YORK COUNTY COMMUNITY COLLEGE
MAINE BGS PROJECT #2410
C WING HVAC UNITS

112 College Drive
Wells, Maine

Owner:
State of Maine
York County Community College
112 College Drive
Wells, Maine 04090

Prepared by:
Stantec
482 Payne Road
Scarborough, Maine 04074

June, 2014

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00 11 13
Notice to Contractors

YORK COUNTY COMMUNITY COLLEGE
MAINE BGS PROJECT #2410
C WING HVAC UNITS

The project involves demolition of two existing rooftop packaged HVAC units and installation of two new replacement rooftop packaged HVAC units for the C Wing at the York County Community College campus in Wells, Maine. The project includes all rigging and hoisting, DDC controls, electrical work, and ancillary work required to produce a complete and fully functional system.

The cost of the work is approximately $ 250,000. The work to be performed under this contract shall be completed on or before *30 October 2014*.

1. Sealed Contractor bids for the project noted above, in envelopes plainly marked "Bid for *York Community College, Maine BGS Project #2410, C Wing HVAC Units*" and addressed to:
   Nancy Drouin
   York County Community College
   112 College Drive
   Wells, Maine

   will be opened and read aloud at *the address shown above* at **2:00 p.m.** on ***July 24, 2014***. Bids submitted after the noted time will not be considered and will be returned unopened.

2. The bid shall be submitted on the Contractor Bid Form (section 00 41 13) provided in the Bid Documents. The Owner reserves the right to accept or reject any or all bids as may best serve the interest of the Owner.

3. Bid security *is required* on this project.
   The Bidder shall include a satisfactory Bid Bond (section 00 43 13) or a certified or cashier's check for 5% of the bid amount with the completed bid form submitted to the Owner.

4. Performance and Payment Bonds *are required* on this project.
   The selected Contractor shall furnish a 100% contract Performance Bond (section 00 61 13.13) and a 100% contract Payment Bond (section 00 61 13.16) in the contract amount to cover the execution of the Work.

5. Filed Sub-bids *are not required* on this project.

6. There *are no* Pre-qualified General Contractors on this project.
   The Pre-qualified General Contractors are listed below.
   insert name of company, city, state
   insert name of company, city, state
   insert name of company, city, state
   insert name of company, city, state
   insert name of company, city, state
   insert name of company, city, state
   insert name of company, city, state
   insert name of company, city, state
   insert name of company, city, state

insert name of company, city, state
insert name of company, city, state
insert name of company, city, state
insert name of company, city, state

7. An on-site pre-bid conference *will* be conducted for this project.
   The pre-bid conference is *optional* for General Contractors and optional for Subcontractors and suppliers. Contractors who arrive late or leave the meeting early may be prohibited from participating in this meeting and bidding. *Pre-bid conference will be held at YCCC on July 17, 2014 at 10:00 a.m.*

8. Bid Documents - full sets only - will be available on or about *July 7, 2014* and may be purchased *at no cost* from:
   BGS Web Site

9. Bid Documents may be examined at:

AGC Maine
188 Whitten Road
Augusta, ME 04332
Phone 207-622-4741 Fax 207-622-1625

Construction Summary
734 Chestnut Street
Manchester, NH 03104
Phone 603-627-8856 Fax 603-627-4524

00 21 13
Instructions to Bidders

1. Bidder Requirements

1.1 A bidder is a Contractor who is qualified, or has been specifically pre-qualified by the Bureau of General Services, to bid on the proposed project described in the Bid Documents.

1.2 Contractors and Subcontractors bidding on projects that utilize Filed Sub-bids shall follow the requirements outlined in these Bid Documents for such projects. See Section 00 22 13 for additional information.

1.3 Contractors are not eligible to bid on the project when their access to project design documents prior to the bid period distribution of documents creates an unfair bidding advantage. Prohibited access includes consultation with the Owner or with design professionals engaged by the Owner regarding cost estimating, constructability review, or project scheduling. This prohibition to bid applies to open, competitive bidding or pre-qualified contractor bidding or Filed Sub-bidding. The Bureau may require additional information to determine if the activities of a Contractor constitute an unfair bidding advantage.

1.4 Each bidder is responsible for becoming thoroughly familiar with the Bid Documents prior to submitting a bid. The failure of a bidder to review evident site conditions, to attend available pre-bid conferences, or to receive, examine, or act on addenda to the Bid Documents shall not relieve that bidder from any obligation with respect to their bid or the execution of the work as a Contractor.

1.5 Prior to the award of the contract, General Contractor bidders or Filed Sub-bidders may be required to provide documented evidence to the Owner or the Bureau showing compliance with the provisions of this section, their business experience, financial capability, or performance on previous projects.

1.6 The selected General Contractor bidder will be required to provide proof of insurance before a contract can be executed. Refer to section 00 73 16 Insurance Requirements, for specific requirements.

1.7 Contracts developed from this bid shall not be assigned, sublet or transferred without the written consent of the Owner.

2. Authority of Owner

2.1 The Owner reserves the right to accept or reject any or all bids as may best serve the interest of the Owner.

2.2 Subject to the Owner’s stated right to accept or reject any or all bids, the Contractor shall be selected on the basis of the sum of the lowest acceptable bid plus any Alternate Bids the Owner elects to include.

2.3 The Owner is exempt from the payment of Federal Excise Taxes and Federal Transportation Tax on all shipments, as well as Maine State Sales and Use Taxes on items "…physically incorporated in real property …". The bidder shall not include these taxes in their bid. See Section 00 72 13 for additional information.

3. Submitting Bids and Bid Requirements

3.1 Each bid shall be submitted on the forms provided in the Bid Documents.

3.2 Each bid shall be valid for a period of thirty calendar days following the Project bid opening date and time.

3.3 A bid that contains an escalation clause is considered invalid.

3.4 Bidders shall include a Bid Bond or other approved bid security with the bid form submitted to the Owner when the bid form indicates such bid security is required. The bond value shall be 5% of the bid amount. The form of bond is shown in section 00 43 13.

3.5 Bidders shall include the cost of Performance and Payment Bonds in the bid amount if the bid amount will result in a construction contract value over $125,000, inclusive of alternate bids that may be awarded in the contract. Pursuant to 14 M.R.S.A., Section 871, Public Works Contractors' Surety Bond Law of 1971, subsection 3, the selected Contractor is required to provide these bonds before a contract can be executed. The form of bonds are shown in section 00 61 13.13 and 00 61 13.16.

3.6 Bidders may modify bids in writing prior to the bid closing time. Such written amendments shall not disclose the amount of the initial bid. If so disclosed, the entire bid is considered invalid.

3.7 Bidders shall acknowledge on the bid form all Addenda issued in a timely manner. The Architect shall not issue Addenda affecting bidders less than 72 hours prior to the bid closing time. Addenda shall be issued to all companies who are registered holders of Bid Documents.

3.8 A bid may be withdrawn without penalty if a written request by the bidder is presented to the Owner prior to the bid closing time. Such written withdrawal requests are subject to verification as required by the Bureau. After the bid closing time, such written withdrawal requests may be allowed in consideration of the bid bond or, without utilizing a bid bond, if the Contractor provides documented evidence to the satisfaction of the Bureau that factual errors had been made on the bid form.

3.9 Projects which require a State of Maine wage determination will include that schedule as part of the Bid Documents. See section 00 73 46, if such rates are required.

3.10 Projects which require compliance with the Davis-Bacon Act are subject to the regulations contained the Code for Federal Regulations and the federal wage determination which is made a part of the Bid Documents. See section 00 73 46, if such rates are required.

00 41 13
Contractor Bid Form

YORK COUNTY COMMUNITY COLLEGE
MAINE BGS PROJECT #2410
C WING HVAC UNITS

To: *Nancy Drouin*
York County Community College
112 College Drive
Wells, Maine

The undersigned, or "Bidder", having carefully examined the form of contract, general conditions, specifications and drawings dated *7 July 2014*, prepared by *Stantec* for *York Community College, Maine BGS Project #2410, C Wing HVAC Units*, as well as the premises and conditions relating to the work, proposes to furnish all labor, equipment and materials necessary for and reasonably incidental to the construction and completion of this project for the Base Bid amount of:

_____ Dollars

$ _____

Allowances *are not included* on this project.

1. Alternate bids *are not included* on this project.

2. The Bidder acknowledges receipt of the following addenda to the specifications and drawings:

   Addendum No. ____ Dated: _____

   Addendum No. ____ Dated: _____

   Addendum No. ____ Dated: _____

   Addendum No. ____ Dated: _____

   Addendum No. ____ Dated: _____

3. Bid security *is required* on this project.
   The Bidder shall include a satisfactory Bid Bond (section 00 43 13) or a certified or cashier's check for 5% of the bid amount with this completed bid form submitted to the Owner.

4. Filed Sub-bids *are not required* on this project.
   The bid amount includes the following Filed Sub-bids which were submitted to the Bidder and to the Maine Construction Bid Depository.

York Community College, Maine BGS Project #2410, C Wing HVAC Units

5. The Bidder agrees, if this bid is accepted by the Owner, to sign the designated Owner-Contractor contract and deliver it, with any and all bonds and affidavits of insurance specified in the Bid Documents, within twelve calendar days after the date of notification of such acceptance, except if the twelfth day falls on a State of Maine government holiday or other closure day, a Saturday, or a Sunday, in which case the aforementioned documents must be received before 12:00 noon on the day following the holiday or other closure day, Saturday or Sunday.

   As a guarantee thereof, the Bidder submits, together with this bid, a bid bond or other acceptable instrument as and if required by the Bid Documents.

6. This bid is hereby submitted by:

Signature: _____

Printed name and title: _____

Company name: _____

Mailing address: _____

City, state, zip code: _____

Phone number: _____

Email address: _____

State of incorporation, if a corporation: _____

List of all partners, if a partnership: _____

00 43 13
Contractor Bid Bond

We, the undersigned, ***insert company name of Contractor***, ***select type of entity*** of ***insert name of municipality*** in the State of ***insert name of state*** as principal, and ***insert name of surety*** as Surety, are hereby held and firmly bound unto ***Treasurer of the Maine Community College System*** in the penal sum of ***five percent of the bid amount***, for the payment of which, well and truly to be made, we hereby jointly and severally bind ourselves, our heirs, executors, administrators, successors and assigns, signed this ***insert day, i.e.: 8th*** day of ***select month***, ***select year***, which is the same date as that of the bid due date.

The condition of the above obligation is such that whereas the principal has submitted to the Owner, or State of Maine, to a certain bid, attached hereto and hereby made a part hereof, to enter into a contract in writing, for the construction of ***insert name of project as designated in the contract documents***

Now therefore:

If said bid shall be rejected, or, in the alternate,

If said bid shall be accepted and the principal shall execute and deliver a contract in the form of contract attached hereto, properly completed in accordance with said bid, and shall furnish a bond for the faithful performance of said contract, and for the payment of all persons performing labor or furnishing material in connection therewith, and shall in all other respects perform the agreement created by the acceptance of said bid, then this obligation shall be void.

Otherwise, the same shall remain in force and effect- it being expressly understood and agreed that the liability of the Surety for any and all claims hereunder shall, in no event, exceed the penal amount of this obligation as herein stated.

The Surety, for value received hereby stipulates and agrees that the obligation of said Surety and its bonds shall be in no way impaired or affected by any extension of the time within which the Obligee may accept such bid and said Surety does hereby waive notice of any such extension.

In witness whereof, the principal and the Surety have hereunto set their hands and seals, and such of them as are corporations have caused their corporate seals to be hereto affixed and these presents to be signed by their proper officers, the day and year first set above.

Signed and sealed this ***insert day, i.e.: 8th*** day of ***select month***, ***select year***, which is the same date as that of the bid due date.

Contractor

_____

(Signature)

insert name and title

insert company name

insert address
insert city state zip code

Surety

_____

(Signature)

insert name and title

insert company name

insert address
insert city state zip code

If Contractor is a partnership, all partners shall execute the bond. A power of attorney document indicating that it still is in full force and effect shall be provided by the person executing this bond.

Funding: _____

STATE OF MAINE
Maine Community College System
CONSTRUCTION CONTRACT

THIS AGREEMENT made the ***date*** of ***month*** in the year ***2014*** by and between the State of Maine, Maine Community College System through the ***York County Community College*** hereinafter called the *Owner* and ***Contractor company name*** hereinafter called the *Contractor*.

BGS Project No.:***2410***
Other Project No.:_____

WITNESSETH, That the *Owner* and the *Contractor* for the consideration hereinafter named agree as follows:

ARTICLE 1 SCOPE OF WORK
§ 1.1 The *Contractor* shall furnish all of the materials and perform all the work described in the specifications and shown on the drawings for the project entitled: ***York County Community College, Maine BGS Project #4210 - C Wing HVAC Unis***.

§ 1.2 The specifications and the drawings have been prepared by ***Stantec, Scarborough, ME***, acting as Designer and named in the documents as the Architect or Engineer. This firm has responsibilities for defining the scope of work governed by their agreement with the *Owner*, the specifications and the drawings, and the General Conditions and Special Provisions of the contract.

ARTICLE 2 COMPLETION DATE
§ 2.1 The work to be performed under this contract shall be completed on or before ***30 October 2014*** . For each calendar day the project remains uncompleted ***$750.00*** shall be charged as liquidated damages.

ARTICLE 3 CONTRACT SUM
§ 3.1 The *Owner* shall pay the *Contractor* for the performance of the contract, subject to additions and deductions provided by approved Change Orders in current funds as follows:
amount in words dollars and ***00***cents,
$0.00

ARTICLE 4 CONTRACT BONDS
§ 4.1 Contract bonds are not required if the contract amount is less than $125,000 unless bonds are specifically mandated by the contract documents.

§ 4.2 On this project, the *Contractor* ***shall*** furnish the *Owner* the appropriate contract bonds in the amount of 100% of the contract amount.

ARTICLE 5 PROGRESS PAYMENTS

§ 5.1 The *Owner* shall make payments on account of the contract as provided therein as follows: Each month 95% of the value, based on contract prices of labor and materials incorporated in the work and of materials suitably stored at the site thereof up to the first day of that month, as certified by the Architect or Engineer.

§ 5.2 The *Owner* may cause the *Contractor* to be paid such portion of the amount retained hereunder as he deems advisable.

ARTICLE 6 FINAL PAYMENT

§ 6.1 Final payment shall be due 30 days after completion and acceptance of the work, provided the *Contractor* has submitted evidence satisfactory to the *Owner* that all payrolls, material bills and other indebtedness connected with the work has been paid.

ARTICLE 7 CONTRACT DOCUMENTS

§ 7.1 The General Conditions of the contract, instructions to bidders, bid form, Special Provisions, the written specifications and the drawings, and any Addenda, together with this agreement, form the contract; they are as fully a part of the contract as if hereto attached or herein repeated.

§ 7.2 Specifications: ***date of issuance***

§ 7.3 Drawings: ***each sheet number and title***

§ 7.4 Addenda: ***each addenda number and date, or "none"***

ARTICLE 8 OTHER PROVISIONS

§ 8.1 The *Owner* and the *Contractor* shall comply with applicable provisions of the American Recovery and Reinvestment Act (ARRA), including, but not limited to, the Buy American criteria, federal wage rates, and program-specific reporting requirements, for those projects funded through ARRA.

§ 8.2 On this project, ARRA funds ***will not*** be used.

The *Owner* and the *Contractor* hereby agree to the full performance of the covenants herein.

IN WITNESS WHEREOF the parties hereby execute this agreement the day and year first above written.

OWNER	CONTRACTOR
(Signature) *(Date)*	*(Signature)* *(Date)*
David Schoenherr - Project Manager	
(Printed name and title)	*(Printed name and title)*
York County Community College	
(College name)	*(Contractor company name)*

BUREAU OF GENERAL SERVICES	
Contract Reviewed by:	Contract Approved by:
(Signature) *(Date)*	*(Signature)* *(Date)*
	Joseph Ostwald
Project Manager/ Contract Administrator	*Director, Planning, Design & Construction*

00 61 13.13
Contractor Performance Bond

Bond No.: **insert bond number**

We, the undersigned, ***insert company name of Contractor***, ***select type of entity*** of ***insert name of municipality*** in the State of ***insert name of state*** as principal, and ***insert name of surety*** as Surety, are hereby held and firmly bound unto ***select title of obligee*** in the penal sum of the Contract Price $ ***insert the Contract Price in numbers*** for the payment of which, well and truly to be made, we hereby jointly and severally bind ourselves, our heirs, executors, administrators, successors and assigns.

The condition of the above obligation is such that if the principal shall promptly and faithfully perform the contract entered into this ***insert day, i.e.: 8th*** day of ***select month***, ***select year***, which is the same date as that of the construction contract, for the construction of ***insert name of project as designated in the contract documents***, then this obligation shall be null and void.

Otherwise, the same shall remain in force and effect- it being expressly understood and agreed that the liability of the Surety for any and all claims hereunder shall, in no event, exceed the penal amount of this obligation as herein stated.

The Surety, for value received hereby stipulates and agrees that the obligation of said Surety and its bonds shall be in no way impaired or affected by any extension of the time which the Obligee may accept during the performance of the contract and said Surety does hereby waive notice of any such extension.

In witness whereof, the principal and the Surety have hereunto set their hands and seals, and such of them as are corporations have caused their corporate seals to be hereto affixed and these presents to be signed by their proper officers, the day and year first set above.

Signed and sealed this ***insert day, i.e.: 8th*** day of ***select month***, ***select year***, which is the same date as that of the construction contract.

Contractor

_____

(Signature)

insert name and title

insert company name

insert address
insert city state zip code

Surety

_____

(Signature)

insert name and title

insert company name

insert address
insert city state zip code

If Contractor is a partnership, all partners shall execute the bond. A power of attorney document indicating that it still is in full force and effect shall be provided by the person executing this bond.

00 61 13.16
Contractor Payment Bond

Bond No.: **insert bond number**

We, the undersigned, ***insert company name of Contractor***, ***select type of entity*** of ***insert name of municipality*** in the State of ***insert name of state*** as principal, and ***insert name of surety*** as Surety, are hereby held and firmly bound unto ***select title of obligee*** in the penal sum of the Contract Price $ ***insert the Contract Price in numbers*** for the use and benefit of claimants, defined as an entity having a contract with the principal or with a subcontractor of the principal for labor, materials, or both labor and materials, used or reasonably required for use in the performance of the contract, for the payment of which, well and truly to be made, we hereby jointly and severally bind ourselves, our heirs, executors, administrators, successors and assigns.

The condition of the above obligation is such that if the principal shall promptly satisfy all claims and demands incurred for all labor and materials, used or required by the principal in connection with the work described in the contract entered into this ***insert day, i.e.: 8th*** day of ***select month***, ***select year***, which is the same date as that of the construction contract, for the construction of ***York County Community College - Maine BGS Project #2410 - C Wing HVAC Units, as designated in the contract documents***, and shall fully reimburse the oblige for all outlay and expense with said oblige may incur in making good any default of said principal, then this obligation shall be null and void.

Otherwise, the same shall remain in force and effect- it being expressly understood and agreed that the liability of the Surety for any and all claims hereunder shall, in no event, exceed the penal amount of this obligation as herein stated.

The Surety, for value received hereby stipulates and agrees that the obligation of said Surety and its bonds shall be in no way impaired or affected by any extension of the time which the Obligee may accept during the performance of the contract and said Surety does hereby waive notice of any such extension.

In witness whereof, the principal and the Surety have hereunto set their hands and seals, and such of them as are corporations have caused their corporate seals to be hereto affixed and these presents to be signed by their proper officers, the day and year first set above.

Signed and sealed this ***insert day, i.e.: 8th*** day of ***select month***, ***select year***, which is the same date as that of the construction contract.

Contractor

_____

(Signature)

insert name and title

insert company name

insert address
insert city state zip code

Surety

_____

(Signature)

insert name and title

insert company name

insert address
insert city state zip code

If Contractor is a partnership, all partners shall execute the bond. A power of attorney document indicating that it still is in full force and effect shall be provided by the person executing this bond.

00 63 46
Construction Change Directive Form

[Project name]
[location]
[address]
[city state zip]

C. C. D. Number:

Date:

Other Project Number:

To: **[Contractor company name]**

BGS Project Number:

> *Fully describe the scope of work of the CCD item below and on attached drawings and specifications as necessary.*
> *Include the reason for the work, and the estimated cost and schedule impact.*
> *Final cost and time changes are subject to a subsequent Change Order review process.*

No.	Description	Cost
1	[Replace this text. Please describe the scope of the work completely. Indicate item number at left and cost at right. Repeat below for items as needed.]	
	Total:	**$0**

	Method of compensation	
	*"**X**" in box at left*	
	lump sum	(as shown above)
	unit prices	$0 / [units]
	cost plus designated percentage	0.00 %
	cost plus fixed fee	$0 (fixed fee)

Current Completion Date:

Extend Completion Date by This Number of Days:

New Completion Date:

Architect/Engineer	Contractor	Owner
[Firm name]	[Company name]	[Agency name]
[address]	[address]	[address]
[city state zip]	[city state zip]	[city state zip]
[type name here - signature above]	[type name here - signature above]	[type name here - signature above]
date:	date:	date:

> *approved by:* **Bureau of General Services** date:

00 63 63
Change Order Form

[Project name]
[location]
[address]
[city state zip]

C. O. Number:

Date:

Other Project Number:

To: **[Contractor company name]**

BGS Project Number:

> *Number and briefly summarize each Change Order item below. Include description of and reason for work, and cost.*
> *Attach appropriate supporting documentation including drawings and specifications.*
> *Change Order is not valid until signed by all parties.*

No.	Description	Cost
1	[Replace this text. Please keep the description brief so the text is completely visible when printed. Indicate item number at left and cost at right. Repeat below for items as needed.]	
	Total:	**$0**

	Add	Deduct	Total
Amount of This Change Order	$0	$0	
Amount of Previous Change Orders	$0	$0	
Net Change Orders to Date	$0	$0	$0
Original Contract Amount			$0
Contract Total to Date			**$0**

Current Completion Date:

Extend Completion Date by This Number of Days:

New Completion Date:

Architect/Engineer	**Contractor**	**Owner**
[Firm name]	[Company name]	[Agency name]
[address]	[address]	[address]
[city state zip]	[city state zip]	[city state zip]
[type name here - signature above]	[type name here - signature above]	[type name here - signature above]
date:	date:	date:

> *approved by:* **Bureau of General Services** date:

00 71 00
Definitions

1. Definitions

1.1 *Addendum*: A document issued by the Architect that amends the Bid Documents. Addenda shall not be issued less than seventy-two hours prior to the specified bid opening time.

1.2 *Allowance*: A specified dollar amount for a particular scope of work or service included in the Work that is identified in the Bid Documents and included in each Bidder's Bid. The Contractor shall document expenditures for an Allowance during the Project. Any unused balance shall be credited to the Owner. The Contractor is responsible for notifying the Owner of anticipated expenses greater than the specified amount and the Owner is responsible for those additional expenses.

1.3 *Alternate Bid*: The Contractor's written offer of a specified dollar amount, submitted on the Bid Form, for the performance of a particular scope of work described in the Bid Documents. The Owner determines the low bidder based on the sum of the base Bid and any combination of Alternate Bids that the Owner selects.

1.4 *Architect*: The Architect or Engineer acting as Professional-of-Record for the project. The Architect is responsible for the design of the Project.

1.5 *Architectural Supplemental Instruction (ASI)*: A written instruction from the Architect for the purpose of clarification of the Contract Documents. An ASI does not alter the Contract Price or Contract Time. ASIs may be responses to RFIs and shall be issued by the Architect in a timely manner to avoid any negative impact on the Schedule of Work.

1.6 *Bid*: The Contractor's written offer of a specified dollar amount or amounts, submitted on a form included in the Bid Documents, for the performance of the Work. A Bid may include bonds or other requirements. A base Bid is separate and distinct from Alternate Bids, being the only cost component necessary for the award of the contract, and representing the minimum amount of Work that is essential for the functioning of the project.

1.7 *Bid Bond*: The security designated in the Bid Documents, furnished by Bidders as a guaranty of good faith to enter into a contract with the Owner, should a contract be awarded to that Bidder.

1.8 *Bidder*: Any business entity, individual or corporation that submits a bid for the performance of the work described in the Bid Documents, acting directly or through a duly authorized representative.

1.9 *Bid Documents*: The drawings, procurement and contracting requirements, general requirements, and the written specifications -including all addenda, that a bidder is required to reference in the submission of a bid.

1.10 *Bureau*: The State of Maine Bureau of General Services in the Department of Administrative and Financial Services.

1.11 *Calendar days*: Consecutive days, as occurring on a calendar, taking into account each day of the week, month, year, and any religious, national or local holidays.

1.12 *Certificate of Substantial Completion*: A document developed by the Architect that describes the final status of the Work and establishes the date that the Owner may use the facility for its intended

purpose. The Certificate of Substantial Completion also include a provisional list of items (a "punch list") remaining to be corrected by the Contractor, if any, and identifies a date from which the project warranty period commences.

1.13 *Certificate of Occupancy*: A document developed by a local jurisdiction such as the Code Enforcement Officer that grants permission to the Owner to occupy a building.

1.14 *Change Order (CO)*: A document that modifies the contract and establishes the basis of a specific adjustment to the Contract Price or the Contract Time, or both. Change Orders may address correction of omissions, errors, and document discrepancies, or additional requirements. Change Orders should include all labor, materials and incidentals required to complete the work described. A Change Order is not valid until signed by the Contractor, Owner and Architect and approved by the Bureau.

1.15 *Change Order Proposal (COP)*: Change proposed by the Contractor in the contract amount, requirements, or time, which becomes a Change Order when approved by the Owner.

1.16 *Clerk of the Works*: The authorized representative of the Architect on the job site. Clerk of the Works is also called Architect's representative.

1.17 *Construction Change Directive (CCD)*: A written order prepared by the Architect and signed by the Owner and Architect, directing a change in the Work prior to final agreement with the Contractor on adjustment, if any, in the Contract Price or Contract Time, or both.

1.18 *Contract*: A written agreement between the Owner and the successful bidder which obligates the Contractor to perform the work specified in the Contract Documents and obligates the Owner to compensate the Contractor at the mutually accepted sum, rates or prices.

1.19 *Contract Bonds (also known as Payment and Performance Bonds)*: The approved forms of security, furnished by the Contractor and their surety, which guarantee the faithful performance of all the terms of the contract and the payment of all bills for labor, materials and equipment by the Contractor.

1.20 *Contract Documents*: The drawings and written specifications (including all addenda), Standard General Conditions, and the contract (including all Change Orders subsequently incorporated in the documents).

1.21 *Contract Price*: The dollar amount of the construction contract, also called *Contract Sum*.

1.22 *Contract Time*: The designated duration of time to execute the Work of the contract, with a specific date for completion.

1.23 *Contractor*: Also called the "General Contractor" or "GC" the individual or entity undertaking the execution of the general contract work under the terms of the contract with the Owner, acting directly or through a duly authorized representative. The Contractor is responsible for the means, methods and materials utilized in the execution and completion of the Work.

1.24 *Drawings*: The graphic and pictorial portion of the Contract Documents showing the design, location and dimensions of the Work, generally including plans, elevations, sections, details, schedules, and diagrams.

1.25 *Filed Sub-bid*: The designated major Subcontractor's (or, in some cases, Contractor's) written offer of a specified dollar amount or amounts, submitted on a form included in the Bid Documents, for the performance of a particular portion of the Work. A Filed Sub-bid may include bonds or other requirements.

1.26 *Final Completion*: Project status indicating when the Work is fully completed in compliance with the Contract Documents. Final Completion is documented by a date on which the Contractor's obligations under the contract are complete and accepted by the Owner and final payment becomes due and payable.

1.27 *General Requirements*: The on-site overhead expense items the Contractor provides for the Project, typically including, but not limited to, building permits, construction supervision, Contract Bonds, insurance, field office, temporary utilities, rubbish removal, and site fencing. Overhead expenses of the Contractor's general operation are not included. Sometimes referred to as the Contractor's General Conditions.

1.28 *Owner*: The State agency which is represented by duly authorized individuals. The Owner is responsible for defining the scope of the Project and compensation to the Architect and Contractor.

1.29 *Owner's Representative*: The individual or entity contracted by the Owner to be an advisor and information conduit regarding the Project.

1.30 *Overhead*: General and administrative expenses of the Contractor's principal and branch offices, including payroll costs and other compensation of Contractor employees, deductibles paid on any insurance policy, charges against the Contractor for delinquent payments, and costs related to the correction of defective work, and the Contractor's capital expenses, including interest on capital used for the work.

1.31 *Performance and Payment Bonds (also known as Contract Bonds)*: The approved forms of security, furnished by the Contractor and their surety, which guarantee the faithful performance of all the terms of the contract and the payment of all bills for labor, materials and equipment by the Contractor.

1.32 *Post-Bid Addendum*: Document issued by the Architect that defines a potential Change Order prior to signing of the construction contract. The Post-Bid Addendum allows the Owner to negotiate contract changes with the Bidder submitting the lowest valid bid, only if the negotiated changes to the Bid Documents result in no change or no increase in the bid price.

A Post-Bid Addendum may also be issued after a competitive construction Bid opening to those Bidders who submitted a Bid initially, for the purpose of rebidding the Project work without re-advertising.

1.33 *Project*: The construction project proposed by the Owner to be constructed according to the Contract Documents. The entire public improvement project may also include separate construction and other

activities conducted by the Owner or other contractors. The Owner shall inform all contractors of the scope of the entire public improvement project relative to each individual contract.

1.34 *Proposal*: The Contractor's written offer submitted to the Owner for consideration containing a specified dollar amount or rate, for a specific scope of work, and including a schedule impact, if any. A proposal shall include all costs for overhead and profit. After acceptance by all parties a proposal amends the contract and is implemented by the Contractor.

1.35 *Proposal Request (PR)*: An Owner's written request to the Contractor for a Change Order Proposal.

1.36 *Punch List*: A document that identifies the items of work remaining to be done by the Contractor at the Close Out of a Project. The Punch List is created as a result of a final inspection of the work only after the Contractor attests that all of the Work is in its complete and permanent status.

1.37 *Request For Information (RFI)*: A Contractor's written request to the Architect for clarification, definition or description of the Work. RFIs shall be presented by the Contractor in a timely manner to avoid any negative impact on the Schedule of Work.

1.38 *Request For Proposal (RFP)*: An Owner's written request to the Contractor for a Change Order Proposal.

1.39 *Requisition for Payment*: The document in which the Contractor certifies that the Work described is, to the best of the Contractor's knowledge, information and belief, complete and that all previous payments have been paid by the Contractor to Subcontractors and suppliers, and that the current requested payment is now due. See *Schedule of Values.*

1.40 *Retainage*: The amount, calculated at five percent (5%) of the contract value or a scheduled value, that the Owner shall withhold from the Contractor until the work or portion of work is declared substantially complete or otherwise accepted by the Owner. The Owner may, if requested, reduce the amount withheld if the Owner deems it desirable and prudent to do so. (See Title 5 M.R.S.A., Section 1746.)

1.41 *Sample*: A physical example provided by the Contractor which illustrates materials, equipment or workmanship and establishes standards by which the Work will be judged.

1.42 *Schedule of the Work*: The document prepared by the Contractor and approved by the Owner that specifies the dates on which the Contractor plans to begin and complete various parts of the Work, including dates on which information and approvals are required from the Owner.

1.43 *Schedule of Values*: The document prepared by the Contractor and approved by the Owner before the commencement of the Work that specifies the dollar values of discrete portions of the Work equal in sum to the contract amount. The Schedule of Values is used to document progress payments of the Work in regular (usually monthly) requisitions for payment. See *Requisition for Payment*.

1.44 *Shop Drawings*: The drawings, diagrams, schedules and other data specially prepared for the Work by the Contractor or a Subcontractor, manufacturer, supplier or distributor to illustrate some portion of the Work.

1.45 *Specifications*: The portion of the Contract Documents consisting of the written requirements of the Work for materials, equipment, systems, standards, workmanship, and performance of related services.

1.46 *Subcontractor*: An individual or entity undertaking the execution of any part of the Work by virtue of a written agreement with the Contractor or any other Subcontractor. Also, an individual or entity retained by the Contractor or any other Subcontractor as an independent contractor to provide the labor, materials, equipment or services necessary to complete a specific portion of the Work.

1.47 *Substantial Completion*: Project status indicating when the Work or a designated portion of the Work is sufficiently complete in compliance with the Contract Documents so that the Owner can occupy or utilize the Work for its intended purpose without unscheduled disruption. Substantial Completion is documented by the date of the Certificate of Substantial Completion signed by the Owner and the Contractor.

1.48 *Superintendent*: The representative of the Contractor on the job site, authorized by the Contractor to receive and fulfill instructions from the Architect.

1.49 *Surety*: The individual or entity that is legally bound with the Contractor and Subcontractor to insure the faithful performance of the contract and for the payment of the bills for labor, materials and equipment by the Contractor and Subcontractors.

1.50 *Work*: The construction and services, whether completed or partially completed, including all labor, materials, equipment and services provided or to be provided by the Contractor and Subcontractors to fulfill the requirements of the Project as described in the Contract Documents.

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General Conditions

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1. Preconstruction Conference

1.1 The Contractor shall, upon acceptance of a contract and prior to commencing work, schedule a preconstruction conference with the Owner and Architect. The purpose of this conference is to:

a) introduce all parties who have a significant role in the Project, including:
Owner (State Agency)
Bureau of General Services (BGS)
Architect
Consultants
Clerk-of-the-works
Contractor (GC)
Superintendent
Subcontractors
Other State agencies
Owner's Representative
Construction testing company
Commissioning agent
Special Inspections agent;

b) review the responsibilities of each party;

c) review any previously-identified special provisions of the Project;

d) review the Schedule of the Work calendar submitted by the Contractor to be approved by the Owner and Architect;

e) review the Schedule of Values form submitted by the Contractor to be approved by the Owner and Architect;

f) establish routines for Shop Drawing approval, contract changes, requisitions, et cetera;

g) discuss jobsite issues;

h) discuss Project close-out procedures;

i) provide an opportunity for clarification of Contract Documents before work begins;

j) schedule regular meetings at appropriate intervals for the review of the progress of the Work.

2. Intent and Correlation of Contract Documents

2.1 The intent of the Contract Documents is to describe the complete Project. The Contract Documents consist of various components; each component complements the others. What is shown as a requirement by any one component shall be inferred as a requirement on all corresponding components.

2.2 The Contractor shall furnish all labor, equipment and materials, tools, transportation, insurance, services, supplies, operations and methods necessary for, and reasonably incidental to, the construction and completion of the Project. Any work that deviates from the Contract Documents which appears to be required by the exigencies of construction or by inconsistencies in the Contract Documents, will be determined by the Architect and authorized in writing by the Architect, Owner and the Bureau prior to execution. The Contractor shall be responsible for requesting clarifying information where the intent of the Contract Documents is uncertain.

2.3 The Contractor shall not utilize any apparent error or omission in the Contract Documents to the disadvantage of the Owner. The Contractor shall promptly notify the Architect in writing of such errors or omissions. The Architect shall make any corrections or clarifications necessary in such a situation to document the true intent of the Contract Documents.

3. Additional Drawings and Specifications

3.1 The Owner shall provide to the Contractor, at no additional expense to the Contractor, a reasonable quantity of additional Drawings and Specifications for the execution of the Work.

3.2 The Architect shall promptly furnish additional revised Drawings and Specifications that are created due to corrections or clarifications made by the Architect. All such information shall be consistent with, and reasonably inferred from, the Contract Documents. The Contractor shall do no work without the proper Drawings and Specifications.

4. Record of Documents

4.1 The Contractor shall maintain one complete set of Contract Documents on the jobsite, in good order and current status, for access by the Owner and Architect.

4.2 The Contractor shall maintain, continuously updated, complete records of Requests for Information, Architectural Supplemental Instructions, Information Bulletins, supplemental sketches, Change Order Proposals, Change Orders, Shop Drawings, testing reports, et cetera, for access by the Owner and Architect.

5. Ownership of Contract Documents

5.1 The designs represented on the Contract Documents are the property of the Architect. The Drawings and Specifications shall not be used on other work without consent of the Architect.

6. Shop Drawings

6.1 The Contractor shall administer Shop Drawings prepared by the Contractor, Subcontractors, suppliers or others to conform to the approved Schedule of the Work. The Contractor shall verify all field measurements, check and authorize all Shop Drawings and schedules required by the Work. The Contractor is the responsible party and contact for the Contractor's work as well as that of Subcontractors, suppliers or others who provide Shop Drawings.

6.2 The Architect shall review and acknowledge Shop Drawings, with reasonable promptness, for general conformity with the design concept of the project and compliance with the information provided in the Contract Documents.

6.3 The Contractor shall provide monthly updated logs containing: requests for information, information bulletins, supplemental instructions, supplemental sketches, change order proposals, change orders, submittals, testing and deficiencies.

6.4 The Contractor shall make any corrections required by the Architect, and shall submit a quantity of corrected copies as may be needed. The acceptance of Shop Drawings or schedules by the Architect shall not relieve the Contractor from responsibility for deviations from Drawings and Specifications, unless the Contractor has called such deviations to the attention of the Architect at the time of submission and secured the Architect’s written approval. The acceptance of Shop Drawings or schedules by the Architect does not relieve the Contractor from responsibility for errors in Shop Drawings or schedules.

7. Samples

7.1 The Contractor shall furnish for approval, with reasonable promptness, all samples as directed by the Architect. The Architect shall review and approve such samples, with reasonable promptness, for general conformity with the design concept of the project and compliance with the information provided in the Contract Documents. The subsequent work shall be in accord with the approved samples.

8. Substitutions

8.1 The Contractor shall furnish items and materials described in the Contract Documents. If the item or material specified describes a proprietary product, or uses the name of a manufacturer, the term "or approved equal" shall be implied, if it is not included in the text. The specific item or material specified establishes a minimum standard for the general design, level of quality, type, function, durability, efficiency, reliability, compatibility, warranty coverage, installation factors and required maintenance. The Drawing or written Specification shall not be construed to exclude other manufacturers products of comparable design, quality, and efficiency.

8.2 The Contractor may submit detailed information about a proposed substitution to the Architect for consideration. Particular models of items and particular materials which the Contractor asserts to be equal to the items and materials identified in the Contract Documents shall be allowed only with written approval by the Architect. The request for substitution shall include a cost comparison and a reason or reasons for the substitution.

8.3 The Architect may request additional information about the proposed substitution. The approval or rejection of a proposed substitution may be based on timeliness of the request, source of the information, the considerations of minimum standards described above, or other considerations. The Architect should briefly state the rationale for the decision. The decision shall be considered final.

8.4 The duration of a substitution review process can not be the basis for a claim for delay in the Schedule of the Work.

9. Patents and Royalties

9.1 The Contractor shall, for all time, secure for the Owner the free and undisputed right to the use of any patented articles or methods used in the Work. The expense of defending any suits for infringement or alleged infringement of such patents shall be borne by the Contractor. Awards made regarding patent suits shall be paid by the Contractor. The Contractor shall hold the Owner harmless regarding patent suits that may arise due to installations made by the Contractor, and to any awards made as a result of such suits.

9.2 Any royalty payments related to the work done by the Contractor for the Project shall be borne by the Contractor. The Contractor shall hold the Owner harmless regarding any royalty payments that may arise due to installations made by the Contractor.

10. Surveys, Layout of Work

10.1 The Owner shall furnish all property surveys unless otherwise specified.

10.2 The Contractor is responsible for correctly staking out the Work on the site. The Contractor shall employ a competent surveyor to position all construction on the site. The surveyor shall run the

axis lines, establish correct datum points and check each line and point on the site to insure their accuracy. All such lines and points shall be carefully preserved throughout the construction.

10.3 The Contractor shall lay out all work from dimensions given on the Drawings. The Contractor shall take measurements and verify dimensions of any existing work that affects the Work or to which the Work is to be fitted. The Contractor is solely responsible for the accuracy of all measurements. The Contractor shall verify all grades, lines, levels, elevations and dimensions shown on the Drawings and report any errors or inconsistencies to the Architect prior to commencing work.

11. Permits, Laws, and Regulations

11.1 The Owner is responsible for obtaining any zoning approvals or other similar local project approvals necessary to complete the Work, unless otherwise specified in the Contract Documents.

11.2 The Owner is responsible for obtaining Maine Department of Environmental Protection, Maine Department of Transportation, or other similar state government project approvals necessary to complete the Work, unless otherwise indicated in the Contract Documents.

11.3 The Owner is responsible for obtaining any federal agency project approvals necessary to complete the Work, unless otherwise indicated in the Contract Documents.

11.4 The Owner is responsible for obtaining all easements for permanent structures or permanent changes in existing facilities.

11.5 The Contractor is responsible for obtaining and paying for all permits and licenses necessary for the implementation of the Work. The Contractor shall notify the Owner of any delays, variance or restrictions that may result from the issuing of permits and licenses.

11.6 The Contractor shall comply with all ordinances, laws, rules and regulations and make all required notices bearing on the implementation of the Work. In the event the Contractor observes disagreement between the Drawings and Specifications and any ordinances, laws, rules and regulations, the Contractor shall promptly notify the Architect in writing. Any necessary changes shall be made as provided in the contract for changes in the work. The Contractor shall not perform any work knowing it to be contrary to such ordinances, laws, rules and regulations.

11.7 The Contractor shall comply with local, state and federal regulations regarding construction safety and all other aspects of the Work.

12. Taxes

12.1 The Owner is exempt from the payment of Federal Excise Taxes on articles not for resale and from the Federal Transportation Tax on all shipments, as well as Maine State Sales and Use Taxes. Pricing in all Change Order Proposals from the Contractor and Subcontractors shall not include these taxes.

12.2 Maine statute (36 M.R.S.A. §1760) allows "…an exemption from sales and use tax on items which will be physically incorporated in real property of an exempt organization. This exemption only applies to lumber, hardware, doors and windows, nails, insulation and other building materials actually affixed to realty. Tools, wearing apparel, consumable supplies, machinery and equipment used by the Contractor are taxable even if purchased specifically for the exempt job."

12.3 The Contractor may contact Maine Revenue Services, 24 State House Station, Augusta, Maine 04333 for guidance on tax exempt regulations authorized by 36 M.R.S.A. §1760 and detailed in Rule 302 (18-125 CMR 302).

