PROJECT MANUAL FOR:

Fayette Clinic – HVAC Update

CP 190761

AT

UNIVERSITY OF MISSOURI
COLUMBIA, MISSOURI

FOR:

THE CURATORS OF THE UNIVERSITY OF MISSOURI

PREPARED BY:

SSC Engineering, Inc.
J. Chris Cornett
18207 Edison Ave.
Chesterfield, Missouri 63005

December 23, 2019

ISSUED FOR BID
PROJECT MANUAL FOR: Fayette Clinic – HVAC Update

PROJECT NUMBER: CP 190761

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Chesterfield, Missouri 63005

DATE: December 23, 2019

I hereby certify that these Drawings and/or Specifications have been prepared by me, or under my supervision. I further certify that to the best of my knowledge these Drawings and/or Specifications are as required by and in compliance with Building Codes of the University of Missouri.

Signature: ____________________________
James. C. Cornett

MU #CP190761
Division 1

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**END OF SECTION**
ADVERTISEMENT FOR BIDS

Sealed bids for:

FAYETTE CLINIC –
HVAC UPDATE
UNIVERSITY OF MISSOURI
COLUMBIA, MISSOURI
PROJECT NUMBER: CP190761

CONSTRUCTION ESTIMATE $336,767 - $374,186

will be received by the Curators of the University of Missouri, Owner, at Campus Facilities, Planning, Design & Construction, Room L100 (Front Reception Desk), General Services Building, University of Missouri, Columbia, Missouri 65211, until 1:30 p.m., C.T., January 16, 2020 and then immediately opened and publicly read aloud.

Drawings, specifications, and other related contract information may be obtained at http://operations-webapps.missouri.edu/pdc/adsite/ad.html. Electronic bid sets are available at no cost and may be printed as desired by the plan holders. No paper copies will be issued. If paper copies are desired, it is the responsibility of the user to print the files or have them printed. Questions should be directed to the office of Planning, Design & Construction at (573) 882-0455.

Questions regarding the scope of work should be directed to Chris Cornett with SSC Engineering at (636) 530-7770 or ccornett@sscengineering.com. Questions regarding commercial conditions should be directed to Brad Rackers at (573) 884-7086 or rackersba@missouri.edu.

Information regarding bid results will be available the day following the bid opening by calling (573) 882-6894.

A MANDATORY prebid meeting will be held at 9:00 a.m., C.T., January 8, 2020 at the Fayette Medicine Clinic, 308 S. Church St, Fayette, Missouri, followed by a walk-through at the site. All interested bidders are required to attend this meeting. Additional walk-throughs of the project have been arranged for January 9, 2020 or January 14, 2020 these MUST be scheduled 24 hours in advance by contacting the Prebid Inspection Guide at (573) 882-2228 or mucfpmprebidinspectionsguides@missouri.edu.

A Diversity Participation goal of 10% Combined MBE, WBE, DBE, Veteran and 3% SDVE has been established for this contract.

The Owner reserves the right to waive informalities in bids and to reject any and all bids.

Individuals with special needs as addressed by the Americans with Disabilities Act may contact (573) 882-1133.

Advertisement Date: December 23, 209

Gary Ward
Vice Chancellor of Operations & Chief Operating Officer
University of Missouri
SECTION 1.A

BID FOR LUMP SUM CONTRACT

Date: __________________________

BID OF

(hereinafter called "Bidder") a corporation* organized and existing under laws of the State of __________________________

a partnership* consisting of ____________________________________________.

an individual* trading as ____________________________________________.

a joint venture* consisting of ____________________________________________.

*Insert Corporation(s), partnership or individual, as applicable.

TO: Curators of the University of Missouri
c/o Associate Vice Chancellor – Facilities
Room L100, General Services Building
University of Missouri
Columbia, MO 65211

1. Bidder, in compliance with invitation for bids for construction work in accordance with Drawings and Specifications prepared by SSC Engineering entitled “Fayette Clinic – HVAC Update”, project number CP190761, dated December 23, 2019 having examined Contract Documents and site of proposed work, and being familiar with all conditions pertaining to construction of proposed project, including availability of materials and labor, hereby proposes to furnish all labor, materials and supplies to construct project in accordance with Contract Documents, within time set forth herein at prices stated below. Prices shall cover all expenses, including taxes not covered by the University of Missouri’s tax exemption status, incurred in performing work required under Contract documents, of which this Bid is a part.

Bidder acknowledges receipt of following addenda:

Addendum No. ___________________________ Dated ___________________________
Addendum No. ___________________________ Dated ___________________________
Addendum No. ___________________________ Dated ___________________________
Addendum No. ___________________________ Dated ___________________________

2. In following Bid(s), amount(s) shall be written in both words and figures. In case of discrepancy between words and figures, words shall govern.

3. BID PRICING

a. Base Bid:
The Bidder agrees to furnish all labor, materials, tools, and equipment required to replace of 5 existing furnace split systems with 8 new furnace split systems along with an energy recovery unit. Demolition shall consist of removal of 5 split systems, minor landscaping, drywall, ceiling. Architectural work shall consist of removal and replacement as needed for HVAC work. Electrical work shall consist of a new electrical panel to support the HVAC Upgrade as indicated on the Drawings and described in these Specifications for sum of:

__________________________________________ DOLLARS ($____________________).

1.A - 1
b. Additive Alternate Bids:

Above Base Bid may be changed in accordance with following Alternate Bids as Owner may elect. Alternates are as described in Section 1.H of Project Manual. Alternates are written in a priority order, but Owner is not required to accept or reject in order listed. This is a one (1) contract project, therefore, Alternates shall be studied by each Bidder to determine effect on Bids of Contractor and each Subcontractor and/or Material supplier.

(1) Additive Alternate No. 1: Provide heat pumps in lieu of condensing units. All for sum of:

________________________________________________________________________ DOLLARS ($ ____________).

4. PROJECT COMPLETION

a. Contract Period - Contract period begins on the day the Contractor receives unsigned Contract, Performance Bond, Payment Bond, and "Instructions for Execution of Contract, Bonds, and Insurance Certificates." Bidder agrees to complete project within one hundred and twenty (120) calendar days from receipt of aforementioned documents. Fifteen (15) calendar days have been allocated in construction schedule for receiving aforementioned documents from Bidder.

b. Commencement - Contractor agrees to commence work on this project after the "Notice to Proceed" is issued by the Owner. "Notice to Proceed" will be issued within seven (7) calendar days after Owner receives properly prepared and executed Contract documents listed in paragraph 4.a. above.

d. Refer to Special Scheduling Requirements in Special Conditions for specific scheduling of the following activities:

  1. Special work times

6. SUPPLIER DIVERSITY PARTICIPATION GOALS

A Diversity Participation goal of 10% combined MBE, WBE, DBE and VET Owned Business; and a 3% SDVE has been established for this contract.

a. The Contractor shall have as a combined goal subcontracting with Minority Business Enterprise (MBE), Women Business Enterprise (WBE), Disadvantage Business Enterprise (DBE), and/or Veteran Owned Business of TEN PERCENT (10%); and with Service Disabled Veteran Owned Business (SDVE) of THREE PERCENT (3%) of awarded contract price for work to be performed.

b. Requests for waiver of this goal shall be submitted on the attached Application For Waiver form. A determination by the Director of Facilities Planning & Development, UM, that a good faith effort has not been made by Contractor to achieve above stated goal may result in rejection of bid.

c. The Undersigned proposes to perform work with following Supplier Diversity participation level:

\[
\text{MBE, WBE, DBE, and/or VETERAN PERCENTAGE PARTICIPATION: } \frac{\text{amount}}{\text{total}} \times 100 \%
\]

\[
\text{SDVE PERCENTAGE PARTICIPATION: } \frac{\text{amount}}{\text{total}} \times 100 \% \]

1.A - 2
d. A Supplier Diversity Compliance Evaluation form shall be submitted with this bid for each diverse subcontractor to be used on this project.

7. BIDDER'S ACKNOWLEDGMENTS

   a. Bidder declares that he has had an opportunity to examine the site of the work and he has examined Contract Documents therefore; that he has carefully prepared his bid upon the basis thereof; that he has carefully examined and checked bid, materials, equipment and labor required thereunder, cost thereof, and his figures therefore. Bidder hereby states that amount, or amounts, set forth in bid is, or are, correct and that no mistake or error has occurred in bid or in Bidder's computations upon which this bid is based. Bidder agrees that he will make no claim for reformation, modifications, revisions or correction of bid after scheduled closing time for receipt of bids.

   b. Bidder agrees that bid shall not be withdrawn for a period of (60) days after scheduled closing time for receipt of bids.

   c. Bidder understands that Owner reserves right to reject any or all bids and to waive any informalities in bidding.

   d. Accompanying the bid is a bid bond, or a certified check, or an irrevocable letter of credit, or a cashier's check payable without condition to "The Curators of the University of Missouri" which is an amount at least equal to five percent (5%) of amount of largest possible total bid herein submitted, including consideration of Alternates.

   e. Accompanying the bid is a Bidder's Statement of Qualifications. Failure of Bidder to submit the Bidder's Statement of Qualifications with the bid may cause the bid to be rejected. Owner does not maintain Bidder's Statements of Qualifications on file.

   f. It is understood and agreed that bid security of two (2) lowest and responsive Bidders will be retained until Contract has been executed and an acceptable Performance Bond and Payment Bond has been furnished. It is understood and agreed that if the bid is accepted and the undersigned fails to execute the Contract and furnish acceptable Performance/Payment Bond as required by Contract Documents, accompanying bid security will be realized upon or retained by Owner. Otherwise, the bid security will be returned to the undersigned.

8. BIDDER'S CERTIFICATE

Bidder hereby certifies:

   a. His bid is genuine and is not made in interest of or on behalf of any undisclosed person, firm or corporation, and is not submitted in conformity with any agreement or rules of any group, association or corporation.

   b. He has not directly or indirectly induced or solicited any other bidder to put in a false or sham bid.

   c. He has not solicited or induced any person, firm or corporation to refrain from bidding.

   d. He has not sought by collusion or otherwise to obtain for himself any advantage over any other Bidder or over Owner.

   e. He will not discriminate against any employee or applicant for employment because of race, color, religion, sex or national origin in connection with performance of work.

   f. By virtue of policy of the Board of Curators, and by virtue of statutory authority, a preference
will be given to materials, products, supplies, provisions and all other articles produced, manufactured, mined or grown within the State of Missouri. By virtue of policy of the Board of Curators, preference will also be given to all Missouri firms, corporations, or individuals, all as more fully set forth in "Information For Bidders."

9. BIDDER'S SIGNATURE

Note: All signatures shall be original; not copies, photocopies, stamped, etc.

<table>
<thead>
<tr>
<th>Authorized Signature</th>
<th>Date</th>
</tr>
</thead>
<tbody>
<tr>
<td>Printed Name</td>
<td>Title</td>
</tr>
<tr>
<td>Company Name</td>
<td></td>
</tr>
<tr>
<td>Mailing Address</td>
<td></td>
</tr>
<tr>
<td>City, State, Zip</td>
<td></td>
</tr>
<tr>
<td>Phone No.</td>
<td>Federal Employer ID No.</td>
</tr>
<tr>
<td>Fax No.</td>
<td>E-Mail Address</td>
</tr>
<tr>
<td>Circle one:</td>
<td>Individual Partnership Corporation Joint Venture</td>
</tr>
<tr>
<td>If a corporation, incorporated under the laws of the State of________</td>
<td></td>
</tr>
<tr>
<td>Licensed to do business in the State of Missouri?  _____yes  _____no</td>
<td></td>
</tr>
</tbody>
</table>

(Each Bidder shall complete bid form by manually signing on the proper signature line above and supplying required information called for in connection with the signature. Information is necessary for proper preparation of the Contract, Performance Bond and Payment Bond. Each Bidder shall supply information called for in accompanying "Bidder's Statement of Qualifications.")

END OF SECTION
UNIVERSITY OF MISSOURI
BIDDER'S STATEMENT OF QUALIFICATIONS

Submit with Bid for Lump Sum Contract in separate envelope appropriately labeled. Attach additional sheet if necessary.

1. Company Name__________________________________________

Phone# ___________________________ Fax #: ___________________________

Address ______________________________________________________

2. Number of years in business _____. If not under present firm name, list previous firm names and types of organization.

____________________________________________________________________

3. List contracts on hand (complete the following schedule, include telephone number).

<table>
<thead>
<tr>
<th>Project &amp; Address</th>
<th>Owner/Owner's Representative</th>
<th>Phone Number</th>
<th>Architect</th>
<th>Amount of your Contract</th>
<th>Percent Completed</th>
</tr>
</thead>
</table>

____________________________________________________________________

4. General character of work performed by your company personnel.

____________________________________________________________________

5. List important projects completed in the last five (5) years on a type similar to the work now bid for, including approximate cost and telephone number.

<table>
<thead>
<tr>
<th>Project &amp; Address</th>
<th>Owner/Owner's Representative</th>
<th>Phone Number</th>
<th>Architect</th>
<th>Amount of your Contract</th>
<th>Percent Completed</th>
</tr>
</thead>
</table>

____________________________________________________________________

6. Other experience qualifying you for the work now bid.

____________________________________________________________________

7. No default has been made in any contract complete or incomplete except as noted below:
   (a) Number of contracts on which default was made ______________________
   (b) Description of defaulted contracts and reason therefor

____________________________________________________________________

8. (a) Have you or your company participated in any contract subject to an equal opportunity clause similar to that described in the General Conditions?
    Yes _____  No _____

(b) Have you filed all required compliance reports?
    Yes _____  No _____
(c) Is fifty percent or more of your company owned by a minority?
   Yes ______  No ______

(d) Is fifty percent or more of your company owned by a woman?
   Yes ______  No ______

(e) Is fifty percent or more of your company owned by a service disabled veteran?
   Yes ______  No ______

(f) Is fifty percent or more of your company owned by a veteran?
   Yes ______  No ______

(g) Is your company a Disadvantaged Business Enterprise?
   Yes ______  No ______

9. Have you or your company been suspended or debarred from working at any University of Missouri campus?
   Yes ______  No ______ (If the answer is "yes", give details.)

10. Have any administrative or legal proceedings been started against you or your company alleging violation of any wage and hour regulations or laws?
    Yes ______  No ______ (If the answer is "yes", give details.)

11. Workers Compensation Experience Modification Rates (last 3 yrs): ______/_____/_____
    Incidence Rates (last 3 years): ______/_____/_____

12. List banking references.

13. (a) Do you have a current confidential financial statement on file with Owner?
    Yes ______  No ______ (If not, and if desired, Bidder may submit such statement with bid, in a separate sealed and labeled envelope.)

   (b) If not, upon request will you file a detailed confidential financial statement within three (3) days?
    Yes ______  No ______

Dated at ______________________________ this __________ day of ______________________ 20____

Name of Organization

__________________________________________
Signature

__________________________________________
Printed Name

__________________________________________
Title of Person Signing

END OF SECTION
SUPPLIER DIVERSITY COMPLIANCE EVALUATION FORM

This form shall be completed by Bidders and submitted with the Bidder's Statement of Qualifications form for each diverse firm who will function as a subcontractor on the contract.

The undersigned submits the following data with respect to this firm's assurance to meet the goal for Supplier Diversity participation.

I. Project:
   CP 190761 Fayette Clinic - HVAC Update

II. Name of General Contractor:

III. Name of Diverse Firm:

   Address: ____________________________________________________________
   Phone No.: ______________________ Fax No.: ____________________________

   Status (check one)  MBE _____  WBE _____  Veteran_____  Service Disabled Veteran______ DBE______

IV. Describe the subcontract work to be performed. (List Base Bid work and any Alternate work separately):

   Base Bid: ____________________________________________________________
   ____________________________________________________________
   ____________________________________________________________
   ____________________________________________________________
   ____________________________________________________________

V. Dollar amount of contract to be subcontracted to the Diverse firm:

   Base Bid: ____________________________________________________________
   Alternate(s), (Identify separately): ____________________________________________
   ____________________________________________________________
   ____________________________________________________________
   ____________________________________________________________
   ____________________________________________________________

VI. Is the proposed subcontractor listed in the Directory of M/W/DBE Vendors, Directory of Serviced Disabled Veterans and/or the Directory of Veterans maintained by the State of Missouri?

   Yes _____  No _____
Is the proposed subcontractor certified as a diverse supplier by any of the following: federal government agencies, state agencies, State of Missouri city or county government agencies, Minority and/or WBE certifying agencies?

Yes ______  No ______  If yes, please provide details and attach a copy of the certification.


Does the proposed subcontractor have a signed document from their attorney certifying the Supplier as a Diverse and meeting the 51% owned and committed requirement?

Yes ______  No ______  If yes, please attach letter.

Signature: __________
Name: __________
Title: __________
Date: __________
APPLICATION FOR WAIVER

This form shall be completed and submitted with the Bidder's Statement of Qualifications. Firms wishing to be considered for award are required to demonstrate that a good faith effort has been made to include diverse suppliers. This form will be used to evaluate the extent to which a good faith effort has been made. The undersigned submits the following data with respect to the firm's efforts to meet the goal for Supplier Diversity Participation.

1. List pre-bid conferences your firm attended where Supplier Diversity requirements were discussed.

2. Identify advertising efforts undertaken by your firm which were intended to recruit potential diverse subcontractors for various aspects of this project. Provide names of newspapers, dates of advertisements and copies of ads that were run.

3. Note specific efforts to contact in writing those diverse suppliers capable of and likely to participate as subcontractors for this project.

4. Describe steps taken by your firm to divide work into areas in which diverse suppliers/contractors would be capable of performing.

5. What efforts were taken to negotiate with prospective diverse suppliers/contractors for specific sub-bids? Include the names, addresses, and telephone numbers of diverse suppliers/contractors contacted, a description of the information given to diverse suppliers/contractors regarding plans and specifications for the assigned work, and a statement as to why additional agreements were not made with diverse suppliers/contractors.

6. List reasons for rejecting a diverse supplier/contractor which has been contacted.
8. Describe the follow-up contacts with diverse suppliers/contractors made by your firm after the initial solicitation.


9. Describe the efforts made by your firm to provide interested diverse suppliers/contractors with sufficiently detailed information about the plans, specifications and requirements of the contract.


10. Describe your firm's efforts to locate diverse suppliers/contractors.


Based on the above stated good faith efforts made to include supplier diversity, the bidder hereby requests that the original supplier diversity percentage goal be waived and that the percentage goal for this project be set at ________ percent.

The undersigned hereby certifies, having read the answers contained in the foregoing Application for Waiver, that they are true and correct to the best of his/her knowledge, information and belief.

Signature

Name

Title

Company

Date
AFFIDAVIT

"The undersigned swears that the foregoing statements are true and correct and include all material information necessary to identify and explain the operation of ____________________________ (name of firm) as well as the ownership thereof. Further, the undersigned agrees to provide through the prime contractor or directly to the Contracting Officer current, complete and accurate information regarding actual work performed on the project, the payment therefore and any proposed changes, if any, of the project, the foregoing arrangements and to permit the audit and examination of books, records and files of the named firm. Any material misrepresentation will be grounds for terminating any contract which may be awarded and for initiating action under federal or state laws concerning false statements."

Note - If, after filing this information and before the work of this firm is completed on the contract covered by this regulation, there is any significant change in the information submitted, you must inform the Director of Facilities Planning and Development of the change either through the prime contractor or directly.

Signature

Name

Title

Date

Corporate Seal (where appropriate)

Date

State of

County of

On this __________________ day of __________________, 19__, before me appeared (name) ____________________________________________ to me personally known, who, being duly sworn, did execute the foregoing affidavit, and did state that he or she was properly authorized by (name of firm) __________________________ to execute the affidavit and did so as his or her own free act and deed.

(Seal)

Notary Public

Commission expires
AFFIDAVIT FOR AFFIRMATIVE ACTION

State of Missouri )
County of ) ss.

__________________________________________________________ first being duly sworn on his/her oath
states: that he/she is the (sole proprietor, partner, or officer) of __________________________________________
_______________________ a (sole proprietorship, partnership, corporation), and as such (sole proprietor, partner, or officer) is
duly authorized to make this affidavit on behalf of said (sole proprietorship, partnership, corporation); that under the contract
known as "___________________________________________________________________________________________"
Project No. ________________ less than 50 persons in the aggregate will be employed and therefore, the applicable Affirmative
Action requirements as set forth in the "Nondiscrimination in Employment Equal Opportunity," Supplemental Special
Conditions, and Article 13 in the General Conditions do not apply.

____________________________________________________________________________

Subscribed and sworn before me this ______________ day of ___________________________, 19________.

My commission expires __________________________________________________________, 19________.
CERTIFYING SUPPLIER DIVERSITY AGENCIES

Diverse firms are defined in General Conditions Articles 1.1.7 and those businesses must be certified as disadvantaged by an approved agency. The Bidder is responsible for obtaining information regarding the certification status of a firm. A list of certified firms may be obtained by contacting the agencies listed below. Any firm listed as disadvantaged by any of the following agencies will be classified as a diverse firm by the Owner.

St. Louis Development Corporation
1520 Market St., Ste. 2000
St. Louis, MO 63103
P: 314.982.1400
W: www.slouis-mo.gov/sldc/

Bi-State Development
211 N. Broadway, Ste. 700
St. Louis, MO 63102
P: 314.982.1400
W: www.metrostlouis.dbesystem.com

St. Louis Minority Business Council
211 N. Broadway, Ste. 1300
St. Louis, MO 63102
P: 314.231.5555
W: www.slmbc.org

U.S. Small Business Administration - St. Louis, MO
8(a) Contractors, Minority Small Business
1222 Spruce Street, Suite 10.103
St. Louis, MO 63101
P: 314.539.6600
W: www.sba.gov

Lambert St. Louis International Airport
Business Diversity Development Office
11495 Navaid
Bridgeton, MO 63044
P: 314-426-8111

City of Kansas City, Missouri
Human Relations Department, MBE/WBE Division
4th Floor, City Hall
414 E. 12th Street
Kansas City, MO 64106
P: 816.513.1836
W: kcmohrd.mwdbe.com/?TN=kcmohrd

Mid-States Minority Supplier Development Council
505 N. 7th Street, Ste. 1820
St. Louis, MO 63101
P: 314.278.5616
W: midstatesdc.org

U.S. Small Business Administration - Kansas City, MO
8(a) Contractors, Minority Small Business
1000 Walnut, Suite 500
Kansas City, MO 64106
P: 816.426.4900
W: kcmohrd.mwdbe.com/?TN=kcmohrd

Missouri Department of Transportation
Division of Construction
1617 Missouri Blvd.
P.O. Box 270
Jefferson City, MO 65102
P: 573.526.2978
W: www.modot.org/nrcc-directory

Illinois Department of Transportation
MBE/WBE Certification Section
2300 Dirksen Parkway
Springfield, IL 62764
217/782-5490; 217/785-1524 (Fax)
W: webapps.dot.illinois.gov/UCP/ExternalSearch

State of Missouri OA
Office of Equal Opportunity
301 W. High St. HSC Rm 870-B
Jefferson City, MO 65101
P: 877.259.2963
W: oeo.mo.gov/
Minority Newspapers

Dos Mundos Bilingual Newspaper  
902A Southwest Blvd.  
Kansas City, MO 64108  
816-221-4747  
www.dosmundos.com

Kansas City Hispanic News  
2918 Southwest Blvd.  
Kansas City, MO 64108  
816/472-5246  
www.kchispanicnews.com

The Kansas City Globe  
615 E. 29th Street  
Kansas City, MO 64109  
816-531-5253  
www.thekcglobe.com/about_us.php

St. Louis American  
4144 Lindell  
St. Louis, MO 63108  
314-533-8000  
www.stlamerican.com

St. Louis Chinese American News  
1766 Burns Ave, Suite 201  
St. Louis, MO 63132  
314-432-3858  
www.scannews.com

St. Louis Business Journal  
815 Olive St., Suite 100  
St. Louis, MO 63101  
314-421-6200  
www.bizjournal.com/stlouis

Kansas City Business Journal  
1100 Main Street, Suite 210  
Kansas City, MO 64105  
816-421-5900  
www.bizjournals.com/kansascity
AFFIDAVIT OF SUPPLIER DIVERSITY PARTICIPATION

The apparent low Bidder shall complete and submit this form within 48 hours of bid opening for each Diverse firm that will participate on the contract.

1. Diverse Firm: __________________________________________

   Contact Name: __________________________________________
   Address: ________________________________________________
   Phone No.: ___________________________ E-Mail: ______________________

   Status (check one)  MBE ☐  WBE ☐  Veteran ☐  Service Disabled Veteran ☐  DBE ☐
   If MBE, Certified as (circle one):  1) Black American  2) Hispanic American  3) Native American  4) Asian American

2. Is the proposed diverse firm certified by an approved agency [see IFB article 15]?  Yes ☐  No ☐

   Agency: ________________________________________________ [attach copy of certification authorization from agency]
   Certification Number: ____________________________________

3. Diverse firm scope work and bid/contract dollar amount of participation (List Base Bid and Alternate work separately). The final Dollar amount will be determined at substantial completion:

<table>
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<tr>
<th>Scope of Work</th>
<th>Bid/Contract Amount</th>
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<tr>
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<td>Alternate #6</td>
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</table>

The undersigned certifies that the information contained herein (i.e. Scope of Work and Bid/Contract Amount) is true and correct to the best of their knowledge, information and belief.

General Contractor: ______________________________ Diverse Firm: ______________________________

Signature: ______________________________ Signature: ______________________________

Name: ______________________________ Name: ______________________________

Title: ______________________________ Title: ______________________________

Date: ______________________________ Date: ______________________________

The undersigned certifies that the information contained herein (i.e. Scope of Work and Final Dollar Amount) is true and correct to the best of their knowledge, information and belief. If the Final Dollar Amount is different than the Bid/Contract Amount, then attach justification for the difference.

Contractor: ______________________________ Diverse Firm: ______________________________

Signature: ______________________________ Signature: ______________________________

Name: ______________________________ Name: ______________________________

Title: ______________________________ Title: ______________________________

Date: ______________________________ Date: ______________________________
1. **Contract Documents**
   1.1 Drawings, specifications, and other contract documents, pursuant to work which is to be done, may be obtained shown in the Advertisement for Bids and Special Conditions.

2. **Bidder Obligations**
   2.1 Before submitting bids each bidder shall carefully examine the drawings and specifications and related contract documents, visit site of work and fully inform themselves as to all existing conditions, facilities, restrictions and other matters which can affect the work or the cost thereof.

   2.2 Each bidder shall include in their bid the cost of all work and materials required to complete the contract in a first-class manner as hereinafter specified.

   2.3 Failure or omission of any bidder to receive or examine any form, instrument, addendum, or other document, or to visit the site and acquaint themselves with existing conditions, shall in no way relieve them from any obligation with respect to their bid or contract, and no extra compensation will be allowed by reason of any thing or matter concerning which bidder should have fully informed themselves prior to bidding.

   2.4 Submission of bids shall be deemed acceptance of the above obligations and each and every obligation required to be performed by all of the contract documents in the event the bid is accepted.

3. **Interpretation of Documents**
   3.1 If any prospective bidder is in doubt as to the true meaning of any part of the drawings and specifications or contract documents, they shall submit a written request to the Architect for an interpretation.

   3.2 Requests for such interpretations shall be delivered to the Architect at least one (1) week prior to time for receipt of bids.

3.3 Bids shall be based only on interpretations issued in the form of addenda mailed to each person who is on the Architect's record as having received a set of the contract documents.

4. **Bids**
   4.1 Bids shall be received separately or in combination as shown in and required by the Bid for Lump Sum contract. Bids will be completed so as to include insertion of amounts for alternate bids, unit prices and cost accounting data.

   4.2 Bidders shall apportion each base bid between various phases of the work, as stipulated in the Bid for Lump Sum contract. All work shall be done as defined in the specifications and as indicated on the drawings.

   4.3 Bids shall be presented in sealed envelopes which shall be plainly marked "Bids for (indicate name of project from cover sheet)", and mailed or delivered to the building and room number specified in the Advertisement for Bids. Bidders shall be responsible for actual delivery of bids during business hours, and it shall not be sufficient to show that a bid was mailed in time to be received before scheduled closing time for receipt of bids, nor shall it be sufficient to show that a bid was somewhere in a university facility.

   4.4 The bidder's price shall include all federal sales, excise, and similar taxes, which may be lawfully assessed in connection with their performance of work and purchase of materials to be incorporated in the work. City & State taxes shall not be included as defined within Article 3.16 of the General Conditions for Construction Contract included in the contract documents.

   4.5 Bids shall be submitted on a single bid form, furnished by the Owner or Architect. Do not remove the bid form from the specifications.

   4.6 No bidder shall stipulate in their bid any conditions not contained in the bid form.
4.7 The Owner reserves the right to waive informalities in bids and to reject any or all bids.

5. Modification and Withdrawal of Bids
5.1 The bidder may withdraw their bid at any time before the scheduled closing time for receipt of bids, but no bidder may withdraw their bid after the scheduled closing time for receipt of bids.

5.2 Only telegrams, letters and other written requests for modifications or correction of previously submitted bids, contained in a sealed envelope which is plainly marked "Modification of Bid on (name of project on cover sheet)," which are addressed in the same manner as bids, and are received by Owner before the scheduled closing time for receipt of bids will be accepted and bids corrected in accordance with such written requests.

6. Signing of Bids
6.1 Bids which are signed for a partnership shall be manually signed in the firm name by at least one partner, or in the firm name by Attorney-in-Fact. If signed by Attorney-in-Fact there should be attached to the bid, a Power of Attorney evidencing authority to sign the bid dated the same date as the bid and executed by all partners of the firm.

6.2 Bids that are signed for a corporation shall have the correct corporate name thereon and the signature of an authorized officer of the corporation manually written below corporate name. Title of office held by the person signing for the corporation shall appear below the signature of the officer.

6.3 Bids that are signed by an individual doing business under a firm name, shall be manually signed in the name of the individual doing business under the proper firm name and style.

6.4 Bids that are signed under joint venture shall be manually signed by officers of the firms having authority to sign for their firm.

7. Bid Security
7.1 Each bid shall be accompanied by a bid bond, certified check, or cashier's check, acceptable to and payable without condition to The Curators of the University of Missouri, in an amount at least equal to five percent (5%) of bidder's bid including additive alternates.

7.2 Bid security is required as a guarantee that bidder will enter into a written contract and furnish a performance bond within the time and in form as specified in these specifications; and if successful bidder fails to do so, the bid security will be realized upon or retained by the Owner. The apparent low bidder shall notify the Owner in writing within 48 hours (2 work days) of the bid opening of any circumstance that may affect the bid security including, but not limited to, a bidding error. This notification will not guarantee release of the bidder's security and/or the bidder from the Bidder's Obligations.

7.3 If a bid bond is given as a bid security, the amount of the bond may be stated as an amount equal to at least five percent (5%) of the bid, including additive alternates, described in the bid. The bid bond shall be executed by the bidder and a responsible surety licensed in the State of Missouri with a Best’s rating of no less than A-/XI.

7.4 It is specifically understood that the bid security is a guarantee and shall not be considered as liquidated damages for failure of bidder to execute and deliver their contract and performance bond, nor limit or fix bidder's liability to Owner for any damages sustained because of failure to execute and deliver the required contract and performance bond.

7.5 Bid security of the two (2) lowest and responsive Bidders will be retained by the Owner until a contract has been executed and an acceptable bond has been furnished, as required hereby, when such bid security will be returned. Surety bonds of all other bidders will be destroyed and all other alternative forms of bid bonds will be returned to them within ten (10) days after Owner has determined the two (2) lowest and responsive bids.

8. Bidder's Statement of Qualifications
8.1 Each bidder submitting a bid shall present evidence of their experience, qualifications, financial responsibility and ability to carry out the terms of the contract by completing and submitting with their bid the schedule of information set forth in the form furnished in the bid form.

8.2 Such information, a single copy required in a separate sealed envelope, will be treated as confidential information by the Owner, within the meaning of Missouri Statue 610.010.

8.3 Bids not accompanied with current Bidder's Statement of Qualifications may be rejected.

9. Award of Contract
9.1 The Owner reserves the right to let other contracts in connection with the work, including, but not by way of limitation, contracts for furnishing and installation of furniture, equipment, machines, appliances, and other apparatus.

9.2 In awarding the contract, the Owner may take into consideration the bidder's, and their subcontractor’s, ability to handle promptly the additional work, skill, facilities, capacity, experience, ability, responsibility, previous work, financial standing of bidder, and the bidder’s ability to provide the required bonds and insurance; quality, efficiency and construction of equipment proposed to be furnished; period of time within which equipment is proposed to be furnished; success in achieving the specified Supplier Diversity goal, or demonstrating a good faith effort as described in Article 15; necessity of prompt and efficient completion of work herein described, and the bidder’s status as suspended or debarred. Inability of any bidder to meet the requirements mentioned above may be cause for rejection of their bid.

10. Contract Execution
10.1 The Contractor shall submit within fifteen (15) days from receipt of notice, the documents required in Article 9 of the General Conditions for Construction Contract included in the contract documents.
10.2 No bids will be considered binding upon the Owner until the documents listed above have been furnished. Failure of Contractor to execute and submit these documents within the time period specified will be treated, at the option of the Owner, as a breach of the bidder's bid security under Article 7 and the Owner shall be under no further obligation to Bidder.

11. Contract Security

11.1 When the Contract sum exceeds $50,000, the Contractor shall procure and furnish a Performance bond and a Payment bond in the form prepared by Owner. Each bond shall be in the amount equal to one hundred percent (100%) of the contract sum, as well as adjustments to the Contract Sum. The Performance Bond shall secure and guarantee Contractor’s faithful performance of this Contract, including but not limited to Contractor’s obligation to correct defects after final payment has been made as required by the Contract Documents. The Payment Bond shall secure and guarantee payment of all persons performing labor on the Project under this Contract and furnishing materials in connection with this Contract. These Bonds shall be in effect through the duration of the Contract plus the Guaranty Period as required by the Contract Documents.

11.2 The bonds required hereunder shall be meet all requirements of Article 11 of the General Conditions for Construction Contract included in the contract documents.

11.3 If the surety of any bond furnished by Contractor is declared bankrupt or becomes insolvent or its right to conduct business in the State of Missouri is terminated, or it ceases to meet the requirements of this Article 11, Contractor shall within ten (10) days substitute another bond and surety, both of which must be acceptable to Owner. If Contractor fails to make such substitution, Owner may procure such required bonds on behalf of Contractor at Contractor’s expense.

12. Time of Completion

12.1 Contractors shall agree to commence work within five (5) days of the date "Notice to Proceed" is received from the Owner, and the entire work shall be completed by the completion date specified or within the number of consecutive calendar days stated in the Special Conditions. The duration of the construction period, when specified in consecutive calendar days, shall begin when the contractor receives notice requesting the documents required in Article 9 of the General Conditions for Construction Contract included in the contract documents.

13. Number of Contract Documents

13.1 The Owner will furnish the Contractor a copy of the executed contract and performance bond.

13.2 The Owner will furnish the Contractor the number of copies of complete sets of drawings and specifications for the work, as well as, clarification and change order drawings pertaining to change orders required during construction as set forth in the Special Conditions.

14. Missouri Products and Missouri Firms

14.1 The Curators of the University of Missouri have adopted a policy which is binding upon all employees and departments of the University of Missouri, and which by contract, shall be binding upon independent contractors and subcontractors with the University of Missouri whereby all other things being equal, and when the same can be secured without additional cost over foreign products, or products of other states, a preference shall be granted in all construction, repair and purchase contracts, to all products, commodities, materials, supplies and articles mined, grown, produced and manufactured in marketable quantity and quality in the State of Missouri, and to all firms, corporations or individuals doing business as Missouri firms, corporations or individuals. Each bidder submitting a bid agrees to comply with, and be bound by the foregoing policy.

15. Supplier Diversity

15.1 Award of Contract

The Supplier Diversity participation goal for this project is stated on the Bid for Lump Sum Contract Form, and the Owner will take into consideration the bidder's success in achieving the Supplier Diversity participation goal in awarding the contract. Inability of any bidder to meet this requirement may be cause for rejection of their bid.

The University will grant a three (3) point bonus preference to a Missouri based, certified Service Disabled Veteran Enterprise (SDVE) bidder as defined in Article 1 – (Supplier Diversity Definitions) of the General Conditions of the Contract for Construction included in the contract documents. The three percent (3%) goal can be met, and the bonus points obtained, by a qualified SDVE vendor and/or through the use of qualified subcontractors or suppliers that provide at least three percent (3%) of the total contract value.

15.2 List of Supplier Diversity Firms

15.2.1 The bidder shall submit as part of their bid a list of diverse firms performing as contractor, subcontractors, and/or suppliers. The list shall specify the single designated diverse firm name and address. If acceptance or non-acceptance of alternates will affect the designation of a subcontractor, provide information for each affected category.

15.2.2 Failure to include a complete list of diverse firms may be grounds for rejection of the bid.

15.2.3 The list of diverse firms shall be submitted in addition to any other listing of subcontractors required in the Bid for Lump Sum Contract Form.

15.3 Supplier Diversity Percentage Goal

The bidder shall have a minimum goal of subcontracting with diverse contractors, subcontractors, and suppliers, the percent of contract price stated in the Supplier Diversity goal paragraph of the Bid for Lump Sum Contract Form.

15.4 Supplier Diversity Percent Goal Computation

15.4.1 The total dollar value of the work granted to the diverse firms by the successful bidder is counted towards the applicable goal of the entire contract, unless otherwise noted below.

15.4.2 The bidder may count toward the Supplier Diversity goal only expenditures to diverse firms that perform a commercially useful function in the work of a contract. A diverse firm is considered to perform a commercially useful function when it is responsible for executing a distinct element of the work and carrying out its responsibilities by
actually performing, managing and supervising the work involved. A bidder that is a certified diverse firm may count as 100% of the contract towards the Supplier Diversity goal. For projects with separate MBE, SDVE, and WBE/Veteran /DBE goals, a MBE firm bidding as the prime bidder is expected to obtain the required SDVE, and WBE/Veteran/ DBE participation; a WBE or Veteran or DBE firm bidding as the prime bidder is expected to obtain the required MBE and SDVE participation and a SDVE firm bidding as the prime bidder is expected to obtain the required MBE, and WBE/Veteran/ DBE participation.

15.4.3 When a MBE, WBE, Veteran Business Enterprise, DBE, or SDVE performs work as a participant in a joint venture, only the portion of the total dollar value of the contract equal to the distinct, clearly defined portion of the work of the contract that the MBE, WBE, Veteran Business Enterprise, DBE, or SDVE performs with its own forces shall count toward the MBE, WBE, Veteran Business Enterprise, DBE, or SDVE individual contract percentages.

15.4.4 The bidder may count toward its Supplier Diversity goal expenditures for materials and supplies obtained from diverse suppliers and manufacturers, provided the diverse firm assumes the actual and contractual responsibility for the provision of the materials and supplies.

15.4.4.1 The bidder may count its entire expenditure to a diverse manufacturer. A manufacturer shall be defined as an individual or firm that produces goods from raw materials or substantially alters them before resale.

15.4.4.2 The bidder may count its entire expenditure to diverse suppliers that are not manufacturers provided the diverse supplier performs a commercially useful function as defined above in the supply process.

15.4.4.3 The bidder may count 25% of its entire expenditures to diverse firms that do not meet the definition of a subcontractor, a manufacturer, nor a supplier. Such diverse firms may arrange for, expedite, or procure portions of the work but are not actively engaged in the business of performing, manufacturing, or supplying that work.

15.4.5 The bidder may count toward the Supplier Diversity goal that portion of the total dollar value of the work awarded to a certified joint venture equal to the percentage of the ownership and control of the diverse partner in the joint venture.

15.4.6 On projects with separate MBE and WBE/Veteran/DBE goals, the Owner may allow MBE participation provided in excess of the MBE goal to be counted towards the WBE/Veteran/DBE goal.

15.5 Certification by Bidder of Diverse Firms

15.5.1 The bidder shall submit with its bid the information requested in the "Supplier Diversity Compliance Evaluation Form" for every diverse firm the bidder intends to award work to on the contract.

15.5.2 Diverse firms are defined in Article 1 – (Supplier Diversity Definitions) of the General Conditions of the Contract for Construction included in the contract documents, and as those businesses certified as disadvantaged by an approved agency. The bidder is responsible for obtaining information regarding the certification status of a firm. A list of certified firms may be obtained by contacting the agencies listed in the proposal form document “Supplier Diversity Certifying Agencies”. Any firm listed as disadvantaged by any of the identified agencies will be classified as a diverse firm by the Owner.

15.5.3 Bidders are urged to encourage their prospective diverse contractors, subcontractors, joint venture participants, team partners, and suppliers who are not currently certified to obtain certification from one of the approved agencies.

15.6 Supplier Diversity Participation Waiver

15.6.1 The bidder is required to make a good faith effort to locate and contract with diverse firms. If a bidder has made a good faith effort to secure the required diverse firms and has failed, the bidder shall submit with the bid, the information requested in "Application for Supplier Diversity Participation Waiver." The Contracting Officer will review the bidder's actions as set forth in the bidder's "Application for Waiver" and any other factors deemed relevant by the Contracting Officer to determine if a good faith effort has been made to meet the applicable percentage goal. If the bidder is judged not to have made a good faith effort, the bid may be rejected. Bidder's who demonstrate that they have made a good faith effort to include Supplier Diversity participation may be awarded the contract regardless of the percent of Supplier Diversity participation, provided the bid is otherwise acceptable and is determined to be the best bid.

15.6.2 To determine good faith effort of the bidder, the Contracting Officer may evaluate factors including, but not limited to, the following:

15.6.2.1 The bidder’s attendance at pre-proposal meetings scheduled to inform bidders and diverse firms of contracting and subcontracting opportunities and responsibilities associated with Supplier Diversity participation.

15.6.2.2 The bidder’s advertisements in general circulation trade association, and diverse (minority) focused media concerning subcontracting opportunities.

15.6.2.3 The bidder’s written notice to specific diverse firms that their services were being solicited in sufficient time to allow for their effective participation.

15.6.2.4 The bidder’s follow-up attempts to the initial solicitation(s) to determine with certainty whether diverse firms were interested.

15.6.2.5 The bidder’s efforts to divide the work into packages suitable for subcontracting to diverse firms.

15.6.2.6 The bidder’s efforts to provide interested diverse firms with sufficiently detailed information about the drawings, specific actions and requirements of the contract, and clear scopes of work for the firms to bid on.
15.6.2.7 The bidder’s efforts to solicit for specific sub-bids from diverse firms in good faith. Documentation should include names, addresses, and telephone numbers of firms contacted a description of all information provided the diverse firms, and an explanation as to why agreements were not reached.

15.6.2.8 The bidder's efforts to locate diverse firms not on the directory list and assist diverse firms in becoming certified as such.

15.6.2.9 The bidder's initiatives to encourage and develop participation by diverse firms.

15.6.2.10 The bidder’s efforts to help diverse firms overcome legal or other barriers impeding the participation of diverse firms in the construction contract.

15.6.2.11 The availability of diverse firms and the adequacy of the bidder's efforts to increase the participation of such business provided by the persons and organizations consulted by the bidder.

15.7 Submittal of Forms
15.7.1 The bidder will include the Supplier Diversity Compliance Evaluation Form(s), or the Application for Waiver and other form(s) as required above in the envelope containing the "Bidder's Statement of Qualifications", see Article 8.

15.8 Additional Bid/Proposer Information
15.8.1 The Contracting Officer reserves the right to request additional information regarding Supplier Diversity participation and supporting documentation from the apparent low bidder. The bidder shall respond in writing to the Contracting Officer within 24 hours (1 work day) of a request.

15.8.2 The Contracting Officer reserves the right to request additional information after the bidder has responded to prior 24 hour requests. This information may include follow up and/or clarification of the information previously submitted.

15.8.3 The Owner reserves the right to consider additional diverse subcontractor and supplier participation submitted by the bidder after bids are opened under the provisions within these contract documents that describe the Owner’s right to accept or reject subcontractors including, but not limited to, Article 16 below. The Owner may elect to waive the good faith effort requirement if such additional participation achieves the Supplier Diversity goal.

15.8.4 The Bidder shall provide the Owner information related to the Supplier Diversity participation included in the bidder’s proposal, including, but is not limited to, the complete Application for Waiver, evidence of diverse certification of participating firms, dollar amount of participation of diverse firms, information supporting a good faith effort as described in Article 15.6 above, and a list of all diverse firms that submitted bids to the Bidder with the diverse firm’s price and the name and the price of the firm awarded the scope of work bid by the diverse firm.

16. List of Subcontractors
16.1 If a list of subcontractors is required on the Bid for Lump Sum Contract Form, the bidders shall list the name, city and state of the firm(s) which will accomplish that portion of the contract requested in the space provided. This list is separate from both the list of diverse firms required in Article 15.2, and the complete list of subcontractors required in Article 10.1 of this document. Should the bidder choose to perform any of the listed portions of the work with its own forces, the bidder shall enter its own name, city and state in the space provided. If acceptance or non-acceptance of alternates will affect the designation of a subcontractor, the bidder shall provide that information on the bid form.

16.2 Failure of the bidder to supply the list of subcontractors required or the listing of more than one subcontractor for any category without designating the portion of the work to be performed by each, shall be grounds for the rejection of the bid. The bidder can petition the Owner to change a listed subcontractor within 48 hours of the bid opening. The Owner reserves the right to make the final determination on a petition to change a subcontractor. The Owner will consider factors such as clerical and mathematical bidding errors, listed subcontractor’s inability to perform the work for the bid used, etc. Any request to change a listed subcontractor shall include at a minimum, contractor’s bid sheet showing tabulation of the bid; all subcontractor bids with documentation of the time they were received by the contractor; and a letter from the listed subcontractor on their letterhead stating why they cannot perform the work if applicable. The Owner reserves the right to ask for additional information.

16.3 Upon award of the contract, the requirements of Article 10 of this document and Article 5 of the General Conditions of the Contract for Construction included in the contract documents will apply.
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ARTICLE 1
GENERAL PROVISIONS

1.1 Basic Definitions
As used in the Contract Documents, the following terms shall have the meanings and refer to the parties designated in these definitions.

1.1.1 Owner
The Curators of the University of Missouri. The Owner may act through its Board of Curators or any duly authorized committee or representative thereof.

1.1.2 Contracting Officer
The Contracting Officer is the duly authorized representative of the Owner with the authority to execute contracts. Communications to the Contracting Officer shall be forwarded via the Owner's Representative.

1.1.3 Owner's Representative
The Owner’s Representative is authorized by the Owner as the administrator of the Contract and will represent the Owner during the progress of the Work. Communications from the Architect to the Contractor and from the Contractor to the Architect shall be through the Owner's Representative, unless otherwise indicated in the Contract Documents.

1.1.4 Architect
When the term "Architect" is used herein, it shall refer to the Architect or the Engineer specified and defined in the Contract for Construction or its duly authorized representative. Communications to the Architect shall be forwarded to the address shown in the Contract for Construction.

1.1.5 Contractor
The Contractor is the person or entity with whom the Owner has entered into the Contract for Construction. The term “Contractor” means the Contractor or the Contractor’s authorized representative.

1.1.6 Subcontractor and Lower-tier Subcontractor
A Subcontractor is a person or organization who has a contract with the Contractor to perform any of the Work. The term "Subcontractor" is referred to throughout the Contract Documents as if singular in number and means a Subcontractor or its authorized representative. The term "Subcontractor" also is applicable to those furnishing materials to be incorporated in the Work whether work performed is at the Owner’s site or off site, or both. A lower-tier Subcontractor is a person or organization who has a contract with a Subcontractor or another lower-tier Subcontractor to perform any of the Work at the site. Nothing contained in the Contract Documents shall create contractual relationships between the Owner or the Architect and any Subcontractor or lower-tier Subcontractor of any tier.

1.1.7 Supplier Diversity Definitions
Businesses that fall into the Supplier Diversity classification shall mean an approved certified business concern which is at least fifty-one percent (51%) owned and controlled by one (1) or more diverse suppliers as described below.

1. Minority Business Enterprises (MBE)
Minority Business Enterprise [MBE] shall mean an approved certified business concern which is at least fifty-one percent (51%) owned and controlled by one (1) or more minorities as defined below or, in the case of any publicly-owned business, in which at least fifty-one percent (51%) of the stock of which is owned by one (1) or more minorities as defined below, and whose management and daily business operations are controlled by one (1) or more minorities as defined herein.

1.1 "African Americans", which includes persons having origins in any of the black racial groups of Africa.

1.2 "Hispanic Americans", which includes persons of Mexican, Puerto Rican, Cuban, Central or South American, or other Spanish culture or origin, regardless of race.

1.3 "Native Americans", which includes persons of American Indian, Eskimo, Aleut, or Native Hawaiian origin.

1.4 "Asian-Pacific Americans", which includes persons whose origins are from Japan, China, Taiwan, Korea, Vietnam, Laos, Cambodia, the Philippines, Samoa, Guam, the U.S. Trust Territories of the Pacific, or the Northern Marinas.

1.5 "Asian-Indian Americans", which includes persons whose origins are from India, Pakistan, or Bangladesh.

2 Women Business Enterprise (WBE)
Women Business Enterprise [WBE] shall mean an approved certified business concern which is at least fifty-one percent (51%) owned and controlled by one (1) or more women or, in the case of any publicly-owned business, in which at least fifty-one percent (51%) of the stock of which is owned by one (1) or more women, and whose management and daily business operations are controlled by one (1) or more women.

3 Veteran Owned Business
Veteran Owned Business shall mean an approved certified business concern which is at least fifty-one percent (51%) owned and controlled by one (1) or more Veterans or, in the case of any publicly-owned business, in which at least fifty-one percent (51%) of the stock of which is owned by one (1) or more Veterans, and whose management and daily business operations are controlled by one (1) or more Veterans. Veterans must be certified by the appropriate federal agency responsible for veterans’ affairs.

4 Service Disabled Veteran Enterprise (SDVE)
Service Disabled Veteran Enterprise (SDVE) shall mean a business certified by the State of Missouri Office of Administration as a Service Disabled Veteran Enterprise, which is at least fifty-one percent (51%) owned and controlled by one (1) or more Serviced Disabled Veterans or,
in the case of any publicly-owned business, in which at least fifty-one percent (51%) of the stock of which is owned by one (1) or more Service Disabled Veterans, and whose management and daily business operations are controlled by one (1) or more Service Disabled Veterans.

.5 Disadvantaged Business Enterprise (DBE)
A Disadvantaged Business Enterprise (DBE) is a for-profit small business concern where a socially and economically disadvantaged individual owns at least 51% interest and also controls management and daily business operations. These firms can and also be referred to as Small Disadvantaged Businesses (SDB). Eligibility requirements for certification are stated in 49 CFR (Code of Federal Regulations), part 26, Subpart D.

U.S. citizens that are African-Americans, Hispanics, Native Americans, Asian-Pacific and Subcontinent Asian Americans, and women are presumed to be socially and economically disadvantaged. Also recognized as DBE’s are Historically Black Colleges and Universities (HBCU) and small businesses located in Federal HUB Zones.

To be regarded as economically disadvantaged, an individual must have a personal net worth that does not exceed $1.32 million. To be seen as a small business, a firm must meet Small Business Administration (SBA) size criteria (500 employees or less) and have average annual gross receipts not to exceed $22.41 million. To be considered a DBE/SDB, a small business owned and controlled by socially and/or economically disadvantaged individuals must receive DBE certification from one of the recognized Missouri state agencies to be recognized in this classification.

1.1.9 Work
Work shall mean supervision, labor, equipment, tools, material, supplies, incidentals operations and activities required by the Contract Documents or reasonably inferable by Contractor therefrom as necessary to produce the results intended by the Contract Documents in a safe, expeditious, orderly, and workmanlike manner, and in the best manner known to each respective trade.

1.1.10 Approved
The terms "approved", "equal to", "directed", "required", "ordered", "designated", "acceptable", "satisfactory", and similar words or phrases will be understood to have reference to action on the part of the Architect and/or the Owner's Representative.

1.1.11 Contract Documents
The Contract Documents consist of (1) the executed Contract for Construction, (2) these General Conditions of the Contract for Construction, (3) any Supplemental Conditions or Special Conditions identified in the Contract for Construction, (4) the Specifications identified in the Contract for Construction, (5) the Drawings identified in the Contract for Construction, (6) Addenda issued prior to the receipt of bids, (7) Contractor’s bid addressed to Owner, including Contractor’s completed Qualification Statement, (8) Contractor’s Performance Bond and Contractor’s Payment Bond, (9) Notice to Proceed, (10) and any other exhibits and/or post bid adjustments identified in the Contract for Construction, (11) Advertisement for Bid, (12) Information for Bidders, and (13) Change Orders issued after execution of the Contract. All other documents and technical reports and information are not Contract Documents, including without limitation, Shop Drawings, and Submittals.

1.1.12 Contract
The Contract Documents form the Contract and are the exclusive statement of agreement between the parties. The Contract represents the entire and integrated agreement between the parties hereto and supersedes prior representations or agreements, either written or oral. The Contract Documents shall not be construed to create a contractual relationship of any kind between the Owner and a Subcontractor or any lower-tier Subcontractor.

1.1.13 Change Order
The Contract may be amended or modified without invalidating the Contract, only by a Change Order, subject to the limitations in Article 7 and elsewhere in the Contract Documents. A Change Order is a written instrument signed by the Owner and the Contractor stating their agreement to a change in the Work, the amount of the adjustment to the Contract Sum, if any, and the extent of the adjustment to the Contract Time, if any. Agreement to any Change Order shall constitute a final settlement of all matters relating to the change in the work which is the subject of the Change Order, including, but not limited to, all direct and indirect costs associated with such change and any and all adjustments of the Contract sum, time and schedule.

1.1.14 Substantial Completion
The terms “Substantial Completion” or "substantially complete" as used herein shall be construed to mean the completion of the entire Work, including all submittals required under the Contract Documents, except minor items which in the opinion of the Architect, and/or the Owner's Representative will not interfere with the complete and satisfactory use of the facilities for the purposes intended.

