DAMPER, SMOKE DETECTOR, FAN COIL UNIT, VAV TERMINAL. Include any unique identifier number that is indicated on the plans. Verify the exact designation with Owner and abbreviate as they will allow.
- E. Labels: With clean cut symbols and letters of following size:

<u>OUTSIDE DIAMETER OF INSULATION OR PIPE</u>	<u>MIN LENGTH OF COLOR FIELD</u>	<u>SIZE OF LETTERS</u>
1-1/2" - 2"	8"	3/4"
2-1/2" - 6"	12"	1-1/4"
8" - 10"	24"	2-1/2"
Over 10"	32"	3-1/2"
Ductwork	12"Tx16"L	3-1/2"
Equipment	---	3-1/2"
AHU/Chiller/Cooling Tower	12"Tx24"L	6"

(All piping, duct and equipment requires labeling with vinyl adhesive labels)

<u>LABEL DUCT/PIPING</u>	<u>COLOR IDENTIFIER</u>	<u>LETTERING</u>
COLD WATER	GREEN	WHITE
HOT WATER	GREEN	WHITE
HOT WATER RETURN	GREEN	WHITE
INDIRECT WASTE	BROWN	WHITE
NON-POT COLD WATER	YELLOW	BLACK
HEATING WATER SUPPLY	GREEN	WHITE
HEATING WATER RETURN	GREEN	WHITE
STEAM	YELLOW	BLACK
STEAM COND RETURN	YELLOW	BLACK
INDIRECT WASTE	BROWN	WHITE
NON-POT COLD WATER	YELLOW	BLACK
NATURAL GAS	YELLOW	BLACK
CHILLED WATER SUPPLY	GREEN	WHITE
CHILLED WATER RETURN	GREEN	WHITE
FUEL OIL SUPPLY	YELLOW	BLACK
FUEL OIL RETURN	YELLOW	BLACK
DUCTWORK SUPPLY AIR	BLUE	WHITE
DUCTWORK RETURN AIR	ORANGE	BLACK
DUCTWORK EXHAUST AIR	BLACK	WHITE
DUCTWORK OUTSIDE AIR	GREEN	WHITE
FIRE PROTECTION	RED	WHITE
MECHANICAL / PLUMBING / FIRE		

EQUIPMENT	WHITE	BLACK
FIRE, FIRE SMOKE DAMPERS	RED	WHITE

- F. Underground Utilities: Brass survey marker, 3" in diameter, 0.125" thick, Lietz # 8134-08 or equal. Grout for embedment to be non-shrink equal to Embecco or SinkagROUT. Install metallic brightly colored tape above all buried utilities in a continuous run 12" above the piping.
- G. Brass Valve Tag: 19 Gauge 1.5" diameter brass tag with an abbreviated 0.25" tall black text top line that designates the service and a 0.50" tall second line that is a unique three digit number that defines each valve in a system. Each tag to have a #16 brass jack chain and brass S-hook to secure the tag to a valve stem or a hole in the lever handle of ball valves.
- H. Valve Tag Chart: 8.5" x 11" framed chart with a heavy gauge aluminum frame that provides a type written listing of the valve number and the room(s)/utility that is controlled by the valve. Plumbing, fire protection and HVAC valve charts to be separate.

PART 3 EXECUTION

3.01 PREPARATION

- A. Degrease and clean surfaces to receive adhesive labeling for identification. Application of markings must be on clean surfaces. Adhesive markings are subject to rejection if applied improperly. Adhesive labels which exhibit any lifting at corners shall be removed, discarded and replaced.

3.02 INSTALLATION

- A. Adhesive Vinyl Equipment Tags: Provide at all equipment with name of equipment, e.g. "VFD-AHU1A" or "HWP7", as shown on the plans. Nameplate shall lay flat with no buckling, trapped bubbles or cracking and be located horizontal in the most readily seen location uniformly applied on all similar types of equipment. Two labels are required on all large equipment, AHUs, chillers, boilers, cooling towers and similar sized equipment.
- B. Location of Tag: Locate so that marking is easily read from floor in exposed locations or from side when above suspended ceiling. Label arrows to completely wrap piping. On duct and equipment background to be rectangular with background 2" beyond letters on all sides. Flow indicating arrow at text. Provide two labels when location is difficult to read. Label piping 30 feet on center, at both sides of wall or floor penetration, at valves, at equipment connections. Label duct 50 feet on center, at equipment, at wall and floor penetrations on each side, Label to include the equipment served, flow arrow, type of air. No labeling required on duct that is less than 2.5 SF in cross section nor on duct that is on the room side of terminal units. Label all duct regardless of size at chase penetrations. Label access door and ceiling grid at fire dampers, smoke dampers and combination fire-smoke dampers with unique designations, red labels and white 3/4" text. Designations will be provided by the test and balance agency.
- C. Equipment: Air handling units, fans exceeding 18" in diameter and roof mounted

units. Identify with vinyl adhesive labels. Black block text with white border.

- D. Piping: Plastic Tape Pipe Labels. Install so that label is easily read from floor in exposed locations or from side when above suspended ceiling. Completely wrap flow indicating arrow tape around pipe/insulation at both ends, partially overlapping fluid label in accordance with manufacturer's instructions. Provide two labels when location is difficult to read.
- E. Equipment: Pumps, tanks, fans less than 18", VAV terminals, VFDs, Disconnect Switches, Motor Starters and similar equipment. Label to use 3/4" tall letters. Identify by (1) name and (2) number designations to correspond with as-built drawings. Install in clear view. Label the ceiling grid as well as the equipment concealed above the ceiling.
- F. Controls: Identify control panels and major control components outside panels with adhesive backed clear plastic name tags, 1/4" tall letters.
- G. Apply ceiling markers on the ceiling grid of suspended ceiling systems, on the access door of hard ceilings below all concealed equipment, fire dampers, valves, control devices, etc. Location shall be at the best point of access rather than directly below the item where applicable.
- H. Pipe tags to be applied by floor level and by discipline. All valves require valve tags unless specifically noted otherwise. Valve tags are not required at individual terminal units, at coil sections of AHUs where there are multiple coils per AHU, at individual plumbing fixtures where the valve located within 36" and is within sight of the fixture served. Valve charts are required at all entrances of each mechanical room and at all entrances to each interstitial floors. Coordinate among trades to provide identical valve tags and charts. On the first floor locate valve charts in the electrical room.

3.02 CONTROL DIAGRAMS

- A. Provide control and systems instructions and diagrams, laminated within two sheets of plastic. Mount laminated diagrams on walls in conspicuous, easily accessible places in each separate equipment room housing an HVAC system to which the individual diagrams are applicable. The following instructions and diagrams are required:
 - 1. Control System diagrams.
 - 2. Electrical control diagrams
 - 3. Wiring diagrams.
 - 4. Sequence of operation, where applicable.
 - 5. Required concise operating instructions.
- B. Diagrams and instructions may be reduced in size provided they are easily readable and lettering is not smaller than 1/16" tall.
- C. The diagrams and instructions are to be sufficiently detailed to allow a competent HVAC technician to troubleshoot, and repair the systems and the instructions should allow any building Engineer to operate heating and cooling systems.

END OF SECTION

**SECTION 15242
VIBRATION ISOLATION**

PART 1 - GENERAL

1.01 WORK INCLUDED

- A. All work specified in this section shall comply with the provisions of Section 15010.
- B. Provide vibration materials and related items, and perform work as shown on drawings and as specified herein.
- C. Factory fabricated vibration isolators shall be sized by the vibration isolation supplier in consultation with equipment supplier.

1.02 RELATED WORK

- A. Section:
15140 - Supports and Anchors
15540 – Pumps

1.03 QUALITY ASSURANCE

- A. Responsibility for Products:
 - 1. Deflection for spring isolators shall be selected in accordance with recommendations in the current issue of ASHRAE Applications Handbook and Mason industries recommendations for vibration isolation and seismic restraints unless noted otherwise on drawings.
 - 2. Installer to be responsible for providing vibration isolators of appropriate sizes and weight loading in accordance with instructions of manufacturer of vibration isolators.
 - 3. Remove and replace springs as necessary to achieve proper range and deflection for installed conditions.

1.04 SUBMITTALS

- A. Submit product data as required by Section 15010 and Division 1.
- B. Include a tabular listing of all vibration isolation products with the application, model, quantity, deflection and load.

PART 2 - PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

- A. Mason Industries, Inc., Amber/Booth, Vibration Eliminator Co, Vibration Mountings and Controls, Inc.
- B. All vibration isolators to be supplied by single manufacturer.

- C. Manufacturer's representative to instruct installer in proper installation procedures and supervise the adjustment of all isolators.

2.02 FLOOR MOUNTED RESTRAINED SPRING ISOLATORS

- A. Mason Industries type SLF or SLR with height saving bracket.
 - 1. On rotating equipment with impellers or fan wheels up to 14". Deflection 2" minimum.
 - 2. On rotating equipment with impellers or fan wheels up to 15" to 42". Deflection 3" minimum.
- B. The following equipment and supports shall be isolated:
 - 1. Floor mounted pumps that are not on-grade.

2.03 OVERHEAD SUPPORTED PIPING, DUCT AND EQUIPMENT

- A. Mason Industries type PC30. 1" deflection, 30 degree angular deflection, neoprene isolation washer to completely separate the rod from contact with the spring housing springs with an additional minimal travel to solid equal to 50% of the rated deflection. Precompressed spring shall allow installation of piping without allowing hanger movement. A nut will be backed off after installation is complete to allow proper vibration isolation. A neoprene isolator will have a raised neck which prevents all contact between threaded support rod and isolator housing.
 - 1. All water piping supported from the overhead in the equipment rooms other than the penthouse.
 - 2. All suspended equipment that has a motor.
 - 3. All piping connected to and within 20 feet horizontally of spring isolated equipment. Where piping is larger than 6" they are required within 30 feet horizontally.
- B. The following connections shall be included:
 - 1. In-line Pumps.

2.04 PIPING ISOLATION

- A. On piping connections to equipment subject to vibration, install Mason Industries Safe-Flex reinforced rubber flexible connections with integral flanges and control cables. 200 psig working pressure at 250F. All flexible connections require control rods.
- B. The following connections shall be included:
 - 1. Pumps

2.05 NEOPRENE PADS FOR BOTTOM SUPPORTED EQUIPMENT

- A. On equipment supported from below with broad flat surfaces and minimal requirement for vibration isolation and non-critical applications, install Mason Industries type "Super-W" neoprene waffle pads, 0.75" thick. Use type WM for equipment which is bolted down. Use Type "HG" Bolt isolator bushings to separate and confine anchor bolt and mounting plate.

- B. The following equipment and supports shall be included:
1. All pipe stands. 0.25" deflection
 2. Seismic restraints at isolated equipment for horizontal force braces.
 3. At bottom connection of trapeze piping supports.
 4. Where indicated in drawings.

2.06 FLOOR MOUNTED SPRING SUPPORTS WITH RESTRAINED HOUSING

- A. Mason Industries type SSLFH.
1. On restrained floor mounted rotating equipment where supplemental restraints are not applied.
 2. On floor mounted piping supports at rotating equipment.
 3. Spring deflections are required as indicated on the plans or in accordance with ASHRAE recommendations if the spring deflection is not noted. Minimum of 3" for pumps and associated pump accessories that are not slab on grade.

PART 3 - EXECUTION

3.01 VIBRATION CONTROL

- A. All vibration control equipment shall be installed in accordance with the manufacturer's installation instructions and as specified.
- B. All vibration control equipment shall be selected as specified and sized in accordance with weight distribution, pull or the torque imposed by the shop drawing of approved equipment being isolated. Minimum static deflections may be revised subject to prior approval. The selection shall allow for duct and pipe connection which effect additional load on to the equipment and be load distribution coordinated with the installing Contractor.
- C. Provide revised vibration control equipment to match revised or substituted equipment. Replace supports after all equipment is installed and operating to assure that the equipment, duct and piping is isolated under all operational conditions.

3.02 INSTALLATION

- A. Set anchor bolts when concrete is placed.
- B. Install isolators in accordance with recommendations of isolator manufacturer and equipment manufacturer.
- C. Isolate mechanical equipment as indicated.
- D. The isolator manufacturer's factory trained representative shall visit the sites as the first isolation is installed and on other occasions as the work progresses to assure that the isolators are properly applied and adjusted.

END OF SECTION

SECTION 15250 INSULATION

PART 1 GENERAL

1.01 WORK INCLUDED

- A. Piping, piping accessories and equipment insulation installed or modified under this project.
- B. Duct, duct accessories and equipment insulation installed or modified under this project.
- C. Jackets and accessories.
- D. Allow for repair of existing insulation that is damaged by equipment removal, replacement and connection to existing duct/piping.
- E. All work specified in this section shall comply with the provisions of Division 1 and Section 15010.

1.02 REFERENCES

- A. ANSI/ASTM C195 - Mineral Fiber Thermal Insulation Cement.
- B. ANSI/ASTM C547 - Mineral Fiber Preformed Pipe Insulation.
- C. ANSI/ASTM C552 - Cellular Glass Block and Pipe Thermal Insulation.
- D. ASTM C449 - Mineral Fiber Hydraulic-setting Thermal Insulating and Finishing Cement.
- E. NFPA 90A - Energy Conservation in new building design.
- F. State Energy Code.
- G. ASTM E84 - Surface Burning Characteristics of Building Materials.
- H. NFPA 255 - Surface Burning Characteristics of Building Materials.
- I. UL 723 - Surface Burning Characteristics of Building Materials.
- J. ANSI/ASTM C553 - Mineral Fiber Blanket and Felt Insulation.
- K. ANSI/ASTM C612 - Mineral Fiber Block and Board Thermal Insulation.

1.03 QUALITY ASSURANCE

- A. Applicator: Company specializing in insulation application with five years minimum experience in this type of insulation using only experienced, qualified workmen.
- B. All Materials: Flame spread/smoke developed rating of 25/50 in accordance with ASTM E84, NFPA 255 or UL 723.
- C. Products shall meet applicable national, model, state, and local building codes and be UL or ETL listed for intended service.
- D. All Materials: Asbestos free.

1.04 SUBMITTALS

- A. Submit product data under provisions of Division 1 and Sections 15010.
- B. Include product description, list of materials, material safety data sheets and thickness for each service, and locations.
- C. Submit manufacturer's installation instructions under provisions of Division 1 and Section 15010.
- D. Include a letter to the Owner certifying that all insulation products and accessories used on this project are asbestos free.

PART 2 PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

- A. Owens Corning, Knauf, Manville, Certainteed, Armstrong or Pittsburgh Corning.

2.02 PIPE INSULATION

- A. Type A: Glass fiber insulation; ANSI/ASTM C547; 'k' value of 0.23 at 75F; noncombustible. Product to be Fiberglass 25 ASJ/SSL-II Pipe Insulation as manufactured by Owens Corning, or equivalent by Knauf, Manville or Certainteed.
- B. Type B: Cellular glass; ANSI/ASTM C552; maximum water vapor transmission rating of 0.1 perms; 'k' value of 0.40 at 75F. Product to be Foamglas as manufactured by Pittsburgh Corning or equivalent.
- C. Type C: Cellular foam; closed cell flexible, elastomeric; 'k' value of 0.28 at 75F. Product to be "Armaflex AP" as manufactured by Armstrong, or equivalent by Manville or Rubatex.
- D. Type D: Expanded polystyrene insulation; 'k' value of 0.23 at 75F; 1.25 lbs/cu ft density, 1.0 perm/inch maximum water vapor transmission, -20 to 165 F minimum service temperature range, 30 compressive strength at 10% deflection per ASTM D1621, 0.5% water absorption by volume per ASTM C272. Product to be Permatherm #407 or equivalent by Dow, Owens Corning, Knauf, Manville or Certainteed.

2.03 PIPE JACKETS

- A. Interior Concealed Applications:
 - 1. Vapor Barrier Jackets: Kraft reinforced foil vapor barrier with self-sealing adhesive joints, maximum vapor transmission rate 0.02 perms in accordance with ASTM E96, white finish.
 - 2. PVC Jackets: ASTM D1784, CLASS 14253-C; 30 mils thick; smooth white glossy finish; high impact strength; UV resistant; factory precut and curled; assembled with adhesive; equal to CEEL-CO 300 Series PVC. PVC factory molded fitting covers.
 - 3. Flexible elastomeric insulation does not require a separate jacket in concealed locations.
- B. Interior Exposed Applications 84" AFF or higher:
 - 1. Vapor Barrier Jackets: Kraft reinforced foil vapor barrier with self-sealing adhesive joints, maximum vapor transmission rate 0.02 perms in accordance with ASTM E96, white finish.
 - 2. PVC Jackets: ASTM D1784, CLASS 14253-C; 30 mils thick; smooth white glossy finish; high impact strength; UV resistant; factory precut and curled; assembled with adhesive; equal to CEEL-CO 300 Series PVC. PVC factory molded fitting covers. Z-Tape or equal matched to the jacket color to finish joints in the jacketing .
 - 3. Paint Flexible Elastomeric insulation with two coats of white water based latex enamel highly flexible coating equivalent to Armstrong "WB Armaflex Finish".

Custom color blend to match surrounding surfaces where noted on drawings.

- C. All Weather Exposed/Vaults/Outdoor Applications of all Elevations & Interior Exposed Applications up to 84" above adjacent working level :
 - 1. PVC Jackets: ASTM D1784, CLASS 14253-C; 30 mils thick; smooth white glossy finish; high impact strength; UV resistant; factory precut and curled; assembled with adhesive; equal to CEEL-CO 300 Series PVC. PVC factory molded fitting covers.
 - 2. Paint Flexible Elastomeric insulation with two coats of white water based latex enamel highly flexible coating equivalent to Armstrong "WB Armaflex Finish". Custom color blend to match surrounding surfaces or color code as applicable.
- D. Direct Buried Applications:
 - 1. Pittwrap: Factory manufactured jacket with multiple layers of tar and fiberglass reinforcing utilizing heat set methods of bonding jacket seams and joints.
- E. Cast in concrete walls:
 - 1. Wrap steel piping that does not receive insulation per the schedule with double lapped PVC tape.
 - 2. Pittwrap: Factory manufactured jacket with multiple layers of tar and fiberglass reinforcing utilizing heat set methods of bonding jacket seams and joints. Insulation does not need to exceed 1" thickness in this application.
 - 3. Wrap cast iron gravity flow piping with 1" fiberglass ASJ.

2.04 DUCT INSULATION MATERIALS

- A. Type A (Duct Wrap): Flexible glass fiber; ANSI/ASTM C553; commercial grade; 0.75 PCF; 0.002 inch foil FSK jacket; maximum vapor transmission rate of 0.02 perms, and a puncture resistance rating of 40 units. Owens Corning Fiberglass All-Service Duct Wrap.
- B. Type B (Duct Board): Rigid glass fiber; ANSI/ASTM C612, 3.0 PCF; Class 1; 0.002 inch foil FSK jacket; maximum vapor transmission rate of 0.02 perms. Owens Corning Fiberglass 705 Series foil faced boards.
- C. Type C (Duct Liner): Flexible glass fiber; ANSI/ASTM C553; 'k' value of 0.26 at 75 degrees F; 2.0 lb/cu ft minimum density; coated and sealed air side for maximum 6,000 ft/min air velocity, ASTM C1071. ASTM C 665 & G21/22 will not support or promote fungal or bacterial growth as described in these standards. Owens Corning Aeroflex PLUS Duct Liner.
- D. Type D (Flexible Closed Cell Elastomeric Sheet): Armstrong AP equipment insulation or equivalent.
- E. Type E: FyreWrap Elite 1.5 Air Distribution Insulation; 6 PCF high temperature core blanket of magnesia, silica and calcia with a encapsulating FSK jacketing; 'k' value of 0.21 at 75 degrees F;. Listed to encapsulate the metal duct providing a 2 hour fire rating in accordance with UL 723, comply with ASTM E-84 and not exceed the 25/50 Flame Spread / Smoke Developed criteria. Manufactured by Unifrax or equal by 3M.

2.05 ACCESSORIES

- A. Insulating Cement: ANSI/ASTM C195; hydraulic setting mineral wool.
- B. Finishing Cement: ASTM C449.
- C. Fibrous Glass Cloth: Untreated; 9 oz/sq yd weight.
- D. Adhesives: Compatible with insulation.
- E. Insulation Bands: 3/4 inch wide; 0.007 inch thick aluminum.
- F. Metal Jacket Bands: 3/8 inch wide; 0.015 inch thick aluminum.
- G. Tape: Pressure sensitive, fiber reinforced, with a finish that matches the insulation jacket. 3" wide minimum.
- H. Pipe Supports: Match thickness of adjacent insulation. Provide a FoamGlass insert minimum of 12" long with a formed galvanized steel saddle. Provide 18" length for piping over 6" nominal.

PART 3 EXECUTION

3.01 PREPARATION

- A. Install materials after piping/duct has been tested, approved and released for insulation application. Obtain Owner's representative signature that pressure testing of piping/duct is complete.
- B. Surfaces shall be clean and dry.
- C. Verify that all heat tracing of pipe is complete.
- D. Verify that duct pressure testing is complete.
- E. Where insulation is installed on interstitial levels the insulation is considered to be in a concealed ceiling space and the requirements for additional jacketing and coatings that are applicable to 84" above working level in equipment rooms are not applicable to interstitial levels.

3.02 INSTALLATION

- A. Install materials in accordance with manufacturer's instructions using professional insulators with documented experience in installations of this project's scope.
- B. Continue insulation with vapor barrier through penetrations of floors and walls with fire resistive construction maintaining vapor barrier. Seal penetration to maintain fire rating. Make floor and exterior wall penetrations watertight.
- C. In exposed piping, locate insulation and cover seams in least visible locations so as to have a well tailored appearance.

- D. On insulated piping with vapor barrier required, insulate fittings, valves, unions, flanges, strainers, flexible connections, and expansion joints. Use mitered or premolded insulation for all pipe fittings, DO NOT USE BATT INSULATION. Butterfly valves, flanges, couplings and other hydronic accessories which are not readily covered by mitered insulation may be insulated with 3/4" thick elastomeric foam with rigid fiberglass insulation for backing and support. Where PVC jackets are allowed completely fill with multiple layers of rigid insulation to fill all voids and prevent collapsing of PVC fitting covers.
- E. On piping with glass fiber insulation, 1-1/4" diameter or larger, provide a cellular glass or calcium silicate insert, 180 degree, length to match external support shield, but not less than 12" long. Match thickness and contour as adjoining insulation and install under the vapor barrier jacket, between support shield and piping. For piping over 1-1/2" provide a galvanized steel, 180 degree support shield at each support point, not less than 12" long equal to Bline B3153. For elastomeric foam insulation up to 2.5" provide a manufactured pipe support saddle with integral insulation equal to Armafix IPH pipe support with integral aluminum jacket. On chilled water piping over 6" install a cellular glass insert 18" long where clevis hangars are allowed. All chilled water piping 3" and larger shall have clamped hangar that directly attach to the piping and will require foam insulation up 8" from the top of the pipe insulation with a complete vapor barrier to control condensation on the hangar and rod. Refer to Section 15140 for location and length of pipe saddles.
- F. Taper cut and neatly finish seal insulation at valve handles, flanges, unions, supports, protrusions, and interruptions. Do not leave insulation fibers exposed. Extend insulation onto hanger +/- 8" where a hanger penetrates the jacket. Provide removable covers at unions, flanges, strainers, flow measuring stations, P&T plugs etc. which must be removed to service connected equipment where fluid is below ambient.
- G. Insulate outdoor piping and piping in vaults with Type B cellular glass insulation. Insulate fittings, joints, and valves with insulation of like material, density & thickness as adjoining pipe, and finish with vapor barrier mastic. Cover all insulation with factory formed PVC covers. Locate seams on bottom side of horizontal piping. Solvent weld all seams and joints. Install flashing to shed rain around ends of piping where it joins equipment. A completely watertight PVC jacket system is required. Provide for PVC jacket expansion. Remove and replace any work found to leak during the warranty period. Type C, flexible foam, insulation may be used where necessary at flanges, flexible connectors and similar areas to enhance the appearance of the insulation system.
- H. Miter insulation to fit or be tucked snugly into the throat of fitting and edges adjacent to pipe covering, tufted, tucked, taped, etc., to form a fully insulated pipe covering. Use adhesive and glass cloth specified for type of insulation to insure a thorough smooth covering.
- I. Tape or butt ends securely to adjacent pipe covering. Tape to extend over adjacent pipe insulation and have an overlap of at least 1-1/2" on both sides.
- J. Do not insulate heat traced piping until the piping has been tested and approved by the Owner to cover with insulation.

- K. Provide water stop in all piping insulation systems that operate below the ambient dew point temperature, e.g. refrigerant suction piping, chilled water piping, etc. Water stops shall be installed 40 foot on center, at piping branch connections to mains, at pump/chiller/AHU, at vertical drops to equipment and at each floor on vertical risers. Water stops shall be formed from mastic, tape, or similar water barrier system and shall extend from the pipe surface with a 3" contact length and extend over the vapor barrier insulation jacket with a 3" contact length. Match the adjacent insulating materials and insulation system vapor barrier and as recommended by manufacturer and install in accordance with manufacturer's installation instructions. Water stops shall provide a water tight barrier between the pipe surface and pipe insulation system vapor barrier. The water stop is intended to limit the amount of insulation damage and moisture migration should a vapor barrier fail or be damaged.
- L. In renovation projects the existing duct and piping will be damaged during the renovation and will have insulation and vapor barriers which are no longer intact. Allow for replacing and patching 5% of the existing duct and piping insulation in the area of renovation. Patching shall be limited to damaged insulation and vapor barrier. This project has possible asbestos abatement which is not defined in bid package #1. Provide pipe insulation where piping is removed and capped or is in the path of demolition and the insulation must be removed to perform demolition of adjacent pipe or duct. This work is not delineated on the plans and must be covered under the base bid of bid package #1.

3.03 EQUIPMENT INSULATION AND PIPING ACCESSORIES

- A. Prior to application of flexible sheet elastomeric insulation, thoroughly clean all metal surfaces, making sure that all dirt, scale, loose paint, plaster, and oil has been removed and that surfaces are dry. If surface has been primed, test a two square foot section using adhesive equivalent to Armstrong No. 520 in order to determine whether solvent in adhesive will loosen or lift the primer. If primer is loosened, then remove it. When testing proves acceptable, adhere insulation with smooth side out, using thin but adequate coating of same adhesive. Follow manufacturer's instructions. Coat all butt edges of each sheet. Stagger all joints. Insulate all standing seams or flanges with same thickness of insulation material as that used on main surface. Verify that all heat tracing is installed. Where equipment is to be heat traced the insulator will be responsible for removal and replacement of any insulation due to the heat tracing not being installed prior to insulating.
- B. Do not insulate over nameplate or ASME stamps. Bevel and seal insulation around such where sweating will not occur. If sweating will occur the nameplate should be removed and riveted in a conspicuous location on the equipment base.
- C. Do not insulate factory insulated equipment.
- D. Use flexible, removable, snug-fitting covers for equipment and piping accessories that require periodic opening for maintenance, repair, testing or cleaning. Install insulation in such a manner that it can be easily removed and replaced without damage to insulation. Specifically, but not exclusively, this applies to pumps, chillers, strainer covers, chilled water control valves, flow measuring stations, pressure and temperature sensing locations, and drains/vents. Where a round access plug is possible provide an interference fit plastic plug with elastomeric insulation inside the plug. Plugs available through McMaster Carr # 9567K21, 12, 15, 17.

- E. On new chilled water pumps and chiller evaporator barrel end cap, opposite the piping connections, provide a 22 gauge galvanized sheet steel box with 1" thick flexible elastomeric insulation bonded to the interior. Construction to be rugged and readily broken down for servicing pumps by removing toggle type clamps. Seal any joints using neoprene gasketing. Provide a compression seal at piping penetrations using Armaflex insulation. This removable cover shall provide ready access to the chiller barrel end cap and associated attachment bolts and lifting lugs.
- F. On heat exchangers finish with an Aluminum Jacket in lieu of a PVC jacket. Insulate heads with a removable section which will permit access to remove tube bundle.
- G. Provide flexible insulated covers for steam traps. Strap covers in place with means which will permit reattachment by unskilled technicians.
- H. Fire Rated Duct Insulation
 - 1. Apply in accordance with manufacturers' recommendations for a 2 hour fire rated equivalent chase around the duct.

3.04 PIPE INSULATION SCHEDULE

<u>PIPING</u>	<u>TYPE</u>	<u>PIPE SIZE</u>	<u>INSULATION</u>
			<u>THICKNESS</u>
	Inch	Inch	Inch
Indoor			
Heating Water	A	up to 1"	1.0
Heating Water	A	Over 1"	1.5
Piping Accessories	None		
Steam & Steam Condensate	A	All	2.0
Vents	A	All	2.0
Piping Accessories	None		
Potable Cold Water	A	All	1.0
Potable Hot Water	A	All	1.0
Potable Hot Water Return	A	All	1.0
Non-Potable Cold Water	A	All	1.0
Boiler Feedwater	A	All	1.5
Accessories	n/a	n/a	None

3.05 DUCT INSULATION

- A. Insulate concealed side of all air supply outlets with duct wrap. Maintain vapor barrier by taping to 1" lip at perimeter of outlet. Do not tape to ceiling support grid.
- B. Provide insulation with vapor barrier for all outdoor air, supply air and return air duct. Vapor barrier integrity shall be assured by taping all seams and joints. Shiplap and staple then tape with 3" wide tape rubbing all tape tight with a nylon sealing tool.

Where joints or seams are not shiplapped use 5" wide tape.

- C. Maintain integrity of vapor barrier throughout installation, including where new and existing insulation is joined, where dampers are installed and where diffusers or registers are connected. Insulate any air valves, dampers, coils, equipment and accessories which are not insulated from the factory equivalent to the duct insulation schedule.
- D. Where duct liner is interrupted at heating devices, dampers or otherwise the insulation shall be overlapped 6" and the insulation shall be continuous using exterior insulation. In concealed locations 2" duct wrap is allowed in exposed location 1" duct board or 3/4" armafex is required.
- E. Duct Wrap or Board Exterior Insulation (Type A or B) Application:
 - 1. Secure vapor barrier and insulation using outward clenching staples 4" on center and sealing all joints with tape to match jacketing. Tape all seams, joints, impale anchor washers, staple penetrations and edges where damper shafts, hangers, etc protrude.
 - 2. Install without sag or droop on bottom and sides of ductwork. On rectangular duct areas 16" and wider use mechanical welded impale fasteners with speed washers 12" on center and within 3" of all edges or corners. Install washers without compressing insulation, cut off excess fastener shaft and cover holding washer with tape to maintain and match vapor barrier.
 - 2. Band rigid board insulation to round or irregular surfaces using aluminum strapping 12" O.C..
 - 3. Band duct wrap insulation to round or irregular surfaces using aluminum strapping 12" O.C. where nominal diameter exceeds 30". Do not compress insulation.
 - 4. Impale anchors must be attached to the duct by clinched pin or electric resistance welding.
- F. Liner (Type C) Application:
 - 1. The velocity rated side of liner must face the air flow. Adhere insulation with adhesive for 100 percent coverage. Secure insulation with mechanical fasteners in rows every 16 inches of duct run. Fasteners to be located in strict accordance with manufacturers recommendations for 6000 fpm duct velocities where duct construction exceeds +3" or -3". Comply with SMACNA , FIG 2-19, spacing criteria for 2500 FPM duct velocities where duct construction is between -3" and +3". Seal and smooth all liner joints and edges with adhesive. Liner shall be cut to assure overlapped and butted longitudinal joints. Seal all vapor barrier penetrations by mechanical fasteners.
 - 2. Nosing is required on the leading edge of duct liner insulation where duct velocity exceeds 3000 fpm. Comply with SMACNA standard requirements, Figure 2-22. Weld/screw/rivet nosing in place.
 - 3. Anchor pins must be attached to the duct by clinched pin or electric resistance welding and shall indefinitely hold a 50 pound tension load perpendicular to the duct wall. The pull-out strength of anchors shall be demonstrated to the Owner/Engineer upon request. Failure to comply shall result in the entire anchor system being rejected.

G. Flexible Elastomeric Foam Sheet (Type D) Application:

1. Prior to application of flexible sheet elastomeric insulation, thoroughly clean all metal surfaces, making sure that all dirt, scale, loose paint, plaster, and oil has been removed and that surfaces are dry. Adhere insulation with smooth side out, using thin but adequate coating of adhesive. Follow manufacturer's instructions. Coat all butt edges of each sheet. Stagger all joints. Insulate all standing seams or flanges with same thickness of insulation material as that used on main surface. Paint exposed surfaces with 2 coats of Armstrong AP paint to match adjacent wall surface. Custom blend may be required.
2. Use flexible, removable, snug-fitting covers for equipment and accessories that require periodic opening for maintenance, repair, testing or cleaning. Install insulation in such a manner that it can be easily removed and replaced without damage to insulation.
3. Do not insulate factory insulated equipment.
4. Insulate exterior of flexible duct connections at fans and AHUs using 1/2" thick flexible elastomeric insulation.

3.06 SCHEDULE

<u>DUCTWORK</u>	<u>TYPE</u>	<u>INSULATION THICKNESS</u>
		Inch
SUPPLY AIR DUCT		
Concealed	A	2
Exposed in equipment rooms above 10' AFF	A	2
Exposed in equipment rooms up to 10' AFF	B	1
RETURN AIR DUCT,		
Round	NONE	N/A
Rectangular	C	1
EXHAUST AIR DUCT	NONE	N/A

Notify Architect/Engineer of any conflicts. Note that drawing notations are clear inside of duct. Increase sheet metal sizes to allow for scheduled internal insulation.

END OF SECTION

**SECTION 15300
FIRE PROTECTION SYSTEM**

PART 1 - GENERAL

1.01 WORK INCLUDED

- A. All work specified in this section shall comply with the provisions of Division 1 and Section 15010.
- B. Sprinkler system shall be ordinary hazard, standard response, wet system in 140 Washington basement level where the new partitions require additional sprinklers or relocation to comply with current code requirement. Rework the existing sprinkler system and provide new piping and sprinklers as necessary to maintain complete coverage in the Basement Sprinkler system and coverage shall comply with NFPA, state and local authority requirements.
- F. Extent of work:
 - 1. Shop drawings, hydraulic calculations, fees and other costs associated with review and approval of insurer, local and state authorities.
 - 2. Pipe, fittings, valves.
 - 3. Hangers, supports, penetrations and sleeves.
 - 4. Sprinkler heads, extra sprinkler cabinet.
 - 5. All indicated or required fire department connections, fire hydrant, indicating valves, test connections, flow switches, tamper switches, pressure switches and accessories.
 - 6. Signage and testing per applicable code and AHJ requirements. Label piping per Section 15190 - Mechanical Identification.
 - 7. Testing and flushing.
 - 8. Comply with Owner's insurance company's requirements and the requirements of all Authorities Having Jurisdiction, AHJ. Where these requirements are more stringent than what is shown in the Contract Documents then the more stringent shall apply with no change in Contract amount.
 - 9. Provide complete coverage per NFPA 13 requirements.

1.02 GENERAL

- A. Install system in accordance with the drawings and specifications, however, no requirement of NFPA 13, NFPA 14, NFPA 20, NFPA 24, NFPA 25, Owner's insurance underwriter or Authorities Having Jurisdiction may be violated.
- B. Provide material and labor to fully comply with the Contract Documents and with the applicable rules, regulations, ordinances and AHJ requirements.
- C. Include the following requirements:
 - 1. Provide light hazard protection unless otherwise noted or required.
 - 2. Provide all signage in accordance with code and authority requirements.
 - 3. Contractor shall provide the results of a recent flow test to determine the adequacy of the water supply before construction begins. Submit this with sprinkler system drawings and calculations.

1.03 WORK EXCLUDED

- A. Painting
- B. Electrical wiring.

1.04 QUALITY ASSURANCE AND COMMISSIONING

- A. Materials to be UL and FM approved, where such approval is available. FM approval may be waived by the Engineer if FM Global is not the insurance underwriter on the facility. All hose threads, operating nuts, and accessories for hydrants, Siamese connections, to be local Fire Department Standard.

1.05 SUBMITTALS AND SHOP DRAWINGS

- A. Prepare complete detailed working drawings for Fire Protection System. Drawings to be submitted to local authorities and Owner's insurance carrier for approval. After receiving this approval, submit to Architect/Engineer for his review of the shop drawings, and approval prior to starting installation. Coordinate work with other trades. Fire protection piping shall not take priority over Architectural features, lighting, HVAC duct work or gravity flow piping.
- B. Equipment submittal drawings and data are required on all items named by manufacturer, including the following:
 - 1. Sprinkler Heads
 - 2. Valves, Pressure Regulators
 - 3. Water Flow and Tamper Switches
 - 4. FDC, PIV, FHVC, FDV & FH
 - 5. Piping, fittings and supports

1.06 APPLICABLE CODES

- A. NFPA 10, 13,14, 20, 24, 25
- B. ANSI A17.1 - Elevator Code

PART 2 - PRODUCTS

2.01 GENERAL

- A. Products listed indicate standard. Products by other manufacturers as set forth in Section 15010 are acceptable.

2.02 VALVES

- A. Interior valves: Check valves shall be equal to Crane No. 375 UL approved flanged pattern iron body swing check valves. Cutoff valves shall be equal to Crane No. 467 UL flanged pattern outside screw and yoke wedge gate valves. Cutoff valves up to 2" shall be bronze, equal to Crane No. 459 or indicating butterfly vales with integral tamper switches and tamperproof position indication.

2.03 PIPE AND FITTINGS

- A. Interior Pipe and Fittings:
 - 1. All pipe inside of building shall be Schedule 40 (ASTM-120) black steel pipe,

with 175 PSIG fittings, screwed, flanged, or mechanical coupled. Where approved by FM Global, state and local authorities the use of Allied XL Thin-wall pipe or Schedule 10, ASTM-135 with mechanical couplings is allowed. Provide piping rated for the maximum anticipated pressure upstream from pressure reducing valves. Where pressure reducing valves are installed they shall not be set in excess of 100 PSIG. Where existing pressure reducing valves serve the new system provide materials that exceed the maximum delivered pressure with a 10% margin of safety. Where the piping is exposed to pressures in excess of 175 PSIG provide pipe and fittings that are rated for cold working pressures 25 PSIG more than the pressure created at that location when the fire pump is at no flow conditions, (Churn).

2. Dry pipe systems shall use galvanized steel pipe and fittings. Pilot lines shall be a minimum of 3/4" Sch 40 black steel where concealed, provide 3/4" galvanized fittings and galvanized steel piping in exposed locations.
3. MRI and NMR areas shall apply only copper piping with silver phosphorus brazed joints. Provide dielectric unions for separation from steel piping.

B. Hangers, Supports, and Sleeves:

1. Piping to be supported with UL and FM approved hangers. All new piping is required to be seismically restrained per NFPA, FM Global and local AHJ requirements and Section 15140. A licensed structural Engineer must review and approve all seismic restraint design.

2.04 SPRINKLER HEADS, EXTRA SPRINKLER CABINET

- A. The following sprinkler heads to be the proper types, ratings, and spacing for areas involved. Appropriate finishes must be compatible with space finishes being served. Quick Response unless noted otherwise.
1. Gem, Star, Tyco, Viking, Automatic Sprinkler or approved equal.
 2. In areas with finished ceilings provide semi-recessed sprinklers. Finish of these sprinklers to be white standard from factory. Field painting will not be allowed under any circumstances. The actual sprinkler shall be submitted to the Architect for color and appearance approval.
 3. In areas without finished ceilings provide standard brass finished pendent/upright sprinklers.
 4. Wire guards are required in all areas that do not receive a ceiling and are not designated as shell space.
 5. The first floor shall have concealed sprinklers throughout all spaces where the sprinkler is visible. In addition there are a number of ceiling features on the first floor that must be carefully reviewed to determine the sprinkler requirements. In some cases two complements of sprinklers are required where ceilings are open to the overhead structure or a feature ceiling is installed below a higher ceiling.

2.05 FIRE PROTECTION COMPONENTS

A. Flow and Tamper Switches

1. Flow switch equal to Notifier WFD-6 vane type with pneumatic retard adjustable from 0-90 seconds complete with double pole double throw micro feature.

2. Tamper switch equal to Notifier SGV for 4" and larger; Potter Roemer OSYSU-A2 for pipe less than 4". All equipped with double pole double throw micro feature.
- B. Drain Valves
1. Bronze body, chrome plated brass ball valves with hose connection at all low points and other locations requiring drain valves.
- C. Floor Control Valve
1. Factory assembled multiple use valve with all of the following features:
 - A. Indicating butterfly isolation valve with integral tamper switch.
 - B. Three position combination valve for normal operation - test - drain of the area served.
 - C. Indicating flow device with double sided glass view ports and a wheel that spins to indicate flow.
 - D. Check valve to allow riser maintenance and draining without isolating floor valves.
 - E. Pressure regulating valves for application on all systems with a fire pump or those that have normal operating pressure in excess of 100 PSIG. Regulate distribution pressure to 100 PSIG leaving the floor control valve.

PART 3 - EXECUTION

3.01 COORDINATION

- A. Coordinate installation with other trades under the direction of the Prime Contractor to eliminate conflicts.
- B. Position heads in the center of ceiling tiles and symmetrical in rooms. Refer to the Architectural for any layout provisions and lay out sprinklers accordingly.

3.02 PIPE INSTALLATION

- A. Comply with NFPA 13.
- B. Attach hangers to concrete structure using expansion shields and to structural steel with clamps or other approved methods. Structural steel shall not be drilled or punched. Wherever necessary, furnish, install, and securely anchor to building members with suitable angle iron or other steel members to support piping.
- C. Support for grooved piping shall conform to requirements of MSS-SP-69, "Pipe Hangers and Supports - Selection and Application". In addition to these requirements, horizontal pipe shall not be left unsupported between any two couplings nor shall any pipe be left unsupported whenever a change in direction of flow takes place. Supports shall meet the requirements stated above but in no case shall the distance between supports exceed the following:

PIPE SIZE	MAXIMUM SPAN BETWEEN HANGERS
1 inch	8 feet
1 1/4 thru 2 inch	10 feet
2 1/2 thru 4 inch	12 feet
5 thru 8 inch	14 feet
10 thru 12 inch	15 feet

- D. Vertical piping shall be supported at every other floor or every other pipe length, whichever is most frequent. The base of the riser or base fitting shall be set on a pedestal or foundation.