13. Labor and Wages

13.1 The Contractor shall conform to the labor laws of the State of Maine, and all other laws, ordinances, and legal requirements affecting the work in Maine.

13.2 The Architect shall include a wage determination document prepared by the Maine Department of Labor in the Contract Documents for state-funded contracts in excess of $50,000. The document shows the minimum wages required to be paid to each category of labor employed on the project.

13.3 On projects requiring a Maine wage determination, the Contractor shall submit monthly payroll records to the Owner ("the contracting agency") showing the name and occupation of all workers and all independent contractors employed on the project. The monthly submission must also include the Contractor's company name, the title of the project, hours worked, hourly rate or other method of remuneration, and the actual wages or other compensation paid to each person.

13.4 The Contractor shall not reveal, in the payroll records submitted to the Owner, personal information regarding workers and independent contractors, other than the information described above. Such information shall not include Social Security number, employee identification number, or employee address or phone number, for example.

13.5 The Contractor shall conform to Maine statute by providing to the Owner a list of all subcontractors and independent contractors on the job site and a record of the entity to whom that subcontractor or independent contractor is directly contracted and by whom that subcontractor or independent contractor is insured for workers' compensation purposes.

13.6 The Contractor shall enforce strict discipline and good order among their employees at all times, and shall not employ any person unfit or unskilled to do the work assigned to them.

13.7 The Contractor shall promptly pay all employees when their compensation is due, shall promptly pay all others who have billed and are due for materials, supplies and services used in the Work, and shall promptly pay all others who have billed and are due for insurance, workers compensation coverage, federal and state unemployment compensation, and Social Security charges pertaining to this Project. Before final payments are made, the Contractor shall furnish to the Owner affidavits that all such payments described above have been made.

13.8 The Contractor may contact the Maine Department of Labor, 54 State House Station, Augusta, Maine 04333 for guidance on labor issues.

14. Insurance Requirements

14.1 The Contractor shall not commence work under this contract until the Contractor has obtained all insurance required under this article and such insurance has been approved by the Owner. The Contractor shall not allow any Subcontractor to commence work on a subcontract until all similar insurance required of the Subcontractor has been so obtained and approved.

14.2 The Owner does not warrant or represent that the insurance required under this article constitutes an insurance portfolio which adequately addresses all risks faced by the Contractor or its Subcontractors. The Contractor and Subcontractors of every tier shall satisfy themselves as to the existence, extent and adequacy of insurance prior to commencement of work.

14.3 The Contractor and any Subcontractor shall procure and maintain for the duration of the Project insurance of the types and limits set forth under this article and such insurance as will protect themselves from claims which may arise out of or result from the Contractor’s or Subcontractor’s execution of the work, whether such execution be by themselves or by anyone directly or indirectly employed by any of them or by anyone for whose acts any of them may be liable. The insurance coverage provided by the Contractor and any Subcontractor will be primary coverage.

14.4 Workers' Compensation Insurance

Worker's Compensation insurance for all employees on site in accordance with the requirements of the Workers' Compensation law of the State of Maine.

Minimum acceptable limits for Employer's Liability are:

Bodily Injury by Accident $500,000
Bodily Injury by Disease ..... $500,000 Each Employee
Bodily Injury by Disease ..... $500,000 Policy Limit

14.5 Liability Insurance

a) General Liability Insurance

General liability insurance for bodily injury and property damage liability for all hazards of the Project including premise and operations, products and completed operations, contractual, and personal injury liabilities. It shall include collapse and underground coverage - as well as explosion coverage if explosion hazards exist. Aggregate limits shall apply on a per location or project basis.

Minimum acceptable limits are:

General aggregate limit $2,000,000
Products and completed operations aggregate $1,000,000
Each occurrence limit $1,000,000
Personal injury aggregate $1,000,000

b) Automobile Liability Insurance

Automobile liability insurance against claims for bodily injury, death or property damage resulting from the maintenance, ownership or use of all owned, non-owned and hired automobiles, trucks and trailers.

Minimum acceptable limit is:

Any one accident or loss $1,000,000

c) Owners Protective Liability Insurance

For Contracts exceeding $50,000 in total Contract amount, Contractor shall secure an Owners Protective Liability policy naming the Owner as the Named Insured.

Minimum acceptable limits are:

General aggregate limit $2,000,000
Each occurrence limit $1,000,000

d) Pollution Liability Insurance

In the event that any disruption, handling, abatement, remediation, encapsulation, removal, transport, or disposal of contaminated or hazardous material is required, the Contractor or its Subcontractor shall secure a pollution liability policy in addition to any other coverages contained in this section. The insurance shall be provided on an occurrence based policy and shall remain in effect for the duration of the Project.

Minimum acceptable limit is:

Each occurrence limit $1,000,000

14.6 Property Insurance

a) New Construction Only

The Contractor shall procure and maintain Builder's Risk insurance naming the Owner, Contractor and all Subcontractors as insureds as their interest may appear. The covered cause of loss form shall be Risks of Direct Physical Loss, endorsed to include flood, earthquake, testing and ensuing loss and shall include coverage for materials in transit and materials stored off site. Coverage shall be on a replacement cost and a completed value basis. Unless specifically authorized by the Owner, the limit of insurance shall not be less than the contract amount and coverage shall apply during the entire contract period until the Certificate of Substantial Completion is accepted by the Owner.

b) Renovations within and Additions to Existing Buildings Insured by State of Maine Risk Management Division

Insurance shall be provided by the Owner. The Owner shall provide the following Project information to the State of Maine Risk Management Division prior to commencement of the Work in order to initiate the insurance coverage: building name, street address and municipality, brief project description, project start date and completion date, contract dollar value, and Contractor name and address. Said insurance shall name the Contractor and all Subcontractors as insureds as their interest may appear. The covered causes of loss form shall be Risks of Direct Physical Loss, endorsed to include flood, earthquake, testing and ensuing loss and shall include coverage for materials in transit and materials stored off site. Theft coverage is not included and exclusions common to commercial property policies are applicable. The Contractor shall be responsible for a $500 deductible per occurrence. Unless specifically authorized by the Owner, the limit of insurance shall not be less than the contract amount and coverage shall apply during the entire contract period until the Certificate of Substantial Completion is accepted by the Owner. Verification of insurance will be furnished to the Contractor upon request. The Contractor may independently acquire, at the Contractor's expense, coverage in excess of that maintained by the State of Maine.

14.7 The Contractor shall provide four original copies of all certificates of insurance in a form, and issued by, companies acceptable to the Owner prior to commencement of work. The certificates shall name the Owner as certificate holder. The certificates shall contain a provision that coverage afforded under the insurance policies will not be canceled or materially changed unless at least thirty (30) calendar days prior written notice by registered letter has been given to the Owner.

15. Contract Bonds

15.1 When noted as required in the Bid Documents, the Contractor shall provide to the Owner a Performance Bond and a Payment Bond, or "contract bonds", upon execution of the contract. Each bond value shall be for the full amount of the contract and issued by a surety company authorized to do business in the State of Maine as approved by the Owner. The bonds shall be executed on the forms furnished in the Bid Documents. The bonds shall allow for any addition or deductions of the contract.

15.2 The contract bonds shall continue in effect for one year after final acceptance of the contract to protect the Owner's interest in connection with the one year guarantee of workmanship and materials and to assure settlement of claims for the payment of all bills for labor, materials and equipment by the Contractor.

16. Allowances

16.1 The Contract Price shall include all allowances described in the Contract Documents. The Contractor shall include all overhead and profit necessary to implement each allowance in their Contract Price.

16.2 The Contractor shall not be required to employ parties for allowance work against whom the Contractor has a reasonable objection. In such a case, the Contractor shall notify the Owner in writing of their position and shall propose an alternative party to complete the work of the allowance.

17. Assignment of Contract

17.1 The Contractor shall not assign or sublet the contract as a whole without the written consent of the Owner. The Contractor shall not assign any money due to the Contractor without the written consent of the Owner.

18. Separate Contracts

18.1 The Owner reserves the right to create other contracts in connection with this Project using similar General Conditions. The Contractor shall allow the Owner's other contractors reasonable opportunity for the delivery and storage of materials and the execution of their work. The Contractor shall coordinate and properly connect the Work of all contractors.

18.2 The Contractor shall promptly report to the Architect and Owner any apparent deficiencies in work of the Owner's other contractors that impacts the proper execution or results of the Contractor. The Contractor’s failure to observe or report any deficiencies constitutes an acceptance of the Owner's other contractors work as suitable for the interface of the Contractor’s work, except for latent deficiencies in the Owner's other contractors work.

18.3 Similarly, the Contractor shall promptly report to the Architect and Owner any apparent deficiencies in their own work that would impact the proper execution or results of the Owner's other contractors.

18.4 The Contractor shall report to the Architect and Owner any conflicts or claims for damages with the Owner's other contractors and settle such conflicts or claims for damages by mutual agreement or arbitration, if necessary, at no expense to the Owner.

18.5 In the event the Owner's other contractors sue the Owner regarding any damage alleged to have been caused by the Contractor, the Owner shall notify the Contractor, who shall defend such proceedings at the Contractor's expense. The Contractor shall pay or satisfy any judgment that may arise against the Owner, and pay all other costs incurred.

19. Subcontracts

19.1 The Contractor shall not subcontract any part of this contract without the written permission of the Owner.

19.2 The Contractor shall submit a complete list of named Subcontractors and material suppliers to the Architect and Owner for approval by the Owner prior to commencing work. The Subcontractors named shall be reputable companies of recognized standing with a record of satisfactory work.

19.3 The Contractor shall not employ any Subcontractor or use any material until they have been approved, or where there is reason to believe the resulting work will not comply with the Contract Documents.

19.4 The Contractor, not the Owner, is as fully responsible for the acts and omissions of Subcontractors and of persons employed by them, as the Contractor is for the acts and omissions of persons directly or indirectly employed by the Contractor.

19.5 Neither the Contract Documents nor any Contractor-Subcontractor contract shall indicate, infer or create any direct contractual relationship between any Subcontractor and the Owner.

20. Contractor-Subcontractor Relationship

20.1 The Contractor shall be bound to the Subcontractor by all the obligations in the Contract Documents that bind the Contractor to the Owner.

20.2 The Contractor shall pay the Subcontractor, in proportion to the dollar value of the work completed by the Subcontractor, the dollar amount allowed to the Contractor at the time each Contractor's Requisition for Payment is approved by the Owner.

20.3 The Contractor shall pay the Subcontractor accordingly if the Contract Documents or the subcontract provide for earlier or larger payments than described in the provision above.

20.4 The Contractor shall pay the Subcontractor on demand for subcontract work or materials as far as executed and fixed in place, less retainage, at the time the Contractor's Requisition for Payment is approved by the Owner, even if the Architect fails to certify a portion of the Requisition for Payment for a cause not the fault of the Subcontractor.

20.5 The Contractor shall not make a claim for liquidated damages or penalty for delay in any amount in excess of amounts that are specified by the subcontract.

20.6 The Contractor shall not make a claim for services rendered or materials furnished by the Subcontractor unless written notice is given by the Contractor to the Subcontractor within ten calendar days of the day in which the claim originated.

20.7 The Contractor shall give the Subcontractor an opportunity to present and to submit evidence in any progress conference or disputes involving subcontract work.

20.8 The Contractor shall pay the Subcontractor a just share of any fire insurance payment received by the Contractor.

20.9 The Subcontractor shall be bound to the Contractor by the terms of the Contract Documents and assumes toward the Contractor all the obligations and responsibilities that the Contractor, by those documents, assumes toward the Owner.

20.10 The Subcontractor shall submit applications for payment to the Contractor in such reasonable time as to enable the Contractor to apply for payment as specified.

20.11 The Subcontractor shall make any claims for extra cost, extensions of time or damages, to the Contractor in the manner provided in these General Conditions for like claims by the Contractor to the Owner, except that the time for the Subcontractor to make claims for extra cost is seven calendar days after the receipt of Architect's instructions.

21. Supervision of the Work

21.1 During all stages of the Work the Contractor shall have a competent superintendent, with any necessary assistant superintendents, overseeing the project. The superintendent shall not be reassigned without the consent of the Owner unless a superintendent ceases to be employed by the Contractor due to unsatisfactory performance.

21.2 The superintendent represents the Contractor on the jobsite. Directives given by the Architect or Owner to the superintendent shall be as binding as if given directly to the Contractor's main office. All important directives shall be confirmed in writing to the Contractor. The Architect and Owner are not responsible for the acts or omissions of the superintendent or assistant superintendents.

21.3 The Contractor shall provide supervision of the Work equal to the industry's highest standard of care. The superintendent shall carefully study and compare all Contract Documents and promptly report any error, inconsistency or omission discovered to the Architect. The Contractor may not necessarily be held liable for damages resulting directly from any error, inconsistency or omission in the Contract Documents or other instructions by the Architect that was not revealed by the superintendent in a timely way.

22. Observation of the Work

22.1 The Contractor shall allow the Owner, the Architect and the Bureau continuous access to the site for the purpose of observation of the progress of the work. All necessary safeguards and accommodations for such observations shall be provided by the Contractor.

22.2 The Contractor shall coordinate all required testing, approval or demonstration of the Work. The Contractor shall give sufficient notice to the appropriate parties of readiness for testing, inspection or examination.

22.3 The Contractor shall schedule inspections and obtain all required certificates of inspection for inspections by a party other than the Architect.

22.4 The Architect shall make all scheduled observations promptly, prior to the work being concealed or buried by the Contractor. If approval of the Work is required of the Architect, the Contractor shall notify the Architect of the construction schedule in this regard. Work concealed or buried prior to the Architect's approval may need to be uncovered at the Contractor’s expense.

22.5 The Architect may order reexamination of questioned work, and, if so ordered, the work must be uncovered by the Contractor. If the work is found to conform to the Contract Documents, the Owner shall pay the expense of the reexamination and remedial work. If the work is found to not conform to the Contract Documents, the Contractor shall pay the expense, unless the defect in the work was caused by the Owner's Contractor, whose responsibility the reexamination expense becomes.

22.6 The Bureau shall periodically observe the Work during the course of construction and make recommendations to the Contractor or Architect as necessary. Such recommendations shall be considered and implemented through the usual means for changes to the Work.

23. Architect's Status

23.1 The Architect represents the Owner during the construction period, and observes the work in progress on behalf of the Owner. The Architect has authority to act on behalf of the Owner only to the extent expressly provided by the Contract Documents or otherwise demonstrated to the Contractor. The Architect has authority to stop the work whenever such an action is necessary, in the Architect's reasonable opinion, to ensure the proper execution of the contract.

23.2 The Architect is the interpreter of the conditions of the contract and the judge of its performance. The Architect shall favor neither the Owner nor the Contractor, but shall use the Architect’s powers under the contract to enforce faithful performance by both parties.

23.3 In the event of the termination of the Architect's employment on the project prior to completion of the work, the Owner shall appoint a capable and reputable replacement. The status of the new Architect relative to this contract shall be that of the former Architect.

24. Management of the Premises

24.1 The Contractor shall place equipment and materials, and conduct activities on the premises in a manner that does not unreasonably hinder site circulation, environmental stability, or any long term effect. Likewise, the Architect's directions shall not cause the use of premises to be impeded for the Contractor or Owner.

24.2 The Contractor shall not use the premises for any purpose other that that which is directly related to the scope of work. The Owner shall not use the premises for any purpose incompatible with the proposed work simultaneous to the work of the Contractor.

24.3 The Contractor shall enforce the Architect’s instructions regarding information posted on the premises such as signage and advertisements, as well as activities conducted on the premises such as fires, and smoking.

24.4 The Owner may occupy any part of the Project that is completed with the written consent of the Contractor, and without prejudice to any of the rights of the Owner or Contractor. Such use or occupancy shall not, in and of itself, be construed as a final acceptance of any work or materials.

25. Safety and Security of the Premises

25.1 The Contractor shall continuously maintain security on the premises and protect from unreasonable occasion of injury all people authorized to be on the job site. The Contractor shall also effectively protect the property and adjacent properties from damage or loss.

25.2 The Contractor shall take all necessary precautions to ensure the safety of workers and others on and adjacent to the site, abiding by applicable local, state and federal safety regulations. The Contractor shall erect and continuously maintain safeguards for the protection of workers and others, and shall post signs and other warnings regarding hazards associated with the construction process, such as protruding fasteners, moving equipment, trenches and holes, scaffolding, window, door or stair openings, and falling materials.

25.3 The Contractor shall designate, and make known to the Architect and the Owner, a safety officer whose duty is the prevention of accidents on the site.

25.4 The Contractor shall restore the premises to conditions that existed prior to the start of the project at areas not intended to be altered according to the Contract Documents.

25.5 The Contractor shall protect existing utilities and exercise care working in the vicinity of utilities shown in the Drawings and Specifications or otherwise located by the Contractor.

25.6 The Contractor shall protect from damage existing trees and other significant plantings and landscape features of the site which will remain a permanent part of the site. If necessary or indicated in the Contract Documents, tree trunks shall be boxed and barriers erected to prevent damage to tree branches or roots.

25.7 Damage to the Work, including that which is reasonably protected, shall be repaired or replaced at the expense of the party who caused the damage.

25.8 The Contractor shall not load, or allow to be loaded, any part of the Project with a force which imperils personal or structural safety. The Architect may consult with the Contractor on such means and methods of construction, however, the ultimate responsibility lies with the Contractor.

25.9 The Contractor shall not jeopardize any work in place with subsequent construction activities such as blasting, drilling, excavating, cutting, patching or altering work. The Architect must approve altering any structural components of the project. The Contractor shall supervise all construction activities carried out by others on site to ensure that the work is neatly done and in a manner that will not endanger the structure or the component parts.

25.10 The Contractor may act with their sole discretion in emergency situations that potentially effect health, life or serious damage to the premises or adjacent properties, to prevent such potential loss or injury. The Contractor may negotiate with the Owner for compensation for expenses due to such emergency work.

25.11 The Contractor shall keep the premises free of any unsafe accumulation of waste materials caused by the work. The Contractor shall regularly keep the spaces “broom clean”. See the Close-out of the Work provisions of this section regarding cleaning at the completion of the project.

26. Changes in the Work

26.1 The Contractor shall not proceed with extra work without an approved Change Order or Construction Change Directive. A Change Order which has been properly signed by all parties shall become a part of the contract.

26.2 A Change Order is the usual document for directing changes in the Work. In certain circumstances, however, the Owner may utilize a Construction Change Directive to direct the Contractor to perform changes in the Work that are generally consistent with the scope of the project. The Owner shall use a Construction Change Directive only when the normal process for approving changes to the Work has failed to the detriment of the Project, or when agreement on the terms of a Change Order cannot be met, or when an urgent situation requires, in the Owner's judgment, prompt action by the Contractor.

26.3 The Architect shall prepare the Construction Change Directive representing a complete scope of work, with proposed Contract Price and Contract Time revisions, if any, clearly stated.

26.4 The Contractor shall promptly carry out a Construction Change Directive which has been signed by the Owner and the Architect. Work thus completed by the Contractor constitutes the basis for a Change Order. Changes in the Contract Price and Contract Time shall be as defined in the Construction Change Directive unless subsequently negotiated with some other terms.

26.5 The method of determining the dollar value of extra work shall be by:

a) an estimate of the Contractor accepted by Owner as a lump sum, or
b) unit prices named in the contract or subsequently agreed upon, or
c) cost plus a designated percentage, or
d) cost plus a fixed fee.

26.6 The Contractor shall determine the dollar value of the extra work for both the lump sum and cost plus designated percentage methods using the following rates. The rates include all overhead and profit expenses.

a) Contractor - for any work performed by the Contractor’s own forces, 20% of the cost;
b) Subcontractor - for work performed by Subcontractor’s own forces, 20% of the cost;
c) Contractor - for work performed by Contractor’s Subcontractor, 10% of the amount due the Subcontractor.

26.7 The Contractor shall keep and provide records as needed or directed for the cost plus designated percentage method. The Architect shall review and certify the appropriate amount which includes the Contractor's overhead and profit. The Owner shall make payments based on the Architect’s certificate.

26.8 Cost reflected in Change Orders shall be limited to the following: cost of materials, cost of delivery, cost of labor (including Social Security, pension, Workers' Compensation insurance, and unemployment insurance), and cost of rental of power tools and equipment. Labor cost may include a pro-ratio share of a foreman's time only in the case of an extension of contract time granted due to the Change Order.

26.9 Overhead reflected in Change Orders shall be limited to the following: bond premium, supervision, wages of clerks, time keepers, and watchmen, small tools, incidental expenses, general office expenses, and all other overhead expenses directly related to the Change Order.

26.10 The Contractor shall provide credit to the Owner for labor, materials, equipment and other costs but not overhead and profit expenses for those Change Order items that result in a net value of credit to the contract.

26.11 The Owner may change the scope of work of the Project without invalidating the contract. The Owner shall notify the Contractor of a change of the scope of work for the Owner's Contractors, which may affect the work of this Contractor, without invalidating the contract. Change Orders for extension of the time caused by such changes shall be developed at the time of directing the change in scope of work.

26.12 The Architect may order minor changes in the Work, not involving extra cost, which is consistent with the intent of the design or project.

26.13 The Contractor shall immediately give written notification to the Architect of latent conditions discovered at the site which materially differ from those represented in the Drawings or Specifications, and which may eventually result in a change in the scope of work. The Contractor shall suspend work until receiving direction from the Architect. The Architect shall promptly investigate the conditions and respond to the Contractor's notice with direction that avoids any unnecessary delay of the Work. The Architect shall determine if the discovered conditions warrant a Change Order.

26.14 The Contractor shall, within ten calendar days of receipt of the information, give written notification to the Architect if the Contractor claims that instructions by the Architect will constitute extra cost not accounted for by Change Order or otherwise under the contract. The Architect shall promptly respond to the Contractor's notice with direction that avoids any unnecessary delay of the Work. The Architect shall determine if the Contractor's claim warrants a Change Order.

27. Correction of the Work

27.1 The Contractor shall promptly remove from the premises all work the Architect declares is non-conforming to the contract. The Contractor shall replace the work properly at no expense to the Owner. The Contractor is also responsible for the expenses of others whose work was damaged or destroyed by such remedial work.

27.2 The Owner may elect to remove non-conforming work if it is not removed by the Contractor within a reasonable time, that time defined in a written notice from the Architect. The Owner may elect to store removed non-conforming work not removed by the Contractor at the Contractor's expense. The Owner may, with ten days written notice, dispose of materials which the Contractor does not remove. The Owner may sell the materials and apply the net proceeds, after deducting all expenses, to the costs that should have been borne by the Contractor.

27.3 The Contractor shall remedy any defects due to faulty materials or workmanship and pay for any related damage to other work which appears within a period of one year from the date of substantial completion, and in accord with the terms of any guarantees provided in the contract.

The Owner shall promptly give notice of observed defects to the Contractor and Architect. The Architect shall determine the status of all claimed defects.

27.4 The Architect may authorize, after a reasonable notification to the Contractor, an equitable deduction from the contract amount in lieu of the Contractor correcting non-conforming or defective work.

28. Owner's Right to do Work

28.1 The Owner may, using other contractors, correct deficiencies attributable to the Contractor, or complete unfinished work. Such action shall take place only after giving the Contractor three days written notice, and provided the Architect approves of the proposed course of action as an appropriate remedy. The Owner may then deduct the cost of the remedial work from the amount due the Contractor.

28.2 The Owner may act with their sole discretion when the Contractor is unable to take action in emergency situations that potentially effect health, life or serious damage to the premises or adjacent properties, to prevent such potential loss or injury. The Owner shall inform the Contractor of the emergency work performed, particularly where it may affect the work of the Contractor.

29. Termination of Contract and Stop Work Action

29.1 The Owner may, owing to a certificate of the Architect indicating that sufficient cause exists to justify such action, without prejudice to any other right or remedy and after giving the Contractor and the Contractor's surety seven days written notice, terminate the employment of the Contractor. At that time the Owner may take possession of the premises and of all materials, tools and appliances on the premises and finish the work by whatever method the Owner may deem expedient. Cause for such action by the Owner includes: if the contractor is adjudged bankrupt, or makes a general assignment for the benefit of its creditors, or if a receiver is appointed due to the Contractor's insolvency, or if the Contractor persistently or repeatedly refuses or fails to provide enough properly skilled workers or proper materials, or if the Contractor fails to make prompt payment to Subcontractors or material or labor suppliers, or if the Contractor persistently disregards laws, ordinances or the instructions of the Architect, or is otherwise found guilty of a substantial violation of a provision of the Contract Documents.

29.2 The Contractor is not entitled, as a consequence of the termination of the employment of the Contractor as described above, to receive any further payment until the Work is finished. If the unpaid balance of the contract amount exceeds the expense of finishing the Work, including compensation for additional architectural, managerial and administrative services, such balance shall be paid to the Contractor. If the expense of finishing the Work exceeds the unpaid balance, the Contractor shall pay the difference to the Owner. The Architect shall certify the expense incurred by the Contractor's default. This obligation for payment shall continue to exist after termination of the contract.

29.3 The Contractor may, if the Work is stopped by order of any court or other public authority for a period of thirty consecutive days, and through no act or fault of the Contractor or of anyone employed by the Contractor, with seven days written notice to the Owner and the Architect, terminate this contract. The Contractor may then recover from the Owner payment for all work executed, any proven loss and reasonable profit and damage.

29.4 The Contractor may, if the Architect fails to issue a certificate for payment within seven days after the Contractor's formal request for payment, through no fault of the Contractor, or if the Owner fails to pay to the Contractor within 30 days after submission of any sum certified by the Architect, with seven days written notice to the Owner and the Architect, stop the Work or terminate this Contract.

30. Delays and Extension of Time

30.1 The completion date of the contract shall be extended if the work is delayed by changes ordered in the work which have approved time extensions, or by an act or neglect of the Owner, the Architect, or the Owner's Contractor, or by strikes, lockouts, fire, flooding, unusual delay in transportation, unavoidable casualties, or by other causes beyond the Contractor's control. The Architect shall determine the status of all claimed causes.

30.2 The contract shall not be extended for delay occurring more than seven calendar days before the Contractor's claim made in writing to the Architect. In case of a continuing cause of delay, only one claim is necessary.

30.3 The contract shall not be extended due to failure of the Architect to furnish drawings if no schedule or agreement is made between the Contractor and the Architect indicating the dates which drawings shall be furnished and fourteen calendar days has passed after said date for such drawings.

30.4 This article does not exclude the recovery of damages for delay by either party under other provisions in the Contract Document.

31. Payments to the Contractor

31.1 As noted under *Preconstruction Conference* in this section, the Contractor shall submit a Schedule of Values form, before the first application for payment, for approval by the Owner and Architect. The Architect may direct the Contractor to provide evidence that supports the correctness of the form. The approved Schedule of Values shall be used as a basis for payments.

31.2 The Contractor shall submit an application for each payment ("Requisition for Payment") on a form approved by the Owner and Architect. The Architect may require receipts or other documents showing the Contractor's payments for materials and labor, including payments to Subcontractors.

31.3 The Contractor shall submit Requisitions for Payment as the work progresses not more frequently than once each month, unless the Owner approves a more frequent interval due to unusual circumstances. The Requisition for Payment is based on the proportionate quantities of the various classes of work completed or incorporated in the Work, in agreement with the actual progress of the Work and the dollar value indicated in the Schedule of Values.

31.4 The Architect shall verify and certify each Requisition for Payment which appears to be complete and correct prior to payment being made by the Owner. The Architect may certify an appropriate amount for materials not incorporated in the Work which have been delivered and suitably stored at the site. The Contractor shall submit bills of sale, insurance certificates, or other such documents that will adequately protect the Owner's interests prior to payments being certified.

31.5 In the event any materials delivered but not yet incorporated in the Work have been included in a certified Requisition for Payment with payment made, and said materials thereafter are damaged, deteriorated or destroyed, or for any reason whatsoever become unsuitable or unavailable for use

in the Work, the full amount previously allowed shall be deducted from subsequent payments unless the Contractor satisfactorily replaces said material.

31.6 The Contractor may request certification of an appropriate dollar amount for materials not incorporated in the Work which have been delivered and suitably stored away from the site. The Contractor shall submit bills of sale, insurance certificates, right-of-entry documents or other such documents that will adequately protect the Owner's interests. The Architect shall determine if the Contractor's documentation for the materials is complete and specifically designated for the Project. The Owner may allow certification of such payments.

31.7 Subcontractors may request, and shall receive from the Architect, copies of approved Requisitions for Payment showing the amounts certified in the Schedule of Values.

31.8 Certified Requisitions for Payment, payments made to the Contractor, or partial or entire occupancy of the project by the Owner shall not constitute an acceptance of any work that does not conform to the Contract Documents. The making and acceptance of the final payment constitutes a waiver of all claims by the Owner, other than those arising from unsettled liens, from faulty work or materials appearing within one year from final payment or from requirements of the Drawings and Specifications, and of all claims by the Contractor, except those previously made and still unsettled.

31.9 The Owner shall retain five percent of each payment due the Contractor as part security for the fulfillment of the contract by the Contractor. The Owner may make payment of a portion of this "retainage" to the Contractor temporarily or permanently during the progress of the Work. The Owner may thereafter withhold further payments until the full amount of the five percent is reestablished. The Contractor may deposit with the Maine State Treasurer certain securities in place of retainage amounts due according to Maine Statute (M.R.S.A. 5, Section 1746).

32. Payments Withheld

32.1 The Architect may withhold or nullify the whole or a portion of any Requisitions for Payment submitted by the Contractor in the amount that may be necessary, in his reasonable opinion, to protect the Owner from loss due to any of the following:

a) defective work not remedied;
b) claims filed or reasonable evidence indicating probable filing of claims;
c) failure to make payments properly to Subcontractors or suppliers;
d) a reasonable doubt that the contract can be completed for the balance then unpaid;
e) liability for damage to another contractor.

The Owner shall make payment to the Contractor, in the amount withheld, when the above circumstances are removed.

33. Liens

33.1 The Contractor shall deliver to the Owner a complete release of all liens arising out of this contract before the final payment or any part of the retainage payment is released. The Contractor shall provide with the release of liens an affidavit asserting each release includes all labor and materials for which a lien could be filed. Alternately, the Contractor, in the event any Subcontractor or supplier refuses to furnish a release of lien in full, may furnish a bond satisfactory to the Owner, to indemnify the Owner against any lien.

33.2 In the event any lien remains unsatisfied after all payments to the Contractor are made by the Owner, the Contractor shall refund to the Owner all money that the latter may be compelled to pay in discharging such lien, including all cost and reasonable attorney's fees.

34. Indemnification

34.1 The Contractor shall indemnify and hold harmless the Owner, its officers, agents, and employees from and against any and all claims, liabilities and costs, including reasonable attorney's fees, for any or all injuries to persons, property or claims for money damages arising from the negligent acts or omissions of the Contractor, its employees or agents, officers or subcontractors in the performance of work under this Agreement.

35. Workmanship

35.1 The Contractor shall provide materials, equipment, and installed work equal to or better than the quality specified in the Contract Documents and approved in submittal and sample. The installation methods shall be of the highest standards, and the best obtainable from the respective trades. The Architect's decision on the quality of work shall be final.

35.2 The Contractor shall know local labor conditions for skilled and unskilled labor in order to apply the labor appropriately to the Work. All labor shall be performed by individuals well skilled in their respective trades.

35.3 The Contractor shall perform all cutting, fitting, patching and placing of work in such a manner to allow subsequent work to fit properly, whether that be by the Contractor, the Owner's Contractors or others. The Owner and Architect may advise the Contractor regarding such subsequent work. Notwithstanding the notification or knowledge of such subsequent work, the Contractor may be directed to comply with this standard of compatible construction by the Architect at the Contractor's expense.

35.4 The Contractor shall request clarification or revision of any design work by the Architect, prior to commencing that work, in a circumstance where the Contractor believes the work cannot feasibly be completed at the highest quality, or as indicated in the Contract Documents. The Architect shall respond to such requests in a timely way, providing clarifying information, a feasible revision, or instruction allowing a reduced quality of work. The Contractor shall follow the direction of the Architect regarding the required request for information.

35.5 The Contractor shall guarantee the Work against any defects in workmanship and materials for a period of one year commencing with the date of the Certificate of Substantial Completion, unless specified otherwise for specific elements of the project. The Work may also be subdivided in mutually agreed upon components, each defined by a Certificate of Substantial Completion.

36. Close-out of the Work

36.1 The Contractor shall remove from the premises all waste materials caused by the work. The Contractor shall make the spaces "broom clean" unless a more exactly cleaning is specified. The Contractor shall wash all windows and glass immediately prior to the final inspection, unless otherwise directed.

36.2 The Owner may conduct the cleaning of the premises where the Contractor, duly notified by the Architect, fails to adequately complete the task. The expense of this cleaning may be deducted from the sum due to the Contractor.

36.3 The Contractor shall participate in all final inspections and acknowledge the documentation of unsatisfactory work, generally called the "punch list", to be corrected by the Contractor. The Architect shall document the successful completion of the Work in a dated Certificate of Substantial Completion, to be signed by Owner, Architect, and Contractor.

36.4 The Contractor shall not call for final inspection of any portion of the Work that is not complete and permanent installed. The Contractor may be found liable for the expenses of individuals called to final inspection meetings prematurely.

36.5 The Contractor and all major Subcontractors shall participate in the end-of-warranty-period conference, typically scheduled close to one year after the Substantial Completion date.

37. Date of Completion and Liquidated Damages

37.1 The Contractor may make a written request to the Owner for an extension or reduction of time, if necessary. The request shall include the reasons the Contractor believes justifies the proposed completion date. The Owner may grant the revision of the contract completion date if the Work was delayed due to conditions beyond the control and the responsibility of the Contractor. The Contractor shall not conduct unauthorized accelerated work or file delay claims to recover alleged damages for unauthorized early completion.

37.2 The Contractor shall vigorously pursue the completion of the Work and notify the Owner of any factors that have, may, or will affect the approved Schedule of the Work. The Contractor may be found responsible for expenses of the Owner or Architect if the Contractor fails to make notification of project delays.

37.3 The Project is planned to be done in an orderly fashion which allows for an iterative submittal review process, construction administration including minor changes in the Work and some bad weather. The Contractor shall not file delay claims to recover alleged damages on work the Architect determines has followed the expected rate of progress.

37.4 The Architect shall prepare the Certificate of Substantial Completion which, when signed by the Owner and the Contractor, documents the date of Substantial Completion of the Work or a designated portion of the Work. The Owner shall not consider the issuance of a Certificate of Occupancy by an outside authority a prerequisite for Substantial Completion if the Certificate of Occupancy cannot be obtained due to factors beyond the Contractor's control.

37.5 Liquidated Damages may be deducted from the sum due to the Contractor for each calendar day that the Work remains uncompleted after the completion date specified in the Contract or an approved amended completion date. The dollar amount per day shall be calculated using the Schedule of Liquidated Damages table shown below.

If the original contract amount is:	The per day Liquidated Damages shall be:
More than $100,000 and less than $2,000,000	$750
More than $2,000,000 and less than $10,000,000	$1,500
More than $10,000,000	$1,500 plus $250 for each $2,000,000 over $10,000,000

38. Dispute Resolution

38.1 Mediation

a) In the event of a dispute between the parties which arises under this Agreement in which the dispute cannot be resolved through informal negotiation, the dispute shall be submitted to a neutral mediator jointly selected by the parties.

b) Either party may file suit before or during mediation if the party, in good faith, deems it to be necessary to avoid losing the right to sue due to a statute of limitations. If suit is filed before good faith mediation efforts are completed, the party filing suit shall agree to stay all proceedings in the lawsuit pending completion of the mediation process, provided such stay is without prejudice.

c) In any mediation between the Owner and the Architect, the Owner has the right to consolidate related claims between Owner and Contractor.

38.2 Arbitration

a) If the dispute is not resolved through mediation, the dispute shall be settled by arbitration. The arbitration shall be conducted before a panel of three arbitrators. Each party shall select one arbitrator; the third arbitrator shall be appointed by the arbitrators selected by the parties. The arbitration shall be conducted in accordance with the Maine Uniform Arbitration Act ("MUAA"), except as otherwise provided in this section.

b) The decision of the arbitrators shall be final and binding upon all parties. The decision may be entered in court as provided in the MUAA.

c) The costs of the arbitration, including the arbitrators' fees shall be borne equally by the parties to the arbitration, unless the arbitrator orders otherwise.

d) In any arbitration between the Owner and the Architect, the Owner has the right to consolidate related claims between Owner and Contractor.

00 73 46
Wage Determination Schedule

PART 1- GENERAL

1.1 Related Documents
A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specifications Sections, apply to this Section.

1.2 Summary
A. This Section includes the wage determination requirements for Contractors as issued by the State of Maine Department of Labor Bureau of Labor Standards or the United States Department of Labor.

1.3 Requirements
A. Conform to the wage determination schedule for this project which is shown on the following page.

PART 2 - PRODUCTS (not used)

PART 3 - EXECUTION (not used)

End of Section 00 73 46

THIS DOCUMENT MUST BE CLEARLY POSTED AT THE PERTAINING STATE FUNDED PREVAILING WAGE CONSTRUCTION SITE

State of Maine
Department of Labor
Bureau of Labor Standards
Wage and Hour Division
Augusta, Maine 04333-0045
Telephone (207) 623-7906

Wage Determination - In accordance with 26 MRSA §1301 et. seq., this is a determination by the Bureau of Labor Standards, of the fair minimum wage rate to be paid laborers and workers employed on the below titled project.

Title of Project --------YCCC C Wing HVAC Unit Repalcement

Location of Project –Wells, York County

2014 Fair Minimum Wage Rates
Building 2 York County
(other than 1 or 2 family homes)

Occupation Title	Minimum Wage	Minimum Benefit	Total	Occupation Title	Minimum Wage	Minimum Benefit	Total
Asbestos/Lead Removal Worker	$12.50	$0.30	$12.80	Ironworker - Structural	$19.00	$3.08	$22.08
Backhoe Loader Operator	$18.00	$2.43	$20.43	Laborers (Incl.Helpers & Tenders)	$13.00	$0.34	$13.34
Boom Truck (Truck Crane) Operator	$26.50	$15.46	$41.96	Laborer - Skilled	$15.00	$1.22	$16.22
Bricklayer	$23.15	$0.00	$23.15	Loader Operator - Front-End	$17.88	$3.12	$21.00
Bulldozer Operator	$17.98	$2.55	$20.53	Mechanic- Maintenance	$25.75	$0.34	$26.09
Carpenter	$20.00	$2.57	$22.57	Mechanic- Refrigeration	$23.22	$3.46	$26.68
Carpenter - Acoustical	$13.88	$2.97	$16.85	Millwright	$22.50	$7.34	$29.84
Carpenter - Rough	$19.00	$2.26	$21.26	Oil/Fuel Burner Serv & Installer (Licensed)	$21.86	$5.45	$27.31
Cement Mason/Finisher	$17.75	$0.00	$17.75	Painter	$12.50	$1.85	$14.35
Communication Equip Installer	$22.50	$3.95	$26.45	Paver Operator	$17.25	$1.63	$18.88
Concrete Pump Operator	$20.50	$3.53	$24.03	Pipe/Steam/Sprinkler Fitter	$25.00	$13.84	$38.84
Crane Operator <15 Tons	$19.50	$4.66	$24.16	Plumber (Licensed)	$24.50	$3.39	$27.89
Crane Operator =>15 Tons)	$23.00	$4.36	$27.36	Plumber Helper/Trainee (Licensed)	$16.54	$2.61	$19.15
Crusher Plant Operator	$17.00	$4.06	$21.06	Propane & Natural Gas Servicer & Inst	$23.00	$3.44	$26.44
Driller - Well	$14.00	$3.20	$17.20	Pump Installer	$21.00	$2.77	$23.77
Dry-Wall Applicator	$21.00	$1.55	$22.55	Rigger	$20.00	$5.83	$25.83
Dry-Wall Taper & Finisher	$21.00	$1.03	$22.03	Roller Operator - Pavement	$17.25	$5.41	$22.66
Electrician - Licensed	$25.00	$6.33	$31.33	Roofer	$16.00	$1.69	$17.69
Electrician Helper/Cable Puller (Licensed)	$15.00	$2.61	$17.61	Sheet Metal Worker	$19.75	$2.94	$22.69
Elevator Constructor/Installer	$51.42	$30.35	$81.77	Sider	$16.00	$1.11	$17.11
Excavator Operator	$17.00	$2.26	$19.26	Stone Mason	$18.00	$0.77	$18.77
Flagger	$11.50	$0.00	$11.50	Tile Setter	$22.05	$3.73	$25.78
Floor Layer	$15.70	$1.96	$17.66	Truck Driver - Light	$16.00	$4.13	$20.13
Glazier	$26.00	$2.47	$28.47	Truck Driver - Medium	$15.00	$1.30	$16.30
Heating	$25.00	$3.25	$28.25	Truck Driver - Heavy	$14.00	$0.51	$14.51
Insulation Installer	$16.00	$1.98	$17.98	Truck Driver - Tractor Trailer	$16.00	$4.21	$20.21
Ironworker - Reinforcing	$20.88	$1.00	$21.88	Truck Driver - Mixer (Cement)	$13.28	$0.84	$14.12

The Laborer classifications include a wide range of work duties. Therefore, if any specific occupation to be employed on this project is not listed in this determination, call the Bureau of Labor Standards at the above number for further clarification.

Welders are classified in the trade to which the welding is incidental.

Apprentices - The minimum wage rate for registered apprentices are those set forth in the standards and policies of the Maine State Apprenticeship and Training Council for approved apprenticeship programs.

Posting of Schedule - Posting of this schedule is required in accordance with 26 MRSA §1301 et. seq., by any contractor holding a State contract for construction valued at $50,000 or more and any subcontractors to such a contractor.

Appeal - Any person affected by the determination of these rates may appeal to the Commissioner of Labor by filing a written notice with the Commissioner stating the specific grounds of the objection within ten (10) days from the filing of these rates with the Secretary of State.