1.1.15 Final Completion
The date when all punch list items are completed, including all closeout submittals and approval by the Architect is given to the Owner in writing.

1.1.16 Supplemental and Special Conditions
1.1.17 Day
The term "day" as used in the Contract Documents shall mean calendar day unless otherwise specifically defined.

1.1.18 Knowledge.
The terms “knowledge,” “recognize” and “discover,” their respective derivatives and similar terms in the Contract Documents, as used in reference to the Contractor, shall be interpreted to mean that which the Contractor knows or should know, recognizes or should recognize and discovers or should discover in exercising the care, skill, and diligence of a diligent and prudent contractor familiar with the work. Analogously, the expression “reasonably inferable” and similar terms in the Contract Documents shall be interpreted to mean reasonably inferable by a diligent and prudent contractor familiar with the work.

1.1.19 Punch List
“Punch List” means the list of items, prepared in connection with the inspection of the Project by the Owner’s Representative or Architect in connection with Substantial Completion of the Work or a portion of the Work, which the Owner’s Representative or Architect has designated as remaining to be performed, completed or corrected before the Work will be accepted by the Owner.

1.1.20 Public Works Contracting Minimum Wage
The public works contracting minimum wage shall be equal to one hundred twenty percent of the average hourly wage in a particular locality, as determined by the Missouri economic research and information center within the department of economic development, or any successor agency.

1.2 Specifications and Drawings
1.2.1 The Specifications are that portion of the Contract Documents consisting of the written requirements for materials, equipment, construction system, standards and workmanship and performance of related services for the Work identified in the Contract for Construction. Specifications are separated into titled divisions for convenience of reference only. Organization of the Specifications into divisions, sections and articles, and arrangement of Drawings shall not control the Contractor in dividing the Work among Subcontractors or in establishing the extent of Work to be performed by any trade. Such separation will not operate to make the Owner or the Architect an arbiter of labor disputes or work agreements.

1.2.2 The drawings herein referred to, consist of drawings prepared by the Architect and are enumerated in the Contract Documents.

1.2.3 Drawings are intended to show general arrangements, design, and dimensions of work and are partly diagrammatic. Dimensions shall not be determined by scale or rule. If figured dimensions are lacking, they shall be supplied by the Architect on the Contractor’s written request to the Owner's Representative.

1.2.4 The intent of the Contract Documents is to include all items necessary for the proper execution and completion of the Work by the Contractor. The Contract Documents are complimentary, and what is required by one shall be as binding as if required by all; performance by the Contractor shall be required only to the extent consistent with the Contract Documents and reasonably inferable from them as being necessary to produce the intended results.

1.2.5 In the event of inconsistencies within or between parts of the Contract Documents, or between the Contract Documents and applicable standards, codes and ordinances, the Contractor shall (1) provide the better quality or greater quantity of Work or (2) comply with the more stringent requirement; either or both in accordance with the Owner’s Representative’s interpretation. On the Drawings, given dimensions shall take precedence over scaled measurements and large scale drawings over small scale drawings. Before ordering any materials or doing any Work, the Contractor and each Subcontractor shall verify measurements at the Work site and shall be responsible for the correctness of such measurements. Any difference which may be found shall be submitted to the Owner’s Representative and Architect for resolution before proceeding with the Work. If a minor change in the Work is found necessary due to actual field conditions, the Contractor shall submit detailed drawings of such departure for the approval by the Owner’s Representative and Architect before making the change.

1.2.6 Data in the Contract Documents concerning lot size, ground elevations, present obstructions on or near the site, locations and depths of sewers, conduits, pipes, wires, etc., position of sidewalks, curbs, pavements, etc., and nature of ground and subsurface conditions have been obtained from sources the Architect believes reliable, but the Architect and Owner do not represent or warrant that this information is accurate or complete. The Contractor shall verify such data to the extent possible through normal construction procedures, including but not limited to contacting utility owners and by prospecting.

1.2.7 Only work included in the Contract Documents is authorized, and the Contractor shall do no work other than that described therein.
1.2.8 Execution of the Contract by the Contractor is a representation that the Contractor has visited the site, become familiar with local conditions under which the Work is to be performed and correlated personal observations with requirements of the Contract Documents. Contractor represents that it has performed its own investigation and examination of the Work site and its surroundings and satisfied itself before entering into this Contract as to:

.1 conditions bearing upon transportation, disposal, handling, and storage of materials;
.2 the availability of labor, materials, equipment, water, electrical power, utilities and roads;
.3 uncertainties of weather, river stages, flooding and similar characteristics of the site;
.4 conditions bearing upon security and protection of material, equipment, and Work in progress;
.5 the form and nature of the Work site, including the surface and sub-surface conditions;
.6 the extent and nature of Work and materials necessary for the execution of the Work and the remedying of any defects therein; and
.7 the means of access to the site and the accommodations it may require and, in general, shall be deemed to have obtained all information as to risks, contingencies and other circumstances.
.8 the ability to complete work without disruption to normal campus activities, except as specifically allowed in the contract documents.

The Owner assumes no responsibility or liability for the physical condition or safety of the Work site or any improvements located on the Work site. The Contractor shall be solely responsible for providing a safe place for the performance of the Work. The Owner shall not be required to make any adjustment in either the Contract Sum or Contract Time concerning any failure by the Contractor or any Subcontractor to comply with the requirements of this Paragraph.

1.2.9 Drawings, specifications, and copies thereof furnished by the Owner are and shall remain the Owner’s property. They are not to be used on another project and, with the exception of one contract set for each party to the Contract, shall be returned to the Owner's Representative on request, at the completion of the Work.

1.3 Required Provisions Deemed Inserted
Each and every provision of law and clause required by law to be inserted in this Contract shall be deemed to be inserted herein, and the Contract shall be read and enforced as though it were included herein; and if through mistake or otherwise any such provision is not inserted, or is not correctly inserted, then upon the written application of either party the Contract shall forthwith be physically amended to make such insertion or correction.

ARTICLE 2
OWNER

2.1 Information and Services Required of the Owner
2.1.1 Permits and fees are the responsibility of the Contractor under the Contract Documents, unless specifically stated in the contract documents that the Owner will secure and pay for specific necessary approvals, easements, assessments, and charges required for construction, use or occupancy of permanent structures, or for permanent changes in existing facilities.

2.1.2 When requested in writing by the Contractor, information or services under the Owner's control, which are reasonably necessary to perform the Work, will be furnished by the Owner with reasonable promptness to avoid delay in the orderly progress of the Work.

2.2 Owner's Right to Stop the Work
2.2.1 If the Contractor fails to correct Work which is not in strict accordance with the requirements of the Contract Documents or fails to carry out Work in strict accordance with the Contract Documents, the Owner's Representative may order the Contractor to stop the Work, or any portion thereof, until the cause for such order has been eliminated; however, the right of the Owner to stop the Work will not give rise to a duty on the part of the Owner to exercise this right for the benefit of the Contractor or any other person or entity. Owner’s lifting of Stop Work Order shall not prejudice Owner’s right to enforce any provision of this Contract.

2.3 Owner's Right to Carry Out the Work
2.3.1 If the Contractor defaults or neglects to carry out the Work in accordance with the Contract Documents, and fails within a seven (7) day period after receipt of a written notice from the Owner to correct such default or neglect, the Owner may, without prejudice to other remedies the Owner may have, correct such default or neglect. In such case, an appropriate Change Order shall be issued deducting from payments then or thereafter due the Contractor the cost of correcting such deficiencies, including compensation for the Architect’s additional services and expenses made necessary by such default or neglect. If payments then or thereafter due the Contractor are not sufficient to cover such amounts, the Contractor shall pay the difference to Owner. However, such notice shall be waived in the event of an emergency with the potential for property damage or the endangerment of students, faculty, staff, the public or construction personnel, at the sole discretion of the Owner.

2.3.2 In the event the Contractor has not satisfactorily completed all items on the Punch List within thirty (30) days of its receipt, the Owner reserves the right to complete the Punch List without further notice to the Contractor or its
ARTICLE 3
CONTRACTOR

3.1 Contractor's Warranty
3.1.1 The Contractor warrants all equipment and materials furnished, and work performed, under this Contract, against defective materials and workmanship for a period of twelve months after acceptance as provided in this Contract, unless a longer period is specified, regardless of whether the same were furnished or performed by the Contractor or any Subcontractors of any tier. Upon written notice from the Owner of any breach of warranty during the applicable warranty period due to defective material or workmanship, the affected part or parts thereof shall be repaired or replaced by the Contractor at no cost to the Owner. Should the Contractor fail or refuse to make the necessary repairs, replacements, and tests when requested by the Owner, the Owner may perform, or cause the necessary work and tests to be performed, at the Contractor's expense, or exercise the Owner's rights under Article 14.

3.1.2 Should one or more defects mentioned above appear within the specified period, the Owner shall have the right to continue to use or operate the defective part or apparatus until the Contractor makes repairs or replacements or until such time as it can be taken out of service without loss or inconvenience to the Owner.

3.1.3 The above warranties are not intended as a limitation, but are in addition to all other express warranties set forth in this Contract and such other warranties as are implied by law, custom, and usage of trade. The Contractor, and its surety or sureties, if any, shall be liable for the satisfaction and full performance of the warranties set forth herein.

3.1.4 Neither the final payment nor any provision in the Contract Documents nor partial or entire occupancy of the premises by the Owner, nor expiration of warranty stated herein, will constitute an acceptance of Work not done in accordance with the Contract Documents or relieve the Contractor of liability in respect to any responsibility for non-conforming work. The Contractor shall immediately remedy any defects in the Work and pay for any damage to other Work resulting therefrom upon written notice from the Owner. Should the Contractor fail or refuse to remedy the non-conforming work, the Owner may perform, or cause to be performed the work necessary to bring the work into conformance with the Contract Documents at the Contractor's expense.

3.1.5 The Contractor agrees to defend, indemnify, and save harmless The Curators of the University of Missouri, their Officers, Agents, Employees and Volunteers, from and against all loss or expense from any injury or damages to property of others suffered or incurred on account of any breech of the aforesaid obligations and covenants. The Contractor agrees to investigate, handle, respond to and provide defense for and defend against any such liability, claims, and demands at the sole expense of the Contractor, or at the option of the University, agrees to pay to or reimburse the University for the defense costs incurred by the University in connection with any such liability claims, or demands. The parties hereto understand and agree that the University is relying on, and does not waive or intend to waive by any provision of this Contract, any monetary limitations or any other rights, immunities, and protections provided by the State of Missouri, as from time to time amended, or otherwise available to the University, or its officers, employees, agents or volunteers.

3.2 Compliance with Laws, Permits, Regulations and Inspections
3.2.1 The Contractor shall, without additional expense to the Owner, comply with all applicable laws, ordinances, rules, statutes, and regulations (collectively referred to as “Laws”).

3.2.2 Since the Owner is an instrumentality of the State of Missouri, municipal, or political subdivision, ordinances, zoning ordinances, and other like ordinances are not applicable to construction on the Owner's property, and the Contractor will not be required to submit plans and specifications to any municipal or political subdivision authority to obtain construction permits or any other licenses or permits from or submit to, inspection by any municipality or political subdivision relating to the construction on the Owner's property, unless required by the Owner in these Contract Documents or otherwise in writing.
3.2.3 All fees, permits, inspections, or licenses required by municipality or political subdivision for operation on property not belonging to the Owner, shall be obtained by and paid for by the Contractor. The Contractor, of its own expense, is responsible to ensure that all inspections required by said permits or licenses on property, easements, or utilities not belonging to the Owner are conducted as required therein. All connection charges, assessments or transportation fees as may be imposed by any utility company or others are included in the Contract Sum and shall be the Contractor’s responsibility, as stated in 2.1.1 above.

3.2.4 If the Contractor has knowledge that any Contract Documents are at variance with any Laws, including Americans with Disabilities Act – Standards for Accessible Design, ordinances, rules, regulations or codes applying to the Work, Contractor shall promptly notify the Architect and the Owner’s Representative, in writing, and any necessary changes will be adjusted as provided in Contract Documents. However, it is not the Contractor’s primary responsibility to ascertain that the Contract Documents are in accordance with applicable Laws, unless such Laws bear upon performance of the Work.

3.3 Anti-Kickback
3.3.1 No member or delegate to Congress, or resident commissioner, shall be admitted to any share or part of this Contract or to any benefit that may arise therefrom, but this provision shall not be construed to extend to this Contract if made with a corporation for its general benefit.

3.3.2 No official of the Owner who is authorized in such capacity and on behalf of the Owner to negotiate, make, accept or approve, or to take part in negotiating, making, accepting, or approving any architectural, engineering, inspection, construction, or material supply contract or any Subcontract of any tier in connection with the construction of the Work shall have a financial interest in this Contract or in any part thereof, any material supply contract, Subcontract of any tier, insurance contract, or any other contract pertaining to the Work.

3.4 Supervision and Construction Procedures
3.4.1 The Contractor shall supervise and direct the Work, using the Contractor’s best skill and attention. The Contractor shall be solely responsible for and have control over construction means, methods, techniques, sequences, and procedures and for coordinating all portions of the Work under the Contract. The Contractor shall supply sufficient and competent supervision and personnel, and sufficient material, plant, and equipment to prosecute the Work with diligence to ensure completion thereof within the time specified in the Contract Documents, and shall pay when due any laborer, Subcontractor of any tier, or supplier.

3.4.2 The Contractor, if an individual, shall give the Work an adequate amount of personal supervision, and if a partnership or corporation or joint venture the Work shall be given an adequate amount of personal supervision by a partner or executive officer, as determined by the Owner's Representative.

3.4.3 The Contractor and each of its Subcontractors of any tier shall submit to the Owner such schedules of quantities and costs, progress schedules in accordance with 3.17.2 of this document, payrolls, reports, estimates, records, and other data as the Owner may request concerning Work performed or to be performed under the Contract.

3.4.4 The Contractor shall be represented at the site by a competent superintendent from the beginning of the Work until its final acceptance, whenever contract work is being performed, unless otherwise permitted in writing by the Owner's Representative. The superintendent for the Contractor shall exercise general supervision over the Work and such superintendent shall have decision making authority of the Contractor. Communications given to the superintendent shall be binding as if given to the Contractor. The superintendent shall not be changed by the contractor without approval from the Owner’s Representative.

3.4.5 The Contractor shall establish and maintain a permanent bench mark to which access may be had during progress of the Work, and Contractor shall establish all lines and levels, and shall be responsible for the correctness of such. Contractor shall be fully responsible for all layout work for the proper location of Work in strict accordance with the Contract Documents.

3.4.6 The Contractor shall establish and be responsible for wall and partition locations. If applicable, separate contractors shall be entitled to rely upon these locations and for setting their sleeves, openings, or chases.

3.4.7 The Contractor’s scheduled outage/tie-in plan, time, and date for any utilities is subject to approval by the Owner’s Representative. Communication with the appropriate entity and planning for any scheduled outage/tie-in of utilities shall be the responsibility of the Contractor. Failure of Contractor to comply with the provisions of this Paragraph shall cause Contractor to forfeit any right to an adjustment of the Contract Sum or Contract Time for any postponement, rescheduling or other delays ordered by Owner in connection with such Work. The Contractor shall follow the following procedures for all utility outages/tie-ins or disruption of any building system:

.1 All shutting of valves, switches, etc., shall be by the Owner's personnel.
3.4.8 The Contractor shall coordinate all Work so there shall be no prolonged interruption of existing utilities, systems and equipment of Owner. Any existing plumbing, heating, ventilating, air conditioning, or electrical disconnection necessary, which affect portions of this construction or building or any other building, must be scheduled with the Owner's Representative to avoid any disruption of operation within the building under construction or other buildings or utilities. In no case shall utilities be left disconnected at the end of a work day or over a weekend. Any interruption of utilities, either intentionally or accidentally, shall not relieve the Contractor from repairing and restoring the utility to normal service. Repairs and restoration shall be made before the workers responsible for the repair and restoration leave the job.

3.4.9 The Contractor shall be responsible for repair of damage to property on or off the project occurring during construction of project, and all such repairs shall be made to meet code requirements or to the satisfaction of the Owner's Representative if code is not applicable.

3.4.10 The Contractor shall be responsible for all shoring required to protect its work or adjacent property and shall pay for any damage caused by failure to shore or by improper shoring or by failure to give proper notice. Shoring shall be removed only after completion of permanent supports.

3.4.11 The Contractor shall maintain at his own cost and expense, adequate, safe and sufficient walkways, platforms, scaffolds, ladders, hoists and all necessary, proper, and adequate equipment, apparatus, and appliances useful in carrying on the Work and which are necessary to make the place of Work safe and free from avoidable danger for students, faculty, staff, the public and construction personnel, and as may be required by safety provisions of applicable laws, ordinances, rules regulations and building and construction codes.

3.4.12 During the performance of the Work, the Contractor shall be responsible for providing and maintaining warning signs, lights, signal devices, barricades, guard rails, fences, and other devices appropriately located on site which shall give proper and understandable warning to all persons of danger of entry onto land, structure, or equipment, within the limits of the Contractor’s work area.

3.4.13 The Contractor shall pump, bail, or otherwise keep any general excavations free of water. The Contractor shall keep all areas free of water before, during and after concrete placement. The Contractor shall be responsible for protection, including weather protection, and proper maintenance of all equipment and materials installed, or to be installed by him.

3.4.14 The Contractor shall be responsible for care of the Work and must protect same from damage of defacement until acceptance by the Owner. All damaged or defaced Work shall be repaired or replaced to the Owner's satisfaction, without cost to the Owner.

3.4.15 When requested by the Owner's Representative, the Contractor, at no extra charge, shall provide scaffolds or ladders in place as may be required by the Architect or the Owner for examination of Work in progress or completed.

3.4.16 The Contractor shall be responsible to the Owner for acts and omissions of the Contractor’s employees, Subcontractors of any tier and their agents and employees, and any entity or other persons performing portions of the Work.

3.4.17 The Contractor shall not be relieved of its obligations to perform the Work in accordance with the Contract Documents either by activities or duties of the Owner’s Representative or Architect in their administration of the Contract, or by tests, inspections or approvals required or performed by persons other than the Contractor.

3.4.18 The Contractor shall be responsible for inspection of portions of the Work already performed under this Contract to determine that such portions are in proper condition to receive subsequent Work.

3.5 Use of Site
3.5.1 The Contractor shall limit operations and storage of material to the area within the Work limit lines shown on Drawings, except as necessary to connect to exiting utilities, shall not encroach on neighboring property, and shall exercise caution to prevent damage to existing structures.

3.5.2 Only materials and equipment, which are to be used directly in the Work, shall be brought to and stored on the Work site by the Contractor. After equipment is no longer required for the Work, it shall be promptly removed from the Work site. Protection of construction materials and equipment stored at the Work site from weather, theft, damage and all other adversity is solely the responsibility of the Contractor.
3.5.3 No project signs shall be erected without the written approval of the Owner's Representative.

3.5.4 The Contractor shall ensure that the Work is at all times performed in a manner that affords reasonable access, both vehicular and pedestrian, to the site of the Work and all adjacent areas. Particular attention shall be paid to access for emergency vehicles, including fire trucks. Wherever there is the possibility of interfering with normal emergency vehicle operations, Contractor shall obtain permission from both campus and municipal emergency response entities prior to limiting any access. The Work shall be performed, to the fullest extent reasonably possible, in such a manner that public areas adjacent to the site of the Work shall be free from all debris, building materials and equipment likely to cause hazardous conditions. Without limitation of any other provision of the Contract Documents, Contractor shall not interfere with the occupancy or beneficial use of (1) any areas and buildings adjacent to the site of the Work or (2) the Work in the event of partial occupancy. Contractor shall assume full responsibility for any damage to the property comprising the Work or to the owner or occupant of any adjacent land or areas resulting from the performance of the Work.

3.5.5 The Contractor shall not permit any workers to use any existing facilities at the Work site, including, without limitation, lavatories, toilets, entrances, and parking areas other than those designated by Owner. The Contractor, Subcontractors of any tier, suppliers and employees shall comply with instructions or regulations of the Owner's Representative governing access to, operation of, and conduct while in or on the premises and shall perform all Work required under the Contract Documents in such a manner as not to unreasonably interrupt or interfere with the conduct of Owner’s operations. Any request for Work, a suspension of Work or any other request or directive received by the Contractor from occupants of existing buildings shall be referred to the Owner’s Representative for determination.

3.5.6 The Contractor and the Subcontractor of any tier shall have its’ name, acceptable abbreviation or recognizable logo and the name of the city and state of the mailing address of the principal office of the company, on each motor vehicle and motorized self-propelled piece of equipment which is used in connection with the project. The signs are required on such vehicles during the time the Contractor is working on the project.

3.6 Review of Contract Documents and Field Conditions by Contractor

3.6.1 The Contractor shall carefully study and compare the Contract Documents with each other and with information furnished by the Architect and Owner and shall at once report in writing to the Architect and Owner's Representative any errors, inconsistencies or omissions discovered. If the Contractor performs any construction activity which it knows or should have known involves a recognized error, inconsistency or omission in the Contract Documents without such written notice to the Architect and Owner’s Representative, the Contractor shall assume appropriate responsibility for such performance and shall bear an appropriate amount of the attributable costs for correction.

3.6.2 The Contractor shall take field measurements and verify field conditions and shall carefully compare such field measurements and conditions and other information known to the Contractor with the Contract Documents before commencing activities. Errors, inconsistencies or omissions discovered shall be reported in writing to the Architect and Owner’s Representative within twenty-four (24) hours.

3.6.3 The Contractor shall provide, at the proper time, such material as required for support of the Work. If openings or chases are required, whether shown on Drawings or not, the Contractor shall see they are properly constructed. If required openings or chases are omitted, the Contractor shall cut them at the Contractors own expense, but only as directed by the Architect, through the Owner Representative.

3.6.4 Should the Contract Documents fail to particularly describe materials or goods to be used, it shall be the duty of the Contractor to inquire of the Architect and the Owner's Representative what is to be used and to supply it at the Contractor’s expense, or else thereafter replace it to the Owner’s Representative’s satisfaction. At a minimum, the Contractor shall provide the quality of materials as generally specified throughout the Contract Documents.

3.7 Cleaning and Removal

3.7.1 The Contractor shall keep the Work site and surrounding areas free from accumulation of waste materials, rubbish, debris, and dirt resulting from the Work and shall
clean the Work site and surrounding areas as requested by the Architect and the Owner’s Representative, including mowing of grass greater than 6 inches high. The Contractor shall be responsible for the cost of clean up and removal of debris from premises. The building and premises shall be kept clean, safe, in a workmanlike manner, and in compliance with OSHA standards at all times. At completion of the Work, the Contractor shall remove from and about the Work site tools, construction equipment, machinery, fencing, and surplus materials. Further, at the completion of the work, all dirt, stains, and smudges shall be removed from every part of the building, all glass in doors and windows shall be washed, and entire Work shall be left broom clean in a finished state ready for occupancy. The Contractor shall advise his Subcontractors of any tier of this provision, and the Contractor shall be fully responsible for leaving the premises in a finished state ready for use to the satisfaction of the Owner’s Representative. If the Contractor fails to comply with the provisions of this paragraph, the Owner may do so and the cost thereof shall be charged to the Contractor.

3.8 Cutting and Patching
3.8.1 The Contractor shall be responsible for cutting, fitting, or patching required to complete the Work or to make its parts fit together properly.

3.8.2 The Contractor shall not damage or endanger a portion of the Work or fully or partially completed construction of the Owner or separate contractors by cutting, patching, or otherwise altering such construction, or by excavation. The Contractor shall not cut or otherwise alter such construction by the Owner or a separate contractor except with written consent of the Owner and of such separate contractor; such consent shall not be unreasonably withheld. The Contractor shall not unreasonably withhold from the Owner or a separate contractor the Contractor's consent to cutting or otherwise altering the Work.

3.8.3 If the Work involves renovation and/or alteration of existing improvements, Contractor acknowledges that cutting and patching of the Work is essential for the Work to be successfully completed. Contractor shall perform any cutting, altering, patching, and/or fitting of the Work necessary for the Work and the existing improvements to be fully integrated and to present the visual appearance of an entire, completed, and unified project. In performing any Work which requires cutting or patching, Contractor shall use its best efforts to protect and preserve the visual appearance and aesthetics of the Work to the reasonable satisfaction of both the Owner’s Representative and Architect.

3.9 Indemnification

3.9.1 To the fullest extent permitted by law, the Contractor shall defend, indemnify, and hold harmless the Owner, the Architect, Architect’s consultants, and the agents, employees, representatives, insurers and re-insurers of any of the foregoing (hereafter collectively referred to as the “Indemnitees”) from and against claims, damages (including loss of use of the Work itself), punitive damages, penalties and civil fines unless expressly prohibited by law, losses and expenses, including, but not limited to, attorneys’ fees, arising out of or resulting from performance of the Work to the extent caused in whole or in part by negligent acts or omissions or other fault of Contractor, a Subcontractor of any tier, or anyone directly or indirectly employed by them or anyone for whose acts they may be liable, regardless of whether or not such claim, damage, loss, or expense is caused in part by the negligent acts or omissions or other fault of a party indemnified hereunder. The Contractor’s obligations hereunder are in addition to and shall not be construed to negate, abridge, or reduce other rights or obligations of indemnity that the Owner may possess. If one or more of the Indemnitees demand performance by the Contractor of obligations under this paragraph or other provisions of the Contract Documents and if Contractor refuses to assume or perform, or delays in assuming or performing Contractor’s obligations, Contractor shall pay each Indemnitee who has made such demand its respective attorneys’ fees, costs, and other expenses incurred in enforcing this provision. The defense and indemnity required herein shall be a binding obligation upon Contractor whether or not an Indemnitee has made such demand. Even if a defense is successful to a claim or demand for which Contractor is obligated to indemnify the Indemnitees from under this Paragraph, Contractor shall remain liable for all costs of defense.

3.9.2 The indemnity obligations of Contractor under this Section 3.9 shall survive termination of this Contract or final payment thereunder. In the event of any claim or demand made against any party which is entitled to be indemnified hereunder, the Owner may in its sole discretion reserve, return or apply any monies due or to become due the Contractor under the Contract for the purpose of resolving such claims; provided, however, that the Owner may release such funds if the Contractor provides the Owner with reasonable assurance of protection of the Owner’s interests. The Owner shall in its sole discretion determine if such assurances are reasonable. Owner reserves the right to control the defense and settlement of any claim, action or proceeding which Contractor has an obligation to indemnify the Indemnitees against under Paragraph 3.9.1.

3.9.3 In claims against any person or entity indemnified under this Section 3.9 by an employee of the Contractor, a Subcontractor of any tier, anyone directly or indirectly employed by them or anyone for whose acts they may be liable, the indemnification obligation under this Section 3.9 shall not be limited by a limitation on amount or type of
damages, compensation or benefits payable by or for the Contractor or a Subcontractor of any tier under workers’ or workmen’s compensation acts, disability benefit acts or other employee benefit acts.

3.9.4 The obligations of the Contractor under Paragraph 3.9.1 shall not extend to the liability of the Architect, his agents or employees, arising out of the preparation and approval of maps, drawings, opinions, reports, surveys, Change Orders, designs, or Specifications.

3.10 Patents
3.10.1 The Contractor shall hold and save harmless the Owner and its officers, agents, servants, and employees from liability of any nature or kind, including cost and expense, for, or on account of, any patented or otherwise protected invention, process, article, or appliance manufactured or used in the performance of the Contract, including its use by the Owner, unless otherwise specifically stipulated in the Contract Documents.

3.10.2 If the Contractor uses any design, device, or material covered by letters patent or copyright, he shall provide for such use by suitable agreement with the Owner of such patented or copyrighted design, device, or material. It is mutually agreed and understood, without exception, that the Contract Sum includes and the Contractor shall pay all royalties, license fees or costs arising from the use of such design, device, or material in any way involved in the Work. The Contractor and/or sureties shall indemnify and save harmless the Owner from any and all claims for infringement by reason of the use of such patented or copyrighted design, device, or material or any trademark or copyright in connection with Work agreed to be performed under this Contract and shall indemnify the Owner for any cost, expense, or damage it may be obligated to pay by reason of such infringement at any time during the prosecution of the Work or after completion of the Work.

3.11 Materials, Labor, and Workmanship
3.11.1 Materials and equipment incorporated into the Work shall strictly conform to the Contract Documents and representations and approved Samples provided by Contractor and shall be of the most suitable grade of their respective kinds for their respective uses, and shall be fit and sufficient for the purpose intended, merchantable, of good new material and workmanship, and free from defect. Workmanship shall be in accordance with the highest standard in the industry and free from defect in strict accordance with the Contract Documents.

3.11.2 Materials and fixtures shall be new and of latest design unless otherwise specified, and shall provide the most efficient operating and maintenance costs to the Owner. All Work shall be performed by competent workers and shall be of best quality.

3.11.3 The Contractor shall carefully examine the Contract Documents and shall be responsible for the proper fitting of his material, equipment, and apparatus into the building.

3.11.4 The Contractor shall base his bid only on the Contract Documents.

3.11.5 Materials and workmanship shall be subject to inspection, examination, and test by the Architect and the Owner's Representative at any and all times during manufacture, installation, and construction of any of them, at places where such manufacture, installation, or construction is performed.

3.11.6 The Contractor shall enforce strict discipline and good order among the Contractor's employees and other persons carrying out the Contract. The Contractor shall not permit employment of unfit persons or persons not skilled in tasks assigned to them.

3.11.7 Unless otherwise specifically noted, the Contractor shall provide and pay for supervision, labor, materials, equipment, tools, construction equipment and machinery, water, heat, utilities, transportation, and other facilities and services necessary for the proper execution and completion of the Work.

3.11.8 Substitutions
3.11.8.1 A substitution is a Contractor proposal of an alternate product or method in lieu of has been specified or shown in the Contract Documents, which is not an “or equal” as set forth in Section 3.12.1.

3.11.8.2 Contractor may make a proposal to the Architect and the Owner's Representative to use substitute products or methods as set forth herein, but the Architect's and the Owner’s Representative’s decision concerning acceptance of a substitute shall be final. The Contractor must do so in writing and setting forth the following:

.1 Full explanation of the proposed substitution and submittal of all supporting data including technical information, catalog cuts, warranties, test results, installation instructions, operating procedures, and other like information necessary for a complete evaluation of the substitution.

.2 Reasons the substitution is advantageous and necessary, including the benefits to the Owner and the Work in the event the substitution is acceptable.

.3 The adjustment, if any, in the Contract Sum, in the event the substitution is acceptable.

.4 The adjustment, if any, in the time of completion of the Contract and the construction schedule in the event the substitution is acceptable.

.5 An affidavit stating that (a) the proposed substitution conforms to and meets all of the
Contract Documents, except as specifically disclosed and set forth in the affidavit and (b) the Contractor accepts the warranty and correction obligations in connection with the proposed substitution as if originally specified by the Architect. Proposals for substitutions shall be submitted to the Architect and Owner’s Representative in sufficient time to allow the Architect and Owner’s Representative no less than ten (10) working days for review. No substitution will be considered or allowed without the Contractor's submittal of complete substantiating data and information as stated herein.

3.11.8.3 Substitutions may be rejected without explanation in Owner’s sole discretion and will be considered only under one or more of the following conditions:

1. Required for compliance with interpretation of code requirements or insurance regulations then existing;
2. Unavailability of specified products, through no fault of the Contractor;
3. Material delivered fails to comply with the Contract Documents;
4. Subsequent information discloses inability of specified products to perform properly or to fit in designated space;
5. Manufacturer/fabricator refuses to certify or guarantee performance of specified product as required; or
6. When in the judgment of the Owner or the Architect, a substitution would be substantially to the Owner's best interests, in terms of cost, time, or other considerations.

3.11.8.4 Whether or not any proposed substitution is accepted by the Owner or the Architect, the Contractor shall reimburse the Owner for any fees charged by the Architect or other consultants for evaluating each proposed substitute.

3.12 Approved Equal

3.12.1 Whenever in the Contract Documents any article, appliance, device, or material is designated by the name of a manufacturer, vendor, or by any proprietary or trade name, the words "or approved equal," shall automatically follow and shall be implied unless specifically indicated otherwise. The standard products of manufacturers other than those specified will be accepted when, prior to the ordering or use thereof, it is proven to the satisfaction of the Owner’s Representative and the Architect they are equal in design, appearance, spare parts availability, strength, durability, usefulness, serviceability, operation cost, maintenance cost, and convenience for the purpose intended. Any general listings of approved manufacturers in any Contract Document shall be for informational purposes only and it shall be the Contractor’s sole responsibility to ensure that any proposed “or equal” complies with the requirements of the Contract Documents.

3.12.2 The Contractor shall submit to Architect and Owner’s Representative a written and full description of the proposed “or equal” including all supporting data, including technical information, catalog cuts, warranties, test results, installation instructions, operating procedures, and similar information demonstrating that the proposed “or equal” strictly complies with the Contract Documents. The Architect or Owner’s Representative shall take appropriate action with respect to the submission of a proposed “or equal” item. If Contractor fails to submit proposed “or equals” as set forth herein, it shall waive any right to supply such items. The Contract Sum and Contract Time shall not be adjusted as a result of any failure by Contractor to submit proposed “or equals” as provided for herein. All documents submitted in connection with preparing an “or equal” shall be clearly and obviously marked as a proposed “or equal” submission.

3.12.3 No approvals or action taken by the Architect or Owner’s Representative shall relieve Contractor from its obligation to ensure that an “or equal” article, appliance, devise or material strictly complies with the requirements of the Contract Documents. Contractor shall not propose “or equal” items in connection with Shop Drawings or other Submittals, and Contractor acknowledges and agrees that no approvals or action taken by the Architect or Owner’s Representative with respect to Shop Drawings or other Submittals shall constitute approval of any “or equal” item or relieve Contractor from its sole and exclusive responsibility. Any changes required in the details and dimensions indicated in the Contract Documents for the incorporation or installation of any “or equal” item supplied by the Contractor shall be properly made and approved by the Architect at the expense of the Contractor. No ‘or equal’ items will be permitted for components of or extensions to existing systems when, in the opinion of the Architect, the named manufacturer must be provided in order to ensure compatibility with the existing systems, including, but not limited to, mechanical systems, electrical systems, fire alarms, smoke detectors, etc. No action will be taken by the Architect with respect to proposed “or equal” items prior to receipt of bids, unless otherwise noted in the Special Conditions.

3.13 Shop Drawings, Product Data, Samples, and Coordination Drawings/BIM Models

3.13.1 Shop Drawings are drawings, diagrams, schedules and other data specifically prepared for the Work by the Contractor or a Subcontractor, sub-subcontractor, manufacturer, supplier or distributor to illustrate some portion of the Work.
3.13.2 Product Data are illustrations, standard schedules, performance charts, instructions, brochures, diagrams and other information furnished by the Contractor to illustrate materials or equipment for some portion of the Work.

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

3.13.4 Coordination Drawings are drawings for the integration of the Work, including work first shown in detail on shop drawings or product data. Coordination drawings show sequencing and relationship of separate units of work which must interface in a restricted manner to fit in the space provided, or function as indicated. Coordination Drawings are the responsibility of the contractor and are submitted for informational purposes. The Special Conditions will state whether coordination drawings are required. BIM models may be used for coordination in lieu of coordination drawings at the contractor’s discretion, unless required in the Special Conditions. The final coordination drawings/BIM Model will not change the contract documents, unless approved by a fully executed change order describing the specific modifications that are being made to the contract documents.

3.13.5 Shop Drawings, Coordination Drawings/BIM Models, Product Data, Samples and similar submittals (collectively referred to as “Submittals”) are not Contract Documents. The purpose of their submittal is to demonstrate for those portions of the Work for which submittals are required the way the Contractor proposes to conform to the information given and the design concept expressed in the Contract Documents.

3.13.6 The Contractor shall schedule submittal of Shop Drawings and Product Data to the Architect so that no delays will result in delivery of materials and equipment, advising the Architect of priority for checking of Shop Drawings and Product Data, but a minimum of two weeks shall be provided for this purpose. Because time is of the essence in this contract, unless noted otherwise in the Special Conditions or Technical Specifications, all submittals, shop drawings and samples must be submitted as required to maintain the contractor’s plan for proceeding, but must be submitted within 90 days of the Notice To Proceed. If Contractor believes that this milestone is unreasonable for any submittal, Contractor shall request an extension of this milestone, within 60 days of Notice To Proceed, for each submittal that cannot meet the milestone. The request shall contain a reasonable explanation as to why the 90 day milestone is unreasonable, and shall specify a date on which the submittal will be transmitted, for approval by the Owner’s Representative. Failure of the Contractor to comply with this section may result in delays in the submittal approval process and/or charges for expediting approval, both of which will be the responsibility of the Contractor.

3.13.7 The Contractor, at its own expense, shall submit Samples required by the Contract Documents with reasonable promptness as to cause no delay in the Work or the activities of separate contractors and no later than twenty (20) days before materials are required to be ordered for scheduled delivery to the Work site. Samples shall be labeled to designate material or products represented, grade, place of origin, name of producer, name of Contractor and the name and number of the Owner’s project. Quantities of Samples shall be twice the number required for testing so that Architect can return one set of the Samples. Materials delivered before receipt of Architect’s approval may be rejected by Architect and in such event, Contractor shall immediately remove all such materials from the Work site. When requested by Architect or Owner’s Representative, samples of finished masonry and field applied paints and finishes shall be located as directed and shall include sample panels built at the site of approximately twenty (20) square feet each.

3.13.8 The Contractor shall perform no portion of the Work requiring submittal and review of Shop Drawings, Product Data, Samples or similar submittals until the respective submittal has been approved by the Architect. Such Work shall be in accordance with approved submittals.

3.13.9 By approving and submitting Shop Drawings, Product Data, Samples and similar submittals, the Contractor represents such Submittals strictly comply with the requirements of the Contract Documents and that the Contractor has determined and verified field measurements and field construction criteria related thereto, that materials are fit for their intended use and that the fabrication, shipping, handling, storage, assembly and installation of all materials, systems and equipment are in accordance with best practices in the industry and are in strict compliance with any applicable requirements of the Contract Documents. Contractor shall also coordinate each Submittal with other Submittals.

3.13.10 Contractor shall be responsible for the correctness and accuracy of the dimensions, measurements and other information contained in the Submittals.

3.13.11 Each Submittal will bear a stamp or specific indication that the Submittal complies with the Contract Documents and Contractor has satisfied its obligations under the Contract Documents with respect to Contractor’s review and approval of that Submittal. Each Submittal shall bear the signature of the representative of Contractor who approved the Submittal, together with the Contractor’s name, Owner’s name, number of the Project, and the item name and specification section number.

3.13.12 The Contractor shall not be relieved of responsibility for deviations from requirements of the Contract Documents by the Architect's approval of Shop Drawings, Product Data,
Samples or similar submittals. The Contractor shall not be relieved of responsibility for errors or omissions in Shop Drawings, Product Data, Samples or similar submittals by the Architect's approval thereof. Specifically, but not by way of limitation, Contractor acknowledges that Architect's approval of Shop Drawings shall not relieve Contractor for responsibility for errors and omissions in the Shop Drawings since Contractor is responsible for the correctness of dimensions, details and the design of adequate connections and details contained in the Shop Drawings.

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

3.13.14 The Contractor represents and warrants that all Shop Drawings shall be prepared by persons and entities possessing expertise and experience in the trade for which the Shop Drawing is prepared and, if required by the Architect or applicable Laws, by a licensed engineer or other design professional.

3.14 Record Drawings
3.14.1 The Contractor shall maintain a set of Record Drawings on site in good condition and shall use colored pencils to mark up said set with "record information" in a legible manner to show: (1) bidding addendums, (2) executed change orders, (3) deviations from the Drawings made during construction; (4) details in the Work not previously shown; (5) changes to existing conditions or existing conditions found to differ from those shown on any existing drawings; (6) the actual installed position of equipment, piping, conduits, light switches, electric fixtures, circuiting, ducts, dampers, access panels, control valves, drains, openings, and stub-outs; and (7) such other information as either Owner or Architect may reasonably request. The prints for Record Drawing use will be a set of "blue line" prints provided by Architect to Contractor at the start of construction. Upon Substantial Completion of the Work, Contractor shall deliver all Record Drawings to Owner and Architect for approval. If not approved, Contractor shall make the revisions requested by Architect or Owner's Representative. Final payment and any retainage shall not be due and owing to Contractor until the final Record Drawings marked by Contractor as required above are delivered to Owner.

3.15 Operating Instructions and Service Manuals
3.15.1 The Contractor shall submit four (4) volumes of operating instructions and service manuals to the Architect before completing 50% of the adjusted contract amount. Payments beyond 50% of the adjusted contract amount may be withheld until all operating instructions and service manuals are received. The operating instructions and service manuals shall contain:

.1 Start-up and Shutdown Procedures: Provide a step-by-step write up of all major equipment. When manufacturer's printed start-up, trouble shooting and shut-down procedures are available, they may be incorporated into the operating manual for reference.

.2 Operating Instructions: Written operating instructions shall be included for the efficient and safe operation of all equipment.

.3 Equipment List: List of all major equipment as installed shall include model number, capacities, flow rate, and name-plate data.

.4 Service Instructions: The Contractor shall be required to provide the following information for all pieces of equipment.

(a) Recommended spare parts including catalog number and name of local suppliers or factory representative.

(b) Belt sizes, types, and lengths.

(c) Wiring diagrams.

.5 Manufacturer's Certificate of Warranty: Manufacturer's certificates of warranty shall be obtained for all major equipment. Warranty shall be obtained for at least one year from the date of Substantial Completion. Where longer period is required by the Contract Documents, the longer period shall govern.

.6 Parts catalogs: For each piece of equipment furnished, a parts catalog or similar document shall be provided which identifies the components by number for replacement ordering.

3.15.2 Submission
.1 Manuals shall be bound into volumes of standard 8 1/2" x 11" hard binders. Large drawings too bulky to be folded into 8 1/2" x 11" shall be separately bound or folded and in brown envelopes, cross-referenced and indexed with the manuals.

.2 The manuals shall identify the Owner's project name, project number, and include the name and address of the Contractor and major Subcontractors of any tier who were involved with the activity described in that particular manual.

3.16 Taxes
3.16.1 The Contractor shall pay all applicable sales, consumer, use, and similar taxes for the Work which are legally enacted when the bids are received, whether or not yet effective or scheduled to go into effect. However, certain purchases by the Contractor of materials incorporated in or consumed in the Work are exempt from certain sales tax pursuant to RSMo § 144.062. The Contractor shall be issued a Project Tax Exemption Certificate for this Work to obtain the benefits of RSMo § 144.062.

3.16.2 The Contractor shall furnish this certificate to all subcontractors, and any person or entity purchasing materials
for the Work shall present such certificate to all material suppliers as authorization to purchase, on behalf of the Owner, all tangible personal property and materials to be incorporated into or consumed in the Work and no other on a tax-exempt basis. Such suppliers shall provide to the purchasing party invoices bearing the name of the exempt entity and the project identification number. Nothing in this section shall be deemed to exempt from any sales or similar tax the purchase of any construction machinery, equipment or tools used in construction, repairing or remodeling facilities for the Owner. All invoices for all personal property and materials purchased under a Project Tax Exemption Certificate shall be retained by the Contractor for a period of five years and shall be subject to audit by the Director of Revenue.

3.16.3 Any excess resalable tangible personal property or materials which were purchased for the project under this Project Tax Exemption Certificate but which were not incorporated into or consumed in the Work shall either be returned to the supplier for credit or the appropriate sales or use tax on such excess property or materials shall be reported on a return and paid by such purchasing party not later than the due date of the purchasing party’s Missouri sales or use tax return following the month in which it was determined that the materials were not used in the Work.

3.16.4 If it is determined that sales tax is owed by the Contractor on property and materials due to the failure of the Owner to revise the certificate expiration date to cover the applicable date of purchase, Owner shall be liable for the tax owed.

3.16.5 The Owner shall not be responsible for any tax liability due to Contractor’s neglect to make timely orders, payments, etc. or Contractor’s misuse of the Project Tax Exemption Certificate. Contractor represents that the Project Tax Exemption Certificate shall be used in accordance with RSMo § 144.062 and the terms of the Project Tax Exemption Certificate. Contractor shall indemnify the Owner for any loss or expense, including but not limited to, reasonable attorneys’ fees, arising out of Contractor’s use of the Project Tax Exemption Certificate.

3.17 Contractor’s Construction Schedules

3.17.1 The Contractor, within fifteen (15) days after the issuance of the Notice to Proceed, shall prepare and submit for the Owner's and Architect's information Contractor's construction schedule for the Work and shall set forth interim dates for completion of various components of the Work and Work Milestone Dates as defined herein. The schedule shall not exceed time limits current under the Contract Documents, shall be revised on a monthly basis or as requested by the Owner’s Representative as required by the conditions of the Work, and shall provide for expeditious and practicable execution of the Work. The Contractor shall conform to the most recent schedule.

3.17.2 The construction schedule shall be in a detailed format satisfactory to the Owner’s Representative and the Architect and in accordance with the detailed schedule requirements set forth in this document and the Special Conditions. If the Owner’s Representative or Architect has a reasonable objection to the schedule submitted by Contractor, the construction schedule shall be promptly revised by the Contractor. The Contractor shall monitor the progress of the Work for conformance with the requirements of the construction schedule and shall promptly advise the Owner of any delays or potential delays.

3.17.3 As time is of the essence to this contract, the University expects that the Contractor will take all necessary steps to insure that the project construction schedule shall be prepared in accordance with the specific requirements of the Special Conditions to this contract. At a minimum, contractor shall comply with the following:

.1 The schedule shall be prepared using Primavera P3, Oracle P6, Microsoft Project or other software acceptable to the Owner’s Representative.

.2 The schedule shall be prepared and maintained in CPM format, in accordance with Construction CPM Scheduling, published by the Associated General Contractors of American (AGC).

.3 Prior to submittal to the Owner’s Representative for review, Contractor shall obtain full buy-in to the schedule from all major subcontractors, in writing if so requested by Owner’s Representative.

.4 Schedule shall be updated, in accordance with Construction CPM Scheduling, published by the AGC, on a monthly basis at minimum, prior to, and submitted with, the monthly pay application or as requested by the Owner’s Representative.

.5 Along with the update the Contractor shall submit a narrative report addressing all changes, delays and impacts, including weather to the schedule during the last month, and explain how the end date has been impacted by same.

.6 The submission of the updated certifies that all delays and impacts that have occurred on or to the project during the previous month have been factored into the update and are fully integrated into the schedule and the projected completion date.

Failure to comply with any of these requirements will be considered a material breach of this contract. See Special Conditions for detailed scheduling requirements.

3.17.4 In the event the Owner’s Representative or Architect determines that the performance of the Work, as of a Milestone Date, has not progressed or reached the level of completion required by the Contract Documents, the Owner shall have the
right to order the Contractor to take corrective measures necessary to expedite the progress of construction, including, without limitation, (1) working additional shifts or overtime, (2) supplying additional manpower, equipment, facilities, (3) expediting delivery of materials, and (4) other similar measures (hereinafter referred to collectively as Extraordinary Measures). Such Extraordinary Measures shall continue until the progress of the Work complies with the stage of completion required by the Contract Documents. The Owner's right to require Extraordinary Measures is solely for the purpose of ensuring the Contractor's compliance with the construction schedule. The Contractor shall not be entitled to an adjustment in the Contract Sum concerning Extraordinary Measures required by the Owner under or pursuant to this Paragraph 3.17.3. The Owner may exercise the rights furnished the Owner under or pursuant to this Paragraph 3.17.3 as frequently as the Owner deems necessary to ensure that the Contractor's performance of the Work will comply with any Milestone Date or completion date set forth in the Contract Documents.

ARTICLE 4
ADMINISTRATION OF THE CONTRACT

4.1 Rights of the Owner
4.1.1 The Owner's Representative will administer the Construction Contract. The Architect will assist the Owner's Representative with the administration of the Contract as indicated in these Contract Documents.

4.1.2 If, in the judgment of the Owner's Representative, it becomes necessary to accelerate the work, the Contractor, when directed by the Owner's Representative in writing, shall cease work at any point and transfer its workers to such point or points and execute such portions of the work as may be required to enable others to hasten and properly engage and carry out the work, all as directed by the Owner's Representative. The additional cost of accelerating the work, if any, will be borne by the Owner, unless the Contractor's work progress is behind schedule as shown on the most recent progress schedule.

4.1.3 If the Contractor refuses, for any reason, to proceed with what the Owner believes to be contract work, the Owner may issue a Construction Directive, directing the Contractor to proceed. Contractor shall be obligated to promptly proceed with this work. If Contractor feels that it is entitled to additional compensation for this work, it may file a claim for additional compensation and/or time, in accordance with 4.4 of this document.

4.1.4 The Owner's Representative, may, by written notice, require a Contractor to remove from involvement with the Work, any of Contractor's personnel or the personnel of its Subcontractors of any tier whom the Owner's Representative may deem abusive, incompetent, careless, or a hindrance to proper and timely execution of the Work. The Contractor shall comply with such notice promptly, but without detriment to the Work or its progress.

4.1.5 The Owner's Representative will schedule Work status meetings that shall be attended by representatives of the Contractor and appropriate Subcontractors of any tier. Material suppliers shall attend status meetings if required by the Owner's Representative. These meetings shall include preconstruction meetings.

4.1.6 The Owner does not allow smoking on University property.

4.2 Rights of the Architect
4.2.1 The Architect will interpret requirements of the Contract Documents with respect to the quality, quantity and other technical requirements of the Work itself within a reasonable time after written request of the Contractor. Contractor shall provide Owner's Representative a copy of such written request.

4.3 Review of the Work
4.3.1 The Architect and the Owner's Representative shall, at all times, have access to the Work; and the Contractor shall provide proper and safe facilities for such access.

4.3.2 The Owner’s Representative shall have authority to reject Work that does not strictly comply with the requirements of the Contract Documents. Whenever the Owner’s Representative considers it necessary or advisable for implementation of the intent of the Contract Documents, Owner’s Representative shall have the authority to require additional inspection or testing of the Work, whether or not such Work is fabricated, installed or completed.

4.3.3 The fact that the Architect or the Owner's Representative observed, or failed to observe, faulty Work, or Work done which is not in accordance with the Contract Documents, regardless of whether or not the Owner has released final payment, shall not relieve the Contractor from responsibility for all damages and additional costs of the Owner as a result of defective or faulty Work.

4.4 Claims
4.4.1 A Claim is a demand or assertion by Contractor seeking, as a matter of right, adjustment or interpretation of Contract terms, payment of money, extension of time or any other relief with respect to the terms of the Contract. The term "Claim(s)" also includes demands and assertions of Contractor arising out of or relating to the Contract Documents, including Claims based upon breach of contract, mistake, misrepresentation, or other cause for Contract Modification or
Claims by Contractor must be made promptly, and no later than within fourteen (14) days after occurrence of the event giving rise to such Claim. Claims must be made by written notice. Such notice shall include a detailed statement setting forth all reasons for the Claim and the amount of additional money and additional time claimed by the Contractor. The notice of Claims shall also strictly comply with all other provisions of the Contract Documents. Contractor shall not be entitled to rely upon any grounds or basis for additional money on additional time not specifically set forth in the notice of Claim. All Claims not made in the manner provided herein shall be deemed waived and of no effect. Contractor shall furnish the Owner and Architect such timely written notice of any Claim provided for herein, including, without limitation, those in connection with alleged concealed or unknown conditions, and shall cooperate with the Owner and Architect in any effort to mitigate the alleged or potential damages, delay or other adverse consequences arising out of the condition which is the cause of such a Claim.

Pending final resolution of a Claim, the Contractor shall proceed diligently with performance of the Contract and the Owner shall continue to make payments that are not in dispute in accordance with the Contract Documents.

Claims by Contractor must be made promptly, and no later than within fourteen (14) days after occurrence of the event giving rise to such Claim. Claims must be made by written notice. Such notice shall include a detailed statement setting forth all reasons for the Claim and the amount of additional money and additional time claimed by the Contractor. The notice of Claims shall also strictly comply with all other provisions of the Contract Documents. Contractor shall not be entitled to rely upon any grounds or basis for additional money on additional time not specifically set forth in the notice of Claim. All Claims not made in the manner provided herein shall be deemed waived and of no effect. Contractor shall furnish the Owner and Architect such timely written notice of any Claim provided for herein, including, without limitation, those in connection with alleged concealed or unknown conditions, and shall cooperate with the Owner and Architect in any effort to mitigate the alleged or potential damages, delay or other adverse consequences arising out of the condition which is the cause of such a Claim.

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Pending final resolution of a Claim, the Contractor shall proceed diligently with performance of the Contract and the Owner shall continue to make payments that are not in dispute in accordance with the Contract Documents.

Claims by Contractor must be made promptly, and no later than within fourteen (14) days after occurrence of the event giving rise to such Claim. Claims must be made by written notice. Such notice shall include a detailed statement setting forth all reasons for the Claim and the amount of additional money and additional time claimed by the Contractor. The notice of Claims shall also strictly comply with all other provisions of the Contract Documents. Contractor shall not be entitled to rely upon any grounds or basis for additional money on additional time not specifically set forth in the notice of Claim. All Claims not made in the manner provided herein shall be deemed waived and of no effect. Contractor shall furnish the Owner and Architect such timely written notice of any Claim provided for herein, including, without limitation, those in connection with alleged concealed or unknown conditions, and shall cooperate with the Owner and Architect in any effort to mitigate the alleged or potential damages, delay or other adverse consequences arising out of the condition which is the cause of such a Claim.

Pending final resolution of a Claim, the Contractor shall proceed diligently with performance of the Contract and the Owner shall continue to make payments that are not in dispute in accordance with the Contract Documents.
4.7.4 The Owner will consider and evaluate requests for time extensions due to changes or other events beyond the control of the Contractor on a monthly basis only, with the submission of the Contractor’s updated schedule, in conjunction with the monthly application for payment.

4.7.3 If any other Force Majeure event results in the delay to the critical path of the project, the Owner will consider a time extension request from the Contractor that is submitted in accordance with the contract terms and conditions.