3.03 SPRINKLERS

- A. Install sprinkler heads and required piping in areas such as concealed spaces, and other special areas and spaces as required by NFPA 13, NFPA 101, applicable state, local, and model codes. The heads may be shown where particular placements is known to be required. Where heads are shown this is not intended to indicate all sprinklers that are required. Provide additional heads as needed to comply with all codes, obstructions and authority requirements in the spaces.
- B. Provide drain valves, pipes and test connections as required by NFPA 13. Pipe drain lines and test connections to outside of building. Test lines shall originate from most hydraulically remote point of each sprinkler zone.
- C. Install heads down the centerline of all spaces and locate in the center of the ceiling tiles where possible. (See Architectural reflected ceiling plans and comply with these requirements where they are more stringent.) If the center of tile location is impossible then sprinkler heads shall not be installed closer than six inches to any ceiling support grid or wall. Most areas require heads to be located in center of tile and symmetrical within the space. Selected areas are not required to be centered, these areas are:
1. Storage rooms, closets, file rooms, janitor closets and mechanical rooms.

END OF SECTION

**SECTION 15410
PLUMBING PIPING**

PART 1 GENERAL

1.01 WORK INCLUDED

- A. Indirect Waste piping system
- B. Potable & Non-Potable Water Piping System
- C. Sanitary Sewer/Vent Piping System
- D. Natural Gas
- E. Seismic restraints.

1.02 RELATED WORK

- A. 15050 – Heat Tracing
- B. 15140 - Supports and Anchors
- C. 15190 - Mechanical Identification
- D. 15242 – Vibration Isolation
- E. 15250 - Insulation
- F. All work specified in this Section shall comply with the provisions of Division 1 and Section 15010.

1.03 REFERENCES

- A. ANSI/ASME B16.3 - Malleable Iron Threaded Fittings Class 150 NS 300.
- B. ANSI/ASME Sec. 9 - Welding and Brazing Qualifications.
- C. ANSI/ASTM B32 - Solder Metal.
- D. ANSI/ASTM D2466 - PVC Plastic Pipe Fittings, Schedule 40.
- E. ANSI/AWS D1.1 - Structural Welding Code.
- F. ASTM A74 - Cast Iron Soil Pipe and Fittings.
- G. ASTM B88 - Seamless Copper Water Tube.
- H. ASTM C564 - Rubber Gaskets for Cast Iron Soil Pipe and Fittings.
- I. ASTM D2241 - PVC Plastic Pipe
- J. ASTM D2513 - Thermoplastic Gas Pressure Pipe, Tubing and Fittings.
- K. ASTM D2729 - PVC Sewer Pipe and Fittings.
- L. ASTM D2855 - Making Solvent-Cemented Joints with PVC Pipe and Fittings.
- M. AWWA C601 - Standard Methods for the Examination of Water and Waste Water.
- N. CISPI 301 - Cast Iron Soil Pipe and Fittings for Hubless Cast Iron Sanitary Systems.
- O. AWWA C110/C111 - Ductile Iron Retainer Gland Mechanical Joint piping and fittings.
- P. ASTM D4101 - Flame Retardant Polypropylene

1.04 QUALITY ASSURANCE

- A. Valves: Manufacturer's name and pressure rating marked on valve body.
- B. Welding Materials and Procedures: Conform to ASME Code
- C. Welders Certification: In accordance with ANSI/ASME Sec 9.

1.05 SUBMITTALS

- A. Submit product data under provisions of Division 1 & Section 15010.
- B. Include data on pipe materials, pipe fittings, valves and accessories.

1.06 DELIVERY, STORAGE, AND HANDLING

- A. Deliver, store and protect products under provisions of Division 1 & 15010.

PART 2 PRODUCTS

2.01 SANITARY SEWER, RAIN LEADER, INDIRECT WASTE (condensate drains) PIPING and associated VENTS - ABOVE GRADE

- A. Cast Iron Pipe: CISPI 301, hubless, service weight. Fittings: Cast iron. Joints: Neoprene gaskets and 304 stainless steel clamp-and-shield coupling assemblies. Heavy duty couplings with colored markings to be applied on all piping. 2" through 4" couplings to have 4 screw clamps per coupling, 5" - 15" to have 6 clamps per coupling with each clamp rated for 80 inch-pounds installation torque. FM1680 compliant, min 1500 PSI tensile strength. Additional strapping is required for rain leaders at changes in direction and for all piping at seismic crossings.
- B. Copper Pipe: ASTM B306, DWV. Fittings: ANSI/ASME B16.3, cast bronze, or ANSI/ASME B16.29, wrought copper. Joints: ANSI/ASTM B32, solder, Grade 50B.

2.02 WATER PIPING, ABOVE GRADE Potable and Non-Potable

- A. 2.5" and less; Copper Tubing: ASTM B88, Type L, hard drawn. Fittings: ANSI/ASME B16.23, cast brass, or ANSI/ASME B16.29, wrought copper. Joints: ANSI/ASTM B32, solder, Grade 95TA, "lead-free".
- B. 3" and less; Copper Tubing: ASTM B88, Type L, hard drawn. Fittings: ANSI/ASME B16.23, cast brass, or ANSI/ASME B16.29, wrought copper. Joints: Proprietary compression joint method, Ridgid Pro Press or Engineer approved alternative.
- C. 3" and above; Copper Tubing: ASTM B88, Type L, hard drawn. Fittings: wrought copper per ASTM B-75 alloy C12200 and ANSI B16-22 with roll grooved ends. Couplings to be ductile iron conforming to ASTM A-395, Grade 65-45-15, and/or ASTM A-536, Grade 65-45-12, coated with copper-colored alkyd enamel. Grooved couplings shall meet the requirements of ASTM F-1476 and have Type 316 stainless steel bolts per ASTM A-193, Grade B8M. Gaskets shall be Grade "E" EPDM compound (green color coded) conforming to ASTM D-2000 designation 2CA615A25B24F17Z, UL/ULC classified to ANSI/NSF 61 for cold and hot potable water service. All components rated for minimum 275 PSIG working pressure at 180F. Victaulic CTS or Engineer approved alternate.
- D. 3" and above; Schedule 10S Type 304L Stainless Steel ASTM A312 with roll grooved ends. Fittings: Rigid Stainless Steel type 316, conforming to ASTM A-351, A-743, and A-744 Grade CF-8M. Rigid coupling housing key shall directly engage the bottom of the groove. Grooved couplings shall meet the requirements of ASTM F-1476 and have Type 316 stainless steel bolts. Gaskets shall be Grade "E" EPDM compound (green color coded) conforming to ASTM D-2000 designation 2CA615A25B24F17Z, UL/ULC classified to ANSI/NSF 61 for cold and hot potable water service. All components rated for minimum 275 PSIG working pressure at 180F.

2.03 NATURAL GAS PIPING, ABOVE GRADE

- A. Over 2" or over 2 PSIG; Steel Pipe: ASTM A53 or A120, Schedule 40 black. Fittings: ASTM A234, forged steel welding type, Joints: ANSI/AWS D1.1, welded. Socket weld fittings required up to 2".
- B. Under 2" and 2 PSIG or less; Steel Pipe: ASTM A53 or A120, Schedule 40 black. Fittings: ANSI/ASTM B16.3, malleable iron threaded or ASME B16.11-1996 forged steel black nipples using ASTM A105 steel, socket welded ANSI/AWS D1.1.

2.04 FLANGES, UNIONS, AND COUPLINGS

- A. Pipe Size 2 Inches and Under: 150 psig malleable iron unions for threaded ferrous piping; bronze unions for copper pipe, soldered joints.
- B. Pipe Size Over 2 Inches 150 psig forged steel welding neck flanges for ferrous piping; bronze flanges for copper piping; neoprene gaskets for gas service; 1/16 inch thick preformed neoprene bonded to asbestos.
- C. Grooved and Shouldered Pipe End Couplings: Malleable iron housing clamps to engage and lock, designed to permit some angular deflection, contraction, and expansion; "C" shape composition sealing gasket; steel bolts, nuts, and washers; galvanized couplings for galvanized pipe.
- D. Dielectric Connections: Union with galvanized or plated steel threaded end, copper solder end, water impervious isolation barrier.

2.05 BALL VALVES (all valves 2" and less unless noted otherwise on drawings)

- A. Crane, Grinnell, Jenkins, Nibco, Watts, Milwaukee. Equal to Nibco S-585-70 with offset lever handle. MSS SP-110, 400F max, 600 PSI CWP.
- B. Bronze body, chrome plated bronze ball, teflon seats and stuffing box ring, extended lever handle offset to clear insulation. Soldered ends.
- C. Oxygen clean ball valves with extended copper pipe stub outs are required for pressurized non flammable gasses.
- D. Natural gas ball valve UL 842 approved and certified by the CGA and ASME B16.33 for application of gas shut-off valve. McDonald #10710 for low pressure applications up to 5 PSIG; McDonald 560 Series lubricated plug valve rated for natural gas up to 175 PSIG pressure.

2.06 HOT WATER RETURN FLOW MEASURING STATIONS

- A. Armstrong CBV.
- B. Device will provide precise flow measurement through differential pressure readings across a tapered plug valve; positive bubble tight shutoff; precision flow adjustment through a vernier scale; easily restored tamper-proof balance setting; drain connection with protective cap and a factory furnished insulating cover that can be removed and readily replaced. Ball valves with scales and pressure ports are not acceptable. 150 psig at 200 F rating. Provide a pressure and temperature tap, "Pete's plug" to allow accurate measurement of temperature at approximately 12" upstream of every balancing valve. Provide a ball valve on the downstream side of each balancing valve to provide a dedicated isolation valve.

- C. Bronze or brass construction rated for application in potable water systems. Armstrong, Grinnell, Mepco or Tour & Anderson.

2.07 BUTTERFLY VALVES (all valves exceeding 2" unless noted otherwise on drawings)

- A. Crane, Grinnell, Jenkins, Nibco, Watts, Milwaukee. Equal to Nibco LD-2000 with extended lever handle, lead free, MSS SP-25, lever lock position plate, 200 PSI at 225F.
- B. Ductile iron lug style body, aluminum bronze disk, teflon seats and stuffing box ring, extended lever handle offset to clear insulation, dielectric flange pack to join with copper or stainless steel flanges.

PART 3 EXECUTION

3.01 PREPARATION

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

3.02 INSTALLATION

- A. Provide non-conducting dielectric connections wherever jointing dissimilar metals.
- B. Route piping in orderly manner and maintain gradient.
- C. Install piping to conserve building space and not interfere with use of space.
- D. Group piping whenever practical at common elevations.
- E. Install piping to allow for expansion and contraction without stressing pipe, joints, or connected equipment.
- F. Provide clearance for installation of insulation and access to valves and fittings.
- G. Provide access where valves and fittings are not exposed. Coordinate size and location of access doors with Prime Contractor.
- H. Slope water piping and arrange to drain at low points.
- I. Establish elevations of buried piping outside the building to ensure not less than 2 ft of cover.
- J. Where pipe support members are welded to structural building framing, scrape, brush clean, and apply one coat of zinc rich primer to welding.
- K. Establish invert elevations, slopes for drainage to 1/8 inch per foot (one percent) minimum on gravity flow piping less than 8". Maintain gradients. Use 1/4 inch per

foot slope wherever possible and on piping less than 3".

- L. Excavation site work and backfill in accordance with Division 02 and Section 15010.
- M. Install bell and spigot pipe with bell end upstream.
- N. Install valves with stems upright or horizontal, not inverted.
- O. Do not route piping above or in front of electrical equipment. Offset 54" in front of electrical equipment. Do not route piping through electrical rooms. Alter route to accommodate this requirement.
- P. Install piping and make joints in full compliance with manufacturers recommendations. Provide U shaped support channels fabricated from 24 gauge G90 steel to support non ferrous water piping to limit unsupported length to 5', B-line or Engineer approved equal. Maintain manufacturers recommendation for joining and installing on the project site and adhere to the best practices as recommended by the manufacturer.
- Q. Heat trace piping in the unconditioned areaways and where noted at remote sink locations.
- R. Use only one manufacturer's grooved piping components and grooving equipment. The grooved coupling manufacturer's factory trained representative shall provide on-site training for contractor's field personnel in the use of grooving tools and installation of grooved joint products. The representative shall periodically visit the jobsite and review contractor is following best recommended practices in grooved product installation.
- S. Apply No-Hub Sealant by Black Swan or an Engineer approved equal sealant to the cast iron piping prior to installation of no-hub connectors.
- T. Rain leaders require riser clamps and all thread rod connection across no-hub joints at each change in direction that is more than 25' below the highest roof drain. Provide rigid pipe bracing to the building structure for all rain leaders.
- U. Support new horizontal piping from building structure with galvanized threaded rod supports, double nut to hangers. Nonmetallic piping supports to apply galvanized steel "v" bottom clevis equal to B-Line B3106 with continuous 18 gauge galvanized steel "v" support channel equal to B-Line B3106V, hangers 7'-6" o.c. maximum spacing and within 12" of all elbows, minimum 2 hangers per channel, overlap channels 6". Install piping high as possible, comply with elevations noted, use 45 deg elbows to offset around building structure or where noted. Do not obstruct existing equipment service space. Relocate, at no expense to the owner, any pipe which blocks or restricts equipment service / aisle access. Install piping as high as practical and allow for expansion and contraction. Do not run piping directly above the electrical gear offset at least 6" from the space above electrical gear.

3.03 APPLICATION

- A. Use grooved mechanical couplings and fasteners only in accessible locations.

- B. Install unions downstream of valves and at equipment or apparatus connections.
- C. Install brass male adapters each side of valves in copper piped system. Sweat solder adapters to pipe.
- D. Install ball or butterfly valves for shut-off and to isolate equipment, part of systems, or vertical risers.
- E. Install ball valves for throttling, bypass, or manual flow control services.
- F. Provide spring loaded check valves on discharge of water pumps.
- G. Provide indicating ball valve or OS&Y valves, outside stem & yoke, in water service branch piping to drench showers and eyewash stations. Label these valves "SERVES EMERGENCY EYEWASH/DRENCHSHOWER" and fix in open position with nylon cable ties.

3.04 DISINFECTION OF DOMESTIC WATER PIPING SYSTEM

- A. Prior to starting work, verify system is complete, flushed and clean.
- B. Ensure PH of water to be treated is between 7.4 and 7.6 by adding alkali (caustic soda or soda ash) or acid (hydrochloric).
- C. Inject disinfectant, free chlorine in liquid, powder, tablet or gas form, throughout system to obtain 50 to 80 mg/L residual.
- D. Bleed water from outlets to ensure distribution and test for disinfectant residual at minimum 15 percent of outlets.
- E. Maintain disinfectant in system for 24 hours.
- F. If final disinfectant residual tests less than 25 mg/L, repeat treatment.
- G. Flush disinfectant from system until residual equal to that of incoming water or 1.0 mg/L.
- H. Take samples no sooner than 24 hours after flushing, from 5 percent of outlets and from water entry, and analyze in accordance with AWWA C601.
- I. Have local utility or health department sample similar outlets and obtain their approval before releasing the system as potable water.

3.05 TESTING OF SYSTEMS

- A. Pressurize each piping system to 150% of its operating pressure, 125 psig minimum for pressurized systems, 4 psig (or 10' head of standing water) minimum for gravity waste, drain and vent systems, whichever is greater. Test gravity systems in sections for no less than 2 hours with no loss in water level during backfill. Test water piping hydrostatically for 24 hours to verify assembly has no leakage prior to insulating. Notify Owner 48 hours in advance so that they may be present during testing.

- B. Remove strainers, aerators as needed to flush any debris from the system prior to turning over to the Owner. Turn over to Owner with all clean strainers, filters, diaphragms and aerators.

3.05 IDENTIFICATION

- A. Label all new and existing piping within the areas of renovation in accordance with the requirements of Section 15190 - Mechanical Identification.

END OF SECTION

**SECTION 15450
PLUMBING EQUIPMENT**

PART 1 - GENERAL

1.01 INCLUDED WORK

- A. Water circulation pumps – potable
- B. Flat Plate Heat Exchangers

1.02 RELATED WORK

- A. All work specified in this Section shall comply with the provisions of Division 1 and Section 15010.
- B. Section 15170: Electric Motors
- C. Section 15140: Supports and Anchors.
- D. Section 15410: Plumbing Piping.
- E. Division 16000: Electrical.

1.03 SUBMITTALS

- A. Submit product data to Engineer for approval as required by Section 15010 and Division 1. Submittal information shall include at least the following:
 - 1. List of equipment capacities, flow rate, head, voltage, phase, FLA, MCA, MOCP. For water heaters provide the specific amperage for each leg in three phase equipment.
 - 2. Composite wiring diagrams indicating equipment, device set points, and interlocks with all affected systems and equipment.
 - 3. Equipment data sheets for all major equipment and components including but not limited to: detailed wiring diagrams for all controllers, field wiring diagrams for level sensors, temperature sensors, limit switches, recommended duty cycles for pumps, motor starter, VFD information from the component manufacturer. Include application, range, and accuracy specifications.

1.04 WARRANTY

- A. Refer to the General Conditions for warranty requirements in addition to those specified herein.
- B. The equipment manufacturer shall guarantee the control system installed under this section of the specification to be free from defects in workmanship and material under normal use and provide service for a period of one year after acceptance by the Engineer and Owner. Any defects in workmanship or material during this time shall be corrected by the manufacture at no charge. Provide a detailed start-up report for each item to inspect, calibrate, lubricate and adjust equipment and controls as required to comply with manufacturers recommendations, and submit written reports. Water heaters shall have a 5 year warranty against leakage.

- C. Prior to final acceptance, the Contractor shall start-up the system and perform all necessary testing, calibrating, and review all operation with the Engineer/Owner. The system warranty period shall not begin until all operations and performance requirements have been approved and successfully demonstrated. Provide all technical personnel required to completely checkout and demonstrate the proper operation of the each system and component.
- D. During the warranty period this Contractor shall provide warranty repairs during regular working hours of 7 AM to 4 PM. Warranty response shall be no later than 11 AM the next working day from the time of telephone request. In addition to normal response time provide emergency response to calls within 3 hours of when the call is placed, 24 hours/day, 7 days/week. If this Contractor does not respond to these warranty calls in a timely manner the work shall be done by others and this cost will be charged to this Contractor.

1.05 OPERATION AND MAINTENANCE DATA

- A. Submit record documents under provisions of Section 15010 and Division 1.
- B. Accurately record actual location of controllers, control valves, dampers, misc control components, including panels, thermostats, and sensors. Additionally note DIP switch and jumper positions, set point adjustments, and electrical circuits used for control system power source.
- C. Revise shop drawings to reflect actual installation and operating sequences including the final levels used for control at each pump station. Laminate and mount per Section 15010.
- D. Include inspection period, cleaning methods, recommended cleaning materials, and calibration tolerances.

PART 2 - PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

- A. Pumps: as scheduled or an Engineer approved equal by one of the named manufacturers.
 - 1. Centrifugal Pumps other: Armstrong, ITT Bell&Gossett, Grundfos, Aurora, Taco
 - 2. Wet Rotor Centrifugal Pump: Armstrong, Taco, Bell&Gossett, Grundfos
 - 3. Flat Plate Heat Exchangers: Polaris, Alpha Lavel, APV, Bell & Gossett

2.02 CENTRIFUGAL PUMP, IN-LINE

- A. Type: Horizontal or vertical shaft, single stage, direct connected, radially or split casing, for 175 psig maximum working pressure, potable water use rated by the manufacturer.
- B. Casing: Bronze with suction and discharge gage ports, renewable bronze casing wearing rings, drain plug, flanged suction and discharge.
- C. Impeller: Bronze or Stainless steel CF-8M, fully enclosed, keyed to shaft.

- D. Bearings: Grease or Permanently lubricated roller or ball bearings, domestic manufactured.
- E. Shaft: Type 316 Stainless steel with stainless steel shaft sleeve.
- F. Seal: Carbon rotating against a stationary ceramic seat, 225 degrees F maximum continuous operating temperature.
- G. Drive: Falk T-35 with coupling guard.

2.03 WET ROTOR IN-LINE CENTRIFUGAL PUMP

- A. Stainless steel impeller, brass pump housing, single phase, wet rotor, class F insulation, thermally protected, rated for domestic water service, 3 speed, EPDM seals, integral unions. 115VAC/1 PH, 1/12 HP, Grundfos UPS15-55SFC, 6 GPM at 12 FT.

2.04 FLAT PLATE HEAT EXCHANGER

- A. A heavy structural steel and reinforced steel plate frame rated to withstand 150% of the design working pressure with no leakage, perceptible deformation or failure. Threaded compression rods which allow field disassembly and reassembly of the heat exchanger.
- B. EPDM, Viton or similar replaceable gaskets at each plate forming a flexible and watertight joint between adjoining plates.
- C. Stainless steel plates with surface treatment to increase the heat transfer efficiency for each SF of heat transfer surface. Integral water mains formed into the plates providing true counterflow heat transfer. Type 316 stainless steel for all components in contact with the water stream. 150 PSIG working pressure unless noted higher in the drawings.
- D. Provide a ventilated chamber between the two wetted surfaces of each plate. The chamber shall be open to the surrounding environment and be at room pressure with weep holes that will drip to indicate a gasket or plate failure. There shall be no way the two pressurized water streams can mix. Heat exchanger shall be labeled by the manufacturer as suitable for potable water heating.

PART 3 EXECUTION

3.01 INSTALLATION AND APPLICATION

- A. Install equipment in accordance with manufacturer's instructions to permit intended performance and servicing.
- B. Provide 3/4" ball valve drain, hose connection and gasketed brass cap on strainer blow down connection at pumps with 3" or smaller strainer.
- C. Support pump fittings and piping above flexible connectors from overhead with supports in accordance with Section 15140.
- D. Support piping on both sides of flexible connectors.

- E. Install isolation valve for gauge on sch 80 nipple no longer than 4". Allow room for handle to clear insulation and gauge. Provide one gauge in lieu of two across pumps, water heaters, and heat exchangers. Provide piping and isolation to allow reading each pressure independently.
- F. Provide thermometers on the entering and leaving side of each water heater and heat exchanger. Thermometers to be Ashcroft 2.5" face stainless steel digital display thermometers.
- G. Provide air cock and drain connection on horizontal pump casings.
- H. Use pressure ports provided with pumps whenever possible for installation of pressure gauges. A single gauge with piping and valves to allow isolation and monitoring of both suction and discharge pressure is required in lieu of two separate gauges. Do not use pitcocks for pressure gauge isolation use 1/4" ball valves using 4" long stainless steel nipples.
- I. Provide P&T ports at both inlet and outlet connections to all pumps, heat exchangers and heaters to field verify pressure and temperature.
- J. Have factory representative inspect and certify that the equipment is installed in full accordance with manufacturers' recommendations with service access. Remove and replace, at no cost, any components that are damaged or installed improperly.

END OF SECTION

**SECTION 15510
HYDRONIC PIPING**

PART 1 GENERAL

1.01 WORK INCLUDED

- A. Pipe and pipe fittings.
- B. Valves.
- C. Heating water piping system.
- D. Associated drains/vents.
- E. Although such work is not specifically indicated, furnish and install all supplementary or miscellaneous items, appurtenances and devices incidental to or necessary for a sound, secure and complete installation.

1.02 RELATED WORK

- A. All work specified in this Section shall comply with the provisions of Division 1 and Section 15010.
- B. Section 15140 - Supports and Anchors.
- C. Section 15242 - Vibration Isolation
- D. Section 15250 - Insulation.
- E. Section 15515 - Hydronic Piping Accessories

1.03 REFERENCES

- A. ANSI/ASME - Boiler and Pressure Vessel Code.
- B. ANSI/ASME Sec 9 - Welding and Brazing Qualifications.
- C. ANSI/ASME B16.3 - Malleable Iron Threaded Fittings Class 150 and 300.
- D. ANSI/ASME B31.9 - Building Services Piping.
- E. ANSI/AWS A5.8 - Brazing Filler Metal.
- F. ANSI/AWS D1.1 - Structural Welding Code.
- G. ASTM A53 - Pipe, Steel, Black and Hot-Dipped Zinc Coated, Welded and Seamless.
- H. ASTM A120 - Pipe, Steel, Black and Hot-Dipped Zinc Coated (Galvanized), Welded and Seamless, for Ordinary Uses.
- I. ASTM B32 - Solder Metal.
- J. ASTM B88 - Seamless Copper Water Tube.

1.04 REGULATORY REQUIREMENTS

- A. Conform to ANSI/ASME B31.9.

1.05 QUALITY ASSURANCE

- A. Valves: Manufacturer's name and pressure rating marked on valve body.
- B. Welding Materials and Procedures: Conform to ANSI/ASME SEC 9.

1.06 SUBMITTALS

- A. Submit product data under provisions of Division 1 and Section 15010.
- B. Include data on pipe materials, pipe fittings, valves, and accessories. Components

- made outside of the USA may not be approved.
- C. Include data on below grade piping corrosion resistant coatings and cathodic protection.

PART 2 PRODUCTS

2.01 CHILLED and HEATING WATER PIPING

- A. Black Steel Pipe: ASTM A53 or A120, Schedule 40 through 12", Std wall over 12".
1. Fittings: ANSI/ASTM B16.9, B16.28 & A234, 150 PSIG ASME rating, malleable iron up to 2" or ASTM A234, forged steel welding type for all pipe sizes, ASME B16.11 forged steel black using ASTM A105 steel, socket weld fittings required for 2" and smaller piping if welded.
 2. Joints: Over 2" - ASTM A53 or A120, Schedule 40 black. Fittings: ASTM A234, forged steel butt welding type, Joints: ANSI/AWS D1.1, welded.
 3. Threaded or socket welded joints for piping up to 2"
 4. Piping 1.25 inch and below and threaded to be sch 80.
 5. Weldolet nipples to be sch 80 if 1.25 inch and below.
- B. Copper Tubing: ASTM B88, Type L, hard drawn. Fittings: ANSI/ASME B16.23, cast brass, or ANSI/ASME B16.29, wrought copper. Joints: ANSI/ASTM B32, solder, Grade 95TA.
1. For all piping 3" and below. Open flame brazing.
 2. Solder joints as well as silver phosphorous brazed T-drill taps are allowed in order to achieve a cost effective installation.
- C. Copper Tubing: ASTM B88, Type L, hard drawn. Fittings: ANSI/ASME B16.23, cast brass, or ANSI/ASME B16.29, wrought copper. Joints: Proprietary compression joint method, Ridgid Pro Press or Engineer approved alternative ANSI/ASTM B32, solder, Grade 95TA. Ridgid Pro Press with Viega or Engineer approved equal fittings
1. For all piping 3" and below.
- D. Copper Tubing: ASTM B88, Type L, annealed. Fittings: tool formed with smooth long radius bends, or ANSI/ASME B16.29, wrought copper. Joints: cast brass flared connections.
1. For piping 1/2" and below allowed for final 36" length connections to terminal units to minimize joints.

2.02 FLANGES, UNIONS, AND COUPLINGS

- A. Pipe Size 2 Inches and Under: 150 psig malleable iron unions for threaded ferrous piping, ground joint, brass to iron seat.
- B. Pipe Size Over 2 Inches: ANSI B16.5, 150 psig forged steel weld neck flanges for ferrous piping; 1/16 inch thick preformed neoprene or equivalent gaskets. Bolts to be carbon steel ASTM A325.
- C. Stainless Steel is forged weld neck flanges, 150 # flanged with spiral wound PTFE and metal gaskets.

2.03 BALL VALVES (all valves 2" and less unless noted otherwise on drawings)

- A. Apollo, Crane, Grinnell, Milwaukee, NIBCO, Powell or Stockham. 150# steam, 600 psig WOG rated. Bubble tight shutoff, three piece bronze body, bronze trim, teflon

seats and stuffing box ring, chrome plated bronze ball, blow-out proof stem, adjustable packing gland, full port, solder or threaded ends. Comply with MSS-SP-110. Protect valve per manufacturers recommendations when soldering to piping.

- B. Extended lever handle offset to clear insulation with a cylindrical sleeve to allow operation of handle without disturbing insulation. Lever extensions which disturb the insulation when operated are not allowed.
- C. The branch isolation valves to the blower coil units and the coil sections of the AHUs require an adjustable memory stop to limit the maximum open position on the return piping connection.
- D. Process chilled water valves to be Nibco BM-590-S6-R-66 all stainless steel, 2000 PSI, butt weld three piece, threaded body, conventional port, ball valves with PTFE seat, graphite seal, Type 316 ball, ASTM A351 Type CF8M body with cast mounting pad construction.

2.04 BUTTERFLY VALVES (All valves over 2" unless noted otherwise)

- A. Crane, DeZurick, Grinnell, Stockham, Lukenheimer, Milwaukee or equal.
- B. Iron body, lug ends, aluminum bronze disc, stainless steel stem, EPDM resilient replaceable seat for service to 220 degrees F, suitable for dead end service, bubble tight shutoff, labeled by manufacturer for intended service, no ferrous metal in contact with flow stream, extended neck. 150 working pressure at 220 F. Manufacturer's name and pressure rating cast into valve body.
- C. Valve operator required on all valves. Motorized operators are furnished by others. Provide geared operators on valves greater than 6". Provide lever actuators on valves up to 6" with multiple position stops, infinite position stops required on process water. On all valves in equipment rooms, regardless of size, installed more than 9' AFF provide gear operators.
- D. Process chilled water valves to be NIBCO LD3022 lug style butterfly valves with CF8M stainless steel disk, EPDM liner/seals, 316 SS stems and bushings, ductile iron body, Bi-directional full pressure dead end service, all stainless steel wetted parts construction, Class 150, 250 PSI, MSS SP-67. Provide stainless steel hardware.

2.05 SWING CHECK VALVES

- A. Grinnell, Crane, Watts, Bell & Gossett, Stockham, Mueller.
- B. Up to 2 Inches: Bronze body 45 degree swing disc, screwed ends, renewable disk, stainless steel spring.
- C. Stainless steel CF8M and 316 construction required on process water. Wafer body, Class 150, PTFE gaskets/seals, spring close assist for non-slam characteristics, with companion flanges and SS hardware and gaskets, Mueller 1601-C, 250 PSI at 250F.

2.06 CHAIN OPERATORS

- A. Provide manufacturers' standard chain operator for all gate and butterfly valves installed 9' AFF or higher. Include hooks to hold chain out of path of walkway. Allow for chain to extend to 76" AFF.

2.07 NON-SLAM CHECK VALVES

- A. Grinnell, Crane, Watts, Bell & Gossett, Stockham, Mueller.
- B. Over 2 Inches: Iron body, flanged ends, bronze trim, renewable disk, stainless steel spring.
- C. Stainless steel CF8M and 316 construction required on process water. Wafer body, Class 150, PTFE gaskets/seals, spring close assist for non-slam characteristics, with companion flanges and SS hardware and gaskets, Mueller 1601-C, 250 PSI at 250F.

2.08 FLANGES, UNIONS, AND COUPLINGS

- A. Flanges: Welding-neck type, 150 lb raised face, carbon steel, ASTM A 181, Grade 1, dimensions in accordance with ANSI B16.5.
- B. Unions: Pipe Sizes 2 inches or Smaller: 250 lb, screwed, black malleable iron, ground joint, brass to iron seat.
- C. Dielectric flange packs (Electrical isolation kit), phenolic flange gaskets, bolt sleeves, and washers. Standard flange packs with zinc plated fasteners and 0.125" red rubber gasket for 150 pound ANSI raised face flanges. Spiral wound 0.125" gaskets with PTFE/316SS construction for stainless steel piping.
- D. Process water to be weld neck flanges.

PART 3 EXECUTION

3.01 PREPARATION

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

3.02 WELDED STEEL PIPING: All piping 3" and above is steel piping unless noted otherwise.

- A. Weld by electric resistance process in accordance with ANSI B31.1.
 - 1. Welding Rods: Grade recommended for purpose by manufacturer and identification.
- B. Line welds, single V-butt type:
 - 1. Mill or machine bevel pipe at 37 ½ degrees to within 1/16" of inside wall, except that in field limited amount of pipe may be flame beveled.
 - 2. Pipe with a wall thickness of 3/16" or less need not be beveled but may be welded by melting down into and building up over abutting ends.
 - 3. Separate abutting ends of joints before welding to permit complete fusion to bottom without overlapping.
 - 4. Tack in 3 or more points to maintain alignment, and fusion weld.

5. Wherever possible, weld continuously around pipe.
- C. Make all welds of sound weld metal, thoroughly fused into ends of pipe, and to bottom of vee. Remove all slag.
 1. Build up weld in excess of pipe wall to reinforce pipe.
 2. Weld metal shall present a gradual increase in thickness from surface of pipe to center of weld.
 3. Minimum weld width: $(2.5 * \text{pipe wall thickness.})$
- D. Do not weld pipe couplings in place of welding fittings for any branch connections.
- E. Weld-o-lets and thread-o-lets:
 1. Scribe and cut openings in main pipes for welded branches accurately taking care to remove all of plugs and cuttings from main pipe.
 2. Full weld for full depth of fillet, with additional beads to form well rounded connection as recommended by weld-o-let manufacturer. Partially filled fillets not acceptable.
- F. Cut all openings into pipe for welded connections accurately to give carefully matched intersections.
- G. Make all welded fittings of same material with same pressure and temperature rating as pipe with which they are used.
- H. Make flanged connections to valves, pumps and specialties with ANSI standard welding neck flanges. All other flange connections may be made with slip-on flanges provided they are seal welded on inside.
- I. Fuse all fillet welds for flanges or fittings into pipe and plate for minimum distance of 1-1/2 times pipe wall thickness and depth weld on 1-1/4 times pipe wall thickness.

3.03 COPPER PIPING

- A. Solder connections using J.W. Harris or equal 95-5 solder and flux. Comply with the solder manufacturers recommendations. Do not allow temperatures above 500F to reach any valve component when joining valves to piping by soldering.
- B. Proprietary T-drill may be used for branch connections of 3/4" and below to main piping as recommended by the T-drill manufacturer. Brazed connections are required for T-drill taps. These assemblies must be fabricated off-site or in mechanical space. The mechanically formed extruded Tee connection shall conform to ASTM 2014-00. All branches to be dimpled and notched to eliminate any protrusion into the main header and insure complete insertion of branch.
- C. Final branch connections to terminal units 1/2" and below may be made with annealed copper piping with tool formed ells and offsets free of any crimps or joints. Final 36" connection to the terminal units only.
- D. Compression connections using Viega fittings and Ridgid "ProPress" or Engineer approved equivalent pipe joining method is allowed for all copper piping runs. Comply with manufacturers recommendations. Install using tradesmen that have been trained by a factory representative in the proper use of this pipe joining method.

Have the installation inspected by the factory representative to assure that the installation is in compliance with manufacturer's requirements. Apply 200 psig hydrostatic test pressure to each completed floor for 12 hours with no pressure loss.

3.04 INSTALLATION

- A. Route piping in orderly manner, plumb and parallel to building structure, and maintain gradient.
- B. Install piping to conserve building space, and not interfere with use of space and other work. Do not block access doors or service side of equipment. Hold 80" clear above all walkways and service areas of equipment rooms at all times. Piping installation shall maintain the maximum clear space above ceilings and in equipment rooms for future work and ease of equipment service. Piping which is installed in a manner that limits service access or prevents future work below or adjacent to piping shall be taken down and relocated as directed by the Engineer.
- C. Group piping whenever practical at common elevations. Unless noted otherwise piping should be routed as high as practical in a space.
- D. Install piping to allow for expansion and contraction without stressing pipe, joints, or connected equipment. Install rigid fixed supports for piping systems where directed by Engineer when flexible connectors/expansion loops are indicated on the plans.
- E. Provide clearance for installation of insulation, and access to valves and fittings.
- F. Provide access doors where valves and fittings are not exposed.
- G. Slope piping and arrange systems to drain at low points. Use eccentric reducers to maintain top of pipe level so that air will not be trapped. Where piping forms a high point install an automatic air vent as detailed on plans. At strainer blowdown and where piping forms a low point install a 3/4" drain valve with hose connection and gasketed brass cap connected with a beaded brass chain.
- H. Where pipe support members are welded to structural building framing, scrape, brush clean, and apply one coat of zinc rich primer to welded area. Repair any spray-on fireproofing that is disturbed.
- I. Where piping is shown as receiving a painted finish prepare pipe, fittings, supports, and accessories to accept finish. Degrease, remove dirt and rust, remove slag and burrs and prime with a rust inhibiting primer. Use motorized wire brushing to assure a clean substrate prior to priming.
- J. Install valves with stems upright or horizontal, not inverted.
- K. Use welding ells to make all turns in welded piping.
- L. Use welding tees or weldolets to make all tees in welded piping.
- M. Laterals may be made using saddle type connections only where the tradesmen demonstrate a superior level of skill and attention to detail in their craft. Architect/Engineer will inspect craftsmanship on a sample lateral prior to other

saddles being performed.

- N. Exercise reasonable care in keeping debris from entering the piping during storage and fabrication. Swab interior to remove foreign material from piping as work progresses. Stainless piping shall be sealed at the end of each work day. Pull a clean cloth through each section as welding is completed until cloth comes out clean. Sections that are cleaned with cloth need not exceed 200 LF of pipe before a tee or elbow is welded in without internal cleaning at that fitting.
- O. Piping accessories at pumps, heat transfer equipment and filters are to be sized the same as distribution piping at that piece of equipment in lieu of the equipment connection size unless noted otherwise.
- P. Where practical route piping parallel to and between the flanges of structural beams to hold piping high and out of the way of other work. Do not disturb beam flanges or web.
- Q. Provide oversized 1.25" weldolets at temperature wells to prevent reducing the free area of piping at control elements. Pay special care in the location of P&T ports, pressure and temperature wells to insure there is access to insert instruments and maximize the ability to read the installed thermometers and gauges. Remove and relocate these devices if they are not in an easily read location.

3.05 APPLICATION

- A. Do not use grooved mechanical couplings.
- B. Install unions downstream of valves and at equipment or apparatus connections to allow removal of equipment without draining system.
- C. Provide non-slam check valves on discharge of chilled and hot water pumps installed under this project. Combination (triple duty) valves meet this non-slam check valve criteria.
- D. Use only lug end butterfly or threaded/flanged end ball valves for isolation service.
- E. Provide 1-1/2 inch minimum ball valves with piping to floor drain at main shut-off valves and strainers exceeding 4" nominal. Provide 3/4" ball valves with hose connections and beaded chain caps at low points of piping, bases of vertical risers, at 4" and smaller strainers and at equipment.
- F. Provide threadolets and temperature wells for all thermometers, temperature sensors and thermostats. Temperature sensors and thermostats will be located by the BAS Contractor.
- G. Provide threadolet fittings for all pressure sensing devices, flow switches, flow sensors and any other drain, vent, or piping connection that is required as a part of the work. Control devices will be located by the BAS Contractor.
- H. Provide P&T plugs at entering and leaving water piping of each heat exchanger, boiler, chiller pump, strainer, AHU coil and terminal unit coil and at thermometer/pressure gauge locations. Locate so that a thermometer inserted into

the P&T will sense the temperature of water flowing through the pipe.

- I. Provide a pair of full port ball valves, or butterfly valves at each coil, heat exchanger, boiler, chiller and pump to allow complete isolation. Where an isolation type balancing valve is required by other portions of this document it is considered as providing the isolation requirement for one of the pair.
- J. Provide Dielectric flange kits at all junctions of dissimilar piping materials. Locate in corridors, mechanical rooms or other readily accessible area. Do not install above any equipment or above sensitive areas.

END OF SECTION

**SECTION 15515
HYDRONIC PIPING ACCESSORIES**

PART 1 GENERAL

1.01 WORK INCLUDED

- A. Strainers.
- B. Temperature\pressure ports and wells.
- C. Flow balancing stations.
- D. Flexible connectors.
- E. Drains and vents
- F. Automatic air vent.
- G. Pressure relief valve.
- H. Combination pump discharge valves.
- I. Pump suction diffusers

1.02 RELATED WORK

- A. Section 15510 - Hydronic Piping.

1.03 QUALITY ASSURANCE

- A. Manufacturer: For each product specified, provide components by same manufacturer throughout.

1.04 OPERATION AND MAINTENANCE DATA

- A. Submit operation and maintenance data under provisions of Division 01 and Section 15010.
- B. Include installation instruction, assembly views, lubrication instructions, and replacement parts list.

1.05 DELIVERY, STORAGE, AND HANDLING

- A. Deliver products to site under provisions of Division 01 and Section 15010.
- B. Store and protect products under provisions of Division 01 and Section 15010.

PART 2 PRODUCTS

2.01 STRAINERS

- A. Size 3 inch and Under: Screwed brass or iron body for 125 psig working pressure, Y pattern with 1/10" stainless steel perforated screen, 39% free area and 20 mesh (1/32" openings, 52% free area) start-up strainer. Bronze body for copper piping, iron body for steel piping. Mueller #351M cast bronze, Mueller#11M cast iron body.
- B. Over 3": Flanged cast iron body for CWP 200 psig at 150°F, Y-pattern with 5/32" stainless steel perforated screen, 62% free area and 20 mesh start-up strainer. Mueller #758 Class 125.

C. Mueller, B&G, Paco, Aurora.

2.02 TEMPERATURE WELLS

A. Provide a 1-1/4" threadolet, 1-1/4" nipple with length as required for 1/2" insertion of well into pipe and a 1-1/4"x3/4" bell reducer. Provide brass well threaded to accept 4" long stem thermometer.