Determination No: B2-078-2014

Filing Date: June 30, 2014

Expiration Date: 12-31-2014

A true copy

Attest: Pamela D. Taylor

Pamela D Taylor
Director
Bureau of Labor Standards

BLS 424BU (R2014) (Building 2 York)

NOTICE TO VENDORS AND BIDDERS:
STANDARD TERMS AND CONDITIONS APPLICABLE TO ALL MCCS CONTRACTS

The following standard contracting terms and conditions are incorporated and shall become a part of any final contract that will be awarded by any college or other operating unit of the Maine Community College System (collectively "MCCS"). These terms and conditions derive from the public nature and limited resources of the MCCS. MCCS DOES NOT AGREE TO:

1. Provide any defense, hold harmless or indemnity;
2. Waive any statutory or constitutional immunity;
3. Apply the law of a state other than Maine;
4. Procure types or amounts of insurance beyond those MCCS already maintains or waive any rights of subrogation;
5. Add any entity as an additional insured to MCCS policies of insurance;
6. Pay attorneys' fees, costs, expenses or liquidated damages;
7. Promise confidentiality in a manner contrary to Maine's Freedom of Access Act;
8. Permit an entity to change unilaterally any term or condition once the contract is signed; and
9. Automatic renewals for term(s) greater than month-to-month.

By submitting a response to a Request for Proposal, bid or other offer to do business with MCCS, YOUR ENTITY UNDERSTANDS AND AGREES THAT:

1. The above standard terms and conditions are thereby incorporated into any agreement entered into between MCCS and your entity; that such terms and condition shall control in the event of any conflict with such agreement; and that your entity will not propose or demand any contrary terms;
2. The above standard terms and conditions will govern the interpretation of such agreement notwithstanding the expression of any other term and/or condition to the contrary;
3. Your entity will not propose to any college or other operating unit of the MCCS any contractual documents of any kind that are not in at least 11-point font and completely contained in one Word or PDF document, and that any references to terms and conditions, privacy policies or any other conditions referenced outside of the contract will not apply; and
4. Your entity will identify at the time of submission which, if any, portion or your submitted materials are entitled to "trade secret" exemption from disclosure under Maine's Freedom of Access Act; that failure to so identify will authorize MCCS to conclude that no portions are so exempt; and that your entity will defend, indemnify and hold harmless MCCS in any and all legal actions that seek to compel MCCS to disclose under Maine's Freedom of Access Act some or all of your submitted materials and/or contract, if any, executed between MCCS and your entity.

SECTION 01 00 00 - GENERAL REQUIREMENTS

PART 1 - GENERAL

1.1 SUMMARY

A. Project Identification: York County Community College BGS Project #4210 – C Wing HVAC Units.
   1. Project Location: 112 College Drive, Wells, Maine.
   2. Owner: State of Maine - York County Community College.

B. Engineer Identification: The Contract Documents were prepared for Project by Stantec, 482 Payne Road, Scarborough, ME 04074.

C. Project will be constructed under a general construction contract. State of Maine, Maine Community College System Construction Contract.

D. Use of Premises: Contractor shall have limited use of premises for construction operations, including use of Project site, during construction period.

1.2 CONTRACT MODIFICATIONS

A. Owner-Initiated Proposal Requests: Architect will issue a detailed description of proposed changes in the Work that may require adjustment to the Contract Sum or the Contract Time. If necessary, the description will include supplemental or revised Drawings and Specifications.

B. Contractor-Initiated Proposals: If latent or unforeseen conditions require modifications to the Contract, Contractor may propose changes by submitting a request for a change to the Architect.

C. On Owner's approval of a Proposal Request, the Engineer will issue a Change Order for signatures of Owner and Contractor on Form included in this Project Manual.

1.3 PAYMENT PROCEDURES

A. Submit the Schedule of Values to Architect at earliest possible date but no later than 7 days before the date scheduled for submittal of initial Applications for Payment.
   1. Provide a detailed breakdown of the agreed Contract Sum showing values allocated to each of the various parts of the Work, as specified herein and in other provisions of the Contract Documents.

B. Provide a separate line item in the Schedule of Values for labor and materials where Applications for Payment may include materials or equipment purchased or fabricated and stored, but not yet installed. Provide Labor and Materials breakdown for major portions of the Work such as sitework, windows, doors and frames, hardware, plumbing, heating and ventilating, electrical and other work as requested by the Architect.

C. Each Application for Payment shall be consistent with previous applications and payments as certified by Architect and paid for by Owner.

D. Payment Application Forms: Use AIA Document G702 and AIA Document G703 Continuation Sheets or Contractor's electronic media driven form, including continuation sheets when required, as form for Applications for Payment.

E. The Owner shall withhold 5% of the money due to Contractor until the work under the Contract has been accepted by or for the Owner. The Owner may, upon the completion of part or parts of the contract and with the approval of the General Contractor and Designer, pay all or part of the retainage on those parts completed as the Owner deems prudent, provided satisfactory release of lien has been provided.

1.4 PROJECT MEETINGS

A. Preconstruction Conference: Architect will schedule a preconstruction conference before starting construction, at a time convenient to Owner and Contractor, but no later than 15 days after execution of the Agreement. Conference will be held at Project site or another convenient location. Meeting will be conducted to review responsibilities and personnel assignments.
   1. Minimum agenda: Data will be distributed and discussed on the following:
      a. Organizational arrangement of Contractor's forces and personnel, and those of subcontractors, materials suppliers, and the Architect;
      b. Channels and procedures for communication;
      c. Construction schedule, including sequence of critical work;
      d. Contract Documents, including distribution of required copies of Drawings and revisions;
      e. Processing of Shop Drawings and other data submitted to the Architect for review;
      f. Processing of field decisions and Change Orders;
      g. Rules and regulations governing performance of the Work; and
      h. Procedures for security, quality control, housekeeping, and related matters.

B. Progress Meetings: Architect will conduct progress meetings at bi-weekly intervals. Coordinate dates of meetings with preparation of payment requests.
   1. Attendance: To the maximum extent practicable, assign the same person or persons to represent the Contractor at project meetings throughout progress of the Work. Subcontractors, materials suppliers, and other may be invited to attend those project meetings in which their aspects of the Work are involved
   2. Minimum agenda: Data will be distributed and discussed on the following:
      a. Review progress of the Work since last meeting, including status of submittals for approval.
      b. Identify problems which impede planned progress.
      c. Develop corrective measures and procedures to regain planned schedule.
      d. Complete other current business.

1.5 CONSTRUCTION SCHEDULE

A. Provide bar chart showing construction schedule. Revise as required during the construction period.

1.6 SUBMITTALS

A. General: Prepare and submit Submittals required by individual Specification Sections.
   1. Number of Copies: Submit the number of copies of each submittal as indicated in individual Specification Sections.

B. Product Data: Collect information into a single submittal for each element of construction and type of product or equipment.

C. Shop Drawings: Prepare Project-specific information, drawn accurately to scale. Do not base Shop Drawings on reproductions of the Contract Documents or standard printed data.

D. Do not order or install materials until the Architect has reviewed the submittal.

E. Substitutions:
   1. Do not substitute materials, equipment, or methods unless such substitution has been specifically approved in writing for this Work by the Architect.

F. "Or equal":
   1. Where the phrase "or equal," or "or equal as approved by the Architect," occurs in the Contract Documents, do not assume that the materials, equipment, or methods will be approved as equal unless the item has been specifically so approved for this Work by the Architect.
   2. The decision of the Architect shall be final.

G. Timing of Submittals:
   1. Make submittals far enough in advance of scheduled dates for installation to provide time required for reviews, for securing necessary approvals, for possible revisions and resubmittals, and for placing orders and securing delivery.
   2. In scheduling, allow at least ten working days for review by the Architect following his receipt of the submittal.

1.7 QUALITY CONTROL

A. Owner Responsibilities: Where quality-control services are indicated as Owner's responsibility, Owner will engage a qualified testing agency to perform these services.
   1. Owner will furnish Contractor with names, addresses, and telephone numbers of testing agencies engaged and a description of the types of testing and inspecting they are engaged to perform.
   2. Payment for these services will be made by the Owner.
   3. Costs for retesting and reinspecting construction that replaces or is necessitated by work that failed to comply with the Contract Documents will be charged to Contractor.

B. Coordination: Coordinate sequence of activities to accommodate required quality-assurance and quality-control services with a minimum of delay and to avoid necessity of removing and replacing construction to accommodate testing and inspecting. Schedule times for tests, inspections, obtaining samples, and similar activities.

1.8 TEMPORARY FACILITIES

A. General: Cost or use charges for temporary facilities are not chargeable to Owner or Architect and shall be included in the Contract Sum.

B. Field Offices: Prefabricated, mobile units with lockable entrances, operable windows, and serviceable finishes; heated and air conditioned; on foundations adequate for normal loading.

C. Fire Extinguishers: Hand carried, portable, UL rated. Provide class and extinguishing agent as indicated or a combination of extinguishers of NFPA-recommended classes for exposures.

D. Self-Contained Toilet Units: Single-occupant units of chemical, aerated recirculation, or combustion type; vented; fully enclosed with a glass-fiber-reinforced polyester shell or similar nonabsorbent material.

E. Drinking-Water Fixtures: Containerized, tap-dispenser, bottled-water drinking-water units, including paper cup supply.

F. Electrical Outlets: Properly configured, NEMA-polarized outlets to prevent insertion of 110- to 120-V plugs into higher-voltage outlets; equipped with ground-fault circuit interrupters, reset button, and pilot light.

G. Power Distribution System Circuits: Where permitted and overhead and exposed for surveillance, wiring circuits, not exceeding 125-V ac, 20-A rating, and lighting circuits may be nonmetallic sheathed cable.

H. Telephone Service: Provide temporary telephone service throughout construction period for common-use facilities used by all personnel engaged in construction activities.

I. Environmental Protection: Provide protection, operate temporary facilities, and conduct construction in ways and by methods that comply with environmental regulations and that minimize possible air, waterway, and subsoil contamination or pollution or other undesirable effects. Avoid using tools and equipment that produce harmful noise. Restrict use of noisemaking tools and equipment to hours that will minimize complaints from persons or firms near Project site.

J. Tree and Plant Protection: Install temporary fencing located as indicated or outside the drip line of trees to protect vegetation from construction damage. Protect tree root systems from damage, flooding, and erosion.

K. Maintenance: Maintain facilities in good operating condition until removal. Protect from damage caused by freezing temperatures and similar elements.

1.9 CLOSEOUT PROCEDURES

A. Substantial Completion: On receipt of request for inspection for Substantial Completion, Architect will either proceed with inspection or notify Contractor of unfulfilled requirements. Architect will prepare the Certificate of Substantial Completion after inspection or will notify Contractor of items, either on Contractor's list or additional items identified by Architect, that must be completed or corrected before certificate will be issued.

1. Reinspection: Request reinspection when the Work identified in previous inspections as incomplete is completed or corrected.

2. Results of completed inspection will form the basis of requirements for Final Completion.

B. Project Record Documents: Do not use Project Record Documents for construction purposes. Protect Project Record Documents from deterioration and loss. Provide access to Project Record Documents for Architect's reference during normal working hours.
   1. Record Drawings: Maintain and submit one set of blue- or black-line white prints of Contract Drawings and Shop Drawings. Mark Record Prints to show the actual installation where installation varies from that shown originally for conceal construction (piping and wiring). Require individual or entity who obtained record data, whether individual or entity is Installer, subcontractor, or similar entity, to prepare the marked-up Record Prints.
   2. Mark record sets with erasable, red-colored pencil. Use other colors to distinguish between changes for different categories of the Work at the same location.
   3. Identify and date each Record Drawing; include the designation "PROJECT RECORD DRAWING" in a prominent location. Organize into manageable sets; bind each set with durable paper cover sheets. Include identification on cover sheets.

C. Operation and Maintenance Manuals: Assemble a complete set of operation and maintenance data indicating the operation and maintenance of the mechanical system. Include operation and maintenance data required in individual Specification Sections and as follows:
   1. Operation Data:
      a. System, subsystem, and equipment descriptions, including operating standards.
      b. Operating procedures, including startup, shutdown, seasonal, and weekend operations.
      c. Description of controls and sequence of operations.
      d. Piping diagrams.
   2. Maintenance Data:
      a. Manufacturer's information, including list of spare parts.
      b. Name, address, and telephone number of Installer or supplier.
      c. Maintenance procedures.
      d. Maintenance and service schedules for preventive and routine maintenance.
      e. Maintenance record forms.
      f. Sources of spare parts and maintenance materials.
      g. Copies of maintenance service agreements.
      h. Copies of warranties and bonds.
   3. Organize operation and maintenance manuals into suitable sets of manageable size. Bind and index data in heavy-duty, 3-ring, vinyl-covered, loose-leaf binders, in thickness necessary to accommodate contents, with pocket inside the covers to receive folded oversized sheets. Identify each binder on front and spine with the printed title "OPERATION AND MAINTENANCE MANUAL," Project name, and subject matter of contents.

D. Warranties: Organize warranty documents into an orderly sequence based on the table of contents of the Project Manual.
   1. Bind warranties and bonds in heavy-duty, 3-ring, vinyl-covered, loose-leaf binders, thickness as necessary to accommodate contents, and sized to receive 8-1/2-by-11-inch (115-by-280-mm) paper.
   2. Provide heavy paper dividers with plastic-covered tabs for each separate warranty. Mark tab to identify the product or installation. Provide a typed description of the product or

installation, including the name of the product and the name, address, and telephone number of Installer.

3. Identify each binder on the front and spine with the typed or printed title "WARRANTIES," Project name, and name of Contractor.

E. Instruction: Instruct Owner's personnel to adjust, operate, and maintain systems, subsystems, and equipment not part of a system.

1.10 CUTTING AND PATCHING

A. Work included: This Section establishes general requirements pertaining to cutting (including excavating), fitting, and patching of the Work required to:
1. Make the several parts fit properly.
2. Uncover work to provide for installing, inspecting, or both, of ill-timed work.
3. Remove and replace work not conforming to requirements of the Contract Documents.
4. Remove and replace defective work.
5. Connect to existing construction.

B. Prior to cutting which effects structural safety, submit written request to the Architect for permission to proceed with cutting.

C. Materials: For replacement of items removed, use materials complying with pertinent Sections of these Specifications.

D. Perform cutting, demolition and patching, by methods that will prevent damage to other portions of the Work and provide proper surfaces to receive installation of repair and new work to Architect's approval.

1.11 CLEANING

A. Progress Cleaning:
1. Retained stored items in an orderly arrangement allowing maximum access, not impeding traffic or drainage, and providing required protection of materials.
2. At least twice each week, and more often if necessary, completely remove all scrap, debris, and waste material from the job site.
3. As required preparatory to installation of succeeding materials, clean the structures or pertinent portions thereof to the degree of cleanliness recommended by the manufacturer of the succeeding material.

B. Final Cleaning: Employ experienced workers or professional cleaners for final cleaning. Clean each surface or unit to condition expected in an average residential building cleaning program. Use only the cleaning materials and equipment which are compatible with the surface being cleaned, as recommended by the manufacturer of the material.
1. Clean Project site, yard, and grounds, in areas disturbed by construction activities, including landscape development areas, of rubbish, waste material, litter, and other foreign substances.
2. Clean exposed exterior and interior hard-surfaced finishes to a dirt-free condition, free of stains, films, and similar foreign substances. Avoid disturbing natural weathering of exterior surfaces. Restore reflective surfaces to their original condition.

3. Clean transparent materials, including mirrors and glass in doors and windows. Remove glazing compounds and other noticeable, vision-obscuring materials. Replace chipped or broken glass and other damaged transparent materials. Polish mirrors and glass, taking care not to scratch surfaces.
4. Clean plumbing fixtures to a sanitary condition, free of stains, including stains resulting from water exposure.
5. Clean light fixtures, lamps, globes, and reflectors to function with full efficiency. Replace burned-out bulbs, and those noticeably dimmed by hours of use, and defective and noisy starters in fluorescent and mercury vapor fixtures to comply with requirements for new fixtures.
6. Leave Project clean and ready for occupancy.

C. Cleaning During Owner's Occupancy: Should the Owner occupy the Work or any portion thereof prior to its completion by the Contractor and acceptance by the Owner, responsibilities for interim and final cleaning shall be as determined by the Architect in accordance with the General Conditions of the Contract

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 01000

SECTION 230500 – COMMON WORK FOR HVAC

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This Section includes the following:
   1. Demolition.
   2. Cutting and Patching.
   3. Waterproofing.
   4. Air Plenums.
   5. Electrical Connections.
   6. Accessibility.
   7. Painting.
   a. Equipment Foundations, Supports, Piers, and Attachments.
   b. Equipment Guards and Rails.
   c. Cleaning, Protection and Adjustment.
   d. Special Tools.
   e. Welding.

1.3 DEMOLITION

A. Review the construction documents, to determine the affected areas of the existing structure. Remove systems in the affected areas not to be reused including equipment, piping, ductwork, controls, hangers, supports, etc.

B. Schedule demolition work with Owner.

C. Demolition work involving electrical systems shall be coordinated prior to commencement of demolition work.

D. All existing piping shall be saw-cut, not broken, at point where piping connects to existing.

E. Where demolition of existing piping, ductwork, and other mechanical equipment, all such service shall be properly terminated in an approved manner to allow affected systems to remain in operation.

F. When demolishing existing equipment, all control wiring or pneumatic tubing serving that equipment shall be properly terminated in an approved manner to allow affected systems to remain in operation. Remove pneumatic tubing back to risers and plug.

G. Where systems serve areas under construction and areas not affected by the construction, all return air and exhaust air terminals in the construction area shall be capped, and fans shall be rebalanced for new air quantities.

H. The Owner has the right-of-first-refusal for any items to be demolished, salvaged or removed. The Contractor and Owner shall jointly review the space where demolition is to occur and identify items the Owner elects to retain prior to demolition and removal. Remove items to be retained by the Owner and deliver them to the location directed by the Owner within a (5) five mile radius of the project. Promptly remove and properly dispose of materials, equipment, ductwork, piping, debris, etc., which is not specified for reuse, storage, or retainage by Owner.

I. Provide support as required for any existing piping and equipment support affected by demolition.

J. Provide cutting and patching to match existing finish of roof, wall, floor, etc., required for demolition of existing systems. Fire and smoke ratings compromised due to demolition shall be immediately restored. Repair or apply fire proofing to structural components that are exposed due to demolition, unless noted otherwise.

K. Where piping, ductwork, etc., serves area affected by demolition and other areas of building not affected by demolition, reconnect piping, ductwork, etc., serving unaffected areas to existing or new systems serving affected areas.

1.4 CUTTING AND PATCHING

A. Provide cutting and patching necessary to install the work specified herein. Patching shall match adjacent surfaces. Refer to Division 1 - Cutting and Patching for specific directions.

B. No structural members shall be cut without prior approval of the Architect.

C. Provide ceiling removal and replacement where work above ceilings is required. Replace ceiling components damaged in the process.

1.5 WATERPROOFING

A. Where work pierces waterproofing, including waterproof concrete, the method of installation shall be approved by the Architect prior to performing the work. Furnish necessary sleeves, caulking and flashing required to make openings absolutely watertight.

1.6 AIR PLENUMS

A. In plenums which are used as part of an air distribution system as defined by NFPA, materials must be of the type rated for air plenum use. The Contractor shall be responsible to utilize the correct materials in ceiling space used for environmental air purposes.

1.7 ELECTRICAL CONNECTIONS

A. Regardless of voltage, provide control wiring, interlock wiring, and equipment control wiring for the equipment provided under this division of the specifications.

B. Furnish electrical disconnect switches, starters and combination starter disconnects required for equipment provided under this division of the specifications. Circuit breakers furnished shall be rated for motor protection.

C. Provide all power wiring for the Building Automation Control System (BACS).

D. Power wiring not used for control functions, complete from power source to motor or equipment junction box, including power wiring through starters, shall be provided under Division 26.

E. Coordinate to ensure that electrical devices furnished or provided are compatible with the electrical systems used.

1.8 ACCESSIBILITY

A. Coordinate to ensure the sufficiency of the size of shafts, and chases, and the adequacy of clearances in hung ceilings and other areas required for the proper installation of this work.

B. Locate equipment which must be serviced, operated or maintained in fully accessible positions. Locations in ceilings requiring access shall be coordinated with, but not limited to lights, curtain tracks, speakers, etc. Equipment requiring access shall include, but is not necessarily limited to, valves, traps, clean-outs, motors, fire dampers, controllers, switchgear, drain points, etc.

C. Furnish access doors under this division for installation by General Contractor (Work Category #9). Coordinate during bidding phase with General Contractor (Work Category #9).

D. Indicate the locations of access doors for each concealed valve, control, damper, or other device concealed behind finished construction and requiring service on the coordination drawings. Equipment below floor slab or finished grade shall be also be indicated on the coordinating drawings.

1.9 PAINTING

A. Painting requirements of this section shall conform to Division 9 – Painting.

B. Provide surface preparation, priming, and final coat application in strict accordance with manufacturer's recommendations.

C. Provide field painting of all piping, ductwork, hangers, supports, equipment platforms, railings, and miscellaneous metals located outdoors (including galvanized jacketed piping, galvanized jacketed ductwork, insulated ductwork, and insulated piping). Piping over 200 deg. F shall be finished with high temperature epoxy paint. Application shall be in strict accordance with manufacturer's recommendations.

1.10 EQUIPMENT FOUNDATIONS, SUPPORTS, PIERS AND ATTACHMENTS

A. Provide necessary foundations, auxiliary steel, supports, pads, bases and piers required for equipment specified in this division; submit drawings in accordance with Shop Drawing Submittal requirements prior to the purchase, fabrication or construction of same.

B. Provide 4 inch thick concrete pads for compressors, base-mounted pumps, rotating equipment, and floor-mounted equipment located in equipment rooms and as indicated on drawings. Pads shall be extended 6 inches beyond machine base in each direction with top edge chamfered. Anchor equipment pads to the floor in accordance with latest building codes seismic requirements.

C. Construction of foundations, supports, and pads where mounted on the floor, shall be of the same materials and same quality of finish as the adjacent and surrounding floor material.

D. Equipment shall be securely attached to the building structure in an approved manner. Attachments shall be of a strong and durable nature and any attachments that are, in the opinion of the Architect, deemed insufficient shall be replaced as directed, with no additional cost to the Owner.

1.11 EQUIPMENT GUARDS AND RAILS

A. Provide readily removable guards or railings for belt drives and rotating machinery. Guards shall consist of heavy angle iron frames, hinged and latched, with heavy galvanized iron crimped mesh wire securely fastened to frames. Railing shall be 1-1/2 inch pipe and railing fittings.

B. Multiple V-belt drives shall have band belts to minimize vibration.

1.12 CLEANING, PROTECTION AND ADJUSTMENT

A. Cleaning:

1. General cleaning requirements are specified in Division 1.

2. Upon completion of the work, clean the exterior surface of equipment, accessories, and trim installed. Clean, polish, and leave equipment, accessories, and trim in first-class condition.

B. Protection of Surfaces:

1. Protect new and existing surfaces from damage during the construction period.

2. Provide plywood or similar material under equipment or materials stored on floors or roofs. Provide protection in areas where construction may damage surfaces.

3. Surfaces damaged during the construction shall be repaired or replaced at the cost of the Contractor at fault. The method of repairing or replacing the surface shall be approved by the Owner and Architect

C. Protection of Services:

1. Protect new and existing services from damage during the construction period.

2. Repair, replace and maintain in service any new or existing utilities, facilities or services (underground, overground, interior or exterior) damaged, broken or otherwise rendered inoperative during the course of construction.

3. Services damaged during the construction shall be replaced at the cost of the Contractor at fault. The method used in repairing, replacing or maintaining the services shall be approved by the Owner and Architect

D. Protection of Equipment and Materials:

1. Equipment and materials shall be stored in a manner that shall maintain an orderly, clean appearance. If stored on-site in open or unprotected areas, equipment and material shall be kept off the ground and out of standing water by means of pallets or racks, and covered with tarpaulins.

2. Equipment and material, if left unprotected and damaged, shall be repainted or otherwise refurbished at the discretion of the Owner. Equipment and material is subject to rejection and replacement if, in the opinion of the Architect or the manufacturer's engineering department, the equipment has deteriorated or been damaged to the extent that its immediate use or performance is questionable, or that its normal life expectancy has been curtailed.

3. During the construction period, protect ductwork, piping and equipment from damage and dirt. Properly cap ductwork and piping, whether in transit, stored or installed. Each system of piping shall be flushed to remove grit, dirt, sand, and other foreign matter for as long a time as required to thoroughly clean the systems.

4. Provide two (2) complete sets of filters. One set shall be installed just prior to balancing but after cleaning of duct and air handling systems. The second set of filters shall be

turned over to Owner for future use. Exception: for HEPA filters, provide only one (1) complete set. HEPA filters shall not be installed until system is turned over to Owner.

5. Should air handling systems be used for temporary heating during construction, provide temporary filters of equivalent efficiencies to those specified in addition to the two (2) permanent sets required above. Temporary filters shall be replaced with additional temporary filters, as required, when the pressure drop is double the initial pressure drop rating of the filter.

E. Adjustment:

1. After the entire installation has been completed, make required adjustments to balancing valves, air vents, automatic controls, circulators, pressure reducing valves and similar devices until performance requirements are met.

2. Provide factory-lubricated bearings for mechanical equipment. Before initial startup of mechanical equipment, inspect and verify bearings for proper amounts of lubricant. If required, provide proper amounts of lubricant in accordance with manufacturer's recommendations.

1.13 SPECIAL TOOLS

A. Provide the Owner's representative with two (2) sets of special tools required for operation and maintenance of equipment provided.

1.14 WELDING

A. General Requirements

1. This paragraph covers the welding of systems. Deviations from applicable codes, approved procedures and approved shop drawings shall not be permitted. Materials or components with welds made off the site shall not be accepted if the welding does not conform to the requirements of this specification. Develop and qualify procedures for welding metals included in the work. Certification testing shall be performed by an approved independent testing laboratory. Bear costs of such testing.

2. Certified welders, previously certified by test, may be accepted for the work without re-certification provided that all of the following conditions are fulfilled:

a. Submit copies of welder certification test records in accordance with this Division and Division 1 requirements.

b. Testing was performed by an independent testing laboratory.

c. The welding procedures and welders are certified in accordance with the "ASME Boiler and Pressure Vessel Code," and base materials, filler materials, electrodes, equipment, and processes conform to the applicable requirements of this specification.

d. Certification has been within a one (1) year period from the start of the project.

3. Filler metals, electrodes, fluxes and other welding materials shall be delivered to the site in manufacturers' original packages and stored in a dry space until used. Packages shall be properly labeled and designed to give maximum protection from moisture and to assure safe handling.

4. Submit welding certificates for review. Each welder assigned to work covered by this specification shall be certified by performance tests using equipment, positions, procedures, base metals, and electrodes or bare filler wires.

5. Before assigning welders to the work, provide the architect with their names, together with certification that each individual is certified as specified. No welding work shall start prior to submissions. The certification shall state the type of welding and positions for which each is certified, the code and procedure under which each is certified, date certified, and the firm and individual certifying the certified tests.

6. Each welder shall be assigned an identifying number, letter, or symbol that shall be used to identify his welds. A list of the welders' names and symbol for each shall be submitted. To identify welds, either written records indicating the location of welds made by each welder shall be submitted, or each welder shall apply his mark adjacent to his weld using an approved rubber stamp or felt-tipped marker with permanent, weatherproof ink or other approved methods that do not deform the metal. For seam welds, identification marks shall be placed adjacent to the welds at 3 foot intervals. Identification by die stamps or electric etchers shall be confined to the weld reinforcing crown, preferably in the finished crater.

PART 2 - PRODUCTS

2.1 ACCESS DOORS

A. Each access door assembly manufactured as an integral unit, complete with all parts and ready for installation.

B. Access doors and frames shall be of continuous welded steel construction, unless otherwise indicated. Grind welds smooth and flush with adjacent surfaces. Furnish attachment devices and fasteners of type required to secure access panels to types of support shown.

C. Frames shall be fabricated from 16-gauge steel.

1. Fabricate frame with exposed flange nominal 1 inch wide around perimeter of frame for units installed in the following construction:

a. Exposed Masonry

2. For gypsum drywall or veneer gypsum plaster, furnish perforated frames with drywall bead.

3. For installation in masonry construction, furnish frames with adjustable metal masonry anchors.

4. For full-bed plaster applications, furnish frames with galvanized expanded metal lath and exposed casing bead, welded to perimeter of frame

D. Flush Panel Doors shall be fabricated from not less than 14-gauge sheet steel, with concealed spring hinges or concealed continuous piano hinge set to open 175°. Finish with manufacturer's factory-applied prime paint.

1. For fire-rated units, provide manufacturer's standard insulated flush panel/doors, with continuous piano hinge and self-closing mechanism.

E. Locking devices shall be flush, screwdriver-operated cam locks of number required to hold door in flush, smooth plane when closed.

F. Manufacturers:

1. Bar-Co., Inc.
2. J. L. Industries
3. Karp Associates, Inc.
4. Nystrom, Inc.

2.2 WELDING

A. Welding materials shall comply with the "ASME Boiler and Pressure Vessel Code." Welding equipment, electrodes, welding wire, and fluxes shall be capable of producing satisfactory welds when used by a certified welder using qualified welding procedures.

PART 3 - EXECUTION

3.1 ACCESS DOORS

A. Coordinate installation of access doors with the General Contractor. Locations of access shall be submitted and doors furnished in sufficient time to allow installation in the normal course of the work.

3.2 WELDING

A. Perform welding in accordance with qualified procedures using certified welders. Welding shall not be done when the quality of the completed weld could be impaired by the prevailing working or weather conditions. Welding of hangers, supports, and plates to structural members shall conform to AWS specifications.

B. Field bevels and shop bevels shall be by mechanical means or by flame cutting. Where beveling is by flame cutting, thoroughly clean surfaces of scale and oxidation just prior to welding. Beveling shall conform to ANSI B31.1 and AWS B3.0.

C. Replace and reinspect defective welds. Repairing defective welds by adding weld material over the defect or by peening shall not be permitted. Welders responsible for defective welds must be re-certified.

D. Store electrodes in a dry heated area, keep free of moisture and dampness during fabrication operations. Discard electrodes that have lost part of their coating.

END OF SECTION 230500

SECTION 23 05 01 - BASIC MECHANICAL REQUIREMENTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. General Provisions of Contract, including general and supplementary conditions and general requirements (if any) apply to work specified in this Section.

1.2 SUMMARY

A. This section includes the following general administrative and procedural requirements for mechanical installations, and shall supplement the requirements of Division 1.
1. Alternates.
2. Description of work.
3. Contractor’s detailed phasing plan.
4. Quality assurance.
5. Materials.
6. Plans and specifications.
7. Shop drawings.
8. Product handling.
9. Record documents.
10. Maintenance manuals.
11. Objectionable noise and vibration.
12. Warrantees and guarantees.
13. Minor deviations and discrepancies.
14. Workplace safety.
15. Rough-ins.
16. Mechanical installations.
17. Cutting and patching.
18. Delivery, storage, and handling.

1.3 ALTERNATES

A. There are no Mechanical Alternates.

1.4 DESCRIPTION OF WORK

A. The project involves demolition of two existing rooftop packaged HVAC units and installation of two new rooftop packaged HVAC units for the C Wing at the York County Community College campus in Wells, Maine.

B. The mechanical contractor will be responsible for any and all mechanical, plumbing, electrical and fire protection work required in this project as indicated in these specifications and the project drawings.

C. Mechanical scope of work shall include, but is not limited to:
1. Removal of two existing rooftop packaged HVAC units.

2. Furnish and install two new packaged rooftop air handling units with propane-fired heating.
3. Furnish and install new ductwork and piping as needed to re-connect to the existing systems.
4. Furnish and install new IBControls Delta DDC controls integrated with existing control system.
5. Mechanical contractor shall be responsible for all power wiring required to complete this project, using Electrical contractor as subcontractor if needed.
6. Testing and balancing of all new systems.
7. The mechanical contractor will be responsible for providing all firestopping of all penetrations for the mechanical installation. Refer to other sections of the project specification for materials allowed.

D. Work Included
1. Furnish all labor, materials, equipment, transportation, and perform all operations required to install a complete heating, ventilating, and air conditioning system in the building, in accordance with these specifications and applicable drawings.
2. Specifications and accompanying drawings do not indicate every detail of pipe, valves, fittings, hangers, ductwork and equipment necessary for complete installation; but are provided to show general arrangement and extent of work to be performed.
3. Before submitting proposal, mechanical contractor shall be familiar with all conditions. Failure to do so does not relieve mechanical contractor of responsibility regarding satisfactory installation of the system.
4. Mechanical contractor shall be responsible for rigging to hoist his own (and his sub-contractors) materials and equipment into place.
5. Mechanical contractor and his sub-contractors shall be responsible for start-up of all equipment provided under Division 23 sections.

E. Related Work Described Elsewhere
1. Cutting and patching
2. Firestopping between building construction and pipe sleeves and between building construction and ductwork
3. Electrical conduit and wiring, except as noted below
4. Roofing, curbs, curb openings and framing of openings.
5. All finish work

F. Mechanical-Electrical Work
1. Provide and erect all motors, temperature controls, limit switches as specified.
2. Switches, fused switches, outlets, power supply to line terminals of equipment, and all related wiring and fuses to properly connect and operate all electrical equipment specified shall be furnished and installed under Division 26, "ELECTRICAL" (electrical contractor) unless noted otherwise. Motor starters shall be furnished, installed and wired under Division 26 unless noted otherwise. Division 26 shall not mount disconnect switches to indoor mechanical equipment. Coordinate all wiring between mechanical and electrical trades to provide a complete and operating system.

3. All wiring provided under this section shall be in accordance with the latest rules and regulations of the National Fire Underwriters, National Electric Code, State and Local Codes. Install all wiring under the supervision of the electrical contractor. Any wiring that is not installed according to these standards, and which does not match wiring installed by Division 26 in type, quality and appearance shall be corrected by Division 26 at the expense of this section.
4. Variable frequency drives shall be furnished by the mechanical contractor; shall be installed by the electrical contractor and shall be programmed by the controls contractor.
5. Temperature Control Systems
   Control wiring shall be furnished and installed by controls contractor under supervision of electrical contractor. Any wiring that is not installed according to these standards, and which does not match wiring installed by Division 26 in type, quality and appearance shall be corrected by Division 26 at the expense of this section.
6. Fans:
   a. Single-phase, 120-volt units: Electrical contractor to wire to unit mounted disconnect switch with overload protection provided with unit.
   b. Three-phase units: Electrical contractor shall provide combination disconnect switches with magnetic starters unless specifically indicated otherwise, and wire power to supply through to line terminals on unit motor. Starters shall have auxiliary contactors for Automatic Temperature Control interlocks. Controls contractor SHALL COORDINATE his requirements with electrical contractor as soon as possible after award of contract. Fans shall operate as indicated in "Sequence of Operation" section of this specification.
   c. Motor operated dampers associated with exhaust fans: Electrical contractor to provide 120 or 208 volt power from exhaust fans to damper.
7. All motors 1/3 HP and smaller shall be wired for 120 volt, 1 phase, 60 hz; motors 1/2 hp and larger shall be wired for 208 volt, 3 phase, 60 hz, unless specifically shown otherwise. Minimum guaranteed motor efficiencies shall be as follows:

HP	1200 RPM	1800 RPM	3600 RPM
1	81.5	82.5	--
1½	85.5	84.0	82.5
2	86.5	85.5	84.0
3	88.5	87.5	85.5
5	87.4	87.4	86.3
7½	89.4	89.8	87.7
10	89.7	90.3	89.0
15	90.5	91.4	89.3
20	90.8	91.6	90.4
25	92.0	92.6	91.1
30	92.3	92.6	91.4
40	93.2	93.3	91.9
50	93.0	93.6	92.4
60	93.6	93.9	92.5
75	94.1	94.4	92.9

1.5 CONTRACTOR'S DETAILED PHASING PLAN

A. In conjunction with the construction schedule as stipulated in Division 1, the contractor shall prepare and submit a logical demolition and construction phasing plan to the architect for review and comment. The preliminary phasing plan shall be submitted for review and comment prior to the start of new work.

B. The contractor's phasing plan shall be based on the contract documents and contractor confirmation of existing conditions and coordination of occupancy of adjacent areas of the building.

C. The phasing plan shall include a logical sequence for demolition/removal and new construction which minimizes interruption of services, utilities and operations to occupied portions of the building. Include detailed sequence for shutoff of utility services to the occupied portions of the building to accommodate demolition and removal work, tie-ins of new piping/ductwork to existing systems, and temporary removal of ductwork or piping systems.

D. All costs associated with the phasing activities including the design and installation of temporary ductwork and piping are to be base bid of this contract.

1.6 CODES, ORDINANCES AND PERMITS

A. All work performed under this Section of the Specifications shall be done in accordance with applicable National, State and local Codes, Laws and Ordinances. The following abbreviations are used for reference to standards which are to be followed:

AABC	Associated Air Balance Council
ADA	Americans With Disabilities
AMCA	American Moving & Conditioning Association

ANSI	American National Standards Institute
ARI	Air Conditioning and Refrigeration Institute
ASHRAE	American Society of Heating, Refrigeration and Air Conditioning Engineers
ASME	American Society of Mechanical Engineers
ASTM	American Society for Testing and Materials
BOCA	Building Officials and Code Administrators
NEC	National Electrical Code
NFPA	National Fire Protection Association
NEMA	National Electrical Manufacturer's Association
OSHA	Occupational Safety and Health Act
SMACNA	Sheet Metal and Air Conditioning Contractors National Association
UL	Underwriter's Laboratories

B. The latest issue of each Code in effect at the time of bidding shall be used. Code requirements are the minimum quality and/or performance acceptable. Where the Specifications and/or Drawings indicate more stringent requirements, these requirements shall govern.

C. The mechanical contractor shall be responsible for providing and filing all Plans, Specifications and other documents, pay all requisite fees and secure all permits, inspections and approvals necessary for the legal installation and operation of the systems and/or equipment furnished under this Section of the Specifications.

D. The mechanical contractor shall frame under glass all permits, secured by him, adjacent to the respective system and/or equipment and required to be displayed by Code, law or ordinance. Those permits secured but not required to be displayed shall be laminated in plastic and included in the Owner's maintenance manual.

1.7 QUALITY ASSURANCE

A. Qualification of Workmen

Use sufficient qualified workmen and competent supervisors in execution of this portion of the work to ensure proper and adequate installation of system throughout.

B. Work performed shall conform with all Local and State Rules and Regulations, as well as those of the National Fire Protection Association (N.F.P.A.).

C. Piping design shall conform to ANSI, ASME B31.9 and AWS D10.9 codes.

D. Welding standards shall conform to ANSI Boiler Code, Section IX, B31.1

1.8 MATERIALS

All materials and equipment shall be new and of the latest design of respective manufacturers. All materials and equipment of the same classification shall be the product of the same manufacturer, unless specified otherwise.

A. Proposed substitution of Mechanical equipment shall be made in writing PRIOR OF OPENING OF BIDS, see Section 01 60 00, - Product Requirements. Submit full details for consideration and obtain written approval of the Architect. The phrase "or approved equal" used in this section shall be intended to mean that the Architect, not the contractor, shall make final determination whether or not substitute materials are an equal to that which is specified. The contractor shall be responsible to certify with his submittals that any equipment to be considered as an "approved equal" will physically fit within the space provided and still provide adequate space adjacent to the equipment for service. If requested by the Architect the contractor shall provide said certification in the form of scale drawings before review will be made. Architect's decision on acceptability of substitute materials shall be final.

B. Approval by Architect for such substitution shall not relieve mechanical contractor from responsibility for a satisfactory installation and shall not affect his guarantee covering all parts of work.

C. Any material or equipment submitted for approval which are arranged differently or is/are of different physical size from that shown or specified shall be accompanied by shop drawings indicating different arrangements of size and method of making the various connections to equipment. Final results will be compatible with system as designed.

D. Any additional cost resulting from the substitution of equipment shall be paid by this Contractor.

E. All materials not specified otherwise shall be manufactured within the United States and supplied locally (within the state) when available.

1.9 PLANS AND SPECIFICATIONS

Mechanical Contractor shall provide his sub-contractors with a copy of the ENTIRE portion of Part 1 of this specification, portions of this specification and copies of drawings which pertain to the equipment to be supplied at no cost to the sub-contractor. Provide ATC Contractor with entire set of Electrical plans and specifications. Provide Testing and Balancing sub-contractor with copies of shop drawings indicating coil flows, air handling unit air volumes, etc. Failure to do so may result in the Architect providing the required materials at the Contractor's expense.

1.10 SHOP DRAWINGS

A. As soon as possible after award of Contract, before any material or equipment is purchased, Mechanical Contractor shall submit to the Architect no less than six (6) copies of shop drawings for approval. Shop drawings shall be properly identified and shall describe in detail the material and equipment to be provided, including all dimensional data, performance data, fan curves, pump curves, computer selection print-outs, etc. Capacities indicated are minimums. Equipment submitted with capacities below specified parameters will be refused. NOTE: ALL SUBMITTAL PAGES SHALL BE NUMBERED; i.e. 1 of 8, 2 of 8, etc.

B. Corrections or comments made on the shop drawings do not relieve the contractor from compliance with requirements of the drawings and specifications. Shop drawing review is ONLY for review of general conformance with the design concept of the project and general compliance with the information given in the contract documents. The contractor is responsible for confirming and correlating all quantities and dimensions, selecting fabrication processes and techniques of construction; coordinating his work with that of all other trades and performing his work in a safe and satisfactory manner.

C. All related items shall be submitted as a package. Partial submission shall not be reviewed until the package is complete, as itemized in paragraph "F" below.

D. Mechanical shop drawings shall be separate from Plumbing shop drawings. All submittals shall have a clear area on the front no less than 4inches x 3inches to be reserved exclusively for the Engineers' shop drawing stamp or they will be refused for re-submittal.

E. Review must be obtained on the following items:
   1. Ductwork and Accessories
      a. Duct access doors
      b. Volume control dampers (manual and automatic)
      c. Duct sealant
      d. Fire dampers <u>and</u> sleeves
      e. Turning vanes
      f. Side takeoff fittings
      g. Flexible duct
      h. Duct lining
      i. Filters
   2. Mechanical Equipment
      a. AC units and accessories - provide computer selection printouts.
      b. Equipment identification tags
   3. Piping and Accessories
      a. Pipe, valves, unions and flanges
      b. Pipe hangers and insulated pipe supports
      c. Pressure gauges and thermometers
      d. Pipe flexible connectors
      e. Pipe and valve markers
      f. Flow control valves
      g. Pipe sleeve wall closure devices
   5. Insulation
      a. Duct
   6. Temperature Controls

1.11 PRODUCT HANDLING

A. Use all means necessary to protect heating, ventilating and air conditioning materials before, during and after installation and to protect the installed work and materials of all other trades.