4.7.2 If the contract obligations have been satisfied, the Owner will review requests for non-compensable time extensions for critical path activities as follows:

2.1 If the Contractor cannot work on a critical path activity due to adverse weather, after implementing all reasonable temporary weather protection, the Contractor will so notify the Owner’s Representative. Each week, the Contractor will notify the Owner’s Representative of the number of adverse weather days that it believes it has experienced in the previous week. As provided in the contract, until such time as the weather days acknowledged by the Owner’s Representative exceed the number of days of adverse weather contemplated in the Special Conditions, no request for extension of the contract completion time will be considered.

2.2 If the Contractor has accumulated in excess of the number of adverse weather days contemplated in the Special Conditions due to the stoppage of work on critical path activities due to adverse weather, the Owner will consider a time extension request from the Contractor that is submitted in accordance with the contract requirements. The Owner will provide a change order extending the time for contract completion or direct an acceleration of the work in accordance with the contract terms and conditions to recover the time lost due to adverse weather in excess of the number of adverse weather working days contemplated in the Special Conditions.

4.8 Resolution of Claims and Disputes

4.8.1 The Owner's Representative will review Claims and take one or more of the following preliminary actions within ten days of receipt of a Claim: (1) request additional supporting data from the Contractor, (2) reject the Claim in whole or in part, (3) approve the Claim, or (4) suggest a compromise.

4.8.2 If a Claim has not been resolved, the Contractor shall, within ten days after the Owner's Representative's preliminary response, take one or more of the following actions: (1) submit additional supporting data requested, (2) modify the initial Claim, or (3) notify the Owner's Representative that the initial Claim stands.

4.8.3 If a Claim has not been resolved after consideration of the foregoing and of further information presented by the Contractor, the Contractor has the right to seek administrative review as set forth in Section 4.9. However, Owner’s Representative’s decisions on matters relating to aesthetics will be final.

4.9 Administrative Review

4.9.1 Claims not resolved pursuant to the procedures set forth in the Contract Documents except with respect to Owner’s Representative’s decision on matters relating to aesthetic effect, and except for claims which have been waived by the making or acceptance of final payment, or the Contractor's acceptance of payments in full for changes in work may be submitted to administrative review as provided in this section. All requests for administrative review shall be made in writing.

4.9.2 Upon written request from the Contractor, the Owner’s Review Administrator authorized by the Campus Contracting Officer will convene a review meeting between the Contractor and Owner’s Representative’s within fifteen (15) days of receipt of such written request. The Contractor and Owner’s Representative will be allowed to present written documentation with respect to the claim(s) before or during the meeting. The Contractor and Owner’s Representative will be allowed to present the testimony of any knowledgeable person regarding the claim at the review meeting. The Owner’s Review Administrator will issue a written summary of the review meeting and decision to resolve the Claim within fifteen (15) days. If the Contractor is in agreement with the decision the Contractor shall notify the Owner’s Review Administrator in writing within five (5) days, and appropriate documentation will be signed by the parties to resolve the Claim.

4.9.3 If the Contractor is not in agreement with the proposal of the Owner’s Review Administrator as to the resolution of the claim, the Contractor may file a written appeal with the UM System Contracting Officer, [in care of the Director of Facilities Planning and Development, Christmas Day, unless that specific day was approved in writing for work by the Owner’s Representative.
University of Missouri, 109 Old Alumni Centers, University of Missouri, Columbia, Missouri 65211] within fifteen (15) days after receipt of the Owner’s Review Administrator’s proposal. The UM System Contracting Officer will call a meeting of the Contractor, the Owner’s Representative, and the Owner’s Review Administrator by written notice, within thirty (30) days after receipt of the Contractor's written appeal. The Owner’s Review Administrator shall provide the UM System Contracting Officer with a copy of the written decision and summary of the review meeting, the Contractor's corrections or comments regarding the summary of the review meeting, and any written documentation presented by the Contractor and the Owner’s Representative at the initial review meeting. The parties may present further documentation and/or present the testimony of any knowledgeable person regarding the claim at the meeting called by the UM System Contracting Officer.

4.9.4 The UM System Contracting Officer will issue a written decision to resolve the claim within fifteen (15) days after the meeting. If the Contractor is in agreement with the UM System Contracting Officer's proposal, the Contractor shall notify the UM System Contracting Officer in writing within five (5) days, and the Contractor and the Owner shall sign appropriate documents. The issuance of the UM System Contracting Officer's written proposal shall conclude the administrative review process even if the Contractor is not in agreement. However, proposals and any opinions expressed in such proposals issued under this section will not be binding on the Contractor nor will the decisions or any opinions expressed be admissible in any legal actions arising from the Claim and will not be deemed to remove any right or remedy of the Contractor as may otherwise exist by virtue of Contract Documents or law. Contractor and Owner agree that the Missouri Circuit Court for the County where the Work is located shall have exclusive jurisdiction to determine all issues between them. Contractor agrees not to file any complaint, petition, lawsuit or legal proceeding against Owner except with such Missouri Circuit Court.

ARTICLE 5
SUBCONTRACTORS

5.1 Award of Subcontracts
5.1.1 Pursuant to Article 9, the Contractor shall furnish the Owner and the Architect, in writing, with the name, and trade for each Subcontractor and the names of all persons or entities proposed as manufacturers of products, materials and equipment identified in the Contract Documents and where applicable, the name of the installing contractor. The Owner’s Representative will reply to the Contractor in writing if the Owner has reasonable objection to any such proposed person or entity. The Contractor shall not contract with a proposed person or entity to whom the Owner has made reasonable and timely objection.

5.1.2 The Contractor may request to change a subcontractor. Any such request shall be made in writing to the Owner’s Representative. The Contractor shall not change a Subcontractor, person, or entity previously disclosed if the Owner makes reasonable objection to such change.

5.1.3 The Contractor shall be responsible to the Owner for acts, defaults, and omissions of its Subcontractors of any tier.

5.2 Subcontractual Relations
5.2.1 By appropriate agreement, written where legally required for validity, the Contractor shall require each Subcontractor of any tier, to the extent of the Work to be performed by the Subcontractor of any tier, to be bound to the Contractor by terms of the Contract Documents and to assume toward the Contractor all the obligations and responsibilities which the Contractor, by these Documents, assumes toward the Owner and the Architect. Each subcontract agreement of any tier shall preserve and protect the rights of the Owner and the Architect under the Contract Documents with respect to the Work to be performed by the Subcontractor of any tier so that subcontracting thereof will not prejudice such rights and shall allow to the Subcontractor of any tier, unless specifically provided otherwise in the subcontract agreement, the benefit of all rights, remedies, and redress against the Contractor that the Contractor, by the Contract Documents, has against the Owner. Where appropriate, the Contractor shall require each Subcontractor to enter into similar agreements with its sub-subcontractors. The Contractor shall make available to each proposed Subcontractor of any tier, prior to the execution of the subcontract agreement, copies of the Contract Documents to which the Subcontractor of any tier shall be bound. Subcontractors of any tier shall similarly make copies of applicable portions of such documents available to their respective proposed Subcontractors of any tier.

5.2.2 All agreements between the Contractor and a Subcontractor or supplier shall contain provisions whereby the Subcontractor or supplier waives all rights against the Owner, contractor, Owner’s representative, Architect and all other additional insureds for all losses and damages caused by, arising out of, or resulting from any of the perils covered by property or builders risk insurance coverage required of the Contractor in the Contract Documents. If Contractor fails to include said provisions in all subcontracts, Contractor shall indemnify, defend and hold all the above entities harmless in the event of any legal action by Subcontractor or supplier. If insureds on any such policies require separate
waiver forms to be signed by any Subcontractors of any tier or suppliers, Contractor shall obtain the same.

5.3 Contingent Assignment of Subcontract
5.3.1 No assignment by the Contractor of any amount or any part of the Contract or of the funds to be received thereunder will be recognized unless such assignment has had the written approval of the Owner, and the surety has been given due notice of such assignment and has furnished written consent hereto. In addition to the usual recitals in assignment Contracts, the following language must be set forth: "it is agreed that the funds to be paid to the assignee under this assignment are subject to performance by the Contractor of the contract and to claims and to liens for services rendered or materials supplied for the performance of the Work called for in said contract in favor of all persons, firms or corporations rendering such services or supplying such materials.

ARTICLE 6
SEPARATE CONTRACTS AND COOPERATION

6.1 The Owner reserves the right to let other contracts in connection with the Work.

6.2 It shall be the duty of each Contractor to whom Work may be awarded, as well as all Subcontractors of any tier employed by them, to communicate immediately with each other in order to schedule Work, locate storage facilities, etc., in a manner that will permit all Contractors to work in harmony in order that Work may be completed in the manner and within the time specified in the Contract Documents.

6.3 No Contractor shall delay another Contractor by neglecting to perform his work at the proper time. Each Contractor shall be required to coordinate his work with other Contractors to afford others reasonable opportunity for execution of their work. Any costs caused by defective or ill-timed work, including actual damages and liquidated damages for delay, if applicable, shall be borne by the Contractor responsible therefor.

6.4 Each Contractor shall be responsible for damage to Owner's or other Contractor's property done by him or persons in his employ, through his or their fault or negligence. If any Contractor shall cause damage to any other Contractor, the Contractor causing such damage shall upon notice of any claim, settle with such Contractor.

6.5 The Contractor shall not claim from the Owner money damages or extra compensation under this Contract when delayed in initiating or completing his performance hereunder, when the delay is caused by labor disputes, acts of God, or the failure of any other Contractor to complete his performance under any Contract with the Owner, where any such cause is beyond the Owner's reasonable control.

6.6 Progress schedule of the Contractor for the Work shall be submitted to other Contractors as necessary to permit coordinating their progress schedules.

6.7 If Contractors or Subcontractors of any tier refuse to cooperate with the instructions and reasonable requests of other contractors performing work for the Owner under separate contract, in the overall coordinating of the Work, the Owner's Representative may take such appropriate action and issue such instructions as in his judgement may be required to avoid unnecessary and unwarranted delay.

ARTICLE 7
CHANGES IN THE WORK

7.1 CHANGE ORDERS
7.1.1 A change order is a written instrument prepared by the Owner and signed by the Owner and Contractor formalizing their agreement on the following:

.1 a change in the Work
.2 the amount of an adjustment, if any, in the Contract amount
.3 an adjustment, if any, in the Contract time

7.1.2 The Owner may at any time, order additions, deletions, or revisions in the Work by a Change Order or a Construction Change Directive. Such Change Order or Construction Change Directive shall not invalidate the Contract and requires no notice to the surety. Upon receipt of any such document, or written authorization from the Owner’s Representative directing the Contractor to proceed pending receipt of the document, Contractor shall promptly proceed with the Work involved in accordance with the terms set forth therein.

7.1.3 Until such time as the change order is formalized and signed by both the Owner and the Contractor it shall be considered a Change Order Request.

7.1.4 The amount of adjustment in the contract price for authorized Change Orders will be agreed upon before such Change Orders becomes effective and will be determined as follows:

.1 By a lump sum proposal from the Contractor and the Subcontractors of any tier, including overhead and profit.
.2 By a time and material basis with or without a specified maximum. The Contractor shall submit to the Owner’s Representative itemized time and material sheets depicting labor, materials, equipment utilized in completing the Work on a daily basis for the Owner's Representative approval. If this pricing option is utilized, the
Contractor may be required to submit weekly reports summarizing costs to date on time and material change orders not yet finalized.

By unit prices contained in the Contractor's original bid and incorporated in the Construction Contract or subsequently agreed upon. Such unit prices contained in the Contractor's original proposal are understood to include the Contractor's overhead and profit. If unit prices are stated in the Contract Documents or subsequently agreed upon, and if quantities originally contemplated are so changed in a proposed Change Order that application of such unit prices to quantities of the Work proposed will cause substantial inequity to the Owner or to the Contractor, the applicable unit prices shall be equitably adjusted.

7.1.5 The Contractor shall submit all fully documented change order requests with corresponding back-up documentation within the time requested by the Owner but no later than fourteen (14) working days following 1.) the Owner's request for change order pricing in the case of a lump sum; or 2.) the completion of unit price or time and material work.

7.1.6 The Contractor shall submit change order requests in sufficient detail to allow evaluation by the Owner. Such requests shall be fully itemized by units of labor, material and equipment and overhead and profit. Such breakdowns shall be itemized as follows:

1. Labor: The Contractor's proposal shall include breakdowns by labor, by trade, indicating number of hours and cost per hour for each Subcontractor as applicable. Such breakdowns shall only include employees in the direct employ of Contractor or Subcontractors in the performance of the Work. Such employees shall only include laborers at the site, mechanics, craftsmen and foremen. Payroll cost shall include base rate salaries and wages plus the cost of fringe benefits required by agreement or custom and social security contributions, unemployment, payroll taxes and workers' or workmen's compensation insurance and other customary and legally required taxes paid by the Contractor or Subcontractors. Any item or expense outside of these categories is not allowed. The expense of performing Work after regular working hours, on Saturdays, Sundays or legal holidays shall not be included in the above, unless approved in writing and in advance by Owner.

2. Material, supplies, consumables and equipment to be incorporated into the Work at actual invoice cost to the Contractor or Subcontractors; breakdowns showing all material, installed equipment and consumables fully itemized with number of units installed and cost per unit extended. Any singular item or items in aggregate greater than one thousand dollars ($1,000) in cost shall be supported with supplier invoices at the request of the Owner’s Representative. Normal hand tools are not compensable.

3. Equipment: Breakdown for required equipment shall itemize (at a minimum) delivery / pick-up charge, hourly rate and hours used. Operator hours and rate shall not be included in the equipment breakdown. Contractor must use the most cost effective equipment available in the area and should not exceed the rates listed in the Rental Rate Blue Book for Construction Equipment (Blue Book). Contractor shall submit documentation for the Blue Book to support the rate being requested.

7.2 Construction Change Directive

7.2.1 A construction change directive is a written order prepared and signed by the Owner, issued with supporting documents prepared by the Architect (if applicable), directing a change in the Work prior to agreement on adjustment of the Contract amount or Contract time, or both. A Construction Change Directive shall be used in the absence of complete agreement between the Owner and Contractor on the terms of a change order. If the Construction Change Directive allows an adjustment of the contract amount or time, such adjustment amount shall be based on one of the following methods:

1. A lump sum agreement, properly itemized and supported by substantiating documents of sufficient detail to allow evaluation.

2. By unit prices contained in the Contractor's original proposal and incorporated in the Construction Contract or subsequently agreed upon.

3. A method agreed to by both the Owner and the contractor with a mutually agreeable fee for overhead and profit.

4. In the absence of an agreement between the Owner and the Contractor on the method of establishing an adjustment of the contract amount, the Owner, with the assistance of the architect, shall determine the adjustment amount on the basis of expenditures by the Contractor for labor, materials, equipment and other costs consistent with other provisions of the Contract. The contractor shall keep and submit to the Owner an itemized accounting of all cost components, either expended or saved, while performing the Work covered under the Construction Change Directive.

7.2.2 Upon receipt of a Construction Change Directive, Contractor shall promptly proceed with the change in the Work involved and advise Owner of Contractor's agreement or disagreement with the method, if any, provided in the Construction Change Directive for determining the proposed adjustment in the Contract Sum, Contract Time or both.

7.2.3 A Construction Change Directive signed by Contractor indicates the agreement of the Contractor therewith, including adjustment in Contract Sum and Contract Time or the method for determining them.
Such agreement shall be effective immediately and shall be recorded as a Change Order.

7.3 Overhead and Profit
7.3.1 Overhead and Profit on Change Orders shall be applied as follows:

.1 The overhead and profit charged by the Contractor and Subcontractors shall be considered to include, but not limited to, job site office and clerical expense, normal hand tools, incidental job supervision, field supervision, payroll costs and other compensation for project manager, officers, executives, principals, general managers, estimators, attorneys, auditors, accountants, purchasing and contracting agents, expediters, time-keepers, and other personnel employed whether at the site or in principal or a branch office for general superintendent and administration of the Work.

.2 The percentages for overhead and profit charged on Change Orders shall be negotiated and may vary according to the nature, extent, and complexity of the Work involved but in no case shall exceed the following:

15% To the Contractor or the Subcontractor of any tier for Work performed with their respective forces or materials purchased
5% To the Contractor on Work performed by other than his forces
5% To first tier Subcontractor on Work performed by his Subcontractor

.3 The Contractor will be allowed to add 2% for the cost of bonding and insurance to their cost of work. This 2% shall be allowed on the total cost of the added work, including overhead and profit.

.4 Not more than three mark-ups, not to exceed individual maximums shown above, shall be allowed regardless of the number of tier subcontractors. Overhead and profit shall be shown separately for each subcontractor of any tier and the Contractor.

.5 On proposals covering both increases and decreases in the amount of the Contract, the application of overhead and profit shall be on the net change in direct cost for the Contractor or Subcontractor of any tier performing the Work.

.6 The percentages for overhead and profit credit to the Owner on Change Orders that are strictly decreases in the quantity of work or materials shall be negotiated and may vary according to the nature, extent, and complexity of the Work involved, but shall not be less than the following:

7.4 Extended General Conditions
7.4.1 The Contractor acknowledges that the percentage mark-up allowed on change orders for overhead and profit cover the Contractor’s cost of administering and executing the Work, inclusive of change orders that increase the contract time. Contractor further acknowledges that no compensation beyond the specified mark-up percentages for extended overhead shall be due or payable as a result of an increase in the Contract Time.

.2 The Owner may reimburse the Contractor for extended overhead if an extension of the Contract Time is granted by the Owner, in accordance with Article 4.7.1 and the Owner determines that the extension of the Contract Time creates an inequitable condition for the Contractor. If these conditions are determined by the Owner to exist the Contractor may be reimbursed by unit prices contained in the Contractor's original bid and incorporated in the Construction Contract or by unit prices subsequently agreed upon.

.3 If unit prices are subsequently agreed upon, the Contractor’s compensation shall be limited as follows:

1 For the portion of the direct payroll cost of the Contractor’s project manager expended in completing the Work and the direct payroll cost of other onsite administrative staff not included in Article 7.3.1. Direct payroll cost shall include base rate salaries and wages plus the cost of fringe benefits required by agreement or custom and social security contributions, unemployment, payroll taxes and workers' or workmen's compensation insurance and other customary and legally required taxes paid by the Contractor;

2 Cost of Contractor’s temporary office, including temporary office utilities expense;

3 Cost of temporary utilities required in the performance of the work;

4 Profit not to exceed 5% of the total extended overhead direct costs;

7.4.4 All costs not falling into one of these categories and costs of the Contractors staff not employed onsite are not allowed.

7.5 Emergency Work
7.5.1 If, during the course of the Work, the Owner has need to engage the Contractor in emergency work, whether related to the Work or not, the Contractor shall immediately
proceed with the emergency work as directed by the Owner under the applicable provisions of the contract. In so doing, Contractor agrees that all provisions of the contract remain in full force and effect and the schedule for the Work is not impacted in any way unless explicitly agreed to in writing by the Owner.

ARTICLE 8
TIME

8.1 Progress and Completion

8.1.1 Contractor acknowledges and agrees that time is of the essence of this Contract

8.1.2 Contract Time is the period of time set forth in the Contract for Construction required for Substantial Completion and Final Completion of the entire Work or portions of the Work as defined in the Contract Documents. Time limits stated in the Contract Documents are of the essence of the Contract. The Contract Time may only be changed by a Change Order. By executing the Contract, the Contractor confirms that the Contract Time is a sufficient period for performing the Work in its entirety.

8.1.3 The Contractor shall not knowingly, except by agreement or instruction of the Owner in writing, prematurely commence operations on the site or elsewhere prior to the effective date of insurance and bonds required by Article 11 to be furnished by the Contractor.

8.1.4 The Contractor shall proceed expeditiously and diligently with adequate forces and shall achieve Substantial Completion and Final Completion within the time specified in the Contract Documents.

8.2 Delay in Completion

8.2.1 The Contractor shall be liable for all of the Owner's damages for delay in achieving Substantial Completion and/or Final Completion of the entire Work or portions of Work as set forth in the Contract Documents within the Contract Time unless liquidated damages are specifically provided for in the Contract Documents. If liquidated damages are specifically provided for in the Contract for Construction, Contractor shall be liable for such liquidated damages as set forth in Paragraph 8.3

8.2.2 All time limits stated in the Contract are of the essence of the Contract. However, if the Contractor is delayed at any time in the progress of the Work by any act or neglect of the Owner or by the Owner's Representative, by changes ordered in the Work, by strikes, lockouts, abnormal weather conditions, jurisdictional disputes, or any other causes beyond the Contractor's reasonable control which the Owner's Representative determines may justify delay then, upon submission of the Time Impact Schedule Analysis (TIA) called out in Section 4.7 of these General Conditions, the Contract Time may be extended for a reasonable time to the extent such delay will prevent Contractor from achieving Substantial Completion and/or Final Completion within the Contract Time and if performance of the Work is not, was not or would not have been delayed by any other cause for which the Contractor is not entitled to an extension in the Contract Time under the Contract Documents. It shall be a condition precedent to any adjustment of the Contract Time that Contractor provide the Owner's Representative with written notice of the cause of delay within seven (7) days from the occurrence of the event or condition which caused the claimed delay. Written notices hereunder shall be in accordance with the applicable provisions of Section 4.7.

8.2.3 The Contractor further acknowledges and agrees that adjustments in the Contract Time will be permitted for a delay only to the extent such delay (1) is not caused, or could not have been anticipated, by the Contractor, (2) could not be limited or avoided by the Contractor's timely notice to the Owner of the delay, (3) prevents Contractor from completing its Work by the Contract Time, and (4) is of a duration not less than one (1) day. Delays attributable to and within the control of a Subcontractor or supplier shall not justify an extension of the Contract Time.

8.2.4 Notwithstanding anything to the contrary in the Contract Documents, except as otherwise noted in these General Conditions, an extension in the Contract Time, to the extent permitted under this Article, shall be the sole remedy of the Contractor for any (1) delay in the commencement, prosecution or completion of the Work, (2) hindrance or obstruction in the performance of the Work, (3) loss of productivity, or (4) other similar claims due to or caused by any events beyond the control of both the Owner and Contractor. In no event shall the Contractor be entitled to any compensation or recovery of any damages or any portion of damages resulting from delays caused by or within the control of Contractor or by acts or omissions of Contractor or its Subcontractors of any tier or delays beyond the control of both Owner and Contractor. If the Contractor contends that delay, hindrance, obstruction or other adverse condition results from acts or omissions of the Owner, the Owner's Representative or the Architect, Contractor shall promptly provide written notice to the Owner. Contractor shall only be entitled to an adjustment in the Contract Sum to the extent that such acts or omissions continue after the Contractor's written notice to the Owner of such acts or omissions. The Owner's exercise of any of its rights or remedies under the Contract Documents (including, without limitation, ordering changes in the Work, or directing suspension, rescheduling or correction of the Work) regardless of the extent or frequency of the Owner's exercise of such rights or remedies, shall not be the basis of any Claim for an increase in the Contract Sum or Contract
Time. In the event Contractor is entitled to an adjustment in the Contract Sum for any delay, hindrance, obstruction or other adverse condition caused by the acts or omissions of the Owner, the Owner’s Representative or the Architect, Contractor shall only be entitled to its actual direct costs caused thereby and Contractor shall not be entitled to and waives any right to special, indirect, or consequential damages including loss of profits, loss of savings or revenues, loss of anticipated profits, labor inefficiencies, idle equipment, home office overhead, and similar type of damages.

8.2.5 If the Contractor submits a progress report or any construction schedule indicating, or otherwise expressing an intention to achieve completion of the Work prior to any completion date required by the Contract Documents or expiration of the Contract Time, no liability of the Owner to the Contractor for any failure of the Contractor to so complete the Work shall be created or implied. Further, the Contractor acknowledges and agrees that even if Contractor intends or is able to complete the Work prior to the Contract Time, it shall assert no Claim and the Owner shall not be liable to Contractor for any failure of the Contractor, regardless of the cause of the failure, to complete the Work prior to the Contract Time.

8.3 Liquidated Damages
8.3.1 If Liquidated Damages are prescribed on the Bid Form and Special Conditions in the Contract Documents, the Owner may deduct from the Contract Sum and retain as Liquidated Damages, and not as penalty or forfeiture, the sum stipulated in the Contract Documents for each calendar day after the date specified for completion of the Work that the entire Work is not substantially complete and/or finally complete.

8.3.2 The Owner’s Representative shall establish the date of Substantial completion and the date of Final Completion of the Work which shall be conclusive and binding on the Owner and Contractor for the purpose of determining whether or not Liquidated Damages shall be assessed under terms hereof and the sum total amount due.

8.3.3 Liquidated Damages or any matter related thereto shall not relieve the Contractor or his surety of any responsibility or obligation under this Contract.

ARTICLE 9
PAYMENTS AND COMPLETION

9.1 Commencement, Prosecution, and Completion
9.1.1 The Contractor shall commence Work within five (5) days upon the date of a “Notice to Proceed” from the Owner or the date fixed in the Notice to Proceed. Contractor shall prosecute the Work with faithfulness and diligence, and the Contractor shall complete the Work within the Contract Time set forth in the Contract Documents.

9.1.2 The Owner will prepare and forward three (3) copies of the Contract and Performance Bond to the bidder to whom the contract for the Work is awarded and such bidder shall return two (2) properly executed prescribed copies of the Contract and Bond to the Owner.

9.1.3 The construction period, when specified in consecutive calendar days, shall begin when the Contractor receives notice requesting the instruments listed in below. Before the Owner will issue Notice to Proceed to permit the Contractor to begin Work, the Owner shall have received the following instruments, properly executed as described in the Contract Documents. The documents below shall have been received by the Owner within fifteen (15) days after receipt of request for documents:

1. Contract
2. Bond (See Article 11)
3. Insurance (See Article 11)
4. List of Subcontractors of any tier
5. Affirmative Action Plan (see Article 13.4)

9.1.4 In the event Contractor fails to provide Owner such documents, Contractor may not enter upon the site of the Work until such documents are provided. The date the Contractor is required to commence and complete the Work shall not be affected by the Owner denying Contractor access to the site as a result of Contractor’s failure to provide such documents and Contractor shall not be entitled to an adjustment of the Contract Time or Contract sum as a result of its failure to comply with the provisions of this Paragraph

9.1.5 Contracts executed by partnerships shall be signed by all general partners of the partnership. Contracts signed by corporations shall be signed by the President or Vice President and the Secretary or Assistant Secretary. In case the Assistant Secretary or Vice President signs, it shall be so indicated by writing the word "Asst." or "Vice" in front of the words "Secretary" and "President". The corporate seal of the corporation shall be affixed. For all other types of entities, the Contractor and the person signing the Contract on behalf of Contractor represent and warrant that the person signing the Contract has the legal authority to bind Contractor to the Contract.

9.1.6 Any successful bidder which is a corporation organized in a state other than Missouri or any bidder doing business in the State of Missouri under a fictitious name shall furnish, at no cost to the Owner, no later than the time at which the executed Contract for Construction, the Payment Bond, and the Performance Bond are returned, a properly certified copy of its current Certificate of Authority and License to do business in the State of Missouri. No contract will be executed by the Owner until such certificate is furnished by the bidder, unless there already is on file with
the Owner a current certificate, in which event, no additional certificate will be required during the period of time for which such current certificate remains in effect.

9.1.7 Within fifteen (15) calendar days of the issuance of a Notice to Proceed, the Contractor shall submit one (1) signed copy of the following instruments. No payment will be processed until all of these instruments are received and approved by the Owner's Representative.

.1 Reproducible progress and payment schedule
.2 Contractor's Schedule of Values
.3 List of material suppliers
.4 Itemized breakdown of all labor rates for each classification. Overhead and profit shall not be included. Payroll cost shall include base rate salaries and wages plus the cost of fringe benefits required by agreement or custom and social security contributions, unemployment, payroll taxes and workers' or workmen's compensation insurance and other customary and legally required taxes paid by the Contractor or Subcontractors. Any item or expense outside of these categories is not allowed. The expense of performing Work after regular working hours, on Saturdays, Sundays or legal holidays shall not be included in the above, unless approved in writing and in advance by Owner.

.5 Itemized breakdown of anticipated equipment rates (breakout operator rate). Overhead and profit shall not be included. Breakdown for required equipment shall itemize (at a minimum) delivery/pick-up charge, hourly rate and hours used. Operator hours and rate shall not be included in the equipment breakdown. Contractor must use the most cost effective equipment available in the area and should not exceed the rates listed in the Rental Rate Blue Book for Construction Equipment (Blue Book). Contractor shall submit documentation for the Blue Book to support the rate being requested.

9.1.8 The Contractor shall be paid electronically using the Owner's web-based payment program with a direct electronic transfer from the Owner’s account into the Contractor’s account. The Contractor must submit the following information to the Owner’s Representative:

.1 Bank Transit Number for the Contractor’s bank into which the electronic deposit will be made.
.2 Bank Account Number for the Contractor’s account into which the electronic deposit will be made.
.3 Contractor’s E-Mail address so that formal notification of the deposit by the Owner can be provided.

9.2 Contract Sum

9.2.1 The Owner shall compensate Contractor for all Work described herein and in the Contract Documents the Contract Sum set forth in the Contract for Construction, subject to additions and deletions as provided hereunder.

9.3 Schedule of Values

9.3.1 Within fifteen (15) days after receipt of the Notice to Proceed, the Contractor shall submit to the Owner’s Representative a schedule of values allocated to various portions of the Work, prepared in such form and supported by such data to substantiate its accuracy as the Owner’s Representative may require. This schedule, unless objected to by the Owner’s Representative, shall be used as a basis for reviewing the Contractor's Applications for Payment. The values set forth in such schedule may, at the Owner’s option be used in any manner as fixing a basis for additions to or deletions from the Contract Sum.

9.3.2 The progress and payment schedule of values shall show the following:

.1 Enough detail as necessary to adequately evaluate the actual percent complete of any line item on a monthly basis, as determined by the Owner’s Representative.

.2 Line items, when being performed by a subcontractor or material supplier, shall correlate directly back to the subcontract or purchase order amount if requested by the Owner’s Representative.

9.4 Applications for Payment

9.4.1 The Contractor shall submit monthly to the Owner’s Representative and the Architect an itemized Application for Payment for operations completed in accordance with the Schedule of Values. Such application shall be supported by such data substantiating the Contractor's right to payment as the Owner’s Representative or Architect may require, such as copies of requisitions from Subcontractors and material suppliers, and reflecting retainage as provided for herein.

9.4.2 Such applications shall not include requests for payment of amounts the Contractor does not intend to pay to a Subcontractor or material supplier.

9.4.3 Progress payments shall be made on account of materials and equipment delivered to the site and incorporated in the Work. No payments will be made for materials and equipment stored at the Project site but not yet incorporated into the Work except as provided in Paragraph 9.4.4.

9.4.4 If approved in writing and in advance by Owner, progress payments may be made on account of materials and equipment delivered and suitably stored at the site for subsequent incorporation in the Work. Owner may in its sole discretion refuse to grant approval for payments for materials and equipment stored at the Project site but not yet incorporated in the Work. Any approval by Owner for payment for materials and equipment delivered and suitably
stored at the site, or stored offsite as noted below, for subsequent incorporation in the Work shall be conditioned upon Contractor’s demonstrating that such materials and equipment are adequately protected from weather, damage, vandalism and theft and that such materials and equipment have been inventoried and stored in accordance with procedures established by or approved by the Owner. Nothing in this clause shall imply or create any liability on the part of the Owner for the Contractor’s inventory and storage procedures or for any loss or damage to material, equipment or supplies stored on the site, whether incorporated into the work or not. In the event any such loss or damage occurs, the Contractor remains solely responsible for all costs associated with replacement of the affected materials, supplies and equipment including labor and incidental costs, and shall have no claim against the Owner for such loss.

No allowance shall be made in the project pay requests for materials not delivered to the site of the work and incorporated into the work, except as noted below. For the purposes of this Article, Offsite is defined as any location not owned or leased by the Owner. Contractor shall submit a list of materials that they are requesting payment for offsite storage within 60 days of Notice Proceed.

.1 Items considered to be major items of considerable magnitude, if suitably stored, may be allowed in project pay requests on the basis of ninety percent (90%) of invoices
.2 Determination of acceptable “major items of considerable magnitude” and “suitably stored” shall be made by the Owner’s Representative.
.3 Aggregate quantities of materials not considered unique to this project will not be considered for offsite storage payment.
.4 Contractor shall submit to the Owner’s Representative a list of the material for which application for payment for offsite storage is anticipated no less than forty-five days prior to the submission of the applicable pay request. The list shall include a material description, applicable division, quantity and discounts offered to the Owner for early payment. Contractor shall also submit the location the material will be stored and the method of protection
.5 The storage facility shall be subject to approval by the Owner’s representative, shall be located within an acceptable distance of the project sites as established by the Owner’s Representative and all materials for the Owner’s project must be stored separately from all other items within the storage facility and shall be labeled and stored in the name of the Curators of the University of Missouri.
.6 The Owner’s representative shall be provided a minimum of two weeks tice to visit the storage facility and inspect the stored material prior to submission of the pay request.

.7 Upon favorable inspection by the Owner’s Representative, the Contractor shall, at the Owner’s option, submit the appropriate UCC filing, transferring title of the material or equipment to The Curators of the University of Missouri.
.8 An invoice provided by the supplier shall be included with the applicable pay request.
.9 The contractor shall remain fully responsible for all items, until acceptance of the project by the Owner.
10. The contractor shall reimburse all costs incurred by the Owner in inspecting and verifying all material stored offsite, including mileage, airfare, meals, lodging and time, charged at a reasonable hourly rate.

9.4.5 The Application for Payment shall constitute a representation by the Contractor to the Owner that the Work has progressed to the point indicated; the quality of the Work covered by the Application for Payment is in accordance with the Contract Documents; and the Contractor is entitled to payment in the amount requested.

9.4.6 The Contractor will be reimbursed for ninety-five percent (95%) of the value of all labor furnished and material installed and computed in the same manner, less all previous payments made. On projects where a bond is not required, the contractor will be reimbursed for ninety percent (90%) of the value of all labor furnished and material installed and computed in the same manner, less all previous payments made.

9.5 Approval for Payment
9.5.1 The Owner’s Representative will, within fifteen (15) days after receipt of the Contractor's Application for Payment, either approve Contractor’s Application for Payment for such amount as the Owner’s Representative determines is properly due, or notify the Contractor of the Owner’s Representative's reasons for withholding certification in whole or in part as provided in Section 9.6.

9.6 Decisions to Withhold Approval
9.6.1 The Owner’s Representative may decide not to certify payment and may withhold approval in whole or in part, to the extent reasonably necessary to protect the Owner. If the Owner’s Representative is unable to approve payment in the amount of the Application, the Owner’s Representative will notify the Contractor as provided in Paragraph 9.5.1. If the Contractor and Owner’s Representative cannot agree on a revised amount, the Owner’s Representative will promptly issue approval for payment for the amount for which the Owner’s Representative is able to determine is due Contractor. The Owner’s Representative may also decide not to approve payment or, because of subsequently discovered evidence or subsequent observations, may nullify the whole or a part of approval for payment previously issued, to such extent as may
be necessary in the Owner’s Representative opinion to protect the Owner from loss because of:
.1 defective Work not remedied or damage to completed Work;
.2 failure to supply sufficient skilled workers or suitable materials;
.3 third party claims filed or reasonable evidence indicating probable filing of such claims;
.4 failure of the Contractor to make payments properly to Subcontractors or for labor, materials or equipment, Owner may, at its sole option issue joint checks to subcontractors who have presented evidence that it has not been paid in accordance with the Contract;
.5 reasonable evidence that the Work cannot be completed for the unpaid balance of the Contract Sum;
.6 damage to the Owner or another contractor;
.7 reasonable evidence that the Work will not be completed within the Contract Time or an unsatisfactory rate of progress made by Contractor;
.8 Contractor’s failure to comply with applicable Laws;
.9 Contractor’s or Subcontractor’s failure to comply with contract Prevailing Wage requirements; or
.10 Contractor’s failure to carry out the Work in strict accordance with the Contract Documents.

9.6.2 When the above reasons for withholding approval are removed, approval will be made for amounts previously withheld.

9.7 Progress Payments
9.7.1 Based upon Applications for Payment submitted to the Owner by the Contractor and approvals issued by the Owner’s Representative, the Owner shall make progress payments on account of the Contract Sum to the Contractor as provided below and elsewhere in the Contract Documents.

9.7.2 The period covered by each Application for Payment shall be one (1) calendar month.

9.7.3 The Owner shall make payment to Contractor for amounts due and approved by Owner’s Representative not later than thirty (30) days after the Owner approves a properly detailed Application for Payment which is in compliance with the Contract Documents. The Owner shall not have the obligation to process or pay such Application for Payment until it receives an Application for Payment satisfying such requirements.

9.7.4 Based on the Schedule of Values submitted by Contractor, Applications for Payment submitted by Contractor shall indicate the actual percentage of completion of each portion of Contractor’s Work as of the end of the period covered by the Application for Payment.

9.7.5 The Contractor shall promptly pay each Subcontractor and Supplier, upon receipt of payment from the Owner, out of the amount paid to the Contractor on account of such Subcontractor's or supplier's portion of the Work, the amount to which said Subcontractor or supplier is entitled, reflecting percentages actually retained from payments to the Contractor on account of each Subcontractor's or supplier's portion of the Work, in full compliance with state statute. The Contractor shall, by appropriate agreement with each Subcontractor or supplier, require each Subcontractor or supplier to make payments to Sub-subcontractors in similar manner.

9.7.6 Neither the Owner nor Architect shall have an obligation to pay or to see to the payment of money to a Subcontractor of any tier nor a laborer or employee of Contractor except to the extent required by law. Retainage provided for by the Contract Documents are to be retained and held for the sole protection of Owner, and no other person, firm or corporation shall have any claim or right whatsoever thereto.

9.7.7 An approval for payment by Owner’s Representative, a progress payment, or partial or entire use or occupancy of the Project by the Owner shall not constitute acceptance of Work not in accordance with the Contract Documents.

9.8 Failure of Payment
9.8.1 If the Owner is entitled to reimbursement or payment from the Contractor under or pursuant to the Contract Documents, such payment by Contractor shall be made promptly upon demand by the Owner. Notwithstanding anything contained in the Contract Documents to the contrary, if the Contractor fails to promptly make any payment due the Owner, or the Owner incurs any costs and expenses to cure any default of the Contractor or to correct defective Work, the Owner shall have an absolute right to offset such amount against the Contract Sum and may, in the Owner’s sole discretion, elect either to: (1) deduct an amount equal to that to which the Owner is entitled from any payment then or thereafter due the Contractor from the Owner, or (2) issue a written notice to the Contractor reducing the Contract Sum by an amount equal to that to which the Owner is entitled.

9.9 Substantial Completion
9.9.1 Substantial Completion is the stage in the progress of the Work as defined in Paragraph 1.1.9 as certified by the Owner.

9.9.2 When the Contractor considers the Work, or a portion thereof which the Owner agrees to accept separately, is substantially complete, the Contractor shall notify the Owner and the Architect. The Owner’s Representative will make an inspection to determine whether the Work or designated...
portion thereof is substantially complete. If the Owner’s Representative's inspection discloses any item which is not in accordance with the requirements of the Contract Documents, the Contractor shall complete or correct such item upon notification by the Owner’s Representative. The Contractor shall then submit a request for another inspection by the Owner’s Representative to determine Substantial Completion. When the Work or designated portion thereof is substantially complete, the Owner will issue a Certificate of Substantial Completion. Substantial Completion shall transfer from the Contractor to the Owner responsibilities for security, maintenance, heat, utilities, damage to the Work and insurance. In no event shall Contractor have more than thirty (30) days to complete all items on the Punch List and achieve Final Completion. Warranties required by the Contract Documents shall commence on the date of Substantial Completion or as agreed otherwise.

9.11.1 Final Completion and Final Payment
Upon receipt of written notice that the Work is ready for final inspection and acceptance and upon receipt of a final Application for Payment, the Owner’s Representative and the Architect will promptly make such inspection and, when the Owner’s Representative and Architect find the Work acceptable under the Contract Documents and the Contract fully performed, the Owner’s Representative will promptly issue a final approval for payment; otherwise, Owner’s Representative will return Contractor's Final Application for Payment to Contractor, indicating in writing the reasons for refusing to recommend final payment, in which case Contractor shall make the necessary corrections and resubmit the Application. Submission of a Final Application for Payment shall constitute a further representation that conditions listed in Paragraph 9.11.2 as precedent to the Contractor's being entitled to final payment have been fulfilled. All warranties and guarantees required under or pursuant to the Contract Documents shall be assembled and delivered by the Contractor to the Owner’s Representative as part of the final Application for Payment. The final approval for payment will not be issued by the Owner’s Representative until all warranties and guarantees have been received and accepted by the Owner.

9.11.2 The Owner will request the Contractor to submit the application for final payment along with a manually signed notarized letter on the Contractor's letterhead certifying that:
1. Labor costs, prevailing wage rates, fringe benefits and material costs have been paid.
2. Subcontractors of any tier and manufacturers furnishing materials and labor for the project have fully completed their Work and have been paid in full.
3. The project has been fully completed in accordance with the Contract Documents as modified by Change Orders.
4. The acceptance by Contractor of its Final Payment, by check or electronic transfer, shall be and operate as a release of all claims of Contractor against Owner for all things done or furnished or relating to the Work and for every act or alleged neglect of Owner arising out of the Work.

9.11.3 Final Payment constituting the entire unpaid balance due shall be paid by the Owner to the Contractor within thirty (30) days after Owner's receipt of Contractor's Final Application for Payment which satisfies all the requirements of the Contract Documents and Owner’s receipt of all information and documents set forth in Section 9.11.

9.11.4 No payment under this Contract, including but not limited to final payment, shall constitute acceptance by Owner of any Work or act not in accordance with the requirements of the Contract Documents.

9.11.5 No recourse shall be had against any member of the Board of Curators, or officer thereof, for any payment under the Contract or any claim based thereon.

ARTICLE 10
PROTECTION OF PERSONS AND PROPERTY
10.1 Safety Precautions and Programs

10.1.1 The Contractor shall at all times conduct operations under this Contract in a manner to avoid the risk of bodily harm to persons or risk of damage to any property. The Contractor shall promptly take precautions which are necessary and adequate against conditions created during the progress of the Contractor's activities hereunder which involve a risk of bodily harm to persons or a risk of damage to property. The Contractor shall continuously inspect Work, materials, and equipment to discover and determine any such conditions and shall be solely responsible for discovery, determination, and correction of any such conditions. The Contractor shall comply with applicable safety laws, standards, codes, and regulations in the jurisdiction where the Work is being performed, specifically, but without limiting the generality of the foregoing, with rules regulations, and standards adopted pursuant to the Williams-Steiger Occupational Safety and Health Act of 1970 and applicable amendments.

10.1.2 All contractors, subcontractors and workers on this project are subject to the Construction Safety Training provisions 292.675 RSMo.

10.1.3 In the event the Contractor encounters on the site, material reasonably believed to be asbestos, polychlorinated biphenyl (PCB), lead, mercury, or other material known to be hazardous, which has not been rendered harmless, the Contractor shall immediately stop Work in the area affected and report the condition to the Owner's Representative and the Architect in writing. The Work in the affected area shall not thereafter be resumed except by written agreement of the Owner's Representative and Contractor if in fact the material is asbestos or polychlorinated biphenyl (PCB) and has not been rendered harmless. The Work in the affected area shall be resumed in the absence of asbestos or polychlorinated biphenyl (PCB), or when it has been rendered harmless by written agreement of the Owner's Representative and the Contractor. “Rendered Harmless” shall mean that levels of such materials are less than any applicable exposure standards, including but limited to OSHA regulations.

10.2 Safety Of Persons And Property

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

1. students, faculty, staff, the public, construction personnel, and other persons who may be affected thereby;

2. the Work and materials and equipment to be incorporated therein, whether in storage on or off the site, under care, custody, or control of the Contractor or the Contractor's Subcontractors of any tier; and

3. other property at the site or adjacent thereto, such as trees, shrubs, lawns, walks, pavements, roadways, structures, and utilities not designated for removal, relocation, or replacement in the course of construction.

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

10.2.3 The Contractor shall erect and maintain, as required by existing conditions and performance of the Contract, safeguards for safety and protection, including, but not limited to, posting danger signs and other warnings against hazards, promulgating safety regulations, and notifying owners and users of adjacent sites and utilities.

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

10.2.5 The Contractor shall promptly remedy damage and loss (other than damage or loss insured under property insurance required by the Contract Documents) to property referred to in Article 10 caused in whole or in part by the Contractor, a Subcontractor of any tier, or anyone directly or indirectly employed by any of them, or by anyone for whose acts they may be liable, and for which the Contractor is responsible under Article 10, except damage or loss attributable solely to acts or omissions of Owner or the Architect or anyone directly or indirectly employed by either of them, or by anyone for whose acts either of them may be liable, and not attributable to the fault or negligence of the Contractor. The foregoing obligations of the Contractor are in addition to the Contractor's other obligations stated elsewhere in the Contract.

10.2.6 The Contractor shall designate a responsible member of the Contractor's organization at the site whose duty shall be the prevention of accidents, and the maintaining, enforcing and supervising of safety precautions and programs. This person shall be the Contractor's superintendent unless otherwise designated by the Contractor in writing to the Owner's Representative and Architect. The Contractor shall hold regularly scheduled safety meetings to instruct Contractor personnel on safety practices, accident avoidance and prevention, and the Project Safety Program. The Contractor shall furnish safety equipment, and enforce the use of such equipment by it's employees and it's subcontractors of any tier.

10.2.7 The Contractor shall not load or permit any part of the construction or site to be loaded so as to endanger its safety.
10.2.8 The Contractor shall promptly report in writing to the Owner all accidents arising out of or in connection with the Work which cause death, lost time injury, personal injury, or property damage, giving full details and statements of any witnesses. In addition, if death, serious personal injuries, or serious property damages are caused, the accident shall be reported immediately by telephone or messenger to the Owner.

10.2.9 The Contractor shall promptly notify in writing to the Owner of any claims for injury or damage to personal property related to the work, either by or against the Contractor.

ARTICLE 11
INSURANCE & BONDS

11.1 Insurance
11.1.1 Contractor shall secure from the date of the Contract for Construction and maintain for such periods of time as set forth below, insurance of such types and in such amounts specified below, to protect Contractor, Owner and others against all hazards or risks of loss described below. The form of such insurance together with carriers thereof, in each case, shall be approved by Owner, but, regardless of such approval, it shall be the responsibility of Contractor to maintain the insurance coverages set forth herein.

11.1.2 The contractor shall not be allowed on the Owners property without proof of the insurance coverages set forth herein.

11.2 Commercial General Liability
11.2.1 Contractor shall secure from the date of the Contract and for a period of at least five (5) years from the date of Final Completion of the entire Work Commercial General Liability insurance (“CGL”) with a combined single limit of not less than $2,000,000 per occurrence, $5,000,000 general aggregate, $5,000,000 products and completed operations aggregate and $1,000,000 personal injury and advertising injury. General Aggregate should apply per project. An umbrella policy may be used to satisfy these limits. If the General Aggregate is not on a per project basis, the contractor shall provide an additional $2,000,000 general aggregate.

11.2.2 CGL insurance shall be written on a comprehensive form and shall cover claims and liability in connection with or resulting from the Contractor’s operations and activities under the Contract, for personal injuries, occupational sickness, disease, death or damage to property of others, including loss of use resulting therefrom, arising out of any operations or activities of the Contractor, its agents, or any Subcontractors of any tier or by anyone directly or indirectly employed by either of them.

11.2.3 CGL insurance shall include premises, operations, independent contractors, products-completed operations, personal injury and advertising injury and liability assumed under an insured contract (including the tort liability of another assumed in a business contract) coverages. In particular, and not by way of any limitation, the CGL insurance shall cover the Contractor’s indemnity obligations contained in the Contract Documents.

11.2.4 There shall be no endorsement or modification of the CGL policy limiting the scope of coverage for liability arising from blasting, explosion, collapse, or underground property damage.

11.2.5 “The Curators of the University of Missouri” shall be endorsed as an “additional insured” under the CGL policy. The additional insured status must be conveyed by using the ISO CG 2 10 (2004) edition or equivalent and the ISO CG 20 37 (2004) edition. The policy shall be endorsed to be primary coverage and any other insurance carried by the Owner shall be excess only and will not contribute with Contractors’ insurance. To confirm, the Endorsement should accompany the insurance certificate.

11.2.6 Contractor waives all rights against Owner and its agents, officers, representatives and employees for recovery of damages to the extent those damages are covered by the CGL policy required hereunder.

11.3 Licensed for Use Vehicle Liability
11.3.1 Contractor shall secure and maintain from the date of the Contract for Construction until the date of Final Completion of the entire Work, insurance, to be on comprehensive form, which shall protect Contractor against any and all claims for all injuries and all damage to property arising from the use of automobiles, trucks and motorized vehicles, in connection with the performance of Work under this Contract, and shall cover the operation on or off the site of the Work of all motor vehicles licensed for highway use whether they are owned, non-owned or hired. Such insurance shall include contractual liability coverage and shall provide coverage on the basis of the date of any accident. The liability limits under such policy shall not be less than $2,000,000 combined single limit for bodily injury and property damage per accident.

11.3.2 Contractor waives all rights against Owner and its agents, officers, directors and employees for recovery of damages to the extent such damages are covered by the automobile liability insurance required hereunder.

11.4 Workers’ Compensation Insurance
11.4.1 Contractor shall purchase and maintain workers’ compensation insurance and employers’ liability insurance.
which shall protect Contractor from claims for injury, sickness, disease or death of Contractor’s employees or statutory employees. The insurance policies required hereunder shall include an “all states” or “other states” endorsement. In case any Work is sublet, Contractor shall require any Subcontractor of any tier to provide the insurance coverages required under this Section 11.4.

11.4.2 Contractor’s workers’ compensation insurance coverage shall be in compliance with all applicable Laws, including the statutes of the State of Missouri. Contractor’s employers’ liability coverage limits shall not be less than $1,000,000 each accident for bodily injury by accident or $1,000,000 each employee for bodily injury by disease.

11.5 Liability Insurance General Requirements
11.5.1 All insurance coverages procured by Contractor shall be provided by agencies and insurance companies acceptable to and approved by Owner. Any insurance coverage shall be provided by insurance companies that are duly licensed to conduct business in the State of Missouri as an admitted carrier. The form and content of all insurance coverage provided by Contractor are subject to the approval of Owner. All required insurance coverages shall be obtained and paid for by Contractor. Any approval of the form, content or insurance company by Owner shall not relieve the Contractor from the obligation to provide the coverages required herein.

11.5.2 All insurance coverage procured by the Contractor shall be provided by insurance companies having policyholder ratings no lower than "A-" and financial ratings not lower than "XI" in the Best's Insurance Guide; latest edition in effect as of the date of the Contract, and subsequently in effect at the time of renewal of any policies required by the Contract Documents. Insurance coverages required hereunder shall not be subject to a deductible amount on a per-claim basis of more than $10,000.00 and shall not be subject to a per-occurrence deductible of more than $25,000.00. Insurance procured by Contractor covering the additional insureds shall be primary insurance and any insurance maintained by Owner shall be excess insurance.

11.5.3 All insurance required hereunder shall provide that the insurer’s cost of providing the insureds a defense and appeal, including attorneys’ fees, shall be supplementary and shall not be included as part of the policy limits but shall remain the insurer’s separate responsibility. Contractor shall cause its insurance carriers to waive all rights of subrogation, except for Workers’ Compensation, against the Owner and its officers, employees and agents.

11.5.4 The Contractor shall furnish the Owner with certificates, Additional Insured endorsements, policies, or binders which indicate the Contractor and/or the Owner and other Contractors (where required) are covered by the required insurance showing type, amount, class of operations covered, effective dates and dates of expiration of policies prior to commencement of the work. Contractor is required to maintain coverages as stated and required to notify the University of a Carrier Change or cancellation within 2 business days. The University reserves the right to request a copy of the policy. Contractor fails to provide, procure and deliver acceptable policies of insurance or satisfactory certificates or other evidence thereof, the Owner may obtain such insurance at the cost and expense of the Contractor without notice to the Contractor.

11.5.5 With respect to all insurance coverages required to remain in force and affect after final payment, Contractor shall provide Owner additional certificates, policies and binders evidencing continuation of such insurance coverages along with Contractor’s application for final payment and shall provide certificates, policies and binders thereafter as requested by Owner.

11.5.6 The maintenance in full current force and effect of such forms and amounts of insurance and bonds required by the Contract Documents shall be a condition precedent to Contractor’s exercise or enforcement of any rights under the Contract Documents.

11.5.7 Failure of Owner to demand certificates, policies and binders evidencing insurance coverages required by the Contract Documents, approval by Owner of such certificates, policies and binders or failure of Owner to identify a deficiency from evidence that is provided by Contractor shall not be construed as a waiver of Contractor’s obligations to maintain the insurance required by the Contract Documents.

11.5.8 The Owner shall have the right to terminate the Contract if Contractor fails to maintain the insurance required by the Contract Documents.

11.5.9 If Contractor fails to maintain the insurance required by the Contract Document, Owner shall have the right, but not the obligation, to purchase said insurance at Contractor’s expense. If Owner is damaged by Contractor’s failure to maintain the insurance required by the Contract Documents, Contractor shall bear all reasonable costs properly attributable to such failure.

11.5.10 By requiring the insurance set forth herein and in the Contract Documents, Owner does not represent or warrant that coverage and limits will necessarily be adequate to protect Contractor, and such coverages and limits shall not be deemed as a limitation on Contractor’s liability under the indemnities granted to Owner in the Contract Documents.
11.5.11 If Contractor’s liability policies do not contain a standard separation of insureds provision, such policies shall be endorsed to provide cross-liability coverage.

11.5.12 If a part of the Work hereunder is to be subcontracted, the Contractor shall: (1) cover any and all Subcontractors in its insurance policies; (2) require each Subcontractor to secure insurance which will protect said Subcontractor and supplier against all applicable hazards or risks of loss designated in accordance with Article 11 hereunder; and (3) require each Subcontractor or supplier to assist in every manner possible in the reporting and investigation of any accident, and upon request, to cooperate with any insurance carrier in the handling of any claim by securing and giving evidence and obtaining the attendance of witnesses as required by any claim or suit.