2.03 P&T - PRESSURE & TEMPERATURE PORTS

A. Brass construction with neoprene or EPDM seal and threaded cap suitable for 5/32" thermometer insertion, or pressure probe insertion. Self sealing characteristics. 125 psig rated at 180 F.

B. Furnish 2 pressure probes for the Owner's use.

2.04 PRESSURE GAUGE CONNECTIONS

A. Connections to all gauges shall be isolated by 1/4" ball valves. Brass pitcocks will be rejected. Snubbers are required at all gauges located at pumps. Steam pressure gauges require a siphon tube trap between the isolation valve and gauge to prevent live steam from reaching the gauge.

B. Unless noted otherwise a single gauge should be used with appropriate manifolding using 3/8" stainless steel tubing to read inlet and outlet pressures with a single valve. Bend tubing using appropriate bending equipment for smooth radius and uniform changes in direction. Provide tees and other fittings as needed for a complete pressure sensing system.

2.05 FLOW BALANCING STATIONS

A. Armstrong CBV or Engineer approved equivalent by Grinnell, Mepco or Tour & Anderson.

B. Device will provide precise flow measurement through differential pressure readings across a tapered plug valve; positive bubble tight shutoff; precision flow adjustment through a vernier scale; easily restored tamper-proof balance setting; drain connection with protective cap and a factory furnished insulating cover that can be removed and readily replaced. Ball valves with scales and pressure ports are not acceptable. 150 psig at 200F rating.

2.06 VENTURI FLOW MEASURING STATIONS

A. Device will provide precise flow measurement through differential pressure readings across a venturi milled into the throat of the station. Integral isolation ball valve on the downstream side of the venturi with infinitely lockable stops 1/2" through 4" pipe sizes. Provide a chart for reading using a standard differential pressure meter 0-50 ft differential. 150 psig at 200F rating.

B. Gerand or Engineer approved equal.

2.07 AUTOMATIC AIR VENT

- A. High capacity, 150 PSIG rated float type automatic vent. Best quality, cast iron, heavy duty trap required at air separator.
- B. Medium capacity, 150 PSIG rated float type automatic vent. Best quality, stamped steel, heavy duty trap required at high points in piping.
- C. B&G, TACO, Amtrol or equal.

2.08 DRAINS & VENTS

- A. Drains on equipment, headers, risers and other points shall be 3/4" with a gasketed brass cap, brass hose thread male connection, brass beaded chain to hold the cap to the valve body and a brass ball valve . Watts #B6000-CC
- B. Vents on equipment, headers, risers and other high points that can trap air shall have a manual quick vent at the connection to automatic air vents. The connection shall be 3/4" with a gasketed brass cap over the vent. Install with the valve's integral vent on the auto air vent side of the ball valve. The manual vent will be used for rapid air venting at make-up after a system drain down. Watts #IT-3600

2.09 PRESSURE RELIEF VALVES

- A. Bell & Gossett, Watts or equal.
- B. Bronze Body, Teflon seat, stainless steel stem and valves, automatic, direct pressure actuated, all capacities ASME certified and labeled.

2.10 COMBINATION PUMP DISCHARGE VALVES

- A. Straight or angle pattern, iron body, 175 psig working pressure, non-slam check valve with spring loaded bronze disk and seat, stainless steel stem, calibrated adjustment permitting flow regulation and bubble tight shutoff. Mueller Mod# 721 or approved equal by Paco, B&G or Aurora. Size to match piping. Pump discharge sized valves will be rejected.

2.11 SUCTION DIFFUSERS

- A. Over 2" and serving Pump Suction: Flanged inlet and outlet, cast iron body, outlet guide vanes, blow down connection with 3/4" ball valve and hose connection. 150 PSIG working pressure with 5/32" stainless steel perforated screen, 62% free area and 20 mesh start-up strainer. Provide 1-1/2" blow down on diffusers exceeding 4" and pipe to drain.
- B. Pipe base for supporting diffuser from floor.
- C. Mueller 1011 or approved equal by Paco, Armstrong or B&G. Size outlet to match pump suction, size inlet to match piping.

PART 3 EXECUTION

3.01 INSTALLATION AND APPLICATION

- A. Install specialties in accordance with manufacturer's instructions to permit intended

performance and servicing.

- B. Provide 3/4" ball valve drain, hose connection and gasketed brass cap on strainer blow down connection at pumps with 3" or smaller strainer. Provide 1-1/2" ball valve drain with piping to floor drain on strainer blow down connection at pumps with strainers larger than 3".
- C. Support pump fittings and piping above flexible connectors from overhead with supports in accordance with Section 15140.
- D. Support piping on both sides of flexible connectors.
- E. Provide one gauge in lieu of two across pumps, strainers, coils and chiller piping. Provide piping and isolation to allow reading each pressure independently.
- F. Install isolation valve for gauge on sch 80 nipple no longer than 4". Allow room for handle to clear insulation and gauge.
- G. Provide air cock and drain connection on horizontal pump casings.
- H. Use pressure ports provided with pumps whenever possible for installation of pressure gauges. A single gauge with piping and valves to allow isolation and monitoring of both suction and discharge pressure is required in lieu of two separate gauges. Do not use pitcocks for pressure gauge isolation use 1/4" ball valves using 4" long stainless steel nipples.
- I. Provide P&T ports at both inlet and outlet connections to all coils and equipment.
- J. Have factory representative inspect and certify that hydronic accessories are installed in full accordance with manufacturers' recommendations with service access. Remove and replace, at no cost, any components that are damaged or installed improperly.

END OF SECTION

**SECTION 15520
STEAM AND CONDENSATE PIPING**

PART 1 GENERAL

1.01 WORK INCLUDED

- A. Pipe and pipe fittings.
- B. Valves.
- C. Steam, condensate and steam vent piping systems.
- D. Associated drains/vents.
- E. Although such work is not specifically indicated, furnish and install all supplementary or miscellaneous items, appurtenances and devices incidental to or necessary for a sound, secure and complete installation.

1.02 RELATED WORK

- A. All work specified in this Section shall comply with the provisions of Division 1 and Section 15010.
- B. Section 15140 - Supports and Anchors
- C. Section 15250 - Insulation
- D. Section 15525 - Steam and Condensate Piping Accessories

1.03 REFERENCES

- A. ANSI/ASME - Boiler and Pressure Vessel Code.
- B. ANSI/ASME Sec 9 - Welding and Brazing Qualifications.
- C. ANSI/ASME B16.3 - Malleable Iron Threaded Fittings Class 150 and 300.
- D. ANSI/ASME B31.9 - Building Services Piping.
- E. ANSI/AWS A5.8 - Brazing Filler Metal.
- F. ANSI/AWS D1.1 - Structural Welding Code.
- G. ASTM A53 - Pipe, Steel, Black and Hot-Dipped Zinc Coated, Welded and Seamless.
- H. ASTM A120 - Pipe, Steel, Black and Hot-Dipped Zinc Coated (Galvanized), Welded and Seamless, for Ordinary Uses.
- I. ASTM B32 - Solder Metal.
- J. ASTM B88 - Seamless Copper Water Tube.

1.04 REGULATORY REQUIREMENTS

- A. Conform to ANSI/ASME B31.9.

1.05 QUALITY ASSURANCE

- A. Valves: Manufacturer's name and pressure rating marked on valve body.
- B. Welding Materials and Procedures: Conform to ANSI/ASME SEC 9.

1.06 SUBMITTALS

- A. Submit product data under provisions of Division 1 and Section 15010.
- B. Include data on pipe materials, pipe fittings, valves, and accessories. Foreign materials may not be approved.

1.07 DELIVERY, STORAGE, AND HANDLING

- A. Deliver products to site, store and protect under provisions of Division 1 and Section 15010.
- B. Deliver and store valves and accessories in shipping containers with labeling in place.

PART 2 PRODUCTS

2.01 STEAM, STEAM CONDENSATE, PRESSURE RELIEF, BLOW DOWN, DRAIN, STEAM AND GAS VENTING PIPING

- A. Steel Pipe: ASTM A53 or A120 black, Schedule 40 through 12", Schedule 80 required through 2" on steam condensate.
 - 1. Fittings: ANSI/ASTM B16.3, 150 PSIG ASME rating, malleable iron up to 2" or ASTM A234, forged steel welding type for all pipe sizes, ASME B16.11-1996 forged steel black using ASTM A105 steel, socket weld fittings required for 2" and smaller piping if welded.
 - 2. Joints: Over 2" - ASTM A53 or A120, Schedule 40 black. Fittings: ASTM A234, forged steel welding type, Joints: ANSI/AWS D1.1, welded. ANSI/AWS D1.1 welded for pipe over 2 inch.
 - 3. Threaded or socket welded joints for piping up to 2"
 - 4. All piping in the equipment rooms and chases.
 - 5. Piping 1.25 inch and below and threaded to be sch 80.
 - 6. Weldolet nipples to be sch 80 if 1.25 inch and below.

2.02 FLANGES, UNIONS, AND COUPLINGS

- A. Pipe Size 2 Inches and Under:
 - 1. 250 psig malleable iron extra heavy unions for threaded ferrous piping.
- B. Pipe Size Over 2 Inches: 150 psig forged steel weld neck flanges, ASTM A105, ANSI B16.5 for ferrous piping; 1/16 inch thick spiral wound gaskets, MIL-G-15342E, to be submitted for Engineer review. Bolts to be carbon steel ASTM A325.

2.04 GATE VALVES (use for sizes exceeding 2")

- A. Crane, DeZurick, Grinnell, Milwaukee, Stockham or equal.
- B. Iron body, bronze trim, OS&Y, single wedge, flanged ends.
- C. 250 psig SWP, for 16-150 PSIG steam service. Crane 21E.
- D. 125 PSIG SWP for up to 15 PSIG steam service. Crane 465-1/2.

2.05 BALL VALVES (all valves 2" and less unless noted otherwise on drawings)

- A. Apollo, Crane, Grinnell, Jenkins, Watts, Milwaukee, Nibco, Powell or Stockham.
- B. Up to 2 Inches: carbon steel three piece body, with 316 Stainless Steel full port ball and stem, TFE seats and packing, blow-out proof stem, extended lever handle with offset to clear insulation. Threaded ends.
- C. 150 PSIG SWP steam service, 600 PSIG WOG, MSS SP-110. Apollo #83A-140 Series for sizes to 2".

2.06 SWING CHECK VALVES

- A. Grinnell, Crane, Watts, Bell & Gossett, Stockham or Mueller.
- B. Cast Iron body swing disc, Class 125, flanged or screwed ends up to 2", flanged above 2", vertical up-flow and horizontal rated, renewable bronze or stainless steel disk, bolted cap, 150# SWP at 350F, Crane #383.

2.07 CHAIN OPERATORS

- A. Provide manufacturers' standard chain operator for all gate valves installed 9' AFF or higher. Include hooks to hold chain out of path of walkway. Allow for chain to extend to 76" AFF.

2.08 FLANGES, UNIONS, AND COUPLINGS

- A. Weld neck 150# flanges on all applications except steam exceeding 100 psig. 300# flanges on steam exceeding 100 psig.
- B. Dielectric flange packs (Electrical isolation kit), phenolic spiral wound flange gaskets, bolt sleeves, and washers.
- C. Standard flange packs for 150 or 300 pound ANSI flanges.

PART 3 EXECUTION

3.01 PREPARATION

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

3.02 WELDED STEEL PIPING: All piping is steel piping unless noted otherwise.

- A. Weld by electric resistance process in accordance with ANSI B31.1.
 - 1. Welding Rods: Grade recommended for purpose by manufacturer and identification.
- B. Line welds, single V-butt type:
 - 1. Mill or machine bevel pipe at 37 ½ degrees to within 1/16" of inside wall, except that in field limited amount of pipe may be flame beveled.
 - 2. Pipe with a wall thickness of 3/16" or less need not be beveled but may be welded by melting down into and building up over abutting ends.
 - 3. Separate abutting ends of joints before welding to permit complete fusion to bottom without overlapping.
 - 4. Tack in 3 or more points to maintain alignment, and fusion weld.
 - 5. Wherever possible, weld continuously around pipe.
- C. Make all welds of sound weld metal, thoroughly fused into ends of pipe, and to bottom of vee. Remove all slag.
 - 1. Build up weld in excess of pipe wall to reinforce pipe.
 - 2. Weld metal shall present a gradual increase in thickness from surface of pipe to center of weld.

3. Minimum weld width: $(2.5 * \text{pipe wall thickness.})$
- D. Do not weld pipe couplings in place of welding fittings for any branch connections.
- E. Weld-o-lets and thread-o-lets:
 1. Scribe and cut openings in main pipes for welded branches accurately taking care to remove all of plugs and cuttings from main pipe.
 2. Full weld for full depth of fillet, with additional beads to form well rounded connection as recommended by weld-o-let manufacturer. Partially filled fillets not acceptable.
- F. Cut all openings into pipe for welded connections accurately to give carefully matched intersections.
- G. Make all welded fittings of same material with same pressure and temperature rating as pipe with which they are used.
- H. Make flanged connections to valves, pumps and specialties with ANSI standard welding neck flanges. All other flange connections may be made with slip-on flanges provided they are seal welded on inside.
- I. Fuse all fillet welds for flanges or fittings into pipe and plate for minimum distance of 1-1/2 times pipe wall thickness and depth weld on 1-1/4 times pipe wall thickness.

3.03 INSTALLATION

- A. Route piping in orderly manner, plumb and parallel to building structure, and maintain gradient.
- B. Install piping to conserve building space, and not interfere with use of space and other work. Do not block access doors or service side of equipment. Hold 80" clear above all walkways and service areas. Remove and relocate piping which limits access to equipment or prevents future work as directed by the Engineer.
- C. Group piping whenever practical at common elevations. Unless noted otherwise piping should be routed as high as practical in a space.
- D. Install piping to allow for expansion and contraction without stressing pipe, joints, or connected equipment. Install rigid fixed supports for piping systems where directed by Engineer when flexible connectors/expansion loops are indicated on the plans.
- E. Provide clearance for installation of insulation, and access to valves and fittings.
- F. Provide access where valves and fittings are not exposed.
- G. Slope piping 0.25" per 10 feet in the direction of steam travel. Use eccentric reducers to maintain bottom of pipe level. Install traps 150 feet on center with drip legs full pipe size.
- H. Where pipe support members are welded to structural building framing, scrape, brush clean, and apply one coat of zinc rich primer to welded area.

- I. Where piping is shown as receiving a painted finish prepare pipe, fittings, supports, and accessories to accept finish.
- J. Install valves with stems upright or horizontal, not inverted.
- K. Use welding ells to make all turns in welded piping.
- L. Use welding tees, weldolets or thredolets to make all tees in welded piping.
- M. Laterals made using saddle type connections are not permitted.
- N. Exercise reasonable care in keeping debris from entering the piping during storage and fabrication. Swab interior to remove foreign material from piping as work progresses.
- O. Piping accessories at traps, control valves, pressure reducing stations, heat transfer equipment and strainers are to be sized the same as distribution piping at that piece of equipment in lieu of the equipment connection size unless noted otherwise.
- P. Where practical route piping parallel to and between the flanges of structural beams. Do not disturb beam flanges or web.

3.04 APPLICATION

- A. Install unions to allow removal and servicing of traps, valves, equipment and accessories.
- C. Provide isolation valves, strainers and swing check valves on of all steam trap discharge pipes installed under this project.
- D. Use only gate or ball valves for isolation service.
- E. Provide thredolet fittings for all pressure sensing devices and any other drain, vent, or piping connection that is required as a part of the work.
- F. Provide a pair of full port ball valves at each coil, heat exchanger, trap and pump to allow complete isolation.

END OF SECTION

**SECTION 15525
STEAM AND CONDENSATE PIPING ACCESSORIES**

PART 1 GENERAL

1.01 WORK INCLUDED

- A. Strainers
- B. Pressure Gauges
- C. Steam Traps

1.02 RELATED WORK

- A. Section 15520 - Steam and Condensate Piping.
- B. All work specified in this Section shall comply with the provisions of Division 1 and Section 15010.

1.03 QUALITY ASSURANCE

- A. Manufacturer: For each product specified, provide components by same manufacturer throughout.

1.04 OPERATION AND MAINTENANCE DATA

- A. Submit operation and maintenance data under provisions of Division 01 and Section 15010.
- B. Include installation instruction, assembly views, lubrication instructions, and replacement parts list.

1.05 DELIVERY, STORAGE, AND HANDLING

- A. Deliver products to site, store and protect under provisions of Division 01 and Section 15010.

PART 2 PRODUCTS

2.01 STRAINERS

- A. Size 2 inch and Under: Screwed iron body for 250 psig SWP, Y pattern with 0.033" inch 28% free area stainless steel perforated screen strainer. Mueller 11M
- B. Over 2": Cast Iron flanged body for 250 psig SWP, Y-pattern with 3/64 inch 36% free area, stainless steel perforated screen strainer. Mueller 752
- A. Mueller, Keckley, Stockham

2.02 PRESSURE GAUGE CONNECTIONS

- A. Connections to all gauges shall be isolated by a 1/4" ball valve. Brass pitcocks will be rejected. Snubbers are required at all gauges located at pumps. Steam pressure gauges require a siphon tube trap between the isolation valve and gauge to prevent live steam from reaching the gauge.

2.03 STEAM TRAPS

- A. Spence, Armstrong or ITT Hoffman equal to Spence FTN-125 series F&T cast iron bodied trap, all stainless steel internal components, minimum of 3/4" connections with "H" pattern body providing four possible points of connection, fully serviceable without removal from piping system, 125 PSIG rated, balanced pressure thermostatic element. Selected for 0.5 PSIG operating differential with flow rate at 3 times the operating condensate load. For condensate loads in excess of 1000 PPH provide high capacity traps equal to Spence HC.
- B. Spence, Armstrong or ITT Hoffman equal to Spence Dura-Flo Inverted bucket steam traps cast iron bodied trap, horizontal configuration with integral stainless steel strainer, all stainless steel internal components, minimum of 3/4" connections, fully serviceable without removal from piping system, 250 PSIG rated, at 450F. Selected for 0.5 PSIG operating differential with 3 times the operating condensate load.
- C. Orient traps for ease of service with at least 24" clear available on the service side of trap. Provide two isolation valves with unions, an inlet strainer and a discharge check valve at every trap. Select the trap to discharge no less than three times the condensate load at the specified differential pressure. Provide vacuum relief checks on all equipment to prevent trapping of condensate in heat exchanger and heating coils. Adjust all condensate piping for gravity flow from heat exchangers to traps and from traps to condensate return piping.

PART 3 EXECUTION

3.01 INSTALLATION AND APPLICATION

- A. Install specialties in accordance with manufacturer's instructions to permit intended performance and servicing.
- B. Install isolation valve for gauge on nipple no longer than 4". Allow room for handle to clear insulation and gauge.
- C. Have factory representative inspect and certify that steam and condensate accessories are installed in full accordance with manufacturers' recommendations with service access. Remove and replace, at no cost, any components that are damaged or installed improperly.
- D. Orient traps for ease of service with at least 24" clear available on the service side of trap.
- E. Provide two isolation valves with unions, an inlet strainer and a discharge check valve at every trap.
- F. Select the trap to discharge no less than three times the condensate load at the specified differential pressure.
- G. Provide vacuum relief checks on all equipment to prevent trapping of condensate in heat exchanger and heating coils.
- H. Adjust all condensate piping for gravity flow from heat exchangers to traps and from traps to condensate return piping.

END OF SECTION

MEDFAC Engineering
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**SECTION 15540
HVAC PUMPS**

PART 1 GENERAL

1.01 WORK INCLUDED

- A. Vertical Split-Case pumps.
- B. In-Line Pumps.

1.02 RELATED WORK

- A. Section 15170 - Electric Motors and Starters
- B. Section 15171 - Variable Frequency Drives
- C. Section 15250 - Insulation.
- D. Section 15510 - Hydronic Piping.
- E. Section 15515 - Hydronic Piping Accessories
- F. All work specified in this Section shall comply with the provisions of Division 1 and Section 15010.

1.03 REFERENCES

- A. ANSI/UL 778 - Motor Operated Water Pumps.

1.04 QUALITY ASSURANCE

- A. Manufacturer: Company specializing in manufacture and assembly of HVAC pumps with minimum ten years experience.
- B. Alignment: All base mounted pumps shall be aligned by a qualified millwright and alignment certified by a third party laser inspection.

1.05 SUBMITTALS

- A. Submit pump curves showing performance characteristics with pump and system operating point plotted. Include NPSH curve where open systems are served.
- B. Submit manufacturer's installation instructions.

1.06 OPERATION AND MAINTENANCE DATA

- A. Submit operation and maintenance data.
- B. Include installation instructions, assembly views, lubrication instructions, and replacement parts list.

1.07 DELIVERY, STORAGE, AND HANDLING

- A. Deliver products to site, store and protect under provisions of 15010 and Division 1.

PART 2 PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

- A. Aurora, Armstrong, Bell & Gossett, Grundfos or Patterson.
- B. Substitutions per requirements of Division 01 and Section 15010.

2.02 GENERAL CONSTRUCTION REQUIREMENTS

- A. Balance: Rotating parts, statically and dynamically.
- B. Construction: To permit servicing without breaking piping connections.
- C. Pump Motors: Operate at 1750 rpm unless specified otherwise. Premium efficiency, class F insulation, O.D.P. indoors, TEFC outdoors, 1.15 service factor. Comply with all requirements of Section 15170.
- D. Pump Connections: Threaded with unions up to 2", Flanged over 2".

2.03 IN-LINE PUMP - 10 HP maximum

- A. Type: Horizontal/Vertical shaft, single stage, direct connected, for 175 psig maximum working pressure at 200F.
- B. Casing and Companion Flanges: Cast iron with suction and discharge gage ports, flanged suction and discharge.
- C. Impeller: Bronze, fully enclosed, keyed to shaft.
- D. Bearings: Oil lubricated roller or ball bearings.
- E. Shaft: Alloy steel with copper, bronze, or stainless steel shaft sleeve, integral thrust collar.
- F. Seal: Carbon rotating against a stationary ceramic seat.
- G. Drive: Flexible coupling.

2.04 VERTICAL SPLIT CASE PUMPS – 15 HP and larger

- A. Type: Vertical shaft, single stage, direct connected, split casing, for in-line mounting, for 175 psig working pressure.
- B. Casing: Cast iron, double suction, double volute, with suction and discharge gage port, renewable bronze casing wear rings, seal flush connection, drain plug, flanged suction and discharge.
- C. Impeller: Bronze, fully enclosed, keyed directly to shaft.
- D. Shaft: Precision ground, high strength, alloy steel with cartridge type bearing housings to allow a short bearing span for minimal shaft deflection.

- E. Seal: Carbon rotating against a stationary Ni-resist seat, stainless steel spring, 275 degrees F maximum continuous operating temperature.
- F. Drive: T-35 Falk coupling. Coupling guard.
- G. Bearings: Oversize ball type, grease or permanently lubricated, domestic manufacture only.
- H. Coal tar epoxy coat pump casing and associated castings in their entirety prior to factory standard finish painting.

PART 3 EXECUTION

3.01 INSTALLATION

- A. Install pumps in accordance with manufacturer's instructions. Alignment of pump with motor by a qualified millwright documented by 5 years experience, using appropriate laser alignment apparatus is required.
 - 1. Follow manufacturer's cold alignment procedure.
 - 2. Level motor and equipment to avoid "soft foot". Measurements with a range exceeding 0.002 inches shall be corrected prior to proceeding with alignment.
 - 3. Parallel offset in both "X" & "Y" axis not to exceed 0.004 inches total runout.
 - 4. Angular offset in both "X" & "Y" axis not to exceed 0.0005 inches maximum per inch of coupling face outside diameter.
 - 5. Shim under driven equipment to eliminate "soft foot" only.
- B. Provide access space around pumps for service. Provide no less than minimum as recommended by manufacturer.
- C. Insure pumps operate at specified system fluid temperatures without vapor binding and cavitation, are non-overloading in parallel or individual operation throughout their curve, and operate within 25 percent of midpoint of published maximum efficiency curve.
- D. Decrease from line size with flat on top eccentric reducers, long radius reducing elbows or suction diffusers. Support piping adjacent to pump such that weight of piping/hydrionic accessories is not carried by the pump casing. Support in-line pumps independent of piping and support ping within 8 pipe diameters of pump flanges.
- E. Lubricate pumps before start-up.
- F. Insulate pumps conveying fluid below ambient using a direct applied elastomeric foam cover and readily removable sections to permit rebuilding of pump. Extend gauges and lubrication fittings to outside of cover. The pump insulation shall have gaskets at all mating surfaces to assure a tight fit and prevent any surface condensation.
- G. Support pump using integral flanges where they exist. Always support pumps in full accordance with manufacturers' recommendations. For close coupled or base mounted pumps, provide supports under elbows on pump suction and discharge line. Where pumps are on spring isolators all accessories that are rigidly connected to the

pump shall be spring isolated in a similar manner.

- H. Provide line sized shut-off valve and strainer on pump suction, and line sized soft seat non-slam check valve and balancing / isolation valve or combination pump discharge valve on pump discharge.
- I. Provide air cock and drain connection on horizontal pump casings.
- J. Provide flexible connectors between pump casing and pump isolation valves on both suction and discharge sides.
- K. Provide a pressure gauge with manifold to allow reading suction & discharge pressures and upstream strainer pressure with a single gauge.
- L. Manufacturers' start-up of pumps is required by a factory trained representative.
- M. Owner will conduct vibration analysis with coupling installed and with coupling removed. Provide labor and any materials to remove and replace couplings. Readings will be taken in locations recommended by manufacturer. Where any reading exceeds 0.157 in/sec the equipment vibration is to be corrected below these limits at no cost to the Owner.
- N. Extend drain lines from strainer, packing and condensation collection traps to the nearest floor/trench drain. Route along floor using strut and clamps in the least travelled areas to avoid trip hazards. Leave an air gap at the point of discharge to allow visual inspection.

3.02 TRAINING

- A. All training is confined to vertical shaft and end suction pumps. Only factory employees with extensive hands-on knowledge will be considered as qualified instructors.
- B. Allow for two sessions 3 hours each of classroom training session and hands on training. Each session to include a tear down and rebuild of the pump rotating assembly. Allow for training on consecutive shifts
- C. 4 sets of training materials and a pdf of the materials are required.

END OF SECTION

SECTION 15555 STEAM BOILERS

PART 1 GENERAL

1.1 Steam Boiler Characteristics

- A. The Steam Boiler basis of design is Cleaver-Brooks Model CB-LE (200-600 hp, Steam 15-150 psig). The maximum operating pressure shall be 150 psig.
- B. The Steam Boiler basis of design is Burnham Model CL up to 40 HP, Bryan RV Series (50-199 hp, Steam 15-150 psig). The maximum operating pressure shall be 15 psig for steam under 50 HP and 150 psig for steam over 50HP.

1.2 General Boiler Design

- A. The 200-600 hp boiler shall be a four pass horizontal firetube updraft boiler with five square feet of heating surface per rated boiler horsepower. It shall be mounted on a heavy steel frame with integral forced draft burner and burner controls.
- B. The 50-199 hp boiler shall be a flexible water tube steam boiler with five square feet of heating surface per rated boiler horsepower and a minimum of 24" diameter steam drum configured to provide steam quality in excess of 99%. It shall be mounted on a heavy steel frame with integral forced draft burner and burner controls.
- C. The boiler shall be completely preassembled and fire tested at the factory. The unit shall be ready for immediate mounting on floor or simple foundation and ready for attachment of water, steam, fuel, electrical, vent and blowdown connections.
- D. The boiler shall be built to comply with Factory Mutual, and ASME CSD-1. The complete package boiler shall be approved as a unit by Underwriters Laboratories and shall bear the UL/ULC label.
- E. The emissions shall provide 30 ppm or less NO_x (dry volume basis and corrected to 3% O₂) when firing natural gas.
- F. Boiler shall be certified to comply with IBC 2009 Section 1708.4.1 seismic requirements and manufacturer shall provide seismic calculations showing tie-down requirements for anchors. Anchor bolts and tie-down components shall be by Contractor.
- G. All work specified in this Section shall comply with the provisions of Division 1 and Section 15010.

PART 2 PRODUCTS

2.1 Construction

- A. The boiler shell must be constructed in accordance with ASME Boiler Code and must receive authorized boiler inspection prior to shipment. A copy of the inspection report shall be furnished to the purchaser.
- B. Lifting eyes shall be located on top of the boiler.
- C. Front and rear doors on the firetube boiler shall be hinged or davited. Doors are to be sealed with fiberglass tadpole gaskets and fastened tightly using heavy capscrews that thread into replaceable brass nuts.

- D. Rear refractory and insulation on firetube boilers shall be contained in the formed door, which must swing open for inspection of brick work.
- E. The firetubes shall not include turbulators, swirlers or other add-on appurtenances.
- F. Front and rear tube sheets and all flues of firetube boilers must be fully accessible for inspection and cleaning when the doors are swung open. The boiler shall be furnished with adequate handholes to facilitate boiler inspection and cleaning.
- G. For boilers 125 horsepower and over, a manhole shall be provided.
- H. The exhaust gas vent shall be on the top near the center line and shall be capable of supporting:
 - 1. 15-100 hp. 1000 lbs and shall contain a stack thermometer and a locking blade damper.
 - 2. 125-800 hp. 2000 lbs and shall contain a stack thermometer
- I. The boiler shell shall contain a chemical feed connection.
- J. Observation ports for the inspection of flame conditions shall be provided at each end of the boiler.
- K. The boiler insulation shall consist of a 2 inch blanket under a sectional preformed sheet metal lagging. This insulation must be readily removable and capable of being reinstalled.
- L. The entire boiler base frame and other components shall be factory painted before shipment using a hard finish enamel coating.
- M. Boiler shall be certified to comply with IBC 2009 Section 1708.4.1 seismic requirements and manufacturer shall provide seismic calculations showing tie-down requirements for anchors. Anchor bolts and tie-down components shall be by Contractor.

2.2 Steam Boiler Trim

A. Water Column

A water column shall be located on the side of the boiler complete with gauge glass set and water column blowdown valves.

1. Feedwater Pump Control

The boiler feedwater pump control shall be included as an integral part of the water column to automatically actuate a motor driven feed water pump maintaining the boiler water level within normal limits.

- #### 2. WATER COLUMN/LOW WATER CUTOFF AND WATER LEVEL CONTROL SYSTEM
- Shall be comprised of a microprocessor-based electronic controller, a non-contact, non-wearing, continuously reading absolute level sensor and pressure chamber. The control system shall be designed as follows: The electronic controller shall be mounted in the common control panel. The pressure chamber shall be boiler mounted and operate to pressures of 250 PSIG and the level sensor shall operate to pressures of 250 PSIG and temperatures to 400 degrees F. The pressure-containing components shall be constructed in accordance with ASME Code. A shielded, four conductor cable with ground shall be run in metal conduit between the level sensor and the controller. Supply power shall be 115VAC-1 phase- 60 Hz. All wiring shall be in compliance with the National Electrical Code.

The pressure chamber shall have a sight glass and the level sensor shall have an accuracy of 0.1" or smaller. The electronic controller shall have level and error indicating

lights, alphanumeric display for messaging, reset/ menu switch and the following features:

- a. Continuous Level Indication
- b. Low Water Cutoff & Alarm
- c. High Water Alarm
- d. Low & High Water Warning
- e. Full Modulating Control of Modulating Feedwater Control Valve
- f. Continuous Monitoring of Float Operation
- g. Column Blowdown Detection and Reminder
- h. Auto or Manual Reset
- i. Real Time Clock
- j. Alarm Annunciation
- k. Alarm History Files with Time Stamp
- l. Water Column Blowdown Record
- m. Auxiliary Low Water Cutoff Check
- n. RS 232 Interface
- o. Maximum Contacts Rating 15 amps Resistive Load

2.3 Burner and Controls

A. Mode of Operation

Burner operation shall be full modulation principle. The burner shall always return to low fire position for ignition.

B. Blower

1. Air for combustion shall be supplied by a forced draft blower mounted in the front boiler door, above the burner, to eliminate vibration and reduce noise level.
2. Maximum sound level of the boiler/burner package shall not exceed 68 dbA when measured in accordance with ABMA Sound Test Standards.
3. The impeller shall be cast aluminum, radial blade, carefully balanced, and directly connected to the blower motor shaft.

C. Combustion Air Control

Combustion air damper and cam operated fuel metering valves shall be operated by a single damper control motor that regulates the fire according to load demand. Potentiometer type position controls shall be provided to regulate operation of the damper control motor.

D. Fuel Specification and Piping

1. 200-800 hp. Turndown range of the burner shall be a minimum of 10:1 when firing natural gas with a 60 ppm or lower NO_x and a minimum of 8:1 when firing on fuel oil.
2. 50-199 hp. Turndown range of the burner shall be a minimum of 6:1 when firing natural gas with a 60 ppm or lower NO_x and a minimum of 3:1 when firing on fuel oil.

3. Under 50 HP: Turndown range of the burner shall be a minimum of 4:1 when firing natural gas with a 30 ppm or lower NO_x; no fuel oil firing required.
4. Fuel - Light Oil or Gas Fired
 - a. Burner Type - The burner shall be a combination of the low pressure air atomizing type for oil and high radiant multi-port type for gas. The burner shall be approved for operation with either CS12-48 Commercial No. 2 Oil or natural gas.
 - b. Gas Pilot - The gas pilot shall be premix type with automatic electric ignition. An electronic detector shall monitor the pilot so that the primary fuel valve cannot open until flame has been established. The pilot train shall include two manual shut-off valves, solenoid valve, pressure regulator and pressure gauge.
 - c. Oil Burner
 - 1) Oil Pump - An oil pump with a capacity of approximately twice the maximum burning rate shall be included. Separate motor driven pump set, shipped loose, to be installed in a location favorable to the oil storage tank, shall be provided.
 - 2) Oil Burner Piping - Fuel oil piping on the unit shall include oil pressure regulating devices, oil metering controls, solenoid shutoff valves, pressure gauges and fuel strainer, all integrally mounted on the unit. A fuel oil controller shall be provided to combine all of the fuel oil controls into a single casting which is mounted on the front door of the unit. A single tip retractable nozzle shall be used for the low pressure air atomizing burner. A low oil pressure switch shall be included in the oil piping.
 - 3) Low pressure air atomizing - Separate air compressor module mounted on boiler base rail with low atomizing air pressure switch.
 - d. Gas Burner
 - Gas Burner Piping - gas burner piping on all units shall include pressure regulating gas shutoff valve, motor operated with proof of closure switch and plugged leakage test connection. The main gas valve(s) shall be wired to close automatically in the event of power failure, flame failure, low water or any safety shutdown condition. A lubricating plug cock or butterfly shutoff valve shall be provided as a means for a tightness check of the primary shut off valve. An additional plug cock or butterfly valve shall be furnished at entrance to gas train. Select one of the following:
 - 1) Up to 199 hp. High and low gas pressure switches shall be provided. A second motorized safety shutoff valve, plus an additional plugged leakage test connection shall be provided.
 - 2) Above 199 hp additionally provide a valve proving switch shall be located between the safety shutoff valves.

2.4 Boiler Controls and Control Panel

A. Control/Entrance Panel

A common enclosure shall house the control panel and the entrance panel. Enclosure shall be NEMA 4 rated and shall be mounted in a location convenient to the operator. Enclosure shall consist of power and low voltage sections divided by a partition. Low voltage will house boiler controls including flame safeguard, water level system controller, and Hawk ICS or equal controller. Power voltage section will house entrance panel with disconnects and power distribution. The controller must provide all features required by the State Boiler Inspector's office for remote monitoring of the boiler from a single on-site operator's workstation. The C-B Hawk controllers provide this information

and the controller must match these features and interface with the building automation system.

B. Flame Safeguard

1. Each boiler shall be factory equipped with flame safeguard controller providing technology and functions equal to the Cleaver- Brooks Model CB780E.

Controller shall be computerized solid state having sequence and flame-on lights and digital "first out" fault code indications of flame safeguard trip functions. It shall include dynamic self-check logic. The controller shall have a fixed operating sequence incapable of being manually altered. The sequence shall include start, pre-purge, pilot and main fuel ignition run and post-purge cycles.

Controller shall be the non-recycle type for maximum safety that shall shutdown the burner and indicate as a minimum the following trip functions: pilot and main flame failure, high and low fire proving switch faults, running interlocks open, false flame signal and fuel valve open (when proof of closure switch is furnished).

The controller shall have a run/test switch. It shall allow interruptions to sequence just after pre-purge, during pilot ignition trial and run cycles for adjustments to firing rate motor, damper linkages and pilot flame for minimum turndown tests.

2. Lights

White - load demanded.

White - fuel valve open.

Red - low water.

Red - flame failure.

3. Control Switches

Burner On-Off.

Manual-Automatic.

Manual Firing Rate Control.

4. Oil, heat and moisture resistant wire shall be used and identified with circuit numbers corresponding to the electrical wiring diagram.

5. All electrical equipment and wiring shall be in conformance with Underwriters Laboratories requirements.

6. Boiler to be supplied with a control circuit transformer and fuse protection for the control circuit.

C. CB-HAWK ICS Integrated Boiler Control and Management System or Engineer approved equal:

Boiler Control System combining a Digital Burner Management System for flame safety and a Programmable Logic Controller for boiler modulation and operator interface functions.

The factory pre-configured Boiler Control System shall integrate the Burner Management functions and the PLC based modulation and operator interface functions. The logic of the Burner Management System and the modulating controls will not be run in the same processor or powered by the same DC supply. The PLC and Operator Interface Hardware shall be as manufactured by Allen Bradley.

Major system components shall include:

- Programmable Logic Controller
- Touch Screen interface
- One Burner Management Controller with Wiring Sub-Base
- One Flame Scanner and amplifier
- Various Temperature and Pressure Sensors

Major functions provided by the Boiler Control System shall be:

- Automatic sequencing of the boiler through standby, pre-purge, pilot flame establishing period, main flame establishing period, run, flame proving and lockout and post-purge
- Full modulating control of fuel and air
- Utilize solid state controls and sensors to provide various control functions, such as:

Modulating control (algorithm shall be Proportional-Integral-Derivative (PID) type)

Thermal shock protection

High and Low limit alarms and shutdowns

- Touch Screen graphical operator interface and monitoring

Manual control of the boiler firing rate using control screens on the HMI to increment or decrement the firing rate

On screen indication of burner management controller status and diagnostics

On screen display of system alarms and faults

On screen history of alarms and faults

On screen recommendations for troubleshooting of fault conditions

On screen water level indication and alarm(s)

- Stack Flue Gas, Combustion Air and Shell (water) temperature indication
- Boiler efficiency calculation
- Low Fire Hold with Minimum Temperature Control
- Assured Low Fire Cut-Off (ALFCO)

The Boiler Control System shall incorporate the following safety provisions:

- Examine all load terminals to assure it is capable of recognizing the true status of the external controls, limits and interlocks. If any input fails this test, the Burner Management System shall lockout on safety shutdown.
- Closed-loop logic test of critical loads (ignition, pilot and main fuel valves) and must be able to lockout on safety.
- Pre-ignition interlocks (fuel valve proof of closure, etc.) and flame signal checked during Standby and Pre-Purge.
- Dynamic checking of the flame signal amplifier.
- Safe start check and expand check to include monitoring flame signal during standby.
- High and Low fire switches checked for proper sequencing.

The Boiler Control System shall provide the ability to communicate with external digital devices via Ethernet as standard. OPC compliant Internet communications shall be supported, with the Boiler Control System supplied with its own IP address.

2.5 Efficiency Guarantee

- A. The boiler manufacturer shall guarantee that, at the time of startup, the boiler will achieve scheduled fuel-to-steam efficiency at 100% firing rate when burning natural gas and scheduled fuel-to-steam efficiency at 100% firing rate when burning oil. If the boiler(s) fail to achieve the corresponding guaranteed efficiency as published, the boiler manufacturer will rebate, to the ultimate boiler owner, 10% of the boiler sales price for every full efficiency point (1.0%) that the actual efficiency is below the guaranteed level.

The specified boiler efficiency is based on the following conditions.

- B. Fuel specification used to determine boiler efficiency:
- Natural Gas
 - Carbon,% (wt) = 69.98
 - Hydrogen,% (wt) = 22.31
 - Sulfur,% (wt) = 0.0
 - Heating value, Btu/lb. = 21,830
 - No. 2 Oil
 - Carbon,% (wt) = 85.8
 - Hydrogen,% (wt) = 12.7
 - Sulfur,% (wt) = 0.2
 - Heating value, Btu/lb. = 19,420
- C. Efficiencies are based on ambient air temperature of 80 °F, relative humidity of 30%, and 15% excess air in the exhaust flue gas.
- D. Efficiencies are based on manufacturer's published radiation and convection losses.
- E. Any efficiency verification testing will be based on the stack loss method.

2.6 BOILER FLUE VENTING

- A. Venting shall be approved for this application by the boiler manufacturer. Venting shall be accomplished with ANSI Category IV vent piping, UL1738 listed, positive pressure, 1400F factory built chimney rated, installed in accordance with manufacturer's recommendations, applicable national and local codes. Stainless steel type 316 for the interior flue with a minimum 0.035" wall, aluminized steel exterior casing with a minimum 0.024" wall, and a 1" ceramic fiber insulated cavity.
- B. Vent is provided by the boiler supplier with all accessories to provide a watertight and secure installation in accordance with code and manufacturers recommendations. Equal to Metal-Fab IPIC-1. Refer to the drawings for general configuration and coordinate with the contractor. Provide shop drawings that are field verified and incorporate every manufacturer recommended accessory for best practice application of the vent system, provide expansion sleeves, drain provisions riser clamps, roof support plates, discharge collars, transition sections to connect to boiler vent collar

and anything else that proves necessary to comply with best practice.

PART 3 EXECUTION

3.1 Shop Tests

- A. The packaged boiler must receive factory tests to check the construction, controls, and operation of the unit. All tests may be witnessed by the Owner. All travel expenses will be the responsibility of the Owner.