B. In the event of damage, immediately make all repairs and replacements necessary to the approval of the Architect at no additional cost to the Owner.

1.12 RECORD DOCUMENTS

A. Keep in good condition at the job, apart from all other prints used in actual construction, one complete set of all blueprints furnished for this job. On this special set of blueprints, record completely and accurately all differences between the work as actually installed and the design as shown on the drawings. These record prints must be kept up to date by recording all changes within one week of the time that the changes are authorized. At the completion of the work, this set of drawings shall be delivered to the Architect for the Owner. If the Mechanical Contractor does not make a complete record of changes, the Engineers shall make a record, and this Mechanical Contractor shall pay for the cost of the record. If the contractor prefers, copies of the mechanical drawings can be provided in electronic format for CAD application should he care to document the as-built conditions in this manner. Drawings shall be dated accordingly and clearly identified as “RECORD DOCUMENTS”. Specify required CAD format when requesting the files. Files will be zipped and will require “WinZip” for extraction.

1.13 MAINTENANCE MANUAL

A. On completion of this portion of the work, and as a condition of its acceptance, submit for approval two copies of a manual describing the system. Mechanical equipment manuals shall be separate from plumbing manuals and each building shall have its own manual with the equipment and systems unique to that building in the manual. All manuals shall be original copies, not photocopies or they will be refused for re-submittal. Prepare manuals in durable 3-ring binders approximately 8½ inches by 11 inches in size with at least the following:
   1. Identification on the front cover and spine stating general nature of the manual.
   2. Neatly typewritten index.
   3. Complete instructions regarding operation and maintenance of all equipment involved.
   4. Complete nomenclature of all replaceable parts, their part numbers, current cost, and name, address and telephone number of nearest vendor of parts.
   5. Copy of all guarantees and warranties issued.
   6. Where contents of manuals including manufacturer's catalog pages, clearly indicate the precise item included in this installation and delete, or otherwise clearly indicate, all manufacturers' data with which this installation is not concerned.

B. In addition to above, provide two (2) separate binders properly identified, each containing a copy of all reviewed shop drawings and catalog cuts. (NOTE: May be incorporated in Maintenance Manuals, if binders are of adequate size.)

1.14 OBJECTIONABLE NOISE AND VIBRATION

A. Mechanical equipment shall operate without objectionable noise and vibration. Should objectionable noise or vibration be transmitted to any occupied part of the building by apparatus, piping or ducts, as determined by the Architect, the necessary changes

eliminating the noise or vibration shall be made by this mechanical contractor at no extra cost to the Owner.

1.15 GUARANTEE

A. This Contractor shall guarantee all materials and workmanship furnished by him or his sub-contractors to be free from all defects for a period of no less than one (1) year from date of final acceptance of completed system and shall make good, repair or replace any defective work which may develop within that time at his own expense and without expense to the Owner. Any additional costs required to extend manufacturer's guarantee and warranty for the period specified, shall be included in Contractor's base bid.

1.16 MINOR DEVIATIONS AND DISCREPANCIES

A. The drawings are intended to indicate only diagrammatically the extent, general character and approximate locations of mechanical work. Work indicated, but having minor details obviously omitted, shall be furnished complete to perform the functions intended without additional cost to the Owner. Follow the architectural, structural, plumbing and electrical drawings so that work under this section is properly installed and coordinated with other Sections.

B. The drawings and specifications are complimentary to each other and what is called for in one, shall be as binding as if called for by both. In the event of conflicting information on the mechanical drawings, or between drawings and specifications, or between trades, that which is better, best or most stringent shall govern.

1.17 WORKPLACE SAFETY

A. Mechanical contractor shall be responsible for the safety of his workmen.

PART 2 – PRODUCTS

PART 3 - EXECUTION

3.1 ROUGH-IN

A. Verify final locations for rough-ins with field measurements and requirements of actual equipment to be installed.

3.2 MECHANICAL INSTALLATIONS

A. General: Sequence, coordinate, and integrate the various elements of mechanical systems, materials, and equipment. Comply with the following requirements:
   1. Coordinate mechanical systems, equipment, and materials installation with other building components.
   2. Verify all dimensions by field measurements.

3. Arrange for chases, slots and openings in other building components during progress of construction to allow for mechanical installations.
4. Coordinate the installation of required supporting devices and sleeves to be set in poured-in-place concrete and other structural components, as they are constructed.
5. Sequence, coordinate, and integrate installations of mechanical materials and equipment for efficient flow of the Work. Give particular attention to large equipment requiring positioning prior to closing in the building.
6. Where mounting heights are not detailed or dimensioned, install systems, materials, and equipment to provide the maximum headroom possible.
7. Coordinate connection of mechanical systems with exterior underground and overhead utilities and services. Comply with requirements of governing regulations, franchised service companies, and controlling agencies. Provide required connection for each service.
8. Install systems, materials, and equipment to conform with approved submittal data, including coordination drawings, to greatest extent possible. Conform to arrangements indicated by the Contract Documents, recognizing that portions of the Work are shown only in diagrammatic form. Refer conflicts between coordination requirements and individual system requirements to the Architect.
9. Install systems, materials, and equipment level and plumb, parallel and perpendicular to other building systems and components, where installed in finished spaces.
10. Install mechanical equipment to facilitate servicing maintenance, and repair or replacement of equipment components. As much as practical, connect equipment for ease of disconnecting, with minimum interferences with other installations. Extend grease fittings to an accessible location.
11. Install access panels or doors where units are concealed behind finished surfaces. Access panels and doors are specified in Division 8 Section “Access Doors.”
12. Install systems, materials, and equipment giving right-of-way priority to systems required to be installed at a specified slope.

3.3 CUTTING AND PATCHING

A. General: Perform cutting and patching in accordance in Division 1 Section “Cutting and Patching.” In addition to the requirements specified in Division 1, the following requirements apply:
   1. During cutting and patching protect adjacent installations.

B. Perform cutting, fitting, and patching of mechanical equipment and materials required to:
   1. Uncover work to provide for installation of ill-timed work.
   2. Remove and replace defective work.
   3. Remove and replace Work not conforming to requirements of Contract Documents.
   4. Remove samples of installed Work as specified for testing.
   5. Install equipment and materials in existing structures.
   6. Upon written instructions from the Architect, uncover and restore Work to provide for Architect/Engineer observation of concealed Work.

C. Cut, remove, and legally dispose of selected mechanical equipment, components, and materials as indicated including, but not limited to, removal of mechanical piping, heating units, plumbing fixtures and trim, and other mechanical items made obsolete by the new Work.

D. Protect the structure, furnishings, finishes, and adjacent materials not indicated or scheduled to be removed.

E. Provide and maintain temporary partitions or dust barriers adequate to prevent the spread of dust and dirt to adjacent areas.

F. Patch existing finished surfaces and building components using new materials and experienced Installers. Installers' qualifications refer to the materials and methods required for the surface and building components being patched.

3.4 DELIVERY, STORAGE, AND HANDLING

A. Deliver products to the project properly identified with name, model number, type, grade, compliance label, and other information needed for identification.

END OF SECTION 23 05 01

SECTION 23 05 13 - COMMON MOTOR REQUIREMENTS FOR HVAC EQUIPMENT

PART 1 GENERAL

1.1 SUMMARY

A. Section includes single- and three-phase motors for application on equipment provided under other sections and for motors furnished loose to Project.

B. Related Sections:
1. Section 26 05 26 - Grounding and Bonding.

1.2 REFERENCES

A. American Bearing Manufacturers Association:
1. ABMA 9 - Load Ratings and Fatigue Life for Ball Bearings.

B. National Electrical Manufacturers Association:
1. NEMA MG 1 - Motors and Generators.

C. International Electrical Testing Association:
1. NETA ATS - Acceptance Testing Specifications for Electrical Power Distribution Equipment and Systems.

1.3 SUBMITTALS

A. Product Data: Submit catalog data for each motor furnished loose. Indicate nameplate data, standard compliance, electrical ratings and characteristics, and physical dimensions, weights, mechanical performance data, and support points.

B. Test Reports: Indicate procedures and results for specified factory and field testing and inspection.

1.4 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing products specified in this section with minimum three years experience.

B. Testing Agency: Company member of International Electrical Testing Association and specializing in testing products specified in this section.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Section 01 60 00 – Product Requirements: Product storage and handling requirements.

B. Lift only with lugs provided. Handle carefully to avoid damage to components, enclosure, and finish.

C. Protect products from weather and moisture by covering with plastic or canvas and by maintaining heating within enclosure.

D. For extended outdoor storage, remove motors from equipment and store separately.

PART 2 PRODUCTS

2.1 PRODUCT REQUIREMENTS FOR MOTORS FURNISHED WITH EQUIPMENT

A. Motors 1/2 hp and Larger: Three-phase motor as specified below.

B. Motors Smaller Than 1/2 hp: Single-phase motor as specified INSECTION 15010, except motors less than 250 watts or 1/4 hp may be equipment manufacturer's standard.

C. Three-Phase Motors: NEMA MG 1, Design B, energy-efficient squirrel-cage induction motor, with windings to accomplish starting methods and number of speeds as indicated on Drawings.
1. Voltage: As indicated on Drawings.
2. Service Factor: 1.15.
3. Enclosure: Meet conditions of installation unless specific enclosure is indicated on Drawings.
4. Design for continuous operation in 40 degrees C environment, with temperature rise in accordance with NEMA MG 1 limits for insulation class, service factor, and motor enclosure type.
5. Insulation System: NEMA Class F.
6. Motor Frames: NEMA Standard T-Frames of steel, aluminum, or cast iron with end brackets of cast iron or aluminum with steel inserts.
7. Thermistor System (Motor Frame Sizes 254T and Larger): Three PTC thermistors embedded in motor windings and epoxy encapsulated solid state control relay with wiring to terminal box.
8. Bearings: Grease lubricated anti-friction ball bearings with housings equipped with plugged provision for relubrication, rated for minimum ABMA 9, L-10 life of 200,000 hours. Calculate bearing load with NEMA minimum V-belt pulley with belt center line at end of NEMA standard shaft extension. Stamp bearing sizes on nameplate.
9. Sound Power Levels: Conform to NEMA MG 1.

D. Single Phase Motors:
1. Permanent split-capacitor type where available, otherwise use split-phase start/capacitor run or capacitor start/capacitor run motor.
2. Voltage: As indicated on Drawings.

E. In VFD application, motors shall be "Inverter Rated" designed to NEMA MG1, Part 31, paragraph 31.40.4.2, rated for 1600 volts peak. Manufacturer shall have been in production of "Inverter Rated" motors for a minimum of 5 years.

F. Wiring Terminations: Furnish terminal lugs to match branch circuit conductor quantities, sizes, and materials indicated.

2.2 THREE-PHASE MOTORS FURNISHED LOOSE

A. Product Description: NEMA MG 1, Design B, energy-efficient squirrel-cage induction motor, with windings to accomplish starting methods and number of speeds indicated.

B. Voltage: As indicated on Drawings.

C. Service Factor: 1.15.

D. Enclosure: Meet conditions of installation unless specific enclosure is specified or indicated.

E. Design for continuous operation in 40 degrees C environment, with temperature rise in accordance with NEMA MG 1 limits for insulation class, service factor, and motor enclosure type.

F. Insulation System: NEMA Class F.

G. Motor Frames: NEMA Standard T-Frames of steel, aluminum, or cast iron with end brackets of cast iron or aluminum with steel inserts.

H. Thermistor System (Motor Frame Sizes 254T and Larger): Three PTC thermistors embedded in motor windings and epoxy encapsulated solid state control relay with wiring to terminal box.

I. Bearings: Grease lubricated anti-friction ball bearings with housings equipped with plugged provision for relubrication, rated for minimum ABMA 9, L-10 life of 200,000 hours. Calculate bearing load with NEMA minimum V-belt pulley with belt center line at end of NEMA standard shaft extension. Stamp bearing sizes on nameplate.

J. Sound Power Levels: Conform to NEMA MG 1.

K. Wiring Terminations: Furnish terminal lugs to match branch circuit conductor quantities, sizes, and materials indicated.

L. In VFD application, motors shall be “Inverter Rated” designed to NEMA MG1, Part 31, paragraph 31.40.4.2, rated for 1600 volts peak. Manufacturer shall have been in production of “Inverter Rated” motors for a minimum of 5 years.

2.3 SOURCE QUALITY CONTROL

A. Test motors in accordance with NEMA MG 1, including winding resistance, no-load speed and current, locked rotor current, insulation high-potential test, and mechanical alignment tests.

PART 3 EXECUTION

3.1 INSTALLATION

A. Install securely on firm foundation. Mount ball bearing motors with shaft in any position.

B. Ground and bond motors in accordance with electrical specification section 26 05 26..

END OF SECTION 23 05 13

SECTION 23 05 29 - HANGERS AND SUPPORTS FOR MECHANICAL PIPING AND EQUIPMENT

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes:
1. Pipe hangers and supports.
2. Hanger rods.
3. Inserts.
4. Flashing.
5. Sleeves.
6. Mechanical sleeve seals.
7. Formed steel channel.
8. Firestopping relating to mechanical work.
9. Firestopping accessories.
10. Equipment bases and supports.

B. Related Sections:
1. Section 22 00 00 - Plumbing: Execution requirements for placement of hangers and supports specified by this section.

1.2 REFERENCES

A. American Society of Mechanical Engineers:
1. ASME B31.5 - Refrigeration Piping.
2. ASME B31.9 - Building Services Piping.

B. American Society for Testing and Materials:
1. ASTM E84 - Test Method for Surface Burning Characteristics of Building Materials.
2. ASTM E119 - Method for Fire Tests of Building Construction and Materials.
3. ASTM E814 - Test Method of Fire Tests of Through Penetration Firestops.
4. ASTM F708 - Standard Practice for Design and Installation of Rigid Pipe Hangers.

C. American Welding Society:
1. AWS D1.1 - Structural Welding Code - Steel.

D. Factory Mutual System:
1. FM - Approval Guide, A Guide to Equipment, Materials & Services Approved By Factory Mutual Research For Property Conservation.

E. Manufacturers Standardization Society of the Valve and Fittings Industry:
1. MSS SP 58 - Pipe Hangers and Supports - Materials, Design and Manufacturer.
2. MSS SP 69 - Pipe Hangers and Supports - Selection and Application.
3. MSS SP 89 - Pipe Hangers and Supports - Fabrication and Installation Practices.

F. Underwriters Laboratories Inc.:
   1. UL 263 - Fire Tests of Building Construction and Materials.
   2. UL 723 - Tests for Surface Burning Characteristics of Building Materials.
   3. UL 1479 - Fire Tests of Through-Penetration Firestops.
   4. UL - Fire Resistance Directory.

1.3 DEFINITIONS

A. Firestopping (Through-Penetration Protection System): Sealing or stuffing material or assembly placed in spaces between and penetrations through building materials to arrest movement of fire, smoke, heat, and hot gases through fire rated construction.

1.4 SUBMITTALS

A. Section 01 33 00 - Submittals: Submittal procedures.

B. Shop Drawings: Indicate system layout with location including critical dimensions, sizes, and pipe hanger and support locations and detail of trapeze hangers.

C. Product Data:
   1. Hangers and Supports: Submit manufacturers catalog data including load capacity.

D. Design Data: Indicate load carrying capacity of trapeze, multiple pipe, and riser support hangers. Indicate calculations used to determine load carrying capacity of trapeze, multiple pipe, and riser support hangers.

E. Manufacturer's Installation Instructions:
   1. Hangers and Supports: Submit special procedures and assembly of components.
   2. Firestopping: Submit preparation and installation instructions.

F. Manufacturer's Certificate: Certify products meet or exceed specified requirements.

1.5 QUALITY ASSURANCE

A. Perform Work in accordance with AWS D1.1 for welding hanger and support attachments to building structure.

1.6 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing Products specified in this section with minimum three years experience.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Accept materials on site in original factory packaging, labeled with manufacturer's identification.

B. Protect from weather and construction traffic, dirt, water, chemical, and mechanical damage, by storing in original packaging.

1.8 ENVIRONMENTAL REQUIREMENTS

A. Do not apply firestopping materials when temperature of substrate material and ambient air is below 60 degrees F.

B. Maintain this minimum temperature before, during, and for minimum 3 days after installation of firestopping materials.

C. Provide ventilation in areas to receive solvent cured materials

1.9 WARRANTY

A. Furnish manufacturer's standard warranty for pipe hangers and supports.

PART 2 PRODUCTS

2.1 PIPE HANGERS AND SUPPORTS

A. Available Manufacturers:
1. Carpenter & Paterson Inc.

B. Plumbing Piping - DWV:
1. Conform to ASME B31.9.
2. Hangers for Pipe Sizes 1/2 to 1-1/2 inch: Malleable iron, adjustable swivel, split ring.
3. Hangers for Pipe Sizes 2 inches and Larger: Carbon steel, adjustable, clevis.
4. Multiple or Trapeze Hangers: Steel channels with welded spacers and hanger rods.
5. Wall Support for Pipe Sizes 3 inches and Smaller: Cast iron hook.
6. Wall Support for Pipe Sizes 4 inches and Larger: Welded steel bracket and wrought steel clamp.
7. Vertical Support: Steel riser clamp.
8. Floor Support: Cast iron adjustable pipe saddle, lock nut, nipple, floor flange, and concrete pier or steel support.
9. Copper Pipe Support: Copper-plated, carbon-steel adjustable, ring.

C. Plumbing Piping - Water:
1. Conform to ASME B31.9.
2. Hangers for Pipe Sizes 1/2 to 1-1/2 inch: Malleable iron, adjustable swivel, split ring.
3. Hangers for Cold Pipe Sizes 2 inches and Larger: Carbon steel, adjustable, clevis.
4. Hangers for Hot Pipe Sizes 2 to 4 inches and Larger: Carbon steel, adjustable, clevis.
5. Multiple or Trapeze Hangers: Steel channels with welded spacers and hanger rods.

6. Wall Support for Pipe Sizes 3 inches and Smaller: Cast iron hook.
7. Wall Support for Pipe Sizes 4 inches and Larger: Welded steel bracket and wrought steel clamp.
8. Vertical Support: Steel riser clamp.
9. Floor Support for Cold Pipe: Cast iron adjustable pipe saddle, lock nut, nipple, floor flange, and concrete pier or steel support.
10. Floor Support for Hot Pipe Sizes 4 inches and Smaller: Cast iron adjustable pipe saddle, lock nut, nipple, floor flange, and concrete pier or steel support.
11. Copper Pipe Support: Copper-plated, Carbon-steel ring.

D. Hydronic Piping:
1. Conform to ASME B31.9.
2. Hangers for Pipe Sizes 2-1/2 inches and Smaller: Carbon steel, adjustable, clevis.
3. Hangers for Hot Pipe Sizes 3-6 inches: Adjustable steel yoke, cast iron roll.
4. Multiple or Trapeze Hangers: Steel channels with welded spacers and hanger rods.
5. Wall Support for Pipe Sizes 3 inches and Smaller: Cast iron hooks.
6. Wall Support for Pipe Sizes 4 inches and Larger: Welded steel bracket and wrought steel clamp.
7. Vertical Support: Steel riser clamp.
8. Floor Support for Cold Pipe: Cast iron adjustable pipe saddle, lock nut, nipple, floor flange, and concrete pier or steel support.
9. Floor Support for Hot Pipe Sizes 4 Inches and Smaller: Cast iron adjustable pipe saddle, lock nut, nipple, floor flange, and concrete pier or steel support.
10. Floor Support for Hot Pipe Sizes 6 inches and Larger: Adjustable cast iron roll and stand, steel screws, and concrete pier or steel support.
11. Copper Pipe Support: Copper-plated, carbon steel ring.

2.2 ACCESSORIES

A. Hanger Rods: Mild steel threaded both ends, threaded on one end, or continuous threaded.

2.3 INSERTS

A. Inserts: Malleable iron case of 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.

2.4 FLASHING

A. Metal Flashing: 26 gage thick galvanized steel.

B. Metal Counterflashing: 22 thick galvanized steel.

C. Lead Flashing:
1. Waterproofing: 5 lb./sq. ft sheet lead
2. Soundproofing: 1 lb./sq. ft sheet lead.

D. Flexible Flashing: 47 mil thick sheet butyl; compatible with roofing.

E. Caps: Steel, 22 gage minimum; 16 gage at fire resistant elements.

2.5 SLEEVES

A. Sleeves for Pipes Through Non-fire Rated Floors: 18 gage thick galvanized steel.

B. Sleeves for Pipes Through Non-fire Rated Beams, Walls, Footings, and Potentially Wet Floors: Steel pipe or 18 gage thick galvanized steel.

C. Sleeves for Round Ductwork: Galvanized steel.

D. Sleeves for Rectangular Ductwork: Galvanized steel or wood.

2.6 MECHANICAL SLEEVE SEALS

A. Manufacturers:
1. Thunderline Link-Seal, Inc.
2. NMP Corporation.

B. Product Description: Modular mechanical type, consisting of interlocking synthetic rubber links shaped to continuously fill annular space between object and sleeve, connected with bolts and pressure plates causing rubber sealing elements to expand when tightened, providing watertight seal and electrical insulation.

2.7 FORMED STEEL CHANNEL

A. Available Manufacturers:
1. Carpenter and Patterson.

B. Product Description: Galvanized 12 gage thick steel. With holes 1-7/8 inches on center.

2.8 FIRESTOPPING

A. Manufacturers:
1. Dow Corning Corp.
2. Fire Trak Corp.
3. Hilti Corp.
4. International Protective Coating Corp.
5. 3M fire Protection Products.
6. Specified Technology, Inc.

B. Product Description: Different types of products by multiple manufacturers are acceptable as required to meet specified system description and performance requirements; provide only one type for each similar application.
1. Silicone Firestopping Elastomeric Firestopping: Single or multiple component silicone elastomeric compound and compatible silicone sealant.
2. Foam Firestopping Compounds: Single or multiple component foam compound.

3. Formulated Firestopping Compound of Incombustible Fibers: Formulated compound mixed with incombustible non-asbestos fibers.
4. Fiber Stuffing and Sealant Firestopping: Composite of mineral or ceramic fiber stuffing insulation with silicone elastomer for smoke stopping.
5. Mechanical Firestopping Device with Fillers: Mechanical device with incombustible fillers and silicone elastomer, covered with sheet stainless steel jacket, joined with collars, penetration sealed with flanged stops.
6. Intumescent Firestopping: Intumescent putty compound which expands on exposure to surface heat gain.
7. Firestop Pillows: Formed mineral fiber pillows.

C. Color: As selected by Architect.

2.9 FIRESTOPPING ACCESSORIES

A. Primer: Type recommended by firestopping manufacturer for specific substrate surfaces and suitable for required fire ratings.

B. Dam Material: Permanent:
1. [Mineral fiberboard.]
2. [Mineral fiber matting.]
3. [Sheet metal.]
4. [Plywood or particle board.]
5. [Alumina silicate fire board.]

C. Installation Accessories: Provide clips, collars, fasteners, temporary stops or dams, and other devices required to position and retain materials in place.

D. General:
1. Furnish UL listed products [or products tested by independent testing laboratory].
2. Select products with rating not less than rating of wall or floor being penetrated.

E. Non-Rated Surfaces:
1. Stamped steel, chrome plated, hinged, split ring escutcheons or floor plates or ceiling plates for covering openings in occupied areas where piping is exposed.
2. For exterior wall openings below grade, furnish mechanical sealing device to continuously fill annular space between piping and cored opening or water-stop type wall sleeve.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify openings are ready to receive sleeves.

B. Verify openings are ready to receive firestopping.

3.2 PREPARATION

A. Clean substrate surfaces of dirt, dust, grease, oil, loose material, or other matter affecting bond of firestopping material.

B. Remove incompatible materials affecting bond.

C. Install damming materials to arrest liquid material leakage.

D. Obtain permission from Architect/Engineer before using powder-actuated anchors.

E. Obtain permission from Architect/Engineer before drilling or cutting structural members.

3.3 INSTALLATION - INSERTS

A. Install inserts for placement in concrete forms.

B. Install inserts for suspending hangers from reinforced concrete slabs and sides of reinforced concrete beams.

C. Provide hooked rod to concrete reinforcement section for inserts carrying pipe 4 inches and larger.

D. Where concrete slabs form finished ceiling, locate inserts flush with slab surface.

E. Where inserts are omitted, drill through concrete slab from below and provide through-bolt with recessed square steel plate and nut slab.

3.4 INSTALLATION - FIRESTOPPING

A. Install material at fire rated construction perimeters and openings containing penetrating sleeves, piping, ductwork, and other items, requiring firestopping.

B. Apply primer where recommended by manufacturer for type of firestopping material and substrate involved, and as required for compliance with required fire ratings.

C. Apply firestopping material in sufficient thickness to achieve required fire and smoke rating.

D. Compress fibered material to maximum 40 percent of its uncompressed size.

E. Fire Rated Surface:
   1. Seal opening at floor, wall, partition, ceiling, and roof as follows:
      a. Install sleeve through opening and extending beyond minimum of 1 inch on both sides of building element.
      b. Size sleeve allowing minimum of 1 inch void between sleeve and building element.
      c. Pack void with backing material.

d. Seal ends of sleeve with UL listed fire resistive silicone compound to meet fire rating of structure penetrated.

F. Non-Rated Surfaces:
1. Seal opening through non-fire rated wall, partition, floor, ceiling, and roof opening as follows:
a. Install sleeve through opening and extending beyond minimum of 1 inch on both sides of building element.
b. Size sleeve allowing minimum of 1 inch void between sleeve and building element.
c. Install type of firestopping material recommended by manufacturer.
2. Install escutcheons where conduit, penetrates non-fire rated surfaces in occupied spaces. Occupied spaces include rooms with finished ceilings and where penetration occurs below finished ceiling.
3. Exterior wall openings below grade: Assemble rubber links of mechanical sealing device to size of piping and tighten in place, in accordance with manufacturer's instructions.
4. Interior partitions: Seal pipe penetrations at [clean rooms,] [laboratories,] computer rooms, telecommunication rooms, and data rooms . Apply sealant to both sides of penetration to completely fill annular space between sleeve and conduit.

3.5 INSTALLATION - PIPE HANGERS AND SUPPORTS

A. Install in accordance with ASME 31.9.

B. Support horizontal piping as scheduled.

C. Install hangers with minimum 1/2 inch space between finished covering and adjacent work.

D. Place hangers within 12 inches of each horizontal elbow.

E. Use hangers with 1-1/2 inch minimum vertical adjustment.

F. Support horizontal cast iron pipe adjacent to each hub, with 5 feet maximum spacing between hangers.

G. Support vertical piping at every floor. Support vertical cast iron pipe at each floor at hub.

H. Where piping is installed in parallel and at same elevation, provide multiple pipe or trapeze hangers.

I. Support riser piping independently of connected horizontal piping.

J. Provide copper plated hangers and supports for copper piping.

K. Design hangers for pipe movement without disengagement of supported pipe.

L. Prime coat exposed steel hangers and supports. Hangers and supports located in crawl spaces, pipe shafts, and suspended ceiling spaces are not considered exposed.

M. Provide clearance in hangers and from structure and other equipment for installation of insulation. Refer to Section 23 07 01.

3.6 INSTALLATION - EQUIPMENT BASES AND SUPPORTS

A. Provide housekeeping pads of concrete, minimum 4 inches thick and extending 6 inches beyond supported equipment.

B. Using templates furnished with equipment, install anchor bolts, and accessories for mounting and anchoring equipment.

C. Construct supports of formed steel channel. Brace and fasten with flanges bolted to structure.

D. Provide rigid anchors for pipes after vibration isolation components are installed. Refer to Section 23 05 48.

3.7 INSTALLATION – FLASHING

A. Provide flexible flashing and metal Counterflashing where piping and ductwork penetrate weather or waterproofed walls, floors, and roofs.

B. Flash vent and soil pipes projecting 3 inches minimum above finished roof surface with lead worked 1 inch minimum into hub, 8 inches minimum clear on sides with 24 x 24 inches sheet size. For pipes through outside walls, turn flanges back into wall and caulk, metal counter-flash, and seal.

C. Flash floor drains in floors with topping over finished areas with lead, 10 inches clear on sides with minimum 36 x 36 inch sheet size. Fasten flashing to drain clamp device.

D. Seal floor, shower, and mop sink drains watertight to adjacent materials.

E. Provide acoustical lead flashing around ducts and pipes penetrating equipment rooms for sound control.

F. Flash and counter-flash mechanical equipment roof curbs with sheet metal; seal watertight. Attach Counterflashing mechanical equipment and lap base flashing on roof curbs. Flatten and solder joints.

G. Adjust storm collars tight to pipe with bolts; caulk around top edge. Use storm collars above roof jacks. Screw vertical flange section to face of curb.

3.8 INSTALLATION - SLEEVES

A. Exterior watertight entries: Seal with mechanical sleeve seals.

B. Set sleeves in position in forms. Provide reinforcing around sleeves.

C. Size sleeves large enough to allow for movement due to expansion and contraction. Provide for continuous insulation wrapping.

D. Extend sleeves through floors 1 inch above finished floor level. Caulk sleeves.

E. Where piping or ductwork penetrates floor, ceiling, or wall, close off space between pipe or duct and adjacent work with firestopping insulation and caulk airtight. Provide close fitting metal collar or escutcheon covers at both sides of penetration.

F. Install chrome plated steel escutcheons at finished surfaces.

3.9 FIELD QUALITY CONTROL

A. Inspect installed firestopping for compliance with specifications and submitted schedule.

3.10 CLEANING

A. Clean adjacent surfaces of firestopping materials.

3.11 PROTECTION OF FINISHED WORK

A. Protect adjacent surfaces from damage by material installation.

3.12 SCHEDULES

PIPE HANGER SPACING

PIPE SIZE	MAX. HANGER SPACING	HANGER ROD DIAMETER
Inches	Feet	Inches
1/2	7	3/8
3/4	7	3/8
1	7	3/8
1-1/4	7	3/8
1-1/2	9	3/8
2	10	3/8
2-1/2	11	1/2
3	12	1/2
4	14	5/8
5	16	5/8
6	17	3/4
C.I. Bell and Spigot (or No-Hub) And at Joints	5	5/8
PVC (all sizes)	As Recommended by Manufacturer, or required by Code.	

END OF SECTION 23 05 29

SECTION 23 05 48 - MECHANICAL VIBRATION AND SEISMIC CONTROL

PART 1 - GENERAL

1.1 SUMMARY

A. General
1. This section provides for vibration isolation as well as seismic control for the "equipment" as listed below. This specification is part of the general conditions for the HVAC, plumbing, fire protection and electrical contracts.

B. Intent
1. It is the intent of the seismic restraint portion of this specification to provide restraint of non-structural building components. Restraint systems are intended to withstand the stipulated seismic accelerations applied through the component center of gravity.

C. The work in this section includes the following:
1. Vibration isolation elements for equipment.
2. Equipment isolation bases.
3. Piping flexible connectors.
4. Seismic restraints for isolated equipment.
5. Seismic restraints for non-isolated equipment.
6. Certification of seismic restraint designs and installation supervision.
7. Certification of seismic attachment of housekeeping pads.

Table C **Vibration Isolation and Seismic Restraint Requirements for Electrical Equipment**			**EQUIPMENT INSTALLATION ATTACHMENT POINT**							
			On Grade				**Above Grade**			
Equipment	**Size**	**Mounting**	**ISOL**	**DEFL**	**BASE**	**RESTR**	**ISOL**	**DEFL**	**BASE**	**RESTR**
Transformers - dry type	All	Floor	- -	- -	- -	- -	D	0.30	- -	V
		Ceiling	- -	- -	- -	- -	E	0.20	- -	III
Generators	All	Floor	G	0.10	- -	V	B	1.50	- -	V

D. Definitions
1. The term EQUIPMENT will be used throughout this specification and it includes ALL non-structural components within the facility and/or serving this facility, such as equipment located in outbuildings or outside of the main structure on grade within five feet of the foundation wall. Equipment buried underground is excluded but entry of services through the foundation wall is included. Equipment referred to in Table C is a partial list; (equipment not listed is still included in this specification)
2. Life Safety Systems Defined
   a. All systems involved with fire protection including sprinkler piping, fire pumps, jockey pumps, fire pump control panels, service water supply piping, water tanks, fire dampers and smoke exhaust systems.

b. All systems involved with and/or connected to emergency power supply including all generators, transfer switches, transformers and all circuits to fire protection, smoke evacuation and/or emergency lighting systems.
c. All medical and life support systems.
d. Fresh air relief systems on emergency control sequence including air handlers, conduit, duct, dampers, etc.

3. Positive Attachment:
   a. Positive attachment is defined as a support location with a cast-in or wedge type expansion anchor, a double sided beam clamp, a welded or through bolted connection to the structure.
4. Transverse Bracing:
   a. Restraint(s) applied to limit motion perpendicular or angular to the centerline of the pipe, duct, or conduit.
5. Longitudinal Bracing:
   a. Restraint(s) applied to limit motion along the centerline of the pipe, duct, conduit, etc.

1.2 OEM EQUIPMENT ISOLATION PACKAGES

A. Internal and/or External Systems
1. Substitution of internally or externally isolated and restrained equipment in lieu of the isolation and restraints specified in this section is acceptable provided all conditions of this section are met. The equipment manufacturer shall provide a letter of guarantee from their Engineering Department stamped and certified per the section on Seismic Restraints and Analysis stating that the seismic restraints are in full compliance with these specifications. A copy of an in force Errors and Omissions Insurance Certificate must accompany the submittal. Letters from field offices or representatives are unacceptable.
2. All costs for converting to the specified vibration isolation and/or restraints shall be borne by the equipment manufacturer in the event of non compliance with the preceding.
3. In the event that the equipment is internally isolated and restrained, the entire unit assembly must be seismically attached to the structure. This attachment and certification thereof shall be by this section.

1.3 SUBMITTAL DATA REQUIREMENTS

A. Submittals
1. Catalog cuts or data sheets on specific vibration isolators and restraints to be utilized detailing compliance with the specification including specification reference "Type" as per "Products" section of this specification.
2. An itemized list of all isolated and non-isolated equipment. Detailed schedules showing isolator and seismic restraints proposed for each piece of equipment, referencing material and seismic calculation drawing numbers.

B. Shop Drawings
1. Show base construction for equipment; include dimensions, structural member sizes and support point locations.

2. When walls and slabs are used as seismic restraint locations, details of acceptable methods for ducts, conduit and pipe must be included, with supporting certified calculations.
3. Indicate isolation devices selected with complete dimensional and deflection data before condition is accepted for installation.
4. Provide specific details of seismic restraints and anchors; include number, size and locations for each piece of equipment.
5. Coordinated or contract drawings shall be marked-up with the specific locations and types of restraints shown for all pipe, duct, conduit and cable tray. Rod bracing and assigned load at each restraint location shall be clearly delineated.
6. For ceiling suspended equipment provide minimum/maximum installation angle allowed for restraint system as well as braced and unbraced rod lengths at each allowable installation condition.
7. Calculate thrust for fan heads, axial and centrifugal fans to determine whether thrust restraints are required (see Equipment Installation).

C. Seismic Certification and Analysis
1. Seismic restraint calculations must be provided for all connections of equipment to the structure. All performance of products (such as; strut, cable, anchors, clips, etc.) associated with restraints must be supported with manufacturer's data sheets or certified calculations.
2. Seismic restraint calculations must be based on the acceleration criteria shown in the following Tables. Note: For roof mounted equipment both the seismic acceleration and wind loads shall be calculated, the highest load shall be utilized for the design of the restraints and isolators.
3. Calculations to support seismic restraint designs must be stamped by a registered professional engineer with at least five years of seismic design experience.
4. Table elevations refer to the structural point of attachment of the equipment support system. (i.e. Use floor slab for floor supported equipment and the elevation of the slab above for suspended equipment.)
5. Analysis must indicate calculated dead loads, derived loads and materials utilized for connections to equipment and structure. Analysis must detail anchoring methods, bolt diameter, embedment and/or weld length.
6. A seismic design Errors and Omissions insurance certificate must accompany submittals.

DESIGN LEVEL OF ACCELERATION AT EQUIPMENT CENTER OF GRAVITY				
Seismic Zone 1 A_V 0.05 to 0.09				
Elevation (Expressed in feet relative to grade level)	**Rigid* Mounted Equipment**	**Flexible* Mounted Equipment**	**Pipe, Duct, Cable Trays, Conduit, Etc.**	**Life Safety Equipment**
Below Grade up to 20 feet above grade	0.100 "g"	0.400 "g"	0.250 "g"	
21 ft. - 300 ft.	0.200 "g"	0.450 "g"	0.400 "g"	
301 ft. - 600 ft.	0.350 "g"	0.500 "g"	0.500 "g"	1.000 "g"
Seismic Zone 2 A_V 0.10 to 0.19				
Below Grade up to 20 feet above grade	0.125 "g"	0.500 "g"	0.350 "g"	1.000 "g"
21 ft. - 300 ft.	0.500 "g"	0.750 "g"	0.650 "g"	
301 ft. - 600 ft.	0.750 "g"	1.000 "g"	1.000 "g"	
Seismic Zone 3 A_V 0.2 to 0.3				
Below Grade up to 20 feet above grade	0.225 "g"	0.750 "g"	0.530 "g"	1.000 "g"
21 ft. - 300 ft.	0.500 "g"	0.830 "g"	0.710 "g"	1.100 "g"
301 ft. - 600 ft.	0.750 "g"	1.250 "g"	1.000 "g"	1.500 "g"
Seismic Zone 4 A_V > 0.3				
Below Grade up to 20 feet above grade	0.300 "g"	1.000 "g"	0.700 "g"	1.000 "g"
21 ft. - 300 ft.	0.600 "g"	1.250 "g"	1.000 "g"	1.250 "g"
301 ft. - 600 ft.	0.850 "g"	1.350 "g"	1.100 "g"	1.500 "g"

* Rigid mounted equipment is any equipment mounted directly to structure. Flexible mounted equipment is any equipment mounted on resilient supports, ceiling suspended, roof supported or mounted on an independent frame with any primary natural frequency below 16 Hz.

1.4 MANUFACTURER'S RESPONSIBILITY

A. Manufacturer of vibration and seismic control equipment shall have the following responsibilities:
   1. Determine vibration isolation and seismic restraint sizes and locations.
   2. Provide equipment vibration isolation and seismic restraints as specified.
   3. Guarantee specified isolation system deflections.
   4. Provide installation instructions, drawings and field supervision to insure proper installation and performance of systems.
   5. Certify correctness of installation upon completion.

1.5 RELATED WORK

A. Housekeeping Pads
1. Housekeeping pad design shall be by the project structural engineer. Attachment shall be designed and certified according to this section by the seismic/isolation supplier. Material and labor required for attachment and construction shall be by the concrete section contractor.
2. Housekeeping pads shall be sized to accommodate a minimum of six (6) inches of clearance all around the equipment and its mounting package.

B. Supplementary Support Steel
1. Structural support and connections for all equipment, including roof mounted equipment, specified in other sections shall comply with the seismic requirements of this section.

PART 2 - PRODUCTS

2.1 DESCRIPTION

A. Devices
1. All vibration isolation and seismic devices described in this section shall be the product of a single manufacturer. AVNEC, Inc. is the base manufacturer of these specifications; products of other manufacturers are acceptable provided their systems strictly comply with intent, structural design, performance and deflections of the Base Manufacturer.

B. Attachments
1. Hardware and devices such as beam clamps, anchor bolts, cables, cast-in-place plates must be by this section's supplier to ensure seismic compliance and certification.

C. Isolators
1. The theoretical vertical natural frequency for each support point, based upon load per isolator and isolator stiffness, shall not differ from the design objectives for the equipment as a whole by more than $\pm$10% and shall be out of resonance with equipment forcing frequencies or support structure natural frequency.

2.2 SEISMIC RESTRAINTS AND VIBRATION ISOLATION TYPES

A. General
1. All isolation and seismic restraint devices shall be capable of accepting, without failure, the "G" forces as determined by the seismic certification and calculations as described in the "submittal data requirements" section of these specifications.
2. All seismic restraint devices:
a. Shall maintain the equipment in a captive position and not short circuit isolation devices during normal operating conditions.
b. Shall have provisions for bolting and/or welding to the structure.

B. Seismic Restraint Types
1. TYPE I: Same as Type B. Cast or aluminum housings, (except ductile iron) are not acceptable.
   a. Available Manufacturers: Avnec, Inc. TYPE RS.
2. TYPE II: Each corner or side of equipment base shall incorporate a seismic restraint snubber having an all directional resilient pad limit stop. Restraints shall be fabricated of plate, structural members or square metal tubing. Angle bumpers are not acceptable.
   a. Available Manufacturers: Avnec, Inc. Type SSN.
3. TYPE III: Restraints for suspended systems.
   a. Available Manufacturers: Avnec, Inc. Type SCA & SRA.
   b. Isolated systems braced with multiple steel cable type with approved fastening devices to equipment and structure.
   c. Non-isolated systems braced with structural steel strut type with approved fastening devices to equipment and structure.
4. TYPE IV: Double deflection neoprene isolator encased in ductile iron or steel casing.
   a. Available Manufacturers: Avnec, Inc. Type SNCM.
5. TYPE V: Rigid attachment to structure utilizing wedge type expansion anchors for bolting or cast-in plates or wedge type expansion bolt anchored plates for welding. Powder shots are not acceptable.