11.5.13 It is understood and agreed that the insurance coverages required by the provisions of this Article 11 are required in the public interest and that the Owner does not assume any liability for acts of Contractor or Subcontractors of any tier or their employees in the performance of the Contract or Work.

11.6 Builder’s Risk Insurance

11.6.1 The Contractor shall purchase and maintain, in a company or companies lawfully authorized to do business in the State of Missouri, as an admitted carrier, builder’s risk insurance on the entire Work. Such insurance shall be written on a completed value form for the entire Work. The insurance shall apply on a replacement cost basis.

11.6.2 The insurance as required herein shall name as insureds the Owner, Contractor and all Subcontractors of any tier. The insurance policy shall contain a provision that the insurance will not be canceled, allowed to expire or materially changed until at least thirty (30) days prior written notice has been given to Owner.

11.6.3 The insurance as required herein shall cover the entire Work, including reasonable compensation for Architect’s services and expenses made necessary by an insured loss. Insured property shall include portions of the Work located away from the site (including all offsite stored materials) but intended for use at the site, and shall also cover portions of the Work in transit, including ocean transit. The policy shall include as insured property scaffolding, falsework, and temporary buildings located at the site. The policy shall cover the cost of removing debris, including demolition as may be made legally necessary by the operation of any law, ordinance or regulation.

11.6.4 The insurance required herein shall be on an all risk form and shall be written to cover all risks of physical loss or damage to the insured party and shall insure at least against the perils of fire and extended coverage, theft, vandalism, malicious mischief, collapse, lightning, earthquake, flood, frost, water damage, windstorm and freezing.

11.6.5 If there are any deductibles applicable to the insurance required herein, Contractor shall pay any part of any loss not covered because of the operation of such deductibles.

11.6.6 The insurance as required herein shall be maintained in effect until the earliest of the following dates:

1. the date which all persons and organization who are insureds under the policy agree in writing that it shall be terminated;

2. the date on which final payment of this Contract has been made by Owner to Contractor; or

3. the date on which the insurable interests in the property of all insureds other than the Owner have ceased.

11.6.7 The Owner and Contractor waive all rights against (1) each other and any of their subcontractors of any tier, suppliers, agents and employees, each of the other, (2) the Architect and Architect’s consultants, and (3) separate contractors described in Article 6, if any, and any of their subcontractors of any tier, suppliers, agents and employees, for damages caused by fire or other perils to the extent covered by property insurance obtained pursuant to this Section 11.7 or other insurance applicable to the Work, except such rights as they have to proceeds of such insurance. The Owner or Contractor, as appropriate, shall require of the Architect, Architect’s consultants, separate contractors described in Article 6, if any, and the subcontractors of any tier, suppliers, agents and employees of any of them, by appropriate agreements, written where legally required for validity, similar waivers each in favor of other parties enumerated herein. The policies shall provide such waivers of subrogation by endorsement or otherwise. A waiver of subrogation shall be effective as to a person or entity even though that person or entity would otherwise have a duty of indemnification, contractual or otherwise, did not pay the insurance premium directly or indirectly, was at fault or was negligent in causing the loss and whether or not the person or entity had an interest in the property damaged.

11.6.8 A loss insured under Contractor’s property insurance shall be adjusted by the Owner in good faith and made payable to the Owner for the insureds, subject to requirements of the Contract Documents. The Contractor shall pay Subcontractors of any tier their just shares of insurance proceeds received by the Contractor, and by appropriate agreements, written where legally required for validity, shall require Subcontractors of any tier to make payments to their Sub-subcontractors in similar manner.

11.7 Bonds
11.7.1 When the Contract sum exceeds Fifty Thousand Dollars ($50,000), the Contractor shall procure and furnish a Performance Bond and a Payment Bond in the form prepared by the Owner, each in an amount equal to one hundred percent (100%) of the Contract Sum, as well as adjustments to the Contract Sum. The Performance Bond shall secure and guarantee Contractor’s faithful performance of this Contract, including but not limited to Contractor’s obligation to correct defects after final payment has been made as required by the Contract Documents. The Payment Bond shall secure and guarantee payment of all persons performing labor on the Project under this Contract and furnishing materials in connection with this Contract. These Bonds shall be in effect through the duration of the Contract plus the Guaranty Period as required by the Contract Documents.

11.7.2 The bonds required hereunder shall be executed by a responsible surety licensed in the State of Missouri, with a Best’s rating of no less than A-/XI. The Contractor shall require the attorney in fact who executes the required bonds on behalf of the surety to affix thereto a certified and current copy of this power of attorney indicating the monetary limit of such power.

11.7.3 If the surety of any bond furnished by Contractor is declared bankrupt or becomes insolvent or its right to conduct business in the State of Missouri is terminated, or it ceases to meet the requirements of this paragraph, Contractor shall within ten (10) days substitute another bond and surety, both of which must be acceptable to Owner. If Contractor fails to make such substitution, Owner may procure such required bonds on behalf of Contractor at Contractor’s expense.

11.7.4 Upon the request of any person or entity appearing to be a potential beneficiary of bonds covering payment of obligations arising under the Contract, the Contractor shall promptly furnish a copy of the bonds to such person or entity.

11.7.5 The Contractor shall keep the surety informed of the progress of the Work, and, where necessary, obtain the surety’s consent to or waiver of: (1) notice of changes in the Work; (2) request for reduction or release of retention; (3) request for final payment; and (4) any other material required by the surety. The Owner shall be notified by the Contractor, in writing, of all communications with the surety, as it relates to items one through four. The Owner may, in the Owner's sole discretion, inform surety of the progress of the Work, any defects in the Work, or any defaults of Contractor under the Contract Documents and obtain consents as necessary to protect the Owner's rights, interest, privileges and benefits under and pursuant to any bond issued in connection with the Work.

11.7.6 Contractor shall indemnify and hold harmless the Owner and any agents, employees, representative or member of the Board of Curators from and against any claims, expenses, losses, costs, including reasonable attorneys’ fees, as a result of any failure of Contractor to procure the bonds required herein.

ARTICLE 12
UNCOVERING AND CORRECTION OF THE WORK

12.1 Uncovering of the Work
12.1.1 If a portion of the Work is covered contrary to the Architect's request or to requirements specifically expressed in the Contract Documents, it shall, if required in writing by the Architect or the Owner's Representative, be uncovered for the Architect's observation and be replaced at the Contractor's expense without change in the Contract Time.

12.1.2 If a portion of the Work has been covered which the Architect or the Owner's Representative has not specifically requested to observe, prior to its being covered, the Architect or the Owner's Representative may request to see such Work, and it shall be uncovered by the Contractor. If such Work is in accordance with the Contract Documents, costs of uncovering and replacement shall, by appropriate Change Order, be charged to the Owner. If such Work is not in accordance with the Contract Documents, the Contractor shall pay such costs unless the condition was caused by the Owner or a separate contractor in which event the Owner will be responsible for payment of such costs.

12.2 Correction of the Work
12.2.1 The Architect or Owner’s Representative shall have the right to reject Work not in strict compliance with the requirements of the Contract Documents. The Contractor shall promptly correct Work rejected by the Architect or the Owner's Representative for failing to conform to the requirements of the Contract Documents, whether observed before or after final completion and whether or not fabricated, installed, or completed. If Work has been rejected by Architect or Owner's Representative, the Architect or Owner's Representative shall have the right to require the Contractor to remove it from the Project site and replace it with Work that strictly conforms to the requirements of the Contract Documents regardless if such removal and replacement results in “economic waste.” Contractor shall pay all claims, costs, losses and damages caused by or resulting from the correction, removal or replacement of defective Work, including but not limited to, all costs of repair or replacement of Work of others. The Contractor shall bear costs of correcting, removing and replacing such rejected Work, including additional testing and inspections and compensation for the Architect's services and expenses made necessary thereby. If prior to the date of final payment, the Contractor, a Subcontractor or anyone for whom either is responsible uses or damages any portion of
the Work, including, without limitation, mechanical, electrical, plumbing and other building systems, machinery, equipment or other mechanical device, the Contractor shall cause such item to be restored to “like new” condition at no expense to the Owner.

12.2.2 If, within twelve (12) months after the date of Final Completion of the Work or designated portion thereof, or after the date for commencement of warranties, or by terms of an applicable special warranty required by the Contract Documents, any of the Work is found not to be in strict accordance with the requirements of the Contract Documents, the Contractor shall correct or remove and replace such defective Work, at the Owner’s discretion. Such twelve (12) month period is referred to as the “Guarantee Period.” The obligations under this Paragraph 12.2.2 shall cover any repairs, removal and replacement to any part of the Work or other property caused by the defective Work.

12.2.3 The Contractor shall remove from the site portions of the Work which are not in accordance with the requirements of the Contract Documents and are neither corrected by the Contractor nor accepted by the Owner.

12.2.4 If the Contractor fails to correct nonconforming Work within a reasonable time, the Owner may correct or remove it and replace such nonconforming Work. If the Contractor does not proceed with correction of such nonconforming Work within a reasonable time fixed by written notice from the Owner, the Owner may take action to correct or remove the nonconforming work at the contractor’s expense.

12.2.5 The Contractor shall bear the cost of correcting destroyed or damaged Work or property, whether completed or partially completed, of the Owner or of others caused by the Contractor's correction or removal of Work which is not in accordance with the requirements of the Contract Documents.

12.2.6 Nothing contained in Article 12 shall be construed to establish a period of limitation with respect to other obligations that the Contractor might have under the Contract Documents. Establishment of the twelve (12) month Guarantee Period as described in Article 12 relates only to the specific obligation of the Contractor to correct, remove or replace the Work, and has no relationship to the time within which the obligation to comply with the Contract Documents may be sought to be enforced, nor to the time within which proceedings may be commenced to establish the Contractor's liability with respect to the Contractor's obligations under the Contract Documents. The requirements of Article 12 are in addition to and not in limitation of any of the other requirements of the Contract for warranties or conformance of the Work to the requirements of the Contract Documents.

12.3 Acceptance of Nonconforming Work
12.3.1 The Owner may accept Work which is not in accordance with the Contract Documents, instead of requiring its removal and correction, in its sole discretion. In such case the Contract Sum will be adjusted as appropriate and equitable. Such adjustment shall be made whether or not final payment has been made. Nothing contained herein shall impose any obligation upon the Owner to accept nonconforming or defective Work.

ARTICLE 13
MISCELLANEOUS PROVISIONS

13.1 Written Notice
13.1.1 All notices required to be given by the Contractor under the terms of this Contract shall be made in writing. Written notice when served by the Owner will be deemed to have been duly served if delivered in person to the individual or a member of the firm or entity or to an office of the corporation for which it was intended, or if delivered at or sent to the last business address known to the party giving notice.

13.2 Rights and Remedies
13.2.1 Duties and obligations imposed by the Contract Documents, and rights and remedies available thereunder shall be in addition to and not a limitation of duties, obligations, rights, and remedies otherwise imposed or available by law.

13.2.2 No action or failure to act by the Owner, the Architect, or the Owner's Representative will constitute a waiver of a right or duty afforded to the Owner under the Contract Documents, nor will such action or failure to act constitute approval of or acquiescence in a breach thereunder, except as may be specifically agreed in writing.

13.2.3 The terms of this Contract and all representations, indemnifications, warranties and guarantees made in, required by or given in accordance with the Contract Documents, as well as all continuing obligations indicated in the Contract Documents, will survive final payment, completion and acceptance of the Work and termination or completion of the Work and shall remain in effect so long as the Owner is entitled to protection of its rights under applicable law.

13.2.4 Contractor shall carry out the Work and adhere to the current construction schedule during all disputes or disagreements with the Owner. No Work shall be delayed or postponed pending resolution of any disputes or disagreements except as the Owner and Contractor may otherwise agree to in writing.
13.3 Tests and Inspections

13.3.1 Tests, inspections, and approvals of portions of the Work required by the Contract Documents or by laws, ordinances, rules or regulations shall be made at an appropriate time. Unless otherwise provided, the Contractor shall make arrangements for such tests, inspections and approvals with an independent testing laboratory or entity acceptable to the Owner, and shall bear related costs of tests, inspections, and approvals. The Contractor shall give the Architect and the Owner's Representative timely notice of when and where tests and inspections are to be made so the Architect and/or the Owner's Representative may observe procedures.

13.3.2 If the Architect or the Owner's Representative determine that portions of the Work require additional testing, inspection or approval not included in the Contract Documents, or required by law, the Architect, or the Owner's Representative will instruct the Contractor to make arrangements for such additional testing, inspection, or approval by an entity acceptable to the Owner's Representative and the Contractor shall give timely notice to the Architect, and the Owner's Representative, of when and where tests and inspections are to be made so the Architect and/or the Owner's Representative may observe such procedures. The Owner will bear such costs except as provided elsewhere in Article 13.

13.3.3 If such procedures for testing, inspection, or approval under Article 13 reveal failure of the portions of the Work to comply with requirements established by the Contract Documents, the Contractor shall bear all costs made necessary by such failure including those of repeated procedures and compensation for the Architect's services and expenses.

13.3.4 Required certificates of testing, inspection, or approval shall, unless otherwise required by the Contract Documents, be secured by the Contractor and promptly delivered to the Owner's Representative and Architect.

13.3.5 Contractor shall take all necessary actions to ensure that all tests or inspections conducted pursuant to the Contract Documents shall be made promptly to avoid unreasonable delay in the Work.

13.3.6 Contractor shall arrange for and pay for all costs of all testing required by the Contract Documents or any applicable Laws for materials to be tested or certified at or on the place or premises of the source of the material to be supplied. The Owner shall have the right to require testing of all materials at the place of the source of the material to be supplied if not required by the Contract Documents or any applicable Laws. The Owner shall bear the costs of such tests and inspections not required by the Contract Documents or by applicable Laws unless prior defective Work provides Architect or Owner with a reasonable belief that additional defective Work may be found, in which case Contractor shall be responsible for all costs of tests and inspections ordered by the Owner or Architect, whether or not such tests or inspection reveals that Work is in compliance with the Contract Documents.

13.4 Nondiscrimination in Employment Equal Opportunity

13.4.1 The University serves from time to time as a contractor for the United States government. Accordingly, the provider of goods and/or services shall comply with federal laws, rules and regulations applicable to subcontractors of government contracts including those relating to equal employment opportunity and affirmative action in the employment of minorities (Executive Order 11246), women (Executive Order 11375), persons with disabilities (29 USC 706) and Executive Order 11758, and certain veterans (38 USC 4212 formerly [2012]) contracting with business concerns with small disadvantaged business concerns (Publication L. 95-507). Contract clauses required by the Government in such circumstances are incorporated herein by reference.

13.5 Supplier Diversity Goal Program

13.5.1 The Contractor shall subcontract with diverse firms no less than the amount pledged in the Contractor’s Bid and/or the amount accepted by the Owner.

13.5.2 If the Contractor must remove any diverse subcontractor of any tier, the Contractor shall replace the diverse subcontractor of any tier with another diverse subcontractor(s) of equal dollar value to the diverse supplier removed. The Contractor shall immediately notify the Owner’s Representative in writing of the Contractor’s intent to remove any, and the Contractor’s plan to maintain subcontracts with diverse firms of no less than amount pledged in the Contractor’s Bid and/or the amount accepted by the Owner. All changes of diverse subcontractor of any tier shall be approved by the Director of Facilities Planning & Development.

13.5.3 If the Contractor fails to meet or maintain the contractor’s Supplier Diversity subcontracting pledge, the Contractor shall immediately notify in writing the Owner’s Representative, and the Director of Facilities Planning & Development. Such notice shall include a description of the Contractor’s good faith effort to comply with their Supplier Diversity subcontracting pledge.

13.5.4 If the Director of Facilities Planning & Development finds the Contractor has failed to comply in good faith with the Owner’s Supplier Diversity goal program, the Director may take appropriate action, including but not limited to, declaring the Contractor ineligible to participate in any contracts with the Owner for a period not to exceed six (6) months, and/or directing that the Contractor's actions be
declared a material breach of the Contract and that the Contract be terminated.

13.5.5 The Contractor and his subcontractors shall develop, implement, maintain, and submit in writing to the Director of Facilities Planning & Development, an affirmative action program if at least fifty (50) persons in the aggregate are employed under this contract. If less than fifty (50) persons in the aggregate are to be employed under this contract, the Contractor shall submit, in lieu of the written affirmative action program, a properly executed "Affidavit for Affirmative Action" in the form as included in the Contract Documents. For the purpose of this section, an "Affirmative Action Program" means positive actions to influence all employment practices (including, but not limited to, recruiting, hiring, promoting, and training) in providing equal employment opportunity regardless of race, color, sex, national origin, religion, age (where the person affected is between 40 and 70), disabled and Vietnam-era veteran status, and handicapped otherwise qualified status. Such affirmative action program shall include:

.1 A written policy statement committing the total organization to affirmative action and assigning management responsibilities and procedures for evaluation and dissemination.

.2 The identification of a person designated to handle affirmative action.

.3 The establishment of non-discriminatory selection standards, objective measures to analyze recruitment, an upward mobility system, a wage and salary structure, and standards applicable to lay-off, recall, discharge, demotion, and discipline.

.4 The exclusion of discrimination from collective bargaining agreements.

.5 Performance of an internal audit of the reporting system to monitor execution and to provide for future planning.

13.5.6 In the enforcement of this non-discrimination requirement, the Owner may use any reasonable procedures available, including but not limited to: requests, reports, site visits, and inspection of relevant documents of Contractors and Subcontractors of any tier. The contractor shall submit a final Affidavit of Supplier Diversity Participation for each diverse firm at the end of the project stating the actual amount paid to the diverse firm.

13.6 Wage Rates (If the contract amount is less than $75,000, the requirements of this section will not apply. Any contract adjustments that increase the contract above $75,000 will be subject to this section.)

13.6.1 The Contractor shall pay workers employed in the execution of this contract in full each week and not less than the predetermined wage rates and overtime for work of a similar character that have been made a part of this Contract. These rates are determined by the University of Missouri Director of Facilities Planning and Development. The rates are based on wage rates published in the Annual Wage Orders of the Missouri Department of Labor and Industrial Relations (MDLIR). The Contractor is to use MDLIR 8 CSR 30-3.020; .030; .040, .060 in determining the appropriate occupational titles and rates for workers used in the execution of this contract. All determinations and/or interpretations regarding wage rates and classification of workers will be made by the office of the University of Missouri Director of Facilities Planning and Development. The Contractor is responsible for the payment of the aggregate of the Basic Hourly Rate and the Total Fringe Benefits to the workers on the project. Fringe benefit payments may be made to the worker in cash, or irrevocably made by a Contractor or Subcontractor to a trustee or to a third person pursuant to a fund, plan or program, or pursuant to an enforceable commitment, or any combination thereof, to carry out a financially responsible plan or program which was communicated in writing to the workmen affected, for medical or hospital care, pensions on retirement or death, compensation for injuries or illness resulting from occupational activity, or insurance to provide any of the foregoing, for unemployment benefits, life insurance, disability and sickness insurance, accident insurance, for vacation and holiday pay, for defraying costs of apprenticeship or other similar programs, or for other bona fide fringe benefits, but only where the Contractor or Subcontractor is not required by other federal or state law to provide any of the benefits as referenced in §290.210(5) RSMo 1994. Pay for travel, mileage, meals, bonuses, or other expenses are not fringe benefits and cannot be considered part of the workers wage rate. The Contractor shall not make any deductions for food, sleeping accommodations, transportation, use of small tools, uniforms, or anything of any kind or description, unless the Contractor and employee enter into an agreement in writing at the beginning of the worker’s term of employment, and such agreement is approved by the Owner. In the event the contract contains more than one wage determination the Contractor shall comply with both.

13.6.2 The Contractor shall submit to the Owner with the Contractor’s periodic pay request, certified payroll records for labor performed by the Contractor and Subcontractors of any tier. The Contractor shall submit all required certified payroll information records electronically in pdf format using the Owner’s web-based payment program. The certified payroll forms shall contain the name, address, personal identification number, and occupational title of the workers as well as the hours they work each day. The Owner’s acceptance of certified payroll records does not in any way relieve the Contractor of any responsibility for the payment of prevailing wages to workers on the project. The Contractor shall also maintain copies of the certified payroll.
The Owner may, at any time, request copies of, and/or inspect all of the Contractor's payroll records for the Work to verify compliance. The Contractor shall furnish the Owner copies of payroll records within 10 days of the Owner’s written request. The Contractor shall provide copies of workers I-9 forms within 24 hours of written notice. (If applicable, and required by Owner, the Contractor will demonstrate that the Contractor is enrolled and participating in a federal work authorization program with respect to the employees working in connection with this project.) Such payroll records shall be maintained in accordance with Article 13.7.1 and shall be available for inspection for two (2) years after final completion of the Work. The contractor further agrees, in the event the records are not presented as requested, he will abide by any decision made by the Owner regarding underpayment of wages to workers and amounts owed them as well as liquidated damages for underpayment of wages. Falsification of the certified payroll records may result in the debarment of the contractor or subcontractor from future work with the University.

13.6.3 The acquisition of products or services is subject to the supplier's conformance to the rules and regulations of the President's Committee on Equal Employment Opportunity (41 CFR, Ch. 60).

13.6.4 The Contractor shall comply with the Copeland Regulations of the Secretary of Labor (29 CFR, Part 3), which are incorporated herein by reference. In addition, the Weekly Statement of Compliance required by these Regulations shall also contain a statement that the applicable fringe benefits paid are equal to or greater than those set forth in the minimum wage decision.

13.6.5 Contractor acknowledges that violation of the requirements of Article 13.6 result in additional costs to Owner, including, but not limited to, cost of construction delays, of additional work for Owner’s staff and legal expense. The cost of Contractor’s violation of the provisions of Article 13.6 would be and is difficult to determine and establish. In the event that Contractor fails to comply with the provisions of this Article 13.6, Owner shall be entitled to retain or recover from the Contractor, as liquidated damages and not as a penalty, the sum of Fifty Dollars ($50.00) per day per individual who is paid less than the applicable prevailing wage, to approximate the investigative cost resulting to the Owner for such violations. To approximate the delay costs, Owner shall be entitled to retain or recover from the Contractor, as liquidated damages and not as a penalty, the sum of One Hundred Dollars ($100.00) per day for each day the Contract cannot be closed out and final payment made because of Contractor’s failure to comply with the provisions of this Article 13.6. Such liquidated damages shall be collected regardless of whether the Work has been completed. The liquidated damages and other amounts set forth in this Article 13.6 shall be in addition to all other liquidated damages the Owner may be entitled as set forth in the Contract Documents.

13.6.6 The Owner may deduct liquidated damages described Article 13 and the amounts set forth in Article 13 from any unpaid amounts then or thereafter due the Contractor under the Contract. Any liquidated damages not so deducted from any unpaid amounts due the Contractor shall be payable to the Owner at the demand of the Owner.

13.6.7 The Contractor shall specifically incorporate the obligations of Article 13 into the subcontracts, supply agreements and purchase orders for the Work and require the same of any Subcontractors of any tier.

13.6.8 Contractor acknowledges and recognizes that a material factor in its selection by the Owner is the Contractor’s willingness to undertake and comply with the requirements of this Article 13.6. If Contractor fails to comply with the provisions of this Article 13.6, Owner may, in its sole discretion, immediately terminate the Contract upon written notice. The rights and remedies of Owner provided herein shall not be exclusive and are in addition to other rights and remedies provided by law or under this Contract.

13.6.9 Only such workers who are individually registered in a bona fide apprenticeship program approved by the U.S. Department of Labor, Office of Apprenticeship can be paid less than the journeyperson rate of pay. “Entry Level Workers; must be registered apprentices. The apprenticeship ratio will be one to one with a journeyperson of the same classification. Any worker not registered as an apprentice per this section will be paid as a journeyperson.

13.6.10 The Contractor shall post the wage rates for the contract in a conspicuous place at the field office on the project. On projects where there is no field office the Contractor may post the wage rates at their local office, as long as they provide a copy of the wage rates to a worker upon request. The wage rates shall be kept in a clearly legible condition for the duration of the project.

13.6.11 Neither the Contractor, nor any Subcontractor of any tier, nor any person hired by them or acting on their behalf, shall request or demand that workers pay back, return, donate, contribute or give any part, or all, of said workers wages, salary, or any thing of value, upon the statement, representation or understanding that failure to comply with such request or demand will prevent such worker from procuring or retaining employment. The exception being to an agent or representative of a duly constituted labor organization acting in the collection of dues or assessments of such organization.
13.6.12 No contractor or subcontractor may directly or indirectly receive a wage subsidy, bid supplement, or rebate for employment on this project if such wage subsidy, bid supplement, or rebate has the effect of reducing the wage rate paid by the employer on a given occupational title below the prevailing wage rate as provided in contract. In the event a wage subsidy, bid supplement, or rebate is provided or received, the entity receiving such subsidy, supplement, or rebate shall report the date and amount of such subsidy, supplement, or rebate to the University within thirty days of receipt of payment. This disclosure report shall be a matter of public record. Any employer not in compliance with this Article shall owe to the University double the dollar amount per hour that the wage subsidy, bid supplement, or rebate has reduced the wage rate paid by the employer below the prevailing wage rate for each hour that work was performed.

13.6.13 Time and one half overtime will be paid on all hours over 10 hours per day or 40 hours per week. The wage rate is the total of the “Basic Hourly Rate” plus “Total Fringe Benefits” or the “public works contracting minimum wage”. For all work performed on a Sunday or Holiday, not less than twice the prevailing hourly rate of pay or public works contracting minimum wage will apply. Holidays are as follows: January first, the last Monday in May, July fourth, the first Monday in September, November 11, the fourth Thursday in November, December twenty-fifth. If any holiday falls on a Sunday, the following Monday shall be considered a holiday.

13.7 Records

13.7.1 The Owner, or any parties it deems necessary, shall have access to and the right to examine any accounting or other records of the Contractor involving transactions and Work related to this Contract for five (5) years after final payment or five (5) years after the final resolution of any on going disputes at the time of final payment. All records shall be maintained in accordance with generally accepted accounting procedures, consistently applied. Subcontractors of any tier shall be required by Contractor to maintain records and to permit audits as required of Contractor herein.

13.8 Codes and Standards

13.8.1 The Work shall be performed to comply with the International Code Council (ICC) Codes, and the codes and standards noted below. The latest editions and supplements of these Codes and Standards in effect on the date of the execution of the Contract for Construction shall be applicable unless otherwise designated in the Contract Documents. Codes and standards required by accreditation agencies will also be used unless the ICC requirements are more stringent. In the event that special design features and/or construction systems are not covered in the ICC codes, the applicable edition of the National Fire Protection Association (NFPA) family of standards and/or the NFPA 101 Life Safety Code shall be used.

.1 ICC International Building Code and reference standards
.2 ICC International Plumbing Code
.3 ICC International Mechanical Code
.4 NFPA 70 National Electric Code (NEC)
.5 Americans with Disabilities Act – Standards for Accessible Design
.6 American National Standard Safety Code for Elevators, Dumbwaiters, Escalators, and Moving Walks as published by the American Society of Mechanical Engineers (ASME), American National Standards Institute (ANSI) A17.1
.7 NFPA 101 Life Safety Code (as noted above)
.8 American Concrete Institute (ACI)
.9 American National Standards Institute (ANSI)
.10 American Society of Heating, Refrigeration and Air Conditioning Engineers (ASHRAE)
.11 American Refrigeration Institute (ARI)
.12 American Society for Testing and Materials (ASTM)
.13 Missouri Standard Specification for Highway Construction, Missouri State Highway Commission
.14 National Electrical Manufacturers Association (NEMA)
.15 Underwriter's Laboratories, Inc. (UL), Federal Specifications
.16 Williams Steiger Occupational Safety and Health Act of 1970 (OSHA)

13.9 General Provisions

13.9.1 Any specific requirement in this Contract that the responsibilities or obligations of the Contractor also apply to a Subcontractor is added for emphasis and are also hereby deemed to include a Subcontractor of any tier. The omission of a reference to a Subcontractor in connection with any of the Contractor’s responsibilities or obligations shall not be construed to diminish, abrogate or limit any responsibilities or obligations of a Subcontractor of any tier under the Contract Documents or the applicable subcontract.

13.9.2 This Contract shall be interpreted, construed, enforced and regulated under and by the laws of the State of Missouri. Whenever possible, each provision of this Contract shall be interpreted in a manner as to be effective and valid under applicable law. If, however, any provision of this Contract, or a portion thereof, is prohibited by law or found invalid under any law, only such provision or portion thereof shall be ineffective, without invalidating or affecting the remaining provisions of this Contract or valid portions of such provision, which are hereby deemed severable. Contractor and Owner further agree that in the event any provision of this Contract, or a portion thereof, is prohibited by law or found
13.9.3 Contractor and Owner each agree that the State of Missouri Circuit Court for the County where the Project is located shall have exclusive jurisdiction to resolve all Claims and any issue and disputes between Contractor and Owner. Contractor agrees that it shall not file any petition, complaint, lawsuit or legal proceeding against Owner in any other court other than the State of Missouri Circuit Court for the County where the Project is located.

13.9.4 Owner’s total liability to Contractor and anyone claiming by, through, or under Contractor for any Claim, cost, loss, expense or damage caused in part by the fault of Owner and in part by the fault of Contractor or any other entity or individual shall not exceed the percentage share that Owner’s fault bears to the total fault of Owner, Contractor and all other entities and individuals as determined on the basis of comparative fault principles.

13.9.5 Contractor agrees that Owner shall not be liable to Contractor for any special, indirect, incidental, or consequential damage whatsoever, whether caused by Owner’s negligence, fault, errors or omissions, strict liability, breach of contract, breach of warranty or other cause or causes whatsoever. Such special, indirect, incidental or consequential damages include, but are not limited to loss of profits, loss of savings or revenue, loss of anticipated profits, labor inefficiencies, idle equipment, home office overhead, and similar types of damages.

13.9.6 Nothing contained in this Contract or the Contract Documents shall create any contractual relationship with or cause of action in favor of a third party against the Owner.

13.9.7 No member or officer of the Board of Curators of the University incurs or assumes any individual or personal liability under the Contract or by reason of the default of the Owner in the performance of any terms thereof. Contractor releases and discharges all members or officers of the Board of Curators of the University from any liability as a condition of and as consideration for the award of the Contract to Contractor.

13.9.8 The Contractor hereby binds itself, its partners, successors, assigns and legal representatives to the Owner in respect to covenants, agreements and obligations contained in the Contract Documents. Contractor shall not assign the Contract or proceeds hereof without written consent of the Owner. If Contractor attempts to make such an assignment without such consent, it shall be void and confer no rights on third parties, and Contractor shall nevertheless remain legally responsible for all obligations under the Contract. The Owner’s consent to any assignment is conditioned upon Contractor entering into a written assignment which contains the following language: “it is agreed that the funds to be paid to the assignee under this assignment are subject to performance by the Contractor and to claims and to liens for services rendered or materials supplied for the performance of the Work required in said Contract in favor of all persons, firms, corporations rendering such services or supplying such materials.”

13.10 Debarment and Suspension Certification
The contractor certifies to the best of its knowledge and belief that it and its principals are not presently debarred, suspended, proposed for debarment, declared ineligible, or voluntarily excluded from covered transactions by any Federal department or agency in accordance with Executive Order 12549 (2/18/86).

ARTICLE 14
TERMINATION OR SUSPENSION OF THE CONTRACT

14.1 Termination by Owner for Cause
14.1.1 In addition to other rights and remedies granted to Owner under the Contract Documents and by law, the Owner may terminate the Contract if the Contractor:
.1 refuses or fails to supply enough properly skilled workers, superintendents, foremen, or managers;
.2 refuses or fails to supply sufficient or proper materials;
.3 fails to make payment to Subcontractors for materials or labor in accordance with the respective agreements between the Contractor and the Subcontractors;
.4 disregards laws, ordinances, rules, or regulations or orders of a public authority having jurisdiction;
.5 disregards the authority of the Owner’s Representative or Architect;
.6 breaches any warranty or representations made by the Contractor under or pursuant to the Contract Documents;
.7 fails to furnish the Owner with assurances satisfactory to the Owner evidencing the Contractor's ability to complete the Work in compliance with all the requirements of the Contract Documents;
.8 fails after commencement of the Work to proceed continuously with the construction and completion of the Work for more than ten (10) days, except as permitted under the Contract Documents;
.9 fails to maintain a satisfactory rate of progress with the Work or fails to comply with approved progress schedules; or
.10 violates in any substantial way any provisions of the Contract Documents.

14.1.2 When any of the above reasons exist, the Owner may, without prejudice to any other rights or remedies of the Owner,
terminate this Contract by delivering a written notice of termination to Contractor and Contractor’s surety, and may:

.1 take possession of the site and of all materials, equipment, tools, and construction equipment and machinery thereon owned by the Contractor;

.2 accept assignment of subcontracts pursuant to Paragraph 5.3; and

.3 finish the Work by whatever reasonable method the Owner may deem expedient, including turning the Work over to the surety.

14.1.3 The Contractor, in the event of a termination under Section 14.1, shall not be entitled to receive any further payments under the Contract until the Work is completed in its entirety. Then, if the unpaid balance under the Contract shall exceed all expenses of the Owner in finishing the Work, including additional compensation for the Architects services and expenses made necessary thereby, such excess will be paid to the Contractor; but, if such expenses of Owner to finish the Work shall exceed the unpaid balance, the Contractor and its surety shall be liable for, and shall pay the difference and any damages to the Owner. The obligation of the Contractor and its surety for payment of said amounts shall survive termination of the Contract.

14.1.4 In exercising the Owner's right to secure completion of the Work under any of the provisions hereof, the Owner shall have the right to exercise the Owner's sole discretion as to the manner, methods, and reasonableness of costs of completing the Work.

14.1.5 The rights of the Owner to terminate pursuant to Article 14.1 will be cumulative and not exclusive and shall be in addition to any other remedy provided by law or the Contract Documents.

14.1.6 Should the Contractor fail to achieve Final Completion of the Work within thirty (30) calendar days following the date of Substantial Completion, the Owner may exercise its rights under Article 14.1.

14.2 Suspension by the Owner for Convenience

14.2.1 The Owner may, without cause, order the Contractor in writing to suspend, delay, or interrupt the Work in whole or in part for such period of time as the Owner may determine.

14.2.2 An adjustment will be made to the Contract Sum for increases in the cost of performance of the Contract caused by suspension, delay or interruption. However, in the event of a suspension under this Article 14.2, Contractor hereby waives and forfeits any claims for payment of any special, indirect, incidental or consequential damages such as lost profits, loss of savings or revenue, loss of anticipated profits, idle labor or equipment, home office overhead, and similar type damages. No adjustment will be made to the extent:

.1 that performance is, was, or would have been so suspended, delayed or interrupted by another cause for which the Contractor in whole or in part is responsible, or

.2 that an equitable adjustment is made or denied under another provision of this Contract.

14.3 Owner’s Termination for Convenience

14.3.1 The Owner may, at any time, terminate the Contract in whole or in part for the Owner's convenience and without cause. Termination by the Owner under this Paragraph shall be by a notice of termination delivered to the Contractor specifying the extent of termination and the effective date.

14.3.2 Upon receipt of a notice of termination for convenience, the Contractor shall immediately, in accordance with instructions from the Owner, proceed with performance of the following duties regardless of delay in determining or adjusting amounts due under this Paragraph:

.1 cease operation as specified in the notice;

.2 place no further orders and enter into no further subcontracts for materials, labor, services or facilities except as necessary to complete Work not terminated;

.3 terminate all subcontracts and orders to the extent they relate to the Work terminated;

.4 proceed to complete the performance of Work not terminated; and

.5 take actions that may be necessary, or that the Owner may direct, for the protection and preservation of the terminated Work.

14.3.3 Upon such termination, the Contractor shall recover as its sole remedy payment for Work properly performed in connection with the terminated portion of the Work prior to the effective date of termination and for items properly and timely fabricated off the Project site, delivered and stored in accordance with the Owner's instructions and for all Owner approved claims, costs, losses and damages incurred in settlement of terminated contracts with Subcontractors and suppliers. The Contractor hereby waives and forfeits all other claims for payment and damages, including, without limitation, anticipated profits, consequential damages and other economic losses.

14.3.4 The Owner shall be credited for (1) payments previously made to the Contractor for the terminated portion of the Work, (2) claims which the Owner has against the Contractor under the Contract and (3) the value of the materials, supplies, equipment or other items that are to be disposed of by the Contractor that are part of the Contract Sum.

14.3.5 Upon determination by a court that termination of Contractor or its successor in interest pursuant to Paragraph 14.1 was wrongful, such termination will be deemed converted
to a termination for convenience pursuant to Paragraph 14.3, and Contractor's sole and exclusive remedy for wrongful termination is limited to recovery of the payments permitted for termination for convenience as set forth in Paragraph 14.3.
SECTION 1.E
SPECIAL CONDITIONS

1. DEFINITIONS

a. "Drawings"

Drawings referred to in and accompanying Project Manual consist of Drawings prepared by and bearing name of below defined Architect/Engineer, bearing December 23, 2019, MU #CP19076111, Fayette Clinic – HVAC Update

a. Architect / Engineer

SSC Engineering, Inc.
J. Chris Cornett
18207 Edison Ave.
Chesterfield, Missouri 63005


2. SPECIAL SCHEDULING REQUIREMENTS

a. Special scheduling requirements supplemental to the bid form:

(1) Contractor may begin on-site mobilization only after approval of shop drawings and receipt of materials.

(2) Work shall be continuous with no down time.

(3) Normal working hours are defined as weekdays between the hours of 7:00 am and 5:00 pm.

(4) Night hours are defined as 5:00 pm through 7:00 am.

(5) Weekend hours are defined as after 3:00 p.m. on Friday until 7:00 a.m. Monday.

(6) Noisy work must be completed during weekend or night hours.

3. SCOPE OF WORK

a. The Contractor shall furnish all labor, materials, tools, equipment necessary for, and incidental to, construction of this project as indicated on Drawings and specified herein.
b. Work shall include everything requisite and necessary to finish work properly, notwithstanding that every item of labor or materials or accessories required to make project complete may not be specifically mentioned.

c. General Description of Work:

(1) Project generally consists of replacement of 5 existing furnace split systems with 8 new furnace split systems along with an energy recovery unit.

(2) Demolition shall consist of removal of 5 split systems, minor landscaping, drywall, ceiling.

(3) Architectural work shall consist of removal and replacement as needed for HVAC work.

(4) Electrical work shall consist of a new electrical panel to support the HVAC Upgrade.

4. LOCATION

Work shall be performed under this Contract in Fayette, Missouri.

5. NUMBER OF CONSTRUCTION DOCUMENTS

a. The Owner's Representative will furnish the Contractor a copy of executed Contract and a complete sets of Drawings and Specifications in pdf format.

b. The Owner will furnish explanatory and changed Drawings in pdf format to Contractor as issued during project.

c. Hard copy prints of any documents (bid or explanatory) will be printed at the Contractor’s expense through a printer of their choosing.

6. SUBMITTALS

a. The Contractor shall submit for approval to the Architect\Engineer, equipment lists and Shop Drawings, as expeditiously as possible. Failure of the Contractor to submit Shop Drawings in a timely manner will result in the Owner holding back Contractor payments. (See General Conditions)

b. The material and equipment lists shall be submitted and approved before any material or equipment is purchased and shall be corrected to as-built conditions before the completion of the project.

c. The Contractor shall submit electronic versions of all required Shop Drawings, material and equipment lists. The Contractor shall upload all Shop Drawings to a secure information sharing website determined by the Owner notifying the Owner and Consultant that these shop drawings are available for review. Refer to: http://www.cf.missouri.edu/pdc/sharepoint_guides.html for protocols for the use of
this website. Emails regarding RFI’s or Submittals shall also be copied to “submittals@sscengineering.com”.

d. Each submittal shall have the General Contractors digital stamp affixed to the first page signifying their review and acceptance. Review comments, approvals, and rejections will be posted on this same site with notification to the contractor. Submittals requiring a professional seal shall be submitted hard copy with a manual seal affixed.

(1) The Contractor shall identify each submittal item with the following:

(a) Project Title and Location
(b) Project Number
(c) Supplier’s Name
(d) Manufacturer’s Name
(e) Contract Specification Section and Article Number
(f) Contract Drawing Number
(g) Acrobat file name: Spec Section_Times Submitted-Spec Title: 033000_01-Cast In Place Concrete.pdf

(2) Reference the accompanying Shop Drawing and Submittal Log at the end of this section (1.E.3) for required submittal information.

d. The Contractor shall submit to the Architect/Engineer one (1) bound copy and one pdf copy of all required Operating Instructions and Service Manuals for the Architect’s and the Owner’s sole use prior to completing 50% of the adjusted contract. Payments beyond 50% of the contract amount may be withheld until all Operating Instructions and Service Manuals are received as referenced in the accompanying Operating Instructions and Service Manual Log at the end of this section (1.E.4).

e. The Contractor shall submit to the Owner’s Representative all items referenced in the accompanying Closeout Log (1.E.5) within 30 days following substantial completion of the work. The Owner’s Representative will maintain the closeout log and include as an agenda item at all coordination meetings.

7. NOTIFICATION

Before beginning Demolition Work or service outages, the Contractor shall provide, at minimum, seventy-two (72) hours advance notice to Owner’s Representative for purpose of verifying utility locations including, but not limited to, gas, telecommunications, electric, water, steam, sewer, and nitrogen. Contractor shall minimize the number of outages, minimize the length of outages and related work shall be continuous until the utility is restored.

8. USE OF PREMISES

a. Access: Access to construction site shall be as indicated on Drawings and as directed by the Owner's Representative.
b. Parking: Contractor shall be issued parking permits for (3) service vehicles to park in location directed by the Owner’s Representative. Employee parking shall be on public streets or where directed by the Owner’s Representative.

c. Storage of materials: The Contractor shall store all materials within project limits. The Contractor shall confine apparatus, materials, and operation of workers to location established by the Owner's Representative. The Contractor shall not unreasonably encumber premises with materials. Storage trailer locations shall be subject to approval by the Owner's Representative and are available to the Contractor without cost.

d. Utilities: Drinking water, water required to carry on work, and 120 volt electrical power required for small tool operation may be obtained without cost to the Contractor from existing utilities at locations designated by the Owner's Representative. Provisions for obtaining power, including temporary extensions, shall be furnished and maintained by the Contractor. Upon completion of work such extensions shall be removed and any damage caused by use of such extensions shall be repaired to satisfaction of the Owner's Representative, at no cost to the Owner.

e. Restroom: Existing toilet facilities within Project Limits or Restrooms designated by the Owner's Representative for use by the Contractor will be available. Failure of the Contractor to maintain restrooms in a clean condition will be cause for the Contractor's discontinued use of the restroom.

f. The use of tobacco products is prohibited at the University of Missouri and all properties owned, operated, leased or controlled by the University of Missouri. Violation of the policy is defined as the use of any tobacco products, including e-cigarettes.

g. The Contractor shall remove and legally dispose of excavated or demolished materials off the Owner’s property.

h. Care of Project Work Site: The contractor shall be responsible for maintaining the construction site in a reasonably neat and orderly condition by regular cleaning and mowing of the premises as determined by the Owner’s Representative.

9. PROTECTION OF OWNER'S PROPERTY

a. The Contractor shall be responsible for repair of damage to building exterior and interior, drives, curbs, streets, walks, grass, shrubbery and trees, which was caused by workmen or equipment employed during progress of work. All such repairs shall be made to satisfaction of the Owner's Representative, at no cost to the Owner, or reimburse the Owner if the Owner elects to make repairs.

   (1) Fencing will not be required as a part of work.
c. Preserving and Protecting Existing Vegetation:

(1) Protection and compensation for damages:

(a) Trees and shrubs within work area designated to remain shall be protected from damage during construction by fixed chain link fencing or armoring as indicated on Drawings or specified herein. Plant protection devices shall be installed before work has begun and shall be maintained for duration of work unless otherwise directed by Owner's Representative.

(2) Plants within work area designated for removal shall be removed by Contractor.

(3) To prevent compaction of soil over tree roots, vehicles or equipment shall not at any time park or travel over, nor shall any materials be stored within drip line of trees designated to remain.

10. SUBSTITUTIONS and EQUALS

a. Substitutions are defined in General Conditions article 3.11.8 for and Equals are defined General Conditions Article 3.12.

b. Substitutions and/or Equals of the item(s) listed below will be allowed only prior to receipt of bids provided that a written request for approval has been received by both the Architect and the Owner at least ten calendar days prior to the date for receipt of Bids. All other substitution and/or Equals items shall follow the procedures set forth in the General Conditions.

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To be considered, bidder’s proposal shall include a complete description of the proposed substitution and/or equal and a comparison of significant qualities of the proposed substitution and/or equal with those specified including drawings, performance and test data, and other information necessary for an evaluation. The Architect/Engineer's decision on the approval or disapproval of a proposed substitution and/or equal shall be final.

c. If the Architect and Owner approve a proposed substitution prior to receipt of Bids, such approval will be set forth in an Addendum. Bidders shall not rely upon approval made in any other manner.

d. No substitutions and/or equal will be allowed for the following items:

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11. CODES AND STANDARDS

The Contractor shall comply with applicable codes and standards as listed in General Conditions. The following codes and standards shall also apply:

12. PERMITS

a. Permits are necessary for work on or along other Owner’s property and for installation of Health Care work. Hot Work, Energized Work, Red Tag, Fire Alarm Outage & Infection Control Permits are required for health care projects.

b. Hot Work Permit: Contractor’s hot work permitting process must comply with requirements of NFPA 51B. Hot Work Permits must be requested from and completed by Owner’s Representative, posted and signed off by Contractor’s performing work involving open flames or work that produces heat and/or sparks. This includes, but is not limited to, brazing, cutting, soldering, thawing pipes, torch applied roofing and welding within Hospital property. At least one day notice is required prior to fire alarm shut down.

c. Red Tag Permit: Prior to disruption of Fire Protection System service Contractor must obtain a permit. An example is included at the end of this section.

d. Construction Infection Control Permit: Prior to construction commencement Contractor must obtain a permit. An example is included at the end of this section.

13. SPECIALTIES

14. PRE-BID INSPECTION

All pre-bid inspections of work areas shall be scheduled with pre-bid inspection guide, telephone: (573) 882-2228.

16. MODIFICATIONS TO INFORMATION TO BIDDERS

17. MODIFICATION TO INFORMATION FOR BIDDERS: BIDDERS STATEMENT OF QUALIFICATIONS

18. MODIFICATIONS TO GENERAL CONDITIONS

a. General Conditions:

(1) Reference: General Conditions, Article 3.13.5

DELETE last three sentences of existing article 3.13.5. INSERT the following sentence to read as follows:

No payments will be made until all submittals have been received and approved by Architect.
19. PROJECT SCHEDULING

The project scheduling specification for the project are included immediately after the Special Conditions. For this project the Contractor shall meet the following scheduling requirements.

Option 1: Contractor Schedule (Small Projects only) – Contractor is responsible for the schedule and must comply with the Owner’s requirements. See Contractor Schedule Specification included in these documents.

20. PROJECT COORDINATION

a. Coordinate construction operations included in various Sections of these Specifications to assure efficient and orderly installation of each part of the Work. Coordinate construction operations included under different Sections that depend on each other for proper installation, connection, and operation.

(1) Schedule construction operations in the sequence required to obtain the best results where installation of one part of the Work depends on installation of other components, before or after its own installation.

(2) Coordinate installation of different components to assure maximum accessibility for required maintenance, service, and repair.

(3) Make provisions to accommodate items scheduled for later installation.

21. VALUE ENGINEERING

a. After execution of the contract with the successful contractor, the Owner will entertain value engineering initiatives from the contractor. These initiatives may include modifications to the drawings and specifications. The Owner will not entertain modifications that affect the functions or characteristics of the project, including but not limited to: service life of systems or components, economy of operations, ease of maintenance, appearance, or design and safety standards.

a. Once a value initiative is recommended to the Owner’s Representative, the Owner’s Representative will determine if the proposal deserves further merit. If not, the Contractor will be notified the proposal has not been accepted. If the Owner’s Representative determines the proposal should be considered, a team will be assembled consisting of the Owner’s Representative, Architect, Contractor and other parties that may be necessary to appropriately review the initiative. The team will review the initiative and determine whether to proceed with a value engineering joint proposal. The Owner and Contractor must jointly agree to the merit of any value engineering initiative before the preparation of the value
engineering joint proposal. The Owner will not be liable for the failure to accept any value engineering initiative.

b. If the Owner and the Contractor jointly agree to the initiative, the Contractor shall prepare the value engineering joint proposal. The proposal shall contain, at a minimum, the following:

(1) An itemized list of existing contract requirements recommended to be changed and proposed language for modification.

(2) All construction documents and computations necessary for a thorough and expeditious evaluation.

(3) A detailed estimate of the cost of performing the work under the existing contract and under the proposed changes, including the cost of implementing the changes.

(4) Estimate of costs the Owner may incur related to the proposed changes such as maintenance and operating cost.

(5) Changes to the project schedule.

(6) Estimate of any other project cost that may be incurred to develop the recommended changes, including Owner’s professional fees.

c. The Contractor shall submit the value engineering joint proposal to the Owner’s Representative. The Contractor will be notified if the proposals have been accepted or if clarifications and/or negotiations are necessary.

e. If the proposal is rejected, the issue is dismissed and each party is responsible for their own cost incurred.

f. If the proposal is accepted in whole or in part, the Owner’s Representative will prepare a Change Order to implement the proposal in the project.

(1) The net savings for the proposal will be calculated by subtracting from the total construction cost savings, the Owner’s cost associated with the proposal including professional fees. The Owner will be the sole judge of the acceptability of a proposal, and the estimated net savings from the adoption of all or any part of the proposal. The Owner reserves the right to disregard the contract bid prices and/or the Contractor’s breakdown of cost, if, in the Owner’s judgment, such prices do not represent a fair measure of the value of the work to be performed or deleted.

(2) Savings resulting solely from the elimination or reduction in quantity of a bid item will not be considered as a value engineering initiative.

(3) Value Engineering initiatives will only be considered by the Owner within the first 150 days of the contract.
(4) For those initiatives accepted by the Owner, the Contractor will be paid 50 percent of the net savings.

(5) Upon acceptance of a value engineering joint proposal, any restriction imposed by the Contractor on its use or on disclosure of the information shall become void, and the Owner thereafter shall have the right to use all or any part of the proposal without obligation or compensation of any kind to the Contractor.

23. BUILDING SYSTEM COMMISSIONING

a. Contractor shall provide all personnel and equipment required to complete the commissioning activities referenced in the Commissioning Plan. The requirements of the commissioning plan shall be completed in their entirety before substantial completion and submitted as referenced in the Closeout Log.

b. The contractor shall designate a competent person, separate from the superintendent or Project Manager, to act as the contractor’s commissioning coordinator. The commissioning coordinator is responsible for planning, scheduling, coordinating, conducting and verifying all commissioning activities required by the commissioning plan and ensuring all building systems are complete, operable and ready for use by the Owner. At a minimum, building ventilation systems, chilled/hot water generation systems, hydronic distribution systems, power distributions systems and fire detection and alarm systems, as applicable.

27. SAFETY PRECAUTIONS AND PROGRAMS

a. The Bidder’s Statement of Qualifications includes a requirement that the Bidder provide its Worker’s Compensation Experience Modification Rates (EMR) and Incidence Rates for the three recent years. The Bidder shall also include the EMR and Incidence Rates of listed major subcontractors on the Bid for Lump Sum Contract. If the EMR exceeds 1 or the Incidence Rate exceeds 13, the Contractor or major subcontractor shall take additional safety measures including, but not limited to, developing a site specific safety plan and assigning a Safety Manager to the Project to perform inspections on a schedule as determined acceptable by the Owner with written reports to be submitted to the Owner. The Owner reserves the right to reject a Bidder or major subcontractor whose rates exceed these stated rates.

b. The contractor shall provide Emergency Contact Information for the Contractor’s on-site staff and home office management as well as contact information for all major subcontractor personnel. This information shall contain business and personal phone numbers for each individual for contact during or after hours in case of an emergency. This information shall be submitted within 15 days of the Notice to Proceed.
28. CONSTRUCTION WASTE MANAGEMENT

a. The goal of Construction Waste Management is to divert waste from the sanitary landfill. This shall be accomplished through reuse, recycling and/or salvage of non-hazardous construction and demolition debris to the greatest extent practical.

b. Track and report all efforts related to reuse, recycling and/or salvage materials from the project (including clean fill material). Report all material types and weights, where material was diverted, type of diversion, documentation of diversion (eg: waste or recycling tickets), and applicable dates. In order to calculate the diversion percentage, total weights of all non-hazardous landfill material must be reported. This information shall be updated monthly utilizing the Construction Waste Management Worksheet provided here: http://www.cf.missouri.edu/cf/pdc/contractor_information.

c. Copies of all applicable receipts, tickets and tracking logs shall be uploaded to the Owner’s information sharing website or reported as required by the Project Manager.

29. WARRANTY WALKTHROUGH

Contractor shall attend a walk-thru with the Owner at 11 months after acceptance to review and document any warranty items to be addressed as part of the 12 month warranty stated in article 3.1 of the General Conditions.

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</tr>
</tbody>
</table>
Section 1 Training Requirements

The purpose of the training requirements for contractors is to ensure that construction project work in and around the healthcare environment is managed in such a way to minimize health and safety risks associated with construction activities and that contractors know and understand their responsibilities.

Required Training
1. Contractor project managers, superintendents and subcontractor foremen will be required to attend the following training:
   - Minimum of One (1) hour training related to “Infection Control & Dust Barriers” and “Healthcare Construction Training for Contractors”.
2. Contractor project managers, superintendents and subcontractor foremen have the responsibility for ensuring that contractor employees are knowledgeable of the training requirements and direct their employees and project work accordingly.
3. Contractors will be required to utilize the MU Hospital online eMeditrack system for initiating work requests of various types, examples may include infection control barriers, utility outage, various permits required.
4. Contractors are required to report in and sign in and out at the designated location per building location each work day upon arrival and exit of the work location.