3.2 Start-up Service

- A. After boiler installation is completed, the manufacturer shall provide the services of a field representative for starting the unit and training the operator at no additional costs.
- B. A factory approved and authorized start-up report shall be submitted to the customer/user at the time of start-up.

END OF SECTION

SECTION 15565
FIRE TUBE CONDENSING BOILER

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Boilers.
- B. Controls and boiler trim.
- C. Hot water connections.
- D. Fuel burning system and connection.
- E. Chimney connection.

1.02 REFERENCES

- A. AGA - Directory of Certified Appliances and Accessories.
- B. ANSI/AGA Z21.13 - Gas-Fired Low-Pressure Steam and Hot Water Boilers.
- C. ANSI/AGA Z223.1 - National Fuel Gas Code.
- D. ANSI/ASME SEC4 - Boiler and Pressure Vessel Codes - Rules for Construction of Heating Boilers.
- E. ANSI/ASME SEC8D - Boiler and Pressure Vessel Codes - Rules for Construction of Pressure Vessels.
- F. ANSI/NFPA 70 - National Electrical Code.
- G. HI (Hydronics Institute) - Testing and Rating Standard for Cast Iron and Steel Heating Boilers.
- H. ABMA - American Boiler Manufacturer's Association
- I. ASME CSD-1 - Controls and Safety Devices

1.03 SUBMITTALS

- A. Submit product data indicating general assembly, components, controls, safety controls, and wiring diagrams and service connections. Provide manufacturer's installation instructions, operations and maintenance manuals, field start-up and commissioning reports, test reports and certifications that boiler is in full compliance with manufacturers recommended performance parameters.
- B. Submit final reports indicating specified performance and efficiency has been met or exceeded and that the system is fully installed in accordance with manufacturer's recommendations.

1.04 OPERATION AND MAINTENANCE DATA

- A. Include manufacturer's descriptive literature, operating instructions, cleaning procedures, replacement parts list, and maintenance and repair data.

1.05 QUALITY ASSURANCE

- A. Manufacturer: Company specializing in manufacturing the products specified in this Section with minimum ten years documented experience.

1.06 REQUIREMENTS

- A. Conform to ANSI/ASME SEC4 and SEC8D and ANSI/AGA Z21.13 for construction of boilers.
- B. Conform to applicable ANSI/NFPA 70 code for internal wiring of factory wired equipment.
- C. Units: AGA certified.
- D. All work specified in this Section shall comply with the provisions of Division 1 and Section 15010.

1.07 DELIVERY, STORAGE, AND HANDLING

- A. Deliver, store and protect products from freezing, scratches and physical damage. Cover boilers with masonite or heavy corrugated cardboard during all construction. Install wood or other similar protection over the top of the boiler to guard against damage from installers standing on the boiler. Repaint and replace any damaged components for a new appearance prior to substantial completion. Protect boilers from damage by leaving factory inspection openings and shipping packaging in place until final installation.

1.08 WARRANTY

- A. Provide one year manufacturer's warranty for the entire boiler from date of substantial completion.
- B. Warranty the boiler for the water source heat pump application as it is applied in this project. This warranty shall be on the manufacturer's letterhead and signed by an officer of the manufacturer. Nothing from the local representative will meet this requirement.
- C. The pressure vessel shall be guaranteed against thermal shock for 20 years when utilized in a closed loop hydronic heating system with a temperature differential of 170 °F or less. The boiler pressure vessel shall be guaranteed accordingly without a minimum flow rate or return water temperature requirement. The boiler shall not require the use of flow switches or other devices to ensure minimum flow.
- D. The pressure vessel, tubes and tube sheets (heat exchanger) shall be guaranteed against flue gas corrosion and materials/workmanship for a period of 10 years. The condensate collection box shall be guaranteed for 20 years.

1.09 EXTRA MATERIALS

- A. Provide any special tools required for tube replacement.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Fulton HW/QT, Aerco Benchmark, Lochinvar Intelli-Fin, Patterson - Kelley Mach, Raypak.

2.02 GENERAL DESCRIPTION

- A. The boiler, with all piping and wiring, shall be factory packaged with a painted casing, neatly finished, thoroughly tested and properly packaged for shipping. Boiler design and construction shall be in accordance with Section IV of the ASME Code for hot

water heating boilers with a maximum working pressure of 100 PSIG. The boiler shall be CSA (formerly AGA/ CGA) certified as an indirect or direct vent boiler and comply with ASME CSD-1 Code requirements.

2.03 BOILER DESIGN

- A. Boiler shall be compact, modulating, condensing natural gas fired with stainless steel surfaces throughout the combustion chambers and condensing sections of the boiler. The boiler pressure vessel shall be completely insulated with a minimum of 2" of insulation and shall be encased in an 18 gauge metal cabinet with powder coated finish.
- B. The Vessel shall be mounted on a structural steel stand with exhaust gasses collected with drain fitting for draining condensation products of combustion.
- C. The vessel shall be fully insulated with a minimum of 2" of insulation, external convection and radiation heat losses to the boiler room from the boiler shall be less than 1% of the rated input.
- D. The condensing capability shall allow the boiler to be operated without the use of a 3-way valve for the boiler supply water temperature reset. No minimum boiler return water temperature or secondary pump or minimum flow rate shall be required.
- E. Boiler shall be certified to comply with IBC 2009 Section 1708.4.1 seismic requirements and manufacturer shall provide seismic calculations showing tie-down requirements for anchors. Anchor bolts and tie-down components shall be by Contractor.
- F. Each boiler shall be constructed in accordance with the A.S.M.E. Section IV Code and bear the "H" stamp and shall be manufactured within an ISO 9001 Certified facility to ensure high quality standards.
- G. The maximum water pressure drop through the boiler shall not exceed 5 PSI with a 20-degree differential and less than 1.0 PSI with a 60-degree differential.

2.04 BURNER DESIGN

- A. General: Forced draft burner The burner door shall utilize easy removable.
- B. The burner shall be of the Unitized Venturi, Gas Valve, Blower, and burner head design. This pre-mix design shall utilize a variable speed fan connected to a venturi to simultaneously modulate fuel and air for a minimum a 4:1 turndown ratio. The venturi design shall also act as a method for compensating for changes in barometric pressure, temperature and humidity so the excess air levels are not adversely affected by changes in atmospheric conditions. External linkages, damper motor drives and single speed fans are not acceptable.
- C. Emissions: The boiler(s) burner shall be guaranteed to limit NOx emissions to 20 PPM or less, as certified by an independent testing lab. NOx emissions shall be at full operating conditions. Proof of such certification shall be made available to the Engineer and purchaser. External flue gas recirculation is not acceptable for emission control.

- D. Gas Train - As a minimum, the gas train shall meet the requirements of CSA and ASME CSD-1 and shall include:
1. Low Gas Pressure Interlock, manual reset.
 2. High Gas Pressure Interlock, manual reset.
 3. Upstream and downstream manual test cocks.
 4. Ball Type manual shutoff valve upstream of the main gas valve.
 5. Unibody double safety gas valve assembly.
 6. Gas Pressure Regulator
 7. Union connection to permit burner servicing.
 8. Combustion Air Proving Switch shall be furnished to ensure sufficient combustion airflow is present for burner firing.
- E. To ensure that proper draft is not blocked in the stack, the burner shall include a High Air Pressure Switch sensing the outlet pressure connection relative to stack back draft.

2.05 BOILER TRIM

- A. Safety valve(s) shall be ASME Section IV approved side outlet type mounted on the boiler water outlet. Size shall be in accordance with code requirements and set to open at 60 psig.
- B. Temperature and pressure gauge shall be mounted on the water outlet.
- C. Solid State Low water cut-off probe with manual reset and test switch.
- D. Outlet water supply sensing probe for operating water limit setpoint.
- E. Return water-sensing probe for operating water limit setpoint.

2.06 BOILER CONTROLS

- A. The Boiler shall include a Computerized Boiler Burner control which shall be an integrated, solid state digital micro-processing modulating device, complete with sequence indication, fault reset, mode selection, and parameter set-point switches. It shall be mounted at the front of the boiler panel for easy access and viewing.
- B. Controller shall provide for both flame safeguard and boiler control and shall perform the following functions:
 1. Burner modulation with safe start check, pre-purge, electronic direct spark ignition, and post purge. Flame rod to prove combustion.
 2. Flame Supervision - the control shall provide pre-purge and post-purge and shall maintain a running history of operating hours, number of cycles, and the most recent faults. The control shall be connected to a touchscreen display module that will retrieve this information.
 3. Safety Shutdown with display of error.
 4. Modulating control of the variable speed fan for fuel/air input relative to load requirements.
 5. High Limit temperature control.
 6. Gas pressure supervision, high and low.
 7. Combustion Air Proving Supervision.
 8. High Air Pressure (back draft too high) Supervision.
 9. Display of supply temperature and set-point temperature shall be accessible via touchscreen. Output shall be continuous PID via 4 -20 mA current.
 10. Controller shall have an option for communication device to a laptop computer

- interface service and troubleshooting.
11. Include the programming of system circulating pump and provide the programming of 2 heating loops.
- C. All parameter input control set-points shall be factory downloaded with jobsite conditions programmed at the time of initial jobsite operation.
 - D. All controls to be panel mounted and so located on the boiler as to provide ease of servicing the boiler without disturbing the controls and also located to prevent possible damage by water according to CSA requirements.
 - E. Building automation system basic interface: digital contact input for boiler enable, 0-10VDC input signal for heating water set point adjustment, 0-10VDC output signal for burner firing rate, digital contact output for boiler run status and boiler alarm / flame failure. The building automation system will provide setpoint control and boiler staging.

2.07 BOILER FLUE VENTING

- A. The Boiler shall be CSA certified as an indirect or direct vent boiler. Venting shall be accomplished with a category IV vent piping, UL-1738 and ULC-S636 listed, installed in accordance with manufacturer's recommendations, applicable national and local codes.
- B. For direct venting, the boiler shall have the combustion air intake supply ducted with G90 galvanized steel spiral duct from the outside. Where the duct crosses the service aisle and is less than 12' AFF provide toggle clamps equal to Nord-Fab #Quick-Fit 3260 series
- C. Venting shall be approved for this application by the boiler manufacturer. Venting shall be accomplished with ANSI Category IV vent piping, UL1738 listed, positive pressure, polypropylene fire retardant water tight vent, installed in accordance with manufacturer's recommendations, applicable national and local codes. Centrotherm InnoFlue or equal system approved by the boiler manufacturer,. Allow for custom fabrication of components as necessary to minimize the back to back space of the 3,000 MBTU boilers, a mitered fitting is required with integral drain.
- D. Vent is provided by the boiler supplier with all accessories to provide a watertight and secure installation in accordance with code and manufacturers recommendations.. Refer to the drawings for general configuration and coordinate with the contractor. Provide shop drawings that are field verified and incorporate every manufacturer recommended accessory for best practice application of the vent system, provide expansion sleeves, drain provisions riser clamps, roof support plates, discharge collars, transition sections to connect to boiler vent collar and anything else that proves necessary to comply with best practice.
- E. Combustion air piping with filter plenum is provided by the installing Contractor.

PART 3 EXECUTION

3.01 INSTALLATION

- A. Install in accordance with the recommendations and requirements of the manufacturer, state and local code officials and the Construction Documents, whichever is the most stringent. The Engineer shall render any decisions where there is a conflict in direction/requirements. There will be no change in Contract amount due to this compliance.
- B. Provide all information, materials and coordination for connection of vent, gas, electrical to equipment installed under this project.
- C. Pipe drains, strainers and relief valves to nearest floor drain. Pipe gas and combustion vents to an outdoor location acceptable to the local and state authorities as well as the Engineer.
- D. Provide a level 5-1/2" concrete base to support and anchor the boilers. A steel base is required in the penthouse to distribute the load and create an auxiliary drain pan.
- E. Relocate and repipe as necessary to suit field conditions. Prepare shop drawings to determine the best piping and venting system configuration to suit the boiler and other equipment requirements that are proposed for use on this project. The basis of design does not consider varying equipment requirements of the various manufacturers, provide all control, piping, venting and accessories required to properly apply proposed equipment at no change in contract amount.

3.02 MANUFACTURER'S FIELD SERVICES

- A. General: The boiler supplier's factory authorized service organization shall be responsible for performance of inspections, start up and testing of the packaged boiler, and accessory equipment and materials furnished under this Section. A detailed written record of the start up performance, including burner setting data over the entire load range shall be furnished to the Engineer before final acceptance. All labor, equipment, and test apparatus shall be furnished by the authorized service organization. All equipment defects discovered by the tests shall be rectified either by the service organization or boiler manufacturer.
- B. Equipment inspection: Boiler representative to inspect boilers and other equipment upon arrival, verifying completeness of equipment supplied and potential damages. All shipped loose components, such as casing, to be mounted on boiler by boiler provider after Contractor has set boiler in building.
- C. Pre start-up walk through: Boiler representative shall review installation with mechanical Contractor to be conducted approximately 1 week prior to startup.
- D. Start-up shall be conducted by experienced and factory authorized technician in the regular employment of the authorized service organization, and shall include:
 - 1. Demonstrate that boiler, burner, controls, and accessories comply with requirements of this Section as proposed by the boiler and accessories supplier. Pre-test all items prior to scheduling the final testing that will be witnessed by the test Engineer.
 - 2. Readings at different firing rates (20, 50, 75 and 100%) of load for the modulating burner shall be taken with a written report of the tests submitted to the Engineer. The reports shall include readings for each firing rate tested and

- include stack temperatures, O₂, CO, NO_x, and overall boiler efficiency.
3. Auxiliary Equipment and Accessories: Observe and check all valves, draft fans, electric motors and other accessories and appurtenant equipment during the operational and capacity tests for leakage, malfunctioning, defects, and non compliance with referenced standards or overloading as applicable.
 4. Requirements:
 - a. Fireside inspection
 - b. Set up fuel train and combustion air system
 - c. Set up operating set points
 - d. Check all safeties, including Flame safeguard, LWCO, Airflow, Fuel pressures, High limits.
 - e. Set up and verify efficiencies at 25%, 50%, 75%, and 100%
 - f. Set up and verify burner turndown.
 5. Provide a minimum of 4.0 hours of on-site training for six operator/service technicians. 1.5 hours prior to substantial completion and 2.5 hours at a later time during the first 12 months of operation.
 6. Provide combustion test and submit report. Test shall include every item recommended by the manufacturer and in addition the following: All nameplate data, boiler firing rate, overfire draft, gas flow rate, heat input, burner manifold gas pressure, percent carbon monoxide, percent oxygen, percent excess air, flue gas temperature at outlet, ambient temperature, net stack temperature, percent stack loss, percent combustion efficiency, heat output, . Simulate a failure of each safety device and verify that boiler shuts down and alarm is annunciated. Verify that alarm lights illuminate on each annunciated point. Where boilers have multiple firing rates the tests shall be performed at two or more firing rates for each installed boiler.

END OF SECTION

**SECTION 15790
AIR COILS**

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Hydronic coils.

1.02 RELATED SECTIONS

- A. All work specified in this Section shall comply with the provisions of Division 1 and Section 15010.

1.03 REFERENCES

- A. ANSI/ARI 410 - Forced-Circulation Air-Cooling and Air-Heating Coils.
- B. SMACNA - HVAC Duct Construction Standards, Metal and Flexible.

1.05 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing the products specified in this Section with minimum three years documented experience.
- B. Carrier, McQuay, Aeon, Trane, York, Heatcraft, US Coil, or Air Enterprise.

1.06 DELIVERY, STORAGE, AND HANDLING

- A. Deliver products to site under provisions of Division 1.
- B. Contractor shall store and protect products under provisions of Division 1.
- C. Protect coil fins from crushing and bending by leaving in shipping cases until installation, and by storing indoors.
- D. Protect coils from entry of dirt and debris with pipe caps or plugs.

PART 2 PRODUCTS

2.01 FABRICATION

- A. Tubes: 1/2" or 5/8" OD seamless copper, 0.025 wall, arranged in parallel or staggered pattern, expanded into fins, brazed joints, 8 row max. True return bends with no reduction in wall thickness are required.
- B. Fins: Aluminum, 0.007 minimum thickness, continuous plate type with full fin collars, Spacing of fins shall be no more than 11 per inch on cooling coils, 12 FPI on heating coils.
- C. Casing: Die formed channel frame of 18 gage galvanized steel with intermediate tube supports for coils longer than 42 inches. Stainless steel required on cooling coil applications.
- D. Verify integrity of assembly by pressurizing coil to: 300 psig for hydronic, 450 psig refrigerant, under water with no indication of leaks.
- E. Capacity: As scheduled.
- F. Refer to the specific equipment sections for additional requirements.

PART 3 EXECUTION

3.01 INSTALLATION

- A. Install in accordance with manufacturer's instructions.
- B. Install in ducts and casings in accordance with SMACNA HVAC Duct Construction Standards, Metal and Flexible.
- C. Support coil sections independent of piping on steel channel or double angle frames and secure to casings. Provide frames for maximum three coil sections. Do not use cooling coil sections exceeding 42" height per section. Arrange supports to avoid piercing drain pans. Provide airtight seal between coil and duct or casing.
- D. Protect coils to prevent damage to fins and flanges. Comb out bent fins.
- E. Install coils with tubes horizontal.
- F. Make connections to coils with unions or flanges and support piping independently from coil.
- G. On water coils, provide shut-off valve on supply and return line. Locate water supply at bottom of supply header and return water connection at top. Provide manual air vents at high points complete with stop valve. Ensure water coils are drainable and provide drain connection at low points.
- H. On water coils, connect water supply to leaving air side of coil (counterflow arrangement).
- I. Install coils with headers enclosed by casing. If not possible then insulate headers located outside air flow as specified for piping. Insulate piping inside casing and subject to sweating with 3/4" thick flexible elastomeric insulation. Refer to Section 15250.
- J. Install piping to allow isolation of coil with unions/flanges to permit coil to be readily removed.

END OF SECTION

SECTION 15860 FANS

PART 1 GENERAL

1.01 WORK INCLUDED

- A. Wall mounted axial flow fans.
- B. In-line cabinet fans.
- C. Motors and drives.

1.02 RELATED WORK

- A. All work specified in this Section shall comply with the provisions of Division 1 and Section 15010
- B. Section 15890 - Ductwork.
- C. Section 15910 - Ductwork Accessories.

1.03 REFERENCES

- A. AMCA 99 - Standards Handbook.
- B. AMCA 210 - Laboratory Methods of Testing Fans for Rating Purposes.
- C. AMCA 300 - Test Code for Sound Rating Air Moving Devices.
- D. AMCA 301 - Method of Publishing Sound Ratings for Air Moving Devices.
- E. SMACNA - Duct Construction Standard.

1.04 QUALITY ASSURANCE

- A. Performance Ratings: Conform to AMCA 210 and bear the AMCA Certified Rating Seal.
- B. Sound Ratings: AMCA 301, tested to AMCA 300, and bear AMCA Certified Sound Rating Seal.
- C. Fabrication: Conform to AMCA 99.

1.05 SUBMITTALS

- A. Submit product data under provisions of Section 15010.
- B. Provide fan curves with specified operating point clearly plotted.
- C. Submit motor information to demonstrate compliance with Section 15170.

1.06 OPERATION AND MAINTENANCE DATA

- A. Submit operation and maintenance data under provisions of Section 15010.
- B. Include instructions for lubrication, motor and drive replacement, spare parts list, and wiring diagrams.

PART 2 PRODUCTS

2.01 PROPELLER FAN -DIRECT OR BELT DRIVE

- A. Greenheck, Twin City, Loren Cook or Hartzell.
- B. Fans used shall not decrease motor size, increase noise level, or increase tip speed by more than 10 percent, or increase inlet air velocity by more than 15 percent, from specified criteria. Fans shall be capable of accommodating static pressure variations of plus 10% or minus 75% and shall be non-overloading at reduced static pressures with increased flows. Base performance on sea level conditions.
- C. Fan panels shall be constructed of no less than 14 gauge galvanized steel with spun steel inlet cone and fabricated structural steel motor and bearing supports.
- D. Statically and dynamically balance fans to 0.157"/sec in all three planes. Balance fan over entire range of speeds from 10% to 120% of design value.
- E. Provide a 16 gauge or heavier galvanized steel wall sleeve, OSHA compliant inlet guard and backdraft damper gravity activated, aluminum multiple blade construction, felt edged with nylon bearings. Where scheduled provide a motorized heavy duty discharge damper with airfoil damper blades and an end switch as scheduled. Interlock fan operation to start only after end switch confirms that damper is open. Denergize fan and close damper simultaneously. Damper equal to Ruskin CD60 with features as defined by Section 15910.
- F. Propellers: Cast aluminum airfoil.
- G. Belt or direct driven. Attach to wall with 1/4" fasteners on 12" centers, minimum of 2 per side, using 1-1/2" angle steel at wall.
- H. Sheaves: Cast iron or steel, dynamically balanced, bored to fit shafts and keyed; variable and adjustable pitch motor sheave selected so required rpm is obtained with sheaves set at mid-position; fan shaft with self-aligning pre-lubricated ball bearings.
- I. HP and RPM as scheduled. Single phase motors internally overload protected, PSC, with solid state speed control. Three phase motors premium efficiency, Class F insulation, 1750 nominal RPM, TEFC, 1.15 service factor. Refer to schedule for variations in RPM with direct drive applications. All 3 phase motors rated for VFD application, See Section 15170.
- J. Bearings: ANSI/AFBMA 11, heavy duty pillow block type, self-aligning, grease-lubricated ball bearings, selected for an average L50 life of 200,000 hours at design conditions.
- K. Shafts: Solid hot rolled steel, ground and polished, with key-way, and protectively coated with lubricating oil.
- L. Factory V-Belt Drive: Cast iron or steel sheaves, dynamically balanced, bored to fit shafts and keyed. Variable and adjustable pitch sheaves selected so required rpm is obtained with sheaves set at mid-position, and drive rated as a minimum 1.3 times nameplate rating of the motor.

2.02 CENTRIFUGAL, CABINET IN-LINE

- A. Greenheck, ACME, Loren Cook or Hartzell.
- B. Fans used shall not decrease motor size, increase noise level, or increase tip speed by more than 10 percent, or increase inlet air velocity by more than 15 percent, from specified criteria. Fans shall be capable of accommodating static pressure variations of plus 10% or minus 75% and shall be non-overloading at reduced static pressures with increased flows.
- C. Base performance on sea level conditions.
- D. Statically and dynamically balance fans to eliminate vibration or noise transmission to occupied areas.
- E. Provide a set of spring and neoprene isolation supports for the installation position indicated on the drawings. Backdraft damper gravity activated, aluminum multiple blade construction, felt edged with nylon bearings.
- F. Single phase motors to be internally overload protected, PSC, with solid state speed control. Factory disconnect switch at fan motor, factory wired, non-fusible, in housing. Provide factory wired disconnect for three phase motors within housing.
- G. Centrifugal Unit: V-belt or direct driven, with formed inlet cone and discharge capable of being converted in the field from straight air path to 90 degree air path and a resilient mounted motor.
- H. Sheaves: Cast iron or steel, dynamically balanced, bored to fit shafts and keyed; variable and adjustable pitch motor sheave selected so required rpm is obtained with sheaves set at mid-position; fan shaft with self-aligning pre-lubricated ball bearings.
- I. Three Phase Motors: HP as scheduled. Premium efficiency. 1750 nominal RPM, O.D.P., 1.15 service factor. GE, Leeson, US Motor, Lincoln, Toshiba, Reliance or Marathon.
- J. Bearings: ANSI/AFBMA 11, heavy duty pillow block type, self-aligning, grease-lubricated ball bearings, selected for an AFBMA L50 average life of 200,000 hours at design conditions.
- K. Shafts: Solid hot rolled steel, ground and polished, with key-way, and protectively coated with lubricating oil.
- L. Factory V-Belt Drive: Cast iron or steel sheaves, dynamically balanced, bored to fit shafts and keyed. Variable and adjustable pitch sheaves selected so required rpm is obtained with sheaves set at mid-position, and drive rated as a minimum 1.3 times nameplate rating of the motor. Motor and drive assembly guard that is OSHA compliant and readily removable.

PART 3 EXECUTION

3.01 INSTALLATION

- A. Do not operate fans for any purpose until ductwork is clean, bearings lubricated, and fans have been test run under observation.
- B. Install fans as indicated. Install with resilient mountings and with flexible electrical leads.
- C. Install flexible connections between fan inlet and ductwork. Ensure metal bands of connectors are parallel with minimum three inches of flex between ductwork and fan while running.
- D. Provide roof curb with integral backdraft damper for roof mounted fans. Secure fan to curb with no less than eight #5/16" screws 1.5" long minimum, 12" O.C. maximum spacing. Extend the exhaust duct thru the roof curb and seal with 1" wide, 1/4" foam gasket, to the top of the curb for an air tight fit between the duct and fan inlet. Curb shall provide no less than 8" clear height above finished roof and no less than 14" overall height above mounting surface, verify insulation thickness prior to ordering. Curb to roof anchors to be no less than eight 3/8" x 2" expansion bolts equally spaced around the curb flange. Where deck is not composite or is too thin to provide anchor installation provide through bolts to the angle steel reinforcing the opening below the roof.
- E. Install all backdraft and automatic dampers to avoid binding or partial opening due to interference with housings or fasteners.
- F. Provide exterior roof/wall opening for fan. Seal and flash exterior penetrations watertight. Make all inlet and outlet connections air tight.
- G. Support fans from building structure as recommended by manufacturer. Reinforce roof/wall openings with structural steel to maintain a rigid and secure roof system. Minimum of 3"x3"x1/4" reinforcing steel on all four sides of opening and extended to bear on structural members.
- H. Provide additional bracing and reinforcement as directed by the Engineer to provide a secure, durable and professional installation.

END OF SECTION

**SECTION 15890
DUCTWORK**

PART 1 GENERAL

1.01 WORK INCLUDED (the most stringent condition shall be applied)

- A. Outside Air Duct serving boilers with combustion air ducted to boilers:
Round: +6.0" Construction
- B. Outside Air Duct supplying combustion air to the equipment room
Rectangular and round +4.0" Construction
- C. Supply, Exhaust and Return Air Duct.
Round & all Rectangular up to 6 SF cross section: -4.0" Construction
- D. Contractor fabricated plenums: +6.0" Construction for boiler vent chase
-6.0" Construction for negative pressure
- E. Stainless steel Type 304 construction is required in the following locations:
 - 1. Roof cap, stack and flashing where combustion air duct is exposed to weather.

1.02 RELATED WORK

- A. Section 15250 - Insulation.
- B. Section 15910 - Ductwork Accessories
- C. Section 15990 - Testing, Adjusting and Balancing.
- D. All work specified in this Section shall comply with the provisions of Division 1 and Section 15010.

1.03 REFERENCES

- A. ASHRAE - Handbook 2013 Fundamentals; Chapter 35 - Duct Design.
- B. SMACNA - Duct Construction Standards, Metal and Flexible. Current edition.
- C. ASTM A 90 - Weight of Coating on Zinc-Coated (Galvanized) Iron or Steel Articles.
- D. ASTM A 525 - General Requirements for Steel Sheet, Zinc-Coated (Galvanized) by the Hot-Dip Process.
- E. ASTM A 527 - Steel Sheet, Zinc-Coated (Galvanized) by Hot-Dip Process, Lock Forming Quality.
- F. NFPA 90A - Installation of Air Conditioning and Ventilating Systems.
- G. UL 181 - Factory-Made Air Ducts and Connectors.

1.04 DEFINITIONS

- A. Duct Sizes: Inside clear dimensions are shown on plans. For lined ducts, enlarge metal sizes to maintain clear dimensions indicated inside lining.
- B. Elevations are to the bottom of duct or air device unless noted otherwise.
- C. FOT = Flat On Top Duct, FOB = Flat On Bottom Duct
R = Rise in direction of arrow, F = Fall in direction of arrow

1.05 REGULATORY REQUIREMENTS

- A. Construct ductwork to NFPA 90A and SMACNA standards.

1.06 SUBMITTALS

- A. Submit duct fittings, particulars such as gages, sizes, joint methods, take-offs, hangars, turning vanes, splitters, sealants and configuration prior to start of work.
- B. Provide coordination drawings of equipment rooms and congested areas which coordinate the duct with work of other trades. Refer to 15010 for coordination drawing requirements.

PART 2 PRODUCTS

2.01 MATERIALS

- A. General: Non-combustible or conforming to requirements for Class 1 air duct materials, or UL 181.
- B. Steel Ducts: ASTM A525 or ASTM A527 galvanized steel sheet, lock-forming quality, having zinc coating of 1.25 oz per sq ft for each side in conformance with ASTM 90A.
- C. Fasteners: Rivets, bolts, or cadmium plated sheet metal screws.
- D. Sealant: Non-hardening, water resistant, fire resistive, compatible with mating materials, Hardcast, 3M or Foster. Use with woven fiberglass tape.
- E. Hanger Rod and Strap: Steel, galvanized; threaded rod or strap. Size per SMACNA recommendations.
- F. Internal Reinforcement: EMT conduit with continuous threaded rod inside conduit and through duct.
- G. Insulated Flexible Ducts: Flexible duct wrapped with 1" thick flexible glass fiber insulation, enclosed by seamless aluminum pigmented plastic vapor barrier jacket; maximum 0.23 K value at 75 degrees F. Class I, Labeled for the pressure noted in the documents, or 6" positive as a minimum.
- H. Stainless Steel Ducts: ASTM A-167 and ASTM A-480 Type 304 or 316 stainless steel with welded joints, seams and taps for a watertight assembly.

2.02 DUCTWORK

- A. Fabricate and support for pressures noted in accordance with most recent SMACNA Duct Construction Standards and ASHRAE handbooks, unless indicated otherwise in the Contract Documents. Provide duct material, supports, gages, reinforcing, and sealing for operating pressures indicated. Use 6" positive pressure for duct construction requirements if not noted otherwise. Mastic seal all gore seams, taps and transverse joints of duct regardless of pressure rating. Seal all longitudinal seams of duct where rating exceeds 2". Sealing shall comply with SMACNA Class A.

Mastic seal shall be a minimum of 1/16" thick and 3" wide. Refer to the terminal unit Section and seal factory seams in terminal units equal to this requirement.

- B. Size round ducts installed in place of rectangular ducts in accordance with ASHRAE table of equivalent rectangular and round ducts. No variation of duct configuration or sizes permitted except by written permission.
- C. Construct T's, bends, and elbows with radius of not less than 1-1/2 times width of duct on centerline. Where rectangular elbows are necessary, or changes in direction exceeding 45 degrees occurs in any duct shown on the plans provide single wall turning vanes with radius, $R=4.5"$ and spacing, $S=2.25"$, with no trailing edge. Provide embossed or welded vane runners, 20 gauge minimum vanes for width to 36", where width of vane exceeds 36" provide welded 1/4" rods on both sides of vanes to limit free length to 36" or less.
- D. Increase duct sizes gradually, not exceeding 1" in 7" divergence wherever possible. Divergence upstream of equipment shall not exceed 1" in 4"; convergence downstream from equipment shall not exceed 1" in 1".
- E. Provide easements where ductwork conflicts with piping and structure. Where easements exceed 10 percent duct area, split into two ducts maintaining original duct area.
- F. Connect flexible ducts to metal ducts with adhesive plus plastic draw bands. 6 feet maximum length of flex duct, 45° maximum bend. Provide rigid or adjustable elbows where bends greater than 45° are required.
- G. Ductmate TDC and Ward manufactured duct system connectors are allowed on this project. Complete system details required in submittal.
- H. Crossbreak bottom and sides of flat portions of duct greater than 3 square feet in area. Rolled ridges, 18" maximum spacing, are considered equivalent to crossbreaking.
- I. Where notes on drawings indicate that duct will receive paint then fabricate from "Paintgrip" or equal material labeled by the manufacturer for "ready to paint" surface qualities. All miscellaneous components associated with supporting and joining exposed duct fabricated from same material.
- J. Reinforce rectangular duct operating at more than 4" or less than -4" with internal tie rods using continuous ATR connectors inside of EMT. Use 1/2" EMT and 1/4" ATR where maximum duct dimension exceeds 36", use 1" EMT and 3/8" ATR where duct dimension exceeds 60". Space tie rods 36" O.C. along length of duct. Ducts operating at lower pressures that experience deformation in excess of 1/8" per foot of duct width shall be reinforced with tie rods of sufficient size and spacing to hold total deformation to less than 3/8" at the maximum swell point. Maximum swell shall be measured at no flow and full flow conditions.
- K. Flexible duct bellows applied in MRI/NMR helium cryogenic quench duct applications to be equal to Flexicraft, 2.25" axial elongation, weld ends, round duct joint.

2.04 EQUIPMENT CASINGS

- A. Shop fabricate equipment casings for containment of fan systems using SMACNA standard equipment details for the pressure rating of the duct construction. Casing to be procured from a specialty manufacturer specializing in this type of work. Provide structural supports where casing sections exceed 12 feet between support points.
- B. Include submittals of casing fabrication in ductwork submittal.

PART 3 EXECUTION

3.01 INSTALLATION

- A. Locate ducts with sufficient space around equipment to allow normal operating and maintenance activities. Use only galvanized steel for supports, hangers, connectors, drives and accessories unless noted otherwise in the Contract Documents.
- B. Install in accordance with SMACNA standards and in compliance with the local authorities having jurisdiction requirements. Supports to be:
 - 1. 1" x 18 gauge galvanized steel band for duct up to 4 SF in cross section.
 - 2. 1" x 1/8" galvanized steel band may be used on duct up to 6 SF in cross section.
 - 3. Threaded rod and strut required on duct exceeding 6 SF.
 - 4. Secure steel band to building structure using locking "C" clamp to steel structure, use a Hilti KH-EZ or an expansion anchor for securing to concrete structure.
- C. Where duct elevations are provided comply with such to the greatest extent possible, but do not adhere to elevations when field investigation or coordination drawings indicate variations are appropriate. Where obstructions interfere with routing shown coordinate with other trades to move obstructions. If obstructions can not move design proposed relocation of duct and submit to Architect/Engineer for approval. Offset duct to clear obstructions as determined by field coordination. Do not fabricate duct or release order for duct accessories until routing is confirmed by coordination drawings and field investigation. No change is allowed in contract amount to relocate duct or adjust duct sizes caused by such obstructions. Allow for coordination, duct size adjustment and associated redesign of duct layout in bid.
- D. Where elevations are not provided install as high as possible in the above ceiling space. Maintain a minimum of 12" clear between the bottom of metal duct and finished ceiling elevation.
- E. Offset duct to clear obstructions using gentle sweeps with splitter dampers or off sets with angles of 45 degrees or less. Offsets are not shown and will need to be confirmed with coordination drawings
- F. Install balancing/splitter dampers in locations specified by test and balance Contractor as needed to achieve proper balance. No increase in Contract amount will be allowed for installation of these dampers.
- G. Crossbreak or roll ridges 18" maximum spacing, in rectangular duct sections that exceed 3 square feet in area.

- H. Round lateral fittings to be conical 90 degree, or straight 45 degree. On pressures 2" and less spin-in or flanged adhesive faced "seal-tight" conical laterals with sheet metal screws 8" O.C. are acceptable if they are additionally sealed with duct sealant. Every take-off, collar or lateral requires a manual balancing damper. These are not indicated on the plans since they apply without exception. Provide "stand-offs" with locking lever for control of the manual balancing dampers at each lateral and stay clear of insulation jacket.
- I. Rectangular laterals and collars to take off from duct mains with a 45 degree leading edge and a 90 degree trailing edge.
- J. Duct mounted air inlets and outlets require collars which extend a minimum of 6" from the duct and completely remove their volume regulators from the air stream of the main duct.
- K. Apply paintable mastic used for sealing neatly with heavy, complete, coverage of all joints, collars, taps and laterals. Seal Longitudinal seams when noted elsewhere in this Section. For positive pressure duct exceeding 4" construction apply 5" wide, open weave fiberglass cloth. While mastic is wet place cloth in sealer and smooth out all bubbles in duct, let cure then apply a second coat of mastic to completely cover the cloth. Remove any excess mastic while wet. Once duct is placed in operation thoroughly inspect all duct for audible leakage and seal all perceptible duct leaks. Wherever possible install sealant to the duct interior on positive pressure applications.
- L. Every tap of a duct requires a balancing damper with an offset base to clear insulation and a balancing lever with indicator and locking wing nut. Seal joints as described elsewhere in this Section. Manual balancing damper are shall be installed as close to the main duct as possible. If duct is externally insulated provide a smooth metal mounting surface for locking quadrant damper operator to protect insulation.
- M. Install flexible duct elongated to 80% of its maximum length. Sags in excess of 1/2" per foot of run are not permitted. Support flexible duct on 6' centers using band clamps secured to the building structure with strapping. Band clamps shall be rolled to conform to the outside diameter of jacket.
- N. Cover duct openings on a daily basis to keep duct interior clean using duct tape and 0.7 mil plastic trash bags.
- O. Seismic restraints are required in accordance with Section 15140.
- P. Label the duct to indicate the AHU or Fan system served, EA/SA/RA/OA for the type of air conveyed and an arrow to indicate flow direction. See Section 15190 for the size, type and locations of these labels. Wipe down the duct or insulation surface prior to applying of the labels. Remove and replace any label that is not 100% adhered to the surface of the duct or insulation.
- Q. Position quench duct flexible bellows 30' on center and at changes in direction. The duct will contract up to 1.5" in each section. Compress each bellows 0.75" (350 pounds of force required) and secure in this position with a 11 gauge riser clamp on each side of bellows held together with two 3/8" ATR and jamb nuts. At the center of

each span of quench duct secure to the building structure with 11 ga riser clamps 2" wide and two threaded rods ½-13 anchored to the building structure.

3.02 TESTING

- A. Twenty Five percent of all round duct on the fan (AHU) side of terminal units and all duct in chases, all rectangular duct and all duct in mechanical rooms shall be pressure tested according to SMACNA test procedures using the HVAC Air Duct Leakage Test Manual. Notify Owner minimum seven (7) calendar days in advance of leakage testing. The Owner will select the round duct sections to test.
1. Design pressure for testing ductwork shall be the static pressure rating of the duct sections being tested. Lower pressure duct being tested with higher pressure duct shall be tested at the higher pressure duct's rating. All duct to be tested using positive pressure, Leakage Class method as $L_{max} = C_L P^{0.65}$ where: L_{max} = maximum permitted leakage in cfm/100 ft² ductwork surface area; C_L = duct leakage class, cfm/100ft² at 1 inch water gage; P = test pressure, :
 - a) $P=10"$ WC for 10" rated duct ; $C_L = 4$ for round duct, 6 for rectangular duct.
 - b) $P=6"$ WC for 6" rated duct; $C_L = 4$ for round duct, 6 for rectangular duct.
 - c) $P=4"$ WC for 4" rated duct ; $C_L = 4$ for round duct, 4 for rectangular duct.
 2. The largest test section shall not exceed 25% of the duct on a single floor. Ducts in a shaft shall be tested in their entirety after completely installed.
 3. When partial sections of the duct system are tested, the summation of the leakage for all sections shall not exceed the total allowable leakage. The test and balance agency shall either pass or fail each section of duct. This Section is responsible for location and sealing of leaks.
 4. Leaks identified during leakage testing shall be repaired by:
 - a) Complete removal of the sealing materials.
 - b) Thorough cleaning of the joint surfaces.
 - c) Installation of multiple layers of sealing materials.
 5. The entire ductwork system that is identified for testing shall be tested. The connections to the terminal units shall be capped immediately prior to the terminal units, and tested as described above.
 6. After testing has proven that ductwork is installed and performs as specified, the terminal units shall be connected to ductwork and connections sealed with extra care. Contractor shall inform the Owner when joints may be visually inspected for voids, splits, or improper sealing of the joints. If any leakage exists in the terminal unit connections/joints after the systems have been put into service, leaks shall be repaired as specified for other leaks. Note that only fan powered terminals are joined with flexible duct. All other terminals are to connect to the duct system with metal duct.
 7. Fixed flow measurement devices (i.e. orifice tubes, nozzles, etc.) shall have current calibration documentation showing that the device was verified to a National Institute Of Standards and Technology (NIST) standard within the previous five years or as recommended by the manufacture and be accurate to at least +/- 2% of reading.
 8. Pressure measurement instrumentation (i.e. manometer) shall have current calibration documentation showing that the device was verified to a NIST standard within the previous year or as recommended by the

manufacture. Instrumentation shall have an accuracy of at least +/- 2% of reading and have a resolution of 2:1 with respect to the measured pressure (i.e. resolution of 0.01 measured 0.1).

- B. All 2" WC and lower pressure duct systems (positive or negative) shall be inspected for visible and audible signs of leakage.
 - 1. Leaks identified by inspection shall be repaired by:
 - a) Complete removal of the sealing materials.
 - b) Thorough cleaning of the joint surfaces.
 - c) Installation of multiple layers of sealing materials.
 - 2. Discrepancies found during testing and balancing between duct traverses and diffuser/grille readings shall result in re-inspection, repair and retest until discrepancies are eliminated.
- C. Ductwork leakage testing and/or inspection shall be performed prior to installation of external ductwork insulation.

3.03 EQUIPMENT CASINGS

- A. All construction shall comply with SMACNA FIG 6-3 using the option to face joints toward the inside. Apply sealant between panel joints during panel installation. Use 18 gauge as a minimum for panel construction. Face the joints to the inside to provide a mounting track for insulation. Install 3" thick duct liner between the joints on the casing air side. Install 20 gauge perforated G90 steel across the joints to hold the liner in place and allow full attenuation capabilities of the liner. Attach using rivets and washers 12" O.C.. Liner free area of 40% using 1/8" diameter holes on 3/16" centers. Install nosing where the liner would otherwise be exposed. Hem any exposed perforated liner edges.
- B. Construct the floor and roof using equivalent structures with the floor utilizing no less than 14 gauge perforated steel for the interior liner. Seal all seams and joints to eliminate casing leakage. Provide light gauge bar grating on the floors in any areas that deflect 1/4" under a 250 pound load.
- C. Provide man doors in casing with view lights equivalent to the doors specified for AHUs in Section 15855.