C. Vibration Isolator Types
1. TYPE A: Spring Isolator
   a. Available Manufacturers: Avnec, Inc., Type FSS.
   b. Spring shall have a minimum outside diameter to overall height ratio at rated deflection of 0.8 : 1.0.
   c. Corrosion resistance for outdoor applications shall be as follows:
      1) Springs cadmium plated, electro-galvanized, neoprene coated or powder coated.
      2) Hardware cadmium plated.
      3) All other metal parts hot spray or hot dip galvanized.
   d. Reserve deflection (from published load ratings to solid height) of 50% of the rated deflection.
   e. Minimum 1/4" thick neoprene acoustical base pad or cup on underside, unless designated otherwise.
   f. Designed and installed so that ends of springs remain parallel.
2. TYPE B: Spring Isolator - restrained
   a. Available Manufacturers: Avnec, Inc., Type RS.
   b. Shall be the same as TYPE A with the following additional features.
      1) Capable of increasing vertical height by a minimum of 3/4". The integrity of restraint hardware shall not be compromised by these leveling features.
      2) Integral restraining bolts with elastomeric cushions preventing metal-to-metal contact.
      3) Internal spring adjusting nut or bolt with leveling capability.
      4) Capable of supporting equipment at fixed elevation during equipment installation. Installed and operating heights shall be

identical, unless additional increased vertical height adjustment becomes necessary.

5) Built-in all directional limit stops with minimum 1/4" clearance under normal operation.

6) Concrete anchor bolt spacing shall be in accordance with ICBO National standards for seismic anchorage.

3. TYPE C: Spring Hanger Isolator
   a. Available Manufacturers: Avnec, Inc., Type SASH.
   b. Spring element (same as Type A) with steel upper spring retainer and a lower elastomer retainer cup with an integral bushing to insulate lower support rod from the hanger box.
   c. Steel hanger box shall be hinged to allow for a minimum of 30 degree misalignment between the rod attachment to structure and the connection to the supported equipment. The hanger box shall withstand three times the rated load without failure.
   d. When used on ductwork, provide eyebolts for attachment to duct straps.
   e. All metal box parts shall be hot spray or hot dip galvanized. All hardware shall be electroplated.
4. TYPE D: Double deflection neoprene isolator encased in ductile iron or steel casing.
   a. Available Manufacturers: Avnec, Inc. Type SNCM.
5. TYPE E: Elastomer Hanger Isolator
   a. Available Manufacturers: Avnec, Inc., Type SANH.
   b. Molded neoprene element with an integral bushing to insulate lower support rod from the hanger box.
   c. Steel hanger box shall be hinged to allow for a minimum of 30 degree misalignment between the rod attachment to structure and the connection to the supported equipment. Hanger boxes shall be designed and constructed to support loads over three times the rated load without failure.
   d. When used on ductwork, provide eyebolts for attachment to duct straps.
   e. All metal box parts shall be hot spray or hot dip galvanized. All hardware shall be electroplated.
6. TYPE F: Combination Spring/Elastomer Hanger Isolator.
   a. Available Manufacturers: Avnec, Inc., SANSH.
   b. Spring and neoprene elements in a hinged steel hanger box with the features as described for TYPE C and E isolators.
7. TYPE G: Pad type elastomer isolator
   a. Available Manufacturers: Avnec, Inc., Type NP Pad.
   b. Neoprene pad shall have 0.75" minimum thickness and shall have opposed cylindrical supports spaced on one inch centers to provide uniform deflection of 0.1 inch under rated load. Supports shall be connected in the center by an 1/8" tear strip to facilitate trimming to desired size in one inch increments. Supports will also have thru holes to accept up to 3/8" bolts without special drilling or coring.
   c. 1/16" galvanized steel plate between multiple pad layers.
   d. Load distribution plate where attachment to equipment bearing surface is less than 75% of the pad area.

e. When bolting is required for seismic compliance, neoprene and duck washers and bushings shall be provided to prevent short circuiting of bolt.

8. TYPE H: Pad type elastomer isolator
   a. Available Manufacturers: Avnec, Inc., Type NIDP Pad.
   b. Laminated canvas duck and neoprene, maximum loading 1000 psi, minimum 1/2" thick.
   c. Load distribution plate where attachment to equipment bearing surface is less than 75% of the pad area.
   d. When bolting is required for seismic compliance, neoprene and duck washers and bushings shall be provided to prevent short circuiting.
9. TYPE I: Thrust Restraints
   a. Available Manufacturers: Avnec, Inc., Type TR.
   b. A spring element same as TYPE A shall be combined with steel angles, backup plates, threaded rod, washers and nuts to produce a pair of devices capable of limiting movement of air moving equipment to 1/4".
   c. Restraints shall be easily converted in the field from a compression thrust type to tension type.
   d. Unit shall be factory precompressed.
   e. All metal parts shall be hot spray or hot dip galvanized. All hardware shall be electroplated.
10. TYPE J: Telescoping Riser Guide – non-isolated
    a. Available Manufacturers: Avnec, Inc., Type TPG.
    b. Telescoping arrangement of two sizes of steel tubing.
11. TYPE K: Resilient Pipe Anchors and Guides
    a. Available Manufacturers: Avnec, Inc., Type RPA anchors and RaPTG guides.
    b. All directional acoustical pipe anchor, consisting of a telescopic arrangement of two sizes of steel tubing separated by a minimum 1/2" thickness of TYPE H pad.
    c. Vertical restraints shall be provided by a similar material arranged to prevent vertical travel in either direction.
    d. Allowable loads on neoprene pad shall not exceed 500 PSI and the design shall be balanced for equal resistance in any direction.
    e. All metal parts shall be hot spray or hot dip galvanized. All hardware shall be electroplated.
12. TYPE L: Isolated Pipe Hanger System
    a. Available Manufacturers: Avnec, Inc., Type CIH, CIR, TIH, TIR and PIH.
    b. Precompressed spring and elastomer isolation hanger combined with pipe support into one assembly. Replaces standard clevis, single or double rod roller, or double rod fixed support.
    c. Spring element (same as Type A) with steel lower spring retainer and an upper elastomer retainer cup with an integral bushing to insulate support rod from the isolation hanger.
    d. The neoprene element under the lower steel spring retainer shall have an integral bushing to insulate the support rod from the steel spring retainer.
    e. Hanger shall be hinged to allow for a normal misalignment between the rod attachment to structure and the connection to the isolation hanger.

Hangers shall withstand loads of three times the rated load without failure.

f. System shall be precompressed to allow for rod insertion and standard leveling.

g. All metal box parts shall be hot spray or hot dip galvanized. All hardware shall be electroplated.

13. TYPE M: Flashable restrained isolator

a. Available Manufacturers: Avnec, Inc., Type FRS.

b. Shall have all features of TYPE B isolator.

c. Shall have waterproof spring covers for adjustment or removal of springs.

d. Unit shall have a structural top plate for welding or bolting of supplementary support steel.

e. Isolator shall accept 2" roofing insulation and be flashed directly into the waterproofing membrane.

e. To be complete with wood nailer and flashing.

14. TYPE P: Elastomer Isolator

a. Available Manufacturers: Avnec, Inc., Type NCM.

b. Double deflection neoprene compression mountings shall have all metal surfaces neoprene coated.

c. Non-skid top and bottom surfaces.

d. Threaded bolting sleeves shall be embedded in the isolator.

e. Drilled tie-down bolt holes shall be provided in the base plate.

2.3 EQUIPMENT BASES

A. General

1. All Curbs and roof rails are to be bolted or welded to the building steel or anchored to the concrete deck to attain specified acceleration criteria and shall also be capable of resisting a minimum 110 MPH wind loads. (non-simultaneous)

B. Base Types

1. TYPE B-1: Integral Structural Steel Base

a. Available Manufacturers: Avnec, Inc., Type SB.

b. Constructed of structural members as required to prevent base flexure at equipment startup and misalignment of driver and driven units. Centrifugal fan bases shall be complete with motor slide rails and drilled for driver and driven units.

c. Height saving brackets shall be used to reduce operating height and maintain 1" operating clearance under base.

d. Member depth shall be such that the maximum deflection of the longest side to be 1/360 of span, not to exceed 1/2".

2. TYPE B-2: Concrete Inertia Base

a. Available Manufacturers: Avnec, Inc., Type CB.

b. Steel or wood concrete forms for floating foundations. Bases for pumps shall be large enough to support elbows and/or suction diffusers. ("T" shaped if indicated on the drawings) The base depth shall be a minimum of 1/12 the longest unsupported span, but not less than 6" or greater than 14". Forms shall include concrete reinforcement consisting of 3/8" bars or angles welded in place on 6" centers both ways. A layer 1-1/2" above

the bottom and an additional top layer of reinforcing for all bases exceeding 120" in one direction.

c. Isolators may be set into pocket housings which are an integral part of the base construction or utilize height saving brackets set at the proper height to maintain 2" clearance below the base. Base shall be furnished with templates for equipment attachment and anchor bolt sleeves.

3. TYPE B-3: Spring Roof Curb
   a. Available Manufacturers: Avnec, Inc., Type P.
   b. Structural steel spring isolation curbs that bear directly on the roof support structure and are flashed and waterproofed into the roof's membrane waterproofing system. Equipment manufacturer's curb shall not be used.
   c. All spring locations shall have removable waterproof covers to allow for spring adjustment and/or removal. Disassembly of the weather and air seal to gain access to the isolators is not acceptable. Springs shall have all of the features of TYPE B.
   d. Shall be sound attenuating type utilizing standard 2" roof insulation supplied and installed by the roofing contractor to act thermally outside and acoustically inside. Curbs supplied without this feature shall be factory acoustically lined with 2" duct liner.
   e. An air tight neoprene seal shall be incorporated into the curb design to prevent air leakage or infiltration. Air Seal must not be exposed so that it could be damaged or that in the event of the air seal failure, water could leak into the curb's interior.
   f. Wood nailer and flashing shall be provided.
   g. Shall be manufactured to NRCA standards.
   h. Shall include a sound barrier package consisting of two layers of waterproof gypsum board and 2" thick rigid fiberglass insulation. The gypsum wallboard shall have staggered and caulked joints.
   i. Contractor shall have the option of ordering the curb built to the roof pitch or field leveled in accordance with all seismic provisions of this section.
   j. Individual pier supported curbs are not acceptable.
4. TYPE B-4: Flashable Roof Rail System - Isolated
   a. Available Manufacturers: Avnec, Inc., Type R.
   b. Continuous structural support rails that combine equipment support and isolation mounting into one unitized assembly.
   c. Rails shall incorporate TYPE B springs which are adjustable, removable and interchangeable after equipment has been installed.
   d. The system shall maintain the same installed and operating height with or without the equipment load and shall be capable of being utilized as a blocking device.
   e. The entire assembly shall be an integral part of the roof's membrane waterproofing and shall be dry galvanized or plastic coated.
   f. Unit to be supplied with continuous upper and lower galvanized flashing.
5. TYPE B-5: Transformer Base
   a. Available Manufacturers: Avnec, Inc., Type TRAF and TRCF.
   b. Base shall be constructed from structural steel angles or channels sized as required to prevent flexure and misalignment under load.
   c. Each base shall be the full length of the supported equipment and be welded or bolted to a series of TYPE B isolators. Bolt-on cross ties at the ends and center shall form one rigid platform.
6. TYPE B-6: Non-isolated roof curb
   a. Available Manufacturers: Avnec, Inc., Type P-6000.
   b. Same as B-3 without spring isolation.

7. TYPE B-7: Computer room Unit Base
   a. Available Manufacturers: Avnec, Inc., Type CRTF.
   b. Computer room air conditioning units shall be welded or bolted to welded structural steel stands having a minimum 1/2 "G" certified lateral acceleration capabilities or if greater, the acceleration required per the seismic calculations required by the Submittal Requirements section of these specifications.
   c. Stand shall have +/- 1 -1/2" of leveling adjustment.
8. TYPE B-8: Non-isolated
   a. Available Manufacturers: Avnec, Inc., Type R-7000.
   b. Same as continuous support rails, Type B-4 without the spring isolation.
9. TYPE B-9: Steel Rails
   a. Available Manufacturers: Avnec, Inc., Type SR.
   b. Steel members of sufficient strength to prevent equipment flexure during operation.
   c. Height saving brackets as required to reduce operating height.

2.4 FLEXIBLE CONNECTORS

A. All connectors shall be installed on the equipment side of shutoff valves; horizontal and parallel to equipment shafts whenever possible. Piping shall be supported and/or anchored to resist pipe movement beyond the allowable movement of the flexible connector. Installations must include check valves and/or other design and installation precautions to reduce the threat to life safety when subjected to the specified seismic accelerations. The manufacture's submittal package must detail the design precautions included and/or the installation precautions required.

B. TYPE FC-1: Elastomer Connector
   1. Available Manufacturers: Avnec, Inc., Type TSF.
   2. Manufactured of nylon tire cord and neoprene, both molded and cured in hydraulic presses.
   3. Straight connectors to have two (2) spheres.
   4. Rated at 225 psi at 170°F, dropping in a straight line to 170 psi at 225°F for sizes 1-1/2" to 12".
   5. Sizes 10" and 12" at 200 PSI and greater operating pressure, to employ control rods with neoprene end fittings isolated from anchor plates by means of 1/2" bridge bearing neoprene bushings.
   6. Connectors shall be installed pre-extended per manufacturer's recommendations to prevent elongation under pressure.
   7. Minimum safety factor of 3:1 at maximum pressure ratings.
   8. Connectors bolted to victaulic type coupling or gate, butterfly or check valves to have a minimum 5/8" flange spacer installed between the connector and the coupling flange.

C. TYPE FC-2: Flexible Stainless Steel Hose
   1. Available Manufacturers: Avnec, Inc., Type SS.
   2. Stainless steel hose and braid rated with 3:1 safety factor.
   3. 2" diameter and smaller with male nipples, 2-1/2" and larger with fixed steel flanges.

D. TYPE FC-3: Unbraided Exhaust Hose
1. Available Manufacturers: Avnec, Inc., Type SSE.
2. Low pressure Stainless steel annularly corrugated with flanged ends.
3. Maximum temperature of 1500°F.

E. TYPE FC-4: Wire Braid Reinforced Flexible Metal Hose
1. Available Manufacturers: Avnec, Inc., Type RC.
2. Metal hose and braid rated with a minimum 3:1 safety factor. (Minimum 150 PSI)
3. Copper tube ends.

PART 3 - EXECUTION

3.1 GENERAL

A. Isolation and seismic restraint systems must be installed in strict accordance with the manufacturer's written instructions and all submittal data.

B. Vibration isolators shall not cause any change of position of equipment resulting in stress on equipment connections.

3.2 EQUIPMENT INSTALLATION

A. Equipment shall be isolated and restrained as indicated in TABLES A, B, C and D at the end of this section.

B. Additional Requirements
1. The minimum operating clearance under concrete inertia bases shall be 2".
2. The minimum operating clearance under all other bases shall be 1".
3. All bases shall be placed in position and supported temporarily by blocks or shims prior to the installation of the equipment, isolators and restraints.
4. Spring isolators shall be installed after all equipment is installed without changing equipment elevations.
5. After the entire installation is complete and under full operational load, the spring isolators shall be adjusted so that the load is transferred from the blocks to the isolators.
6. Remove all debris from beneath the equipment and verify that there are no short circuits of the isolation. The equipment shall be free in all directions.
7. Install equipment with flexibility in wiring.
8. Thrust restraints shall be installed on all cabinet fan heads, axial or centrifugal fans whose thrust exceeds 10% of unit weight.
9. Housekeeping pads for equipment in this section must be properly doweled or wedge type expansion bolted to the structure to meet the acceleration criteria. Anchor equipment or isolators to housekeeping pad.

3.3 PIPING AND DUCTWORK ISOLATION

A. Installation

1. General
   a. Hanger isolators shall be installed with the hanger box hung as close as possible to the structure (without touching).
   b. Hanger rods shall not short circuit the hanger box.
   c. TYPE L hangers may be substituted for all other hangers listed below.
2. Ceiling supported piping outside shafts connected to rotating or reciprocating equipment and pressure reducing stations whether the equipment is isolated or not shall be isolated as follows:
   a. Water and steam piping within 50 feet or 100 pipe diameters (whichever is greater) from equipment connection.
      1) Horizontal suspended water piping 1-1/4" to 2" and all steam piping larger than 1" shall be hung with TYPE E isolators with 0.3" deflection.
      2) Water pipe larger than 2" shall be hung with TYPE F isolators. The first three supports for piping connected to isolated equipment shall have deflection equal to the equipment isolators up to 2" deflection, all supports thereafter shall have 0.75" deflection isolators.
3. Floor supported piping outside shafts connected to isolated rotating or reciprocating equipment and pressure reducing stations shall be isolated as follows:
   a. Horizontal floor or roof mounted water piping 1-1/4" to 2" and all steam piping larger than 1" shall be supported by TYPE P isolators with a minimum 0.3" deflection.
   b. Water pipe larger than 2" shall be supported by TYPE B isolators with a minimum of 0.75" deflection.
4. Control air piping and vacuum piping from compressor discharge to receiver shall be suspended by TYPE E isolators with a minimum 0.3" deflection or supported by TYPE P isolators with a minimum 0.3" deflection.
5. All ductwork over four square feet face area located in the mechanical equipment room(s) shall be supported by TYPE C hangers with a minimum of 0.75" deflection.
6. Emergency generator exhaust shall be isolated with TYPE C isolators with a minimum of 0.75" deflection (all neoprene components shall be omitted).
7. Vertical riser supports for pipe 4" diameter and larger shall be isolated from the structure.
   a. For vertical riser guides use TYPE K.
   b. For vertical riser anchors use TYPE K.
8. Install TYPE FC-1 flexible connectors at all connections of pipe to isolated equipment as shown on drawings. Where not installed on isolated equipment, use spool pieces on equipment side of shutoff valve.
9. Install FC-2 or 4 type connectors only at locations which exceed temperature limitations of FC-1 or service requires stainless steel or bronze construction flex. (Such as gas, fuel oil, steam or freon)

3.4 SEISMIC RESTRAINTS

A. Installation

1. All equipment shall be isolated and restrained per TABLES A, B, C and D at the end of this section.
2. All floor mounted equipment whether isolated or not shall be snubbed, anchored, bolted or welded to the structure to comply with the required acceleration. Calculations that determine that isolated equipment movement may be less than the operating clearance of snubbers (restraints) do not preclude the need for snubbers. All equipment must be positively attached to the structure.
3. All suspended equipment and piping including, but not limited to fans, tanks, stacks, VAV boxes, unit heaters, fan powered boxes, cabinet unit heaters shall be two or four point independently braced with TYPE III restraints, installed taught for non-isolated equipment and slack with 1/2" cable deflection for isolated equipment. VAV Boxes (without fans) attached directly to ductwork on the main supply side shall be considered as ductwork for seismic design purposes. Rod bracing shall be installed as per approved submittals and shop drawings.
4. All horizontally suspended pipe, duct, cable trays, bus duct and conduit shall use RESTRAINT TYPE III or V. Spacing of seismic bracing shall be as per Table D at the end of this section.
5. For all trapeze supported piping and conduit, the individual pipes and conduits must be transversely and vertically restrained to the trapeze support at the designated restraint locations.
6. For overhead supported equipment, overstress of the building structure must not occur. Bracing may occur from:
   a. Flanges of structural beams.
   b. Upper truss chords in bar joists.
   c. Cast in place inserts or drilled and shielded inserts in concrete structures.
7. Pipe Risers
   a. Where pipes pass through cored holes, core diameters to be a maximum of 2" larger than pipe O.D., including insulation. Cored holes must be packed with resilient material or firestop as specified in other sections of this specification and/or state and local codes. No additional horizontal seismic bracing is required.
   b. Non-isolated, constant temperature pipe risers through cored holes require a riser clamp at each floor level on top of the slab attached in a seismically approved manner for vertical restraint.
   c. Non-isolated, constant temperature pipe risers in pipe shafts require structural steel attached in a seismically approved manner at each floor level and a riser clamp at each floor level on top of, and fastened to the structural steel. The riser clamp and structural steel must be capable of withstanding all thermal, static and seismic loads.
   d. Isolated and/or variable temperature risers through cored holes require Type K riser resilient Guides and Anchors installed to meet both thermal expansion and seismic acceleration criteria. Each floor level must have either a riser clamp that does not interfere with the thermal expansion/contraction of the pipe or a riser clamp/cable assembly (also non-interfering) capable of supporting the weight of the pipe between floors in the event of pipe joint failure. Riser guides and anchors must also be selected to serve as seismic restraints.
   e. Isolated and/or variable temperature risers in pipe shafts require Type K resilient riser guides and Anchors installed on structural steel to meet both

thermal expansion and seismic acceleration criteria. Each floor level must have a riser clamp/cable assembly that does not interfere with the thermal expansion/contraction of the pipe capable of supporting the weight of the pipe between floors in the event of pipe joint failure. Riser guides and anchors must also be selected to serve as seismic restraints.

8. Chimneys, stacks and boiler breeching passing through floors are to be bolted at each floor level or secured above and below each floor with riser clamps.
9. Lay-in ceilings in compliance with seismic zone requirements may use earthquake clips or other approved means of positive attachment to secure fixtures such as panel light and diffusers to T-bar structure.
10. All non-isolated floor or wall mounted equipment and tanks shall use RESTRAINT TYPE III or V.
11. Where base anchoring of equipment is insufficient to resist seismic forces, restraint TYPE III shall be located above the units center of gravity to suitably resist "G" forces specified.
    a. Vertically mounted tanks and up-blast tubular centrifugal fans, tanks, or similar equipment, may require this additional restraint.

B. Exclusions
1. Exclusions do not apply for Life Safety equipment, as follows:
    a. Electrical
        1) Critical, Standby or Emergency power conduit (1" nominal diameter and larger), cable tray or bus duct.
    b. Piping
        1) Fuel oil, gasoline, natural gas, medical gas, compressed air or any piping containing hazardous or corrosive materials that is 1" nominal diameter and larger.
    c. Duct
        1) Smoke evacuation duct or fresh air make-up connected to emergency system.
2. The following equipment exclusions do apply:
    a. Curb mounted mushroom, exhaust and vent fans with curb area less than nine square feet are excluded unless specifically detailed in the schedules or drawings.
    b. Duct
        1) Rectangular, Square, and Oval air handling ducts less than six square feet in cross sectional area.
        2) Round air handling duct less than 28 inches in diameter.
        3) Duct supported at locations by two rods less than 12 inches in length from the structural support to the structural connection at the ductwork with positive attachment to the structure.
    c. Piping
        1) All piping less than 2-1/2" diameter.
        2) All clevis or trapeze supported piping suspended by hanger rods less than 12 inches in length (6 inches or less for fire sprinkler piping) with positive attachment to structure.
        3) PVC or Fiberglass suspended waste or vent pipe 6 inch diameter or smaller.

d. Electrical
   1) All conduit less than 2-1/2" diameter suspended by individual hanger rods.
   2) All clevis or trapeze supported conduit suspended by hanger rods less than 12 inches in length from the bottom of the support to the top of the conduit with positive attachment to structure.
   3) Trapeze supported cable trays and bus duct suspended by hanger rods less than 12 inches in length with positive attachment to structure.

3.5 INSPECTION

A. Upon completion of installation of all vibration isolation and seismic restraint devices, a certification report prepared by the manufacturer shall be submitted in writing to the contractor indicating that all systems are installed properly and in compliance with the specifications. The report must identify those areas that require corrective measures or certify that none exists. Any field coordination type changes to the originally submitted seismic restraint designs must be clearly defined and detailed in this report.

TABLES A, B & C NOTES:

GENERAL: **ISOL**= ISOLATOR, **DEFL**. = DEFLECTION, **RESTR** = SEISMIC RESTRAINT, ALL DEFLECTIONS INDICATED ARE IN INCHES.

(1) UNITS MAY NOT BE CAPABLE OF POINT SUPPORT. REFER TO SEPARATE AIR HANDLING OR AIR CONDITIONING UNIT SPECIFICATION SECTION, IF BASE IS NOT PROVIDED BY THAT SECTION AND EXTERNAL ISOLATION IS REQUIRED, PROVIDE TYPE B-1 BASE BY THIS SECTION FOR ENTIRE UNIT.

(2) STATIC DEFLECTION SHALL BE DETERMINED BASED ON THE DEFLECTION GUIDE. DEFLECTIONS INDICATED ARE MINIMUMS AT ACTUAL LOAD AND SHALL BE SELECTED FROM MANUFACTURER'S NOMINAL 4", 3", 2" AND 1" DEFLECTION SPRING SERIES. **R.P.M. IS DEFINED AS THE SLOWEST OPERATING SPEED OF THE EQUIPMENT.**

DEFLECTION GUIDE	
R.P.M.	DEFLECTION
LESS THAN 400	3.50"
401 TO 600	2.50"
601 TO 900	1.50"
OVER 900	0.75"

(3) SINGLE STROKE COMPRESSORS MAY REQUIRE INERTIA BASES WITH THICKNESS GREATER THAN 14" MAX. AS DESCRIBED FOR BASE B-2.

INERTIA BASE MASS SHALL BE SUFFICIENT TO MAINTAIN DOUBLE AMPLITUDE OF 1/8".

(4) FOR FLOOR MOUNTED FANS SUBSTITUTE BASE TYPE B-2 FOR CLASS 2 OR 3 OR ANY CLASS FAN WITH STATIC PRESSURE OVER 5".

(5) EQUIPMENT WITH LESS THAN ONE H.P. ARE EXCLUDED FROM VIBRATION REQUIREMENTS. (SEISMIC REQUIREMENTS STILL APPLY)

(6) UTILITY SETS WITH WHEEL DIAMETERS LESS THAN 24" NEED NOT HAVE DEFLECTIONS GREATER THAN .75".

(7) CURB MOUNTED FANS WITH CURB AREA LESS THAN NINE (9) SQUARE FEET ARE EXCLUDED.

(8) FOR EQUIPMENT WITH MULTIPLE MOTORS, H.P. CLASSIFICATION APPLIES TO LARGEST SINGLE MOTOR.

TABLE D

SEISMIC BRACING TABLE

EQUIP.	**ON CENTER SPACING**		**EACH CHANGE WITHIN OF DIRECTION (LARGER OF ...)**
	TRANSVERSE	**LONGITUDINAL**	
DUCT	30 FEET	60 FEET	15 FEET
PIPE (THREADED, WELDED, SOLDERED or GROOVED)			
TO 16"	40 FEET	80 FEET	10 FEET or 15 DIAMETERS
18" - 28"	30 FEET	60 FEET	10 FEET or 15 DIAMETERS
30" - 40"	20 FEET	60 FEET	10 FEET or 15 DIAMETERS
42" & LARGER	10 FEET	30 FEET	10 FEET or 15 DIAMETERS
(NO-HUB BELL & SPIGOT, CAST IRON)			
2.5" & LARGER	10 FEET	20 FEET	4 FEET
BOILER BREECHING	30 FEET	60 FEET	10 FEET or 15 DIAMETERS
CHIMNEYS & STACKS	30 FEET	60 FEET	10 FEET or 15 DIAMETERS
CONDUIT	40 FEET	80 FEET	10 FEET or 15 DIAMETERS
BUS DUCT	20 FEET	40 FEET	4 FEET
CABLE TRAY	40 FEET	80 FEET	10 FEET

TABLE A VIBRATION ISOLATION/SEISMIC RESTRAINT REQUIREMENTS FOR HVAC EQUIPMENT				EQUIPMENT INSTALLATION ATTACHMENT POINT							
				ON GRADE				ABOVE GRADE			
EQUIPMENT		SIZE (5)(8)	MOUNTING	ISOL	DEFL	BASE	RESTR	ISOL	DEFL	BASE	RESTR
AIR HANDLING/CONDITIONING UNITS AND CABINET TYPE FANS		TO 10 HP	FLOOR	D	0.30	(1)	V	B	0.75	(1)	V
			CEILING	--	--	--	--	F	0.75	(1)	III
		OVER 10 HP	FLOOR	D	0.30	(1)	V	B	(2)	(1)	V
			CEILING	--	--	(1)	III	F	(2)	(1)	III
AIR OR REFRIGERANT COMPRESSORS	TANK	TO 10 HP	FLOOR	D	0.30	--	V	B	0.75	--	V
		OVER 10 HP		B	0.75	--	V	B	1.50	B-2	V
	UNITARY	TO 10 HP		D	0.30	--	V	B	0.75	B-2 (3)	V
		OVER 10 HP		B	0.75	--	V	B	1.50	B-2 (3)	V
AIR COOLED CONDENSERS		ALL	ROOF	--	--	--	--	B	1.50	B-4	V
AXIAL FANS		TO 15 HP	FLOOR(roof)	D	0.30	--	V	B	(2)	(B3 or 4)	V
			CEILING	--	--	--	--	F		--	III
		OVER 15 HP	FLOOR (Roof)	B	0.75	--	V	B		(B3 or 4)	V
			CEILING	--	--	--	--	F		--	III
BOILERS &		ALL	FLOOR	--	--	--	V	B	0.75	--	V
		ELECTRIC		--	--	--	V	G	0.10	--	V
CENTRIFUGAL FANS	ARRG'T	ALL	FLOOR (Roof)	B	0.75	B-1	V	B	(2) (6)	B1(B4)	V
			CEILING	--	--	--	--	F			III
	ARRG'T		FLOOR (Roof)	D	0.30	--	V	B		(B-4)	V
			CEILING	--	--	--	--	F		--	V
CHILLERS AND CONDENSING UNITS	ABSORB	ALL (8)	FLOOR	G	0.10	--	V	B	0.75	--	V
	CENTRIF		FLOOR	G	0.10	--	V	B	0.75	--	V
	RECIPR		FLOOR (Roof)	B	0.75	--	V	B	1.50	(B-4)	V
	ROTARY		FLOOR (Roof)	G	0.10	--	V	B	0.75	(B-4)	V
COMPUTER ROOM UNITS		ALL	FLOOR	--	--	B-7	V	--	--	B-7	V
			CEILING	--	--	--	--	F	0.75	--	III

COOLING TOWERS		TO 200 TONS	FLOOR OR ROOF	G	0.10	--	V		B	1.50	--	V
		200+ TONS				--				2.50	--	V
CURB MOUNTED FANS		ALL (7)	ROOF	--	--	--	--		--	--	B-6	V
FAN COIL UNITS FAN POWERED BOXES CABINET UNIT HEATERS UNIT VENTILATORS		ALL	CEILING	--	--	--	--		F	0.75	--	III
PUMPS	BASE MOUNTED	TO 15 HP	FLOOR	D	0.30	B-2	V		B	0.75	B-2	V
		15-30 HP		B	0.75	B-2	V		B	0.75	B-2	V
		OVER 30 HP		B	0.75	B-2	V		B	1.50	B-2	V
	IN LINE	ALL	FLOOR	--	--	--	--		D	0.30	--	V
			CEILING	--	--	--	--		F	0.75	--	III
	CONDENSATE		FLOOR	D	0.30	B-9	V		D	0.30	B-9	V
	BOILER FEED			D	0.30	--	V		D	0.30	--	V
PACKAGED ROOF TOP AIR HANDLING UNITS		TO 15 TONS	CURB MOUNTED POINT SUPPORTED	--	--	--	--		--	0.75	B-3	V
		15+ TONS		--	--	--	--		--	2.50	B-3	V
		TO 15 TONS		--	--	--	--		B	0.75	--	V
		15+ TONS		--	--	--	--		B	2.50	--	V
UNIT HEATERS		ALL	CEILING	--	--	--	--		E	0.30	--	III

Table Note: Bases shown in ( ) indicate roof mounted system.

END OF SECTION 23 05 48

SECTION 23 05 53 - IDENTIFICATION OF HVAC PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 DESCRIPTION OF WORK

A. Mechanical identification work is required by this section and/or specified in other Division 23 sections.

B. Types of identification devices specified in this section include the following:
1. Painted Identification Materials.
2. Plastic Pipe Markers.
3. Plastic Tape.
4. Plastic Duct Markers.
5. Valve Tags.
6. Valve Schedule Frames.
7. Engraved Plastic-Laminate Signs.
8. Plastic Equipment Markers.
9. Plasticized Tags.
10. Ceiling Tacks (color coded).

C. Mechanical identification furnished as part of factory-fabricated equipment, is specified as part of equipment assembly in other Division-23 sections.

1.3 QUALITY ASSURANCE

A. Manufacturer's Qualifications: Firms regularly engaged in the manufacture of identification devices of types and sizes required, whose products have been in satisfactory use in similar service for not less than 5 years.

B. Codes and Standards:
1. ANSI Standards: Comply with ANSI A13.1 for lettering size, length of color field, colors, and viewing angles of identification devices.
2. Maintain one (1) copy of document on site.

1.4 SUBMITTALS

A. Product Data: Submit manufacturer's technical product data and installation instructions for each identification material and device required.

B. Schedules: Submit valve schedule for each piping system, typewritten and reproduced on 8 1/2" x 11" bond paper. Tabulate valve number, piping system, system abbreviation (as shown on tag), location of valve (room or space), and variations for identification (if any). Mark valves that are intended for emergency shut-off and similar special uses, by special "flags", in margin of schedule. In addition to mounted copies, furnish extra copies for Maintenance Manuals as specified in Division 1.

C. Maintenance Data: Include product data and schedules in maintenance manuals; in accordance with requirements of Division 1.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. Manufacturer: Subject to compliance with requirements, provide mechanical identification materials of one of the following:
1. Allen Systems, Inc.
2. Brady (W.H.) Co.; Signmark Div.
3. Industrial Safety Supply Co., Inc.
4. Seton Name Plate Corp.

2.2 MECHANICAL IDENTIFICATION MATERIALS

A. General: Provide manufacturer's standard products of categories and types required for each application as referenced in other Division-23 sections. Where more than a single type is specified for application, selection is Installer's option, but provide single selection for each product category.

2.3 PAINTED IDENTIFICATION MATERIALS

A. Stencils: Standard fiberboard stencils, prepared for required applications with letter sizes generally complying with recommendations of ANSI A13.1 for piping and similar applications, but not less than 1-1/2" high letters for ductwork and not less than 3/4" high letters for access door signs and similar operational instructions.

B. Stencil Paint: Standard exterior type stenciling enamel; black, except as otherwise indicated; either brushing grade or pressurized spray-can form and grade.

C. Identification Paint: Standard identification enamel of colors indicated or, if not otherwise indicated for piping systems, comply with ANSI A13.1 for colors.

2.4 PLASTIC PIPE MARKERS

A. Snap-On Type: Provide manufacturer's standard pre-printed, semi-rigid snap-on, color-coded pipe markers, complying with ANSI A13.1. Provide weather and ultra-violet resistant, pressure sensitive vinyl markers for outdoor locations. Strap around type with nylon ties or stainless steel bands for pipe sizes 6 inches in diameter and larger.

B. Pressure-Sensitive Type: Provide manufacturer's standard pre-printed, permanent adhesive, color-coded, pressure-sensitive vinyl pipe markers, complying with ANSI A13.1. Provide weather and ultra-violet resistant, pressure sensitive vinyl markers for outdoor locations.

C. Insulation: Furnish 1" thick molded fiberglass insulation with jacket for each plastic pipe marker to be installed on uninsulated pipes subjected to fluid temperatures of 125°F (52°C) or greater. Cut length to extend 2" beyond each end of plastic pipe marker.

D. Taped to Pipe Type - Small Pipes: For external diameters less than 6" (including insulation if any), provide full-band pipe markers, extending 360 degrees around pipe at each location, fastened by one of the following methods:
1. Snap-on application of pre-tensioned semi-rigid plastic pipe marker.
2. Adhesive lap joint in pipe marker overlap.
3. Laminated or bonded application of pipe marker to pipe (or insulation).
4. Taped to pipe (or insulation) with color-coded plastic adhesive tape, not less than 3/4" wide; full circle at both ends of pipe marker, tape lapped 1-1/2".

E. Taped to Pipe Type - Large Pipes: For external diameters of 6" and larger (including insulation if any), provide either full-band or strip-type pipe markers, but not narrower than 3 times letter height (and of required length), fastened by one of the following methods:
1. Laminated or bonded application of pipe marker to pipe (or insulation).
2. Taped to pipe (or insulation) with color-coded plastic adhesive tape, not less than 1 1/2" wide: full circle at both ends of pipe marker, tape lapped 3".
3. Strapped-to-pipe (or insulation) application of semi-rigid type, with manufacturer's standard stainless steel bands.

F. Lettering: Manufacturer's standard pre-printed nomenclature which best describes piping system in each instance, as selected by Architect in cases of variance with name as shown or specified.

G. Lettering: Comply with piping system nomenclature as specified, scheduled or shown, and abbreviate only as necessary for each application length.

1. Arrows: Print each pipe marker with arrows indicating direction of flow, either integrally with piping system service lettering (to accommodate both directions), or as separate unit of plastic.

2.5 PLASTIC DUCT MARKERS

A. General: Provide manufacturer's standard laminated plastic, color coded duct markers. Conform to the following color code:
1. Green: Cold air.

2. Yellow: Hot air.
3. Yellow/Green: Supply air.
4. Blue: Exhaust, outside, return, and mixed air.

B. Nomenclature: Include the following:
1. Direction of air flow.
2. Duct service (supply, return, exhaust, etc.).
3. Duct origin (from).
4. Duct destination (to).
5. Design cfm.

2.6 PLASTIC TAPE

A. General: Provide manufacturer's standard color-coded pressure-sensitive (self-adhesive) vinyl tape, not less than 3 mils thick.

B. Width: Provide 1 1/2" wide tape markers on pipes with outside diameters (including insulation, if any) of less than 6", 2 1/2" wide tape for larger pipes.

C. Color: Comply with ANSI A13.1, except where another color selection is indicated.

2.7 VALVE TAGS

A. Brass Valve Tags: Provide 19-gage polished brass valve tags with stamp-engraved piping system abbreviation in 3/4" high letters and sequenced valve numbers 3/4" high, and with 5/32" hole for fastener.
1. Provide 1 1/2" diameter tags, except as otherwise indicated.
2. Fill tag engraving with black enamel.

B. Valve Tag Fasteners: Provide manufacturer's standard solid brass chain (wire link or beaded type), or solid brass S-hooks of the sizes required for proper attachment of tags to valves, and manufactured specifically for that purpose.

2.8 ACCESS PANEL MARKERS

A. Provide manufacturer's standard 1/16" thick engraved plastic laminate access panel markers, with abbreviations and numbers corresponding to concealed valve. Include 1/8" center hole to allow attachment.

2.9 VALVE SCHEDULE FRAMES

A. General: For each page of valve schedule, provide glazed display frame, with screws for removable mounting on masonry walls. Provide frames of finished hardwood or extruded aluminum, with SSB-grade sheet glass.

2.10 ENGRAVED PLASTIC-LAMINATE SIGNS

A. General: Provide engraving stock melamine plastic laminate, complying with FS L-P-387, in the sizes and thicknesses indicated, engraved with engraver's standard letter style of the sizes and wording indicated, black with white core (letter color) except as otherwise

indicated, punched for mechanical fastening except where adhesive mounting is necessary because of substrate.

B. Thickness: 1/16" for units up to 20 sq. in. or 8" length; 1/8" for larger units.

C. Fasteners: Self-tapping stainless steel screws, except contact-type permanent adhesive where screws cannot or should not penetrate the substrate.

2.11 PLASTIC EQUIPMENT MARKERS

A. General: Provide manufacturer's standard laminated plastic, color coded equipment markers. Conform to the following color codes:
1. Green: Cooling equipment and components.
2. Yellow: Heating equipment and components.
3. Yellow/Green: Combination cooling and heating equipment and components.
4. Brown: Energy reclamation equipment and components.
5. Blue: Equipment and components that do not meet any of the above criteria.

B. Nomenclature: Include the following, matching terminology on schedules as closely as possible:
1. Name and plan number.
2. Equipment service.
3. Design capacity.
4. Other design parameters such as pressure drop, entering and leaving conditions, rpm, etc.

C. Size: Provide approximate 2" x 4" markers for VAV boxes, control devices, dampers, and valves; and 4" x 6" for equipment.

2.12 CEILING TACKS

A. Description: Steel with 3/4 inch diameter color-coded head.

B. Color code as follows:
1. HVAC equipment: Yellow.
2. Fire dampers/smoke dampers: Red.
3. Plumbing valves: Green.
4. Heating/cooling valves: Blue.

2.13 LETTERING AND GRAPHICS

A. General: Coordinate names, abbreviations and other designations used in mechanical identification work, with corresponding designations shown, specified or scheduled. Provide numbers, lettering and wording as indicated or, if not otherwise indicated, as recommended by manufacturers or as required for proper identification and operation/maintenance of mechanical systems and equipment.
1. Multiple Systems: Where multiple systems of same generic name are shown and specified, provide identification which indicates individual system number as well as service (as examples; Boiler No. 3, Air Supply No. 1H, Standpipe F12).

PART 3 - EXECUTION

3.1 GENERAL INSTALLATION REQUIREMENTS

A. Coordination: Where identification is to be applied to surfaces which require insulation, painting or other covering or finish, including valve tags in finished mechanical spaces, install identification after completion of covering and painting. Install identification prior to installation of acoustical ceilings and similar removable concealment.

3.2 DUCTWORK IDENTIFICATION

A. General: Identify air supply, return, exhaust, intake and relief ductwork with duct markers; or provide stenciled signs and arrows, showing ductwork service and direction of flow, in black or white (whichever provides most contrast with ductwork color).

B. Location: In each unfinished space where ductwork is exposed, or concealed only by removable ceiling system, locate signs near points where ductwork originates or continues into concealed enclosures (shaft, underground or similar concealment), and at 50' spacings along exposed runs.

C. Access Doors: Provide duct markers or stenciled signs on each access door in ductwork and housings, indicating purpose of access (to what equipment) and other maintenance and operating instructions, and appropriate safety and procedural information.

D. Concealed Doors: Where access doors are concealed above acoustical ceilings or similar concealment, plasticized tags may be installed for identification in lieu of specified signs, at Installer's option.

3.3 PIPING SYSTEM IDENTIFICATION

A. General: Install pipe markers of one of the following types on each system indicated to receive identification, and include arrows to show normal direction of flow:
   1. All new exposed piping located in mechanical rooms.
      a. plastic pipe markers, snap-on type, semi-rigid and color coded.
   2. All other locations select one of the types listed below.
      a. Plastic pipe marker, snap-on type, semi-rigid and color coded.
      b. Pressure sensitive type.
      c. Taped to pipe type.

B. Locate pipe markers and color bands as follows wherever piping is exposed to view in occupied spaces, machine rooms, accessible maintenance spaces (shafts, tunnels, plenums) and exterior non-concealed locations.
   1. Near each valve and control device.
   2. Near each branch, excluding short take-offs for fixtures and terminal units; mark each pipe at branch, where there could be question of flow pattern.
   3. Near locations where pipes pass through walls or floors/ceilings, or enter non-accessible enclosures.
   4. At access doors, manholes and similar access points that permit view of concealed piping.