Training Agenda
At a minimum the topics to be covered in the training include the following:
2. Contractor Training Requirements.

Documentation
1. All employees who receive training will be required to sign their name on a training acknowledgement form stating that they have been oriented to the training requirements.
2. Healthcare Safety and Infection Control Requirements will be in the project contract documents for further review as required.
3. COMPLIANCE VIOLATIONS: Contractors/Vendors who violate the requirements of this Guideline are subject to disciplinary action and removal from the project.

Section 2 Emergency Phone Numbers & Contact Information
Telephone contacts should be used by the contractor for emergency situations which may arise during the construction project. Contact Plan will be identified and coordinated at the project Pre-Construction Meeting by the owner’s representative.

Section 3 Contractor Identification Badge
Contractors working in and around the MUHC facilities will be required to display and wear the “Contractor Identification Badge” and in accordance with the information displayed below. It is the responsibility of the contractor to provide the computer and color printer for reproduction of badges required. Consult the Owner’s Representative for the electronic file.

Contractor ID Badge
1. Contractor is to issue badges to employees as required. (Contractor to validate employee with proof of ID).
2. Contractor to edit the information, print in color, cut out the badges, fold in the center and insert. Contractor will provide badge holders.
3. Contractor shall keep a roster/log of badged employees by trade/subcontractor at the project jobsite for reference by the Owners Representative.
4. All badges to be collected and returned to PD&C at the end of the project.
5. Any orientation required will be discussed at the pre-construction meeting with the Owner’s Representative.
6. Contractor employees are to wear the badge on the upper chest facing forward unless approved otherwise for safety reasons.
7. All contractor superintendent and foreman shall attend “Healthcare Construction Training” and affix issued “T” sticker in the circle area on badge as shown. This will show evidence that the employee has completed training.
8. The Badge document will be provided to the Contractor to make copies and distribute as required. See Page HCG 12.

Section 4 General Safety Requirements for Health Care Projects
The General Contractor and its Subcontractors are responsible for understanding, planning and implementing the following requirements in the management of the project.
1. Make sure shoes/boots and clothing are free of excessive dirt/debris before entering and leaving the construction area.
2. If you leave any dust/dirt or tracks in the occupied area of the healthcare facility, you must stop and clean them up immediately by using a HEPA filtered vacuum and/or a clean dampened floor mop with a UMTH hospital approved furnished cleaning solution.
3. Assure that all construction material, supplies and tools are cleaned and covered with a clean covering material while transporting through the healthcare facility.
4. Ensure that the carts and wheels on tool and supply carts as well as trash/demolition waste carts are properly wiped clean before leaving the construction area. Cleaning/wiping solutions are provided by the hospital and must be approved per direction of the Owner’s Representative.
5. Staff and patients ALWAYS have priority and the “Right of Way” in the elevators and corridors.
6. Never use aerosol sprays or cleaning solvents that could dispense fumes, odors or cause potentially allergenic reactions or medical problems to susceptible patients, staff or visitors.

Section 5 Construction-Renovation-Maintenance Risk Assessment (CRMRA)
The “Construction-Renovation-Maintenance Risk Assessment” (CRMRA) planning process establishes criteria to be used and measures to be taken for the protection of patients, healthcare workers, visitors and contractors, from construction/renovation activities which could lead to infections or compromise existing life safety systems in the healthcare facility.

Once the Contractor is selected, they will be required, and the Subcontractors as applicable to participate in the “CRMRA” planning process for orientation of project requirements and help in identifying any additional project needs or risks prior to any contract construction work commencing.

The owner’s representative will work with the contractor to coordinate and facilitate these CRMRA planning activities with MUHC engineering services, infection control department and others as required during the duration of the project.

Section 6 Construction – Renovation – Maintenance Infection Control Risk Mitigation Criteria
The “Construction–Renovation–Maintenance Infection Control Risk Mitigation Criteria” (CRMICRMIC) is a process to evaluate construction projects for required interventions during construction in order to minimize Hospital Acquired Infections (HAI’s), and controlling dispersal of air and/or water-borne infectious agents concealed within the building components.

All construction activities shall be defined and managed in such a way that occupant’s exposure to dust, moisture and their accompanying hazards is limited.

1. Construction–Renovation–Maintenance Infection Control Risk Mitigation Criteria and the Construction–Renovation–Maintenance Infection Control Risk Mitigation Permit which will be used for all MUHC construction and renovation projects.
2. Any work required outside the main project limits will require a NEW Infection Control Risk Assessment.
3. The owner’s representatives and Contractor will work together to coordinate the assessment and determine the requirements and permit.
4. The owner’s representative will ensure that all required infection control interventions and needed life safety measures required for the project are in place by the contractor prior to starting work. (i.e. barrier walls, tacky mats, required exits, etc.)
5. The contractor shall follow all requirements to support the “Construction – Renovation- Maintenance Infection Control Risk Mitigation Criteria”.
6. The contract documents and CRM IC Permit will provide requirements specific to the project.
7. **Work outside of construction limits.** Prior to contractor performing any work outside of construction limits, the owner’s representative must be notified.

8. Contractors that violate the requirements of the “Construction – Renovation- Maintenance Infection Control Risk Mitigation Criteria/Permit” will be removed from the project.

### Section 7 Construction of Dust Barrier Walls

Infection control is the number one health concern in a construction project. Infection can occur when workers are not cautious about keeping dust, bacteria, mold, etc. from becoming airborne during the construction process. For these reasons, barrier walls are built to isolate dust and fumes in the construction site to separate the patient care and public areas of the healthcare facility.

#### Dust Barriers Walls and Contamination Reduction
1. A signed copy of the “CRM Infection Control Construction Permit” shall be kept at the job site at all times. Large AND small projects may have several “CRM Infection Control Construction Permits” issued as project phases, needs and assessments evolve.
2. Barriers are required to contain the ceiling envelope, chases, interstitial spaces, etc.
3. When access and exiting to the construction site can only be accomplished through a public area, the interior space of the construction site must be cleaned once every 8 – hour shift to control excessive dust and ventilation filtering issues. Debris shall be removed daily.
4. A temporary fire resistant 6 mil., polyethylene dust barrier is required to control dust while the rigid barrier is being constructed as well as at the end of the job during removal of the rigid barrier.
5. Contractors are responsible to ensure that barrier systems and walls are properly constructed, penetrations sealed and maintained for effectiveness for the duration of the project. Anytime polyethylene is used in a control barrier, it must be fire resistant, 6 mil. See “Approved Equipment and Product Information”.
6. Once barrier walls are built they are required to be cleaned or wiped down prior to the start of work.
7. Barrier doors and exits from the construction site must be installed with a closer and kept in good working order with positive latching.
8. Keep doors closed except when in use in order to minimize migration of dust and to maintain negative air pressure relationships.
9. Doors must have a seal/door sweep installed at the undercut and weather stripping around the metal frame to control the migration of dust from the construction site.
10. Doors in barrier walls which are not in use by the contractor to the public spaces must be sealed off and taped around the door, frame and threshold undercut, in order to minimize migration of dust and to maintain negative air pressure requirements.
11. If an elevator, dumb waiter, pneumatic tube system, stairway, linen chute, or any other chased or open type building system is located within the construction site, a barrier wall system will be required to be built around the open building system from deck to deck and properly sealed at top, bottom and sidewalls.
12. **Upon completion of barriers and prior to beginning work,** the contractor shall notify the owner’s representative and healthcare construction compliance manager to coordinate an inspection and verify that the barrier wall meets requirements and that acceptable negative air pressure is being achieved.

#### Special Notes:
1. See “Barrier Wall Design Details” for additional requirements.
2. See section in this manual on “Ventilation and Negative Air Pressure Requirements” for additional requirements when building dust barrier systems and walls.
3. See section in this manual on “Approved Equipment and Product Information”.

### Section 8 Ventilation and Negative Air Pressure Requirements

The first step is building of dust barrier walls to isolate the construction site from patient care and public areas of the healthcare facility to protect patients and the public from construction related dust, fumes and other activities. The effectiveness of barrier walls is minimal unless the construction site is also under negative air pressure. (i.e. air must flow from clean or public spaces into the dirty or construction site).

The following are the “Ventilation and Negative Air Pressure Requirements” which contractors shall strictly follow in the management and construction of their projects.

**Negative Air Pressure Requirements**
1. The contractor shall provide all necessary “Negative Air HEPA Filtered Ventilation Units” required for the negative air requirements of the construction area.

2. See section in this manual on “Approved Equipment and Product Information” for more information.

3. The contractor will work with the owner’s representative to determine best methods and equipment setup requirements for the project.

4. The contractor shall run the “Negative Air HEPA Filtered Ventilation Unit” in the work zone location prior to starting any barrier wall construction or work.

5. “Negative Air HEPA Filtered Ventilation Units”, may be connected to normal or emergency power and shall run continuously, 24/7. Critical areas of the healthcare facility may require the HEPA filtered ventilation units to be connected to emergency power only.

6. A secondary method to maintain negative air pressure is by using the hospital’s exhaust system attached to the “Negative Air HEPA Filtered Ventilation Units”. This process and installation must be approved by the owner’s representative.

7. Pre-Filters shall be changed at least twice weekly during demolition and drywall sanding and a minimum of once a week during other times. This frequency requirement may be relaxed for lower risk projects and on prior approval from the owner’s representative.

8. The contractor shall furnish and install the negative air-monitoring device to monitor daily negative air pressure -0.01 inches of water column. See section in this manual on “Approved Equipment and Product Information”.

9. The contractor shall record daily on the “Negative Air Pressure and Filter Change Log” the air pressure reading in the construction area to insure that appropriate negative air pressure is being maintained.

10. See “Negative Air Pressure and Filter Change Log” form at the end of this section.
**Negative Air Pressure and Filter Change Log**

Project Name: ________________________________

Location: ____________________________________

Contractor to complete the **Negative Air Pressure and Filter Change Log** daily at the start of each work shift and maintain completed forms in the project safety file for future review. Post this log inside construction site entrance for use and review.

### Pressure Relationship Illustration

<table>
<thead>
<tr>
<th>Pressure Relationship Illustration</th>
</tr>
</thead>
<tbody>
<tr>
<td>Negative</td>
</tr>
<tr>
<td>-0</td>
</tr>
</tbody>
</table>

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Section 9  Interim Life Safety Measures Assessment (ILSM)
Interim Life Safety Measures (ILSM) are a series of administrative actions that must be taken to compensate temporarily for the hazards posed by existing NFPA Life Safety Code 101, 2014 edition deficiencies, other building code issues or construction activities. Examples of when construction activities require ILSM’s to be implemented are as follows:
1. Fire alarm system, detection, and/or sprinkler system are impaired or disabled.
2. Normal exits or exit routes and/or exit lighting have been compromised.
3. Re-routing of traffic due to construction activities.
4. Temporary narrowing of the corridor.
5. Deficiencies in fire and/or smoke separations and systems caused by construction activities. (Changes to wall, door, dampers, penetrations, etc.)
8. Hot work.

Whenever an “Interim Life Safety Measure” is identified for implementation during the construction project, there will typically be measures or actions required by both the MUHC engineering services department as well as the contractor.

The contractor has the responsibility prior to the beginning of work and throughout the project to become familiar with the ILSM in order to plan and identify what construction related activities will require an evaluation of ILSM’s as noted in the ILSM. The “Interim Life Safety Measures Evaluation” is a required team effort.

Section 10  Noise and Vibration Control Management
Construction related noise and vibration control and mitigation measures are to be implemented when the contractor is working in and around healthcare facilities. The contractor shall work with the owner’s representative to develop means and methods for controlling excessive noise and vibration during construction.

Section 11  Above Ceiling Work Permit
All contractors who need access above ceilings in the public areas of the healthcare facility and outside the approved construction site shall be required to obtain an “Above Ceiling Work Permit” from the owner’s representative prior to disrupting or lifting out ceiling tiles. The contractor shall notify the owner’s representative fourteen (14) days prior to the need for ceiling access in order to process and evaluate any special requirements of the permit.

General Requirements for Working above Ceilings (“Above Ceiling Permit Required”)
1. The Construction-Renovation-Maintenance Infection Control Risk Mitigation Permit issued for the work activity will note specifics required for Barrier Types.
2. Any cable and wiring pulls through the healthcare facility which will require a ceiling disturbance must be approved in advance by obtaining an “Above Ceiling Work Permit”.
3. Ceiling tiles must not be left displaced by the contractor if he walks away from the area unless the area has been contained by an approved “Dust Barrier”.
4. If a ceiling tile is damaged by the contractor he should notify the owner’s representative to acquire a new tile for replacement.
5. All debris shall be cleaned up by the contractor daily when working in cabling and electrical closets.
6. Pulling of communication cables in a patient care or other critical care areas will require special scheduling. Consult with the owner’s representative for coordination.
7. When cables must be pulled in an active patient care unit, a dust partition must be used at the site of entry and exit of the cable.
8. The dust partition may be attached to the false ceiling because taking it to deck may interfere with the work.
9. The site of entry and exit of the cable or other above ceiling work must be HEPA vacuumed (ceiling tiles and pipes) before the work begins.
Section 12  Lock Out/Tag out Permit
The contractor shall give a minimum fourteen (14) working days notice to the owner’s representative for shutdown work on electrical systems or other critical utility systems which could significantly impact the healthcare facilities operations, the contractor will be required to plan these “Lock Out/Tag Out” activities ten (14) days in advance. Major utility shutdowns may require weeks of notice and planning. The contractor shall work with the owner’s representative to identify these time planning requirements.

Section 13  Utility Systems Shutdown & Service Permit
The “Utility Systems Shutdown & Service Permit” is to be used when work on an existing utility system may cause a disruption within the MUHC facility.

“Utility Systems” shall be defined as any system that would hinder the delivery of patient care and hospital operations should the system be interrupted for any reason. Planning for this work usually requires a contingency plan by the healthcare facility management department to address any failure of the utility system.

Utility Shutdown
Any and all utility or system connections, shut-off, or interruptions must be scheduled with the owner’s representative prior to commencement of the work. This work shall be defined as a “Utility Shutdown” and notice shall be made to the owner’s representative to coordinate the request and facilitation.

Utility Service - (System must be worked live or energized)
In addition to utility system connection, shut-off, or interruption, the contractor must also schedule any work on existing utility systems that either do not require interruption or cannot be interrupted to accomplish the work. This type of work shall be defined as “Utility Service” and notice shall be made to the owner’s representative. The contractor shall give up to 14 working days’ notice to the owner’s representative in order to properly plan and coordinate required activities.

All permits are to be posted at the job site location for the duration of the permit. When complete the contractor shall file the permits in the contractor job safety file for future review as may be required.

Section 14  Hot Work & Permit
Hot work shall be defined as welding, brazing, cutting soldering, grinding, or other activities which produce sparks or use flame which are capable of initiating fires or explosions.

All contractors performing construction, renovation and installation work for MUHC facilities are required to follow the requirements and provisions of NFPA 51B and the owner’s representative procedures related to “Hot Work” and obtaining a “Hot Work Permit”.

The following are the requirements for a contractor to obtain a “Hot Work Permit”.

1. Contractors shall contact the owner’s representative two (2) days, forty eight (48) hours in advance to request a hot work permit. A request for complex projects which requires extensive planning on behalf of the owner’s representative may require a longer notice period.
2. All hot work sites are inspected by the owner’s representative using the requirements printed on the “Hot Work Permit”.
3. The owner’s representative will issue a “Hot Work Permit” tag to be attached in the vicinity of the actual hot work being performed. Upon completion, the hot work tag shall be returned to the owner’s representative. “Hot Work Permits” will be issued for only one shift unless other arrangements have been made with owner’s representative. All permits expire 30 minutes prior to the end of the shift.
4. If hot work cannot be completed within one work shift, the contractor is responsible for obtaining approval for a revised permit extension from the owner’s representative. The contractor is responsible for meeting all the safety requirements required by the permit for any and all extensions granted.
5. The contractor shall be responsible for supplying a trained worker for the requirement of a fire watch during the actual hot work. The fire watch’s only responsibility will be as a fire watch.
7. A fire watch shall be provided for 30 minutes following the completion of work, including during lunch and breaks by the contractor.

8. The contractor shall provide at a minimum a ten pound (10) ABC fire extinguisher that has a current, valid inspection tag.

9. A copy of the “Hot Work Permit” shall be kept in the general contractors project file for future review as may be required.

10. The contractor shall upload completed Hot Work Permits to the owner’s electronic construction document program (Projex 4) in the Hot Work Permit folder for the project not less than on a weekly basis or as instructed by the owner’s representative.
### Section 16 Required Forms, Permits, Postings and Documentation

**Note:** Refer to the sections in the “Healthcare Construction Requirements” manual for detailed information on each form and permit approval procedure.

<table>
<thead>
<tr>
<th>Category</th>
<th>Required Notice</th>
<th>Form</th>
<th>Permit Approval</th>
<th>Job Site Posting</th>
<th>Contractor Safety File</th>
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<tr>
<td>CRM Infection Control Construction Permit</td>
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<td>CRM Risk Assessment</td>
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<td>Interim Life Safety Signage</td>
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</table>

The contractor will be required to furnish and install a “Project Safety Information” bulletin board on their project site for posting of required safety information. Small, short duration projects may have this requirement waived by the owner’s representative.

**Legend**  CRM = Construction-Renovation-Maintenance
Section 17  Project Cleaning and Barrier Removal Process
The following is the typical sequence prior to the removal of barrier walls.
With the barrier in place and with the “Negative Air HEPA Filtered Ventilation Unit” running, the contractor will
HEPA vacuum all horizontal and vertical surfaces.
1. Clean the covers that are isolating the HVAC ducts.
2. Clean the outside of the negative air HEPA machine and its exhaust duct.
3. The contractor shall notify the owner’s representative to schedule a walk-through of the clean space for
inspection and approval prior to removal of the barrier wall.
4. Following all job site cleaning and flushing of plumbing, the contractor can begin the barrier cleaning process.
5. During construction or removal of barrier walls, fire resistant polyethylene barriers must be put into place to
help control any construction or demolition dust of the barrier wall system.
6. MUHC must approve removal of any Infection Control or other barriers. Prior to removal of the temporary fire
resistant polyethylene barrier, it shall be vacuumed with a HEPA vacuum to eliminate any dust attached to the
plastic. The polyethylene barrier is then wiped down with the use of damp cleaning clothes and using a hospital
furnished approved infection control cleaning solution. The contractor shall roll or fold the polyethylene in on
itself creating as little dust as possible prior to transporting out of the building in a covered cart.
7. Remove the covers or caps from any and all HVAC system supply, return and exhaust ducts and restore the
HVAC system.
8. The “Negative Air HEPA Filtered Ventilation Unit” is removed from the project site once the HVAC system is
verified is operating properly.

If Air Sampling Is Required
When construction/renovation is done and completed in or near a high risk assessment critical care unit (i.e. Burn
Unit, Operating Rooms, Intensive Care, etc.) there may be a requirement to do air sampling after the negative air
system has been removed and the building HVAC system has been restored. This will be a requirement only if the
infection control department determines the need at the end of the project and prior to occupancy.

Section 18  Approved Equipment and Product Information

“NEGATIVE AIR HEPA FILTERED VENTILATION UNIT”, HEPA filter equipped negative air machines that
provide rough in filters, primary filters and a HEPA final filter. Rating of 300 to 2000 cubic feet per minute, (CFM).
HEPA filters must be a minimum 99.97% efficient @ 0.3 microns. Differential pressure alarm required if not
installed in another fashion to monitor construction site negative air of
– 0.01 water column. Or approved equal.

- MICRO Trap Corporation, Models MT 1000 or Model MT 2000. 1300 W. Steel Road, No. 2 Morrisville, PA
  19067 (215) 295-8208 or (877) 646-8208.
- ABATEMENT Technologies, Inc. Model HEPA-AIRE PAS2400HC Portable Air Scrubber or Model PAS1200HC
  605 Satellite Blvd. Suite 300 Suwanee, GA 30024 (800) 634-9091

“HEPA VACUUM”, A shop style vacuum with a HEPA filter cartridge at 99.97% filtration @ 0.3 microns. Or
approved equal.

- ABATEMENT Technologies Inc. Model V8000WD Canister Style Wet/Dry HEPA Vacuum. 605 Satellite
  Blvd. Suite 300 Suwanee, GA 30024 (800) 634-9091.
- ABATEMENT Technologies Inc. Model V1300H Hip Mounted HEPA Vacuum, designed for use on
  scaffolding and mobile conditions such as ceiling tile type cleaning. Lightweight at 6.4 lbs. 605 Satellite
  Blvd. Suite 300 Suwanee, GA 30024 (800) 634-9091.

“ADHESIVE WALK OFF MATS”, 24” x 36” Tacky Mat. Peel up dirty layer and dispose to reveal a new, fresh
clean tacky mat.

- Tacky walk off mat No. 5838 24” x 36”, 60 tacky mats to a unit. Four units per case.
“NEGATIVE AIR PRESSURE INDICATOR”, Manometer.

- Model “Mark II Model No. 25 inclined-vertical Manometer. Dwyer Instruments Inc. PO Box 373, Michigan City, IN 46361 (219) 879-2000.
- MICRO Trap Corporation, Model Tri/Mon, digital recording manometer for tracking differential pressure. 1300 W. Steel Road, No. 2 Morrisville, PA 19067 (215) 295-8208 or (877) 646-8208.

“PORTABLE WORK ENCLOSURE”, For temporary fire resistant polyethylene dust barrier. System components supplier of zip poles, door opening access zippers, dust sealing system parts, etc.

- Zip Wall, LLC. 37 Broadway, Arlington, MA 02474 (800) 718-2255. Or approved equal.


Example of Badge for Contractor use -

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SECTION 19 Health Care Construction Cleaning Definitions

Construction Clean
1. Remove tools & equipment from the work area.
2. Remove all bulk trash from the work area.
3. Thoroughly sweep all floor surfaces in the work area utilizing a dust compound (floor sweep) material.
4. Dry wipe all horizontal & vertical surfaces in the work area. Surfaces to include but not limited to walls, window sills, doors & door frames, base trim, casework (inside & out), fixtures, and wall-mounted equipment.
5. Sweep all floor surfaces utilizing a dust mop.
6. Wet mop all floor surfaces.

Thorough Clean
1. To be implemented only after Construction Clean procedures have been completed.
2. Wet wipe all horizontal and vertical surfaces utilizing a MUHC – Infection Control Department approved germicidal disinfectant. Surfaces to include but not limited to walls, window sills, doors & door frames, base trim, casework (inside & out), all fixtures, and wall-mounted equipment.
3. Wet mop all floor surfaces utilizing a MUHC Infection Control Department approved germicidal disinfectant.

Terminal Clean
1. To be implemented only after Through Clean procedures have been completed.
2. Cleaning procedures shall be conducted by MUHC trained Environmental Services, Sterile Processing or Surgical Services staff only.
3. Thoroughly clean and disinfect surfaces on the ceiling such as diffusers, light fixtures, and ceiling mounted devices & equipment.
4. Thoroughly clean and disinfect all equipment in the work area.
5. Thoroughly clean and disinfect all flooring including moving equipment & furnishings to allow access to all floor surfaces.
6. Move all portable equipment and furnishings away from the walls. Wet wipe and disinfect all wall surfaces and wall mounted equipment.
## Contractor Checklist

<table>
<thead>
<tr>
<th>Project Name/No.</th>
<th>Date/Time:</th>
</tr>
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<tbody>
<tr>
<td>Contractor Company Name:</td>
<td>Contractor Rep:</td>
</tr>
<tr>
<td>Project Area:</td>
<td>Contractor Rep Phone #:</td>
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</table>

<table>
<thead>
<tr>
<th>Y</th>
<th>N</th>
<th>N</th>
<th>A</th>
<th>Corrective Action</th>
</tr>
</thead>
</table>

**Legend: IC=Infection Control, LS=Life Safety, RA=Risk Assessment**

Construction areas are free of nonconforming storage and housekeeping materials, food waste, and construction debris to reduce flammable and combustible fire load of the building, above noted items are removed from the jobsite on a daily basis or as required.

1. All Exits provide free and unobstructed egress through construction
2. Alternative exits are clearly identified, and Project is Secure at all times, door gaskets and hardware are in good working order to maintain Negative Air
3. Exit signage is operational
4. Emergency Services, (Fire, Police, Ambulatory) ingress and egress paths are clear
5. Infection Control Barriers are Intact (no evidence of dust on the clean side)
6. Walk off/tacky mats are clean and changed as required
7. HEPA Vacuum and cleaning supplies area readily available
8. Negative Air equipment is operating and maintained, exhaust duct is properly installed and maintained and filters are changed as required
9. Negative Air and Filter management is documented
10. Construction Barriers maintain negative pressure relationships as required
11. HVAC vents and diffusers are sealed as required for Negative Air and IC
12. Construction carts transporting debris are properly covered and personnel are utilizing the designated routes for access to and from the project site
13. Workers comply with use of surgical attire as needed
14. Construction site activities are properly isolated from fresh air intakes
15. Exhaust and Supply ducts are sealed/capped, piping is capped as required
16. Temporary fire alarm detection systems are in place and functional
17. Temporary Fire Suppression systems are in place and functional
18. Fire Extinguishers are present with current inspection tag
19. Hot Work Permits are issued as required and posted properly
20. Fire Watch is conducted with proper precautions
21. Project area is free of excess combustible materials
**Contractor Checklist**

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<tr>
<td>22. Proper Lock out / tag out procedures are utilized</td>
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<td>23. Adequate temporary lighting is provided in the project area</td>
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<td>24. Proper GFI is utilized by all trades</td>
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<td>25. MU No Tobacco policy is enforced</td>
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<td>26. Contractor personnel are wearing required identification for the project</td>
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Additional Comments:
Option #1 – Contractor Schedule

1. GENERAL
   a) Time is of the essence for this contract. The time frames spelled out in this contract are essential to the success of this project. The University understands that effective schedule management, in accordance with the General Conditions and these Special Conditions is necessary to insure that the critical milestone and end dates spelled out in the contract are achieved.
   b) Related Documents
      Drawings and general provisions of the Contract, including General Conditions’ Article 3.17 shall apply to this Section.
   c) Stakeholders
      A Stakeholder is anyone with a stake in the outcome of the Project, including the University, the University Department utilizing the facility, the Design Professionals, the Contractor and subcontractors.
   d) Weather
      (1) Contractor acknowledges that there will be days in which work cannot be completed due to the weather, and that a certain number of these lost days are to be expected under normal weather conditions in Missouri.
      (2) Rather than speculate as to what comprises “normal” weather at the location of the project, Contractor agrees that it will assume a total of 44 lost days due to weather over the course of a calendar year, and include same in its as planned schedule. For projects of less than a calendar year, lost weather days should be prorated for the months of construction in accordance with the following schedule.
      (3) Anticipated weather days for allocation/proration only. For projects lasting 12 months or longer, the 44 days per year plus whatever additional months are included will constitute normal weather.

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2. SCHEDULING PROCESS
   a) The intent of this section is to insure that a well-conceived plan, that addresses the milestone and completion dates spelled out in these documents, is developed with input from all stakeholders in the project. Input is limited to all reasonable requests that are consistent with the requirements of the contract documents, and do not prejudice the Contractor’s ability to perform its work consistent with the contract documents.
      Further, the plan must be documented in an understandable format that allows for each stakeholder in the project to understand the plan for the construction and/or renovation contained in the Project.
   b) Contractor Requirements
      (1) Schedule Development
         Contractor shall prepare the Project Schedule using Primavera SureTrack or P3, Microsoft Project, Oracle P6, or other standard industry scheduling software, approved by the Owner’s Representative.
      (2) Schedule Development
         Within 2 weeks of the NTP, contractor shall prepare a schedule, preferably in CPM format, but in detailed bar chart format at a minimum, that reflects the contractor’s and each subcontractors plan for performing the contract work.
Contractor shall review each major subcontractor’s schedule with the sub and obtain the subcontractor’s concurrence with the schedule, prior to submitting to the University.

(3) Schedule Updates.
   (a) Schedule Updates will be conducted once a month, at a minimum. Actual Start and Finish dates should be recorded regularly during the month. Percent Complete, or Remaining Duration shall be updated as of the data date, just prior to Contractor’s submittal of the update data.
   (b) Contractor will copy the previous months schedule and will input update information into the new monthly update version.
   (c) Contractor will meet with the Owner’s Representative to review the draft of the updated schedule. At this meeting, Owner’s Representative and Contractor will:
      (i) Review out of sequence progress, making adjustments as necessary,
      (ii) Add any fragment necessary to describe changes or other impacts to the project schedule and
      (iii) Review the resultant critical and near critical paths to determine any impact of the occurrences encountered over the last month.

(4) Schedule Narrative
   After finalization of the update, the Contractor will prepare a Narrative that describes progress for the month, impacts to the schedule and an assessment as to the Contractor’s entitlement to a time extension for occurrences beyond its control during the month and submit in accordance with this Section.

(5) Progress Meetings
   (a) Review the updated schedule at each monthly progress meeting. Payments to the Contractor may be suspended if the progress schedule is not adequately updated to reflect actual conditions.
   (b) Submit progress schedules to subcontractors to permit coordinating their progress schedules to the general construction work. Include 4 week look ahead schedules to allow subs to focus on critical upcoming work.

3. CRITICAL PATH METHOD (CPM)
   a) This Section includes administrative and procedural requirements for the critical path method (CPM) of scheduling and reporting progress of the Work.
   b) Refer to the General and Special Conditions and the Agreement for definitions and specific dates of Contract Time.
   c) Critical Path Method (CPM): A method of planning and scheduling a construction project where activities are arranged based on activity relationships and network calculations determine when activities can be performed and the critical path of the Project.
   d) Critical Path: The longest continuous chain of activities through the network schedule that establishes the minimum overall project duration.
   e) Network Diagram: A graphic diagram of a network schedule, showing the activities and activity relationships.
   f) Activity: A discrete part of a project that can be identified for planning, scheduling, monitoring, and controlling, the construction project. Activities included in a construction schedule consume time and resources.
   g) Critical activities are activities on the critical path.
   h) Predecessor activity is an activity that must be completed before a given activity can be started.
   i) Milestone: A key or critical point in time for reference or measurement.
   j) Float or Slack Time: The measure of leeway in activity performance. Accumulative float time is not for the exclusive use or benefit of the Owner or Contractor, but is a project resource available to both parties as needed to meet contract milestones and the completion date.
k) Total float is herein defined as the measure of leeway in starting or completing an activity without adversely affecting the planned project completion date.

l) Weather: Adverse weather that is normal for the area must be taken into account in the Contractor’s Project Schedule. See 1.d.3, above.

m) Force Majeure Event: Any event that delays the project but is beyond the control and/or contractual responsibility of either party.

n) Schedule shall including the following, in addition to Contractor’s work.
   (1) Phasing: Provide notations on the schedule to show how the sequence of the Work is affected by the following:
      (a) Requirements for phased completion and milestone dates.
      (b) Work by separate contractors.
      (c) Work by the Owner.
      (d) Coordination with existing construction.
      (e) Limitations of continued occupancies.
      (f) Uninterruptible services.
      (g) Partial occupancy prior to Substantial Completion.

o) Area Separations: Use Activity Codes to identify each major area of construction for each major portion of the Work. For the purposes of this Article, a "major area" is a story of construction, a separate building, or a similar significant construction element.

4. TIME EXTENSION REQUEST

a) Refer to General Conditions of the Contract for Construction, Article 4.7 Claims for Additional Time.

b) Changes or Other Impacts to the Contractor’s Work Plan

The Owner will consider and evaluate requests for time extensions due to changes or other events beyond the control of the Contractor on a monthly basis only, with the submission of the Contractor’s updated schedule, in conjunction with the monthly application for payment. The Update must include:
   (1) An activity depicting the event(s) impacting the Contractors work plan shall be added to the CPM schedule, using the actual start date of the impact, along with actually required predecessors and successors.
   (2) After the addition of the impact activity(ies), the Contractor will identify subsequent activities on the critical path, with finish to start relationships that can be realistically adjusted to overlap using good, standard construction practice.
      (a) If the adjustments above result in the completion date being brought back within the contract time period, no adjustment will be made in the contract time.
      (b) If the adjustments above still result in a completion date beyond the contract completion date, the delay shall be deemed excusable and the contract completion date shall be extended by the number of days indicated by the analysis.
      (c) Contractor agrees to continue to utilize its best efforts to make up the time caused by the delays. However the Contractor is not expected to expend costs not contemplated in its contract, in making those efforts.

c) Questions of compensability of any delays shall be held until the actual completion of the project. If the actual substantial completion date of the project based on excusable delays, excluding weather delays, exceeds the original contract completion date, AND there are no delays that are the responsibility of the contractor to consider, the delays days shall be considered compensable. The actual costs, if any, of the Contractor’s time sensitive jobsite supervision and general conditions costs, shall be quantified and a change order issued for these costs.

UNIVERSITY OF MISSOURI
CONTRACTORS ROOFING/FLASHING/SHEET METAL GUARANTEE
(Revised 12/94)
WHEREAS (NAME AND ADDRESS OF COMPANY) herein referred to as Roofing Contractor, certify that they have furnished and installed all roofing, flashing, sheet metal and related components in accordance with the Contract Documents and as required by the Roofing System Manufacturer=s installation instructions on the facility described below:

Facility: __________________________________________

Owner: University of Missouri-(CAMPUS)
(CAMPUS ADDRESS)

Date of Full Completion: ________________________

Approximate Area of Roof: ________________________

Type of Roofing Material: ________________________

Manufacturer’s Specification Number: ____________

Thickness and Type of Roof Insulation: ________________________

NOW, THEREFORE, Roofing Contractor guaranties to the Owner, subject only to the exclusions stated hereinafter, that all roofing, flashing and sheetmetal work is fully and integrally watertight and is free from faults and defects in material or workmanship, and is guaranteed for a period of three (3) years from date of full completion of work.

EXCLUSIONS: This guarantee does not cover, and Roofing Contractor shall not be liable for the following:

1. Damage to the roofing system caused by fire, lightning, tornado, hurricane or hailstorm.

2. Damage to roof system caused by significant settlement, distortion or failure of roof deck, walls, or foundations of building, excepting normal building expansion and contraction is not a part of this exclusion.

3. Abuse by the Owner and/or third parties.

REPAIRS: Owner shall promptly notify Roofing Contractor, in writing, of the need for repair of roofing, flashing, or sheet metal:

1. Roofing Contractor, within eight (8) hours after receipt of such notice, shall make emergency repairs at its expense, as required to render the facility watertight.

2. Within five (5) days after receipt of such notice, Roofing Contractor shall at its expense correct any faults or defects in material or workmanship.

3. Should needed repairs not be covered by this guarantee, Roofing Contractor, after having obtained Owner’s written consent, shall make such repairs at Owner’s expense. Following said repairs, this guarantee shall thereafter remain in effect for the unexpired portion of the original term. If Owner does not so consent or repairs are made by others than the Roofing Contractor, this guarantee shall terminate for those parts of the roof affected by the repair.

4. In the event that Owner has notified the Roofing Contractor of the need for repairs and (i) Roofing Contractor does not immediately make repairs, or (ii) Roofing Contractor disclaims responsibility for the repairs and Owner disagrees, or (iii) Owner considers Roofing Contractor=s quoted cost for repairs not covered by this guarantee to be unreasonable and, an emergency condition exists which requires prompt repair to avoid substantial damage or loss to Owner, then, Owner may make such temporary repairs as he finds necessary and such action shall not be a breach of the provisions of this guarantee.

ANNUAL INSPECTIONS: Roofing Contractor shall inspect roof installation prior to each of the three anniversary dates from date of full completion of the work.

CRFSMG - 4
1. Inspection team to include Roofing Contractor, Roof Manufacturer, and Owner=s Representative.

2. Inspection of total roof system will be included in the annual inspections.

3. All defects in total roof system will be corrected by the Roofing Contractor within 30 days of inspection.

4. Roof manufacturer will certify by a written report that roof inspection has been completed, defects are acknowledged, and will warrant any repairs.

5. All corrective work completed by Roofing Contractor shall be warranted as approved by the Roofing Manufacturer.

ROOF MODIFICATION: Should Owner require work to be done on roof of said facility including modifications, alternations, extensions or additions to roof and including installation of vents, platforms, equipment, bracings or fastenings, Owner shall notify Roofing Contractor and give Roofing Contractor an opportunity to make recommendations as to methods necessary to safeguard against damage to roofing covered by this guarantee. Failure of Owner to give Roofing Contractor such opportunity or failure to follow methods recommended by Roofing Contractor shall render this guarantee null and void to the extent such failure should result in damage to roofing covered by this guarantee.

NOTICES: Notification of Roofing Contractor by Owner, shall be fulfilled by sending notice to Roofing Contractor.

IN WITNESS WHEREOF, we set our hands this _____ day of ___________, 20___.

By: ________________________________

Title: ________________________________

For Roofing Contractor

Name: ________________________________

Address: ________________________________

Phone: ____________
## SHOP DRAWING AND SUBMITTAL LOG

Project:  
Project Number:  
Contractor:

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SDSL - 1
## OPERATING INSTRUCTIONS AND SERVICE MANUAL LOG

**Project:**  
**Project Number:**  
**Contractor:**

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<tr>
<th>Section</th>
<th>Description</th>
<th>Catalog Data</th>
<th>Wiring Diagrams</th>
<th>Installation Instructions</th>
<th>Service &amp; Maintenance Instructions</th>
<th>Parts List &amp; Availability</th>
<th>Performance Curves</th>
<th>Startup &amp; Operating Instructions</th>
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## CLOSEOUT LOG

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**Project Number:**
**Contractor:**

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<td>Executed commissioning plan w/ required documentation</td>
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<td>List special warranties and guarantees for each section</td>
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<td>List any required maintenance stock, spare parts, etc.</td>
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# Sustainability Report

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</table>

Total weight of all demolition material:  

Percentage of total material diverted:  
SECTION 1.F

INDEX OF DRAWINGS

Drawings referred to in and accompanying Project Manual consist of following sheets April 12, 2019.

Sheet 1 of 16: G001 Cover Sheet
Sheet 2 of 16: A101 Architectural First Floor Plan
Sheet 3 of 16: A102 Architectural Attic Plan
Sheet 4 of 16: IC101 Infection Control First Floor Plan
Sheet 5 of 16: IC102 Infection Control Attic Plan
Sheet 6 of 16: M001 Mechanical Symbols, Notes, Abbreviations and Details
Sheet 7 of 16: M002 Mechanical Details and Schedules
Sheet 8 of 16: MD101 Mechanical First Floor Plan - Demolition
Sheet 9 of 16: MD102 Mechanical Attic Plan - Demolition
Sheet 10 of 16: M101 Mechanical First Floor Plan - Renovation
Sheet 11 of 16: M102 Mechanical Attic Plan – Ductwork Renovation
Sheet 12 of 16: M103 Mechanical Attic Plan – Piping Renovation
Sheet 13 of 16: E001 Electrical Symbols, Notes, Abbreviations and Details
Sheet 14 of 16: E002 Electrical Details and Panel Schedules
Sheet 15 of 16: ED101 Electrical Plan - Demolition
Sheet 16 of 16: E101 Electrical Plan - Renovation

END OF SECTION
Annual Wage Order No. 25  
Boone County  
effective 8/28/2018

These are the wage rates applicable to this project in accordance with 13.6.1 of the general conditions. Overtime provisions are specified under 13.6.13

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<thead>
<tr>
<th>OCCUPATIONAL TITLE</th>
<th>BASIC HOURLY RATES</th>
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<tr>
<td>Asbestos Worker (H&amp;F) Insulator</td>
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<td>Boilermaker</td>
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<tr>
<td>Bricklayer</td>
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<tr>
<td>Carpenter, Pile Driver, Millwright, Lather, Linoleum Layer</td>
<td>$43.25</td>
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<tr>
<td>Cement Mason, Plasterer</td>
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<tr>
<td>Communication Technician</td>
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<tr>
<td>Electrician (Inside Wireman)</td>
<td>$50.23</td>
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<tr>
<td>Electrician (Outside-Line Construction/Lineman)</td>
<td>$66.35</td>
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<tr>
<td>Elevator Constructor</td>
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<td>Glazier</td>
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<tr>
<td>Ironworker</td>
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<tr>
<td>Laborer, 1st Semi Skilled Laborer, 2nd Semi Skilled Laborer</td>
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<tr>
<td>Mason, Marble Mason, Marble Finisher, Terrazzo Worker, Terrazzo Finisher, Tile Setter, Tile Finisher</td>
<td>$35.29</td>
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<tr>
<td>Operating Engineer</td>
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<tr>
<td>Painter</td>
<td>$36.67</td>
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<tr>
<td>Plumber, Pipefitter</td>
<td>$59.60</td>
</tr>
<tr>
<td>Roofer/Waterproofer</td>
<td>$45.59</td>
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<tr>
<td>Sheet Metal Worker</td>
<td>$49.43</td>
</tr>
<tr>
<td>Sprinkler Fitter - Fire Protection</td>
<td>$57.26</td>
</tr>
<tr>
<td>Truck Driver</td>
<td>$36.00</td>
</tr>
</tbody>
</table>

END OF SECTION
SECTION 1.H

ALTERNATES

Base Bid may be increased in accordance with following Additive Alternate proposal(s) as Owner may elect:

1. Additive Alternate No. 1: Provide Heat Pump units in lieu of Condensing Units.

END OF SECTION
TABLE OF CONTENT
DIVISION 23 – MECHANICAL

018574  Indoor Air Quality Plan During Construction
230000  Mechanical General Conditions
230010  Basic Mechanical Materials and Methods
230020  Vibration and Seismic Controls for HVAC Piping and Equipment
230100  Installation of Mechanical Piping
230140  Natural Gas Piping
230150  Refrigerant Piping
230200  Mechanical Insulation
230605  Energy Recovery Units
230719  HVAC Piping Insulation
230812  VRF Fan Coil Systems
230850  Furnaces and Matching Condensing Units
230900  Air Distribution
230910  Start-Up, Cleaning and Testing
230930  Testing and Balancing
230960  Temperature Controls
SECTION 018574 - INDOOR AIR QUALITY PLAN DURING CONSTRUCTION

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Description of an Indoor Air Quality (IAQ) Construction Plan
2. IAQ Construction Requirements

B. Related Sections: Site protection specifications included in this section should be coordinated with the following sections of the Project Manual, including:

1. Section 230010 - Basic Mechanical Material
2. Section 230200 - Mechanical Insulation and Methods
3. Section 230900 - Air Distribution

C. SUBMITTALS

1. General: Submit the following in accordance with Section 230000.
2. Product data including materials, details of construction, dimensions of individual components, profiles, manufacturer’s installation instructions, and finishes for the following items:
   a. Provide 18 photographs, six photos taken on three different occasions during construction, along with identification of the SMACNA approach featured by each photograph to show consistent adherence to the SMACNA requirements.
   b. Declare the five Design Approaches of the SMACNA IAQ Guideline which were used during building construction. Include a brief description of the important design approaches employed.

1.2 INDOOR AIR QUALITY

A. Goals: The owner has set the following indoor air quality goals for jobsite operations on project, within the limits of the construction schedule, contract sum, and available materials, equipment, products and services. Goals include:

1. Protect workers on the site from undue health risks during construction.
2. Prevent residual problems with indoor air quality in the completed building.

1.3 INDOOR AIR QUALITY PLAN

A. Within fourteen (14) days after receipt of Notice of Award and prior to any waste removal by the Contractor from the Project, the Contractor shall develop and submit to the Owner for review a healthy indoor air quality plan. This plan shall be Part II of a “Sustainable Job Site Operations Plan.”

1. List of IAQ protective measures to be instituted on the site
2. Schedule for inspection and maintenance of IAQ measures
1.4 SUBSTITUTIONS

A. Should the Contractor desire to use procedures, materials, equipment, or products that are
not specified but meet the intent of these specifications to protect air quality on the site, the
Contractor shall propose these substitutions in accordance with Substitutions and “Or Equal”
in General Requirements.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Low emitting products have been specified in appropriate sections.

PART 3 - EXECUTION

3.1 ALL PHASES

A. The Contractor is minimally required to meet or exceed the minimum requirements of the
Sheet Metal and Air Conditioning National Contractors Association (SMACNA) IAQ Guidelines
for Occupied Buildings Under Construction, 1995 to:

1. Protect the ventilation system components from contamination, OR provide cleaning of
   the ventilation components exposed to contamination during construction prior to
   occupancy.
2. Provide a continuous ventilation rate of one air change per hour minimum during
   construction, OR, conduct a building flush-out with new filtration media at 100% outside
   air after construction ends (following issuance of Occupancy Certificate) and prior to
   occupancy for seven days (one week).

   a. Provide a minimum of MERV 8 filtration (as determined by ASHRAE Standard
      52.2-1999) at each return air grille or at any open return air duct for systems
      operational during construction, and replace filtration media immediately prior to
      occupancy. See Section 230885, Air Cleaning, for additional requirements.

B. During installation of carpet, paints, furnishings, and other VOC-emitting products, provide
   supplemental (spot) ventilation for at least 72 hours after work is completed. Preferred HVAC
   system operation uses supply air fans and ducts only; exhaust provided through windows. Use
   exhaust fans to pull exhaust air from deep interior locations. Stair towers and other paths to
   exterior can be useful during this process.

C. Conduct regular inspection and maintenance of indoor air quality measures including
   ventilation system protection, and ventilation rate.

D. Require VOC-safe masks for workers installing VOC-emitting products (interior and exterior)
   defined as products that emit 150 gpl or more UNLESS local jurisdiction's requirements are
   stricter, in which case the strictest requirement shall be followed for use of VOC-safe masks.

E. Use low-toxic cleaning supplies for surfaces, equipment, and worker’s personal use. Options
   include several soybean-based solvents and cleaning options (SoySolv) and citrus-based
   cleaners.
F. Use wet sanding for gypsum board assemblies. Exception: Dry sanding allowed subject to owner approval of the following measures:

1. Full isolation of space under finishing
2. Plastic protection sheeting is installed to provide air sealing during the sanding
3. Closure of all air system devices and ductwork
4. Sequencing of construction precludes the possibility of contamination of other spaces with gypsum dust
5. Worker protection is provided

G. Use safety meetings, signage, and subcontractor agreements to communicate the goals of the indoor air quality construction plan.

END OF SECTION 018574
SECTION 230000 – MECHANICAL GENERAL CONDITIONS

PART 1 - GENERAL

1.1 WORK INCLUDED

A. All drawings and applicable provisions of Division 0 Bidding Requirements and Division 1 General Requirements apply to work of this Section and should a conflict arise between Section 230000 General Conditions and other Sections, the General and Supplementary Conditions of Division 1 shall take precedence.

B. The mechanical work shall comply with all provisions of the architectural, plumbing, fire protection, mechanical and electrical drawings and specifications.

1.2 RULES AND REGULATIONS – See Division 1.

1.3 PERMITS AND FEES – See Division 1.

1.4 PLANS AND SPECIFICATIONS

A. Data given herein and on the drawings is as exact as could be secured. Their absolute accuracy is not guaranteed and this Contractor shall obtain and verify exact locations, measurements, levels, space requirements, etc., at the site, and shall satisfactorily adapt the work to actual conditions at the building as constructed.

B. The drawings shall be considered schematic and are not intended to indicate all changes in direction and necessary fittings to be installed by this Contractor. Ductwork, equipment, etc., shall be installed so all items clear the structure and other building elements and maintain appropriate clearances for access, service and maintenance.

C. Some of the details on the plans are schematic or diagrammatic. These details are not intended to show all duct, fittings, etc., required to achieve the arrangement shown on the plan view, but instead are intended to show those items, such as curbs and sealing, etc., which are not shown on the plan view. This Contractor shall appropriately adapt these details to the actual conditions of the job.

D. Routing of piping, location of equipment, and location of other devices are shown on plans for general guidance. This Contractor shall coordinate his work with other Contractors and shall provide necessary deviations in routing as far as 10 feet from those shown to provide systems as specified or implied, without interference and pursuant to these requirements at no additional cost to the Owner, Architect or Engineer.

E. Contractor shall not scale the drawings. Refer to architectural and structural drawings for building construction and dimensions and to room finish schedule on architectural drawings for material, finish and construction method of walls, floors and ceilings in order to insure proper rough-in and installation of contractor’s work.

F. Changes, modifications or variations to the plans and specifications will be issued by the Engineer in writing.
1.5 DISCREPANCIES OR OMISSIONS

A. During the bidding period, should a bidder find discrepancies or omissions in any of the documents or should he be in doubt as to their meaning, he should at once notify the Engineer who will, time permitting, issue a written instruction in the form of an addendum to all bidders of record. The Engineer will not be responsible for any oral explanations or interpretations of the documents.

B. During construction, should a discrepancy or omission be found, it shall be brought to the attention of the Engineer at once for resolution.

C. No changes in contract price will be allowed for minor changes in layout or location required to avoid interferences, obstructions, etc. Contract price changes will be considered only for changes in the scope of the project requirements. All such scope changes and price revisions must be authorized in writing.

D. If discrepancies are found within the contract documents, the most demanding requirement shall take precedence unless otherwise agreed by the engineer in writing.

1.6 VISITING THE SITE – See Division 1.

1.7 HOISTING

A. Contractor shall be responsible for hoisting of all materials and equipment furnished or installed under this Section of the Specifications, in accordance with all city, state and federal rules and regulations.

1.8 SHOP DRAWINGS – See Division 1.

1.9 RELEASE OF CAD FILES

A. See “Release of CAD Files” at the end of this section.

1.10 OPERATING AND MAINTENANCE INSTRUCTIONS AND MANUALS

A. See Division 1.

B. Upon completion of the job, the installing contractors and major suppliers shall instruct the Owner's representatives in the proper operation and maintenance of the systems installed. The installing Contractors shall submit documentation indicating the date of instruction; names and organization of persons providing and receiving the instructions; systems the instructions covered; and materials received.

1.11 AS-BUILT RECORD DRAWINGS

A. During construction, a separate set of plans at the jobsite shall be maintained by the Contractor to keep a record of all changes of locations. See additional requirements in General Conditions and Supplementary Conditions.
B. Locations of piping, ductwork and other concealed facilities are to be shown by the Contractor if and when they differ from the drawings. Underground piping shall be dimensioned on those drawings.

C. "As built" drawings are to be submitted to Architect/Engineer for review prior to the time of request for final payment. Submit as-built record drawings in accordance with the General Conditions.

D. For drawings that SSC has furnished to the contractor in CAD format, contractor shall prepare “As Built” drawings in CAD format. "As built" drawings in CAD format are to be submitted to Architect/Engineer, in addition to marked up paper documents for review prior to the time of request for final payment. Submit as-built record drawings in accordance with the General Conditions.

1.12 GUARANTEE AND WARRANTY – See Division 1.

PART 2 - PRODUCTS

A. MATERIAL SUBSTITUTION - See Division 1.

PART 3 - EXECUTION

3.1 GENERAL

A. Contractor shall provide all material, equipment, labor, services, and supplies, required to execute all work shown on the mechanical drawings; described in these specifications; or made necessary by the work shown on the drawings and/or described in these specifications and as stated in Division 1.

3.2 COORDINATION OF TRADERS

A. Prior to the fabrication or installation of any materials, Contractor shall review the drawings indicating work to be performed by each trade. If conflicts occur, they shall be brought to the attention of the Engineer for resolution.

B. If Contractor installs the work without coordinating with the other trades, then, if requested by the Owner, Architect, or Engineer, Contractor shall remove and rework some installed work to resolve a conflict, and such change shall be done at no change in contract price.

C. The Contractor supplying the equipment shall furnish all motors and components which are part of the equipment.

D. Control wiring is defined as that wiring which conducts electrical energy at a voltage of less than 100 volts. Interlock wiring is defined as that wiring which performs a control function, but at a voltage of 100 volts or greater. All other wiring shall be considered power wiring.

E. The Electrical Contractor shall provide power wiring to, and including connection to the equipment. Unless specifically noted otherwise, all interlock wiring shall be provided by the Temperature Control Contractor. Unless noted otherwise, the control wiring shall be provided by the Contractor furnishing the controlled equipment.
F. Unless noted otherwise, the Electrical Contractor shall provide all starters, disconnects, switches, push-button stations, etc., except those which are furnished with the equipment as a part of a factory-assembled package. Heater elements for overload relays on magnetic motor starters (except the starters factory pre-wired with equipment) shall be sized, furnished and installed by the Electrical Contractor. Magnetic motor starters for mechanical equipment (except starters factory pre-wired with equipment such as chillers and packaged air conditioners) shall be provided by the Electrical Contractor. Magnetic motor starters will be provided with:

1. Auxiliary contacts as required by the interlocks defined on the drawings or in the specifications.
2. Control Power Transformer - 120 volt secondary, minimum 40 Volt Amps.

G. Each Contractor furnishing motor-operated equipment shall furnish a list of motor characteristics to the Electrical Contractor so that properly sized heater elements may be provided. The list shall include equipment identification by name and by number, the full load current, locked rotor current, voltage rating, and suggested service factor to compensate for operating duty cycle and ambient temperatures.

H. Unless specifically noted otherwise, pilot controllers (aquastats, flow switches, pressure switches, etc.) shall be furnished and mounted by the Contractor furnishing the controlled equipment.

I. Unless specifically noted otherwise, thermal wells for temperature control system sensors shall be provided by the Temperature Control Contractor and installed by the Mechanical Contractor.

J. Unless specifically noted otherwise, control valves and control dampers shall be furnished by the Temperature Control Contractor and installed by the Mechanical Contractor.

K. Electrical Work For Mechanical Equipment: Electrical Contractor shall wire all mechanical equipment furnished by various contractors in accordance with the following general provisions:

1. Power wiring from panel to motor controllers, relays, etc., and from controller to motor terminals per equipment manufacturer’s wiring diagram.
2. Receive, unload, set and align all separately shipped motors. Adjust and align drive and adjust belt tension.
3. Field lubricate all motors prior to initial operation of same.
4. Install individual motor starters specifically called for to be furnished by other Contractors when not a factory pre-wired component.