END OF SECTION

**SECTION 15910
DUCTWORK ACCESSORIES**

PART 1 GENERAL

1.01 WORK INCLUDED

- A. Manual Balancing Dampers.
- B. Flexible Duct Connections at Fans and Equipment.
- C. Duct Access Doors.
- D. Fire and Smoke Dampers and Smoke Dampers.
- E. Motorized Control Dampers.
- F. Fire Dampers.
- G. Backdraft Dampers.
- H. Roof Curb

1.02 RELATED WORK

- A. All work specified in this Section shall comply with the provisions of Division 1 and Section 15010.
- B. Section 15890 - Ductwork.
- C. DIV16 - Fire Alarm

1.03 REFERENCES

- A. NFPA 90A - Installation of Air Conditioning and Ventilating Systems.
- B. SMACNA - Duct Construction Standards - Metal and Flexible
- C. SMACNA - Fire, Smoke and Radiation Damper Installation Guide for HVAC Systems

1.04 SUBMITTALS

- A. Submit product data under provisions of Division 1 and Section 15010.
- B. Provide shop drawings for shop fabricated assemblies indicated, including volume control dampers, duct access doors. Provide product data for hardware used.

PART 2 PRODUCTS

2.01 BALANCING DAMPERS.

- A. Fabricate in accordance with SMACNA Duct Construction Standards or provide factory fabricated dampers rated for the duct pressure classifications.
- B. Fabricate splitter dampers of material same gage as duct to 24 inches size in either direction, and two gages heavier for sizes over 24 inches.
- C. Fabricate splitter dampers of single thickness sheet metal to streamline shape. Secure blade with continuous hinge or rod. Operate with minimum 1/4 inch diameter rod in self aligning, universal joint action flanged bushing with set screw.

- D. Factory fabricated single or multi-blade damper, opposed blade pattern when multiple blade, with maximum blade sizes 9 x 48 inch. Assemble center and edge crimped blades in prime coated or galvanized channel frame with suitable hardware.
- E. In round ductwork 12 inches and smaller, provide end bearings. On multiple blade dampers, provide oil-impregnated nylon or sintered bronze bearings.
- F. Provide locking, indicating quadrant regulators on single and multi-blade dampers. Where rod lengths exceed 30 inches provide regulator at both ends.
- G. On exterior insulated ducts mount quadrant regulators on stand-off mounting brackets, bases, or adapters to prevent damage to insulation.
- H. Air Balance, Greenheck, Ruskin or approved equal.

2.02 FLEXIBLE DUCT CONNECTIONS - FANS AND EQUIPMENT

- A. Fabricate in accordance with SMACNA Duct Construction Standards.
- B. UL listed fire-retardant neoprene coated fiberglass fabric, minimum 0.05" thick, approximately 3 inches wide flexible, with formed metal banding on both side. Clamping angles and polyurethane sealant to be used on both sides of the flex to effect a complete seal between the flexible and rigid duct connection. Durodyne or Ventfabrics rated for 10".

2.03 DUCT ACCESS DOORS

- A. Fabricate in accordance with SMACNA Duct Construction Standards to match the duct system where the door is applied. Sash locks to be die-cast or 14 gauge formed steel.
- B. Review locations prior to fabrication or ordering. Construction must be rated for the duct in which it is applied and the door must provide access to reach, service, reset, repair the interior item which it is installed to serve. On larger duct the access door may require head and shoulder access inside of the duct to reach multiple fusible links or damper actuators. A 12x18 is the minimum clear opening for head and shoulder access. For duct wider than 36" provide a 24 x 24 door in the side of the duct to allow service personnel full body access to the duct interior.
- C. Factory fabricated rigid and close-fitting doors of galvanized steel with sealing gaskets and quick fastening locking devices. For insulated ductwork, install minimum one inch thick insulation and a double wall metal door.
- D. Access doors up to 12x12 may be secured with 4 sash locks.
- E. Provide piano hinge and two sash locks for sizes up to 18 inches square. Extruded aluminum framing and 2" construction with two compression latches with outside and inside handles for sizes up to 24 x 36 inches.
- F. Access doors with sheet metal screw fasteners are not acceptable.

- G. The duct pressure shall act to seat the sealing edges of access doors. Doors shall be opened "in" to positively pressure duct and "out" of negatively pressured duct. Collar of duct access door shall provide a relatively flush fit of the door to the duct interior surface. Two piece mating shells with hand tightened screws shall meet the construction requirements.
- H. Access doors shall be sized no less than 10/6 for duct up to 8", 10/10 for duct up to 14" and 12/12 for duct up to 24", 12/18 for duct to 36" and 24/24 minimum for larger duct. Provide larger doors where shown on plans or noted elsewhere. Larger doors or multiple doors may be required to provide access to the duct interior due to installation requirements that prevent locating the door for the best access to the interior components. Provide doors as directed by the Engineer when the installation circumstances prevent ready access for normal maintenance, inspection, repair and service.
- I. Refer to the plans for notes, swings and locations of access doors that will be used for full passage at AHU casing and partitions. 24/24 and 24/72 doors are used for man access to be Cesco #HFG20-IO with insulated pane wire glass in the 72" tall model. Additional requirements are noted on the drawings.
- J Ruskin, Wade, Cesco, Ductmate

2.04 BACKDRAFT DAMPERS.

- A. Multi-blade, parallel action gravity balanced backdraft dampers of extruded aluminum, with center pivoted blades of maximum 6 inch width, with felt or flexible vinyl sealed edges, linked together in rattle-free manner with 90 degree stop, steel ball bearings, and plated steel pivot pin; adjustment device to permit setting for varying differential static pressure opening pressures. Refer to plans for locations and specific features.
- B. Neoprene coated fabric in room relief air applications. Refer to drawing details.
- C. Air Balance, Greenheck, Ruskin or approved equal.

2.05 COMBINATION FIRE AND SMOKE DAMPERS or SMOKE DAMPERS

- A. Provide combination fire and smoke dampers when smoke dampers are indicated. Fabricate in accordance with NFPA 90A and UL 555S for a Class I leakage rated smoke damper. Damper shall be rated for operation against 4000 FPM and 6" static pressure. Parallel blades, refer to plans for blade orientation and provide factory modifications to allow blades to be installed vertically where indicated on plans.
- B. Provide factory sleeve and mounting angles for each damper. Install damper operator on exterior of sleeve and link to damper operating shaft. Configuration shall permit damper to be in the plane of the wall with the motor outside the plane of the wall.
- C. Fabricate with one or more blades with extruded aluminum true airfoil blades. Frame to be 14 gauge galvanized steel with stainless steel sleeve bearings and plated steel axles, stainless steel jamb seals, 1/8 x 1/2 inch plated steel concealed linkage,

stainless steel closure spring, blade stops, and lock, and 1/2 inch actuator shaft. True airfoil blades on all rectangular dampers, on round dampers exceeding 24" dia, single thickness with stiffening ribs on round dampers up to 24" diameter.

- D. Operators shall be resettable, spring close, 120VAC normally closed with a device to keep dampers from closing faster than 7 seconds from the full open position. Operators shall be UL listed and labeled. A separate dry contact in the form of a SPDT switch will open if the damper is less than 70% open. Local LED annunciation/test and reset station required in wall at the ceiling level of occupied space at every damper location.
- E. Fusible links, UL 33, shall separate at 212F.
- F. At wall grilles provide equivalent damper with a mounting sleeve suitable for complete concealment within a wall grille.
- G. Ruskin, Greenheck, Air Balance. Ruskin FSD60 for rectangular and round exceeding 24", FSDR25 for round to 24", SD50 for smoke damper only applications.

2.06 MOTORIZED CONTROL DAMPERS

- A. Provide motorized control dampers where indicated. Fabricate in accordance with AMCA 500 for a leakage rating of no more than 2 CFM/SF at 1" W.C. rectangular and no more than 4 CFM/SF at 4" W.C. round. Suitable for 6" static pressures and rated for operation at 4000 FPM. Pressure loss not to exceed 0.15" W.C through a 48x12 damper at 8000 CFM. Pressure loss not to exceed 0.05" W.C through a 24" round damper at 3000 FPM.
- B. Where damper is applied in a duct system it shall be furnished with mounting suitable for direct installation inside of duct. Where damper is applied at an equipment housing a flanged frame is required. Low profile casings are required on all rectangular applications less than 14" tall.
- C. Install all shafts for mounting of an actuator on the exterior of the damper. Provide the ability to field modify the mounting to allow internal mounting of the actuator. Parallel blade operation unless noted otherwise. Refer to drawing notes for damper actuator locations.
- D. Fabricate with one or more true airfoil blades with extruded aluminum or 16 gage galvanized steel frame and blades, 1/2 inch actuator shaft, neoprene blade edge seals, stainless steel sleeve bearings and plated steel axles. Rectangular dampers equipped with flexible metal jamb seals, heavy gauge steel concealed linkage, and factory installed jackshaft for multiple section dampers. Double wall airfoil blades on rectangular, single thickness on round. Galvanized blades that are not true airfoil are not allowed.
- E. Operators shall be furnished and installed by Section 15950. Coordinate with 15950 providing all jackshaft information, torque requirements and mounting plates necessary to properly select and apply actuators. For each damper furnished provide the operating torque to close and to open 4" W.C. and 4000 FPM. If torque varies for horizontal and vertical configurations provide both values. 15950 is required to

furnish actuators with 150% of the rated torque requirements. Provide end switches to indicate open damper position.

- F. Ruskin, Greenheck, Air Balance: Ruskin CD60 for rectangular; Ruskin CDRS25 for round up to 24", Ruskin CDR25 for round 26" - 40", Ruskin CDR82 for round exceeding 40".

2.07 FIRE DAMPER

- A. Provide in the locations shown. Fire dampers shall be dynamic curtain style dampers constructed and tested in accordance with UL Safety Standard 555, fourth edition – 1990. Damper curtain does not reduce the free area of adjacent duct. Ruskin DIBD2 Style B.
- B. Provide factory sleeve and factory retaining angles for every damper. Plate style collar for round duct and rectangular collar for rectangular duct. Single side retaining angles are required to be supplied by the manufacturer where this is an option and is a part of a UL Listed assembly.
- C. Dampers to be labeled for vertical or horizontal installation in the locations shown with the damper curtain out of the airstream in its normal position.
- D. Provide 3 hour rated dampers where penetrating partitions rated at more than 2 hours. Ruskin DIBD23 Style B.
- E. Fire dampers in round duct up to 24" diameter, where duct systems are rated more than +2" or less than -2" shall utilize a butterfly style damper in lieu of a curtain style damper. Ruskin FDR25 or equal. Refer to 15890 for duct pressure classification.
- F. At wall grilles provide equivalent thin line damper with a mounting sleeve suitable for complete concealment within a wall grille. Damper in the air stream is allowed. Ruskin DIBDT Style A.
- G. In existing rectangular duct locations that receive new dampers provide air foil dampers to minimize the amount of disturbance to the fire rated floor or wall. Ruskin FD60.
- H. Refer to the details on the drawings and comply with fire damper models specified there where there is a conflict with this section. Each damper to have a 1-1/2 hour fire protection rating where applied in a 2 hour or lower fire rating wall or floor, 165F fusible link except provide a 286F fusible link if exhaust or return connection at chase, and shall include a UL label. Damper shall be designed, rated and listed for use in systems where the fans may remain operational in the event of a fire.
- I. Ruskin, Cesco, Air Balance, Greenheck.

2.08 ROOF CURB

- A. Provide factory welded and insulated roof curb, minimum 14" tall and a minimum of 8" clear above the finished roof surface. 14 gauge or heavier construction, G90 galvanized steel with a wood nailer for attachment of roofing materials. Seismic rated

to 1.5 times the weight of the supported item and suitable for sustained wind forces equal to the largest profile of the roof mounted equipment times 30 pounds per square foot.

- B. R-10 external wall insulation, R-19 internal top cover insulation. Where a top is indicate, such as for combustion air and boiler vent penetrations, provide a type 304 stainless steel 16 gauge cover with integral perimeter counterflashing that is 2.5" tall with a drip lip. Fabricate the cover to shed rain at 1% minimum slope; provide an integral cross break where the curb does not exceed 30" in its smallest dimension; provide internal bracing 16" O.C. using L3"x3"x 16 gauge ribs stitch welded in place to maintain the cover profile. Add additional reinforcement as required to support a 200 pound load applied in the center of cover span. .
- C. Dek-Tite EPDM and silicone boots to provide flashing for round penetrants through the roof curb top.

2.09 ACCEPTABLE MANUFACTURERS - LOUVERS

- A. Arrow, Cesco, Ruskin or Empco. Ruskin ELF445DXH.
- B. Provide 2", 4", or 6" (as shown on drawings, 6" if not shown) deep louvers with stationary, drainable blades, stormproof, non-vision, heavy gauge extruded aluminum frame & blades, 52% free area, 1 /2" openings aluminum bird screen on concealed side of louver; channel frame, (flanged frame in soffit applications. Louver shall withstand a 90 MPH sustained wind with an allowance for gusts to 115 MPH. Provide all bracing and reinforcing to comply with the structural requirements. Where louver must ship in multiple pieces provide mullions coordinated with the louver construction and finish. Louver without visible mullions shall be 10'W x 7'-6". Provide extended color matched extended sill.
- C. Construct using 0.125 extruded aluminum blades, 0.125" frame, mitered joints, welded assembly, with factory custom color 50% Kynar finish baked on. Color selection at submittal by Architect.
- D. Pressure drop not to exceed 0.20" W.C. at 1000 fpm free area face velocity. Water penetration not to exceed 0.01 oz/SF for a 15 minute interval at 1000 fpm free area face velocity. Minimum free area equal to face area times 0.50. All tests in full accordance with AMCA Standard 500

PART 3 EXECUTION

3.01 INSTALLATION

- A. Install accessories in accordance with manufacturer's instructions.
- B. Provide balancing dampers at points on supply, return, and exhaust systems where branches are taken from larger ducts. Use splitter dampers only where indicated. Test and balance firm shall spot location of any additional dampers that prove necessary to achieve a quiet, balanced system. Make allowances in the bid for any such dampers as there shall be no charge for these dampers.

- C. Provide backdraft dampers on relief air dampers, exhaust/relief fans or exhaust ducts nearest to outside and where indicated.
- D. Provide flexible connections immediately adjacent to equipment in ducts associated with fans and motorized equipment.
- E. On air systems that do not have 85% or better final filters provide duct access doors in the supply duct system for inspection and cleaning. On all new return air systems provide duct access doors for inspection and cleaning. Locate access doors before and after filters, coils, fans, automatic dampers, turning vanes and elsewhere as indicated. Provide minimum 6 x 10 inch on duct less than 12", 12 x 12 inch size for access in other general locations and 18 x 18 inch size for shoulder access at larger coils, dampers, turning vanes and internal duct mounted accessories which are more than 30" away from the duct opening. Where other size door is noted on the plans, comply with plans. Arrange door to open against pressure so that duct pressure always assists in the closing/sealing of the door. Cam locks or spring locks should be used to secure door. Clam shell style access doors are allowed subject to compliance with specified performance. Provide duct access doors, 12" x 12", a maximum of 50' O.C., and at both sides of any turning vanes, to allow inspection and cleaning of duct interior. Locate to allow the best access to duct. Provide larger door as directed by the Engineer for ready access to the duct interior for inspection, service, repair adjustment needed to access the interior where mounting conditions make access awkward. No change in contract amount allowed if larger doors are required.
- F. The minimum outside air dampers and return air dampers are parallel blade construction. Provide control dampers of opposed blade construction when multiple blades are involved unless indicated otherwise on the plans. It is solely the responsibility of the Contractor to verify the damper sizes to assure they will fit in the ducts. Do not release damper order until the size and location has been confirmed by field verification or coordination drawings. If field conditions prevent the installation of control dampers in the locations shown the Contractor shall present alternate location suggestions to the Architect/Engineer for approval and reflect the modifications on the as-built drawings. There will be no additional charge for these modifications if they should occur. Provide jackshafts and actuator mounting brackets for all new multisection dampers. Actuators are mounted in the airstream at the AHU mixed air plenum. Other actuators are mounted outside of the air stream.
- G. Install ceiling access panels where required to gain access to the Work not obtainable in any other reasonable way. There shall be no charge for access panels added to allow access and service to equipment. Refer to complete document set for any access doors anticipated and provided by other Sections. Where access doors are necessary they shall be installed by tradesmen experienced and qualified in this type of work.
- H. Provide openings and accessories as needed to mount control, safety, power, temperature and pressure measuring equipment and raceways to air handling system. Include sealing around penetrations for an airtight assembly. In double wall applications seal both inner and outer walls.

- I. Install field fabricated linkages between the interlocked dampers. Linkages shall exhibit sufficient strength to completely stall the combined actuators which are attached to it with no stretch or deformation. In general these linkages should be formed of round cold rolled steel bar. In lengths exceeding 36" the bars should be protected from deformation by clamping a section of galvanized angle steel to the bar 20" O.C., using "U" bolts. This angle shall be 12" shorter than the rod free length and should be 1-1/2" x 1-1/2" x 1/8" up to 6' long. Longer lengths shall be accomplished with the rod welded to each end of 1-1/2" galvanized steel pipe.

- J. Provide insulated roof curb with external wall insulation, internal top insulation to accommodate roof penetrations by new mechanical work. Secure top to curb with no less than eight #1/4" screws 1.5" long minimum, 12" O.C. maximum spacing. Extend the exhaust duct thru the roof curb and seal with flexible silicone boots rated for 390F penetrants, Dek-Tite or approved equal. Extend the combustion air make-up through the roof curb top and seal with flexible EPDM boots, Dek-Tite or approved equal. Apply a 5/16" bead of clear silicone sealant between the boot and the cover, additionally silicone the penetrant to the boot after tightening the ss screw clamp around the top of boot. Seal the top to the curb with 1" wide x 3/8" foam gasket, to the cover for an air tight fit between the curb and top. Curb shall provide no less than 8" clear height above finished roof and no less than 14" overall height above mounting surface, verify insulation thickness prior to ordering. Curb to roof anchors to be no less than eight 3/8" x 2" expansion bolts equally spaced around the curb flange. Where deck is not composite or is too thin to provide anchor installation provide through bolts to the angle steel reinforcing the opening below the roof.

- K. Install louvers in strict accordance with manufacturers recommendations. Comply with Architectural details where they are provided. Where details are not provided install louver recessed 3/4" from finished wall with a top drip ledge flashing and a bottom extended sill. Apply generous bead of sealant on all sides to create a watertight seal. Install structural steel framing the full perimeter of the louver using standard 8" channel steel welded together and to the building structural steel. Secure the louver to the steel frame using clip angles furnished with the louver and attached using 1/4" fasteners on 12" centers the full perimeter of the louver. Duct connections shall make-up to the structural steel frame and form an airtight assembly. Apply sealant as necessary to eliminate any leaks between the louver and connecting duct.

- L. Bird screens always are installed on the concealed side of louvers and grilles.

END OF SECTION

**SECTION 15950
CONTROL SYSTEMS**

PART 1 - GENERAL

1.01 WORK INCLUDED

- A. All work specified in this section shall comply with the provisions of Section 15010 and Division 1.
- B. Provide a complete microprocessor based programmable electronic two position / modulating control system as shown or described in documents including all hardware, wiring, electrical interlocks, computing equipment, software, programming, sensors, transducers, labeling, relays, transmitters, actuators, automatic valves, panels, graphic displays, switches, and other devices and appurtenances as required to accomplish automatic control of the mechanical systems. Refer to drawings and Project Manual for additional details. Equipment and/or systems to be installed include:
 - 1. Building Automation System (BAS): Master Controllers, Application Specific Controllers, Local Operator Access Panel, Local Control Panels, and Network Control Panels.
 - 2. Temperature, humidity, Carbon Dioxide and differential pressure sensors.
 - 3. Valve and damper actuators.
 - 4. Control valves and dampers. (Dampers per Section 15910 Requirements)
 - 5. Thermostats and differential pressure switches.
 - 6. All other relays, switches, miscellaneous accessories, and interlocks required to accomplish automatic control sequence indicated in the sequence of operation.
- C. Installer: Work is to be performed by a single Contractor with minimum 3 years experience, responsible for providing and installing the system specified, using highly skilled technicians who are experienced and competent in the installation of control systems. Design system under direct supervision of a Controls Engineer experienced in the design of this work.
- D. Manufacturer: Company specializing in manufacturing the products specified in this Section with minimum ten years documented experience.
- E. This Contractor shall make an allowance for coordinating and working with the various equipment manufacturers, test and balance Contractor as required until all HVAC systems are performing as intended. This Contractor should also allow for program changes / modifications as required to achieve the sequence of operation. The Engineer reserves the right, throughout the warranty period, to make changes in the control sequence, if the system is not performing as intended.
- F. Bid Packages #1 and #2 are bound by this section and are two separate scopes of work that will be provided by a prime contractor with Section 15950 being a subcontractor.
- G. Bid package #3 is a stand-alone project that may be awarded independently or with other bid packages. The BAS that serves the Regional Forensics Center at 637

Poplar is not mapped into the central monitoring locations at 160 N Main and 201 Poplar. Under Bid Package #3 this Section will provide all hardware, software and Owner training to allow both of the Central Monitoring locations to monitor and control all BAS points that are existing at the Regional Forensics Center. Bid Package #3 may be awarded direct to a BAS provider or through a Prime Bidder.

1.02 RELATED WORK

- A. Section 15190 - Mechanical Identification.
- B. Section 15910 – Ductwork Accessories
- C. Section 15969 - Thermometers, Gauges & Instrumentation
- D. Section 15990 - Testing and Balancing
- E. All work specified in this Section shall comply with the provisions of Division 1 and Section 15010.
- F. Division 16: Electrical Specifications

1.03 SUBMITTALS

- A. Submit product data to Engineer for approval as required by Section 15010 and Division 1. Submittal information shall include at least the following:
 - 1. Building Automation System Controllers:
 - a) Trunk cable schematic showing programmable control unit locations, and trunk data conductors.
 - b) Schematic of connected data input and control points, including controlled and input device interface schematics.
 - c) System graphics indicating monitored systems, data point locations and operator notations.
 - d) System configuration with peripheral devices, batteries, power supplies, diagrams, modems, and interconnections.
 - e) Descriptive data and sequence of operation of operating, user, and application software.
 - f) Provide sketches of graphic displays for front end operator station indicating displayed data and colors.
 - 2. Complete shop drawings of entire control system.
 - 3. List of control valves, Cv, pressure drops, normal positions, close off rating and spring ranges (if applicable).
 - 4. Composite wiring diagrams indicating equipment, control device set points, and interlocks with all affected systems and equipment.
 - 5. Written sequence of operation for each control system.
 - 6. Equipment data sheets for all major control components including but not limited to: Building Automation System controllers, control valves, actuators, temperature sensors, differential pressure switches and sensors, and other miscellaneous transducers. Include application, range, and accuracy specifications.

1.04 WARRANTY

- A. Refer to the General Conditions for warranty requirements in addition to those specified herein.
- B. The control manufacturer shall guarantee the control system installed under this section of the specification to be free from defects in workmanship and material under normal use and provide service for a period of one year after acceptance by the Engineer and Owner. Any defects in workmanship or material during this time shall be corrected by the control manufacture at no charge. Provide two complete inspections, to inspect, calibrate, and adjust controls as required, and submit written reports.
- C. Prior to final acceptance, the control Contractor shall start-up the system and perform all necessary testing, calibrating, debugging, and review all program sequences and graphic displays with the Engineer/Owner. The system warranty period shall not begin until all programs and graphics have been approved and the sequence of operation has been successfully demonstrated. The control Contractor shall provide all technical personnel required to completely checkout and demonstrate the proper operation of the entire control system.
- D. During the warranty period this Contractor shall provide warranty repairs during regular working hours of 7 AM to 4 PM. Warranty response shall be no later than 11 AM the next working day from the time of telephone request. In addition to normal response time provide emergency response to calls within 3 hours of when the call is placed, 24 hours/day, 7 days/week. If this Contractor does not respond to these warranty calls in a timely manner the work shall be done by others and this cost will be charged to this Contractor.

1.05 PROJECT RECORD DOCUMENTS

- A. Submit record documents under provisions of Section 15010 and Division 1.
- B. Accurately record actual location of controllers, control valves, dampers, misc control components, including panels, thermostats, and sensors. Additionally note DIP switch and jumper positions, set point adjustments, and electrical circuits used for control system power source.
- C. Revise shop drawings to reflect actual installation and operating sequences, laminate and mount per Section 15010.

1.06 OPERATION AND MAINTENANCE DATA

- A. Submit operation and maintenance data under provisions of Section 15010 and Division 1.
- B. Include systems descriptions, set points, and controls settings and adjustments.
- C. Include inspection period, cleaning methods, recommended cleaning materials, and calibration tolerances.

D. Building Automation System Controllers:

- a) Include 2 copies interconnection wiring diagrams of the complete field installed system with identified and numbered, system components and devices.
- b) 2 copies controller and peripheral hardware systems operation and maintenance manual with trouble shooting procedures. Include step by step procedures to temporarily restore controlled equipment operation in the event of a prolonged system crash.
- c) 2 copies of complete "how to" programmers manual. Provide a hard copy print out of the program(s) with English descriptors if required. Include keyboard illustrations and step-by-step procedures indexed for each operator function.
- d) Provide one user and one backup copy of the communication, reporting, graphics, and controller programs in electronic format with written step-by-step procedures to restore automatic operation of the system after a system(s) crash resulting in program loss or system dysfunction.

1.07 PROTECTION OF SOFTWARE RIGHTS

- A. Prior to delivery of software, the Owner and the party providing the software will enter into a software license agreement with provisions for:
1. Limiting use of software to equipment provided under these specifications.
 2. Preserving confidentiality.
 3. Prohibiting transfer to a third party.

1.08 EXTRA MATERIALS

- A. Provide any unusual or specialized tools required for setpoint adjustment, calibration, or disassembly of control components. Electronic multimeters, electronic thermometers or other such diagnostic equipment are excluded from this requirement.

PART 2 - PRODUCTS

2.01 ACCEPTABLE CONTROL MANUFACTURERS – BY LOCATION

- A. Building Automation System:
1. TAC : 160 N. Main – Administration Building | 201 Poplar – Criminal Justice Complex | 814 Jefferson – Health Department | 140 Washington – Courthouse
 2. JCI: 150 Washington – Office Building
 3. Siemens: 280 Washington - Jail Annex | 637 Poplar – Regional Forensic Center
- B. Other control apparatus: Honeywell, Johnson Controls, TAC, Siemens, Kele and Associates, or approved equal.

2.02 Building Automation System:

- A. The intent of this project is to extend the existing building automation system to serve the new equipment and where possible reuse the existing control and monitored points to avoid adding all new points. Automatic temperature control, monitoring and control system using programmable micro-processor based stand alone modular unit(s).
1. Memory: 30 % free memory after software is down loaded.

2. Points: 15% available after all systems are operating in accordance with Contract Document requirements.
3. Manual Override: Local manual override switches and potentiometer for all outputs including analog functions to provide manual controlled equipment operation in the event of a prolonged hardware or software failure.
4. Enclosure: NEMA 12 with hinged and locking door, UL approved.
5. Power Supply: Filtered and regulated with minimum, maximum, and voltage transient protection with a UPS to protect against momentary power interruptions.

B. OPERATOR INTERFACE:

1. Provide graphic display to revise display of new systems and equipment added under the work of this project. All systems shall be accessible through the Owners LAN using web browser.

2.04 DATA INTERFACE UNITS:

Provide equipment required to connect sensors, transducers, interface relays, etc. to monitor and control equipment in sequence of operation and/or as indicated elsewhere on the drawings or in the Project Manual.

2.05 TEMPERATURE SENSORS:

- A. Resistance temperature detector with minimum range of 150°F with sensed media at 50% of selected range and minimum accuracy of 0.5°F.
- B. Non adjustable space temperature sensor shall be brushed stainless steel cover plate type with tamper resistant screws.
- C. Adjustable/override type space temperature sensor shall have durable plastic housing, membrane type override switch, and setpoint adjustment.
- D. Duct temperature sensor shall be insertion type with stainless steel sensing element in duct not affected by temperature stratification or smaller than four square feet. Use averaging element(s) or averaging tube(s) where larger or prone to stratification. Sensor length 20 feet minimum.
- E. Piping temperature sensor shall be insertion type stainless steel sensing element with brass socket with minimum insertion length of 2-1/2 inches. Provide heat transfer gel in the socket prior to element insertion.
- F. Outside air temperature sensor shall have watertight inlet fitting, shielded from moisture, and direct rays of sun.
- G. Low limit thermostats for hydronic coil freeze protection shall be averaging type with 20-foot bulb length per 20 square feet of coil area, designed to open contacts if any 12-inch segment of sensor falls below setpoint. Reset shall be manual.

2.06 CURRENT OPERATED SWITCHES:

Current operated switches (used as digital inputs to the BAS for pump, fan, condensing unit, etc. status) shall have dual range 0-15Amps and 15-300Amps with adjustable setpoint, 2A maximum hysteresis in high range, and 0.5A maximum hysteresis in low range. Response time less than 250 milliseconds. Output solid state, rated for 1.0A continuous.

2.07 DIFFERENTIAL PRESSURE SWITCHES:

Differential pressure switches (used as digital inputs to the BAS for fan and filter status) shall have 0.05"W.C. to 12.0"W.C. setpoint range, 13.8"W.C. max pressure rating, -40 to

180°F temperature rating, SPDT switch rated for 100000 cycles at max conditions of 300VA inductive or 10A non-inductive.

2.08 HUMIDITY SENSORS:

Space or Duct humidity sensors, 0-100% RH range, +/- 2 percent accuracy over 0-90% RH at 68 F, suitable for 23 to 130 F ambients, replaceable capacitive RH sensor, screw terminals, ABS plastic enclosure.

2.09 DIFFERENTIAL PRESSURE SENSORS:

- A. Space: 0-0.1"W.C., +/- 0.001"W.C. accuracy at 72 F, 32 to 125 F operating temperature range, 10 to 95% RH non condensing operating humidity range, dual digital programmable output (2.0A at 24 VDC/VAC), analog output proportional to differential pressure, 4 line x 16 characters per line LCD display, with tubing, power supply, and stainless louvered flow tube cover plate.
- B. Duct: 0-4.0"W.C., accuracy 1.0 % of range, 32 to 125 F operating temperature range, 20 to 90% RH non condensing operating humidity range, analog output proportional to differential pressure, with pitot tube sensing element.
- C. Piping: 0-60 PSID, +/-0.5% of range, 32 to 175 F operating temperature range, 200 PSI over-pressure capability on either port without damage to the pressure sensing element, 12-32 VDC Input, 4-20 mA output proportional to differential pressure, zero and span adjustments. Provide 1/4" stainless steel tubing with 3 valve bypass manifold for connection to hydronic piping. Setra 231-MS1-2F-D-3VLV Series.

2.10 CONTROL PANELS:

- A. Control panels to be constructed of unitized cabinets.
- B. Provide cabinets properly sized to minimize internal congestion, with back plane mounted on standoffs for control component mounting, with hinged, locking door opening to the front.
- C. Cabinets to be NEMA 1 indoors and NEMA 3R if weather exposed, minimum 14 gauge cold-rolled pickled steel, hinged and gasketed door, padlock hasp with a separate backplane for mounting components. Cabinets shall be factory painted with sprayed on and baked enamel finish.
- D. Multiple panels mounted side-by-side to be hinged to the left or on opposite sides to open in the middle.
- E. Start/stop switches, hand-off automatic switches, pilot lights, pneumatic switches, and temperature indicating devices specified to be panel mounted to be flush mounted in panel door. All other devices specified to be panel mounted to be internally mounted within panel.
- F. All control devices not requiring field or remote mounting for proper operation shall be panel mounted.
- G. Panel locations to be approved by Engineer and be accessible for operation and maintenance.
- H. Local panels exposed to weather to be weatherproof NEMA 3R construction.

- I. All devices specified to be mounted in temperature control panel that require electrical connections to be prewired to a dual, numbered terminal strip located inside panel by Control Contractor.
- J. Wiring within unitized cabinet panel to conform to National Electric Code and shall be neatly bundled and laced or enclosed in panduit trough.
- K. All devices inside the panel or mounted on panel face shall have an engraved laminated plastic nameplate.

2.11 ACTUATORS:

- A. Electric/electronic geartrain or hydraulic with spring return and digital input. Modulating electric actuators with 24 VAC power, 4-20mA or 0-10 VDC control signal for positioning.
- B. Sized to operate valve or damper to normal position upon removal of input signal and to full actuated position in a smooth modulating nonbinding fashion upon incremental changes of input signal.
- C. All valve and damper actuators shall be sized to close against system shut-off pressures. Coordinate with pump, AHU, and boiler vendors for shut-off values.
- D. Select damper actuators for 150% of required torque to operate dampers under 4000 FPM velocity and 4" differential pressure. Select the worst condition, opening or closing to select damper actuator. Actuator to have a manual declutching mechanism which allows the damper or valve to be positioned without any control power. Dampers are furnished by Section 15910.
- E. Provide NEMA 4X actuators on all AHUs, cooling towers, chillers and process water heat exchangers, 24 VAC or 120 VAC for all actuators. .

2.12 BUTTERFLY CONTROL VALVES (All hydronic valves over 2" unless noted otherwise.)

- A. Valve Solutions Incorporated, VSI, 2100 Series. Isolation Valves are pipe size, Control Valves are sized based on no more than 2 PSI WPD at design water flow and no more than 20 FPM through the valve. Select valve for water tight shutoff at 150 PSID. Field verify all sizes before ordering.
- B. Ductile iron lug style body, stainless steel disc, stainless steel stem, EPDM resilient molded-in seat for service to 220 degrees F, suitable for dead end service, bubble tight shutoff, labeled by manufacturer for intended service, no ferrous metal in contact with flow stream, extended neck. 200 psig working pressure at 220 F through 12" 150 psig working pressure above 12". Manufacturers' name and pressure rating cast into valve body. Comply with MSS-SP67, MSS -SP25.
- C. Control Valve Actuators: Motorized worm gear drive operators, 120 VAC input power, 4-20ma input control signal, sized to close against system shut-off pressure, bubble tight close off, 150 PSID minimum, auto reset thermal overload, internal heater, travel limit switches, high visibility position indicator, modulating control, any position

mounting, NEMA 4X corrosion resistant housing, manual override hand crank, equal to VSI 1000-X series.

2.13 CONTROL VALVES:

- A. Two-inch and smaller to be bronze body with screwed NPT end connections. Flanged connections on sizes above 2".
- B. Three inch and larger to be iron bodies with flanged connections.
- C. Valve pressure rating to be 150 Psig, 250°F. 30 PSIG rating, 350F for steam valves operating on 15 PSIG steam.
- D. Provide stainless steel stem with removable composition disc and self-adjusting spring loaded Teflon packing for water valves and low pressure steam valves.
- E. Modulating water valves to have equal percentage characteristics and be sized for maximum of 8 Ft water pressure drop unless schedule indicates otherwise. Two way or three way as shown or scheduled. Characterized ball valves are to be applied in all hydronic applications up to 75 GPM. Notify Engineer if a discrepancy is found and provide the valve type as directed by the Engineer at no change in contract amount.
- F. Steam valves for isolation purposes shall be heavy duty industrial ball valve, stainless steel construction, 50 psig rating on 15 psig steam, 150 psig rating on 16-100 psig steam system. Belimo B2...VSS Series for 50 PSIG rated valves.
- G. Close-off rating 50 PSID minimum.

2.14 AIR FLOW MEASURING STATIONS:

- A. Extruded aluminum flow bar assembly for measurement of air flow in ducts with velocities of 250 - 3200 FPM. 3:1 amplification of velocity pressure with a uniform calculation of velocity based on differential pressure measurement at barbed taps in the sensor. Design rigid and suitable for application in duct up to 30" without intermediate support and up to 96" wide duct with supports not exceeding 30" O.C.. Where needed for accurate measurement multiple sensors may be installed and the sensors connected in parallel to differential pressure readings that are equivalent to the duct average velocity.
- B. Kele AMP - Ampliflow air velocity sensor with differential pressure transmitter.
- C. Fans in AHUs are equipped with flow measuring devices and these shall be used for measuring the total flow at each AHU fan.

2.15 WATER FLOW MEASURING STATION

- A. Impeller style all stainless steel wetted parts, type 316L in pure water applications, 304 or 316 in other applications, hot tap assembly for removal from the piping system without draining or reduction of system pressure. Badger Meter SDI series, +/- 1% accuracy at 0.03 to 20 FPS, LCD display of flow on remote NEMA 4 enclosure up to 50 feet from the sensor. NEMA 4X housing, loop powered, 4-20 mA output that is

proportional to the flow rate, 1" NPT adapter and isolation ball valve for attachment via a 1" NPT branch tee or saddle, 250 PSIG at 250 F rating.

2.16 POWER RELAY

- A. BACnet MS/TP network, NEMA 1 enclosed relay device, 20 A SPDT relay, input power 24 VAC/VDC; 120 VAC; 111 mA at 24VAC input power; 1 HP or 770 VA at 120 VAC, plenum rated, DIP switch override capability of relay. Functional devices, Inc Mod# RIBTW2401B-BC.
- B. NEMA 1 enclosed relay device, 20 A SPST-NO relay, input power 120 VAC; 42 mA at 120VAC input power; 1 HP or 770 VA at 120 VAC, plenum rated, rocker switch override capability of relay. Functional devices, Inc Mod# RIB01SBDC.

2.17 24VAC POWER SUPPLY

- A. Enclosed power supply, five Class 2, 24 VAC secondary outputs, primary 480/277/240/120 VAC. Each output individually annunciated with red LED, 6A circuit breaker protection, on/off switch, 100VA per output, Functional Devices Mod# PSH500A.

2.18 SAIL SWITCH

- A. SPDT, sail switch to provide a positive indication of air flow in vertical (up or down) and horizontal air flow. Minimum velocity to make is 250 FPM and contact shall break at 75 FPM or below. Honeywell Mod# S688A1007.

PART 3 - EXECUTION

3.01 INSTALLATION

- A. Components:
 - 1. Sequence work to ensure installation of components is complementary to installation of similar components in other systems.
 - 2. Coordinate work and ensure system is completed and commissioned by Date of Substantial Completion.
 - 3. Coordinate installation of system components with installation of mechanical systems equipment such as pumps and chillers.
 - 4. Provide temperature controllers, motorized valves, control linkages, relays, switches, and related items, necessary to accomplish control sequence shown on drawings. Install all such except as noted herein to the contrary.
 - 5. Deliver automatic valves to jobsite to be installed by Mechanical Contractor under supervision of Control Contractor.
 - 6. Prepare coordinated composite wiring diagram showing all interlock wiring associated with starters, control panel, chillers, chilled water pumps, cooling tower fans, refrigeration equipment, and controls, and other equipment as

- applicable and included in drawings. Diagram to bear approval of refrigeration machine manufacturer prior to submission to Architect / Engineer for final approval.
7. Drawings and Layouts: Contractor to submit for approval complete shop drawings of entire control system before proceeding with installation. Provide sequence of operation written so that Building Engineer can read and understand control scheme and as-built drawings to be framed under plexiglass or laminated and placed in each respective equipment room. All prints to be of "non-fading" print process such as black line Diazo or xerography.
 8. Install in accordance with manufacturer's instructions.
 9. Mount control panels adjacent to associated equipment on vibration free walls or free standing angle iron or unistrut supports. Provide engraved plastic nameplates for instruments and controls inside cabinet and engraved lamincoid nameplates on cabinet face.
 10. Install "hand/off/auto" selector switches to over-ride automatic interlock but not system safety controls when switch is in "hand" position.
 11. Locate all control devices within the Local Control Panels that do not require remote mounting for optimum performance.
 12. Use only solder or crimp-type butt splice connectors on analog input/output devices connected to the BAS.
 13. HOA switches are required for all HVAC equipment controlled by the BAS start/stop points in the energy management system. These HOA Switches are in addition to any HOA switches provided as part of the BAS components (i.e., IOU on-board HOA's). HOA's provided at starters are acceptable for this purpose. It is the intent of this specification to allow full manual operation of any start/stop point should any BAS component fail or be removed and sent out for repair.
 14. Provide modulating adjustment, for every output, as a manual override feature in the event the local controller is damaged or is otherwise not available. The override shall permit positioning of valves and dampers manually without dependence on any features of the digital controller. Valves which are spring return normally open do not require an override. Dampers and other valves which have actuators that include a disengaging clutch and manual positioning do not require a separate override.

B. Electrical:

1. All controls and interlock wiring shall be furnished and installed by this Section. All control/interlock wiring in exposed locations shall be installed in conduit and shall comply with N.E.C. and Division 16 requirements. Division 16 Contractor will provide all fire alarm system duct smoke detectors and a relay for fire alarm shutdown of the AHUs. Class 2 control wiring installed on interstitial floors shall be run using 60" O.C. cable supports and be secured to equipment supports

where it traverses vertically. If there is no vertical path provide EMT conduit to route cabling vertically in the interstice, in no case should cabling be run vertically and not be protected. Class 2 wiring which is run horizontally and is less than 66" above the interstice deck shall be run in conduit.