5. Near major equipment items and other points of origination and termination.
6. Spaced intermediately at maximum spacing of 50' along each piping run, except reduce spacing to 25' in congested areas of piping and equipment.
7. On piping above removable acoustical ceilings, except omit intermediately spaced markers.

3.4 VALVE IDENTIFICATION

A. General: Provide valve tag on every valve, cock and control device in each piping system; exclude check valves, valves within factory-fabricated equipment units, plumbing fixture faucets, convenience and lawn-watering hose bibs, and shut-off valves at plumbing fixtures, HVAC terminal devices and similar rough-in connections of end-use fixtures and units. List each tagged valve in valve schedule for each piping system.
   1. Mount valve schedule frames and schedules in boiler room where indicated or, if not otherwise indicated, where directed by Architect.
   2. Provide ceiling tacks to locate valves above T-bar lay-in ceilings. Locate in corner of panel closest to valve.

3.5 MECHANICAL EQUIPMENT IDENTIFICATION

A. General: Install engraved plastic laminate sign or plastic equipment marker on or near each major item of mechanical equipment and each operational device, as specified herein if not otherwise specified for each item or device. Provide signs for the following general categories of equipment and operational devices:
   1. Main control and operating valves.
   2. Fuel-burning units including boilers.
   4. Pumps and similar motor-driven units.
   5. Heat exchangers, coils, evaporators.
   6. Fans.

B. Optional Sign Types: Where lettering larger than 1" height is needed for proper identification, because of distance from normal location of required identification, stenciled signs may be provided in lieu of engraved plastic, at Installer's option.

C. Lettering Size: Minimum 2" high lettering for name of unit where viewing distance is less than 2'-0", 4" high for distances up to 6'-0", and proportionately larger lettering for greater distances. Provide secondary lettering 2/3 to 3/4 of size of principal lettering.

D. Text of Signs: In addition to name of identified unit, provide lettering to distinguish between multiple units, inform operator of operational requirements, indicate safety and emergency precautions, and warn of hazards and improper operations.

E. Optional Use of Plasticized Tags: At Installer's option, where equipment to be identified is concealed above acoustical ceiling or similar concealment, plasticized tags may be installed within concealed space to reduce amount of text in exposed sign (outside concealment).
   1. Operational valves and similar minor equipment items located in non-occupied spaces (including machine rooms) may, at Installer's option, be identified by installation of plasticized tags in lieu of engraved plastic signs.

F. Provide color coded ceiling tacks to locate equipment above T-bar lay-in ceilings. Locate in corner of panel closest to valve.

3.6 ADJUSTING AND CLEANING

A. Cleaning: Clean face of identification devices, and glass frames of valve charts.

B. Adjusting: Relocate any mechanical identification device which has become visually blocked by work of this division or other divisions.

3.7 EXTRA STOCK

A. Furnish minimum of 5% extra stock of each mechanical identification material required, including additional numbered valve tags (not less than three) for each piping system, additional piping system identification markers, color coded ceiling tacks, and additional plastic laminate engraving blanks of assorted sizes.
   1. Where stenciled markers are provided, clean and retain stencils after completion of stenciling and include used stencils in extra stock, along with required stock of stenciling paints and applicators.
   2. Furnish two (2) containers of spray-on adhesive. And two (2) rolls of pressure-sensitive vinyl tape for each color code and width used.

END OF SECTION 23 05 53

SECTION 23 05 93 - TESTING, ADJUSTING, AND BALANCING

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes:
1. Testing, adjusting, and balancing of air systems.
2. Measurement of final operating condition of HVAC systems.

B. Related Sections:
1. Section 23 09 93- Sequence of Operation: Sequences of operation for HVAC equipment.

1.2 REFERENCES

A. Associated Air Balance Council:
1. AABC MN-1 - National Standards for Testing and Balancing Heating, Ventilating, and Air Conditioning Systems.

B. Natural Environmental Balancing Bureau:
1. NEBB - Procedural Standards for Testing, Adjusting, and Balancing of Environmental Systems.

1.3 SUBMITTALS

A. Section 01 33 00 - Submittals: Submittal procedures.

B. Prior to commencing Work, submit proof of latest calibration date of each instrument.

C. Test Reports: Indicate data on AABC MN-1 National Standards for Total System Balance forms or NEBB reporting forms.

D. Field Reports: Indicate deficiencies preventing proper testing, adjusting, and balancing of systems and equipment to achieve specified performance.

E. Submit draft copies of report for review prior to final acceptance of Project.

F. Furnish reports in soft cover, letter size, 3-ring binder manuals, complete with table of contents page and indexing tabs, with cover identification at front and side. Include set of reduced drawings with air outlets and equipment identified to correspond with data sheets, and indicating thermostat locations.

1.4 CLOSEOUT SUBMITTALS

A. Section 01 70 00 – Execution Requirements: Closeout procedures.

B. Operation and Maintenance Data: Furnish final copy of testing, adjusting, and balancing report inclusion in operating and maintenance manuals.

1.5 QUALITY ASSURANCE

A. Perform Work in accordance with AABC MN-1 National Standards for Field Measurement and Instrumentation, Total System Balance or NEBB Procedural Standards for Testing, Balancing and Adjusting of Environmental Systems.

B. All instruments used for measurement shall be accurate, and calibration histories for each instrument shall be available for examination. Calibration and maintenance of all instruments shall be in accordance with AABC or NEBB requirements.

1.6 QUALIFICATIONS

A. Agency: Company specializing in testing, adjusting, and balancing of systems specified in this section with minimum three experience certified by AABC or Certified by NEBB, or provide at least 3 references for similar projects.

1.7 SEQUENCING

A. Sequence balancing between completion of systems tested and Date of Substantial Completion.

1.8 SCHEDULING

A. Section 01 31 00 – Project Management and Coordination: Coordination and project conditions.

PART 2 PRODUCTS

Not Used.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify systems are complete and operable before commencing work. Verify the following:
1. Systems are started and operating in 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. Final filters are clean and in place. If required, install temporary media in addition to final filters.
5. Duct systems are clean of debris.
6. Fans are rotating correctly.
7. Fire and volume dampers are in place and open.

8. Air coil fins are cleaned and combed.
9. Access doors are closed and duct end caps are in place.
10. Air outlets are installed and connected.
11. Duct system leakage is minimized.
12. Hydronic systems are flushed, filled, and vented.
13. Pumps are rotating correctly.
14. Proper strainer baskets are clean and in place or in normal position.
15. Service and balancing valves are open.

3.2 PREPARATION

A. Furnish instruments required for testing, adjusting, and balancing operations.

3.3 INSTALLATION TOLERANCES

A. Air Handling Systems: Adjust to within plus or minus 10 percent of design.

B. Air Outlets and Inlets: Adjust total to within plus 10 percent and minus 5 of design to space. Adjust outlets and inlets in space to within plus or minus 10 percent of design.

C. Hydronic Systems: Adjust to within plus or minus 10 percent of design.

3.4 ADJUSTING

A. Section 017000 – Contract Closeout: Testing, adjusting, and balancing.

B. Verify recorded data represents actual measured or observed conditions.

C. Permanently mark settings of valves, dampers, and other adjustment devices allowing settings to be restored. Set and lock memory stops.

D. After adjustment, take measurements to verify balance has not been disrupted. If disrupted, verify correcting adjustments have been made.

E. Report defects and deficiencies noted during performance of services, preventing system balance.

F. Leave systems in proper working order, replacing belt guards, closing access doors, closing doors to electrical switch boxes, and restoring thermostats to specified settings.

3.5 GENERAL PROCEDURES

A. All systems, including equipment, apparatus and distribution systems, shall be tested in accordance with the AABC National Standards for Total System Balance, Current Edition, or NEBB Procedural Standards for Testing, Adjusting and Balancing of Environmental Systems published by NEBB, Current Edition.

3.6 AIR SYSTEM PROCEDURE

A. Adjust air handling and distribution systems to obtain required or design supply, return, and exhaust air quantities.

B. Make air quantity measurements in main ducts by pitot tube traverse of entire cross sectional area of duct.

C. Measure air quantities at air inlets and outlets.

D. Adjust distribution system to obtain uniform space temperatures free from objectionable drafts.

E. Use volume control devices to regulate air quantities only to extent adjustments do not create objectionable air motion or sound levels. Effect volume control by using volume dampers located in ducts.

F. Vary total system air quantities by adjustment of fan speeds. Provide sheave drive changes to vary fan speed. Vary branch air quantities by damper regulation.

G. Provide system schematic with required and actual air quantities recorded at each outlet or inlet.

H. Measure static air pressure conditions on air supply units, including filter and coil pressure drops, and total pressure across fan. Make allowances for 50 percent loading of filters.

I. Adjust outside air automatic dampers, outside air, return air, and exhaust dampers for design conditions.

J. Measure temperature conditions across outside air, return air, and exhaust dampers to check leakage.

K. At modulating damper locations, take measurements and balance at extreme conditions. Balance variable volume systems at maximum airflow rate, full cooling, and at minimum airflow rate, full heating.

L. Measure building static pressure and adjust supply, return, and exhaust air systems to obtain required relationship between each to maintain approximately 0.05 inches positive static pressure at location indicated.

3.7 WATER SYSTEM PROCEDURE

A. Adjust water systems, after air balancing, to obtain design quantities.

B. Use calibrated Venturi tubes, orifices, or other metered fittings and pressure gauges 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 system.

C. Adjust systems to obtain 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 or in normal position 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 indexed for balance point.

F. Where available pump capacity is less than total flow requirements or individual system parts, simulate full flow in one part by temporary restriction of flow to other parts.

3.8 SCHEDULES

A. Equipment Requiring Testing, Adjusting, and Balancing:
   1. Plumbing Pumps.
   2. HVAC Pumps.
   3. Packaged Chillers.
   4. Air Handling Units.
   5. Fans.
   6. Air Terminal Units.
   7. Air Inlets and Outlets.

B. Report Forms
   1. Title Page:
      a. Name of Testing, Adjusting, and Balancing Agency
      b. Address of Testing, Adjusting, and Balancing Agency
      c. Telephone and facsimile numbers of Testing, Adjusting, and Balancing Agency
      d. Project name
      e. Project location
      f. Project Architect
      g. Project Engineer
      h. Project Contractor
      i. Project altitude
      j. Report date
   2. Summary Comments:
      a. Design versus final performance

b. Notable characteristics of system
c. Description of systems operation sequence
d. Summary of outdoor and exhaust flows to indicate building pressurization
e. Nomenclature used throughout report
f. Test conditions

3. Instrument List:
   a. Instrument
   b. Manufacturer
   c. Model number
   d. Serial number
   e. Range
   f. Calibration date
4. Electric Motors:
   a. Manufacturer
   b. Model/Frame
   c. HP/BHP and kW
   d. Phase, voltage, amperage; nameplate, actual, no load
   e. RPM
   f. Service factor
   g. Starter size, rating, heater elements
   h. Sheave Make/Size/Bore
5. V-Belt Drive:
   a. Identification/location
   b. Required driven RPM
   c. Driven sheave, diameter and RPM
   d. Belt, size and quantity
   e. Motor sheave diameter and RPM
6. Pump Data:
   a. Identification/number
   b. Manufacturer
   c. Size/model
   d. Impeller
   e. Service
   f. Design flow rate, pressure drop, BHP and kW
   g. Actual flow rate, pressure drop, BHP and kW
   h. Discharge pressure
   i. Suction pressure
   j. Total operating head pressure
   k. Shut off, discharge and suction pressures
   l. Shut off, total head pressure
7. Chillers:
   a. Identification/number
   b. Manufacturer
   c. Capacity
   d. Model number
   e. Serial number
   f. Evaporator entering water temperature, design and actual

g. Evaporator leaving water temperature, design and actual
h. Evaporator pressure drop, design and actual
i. Evaporator water flow rate, design and actual
j. Condenser entering water temperature, design and actual
k. Condenser pressure drop, design and actual
l. Condenser water flow rate, design and actual

8. Cooling Coil Data:
   a. Identification/number
   b. Location
   c. Service
   d. Manufacturer
   e. Air flow, design and actual
   f. Entering air DB temperature, design and actual
   g. Entering air WB temperature, design and actual
   h. Leaving air DB temperature, design and actual
   i. Leaving air WB temperature, design and actual
   j. Water flow, design and actual
   k. Water pressure drop, design and actual
   l. Entering water temperature, design and actual
   m. Leaving water temperature, design and actual
   n. Saturated suction temperature, design and actual
   o. Air pressure drop, design and actual
9. Heating Coil Data:
   a. Identification/number
   b. Location
   c. Service
   d. Manufacturer
   e. Air flow, design and actual
   f. Water flow, design and actual
   g. Water pressure drop, design and actual
   h. Entering water temperature, design and actual
   i. Leaving water temperature, design and actual
   j. Entering air temperature, design and actual
   k. Leaving air temperature, design and actual
   l. Air pressure drop, design and actual
10. Air Moving Equipment:
   a. Location
   b. Manufacturer
   c. Model number
   d. Serial number
   e. Arrangement/Class/Discharge
   f. Air flow, specified and actual
   g. Return air flow, specified and actual
   h. Outside air flow, specified and actual
   i. Total static pressure (total external), specified and actual
   j. Inlet pressure
   k. Discharge pressure
   l. Sheave Make/Size/Bore

m. Number of Belts/Make/Size
n. Fan RPM

11. Return Air/Outside Air Data:
    a. Identification/location
    b. Design air flow
    c. Actual air flow
    d. Design return air flow
    e. Actual return air flow
    f. Design outside air flow
    g. Actual outside air flow
    h. Return air temperature
    i. Outside air temperature
    j. Required mixed air temperature
    k. Actual mixed air temperature
    l. Design outside/return air ratio
    m. Actual outside/return air ratio
12. Exhaust Fan Data:
    a. Location
    b. Manufacturer
    c. Model number
    d. Serial number
    e. Air flow, specified and actual
    f. Total static pressure (total external), specified and actual
    g. Inlet pressure
    h. Discharge pressure
    i. Sheave Make/Size/Bore
    j. Number of Belts/Make/Size
    k. Fan RPM
13. Duct Traverse:
    a. System zone/branch
    b. Duct size
    c. Area
    d. Design velocity
    e. Design air flow
    f. Test velocity
    g. Test air flow
    h. Duct static pressure
    i. Air temperature
    j. Air correction factor
14. Duct Leak Test:
    a. Description of ductwork under test
    b. Duct design operating pressure
    c. Duct design test static pressure
    d. Duct capacity, air flow
    e. Maximum allowable leakage duct capacity times leak factor
    f. Test apparatus
        1) Blower
        2) Orifice, tube size

3) Orifice size
4) Calibrated

g. Test static pressure
h. Test orifice differential pressure
i. Leakage

15. Terminal Unit Data:
    a. Manufacturer
    b. Type, constant, variable, single, dual duct
    c. Identification/number
    d. Location
    e. Model number
    f. Size
    g. Minimum static pressure
    h. Minimum design air flow
    i. Maximum design air flow
    j. Maximum actual air flow
    k. Inlet static pressure
16. Air Distribution Test Sheet:
    a. Air terminal number
    b. Room number/location
    c. Terminal type
    d. Terminal size
    e. Area factor
    f. Design velocity
    g. Design air flow
    h. Test (final) velocity
    i. Test (final) air flow
    j. Percent of design air flow

END OF SECTION 23 05 93

SECTION 23 07 01 - MECHANICAL INSULATION

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes:
1. Ductwork insulation.
2. Insulation jackets.
3. Piping system insulation.
4. Insulation accessories including vapor retarders, jackets, and accessories.

B. Related Sections:
1. Section 23 05 29 - Hangers and Supports: Product and Execution requirements for inserts at hanger locations and firestopping.
2. Section 23 05 23 - Mechanical Identification: Product requirements for mechanical identification.

1.2 REFERENCES

A. ASTM International:
1. ASTM C518 - Standard Test Method for Steady-State Heat Flux Measurements and Thermal Transmission Properties by Means of the Heat Flow Meter Apparatus.
2. ASTM C534 - Standard Specification for Preformed Flexible Elastomeric Cellular Thermal Insulation in Sheet and Tubular Form.
3. ASTM C921 - Standard Practice for Determining the Properties of Jacketing Materials for Thermal Insulation.
4. ASTM C1126 - Standard Specification for Faced or Unfaced Rigid Cellular Phenolic Thermal Insulation.
5. ASTM C1136 - Standard Specification for Flexible, Low Permeance Vapor Retarders for Thermal Insulation.
6. ASTM C1290 - Standard Specification for Flexible Fibrous Glass Blanket Insulation Used to Externally Insulate HVAC Ducts.
7. ASTM D1784 - Standard Specification for Rigid Poly (Vinyl Chloride) (PVC) Compounds and Chlorinated Poly (Vinyl Chloride) (CPVC) Compounds.
8. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials.
9. ASTM E96 - Standard Test Methods for Water Vapor Transmission of Materials.

B. Sheet Metal and Air Conditioning Contractors':
1. SMACNA - HVAC Duct Construction Standard - Metal and Flexible.

1.3 SUBMITTALS

A. Section 01 33 00 - Submittals: Submittal procedures.

B. Product Data: Submit product description, thermal characteristics and list of materials and thickness for each service, and location.

C. Manufacturer's Installation Instructions: Submit manufacturers published literature indicating proper installation procedures.

D. Manufacturer's Certificate: Certify products meet or exceed specified requirements.

1.4 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing products specified in this section with minimum three years experience.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Accept materials on site in original factory packaging, labeled with manufacturer's identification, including product density and thickness.

B. Protect insulation from weather and construction traffic, dirt, water, chemical, and mechanical damage, by storing in original wrapping.

1.6 ENVIRONMENTAL REQUIREMENTS

A. Install insulation only when ambient temperature and humidity conditions are within range recommended by manufacturer.

PART 2 PRODUCTS

2.1 GLASS FIBER, RIGID PIPE

A. Available Manufacturers:
1. Johns Mansville, Model Micro-Lok.
2. Approved Equal.

B. Insulation: ASTM C547, Type I.
1. ‘K’ factor: ASTM C177 or ASTM C518, 0.23 at 75 degrees F.
2. Maximum Service Temperature: 850 degrees F.
3. Maximum Moisture Absorption: 0.2 percent by volume.

C. Vapor Retarder Jacket: ASTM C1136 Flexible, Low Permeance Vapor Retarders for Thermal Insulation, Type II.

2.2 GLASS FIBER, BLANKET

A. Available Manufacturers:
1. Johns Mansville, Model Microlite.
2. Approved Equal.

B. Insulation: ASTM C553, Type II.
   1. 'K' factor: ASTM C177 or ASTM C518, 0.27 at 75 degrees F.
   2. Maximum Service Temperature: 250 degrees F.
   3. Maximum Moisture Absorption: 0.2 percent by volume.

C. Vapor Retarder Jacket: ASTM C1136 Flexible, Low Permeance Vapor Retarders for Thermal Insulation, Type II.

2.3 GLASS FIBER, RIGID DUCT

A. Available Manufacturers:
   1. Johns Mansville, Model 813 Spin-glas.
   2. Approved Equal.

B. Insulation: ASTM C612; rigid, noncombustible.
   1. 'K' factor: ASTM C177 or ASTM C518, 0.23 at 75 degrees F.
   2. Maximum Service Temperature: 350 degrees F.
   3. Maximum Moisture Absorption: 0.2 percent by volume.
   4. Density: 3.0 lb/cu ft.

C. Vapor Retarder Jacket: ASTM C1136 Flexible, Low Permeance Vapor Retarders for Thermal Insulation, Type II.

D. Vapor Retarder Lap Adhesive:
   1. Compatible with insulation.

E. Insulating Cement/Mastic:
   1. ASTM C195; hydraulic setting on mineral wool.

2.4 FIRE BARRIER DUCT WRAP

A. Available Manufacturers:
   1. 3M.
   2. Approved Equal.

B. Insulation: ASTM C411; foil encapsulated, inorganic blanket, UL listed.
   1. Thickness: 2 layers of 1-1/2 inches (3" total).
   2. Banding Material: Carbon steel or stainless steel.
   3. Flame Spread: 0
   4. Smoke Developed: 0
   5. Establishes zero clearance to combustible material.

2.5 ELASTOMERIC CELLULAR FOAM

A. Available Manufacturers:
   1. Armaflex, Model AP.
   2. Approved Equal.

B. Preformed Flexible Elastomeric Cellular Thermal Insulation in Sheet and Tubular form: ASTM C534; Type I, Tubular form.
   1. Temperature Range: -70 – 200 deg F.
   2. Thermal Conductivity: 0.27 btu-in/hr-sf-°F @75°F mean temperature.
   3. Water Vapor Permeability: 0.08.

C. Elastomeric Foam Adhesive:
   1. Air dried, contact adhesive, compatible with insulation.

2.6 PIPE INSULATION AND EQUIPMENT JACKETS

A. PVC Plastic Pipe Jacket:
   1. Product Description: ASTM D1784, One piece molded type fitting covers and sheet material, off-white color.
   2. Thickness: 10 mil.
   3. Connections: Brush on welding adhesive.

B. PVC Plastic Equipment Jacket:
   1. Product Description: Sheet material, off-white color.
   2. Minimum Service Temperature: -40 degrees F.
   3. Maximum Service Temperature: 150 degrees F.
   4. Moisture Vapor Transmission: ASTM E96; 0.002 perm-inches.
   5. Thickness: 10 mil.
   6. Connections: Brush on welding adhesive.

C. PVC Pipe Jacket:
   1. Product Description: ASTM D1784, One piece molded type fitting covers and sheet material, off-white color.
   2. Thickness: 10.
   3. Connections: Brush on welding adhesive.

D. Covering Adhesive Mastic:
   1. Compatible with insulation.

E. Duct Jacket (Outdoors):
   1. Manufacturers
      a. MFM Building Products, Corp, Model Flex Clad 400.
   2. Pre-fabricated, self-adhering, sheet-type waterproofing membrane.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify piping, equipment and ductwork has been tested before applying insulation materials.

B. Verify surfaces are clean and dry, with foreign material removed.

3.2 INSTALLATION

A. Exposed Piping: Locate insulation and cover seams in least visible locations.

B. Insulated pipes conveying fluids below ambient temperature: Insulate entire system including fittings, valves, unions, flanges, strainers, flexible connections, pump bodies, and expansion joints.

C. For hot piping conveying fluids over 140 degrees F, insulate flanges and unions at equipment.

D. Inserts and Shields:
   1. Application: Piping or Equipment 1-1/2 inches diameter or larger.
   2. Shields: Galvanized steel between pipe hangers or pipe hanger rolls and inserts.
   3. Insert location: Between support shield and piping and under finish jacket.
   4. Insert configuration: Minimum 6 inches long, of thickness and contour matching adjoining insulation; may be factory fabricated.
   5. Insert material: Compression resistant insulating material suitable for planned temperature range and service.

E. Continue insulation through penetrations of building assemblies or portions of assemblies having fire resistance rating of one hour or less. Provide intumescent firestopping when continuing insulation through assembly. Finish at supports, protrusions, and interruptions. Refer to Section 07 84 00 for penetrations of assemblies with fire resistance rating greater than one hour.

F. Pipe Exposed in Mechanical Equipment Rooms or Finished Spaces less than 3 feet above finished floor: Finish with aluminum jacket.

G. Factory Insulated Equipment: Do not insulate.

H. Exposed Equipment: Locate insulation and cover seams in least visible locations.

I. Apply insulation close to equipment by grooving, scoring, and beveling insulation. Fasten insulation to equipment with studs, pins, clips, adhesive, wires, or bands.

J. Fill joints, cracks, seams, and depressions with bedding compound to form smooth surface. On cold equipment, use vapor retarder cement.

K. Insulated equipment containing fluids below ambient temperature: Insulate entire system.

L. For hot equipment containing fluids over 140 degrees F, insulate flanges and unions with removable sections and jackets.

M. Finish insulation at supports, protrusions, and interruptions.

N. Include chilled water hydronic equipment (air separator, expansion tank), and chilled water pump bodies.

O. Nameplates and ASME Stamps: Bevel and seal insulation around; do not insulate over.

P. Equipment Requiring Access for Maintenance, Repair, or Cleaning: Install insulation for easy removal and replacement without damage.

Q. Insulated ductwork conveying air below ambient temperature:
1. Provide insulation with vapor retarder jackets.
2. Finish with tape and vapor retarder jacket.
3. Continue insulation through walls, sleeves, hangers, and other duct penetrations.
4. Insulate entire system including fittings, joints, flanges, fire dampers, flexible connections, and expansion joints.

R. Insulated ductwork conveying air above ambient temperature:
1. Provide with or without standard vapor retarder jacket.
2. Insulate fittings and joints. Where service access is required, bevel and seal ends of insulation.

S. Insulated exterior ductwork:
1. Provide with outdoor duct jacket.
2. Insulate fittings and joints. Where service access is required, bevel and seal ends of insulation.
3. Slope exterior duct to exterior wall penetrations to allow water to flow away from building.

APPLICATION AND THICKNESS TABLES

Table 1 - Cold Piping Insulation

Service	Insulation Type	Pipe Size	Thickness	Run-outs * (up to 2 inches)
Domestic Cold Water, Rain Leaders and Condensation Piping	Elastomeric or Glass Fiber	1/2" to 8"	1/2"	1/2”
Chilled water, aboveground only	Elastomeric, cellular glass	1/2" to 8"	1-1/2"	1-1/2”
Chilled water, underground	Cellular glass	Up to 1-1/2" 2” and above	2" 3”	2” 3”
Refrigerant Suction	Elastomeric	1/2" to 1” 1-1/4" and above	1" 1-1/2"	1"
Refrigerant Discharge	Elastomeric	All	1”	Not permitted

Table 2 - Hot Piping Insulation

Service	Insulation Type	Pipe Size	Thickness	Run-outs * (up to 2 inches)
Domestic Hot Water Supply and Recirculated Hot Water	Elastomeric or Glass Fiber	1/2" 3/4" to 2"	1/2" 1"	1/2"
Hot Water Heating Water	Glass Fiber	1/2", 3/4" 1" to 1 1/2" 2" to 3" 4" to 6"	1/2" 1" 1-1/2" 2"	1/2"

* Only run-outs less than 12 feet long.

Table 3 – Air System Insulation

Service	Insulation Type	Thickness
Supply Air Ducts (Indoors through conditioned spaces)	Glass Fiber	1.5"
Outside Air Duct	Glass Fiber	3”
Supply and Return Ducts (Outdoors & Attic)	Glass Fiber	3”
Exhaust Ducts (from exterior wall to backdraft or motorized damper)	Glass Fiber	1”

END OF SECTION 23 07 01

SECTION 23 09 23 - HVAC INSTRUMENTATION AND DDC CONTROLS

PART 1 – GENERAL

1.01 Work Included:

A. GENERAL - Building Management System (BMS) Contractor shall provide and install:

1. New DDC controls as shown in Drawings and Specifications to be fully integrated in existing Building Automation System (BAS) by IBControls, incorporating direct digital control (DDC) for energy management, equipment monitoring and control, and subsystems with open communications capabilities as herein specified.

2. Complete temperature control system to be DDC with electric actuation as specified herein.

3. All wiring, conduit, panels, and accessories for a complete operational system unless specified elsewhere.

4. BMS Contractor shall be responsible for all electrical work associated with the BMS unless specified elsewhere.

   a. Perform all wiring in accordance with all local and national codes.

   b. Install all line voltage wiring, concealed or exposed, in conduit in accordance with the division 26 specifications, NEC and local building code.

   c. Provide all Low Voltage Control interconnecting wiring for specified mechanical systems including chillers, AC units, condensing units, VFD, unit heaters, terminal units, chiller control system.

5. Provide open communications system. The system shall be an open architecture with the capabilities to support a multi-vendor environment. To accomplish this effectively, system shall be capable of utilizing standard protocols as follows as well as be able to integrate third-party systems via existing vendor protocols.

   a. System shall be capable of high speed Ethernet communication using BACnet/IP and TCP/IP protocol.

   b. System shall be capable of BACnet communication according to ANSI/ASHRAE 135-2004 or ANSI/ASHRAE 135-2008.

   c. The system shall be capable of supporting both standard and vendor specific protocols to integrate a wide variety of third-party devices and legacy systems.

6. Provide system graphics for each controlled device and/or integrated systems. Origin of information shall be transparent to the operator and shall be controlled, displayed, trended, etc. as if the points were hardwired to the BMS.

7. Stand-alone Application Specific Controllers (ASCs) for terminal equipment.

B. GENERAL PRODUCT DESCRIPTION

1. The installation of the control system shall be performed under the direct supervision of the controls manufacturer with the shop drawings, flow diagrams, bill of materials, component designation, or identification number and sequence of operation all bearing the name of the manufacturer. The installing manufacturer shall certify in writing, that the shop drawings have been prepared by the equipment manufacturer and that the equipment manufacturer has supervised their installation. In addition, the equipment manufacturer shall certify, in writing, that the shop drawings were prepared by their company and that all temperature control equipment was installed under their direct supervision.

2. All materials and equipment used shall be standard components, regularly manufactured for this and/or other systems and not custom designed especially for this project. All systems and components shall have been thoroughly tested and proven in actual use for at least two years.

3. The system shall be scalable in nature and shall permit expansion of both capacity and functionality through the addition of sensors, actuators, DDC Controllers, and operator devices.

4. System architectural design shall eliminate dependence upon any single device for alarm reporting and control execution. Each DDC Controller shall operate independently by performing its own specified control, alarm management, operator I/O, and data collection. The failure of any single component or network connection shall not interrupt the execution of any control strategy, reporting, alarming and trending function, or any function at any operator interface device.

5. DDC Controllers shall be able to access any data from, or send control commands and alarm reports directly to, any other DDC Controller or combination of controllers on the network without dependence upon a central or intermediate processing device. DDC Controllers shall also be able to send alarm to multiple operator workstations without dependence upon a central or intermediate processing device.

1.02 Products Furnished but Not Installed Under This Section

A. Duct-work Accessories:

1. Damper actuators

1.03 Related Sections

A. The General Conditions of the Contract, Supplementary Conditions, and General Requirements are part of this specification and shall be used in conjunction with this section as part of the contract documents.

B. The following sections constitute related work:

1. Section 01 00 00 – General and Special Requirements
2. Section 01 33 00 – Submittal Requirements
3. Section 01 60 00 – Product Requirements
4. Section 23 05 01 – Common Work Results for HVAC
5. Section 23 30 00 – HVAC Air Distribution
6. Section 23 05 93 – Testing, Adjusting, and Balancing for HVAC

1.04 Approved Control System Contractors and Managers

A. The following are the approved Control System Contractors and Manufacturers:

1. IBControls, 3 Pope Road, Windham, ME 04062; Brian Lajeunesse, 207-893-0081

1.05 Quality Assurance

A. The BAS system shall be designed and installed, commissioned and serviced by factory trained personnel. BMS contractor shall have an in-place support facility within 100 miles of the site with technical staff, spare parts inventory and necessary test and diagnostic equipment. The BMS contractor shall provide an experienced project manager for this work, responsible for direct supervision of the design, installation, start up and commissioning of the BMS.

B. The BMS contractor shall maintain a service organization consisting of factory trained service personnel and provide a list of 10 projects, similar in size and scope to this project, completed within the last five years.

C. Materials and equipment shall be the catalogued products of manufacturers regularly engaged in production and installation of automatic temperature control systems and shall be manufacturer's latest standard design that complies with the specification requirements.

1.06 Codes and Standards

A. Work, materials, and equipment shall comply with the most restrictive of local, state, and federal authorities’ codes and ordinances or these plans and specifications. As a minimum, the installation shall comply with current editions in effect 30 days prior to receipt of bids of the following codes:

1. National Electric Code (NEC)
2. Uniform Mechanical Code (UMC)

3. ANSI/ASHRAE Standard 135- 2004, or ANSI/ASHRAE 135-2008, BACnet—A Data Communication Protocol for Building Automation and Control Networks

1.07 Submittals

A. Product Submittal Requirements. Meet requirements of Section 013300 on Shop Drawings, Product Data, and Samples. Provide six copies of shop drawings and other submittals on hardware, software, and equipment to be installed or furnished. Begin no work until submittals have been approved for conformity with design intent. When manufacturer's cutsheets apply to a product series rather than a specific product, clearly indicate applicable data by highlighting or by other means. General catalogs shall not be accepted as cut sheets to fulfill submittal requirements. Select and show submittal quantities appropriate to scope of work.

B. Provide submittals within 12 weeks of contract award.

C. Submittal data shall consist of the following:

1. Direct Digital Control System Hardware:

a. Complete bill of materials indicating quantity, manufacturer, model number, and relevant technical data of equipment to be used.

b. Manufacturer's description and technical data, such as product specification sheets, installation and maintenance instructions for items listed below and for relevant items not listed below:

1) Direct Digital Controllers (controller panels)
2) Transducers and transmitters
3) Sensors
4) Valves
5) Dampers
6) Relays and Switches
7) Control Panels
8) Power Supplies

c. Wiring diagrams and layouts for each control panel.

2. Controlled Systems:

a. Riser diagrams showing control network layout, communication protocol, and wire types.

a. Schematic diagram of each controlled system. Label control points with point names. Graphically show locations of control elements.

b. Schematic wiring diagram of each controlled system. Label control elements and terminals. Where a control element is also shown on control system schematic use the same name.

c. Complete description of control system operation including sequences of operation. Include and reference schematic diagram of controlled system.

D. Project Record Documents: Submit three copies of record (as-built) documents upon completion of installation. Submittal shall consist of:

1. Project Record Drawings. As-built versions of the submittal shop drawings provided as 11 x 17 prints.

2. Operation and Maintenance (O & M) Manual.

a. As-built versions of the submittal product data.

b. Names, addresses, and 24-hour telephone numbers of installing contractors and service representatives for equipment and control systems.

1.08 Warranty

A. Warrant labor and materials for specified control system free from defects for a period of 12 months after beneficial use acceptance. Failures on control systems that include all computer equipment, transmission equipment and all sensors and control devices during warranty period shall be adjusted, repaired, or replaced at no additional cost or reduction in service to Owner. Respond during normal business hours within 24 hours of Owner's warranty service request.

B. Exception:

1. Contractor shall not be required to warrant systems, equipment and devices or software if the damages and/or failures were caused by lack of training, unauthorized use, negligence or deliberate action of other parties, or job site conditions.

1.09 Ownership of Proprietary Material

A. Project specific software and documentation shall become Owner's property. This includes, but is not limited to:

1. Graphics

2. Record drawings

3. Database

4. Application programming code

PART 2 – PRODUCTS

2.01 Materials:

A. All products used in this project installation shall be new and currently manufactured and shall have been applied in similar installations. Do not use this installation as a product test site unless explicitly approved in writing by Owner or Owner's representative. Spare parts shall be available for at least five years after completion of this contract.

2.02 Communication:

A. The design of the BMS shall support networking of operator workstations and Building Controllers. The network architecture shall consist of two levels, an Ethernet based primary network for all operator workstations, servers, and primary DDC controllers along with secondary Field Level Networks for terminal equipment application specific controllers.

B. Access to system data shall not be restricted by the hardware configuration of the building management system. The hardware configuration of the BMS network shall be totally transparent to the user when accessing data or developing control programs.

C. Primary Network - Panel to Panel Communication:

1. All Building Controllers shall directly reside on the primary BACnet/IP Ethernet network such that communications may be executed directly between Building Controllers, directly between server and Building Controllers on a peer-to-peer basis.

2. Systems that operate via polled response or other types of protocols that rely on a central processor, file server, or similar device to manage panel-to-panel or device-to-device communications shall not be acceptable.

3. All operator interfaces shall have the ability to access all point status and application report data or execute control functions for any and all other devices. Access to data shall be based upon logical identification of building equipment. No hardware or software limits shall be imposed on the number of devices with global access to the network data.

4. The primary network shall use BACnet/IP over Ethernet. All devices must:

a. Auto-sense 10/100 Mbps networks.

b. Receive an IP Address from a Dynamic Host Configuration Protocol (DHCP) Server or be configured with a Fixed IP Address.

c. Resolve Name to IP Addresses for devices using a Domain Name Service (DNS) Server on the Ethernet network.

d. Allow MMI access to an individual Primary Network Controller using industry standard Telnet software to view and edit entire Primary Network.

5. The primary network shall provide the following minimum performance:

   a. Provide high-speed data transfer rates for alarm reporting, report generation from multiple controllers and upload/download efficiency between network devices. System performance shall insure that an alarm occurring at any Building Controller is displayed at any PC workstations, all Building Controllers, and other alarm printers within 15 seconds.

   b. Message and alarm buffering to prevent information from being lost.

   c. Error detection, correction, and re-transmission to guarantee data integrity.

   d. Synchronization of real-time clocks between Building Controllers, including automatic daylight savings time corrections.

   e. The primary network shall allow the Building Controllers to access any data from, or send control commands and alarm reports directly to, any other Building Controller or combination of controllers on the network without dependence upon a central or intermediate processing device.

   f. The primary network controllers shall provide system-wide wild card point search, command, and access direct from any building controller on the network.

   g. The primary network shall allow the Building Controllers to access on-demand display and reports regarding system-wide information including point names, point status, present value, command priority array, trend information, field panel configuration information.

   h. The primary network shall allow the Building Controllers to be configured system-wide by software based tools, and by direct access from any Building Controller on the network.

   i. Devices containing custom programming may reside on the Primary Network.

D. Secondary Network – Application Specific Controller Communication:

1. Communication over the secondary network shall be BACnet MS/TP protocol.

2. This level communication shall support a family of application specific controllers for terminal equipment.

3. The Application Specific Controllers shall communicate bi-directionally with the primary network through Building Controllers for transmission of global data.

2.03 Building Controller Software

A. Web-based Operator Interface

1. Provide a Web-based graphical interface that allows users to access the BAS data via the Internet, extranet, or Intranet (TCP/IP). The Web-based graphical interface shall use HTML-based pages to send and receive data directly from a network of BAS Field Panels to a Web browser.

2. The web server shall support browser access via Microsoft Internet Explorer 6.0 (or later), Firefox, or any browser that supports the compatible plug-in.

    a. Cookies are allowed for compatibility

    b. Microsoft Java Applet (JVM) is allowed for compatibility

    c. Adobe Flash Player shall be allowed for compatibility

3. The web server shall support access via handheld, web enabled devices through apps. The apps shall be available for download from public sites, such as Blackberry App World or Android Market.

4. If a field panel cannot serve up the graphics, then dedicated PC-based Web servers or separate “Web Appliance” devices may be allowed for this purpose.

5. The Web server shall allow monitor and control of data in any field panels networked together on the same automation level TCP/IP Ethernet network.

    a. The Web server must provide a common alarm display that shows alarms in all field panels on the network.

    b. The Web server must be able to provide common graphics that simultaneously display the current value and status for points residing in multiple field panels.

    c. The Web server must be able to display daily mode schedules for points from multiple field panels simultaneously.

6. Access to the Web interface shall be username and password protected. A user’s rights and privileges to database objects within the BAS shall be configurable on a per-user basis. An option shall exist to only allow users “read” access to BAS objects via the Web browser. Operator sessions shall be configurable for “auto-logoff” after a designated period of user inactivity.

    a. A graphic selector list shall allow or limit the graphic displays that a user account has access to.

    b. The embedded Web server shall support an unlimited number of user accounts. A minimum of five concurrent user sessions shall be available for simultaneous operator access to the Web server’s pages.

c. The embedded Web server shall be compatible with and allow coexistence within standard IT security policies and tools (e.g., Firewall protection).

7. The embedded Web server shall provide the following functionality to users via Web browser, based on their access and privilege rights:

a. Point Navigation – Provide a screen that allows users to see all of the points that are active in the system. The points shall include hardwired, software, schedules, trends, alarms and network setup.

1) The point navigation shall display the point name, descriptor, command priority, alarm status, and current value.

2) The user shall be able to run and print a pre-configured point log report through a web interface client that shows the point name, descriptor, command priority, alarm status, and current value.

3) The interface and report shall allow selection filter such that the operator can select or deselect the types of point that are visible.

b. Alarm Display –displays current BAS alarms to which the user has access will be displayed. Users will be able to acknowledge active alarms, erase resolved alarms, and directly link to the Point Commanding feature.

1) The alarm display must provide a filter that displays all alarms whether acknowledged or not.

2) The alarm display must provide a filter that displays only alarms that have not yet been acknowledged.

3) The alarm display must provide a persistent indication whenever there is one or more unacknowledged alarm in any connected field panel.

c. Point details – users will have access to point detail information including operational status, operational priority, physical address, and alarm limits, for point objects to which they have access rights.

d. Point Commanding – users will be able to override and command points they have access to via the Web browser interface.

e. Scheduling – allows operators, depending on their current user privileges, to override schedules selected by date, and to modify the properties of a selected schedule.

1) The scheduler display must be able to represent facility mode schedules in a graphical format.

f. Trend Data Report – allows users to run and print a pre-configured trend data report for historical data reporting, including a representation of the alarm status of the each point for each Trend sample. The report shall allow selection of individual points or wildcard selection of points.

1) Trend data shall be exportable to a data file, such as .csv or other comparable.

g. Network navigation - Provide a screen that allows users to navigate to the panels and terminal units via the network architecture.

8. Graphic Displays – The BAS contractor shall provide a graphical display for each system that is controlled.

a. Display of system graphics shall be available for viewing over the Web browser. Graphic displays will automatically refresh with the latest change of values. Users shall have the ability to command and override points directly from the graphic display as determined by their user accounts rights. The Graphic Display shall accommodate a minimum of 10 customized graphics.

b. The Graphic Display shall accommodate the terminal unit graphics related to the Application Specific Controllers tied in to the Field Panels within the system.

9. The web server shall be able to send SMTP text messages to notify users of alarm status. The owners shall provide a mail server and a connection port. SSL shall not be required.

10. The operator shall be able to add modify and delete controller database program, including points, schedules, alarms, and trends.

a. The operator shall be able to edit the custom program in the field panel that executes the sequences of operations, control loops and logic for the systems controlled.

b. The operator shall be able to add terminal unit controllers that reside on field panel subnetworks.

11. Internet connections, ISP services, as well as necessary firewalls or proxy servers shall be provided by the Owner as required to support the Web access feature.