L. HVAC Contractor shall provide the following:

1. All motors, disconnect switches or control devices specifically called for.
2. Automatic control and interlock wiring diagrams as called for in the specifications.
3. Complete and accurate wiring diagrams to Electrical Contractor for all equipment requiring electrical power wiring including motor terminal connection diagrams.
4. Adjustable motor bases and all bolts and nuts required for installation of base and motor.
5. Supervision of Electrical Contractor in lubrication of motors to eliminate possibility of motor starting or operating without proper lubrication and control systems.

3.3 PROTECTION OF EQUIPMENT AND WORK

A. This Contractor shall, at all times, protect and preserve all materials, supplies, equipment, piping, etc., from damage due to weather, corrosion, dirt, vandalism, theft, etc., and shall further provide all enclosures or special protection as indicated by circumstances.

B. Should any of the materials, equipment, etc., be damaged as a result of his negligence, then this Contractor shall be held responsible for all such damage and costs incurred for repair or replacement.

3.4 CONSTRUCTION STAGING - See Division 1.

3.5 DEMOLITION OF FACILITIES

A. General

1. The demolition work shall consist of removal of mechanical equipment, ductwork, and related piping pertaining to the installation and modifications of the heating, ventilating and air conditioning systems as indicated on the drawings.
   a. Piping to Be Removed: Drain piping and remove portion of piping indicated to be removed and cap or plug remaining piping with same or compatible piping material.
   b. Ducts to Be Removed: Remove portion of ducts indicated to be removed to an existing joint in the duct, unless otherwise indicated, and cap remaining ducts with same or compatible ductwork material or cap with polyethylene film sealed to duct with duct tape.
   c. Equipment to Be Removed: Disconnect and cap services and remove equipment.

2. Contractor shall note the project is a renovation to an existing building. The building shall remain in operation at all times during the construction. Contractor shall allow adequate overtime and supervision to allow for work that is required by the owner to be performed after normal operating hours.

3. Demolition drawings provided are representative of existing conditions, prepared from previous design drawings and field surveys, but may not be all inclusive of existing conditions at the present time. The Contractor shall be responsible to field verify actual existing conditions and remove all items, whether indicated on drawings or not, as required for new work.

4. Contractor shall review the drawings, specifications and existing job conditions and shall include in his bid all demolition work as required and as shown on the mechanical drawings.
5. Where items are removed, utilities and the area from which the items have been removed shall be left in such a manner that they are safe to both people and property.

6. Before disconnection of any systems, advance approved arrangements shall be made to prevent interference with utility services to rooms and structures not otherwise affected by work under this contract.

7. All mechanical equipment to be reused shall be disconnected, marked and protected where necessary.

B. Existing Conditions

1. Contractor shall exercise great caution when performing demolition work to prevent damage to existing systems or items of work that are to remain. If Contractor damages, removes or destroys an existing system which is to remain, Contractor shall repair or replace that system to its original condition.

2. Unless specifically stated otherwise on the plans, where access to mechanical, plumbing, and fire protection items is required, Contractor shall provide the required access by removing ceilings, cutting openings, etc., as required. Prior to cutting openings, this Contractor shall outline the openings and shall obtain approval from and shall cut openings in the manner directed by the Owner’s Representative. Demolition work shall also include the removal and replacement of walls as required for installation or removal of equipment.

3. Repair of openings is a part of this Contractor’s work. Work shall be performed by the proper trades. Materials which are removed, damaged, or soiled shall be replaced with new materials. Ceilings and walls shall be repaired and restored to as close to the original condition as possible. This shall include replacement of surface finish materials such as paint, plaster, drywall, ceiling tile, etc.

4. Repair of floor openings and trenches is a part of this Contractor’s work. Floors shall be repaired to match the level and surface finish of the existing concrete and flooring finishes.

5. Areas shall be repaired with materials matching those which have been removed.

6. Contractor shall repair streets, sidewalks, parking lots and reseed grassed areas which have been altered by his work.

C. Protection

1. During demolition operations, all persons and property shall be protected. This Contractor shall be responsible for the erection of any barriers, fences, guard rails, enclosures, chutes, and shoring to protect all persons and property.

2. Contractor shall minimize any spread of dust, debris and flying particles. Demolition shall not interfere with the surrounding equipment, personnel, or buildings.
3. Where necessary, this Contractor shall provide temporary enclosures to be sure that the area is secured, safe and weatherproofed.

D. Removal of Refrigerant

1. Evacuate all refrigerant meeting EPA guidelines.
2. Coordinate all refrigerant work with Owners Representative.
3. Provide proper paperwork.

E. Disposition of Material

1. Those items of material and equipment to be removed by this Contractor and designated to become the property of the Owner, shall be delivered to an on-site location designated by the Owner.
2. All other materials and equipment removed shall become the property of this Contractor and shall be removed from the job site and legally disposed of.

F. Hazardous Materials

1. It is not expected that hazardous materials will be encountered in the Work. If materials suspected of containing hazardous materials are encountered, do not disturb; immediately notify Owners Representative.

3.6 MAINTENANCE OF WORK AREAS

A. During the project, this Contractor shall maintain his work area in an organized manner, shall not allow debris to accumulate, and shall store equipment, tools and supplies in a manner which shall not cause interference with the activities of others engaged on the project.

B. Open ends of pipe, ductwork, equipment, and specialties shall be kept properly closed during construction and installation so as to avoid contamination.

3.7 CLEANING AND CLEANUP

A. See Drawings and Div 1.

B. Upon completion of this work, the Contractor shall clean all pipe, ductwork, fixtures, and equipment.

C. Contractor shall leave all work in a finished, clean, and satisfactory working condition.

END OF SECTION 230000
PART 1 - GENERAL

1.1 WORK INCLUDED

A. This section covers basic mechanical materials and methods for the systems listed below and applies to work of those sections. Provide Basic Mechanical Material and Methods as indicated and required.

1. Mechanical

1.2 RELATED DOCUMENTS:

A. All drawings and applicable provisions of Division 0 Bidding Requirements and Division 1 General Requirements apply to work of this Section.

B. Section 230000 - Mechanical General Conditions.

PART 2 - PRODUCTS

2.1 PRODUCT CRITERIA

A. Material and equipment shall be the standard product of a manufacturer regularly engaged in the manufacture of the product for at least 5 years.

B. Products shall be supported by a service organization which maintains an inventory of repair parts and is located within 100 miles of the jobsite.

2.2 MATERIALS AND STANDARDS

A. All equipment and materials furnished by this Contractor shall be new, and where two or more items of the same kind are required, they shall be the product of the same manufacturer.

B. All materials, equipment, operations, procedures and installation of all materials and equipment shall conform to:

- ADA Americans with Disabilities Act
- ASME American Society of Mechanical Engineers
- UL Underwriters’ Laboratories, Inc.
- NFPA Applicable sections of the National Fire Protection Association
- NEMA National Electrical Manufacturers Association
- OSHA Occupational Safety and Health Administration
- NEC National Electrical Code
- AMCA Air Moving and Conditioning Association
- ASHRAE American Society of Heating, Refrigeration and Air Conditioning Engineers
- ARI Air Conditioning and Refrigeration Institute
- ANSI American National Standards Institute, Inc.
- ASTM American Society for Testing Materials
- SMACNA Sheet Metal and Air Conditioning Contractors’ National Association
All materials used shall be applied in compliance with the manufacturer's recommendations. If a discrepancy occurs between the application of materials as called for on the drawings or in the specifications and the manufacturer's recommendations, this discrepancy shall be called to the Engineer's attention before materials are purchased or applied.

2.3 PREFABRICATED PIPE SEALS

A. Seals for Roof Penetrations

1. Prefabricated pipe seals shall have a one piece spun aluminum base with a 5" high roof surface flange sloped for runoff. Unit shall have a PVC boot with graduated widths and adjustable stainless steel clamps. Unit shall withstand expansion, and vibration and shall fit pipe sizes from 1/2" through 10" to be heavy-gage, galvanized steel curb with mitered and welded corners; 1-1/2-inch-thick

2. Equal products, complying with these specifications by the following manufacturers are acceptable:
   a. Pate
   b. Roof Products & Systems
   c. Thycurb
   d. Approved Equal

2.4 PREFABRICATED PIPE STANDS

A. Pipe Stands, General: Shop or field-fabricated assemblies made of manufactured corrosion-resistant components to support roof-mounted piping.

1. Manufacturers:
   a. ERICO/Michigan Hanger Co.
   b. MIRO Industries.
   c. Portable Pipe Hangers.
   d. Or Equal

B. Compact Pipe Stand: One-piece plastic unit with integral-rod-roller, pipe clamps, or V-shaped cradle to support pipe, for roof installation without membrane penetration.

2.5 FLASHING:

A. Metal Flashing: 26 gage galvanized steel.
B. Lead Flashing: 5 lb/sq ft sheet lead for waterproofing; one lb/sq ft sheet lead for soundproofing.

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

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

2.6 MISCELLANEOUS MATERIALS

A. Steel Plates, Shapes, and Bars: ASTM A 36. Interior applications shall be galvanized steel or black steel. Exterior applications shall be galvanized steel.

B. Strut systems shall be painted steel equal to B-Line Systems or Unistrut. Where used in exterior applications, the materials shall be galvanized steel.

2.7 ACCESS PANELS SHALL COMPLY WITH THE FOLLOWING:

A. Access panels shall be constructed of heavy gauge steel with factory applied prime coat of baked enamel.

B. Panel doors shall be attached to the frame with concealed hinges.

C. Cam locks shall be provided in not less than the following quantities:

<table>
<thead>
<tr>
<th>Panel Height (Opposite side of hinges)</th>
<th>0 to 18&quot;</th>
<th>1 cam lock</th>
</tr>
</thead>
<tbody>
<tr>
<td>18-1/16&quot; to 30&quot;</td>
<td>2 cam locks</td>
<td></td>
</tr>
<tr>
<td>30-1/16&quot; to 48&quot;</td>
<td>3 cam locks</td>
<td></td>
</tr>
<tr>
<td>48-1/16&quot; to 60&quot;</td>
<td>4 cam locks</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Panel Width</th>
<th>0 to 18&quot;</th>
<th>No cam locks on top or bottom</th>
</tr>
</thead>
<tbody>
<tr>
<td>18-1/16&quot; to 30&quot;</td>
<td>1 cam lock top and bottom</td>
<td></td>
</tr>
<tr>
<td>30-1/16&quot; to 48&quot;</td>
<td>2 cam locks top and bottom</td>
<td></td>
</tr>
</tbody>
</table>

D. On the panel height, one of the cam locks described above shall be a key operated cylinder lock in lieu of the cam lock. One key shall operate all panels.

E. Cam locks shall have tamper-proof heads. Provide 10 tools to the owner.

F. For masonry, tile or wallboard surfaces, provide access panels with extruded aluminum frames, 3/4" border, aluminum piano hinges, screwdriver-operated cam lock, brushed satin aluminum finish. Final painting to match interior decor by others. Paintable finish to be provided when the adjacent construction is paintable.

G. Access panels will not be required in accessible type ceilings.

H. For plastered ceiling or wall, concealed flange, recessed door panel to receive plaster by others, continuous hinges, flush latch, white prime coat finish. Final painting to match interior decor by others.
I. For Fire Rated Partition - Access doors in fire rated walls shall be 1-1/2 hour (B) rated and shall bear the UL label. Doors shall be fabricated of steel and shall be provided with baked enamel prime coat over a phosphate coating. Doors shall be Milcor or approved equal.

J. For locations concealed from public, snap catch latches may be used.

K. Manufacturer - Panels shall be equal to Inryco/Milcor type K for plaster, type DW for drywall, type M for masonry.

2.8 SLEEVES

A. Exterior And Foundation Walls:
   1. All piping through exterior walls, new concrete walls, or new foundation walls shall pass through sleeves which shall be large enough to allow for caulking and sealant materials. No sleeves shall be permitted through concrete structural members unless indicated on the structural drawings or approved by the Structural Engineer. Sleeves shall be cut smooth and flush with each side of the wall.
      a. Sleeves above grade shall be Schedule 40 PVC pipe.
      b. Sleeves below grade shall be cast iron or Schedule 40 PVC pipe.
   2. All piping passing through existing concrete or foundation walls shall pass through core drilled holes which shall be large enough to allow for caulking material.
   3. All duct openings through exterior walls shall be sleeved with 20 gage galvanized steel sheet metal with flanges turned away from the opening on both sides unless otherwise indicated on the drawings. Space between sleeve and duct shall be packed with fiberglass and sealed on both sides.

B. Interior Walls And Partitions:
   1. Non Rated Partitions:
      a. Concealed Locations: Sleeves are not required for piping or ducts unless otherwise indicated on the drawings.
      b. Visible Locations except in boiler, utility, or equipment rooms:
         1) Openings between duct and wall shall be covered with 24 gage galvanized steel sheet metal angles to form an escutcheon over the opening.
         2) Openings between pipes and wall shall be covered with escutcheons. Where required, special deep-type escutcheons shall be used. Escutcheons shall be chrome plated, one-piece or split-pattern, and secured in place.
   2. Mechanical Room Walls and other locations indicated on the drawings: Duct openings shall be sleeved with 22 gauge galvanized steel sheet metal with flanges turned away from the opening on both sides. Space between sleeve and duct shall be packed with fiberglass and sealed on both sides.

C. Floors:
1. Piping through floors shall pass through schedule 40 carbon steel pipe sleeves, extending from the bottom of the slab to 2 inches above floor.

2. For existing concrete floors an oversized hole shall be core drilled. A flange shall be welded to the outside of the sleeve and the sleeve grouted in place. See details on the plans.

2.9 BACKING & SEALANTS:

A. Backing and sealant for piping and ducts passing through floors, plaster ceilings, partition, and walls shall be as follows:

1. Backing Material:
   a. A pure ceramic fiber made of alumina-silica; "Cerafiber- FS" by Manville or equal.
   b. Insulation: Glass fiber type, non-combustible.

2. Sealant: Gun Grade. An 1-part neutral- and basic-curing Silicone sealant, “790" by Dow Corning Corporation;"Spectrem 1 (Basic)" by Tremco, or SilPruf LM SCS2700 by GE Silicones. Sealant shall be low VOC and shall satisfy the LEED criteria for credit.

3. Mechanical Seal: Link-Seal or approved equal. A modular mechanical sealing assembly consisting of interlocking rubber links shaped to fill the annular space between the pipe and sleeve; corrosion-protected carbon steel bolts, nuts, and pressure plates. After the assembly is positioned in the sleeve, tightening the bolts shall cause the rubber links to provide a watertight seal between the pipe and the sleeve. Seal assembly shall be sized as recommended by the manufacturer. Provide sleeves of proper diameters.

4. Fire Retardant Sealants: Products used shall be U.L. Classified and approved for the application. Products shall produce non-toxic fumes and shall be PCB and asbestos free. Subject to compliance with requirements, provide fire retardant sealant products from one of the following: 1) "SpecSeal" by Specified Technologies Inc. 2) 3M, 3) Chase Technology Corporation, 4) Link-Seal, 5) Pyro-Pac by Thunderline Corporation, 6) “Fyre Seal” by Tremco, 7) Pensil 100 by General Electric, 8) Pensil by STI, or 9) "Flameseal" by G. S. Nelson Electric.
   a. Acrylic 1-part silicone rubber, gun applied, fire retardant elastic sealant, "Fyre Seal" by Tremco.
   b. Silicon foam sealant, CTC PR-855 by Chase Technology Corporation.
   d. Intumescent Sealant (SpecSeal SSS100) shall be one-part, two stage intumescent latex compound, expands a minimum of 8 times when exposed to 230°F to >1000°F, thixotropic. Sealant shall be capable of caulking or troweling on to vertical surfaces or overhead. Sealant shall be water-based, sandable, paintable, red in color, and safe for contact with plastics.
   e. Flexible Sealant (SpecSeal LC150) shall be one-part, latex-based compound, flexible and non-shrinking when dry, thixotropic. Sealant shall be capable of
caulking or troweling on to vertical surfaces or overhead. Sealant shall be water-based, sandable, paintable, blue in color, and safe for contact with plastics.

f. Flexible Silicone Sealant (SpecSeal Pensil 300) shall be one-part, neutral curing silicone, completely water resistant, contain no solvents nor inorganic fibers, allow movement of +/-50%. Sealant shall be auto-bonding, ozone and UV resistant, chemical resistant and capable of caulking or troweling on to vertical surfaces or overhead.

g. Intumescence Putty (SpecSeal Firestop Putty) shall be one-part, two stage intumescent, non-hardening compound, expands a minimum of 5 times when exposed to 230°F to >1000°F. Putty shall be soft and pliable with aggressive adhesion, contain no water-soluble intumescent ingredients, water-based, sandable, paintable, red in color, and safe for contact with plastics.

h. Putty Pads (SpecSeal Firestop Putty Pads) shall be one-part, two stage intumescent, non-hardening compound, expands a minimum of 5 times when exposed to 230°F to >1000°F. Putty shall be soft and pliable with aggressive adhesion, contain no water-soluble intumescent ingredients, water-based, sandable, paintable, red in color, and safe for contact with plastics.

i. Pillows (SpecSeal Firestop Pillows) shall be an intumescent pillow heat sealed in a fire-retardant poly bag with a monolithic core encapsulated by flexible intumescent coating and shall expand when exposed to 230°F to >1000°F.

j. Mortar (SpecSeal Firestop Mortar) shall be light weight, fast drying, portland cement based, wet mortar density shall be ≼52 lb./cu.ft., dry mortar density shall be ≼45 lb./cu.ft., approved for combustible and noncombustible penetrants, have chemical adhesion, and be red in color.

k. Silicone Foam (SpecSeal Pensil Silicone Foam) shall be two-part, silicone, room temperature curing foam, completely water resistant, contain no solvents nor inorganic fibers, allow movement of expansion, contraction and vibration.

l. Intumescent Collars (SpecSeal Firestop Collar) shall be factory assembled collar utilizing a molded two stage flexible intumescent insert, insert shall expand a minimum of 15 times when exposed to 230°F to >1000°F, suitable for CPVC, ABS, ABS Foam Core, and FRPP pipes.

m. Intumescent Wrap Strips

1) (SpecSeal Firestop Red Wrap Strip) shall be highly flexible, two-stage intumescent material and shall expand a minimum of 15 times when exposed to 230°F to >1000°F.

2) (SpecSeal Series Blu Wrap Strip) shall be highly flexible, two-stage intumescent material and shall expand a minimum of 30 times when exposed to 230°F to >1000°F.
n. Intumescent coatings (SpecSeal Cable Coating) shall be water based, intumescent coating, expand a minimum of 5 times its dry applied thickness, flexible, water and weather-resistant film, contain no solvents or inorganic fibers. Coating shall be thixotropic and be capable of being applied by brush application or by airless spray.

o. Urethane Joint Sealants

1) Subject to compliance with requirements, provide one of the following:
   a) Pacific Polymers International, Inc.; Elasto-Thane 230 LM Type II.
   b) Polymeric Systems, Inc.; PSI-901.
   c) Approved equal.

5. Single-Component, Nonsag, Urethane Joint Sealant: ASTM C 920, Type S, Grade NS, Class 50, for Use NT.

2.10 FIRE PROOFING ON STRUCTURE:

A. Where fire proofing is existing or has been applied to the structure by others and the work of this contractor damages or removes this fire proofing while making attachments to the structure, this contractor shall include cost to repair the fire proofing to its original condition.

2.11 LINTELS:

A. Unless otherwise indicated on plans, all lintels required for the support of building construction above pipes, boxes, panels, ducts, etc., shall be furnished and installed by the Contractor requiring the opening.

B. Lintels furnished shall be ASTM A 36 structural steel angles, channels, or tees of proper size and sections for the load being supported.

2.12 CUTTING

A. Each Contractor shall be responsible for any cutting required for openings for conduits, pipes, ducts, etc., if sleeves or openings are not otherwise provided. Under no circumstances shall any structural members, load bearing walls, or footings be cut without first obtaining written permission from the Structural Engineer. All cutting and patching shall be done at the expense of the contractor requiring the cutting.

B. Cutting shall be limited to the size necessary for working conditions. When cutting surfaces are difficult or costly to replace, such as glazed tile, wood paneling, etc., each contractor shall obtain the Owner’s approval in advance of the cutting and patching.

2.13 PATCHING:

A. Concrete or concrete block surfaces - Patch the opening with concrete, finished smooth with adjacent surface. Painting is the responsibility of the contractor doing the cutting and patching.
B. Drywall or plastered surfaces - Patch with filler compound. Painting is the responsibility of the contractor doing the cutting and patching.

C. Surfaces with finishing materials such as tiled, paneled, stone or marble surfaces - Patch the opening with cement or plaster to the underside of final finishing material. Final patching is the responsibility of the contractor doing the cutting and patching.

2.14 PIPING and EQUIPMENT SYSTEMS MARKERS

A. Markers shall be by Allen Systems, Inc., W.H. Brady Co.- Signmark Div., Industrial Safety Supply Co., Inc. or equal.

B. Pipe banding shall consist of 1" wide single tape wrapped completely around the circumference of the pipe or insulation.

C. All color coding shall comply with ANSI A13.1 1975.

D. Pipe markers shall be manufacturer's standard pre-printed, semi-rigid plastic, snap-on type or vinyl, pressure-sensitive type with permanent adhesive.

E. Valve tags shall be brass, plastic laminate, or plastic valve tags that are 1½" diameter or square. Indicate piping system abbreviation in ¼" high letters and sequenced valve numbers with ½" high letters. Provide manufacturer's standard solid brass or plated steel chain, or plated steel S-hooks of the sizes required for attachment of tags to valves.

F. Equipment markers shall be manufacturer's standard laminated plastic type. Include the following, matching terminology on schedules as closely as possible: 1) Name, 2) Tag Number, and 3) Equipment Service. Provide approximate 2½" x 4" markers for control devices, dampers, and valves; and 4½" x 6" for equipment.

2.15 CEMENT GROUT

A. Grout: ASTM C 1107, Grade B, factory-mixed and -packaged, non-shrink and nonmetallic, dry, hydraulic-cement grout.

1. Characteristics: Post hardening and volume adjusting; recommended for both interior and exterior applications.


3. Design Mix: 5000-psi, 28-day compressive strength.

2.16 CONCRETE

A. Reinforcing Materials

1. Reinforcing and Joint Dowel Bars: Deformed steel bars, ASTM A 615, Grade 40, unless otherwise indicated. Furnish metal expansion caps for one end of each dowel bar. Design caps with one end closed and a minimum length of 3" to allow bar movement of not less than 1" unless otherwise indicated.

B. Concrete Materials

1. Portland Cement: ASTM C 150, Type II with tricalcium aluminate content of less than 5%.
2. Coarse aggregate shall be clean, hard, durable, uncoated limestone conforming to ASTM C-33. Use size "67" throughout with no more than one percent flint and chert by weight (i.e., when the amount of flint and chert are added together, this quantity shall be less than 1% of the coarse aggregate weight).
5. Water-Reducing Admixture: ASTM C 494, Type A.
6. Membrane-Forming Curing Compound: ASTM C 309, Type I unless other type acceptable to Engineer.

C. Proportioning and Design of Mixes

1. Prepare design mixes for concrete in accordance with applicable provisions of ASTM C 94. Use an independent testing facility for preparing and reporting proposed mix designs. The testing facility may be the same as used for field quality control testing.
2. Submit written reports to Engineer of the proposed mix at least 15 days prior to start of work. Do not begin concrete production until mixes have been reviewed by Engineer.
3. Design mixes to provide normal weight concrete with the following properties: 3500 psi 28-day compressive strength.
4. Adjustment to Concrete Mixes: Mix design adjustments may be requested by Contractor when characteristics of materials, job conditions, weather, test results, or other circumstances warrant, at no additional cost to Owner and as accepted by Engineer. Laboratory test data for revised mix design and strength results must be submitted to and accepted by Engineer before using in work.

D. Admixtures

1. Use air-entraining admixture. Add air-entraining admixture at manufacturer's prescribed rate to result in concrete at point of placement having air content within following limits: 2% to 4% air.
2. Use admixtures for water-reducing and set-control in strict compliance with manufacturer's directions.

E. Slump Limits

1. Proportion and design mixes to result in concrete slump at point of placement at not less than 1" and not more than 4".

2.17 MISCELLANEOUS MATERIALS

B. Mechanical-Anchor Fasteners: Insert-type attachments with pull-out and shear capacities appropriate for supported loads and building materials where used.

C. Drilled Inserts: Self-drilling expansion shields and machine bolt expansion anchors: permitted in concrete not less than four inches thick. Applied load shall not exceed one-fourth the proof test load listed by the manufacturer. Phillips Red-head, wedge anchors or equal.

D. Structural Steel: ASTM A 36/A 36M, steel plates, shapes, and bars, black and galvanized.

E. Bolts and nuts, except as required for piping applications, shall be carbon steel in accordance with ASTM A 307 and shall be cadmium-plated, zinc-coated steel, or Type 304 stainless steel. Each bolt shall be provided with neoprene and cadmium-plated steel washers under the heads.

**PART 3 - EXECUTION**

3.1 EQUIPMENT SUPPORTS

A. This Contractor shall provide all bases, concrete inserts, anchor bolts, and structural steel to support the equipment, ductwork, piping, etc installed by him. Any equipment legs, guy wire, anchors, etc., or any pipe that passes through the roof shall be sealed by a method approved by the Architect.

B. Provide concrete housekeeping pads a minimum of 3-½" high, unless detailed otherwise, under all equipment, pumps, etc., in equipment rooms that have piping containing water. The horizontal distance from the equipment support to the edge of the pad shall be at least 2", but not more than 4". All exposed edges of each pad shall be ½" chamfer and all surfaces shall be smooth. The housekeeping pads shall be reinforced with wire mesh and shall be doweled to the floor.

C. Plywood backboards shall be provided for all wall mounted equipment and controls (with the exception of surface mounted cabinets). Backboards shall be constructed of 3/4" plywood grade B-C. The "B" face shall be exposed. All boards shall be painted before attachment of any surface equipment.

D. Provide prefabricated roof curbs or rails for roof mounted equipment except where otherwise indicated on the drawings.

E. Curbs and rails shall be set on the roof structure and shall have a vertical insulation stop equal to the thickness of the roof insulation. (Field verify insulation for each curb and rail.) Install roof curbs and rails level and plumb, in accordance with manufacturer's written instructions. Coordinate with other elements of the work, including installation of roof deck, substrates, vapor barriers, roof insulation, roofing and flashing, as required to insure that the roof system is waterproof and weather tight.

1. Anchor curbs and rails securely to supporting structural substrates with bolts or by welding, adequate to withstand lateral and thermal stresses as well as inward and outward loading pressures.
2. Secure equipment to roof curbs with cadmium-plated screws or bolts or hardware approved by the Engineer. Install 3/8" thick sponge type gasket on top of curb to seal gaps between equipment and curb, unless otherwise approved by the Engineer.

3.2 PIPE STAND INSTALLATION

A. Pipe Stands: Details on the drawings show a low type support. In general, provide this type. Where the elevation of the roof changes or where the piping is required to slope, provide an adjustable type support that can accommodate the different support heights needed to maintain the proper pipe elevation above the roof.

B. Assemble components and mount on smooth roof surface. Do not penetrate roof membrane. Apply adhesive indicated on drawings between base and roof.

3.3 PIPE AND DUCT PROTECTION DURING CONSTRUCTION

A. Protect pipe and duct interiors with plastic plugs or plastic sheeting during construction to protect from moisture, construction debris and dust, and other foreign materials.

3.4 DRIVE AND COUPLING GUARD

A. Contractor shall provide coupling or belt guards on all drives which do not have guards factory installed. Belt guards shall enclose drive on all sides, shall have a hole for making tachometer readings, and shall comply with requirements of governing agencies including OSHA.

3.5 BUILDING OPENINGS FOR ADMISSION OF EQUIPMENT

A. Contractor shall ascertain from his examination of the architectural and structural drawings and the facility whether any special temporary openings or supports in the building for the admission of apparatus furnished under the Contract will be necessary. The Contractor shall pay all costs of making such openings or providing such supports.

3.6 CUTTING AND PATCHING

A. All cutting necessary for installation of the work and any required patching that results therefrom shall be done by the proper trade involved and shall be included in the work of this Contractor. Columns, beams, girders or other structural members shall not be cut. No openings shall be cut without written approval of the Owner’s Representative.

3.7 ROOF PENETRATIONS

A. Any penetration of the roof shall be provided with a roof curb, pitch pocket, or other appropriate roof penetration apparatus as herein described.

B. Cutting of the metal decking for all unframed openings is the responsibility of the Contractor requiring the opening. Cutting, patching and flashing of roof shall be the responsibility of the Contractor needing the opening. Roof cutting and patching shall be subcontracted to the original roof installer. The original roof warranty shall be maintained.

C. Roof mounted equipment shall be supported on roof curbs.
D. Piping penetrations shall be made using pipe portals in roof curbs.

E. When penetrations occur in new roofs, the installation of the roofing materials to the connection and the waterproofing of the roofing at the roof penetration apparatus shall be by the General Contractor. This Contractor shall schedule his work so all roof curbs, etc., are in place when required for installation of roofing.

F. When penetrations occur in an existing roof, the penetrations shall be made in the presence of the Owner, roof installer or General Contractor. If the penetration reveals any indication of wet or damaged roof, insulation, sub-roof or structure, all roof work by this contractor shall stop and the Owner shall be notified in writing as to the conditions found.

G. At all times during construction, this Contractor shall provide temporary covers, enclosures, etc., required at roof openings to prevent injury to personnel and to prevent outdoor elements (water, wind, etc.) from entering the opening.

3.8 FLASHING:

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

B. Provide acoustical lead flashing around ducts and pipes penetrating equipment rooms, installed in accordance with manufacturer’s instructions for sound control where indicated on the drawings.

3.9 ACCESS

A. All control devices, equipment, specialties, valves, plumbing traps, etc., shall be so located as to provide for easy access and proper clearance for operation, maintenance, and repair. Provide access panels where indicated or required.

B. Where items are located above non-accessible ceilings, in or behind walls, or in other similar concealed areas, contractor whose equipment requires access shall provide access panels.

C. Contractor shall obtain approval of Architect/Engineer of location of access panels that are not indicated on plans.

3.10 PAINTING

A. All pieces of mechanical equipment shall be factory finished machinery-grey or standard color as furnished by the manufacturer, or as called for in the technical section. Scratches shall be touched up in the field after equipment is installed with a paint which matches the original color.

B. All sheet metal plenums that are visible through an air device shall have the inside of the plenum painted flat black.
   1. This Contractor shall paint the following items:
   2. Paint ductwork visible behind air outlets and inlets matte black.
3. Paint exterior natural gas piping that is above grade; primer plus one coat yellow enamel.

3.11 SLEEVES AND ESCUTCHEONS

A. This Contractor shall be responsible for locating, placing and maintaining in proper position all sleeves required for the work. In the event that failure to do so requires cutting and patching of finished work, it shall be done at this Contractor’s expense.

B. Sleeves in foundation walls or footings shall be as detailed on the plans.

C. Where pipes pass through existing concrete floors or walls, the hole shall be core drilled. If sleeves are shown on the plans or details, they shall be grouted in place.

D. Where pipes and ducts pass through fire walls, plaster or drywall shall be applied around the outside of the sleeve to seal between sleeve and wall.

E. The internal diameter/dimensions of sleeves shall be 1” to 2” larger than the outside diameter/dimensions of the pipe, duct or insulation. Insulation shall be continuous through sleeves except for ducts with fire dampers. This space is sufficient to allow some movement of the pipes or ducts without cracking the sealant.

F. The space between the pipes/ducts and the sleeve shall be sealed as follows:

1. Exterior walls above grade: Caulking shall be applied to a minimum 3” total depth. Sealant shall then be applied on both sides of the wall opening to a minimum ½” in depth, finishing flush with the wall.

2. Exterior walls below grade: The space between the pipe and the core drilled hole or sleeve shall be completely filled. Provide mechanical seal and install in accordance with manufacturer’s instructions.

3. Openings in floors or roofs: Caulking shall be applied from the upper side to a minimum depth of 3” recessed ¼” below the finished floor or roof. This ¼” recess shall then be filled with sealant to flush with finished floor or roof.

4. Interior Non-Rated Walls/Partitions:

   a. Concealed locations: Limit the size of the space between the wall and the outside of the pipe or duct to 1” maximum. The space between the duct or pipe and the wall may be left open.

   b. Visible Locations: Openings between duct and wall shall be covered with 24 gage galvanized steel sheet metal angles to form an escutcheon to cover the opening. Openings between pipes and wall shall be covered with chrome plated escutcheons.

5. Interior Fire-Rated Walls/Partitions/Floors/Ceilings:

   a. Where pipes pass through rated assemblies (walls, floors, ceilings, etc.,) the pipes shall be sealed per approved methods to meet U.L. Classifications, see the details on the drawings.
b. Where ducts pass through fire rated interior assemblies (walls, floors, ceilings, etc.) the ducts shall be connected to sleeves with fire dampers. See section 230900, Air Distribution and details on the drawings.

G. Shop drawings shall be submitted on all fire resistant materials and methods.

3.12 PIPING AND EQUIPMENT SYSTEMS MARKERS

A. All piping shall be identified with color coded banding. This color banding shall be applied at the following locations:

1. Adjacent to each valve.
2. At each branch or riser take-off.
3. Where piping goes through floors, walls or ceilings.
4. On horizontal pipe runs at 80 foot intervals, but not less than one per room.

B. Pipe marking shall also include printed markers indicating the service and flow arrows indicating direction of flow.

C. 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. List each tagged valve in valve schedule for each piping system and include valve schedule in O & M Manual.

D. Provide equipment markers on all scheduled equipment. Provide manufacturer's standard laminated plastic markers. Provide approximate 2½" x 4" markers for control devices, dampers, and control valves; and 4½" x 6" for equipment. Include the A) Name and Plan Number and B) Equipment Service, matching terminology on schedules as closely as possible.

E. Install tape on top of all underground piping within 12" of grade. Locate markers as follows:

1. Continuously over all underground pipes.
2. Adjacent to each valve and fitting.
3. At each take-off.
4. At each pipe passage to underground.

END OF SECTION 230010
SECTION 230020 – VIBRATION AND SEISMIC CONTROLS FOR HVAC PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 WORK INCLUDED

A. Provide vibration isolators and seismic restraints as indicated for each type of equipment and for piping and duct systems. This section applies to:

1. HVAC System

1.2 SCOPE OF WORK

A. The following items of equipment shall have flexible duct connections installed at the ductwork connection to the equipment:

1. All air handlers, rooftop units, fan coils units, and variable volume terminals.
2. All exhaust fans, supply fans, relief fans and transfer fans.
3. Flexible duct connections are specified in Section 230900.

B. Unless otherwise noted on the equipment schedule, all mechanical equipment shall be mounted on vibration isolators to prevent the transmission of vibration and mechanically transmitted sound to the building structure. Vibration isolators shall be selected in accordance with the weight distribution to produce reasonably uniform deflections.

C. All isolators and isolation materials shall be of the same manufacturer and shall be selected and certified using published or factory certified data. Any variance or non-compliance with these specification requirements shall be corrected by the contractor in an approved manner.

D. Vibration isolation and seismic control manufacturer shall have the following responsibilities:

1. Determine vibration isolation and seismic restraint sizes and locations.
2. Provide piping, ductwork and equipment isolation systems and seismic restraints as scheduled or specified.
3. Provide installation instructions and drawings.
4. Provide calculations to determine restraint loads resulting from seismic forces in accordance with the Local Building Code (see below), governing codes, project seismic requirements, or 0.5G minimum seismic acceleration applied at the equipment center of mass. Seismic calculations shall be certified by a licensed engineer, experienced in the design of restraints for flexibly mounted equipment.

E. Friction from gravity loads shall not be considered resistance to seismic forces.

F. Fire protection systems shall meet the requirements of NFPA-13 and NFPA-14 for the building seismic requirements.

G. All piping and ductwork shall to be restrained per the latest revision of the SMACNA "Seismic Restrainer Manual Guidelines for Mechanical Systems", Second Edition, 1998. At a minimum, the seismic restraint manufacturer shall provide documentation on maximum restraint spacing for various cable sizes and anchors, as well as 'worst case' reaction loads at restraint locations.
1.3 RELATED DOCUMENTS

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

B. Section 230000 - Mechanical General Conditions.

C. Section 230010 - Basic Mechanical Material and Methods.

1.4 REFERENCES


1.5 DEFINITIONS


B. OSHPD: Office of Statewide Health Planning and Development for the State of California.

1.6 SUBMITTALS

A. Product Data: For the following:

1. Include rated load, rated deflection, and overload capacity for each vibration isolation device.

2. Illustrate and indicate style, material, strength, fastening provision, and finish for each type and size of seismic-restraint component used.

   a. Tabulate types and sizes of seismic restraints, complete with report numbers and rated strength in tension and shear as evaluated by OSHPD or an agency acceptable to authorities having jurisdiction.

   b. Annotate to indicate application of each product submitted and compliance with requirements.

3. Interlocking Snubbers: Include ratings for horizontal, vertical, and combined loads.

B. Delegated-Design Submittal: For vibration isolation and seismic-restraint details indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1. Design Calculations: Calculate static and dynamic loading due to equipment weight and operation, seismic and wind (for outdoor equipment) forces required to select vibration isolators, seismic and wind (for outdoor equipment) restraints, and for designing vibration isolation bases.

   a. Coordinate design calculations with wind load calculations required for equipment mounted outdoors. Comply with requirements in other Division 23 Sections for equipment mounted outdoors.
2. **Riser Supports:** Include riser diagrams and calculations showing anticipated expansion and contraction at each support point, initial and final loads on building structure, spring deflection changes, and seismic loads. Include certification that riser system has been examined for excessive stress and that none will exist.

3. **Seismic and Wind-Restraint Details:**
   
a. **Design Analysis:** To support selection and arrangement of seismic and/or wind restraints. Include calculations of combined tensile and shear loads.
   
b. **Details:** Indicate fabrication and arrangement. Detail attachments of restraints to the restrained items and to the structure. Show attachment locations, methods, and spacings. Identify components, list their strengths, and indicate directions and values of forces transmitted to the structure during seismic events. Indicate association with vibration isolation devices.
   
c. **Coordinate seismic-restraint and vibration isolation details with wind-restraint details required for equipment mounted outdoors.** Comply with requirements in other Division 23 Sections for equipment mounted outdoors.
   
d. **Preapproval and Evaluation Documentation:** By OSHPD or an agency acceptable to authorities having jurisdiction, showing maximum ratings of restraint items and the basis for approval (tests or calculations).
   
C. **Coordination Drawings:** Show coordination of seismic bracing for HVAC piping and equipment with other systems and equipment in the vicinity, including other supports and seismic restraints.

D. **Welding certificates.**

1.7 **QUALITY ASSURANCE**

A. Comply with seismic-restraint requirements in the IBC unless requirements in this Section are more stringent.

B. **Welding:** Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."

**PART 2 - PRODUCTS**

2.1 **VIBRATION ISOLATORS**

A. **Basis-of-Design Product:** Subject to compliance with requirements, provide the products indicated on Drawings or a comparable product by one of the following:

1. Amber/Booth Company, Inc.
2. California Dynamics Corporation.
3. Isolation Technology, Inc.
5. Mason Industries.
7. Vibration Isolation.
8. Vibration Mountings & Controls, Inc.
9. Vibro Acoustics

B. Specification W: 3/4" thick waffle pad shall be made of standard neoprene and shall consist of 2" square modules separated by a thin web. Load distribution plate shall be used as required. Pads shall be Mason Type Super “W”.

C. Specification B: Spring type isolators shall be free standing and laterally stable without any housing and complete with 1/4" neoprene acoustical friction pads between the baseplate and the support. All mountings shall have leveling bolts that must be rigidly bolted to the equipment. Spring diameters shall be no less than 0.8 of the compressed height of the spring at rated load. Springs shall have a minimum additional travel to solid equal to 50% of the rated deflection. Submittals shall include spring diameters, deflections, compressed spring height and solid spring height. Mountings shall be Mason Type SLF.

D. Specification E: Vibration hangers shall contain a steel spring with a rod isolation bushing that passes through the hanger box. Spring diameters and hanger box lower hole sizes shall be large enough to permit the hanger rod to swing thru a 30 degree arc before contacting the hole and short circuiting the spring. Springs shall have a minimum additional travel to solid equal to 50% of the rated deflection. Submittals shall include a scale drawing of the hanger showing the 30 degree capability. Hangers shall be Mason Type 30.

2.2 FACTORY FINISHES

A. Finish: Manufacturer's standard paint applied to factory-assembled and -tested equipment before shipping.

1. Interior Applications
   a. Baked enamel or powder coating for metal components.
   b. Color coding on springs to indicate capacity range.
   c. All hardware shall be electro-galvanized or cadmium plated.

2. Exterior Applications
   a. Hot-dip galvanized metal components except as otherwise indicated.
   b. Neoprene coating with color coding on springs to indicate capacity range.
   c. All hardware shall be electro-galvanized or cadmium plated.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas and equipment to receive vibration isolation and seismic control devices for compliance with requirements for installation tolerances and other conditions affecting performance.

B. Examine roughing-in of reinforcement and cast-in-place anchors to verify actual locations before installation.
C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 APPLICATIONS

A. Multiple Pipe Supports: Secure pipes to trapeze member with clamps approved for application.

B. Hanger Rod Stiffeners: Install hanger rod stiffeners where required to prevent buckling of hanger rods due to seismic forces.

C. Strength of Support and Seismic-Restraint Assemblies: Where not indicated, select sizes of components so strength will be adequate to carry present and future static and seismic loads within specified loading limits.

3.3 INSTALLATION OF VIBRATION ISOLATORS

A. Except as otherwise indicated, comply with manufacturer's instructions for the installation and load application to vibration isolation materials and units. Adjust to ensure that units do not exceed rated operating deflections or bottom out under loading, and are not short-circuited by other contacts or bearing points. Remove space blocks and similar devices (if any) intended for temporary protection against overloading during installation.

B. Locate isolation hangers as near the overhead support structure as possible.

C. Adjust leveling devices as required to distribute loading uniformly onto isolators. Shim units as required where leveling devices cannot be used to distribute loading properly.

D. Install inertia base frames on isolator units as indicated to provide a minimum of 1 inch clearance when frame is filled with concrete and supported equipment has been installed and loaded for operation. Provide 3,000 psi concrete per section 230010 in accordance with manufacturer's instruction to fill base.

E. Roof curbs and rails shall be set on the roof structure and shall be anchored securely to the supporting structural substrates with bolts. Anchoring shall be adequate to withstand static and dynamic loads as indicated in the Building Code indicated in Section 230000.

1. Secure equipment to roof curbs and rails with cadmium-plated screws or bolts or other hardware approved by the Engineer unless otherwise indicated on the drawings.

F. The isolation type scheduled shall be provided for the each type of equipment. (Isolators identified as “With Equipment” shall be furnished as an accessory with the equipment and shall be installed by the equipment manufacturer such as for internally isolated air handlers.)

3.4 ADJUSTING

A. Adjust isolators on piping after piping system is at operating weight.

B. Adjust limit stops on restrained spring isolators to mount equipment at normal operating height. After equipment installation is complete, adjust limit stops so they are out of contact during normal operation.
C. Adjust active height of spring isolators.
D. Adjust restraints to permit free movement of equipment within normal mode of operation.

3.5 HVAC VIBRATION-CONTROL AND SEISMIC-RESTRAINT DEVICE SCHEDULE

A. See schedule on plans.

END OF SECTION 230020
SECTION 230100 – INSTALLATION OF MECHANICAL PIPING

PART 1 - GENERAL

1.1 WORK INCLUDED

A. Furnish all labor, material, services and related items for the HVAC water systems shown on the plans and/or specified herein. These systems shall include:

1. Condensate Drains
2. Refrigerant Piping
3. Natural Gas

1.2 RELATED DOCUMENTS

A. All drawings and applicable provisions of Division 0 Bidding Requirements and Division 1 General Requirements apply to work of this Section.
B. Section 230000 - Mechanical General Conditions.
C. Section 230010 - Basic Mechanical Materials and Methods.
D. Section 230020 - Vibration Isolation and Seismic Restraints.
E. Section 230200 - Mechanical Insulation.
F. Section 230910 - Start-up, Cleaning and Testing.
G. Section 230930 - Testing and Balancing.
H. Section 230960 - Temperature Controls.

1.3 REFERENCES

A. ANSI/ASME Sec 9 - Welding and Brazing Qualifications.
B. ANSI/ASME 31.9 - Building Services Piping.

1.4 QUALITY ASSURANCE

A. Valves: Manufacturer's name and pressure rating marked on valve body.
C. Welders Certification: In accordance with ANSI/ASME Sec 9.

1.5 SUBMITTALS

A. Submit the following in accordance with Section 230000.

1. Product data, including installation instructions for each type of support and anchor. Submit pipe hanger and support schedule showing Manufacturer's figure number, size, location, and features for each required pipe hanger and support. Indicate which piping systems each component will be applied to.
PART 2 - PRODUCTS

2.1 MANUFACTURED UNITS

A. Hangers and support components shall be factory fabricated of materials, design, and manufacturer complying with MSS SP-58 except as modified herein.

1. Hangers: Types 5 and 12 shall not be used.
2. Hangers: Type 3 shall not be used on insulated piping.
3. C-Clamps: Type 19 and 23 C-clamps shall be torqued per MSS SP-69 and have both locknuts and retaining devices, furnished by the manufacturer. Field-fabricated C-clamp bodies or retaining devices are not acceptable.
4. Angle Attachments: Type 20 attachments used on angles and channels shall be furnished with an added malleable-iron heel plate or adapter.
5. Hangers: Type 24 shall be used only on trapeze hanger systems or on fabricated frames.

B. Components shall have galvanized or cadmium plated coatings where installed for piping and equipment that will not have field-applied finish.

C. Pipe supports shall be compatible with the pipe being supported to prevent galvanic corrosion. All supports for copper piping shall be copper coated hangers conforming in general to the above specification. Where copper pipes are separated from hangers by pipe insulation, hangers do not need to be copper coated.

D. Saddles and hangers for insulated piping:

1. Type 40 shields shall:
   a. be used on all insulated pipes less than 12 inches.
   b. provide rigid insulation saddle, equal to Fee and Mason Fig. 71, consisting of rigid urethane foam insulation with vapor barrier jacket and thermal conductivity of 0.13 BTU/HR/FT²/F/°F @ 75°F. Insulation saddle length shall be 6" for pipes 6" and smaller. Thickness shall be the same as pipe insulation.
   c. distribute the loading on the bearing area of the insulation in accordance with the following minimum dimensions covering 180° of arc:

<table>
<thead>
<tr>
<th>PIPE SIZE (INCHES)</th>
<th>GALVANIZED IRON SADDLE LENGTH (INCHES)</th>
<th>GAUGE THICKNESS</th>
</tr>
</thead>
<tbody>
<tr>
<td>1/2 to 4</td>
<td>12</td>
<td>16</td>
</tr>
<tr>
<td>6</td>
<td>18</td>
<td>16</td>
</tr>
<tr>
<td>8 and 10</td>
<td>24</td>
<td>14</td>
</tr>
</tbody>
</table>

E. The hangers or supports for piping with vapor barriers shall be located outside the insulation and the vapor barrier must be left undisturbed for pipes 10 inches and smaller.

F. Pipe supports shall be equal to B-Line model numbers hereinafter listed. Equal products by Unistrut or Grinnell are acceptable. (Grinnell numbers are shown in parentheses)
1. Clevis Hanger       Fig. B 3100 or B3104 (260 or 65)
2. Adjustable Swivel Ring   Fig. B 3170 (9)
3. Adjustable Roller Support Fig. B 3114 or Fig. B 3122 ((171 OR 177)
4. Riser Clamp (Standard Duty) Fig. B 3373 (261)
5. Riser Clamp (Heavy Duty) Fig. (40)
6. Offset Clamp Fig. B 3148 (103)
7. Wall Bracket (Light Duty) Fig. B 3068 (194)
8. Wall Bracket (Medium Duty) Fig. B 3065 (195)
9. Stand with Base Fig. B 3088 or Fig. B 3088T (62 OR 63)
10. U-Bolts Fig. B 3188 (137)
11. Structural Attachments:
    Beam clamps:   B 3031(92), B 3033(93), B 3034(94), B 3050(133), B 3045(217) and retaining straps for seismic applications
    Angle Iron Beam Clamp: B 3046
    Bar Joist:     B 3059
    Concrete Inserts:  B 2500 (281), B 2505 or 2506(285), or B 3014(282)
    Drilled Inserts: Phillips Red-head, wedge anchors

2.2 PREFABRICATED PIPE STANDS

A. See Section 230010.

2.3 MISCELLANEOUS MATERIALS

A. Steel Plates, Shapes, and Bars: ASTM A 36.

PART 3 - EXECUTION

3.1 INSTALLATION OF PIPING

A. All pipe shall be run parallel to or at right angles to walls, beams or columns. Pipe shall be run as direct as possible, avoiding unnecessary offsets, and maintaining maximum headroom. Shortcut diagonal methods will not be allowed.

B. Piping drawings are to be considered schematic and are not intended to indicate all changes in direction and necessary fittings to be furnished and installed. Provide reducers/increasers at connections to equipment as required to match the equipment. Pipe and fittings shall be installed so that all pipe and/or insulation completely clears all nearby structures and piping.

C. All piping shall be supported from the building structures by means of approved hangers and supports. Piping shall be supported to maintain required grading and pitch of lines, to prevent vibration and excessive deflections, and to secure piping in place.

D. Piping shall be arranged to allow for expansion and contraction. Provide expansion loops, guides and anchors where indicated on the drawings.

E. Install branch connections to mains using Tee fittings in main with take-off out the bottom of the main, except for up-feed risers which shall have take-off out the top of the main line.
except branch take-offs shall be made with swing connections where required to avoid stress at these points. Tees shall not be installed in a bullhead arrangement.

F. At swing connections, offsets, expansion loops, etc., pipes shall be cold sprung into place before welding to compensate for fifty percent (50%) of the expansion.

G. Pipes shall not be hung from other piping or from equipment of other trades. Hanger rods and piping shall not pierce ductwork.

H. Pipe supports shall be structurally capable of carrying the pipe or pipes supported by them and shall be capable of vertical adjustment after installation of piping.

I. Piping at all equipment and control valves shall be supported to prevent strains or distortions in the connected equipment and control valves. Piping shall be installed and supported to allow for removal of equipment, valves and accessories with minimum dismantling and without requiring additional supports after these items are removed.

J. Dissimilar metals in the piping system shall be separated with dielectric unions or insulating flange sets.

K. Factory fabricated fittings, similar to Bonney Forge Weldolet, Threadolet, Socklolet, or Elbolet may be used for branch connections to mains where branch size is less than main's size.

L. Welding shall be performed by individuals who are currently qualified under procedures certified as acceptable by the National Certified Pipe Welding Bureau. Individuals must be prepared to provide current qualification certificates upon request. All work shall be done in accordance with the latest revised edition of the ASME Code for Pressure Piping requirements.

M. Lines subject to rapid changes in flow rate shall be anchored to prevent excessive movement or vibration.

N. Drain lines shall be terminated over floor drains to direct the flow vertically into the floor drain. Provide elbows where required. Cut openings in the floor drain strainer where needed to prevent splash-out. Provide clean outs at changes in direction of more than 45 degrees and at maximum 75 feet spacing along the line.

3.2 PIPE JOINT CONSTRUCTION

A. Brazed Joints: Comply with the procedures contained in the AWS "Brazing Manual."

1. CAUTION: Remove stems, seats, and packing of valves and accessible internal parts at piping specialties before brazing.
2. Fill the pipe and fittings during brazing, with an inert gas (ie., nitrogen or carbon dioxide) to prevent formation of scale.
3. Heat joints using oxy-acetylene torch to proper and uniform temperature.

B. Threaded Joints: Conform to ANSI B1.20.1, tapered pipe threads for field cut threads. Join pipe fittings and valves as follows:
1. Note the internal length of threads in fittings or valve ends, and proximity of internal seat or wall, to determine how far pipe should be threaded into joint.
2. Align threads at point of assembly.
3. Apply appropriate tape or thread compound to the external pipe threads (except where dry seal threading is specified).
4. Assemble joint wrench tight. Wrench on valve shall be on the valve end into which the pipe is being threaded.
   a. Damaged Threads: Do not use pipe with threads which are corroded or damaged. If a weld opens during cutting or threading operations, that portion of pipe shall not be used.
C. Welded Joints: Comply with the requirement in ASME Code B31.9-"Building Services Piping."
D. Flanged Joints: Align flanges surfaces parallel. Assemble joints by sequencing bolt tightening to make initial contact of flanges and gaskets as flat and parallel as possible. Use suitable lubricants on bolt threads. Tighten bolts gradually and uniformly using torque wrench.
E. Grooved Joints: Assemble joints in accordance with fitting manufacturers written instructions.

3.3 INSTALLATION OF HANGERS AND SUPPORTS
A. Install hangers, supports, clamps and attachments, complete with necessary inserts, bolts, rods, nuts, washers, and other accessories, to support piping from building structure; comply with MSS SP-58. Arrange for grouping of parallel runs of horizontal piping supported together on field-fabricated, heavy-duty trapeze hangers where possible. Install supports with maximum spacings complying with MSS SP-58.
B. Install building attachments within concrete or to structural steel. Install additional attachments at concentrated loads, including valves, flanges, guides, strainers, expansion joints, and at changes in direction of piping. Install concrete inserts before concrete is placed; fasten insert to forms. Where concrete with compressive strength less than 2,500 psi is indicated, install reinforcing bars through openings at top of inserts. Where inserts are omitted, drill through concrete slab and provide thru-bolt with recessed square steel plate and nut recessed into and grouted flush with slab in locations where nut, etc. will interfere with other work or be a tripping hazard and above slab in other locations.
C. Hangers and supports shall be provided as required to eliminate vibration and excessive deflection, but in no case over the following centers, unless specifically indicated otherwise on the drawing. Rod sizes for individual pipe lines shall not be less than the following schedule:

<table>
<thead>
<tr>
<th>PIPE SIZE (INCHES)</th>
<th>MAXIMUM HANGER SPACING (FEET)</th>
<th>MINIMUM ROD SIZE (INCHES)</th>
<th>MAXIMUM HANGER SPACING (FEET)</th>
<th>MINIMUM ROD SIZE (INCHES)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1/2</td>
<td>STL</td>
<td>STL</td>
<td>CU</td>
<td>CU</td>
</tr>
<tr>
<td></td>
<td>7</td>
<td>3/8</td>
<td>5</td>
<td>3/8</td>
</tr>
</tbody>
</table>
3/4  7  3/8  5  3/8  
1  7  3/8  5  3/8  
1-1/4  7  3/8  8  3/8  
1-1/2  9  3/8  8  3/8  
2  10  3/8  8  3/8  
2-1/2  11  1/2  8  1/2  
3  12  1/2  10  1/2  
3-1/2  13  1/2  10  1/2  
4  14  5/8  10  1/2  

*Maximum spacing for insulated pipe shall be 20 feet.