2. Division 16 is required to wire any 120 VAC interlocks shown on the plans. Any 120 VAC or greater interlocks and power which is not shown on Division 16 plans is the responsibility of Section 15950 to wire and connect. Wiring shall be complete and in accordance with approved wiring diagrams. All wiring within control panels to panel side of terminal strip shall be by the Controls Contractor. Examples of this wiring include fans with motorized intake and discharge dampers, boiler interlocks with local controller, chiller interlocks with pumps and other items which are not specifically shown as a DIV16 requirement. Make allowances in your bid to provide these materials, labor, engineering, programming and investigative services.
3. Refer to Division 16 for raceway and cable requirements. Where single phase power is existing for HVAC equipment it may be used for powering the control system.
4. Provide label in control panels, etc with the location of nearest disconnect or breaker serving the control system.
5. There will be interface with the controls of other equipment which not specifically shown elsewhere in the Documents which is the responsibility of this Section. Specifically boilers, boiler interlocks, communication between boilers, safety shutdown stations, electric duct heaters, boiler feed water tank, domestic water pumps/heaters, heating water pump systems, water softener systems, boiler room ventilation, and any other controls which are needed to control and operate the equipment shown or indicated by this Construction Document set. Include all wiring and calibration of remote sensors, switches, controls, remote contacts for alarms or similar devices which must be interfaced to the equipment. Refer to the individual specification Sections for the equipment and allow for coordination with the equipment Vendor and incorporation, wiring, programming, terminating and integration of any devices which are not specifically shown elsewhere by others.
6. All low voltage control and interlock wiring shall be in raceway as described in Division 16. All conductors within an enclosure with various voltage levels shall have insulation rated for the highest voltage present within the enclosure.
7. Provide all 24 VAC wiring to the plumbing groups for faucet and flush valve controls.
8. Plenum rated cabling or metal raceways are required for all exposed cabling installed in plenum spaces throughout the first floor and in raised floor control rooms on the Sub-Plaza level.

C. Thermostats and Temperature Sensors:

1. Unless noted otherwise on the drawings or in the sequence of operation use non-adjustable space temperature sensors in common areas only such as corridors, waiting rooms, rest rooms, etc. All other spaces receive adjustable setpoint type.
 2. Mount devices with the center of the device 46" above the floor or adjacent to light switches in the space. Provide a recessed wall box with a 3/4" conduit concealed in the wall for routing control wiring/tubing to the above ceiling space. Refer to DIV16. Where DIV16 is shown to provide the wall box it is not required under Section 15950.
 3. Room control device locations shall be coordinated with door swings, light switches, and other wall mounted items.
 4. Provide separable sockets for liquids and flanges for air bulb elements.
- D. Provide permanent labels on all transducers and controlled devices. Label all output channels with manual override instructions or provide a laminated instruction sheet attached to Building Automation System enclosure with the following information: controlled device, switch position for manual override.
- E. When interfacing with equipment with hand off automatic switches maintain the hand function of the switch.
- F. Building Automation System digital output contacts, relays, electric controls, etc. contacts shall be rated for 150% of the connected load.
- G. Provide voltage transient or surge protective devices with status indicator light on the input power to Building Automation Systems, field panels with multiple electronic devices, phone modems, or other microprocessor based equipment input power connections. Also provide at phone lines connected to the Building Automation Systems, and any data or communication cables that are interconnecting unattached buildings. Protective devices shall be located exterior to but at the protected device enclosure. Verify that these devices are connected to a good earth ground.

3.02 QUALITY CONTROL

- A. To ensure reliability, uniformity, and system performance, all field hardware must be from the same manufacturer, (i.e. all sensors from one manufacturer, all valves from one manufacturer, etc.) and designed for total compatibility with the BAS controllers.
- B. Control system to be set up and checked out by factory trained competent technicians skilled in the setting and adjustment of temperature controls used in this project. This mechanic to be experienced in the type of systems associated with this control system.
- C. At time of final observation, Controls Contractor to demonstrate the entire sequence of operation for all systems to the Engineer. Provide two technicians with radios to allow remote measurements and verification at the central monitoring location. Where commissioning is a separate requirement this provision is covered by the commissioning.

- D. The Controls Contractor shall return to the site during the opposite season to verify operation of control systems and make adjustments.
- E. The Controls Contractor shall provide a minimum of 8 hours of instruction to Owner's personnel. Allow for two separate visits to administer training (ie. each session to be two hours with overlapping times at shift change to train as many of the staff as possible. One immediately after acceptance for beneficial use, followed by one 60 days later). At each visit:
 - 1. Provide service Engineer to instruct Owner's representative in operation of systems plant and equipment for two 2-hour periods.
 - 2. Provide basic operator training for up to six persons on operation and maintenance of the control system. The training shall be provided after the system has been installed and checked out. For electronic controllers include training on data display, alarm and status descriptors, requesting data, execution of commands, request of logs, system restoration after equipment failure or prolonged power outage, and manual override and control of mechanical equipment during extended controller failure.
 - 3. Make a video record of the training and turn over to the Owner.

3.03 SEQUENCE OF OPERATION

GENERAL

The following basic control strategies are common to all equipment:

- 1 Timed start/stop (overrides; special days, daily overrides).
- 2 Optimum start, unless indicated differently in specific sequence of operation.
- 3 Day/night setback based on building's average temperature unless indicated differently in specific sequence of operation.
- 4 Alarm reports for temperatures or conditions out of range. i.e. freezestat, smoke detector, loss of phase, high sump water level, etc.
- 5 Stagger start major (high current draw) HVAC equipment and zones of multiple HVAC equipment.
- 6 Equalize operating hours through alternation of lead/lag equipment.
- 7 Monitor motor operational status via the associated VFD or by a current switch.
- 9 Monitor differential pressures for control of each hydronic and fan system in at least two remote locations and average or low signal select as required based on consultation with the Owner, Engineer and T&B Agency to minimize energy consumption while maintaining reliable control. See plans for locations that are established preliminarily by the Engineer.

Safeties:

Placing H-O-A switches in hand shall not override safeties.
Low flow, via flow switch, will shut down the boiler.
Lack of pump run status, via current switch/VFD, will shut down the boiler.
CSD-1 safety shutdown at the primary exit from the boiler room, Interlocked by DIV16 to shut down all boilers.

STEAM BOILER CONTROL- 140 Washington

The steam boiler system supplies cast iron radiators on the north and south exposures of the Courthouse with 1-4 psi steam. The initial setpoint on the boiler is for 5 psi steam. The boiler is enabled during outdoor air temperatures of 60F and below during occupied hours and 55F and below during unoccupied hours. Shut down the boiler if the boiler is enabled and all steam control valves has been closed for 30 minutes. Enable the boiler upon a call for steam valve operation

The Hawkeye or equal controller shall control all aspects of B4 boiler operation as needed to maintain the Steam Pressure setpoint (adjustable). Upon a command to start, the boiler (via hardwire interlock) shall send a signal to its feed water pump system. Boiler parameters, alarms, and setpoints shall be monitored by the BAS through a BACnet interface communication link. The Emergency Shutdown Relay shall be interlocked to effect the emergency shutdown of B4 boiler through the BAS. The Boiler Feedwater Control Panel Alarm(s) shall be enabled, disabled and monitored by the BAS for high or low water alarms, pump status, feedwater tank temperature.

The interlocks shall include a sail switch that must be made to insure forced combustion air is delivered before allowing the boiler to operate. On a call for boiler operation start the fan F1 which will make the sail switch and through hard wired interlocks will energize the boiler. During cooler weather the space thermostat in the boiler room will modulate the SCR controlled duct heater to maintain the room at no less than 50F.

Monitor steam header pressure with a syphon tube and sensor rated for 30 psig steam pressure.

Apply wireless space temperature sensors in the spaces served by radiators and assign a weight to each sensor based upon the floor area it is monitoring if two or more sensors are applied to a single temperature control zone. There are a total of four steam control valves with one serving the north zone and three serving the southeast, south and southwest zones. Replace the existing pneumatic steam control valves with new control valves. The existing control valves are pneumatically actuated and may be rebuilt with new electric actuators or all new valves and actuators installed matching existing Cv rating. Actuators shall be installed that are rated for the installed conditions. Initial space temperature setpoint is 70F occupied and 60F unoccupied.

HEATING WATER PLANT - 140 Washington

The heating water plant is enabled based on outdoor air temperature and occupancy. If any AHU is operational and is calling for heat.

Secondary Heating Water Pumps

HWP8 and HWP9 will operate as lead lag under control of VFDs . Heating water piping differential pressure, HWS-HWR, shall be measured in two remote locations, the southeast branch on the penthouse and basement at the last AHU. The lead pump's speed is modulated to maintain differential pressure setpoint. Reset the differential pressure setpoint based on OA temperature.

60F OA : 7 PSID
30F OA : 14 PSID

If the lead pump modulates to 100% speed and is unable to maintain differential pressure setpoint for 5 minutes then start the lag pump. The lead and lag pump speed shall be matched when operated in parallel.

Primary Heating Water Pumps, BP1-3

Primary heating water pumps are dedicated to the boilers and shall be operated from the boiler controllers. Monitor status via a current switch. BI

Boilers B1, B2 & B3

(BI boiler alarm/trouble, AO boiler start / heating water supply temperature setpoint (common point for all boilers thru sequencer panel), AI boiler percent load, AI global outside air temperature sensor, AI building HWS temperature, AI building HWR temperature)

Boiler sequencing and control will be performed by sequencer panel provided with the boilers. Boiler efficiency is highest at the lowest firing rate and lowest at the maximum firing rate. The sequencer panel shall optimize plant efficiency by maximizing the number of online boilers and firing those boilers at the lowest possible rate and still satisfy the heating load. The sequencer panel will also equalize boiler run-times. The sequencer panel will accept a 4-20mA input for BAS interface with boilers.

Provide a 4-20mA signal to the boiler sequencer panel for boiler control: Coordinate interface with boiler vendor. Initial maximum heating water setpoint 170F, reduce to 150F after the first 2 months of operation in several steps to insure comfort is maintained. The BAS shall monitor boiler firing rate, entering and leaving water temperatures, and annunciate boiler failure via BAS.

Provide a hard wire interface with individual boilers for alarm/fault. Provide outside air and hydronic temperature sensors as shown or described. Provide low voltage communication wiring between boilers, boiler sequencer panel and the BAS.

Heating water supply temperature shall be reset in proportion to OA dry bulb temperature per the following schedule:

20F OSA : 170F HWS, 150F HWS when system is finalized and any deficiencies corrected. (limit maximum reset to 180F HWS)
60F OSA : 120F HWS (limit minimum reset to 120F HWS)

GENERAL EXHAUST AND MAKE-UP FANS – 140 Washington

A signal from the BAS will enable and disable exhaust and ventilation fans based on space temperature or in the case of the F1 fan boiler operation. F1 operates continuously when the boiler is enabled. Exhaust fan EF1 operates if any boiler in the penthouse is enabled.

STEAM PLANT – 201 Poplar

The gas service may be curtailed and the steam boilers would remain ready to fire on fuel oil if necessary. The steam plant is removed from daily service and is resigned to back up heating capacity due to gas curtailment. The boilers will be put away completely filled with water and any deoxygenation procedures recommended by the chemical treatment provider. The boilers will be exercised at regular intervals as determined by the County to insure they are ready for operation during periods that gas might be curtailed.

The main gas supply to the steam boilers is capped, but there is a pilot gas line that remains connected and ready for use to fire the burner on fuel oil.

The control systems on the four existing HVAC steam to hot water heat exchangers and six existing steam fired tank type water heaters shall remain in service with all of the existing steam heat controls in place. Existing steam heat exchanger in the Jail will be converted to hot water use. Steam unit heaters in the penthouse of the jail and the penthouse of the court building will be converted to hot water use.

Eight 2 position isolation butterfly valves are added to the HVAC heat exchangers to divert water around the heat exchangers when they are not in use. The flow switches on these heat exchangers are replaced to insure they will detect water flow before steam valve operation at the respective heat exchanger is enabled. The steam valve remains fully closed if it is not enabled.

When the steam plant is enabled the motorized valves are positioned shut in the bypass and full open to flow water through the HVAC heat exchangers and flow switches confirm flow before steam valve operation is enabled at each HX. Each heat exchanger provides hot water that matches the current reset schedule and is cycled on as the heat load increases. Since the heating water system is variable flow the heat exchangers are sequenced on per the following schedule:

OA	HX enabled
>60F	HX2
45F-59F	HX2, HX4
30F-44F	HX2, HX4, HX3
<30F	HX2, HX4, HX3, HX1

The domestic water heaters operate under the original control sequence. The new condensing boiler plant is disabled when the steam plant is enabled. The heating water variable flow pumps operate under their normal sequence.

HEATING WATER PLANT – 201 Poplar

The heating water plant is always enabled except during gas curtailment.

Secondary Heating Water Pumps

HWP10, HWP11, HWP11 and HWP12 will operate as 3 pumps in parallel, matching speed to meet peak load and retain one pump as a spare. The spare pump will be

rotated on a monthly basis and will be automatically enabled if one of the other pumps is unavailable for any reason. During outdoor air conditions of 60F and above only one pump will be enabled. When OA is below 60F the pumps will be staged on based upon system (HWS-HWR) > 30F and will be cycled off if (HWS-HWR) < 20F. Allow 30 minutes of minimum pump operation before shedding a pump. Cycle the pumps to equalize run hours.

Heating water piping differential pressure, HWS-HWR, shall be measured in four remote locations. The pumps' speed is modulated to maintain the lowest monitored differential pressure setpoint. Reset the differential pressure setpoint based on OA temperature.

60F OA : 7 PSID
20F OA : 18 PSID

If the lead pump modulates to 100% speed, the outdoor air temperature is below 60F and the pump is unable to maintain differential pressure setpoint for 5 minutes then start another pump. The operating pumps' speed shall be matched.

Primary Heating Water Pumps: BP3, BP4, BP5, BP6, BP7, BP8

Primary heating water pumps are dedicated to the boilers and shall be operated from the boiler controllers. Monitor status via a current switch. BI

Boilers: B3, B4, B5, B6, B7, B8

(BI boiler alarm/trouble, AO boiler start / heating water supply temperature setpoint (common point for all boilers thru sequencer panel), AI boiler percent load, AI global outside air temperature sensor, AI building HWS temperature, AI building HWR temperature)

Boiler sequencing and control will be performed by sequencer panel provided with the boilers. Boiler efficiency is highest at the lowest firing rate and lowest at the maximum firing rate. The sequencer panel shall optimize plant efficiency by maximizing the number of online boilers and firing those boilers at the lowest possible rate and still satisfy the heating load. The sequencer panel will also equalize boiler run-times. The sequencer panel will accept a 4-20mA input for BAS interface with boilers.

Provide a 4-20mA signal to the boiler sequencer panel for boiler control: Coordinate interface with boiler vendor. The BAS shall monitor boiler firing rate, entering and leaving water temperatures, and annunciate boiler failure via BAS.

Provide a hard wire interface with individual boilers for alarm/fault. Provide outside air and hydronic temperature sensors as shown or described. Provide low voltage communication wiring between boilers, boiler sequencer panel and the BAS.

Heating water supply temperature shall be reset in proportion to OA dry bulb temperature per the following schedule:

Heating water supply temperature shall be reset in proportion to OA dry bulb temperature per the following schedule:

20F OSA : 150F HWS (limit maximum reset to 160F HWS)

60F OSA : 130F HWS (limit minimum reset to 120F HWS)

DOMESTIC WATER HEATER - 201 Poplar

A new higher capacity circulation pump is provided in place of the existing recirculation pumps. A bypass control valve is added between the HW and HWR to increase the flow through the heat exchanger for recharging the tank. The heat exchanger is a ventilated plate and frame heat exchanger which modulates the flow of HVAC heating water through the non-potable side as needed to maintain the leaving potable hot water temperature as scheduled. During periods of low use the bypass valve is opened to recharge the tank and minimize recirculation heat losses. Open the bypass valve at 7PM until 6 AM MON-FRI on HX1 & HX2. Open the bypass valve at 7PM until 6 AM every day for HX3, HX4, HX5 & HX6.

Reset the HW temperature as follows:

Item	HW [°F]	Schedule
HX1	115	MON-FRI 6AM-7PM
HX2	115	MON-FRI 6AM-7PM
HX3	125	7 D/W 24 H/D
HX4	125	7 D/W 24 H/D
HX5	135	7D/W 6AM-7PM
HX6	135	7 D/W 6AM-7PM

Outside of these times reduce the setpoint 25F.

Monitor the temperature of the HW leaving the heat exchanger and modulate the non-potable HWR control valve to control the leaving water temperature. The control valve must operate relatively quickly with a 30 second maximum stroke time for 90 degrees rotation.

When steam boilers are enabled disable these controls and operate the circulation pumps continuously allowing the existing steam coils in the tanks to provide heating water setpoint control.

ADJUSTMENTS TO AHU CONTROL PARAMETERS (DDC)

The BAS will permit global adjustment of control parameters of similar equipment. For example if the BAS operator wished to change the boiler enable temperature for all boilers she could do so by changing a single input. There will also be the ability to change each control setpoint on each item separately.

The local DDC panels will have separate manual override of start/stop, damper positions and valve positions under its control. This override function will not be dependent on the DDC panel being operable and in place. If needed a separate control device shall be

furnished in the same or adjacent panel which can effect these position and start/stop functions.

Where a H-O-A switch is available for motor control the start/stop override is not required. Motorized valves which have a release clutch and manual operator do not require an override at the DDC panel. The intent of manual override is to allow a marginally skilled mechanic to readily put a system in operable condition for 8 hours or less.

END OF SECTION

**SECTION 15969
THERMOMETERS, GAUGES & INSTRUMENTATION**

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Thermometers.
- B. Water Pressure Gauges

1.02 SUBMITTALS

- A. Submit under provisions of Division 1 and Section 15010. Include a list of applications with selected gauge/range for each thermometer and gauge application. Include complete O&M as well as general submittal information on the other monitors, apparatus and alarms

PART 2 PRODUCTS

2.01 THERMOMETERS

- A. Range: -50 to 300F solar powered digital thermometer, 3.5" stem for hydronic and plumbing applications, 6" stem for ducted applications. With a brass well for plumbing and hydronic applications, 316 SS well for pure water and process water applications and a plate/locking flange for ducted applications. -30 to 140F ambient. Weiss DVD6 or DVU3.5.
- B. Thermister sensing element, rear connection, LCD display, glass lens, 10 lux power requirement, Variangle adjustment for direct reading from the floor, 1/2" tall text. Externally adjustable for calibration, Provide a factory weatherproof cover where installed outdoors or in areas subject to condensation. ABS construction, 1% FS accuracy, Weiss, Ashcroft, Taylor or approved equal.
- C. Brass temperature wells, tapered shank. 3/4" MNPT connection to piping for hydronic and plumbing applications, flanged galvanized connections with perforated sleeve and mounting flange for duct applications (1-3/8" hole in duct/AHU casing required).

2.02 PRESSURE GAUGES

- A. Digital pressure gauges, two AAA battery powered with automatic shut off after 5 minutes to preserve battery life, range as required to provide middle 50% of scale reading under most conditions, -30/60 or 0/200 psig. Ashcroft Type DG2551L1—M02L60#&V or DG2551L1—M02L200# with 2.5" dial, black protective boot, stainless steel housing and sensor, 0.5% of span accuracy, 4.5 digit display, 0.5" tall characters, 1/4 NPT.

PART 3 EXECUTION

3.01 INSTALLATION

- A. Install in accordance with manufacturer's instructions.
- B. Install thermometers in piping using threadolets, extended neck sockets, 1-1/4" pipe nipple with 1-1/4"x3/4" bell reducer to allow removal of thermometers without disturbing insulation. Thermometer well should stop at, without protruding into, the flow stream, but should have free water circulation around well. Fill thermometer well with heat transfer grease labeled for this application. Install on top, bottom, side or otherwise to provide the best viewing position and readability. If possible install on the side of piping at an elevation of 60" +/- 12" above floor. Remove and relocate thermometers that are not readily readable from a standing position on the working level of access. Provide a P&T port at each thermometer location.
- C. Install pressure gauges with a manifold to allow a single pressure gauge to be used for inlet and outlet pressure readings. Ball valves, not sill cocks, are required for isolating the gauge from each sensing port. Rigidly support the gauge with mounting to carry the gauge weight. Interconnecting piping to the gauge from pressure sensing points shall be 3/8" stainless steel routed using tubing benders to produce uniform and jointless direction changes. Install gauge on the side of piping at an elevation of 60" +/- 12" above floor. Remove and relocate gauges that are not readily readable from a standing position on the working level of access. Provide a P&T port at every gauge location.
- D. Provide pressure and temperature measuring ports, P&T plugs, on piping entering and leaving all heat transfer equipment and pumps as well as each coil where AHU coils are comprised of multiple individual coils.
- E. Provide thermometers on piping entering and leaving heating water boilers, each coil section of AHUs and heat exchangers.
- F. Where thermometer probes protrude into plenums that are configured for ready access to the interior by service personnel they shall have a 1" x 16 gauge formed guard installed to extend over the probe in a "D" shape to prevent accidental impalement. Screw to the housing with two #10 screws. Provide thermometers on the side of AHUs and ERU/ERV to indicate temperatures of the:
 - 1. Return Air / Exhaust air as applicable
 - 2. Discharge Air
 - 3. Outside Air
- G. Install in accordance with manufacturer's instructions for a rigid and secure installation. Do not install control components on vibrating equipment unless no other mounting is possible. Provide stands supported from building structure if needed to provide the vibration free mounting.
- H. Provide threadolets in piping for pressure and temperature measuring sensors where needed to effect system installation. Also install P&T plugs at these locations to allow ready verification of temperature and pressure.

END OF SECTION

SECTION 15990
TESTING, ADJUSTING AND BALANCING

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Testing, adjustment, and balancing of air systems added or modified under this project.
- B. Testing, adjustment, and balancing of hydronic systems added or modified under this project.
- C. Refer to the sequence of operation and provide all assistance and calibration that is required by the BAS contractor. Provide flow balance of domestic water recirculation pumps added under this project. Assist with all settings associated with the new domestic water heaters. Use ultrasonic meters to confirm flows.
- D. Include testing all new fire dampers to verify they are accessible for removal/replacement of fusible link, confirm operation of curtain or blade type damper with complete closure. Any latches shall be accessed from the access door so the damper may be readily reset. Provide labels per Section 15190 and a labeling scheme to uniquely tag each damper with nomenclature that is acceptable to the Owner. Include ceiling grid labeling if dampers are accessed through the ceiling.

1.02 RELATED SECTIONS - Division 15 in its entirety

1.03 REFERENCES

- A. ASHRAE - 2011 HVAC Applications Handbook: Chapter 38, Testing, Adjusting and Balancing.
- B. SMACNA - Testing, Adjusting & Balancing.
- C. AABC - Associated Air Balance Council, recommended practice for air and hydronic system balance.

1.04 SUBMITTALS

- A. Submit test report forms as a submittal.
- B. Submit a written plan in which you discuss in details specific to this project how you will balance the various systems. Indicate any challenges that are expected and suggest how you will overcome these challenges. Include in the plan your methods of communication with the Owner, Engineer, Mechanical and Controls Contractor so that work is performed in a timely manner and the efforts of all involved parties are minimized.

1.05 REPORT FORMS

- A. Forms shall include the following information:
 - 1. Instrument List:
 - a. Instrument
 - b. Manufacturer
 - c. Model
 - d. Serial number
 - e. Range

- f. Calibration date
2. Air Moving Equipment (all equipment with a fan):
 - a. Identification/Serial #/Manufacturer/Model #/Location
 - b. Air flow, specified, test and final
 - c. Motor brake HP specified/actual
 - d. Fans 20 HP and larger: Vibration switch operational test, make all adjustments in accordance with manufacturer's recommendations and adjust start-up delay so that there are no false trips on start-up.
 - e. Inlet/discharge static pressure, specified, test and final
 - f. Motor/fan sheave & belt size, test and final
 - g. Fan RPM, (also motor RPM if variable speed)
 - h. Nameplate V/FLA, Actual V/FLA
 - i. Motor Frame Size
 - j. Overload Heater Size and Rating.
 - k. Fuses, size, rating, type
 - l. AHU supply, return, relief, minimum outdoor, economizer outdoor air flows specified, test, final.
 - m. AHU pressure profile with the static pressure and differential pressure at each section shown graphically. Provide a separate cooling and heating modes as well as a min OA mode and full economizer mode.
 3. Air Distribution Test Sheet with Each Outlet Shown Schematically:
 - a. Design air flow
 - b. Test and final air flows
 - c. Percent of design air flow
 - d. Size of outlet and neck
 4. Hydronic Coil Data (all equipment with a water coil):
 - a. Identification/Serial #/Manufacturer/Model #/Location
 - b. Service
 - c. Rows and fins per inch.
 - d. Air flow, design, test and final
 - e. Water flow, design, test and final
 - f. Water pressure drop, design, test and final
 - g. Entering water temperature, design and actual
 - h. Leaving water temperature, design, test and final
 - i. EAC, DB/(WB if cooling), design and actual
 - j. LAC, DB/(WB if cooling), design, test and final
 5. Potable hot water balance valves (see plumbing drawings):
 - a. Identification/Serial #/Manufacturer/Model #/Location
 - b. Water temperature HWR/EWR final at each floor, at heater.
 - c. Water flow HWR/EWR, design, test and final
 - d. Water temperature HW/EW, final leaving heater
 6. Fire, smoke & fire/smoke dampers:
 - a. Identification/Serial #/Manufacturer/Model #/Location/Link Temperature
 - b. Verify that damper is accessible, remove link, verify fire damper closes smoothly, reinstall link and reset.
 - c. Furnish and install permanent label on the exterior of each damper after coordinating the numbering scheme with the Owner. 0.75" tall vinyl labels

red text on white background. Coordinate and provide sequential list of every damper in a format that is acceptable to the Owner. The strategy applied in Chili's Care Center is the example that should be followed.

7. Pumps (Plumbing, Process and HVAC):
 - a. Identification/Serial #/Manufacturer/Model #/Location
 - b. Service
 - c. Manufacturer/Model
 - d. Water flow, design, test and final
 - f. Water pressure drop, design, test and final
 - e. Do not throttle pumps to achieve design water flow.
 - g. Pump RPM at design flow
 - h. Nameplate V/FLA, Actual V/FLA
 - i. Motor Frame Size
 - j. Overload Heater Size and Rating.
 - k. Fuses, size, rating, type
 - l. Suction and discharge water pressure, design and actual
 - m. Suction and discharge water pressure, design and actual at 60 Hz
 - n. Include the existing CCC chilled and condenser water pumps to verify that they are non overloading.

8. Plate and Frame Heat Exchanger (plumbing)
 - a. Identification/Serial #/Manufacturer/Model #/Location
 - b. Service
 - c. Entering water temperature, design and actual
 - d. Leaving water temperature, design, test and final
 - e. Water flow, design, test and final
 - f. Water pressure drop, design, test and final
 - g. All measurements on each circuit.

1.06 QUALITY ASSURANCE

- A. Agency shall be an AABC certified company experienced in the testing, adjusting and balancing of systems specified in this Section and shall have a minimum of five years experience. The firm shall not engage in any other construction or controls activity.
- B. Total system balance shall be performed in accordance with AABC, SMACNA and ASHRAE Standards for Testing, Balancing and Adjusting of HVAC Systems.

1.07 SEQUENCING AND SCHEDULING

- A. Sequence work to commence after completion of systems and schedule completion of work before Substantial Completion of Project.
- B. Perform retesting when any substantial changes are made to the system, prior to final acceptance, at no cost.
- C. Allow for performing balancing during the season where ambient conditions provide the load and flow conditions appropriate for best balancing. Provide any preliminary balancing necessary for system start-up and commissioning at no additional cost.

- D. All procedures are subject to Engineer approval. Coordinate and clear procedure for testing of every system with Engineer prior to proceeding with work. Engineer shall render all decisions.
- E. This Contractor shall allow for coordinating and working with the controls Contractor as required to achieve the scheduled design air and water flows. Retest / rebalance equipment as required, at no cost, if mechanical / control deficiencies are identified and corrected. Assist controls Contractor as required during the controls tuning period in particular balancing SA with RA, Rel A, and EA.

PART 2 PRODUCTS

NONE

PART 3 EXECUTION

3.01 EXAMINATION

- A. Before commencing work, verify that systems are complete and operable. Ensure the following:
 - 1. Equipment is operable and in a safe and normal condition.
 - 2. Temperature control systems are installed complete and operable.
 - 3. Proper thermal overload protection is in place for electrical equipment.
 - 4. Filters are clean and in place.
 - 5. Duct systems are clean of debris.
 - 6. Correct fan rotation.
 - 7. Fire, smoke and volume dampers are in place and open.
 - 8. Access doors are closed and duct end caps are in place.
 - 9. Air outlets are installed and connected.
 - 10. Duct system leakage has been minimized.
 - 11. Hydronic system is clean and start-up strainers have been removed.
- B. Report any defects or deficiencies noted during performance of services to Architect/Engineer.
- C. Promptly report abnormal conditions in mechanical systems or conditions which prevent system balance.
- D. If, for design reasons, system cannot be properly balanced, report as soon as observed.
- E. Beginning of work means acceptance of existing conditions.
- F. Assure that the fans are operating at the lowest speed that will satisfy total flow requirements and that the end of run damper adjustments are near their full open positions at maximum scheduled flow. Contractor shall rebalance at his own expense to the satisfaction of the Engineer if this requirement is not met.

3.02 PREPARATION

- A. Provide instruments required for testing, adjusting, and balancing operations. Make instruments available to Architect/Engineer to facilitate spot checks during testing.

3.03 INSTALLATION TOLERANCES

- A. Adjust air handling systems to plus 10%, minus 10% for exhaust and supply at the terminal units/air valves from figures indicated. Individual inlets and outlets may vary +/- 10% within a single space served. Fume hoods, isolation rooms, operating rooms and SPD are to be balanced to plus 5%, minus 5%. Observe space pressurization requirements and make adjustments in air flow as needed to insure relative pressurization is achieved. Failure to maintain these tolerances during the Engineer's inspection will result in the balance being rejected.
- B. Adjust hydronic systems to plus or minus 5% from figures indicated on chilled water and process water and plus or minus 10% on heating water and plumbing water.

3.04 ADJUSTING & BALANCING

- A. Adjust work to provide a fully operational system.
- B. Recorded data shall represent actually measured or observed conditions.
- C. Permanently mark settings of dampers, balancing valves and other adjustment devices allowing settings to be restored. Set and lock memory stops where available. Scribe in end of damper shaft the position of the damper blade. Mark maximum and minimum positions with an indelible black marker or permanent label. Document balancing device final position in balancing report.
- D. After adjustment, take measurements to verify balance has not been disrupted or that such disruption has been rectified.
- E. Leave systems in proper working order.
- F. At final inspection, recheck random selections of data recorded in report. Recheck points or areas as selected and witnessed by the Engineer.
- G. Measure air quantities at air inlets and outlets.
- H. Adjust distribution system to obtain uniform space temperatures free from objectionable drafts and noise.
- I. Use volume control devices to regulate air quantities only to extent that adjustments do not create objectionable air motion or sound levels. Effect volume control by duct internal devices such as dampers and splitters prior to adjustments at the air outlet or inlet wherever possible.
- J. Vary total system air quantities by replacement of motor sheaves and or variable speed drive settings. Note that fans and unit heaters may be equipped with variable speed controls. Provide final sheave size requirements to equipment installer. The sheaves will be replaced and drives adjusted for final operating conditions. Select sheave to obtain the lowest fan speed that will satisfy design flow conditions with a 5-10% margin of safety. On AHUs allow for fully loaded filters when selecting sheaves.
- K. Measure static air pressure conditions on air supply unit discharge and return at design air flow.

- L. Where modulating dampers are provided, take measurements and balance at extreme conditions.

3.05 WATER SYSTEM PROCEDURE

- A. Adjust water systems to provide required or design quantities.
- B. Use calibrated fittings and pressure gages to determine flow rates for system balance. Where flow metering devices are not installed, base flow balance on temperature difference across various heat transfer elements in the system.
- C. Adjust systems to provide specified pressure drops and flows through heat transfer elements prior to thermal testing. Perform balancing by measurement of temperature differential in conjunction with air balancing.
- D. Effect system balance with automatic control valves fully open to heat transfer elements.
- E. Effect adjustment of water distribution systems by means of balancing cocks, valves, and fittings. Do not use service or shut-off valves for balancing unless memory stops are provided for balance point. Permanently mark balance point. Paint indicator of geared control valve to readily indicate position of butterfly valves at a distance.

END OF SECTION

DIVISION 16 - ELECTRICAL
SECTION 16010 - Basic Electrical Requirements

PART 1 - GENERAL

DIVISION 16000 INDEX

Section	16010 - General Provisions
	16110 - Raceways
	16121 - Conductors 600 Volts and Below
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	16140 - Wiring Devices
	16170 - Safety Switches and Motor Starters
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	16510 - Lighting and Lamps
	16721 - Fire Alarm System

1.01 WORK INCLUDED

- A. All labor, materials, tools, and services for a complete installation of electrical equipment and systems contained in the Contract Documents. The finished system is to be complete in all details and finished to the best standard of professional installation.
- B. Principal features of the work included are:
 - 1. Primary electrical service conduits beginning at utility riser pole and including all preparation as required by the utility. Secondary electrical service beginning at the distribution points of connection. All associated raceways wiring, panelboards, lighting, receptacles and fire alarm system. Connections to new equipment, feeders, circuit breakers, disconnects, relays, enclosures and accessories for a complete and operable system.
 - 2. Secondary electrical services for electrical power and lighting systems beginning at indicated distribution points and extending to the devices and utilization equipment.
 - 3. Provide all associated raceways, wiring, panelboards, supports, interlocks, terminations, connections, equipment, gear, busway, lugs, fuses, feeders, circuit breakers, disconnects, relays, instrumentation, enclosures and accessories for a complete and operable system.
 - 4. Expand the existing addressable fire alarm system as required. Fire alarm system shall be UL listed and certified by qualified firm. Provide all hardware, software, power supplies, amplifiers and programming as required for a complete operational system. Systems shall be installed in accordance with the specifications and drawings.

5. Provide and install new power distribution and panelboards, rework existing motor control centers.
6. Interior lighting, lamps, ballast, interlocks, pull boxes, hangers and accessories including lamps for work shown.
7. Temporary electrical service, lighting and OSHA compliant distribution to support construction activities. Identification of circuits and locations served where active circuits are routed through construction areas or are otherwise affected by demolition. Provide temporary service to any electrical load that is not contained within the construction area. Avoid disturbing active circuits routed through the area of construction. Remove abandoned line and low voltage electrical systems within the areas of renovation. Resupport all electrical both line and low voltage, within the area of renovation to comply with the specifications for new.
8. Wiring devices with all accessories for a complete and operable system. Coordinate locations with Architectural millwork, systems furniture and equipment submittals prior to any installation. Provide all cord sets, plugs, disconnect switches and receptacles as needed for final connection of all equipment.
9. All 120VAC or higher power and interlock wiring that is required by code to be performed by a licensed electrician. All interlocks between damper actuators and fans are by this division. The manufacturers shop drawings and submittal information of equipment furnished by others must be referred to in order to complete this work and these will not be available until submittals have been approved. Always refer to the nameplate data on all fixtures, devices and equipment and comply with nameplate data before making connections.
10. Disconnect switches, motor starters and controllers, where shown are both furnished and installed by this Division. Where equipment is shown with a power circuit only it is supplied with integral disconnects and/or motor controllers for installation and wiring by this Division. Where VFDs are shown they are furnished by others with all handling, installation and wiring by this division.
11. Data, telephone, and communication raceways. Interior provisions include, but are not limited to: cable tray main paths, data/com openings and raceways to accessible ceiling. Structured cabling and additional supports from cable trays to opening by others.
12. Demolition of all existing work in areas of renovation. Field verify and remove all raceways, conductors, panelboards, light fixtures, receptacles, wall switches, data/com outlets, fire alarm, speakers, panels, cctv, transformers, equipment and supports. Raceways, conductors and electrical equipment shown as existing and feeding remaining loads shall remain. Re-feed / relocate new and existing electrical work that is in the path of new work. Field verify elevations of existing raceway that remain and relocate such that raceways are not in the path of other trades.

- C. Provide temporary electrical service where required for construction and to maintain normal use of the facility to the areas that are not renovated. Service interruptions serving occupied areas shall occur outside of normal business hours, 7:00pm - 5:00A.M and/or on weekends. If any electrical service interruption cannot be completed during unoccupied times contractor shall provide temporary power to serve all existing remaining loads. The intent is that the Contractor has provisions in his scope to provide electrical power as needed to maintain normal business operations in the building if any electrical service interruption cannot be completed during unoccupied times. Include all temporary service to mechanical and electrical equipment necessary to maintain all HVAC, lighting, receptacles and other electrically powered equipment in full operation while the spaces are occupied. Note: All interruptions (of any duration) in electrical service shall be coordinated with the Owner at least two weeks in advance. Include all costs of temporary power in the Bid amount. Refer to General Conditions.
- D. Temporary circuiting and provisions as needed to accommodate the phased installation of the new work and partial use and occupancy that must be accommodated throughout the course of this project. This work is not specifically indicated on the plans, but power, lighting, signaling and communication systems suitable for the use of the space must be maintained via permanent or temporary means for all occupied areas.
- E. Penetrations, excavation, backfill and restoration of disturbed area for electrical work.
- F. Provide on-site handling, power wiring and complete installation of Variable Frequency Drives, VFDs, are furnished by others.

1.02 RELATED WORK REQUIRED UNDER THIS DIVISION

- A. Foundations, supports and pads for equipment furnished or installed under this Division of the specifications.
- B. Flashing of conduits into roofing and outside walls. Firestopping of any penetration of a fire rated wall, floor, roof or partition.
- C. Cutting, trenching, backfill and patching for electrical work.

1.03 OWNER'S REPRESENTATIVE

- A. Where the term "Owner's Representative" is used throughout this specification it shall be interpreted to be the Engineer.

1.04 QUALITY ASSURANCE

- A. Comply with applicable local, state, and federal codes.
- B. Electrical work shall be guaranteed against faulty material or workmanship for a period of one year from the date of final acceptance. If the project is occupied or the systems placed into operation in several phases at the request of the Owner, then the guarantee of each system or piece of equipment used, shall begin on the date each system or piece of equipment was placed in satisfactory operation

and accepted as such, in writing, by the Owner. The use of building equipment for temporary service and testing does not constitute the beginning of the warranty.

- C. Equipment and material provided under this Division shall be periodically inspected and serviced by competent mechanics. This function becomes the responsibility of the Owner when the system is accepted by the Owner. The one year material and workmanship guarantee is not intended to supplant normal inspection or service and shall not be construed to mean the Contractor will provide free service for normal maintenance items such as periodic lubrication and adjustment due to normal use, nor to correct without charge, breakage, maladjustment, and other trouble caused by improper maintenance.
- D. Any electrical equipment provided under this division shall be turned over to the Owner in lubricated, tested and ready to use condition. Instructions on care and maintenance of equipment shall be included in the operating instructions.

1.05 STANDARDS

- A. Perform work specified in Division 16 in accordance with standards listed below. Where these specifications or local codes are more stringent, they shall take precedence. In case of conflict, obtain a decision from the Engineer.
 - 1. NFPA-101 (2006).
 - 2. NFPA-70: National Electrical Code. (2008).
 - 3. NFPA-72: National Fire Alarm Code. (2010).
 - 4. Joint Electrical Code. Local Ordinances pertaining to electrical work.(2012)
 - 5. ANSI A117.1 2012
 - 6. IBC Building Code. (2009).
 - 7. International Energy Conservation Code (2009).

1.06 SUBMITTALS

- A. Within 14 days after the award of contract, submit for review to the Engineer complete list of materials, equipment, accessories and alternates submitted as equals by vendors proposed for use on the project together with costs for an evaluation to select supplier. This review shall be conducted prior to submission of shop drawings and product data.
- B. Brochures: Based on manufacturers selected under foregoing paragraph, contractor is to submit complete descriptions, illustrations, specification data, etc., of all materials, fittings, devices, fixtures, special systems, etc., as required by the individual sections of this chapter.
- C. When specifications list more than one manufacturer and do not say "or approved equal", furnish one of the manufacturers named.
- D. Shop drawing submittal and review are intended to show that the Contractor understands the design concept. Submittals demonstrate that the Contractor understands the materials and fabrication and construction methods to be used. Submittals are not intended to modify or change the contract documents.

- E. Shop drawings and submittals shall bear the stamp or approval of the Contractor as evidence that they have been checked by him and certified as to having met the contract documents. Submittals without this stamp of approval will not be considered and will be returned for proper resubmission. If the submittals show variances from the requirements of the contract documents, the Contractor shall make specific mention of such variation in his letter of transmittal in order that, if acceptable, suitable action may be taken for proper adjustment; otherwise the Contractor shall not be relieved of the responsibility for executing the work in accordance with the contract documents.
- F. Shop Drawings: In addition to the above, submit four copies of shop drawings for major materials where called for or when requested by the Engineer for the following:
 - 1. Panelboards, transformers and switchgear.
 - 2. Dimensioned layout of each electrical and generator room, drawn to scale, with equipment location shown therein. Show all required clearances. Show complete details of connections with elevations at wireways to verify panel lug requirements, top/bottom feed and to assure that the finished installation is as professional as is practical in each space.
 - 3. Fire Alarm.
- G. Generator controls, panelboard, bus duct submittals will be rejected without dimensioned room layouts.
- H. Five sets of the following data are required:
 - 1. Operating and maintenance instructions.
 - 2. Spare parts lists.
 - 3. Copies of approved submittal data.
- I. Arrange each set of data in an orderly way, provide tabs for the individual sections and bind each set in a separate 3-ring, hard-cover binder.
- J. Within 14 days of the completion of the work, submit the five (5) complete sets of data to the Engineer.

1.07 DELIVERY AND STORAGE

- A. Insofar as possible, deliver items in manufacturer's original unopened packaging. Where this is not practical, cover items with protective materials to keep them from being damaged. Use care in loading, transporting, unloading, and storage to keep items from being damaged.
- B. Store items in a clean dry place and protect from damage.

1.08 RECORD DRAWINGS

- A. Keep a set of drawings prints at the job site exclusively for recording deviations from the drawings which are necessary because of job conditions. Record locations and depths of buried and concealed conduits from fixed, easily identifiable objects, such as building walls. Where conduits are concealed in walls, indicate distances off of building corners or other building features not

likely to be disturbed by future alterations. Mark deviations in colored pencils so that work of various systems can be easily identified.