B. General:

1. Furnish the following applications software to form a complete operating system for building and energy management as described in this specification.

2. The software programs specified in this section shall be provided as an integral part of Building Controllers and shall not be dependent upon any higher level computer or another controller for execution.

3. The Building Controller Software shall be capable of BACnet communications. The BACnet Building Controller (B-BC) shall have demonstrated interoperability during at least one BTL Interoperability Workshop, have

demonstrated compliance to BTL through BTL listing and shall substantially conform to BACnet Building Controller (B-BC) device profile as specified in ANSI/ASHRAE 135-2004, Annex L.

4. Building Controllers shall have the ability to perform energy management routines including but not limited to time of day scheduling, calendar-based scheduling, holiday scheduling, temporary schedule overrides, start stop time optimization, automatic daylight savings time switch over, night setback control, enthalpy switch over, peak demand limiting, temperature-compensated duty cycling, heating/cooling interlock, supply temperature reset, priority load shedding, and power failure restart.

5. The Building Controllers shall have the ability to perform the following pre tested control algorithms:

   a. Two position control

   b. Proportional control

   c. Proportional plus integral control

   d. Proportional, integral, plus derivative control

   e. Automatic tuning of control loops

6. Each controller shall be provided with an interactive HELP function to assist operators using POTs and remote connected operators.

7. Building Controllers shall not be susceptible to Microsoft Windows operating systems based viruses.

C. System Security

1. User access shall be secured using individual security passwords and user names.

2. Passwords shall restrict the user to the objects, applications, and system functions as assigned by the system manager.

3. Building Controllers shall be able to assign a minimum of 50 passwords access and control priorities to each point individually. The logon password (at any Operator Interface or portable operator terminal) shall enable the operator to monitor, adjust and control only the points that the operator is authorized for. All other points shall not be displayed at the Operator Interface or portable terminal. Passwords and priorities for every point shall be fully programmable and adjustable.

4. User Log On/Log Off attempts shall be recorded.

5. The system shall protect itself from unauthorized use by automatically logging off following the last keystroke. The delay time shall be user-definable.

6. Use of workstation resident security as the only means of access control is not an acceptable alternative to resident system security in the field panel.

D. User Defined Control Applications:

1. Controllers shall be able to execute custom, job-specific processes defined by the user, to automatically perform calculations and special control routines.

2. It shall be possible to use any system measured point data or status, any system calculated data, a result from any process, or any user-defined constant in any controller in the system.

3. Any process shall be able to issue commands to points in any and all other controllers in the system.

4. Each controller shall support plain language text comment lines in the operating program to allow for quick troubleshooting, documentation, and historical summaries of program development.

5. Controller shall provide a HELP function key, providing enhanced context sensitive on-line help with task oriented information from the user manual.

E. Alarm Management:

1. Alarm management shall be provided to monitor and direct alarm information to operator devices. Each Building Controller shall perform distributed, independent alarm analysis, minimize network traffic and prevent alarms from being lost. At no time shall the Building Controllers ability to report alarms be affected by either operator or activity at a PC workstation, local I/O device or communications with other panels on the network.

2. Conditional alarming shall allow generation of alarms based upon user defined multiple criteria.

3. An Alarm “shelving” feature shall be provided to disable alarms during testing. (Pull the Plug, etc.).

4. Binary Alarms. Each binary object shall be set to alarm based on the operator-specified state. Provide the capability to automatically and manually disable alarming.

5. Analog Alarms. Each analog object shall have both high and low alarm limits. Alarming must be able to be automatically and manually disabled.

6. All alarm or point change reports shall include the point's user-defined language description and the time and date of occurrence.

7. Alarm reports and messages shall be routed to user-defined list of operator workstations, or other devices based on time and other conditions. An alarm shall

be able to start programs, print, be logged in the event log, generate custom messages, and display graphics.

8. In addition to the point's descriptor and the time and date, the user shall be able to print, display or store a 200-character alarm message to more fully describe the alarm condition or direct operator response.

F. Automatic Daylight Savings Time Switchover. The system shall provide automatic time adjustment for switching to/from Daylight Savings Time.

G. Night setback control. The system shall provide the ability to automatically adjust setpoints for night control.

H. Loop Control. A PID (proportional-integral-derivative) closed-loop control algorithm with direct or reverse action and anti-windup shall be supplied. The algorithm shall calculate a time-varying analog value that is used to position an output or stage a series of outputs. The controlled variable, setpoint, and weighting parameters shall be user-selectable.

I. Sequencing. Provide application software based upon the sequences of operation specified to properly sequence equipment.

J. Data Collection:

1. A variety of historical data collection utilities shall be provided to manually or automatically sample, store, and display system data for all points.

2. Building Controllers shall store point history data for selected analog and digital inputs and outputs:

a. Any point, physical or calculated may be designated for trending. Any point, regardless of physical location in the network, may be collected and stored in each Building Controllers point group.

b. Two methods of collection shall be allowed: either by up to four pre-defined time intervals or upon a pre-defined change of value. Sample intervals of l minute to 7 days shall be provided.

3. Trend data shall be stored at the Building Controllers and uploaded to the workstation when retrieval is desired. Uploads shall occur based upon either user-defined interval, manual command or when the trend buffers are full. All trend data shall be available for use in third-party personal computer applications.

2.04 Building Controllers

A. Building Controllers shall be 32-bit, multi-tasking, multi-user, real-time 100 MHz digital control processors consisting of modular hardware with plug-in enclosed processors, communication controllers, power supplies and input/output point modules. Controller size shall be sufficient to fully meet the requirements of this specification and the attached point list.

B. Each Building Controller shall have sufficient memory, a minimum of 24 megabyte, to support its own operating system and databases, including control processes, energy management applications, alarm management applications, historical/trend data for points specified, maintenance support applications, custom processes, operator I/O, and dial-up communications.

C. Provide Universal I/O capability.

D. Building Controller shall have an integral real-time clock.

E. Each Building Controller shall support firmware upgrades without the need to change hardware.

F. Each Building Controller shall support:

1. Monitoring of industry standard analog and digital inputs, without the addition of equipment outside the Building Controller cabinet.

2. Monitoring of industry standard analog and digital outputs, without the addition of equipment outside the Building Controller cabinet.

G. Serial Communication. Building Controllers shall provide at least one EIA-232C serial data communication ports for operation of operator I/O devices such as industry standard printers, operator terminals, and portable laptop operator's terminals. Building Controllers shall allow temporary use of portable devices without interrupting the normal operation of permanently connected printers or terminals. A USB port shall alternatively be available to support local HMI tools connection.

H. I/O Status and Indication. Building Controllers shall provide local LED status indication for each digital input and output for constant, up-to-date verification of all point conditions without the need for an operator I/O device.

I. Self Diagnostics. Each Building Controller shall continuously perform self diagnostics, communication diagnosis, and diagnosis of all panel components. The Building Controller shall provide both local and remote annunciation of any detected component failures, low battery conditions or repeated failure to establish communication for any system.

J. Power loss. In the event of the loss of power, there shall be an orderly shutdown of all Building Controllers to prevent the loss of database or operating system software. Non-volatile memory shall be incorporated for all critical controller configuration data and battery backup shall be provided to support the real-time clock and all volatile memory for a minimum of 30 days.

K. Environment.

1. Controller hardware shall be suitable for the anticipated ambient conditions.

2. Controllers used outdoors and/or in wet ambient conditions shall be mounted within waterproof enclosures and shall be rated for operation at 0°C to 49°C (32°F to 120°F).

3. Controllers used in conditioned space shall be mounted in dust-proof enclosures and shall be rated for operation at 0°C to 49°C (32°F to 120°F).

2.05 Application Specific Controllers (ASC)

A. General:

1. Provide for control of each piece of equipment , including, but not limited to the following:

a. Reheat Coils (RH)

b. Finned Tube Radiation (FTR)

c. Unit Heaters/ Cabinet Unit Heaters

d. Pumps

2. Each Building Controller shall be able to communicate with application specific controllers (ASCs) over the Secondary Network to control terminal equipment only.

3. The use of Secondary Network controllers with custom program applications to control AHU's, water systems, etc. is not acceptable.

4. Each ASC shall operate as a stand-alone controller capable of performing its specified control responsibilities independently of other controllers in the network. Each ASC shall be a microprocessor-based, multi-tasking, real-time digital control processor.

5. Each ASC shall include all point inputs and outputs necessary to perform the specified control sequences. The ASC shall accept input and provide output signals that comply with industry standards. Controllers utilizing proprietary control output signals shall not be acceptable. Outputs utilized either for two-state, modulating floating, or proportional control, allowing for additional system flexibility.

6. Space Temperature Sensors. Each controller performing space temperature control shall be provided with a matching room temperature sensor.

a. The space temperature sensor shall be available in wired and wireless versions.

b. Wired temperature sensor specifications. The sensing element for the space temperature sensor must be IC-based and provide the following.

1) Digitally communicating with the Application Specific Controller.
2) Mountable to and fully covering a 2 x 4 electrical junction box without the need for an adapter wall plate.
3) IC Element Accuracy: Factory Standard
4) Operating Range: 55 to 95°F
5) Setpoint Adjustment Range: User limiting, selectable range between 55 and 95°F
6) Display of temperature setpoint with numerical temperature values
7) Calibration: Single point, field adjustable at the space sensor to +/- 5°F
8) Installation: Up to 100 ft. from controller
9) Auxiliary Communications Port: included
10) Local OLED Temperature Display: optional
11) Display of Temperature to one decimal place
12) Temperature Setpoint Adjustment included
13) Occupancy Override Function included

c. Auxiliary Communication Port. Each room temperature sensor shall include a terminal jack integral to the sensor assembly. The terminal jack shall be used to connect a portable operator's terminal to control and monitor all hardware and software points associated with the controller. RS-232 communications port shall allow the operator to query and modify operating parameters of the local room terminal unit from the portable operator’s terminal.

d. Setpoint Adjustment Dial. The setpoint adjustment function shall allow for modification of the temperature by the building operators. Setpoint adjustment may be locked out, overridden, or limited as to time or temperature through software by an authorized operator at any central workstation, Building Controller, or via the portable operator's terminal.

e. Override Switch. An override button shall initiate override of the night setback mode to normal (day) operation when activated by the occupant and enabled by building operators. The override shall be limited to two (2) hours (adjustable.) The override function may be locked out, overridden, or limited through software by an authorized operator at the operator interface, Building Controller, or via the portable operator's terminal.

7. Communication. Each controller shall perform its primary control function independent of other Secondary Network communication, or if Secondary Network communication is interrupted. Reversion to a fail-safe mode of operation during Secondary Network interruption is not acceptable.

8. Control Algorithms. The controller shall receive its real-time data from the Building Controller time clock to ensure Secondary Network continuity. Each controller shall include algorithms incorporating proportional, integral and derivative (PID) gains for all applications. All PID gains and biases shall be

field-adjustable by the portable operator's terminal as specified herein. Controllers that incorporate proportional and integral (PI) control algorithms only shall not be acceptable.

9. Control Applications. Operating programs shall be field-selectable for specific applications. In addition, specific applications may be modified to meet the user's exact control strategy requirements, allowing for additional system flexibility. Controllers that require factory changes of all applications are not acceptable.

10. Memory.

    a. Provide each ASC with sufficient memory to accommodate point databases, operating programs, local alarming and local trending. All databases and programs shall be stored in non-volatile EEPROM, EPROM and PROM, or minimum of 72-hour battery backup shall be provided. The controllers shall be able to return to full normal operation without user intervention after a power failure of unlimited duration.

    b. Upon replacement, new ASCs shall recover control function and site specific defaults automatically and resume normal operation.

11. Power Supply. The ASCs shall be powered from a 24 Vac source and shall function normally under an operating range of 18 to 28 Vac, allowing for power source fluctuations and voltage drops. Power supply for the ASC must be rated at a minimum of 125% of ASC power consumption and shall be of the fused or current limiting type. The BMS contractor shall provide 24 Vac power to the terminal units by utilizing:

    a. Dedicated line voltage power source and Class 2 transformers at a central location and installing 24 Vac power trunk to supply multiple ASCs in the area.

12. Environment. The controllers shall function normally under ambient conditions of 32 to 122°F (0 to 50°C) and 10% to 95% rh (non-condensing). Provide each controller with a suitable cover or enclosure to protect the circuit board assembly.

2.06 Input/Output Interface:

A. Hardwired inputs and outputs may tie into the system through building or application specific controllers.

B. All input points and output points shall be protected such that shorting of the point to itself, to another point, or to ground will cause no damage to the controller. All input and output points shall be protected from voltage up to 24V of any duration, such that contact with this voltage will cause no damage to the controller.

C. Binary inputs shall allow the monitoring of On/Off signals from remote devices. The binary inputs shall provide a wetting current of at least 12 mA to be compatible with commonly available control devices and shall be protected against the effects of contact

bounce and noise. Binary inputs shall sense “dry contact” closure without external power (other than that provided by the controller) being applied.

D. Pulse accumulation input objects. This type of object shall conform to all the requirements of binary input objects and also accept up to 10 pulses per second for pulse accumulation.

E. Analog inputs shall allow the monitoring of low-voltage (0 to 10 Vdc), current (4 to 20 mA), or resistance signals (thermistor, RTD). Analog inputs shall be compatible with—and field configurable to—commonly available sensing devices.

1. 24 Vdc shall be available next to the point signal for powering the output device.

F. Binary outputs shall provide for On/Off operation or a pulsed low-voltage signal for pulse width modulation control. Outputs shall be selectable for either normally open or normally closed operation.

G. Analog outputs shall provide a modulating signal for the control of end devices. Outputs shall provide either a 0 to 10 Vdc, or 4 to 20 mA signal as required to provide proper control of the output device.

H. Tri-State Outputs. Provide tri-state outputs (two coordinated binary outputs) for control of three-point floating type electronic actuators without feedback. Use of three-point floating devices shall be limited to zone control and terminal unit control applications (VAV terminal units, duct-mounted heating coils, zone dampers, radiation, etc.). Control algorithms shall run the zone actuator to one end of its stroke once every 24 hours for verification of operator tracking.

I. System Object Capacity. The system size shall be expandable to at least twice the number of input/ output objects required for this project. Additional controllers (along with associated devices and wiring) shall be all that is necessary to achieve this capacity requirement. The operator interfaces installed for this project shall not require any hardware additions or software revisions in order to expand the system.

2.07 Power Supplies

A. Control transformers shall be UL listed. Furnish Class 2 current-limiting type or furnish over-current protection in both primary and secondary circuits for Class 2 service in accordance with NEC requirements. Limit connected loads to 80% of rated capacity.

2.08 Auxiliary Control Devices

A. AUTOMATIC DAMPERS

1. Manufacturers:
   a. Ruskin.
   b. Arrow.
   c. Greenheck.
   d. American Warming & Ventilating.

2. Provide automatic control dampers not specified to be integral with other equipment.

3. Dampers shall be ultra-low leakage type, with blade edges fitted with replaceable inflatable seals to limit damper leakage to 6 CFM per square foot at 1 in. w.g. Side seals shall be stainless steel of the tight-seal spring type.

4. Dampers in Galvanized Steel Ductwork:
   a. For applications not exceeding 36 inches blade length in an individual section, 1,500 fpm face velocity, 2.5 in. w.g. total system static pressure, and 180EF operating temperature, dampers shall be equal to Ruskin model CD-36, low leakage type with roll-formed blades. Blades shall be not less than 16-gauge (1.6 mm) galvanized steel, with PVC-coated polyester fabric edge seals mechanically locked into blade edges.
   b. For applications exceeding any of the criteria listed above, dampers shall be equal to Ruskin model CD-60, low leakage type with high-performance airfoil blades. Blades shall be double-skin construction of 14 gauge (2.0 mm) equivalent thickness, with extruded Ruskiprene (TPR) (or equal) blade edge seals locked into blade edges. Dampers shall be suitable for 60 inches maximum single-section width, 6,000 fpm face velocity, up to 11 in. w.g. static pressure (8.5 in. w.g. total system pressure requires maximum section width of 36 inches), and operating temperature range of -72EF to 275EF.
   c. Frames shall be not be less than 13-gauge (2.28 mm) galvanized steel, or shall be fabricated of 16-gauge (1.6 mm) galvanized steel hat channel reinforced with corner braces for structural strength equal to 13-gauge channel frames..

5. Dampers in Aluminum Ductwork:
   a. Dampers shall be equal to Ruskin CD-50, low leakage type with high-performance airfoil blades. Blades shall be heavy-gauge extruded aluminum, with extruded Ruskiprene (TPR) (or equal) blade edge seals locked into blade edges. Dampers shall be suitable for 60 inches maximum single-section width, 6,000 fpm face velocity, up to 11 in. w.g. static pressure (8.5 in. w.g. total system pressure requires maximum section width of 36 inches), and operating temperature range of -72EF to 275EF.
   b. Frames and blades shall be of 6063T5 aluminum alloy. Frames shall have minimum wall thickness of 0.125 inches.

6. Blades shall not be over 8 inches wide. Bearings shall be oilite, stainless steel sleeve, ball-bearing, or nylon. Blade axles shall be 2" plated steel hex rods. Control shafts shall be 2" diameter, 6 inches long, removable. Multiple-section dampers shall have factory-installed jackshafts.

7. Frames channels shall not exceed 1-inch high for damper heights over 12 inches, and shall not exceed 1/2-inch high for damper heights 12 inches and less.

8. Proportional control dampers shall be opposed blade type; two-position dampers shall be parallel blade type.

9. Dampers shall be fabricated of materials that are similar to the ductwork in which

they are installed. Provide non-electrically-conductive material between dissimilar metals.

10. Dampers that are located in outside walls or in roof line that are 10 sq ft or larger shall be insulated. Dampers shall be equal to Ruskin CDTI-50, thermally insulated dampers.

11. Submittals: Submit construction specifications, pressure, velocity, and temperature ratings, and leakage data. Submit a schedule of damper sizes indicating size, location, and face velocity, with required torque for selection of actuators.

B. Electric Damper Actuators

1. General

a. The actuator shall have mechanical or electronic stall protection to prevent damage to the actuator throughout the rotation of the actuator.

b. Where shown, for power-failure/safety applications, an internal mechanical, spring-return mechanism shall be built into the actuator housing. Alternatively, an uninterruptible power supply (UPS) may be provided. On terminal unit valves actuators and 2-second timing damper actuators capacitor driven fail action is permitted.

c. Proportional actuators shall accept a 0 to 10 Vdc or 0 to 20 mA control signal and provide a 2 to 10 Vdc or 4 to 20 mA operating range. Modulating actuator shall accept a 0-10 Vdc control signal and provide a 0-10 Vdc operating range

d. All 24 Vac/Vdc actuators shall operate on Class 2 wiring.

e. All actuators shall have an external manual gear release to allow manual positioning of the damper when the actuator is not powered. Spring-return actuators with more than 7 Nm (60 in.-lb) torque capacity shall have a manual crank for this purpose.

f. Electric actuators for emergency generator damper control shall be provided, installed and wired by generator manufacturer.

2. All damper actuators having more than 100 lb-in torque output shall have a self-centering damper shaft clamp. V-bolt type damper shaft clamp is not acceptable

3. All actuators that provide a factory mounted electrical appliance or plenum rated cabling must be marked with numbers on the wires as well as color coded.

4. Control damper actuators shall be RoHS Part A complaint.

B. MOTORIZED ISOLATION VALVES

1. Butterfly Valves.

   a. Furnish automatic butterfly valves for isolation requirements as shown on the drawings or required herein. All butterfly valves shall have body ratings in accordance with the piping specifications. Valves shall be high performance, fully lugged with carbon steel body ANSI 150/300. Valves shall be rated for bubble tight dead end closure, with 316 stainless steel disc, stainless steel shaft and reinforced Teflon® seat and seals.

   b. Motorized valves located outdoors or in areas subject to outdoor air conditions provide fail in place, electric operators with water proof enclosure, crankcase heater, and open and closed position limit switches. Valve and all accessories shall be constructed for outdoor use. All electrical devices shall be weather proof and NEMA 4 rated.

   c. All valves shall be provided with external position indicators and a speed control device to prevent rapid closure.

   d. All valves shall be provided with manual override hand wheels for operating the valve.

   e. The valves shall be line size as shown on plans.

C. AUTOMATIC CONTROL VALVES.

1. Automatic control valves 2" and smaller shall be screwed type; valves 2 1/2" and larger shall be flanged. Valves shall be ANSI-rated to withstand the pressures and temperatures encountered.

2. Unitary valves shall be straight-through type. Stems shall be polished stainless-steel and packing shall be Teflon suitable for chilled water service, hot water service up to 217 psi (1495kPa) at 250 F (121 C), and steam service up to 100 psi (689 kPa) at 337 F (169 C). Seating shall be Teflon or composition disc for water service, and metal-to-metal for steam service. Rubber-paddle-type valves such as Erie valves zone valves are not allowed. Valves with thermal wax motors are not allowed.

3. Provide modulating straight-through water valves with equal-percentage contoured throttling plugs.

4. Modulating and 2 position valves shall be sized for a pressure drop equal to the coil they serve but not to exceed 3 psi (20.7 kPa).

5. Water valves shall fail normally open or closed, as scheduled on plans, or as follows:

   a. Heating coils in air handlers: normally open.

   b. Chilled water control valves: normally closed.

c. Differential pressure valves: normally open.

d. Terminal units: floating control

D. BINARY TEMPERATURE DEVICES

1. Line-voltage space thermostat:

a. Line-voltage thermostats shall be bimetal-actuated, snap acting SPDT contact, enclosed, UL listed for electrical rating. The thermostat cover shall provide exposed setpoint adjustment knob. The thermostat shall operate within the 55°F to 85°F setpoint range, with 2°F maximum differential.

2. Low-temperature safety thermostat:

a. Low-limit air stream thermostats shall be UL listed, vapor pressure type, with a sensing element of 20 ft. minimum length. Element shall respond to the lowest temperature sensed by any 1 ft. section. The low-limit thermostat shall be manual reset.

3. Aquastat:

Strap-on type thermostats shall be provided for low or high temperature limit service on hot water or steam condensate pipes. The thermostats shall be UL Listed, with a liquid-filled bulb type sensing element and capillary tubing. The thermostat shall operate within the 20°F to 120°F, or 100°F to 240°F, setpoint range.

E. TEMPERATURE SENSORS.

1. Provide the following instrumentation as required by the monitoring, control and optimization functions. All temperature sensors shall use platinum RTD elements only, nickel or silicon are not acceptable.

2. Room Temperature:

a. Output signal	4-20 mA or RTD
b. Installation adjustments	factory calibrated
c. Calibration adjustments	factory calibrated
d. Factory calibration point	32°F
e. Accuracy at calibration point	+/- 0.7°F

3. Liquid Immersion Temperature

a. Output signal	4-20 mA or RTD
b. Installation adjustment	factory calibrated
c. Calibration adjustments	factory calibrated
d. Factory calibration point	32°F
e. Accuracy at calibration point	+/- 0.54°F

4. Duct (Single Point) Temperature

a. Output signal	4-20 mA or RTD

b. Installation adjustments factory calibrated
c. Calibration adjustments factory calibrated
d. Factory calibration point 70°F
e. Accuracy at calibration point +/- 0.54°F

5. Duct (Averaging) Temperature

a. Temperature monitoring range +20/+120°F
b. Output signal 4-20 mA or RTD
c. Installation adjustments factory calibrated
d. Calibration adjustments factory calibrated
e. Factory calibration point 32°F
f. Accuracy at calibration point +/- 0.54°F

6. Outside Air Temperature
a. Output signal 4-20 mA or RTD
b. Installation adjustments factory calibrated
c. Calibration adjustments factory calibrated
d. Factory calibration point 32°F
e. Accuracy at calibration point +/- 0.54°F

F. DEW POINT/HUMIDITY SENSORS

1. Room/duct Relative Humidity

a. Sensor Humidity range 0 to 100%
b. Operating temperature 15°F to +170°F
c. Accuracy +/-5% rh
d. Sensing element Capacitive sensor
e. Output signal 4-20 mA DC
f. Installation adjustments none required
g. Operating temperature 15°F to +170°F
h. Voltage requirement 12-36 Vdc

G. PRESSURE SENSORS

1. Air Static Pressure Sensor

a. Duct Static range -.5 to + 7.5" wg
b. Output signal 4 - 20 mA

H. WATER DIFFERENTIAL PRESSURE SENSOR

1. Transducer shall have linear output signal.

2. Transducer sensing elements shall withstand continuous operating conditions of positive or negative pressure 50% greater than calibrated span without damage.

3. Water pressure transducer shall have stainless steel diaphragm construction, proof pressure of 150 psi minimum.

I. DIFFERENTIAL PRESSURE SWITCHES.

1. Water Differential Pressure Switch

a. Differential pressure type switches (air or water service) shall be UL listed, SPDT snap-acting, pilot duty rated (125 VA minimum), NEMA 4 enclosure, with scale range and differential suitable for intended application or as shown.

2. Air Differential Pressure Switch

a. Differential pressure switches shall be diaphragm type, with die-cast aluminum housing and adjustable setpoint. Switch rating shall be a minimum 5 amps at 120 Vac. Switch pressure range shall be suited for application (e.g., filter 0-2.0", fan status 0-5.0", etc.).

J. CURRENT SWITCHES.

1. Current-operated switches shall be self-powered, solid-state with adjustable trip current. The switches shall be selected to match the current of the application and output requirements of the DDC system.

2.09 Communication and Control Wiring

A. General:

1. Provide copper wiring, plenum cable, and raceways as specified in the applicable sections of Division 26 unless otherwise noted herein.
2. All insulated wire to be copper conductors, UL labeled for 90°C minimum service.

B. Control Wiring:

1. Digital Input/Output wiring shall use Class 2 twisted pair, insulated.
2. Analog inputs shall use Class 2 twisted s pair, insulated.
3. Actuators with tri-state control shall use three (3) conductors with same characteristics..

C. Communication Wiring

1. Ethernet Cable shall be minimum CAT5E.
2. Secondary level network shall be 24 gage, 1-1/2 pair, low capacitance cable, suitable for BACNET applications

D. Approved Cable Manufacturers:

1. Wiring from the following manufacturers which meet the above criteria shall be acceptable:

a. Anixter

PART 3 – EXECUTION

3.01 Examination:

A. The project plans shall be thoroughly examined for control device and equipment locations. Any discrepancies, conflicts, or omissions shall be reported to the architect/engineer for resolution before rough-in work is started.

B. The contractor shall inspect the site to verify that equipment may be installed as shown. Any discrepancies, conflicts, or omissions shall be reported to the engineer for resolution before rough-in work is started.

3.02 Protection:

A. The contractor shall protect all work and material from damage by its employees and/or subcontractors and shall be liable for all damage thus caused.

B. The contractor shall be responsible for its work and equipment until finally inspected, tested, and accepted.

3.03 Coordination:

A. Site

1. The project coordination between trades is the responsibility of the prime contractor who is the one tier higher contractual partner such as mechanical contractor, general contractor, construction manager, owner or owner's representative as applicable.

2. The controls contractor shall follow prime contractor's job schedule and coordinate all project related activities through the prime contractor except otherwise agreed or in minor job site issues. Reasonable judgment shall be applied.

3. Where the work will be installed in close proximity to, or will interfere with, work of other trades, the contractor shall assist in working out space conditions to make a satisfactory adjustment.

4. If the contractor deviates from the job schedule and installs work without coordinating with other trades, so as to cause interference with work of other trades, the contractor shall make the necessary changes to correct the condition without extra charge.

5. Coordinate and schedule work with all other work in the same area, or with work that is dependent upon other work, to facilitate mutual progress.

B. Submittals.

1. Refer to the *Submitttals* section in *PART 1 – GENERAL* of this specification for requirements.

C. Life Safety

1. Smoke initiation device required for air handler shutdown are supplied under Division 26 of this specification.

2. Smoke dampers and actuators required for duct smoke isolation are provided under another Section of Division 23.

3. Fire/smoke dampers and actuators required for fire rated walls are provided under another Section of Division 23. Control and wiring of these dampers shall be by Division 26.

D. Coordination with controls specified in other sections or divisions.

1. Other sections and/or divisions of this specification include controls and control devices that are to be part of or interfaced to the control system specified in this section. These controls shall be integrated into the system and coordinated by the contractor as follows:

2. All communication media and equipment shall be provided as specified in the *Communications* section in *PART 2 – PRODUCTS* of this specification.

3. Each supplier of controls product is responsible for the configuration, programming, startup, and testing of that product to meet the sequences of operation described in this section.

4. The Contractor shall coordinate and resolve any incompatibility issues that arise between the control products provided under this section and those provided under other sections or divisions of this specification.

5. The contractor is responsible for providing all controls described in the contract documents regardless of where within the contract documents these controls are described.

3.04 General Workmanship:

A. Install equipment, piping, and wiring/raceway parallel to building lines (i.e., horizontal, vertical, and parallel to walls) wherever possible.

B. Provide sufficient slack and flexible connections to allow for vibration of piping and equipment.

C. Install all equipment in readily accessible locations as defined by Chapter 1, Article 100, Part A of the National Electrical Code (NEC).

D. Verify integrity of all wiring to ensure continuity and freedom from shorts and grounds.

E. All equipment, installation, and wiring shall comply with acceptable industry specifications and standards for performance, reliability, and compatibility and be executed in strict adherence to local codes and standard practices.

3.05 Field Quality Control:

A. All work, materials, and equipment shall comply with the rules and regulations of applicable local, state, and federal codes and ordinances as identified in *PART 1 – GENERAL* of this specification.

B. Contractor shall continually monitor the field installation for code compliance and quality of workmanship.

3.06 Wiring:

A. All control and interlock wiring shall comply with national and local electrical codes and Division 26 of this specification. Where the requirements of this section differ from those in Division 26, the requirements of this section shall take precedence.

B. All NEC Class 1 (line voltage) wiring shall be UL Listed in approved conduit according to NEC and Division 26 requirements.

C. All low-voltage wiring shall meet NEC Class 2 requirements. (Low-voltage power circuits shall be sub–fused when required to meet Class 2 current limit.)

D. Where NEC Class 2 (current-limited) wires are in concealed and accessible locations, including ceiling return air plenums, approved cables not in conduit may be used provided that cables are UL Listed for the intended application. For example, cables used in ceiling plenums shall be UL Listed specifically for that purpose.

E. All wiring in mechanical, electrical, or service rooms—or where subject to mechanical damage—shall be installed in conduit.

F. Do not install Class 2 wiring in conduit containing Class 1 wiring. Boxes and panels containing high voltage wiring and equipment may not be used for low-voltage wiring except for the purpose of interfacing the two (e.g., relays and transformers).

G. Where low voltage cable is run exposed, wiring is to be run parallel along a surface or perpendicular to it and neatly tied at 3 m (10 ft) intervals.

H. Where low voltage cable is used without conduit, it shall be supported from or anchored to structural members. Cables shall not be supported by or anchored to ductwork, electrical conduits, piping, or ceiling suspension systems.

I. All wire-to-device connections shall be made at a terminal block or wire nut. All wire-to-wire connections shall be at a terminal strip or wire nut.

J. All wiring within enclosures shall be neatly bundled and anchored to permit access and prevent restriction to devices and terminals.

K. Maximum allowable voltage for control wiring shall be 120V. If only higher voltages are available, the contractor shall provide step-down transformers or interposing relays.

L. All wiring shall be installed as continuous lengths, with no splices permitted between termination points.

M. All wiring in conduit shall be installed as continuous lengths, with no splices permitted between termination points or junction boxes.

N. Size and type of conduit and size and type of wire shall be the responsibility of the contractor, in keeping with the manufacturer's recommendations and NEC requirements, except as noted elsewhere.

O. Conceal all conduit, except within mechanical, electrical, or service rooms. Install conduit to maintain a minimum clearance of 15 cm (6 in.) from high-temperature equipment (e.g., steam pipes or flues).

P. Secure conduit with conduit clamps fastened to the structure and spaced according to code requirements. Conduit and pull boxes may not be hung on flexible duct strap or tie rods. Conduits may not be run on or attached to ductwork.

Q. Adhere to this specification's Division 26 requirements where conduit crosses building expansion joints.

R. Flexible metal conduits and liquid-tight, flexible metal conduits shall not exceed 1 m (3 ft) in length and shall be supported at each end. Flexible metal conduit less than 1/2 inches electrical trade size shall not be used.

S. Conduit must be adequately supported, properly reamed at both ends, and left clean and free of obstructions. Conduit sections shall be joined with couplings (according to code). Terminations must be made with fittings at boxes, and ends not terminating in boxes shall have bushings installed.

3.07 Communication Wiring:

A. All cabling shall be installed in a neat and workmanlike manner. Follow manufacturer's installation recommendations for all communication cabling.

B. Do not install communication wiring in raceway and enclosures containing Class 1 wiring.

C. Maximum pulling, tension, and bend radius for cable installation, as specified by the cable manufacturer, shall not be exceeded during installation.

D. All runs of communication wiring shall be unspliced length when that length is commercially available.

3.08 Installation Of Sensors:

A. General:

1. Install sensors in accordance with the manufacturer's recommendations.

2. Mount sensors rigidly and adequately for the environment within which the sensor operates.

3. Room temperature sensors shall be installed on concealed junction boxes, provided and installed by Division 26,

4. All wires attached to sensors shall be air sealed in their raceways or in the wall to stop air transmitted from other areas affecting sensor readings.

5. Sensors used in mixing plenums and hot and cold decks shall be of the averaging type.

6. Low-limit sensors used in mixing plenums shall be installed in a serpentine manner horizontally across the full face of the coil.

7. All pipe-mounted temperature sensors shall be installed in wells. Install all liquid temperature sensors with heat-conducting fluid in thermal wells.

8. Install outdoor air temperature sensors on north wall, complete with sun shield at designated location.

B. Room Instrument Mounting

1. Room instruments, including but not limited to wall mounted thermostats and sensors located in occupied spaces shall be mounted per engineer's specification and ADA requirements, unless otherwise shown.

C. Instrumentation Installed in Piping Systems

1. Thermometers and temperature sensing elements installed in liquid systems shall be installed in thermowells.

D. Duct Smoke Detectors

1. Duct smoke detectors will be provided by the Fire Alarm System Contractor in supply and return air ducts in accordance with Division 26.

E. Averaging Temperature Sensing Elements

1. Sensing elements shall be installed in a serpentine pattern.

2. Averaging sensors shall be installed in a serpentine manner vertically across the duct. Each bend shall be supported with a capillary clip.

3.09 Actuators:

A. Mount and link control damper actuators according to manufacturer's instructions.

1. Check operation of damper/actuator combination to confirm that actuator modulates damper smoothly throughout stroke to both open and closed positions.

2. Provide all mounting hardware and linkages for actuator installation.

B. Electric/Electronic

1. Dampers: Actuators shall be direct-mounted on damper shaft or jackshaft unless shown as a linkage installation. For low-leakage dampers with seals, the actuator shall be mounted with a minimum 5° available for tightening the damper seals. Actuators shall be mounted following manufacturer's recommendations.

2. Valves: Actuators shall be connected to valves with adapters approved by the actuator manufacturer. Actuators and adapters shall be mounted following the actuator manufacturer's recommendations.

3.10 PROGRAMMING:

A. Provide sufficient internal memory for the specified sequences of operation and trend logging.

B. Point Naming: System point names shall be modular in design, allowing easy operator interface without the use of a written point index. Point Naming standard shall be agreed upon between owner and BAS contractor. Refer to the *Submittals* section in *PART 1 – GENERAL* of this specification.

C. Software Programming

1. Provide programming for the system and adhere to the sequences of operation provided. The contractor also shall provide all other system programming necessary for the operation of the system, but not specified in this document. Imbed into the control program sufficient comment statements to clearly describe each section of the program. The comment statements shall reflect the language used in the sequences of operation and be of different font and color in text editor.

D. Operator Interface

1. Standard graphics—Provide graphics for all mechanical systems and floor plans of the building. This includes each chilled water system, hot water system, chiller, boiler, air handler, and all terminal equipment. Point information on the graphic displays shall dynamically update. Show on each graphic all input and output points for the system. Also show relevant calculated points such as setpoints.

3.11 CONTROL SYSTEM CHECKOUT AND TESTING

A. Field I/O Calibration and Commissioning

1. All field devices are factory calibrated. No field calibration is required.
2. Verify that each control panel has been installed according to plans, specifications and approved shop drawings. Verify function of each control sensor and device.
3. Functional testing and documentation will be provided.

3.12 CONTROL SYSTEM DEMONSTRATION AND ACCEPTANCE

A. Demonstration

1. As each control input and output is checked, a log shall be completed showing the date, technician’s initials, and any corrective action taken or needed.
2. Demonstrate compliance with sequences of operation through all modes of operation.
3. Demonstrate operation of operator interface.

3.13 TRAINING

A. The Contractor shall provide competent instructors to give full instruction to designated personnel in the adjustment, operation and maintenance of the system installed. All training shall be held during normal work hours of 8:00 a.m. to 4:30 p.m. weekdays.

B. Provide 8 hours of site specific training for Owner's operating personnel.

3.14 SEQUENCES OF OPERATION

A. Refer to Drawings.

3.15 POINT LIST

A. Include all points needed for a complete and functioning control system based on the drawings and specifications.

END OF SECTION 23 09 23

SECTION 23 10 00 - FUEL GAS PIPING

PART 1 – GENERAL

1.1 SUMMARY

A. Section Includes:
1. LPG gas piping above grade.
2. Unions and flanges.
3. Valves.
4. Pipe hangers and supports.
5. Strainers.

B. Related Sections:
1. Section 07 84 00 – Fire Stopping
2. Section 09 91 00 - Paints and Coatings: Product requirements for painting for placement by this section.
3. Section 23 05 29 - Hangers and Supports: Product requirements for pipe hangers and supports for placement by this section.
4. Section 23 05 53 - Mechanical Identification: Product requirements for valve and pipe identification for placement by this section.

1.2 REFERENCES

A. American Society of Mechanical Engineers:
1. ASME B16.3 - Malleable Iron Threaded Fittings.
2. ASME B16.26 - Cast Copper Alloy Fittings for Flared Copper Tubes.
3. ASME B31.9 - Building Services Piping.
4. ASME Section IX - Boiler and Pressure Vessel Code - Welding and Brazing Qualifications.

B. ASTM International:
1. ASTM A53/A53M - Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless.
2. ASTM A234/A234M - Standard Specification for Piping Fittings of Wrought Carbon Steel and Alloy Steel for Moderate and High Temperature Service.
3. ASTM B68 - Standard Specification for Seamless Copper Tube, Bright Annealed.
4. ASTM B75 - Standard Specification for Seamless Copper Tube.
5. ASTM B88 - Standard Specification for Seamless Copper Water Tube.
6. ASTM B280 - Standard Specification for Seamless Copper Tube for Air Conditioning and Refrigeration Field Service.
7. ASTM B749 - Standard Specification for Lead and Lead Alloy Strip, Sheet, and Plate Products.
8. ASTM F708 - Standard Practice for Design and Installation of Rigid Pipe Hangers.

C. American Welding Society:
1. AWS D1.1 - Structural Welding Code - Steel.

D. American Water Works Association:
   1. AWWA C105 - American National Standard for Polyethylene Encasement for Ductile-Iron Pipe Systems.

E. Manufacturers Standardization Society of the Valve and Fittings Industry:
   1. MSS SP 58 - Pipe Hangers and Supports - Materials, Design and Manufacturer.
   2. MSS SP 69 - Pipe Hangers and Supports - Selection and Application.
   3. MSS SP 89 - Pipe Hangers and Supports - Fabrication and Installation Practices.
   4. MSS SP 110 - Ball Valves Threaded, Socket-Welding, Solder Joint, Grooved and Flared Ends.

F. National Fire Protection Association:
   1. NFPA 54 - National Fuel Gas Code.
   2. NFPA 58 - Liquefied Petroleum Gas Code.

G. Underwriters Laboratories Inc.:
   1. UL 842 - Valves for Flammable Fluids.

1.3 SYSTEM DESCRIPTION

A. Where more than one piping system material is specified, provide compatible system components and joints. Use non-conducting dielectric connections when joining dissimilar metals in systems.

B. Provide flanges, unions, or couplings at locations requiring servicing. Use unions, flanges, or couplings downstream of valves and at equipment connections. Do not use direct welded or threaded connections to valves, equipment.

C. Provide pipe hangers and supports in accordance with ASME B31.9.

D. Use plug or ball valves for shut-off and to isolate equipment, part of systems, or vertical risers.

1.4 DEFINITIONS

A. Where designation LPG is used, it is abbreviation for Liquefied Petroleum Gas, most commonly Propane.

1.5 SUBMITTALS

A. Section 01 33 00 - Submittal Procedures: Submittal procedures.

B. Product Data:
   1. Piping: Submit data on pipe materials, fittings, and accessories. Submit manufacturers catalog information.
   2. Valves: Submit manufacturers catalog information with valve data and ratings for each service.
   3. Hangers and Supports: Submit manufacturers catalog information including load capacity.
   4. Piping Specialties: Submit manufacturers catalog information including capacity, rough-in requirements, and service sizes for the following:
      a. Strainers.

C. Design Data: Indicate pipe size. Indicate load carrying capacity of trapeze, multiple pipe, and riser support hangers.

D. Test Reports: Indicate results of piping system pressure test.

E. Manufacturer's Certificate: Certify Products meet or exceed specified requirements.

F. Welders Certificates: Certify welders employed on the Work, verifying AWS qualification within previous 12 months.

1.6 CLOSEOUT SUBMITTALS

A. Section 01 77 00 - Execution Requirements: Closeout procedures.

B. Project Record Documents: Record actual locations of valves and system components.

C. Operation and Maintenance Data: Submit for valves and gas pressure regulators installation instructions, and spare parts lists.

1.7 QUALITY ASSURANCE

A. Perform LPG Work in accordance with NFPA 58.

B. Perform Work in accordance with ASME B31.9 code for installation of piping systems and ASME Section IX for welding materials and procedures.

C. Perform Work in accordance with applicable code for welding hanger and support attachments to building structure.

D. Perform Work in accordance with State of Maine standard.

1.8 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing products specified in this section with minimum three years documented experience.