1. An additional hanger shall be installed at every change in direction of piping.

D. When trapeze type hangers are used to support two or more pipes, rods shall be used for vertical hanger members and angles, channels, Unistrut or tee sections for horizontal hanger members. The material used shall be sized to support the load without excessive deflection. Spacing of trapeze hangers shall be based on the smallest pipe supported on the trapeze hanger. Rod sizes and spacing for trapeze hangers shall be based on supported weight and load carrying capacity of attachment device. Size trapeze bar for allowable loads indicated in SMACNA HVAC Duct Construction Manual (2005), Table 4-3, or as otherwise approved by the Engineer.

E. Hanger rods shall have double nuts and lockwashers at all connections.

F. Piping at walls shall be supported with wall brackets; vertical pipes shall be supported with riser clamps.

G. Contractor shall verify loading on hangers, hanger rods and structural attachments. Loading on the assembly shall not exceed 75% of the manufacturer's rating for any component of the assembly. If loading does exceed the 75%, then hanger spacing shall be reduced.

H. Piping shall not be supported from joist bridging or a roof metal deck.

I. Horizontal pipe supports shall be spaced as specified in MSS SP-69 and a support shall be installed not over 1 foot from the pipe fitting joint at each change in direction of the piping. Pipe supports shall be spaced not over 5 feet apart at valves. Pipe hanger loads in excess of 50 pounds, suspended from steel joists, shall have the hanger loads suspended from panel points. Pipe supports for PVC piping shall be maximum 4 feet on centers. Where local codes require closer spacing than indicated on the plans or specifications, the supports shall conform to the local code requirements. For buildings built with steel joists before 1985, pipe supports shall be attached to the top leg of the joist.

J. Vertical pipe shall be supported at each floor, except at slab-on-grade, and at intervals of not more than 15 feet, not more than 8 feet from end of risers, and at vent terminations.

3.4 Exterior Wall Penetrations: Seal pipe penetrations through exterior walls using sleeves and mechanical sleeve seals. Pipe sleeves smaller than 6 inch shall be steel; pipe sleeves 6-inch and larger shall be sheet metal. See additional requirements in Section 230010.
3.5 Fire Barrier Penetrations: Where pipes pass through fire rated walls, partitions, ceilings, and floors, maintain the fire rated integrity. Refer to Section 230010 for sealants and materials.

3.6 Provide thermometers, thermometer sockets, and thermal wells where indicated on the drawings or in the specifications. Install in tees or in extra heavy nipples welded to the pipe or as indicated on the drawings. Install thermal wells for temperature control system temperature sensors (furnished under Section 230960 - Temperature Control Systems) and where indicated on the drawings. Coordinate the location of temperature sensor wells with the temperature control contractor and the Engineer.

3.7 Install control valves and pressure sensors in accordance with the manufacturer’s instructions where indicated on the drawings or in the specifications. Install taps and shut off valves for pressure sensors for temperature control system sensors (furnished under Section 230960 - Temperature Control Systems) and where indicated on the drawings.

3.8 Provide pressure gauges and test plugs where indicated on the drawings or in the specifications.

3.9 Dielectric unions shall be provided at the following locations:

A. At the connection of copper and steel piping.
B. At the connection of steel piping to copper coils.

END OF SECTION 230100
PART 1 - GENERAL

1.1 DESCRIPTION OF WORK

A. Furnish all labor, material, services and related items necessary to complete the natural gas piping work indicated on the drawings and/or specified herein. Work to be performed shall include, but not be limited to, the following items:

1. Demolition and installation of natural gas piping including connections to equipment.
2. Connections to the utilities gas meter is existing.

1.2 RELATED DOCUMENTS

A. All drawings and applicable provisions of Division 0 Bidding Requirements and Division 1 General Requirements apply to work of this Section.

B. Section 230000 - Mechanical General Conditions.

C. Section 230010 - Basic Mechanical Materials and Methods.

D. Section 230020 - Vibration Isolation and Seismic Restraints.

E. Section 230100 - Installation of Piping.

F. Section 230910 - Start-up, Cleaning and Testing.

1.3 SUBMITTALS

A. Submit product data for each gas piping, specialty and valve under provisions of Section 230000. Include rated capacities of selected models, furnished specialties and accessories, and installation instructions.

B. Shop drawings detailing dimensions, required clearances, for connection to gas meter.

C. Maintenance data for gas specialties and valves, for inclusion in operating and maintenance manual specified in Section 230000.

D. Welders' qualification certificates, certifying that welders comply with the quality requirements specified under "Quality Assurance" below.

1.4 QUALITY ASSURANCE

A. Codes and Standards

1. Applicable local, state and national codes.
2. NFPA Pamphlet 54A and 54
3. Rules and regulations of the local utility company.
2.1 MATERIALS

A. Pipe - Carbon steel pipe ASTM-A53 continuous electric weld or seamless, Schedule 40.


C. Weld Fittings - Seamless carbon steel Grade B standard weight butt weld fittings, ASA B16.9, material ASTM A-234.


E. Flanges - Forged carbon steel bored to match Schedule 40 pipe, 150 lb., ASA B16.5, raised face, slip-on, materials ASTM A-181, Grade 1.

2.2 VALVES AND SPECIALTIES

A. Gas cocks shall be "Lubroseal" by Mueller Company or approved equal. Use threaded cocks in threaded piping and flanged cocks in welded pipe. Gas cocks shall be bronze body with AGA stamp, plug type with bronze plug and flat or square head, ball type with chrome-plated brass ball and lever handle, or butterfly valve with stainless-steel disc and fluorocarbon elastomer seal and lever handle; 125 psig minimum pressure rating. Include feature for locking.

B. Insulating unions shall be Eclipse Wedge Seal or approved equal. Insulation flanges shall have Type FNDW gasket set as manufactured by F. H. Maloney Company or approved equal. Install unions or flanges where shown on drawings and whether shown or not, at entrance to building.

2.3 GAS PRESSURE REGULATORS

A. Gas pressure regulators shall be provided for all gas-fired equipment. Equal products by the following manufacturers are acceptable:

1. Maxitrol, Inc.
2. American Meter Co.
3. Actaris Metering Systems
7. Schlumberger Industries; Gas Div.

B. Gas pressure regulators shall be adjustable, spring compression, single stage and suitable for natural gas fuel service. Include steel jacket, corrosion-resistant components, elevation compensator, and atmospheric vent. Regulators for outside service shall be rated for such use.
1. Natural gas distribution system within the building has been based on a 2 PSIG delivery pressure at the meter.

2. Pipe Connections:
   a. NPS 2 and Smaller: Threaded ends according to ASME B1.20.1 for pipe threads.
   b. NPS 2-1/2 and Larger: Flanged ends according to ASME B16.5 for steel flanges and according to ASME B16.24 for copper and copper-alloy flanges.

3. Service Pressure Regulators: ANSI Z21.80. Rated for pounds to pounds service with inlet pressure of 100 psig and outlet pressure of 2 psig. American Meter 1200 Series or as approved by the local Gas Utility company.

   C. Pressure Regulator Vents: Factory- or field-installed, corrosion-resistant screen in opening if not connected to vent piping.

2.4 FLEXIBLE GAS CONNECTORS

A. Flexible gas connectors shall comply with the following:
   1. Bronze metal braided, bellows type, screwed or flanged, unbraided working pressure rating of 45 psig at a maximum service temperature of up to 175°F. End fittings factory welded to hose.
   2. Suitable for natural gas.
   3. Connector length shall be no greater than 24".
   4. Manufactured by Flexonics, Anaconda, or Metalflex.

2.5 PRESSURE GAUGES

A. Manufacturer: Subject to compliance with requirements, provide hydronic piping system products from one of the following:
   1. Marsh
   2. Weiss
   3. U.S. Gauge
   4. Weksler
   5. Trerice

B. Gauges shall be equal to Trerice #800B.

C. Gauges shall include the following:
   1. 1-1/2" diameter
   2. Drawn steel, black case
   3. Styrene acrylonitrile window
   4. ABS plastic white dial face with black graduations
   5. Bronze tube, Bourdon Type
   6. Brass movement
   7. 1/4" NPT bottom connections with brass tee handle cock.

D. Submit shop drawings on gauges.
E. Graduation of pressure gauges shall be:

<table>
<thead>
<tr>
<th>RANGE</th>
<th>DIVISIONS</th>
<th>FIG. INTERVAL</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gas</td>
<td>0 – 15 psi</td>
<td>0.5 psi</td>
</tr>
</tbody>
</table>

F. Gauge cocks shall be brass, equal to Trerice No. 865 or 880, and shall be provided at all gauges.

PART 3 - EXECUTION

3.1 INSTALLATION – GENERAL

A. See Section 230100 for general piping installation.

B. Comply with ANSI Z223.1, "Prevention of Accidental Ignition".

C. Contractor shall extend gas piping to all gas fired equipment. A gas cock shall be provided at each item.

D. Gas cocks shall be provided upstream of all gas pressure regulators.

E. Dirt legs shall be provided at the connection to all gas fired equipment.

F. Thread sealing compound compatible with service shall be used on all threaded joints.

G. Gas piping above ground, not in concealed spaces, 3” and smaller shall be either threaded or welded.

H. All gas piping in concealed spaces shall have joints welded, and pipe shall be run in sealed EMT conduit with both ends vented to the outside of the building. The following gas piping shall be considered concealed:

1. Piping located in walls.
2. Piping located in any non-ventilated space.

I. Contractor shall extend all gas train vents to and terminate outside the building. Vents shall terminate with screened vent elbow turned down. Each vent connection shall be individually extended to outdoors.

J. Flexible connectors shall be used only where specifically called for on the plans. Do not install flexible connectors where prohibited by local code.

3.2 PRESSURE REGULATOR INSTALLATION

A. Install pressure regulators in accordance with manufacturer’s written installation instructions.

B. Regulators installed outdoors shall have a factory furnished vent protector to protect breather hole from rain, snow, and insects. Or contractor may provide full size pipe and elbows turned down with screened outlet terminated a minimum of 2'-0" above roof or ground.

C. For vented regulators installed inside the building, extend vent to outside of building or enclosure. Vent pipe shall be turned down, terminated a minimum of 2'-0" above roof or
ground with screened vent elbow. Size of vent line shall be not less than 3/4". Where required by regulator manufacturer, increase the size of the vent line to prevent excessive back pressure on the regulator. Where there is more than one regulator at a location, each regulator shall have a separate vent to the outside unless a manifold vent is permitted by the Authorities Having Jurisdiction. Manifolds shall be in accordance with accepted engineering practices to minimize back pressure.

3.3 ADJUSTING

A. Adjust controls and safety devices. Replace damaged and malfunctioning controls and safety devices.

END OF SECTION 230140
1.1 DESCRIPTION OF WORK

A. Furnish all labor, material, services and related items necessary for the refrigerant piping systems shown on the plans and as specified herein. These systems shall include:

1. Refrigerant Piping
2. Refrigerant
3. Refrigerant Piping Specialties

B. Coordinate refrigerant pipe size with refrigerant component manufacturer.

1.2 RELATED DOCUMENTS

A. All applicable provisions of Division 0 Bidding Requirements and Division 1 General Requirements apply to work of this Section.

B. Section 230000 - Mechanical General Conditions.

C. Section 230010 - Basic Mechanical Materials and Methods.

D. Section 230020 - Vibration Isolation and Seismic Restraints.

1.3 REFERENCES


B. ANSI/ASHRAE 34 - Number Designation of Refrigerants.


E. ANSI/ASME B16.22 - Wrought Copper and Copper Alloy Solder Joint Pressure Fittings.

F. ANSI/ASME B31.5 - Refrigeration Piping.

G. ANSI/ASME B31.9 - Building Services Piping.

H. AWS - Brazing.

I. ANSI/ASTM B88 - Seamless Copper Water Tube.

J. ANSI/AWS A5.8 - Brazing Filler Metal.

1.4 REGULATORY REQUIREMENTS

A. Conform to ANSI/ASME B31.9.

B. Welding Materials and Procedures: Conform to ANSI/ASME SEC 9 and applicable state labor regulations.

C. Welder’s Certification: In accordance with ANSI/ASME SEC 9.

1.5 SUBMITTALS
A. Provide submittals in accordance with Section 230000 - Mechanical General Conditions.

B. Submit shop drawings indicating isometric layout of system, including equipment, critical dimensions, and sizes.

C. Submit product data indicating general assembly of specialties, including manufacturer’s catalog information.

D. Submit manufacturer’s installation instructions under provisions of Section 230000.


F. Submit test reports indicating results of leak test, acid test.

G. Wiring Diagrams: Submit manufacturer’s electrical requirements for power supply wiring to units. Submit manufacturer’s ladder-type wiring diagrams for interlock and control wiring.

1.6 DELIVERY, STORAGE, AND HANDLING

A. All refrigerant and refrigerant oil shall be delivered to the site in factory sealed containers.

B. Deliver and store piping and specialties in shipping containers with labeling in place.

C. Protect piping and specialties from entry of contaminating material by leaving end caps and plugs in place until installation.

PART 2 - PRODUCTS

2.1 REFRIGERANT PIPE AND FITTINGS

A. Piping: Copper Tubing, ASTM B280, Type ACR, hard drawn, factory cleaned, dehydrated and pre-charged with nitrogen. "ACR" as manufactured by Mueller Brass Company or equal.

B. Fittings: ANSI/ASME B16.22 wrought copper or forged brass.

C. Joints: AWS Classification BAg-1 (silver). Mueller Brass No.122 solder and silver brazing flux or equal. All joints shall be soldered with a constant bleed of nitrogen to prevent formation of oxide or scale.

2.2 REFRIGERANT LINE KITS

A. Annealed-copper suction and liquid lines factory cleaned, dried, pressurized with refrigerant, sealed, and with suction line insulated. Provide in standard lengths for installation without joints, except at equipment connections.

1. Flexible Elastomeric: Closed-cell, sponge- or expanded-rubber materials. Comply with ASTM C 534, Type I, 3/8 inch thick.

2.3 REFRIGERANT SPECIALTIES

A. Manufacturers: One manufacturer has been listed with the various specialties to establish desired type. Equal product of the following manufacturers are acceptable.
1. Expansion valves, solenoid valves, filter driers, moisture and liquid indicators.
   a. Alco Valve Company
   b. Sporlan Company
   c. Mueller Brass

2. Valves, strainers, check valves, relief valves.
   a. Mueller Brass
   b. Henry Valve Company
   c. Superior Valve Company
   d. Vilter
   e. York

3. Receivers
   a. Standard Refrigeration
   b. Vilter
   c. E. L. Nickel

4. Flexible Connectors
   a. Resistoflex
   b. Flexonics
   c. Keflex

B. Shut off Valves: Packed, back seating type with seal cap and arranged for straight through flow. Valves shall be full line size with renewable seats, brass body. Capable of being re-packed under line pressure. Rated for maximum working pressure of 500 psi and maximum temperature of 275 degrees F. Mueller Brass "Globemaster".

C. Filter Driers:
   1. Sealed type: "Catch-All" by Sporlan Valve Company. UL listed. Size of drier as recommended by manufacturer with a maximum drop of 1 PSI. Rated for maximum working pressure of 350 psi.
   2. Replaceable Cartridge Angle Type: ANSI/ARI 710, UL listed, brass shell and bronze cap, perforated brass shell and molded desiccant filter core; size of drier as recommended by manufacturer with a maximum drop of 1 PSI. Rated for maximum working pressure of 350 psi.

D. Sight Glasses: Liquid and moisture indicating type, "Eye-Spy" by Alco Valve. Full line size. Where line size is larger than standard sight glass size, install in bypass line using manufacturer's bypass kit in accordance with manufacturer's recommendations.

E. Solenoid Valves: ARI 760, pilot operated, copper or brass body and internal parts, synthetic seat, stainless steel stem and plunger assembly, with solder ends; for maximum working pressure of 500 psi. Stem shall permit manual operation in case of coil failure. Coil Assembly:
UL listed, replaceable with molded electromagnetic coil, moisture and fungus proof, with integral junction box; ANSI/UL 429.

F. Expansion Valves: ARI 750; design suitable for refrigerant, brass body, internal or external equalizer, bleed hole, adjustable superheat setting, replaceable inlet strainer, with non-replaceable capillary tube, remote sensing bulb and remote bulb well.

1. Selection: Evaluate refrigerant pressure drop through system to determine available pressure drop across valve. Select valve for maximum load at design operating pressure and minimum 10 degrees F superheat. Select to avoid being undersized at full load and excessively oversized at part load.

G. Strainers: Brass shell, cap and flange, and replaceable cartridge, with screen of stainless steel wire or monel reinforced with brass; for maximum working pressure of 430 psi.

H. Check Valves:

1. Globe Type: Cast bronze or forged brass body, forged brass cap with neoprene seal, brass guide and disc holder, phosphor-bronze or stainless steel spring, teflon seat disc; for maximum working pressure of 500 psi and maximum temperature of 300 degrees F.
2. Straight Thru Type: Brass body and disc, phosphor-bronze or stainless steel spring, neoprene seat; for maximum working pressure of 500 psi and maximum temperature of 200 degrees F.

I. Pressure Relief Valves: Straight Thru or Angle Type: Brass body and disc, neoprene seat, factory sealed and stamped with ASME UV and National Board Certification NB; for standard 235 psi setting; selected to ANSI/ASHRAE 15.

J. Receivers:

1. Internal Diameter 6 inch and Smaller: ANSI/ARI 495, UL listed, steel, brazed; 400 psi maximum pressure rating, with tappings for inlet, outlet, and pressure relief valve.
2. Internal Diameter Over 6 inch: ANSI/ARI 495, welded steel, tested and stamped in accordance with Section 8D of the ANSI/ASME Boiler and Pressure Vessels Code; 400 psi with tappings for inlet, outlet and pressure relief valve.

K. Flexible Connectors: Corrugated stainless steel hose with single layer of stainless steel exterior braiding, minimum 9 inches long with copper tube ends; for maximum working pressure 500 psi.

L. Refrigerant: R-410A.

PART 3 - EXECUTION

3.1 PIPING INSTALLATION

A. Install piping as shown on the plans with no additional bends or offsets. If a conflict occurs between refrigerant piping and other building components, notify the Engineer for resolution before proceeding.
B. Piping may be pre-insulated line sets if approved by the manufacturer of the condenser, condensing unit, evaporator, and other refrigeration components.

C. If refrigerant pipe sizes are not shown on the plans, sizing and routing shall be in accordance with the refrigerant component manufacturer’s recommendations. If refrigerant pipe sizes are shown on the plans, verify refrigerant pipe sizing and routing with the manufacturer of the condenser, condensing unit, evaporator, and other components PRIOR TO THE INSTALLATION of any piping and report to the Engineer if the sizes or routing are in conflict with the manufacturer’s recommendations. Install piping of the sizes recommended by the manufacturer at no additional cost to the Owner or Engineer.

D. All components of the refrigerant system shall be designed for the type of application, refrigerant, and the system pressures encountered. All components, methods of installation, testing procedures, etc., shall be in accordance with all applicable codes.

E. Hanging and supporting of refrigerant piping shall be as specified in Section 230100, Installation of Piping.

F. Pitch piping in the direction of flow with no pockets or traps other than those indicated on the plans. Oil traps that are indicated shall be made as small as possible and still retain the intended function.

3.2 INSTALLATION OF REFRIGERANT SPECIALITIES

A. Install refrigeration specialties in accordance with manufacturer’s instructions.

B. Filter Driers
   1. Provide permanent filter-driers in low temperature systems, systems utilizing hermetic compressors, and where indicated.
   2. Provide replaceable cartridge filter-driers vertically in liquid line adjacent to receivers.
   3. Provide replaceable cartridge filter-driers, with three-valve bypass assembly.
   4. Provide filter-driers for each solenoid valve.

C. Sight Glasses
   1. Provide sight glasses ahead of all solenoid valves and where indicated.
   2. Provide line size sight glasses in main liquid line leaving condenser, or if receiver is provided, in liquid line leaving receiver.

D. Solenoid Valves
   1. Provide solenoid valves in liquid line of systems operating with single pump-out or pump-down compressor control, in liquid line of single or multiple evaporator systems, in oil bleeder lines from flooded evaporators to stop flow of oil and refrigerant into the suction line when system shuts down, and where indicated.
   2. Provide electrical connection to solenoid valves.

E. Expansion Valves
1. Provide expansion valves in liquid line at each connection to DX coils (distributor) and where indicated.
2. Locate expansion valve sensing bulb immediately downstream of evaporator on suction line.
3. Provide external equalizer piping on expansion valves with refrigerant distributor connected to evaporator.

F. Strainers
1. Provide line size strainer upstream of each automatic valve. Where multiple expansion valves with integral strainers are used install single main liquid line strainer.

G. Shut Off Valves
1. Provide shut-off valves on each side of strainer and where indicated.
2. Provide refrigerant charging (packed angle) valve connections in liquid line between receiver shut-off valve and expansion valve.

H. Check Valves: Install where indicated.

I. Relief Valves: Install where required by code and where indicated.

J. Receivers: Install where indicated.

K. Flexible Connectors
1. Utilize flexible connectors at or near compressors where piping configuration does not absorb vibration and where indicated.
2. Install flexible connectors at right angles to axial movement of compressor.

3.3 TESTING

A. Testing for pre-charged refrigerant line kits is not required.

B. When installation of field installed refrigerant piping and fittings is complete, disconnect and cap all lines to gauges, controllers, etc., which might be damaged by a pressure test. Open all service valves in systems and charge system with refrigerant in accordance with the manufacturer’s written requirement. Add sufficient dry nitrogen to raise system to pressures on suction, discharge and liquid sides of system as indicated below (or higher if required by local code). Check all joints and connections for leaks with a halide torch or electronic leak detector. If leaks are found, all leaks shall be repaired and system retested.

C. After system is proven to be completely free of leaks, the entire system shall be dehydrated by evacuating with vacuum pump. System compressors shall not be used as a vacuum pump. Pull system down to 100 microns and hold for 8 hours. Break vacuum with dry nitrogen. Repeat procedure three times with vacuum being broken the last time with refrigerant. Charge system with refrigerant and check the equipment in accordance with manufacturer's recommendations.

D. DO NOT DISCHARGE ANY REFRIGERANT TO THE ATMOSPHERE.

MU #CP190761
REFRIGERANT PIPING 230150 - 6
E. Test Pressure Requirements

1. Line Test Pressure for Refrigerant R-410A:
   

3.4 Troubleshoot all components of the refrigerant system, both new and existing, when the refrigeration system is started up until the system is operating satisfactorily.

   END OF SECTION 230150
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SECTION 230200 – MECHANICAL INSULATION

PART 1 - GENERAL

1.1 WORK INCLUDED

A. Furnish all labor, services, material and related items necessary to complete the thermal insulation work indicated on the drawings and/or specified herein.
   1. Mechanical Piping.
   3. Ductwork.

1.2 WORK EXCLUDED

A. Work not included in this Section that is specified in other Sections of these specifications:
   1. Insulation saddles for the piping system - Section 230110.
   2. Plumbing systems piping insulation - Section 220400.
   3. Duct liner - Section 230900.

1.3 RELATED DOCUMENTS

A. All drawings and applicable provisions of Division 0 Bidding Requirements and Division 1 General Requirements apply to work of this Section.
B. Section 230000 - Mechanical General Conditions.
C. Section 230100 - Installation of Mechanical Piping.
D. Section 220400 - Plumbing Systems (plumbing piping insulation).
E. Section 230900 - Air Distribution.

1.4 QUALITY ASSURANCE

A. Flame/Smoke Ratings: Provide composite mechanical insulation (insulation, jackets, coverings, sealers, mastics and adhesives) with flame-spread index of 25 or less, and smoke-developed index of 50 or less, as tested by ASTM E 84 (NFPA 255) method.

1.5 SUBMITTALS

A. Product Data: Submit manufacturer’s technical product data and installation instructions for each type of mechanical insulation. Submit schedule showing manufacturer’s product number, k-value, thickness, and furnished accessories for each mechanical system requiring insulation.

B. Submit product data under provisions of Section 230000. Indicate application for each product.
   1. Detail application of protective shields, saddles, and inserts at hangers for each type of insulation and hanger.
   2. Detail attachment and covering of heat tracing inside insulation.
   3. Detail insulation application at pipe expansion joints for each type of insulation.
4. Detail insulation application at elbows, fittings, flanges, valves, and specialties for each type of insulation.
5. Detail removable insulation at piping specialties, equipment connections, and access panels.
6. Detail application of field-applied jackets.
7. Detail application at linkages of control devices.
8. Detail field application for each equipment type.

1.6 DELIVERY, STORAGE, AND, HANDLING

A. Deliver insulation, coverings, cements, adhesives, and coatings to site in containers with manufacturer's stamp or label, affixed showing fire hazard indexes of products.

B. Store insulation in a clean, dry place and protect against dirt, water, and chemical and mechanical damage. Do not install damaged or wet insulation; remove from project site.

1.7 REFERENCES


PART 2 - PRODUCTS

2.1 The piping insulation material for each Type is specified to establish the desired quality and performance. Equal products, complying with the requirements of these specifications, by the following manufacturers are acceptable:

A. Owens-Corning
B. Certain-Teed
C. Armstrong
D. Manson formerly Manville
E. Knauf
F. Rubbatex
G. Imcoa
H. Foamglas

2.2 Type (1) - Owens-Corning Fiberglass, Fiberglass 25 with ASJ all service jacket, seal down lap joints, vapor barrier in jacket. Thermal conductivity of 0.26 BTU/HR/SF°F/IN @ 100°F mean temperature, 0.3 @ 200°F, 0.35 @ 300°F. PVC jacket over fittings. Aluminum jacket over straight sections of piping located outdoors.

2.3 Type (3) - Armacell AP/Unslit (Flame/Smoke Rating less than 25/50 thru 1" thickness per ASTM E-84) Armaflex foamed plastic flexible tubing insulation Unslit. Thermal conductivity of 0.28 BTU/HR/SF°F/IN @ 90°F mean temperature. See Execution for allowable locations of Lap Seal.

A. Provide Armafix insulated pipe hangers at all pipe hangers.

2.4 Type (4) - Owens Corning type 703-FRK-25, 3 pound per cubic foot density, rigid insulation. Temperature range -60°F to 450°F. "K" value (BTU/HR/FT^2/IN/F) of 0.28 at 75 degrees F and 0.30 at 100 degrees F. Factory applied vapor barrier. Odor free and resistant to growth of bacteria or fungus.
2.5 Type (6) - Owens Corning All-Service Duct Wrap, 1.5 pound per cubic foot density, blanket type insulation with all service facing with a 2” min. stapling and taping flange on one edge. Temperature range -60°F to 250°F. Factory applied reinforced Foil-Kraft (FRK) vapor barrier. Odor free and resistant to growth of bacteria or fungus. Installed thicknesses and R-Values as indicated below. (* hr-ft2-°F/Btu at 75°F mean temperature.) & (** Assumes 25% compression of insulation.)

<table>
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<tr>
<th>Nominal Thickness, in.</th>
<th>Density, pcf</th>
<th>Out-of-Package R-Value*</th>
<th>Installed Thickness, in.</th>
<th>Installed R-Value*</th>
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<tr>
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</table>

2.6 Type (12) - Armaflex AP White Unslit (Flame/Smoke Rating 25/50 thru 1” thickness) Armaflex white foamed plastic flexible tubing insulation, Unslit. UV resistant thermal conductivity of 0.28 BTU/HR/SF°F/IN @ 90°F mean temperature. Available ½” thick thru 2-5/8” ID and 3/4” or 1” thick thru 4-1/8” ID. See Execution for allowable locations of Lap Seal.

A. Provide Armaflex insulated pipe hangers at all pipe hangers.

2.7 JACKETS

A. Vapor Barrier Jackets: Kraft reinforced foil vapor barrier with self-sealing adhesive joints.

B. PVC Jackets: One piece, premolded type.

C. Aluminum Jackets: ASTM B209; 0.032 inch thick; Stucco Embossed corrugated finish; 2-1/2” deep corrugations. Childers jacketing system, ITW Insulation system, or equal.

1. Finish and thickness are indicated in field-applied jacket schedules.
2. Moisture Barrier for Indoor Applications: 1-mil thick, heat-bonded polyethylene and kraft paper or 2.5-mil thick polysurlyn.
3. Moisture Barrier for Outdoor Applications: 2.5-mil thick polysurlyn.

D. Vapor barrier mastic coatings:

1. for outdoor service: Foster Division - 30-15
2. for indoor service: Foster Division - 30-80 or 30-90 (water based)
3. Or equal products by the following manufacturers:
   a. Exxon Chemical Company USA
   b. Insul - Coustic IC
c. Epolux-Cadalar

E. Reinforced Polyvinyl-Chloride (PVC) Flashing Sheet: ASTM D 4434, Type III, fabric reinforced and fabric scrim-backed; felt backed; capable of being heat-welded. Sheet Thickness: 60 mils, nominal. (For use on ductwork exterior location where indicated on the plans.)

F. Thermoplastic Polyolefin (TPO) Flashing Sheet: ASTM D 6878, internally fabric or scrim reinforced, uniform, flexible TPO sheet; free of surface defects and embossing or marking which affect membrane thickness or performance; capable of being heat-welded. Thickness: 60 mils, nominal. (For use on ductwork exterior location where indicated on the plans.)

G. PVC Insulation Fitting Covers:
   1. Factory fabricated, pre-molded, fitting covers manufactured from 20-mil- thick, high-impact, ultraviolet-resistant PVC.
   2. Factory fabricated, pre-molded, fiberglass fitting inserts, 1-1/2 pound per cubic foot density, semi-rigid insulation formed to fit the pipe fitting, valve, etc. that it is designed to cover.
   3. Shapes: 45- and 90-degree, short- and long-radius elbows, tees, valves, flanges, reducers, end caps, traps, and mechanical joints.
   4. Acceptable manufacturers:
      a. Ceel-Co, “Ceel-tite #320” (indoors), #330 (outdoors 0°F to 150°F)
      b. Certain Teed, “Snap Form”
      c. Foster Div., H.B. Fuller Co., “Speedline Smoke-Safe”
      d. Knauf, “Proto Lo SMOKE”
      e. Manville, “Zeston 2000”
   5. Adhesive: Compatible with fitting cover material. Do not use regular PVC cement.
      a. Acceptable manufacturers:
         1) Ceel-Co, “Ceel-tite #300” Solvent Welding Adhesive
         2) Knauf, “Proto Solvent Adhesive”
         3) Manville, “Perma-Weld Adhesive”
         4) Aluminum fitting covers by GASCO are equally acceptable.

2.8 ACCESSORIES

A. Insulation Bands: ¾ inch wide; 0.015 inch thick galvanized steel.
B. Metal Jacket Bands: ½ inch wide; 0.015 inch thick aluminum.
D. Finishing Cement: ASTM C449.
E. Fibrous Glass Cloth: Untreated; 9 oz/sq yd weight.
F. Adhesives/Tapes: Compatible with insulation.
G. Flexible elastomeric foam finish-Armstrong FR/Armaflex finish.

PART 3 - EXECUTION

3.1 INSTALLATION OF PIPING INSULATION
A. Install insulation, vapor retarder and jacketing per manufacturer’s recommendations. Particular attention should be paid to recommendations for joint staggering, adhesive application, external hanger design, expansion/contraction joint design and spacing and vapor retarder integrity.

B. Insulate all pipe, valves, and specialties except where insulation is specifically indicated to be omitted.

C. All insulation shall be continuous through wall, floor, and ceiling openings and sleeves.

D. Install insulation with all joints tightly butted (except expansion joints in hot applications).

E. Piping insulation and jacketing shall be applied in accordance with MICA (Midwest Insulation Contractors Association) Plate #3 (b) requirements. Insulation at hangers shall be applied in accordance with MICA Plate #6A. Insulation for fittings, valves, flanges, and couplings shall be installed in accordance with MICA Plates 10-18.

F. The open end of all insulation shall be neatly beveled either by beveling the insulation or by using finish cement.

G. Prior to application of insulation, heat tracing, or painting; piping and equipment shall have been tested and accepted.

H. All surfaces to be insulated shall be clean and dry. Special solvents are not required for use in cleaning, but any oil, grease, dirt or foreign material shall be wiped or scraped from the pipe or equipment surface. Insulation shall not be applied on damp or frosty surfaces.

I. All pipe lines with hangers, saddles, etc., shall be set in their permanent location before insulation is applied. Should it be necessary to block or shore up pipe to install insulation, or should it be necessary to displace or remove hangers, the pipe and hangers shall be restored to their original location and alignment when the insulation is complete. Where pipe hangers are installed in a manner that prevents the specified insulation thickness to be installed, the pipe hangers shall be adjusted or moved and rehung to allow the specified insulation thickness to be applied.

J. Where insulated piping is supported by hangers clamped directly to the pipe, the insulation shall be carefully fitted around hanger clamp and sealed at openings in jacket.

K. For all cold service piping:
   1. Seal the beginning and end of each run of insulation to the pipe being insulated with vapor barrier mastic to prevent air from entering the space between the pipe and the insulation. This especially applies at connections to air handling units and similar equipment. See details on plans.
   2. Install a vapor stop on each side of all valves that are not fully encapsulated by the insulation including all valves where the stem or handle protrudes outside the insulation. The vapor stop shall consist a vapor barrier and mastic to prevent moisture from traveling longitudinally along the insulation in the space between the pipe and the insulation. See details on plans.
3. Vapor retarder/seal shall be installed in a continuous manner. No staples, rivets, screws or any other attachment device capable of penetrating the vapor retarder/seal shall be used to attach the vapor retarder/seal or jacketing. No wire ties capable of penetrating the vapor retarder/seal shall be used to hold the insulation in place. Banding shall be used to attach PVC or metal jacketing.

4. Where cold service piping attaches to coils in air handling equipment, vapor seal the end of the insulation and seal insulation to air handling unit casing. Seal in accordance with air handling unit manufacturer’s installation instructions or as directed by the Engineer.

5. At pipe riser supports, where the support is clamped directly to the pipe, insulation shall be installed over the outside of the riser support clamp and shall totally enclose the riser clamp.

L. Insulate heating and cooling coil headers located outside of units or ductwork or not located above a condensate pan as specified for piping.

M. Unions, flanges and valves:
   1. All unions, flanges, valves and other similar fittings shall be insulated unless otherwise indicated.
   2. Extended Stems: Where insulation is indicated or specified, coordinate with contractor furnishing valves to furnish extended stems arranged to receive insulation. Cold service valves that are insulated with removable covers do not require extended stems.
   3. For all cold service piping:
      a. Insulate all balance (flow control) valves, flow measuring devices, and stop valves (except valves located in mechanical rooms and valves exterior to the building) with molded, pre-shaped fiberglass insulation inserts and cover with a two piece PVC Fitting Cover. Insulation and fitting cover shall be removable. Secure the two piece PVC fitting cover by taping the ends to the adjacent pipe covering. All seams of cover shall be sealed with vapor barrier pressure sensitive color matched tape.
      b. Insulate all balance (flow control) valves, flow measuring devices, and stop valves (except valves located in mechanical rooms and valves exterior to the building) with factory fabricated removable/reusable valve covers. Install in accordance with the manufacturer’s instructions to prevent the condensation. All removable valve covers shall be the same manufacture.
      c. Insulate all fittings, control valves, manual valves (in mechanical rooms and valves exterior to the building), check valves, unions, instruments, hanger rods and clamps, and flanges with molded, pre-shaped insulation inserts of the same material as the straight pipe insulation, or wrap the fitting, valve, etc. with 1.5-pound density flexible fiberglass insulation to a thickness equal to the adjacent piping insulation, and cover with a one piece PVC Fitting Cover per MICA Plate 17A or 18. Tuck the ends of the insulation snugly into the throat of the fitting and the edge adjacent to the pipe fitting. Secure the one piece PVC fitting cover by taping the ends to the adjacent pipe covering. All seam edges of cover shall be sealed with vapor barrier pressure sensitive color matched tape. The tape shall
extend over the adjacent pipe insulation and have an overlap on itself at least 2 inches. Use of polyurethane spray-foam to fill PVC elbow jacket is prohibited on cold applications.

4. For all hot service piping:
   a. Insulate all fittings, manual valves, hanger rods and clamps, and flanges with molded, pre-shaped insulation inserts of the same material as the straight pipe insulation, or wrap fiberglass installations with 3-pound density flexible fiberglass insulation to a thickness equal to the adjacent piping insulation, and cover with a one piece PVC Fitting Cover. Tuck the ends of the insulation snugly into the throat of the fitting and the edge adjacent to the pipe cover. Secure the one piece PVC fitting cover by taping or riveting the ends to the adjacent pipe covering. Use of polyurethane spray-foam to fill PVC elbow jacket is prohibited on cold applications.
   b. Insulate all control valves, PRVs, safety valves and discharge vent piping, vacuum breakers, thermostatic vent valves, check valves, unions, instruments similar to fittings as indicated above.
   c. All control valves, PRVs, safety valves and discharge vent piping, vacuum breakers, thermostatic vent valves, balance valves, check valves, unions, instruments shall be UNINSULATED. Insulate piping to within approximately 3 inches of uninsulated items.

N. At pipe hangers, furnish and install a sheet metal protection shield and wooden inserts the same thickness as the insulation. Shields and blocks are intended to prevent the crushing of the insulation. Blocks shall be sealed to provide continuity of the vapor barrier.
   1. In lieu of the wooden blocks at pipe hangers, this Contractor may, at his option, provide rigid insulation saddle, equal to Fee and Mason Fig. 71, consisting of rigid urethane foam insulation with vapor barrier jacket. Thermal conductivity of 0.13 BTU/HR/FT²/°F/IN @ 75°F. Insulation lengths shall be three (3) times the pipe diameter plus 8” with a minimum length of 20”. Insulation thickness shall be the same as the pipe insulation.

O. Exterior Applications
   1. Type 12: Coat with flexible elastomeric foam finish per manufacturer’s instructions.

3.2 INSTALLATION OF CELLULAR-GLASS INSULATION

A. Insulation Installation on Straight Pipes:
   1. Secure each layer of insulation to pipe with wire or bands and tighten bands without deforming insulation materials.
   2. Where vapor barriers are indicated, seal longitudinal seams, end joints, and protrusions with vapor-barrier mastic and joint sealant.
   3. For insulation with factory-applied jackets on above-ambient services, secure laps with outward-clinched staples at 6 inches o.c.
4. For insulation with factory-applied jackets on below-ambient services, do not staple longitudinal tabs. Instead, secure tabs with additional adhesive as recommended by insulation material manufacturer and seal with vapor-barrier mastic and flashing sealant.

5. Only where Unslit Insulation cannot be installed and longitudinal slit is needed, provide Lap Seal insulation. The longitudinal slit should only be used when insulating existing piping.

B. Insulation Installation on Pipe Flanges:

1. Install preformed pipe insulation to outer diameter of pipe flange.
2. Make width of insulation section same as overall width of flange and bolts, plus twice the thickness of pipe insulation.
3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with cut sections of cellular-glass block insulation of same thickness as pipe insulation.
4. Install jacket material with manufacturer's recommended adhesive, overlap seams at least 1 inch, and seal joints with flashing sealant.

C. Insulation Installation on Pipe Fittings and Elbows:

1. Install preformed sections of same material as straight segments of pipe insulation when available. Secure according to manufacturer's written instructions.
2. When preformed sections of insulation are not available, install mitered sections of cellular-glass insulation. Secure insulation materials with wire or bands.

D. Insulation Installation on Valves and Pipe Specialties:

1. Install preformed sections of cellular-glass insulation to valve body.
2. Arrange cellular glass insulation to permit access to packing and to allow valve operation without disturbing insulation.
3. Install insulation to flanges as specified for flange insulation application.

3.3 INSTALLATION OF EQUIPMENT INSULATION

A. Install equipment insulation products in accordance with manufacturer's written instructions, and in compliance with recognized industry practices to ensure that insulation serves intended purpose.

B. Install insulation materials with smooth and even surfaces and on clean and dry surfaces. Redo poorly fitted joints. Do not use mastic or joint sealer as filler for gapping joints and excessive voids resulting from poor workmanship.

C. Maintain integrity of vapor-barrier on equipment insulation and protect it to prevent puncture and other damage.

D. Do not apply insulation to equipment while the equipment surface temperature is above or below ambient air temperature.
E. Apply insulation using staggered joint method for both single and double layer construction, where feasible. Apply each layer of insulation separately.

F. Coat insulated surfaces with layer of insulating cement, troweled in workmanlike manner, leaving smooth continuous surface. Fill in scored block, seams, chipped edges and depressions, and cover over wire netting and joints with cement of sufficient thickness to remove surface irregularities.

G. Cover insulated surfaces with all-service jacketing neatly fitted and firmly secured. Lap seams at least 2". Apply over vapor barrier where applicable.

H. Provide removable insulation sections to cover parts of equipment which must be opened periodically for maintenance; include metal vessel covers, fasteners, flanges, frames and accessories.

I. Attachments beyond the insulation line on equipment such as stiffening rings shall be considered an integral part of the equipment and shall be insulated and finished in the same manner as the equipment proper. Thickness of insulation on such attachments and projections shall be the same as the adjoining insulation.

J. Equipment exposed to Weather: Protect outdoor insulation from weather by installation of mastic or weather-barrier protective finish, or jacketing, as recommended by manufacturer.

3.4 DUCT INSULATION

A. Installation shall comply with the manufacturer's recommendations using manufacturer's recommended procedures, adhesives, joint tape, and methods.

1. For ducts 18" and larger in width, welding pins shall be used on not greater than 16" o.c. on the bottom and sides of the ducts and maximum 3” from insulation joints to prevent sagging. Pins shall be covered with duct tape. All parts of the duct system shall be insulated in such a manner to form a continuous insulation and prevent excessive heat loss, heat gain, or condensation.

2. For ducts 18” and smaller, place pins along long individual centerline of duct. Space 3” inches maximum from insulation end joints and 16” inch on center.

3.5 INDOOR, FIELD-APPLIED JACKET SCHEDULE

A. Install jacket over insulation material. For insulation with factory-applied jacket, install the field-applied jacket over the factory-applied jacket.

B. Ducts and Plenums, Exposed

1. None.
2. PVC 30 mils thick.

C. Piping, Exposed or Concealed:

1. None.
2. PVC 30 mils thick.
3. Aluminum, Smooth: 0.024 inch thick.

D. If more than one material is listed, selection from materials listed is Contractor's option.

E. Equipment, Exposed, up to 48 inches Diameter or with Flat Surfaces up to 72 inches:
   1. None.
   2. Aluminum: Corrugated: 0.032 inch thick.
   3. Stainless Steel, Type 304, Corrugated 0.016 inch thick.

3.6 PROTECTION AND REPLACEMENT

A. Replace damaged insulation which cannot be repaired satisfactorily, including units with vapor barrier damage and moisture saturated units.

B. Protection: Insulation Installer shall advise Contractor of required protection for insulation work during remainder of construction period, to avoid damage and deterioration.

3.7 INSULATION THICKNESS

A. The following equipment requires field applied insulation:
   1. The following equipment requires field applied insulation:
   2. The following piping requires field applied insulation:

<table>
<thead>
<tr>
<th>System</th>
<th>Insulation Type</th>
<th>Thickness</th>
</tr>
</thead>
<tbody>
<tr>
<td>Condensate Drain Lines (Inside Building)</td>
<td>3</td>
<td>1/2”</td>
</tr>
<tr>
<td>Refrigerant Suction Gas Piping (attic)</td>
<td>3</td>
<td>3/4”</td>
</tr>
<tr>
<td>Refrigerant liquid piping (attic)</td>
<td>3</td>
<td>3/4”</td>
</tr>
<tr>
<td>Refrigerant liquid piping (exterior)</td>
<td>12</td>
<td>1”</td>
</tr>
<tr>
<td>Refrigerant suction gas piping (exterior)</td>
<td>12</td>
<td>1”</td>
</tr>
<tr>
<td>Any Pipe Thru Rated Wall where Details Show</td>
<td>5</td>
<td>Match thickness above</td>
</tr>
<tr>
<td>This density is required</td>
<td></td>
<td></td>
</tr>
<tr>
<td>All VRF refrigerant piping (exterior or attic)</td>
<td>12</td>
<td>1”</td>
</tr>
</tbody>
</table>

3. The following ductwork requires field applied insulation:

<table>
<thead>
<tr>
<th>System</th>
<th>Insulation Type</th>
<th>Thickness</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ductwork above ceilings, in chases, and other concealed locations</td>
<td>6</td>
<td>1-1/2”</td>
</tr>
<tr>
<td>Air ductwork from energy recovery units</td>
<td>6</td>
<td>1-1/2”</td>
</tr>
</tbody>
</table>

END OF SECTION 230200
SECTION 230605 – ENERGY RECOVERY UNITS

PART 1 - GENERAL

1.1 DESCRIPTION OF WORK

A. Furnish all labor, material, services and related items necessary to complete the energy recovery unit installation shown on the plans and as specified herein.

1.2 RELATED DOCUMENTS

A. All drawings and applicable provisions of Division 0 Bidding Requirements and Division 1 General Requirements apply to work of this Section.
B. Section 230000 - Mechanical General Conditions.
C. Section 230010 - Basic Mechanical Materials and Methods.
D. Section 230050 - Motors.
E. Section 230900 - Air Distribution.
F. Section 230960 - Temperature Controls.

1.3 QUALITY ASSURANCE

A. Manufacturer's Qualifications: Firms regularly engaged in manufacture of packaged energy recovery units of types and capacities required, whose products have been in satisfactory use in similar service for not less than 5 years.
B. Each unit shall be furnished complete with specified components and accessories as required.
C. All units shall be rated and certified as complete units in accordance with ARI Standard 1060, and shall bear the ARI seal.
D. All units shall have energy transfer ratings certified in accordance with ARI Standard 1060, and shall bear the ARI seal.
E. Units, and all accessories, shall be listed by Underwriter's Laboratories, Inc. or Engineering Testing Laboratories and bear the appropriate U.L. or ETL label.
F. Where indicated on the plans, units shall have a maximum cross contamination from the exhaust air stream to the make-up air stream of 1.0%. If needed to meet this criteria, unit shall be furnished with a purge section on the wheel.

1.4 SUBMITTALS

A. Submit shop drawings and product data under provisions of Section 230000.
B. Shop drawings shall indicate complete assembly, unit dimensions, weight loading, required clearances, details of construction, and location and size of field connections.
C. Product data shall indicate typical catalog of information including optional components and arrangement, unit size, capacities at scheduled conditions, ratings, fan performance, motor electrical characteristics, and gages and finishes of materials.
D. Submit fan curves with specified operating point clearly plotted and note operating motor load and conditions of overload.

E. Submit sound power levels by octave band for both fan outlet and casing radiation at rated capacity.

F. Submit product data including coil and frame configurations, dimensions, materials, rows, connections, and rough-in dimensions.

G. Submit manufacturer's certificate that capacities, pressure drops, and selection procedures meet or exceed specified requirements.

H. Submit product data of filter media, filter performance data, filter assembly, and filter frames.

I. Submit certified damper performance data including pressure drop, leakage rate and torque requirements.

J. Submit electrical requirements for power supply wiring including wiring diagrams for interlock and control wiring, clearly indicating factory-installed and field-installed wiring.

K. Submit manufacturer's installation instructions.

L. Submit operation and maintenance data under provisions of Section 230000 including start-up instructions, instructions for lubrication, maintenance data, parts lists, controls, and accessories. Include trouble-shooting guide.

M. Submit calibration certification documentation of factory installed temperature, humidity, enthalpy and control sensors.

1.5 REFERENCES

A. The publications listed below form a part of this specification to the extent referenced. The publications are referenced in the text by the basic designation only. Latest edition shall apply unless otherwise indicated.

B. ASTM A 525 - General Requirements for Steel Sheet, Zinc-Coated (Galvanized) by the Hot-Dip Process.

C. ASTM A 527 - Steel Sheet, Zinc-Coated (Galvanized) by Hot-Dip Process, Lock Forming Quality.


E. NFPA 90A - Installation of Air Conditioning and Ventilating Systems.

F. ANSI/AMCA Standard 204-05 - "Balance Quality and Vibration Levels for Fans".

G. ANSI/AHRI Standard 260-12 - "Sound Rating of Ducted Air Moving and Conditioning Equipment”.

1.6 STORAGE AND HANDLING
A. Hoist energy recovery units to the location where they will be installed.

B. Handle energy recovery units and components carefully to prevent damage, breakage, denting and scoring. Do not install damaged energy recovery units or components; replace with new. Comply with manufacturer’s rigging and installation instructions for unloading energy recovery units, and transporting them to final location.

C. Store in a clean, dry place and protect units from damage by weather, dirt, fumes, construction debris, water, and physical damage.

PART 2 - PRODUCTS

2.1 GENERAL
A. Construct energy recovery units for interior installation as indicated. Units shall have supply and exhaust fans, filters for outside air and exhaust air ahead of the energy wheel, an enthalpy recovery wheel to transfer both sensible and latent heat between the outside air and exhaust air streams, a single point power connection, motorized dampers on both the outside air intake and the exhaust air outlet, and defrost controls.

B. Manufacturer shall provide all other components required to provide a complete installation.

C. Energy recovery unit shall include casing, structural frame, centrifugal fans, ECM motors.

D. All materials shall have a flame spread rating of 25 or less and a smoke developed rating of 50 or less when tested in accordance with NFPA Standard 84.

2.2 MANUFACTURERS
A. Energy recovery unit selection has been based on the manufacturer scheduled to establish the desired quality, style and type. Equal products, complying with these specifications by the following manufacturers are acceptable:

1. Semco
2. Venmar
3. Carnes
4. Governaire
5. Greenheck
6. Valent

B. All energy recovery units shall be by one manufacturer.

2.3 UNIT CABINET: UNITS 3,500 CFM OR LESS
A. Cabinet shall be constructed of reinforced galvanized steel with 12 gauge frame and 20 gauge skin enclosing the equivalent of 0.75 inch thick, foil faced fiberglass insulation. Unit shall have removable panels for access to the heat wheel and fans. Cabinet shall be finished with either galvanizing or factory-applied corrosion resistant paint. Cabinet work shall be properly reinforced and gasketed to withstand the fan close-off static pressure at operating speed. Cabinets shall be suitable for draw-thru arrangement.
B. Sheet metal shall be mill-galvanized (two-sided) carbon steel and shall conform to ASTM A525 coating class G-90, lock forming quality. Provide 1/4 turn fasteners at access doors.

2.4 ENERGY WHEELS

A. Enthalpy Wheels

1. The rotor media shall be made of coated aluminum or lightweight polymer media. All media surfaces shall be coated with a non-migrating solid absorbent layer. Desiccant coatings that are sprayed on or dip coated, or desiccants that must be reapplied over time are not acceptable.
2. The desiccant shall be for the selective adsorption of water vapor.
3. Performance and pressure loss data shall be tested in accordance with the ASHRAE 84 standard. The desiccant material shall not transfer pollutants typically encountered in the indoor air environment from the exhaust air to the supply air.
4. The media shall be cleanable without degrading the latent recovery. Dry particles up to 800 microns shall freely pass through the media.
5. The rotor shall be supplied with face and perimeter seals.
6. The rotor housing shall be housed in a removable cassette. The housing shall be made of galvanized steel.
7. The rotor shall be driven by a self-adjusting belt system and an A/C motor with a variable speed inverter drive.

2.5 FANS

A. General

1. Provide fans that are factory fabricated and assembled, factory tested, and factory finished, with indicated capacities and characteristics. Balance fans in accordance with AMCA 204-05.
2. Fans up to 3,500 cfm shall be DWDI, forward curved centrifugal type.

B. Fans and Shafts: Statically and dynamically balance and designed for continuous operation at the maximum rated fan speed and motor horsepower. Fan shaft shall be turned, ground, and polished steel, designed to operate at no more than 70 percent of the first critical speed at the top of the speed range of the fan's class.

C. ECM Motor.

D. Fan Wheels: Hub keyed to the shaft.

1. Blade Materials: Steel or aluminum.
2. Blade Type: Forward curved.

E. Shaft Bearings: Prelubricated and sealed, self-aligning, ball bearings.

F. Isolators:
1. Fans 3,500 cfm or less shall be isolated within the unit on rubber in shear isolators that are seismically restrained. Isolators shall have 0.75" static deflection and be equal to Model RBA by Mason Industries.

G. Sound Levels

1. Supply fan discharge sound levels and return air inlet sound levels shall not exceed following levels (Db re 10 to the -12 power watts):

<table>
<thead>
<tr>
<th>OCTAVE BAND</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>69</td>
<td>65</td>
<td>64</td>
<td>58</td>
<td>59</td>
<td>55</td>
</tr>
</tbody>
</table>

2.6 MOTORS AND DRIVES

A. Motors shall have open, drip proof enclosures and shall have a service factor not less than 1.15. Motors shall be in accordance with Section 230050. Motors shall have electrical characteristics as indicated on the schedule on the plans.

2.7 ACCESS DOORS AND PANELS

A. Access doors shall be of 20-gage construction and shall provide access from two sides minimum.

2.8 FILTERS

A. Provide flat filter frames for bottom or side servicing with necessary gasketing to seal between filter and frame and spring type hold down clips to secure filters in place. Air filter shall be 35% efficiency. Filters shall be changeable without the need of tools, nuts or bolts. Size for standard 24" x 24" x 2" filter media. Provide filters for both supply and exhaust airstreams.