- B. The Architect/Engineer will provide magnetic media floor plans for use by the Contractor. The Contractor shall revise the magnetic media floor plans to depict "as-built" conditions and provide the Owner with both magnetic media and reproducible vellum plots with all deviations from the original plans depicted.

PART 2 - PRODUCTS

2.01 MATERIALS AND EQUIPMENT

- B. All materials and equipment used in carrying out these specifications to be American made unless approved otherwise (by Owner) and to be new and have UL listing, or listing by other recognized testing laboratory when such listings are available. Specifications and drawings indicate name, type, or catalog numbers of materials and equipment to be used as "standards". Proposals shall be based on "standards" specified. The "standards" shall not be construed as limiting competition. Contractor may, subject to Engineer approval, use any materials and equipment equivalent to that specified.
- C. Equipment and materials furnished shall be listed by UL or other nationally recognized testing laboratory where available. When listing is not available for a piece of equipment, it will be accepted provided it is furnished in accordance with drawings and specifications and is approved by the authorities having jurisdiction.
- D. Specifications and drawings indicate name, type and/or catalog number of materials and equipment to establish standards of quality. Submittals shall be based on the standards specified. The standards should not be construed as limiting competition.
- E. The contractor shall properly dispose of all lamps and ballasts removed under this project. Lamps are assumed to contain mercury and ballasts may contain PCB's. Dispose of lamps and ballasts in accordance with Toxic Substances Control Act of 1976 (TSCA). Contractor shall provide all handling, shipping containers and transportation for all ballasts and lamps with transportation provided by a Contractor provided trucking firm properly licensed for this service. Disposal of these and 100% of the products removed by the work of this project is the responsibility of the Contractor. Disposal shall comply with all aspects of state and federal laws that govern the removal, handling, chain of custody documentation, packaging, transportation and ultimate disposal. It is fully recognized that the Owner remains the Owner of hazardous materials until they are rendered safe or these materials are recovered in salvage operations. The Contractor is to provide complete chain of custody documentation to the Owner as well as a record of how the hazardous materials have been disposed of legally and properly.

PART 3 - EXECUTION

3.01 COORDINATION

- A. Visit site and be informed of conditions under which work must be performed. No subsequent allowance will be made because of error or failure to obtain necessary information to completely estimate and perform work involved.
- B. Examine specifications and drawings to be familiar with items which require electrical connections and coordination. Electrical drawings are diagrammatic and shall not be scaled for exact sizes.
- C. Equipment shall be installed in accordance with manufacturer's recommendation. Where conflicts occur between Contract Documents and these recommendations, a ruling shall be requested of the Engineer for decision before proceeding with such work.
- D. All interlocks, wiring, raceways, devices, instrumentation, accessories, enclosures, programming, control components that are needed for complete and automatic control/regulation of the generators is required and shall be provided by the Contractor under this project. There will be field investigative effort required on the part of the Contractor to fully identify the full extent of phasing and temporary electrical service that is needed on this project. The requirement is stated here to make the Contractor clearly aware that work is required to phase and temporarily serve many areas that is not shown. The finished system shall comply completely with all drawings and written descriptions of intent, features and functions even if wire, conduit and components are not shown on the plans. Much of this work will become apparent as the project progresses, but will be difficult to identify at the outset. Make allowance to include all phasing and temporary services that prove necessary to maintain the Owners' normal use of the facility.

3.02 CUTTING AND PATCHING

- A. Repair any damage caused by cutting or trenching in the performance of work under this Division.
- B. Correct damage caused due to installation of electrical work, brought about through carelessness or lack of coordination.
- C. Holes cut through existing floor slabs to be core drilled with drill designed for this purpose. All openings, sleeves, and holes in slabs between floors to be sealed, fire proofed and water proofed.
- D. Repairs to be performed with materials which match existing materials and to be installed in accordance with appropriate sections of these specifications.
- F. Where raceways 1-1/4" through 4" trade size pass through one-hour fire-rated gypsum board walls, limit annular space to 1/4", fill annular space with 3M CP-25 firestop caulk and seal with a 1/4" bead of 3M CP-25 firestop caulk around perimeter (UL System 147A). If raceway is 1" or smaller, limit annular space to 3/16".

3.03 FOUNDATIONS AND PADS

- A. Foundations and pads are required for equipment and shall be provided under this Division unless indicated otherwise on plans. Proper size and location of

foundations, pads, and anchor bolts shall be determined under this Division. Minimum of 3.5" thick concrete pad with welded wire reinforcing and a #4 bar offset 4" the full perimeter of the pad. Extend pad 6" beyond footprint of equipment and radius tool or chamfer 1" the top edge of curb. Rub out any voids and remove any spillage for a smooth and finished appearance.

3.04 TESTS

- A. On completion of work, installation shall be completely operational and entirely free from grounds, short circuits, and open circuits. Perform a thorough operational test in presence of Engineer. Furnish all labor, materials and instruments for above tests.
- B. Furnish the Owner, as a part of closing file, a copy of such tests including:
 - 1. Main service ground resistance test.
 - 2. Generator load bank test.
 - 4. Short circuit and coordination study.
 - 5. Ampere readings of all panels and major circuit breakers.
 - 6. Insulation resistance reading of motors.
- C. Prior to final observation and acceptance test all electrical systems and equipment shall be in satisfactory operating condition including, but not limited to the following:
 - 1. Electrical distribution system.
 - 2. Electric motors for all equipment. Confirm rotation when any changes are made to the system.
 - 3. Electrical safety devices.
 - 4. Electrical control systems.
 - 5. Fire alarm system.
 - 6. Lighting fixtures and lamps.
 - 7. Generator and automatic transfer switches.
 - 8. HVAC interlocks and relays installed by DIV16.
 - 9. Lighting Control System.
 - 10. Access Control System
 - 11. CCTV System

3.05 FEES AND PERMITS

- A. Obtain and pay for all necessary permits and inspection fees required for electrical installation.

3.06 IDENTIFICATION OF EQUIPMENT

Identify all equipment within the area where work is awarded (Base Bid plus any Alternates) and identify devices on branch circuits only where new devices are added under this work.

- A. Identify all electrical equipment (new and existing) that is tagged with an identifier in the Construction Documents. Switchgear, transfer switches, panelboards, safety switches and disconnects, individually mounted circuit breakers, and

relays, shall be marked with permanently attached vinyl adhesive labels with 1/2" black text on white background on the face of each piece of equipment. Rub on bubble free with no wrinkles or creases. Remove and replace any labels that are not applied thus. Starters and relays connected under this Division shall be identified whether furnished under this Division or under other Divisions of this contract. Labels shall indicate equipment served or designation of panel, panel and circuit number of source of service, and voltage e.g. "PANEL 2A, FED FROM EPH2:7,9,11, 480Y/277" or "AHU 6B, FED FROM H32:14,16,18, 480V/3Ph". White background with black text on normal power, white background with red text on emergency power.

- B. Within every panel provide a typed directory with the area/equipment served by each circuit. Where spares are provided provide adhesive tags beside the appropriate circuit breakers labeled "spare". Upon completion of project turn off all C/B's that are spare.
- C. Trace out all branch circuits and provide an adhesive Brady label on the cover plate of all receptacles and switches. Tag shall have a clear background with black numbers 1/8" tall identifying the panel & circuit, e.g. 1NL:17. On receptacles the tag shall be on the exposed side of the cover plate near the bottom. On wall switches the tag shall be on the concealed side of the cover plate. In exposed locations the tag should be only as long as the text and shall be installed horizontal centered below the lowest receptacle and the edge of the cover. Rub on tightly for a bubble free and secure seal. Remove and replace any labels which are not applied thus.
- D. Circuits which operate above 480VAC shall be labeled at every pull point, disconnect, starter, switch, transformer, motor terminal box and 20' O.C. along the raceway. The label shall be an adhesive backed vinyl with 2" tall black letters on a yellow background identifying the nominal voltage between phase conductors. e.g. 4160VAC, 12,470 VAC.

3.07 TEMPORARY POWER

- A. Prepare a detailed plan and time line for review by the Owner and Engineer on how temporary power will be provided as the work is phased into place and put in service.
- B. Provide temporary electrical lighting and power of adequate size to properly serve the areas of work from temporary panelboards. Panels shall accommodate a minimum of six duplex 20 amp receptacle circuits and one welder circuit for every 10,000 SF of building construction. Temporary power panel shall be located within 150 feet of any point where electrical service for the building construction activities occur. Where applicable coordinate with Owner prior to utilizing any existing panels to limit disruption to normal operations. Temporary work to be installed in a neat and safe manner in accordance with the National Electrical Code, Article 305, and as required by OSHA or applicable local safety codes.
- C. Provide adequate lighting, utilizing temporary fixtures, as required for work in area. In general work areas allow for one 23 watt fluorescent lamp, for every 200 square feet of work area. At the beginning of every week during construction replace the failed lamps.

- D. Where the Owner allows install welder receptacles in locations requested by DIV15. Obtain written approval of each location from the Owner.
- E. Provide temporary electrical service where required for construction and to maintain normal use of the facility by the occupants during construction. Refer to complete document set to determine which areas are occupied. All areas that are occupied shall be provided with power, lighting, fire alarm and all communication and security as other areas are being renovated. Interruptions in power feeding systems and circuits that serve occupied areas shall occur after normal business hours, after 11 PM, or on weekends and holidays. In occupied areas, all power shall be restored and fully operational by 5 AM the day that tenants return to work.

Temporary electrical service to occupied areas and the associated systems serving occupied areas (HVAC, Plumbing, Elevators, fire protection) is required during the occupied times indicated above. Temporary work is to be installed in a neat and safe manner in accordance with the National Electrical Code, Article 305, and as required by OSHA or applicable local safety codes.

- G. Provide additional temporary power as required to provide normal use and operation of this facility during any service interruptions. When the work associated with service interruptions can be accomplished in the unoccupied time noted above temporary electrical service is not required unless special circumstances are defined by the Owner. If the Owner does not allow service interruptions during the Contractor's proposed time the Contractor is obligated to perform necessary interruptions at time(s) that are acceptable to the Owner. This may require temporary feeds from the normal or temporary generator power system as dictated by the Contractor's implementation strategy.

3.08 UNDERGROUND RACEWAYS

- A. Call "Tennessee One Call" prior to any excavation. Thoroughly investigate and proceed with excavation and penetrations in a manner that minimizes any accidental damage. Repair any damage caused by excavation or building penetrations at no charge.
- B. Minimize disturbance to the landscaping and paving, particularly with respect to preserving trees. The raceway routing shown is conceptual and is subject to field adjustment to avoid trees, paving, concealed utilities and fixed structures. Allow for field adjustments as required to suit actual field conditions. Refer to the complete document set and comply with the most stringent requirements. Comply with all routing, trenching and backfill requirements specified elsewhere. Route raceways to stay well beyond the drip edge of trees. Field verify the conditions of installation prior to bid and make allowances for the site conditions.
- C. All underground electrical shall meet the minimum burial depth requirements of 2008 nec table 300.5. Under streets, roads, and driveways a minimum burial depth of 24". Primary raceways have minimum burial depth of 48". In all other areas a minimum burial depth of

18" is required. Where minimum burial depth cannot be achieved raceways shall be covered by a minimum of 2" of concrete. Provide 6" wide continuous red plastic tape 12" above all buried raceways. Red tape shall read "buried electrical. Raceways may be required to be deeper than minimum required burial depths to cross existing utilities and storm drains. 2" provide 24" radius ells, over 2" provide 48" radius ells.

- D. Provide all openings, trenching, backfill, cutting and patching associated with implementing the work of this project. Electrical contractor is responsible for providing trenching as required to install all raceways. Routing and location of all trenches shall be coordinated with the owner/engineer. All trenching shall be field verified and coordinated to prevent damage to any existing buried utilities, etc. Saw cut or core drill all penetrations of asphalt or masonry construction. Install link seal at all penetrations of below grade walls and additionally waterproof the exterior 1" depth of trowel grade polyurethane sealant.
- E. Trench Preparation and Backfill:
Saw cut both sides of the asphalt/concrete paving to a depth of 2" or the full depth of the paving/walkway cap whichever is deeper. Excavate the trench to 3" below the bottom of pipe elevation. Cover the bottom of trench with a 3" layer of class b material passing through a 3/8" sieve and not more passing through a no. 200 sieve, TDOT 903.05 class C or D for a uniform bed to support the conduit.

Backfill as soon as conduit system is complete and inspected by owner and all local authorities. Backfill for trenches up to 48" wide shall be (clsm) controlled low strength material, more commonly known as excavatable flowable fill with an unconfined 28 day compressive strength greater than 120 psi but less than 150 psi and with a unit weight of 115 to 145 pounds per cf. Comply with the national ready mix concrete association "guide specification for clsm".

Trenches exceeding 48" in width may be backfilled with clsm or granular fill. The initial backfill to be placed in 6" lifts and shall cover 6" above the top of pipe using class b material and each lift compacted to 85% std proctor using care in placing fill and compacting to prevent pipes from shifting position. All subsequent lifts shall not exceed 12" in uncompacted depth and be compacted to at least 95% std proctor astm d698 using one of the following: class b material; tdot no 57 or tdot no 67 crushed stone.

Separate top soil during excavation. Final layer of backfill (12" minimum) to be top soil in landscaped areas. Where paving is applicable the final 12" to be flowable fill or crusher run tdot spec 303.07, placed in 6" lifts and compacted to 95% std proctor. Final paving shall be at least 2" thickness of hot mix asphalt level with the adjacent roadway. In no case shall backfilling contain large rocks, tree roots, organic materials, trash or debris. Backfilling should carefully restore surface to its original condition. Where traffic markings are affected by the trench restore marking.

- E. All underground conductors and raceways feeding equipment shall be continuous from origin to panel or equipment. Conductors shall be looped in & out of lighting pole base or pull box to the last load device. There shall be no conductor splices underground. Provide the pull boxes shown as a minimum. Provide additional pull boxes that prove necessary as the project is installed.

END OF SECTION

SECTION 16110 RACEWAYS

PART 1 - GENERAL

1.01 WORK INCLUDED

- A. All work specified in this section shall comply with the provisions of Section 16010.
- B. Provide a complete raceway system with associated couplings, connectors, fittings, hangers and supports.
- C. Raceways to be mechanically and electrically continuous from outlet to outlet and from outlets to cabinets, pull or junction boxes. All nonmetallic raceways shall have a continuous grounding conductor.
- D. Raceway application schedule:

Rigid Galvanized Steel, RGS:

- 1. Installations exposed in equipment rooms, and less than 7'-0" AFF.
- 2. Outdoors in wet, damp or dry locations.
- 3. Within floor slabs and/or buried locations.
- 4. Service entrance raceways at changes in direction and at all exposed locations.
- 5. Within all AHUs, plenums and similar areas.
- 6. All applications exceeding 480 VAC nominal voltage.
- 7. Within fire pump room and on all feeders to the fire pump.

PVC Conduit:

- 1. Within floor slabs, in crawlspaces or buried locations protected by concrete cover.
- 2. Service entrance raceways, both primary and secondary, for straight runs in buried locations protected by concrete cover.
- 3. Buried locations serving site lighting and/or signage without concrete cover.
- 4. Buried locations used as telecommunication duct banks with concrete cover.
RGS required at changes of direction

Electrical Metallic Tubing, EMT:

- 1. Indoors in dry locations unless noted otherwise within Contract Documents.

Flexible Metal Conduit: (Indoors in dry locations)

- 1. Final 72" connection to recessed ceiling mounted light fixtures.
- 2. Across expansion joints with a bonding jumper.
- 3. Not permitted for final connection to control or fire alarm devices in exposed locations.
- 4. Final 16" connection to control and fire alarm devices/appliances in above ceiling concealed locations.
- 5. Final connection to motors, generators, transformers and HVAC equipment. 16" max length for sizes up to 2", 36" max length for sizes over 2".
- 6. Not permitted on exit or emergency fixtures unless concealed above ceiling.
- 7. In raised accessible floor systems a maximum of 36" length is allowed for final connection to raised floor mounted devices. EMT required to be anchored to the subfloor.

Liquidtight Flexible Metal Conduit: (In wet, damp and all outdoor locations)

1. Final connection to motors, transformers and HVAC equipment. 24" max length for sizes less than 2", 36" length max for sizes over 2".
2. Final 16" connection to HVAC control and fire alarm devices/appliances in exposed locations in all equipment rooms

MC Cable: (Indoors in dry locations in wall cavities and above ceilings)

1. Branch circuits of 30 amps or less.
 2. Not permitted for exposed work in finished areas.
 3. Not permitted in equipment rooms.
 4. Not permitted in home runs of 3 circuits or more to the panel.
 5. Not permitted in health care institutions or patient exam/treatment rooms in physician offices below 8' elevation, even if concealed in a wall.
- E. Empty raceway system for data, communication, generator controls and telephones. Provide device box and raceway system as shown on the drawings and as indicated in the project manual. Leave a pull cord/rope in all empty raceways. Extend raceway to an accessible ceiling through the hollow spaces of walls, ceilings, floors and as necessary by routing under slab-on-grade or crawl spaces.

1.02 RELATED WORK

- A. Section 16190: Supporting Devices and Hangers.

1.03 SUBMITTALS

- A. Submittal of products furnished under this Section is not required.

PART 2 - PRODUCTS

2.01 RIGID GALVANIZED STEEL, RGS, CONDUITS AND FITTINGS

- A. Rigid Steel Conduit, ANSI C80.1/UL6, NEC Art. 346, hot dipped galvanized, or electro galvanized interior and exterior, including threads. Standard threaded galvanized couplings. Ericson series 675 couplings are allowed where neither adjacent section can be rotated.
- B. Associated couplings, connectors and fittings shall be all steel as manufactured by Thomas and Betts Corp., O.Z. Gedney Co., EFCOR or approved equal.
- C. Intermediate Metal Conduit, UL 1242, NEC Art. 345, is permitted where RGS is indicated unless noted otherwise.

2.02 ELECTRICAL METALLIC TUBING (EMT)

- A. EMT, ANSI C80.3, NEC Art. 348, electro galvanized steel interior and exterior.
- B. Connectors and couplings for EMT shall be all steel, T&B 5000 series or approved equal and shall be raintight compression or concrete tight set screw type. Diecast connectors and indentation tool connectors are not allowed.

2.03 POLYVINYL CHLORIDE (PVC)

- A. Polyvinyl chloride (PVC) conduit, Schedule 40, NEC Art. 347, and associated couplings, connectors, and fittings. PVC conduit to be UL listed and 90 degrees C. UL rated.
- B. Associated couplings, connectors and fittings shall be PVC solvent welded. Convert to RGS for ells.

2.04 FLEXIBLE METAL CONDUIT

- A. Flexible Metal Conduit, "Greenfield", NEC Art. 350, UL1, ANSI C33.92, galvanized steel.
- B. Fittings UL 514, ANSI C33.84

2.05 LIQUID-TIGHT FLEXIBLE METAL CONDUIT

- A. Liquid-tight flexible metal conduit, NEC Art. 351, UL360, galvanized steel, flexible PVC outer jacket.
- B. Fittings UL 514, ANSI C33.84

2.06 METAL CLAD CABLE

- A. Metal-Clad Cable, NEC Art. 334, UL1569, galvanized steel sheath.
- B. Fittings UL 17909, steel w/screw lock, plastic bushing

PART 3 - EXECUTION

- A. Minimum size of conduits shall be 1/2". Use 3/4" for empty wall boxes used for data, thermostats, etc.. Size conduits as indicated on plans. Where sizes are not indicated select sizes based on NEC requirements for THW insulated conductors and as needed to hold pulling forces below manufacturers recommendations.
- B. Conceal conduits unless noted otherwise. Conduit joints shall be cut square, threaded where applicable, reamed smooth, and drawn up tight so conduit ends will butt in couplings, connectors and fittings.
- C. Make bends or offsets with standard ells or field bends with an approved bender. Telephone, data and communication raceways used for fiber optics require 24" radius bends.
- D. Run conduits in direct line with long sweep bends or offsets. Run conduits parallel to and at right angles to building lines. Group multiple conduit runs in banks. In general run conduits at one elevation range of +/- 4" in the above ceiling space just above and just below the bottom chord of the bar joists. Coordinate raceway installation to avoid conflict with other trades and accommodate their space requirements. Remove and reinstall raceway as needed to avoid conflicts with work of these other trades.
- E. Secure EMT and flexible metal conduits to all boxes and cabinets with locknuts and/or bushings so system will be electrically continuous from service to all outlets.
- F. Cap ends of conduits to prevent entrance of water and other foreign material during construction.

- G. Complete conduit systems before pulling conductors.
- H. Support conduits as specified in 16190.
- I. Provide cable supports in conduits rising vertically in accordance with the National Electrical Code, Article 300-19.
- J. Provide 250 lb. test nylon cord in all empty conduits and install plastic caps on open ends.
- K. Conduits which pass through floor slabs (except ground floor) shall be sealed with firestop sealant. Seal around conduits or other wiring materials passing through fire rated partitions and those passing through fire rated floors/walls. Use UL listed fire stop caulk in full accordance with manufacturers' recommendations to prevent passage of smoke or fire.
- L. Conduits which enter below grade or weather exposed shall be grouted-in and waterproofed to prevent passage of water. Any service entrance conduit shall be closed with flexible duct seal where it enters the building disconnecting means.
- M. Where RGS conduit is installed in a cabinet, junction box, pull box or auxiliary gutter, conductors shall be protected by an insulated bushing.
- N. In areas where enclosed and gasketed fixtures and weatherproof devices are specified, where rigid conduit enters a sheet metal enclosure, junction box and outlet box, and not terminated in a threaded hub, a steel, or malleable iron nylon insulated Bullet Hub, complete with recessed Sealing "O" Ring, shall be used, series 370-379. DO NOT use die cast material.
- O. Provide seal-off fitting in all conduits entering hazardous areas and in cold temperature areas such as air handling units, freezers and refrigerators. Do not use epoxy hard set sealant in non-hazardous areas, use 100% silicone.
- P. When connecting to a generator, switchgear or motor controller coordinate all penetrations carefully with the equipment manufacturer. Penetrate housing in approved locations and route conductors only in approved locations.
- Q. In concrete slabs block up conduit from forms and securely fasten in place. All conduits in slabs shall have a minimum of 1-1/2" concrete coverage above and below. Conduits shall be minimum 3/4" when installed in concrete slabs.
- R. Where conduits running overhead pass through building expansion joints they will be connected by flexible metal conduit of same size with sufficient slack to allow conduits on either side of expansion joint to move a minimum of 3" in any direction. A bonding jumper is required. Provide supports as required on each side of expansion joint, all in accordance with seismic requirements of specific area.
- S. Conduits for feeders and branch circuits shall be terminated directly into panelboard enclosure without the use of pull boxes, junction boxes, wire ways, or auxiliary gutters, unless the panelboard enclosure does not provide sufficient surface area for all conduits. Where such cases exist, the contractor shall notify the Engineer. In no case will splices in such boxes, wire ways, etc. be permitted.

- T. Failure to route conduit through building without interfering with other equipment and construction shall not constitute a reason for an extra charge. Equipment, conduit, and fixtures shall fit into available spaces in building and shall not be introduced into building at such times and manner as to cause damage to structure. Equipment requiring servicing shall be readily accessible. In general raceways shall be routed as high as possible in concealed spaces which also serve HVAC, sprinkler and plumbing piping/duct/equipment. Coordinate with other trades to avoid interferences. Offset raceways as necessary to avoid interferences with other trades. Relocate any raceways which block service access to equipment of other trades.
- U. Field verify existing raceway elevations existing raceways that are in the path of new work shall be relocated and concealed within walls or above ceilings.
- V. Do not route any raceways in elevator hoistways, stairs, fire pump room or mechanical spaces except those raceways which serve equipment in these spaces.
- W. Provide grounding bushings on all feeder conduits. Bond to existing raceways that lack a separate grounding conductor using grounding bushings at each termination point.
- X. Underground PVC raceways shall change direction using galvanized rigid steel elbows. Support all under ground raceways with chairs for uniform separation and concrete coverage, 5 foot on center. Encase primary and secondary service entrance raceways in 3" of concrete, tint red with chalk. Provide 6" wide continuous red plastic tape 12" above all buried raceway "Buried Electrical".
- Y. Telecom and data raceways 2" and larger require a minimum bend radius of 24".
- Z. No PVC shall emerge from the ground or concrete slab, transition to RGS below grade. PVC is allowed in crawlspace on straight runs.
- AA. Make bends in PVC with standard ells or with an approved bender.
- BB. Where MC cabling is allowed homeruns shall be installed in EMT or RGS. Circuits exceeding three phase conductors shall be in EMT or RGS.
- CC. Pendant type industrial fixtures shall be supported by RGS.
- DD. Where flexible metal raceway is installed outdoors or is exposed to continuous or intermittent moisture, conduit shall be liquid tight, UL type UA.
- EE. Where fittings for liquid tight flexible conduit are brought into an enclosure with a knock-out, a gasket assembly, consisting of one piece "O" ring, with Buna-N sealing material, T&B series 5200, shall be installed on outside of box. Fittings shall be made of either steel, or malleable iron only, and shall have insulated throats or insulated bushings.
- FF. In dry locations, where final connections to motors and other equipment may be made with flexible metal conduit, fittings shall be of steel or malleable iron only with insulated throats or insulated bushings, and shall be of wedge and screw type having an angular wedge fitting between convolutions of conduit. Flexible conduit is limited to 16" length for flexible connection to motors, HVAC fans, pumps and major equipment. Flexible connections 2" and larger may be a maximum of 36" long.

- GG. A copper ground wire is required inside of all flexible conduit to assure a continuity of ground to transformers, equipment, controls and other utilization equipment.
- HH. All suspended and recessed lighting fixtures shall be connected with flexible metallic conduit from outlet box to fixture.
- II. Install liquid tight flexible conduit in such a manner as to prevent liquids from running on the surface toward fittings.
- JJ. Allow sufficient slack in flexible conduit to reduce the effect of vibration.
- KK. Conceal raceways wherever possible in walls, floors or ceiling cavities. Route exposed only in equipment rooms.
- LL. Liquid-tight flexible metal conduit shall be used for final connection to control devices exposed in equipment rooms.
- MM. Cabling operated at 30VAC/VDC or less with jackets rated for application in an air handling plenum may be installed in concealed spaces above ceilings and within equipment spaces above 8' AFF without dedicated raceways. Cabling used for intercom, fire alarm, security, access control, HVAC controls, CATV, CCTV and similar low voltage systems must be supported at no more than 60" intervals using metal bridle rings, j-hooks, or cable trays. All supports must be independently attached to the building structure, specifically prohibited is attachment to ceiling support wires. Support for each low voltage system shall be independent of other low voltage systems unless grouping of cabling in supports is specifically allowed elsewhere in these documents.
- NN. Low voltage cabling shall not share raceways or penetrations with any of the building's line voltage electrical or mechanical systems. Low voltage cabling in exposed areas shall be installed in raceways as specified for power wiring. EMT conduit sleeves are required at cable penetrations of all masonry and fire rated walls. Seal in and around conduits and cabling with fire caulk in accordance with UL system recommendations to comply with the wall fire-smoke rating.
- OO. Bridle rings applied for cabling supports to be B-line, Catalog numbers BR-12-T (3/4" diameter ring size) through BR-64-4T (4" diameter ring size) bridle rings made of steel rod with #10/24 and 1/4" threads on the support end, or approved equal. Bridle rings to be mounted within 18" each direction from where the cable enters or exits a raceway and no more than 60" O.C. along the run of the cable. All cables shall be secured to the two immediate bridle rings located at outside corners with a 1/4" minimum size and plenum rated code approved cable-tie, leaving adequate slack in the cables to prevent the abrasion of the cables jacket. The cables shall be pulled tight and secured to a bridle ring each 20 linear feet to prevent excessive sagging of the cables.

END OF SECTION

**SECTION 16121
CONDUCTORS - 600 VOLTS AND BELOW**

PART 1 - GENERAL

1.01 WORK INCLUDED

- A. All work specified in this section shall comply with the provisions of Section 16010.
- B. Provide a complete system of conductors and terminations for all lighting, motors, HVAC equipment, switchboard, equipment, branch circuits, fire alarms, and grounding.

PART 2 - PRODUCTS

2.01 CONDUCTORS

- A. Provide 98% conductivity copper conductors with 600-volt insulation. For all conductors No. 10 AWG and larger, provide stranded type THHW-THHN. For all conductors No. 12 AWG and smaller, provide solid type THHN. Provide type SA at connection to lighting fixtures.
- B. Conductors shall be by Anaconda, Cyprus, Rome, Triangle, Southwire or approved equal.
- C. Connectors shall be by AMP, T&B, Burndy or approved equal.
- D. Provide white or gray colored neutral conductors; provide black, color coded phase conductors.

PART 3 - EXECUTION

3.01 INSTALLATION

- A. All conductors to be continuous from origin to panel or equipment termination without splices. Where splices and taps are indicated or are required, they shall be made in splice boxes.
- B. Install pull boxes in circuits or feeders over 100' long indoors, 200' outdoors.
- C. Use only pulling compound approved by conductor/cable manufacturer to lubricate conductors.
- D. Deliver all conductors to jobsite new and in original wrapping, package or reel.
- E. All conductors and connections shall test free of grounds, shorts, and opens.
- F. Provide No. 10 wire in lieu of No. 12 wire for the entire length of any branch circuit that has a one way conductor length in excess of 100'.
- G. Use Ideal wing nuts, Scotchlok Type Y, R, G, or B, or approved equivalent connectors for fixture connections at outlet boxes.

- H. Make feeder taps and joints with O. Z. Gedney type T, PT, PM, or PTS, or approved equivalent clamp connectors as manufactured by Kupler, or with approved compression sleeves. Wrap connectors with No. 10 electro-seal or approved equivalent plastic filler and vinyl tape or varnished cambric and linen tape with two coats of glyptal or approved equivalent insulating varnish applied overall. Heavy gauge, water tight, heat shrink sleeves are required over connectors outdoors.
- I. Leave a minimum of 8" slack wire in every outlet box whether it be in use or left for future use.
- J. Minimum size branch circuit conductor shall be #12.
- K. Derate conductor ampacity in accordance with NEC Art. 310 when more than three current carrying conductors are in a single raceway. (Two conductors for single phase systems.) Do not combine more than nine current carrying conductors in a single raceway. (80% of rated Ampacity with 4-6 current carrying conductors, 70% of rated Ampacity with 7-9 current carrying conductors)
- L. Use compression lugs on all splices and terminations #1/0 and larger. Motor terminations #3 and larger shall be T&B type MSC.
- M. Select conductors with ampacity at 75 degC to equal or exceed rating of over current device or as indicated on drawings, whichever is larger. Advise Engineer if a voltage drop exceeding 3% is anticipated on any branch or 2% on any feeder.
- N. Color code conductors as follows:

	120/208 Volt	277/480 Volt
Phase A	Black	Brown
Phase B	Red	Orange
Phase C	Blue	Yellow
Neutral	White	Gray
Ground	Green	Green

- O. Use factory color coded conductors where commercially available. If not available, use black conductors and band with color tape. For isolated ground conductors use green jacket with an orange stripe.

P. Size conductors based on the overcurrent protection device rating as follows:

BRANCH CIRCUIT SCHEDULE			
C/B OR FUSE AMPACITY	CONDUCTOR SIZES		CONDUIT SIZES
	PHASE/ NEUTRAL	BRANCH GROUND	
20	#12	#12	1/2"
30	#10	#10	3/4"
40	#8	#10	3/4"
50	#8	#10	3/4"
60	#6	#10	1"
70	#4	#8	1-1/4"
80	#4	#8	1-1/4"
100	#3	#8	1-1/4"
125	#1	#6	1-1/2"
150	#1/0	#6	2"
175	#2/0	#6	2"
200	#3/0	#6	2"
225	#4/0	#4	2-1/2"
250	#250M	#4	2-1/2"
300	#350M	#4	2-1/2"
400	#600M	#3	3-1/2"
500	2SETS #250M	#2	2 @ 2-1/2"
600	2SETS #350M	#1	2 @ 2-1/2"
800	3SETS #300M	#1/0	3 @ 2-1/2"
CIRCUIT TYPE	#CONDUCTORS (PHASE/NEUTRAL)	# GROUND CONDUCTORS	
1PH,2W	1 / 1 OR 2 / 0	1	
1PH,3W	2 / 1	1	
3PH,3W	3 / 0	1	
3PH,4W	3 / 1	1	

Round up the OPD setting if it is not listed herein.

Q. The above sizes are a minimum. Increase to account for derating factors and longer runs of conductors exceeding 100 linear feet. The neutral shall be sized to match the phase conductor(s). The ground shall be sized to match the phase conductor's current rating and may be larger than shown if the phase conductor size is increased above that shown in the table due to derating or voltage drop.

1. Increase conductor one standard size where circuit one way length equals or exceeds the following at the noted voltages:
 - a. 100 LF for 120 VAC single phase.
 - b. 200 LF for 208-240 VAC single or three phase.
 - c. 250 LF for 277 VAC single phase.
 - d. 400 LF for 480 VAC single or three phase.

2. Where the length exceeds twice the distance noted above the conductors shall be increased two standard sizes.

3. Any length exceeding listed values above shall have conductor size determined by the Engineer.
4. Refer to NEC derating tables for reductions due to ambient temperature.

END OF SECTION

**SECTION 16130
OUTLET, PULL, AND JUNCTION BOXES**

PART 1 - GENERAL

1.01 WORK INCLUDED

- A. All work specified in this section shall comply with the provisions of Section 16010.
- B. Provide each fixture, switch, receptacle, and other wiring device with an outlet box of appropriate size and depth for its particular location and use unless indicated otherwise.
- C. Provide pull and junction boxes of appropriate size and depth as indicated on the drawings and as specified hereinafter.

1.02 RELATED WORK

- A. Section 16190: Supporting Devices and Hangers.
- B. Section 16110: Raceways.
- C. Section 16121: Conductors
- D. Section 16140: Wiring Devices

1.03 SUBMITTALS

- A. Submittals of products furnished under this Section is not required unless specifically noted.

PART 2 - PRODUCTS

- A. Pull, outlet, conduit bodies and junction boxes shall be Hubbell, National, Arrow-Hart, Appleton, Raco, G.E., Steel City or approved equal.
- B. In-floor outlet boxes for new construction shall be equal to Hubbell #B-2519 with #S-3925 cover or equal matched to the flooring materials, tile, concrete or carpet. In-floor boxes for renovation work shall be fire rated "poke-throughs", Hubbell System One 4x4 for receptacles and data floor locations and System One Furniture feeds for connection to system furniture. All poke throughs to be 2 hour fire rated, install through a 4" core drilled opening, dual 1" EMT connections for power and data, cast aluminum construction with universal carpet/tile flange, cast aluminum powder coat finish. Submittals required.
- C. Outdoor outlet boxes shall be cast aluminum, equal to Appleton "Unilet", suitable for wet location use. Submittals required.
- D. For interior work, provide galvanized sheet metal boxes of code thickness with lapped and welded joints, 3/4" flanges, screw covers, etc.

- E. For exterior work, provide galvanized sheet metal boxes of code thickness with lapped and welded joints, 3/4" flanges, bolted covers with full gaskets forming a completely raintight assembly.
- F. For exterior below grade work provide non-metallic pull boxes in landscaped areas. Quazite or equal.
- G. Pull boxes shall have solid tops, bottoms and sides. No factory knock-outs are allowed.
- H. Conduit bodies shall be galvanized malleable iron with gasket and steel cover.

PART 3 - EXECUTION

- A. Locate outlet boxes to prevent moisture from entering or accumulating within them.
- B. Support outlet boxes independently of conduit per NEC.
- C. Provide 4" x 1-1/2" octagonal ceiling outlet boxes. For increased cubic capacity, provide 4" x 2-1/8" octagonal, 4" x 1-1/2" square or 4" x 2-1/8" square ceiling outlet boxes.
- D. Where required to hang a specified fixture, provide a fixture stud of the no-bolt, self-locking type on ceiling outlets.
- E. Provide 2-1/2" x 3-3/4" one gang masonry boxes for switches and receptacles installed in concrete block walls not plastered. For increased cubic capacity, provide 3-1/2" x 3-3/4" one gang masonry boxes. Where more than two conduits enter the box from one direction, provide 4" square boxes with square cut device covers not less than 1" deep specifically designed for this purpose. Use round edge plaster rings only if the block walls are to be plastered. Use sectional or gangable type outlet boxes with square edge openings that extend through the gypsum wall board in drywall construction.
- F. Provide double gang device boxes for telephone and other communications system outlets with a plaster ring reducing to accept a single gang cover plate. Provide high capacity masonry boxes for nurse call system devices.
- G. Provide fittings with threaded hubs for screw connections and with the proper type covers for switches and receptacles served by exposed conduit. Use pressed steel outlet only for ceiling fixture outlets.
- H. Provide conduit bodies with threaded hubs and covers and with proper configurations for all changes of direction of exposed conduits. Standard conduit ells may be used if they do not interfere, damage, or mar the appearance of the installation in the opinion of the Engineer. Galvanized malleable bodies required where RGS is specified.

- I. Use boxes of sufficient cubic capacity to accommodate the number of conductors to be installed. See Article 370 of the National Electric Code.
- J. Effectively close unused openings in boxes with metal plugs or plates.
- K. Set boxes so that front edges are flush or immediately recessed at the finished surfaces. Comply with NEC regarding the allowable recess. Covers shall fit tight to finished wall with no gap.
- L. Secure boxes to surfaces upon which they are mounted or embed boxes in concrete masonry. Support boxes from structural members with approved braces.
- M. Install blank device plates on outlet boxes left for future use.
- N. Provide bushings in holes through which cords or conductors pass.
- O. Install outlet boxes so that the covers will be accessible at all times.
- P. Electrical outlet boxes may be installed in vertical fire resistive assemblies classified as 1 hour fire/smoke and smoke partitions without affecting the fire classification, provided such openings occur on one side only in each framing space and that openings do not exceed sixteen square inches. All clearances between such outlet boxes and the gypsum board shall be completely filled with joint compound or approved fire-resistive compound. The wall shall be built around outlet boxes larger than sixteen square inches so as not to interfere with the wall rating. Do not install boxes back-to-back in common wall, but offset boxes a minimum of 24". Coordinate with the General Contractor. Where boxes can not be separated provide a fire rated compound around the exterior of the box to provide a UL listed rating equal to the assembly where it is installed.
- Q. Locate wall switch boxes such that switch center is 46" AFF unless noted otherwise.
- R. Locate receptacle boxes such that receptacle center is 18" AFF unless noted otherwise. At counters and other millwork locate receptacle center 4" above counter or splash unless noted otherwise. Refer to architectural plans for counter top details and adjust locations to clear wall mounted splash. At drinking fountains locate receptacle as required by fountain manufacturer to conceal receptacle within fountain housing.
- S. Provide coverplates for all junction and pull boxes. Blank coverplates are required on all empty boxes.
- T. Where multiple switches/receptacles are adjacent to one another they shall be ganged together. Provide gang plates with suitable openings.
- U. Provide single gang box for thermostats 46" AFF to centerline. Refer to mechanical drawings for locations.

- V. Provide an empty 3/4" raceway from telephone, data, video, security equipment, thermostat and other empty device boxes to the above ceiling space in an accessible location and turn open end of conduit horizontal. In some locations the walls do not extend up directly to the ceiling and the raceway shall be run horizontally and/or below the floor until it reaches an accessible ceiling. Install a plastic bushing in the open end of the conduit. An accessible ceiling is defined as a lay-in suspended acoustical tile ceiling. All control raceways for emergency power systems shall be continuous.
- W. Provide junction boxes where required, sized according to number of conductors in box or type of service to be provided. Minimum junction box size 4" square and 2-1/8" deep. Provide screw covers for junction boxes.
- X. Use minimum 16 gauge steel for pull boxes and provide with screw cover.
- Y. Install boxes in conduit runs wherever necessary to avoid excessive pulling force requirements or bends in excess of code allowances. Do not exceed 100' runs between pull boxes indoors. Do not exceed 200' runs between pull boxes outdoors. In exposed locations use conduit bodies in lieu of pull boxes in 1" and smaller raceways.
- Z. Rigidly secure boxes to walls or building structure. Conduit runs will not be considered as adequate support.
- AA. Install boxes with covers in accessible locations. Size boxes in accordance with Articles 370 and 373 of the latest edition of the National Electric Code.
- BB. Do not install pull or junction boxes for joint use of line voltage and signal or low voltage controls unless all conductors are insulated for the highest voltage being used in the same box.
- CC. Install quazite type boxes in a concrete base 2" above finished grade and 12" wider than pull box. Provide an open bottom with the base being 9" thick of 1" or larger gravel for drainage.
- DD. Label box covers with an indelible black marker to indicate the panel:circuits fed through each box.

END OF SECTION

**SECTION 16134
PANELBOARDS**

PART 1 - GENERAL

1.01 WORK INCLUDED

- A. All work specified in this section shall comply with the provisions of Section 16010.
- B. Provide circuit breaker type panelboards as indicated on drawings and as specified by this Section.

1.02 RELATED WORK

- A. Section 16450: Grounding.
- B. Section 16190: Supporting Devices and Hangers.
- C. Section 16051: Electrical System Protective Device Study

1.03 SUBMITTALS

- A. Submit product data for Engineer approval as required by Section 16010.

PART 2 - PRODUCTS

- A. Panelboards shall be Square "D", GE, Cutler Hammer or Siemens.
- C. Provide panelboards of circuit breaker, dead-front safety type, UL labeled and meeting all applicable requirements of the National Electrical Manufacturers Association.
- D. Provide panelboards with 75C or higher rated lugs (both main lugs and branch circuit lugs) suitable and UL approved for both aluminum and copper conductors.
- E. Provide electrically isolated factory installed neutral bus.
- F. Provide separate, ground bus complete with lugs or connectors on bar. Where noted provide an additional electrically isolated ground bus.
- G. Provide panelboards with distributed phase bussing for: 120/208 volts wye, 277/480 wye, or 480 volts as noted. All bus to be tin plated copper.
- H. Provide panel doors equipped with chrome-plated locks and catches, all keyed alike. Provide two keys for each lock. Provide fronts with adjustable indicating trim clamps. Provide an integral pad-lockable hasp and door-in-door hinged construction to allow full access to panel interior via a hinged front. Door-in-door

construction is limited to NEMA 1 panels located in electrical or mechanical rooms.