B. Installer: Company specializing in performing Work of this section with minimum three years documented experience.

1.9 DELIVERY, STORAGE, AND HANDLING

A. Section 01 60 00 - Product Requirements: Product storage and handling requirements.

B. Accept valves on site in shipping containers with labeling in place. Inspect for damage.

C. Protect piping and fittings from soil and debris with temporary end caps and closures. Maintain in place until installation. Furnish temporary protective coating on cast iron and steel valves.

1.10 FIELD MEASUREMENTS

A. Verify field measurements prior to fabrication.

1.11 COORDINATION

A. Section 01 31 00 - Administrative Requirements: Requirements for coordination.

B. Coordinate trenching, excavating, bedding and backfilling of buried piping systems with General Contractor.

1.12 WARRANTY

A. One year manufacturer warranty for valves excluding packing.

PART 2 PRODUCTS

2.1 LPG GAS PIPING, ABOVE GRADE

A. Steel Pipe: ASTM A53/A53M Schedule 40 black.
   1. Fittings: ASME B16.3, malleable iron, or ASTM A234/A234M forged steel welding type.
   2. Joints: Threaded for pipe 2 inch and smaller; welded for pipe 2-1/2 inches and larger.

2.2 UNIONS AND FLANGES

A. Unions for Pipe 2 inches and Smaller:
   1. Ferrous Piping: Class 150, malleable iron, threaded.
   2. Copper Piping: Class 150, bronze unions with soldered joints.
   3. Dielectric Connections: Union with galvanized or plated steel threaded end, copper solder end, water impervious isolation barrier.

B. Flanges for Pipe 2-1/2 inches and Larger:
   1. Ferrous Piping: Class 150, forged steel, slip-on flanges.
   2. Copper Piping: Class 150, slip-on bronze flanges.
   3. Gaskets: 1/16-inch thick preformed neoprene gaskets.

2.3 BALL VALVES

A. Manufacturers:
1. Crane Valve, North America
2. Hammond Valve
3. Milwaukee Valve
4. NIBCO, Inc.
5. Stockham Valves & Fittings
6. Approved equal.

B. 1/4 inch to 1 inch: MSS SP 110, Class 125, two piece, threaded ends, bronze body, chrome plated bronze ball, reinforced teflon seats, blow-out proof stem, lever handle, UL 842 listed for flammable liquids and LPG, full port.

C. 1-1/4 inch to 3 inch: MSS SP 110, Class 125, two piece, threaded ends, bronze body, chrome plated bronze ball, reinforced teflon seats, blow-out proof stem, lever handle, UL 842 listed for flammable liquids and LPG, conventional port.

2.4 LOCKABLE BALL VALVES

A. Manufacturers:
1. Crane Valve, North America
2. Hammond Valve
3. Milwaukee Valve
4. NIBCO, Inc.
5. Stockham Valves & Fittings
6. Approved equal.

B. 1/4 inch to 1 inch: MSS SP 110, Class 125, two piece, threaded ends, bronze body, chrome plated bronze ball, reinforced teflon seats, blow-out proof stem, lever handle with lockable slide, UL 842 listed for flammable liquids and LPG, full port.

C. 1-1/4 inch to 3 inch: MSS SP 110, Class 125, two piece, threaded ends, bronze body, chrome plated bronze ball, reinforced teflon seats, blow-out proof stem, lever handle with lockable slide, UL 842 listed for flammable liquids and LPG, conventional port.

2.5 ELECTRIC SOLENOID VALVES

A. Manufacturers:
1. ASCO Valve Series 8214
2. Approved equal.

B. 1 inches and Smaller: 2 way pilot operated, 175 psi, brass body, NBR seals, stainless steel trim, 120 VAC coil, manual operator, UL listed for fuel gas service, threaded ends, full port.

2.6 STRAINERS

A. Manufacturers:
1. Mueller Steam Specialty
2. Spirax Sarco, Inc.

3. Approved equal

B. 2 inch and Smaller: Screwed brass or iron body for 175 psig working pressure, Y pattern with 1/32 inch stainless steel perforated screen.

C. 2-1/2 inch to 4 inch: Flanged iron body for 175 psig working pressure, Y pattern with 3/64 inch stainless steel perforated screen.

D. 5 inch and Larger: Flanged iron body for 175 psig working pressure, basket pattern with 1/8 inch (3.2 mm) stainless steel perforated screen.

PART 3 EXECUTION

3.1 EXAMINATION

A. 01 30 00 - Administrative Requirements: Coordination and project conditions.

B. Verify excavations are to required grade, dry, and not over-excavated.

3.2 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.

3.3 INSTALLATION - ABOVE GROUND PIPING SYSTEMS

A. Install LPG piping in accordance with NFPA 58.

B. Provide non-conducting dielectric connections wherever jointing dissimilar metals.

C. Route piping in orderly manner and maintain gradient.

D. Install piping to conserve building space and not interfere with use of space.

E. Group piping whenever practical at common elevations.

F. Install piping to allow for expansion and contraction without stressing pipe, joints, or connected equipment.

G. Sleeve pipe passing through partitions, walls and floors. Refer to Section 23 05 29.

H. Install firestopping at fire rated construction perimeters and openings containing penetrating sleeves and piping. Refer to Sections 23 05 09 and 07 84 00.

I. Provide clearance for installation of insulation and access to valves and fittings.

J. Do not install valves in concealed spaces.

K. Where pipe support members are welded to structural building framing, scrape, brush clean, weld, and apply one coat of zinc rich primer.

L. When tubing is installed vertically in stud walls provide 16 gauge steel striker plates to protect tubing. Plates to extend 4” beyond tubing.

M. Provide support for utility meters in accordance with requirements of utility company.

N. Prepare pipe, fittings, supports, and accessories not pre-finished, ready for finish painting. Refer to Section 09 91 00.

O. Install valves with stems upright or horizontal, not inverted.

P. Protect piping systems from entry of foreign materials by temporary covers, completing sections of the Work, and isolating parts of completed system.

3.4 FIELD QUALITY CONTROL

A. Pressure test LPG piping in accordance with NFPA 58.

3.5 SCHEDULES

PIPE HANGER SPACING		
PIPE SIZE Inches	MAXIMUM HANGER SPACING Feet	HANGER ROD DIAMETER Inches
½	7	3/8
¾	7	3/8
1	7	3/8
1-1/4	7	3/8
1-1/2	9	3/8
2	10	3/8
2-1/2	11	1/2
3	12	1/2
4	14	5/8
5	16	5/8
6	17	3/4
8	19	3/4
10	22	7/8
12	23	7/8
14	25	1
16	27	1
18	28	1
20	30	1-1/4
24	32	1-1/4

END OF SECTION 23 10 00

SECTION 233113 – METAL DUCTS

PART 1 - GENERAL

1.1 GENERAL

A. References to SMACNA-HVAC shall be "SMACNA HVAC Duct Construction Standards, Metal and Flexible" latest edition unless otherwise noted. References to SMACNA-Industrial shall be "SMACNA Industrial Duct Construction Standards" latest edition unless otherwise noted.

B. When the specifications refer to SMACNA Standards, they shall be considered as minimum standards; if local codes or requirements specified herein require more restrictive standards than described in SMACNA, the local codes and requirements specified herein shall govern.

C. Ductwork indicated on drawings is schematic; therefore, changes in ductwork sizes and/or location shall be made when necessary to conform to space conditions. Changes shall be made at no additional cost to the Owner. The engineer shall be consulted for approval of duct size changes which cannot maintain the same equivalent free area dimensions or which require an aspect ratio greater than 4 to 1. Change in duct sizes shall be made with transitions. Transitions shall have not more than a 30° angle parallel to the airflow for a one sided transition or 15° angle for a two sided transition.

D. Duct dimensions indicated on drawings shall be the clear inside dimensions. Provide hat section at turning vanes, dampers, etc., as indicated in SMACNA Figure 2-24.

E. Ductwork shall be constructed true to sizes indicated and shall be airtight with a smooth appearance.

F. Coil frames, damper frames, louver frames, etc., shall be bolted and sealed to ductwork.

G. Provide additional bracing and reinforcing as necessary to prevent buckling and bulging of ductwork.

H. Provide pre-fabricated panel casings for outside air intake plenums and relief air plenums as shown on drawings and as hereinafter specified.

I. Existing ductwork, where demolition is required, shall be properly terminated in accordance with SMACNA standards for +4 or -2 pressure rating, depending on flow.

J. Where specifications require stainless steel or aluminum ductwork for a particular duct system, all components including but not limited to turning vanes, control dampers, volume dampers, fire dampers, combination fire/smoke dampers, smoke dampers, reinforcing, bracing, sound attenuators, and supports shall be same type as duct material.

K. Duct branches serving damp or wet locations including but not limited to shower rooms, locker rooms, etc., shall have aluminum ductwork from outlet to branch ducts. Ductwork shall meet construction, leakage, and static pressure requirements specified elsewhere in this section.

PART 2 - PRODUCTS

2.1 GENERAL

A. Ductwork, fittings, reinforcement, hangers, etc., shall be in accordance with SMACNA-HVAC or SMACNA-Industrial.

2.2 PRESSURE CLASSIFICATION

A. Duct construction for the various duct systems shall have the following ratings:

Duct System	Pressure Rating
Supply to Terminal Boxes	2 inches
Return	-1 inch

2.3 GALVANIZED STEEL DUCTWORK

A. Ductwork shall be galvanized steel ductwork unless otherwise indicated. Duct system pressure rating shall be 2 inches unless otherwise indicated above.

B. Rectangular - Pressure Rating from +1/2 inch w.g. to +1 inch w.g., and from -1/2 inch w.g. to -1 inch w.g.:

1. Galvanized construction including sheet metal hangers and miscellaneous materials.
2. Construction shall be in accordance with SMACNA-HVAC.
3. Duct sealing shall meet duct seal Class B.
4. Metal gauge for duct sides shall be the same thickness.

C. Rectangular - Pressure Rating from +2 inches w.g. to +10 inches w.g., and from -2 inches w.g. to -10 inches w.g.:

1. Galvanized construction including sheet metal hangers and miscellaneous materials.
2. Construction shall be in accordance with SMACNA-HVAC for supply ductwork and return/exhaust ductwork to -3 inches w.g. Construction shall be in accordance with SMACNA-Industrial for return/exhaust ductwork from -4 inches w.g. to -10 inches w.g.
3. Duct sealing shall meet duct seal Class B.
4. Metal gauge for duct sides shall be the same thickness.
5. All traverse duct joints shall be constructed with "Ductmate" rectangular duct connector system or equivalent. System type shall depend on joint class required. Connector system shall have leakage ratings and deflection ratings submitted during shop drawing phase. TDC/TDF connection system is not permitted.

2.4 SLEEVES

A. Provide sleeves for ducts passing through roofs, walls, floors and partitions.

B. Sleeve material shall be 20 gauge galvanized steel except for fire walls and smoke barriers which shall be 16 gauge galvanized steel.

C. Sealant shall be equivalent to Dow Corning 795 Silicone Sealant for general purpose use. Prime sleeves in accordance with manufacturer's recommendations.

D. Sealant in one-hour and two-hour walls and one-hour and two-hour floors shall be equivalent to Dow Corning Fire Stop System Sealants and Foams. Sealants and foams shall be UL listed and installed in accordance with manufacturer's recommendations.

2.5 DUCT SEALANT

A. Duct sealant shall be provided to meet seal class requirements listed elsewhere in this sections.

B. Sealant shall be Childers CP-146 or approved equivalent by Foster or Carlisle.

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PART 3 - EXECUTION

3.1 GENERAL

A. Ductwork construction shall be in strict accordance with the SMACNA-HVAC Standards including ductwork gauges, bracing, reinforcement, joints, seams, hanging, and construction.

B. The drawings schematically indicate the size and location of ductwork. Ductwork system layout shall be modified as required to meet field conditions and facilitate coordination at no additional cost. Unless otherwise noted, ductwork, dampers, and associated fittings shall be concealed behind walls or above ceilings.

3.2 SLEEVES

A. Provide 1/2 inch clearance between duct or duct insulation and sleeve.

B. Install sleeves in time to permit construction progress as scheduled.

C. Grout sleeves to building for watertight fit.

D. Schedule of Sleeve Lengths

Location	Sleeve Length
Floors	Equal to depth of floor construction and at least 1 inch above finished floor construction. In waterproof floor construction and equipment rooms, sleeves shall extend a minimum of 2 inches above finished floor construction.
Roofs	Equal to depth of roof construction including insulation.
Walls and Partitions	Equal to depth of construction and terminated flush with finished surfaces.

E. Schedule of Sleeve Caulking and Packing Type

Caulking/ Packing Type	Caulking/Packing Requirements
A	Caulking not required.
B	Space between duct or duct covering and sleeve shall be vermin proof sealant.
C	Space between duct and sleeve shall be packed with industrial felt or fiberglass caulked at both ends with sealant according to manufacturer's recommendations. Vermin proofing for ducts with insulation shall be minimum 1 inch thick sections of foam glass as long as sleeve with space between foam glass and sleeve packed with industrial felt or fiberglass caulked at both ends with sealant in accordance with manufacturer's recommendations.

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F. Schedule of Sleeve Applications

Location	Sleeve Caulking and Packing Type
Membrane water-proof floor, roof and wall construction	C
Non-membrane waterproof floor, roof and wall construction where flashing is required	C
Interior walls, partitions, and floors	C
Exterior walls	C

3.3 DUCT HANGERS AND SUPPORTS

A. Duct Hanger Support Schedule

Building Construction	Duct Support Method
Poured concrete floor slabs	Galvanized steel inserts, and/or fishplates of sufficient area to support twice the calculated dead load
Building structural steel	Beam attachments and similar devices
Precast concrete floor slabs	Fishplates of sufficient area to support twice the calculated dead load and approve type specialty hanger accessories manufactured for the specific purpose of attaching to precast floors
Metal deck floor slabs with concrete fill	Galvanized steel inserts and/or fishplates of sufficient area to support twice the calculated dead load, and approved type specialty hanger accessories manufactured for the specific purpose of attaching to metal deck floors
Concrete slabs where piping revisions are required and approved after slabs are poured, or existing concrete slabs	"Phillips" or "Hilti" expansion bolts and shields for piping 4 inches and smaller, with main supports welded to structural steel at maximum 20 feet on center 4 inch x 4 inch x 3/8 inch thick clip knee angles with 3/4 inch expansion bolt in shear (horizontal) and supporting rod at 90° from anchor bolt for piping greater than 4 inches, attached to concrete beams or columns
Concrete floor slabs on grade with ground water condition	Drainage, waste and vent piping to be encased in slab construction

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B. Duct Support Spacing

1. Duct supports shall be spaced as per SMACNA. Provide shop drawings of support type and spacing.

END OF SECTION 233113

SECTION 233300 - AIR DUCT ACCESSORIES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Manual volume dampers.
2. Fire dampers.
3. Smoke dampers.
4. Combination fire and smoke dampers.
5. Flange connectors.
6. Turning vanes.
7. Duct-mounted access doors.
8. Flexible connectors.
9. Flexible ducts.
10. Duct accessory hardware.
11. Motorized control damper

B. Related Sections:

1. Section 233113 "Metal Ducts"

1.3 QUALITY ASSURANCE

A. Comply with NFPA 90A, "Installation of Air Conditioning and Ventilating Systems," and with NFPA 90B, "Installation of Warm Air Heating and Air Conditioning Systems."

B. Comply with AMCA 500-D testing for damper rating.

1.4 EXTRA MATERIALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Fusible Links: Furnish quantity equal to 10 percent of amount installed.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for

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acceptable materials, material thicknesses, and duct construction methods unless otherwise indicated. Sheet metal materials shall be free of pitting, seam marks, roller marks, stains, discolorations, and other imperfections.

B. Galvanized Sheet Steel: Comply with ASTM A 653/A 653M.

1. Galvanized Coating Designation: G60.
2. Exposed-Surface Finish: Mill phosphatized.

C. Stainless-Steel Sheets: Comply with ASTM A 480/A 480M, Type 304, and having a No. 2 finish for concealed ducts and No. 2 finish for exposed ducts.

D. Aluminum Sheets: Comply with ASTM B 209, Alloy 3003, Temper H14; with mill finish for concealed ducts and standard, 1-side bright finish for exposed ducts.

E. Extruded Aluminum: Comply with ASTM B 221, Alloy 6063, Temper T6.

F. Reinforcement Shapes and Plates: Galvanized-steel reinforcement where installed on galvanized sheet metal ducts; compatible materials for aluminum and stainless-steel ducts.

G. Tie Rods: Galvanized steel, 1/4-inch minimum diameter for lengths 36 inches or less; 3/8-inch minimum diameter for lengths longer than 36 inches.

H. Where specifications require stainless steel or aluminum ductwork for a particular duct system, including ductwork located outdoors, all components including but not limited to turning vanes, control dampers, volume dampers, fire dampers, combination fire/smoke dampers, smoke dampers, reinforcing, bracing, sound attenuators, and supports shall be same type as duct material.

2.2 BALANCING DAMPERS

A. Balancing dampers for rectangular ductwork shall be opposed blade type, and shall be Ruskin Model MD35 Manual Balancing Damper with Locking Quadrant or equivalent for duct pressure ratings 2 inches w.g. or less, and Ruskin Model CD30AF1 with Locking Quadrant or equivalent for duct pressure ratings greater than 2 inches w.g. All control linkages must be exposed type.

B. Balancing dampers for round ductwork shall be Ruskin Model MDRS25 Round Manual Balancing Damper with Locking Quadrant, or equivalent.

2.3 FIRE DAMPERS

A. Fusible link dampers shall be of the folding blade type, shall meet the requirements of NFPA Bulletin 90A, and shall be UL listed and tested in accordance with UL 555 test criteria. Provide fire dampers UL listed for installation in 1-1/2 hour or 2-hour fire separations or divisions.

B. Fire dampers for vertical installation shall be gravity operated. Fire dampers for horizontal installation shall have closure springs and latches.

C. Fire dampers shall have resettable reusable fire link rated at 165°F.

D. Fire dampers installed in ductwork shall be Ruskin Model IBD2, Style C, CR, or CO to match duct shape, or equivalent. Maximum pressure drop: 0.05 inches w.g. at 1500 fpm face velocity.

E. Equivalent manufacturers: Ruskin, Prefco, National Control Air, Safe-Air, Greenheck, Pottorff.

2.4 DUCT ACCESS DOORS

A. In general, access doors shall be at least 18 inches x 18 inches where physically possible; access doors for fire dampers shall be sized in accordance with the fire damper size.

B. Access doors shall be of double construction and shall be gasketed around the entire perimeter to minimize air leakage between door and frame. Access doors in insulated ducts or casings, and fire damper access doors, shall be fully insulated with rigid fiberglass insulation between the metal panels.

C. In no case shall access to any items of equipment require the removal of nuts, bolts, screws, wedges or any other loose devices.

D. Access doors installed in ductwork 2 inches w.g. class and below shall be Ruskin Model ADH22, or equivalent.

E. Access doors installed in ductwork above 2 inches w.g. class shall be Ruskin Model ADHP-3 High Pressure Access Doors, or equivalent.

2.5 FLEXIBLE CONNECTIONS

A. Flexible connections shall be a minimum of 8 inches long.

B. Flexible connection shall be fabricated from approved flameproofed fabric in accordance with the applicable sections of the NFPA overall fire codes. Asbestos cloth is not permitted.

C. Flexible connections shall have a pressure rating of at least +/- 2 PSIG.

D. Flexible connections shall be Proco Style 520, U-design, Neoprene material, or equal.

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2.6 COMBINATION FIRE AND SMOKE DAMPER

A. Maximum pressure drop for damper assembly shall be 0.05 inches w.g. at 1500 fpm duct face velocity.

B. Dampers shall be UL listed and tested in accordance with UL 555 test criteria and shall be further qualified under UL 555S as a leakage rated damper for use in smoke control systems. The leakage rating shall be no higher than class 1 (4 cfm/sq.ft. at 1 inch w.g.) at 250°F elevated temperature category. UL leakage ratings shall apply to sizes of dampers required herein, and elevated temperature ratings shall apply to operators as well as dampers.

C. Each combination fire and smoke damper shall be equipped with a UL classified firestat which shall function to close damper when duct temperature exceeds 165°F. Firestat package shall include two damper position indicator switches, both linked directly to a damper blade, to provide capabilities of remotely indicating damper position (open or closed). Firestat and damper position indicators shall have capability of interfacing electrically with smoke detectors, building fire alarm systems and remote indicating/control stations. Motor operator shall be 24 volt electric actuated normally closed.

D. Motor damper and firestat assembly shall have maximum draw of 4.0 amps.

E. Firestat position indicator shall have capabilities of electrically locking damper in a closed position whenever duct temperatures exceed 165°F and the capability of permitting appropriate authority to override the smoke detector and re-open damper as may be required to permit desired smoke control functions only. Damper shall remain closed when firestat temperature is above 165°F.

F. Combination motor/fire dampers shall be Ruskin FSD60 or equivalent.

G. Firestat shall be Ruskin Model TS150 or equivalent.

H. Equivalent manufacturers: Ruskin, Prefco, National Control Air, Safe-Air, Greenheck.

2.7 SMOKE DAMPERS

A. Maximum pressure drop for damper assembly shall be 0.05 inches w.g. at 1500 fpm duct face velocity.

B. Dampers shall be UL listed and tested in accordance with UL 555 test criteria and shall be further qualified under UL 555S as a leakage rated damper for use in smoke control systems. The leakage rating shall be no higher than class 1 (4 cfm/sq.ft. at 1 inch w.g.) at 250°F elevated temperature category. UL leakage ratings shall apply to sizes of dampers required herein, and elevated temperature ratings shall apply to operators as well as dampers.

C. Each smoke damper shall be equipped with two damper position indicator switches, linked directly to a damper blade to provide damper position indication (open or closed) at a remote location. Damper position indicators shall have capability of interfacing electrically with building fire alarm systems and remote indicating/control stations.

D. Motor operator shall be 24 volt electric actuated normally closed.

E. Motor damper assembly shall have a maximum draw of 4.0 amps.

F. Smoke dampers shall be Ruskin ~~F~~SD60 or approved equivalent.

G. Equivalent manufacturers: Ruskin, Prefco, National Control Air, Safe-Air, Greenheck.

2.8 THERMOMETERS

A. Thermometer shall be Ashcroft 5 inch dial thermometer, 20°F to 120°F temperature scale, 9 inch stem length.

2.9 TURNING VANES

1. Ductmate Industries, Inc.
2. Duro Dyne Inc.
3. METALAIRE, Inc.
4. SEMCO Incorporated.
5. Ward Industries, Inc.; a division of Hart & Cooley, Inc.

B. Turning Vanes for Metal Ducts shall be curved blades of galvanized sheet steel; support with bars perpendicular to blades set; set into vane runners suitable for duct mounting.

1. Acoustic Turning Vanes: Fabricate airfoil-shaped aluminum extrusions with perforated faces and fibrous-glass fill.

C. Manufactured turning vanes for nonmetal ducts shall be fabricated of curved blades of resin-bonded fiberglass with acrylic polymer coating; support with bars perpendicular to blades set; set into vane runners suitable for duct mounting.

D. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible"; Figures 2-3, "Vanes and Vane Runners," and 2-4, "Vane Support in Elbows."

E. Vane Construction shall be single wall for ducts up to 48 inches wide and double wall for larger dimensions.

2.10 FLEXIBLE DUCTS

A. Noninsulated, flexible duct shall be UL 181, Class 1, multiple layers of aluminum laminate supported by helically wound, spring-steel wire.

1. Pressure Rating: 10-inch wg positive and 1.0-inch wg negative.
2. Maximum Air Velocity: 4000 fpm.
3. Temperature Range: Minus 20 to plus 210 deg F.
4. Length not to exceed 6 feet

B. Insulated, flexible duct shall be UL 181, Class 1, multiple layers of aluminum laminate supported by helically wound, spring-steel wire; fibrous-glass insulation; polyethylene vapor-barrier film, sound attenuating.

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1. Pressure Rating: 10-inch wg positive and 1.0-inch wg negative.
2. Maximum Air Velocity: 4000 fpm.
3. Temperature Range: Minus 20 to plus 210 deg F.
4. Length not to exceed 6 feet

C. Flexible Duct Connectors:

1. Clamps: Stainless-steel band with cadmium-plated hex screw to tighten band with a worm-gear action in sizes 3 through 18 inches, to suit duct size and adhesive mastic.

D. Equivalent manufacturers: Flexmaster U.S.A., McGill AirFlow LLC

2.11 DUCT ACCESSORY HARDWARE

A. Instrument Test Holes: Cast iron or cast aluminum to suit duct material, including screw cap and gasket. Size to allow insertion of pitot tube and other testing instruments and of length to suit duct-insulation thickness.

B. Adhesives: High strength, quick setting, neoprene based, waterproof, and resistant to gasoline and grease.

2.12 MOTORIZED CONTROL DAMPER

A. Motorized control dampers have 5” by 1” 16 gauge galvanized steel frame reinforced with corner braces for structural strength equal to 11 gauge channel frames. Blades shall be airfoil shaped, double skin construction of 14 gauge thickness, 6” wide. Dampers shall have neoprene blade edge seals and flexible metal compressible jamb seals.

B. All linkages shall be exposed type.

C. Pressure rating and leakage performance shall be equivalent to the Ruskin CD60 low leakage control damper

D. Motorized control dampers shall be Ruskin CD60, or approved equivalent.

3 PART 3 - EXECUTION

3.1 INSTALLATION

A. Install duct accessories according to applicable details in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for metal ducts and in NAIMA AH116, "Fibrous Glass Duct Construction Standards," for fibrous-glass ducts.

B. Install duct accessories of materials suited to duct materials; use galvanized-steel accessories in galvanized-steel and fibrous-glass ducts, stainless-steel accessories in stainless-steel ducts, and aluminum accessories in aluminum ducts.

C. Install backdraft dampers at inlet of exhaust fans or exhaust ducts as close as possible to exhaust fan unless otherwise indicated.

D. Install volume dampers at points on supply, return, and exhaust systems where branches extend from larger ducts. Where dampers are installed in ducts having duct liner, install dampers with hat channels of same depth as liner, and terminate liner with nosing at hat channel.

1. Install steel volume dampers in steel ducts.
2. Install aluminum volume dampers in aluminum ducts.

E. Set dampers to fully open position before testing, adjusting, and balancing.

F. Install test holes at fan inlets and outlets and elsewhere as indicated.

G. Install fire and smoke dampers according to UL listing.

H. Connect ducts to duct silencers rigidly.

I. Install duct access doors on sides of ducts to allow for inspecting, adjusting, and maintaining accessories and equipment at the following locations:

1. On both sides of duct coils and terminal reheat coils.
2. Downstream from manual volume dampers, control dampers, turning vanes, and equipment.
3. Adjacent to and close enough to fire or smoke dampers, to reset or reinstall fusible links. Access doors for access to fire or smoke dampers having fusible links shall be pressure relief access doors and shall be outward operation for access doors installed upstream from dampers and inward operation for access doors installed downstream from dampers.
4. At humidifier wands
5. At each change in direction and at maximum 50-foot spacing.
6. Upstream of turning vanes.
7. Elsewhere as indicated.

J. Install access doors with swing against duct static pressure.

K. Access Door Sizes:

1. One-Hand or Inspection Access: 8 by 5 inches.

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2. Two-Hand Access: 12 by 6 inches.
3. Head and Hand Access: 18 by 10 inches.
4. Head and Shoulders Access: 21 by 14 inches.
5. Body Access: 25 by 14 inches.
6. Body plus Ladder Access: 25 by 17 inches.

L. Label access doors according to Division 23 Section "Identification for HVAC Piping and Equipment" to indicate the purpose of access door.

M. Flexible duct installation shall be in strict accordance with the details included in the construction drawings. Maximum length shall be 6 feet.

N. Install flexible connectors to connect ducts to equipment.

O. For fans developing static pressures of 5-inch wg and more, cover flexible connectors with loaded vinyl sheet held in place with metal straps.

P. Connect terminal units to supply ducts directly or with maximum 12-inch lengths of flexible duct. Do not use flexible ducts to change directions.

Q. Connect diffusers to low-pressure ducts with maximum 60-inch lengths of flexible duct clamped or strapped in place.

R. Connect flexible ducts to metal ducts with adhesive plus sheet metal screws.

S. Install duct test holes where required for testing and balancing purposes. Provide and install duct plugs in test holes.

T. Install thrust limits at centerline of thrust, symmetrical on both sides of equipment. Attach thrust limits at centerline of thrust and adjust to a maximum of 1/4-inch movement during start and stop of fans.

3.2 FIELD QUALITY CONTROL

A. Tests and Inspections:

1. Operate dampers to verify full range of movement.
2. Inspect locations of access doors and verify that purpose of access door can be performed.
3. Operate fire, smoke, and combination fire and smoke dampers to verify full range of movement and verify that proper heat-response device is installed.
4. Inspect turning vanes for proper and secure installation.
5. Operate remote damper operators to verify full range of movement of operator and damper.

B. Start-up Checks

1. Start-Up Tests: In addition to specifications, perform the following as a minimum:

Operate installed ductwork accessories to demonstrate compliance with requirements. Test for air leakage while system is operating with all accessories installed. Repair or replace faulty accessories,

as required to obtain proper operation and leak proof performance.

***Adjusting*: Adjust ductwork accessories for proper settings, install fusible links in fire dampers and adjust for proper action.**
Final positioning of manual dampers is specified in Division 23 Section "Testing, Adjusting, and Balancing".

Fire Damper Testing*: For every fire damper, remove the fusible link an verify that the damper operates freely and closes tightly. Reinstall the fusible link

END OF SECTION 233300

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SECTION 23 74 13 - PACKAGED ROOFTOP AIR CONDITIONING UNITS

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes:
1. Packaged rooftop air conditioning units.
2. Roof curb.

B. Related Sections:
1. Section 23 20 00 – HVAC Piping: Condensate drain piping connections
2. Section 23 33 00 - Duct Accessories: Flexible connections.
3. Section 23 09 23 – HVAC Instrumentation and Controls: Controls remote from unit.
4. Section 23 09 93 - Sequence of Operation: Sequences of operation applying to units in this section.
5. Section 26 - Variable Frequency Controllers: Variable frequency controllers.

1.2 REFERENCES

A. Air-Conditioning and Refrigeration Institute:
1. ARI 270 - Sound Rating of Outdoor Unitary Equipment.
2. ARI 340/360 - Commercial and Industrial Unitary Air-Conditioning and Heat Pump Equipment.

B. American Society of Heating, Refrigerating and Air-Conditioning Engineers:
1. ASHRAE 52.1 - Gravimetric and Dust-Spot Procedures for Testing Air-Cleaning Devices Used in General Ventilation for Removing Particulate Matter.

C. American Society for Testing and Materials:
1. ASTM B117 - Standard Practice for Operating Salt Spray (Fog) Apparatus.

D. National Fire Protection Association:
1. NFPA 90A - Standard for the Installation of Air Conditioning and Ventilating Systems.

1.3 SUBMITTALS

A. Product Data: Submit data indicating:
1. Cooling and heating capacities.
2. Fan performance including fan curves.
3. Dimensions.
4. Weights.
5. Rough-in connections and connection requirements.
6. Duct connections.
7. Electrical requirements with electrical characteristics and connection requirements.

8. Material properties.
9. Controls.
10. Accessories.

B. Manufacturer's Installation Instructions: Submit assembly, support details, connection requirements, and include start-up instructions.

C. Manufacturer’s Field Reports: Manufacturer’s Field Reports: Submit start-up report for each unit.

1.4 CLOSEOUT SUBMITTALS

A. Project Record Documents: Record actual locations of controls installed remotely from units.

B. Operation and Maintenance Data: Submit manufacturer's descriptive literature, operating instructions, installation instructions, and maintenance and repair data.

1.5 QUALITY ASSURANCE

A. Cooling Capacity: Rate in accordance with ARI 340/360.

B. Sound Rating: Measure in accordance with ARI 270.

C. Insulation and adhesives: Meet requirements of NFPA 90A.

1.6 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing Products specified in this section with minimum three years experience.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Accept units on site. Inspect for damage.

B. Protect units from damage by storing off roof until roof mounting curbs are in place.

1.8 COORDINATION

A. Coordinate installation of roof curbs with roof structure, roof deck and roof membrane installation.

1.9 WARRANTY

A. Furnish five year manufacturer’s warranty for compressors.

B. Furnish five year manufacturer’s warranty for heat exchanger.

PART 2 PRODUCTS

2.1 PACKAGED ROOFTOP AIR CONDITIONING UNIT

A. Available Manufacturers:
1. Daikin/McQuay

B. Product Description: Self-contained, packaged, factory assembled and wired unit, consisting of roof curb; cabinet, casing, and frame; supply fan section; variable frequency drive; cooling coil section; compressor; condensing section; refrigerant circuit; filter section; outdoor / return / exhaust air section with return fan; propane heating section; electrical; controls; and accessories.

C. Configuration:
1. Air delivery: Downflow.

Module	***HVAC-1***	***HVAC-2***
Economizer/Mixing/Return Fan	**X**	**X**
Angled Filter	**X**	**X**
Blank section	**X**	**X**
Draw-through DX cooling coil	**X**	**X**
Supply Fan	**X**	**X**
Blow through gas heat (propane)	**X**	**X**
Discharge plenum	**X**	**X**
Integral Condensing Unit	**X**	**X**

D. Roof Curb:
1. The new units shall be mounted on existing roof curbs. Field-verify dimensions to ensure accuracy.
2. Furnish all new gaskets for field mounting.

E. Cabinet, Casing, and Frame:
1. Designed for outdoor installation with weatherproof construction.
2. Frame and unit base: Constructed of galvanized steel. Base overhangs roof curb for water runoff and constructed with formed recess seating on roof curb gasket for positive weather tight seal. Furnish lifting brackets on unit base with lifting holes to accept cable or chain hooks.
3. Finish: Exterior surfaces finished with baked on enamel paint exceeding 750 hour salt spray test in accordance with ASTM B117.
4. Insulation: Minimum of 1 inch thick, 0.75 pound per cubic foot density foil faced glass fiber secured to panels.

5. Access doors: Hinged. Constructed of galvanized steel insulated double wall construction. Furnish access doors on both sides of each section.

F. Supply Fan Section:
1. Fan: Double width, double inlet (DWDI) airfoil centrifugal fan, statically and dynamically balanced, resiliently mounted.
2. Fan Drive: V-Belt type, Cast iron or steel sheaves, dynamically balanced, bored to fit shafts and keyed. Furnish solid shaft construction. Select Variable and adjustable pitch motor sheave to obtain required rpm with sheaves set at mid-position as recommended by manufacturer.
   a. Drive Rating: Minimum 1.5 times nameplate rating of motor.
   b. Fan Sheave: Adjustable.
   c. Motor Sheave: Fixed.
3. Fan motor: Three phase, NEMA design B, continuously rated at 40 degrees C, premium efficiency, open drip-proof NEMA T frame, with permanently lubricated bearings and integral overload protection.
4. Fan Assembly Mounting: Furnish spring-type vibration isolators.
5. Supply Fan Modulation: Factory-installed Variable Frequency Drive.

G. Return Fan:
1. Fan: Single width, single inlet (SWSI) airfoil centrifugal fan, statically and dynamically balanced, resiliently mounted.
2. Fan Drive: V-Belt type, Cast iron or steel sheaves, dynamically balanced, bored to fit shafts and keyed. Furnish solid shaft construction. Select Variable and adjustable pitch motor sheave to obtain required rpm with sheaves set at mid-position as recommended by manufacturer.
   a. Drive Rating: Minimum 1.5 times nameplate rating of motor.
   b. Fan Sheave: Adjustable.
   c. Motor Sheave: Fixed.
3. Fan motor: Three phase, NEMA design B, continuously rated at 40 degrees C, premium efficiency, open drip-proof NEMA T frame, with permanently lubricated bearings and integral overload protection.
4. Fan Assembly Mounting: Furnish spring-type vibration isolators.
5. Return Fan Modulation: Factory-installed Variable Frequency Drive.

H. Cooling Coil Section:
1. Coil: Constructed of seamless copper tubes mechanically expanded into aluminum fins. Furnish with intertwined circuits with multiple rows. Factory leak tested under water.
2. Drain Pan: Stainless steel, positively sloped extending beyond leaving side of coil and under cooling coil connections. Connect to drain connection extending through unit base. Furnish units with stacked cooling coils with secondary drain pan connected to primary drain pan.
3. Furnish coil with corrosion resistant coating.

I. Indirect Gas Fired Heater Section (Propane)
1. Indirect-fired gas heaters shall be completely factory assembled, piped, and operationally fire tested at the factory prior to shipment. The heat exchanger

primary drum and secondary tubes shall be constructed from 14-gauge, 321 stainless steel.

2. The industrial / commercial burner shall be UL listed, forced draft, and fully modulating. The gas heat section construction shall match the rest of the air handling unit and be an integral part of the unit. All burner and control components shall be housed in a burner vestibule with a large access door. The entire section shall bear a UL or CUL label for Commercial-Industrial Gas Heating Equipment (ANSI UL Standard 795) and Industrial Gas-Fired Packaged Furnaces (CGA Standard 32-1976)
3. Features:
   a. Propane burner
   b. 3:1 full-modulating nominal turn down
   c. UL I Factory Mutual insurance-rated gas train
   d. Hardwired supply fan interlock.
   e. Microprocessor-based flame safeguard control, combustion air proving switch, pre-purge timer and spark ignition.
4. Field connections:
   a. 7 -14 in. w.c. propane gas pressure in appropriate volume
   b. Condensate drain
   c. Flue stack, factory supplied and field installed.

J. Filter Section:
1. Location: Upstream of fan section.
2. Furnish section with integral galvanized steel filter rack contained within unit.
3. Disposable filters: Frame mounted 2 inch thick MERV 8, 30 percent efficient based on ASHRAE 52.1.

K. Outdoor and Return Air Economizer Section:
1. Dampers: Furnish with leakage rate not to exceed 1 percent of nominal airflow based on 1 inch water column static pressure.
2. Actuators: Furnish factory installed electric damper actuators for outside air, return air, and exhaust air dampers.
3. Economizer: Furnish fully integrated factory installed fully modulating from 0 to 100 percent outside air. Operation through microprocessor based primary temperature controls automatically modulate dampers to maintain space temperature conditions.
   a. Furnish economizer with enthalpy control.
   b. Damper Position: Adjustable, minimum position, with remote control in conditioned space.
   c. Furnish spring return motor for outside air damper closure during unit shutdown or power interruption.

L. Compressors:
1. Scroll type with reversible, positive displacement oil pump, suction and discharge line service valves, crankcase heater, sight glass, anti-slug protection, current sensing, and internal motor overload protection.
2. Furnish vibration isolators.
3. Furnish vibration eliminators on suction and discharge piping.
4. Furnish short cycle protection.

M. Condensing Section:
1. Condenser coils: Multi-row cast aluminum microchannels. Factory leak tested under water.
2. Condenser fans: Direct drive, propeller type, vertical air discharge. Fan blades constructed of steel. Condenser fan motors totally enclosed type with internal motor overload protection, three-phase non-reversing type with permanently lubricated ball bearing and integral rain shield.

N. Refrigeration circuit:
1. Each unit shall have two independent refrigeration circuits.
2. Dehydrate, leak test, and factory charge each circuit with oil and refrigerant.
3. Furnish the following for each circuit:
   a. Thermal expansion device.
   b. Filter-drier.
   c. Replaceable core filter drier.
   d. Suction, discharge, and liquid line service valves with gauge ports.
   e. Sight glass.
   f. High and low pressure safety controls.
   g. Liquid line solenoid valve.
   h. Sub-cooler circuit to provide 15 degrees of liquid sub-cooling.
4. Capacity control:
   a. By cycling compressors, and with hot gas bypass on both circuits.

O. Electrical:
1. Furnish with factory wired weatherproof control panel with deadfront cover.
2. Furnish with single point power terminal block for main power connection.
3. Furnish terminal board for low voltage control wiring.
4. Furnish branch circuit fusing, 115 volt control circuit transformer and fuse, system switches, high temperature sensor, and 115 volt ground fault receptacle with separate electrical connection.
5. Phase Failure and Under Voltage Protection: Furnish for three-phase motors to prevent damage from single phasing, phase reversal, and low voltage conditions.
   a. Ground Fault Protection: Furnish on three-phase motors to protect against arcing ground faults.
6. Non-fused through-door disconnect switch: Factory installed.

P. Controls: Furnish unit with integral “safeties”. Refer to Section 23 09 00 and Drawings for field-installed controls requirements and sequence of operation.

Q. Accessories:
1. Convenience Outlet: Factory installed, 115 volt, 15 amp, GFI type, internally mounted. Factory wired from transformer internal to unit.
2. Roof Curb Adaptor Package: Furnish duct support hardware to adapt unit to existing roof curb.
3. Through-the-base electrical provision.

2.2 SOURCE QUALITY CONTROL

A. Perform factory test of each unit. Test includes:

1. Dynamic trim balance of completed fan assembly.
2. Complete run check of electrical components and safety controls, including control sequencing.
3. Pressure test, at manufacturer's rated pressure, of refrigerant coils and condenser coils prior to unit assembly.
4. Leak check of completed refrigerant circuits.
5. Compressor run check.

B. Make completed unit available for inspection at manufacturer's factory prior to packaging for shipment. Notify Owner at least seven days before inspection is allowed.

C. Allow witnessing of factory inspections and test at manufacturer's test facility. Notify Owner at least seven days before inspections and tests are scheduled.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify roof curbs are installed and dimensions are as shown on shop drawings.

3.2 INSTALLATION

A. Roof Curb:
1. Verify condition of existing roof curb.
2. Install units on roof curb providing watertight enclosure to protect ductwork and utility services.
3. Install gasket material between unit base and roof curb.

B. Connect units to supply and return ductwork with flexible connections. Refer to Section 23 33 00.

C. Install condensate piping with trap and route from drain pan to splash block on roof. Refer to Section 23 20 00.

D. Install components furnished loose for field mounting.

E. Install electrical devices furnished loose for field mounting.

F. Install control wiring between unit and field installed accessories.

G. Provide fixed sheaves required for final air balance.

3.3 MANUFACTURER'S FIELD SERVICES

A. Furnish initial start-up.

3.4 CLEANING

A. Vacuum clean coils and inside of unit cabinet.

B. Install new throwaway filters in units at Substantial Completion.

3.5 DEMONSTRATION

A. Demonstrate unit operation and maintenance.

END OF SECTION