- I. Provide thermal magnetic bolt-on circuit breakers, inverse time delay and instantaneous circuit protection. Circuit breakers shall be calibrated to carry 80% rated current in a 40 degrees C ambient and shall be self derating in higher temperature environments to properly protect the conductor. Breakers to be quick-make, quick-break type with trip indication shown by handle position other than ON or OFF and with a common trip on all multi-pole breakers.
- J. The interrupting rating of the circuit breakers shall be at least equal to the available short circuit current at the line terminals of the circuit breaker and shall conform to UL listed integrated short circuit current rating specified for the panelboards and switchboards. Branch circuit breakers to be "bolt-on" style and 10,000 AIC rated for 240 VAC and lower potentials, 14,000 AIC for 277 to 480 VAC potentials unless higher AIC is noted otherwise. The service entrance breakers and breakers which serve as any panel main overcurrent protection shall be 42,000 AIC rated for 240 VAC and lower potentials, 35,000 AIC for 277 to 480 VAC potentials unless a higher AIC is noted otherwise. Series rating in accordance with UL is allowed to meet this requirement.
- K. Refer to drawings for numbers of branch circuits, their ratings, number of poles, arrangements, etc. Panel schedules indicate spaces where bus provisions are to be provided.
- L. Panelboards for 240/120 or 208Y/120VAC, 3-phase, 4-wire service to be Square "D" NQOD type or approved equivalent. Provide breakers with trip ratings and interrupting ratings as noted on the drawings. Panelboard shall be equipped with circuit breaker integral to panel or remotely located and UL listed. Panels shall be Square D I-Line or an approved equivalent when the panel rating exceeds 600 amps.
- M. Panelboards for 480Y/277VAC, 3-phase, 4-wire service shall be Square "D" NF or approved equivalent. Provide breakers with trip ratings and interrupting ratings as noted on the drawings. Panelboard shall be equipped with circuit breaker integral to panel or remotely located and UL listed. Panels shall be Square D I-Line or an approved equivalent when the line to ground voltage exceeds 277 volts or the panel rating exceeds 600 amps.
- N. NEMA 1 construction indoors. NEMA 3R construction outdoors.
- O. Provide an overcurrent protective device coordination study which document that the downstream devices will clear before the upstream devices.

PART 3 - EXECUTION

- A. Ground separate ground bus to the main service entrance ground bus or step down transformer as applicable with a grounding conductor sized as shown installed in the same conduit as the phase and neutral conductors. Dedicated Isolated ground panels shall have a separate ground conductor which extends to the main building grounding array. See Section 16450 - Grounding.

- B. Install all circuits using a common neutral in accordance with the latest edition of the National Electrical Code, Article Nos. 100, 210-4, 210-5, 220-4d, and 310-11, note 11. Balance all circuits to achieve not greater than 10% unbalanced neutral current in panel feeders.
- C. Provide typed directory cards under plastic on the doors of lighting and branch circuit panelboards. Directories to indicate devices being served including space numbers or space names in which devices or fixtures are located. Distribution panels and switchboards shall have adhesive labels at every overcurrent device indicating the load that is connected and the circuit designation using 1/4" block text.
- D. Panelboards shall be labeled with a 1/2" vinyl adhesive labeling indicating the "panel name, voltage line to line/voltage line to neutral, circuit designation that feeds the panel overcurrent rating of panel feeder".
I.e. "H4, 480/277V, fed from MSB:8,10,12 at 600A/3P"
Text to be black for normal power panels and red for emergency power, all with a 1" tall white background. See 16010 for additional labeling requirements.
- E. Conduits for feeders and branch circuits shall be terminated directly into panelboard enclosure without the use of pull or junction boxes, wireways, or auxiliary gutters unless the enclosure does not provide sufficient surface areas for all conduits. Where such cases exist, the Contractor shall notify the Engineer. In no case will splices in such boxes, wireways, etc., be permitted.
- F. Provide spare raceways for all panels that are installed flush. Raceways are to extend from the top of panel to an accessible ceiling space and have a pull cord where the conduit is more than 10' long. Each panel section with a bus rating of 225A or less to receive 4 @ 3/4" and 1 @ 1" spare. Panel sections with a bus rating of 250 - 600A to receive 4 @ 3/4" and 2 @ 1-1/4" spare.
- G. Anchor panels up to 800A to hollow masonry walls with 4 expansion anchors 3/8" min X 2-1/2" or 6 toggle bolts, 1/4" min. For metal stud walls with studs less than 6" deep provide full height strut to anchor at floor and deck above.

END OF SECTION

**SECTION 16140
WIRING DEVICES**

PART 1 - GENERAL

1.01 WORK INCLUDED

- A. All work specified in this section shall comply with the provisions of Section 16010.
- B. Provide switches, receptacles, and other wiring devices as indicated on drawings.

PART 2 - PRODUCTS

- A. Commercial specification grade devices are required.
- B. Bryant, Hubbell, Pass and Seymour or Cooper. Where models are indicated they are intended to establish a basis of design and not discourage submitting equivalent devices.
- C. White is the color for all devices and cover plates unless noted otherwise. Red is the device color for items fed by stand-by or emergency power.

2.01 SWITCHES

- A. Unless noted otherwise 20-Amp, 120/277VAC, fluorescent lighting rated, 1HP at 120VAC rated per UL20. Specification grade toggle single pole.
- B. Provide 3-way or 4-way switching as indicated for control of lighting from any switch location.
- C. Where pilot light is indicated provide a switch that glows when in off position.
- D. Where keyed switches are indicated provide a switch that has a separate forked key that fits though a slot for operation of the switch. Provide 10 keys per project for use by owner.
- E. Where jamb mounted switches are indicated provide a 1.25" wide push button, momentary contact switch with integral metal switch box for jamb mounting in the hinge side of door frame. Switch shall open when the door is in the closed position. Cooper #1664.
- F. NOT USED - Where occupancy switches are indicated provide Passive Infrared sensors in areas unless indicated otherwise. Provide ultrasonic sensors with no override on/off switch in restrooms. Dual technology PIR and Ultrasonic ceiling devices are required where indicated and will interface with the wall toggle switch. Where OS is indicated next to a wall toggle switch provide a wall sensor. 120/277VAC, 600W a120VAC, 1200W at 277VAC. Hubbell H-Moss adaptive technology sensors that self adjust to the occupancy and surroundings to

minimize false switching. Equivalent by Watt Stopper or Sensor Switch are approved.

- F. Where locking provision is indicated for an NEC lockout provide a metal switch lever guard with padlock acceptance holes to lock toggle in the open or closed position. Cooper #7949.
- G. Where timer switches are indicated provide digital timer switch, timeout range from (5min-12HR) flash lights for visual warning prior to timeout, 120/277VAC. Watt Stopper #TS-400 or equal by NSI Industries.
- H. NOT USED - Fluorescent dimmers to be matched to ballast and supplied with the associated lighting fixtures. Dimmer shall be slide type with on/off toggle switch.

2.02 RECEPTACLES

- A. Unless noted otherwise, 20-Amp, 125 VAC, NEMA 5-20R, UL 498.
- B. Where G is noted provide ground fault circuit interrupter with indicator light, test and reset buttons, per UL943 for GFCI class A people protection. Provide adhesive stickers for five additional receptacles that say "GFCI protected". All receptacles on the load side of a GFCI receptacle are to be labeled thus.
- C. Where IG is noted = Isolated ground, solid orange with matching cover plate.
- D. Where 15-Amp is noted, NEMA 5-15R..
- E. Where hospital grade is noted, provide hospital grade devices with the green dot on face of device.
- F. Where clock receptacles are indicated provide a Nema 5-15R receptacle recessed in a single gang wallplate with an integral hook.
- G. Where a floor box is indicated provide recessed devices with a separate cover plate that hinges to provide access to the devices and lays flush with the floor when closed. Provide a slot to allow cords to pass through the cover when closed. Cover to be a neutral color to complement vinyl floors and have a recess to accept carpet in like floors.
- H. In commercial kitchens where a floor receptacle is indicated provide an above the floor receptacle, nominal 1/2" above finished floor with a die cast aluminum housing, Hubbell #SA6685.
- I. Where SPD is indicated provide surge protection device protection for line to neutral, line to ground and neutral to ground all at 18kA per mode; 400V clamping voltage; UL 1449 compliant; LED indicator to verify surge protection and ground; blue construction.

2.03 Device Plates:

- 1. Unless noted otherwise provide cover plates for all single and ganged devices. Where devices are shown adjacent to each other on the plans

they are to be installed in ganged wall boxes. Up to six devices are to be ganged using a single cover plate.

2. Where plastic or nylon covers are indicated provide high impact-resistant thermoplastic, UL 514 listed and UL94 flammability V2 rated.
3. Provide galvanized steel cover plates in equipment rooms sized to match the wall box.
4. Provide weather proof NEMA 3R cover plates which maintain their rating when in use for all weather exposed applications.

PART 3 - EXECUTION

A. Mounting:

1. Mount all switches 46" above the finished floor to center line of switch unless noted otherwise.
2. Mount all receptacles 18" above the finished floor to center line of receptacle unless noted otherwise.
3. Mount weatherproof receptacles vertically.
4. Mount devices 4" above the finish surface of countertop or backsplash, whichever is higher, where they are noted as "Above Counter" or "AC"

B. Polarity: Properly wire all receptacles so that the hot wire, the neutral wire and the ground wire connect to the appropriate terminals on all receptacles. Install with the ground pin up.

C. Grounding: Install all receptacles in boxes specified under Section 16130 and install a No. 12 green ground wire from device grounding terminal back to the grounding bus in the panelboard.

D. Provide a separate isolated ground and neutral conductor for every isolated ground receptacle circuit. Green insulation with an orange strip for isolated ground.

E. The neutral conductor to be sized same as the phase conductor and dedicated for each phase conductor on the load side of all dimmers and GFCI devices.

F. Switch wiring to conform to manufacturers recommendations and switch rating to exceed the connected wattage by at least 25%. I.e. no more than 960 watts may be connected to a switch rated for 1200W.

END OF SECTION

**SECTION 16170
SAFETY SWITCHES & MOTOR STARTERS**

PART 1 - GENERAL

1.01 WORK INCLUDED

- A. All work specified in this section shall comply with the provisions of Section 16010.
- B. Provide heavy duty, horsepower rated, quick-make, quick-break, safety switches provided with the number of poles and fuse holders as required. General duty or light duty switches are not acceptable.
- C. Fuses in the existing switchgear as needed to achieve the overcurrent protection indicated in the drawings.

1.02 SUBMITTALS

- A. Submittal for products furnished under this section is required in accordance with section 16010.

PART 2 - PRODUCTS

2.01 SAFETY SWITCHES

- A. Safety switches shall be type HD as manufactured by General Electric, Square "D" Company, Siemens or Eaton.
- B. Enclosures to be NEMA 1 for interior use and NEMA 3R for exterior use.
- C. Switches to have arc shields, to be of enclosed construction and fusible or non-fusible as indicated. Switches to be rated for either 250-volt AC or 600-volt AC to exceed voltage rating of equipment served.
- D. All switches shall be capable of interrupting locked rotor current of motor which it serves.
- E. Switches noted on drawings to be SE rated shall be Service Entrance Rated, and shall be UL listed for such service.
- F. Switches mounted outdoors shall be pad lockable in both "ON" and "OFF" positions. Provide owner with 2-hole shackle bars for each, configured so that two padlocks are required to lock switch "ON" and the removal of either padlock will allow operation of switch. Switches to be mounted indoors shall be pad lockable in the "OFF" position only.

2.02 MOTOR STARTERS

- A. Starters shall be type HD as manufactured by General Electric, Square "D" Company, Siemens or Eaton.
- B. Starters shall include overload protection in each phase, two auxiliary contacts & interlocks as required for proper system operation. Starters shall be mounted in NEMA 1 general purpose enclosures, except where noted otherwise. Starters shall provide for hand, off, automatic operational control selection. NEMA 3R required at outdoor locations.
- C. Starters shall have 120 volt control transformers individually fused from the line side of the starter using two cartridge fuses. Transformer fuses shall be sized to carry the holding coil circuit and other connected devices.
- D. Combination starters shall contain circuit breakers sized in accordance with the NEC Table 430-152.
- E. Starters shall be labeled with an adhesive vinyl label with $\frac{3}{4}$ " tall letters describing the equipment served, e.g. "AHU1".
- F. Starter mounted push-button station, selector switches, and pilot lights shall be manufacturer's standard unit, oiltight. Push-button station shall be momentary contact type unless otherwise designated with green start button, red stop button, and a legend plate. Selector switches shall be standard knob maintained contact type with legend plates. Pilot lights shall be 120 volt lamps with red glass color cap.

PART 3 - EXECUTION

- A. Fuses to be furnished with the switch. Provide six spare 100A fuses and three spare fuses of every other size and type furnished under this project. Provide a typed inventory list of the applications and as-built fuse ratings. All is to be delivered to the Owner as a complete package in a single container.
- B. Fuses to be indicating type fuses by Gould, Littlefuse, Bussmann or Engineer approved equivalent.
- C. Provide class R fuses and rejection kit for fusible safety switches serving circuits protected at 250 Amps and above and also any service entrance equipment.
- D. Provide class J time delay fuses for fusible safety switches serving panels, motor loads and other equipment not indicated otherwise.
- D. Mount switches to walls, equipment enclosures, or freestanding supports with a minimum of four bolts using steel expansion anchors for masonry construction, jumbo washers, lock washers and nuts for equipment enclosures. Do not mount directly to AHU enclosures or motorized equipment.
- E. All safety switches shall be identified with labels in accordance with Section 16010.

- G. Provide strut or structural steel stands for all switches and starters to rigidly secure equipment to the building structure and resist 1.0G horizontally applied seismic forces.

PART 3 - EXECUTION

- A. Provide class L fuses for fusible switches in switchboards and rated 600 Amps or greater. Time delay, 200,000 AIC current limiting
- B. Provide class J time delay fuses for fusible safety switches serving panels, motor loads and other equipment not otherwise noted. Time delay, 200,000 AIC current limiting
- C. Provide non-fusible switches at remote equipment locations where switch is required only as a means of disconnect.
- D. Mount switches to walls, equipment enclosures, or freestanding supports with a minimum of four bolts using toggle anchors for masonry construction, Phillips "Red Head" anchors for poured concrete construction and bolts, jumbo washers, lock washers and nuts for equipment enclosures.
- E. All safety switches shall be identified with engraved lamcoid nameplates in accordance with Section 16010.

END OF SECTION

**SECTION 16190
SUPPORTING DEVICES AND HANGERS**

PART 1 - GENERAL

1.01 WORK INCLUDED

- A. All work specified in this section shall comply with the provisions of Section 16010.
- B. Provide a system of supporting devices and hangers to insure secure support or bracing for conduit, electrical equipment, including safety switches, fixtures, panelboards, transformers, outlet boxes, junction boxes, cabinets, etc.
- C. Seismic restraints for cable tray, bus duct, trapeezed raceways, individually supported raceways exceeding 2" with more than 12" of vertical rod used to suspend raceway, electrical equipment and light fixtures.

1.02 RELATED WORK

- A. All of Division 16 Sections unless an individual Section is more stringent.

1.03 SUBMITTALS

- A. Submit shop drawings of trapeze and other equipment supports in accordance with Division 1 and 16010. Seismic restraints require detailed shop drawings of every style restraint that is applied as well as scaled plans that specify the location and type of every restraint.

PART 2 - PRODUCTS

2.01 HANGERS/FASTENERS

Provide appropriate supporting devices and hangers for electrical equipment from the below list of Caddy Fasteners as manufactured by Erico Products, Inc., Steel City, Minerallac, or approved equivalent.

- A. Vertical flange clamps (beam clamps).
- B. "Z" purlin clips.
- C. Conduit clips.
- D. Universal clamps (beam clamps).
- E. Beam clamps (set screw type).
- F. Combination push-in conduit clips.
- G. Combination conduit hanger clamps.
- H. Flexible conduit clips.
- I. Special combination conduit clips.
- J. One hole steel straps.
- K. Minerallac conduit hangers.

2.02 EQUIPMENT PADS

Fabricate pads of concrete with 10 GA 6X6 welded wire reinforcement, and "J" Bolts positioned for securing equipment to pad. Pad height as noted, or 3.5" if not noted. All floor mounted equipment to be provided with a pad or approved structural steel support frame. Extend pad 6" beyond footprint of equipment. Chamfer top edge of pad 1" on all sides. Finish grout and rub for a smooth void free surface. Refer to drawings for any applicable details.

2.03 STRUT

All strut, fasteners, accessories and fittings shall be 14 gauge electroplated or hot dipped galvanized steel.

2.04 SEISMIC RESTRAINTS

- A. Raceway and equipment: Mason Industries, B-Line, Amber-Booth, Kinetics, Tolco or equal
- B. Obtain all seismic bracing and design from a single source vendor specializing in this type work. All raceways and other electrical systems must be axially and longitudinally restrained to limit sway. Supports to comply with all seismic requirements in force during construction as identified in the Civil drawings. Building structure at all points of attachment must be capable of withstanding all imposed loading.
- C. Bolts securing rigidly mounted equipment require bolt isolation washers equal to type HG by Mason. Equipment 401 up to 1000 LBS receive a minimum of four at 1/2" x 4" anchors. Equipment 1001 up to 5000 LBS receive a minimum of four at 3/4" x 6" anchors. Heavier equipment to be laterally braced and secured with an equivalent level of anchors. All anchors used for structural attachment of seismic restraints must be certified for seismic application by ICC Evaluation Service Reports and applied in full compliance with these reports. Secure panels and other equipment weighing up to 400LBS to building structure with rubber isolation bushings equal to Mason PB-175, with 3/8" seismic isolation anchor studs, 2.5" minimum embedment, four per item.

PART 3 - EXECUTION

3.01

- A. Secure conduits to within 3' of each outlet box, junction box, cabinet, fitting, etc., and at intervals not to exceed ten feet (10') in accordance with currently effective edition of the National Electric Code. All counties in Tennessee west of the Tennessee River shall be installed to resist movement during seismic activity. In seismic zones, support 1) conduits 2.5" and larger, 2) cable trays, 3) bus ducts, 4) trapezed conduits exceeding 5 pounds per linear foot with transverse restraints at 30 foot intervals and longitudinal restraints at 60 foot intervals and at each end of conduit run. Seismic restraints are not required if the raceway is rigidly mounted with clamps or all-thread rod with a free distance 12" or less from support to top of raceway. In exposed locations below 9' AFF where raceway is 1" or smaller support with 2-hole straps at 5' intervals and within 18" of each outlet box, J-box, cabinet and fitting.

- B. Install clamps secured to structure for feeder and other conduits routed against the structure. Use drop rods and hangers or racks to support conduits run apart from the structure.
- C. Provide and install suitable strut, angle iron, channel iron or steel metal framing with accessories to support or brace electrical equipment including safety switches, fixtures, panelboards, etc. All equipment shall be rigidly supported to prevent toppling. All supports shall be galvanized steel strut. All strut, braces, joints and connections shall be made using galvanized steel components, B-line strut systems or equal by Unistrut, or Grinnell
- D. Paint all supporting metal not otherwise protected, with rust inhibiting primer and then with a finish coat to match the surrounding surfaces.
- E. Use of chains, perforated iron, baling wire, or tie wire for supporting conduit runs will not be permitted.
- F. For support of low voltage wiring not required to be in conduit, contractor shall bundle cables together in a neat manner using approved nylon tie wraps. Bundled cables shall be supported with "J" hooks a minimum of five feet on centers. Alternate cable tray supports are allowed subject to approval by the Engineer. Cable trays are required in selected locations where indicated.
- G. Secure each section of floor mounted equipment at the top and bottom to building structure. Supports to resist the full weight of equipment. 1/2" x 4" expansion bolt at each corner as a minimum.

END OF SECTION

SECTION 16450 GROUNDING

PART 1 - GENERAL

1.01 WORK INCLUDED

- A. All work specified in this section shall comply with the provisions of Section 16010.
- B. The entire system of raceways and equipment to be grounded in accordance with Article No. 250 of the National Electrical Code and any local regulation or governmental governing authority.
- C. The service grounding conductors and bonding is to be brought in accordance with current code under this project.

PART 2 - PRODUCTS

- A. Ground clamps: OZ Electrical Manufacturing Company Type "OG", or equal by Steel City or Appleton. Exothermic welding connections are required for service ground terminations.
- B. Raceways, conductors, outlet boxes, pull and junction boxes, etc., to be furnished in accordance with applicable sections of these specifications. Inspection box for driven ground rod terminations nominal 14" deep with 12" diameter interior with cover embossed with ground or similar label.
- C. Grounding electrode rods shall be copper clad, 10' length and 3/4" diameter minimum, designed for use as grounding electrode.
- D. Horizontal service grounding conductor to be minimum #3/0 bare copper buried no less than 24" below finished grade.

PART 3 - EXECUTION

3.01 INSTALLATION

- A. General:
 - 1. Clean all conductive surfaces on equipment to be grounded, to assure good electrical continuity.
 - 2. Effectively bond all grounding conductors to grounding electrodes, equipment enclosures and ground busses, except for grounding conductors in isolated ground systems. These shall be bonded only to the isolated ground bus, and shall be kept electrically isolated from the equipment enclosure/raceway system. In isolated ground systems, a second, separate grounding conductor shall be installed for grounding of equipment.

3. Locate all grounding attachments away from areas subject to physical damage. Provide protective covering as required.

B. Main Switchboard/Building Ground:

Main grounding electrode system shall be as indicated in the contract documents with all service ground terminations made by exothermic welding to bare copper conductors. Additional driven ground rods shall be installed if required to achieve 10 ohm effective resistance to earth. Maintain access to ground rod termination points using Erico or equal inspection caps. Top of ground rods to be nominal 6" below finish grade and centered in the inspection cover work box.

C. Feeder/Branch Circuits:

1. Feeder circuits to panels and equipment loads to have a separate green grounding conductor in conduit sized as shown. Grounding conductor shall be kept electrically isolated from the metallic raceway ground at all points.
2. All branch circuits to have a separate green grounding conductor installed in same conduit as phase and neutral conductor from panel ground bus to device. The grounding conductor to be sized in accordance with Table 250-95 of the National Electrical Code. Three single phase branch circuits may share a ground conductor. The ground shall be sized to match the nominal ampacity of the phase conductor. Where the phase conductor size is increased, increase ground conductor size proportionately to account for voltage drop or other reasons.
3. Flexible conduit will not be approved as achieving continuity of ground. All flexible conduit to have a separate ground wire sized to ampacity of branch breaker and to be connected to conduit system on both ends; this applies to feeders, motors, expansion joints.
4. Isolated ground circuits shall not share a ground wire with other circuits. Isolated grounds bond to the building ground only at the service entrance equipment.

3.02 TEST

- A. Ground on main service to be tested to obtain no greater than 10 ohms. Where the electrical service lateral is rated at 1200 amps or more the service ground must be no greater than 5 ohms. Test data to be submitted to engineer for approval and such approved test data to become part of the final brochure. All resistance tests are to be performed using IEEE 81 fall of potential method. Do not apply any salty solutions, liquids to enhance conductivity or water to the ground area of driven ground electrodes. Do not test until the area has been free of precipitation for 48 hours. If doubling the number of driven ground rods does not achieve the specified resistance other methods will be provided by the Engineer to address this unforeseen condition.

END OF SECTION

**SECTION 16461
DRY TYPE TRANSFORMERS**

PART 1 GENERAL

1.01 WORK INCLUDED

- A. Dry type distribution transformers.

1.02 REFERENCES

- A. ANSI/NEMA - ST 1 - Specialty Transformers.
- B. ANSI/NEMA ST 20 - Dry Type Transformers for General Applications.

1.03 SUBMITTALS

- A. Submit product data under provisions of Section 16010.
- B. Include outline and support point dimensions of enclosures and accessories, unit weight, voltage, KVA, and impedance ratings and characteristics, loss data, efficiency at 25, 50, 75 and 100 percent rated load, sound level, tap configurations, insulation system type, and rated temperature rise.

1.04 DELIVERY, STORAGE, AND HANDLING

- A. Store and protect products under provisions of Section 16010.
- B. Store in a warm, dry location with uniform temperature. Cover ventilating openings to keep out dust.
- C. Handle transformers using only lifting eyes and brackets provided for that purpose. Protect units against entrance of rain, sleet, or snow if handled in inclement weather.

PART 2 PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS - DRY TYPE DISTRIBUTION TRANSFORMERS

- A. Square "D", I-T-E, General Electric, Powersmith or Cutler Hammer.

2.02 DRY TYPE DISTRIBUTION TRANSFORMERS

- A. Dry-type energy efficient transformers labeled for EPA energy star program and compliant with NEMA standard TP-1 for optimum energy efficiency at 35% load in low voltage distribution transformers. Unless indicated otherwise 480V Delta primary, 208Y/120V secondary, 150 Degree C rise above 40 Degree C ambient,

six 2.5% taps to adjust secondary voltage, ventilated, weathershield for NEMA 3R even where transformer can be NEMA 1.

PART 3 EXECUTION

3.01 INSTALLATION

- A. Set transformer plumb and level.
- B. Use flexible conduit, 2 ft (0.6 m) minimum length, for connections to transformer case. Make conduit connections to side panel of enclosure.
- C. Mount transformers on neoprene isolators bolted to the floor and to the transformer using 3/8" anchors 3" embedment, 2 per corner and four 3/8" bolts on each transformer. Four mounts per transformer using Mason BRA 205 pound or equal restrained neoprene isolators for 75 kVA and smaller. BRB 450 pound isolators for transformers up to 225 kVA.
- D. Leave room around the transformer for free air circulation per manufacturers recommendations, but not less than 5" on all sides.
- E. Suspend units where required. Provide a welded angle iron frame L2.5"x2.5"x0.375" ASTM A325 steel with 0.625" threaded rod supports to the overhead building structure, 4" embedment, with bracing to the wall with 0.50" wall anchors and 3" embedment.

3.02 FIELD QUALITY CONTROL

- A. Check for damage and tight connections prior to energizing transformer.
- B. Measure primary and secondary voltages and make appropriate tap adjustments.

END OF SECTION

**SECTION 16510
LIGHTING AND LAMPS**

PART 1 - GENERAL

1.01 WORK INCLUDED

- A. All work specified in this section shall comply with the provisions of Section 16010.
- B. Provide labor, material, equipment and services necessary to provide all lighting fixtures, necessary hangers and lamps. Fixtures include all interior fixtures plus all exterior fixtures and signage.
- C. Fluorescent fixtures shall be designed in such a manner that all electrical components may be replaced without disturbing fixture in or going above the ceiling.

1.02 SUBMITTALS

- A. Submit for approval prior to purchasing fixtures, a complete list of fixtures proposed to be used. Include cuts of both specified fixtures and proposed equivalent fixtures. See Section 16010 for submittal requirements.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

- A. Fixtures are scheduled by Manufacturer and Model number on the project drawings in order to define the type, performance, and quality required. Equal fixtures to be one of the following Approved Manufacturers: Prescolite, Columbia, Metalux, Portfolio, McGraw Edison, Hydrel, Williams, Lithonia and Halo. Others may be considered subject to Owner Approval. Only lensed fixtures are allowed in patient care areas.
- B. Fluorescent lamps shall be General Electric, Sylvania, Osram, Phillips or Engineer approved equal.
- C. Incandescent and HID lamps shall be General Electric, Sylvania, Phillips, Venture or an Engineer approved equal as recommended by fixture manufacturer.
- D. Ballasts shall be Lutron, Advance, Universal, GE or Osram-Sylvania, energy-saving electronic, high power factor type. Electronic ballasts for fluorescent lamps shall have less than 10% Total Harmonic Distortion. Power factor above 0.99. Crest factor below 1.5. Provide a molded quick connection to allow the ballast power to be disconnected and reconnected without exposing any bare conductors.
- E. Provide dimmers matched to ballast. Dimmer shall have a slide for increasing/dimming the light levels and an on/off rocker switch which when turned on brings lighting levels to preset levels.

2.02 EXTRA LAMPS

- A. Provide 5% additional lamps of each type of lamp installed to the Owner at project closeout, but not less than 2 lamps of each type installed. All lamps shall

be operational at the time of project closeout. Return to the project site 2 months after project closeout and replace any lamps that have failed using the Owner's inventory.

PART 3 - EXECUTION

- A. All fixtures shall be securely mounted as required by NEC and as specified herein.
- B. Fixtures mounted in a suspended ceiling shall be secured to the structure above with two wires extending from each corner to the building structure. Typically one wire extending diagonally across the fixture through a single suspension point overhead will meet this requirement.
- C. Recessed fixtures in dropped ceiling areas shall be connected using 6' whips and No. 16 THHN wire. Whips shall be connected to fixture and outlet box. Each whip shall have installed in it a separate insulated green grounding conductor not smaller than No. 16 AWG for grounding continuity between fixture and conduit system. Grounding conductor shall be mechanically connected in a permanent and effective manner to fixture and conduit system and to be electrically continuous. No conduit shall enter a recessed fixture directly as this would prevent removal of fixture without disturbing balance of circuit.
- D. Outdoor fixtures shall be fully rated for wet locations. Penetrations through walls and roof shall be sealed weathertight. Aiming and/or socket position adjustment of all HID fixtures shall be adjusted until approved by Architect. Allow for evening work as necessary.
- E. Outdoor poles and pole-mounted fixtures shall be as scheduled with substitution subject to Owner and Engineer approval. Pole lighting systems shall be rated for 150 percent of maximum effective fixture projected area for design wind of locale. The site lighting is extremely critical with the local zoning department having close oversight of this project. Ground mounted fixtures are to be set on uniform and void free concrete bases. Where bases are in planting areas they shall be kept to no more than 4" above finished grade. Where dimensions are not provided the fixtures shall be set at uniform spacings and aligned with the building architectural features. Obtain clarification from the Engineer as needed.
- B. In mechanical spaces the locations must be adjusted to provide full use of the light output from every fixture to illuminate the space. Coordinate with the other trades and adjust fixture locations to meet this requirement. Relocate fixtures as directed by the Engineer which, in the opinion of the Engineer, are not properly located.
- C. Provide seismic restraints on all fixtures attaching the fixtures to the building structure using wires or cables and also to the ceiling system with screws or approved clips. Comply with local and state authority requirements.

END OF SECTION

**SECTION 16721
FIRE ALARM SYSTEM**

PART 1.0 - GENERAL

1.01 REQUIREMENTS

- A. Applicable provisions of the General Conditions and of Section 16010 govern all work specified in this Section.
- B. Relocate, expand and program the existing addressable fire alarm system and integrate the new appliances and devices as indicated on the plans. Provide an allowance to correct any cabling or raceway deficiencies within the area of work, provide additional supports, add additional appliances, devices and features that may be required by the code officials having jurisdiction over this project. Provide shop drawings showing all existing remaining fire alarm components.

1.02 DESCRIPTION:

- A. Furnish and install all bridle rings, conduit, wire, outlet boxes, junction boxes, terminal equipment, and accessories to add devices and appliances indicated on the drawings and meet all requirements of local officials and the requirements of NFPA 72.
- B. This section includes the furnishing, installation, and connection of the equipment required to form a complete coordinated system ready for operation. It shall include, but not be limited to, alarm initiating devices, alarm notification appliances, auxiliary control devices, annunciators and wiring as shown on the drawings and as required to achieve fully functional system. The existing system is not intended to be altered under this project beyond what is necessary to integrate the new appliances and devices into the new system.
- C. The fire alarm system shall comply with requirements of NFPA Standard No. 72 for protected premises signaling systems except as modified and supplemented by this specification. The system shall be electrically supervised and monitor the integrity of all conductors.

1.03 SUBMITTALS

- A. General:
 - 1. Submittals are required for all products in this section in accordance with Section 16010 and DIV 01.
 - 2. For equipment other than that specified, the contractor shall supply proof that such substitute equipment equals or exceeds the features, functions, performance, and quality of the specified equipment.
 - 3. Submit one copy of specifications, plans, and product literature to the local Fire Prevention Bureau for review and comment. Include returned comment letter from local and state Fire Prevention Bureau with submittals. Comply with all requirements of local authorities.

B. Shop Drawings:

1. Sufficient information, clearly presented, shall be included to determine compliance with drawings and specifications.
2. Include manufacturer's name(s), model numbers, ratings, power requirements, equipment layout, device arrangement, complete wiring diagrams, and conduit layouts.
3. Show annunciator layout, configurations, and terminations.
4. Fire Alarm shop drawings shall include and show all existing devices and components for a complete drawing when complete.

C. Software Modifications

1. Provide the services of a factory trained and authorized technician to perform all system software modifications, upgrades or changes. Response time of the technician to the site shall not exceed 4 hours.
2. Provide all hardware, software, software upgrades, programming tools and documentation necessary to modify the fire alarm system on site. Modification includes addition and deletion of devices, circuits, zones and changes to system operation and custom label changes for devices or zones. The system structure and software shall place no limit on the type or extent of software modifications on-site. Modification of software shall not require power-down of the system or loss of system fire protection while modifications are being made.
3. Provide all software upgrades, hardware, power supplies, amplifiers, tone generators and programming as required for a complete operational system.

1.05 GUARANTY:

Refer to General Conditions.

1.06 APPLICABLE SPECIFICATIONS:

The specifications and standards listed below form a part of this specification. The system shall fully comply with these standards.

A. National Fire Protection Association (NFPA):

No. 70-2008 National Electrical Code (NEC)

No. 72-2010 National Fire Alarm Code

No. 101-2006 Life Safety Code

B. Underwriters Laboratories Inc. (UL):

- No. 268 Smoke Detectors for Fire Protective Signaling Systems
- No. 864 Control Units for Fire Protective Signaling Systems
- No. 268A Smoke Detectors for Duct Applications.
- No. 521 Heat Detectors for Fire Protective Signaling Systems
- No. 464 Audible Signaling Appliances.
- No. 38 Manually Actuated Signaling Boxes.
- No. 1971 Visual Indicating Appliances.

C. Local and State Building Codes

D. All requirements of the Authority Having Jurisdiction (AHJ).

1.07 APPROVALS:

A. The system shall have proper listing and/or approval from the following nationally recognized agencies:

UL	Underwriters Laboratories Inc.
FM	Factory Mutual.

B. Each subassembly of the FACP shall carry the appropriate and official UL modular label.

C. The system shall be listed by the national agencies as suitable for extinguishing release applications.

PART 2.0 PRODUCTS

2.01 EQUIPMENT AND MATERIAL, GENERAL:

A. All equipment and components shall be new, and the manufacturer's current model. The materials, appliances, equipment and devices shall be tested and listed by a nationally recognized approvals agency for use as part of a protected premises protective signaling (fire alarm) system.

B. All equipment and components shall be installed in strict compliance with manufacturers' recommendations. Consult the manufacturer's installation manuals for all wiring diagrams, schematics, physical equipment sizes, etc., before beginning system installation.

C. All appliances and devices, ceiling smoke detectors, speaker/strobes, manual pull stations, etc shall have a white finish with "FIRE" in red lettering.

D. All equipment shall be attached to walls and ceiling/floor assemblies and shall be held firmly in place (e.g., detectors shall not be supported solely by suspended ceilings). Fasteners and supports shall be adequate to support the required load.

2.02 CONDUIT AND WIRE:

A. Conduit:

1. Conduit shall be in accordance with The National Electrical Code (NEC), local and state requirements, and Section 16110 of this Division.
2. Provide conduit sleeves above non-accessible ceiling to the nearest accessible ceiling. All wiring in exposed locations shall be installed in conduit. Conduit fill shall not exceed 40 percent of interior cross sectional area where three or more cables are contained within a single conduit.
4. Cable must be separated from any open conductors of Power, or Class 1 circuits, and shall not be placed in any conduit, junction box or raceway containing these conductors, as per NEC Article 760-29.
5. Wiring for 24 volt control, alarm notification, emergency communication and similar power-limited auxiliary functions may be run in the same conduit as initiating and signaling line circuits. All circuits shall be provided with transient suppression devices and the system shall be designed to permit simultaneous operation of all circuits without interference or loss of signals.
6. Conduit shall not enter the Fire Alarm Control Panel, or any other remotely mounted Control Panel equipment or backboxes, except where conduit entry is specified by the FACP manufacturer.
7. Conduit shall be 1/2 inch minimum, and shall be supported at no more than 5-foot intervals in addition to requirements in Section 16110. All conduit fittings and junction box cover plates shall be painted red.

B. Wire:

1. Wiring shall be in accordance with local, state and national codes (e.g., NEC Article 760), NFPA 72, as specified in Section 16121, and as recommended by the manufacturer of the fire alarm system. Number and size of conductors shall be as recommended by the fire alarm system manufacturer. Label all conductors using adhesive number labels which correspond with shop drawings. Label at origin, at termination point and at any junction boxes.
3. All wire and cable shall be listed and/or approved by a recognized testing agency for use with a protective signaling system.
4. Wiring used for the multiplex communication loop shall be twisted and shielded. The system shall permit use of IDC and IAC wiring in the same conduit with the communication loop.
5. All field wiring shall be completely supervised.
6. Branch wiring on each floor shall be plenum rated cabling supported in bridle rings 5'-0" O.C. above accessible ceilings. Provide conduit sleeves

above non-accessible ceiling to the nearest accessible ceiling. All wiring in exposed locations shall be installed in conduit.

C. Terminal Boxes, Junction Boxes and Cabinets:

All boxes and cabinets shall be UL listed for their use and purpose.

D. Initiating circuits shall be arranged to serve like categories (manual, smoke, water flow). Mixed category circuitry shall not be permitted except on signaling line circuits connected to intelligent reporting devices. In all applications the speaker shall be capable of being silenced while the visual appliances remain activated.

PART 3.0 - EXECUTION

3.1 INSTALLATION:

- A. Installation shall be in accordance with the NEC, NFPA 72, local and state codes, as shown on the drawings, and as recommended by the equipment manufacturer.
- B. All conduit, junction boxes, conduit supports, bridle rings and hangers shall be concealed in finished areas and may be exposed in unfinished areas. Smoke detectors shall not be installed prior to the system programming and test period. If construction is ongoing during this period, measures shall be taken to protect smoke detectors from contamination and physical damage.
- C. All fire detection and alarm system devices, control panels and remote annunciators shall be flush mounted when located in finished areas and may be surface mounted when located in unfinished areas.
- D. Provide synchronization of strobes in areas where more than one strobe is visible at a time.
- E. All junction boxes to be fitted with red painted covers tethered to the box by a flexible cable.

3.2 TEST:

Provide the service of a competent, factory-trained engineer or technician authorized by the manufacturer of the fire alarm equipment to technically supervise and participate during all of the adjustments and tests for the system.

1. Before energizing the cables and wires, check for correct connections and test for short circuits, ground faults, continuity, and insulation.
2. Verify activation of all flow switches.
3. Open initiating device circuits and verify that the trouble signal actuates.

4. Open and short signaling line circuits and verify that the trouble signal actuates.
4. Open and short indicating appliance circuits and verify that trouble signal actuates.
6. Ground all circuits and verify response of trouble signals.
7. Check presence and audibility of tone at all alarm notification devices.
8. Check installation, supervision, and operation of all intelligent smoke detectors using the Walk Test.
9. Each of the alarm conditions that the system is required to detect should be introduced on the system. Verify the proper receipt and the proper processing of the signal at the FACP and the correct activation of the control points.
10. When the system is equipped with optional features, the manufacturer's manual should be consulted to determine the proper testing procedures. This is intended to address such items as verifying controls performed by individually addressed or grouped devices, sensitivity monitoring, verification functionality and similar.

3.3 FINAL INSPECTION:

- A. At the final inspection at least two factory trained representatives of the fire alarm contractor shall demonstrate that the systems function properly in every respect. All coordination of code officials, Owner, DIV 16 and sprinkler contractors and the Owner's representative is the fire alarm contractor's responsibility. All of these parties shall be represented at the final inspection. In preparation for final inspection perform a complete check of every device with the GC two weeks in advance of final, make any corrective actions that prove necessary then retest the entire system until there are zero deficiencies. Provide demonstration for any authorities having jurisdiction where multiple authorities will review the completed project.
- B. The fire alarm contractor shall provide all ladders, canned smoke, test equipment, ladders, two-way radios, sound meters.
- C. Furnish "as-built" copies of the fire alarm system on CAD and provide sensitivity tests of all smoke detectors. All deficiencies must be corrected prior to acceptance by the Owner. Written acceptance of the system by the Engineer, code officials must be provided before final payment.
- D. If the fire alarm system does not pass inspection on the final inspection by any authority having jurisdiction \$2,000 shall be withheld from final payment. The money withheld will be additive should the system fail multiple inspections.

3.4 INSTRUCTION:

- A. Provide 3 hours factory-approved instruction as required for operating, maintaining, and repairing the system. "Hands-on" demonstrations of the

operation of all system components and the entire system including program changes and functions shall be provided in addition to service training.

- B. The Contractor and/or the Systems Manufacturer's representatives shall provide a typewritten "Sequence of Operation" to the Owner.

3.5 SITE DOCUMENTATION:

- A. Verify and document the condition of the existing fire alarm system prior to beginning work on this project. Present any deficiencies in writing to the Owner's representative prior to initiation of any other work.
- B. Furnish a complete set of fire alarm manuals and one set of as-built fire alarm plans. The as-built plans shall include the location and address of every device and shall indicate the type of device. The drawings may be as small as 1/32" scale if the text and devices are easily legible. A sample drawing shall be submitted to the Owner's representative for approval.

END OF SECTION