B. Provide filter gages with 3-1/2" diameter diaphragm actuated dial in a metal case with black figures on white background, vent valves, front calibration adjustment, range 0 - 2.0" W.G. and 2% of full scale accuracy. Provide static pressure tips with integral compression fittings, 1/4" aluminum tubing and 3 way vent valves. Gauge shall be equal to Dwyer 2000 Series.

C. Provide 2 inch thick Farr 30-30 filters or equal.

2.9 DAMPERS

A. Outside air/exhaust air dampers.

1. The dampers shall be equivalent to Ruskin series CD60 low leakage opposed blade control dampers or approved equal.

2. Frame shall be 16 gauge galvanized steel. Blades shall be 14 gauge equivalent thickness, maximum 6" wide. Seals shall be extruded vinyl blade edge seals and flexible metal compressible jamb seals. Bearings shall be stainless steel sleeve. Axles shall be ½" plated steel hex. Provide mill galvanized finish.
3. Maximum Leakage at 1" water gauge differential pressure and when tested in accordance with AMCA Standard 500 shall not exceed 4 CFM per sq. ft.
4. Maximum single dampers section shall be 60" wide x 72" high. For multiple section dampers, each section shall be operated by a separate actuator.
5. The actuators shall be two position, spring return, normally closed for fail-safe operation, and shall be interlocked to open when the unit is energized. Actuators shall be Belimo or approved equal.
6. The actuator shall have built in overload protection to prevent damage to the actuator when the actuator or damper reaches its end position. The actuator shall be UL listed. Actuator on the fresh air inlet damper shall be provided with auxiliary end switch for fan interlock to be provided under Section 230960.

B. Back draft dampers shall comply with the following:
1. Back draft dampers shall be equivalent to Ruskin model BD-6.
2. Shall have minimum 2", 0.125" thick extruded aluminum frame reinforced for rigidity.
3. Aluminum blades of maximum 6" width.
4. Adjustable counterweight.
5. Cadmium plated steel shafts.
7. Hardware shall be cadmium plated steel with brass pins.
8. Dampers shall include blade edge seals. Leakage shall be less than 12 cfm per sq. ft. at 1/2 inch W.G.

2.10 ELECTRICAL
A. Unit shall have a single connection for the voltage shown on the equipment schedule. Include all starters, transformers, integral door interlock disconnecting device, etc. Include a non-fused disconnect switch at the single point of connection.

B. Electrical components shall be NEMA 1 enclosures for equipment located indoors and NEMA 3R enclosures for enclosures exposed to the weather.

C. Starters shall be magnetic type for the motor voltage indicated. In each magnetic starter provide:
1. Cover-mounted "Start" button, cover-mounted "Hand-Off-Automatic" selector switch or "Start-Stop" pushbutton, and manual overload reset button.
3. Three overload relays properly sized for the actual motor nameplate current and motor operating conditions.
4. Auxiliary contacts required for sequence of operation.
5. Control transformer (unless otherwise indicated) for maximum control voltage of 120 VAC complete with primary and secondary overcurrent and short circuit protection.

2.11 MAGNETIC CONTROLLERS
A. Full voltage, across the line, electrically held, for supply and return fans.
1. Configuration: Nonreversing.
2. Contactor Coils: Pressure-encapsulated type
3. Power Contacts: Totally enclosed, double-break, silver-cadmium oxide; assembled to allow inspection and replacement without disturbing line or load wiring.
4. Control Circuits: 120-V ac; obtained from integral CPT, with primary and secondary fuses.
5. Solid-State Overload Relay:
   a. Switch or dial selectable for motor running overload protection.
   b. Sensors in each phase.
   c. Class 10/20 selectable tripping characteristic selected to protect motor against voltage and current unbalance and single phasing.
   d. Class II ground-fault protection, with start and run delays to prevent nuisance trip on starting.
   e. Analog communication module.
6. N.O. isolated overload alarm contact.
7. External overload reset push button.

2.12 CONTROLS
A. Unit shall be provided with a factory mounted and wired microprocessor control operating on 115 volts or less.
B. Unit shall have contacts for placing unit in Occupied/Unoccupied operation from a building DDC system.
C. Occupied contacts shall start the ERU unit. Wiring in the control panel shall start the exhaust fan, the supply fan, and the energy recovery wheel, after the outside and exhaust dampers are open. Both the supply fan and the exhaust fan shall operate continuously during occupied time periods.
D. Provide normally closed contacts from a 24 vac relay wired to the exhaust fan starter coil to allow the exhaust fan to be remotely de-energized when so required for smoke evacuation operation in the building.
E. Unit shall have defrost controls to prevent ice from forming in the unit by slowing the unit supply and exhaust fans and wheel when the outdoor temperature is below 0°F.

2.13 ELECTRIC PREHEAT COILS - NONE

PART 3 - EXECUTION

3.1 EXAMINATION
A. Examine areas and conditions for compliance with requirements for installation tolerances, support structure, and other conditions affecting performance of energy recovery units.
B. Examine rough-in for electrical to verify actual locations of connections prior to installation.
C. Do not proceed until unsatisfactory conditions have been corrected.

3.2 INSTALLATION
A. Install units level and plumb, in accordance with manufacturer's written instructions. Support units as described below, using the vibration control devices indicated. Vibration control devices are specified in Section 230020 "Vibration Controls."

1. Suspended Units: Units shall be suspended from structure using threaded steel rods, double nuts, and vibration isolators indicated in Section 230020.

B. Arrange installation of units to provide access space around units for service and maintenance.

3.3 CONNECTIONS
A. Piping installation requirements are specified in other Division 23 sections. The Drawings indicate the general arrangement of piping, valves, fittings, and specialties. The following are specific connection requirements:

1. Arrange piping installations adjacent to units to allow for unit servicing and maintenance.
2. Connect piping to units.
3. Connect condensate drain pans using 1¼ inch copper tubing, unless otherwise indicated. Extend to the nearest equipment or floor drain. Construct trap at connection to drain pan to provide a water seal correlated to the fan TSP and install cleanouts at changes in direction. Install trap per details on the plans and the manufacturer's instructions.

B. Duct installations and connections are specified in Section 230900. Make final duct connections with flexible connections.

C. Electrical Connections: The following requirements apply:

1. Electrical power wiring is specified in Division 26.
2. Temperature control wiring and interlock wiring is specified in Section 230950 or 230960, Temperature Controls.
3. Grounding: Connect unit components to ground in accordance with the National Electrical Code.

3.4 Adjust damper linkages for proper damper operation.

3.5 Clean unit interiors to remove foreign material and construction dirt and dust. Vacuum clean fan wheel and cabinet before start-up and before placing unit in operation.

A. Demonstration Services: A contractor's representative shall train Owner's maintenance personnel on the following:

1. Procedures and schedules related to start-up and shut down, troubleshooting, servicing, preventative maintenance, and procurement of replacement parts. A copy of training documentation shall be provided.
2. Schedule training with Owner, provide a least 7 days’ advance notice.
B. Provide new filters before air balance and before substantial completion.

3.6 Refer to Sections 230910, "Start-up, Cleaning and Testing", 230930 "Balancing" and 230950 or 230960 "Temperature Controls" for procedures for air-handling-system testing, adjusting, and balancing.

3.7 COMMISSIONING

A. Perform the following operations and checks before start-up:

1. Remove shipping, blocking, and bracing.
2. Verify unit is secure on mountings and supporting devices and those connections for piping, ductwork, and electrical are complete. Verify proper thermal overload protection is installed in motors, starter, and disconnects.
3. Disconnect fan drive from motor, verify proper motor rotation direction, and verify free fan wheel rotation and smooth bearing operation. Reconnect fan drive system, align belts, and install belt guards.
4. Lubricate bearings, pulleys, belts, and other moving parts with factory-recommended lubricants.
5. Adjust or replace fan and motor pulleys as required to achieve design conditions.
6. Measure and record motor electrical values for voltage and amperage.
7. Verify fans and wheel start/stop in response to the Occupied/Unoccupied signal. Verify that the wheel operates at full speed above 55°F and varies the speed of the wheel below 55°F to maintain a maximum discharge temperature of 55°F.
SECTION 230719 – PIPING INSULATION

DESIGN GUIDELINES:

A. General

1. Flame/Smoke Ratings: Provide composite mechanical insulation (insulation, jackets, coverings, sealers, mastics and adhesives) with flame-spread index of 25 or less, and smoke-developed index of 50 or less, as tested by ASTM E 84 (NFPA 255) method.
   a. Exception: Outdoor mechanical insulation may have flame spread index of 75 and smoke developed index of 150.
2. Insulation thickness shall comply with ASHRAE 90.1 or the table below whichever is greater.

SPECIFICATION REQUIREMENTS:

A. Insulation thickness requirements:

<table>
<thead>
<tr>
<th>System Type</th>
<th>Insulation Material</th>
<th>Jacket*</th>
<th>Branches, Mains, and Loops</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>Pipe Diameter (inches)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>&lt;1</td>
</tr>
<tr>
<td>AC condensate</td>
<td>Flexible Elastomeric</td>
<td>Not required</td>
<td>1</td>
</tr>
<tr>
<td>Refrigerant suction, interior</td>
<td>Flexible Elastomeric</td>
<td>Not required</td>
<td>1†</td>
</tr>
<tr>
<td>Refrigerant suction, exterior</td>
<td>Flexible Elastomeric</td>
<td>Aluminum jacket to protect from sun.</td>
<td>1.5</td>
</tr>
</tbody>
</table>

*See jacket requirements below for outdoor installation or exposed piping within specified distances from floors.
†Exceeds ASHRAE 90

1. All exterior, exposed piping shall have an aluminum jacket installed to protect the insulation. The jacket shall be weather-resistant, water-proof, smooth surfaced aluminum.
2. All new interior piping, exposed to view in occupied areas, shall be painted to match the surrounding background.
3. All new interior piping, exposed to view in occupied areas, and within 6'-0" of the finished floor, shall have a PVC jacket installed.
4. All new interior piping that is exposed in mechanical rooms, and within 6'-0" of the finished floor, shall have an aluminum jacket installed.

5. **DO NOT INSULATE**
   5.1 Unions, flanges, strainers, flexible connections, and expansion joints on hot piping.

6. Install insulation products in accordance with manufacturer's written instructions, and in accordance with recognized industry practices to ensure that insulation serves its intended purpose.

7. Install insulation on pipe systems subsequent to installation of heat tracing, painting, testing, and acceptance of tests.

8. Install insulation materials with smooth and even surfaces. Insulate each continuous run of piping with full-length units of insulation, with a single cut piece to complete run. Do not use cut pieces or scraps abutting each other.

9. Clean and dry pipe surfaces prior to insulating. Butt insulation joints firmly together to ensure a complete and tight fit over surfaces to be covered.

10. Maintain integrity of vapor-barrier jackets on pipe insulation, and protect to prevent puncture or other damage.

11. Cover valves, fittings and similar items in each piping system with equivalent thickness and composition of insulation as applied to adjoining pipe run. Install factory molded, precut or job fabricated units (at Installer's option) except where specific form or type is indicated.

12. Extend piping insulation without interruption through walls, floors and similar piping penetrations, except where otherwise indicated.

13. Butt pipe insulation against pipe hanger insulation inserts. For hot pipes, apply 3" wide vapor barrier tape or band over the butt joints. For cold piping apply wet coat of vapor barrier lap cement on butt joints and seal joints with 3" wide vapor barrier tape or band.

14. Where piping passes through fire walls indicated on the contract drawings, contractor shall install firestopping per firestop manufacturers instructions.

15. Insulation Installer shall advise Contractor of required protection for insulation work during remainder of construction period, to avoid damage and deterioration.

END OF SECTION 230719
PART 1 - GENERAL

1.1 SYSTEM DESCRIPTION

A. The system shall be a variable capacity, split system, direct expansion (DX) air conditioning system. The system shall consist of multiple evaporators, refrigerant distribution piping, and a condensing unit and shall use refrigerant R-410A. Heat Recovery systems may connect indoor evaporator capacity up to 130% of the condensing unit capacity. Each evaporator on a heat recovery system shall be capable of operating separately with individual temperature control.

1. Heat Pump systems may connect indoor evaporator capacity up to 200% of the condensing unit capacity. Each evaporator on a heat pump system shall be capable of operating separately with individual temperature control except that all evaporator units must be in heating at one time or cooling depending if the condensing unit is in heating or cooling mode of operation.

B. Each system shall include a full charge of refrigerant R-410A and oil.

C. Performance: The unit selected shall operate at conditions specified in the schedule. The full load operation of the unit shall not exceed the demands indicated on the schedule. System shall provide the efficiency (EER) indicated on the plans or higher.

D. Operation of the system shall permit either individual cooling or heating of each indoor unit simultaneously or all of the indoor units associated with one branch cool/heat selector box. Each indoor unit or group of indoor units shall be able to set its set point via a local controller or an interface with the building DDC system.

1.2 REFERENCES

A. ANSI Compliance: Comply with ANSI B9.1 safety code requirements pertaining to unit construction of condensing units and condensers.


C. ANSI/NFPA 70 National Electrical Code: Comply with applicable National Electrical Code (NEC) requirements pertaining to electrical power and control wiring for construction and installation of condensing units and condensers.

D. ANSI/UL 207 - Refrigerant-Containing Components and Accessories, Non-Electrical.


F. ARI 270 - Sound Rating of Outdoor Unitary Equipment.


H. ARI 520 - Positive Displacement Refrigerant Compressors, Compressor Units and Condensing Units.
I. ASHRAE 14 - Methods of Testing for Rating Positive Displacement Condensing Units.


K. ASME Compliance: Construct and test condensing units and condensers in accordance with ASME Boiler and Pressure Vessel Code, Section 8.

L. UL Compliance: Comply with applicable requirements of UL 465, "Central Cooling Air Conditioners," pertaining to construction and installation of condensing units and condensers. Provide condensing units and condensers which are UL-listed and labeled.

1.3 RELATED DOCUMENTS
A. All drawings and applicable provisions of Division 0 Bidding Requirements and Division 1 General Requirements apply to work of this Section.

B. Section 230000 - Mechanical General Conditions

C. Section 230010 - Basic Material and Methods.

D. Section 230020 - Vibration Isolation and Seismic Restraints.

E. Section 230050 - Motors

F. Section 230150 - Refrigerant Piping.

G. Section 230900 - Ductwork.

H. Section 230965 - BACnet Direct Digital Temperature Controls System.

1.4 QUALITY ASSURANCE
A. The units shall be listed by Electrical Laboratories (ETL) and bear the cETL label.

1.5 SUBMITTALS
A. Submit shop drawings, product data, and Operation and Maintenance data under provisions of Section 230000.

B. Include manufacturer's descriptive literature, operating instructions, installation instructions, maintenance and repair data, and parts listing.

C. Product Data: Submit manufacturer's technical product data, including rated capacities, indicated EERs, weights (shipping, installed, and operating), furnished specialties and accessories; and rigging, installation, and start-up instructions.

D. Shop Drawings: Submit manufacturer's assembly-type shop drawings indicating dimensions, weight loadings, required clearances, methods of assembly of components, and location and size of each field-connection.

E. Provide templates for anchor bolt placement in concrete pad.
F. **Wiring Diagrams:** Submit manufacturer’s electrical requirements for power supply wiring to units. Submit manufacturer's ladder-type wiring diagrams for interlock and control wiring. Clearly differentiate between portions of wiring that are factory-installed and portions to be field-installed.

G. **Operation and Maintenance:** Submit manufacturer’s operation and maintenance data.

### 1.6 DELIVERY, STORAGE AND HANDLING

A. Deliver products to site and hoist in place.

B. Protect units from physical damage.

### 1.7 WARRANTY

A. The units shall have a manufacturer’s warranty and a labor warranty for a period of one (1) year from date of substantial completion of the project.

B. The compressors shall have a warranty of five (5) years from date of substantial completion of the project.

### 1.8 INSTALLATION REQUIREMENTS

A. The system shall be installed by a factory trained contractor/dealer. The bidders shall be required to submit training certification proof prior to the start of the installation.

B. Control wiring shall be installed by a factory trained contractor/dealer with minimum two (2) years’ experience installing VRF System Controls.

### PART 2 - PRODUCTS

### 2.1 MANUFACTURERS

A. Manufacturer and model numbers given in the schedule are intended to establish desired type, quality and performance.

1. Daikin AC.
2. Mitsubishi City Multi.
4. LG.

B. For any manufacturer other than scheduled, Mechanical Contractor will be responsible for all changes and costs required to provide an Alternate VRF System including but not limited to:

1. Cost for Architectural, Mechanical, Electrical and Structural revisions as defined in Section 230000, Part 2, “Substitutions”, except that the proposal does not need to be submitted prior to the bid date.
2. Confirm that proposed manufacturer meets or exceeds heating requirement at zero (0)°F.
3. Provide detailed information of the alternate system efficiencies for the engineer to compare to the base system.
4. If alternate unit MCA / MOCP’s exceed specified values, include cost of needed electrical feeder and equipment in price of the substitution.
5. Provide noise data for outdoor units and fan coil units to allow engineer to compare to the basis of design manufacturer.

2.2 VRF FAN COIL UNITS

A. General

1. The following criteria apply to all fan coil units:

2. Casing
   a. Factory assembled and tested.
   b. Factory wiring, piping, electronic proportional expansion valve, control circuit board, fan motor thermal protection, condensate drain pan, condensate drain pump, self-diagnostics, auto-restart function, fused time delay, and test run switch.
   c. The cabinet shall be constructed with sound absorbing foamed polystyrene and polyethylene insulation.
   d. Provide fresh air intake kit except where indicated on the drawings.
   e. Condensate pump shall provide up to 21” of lift unless otherwise noted.
   f. The condensate pan shall have a built-in safety alarm.

3. Controls
   a. PID control shall be used to control superheat to control the room temperature.
   b. Return air thermistor.
   c. The unit shall have controls provided by manufacturer to perform input functions necessary to operate the system.
   d. A thermistor will be located on the liquid and gas line.
   e. Provide remote “in-room” wall mounted, hard wired remote sensor.

4. Piping
   a. Unit and refrigerant pipes shall be charged with dehydrated air prior to shipment.
   b. Both refrigerant lines shall be insulated.

5. Fan
   a. The fan shall be direct-drive fan with statically and dynamically balanced impeller with high, medium, and low fan speeds.
   b. The fan motor shall comply with Section 230050, Motors, and operate on the voltage with a motor output indicated on the plans. The fan motor shall be thermally protected.
   c. The airflow rate shall be as indicated on the plans.

6. Coil
a. Coils shall be the direct expansion type constructed from copper tubes expanded into aluminum fins. Capacity shall be as indicated on the plans. The refrigerant connections shall be flare connections.

7. Provide MERV-3 filter.

8. Electrical
   a. Each fan coil unit shall have a separate power supply at the voltage indicated on the plans.
   b. Non-fused disconnect switch.

B. Wall Mounted
   1. The unit shall be constructed of a galvanized steel casing with a vertical discharge air and a horizontal or bottom return air configuration.
   2. The cabinet shall be insulated.
   3. Provide refrigerant coil to match capacity scheduled on the plans.

2.3 OUTDOOR REFRIGERATION UNIT (Condensing Unit)

A. General: The outdoor refrigeration unit shall be factory assembled and pre-wired with all necessary electronic and refrigerant controls. The refrigeration circuit of the condensing unit shall consist of scroll compressors, motors, fans, condenser coil, electronic expansion valves, solenoid valves, 4-way valve, distribution headers, capillary tubes at suction lines, subcooling circuits and oil return lines, filters, shut off valves, oil separators, service ports and refrigerant regulator. High/low pressure gas line, liquid and suction lines shall be individually insulated between the outdoor and indoor units.

B. The maximum connection ratio of indoor units to outdoor unit shall be up to 130%. Each outdoor system shall be able to support the connection of up to the number of indoor units indicated on the plans.

C. The system shall automatically restart operation after a power failure and shall not cause any settings to be lost.

D. The unit shall incorporate an auto-charging or an auto-check feature and a refrigerant charge check function.

E. The following safety devices shall be included on the condensing unit; high pressure switch, control circuit fuses, crankcase heaters, fusible plug, high pressure switch, overload relay, inverter overload protector, thermal protectors for compressor and fan motors, over current protection for the inverter and anti-recycling timers.

F. The condenser shall be provided with sub-cooling to prevent flash gas ahead of expansion valves.

G. Oil recovery cycle shall be automatic.

H. The outdoor unit shall be capable of starting and heating operation at 0°F dry bulb ambient temperature without additional low ambient controls.
I. The system shall continue to provide heat to the indoor units in heating operation while in the defrost mode.

J. The unit shall be constructed from steel panels coated with a baked enamel finish.

K. The condensing unit shall consist of one or more propeller type, direct-drive fan motors that have multiple speed operation via a digitally commutating inverter. The fan shall be a vertical discharge.

L. The fan motors shall have inherent protection and permanently lubricated bearings and be mounted and shall be provided with a fan guard.

M. The condenser coil shall be manufactured from copper tubes expanded into aluminum fins. The fins are to be covered with an anti-corrosion acrylic resin and hydrophilic film type E1. The pipe plates shall be treated with powdered polyester resin for corrosion prevention. The thickness of the coating must be between 2.0 to 3.0 microns.

N. Scroll compressors shall be variable speed controlled and/or digital scroll type and shall change the speed to follow the variations cooling and heating load as determined by the suction gas pressure as measured in the condensing unit. Monitor evaporator and condenser temperatures control compressor capacity. Digital scroll compressors are acceptable for lead compressors.

O. The inverter driven compressor in each condensing unit shall be a hermetically sealed scroll "G-type" with a maximum speed of 7,980 rpm.

P. The capacity control range shall be as low as 6%.

Q. Each non-inverter compressor shall also be of the hermetically sealed scroll type.

R. Each compressor shall be equipped with a crankcase heater, high pressure safety switch, and internal thermal overload protector. Compressors shall be spring mounted.

S. Provide oil separators together with an oil management system.

T. Provide a metal guard over the condenser coils to protect them from hail damage.

U. Units sized 6-12 tons shall contain a minimum of 2 compressors, 14 ton units shall contain a minimum of 3 compressors, and 16-20 ton units shall contain a minimum of 4 compressors. In the event of compressor failure the remaining compressors shall continue to operate and provide heating or cooling as required at a proportionally reduced capacity. The microprocessor and associated controls shall be designed to specifically address this condition.

V. In the case of multiple condenser modules, conjoined operation hours of the compressors shall be balanced by means of the Duty Cycling Function, ensuring sequential starting of each module at each start/stop cycle, completion of oil return, completion of defrost or as required by manufacturer for proper operation.

W. The power supply to the outdoor unit shall be as indicated on the plans.

X. The control wiring shall be a shielded or non-shielded as required by equipment manufacturer.
PART 3 - EXECUTION

3.1 Examine areas and conditions, with Installer present, for compliance with requirements for installation tolerances, housekeeping pads, and other conditions affecting performance of fan coil units. Do not proceed until unsatisfactory conditions have been corrected.

3.2 Install fan coil units level and plumb, in accordance with manufacturer's written instructions.

3.3 Provide isolators and seismic restraints in accordance with Section 230020.

3.4 Arrange installation of fan coil units to provide access space around units for service and maintenance.

3.5 Refrigerant Piping

A. Install refrigerant piping of the sizes shown on the drawing in accordance with manufacturer's recommendations and Section 230150.

1. Refrigerant line sets may be used for refrigerant lines up to and including 5/8 inch diameter.
2. Hard drawn ACR copper piping shall be used for any lines larger than 5/8 inch.
3. See Section 230150, Refrigerant Piping, for tolerances on refrigerant piping slope and level.

B. Charge per manufacturers specifications with R-410A. Do NOT discharge any refrigerant to the atmosphere.

C. Insulate ALL refrigerant piping; both gas and liquid lines. Coat all insulation exposed to sunlight. See Section 230200, Mechanical Insulation.

3.6 Duct installations and connections are specified in other Section 230900, Ductwork. Make final duct connections with flexible connections.

3.7 Connect condensate drain line and route to floor drain or as otherwise indicated on the plans.

3.8 Electrical Connections: The following requirements apply:

A. Electrical power wiring is specified in Division 26.

B. Temperature control wiring and interlock wiring is specified in Section 230960, Temperature Controls or Section 230965 BacNet Temperature Controls.

C. Grounding: Connect unit components to ground in accordance with the National Electrical Code.

3.9 Clean unit cabinet interiors to remove foreign material and construction dirt and dust. Vacuum clean fan wheel and cabinet.

3.10 Refer to Sections 230910, "Start-up, Cleaning and Testing", 230930 "Testing and Balancing" and 230885 “Air Cleaning” for additional requirements.

END OF SECTION 230812
PART 1 - GENERAL

1.1 WORK INCLUDED

A. Furnish all labor, services, material and related items necessary to complete the Furnace and Condensing Unit installation indicated on the drawings and/or specified herein.

B. Furnaces and condensing units shall be by the same manufacturer unless otherwise indicated.

1.2 REFERENCES

B. ARI 270 - Sound Rating of Outdoor Unitary Equipment.
C. ANSI/NFPA 70 National Electrical Code.
E. ANSI/UL 207 - Refrigerant-Containing Components and Accessories, Non-Electrical.
G. ANSI/UL 465 - Central Cooling Air Conditioners.
I. ARI 520 - Positive Displacement Refrigerant Compressors, Compressor Units and Condensing Units.

1.3 RELATED DOCUMENTS

A. All drawings and applicable provisions of Division 0 Bidding Requirements and Division 1 General Requirements apply to work of this Section.
B. Section 230000 - Mechanical General Conditions.
C. Section 230010 - Basic Mechanical Materials and Methods.
D. Section 230020 - Vibration Isolation and Seismic Restraints.
E. Section 230050 - Motors.
F. Section 230110 - HVAC Water Systems Piping.
G. Section 230140 - Natural Gas Piping.
H. Section 230150 - Refrigerant Piping.
I. Section 230850 - Air Cleaning.
J. Section 230900 - Ductwork.
K. Section 230960 - Temperature Controls.

1.4 QUALITY ASSURANCE

A. All units shall be rated and certified as complete units in accordance with ARI Standard 210/240-94 and shall bear the ARI seal. Cooling capacity ratings shall be based on ARI Standard 340/360-93 requirements.

B. Units, and all accessories, shall be listed by Underwriter's Laboratories, Inc. and bear the appropriate UL label.

1.5 SUBMITTALS
A. Submit shop drawings and product data under provisions of Section 230000.
B. Submit shop drawings, product data, manufacturer's installation instructions and operation and maintenance data for manufactured products and assemblies required for this project.
C. Indicate electrical service and duct connections on shop drawings or product data.
D. Include manufacturer's descriptive literature, operating instructions, installation instructions, maintenance and repair data, and parts listing.

1.6 DELIVERY, STORAGE AND HANDLING
A. Deliver products to site and hoist in place.
B. Protect units from physical damage.

1.7 WARRANTY
A. Entire unit shall have a one year warranty as described in section 230000.
B. The compressor shall be warranted an additional four (4) years beyond the first year. The additional four years for the compressor shall be for parts only and shall not include labor.

PART 2 - PRODUCTS

2.1 FURNACE
A. Selection has been based on the manufacturer scheduled to establish the desired type, performance and quality. Equal products, complying with these specifications, by the following manufacturers are equally acceptable:
   1. Carrier
   2. Daikin
   3. Trane
   4. Johnson Controls
   5. Lennox
B. Gas furnaces shall include and/or comply with the following:
   1. Unit shall be a factory fabricated, assembled and tested unit, and shall include all safety and operating controls, wiring, piping, etc. necessary for proper operation.
   2. Horizontal, AGA certified natural gas fired furnace.
   3. Direct vent sealed combustion system with side wall terminations for combustion air and vent pipes.
   4. Pilotless ignition system.
   5. Annual Fuel Utilization Efficiency (AFUE) rating of 93%.
   7. Control transformer.
   8. Thermostat provided by owner / contractor to install, see diagram on drawings.
   9. Multiple speed ECM fan motor with cooling relay.
10. Copper tube, aluminum fin evaporator coil assembly with galvanized drain pan and drain connection. Provide capillary tubes or thermostatic expansion valves for units of 6 tons capacity and less, and thermostatic expansion valves and alternate row circuiting for units 7.5 tons cooling capacity and larger.

11. Provide CPVC condensate drain piping to connect furnace condensate trap to cooling coil drain line.

12. Provide CPVC flue exhaust piping and CPVC intake piping and screened intake and exhaust connections.


1. Refrigerant Coil Enclosure: Steel, matching furnace and evaporator coil, with access panel and flanges for integral mounting at or on furnace cabinet and galvanized sheet metal drain pan coated with black asphaltic base paint.

2. Configuration: Up feed with bottom suction to prevent trapping of oil.

D. Cooling Coil Drain Pans:

1. Provide 20 gage galvanized steel drain pan for cooling coils with soldered corners or cold galvanized coating on corners. Minimum 3 inches deep; extend 3 inches from face of coil entering air side and 6 inches from face of coil leaving air; extend on sides of coil bank to 1 inch beyond the greatest projection of coil headers and tube return.

2. Slope pan to the drain connection at minimum 1/8" per foot in direction of airflow. Accommodation for deflection of pan and pan supports shall be made to prevent condensate from standing in drain pans.

3. Provide one 1-1/2" drain pipe connection.

4. Insulate exterior of drain pan with 3/4" thick closed cell rubber to prevent condensation.

E. Miscellaneous Features

1. Filters - Provide 2" Throwaway Filters. Provide access from side panel for removal. Filter rack shall be field converted to two inch capability with field provided filters.

2. Vibration Isolators: Provide neoprene floor-mounted isolators to reduce transmission of noise and vibration to building structures.

2.2 AIR COOLED CONDENSING UNIT

A. Selection has been based on the manufacturer scheduled to establish the desired type, performance and quality. Equal products, complying with these specifications, by the following manufacturers are equally acceptable:

1. Carrier
2. Daikin
3. Trane
4. York
5. Lennox
B. Air cooled condensing unit shall include and/or comply with the following:

1. Unit shall be a factory fabricated, assembled and tested unit, and shall include all safety and operating controls, wiring, piping, etc., assembled in such a manner that the only field connections required are refrigerant suction, refrigerant liquid, electrical power, and control connections.

2. Casing shall make unit fully weatherproof for outdoor installation. Casing shall be fabricated from galvanized steel and shall have a factory applied baked enamel finish. All edges of the metal shall have the same finish to protect the material from rusting. Openings shall be provided for power and refrigerant connections. Panels shall be removable to provide access for servicing.

3. Condenser coil shall be fabricated from copper tubes with mechanically bonded aluminum fins. Coil shall be circuited for subcooling.

4. Condenser fans shall be direct driven propeller type. Each fan shall have a fan guard. Fan motors shall have inherent protection, shall be resiliently mounted, and shall have permanently lubricated bearings.

5. Refrigerant system shall include a filter drier, suction and liquid line service valves with pressure taps and charging connections.

6. Compressors shall comply with the following:
   a. Shall be the scroll type.
   b. Internal and external vibration isolators.
   c. Compressor shall include a crankcase heater.
   d. Compressor shall include discharge and suction shutoff valves.

7. Condensing unit shall include the following controls:
   a. High head pressure cutout.
   b. Low suction pressure cutout.
   c. Timer to prevent short cycling of compressors.
   d. Condenser fan controls.

8. Condensing units, where indicated on the plans, shall include the following options:
   a. Head pressure controls suitable to allow operation down to 0°F.
   b. Winter start controls to allow compressor start to 0°F ambient.
   c. Liquid line solenoid valve.

9. Condensing unit shall comply with the following standards:
   a. Ratings shall be in compliance with ARI 520.
   c. Wiring shall comply with the National Electrical Code.
   d. Unit shall be ETL or UL listed.
10. Unit wiring shall include:
   a. Field power connection, control interlock terminals and unit control system shall be located in a weatherproof enclosure. Panel access doors shall key lock. Dead-front panels shall be provided on the line voltage side.
   b. Control circuit transformer and fusing.
   c. Positive acting timer to prevent short cycling of compressor (approx. 5 minutes).

11. Condensing unit shall have condenser fans with a vertical discharge.

12. Condenser Coil Hail guard.

13. Condensing unit shall have a minimum SEER rating as shown in the schedule.

2.3 SPLIT SYSTEM HEAT PUMP

A. The contractor shall furnish and install split system heat pumps as shown as scheduled on the contract documents. The unit(s) shall be installed in accordance with this specification and perform at the specified conditions as scheduled.

   1. Trane
   2. Daikin
   3. Carrier
   4. York
   5. Lennox

B. General Unit Description

   1. Provide self-contained, packaged, factory-assembled and pre-wired units suitable for outdoor use consisting of cabinet, compressor(s), condensing coil and fan(s), integral subcooling circuit(s), filter drier(s), and controls. Provide expansion valve(s) and check valves for split system heat pump unit(s).
   2. Performance Ratings: Energy Efficiency Rating (EER) and Coefficient of Performance (COP) not less than prescribed by ANSI/ASHRAE 90A.

C. Casing

   1. House components in 18 gauge zinc-coated galvanized steel frame and panels with weather resistant, baked enamel finish. Units surface shall be tested 500 hours in salt spray test.
   2. Mount controls in weatherproof panel provided with removable panels and/or access doors with quick opening fasteners.

D. Condenser Coils

   1. Aluminum fins mechanically bonded to seamless copper tubing.
   2. Provide subcooling circuit(s).
   3. Factory leak test under water to 450 psig, and vacuum dehydrate. Seal with holding charge of nitrogen.
E. Fans and Motors

1. Vertical discharge direct driven propeller type condenser fans with fan guard on discharge.
2. Fans shall be statically and dynamically balanced.
3. Weatherproof motors suitable for outdoor use, with permanently lubricated totally enclosed or open construction motors shall be provided and shall have built-in current and thermal overload protection.
4. Motors shall be either sleeve or ball bearing type.

F. Compressors

1. Provide direct-drive hermetic, reciprocating type compressor(s) with centrifugal oil pump providing positive lubrication to moving parts and automotive type pistons, rings to prevent gas leakage, internal suction and discharge valves, and crankcase heater.
3. External high and low pressure cutout devices shall be provided.
4. Reversing valve.
5. Suction line accumulator.
6. Discharge muffler.
7. Flow control check valve.
8. Solid-state defrost control utilizing thermistors.

G. Controls

1. Provide factory-wired heat pump units with 24 volt control circuit with internal fusing and control transformers, contactor pressure lugs and/or terminal block for power wiring.
2. Contractor to provide field installed unit mounted disconnect switch.
3. Units shall have single point power connections.
4. Provide 24-volt, either 5 or 7 minute fixed-off timer that will prevent compressor short cycling upon shutdown.
5. Factory installed evaporator defrost control to prevent compressor slugging by interrupting compressor operation when low evaporator coil temperatures are encountered.
6. Thermostats: Provide by owner, see schematic on drawings.

H. Miscellaneous Features

2. Low Ambient Control: Electronic head pressure control that allows operation to 0 degree F outdoor ambient.
3. Condenser Coil Hail guard.

PART 3 - EXECUTION

3.1 INSTALLATION OF FURNACE
A. Install units, where indicated on drawings, in accordance with manufacturer's published installation instructions, with recommended clearances provided for service and maintenance.

B. Support units as described below, using the vibration control devices indicated.

   1. Support floor-mounted units on floor using vibration isolators as scheduled. Secure units to provide sufficient height for trap installation and proper drainage.

   2. Suspended Units: Units shall be suspended from structure using threaded steel rods, double nuts with lockwashers, and vibration isolators. Provide sway bracing in accordance with requirements of section 230020.

C. Connect ductwork with a flexible connector and connect condensate drain line. Route condensate drain to floor drain.

D. Provide secondary drain pan under the entire unit and cooling coil, see details on the plans.

E. Arrange installation of units to provide access space around air-handling units for service and maintenance.

F. Replace filters with new filters before air balance for any units that have been operated during construction.

G. Install intake and exhaust piping to sealed combustion chamber.

H. Connect natural gas piping, ductwork and condensate drain line. Route Install drain piping from the sealed combustion chamber to a sanitary drain.

I. Install drain piping from the sealed combustion chamber to a sanitary drain. Provide a JJM Boiler Works, JM series, condensate neutralization tube in the line between the furnace and the sanitary drain.

J. Mounting for the furnace shall be able to withstand 50 lb lateral force.

3.2 INSTALLATION OF CONDENSING UNITS

A. Install units, where indicated on drawings, in accordance with manufacturer's published installation instructions, with recommended clearances provided for service and maintenance.

B. Condensing units shall be located on concrete pad provided by this contractor.

3.3 REFRIGERANT PIPING

A. Install refrigerant piping of the sizes shown on the drawing in accordance with manufacturer's recommendations and Section 230150.

B. Charge per manufacturers specifications with R-410a. Do NOT discharge any refrigerant to the atmosphere.

C. Insulate suction piping.

3.4 ELECTRICAL CONNECTIONS: THE FOLLOWING REQUIREMENTS APPLY:
A. Electrical power wiring is specified in Division 26.

B. Temperature control wiring and interlock wiring is specified in Section 230960, Temperature Controls.

END OF SECTION 230850
SECTION 230900 – AIR DISTRIBUTION

PART 1 - GENERAL

1.1 DESCRIPTION

A. This section includes rectangular and round metal ducts and plenums for heating, ventilating, and air conditioning systems in pressure classes from minus 2 inches to plus 10 inches water gauge.

B. Furnish all labor, services, material and related items necessary to complete the ductwork installation indicated on the drawings and specified herein.

1.2 RELATED DOCUMENTS

A. All drawings and applicable provisions of Division 0 Bidding Requirements and Division 1 General Requirements apply to work of this Section.

B. Section 230000 - Mechanical General Conditions.

C. Section 230010 - Basic Materials and Methods.

D. Section 230020 - Vibration Isolation and Seismic Restraints.

E. Section 230200 - Mechanical Insulation - external duct insulation.

F. Section 230930 - Testing and Balancing.

G. Section 230960 - Temperature Controls - motorized dampers.

H. Section 260720 or 260721, Fire Alarm System - Smoke Detectors.

1.3 REFERENCES

A. The publications listed below form a part of this specification to the extent referenced. The publications are referenced in the text by the basic designation only. Latest edition shall apply unless otherwise indicated.

B. AMCA 500 - Test Method and Louvers, Dampers and Shutters.

C. ASTM A 36 - Carbon Structural Steel.

D. ASTM A 167 - Stainless and Heat-Resisting Chromium-Nickel Steel Plate, Sheet and Strip.


F. ASTM A 480 - General Requirements for Flat-Rolled Stainless Steel, Sheet and Strip.

G. ASTM A 525 - General Requirements for Steel Sheet, Zinc-Coated (Galvanized) by the Hot-Dip Process.

H. ASTM A 527 - Steel Sheet, Zinc-Coated (Galvanized) by Hot-Dip Process, Lock Forming Quality.

I. ASTM A 568 - Steel, Sheet, Carbon, and High-Strength, Low-Alloy, Hot-Rolled and Cold-Rolled.

J. ASTM A 569 - Steel, Carbon (0.15 Maximum, Percent), Hot-Rolled Sheet and Strip, Commercial Quality.


M. AWS D9.1 - Welding of Sheet Metal.

N. NFPA 90A - Installation of Air Conditioning and Ventilating Systems.


T. UL 555 - Standard for Fire Dampers.

1.4 SUBMITTALS

A. General: Submit the following in accordance with Section 230000.

B. Product data including materials, details of construction, dimensions of individual components, profiles, manufacturer's installation instructions, and finishes for the following items:

1. Air Devices: Submit schedule of outlets and inlets indicating type, size, accessories, finish/color, type of mounting, air performance, static pressure drop, throw, and noise level.
2. Duct Liner
3. Sealant and Gasket Materials
4. Fire-Stopping Materials
5. Flexible ducts and clamps, with manufacturer's installation instructions
6. Flexible Connectors
7. Fire Dampers and Sleeves
8. Backdraft Dampers
9. Balance Dampers
10. Access Doors
11. Louvers

C. Shop drawings for duct fabrication, drawn to a scale not smaller than 1/8 inch equals 1 foot, on drawing sheets same size as the Contract Drawings, detailing:

1. Schedules of duct systems, materials and selected SMACNA construction alternatives for joints, gage and reinforcement.
2. Fabrication, assembly, and installation details. Include plans, details of components, and attachments to other work.
3. Duct layout, and sizes in plan view.
4. Fittings, turning vanes and vane attachments to elbows.
5. Reinforcing details and spacing.
7. Penetrations through fire-rated and other partitions.
8. Terminal unit installations.
9. Hangers and supports, including methods for building attachment, vibration isolation, and duct attachment.
10. Location and details for seismic restraints.
D. Ductwork Reinforcement Information: Submit information on the duct reinforcement to be used for each section of duct. Information shall include copies of tables from SMACNA construction standards highlighting the actual duct sizes, pressure class, material, gauge, reinforcement type and spacing, joint type and spacing, applied loads, and hanger type and spacing. When alternate methods of sizing are used as provided by SMACNA, provide calculations to support the reinforcement selection.

E. Proposed deviations of materials and methods from these specifications require approved submittal information prior to any construction. Submittals should clearly note that the submittals is for a change to the specifications and identify the applicable paragraph from this specification. Submittals shall include physical descriptions and results of testing and analysis to support the equal performance of the substituted items. Testing and analysis shall follow the guidelines for “Functional Criteria” from SMACNA standards.

F. Record drawings indicating duct actual routing in accordance with Section 230000.

G. Duct leakage testing confirming compliance with tests required for ducts over 2 inches WG pressure class.

1.5 QUALITY ASSURANCE

A. Perform Work in accordance with SMACNA 2005 - HVAC Duct Construction Standards - Metal and Flexible.

B. Manufacturer Qualifications: Company specializing in manufacturing Products specified with minimum 5 years documented experience.

C. Installer Qualifications: Company specializing in performing the Work of this Section with minimum 5 years documented experience.

D. Regulatory Requirements: Construct ductwork to NFPA 90A and NFPA 96 standards.

E. Duct Sealing, Air Leakage Criteria, and Air Leakage Tests:
   1. All ducts over 2 inches WG pressure class shall meet requirements of seal class A in Section 1 of SMACNA HVAC Air Duct Leakage Test Manual.
   2. All ducts 2 inches w.g. pressure class or less shall meet requirements of seal class C.

1.6 DELIVERY, STORAGE AND HANDLING

A. Section 016000 - Product Requirements: Transport, handle, store, and protect Products.

B. Protect dampers from damage to operating linkages and blades.

C. Deliver sealant and fire-stopping materials to site in original unopened containers or bundles with labels informing about manufacturer, product name and designation, color, expiration period for use, pot life, curing time, and mixing instructions for multi-component materials.
D. Store and handle sealant and fire-stopping materials in compliance with manufacturer’s recommendations to prevent their deterioration or damage due to moisture, high or low temperatures, contaminants, or other causes.

1.7 Sheet metal work as shown on plans is schematic and is based on the specified manufacturer’s equipment and material dimensions. Contractor shall make accurate measurements in the field prior to duct work fabrication and shall provide all necessary offsets and transition pieces required to accommodate actual structural and equipment variations.

1.8 The duct system design, as indicated, has been used to select and size air moving and distribution equipment and other components of the air system. Changes or alterations to the layout or configuration of the duct system must be specifically approved in writing to the Engineer.

1.9 At contractor’s option, round duct may be substituted for rectangular construction and vice versa. Equivalent round duct sizes shall be in accordance with ASHRAE Fundamentals 2009, chapter 21, Table 2. Contractor shall be responsible for coordination with other trades and any subsequent costs incurred by others for substituting round and rectangular ductwork.

1.10 Rectangular sheet metal duct dimensions are free area dimensions. For those ducts with internal liner, the duct dimensions must be increased to include the liner. Bottom of duct elevations, where indicated, are to the bottom of duct reinforcing angles or other components.

1.11 Rectangular duct dimensions are sheet metal dimensions. For those ducts with internal liner, the duct dimensions include the liner.

1.12 Round duct dimensions are inside, free area dimensions.

1.13 The work shall be coordinated with that of other trades in such a manner that when the installation is complete, all items are properly installed and are serviceable.

1.14 Static Pressure Classifications: Except where otherwise indicated, construct duct systems to the following pressure classifications:

A. Ducts for non VAV systems: 2 inches water gauge.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Supply, return, outside air, and relief air ductwork for HVAC systems, Exhaust ductwork (except where otherwise indicated below), and Supply ductwork to kitchen hood systems shall be constructed of:

2. Provide mill phosphatized finish for ducts exposed to view that are to be painted.
3. Reinforcement, Support, Hanger, and Trapeze Shapes and Plates:
a. ASTM A 36/A 36M, steel plates, shapes, and bars. Unless otherwise indicated, provide galvanized finish of fabricated plates, shapes, and bars or provide fabricated plates, shapes, and bars of the same material as the sheet metal ducts.

b. Strut-Channels: Duct reinforcements, supports, and trapeze hangers may alternatively be a bolted metal framing system equal to B-Line. The system shall be channels, fittings and hardware as defined and tested in accordance with the Metal Framing Manufacturers Association Standard Publication MFMA.

1) Channels shall be hot dip galvanized after fabrication and made from steel meeting ASTM A570, Grade 33. Hot dip galvanizing after fabrication shall be in accordance with ASTM A123.

c. Where the galvanic index of the reinforcements, supports, hangers, or trapeze and the duct materials is greater than 0.15 volts (galvanized-steel plates, shapes, bars, or struts are used to reinforce aluminum or stainless steel ducts), isolate the different metals with butyl rubber, neoprene, or EPDM gasket materials.

B. All materials used shall meet the requirements of NFPA 90A and UL 181 for Class I air ductwork.

C. Minimum Sheet Metal Gauges for Ductwork:

1. Rectangular ductwork shall be fabricated from the following minimum thicknesses, regardless of duct construction methods, for sizes indicated:

<table>
<thead>
<tr>
<th>Max. Long Side Dimension</th>
<th>Steel Gauge</th>
</tr>
</thead>
<tbody>
<tr>
<td>0-12 inches</td>
<td>26</td>
</tr>
<tr>
<td>13-30 inches</td>
<td>24</td>
</tr>
<tr>
<td>31-54 inches</td>
<td>22</td>
</tr>
<tr>
<td>55-84 inches</td>
<td>20</td>
</tr>
<tr>
<td>85 inches and above</td>
<td>18</td>
</tr>
</tbody>
</table>

2. Round ductwork shall be fabricated from the following minimum gauges for sizes indicated: (Round ductwork shall not be allowed for ducts over 84").

<table>
<thead>
<tr>
<th>Max. Long Side Dimension</th>
<th>Steel Gauge</th>
</tr>
</thead>
<tbody>
<tr>
<td>2-12 inches</td>
<td>26</td>
</tr>
<tr>
<td>13-21 inches</td>
<td>24</td>
</tr>
<tr>
<td>22-35 inches</td>
<td>22</td>
</tr>
<tr>
<td>36-49 inches</td>
<td>20</td>
</tr>
<tr>
<td>50-59 inches</td>
<td>18</td>
</tr>
<tr>
<td>60-84 inches</td>
<td>16</td>
</tr>
</tbody>
</table>

3. Minimum gauges for stainless steel shall be the same as listed for steel.

4. Minimum thickness and reinforcement for aluminum shall be as indicated in SMACNA 2005 Table 2-50, 2-51 and 2-52 for rectangular - ducts and 3-14, 2-51, and 2-52 for round ducts.
D. Sealants:

1. Joint and Seam Sealant: One-part, nonsag, water based, vinyl acrylic sealant complying with ASTM C-731 and D-2202, rated for indoor and outdoor use, viscosity greater than 350,000 c.p.s, rated per ASTM E-84 with flame spread and smoke developed ratings of 0, formulated with a minimum of 63 percent solids. Carlisle - Hardcast Iron Grip IG-601 or equal. (Water based with VOC=75 g/l)

2. Flanged Joint Gaskets: Butyl rubber, neoprene, or EPDM polymer with polyisobutylene plasticizer. Rated per ASTM E-84 with maximum flame spread and smoke developed ratings of 10. Ductmate 5511M for attaching flanges to ducts, Ductmate 440 tape for flange to flange joints, or approved equal.

3. Isolation Gaskets: Butyl rubber, neoprene, silicone rubber, or EPDM polymer with polyisobutylene plasticizer. Rated per ASTM E-84 with maximum flame spread and smoke developed ratings of 10.

4. Slip On Flange Joint Mastic: Non-drying, non-skinning, polymer base, pumpable sealant. ASTM E-84 with maximum flame spread and smoke developed ratings of 5. Ductmate 5511M for attaching slip on flanges to ducts or approved equal.

5. Fire-Resistant Sealants for filling openings around duct penetrations through walls and floors shall be as specified in Section 230010, Basic Mechanical Materials and Methods.

6. General Sealant: One-part, acid-curing, Silicone, elastomeric joint sealant, complying with ASTM C 920, Type S (single component), Grade NS (nonsag), Class 25, Use O. Provide one of the following:
   a. Chem-Calk 1200; Bostik Inc.
   b. 999-A; Dow Corning.
   c. Construction 1200 or Contractors SCS1000 or SCS1702F; GE Silicones.
   d. HiFlex 392 or NuFlex 302; NUCO Industries, Inc.
   e. HM 270; Ohio Sealants, Inc.
   f. 860 or 863; Pecora Corporation.
   g. Tremsil 300; Tremco.

E. Acoustical Joint Sealants:

1. Applications: Seal joints in drywall sound enclosures as indicated on the sound enclosure details.

2. Acoustical Sealant for Exposed and Concealed Joints: Provide manufacturer's standard nonsag, paintable, nonstaining latex sealant complying with ASTM C 834. Product shall effectively reduce airborne sound transmission through perimeter joints and openings in building construction as demonstrated by testing representative assemblies according to ASTM E 90. Products: Provide one of the following:
   a. AC-20 FTR Acoustical and Insulation Sealant; Pecora Corporation.
   b. BA-98; Pecora Corporation.

3. Acoustical Sealant for Concealed Joints: For each product of this description indicated in the Acoustical Joint-Sealant Schedule at the end of Part 3, provide manufacturer's standard, nondrying, nonhardening, nonskinning, nonstaining, gunnable, synthetic-
rubber sealant recommended for sealing interior concealed joints to reduce airborne sound transmission. Provide one of the following:

a. SHEETROCK Acoustical Sealant; USG Corp., United States Gypsum Co.
b. Pro-Series SC-170 Rubber Base Sound Sealant; Ohio Sealants, Inc.
c. Tremco Acoustical Sealant; Tremco.

2.2 SINGLE WALL RECTANGULAR DUCT FABRICATION

A. Fabricate rectangular ducts in accordance with SMACNA 2005 Tables 2-1 through 2-48, including their associated details, and the Model Specifications shown in SMACNA 2005, except where this specification requires otherwise. Conform to the requirements in the referenced standard for metal thickness (except comply with minimum gages show above), reinforcing types and intervals, tie rod applications, and joint types and intervals.

B. All reinforcements between transverse joints for duct dimension greater than 36 inches shall extend past the edge of the duct and be secured with an approved tie rod or tie angle as generally shown in SMACNA 2005 Figure 2-12 for "tie alternatives for two side reinforcements".

C. All longitudinal seams shall be made with a Pittsburgh lock or a grooved seam. Fabricate transverse joints for all ducts with height or width 48 inches or greater with T-24, T-25, or Ductmate duct connections (or approved equal).

D. Fabricate rectangular ducts in lengths appropriate to reinforcement and rigidity class required for pressure classification.

E. Where Ductmate (or equal) joints are used, they shall be rated as reinforcing class “F” for Ductmate 25, reinforcing class “G” for Ductmate 35, or reinforcing class “H” for Ductmate 45 and integrated with the requirements of SMACNA Tables 2-1 through 2-28. Similar tables from Ductmate Industries shall not be substituted for the SMACNA 2005 tables. Ductmate joints shall be installed in compliance with the manufacturer’s recommendations.

F. Provide materials that are free from visual imperfections such as pitting, seam marks, roller marks, stains, and discolorations.

G. Crossbreaking or Cross Beading: Crossbreak or bead duct sides that are 19 inches and larger and are 20 gauge or less, with more than 10 sq. ft. of unbraced panel area, as indicated in SMACNA 2005 Figure 2-9, unless they are lined or are externally insulated.

H. Tie Rods:

1. Internal tie rods shall be allowed for ducts 36" wide and wider. Midpanel tie rods shall be allowed for ducts 36" wide through 96" wide.

a. Internal tie rods and midpanel ties shall not be allowed:

   1) Within 20 feet of a fan discharge or fan inlet.
   2) In kitchen hood exhaust ducts.
   3) In Fume exhaust ducts.
4) In underground, in-slab, or under slab ducts.
5) In fittings with non-parallel sides unless they have load distributing means such as wedges.
6) In ducts with duct liner.
7) For oval ducts, aluminum ducts or polyvinyl coated steel ducts, unless otherwise noted on the drawings.

2. The maximum internal tie rod diameter shall be 3/4"; straps used for tie rods shall be maximum 1/8" thick and shall be installed with the thickness facing the air flow; angles or other structural shapes shall not be used for internal tie rods. Tie rods shall be attached to ducts in accordance with SMACNA 2005, Figures 2-5 and 2-6.

3. Threaded inserts placed in pipes, tubes and conduits shall be secure for 200% of the loads indicated in SMACNA 2005, Table 2-34.

4. Where internal ties occur in two directions, they shall be either prevented from contacting or be permanently fastened together.

I. Singular Wall Rectangular Duct Fittings:

1. Fabricate elbows, transitions, offsets, branch connections, and other duct construction in accordance with SMACNA 2005 Figures 4-1 through 4-9 and 7-1 through 7-4.

2. All rectangular duct elbows shall be radiused in accordance with SMACNA Figure 4.2 type RE-1 (centerline radius equal to 1.5 x W) unless otherwise indicated.

   a. Other Fitting Types:

      1) Provide radius elbows with vanes, Figure 4.2 Type RE-3, where indicated and in accordance with details shown; minimum inner radius shall be equal to 0.5 x W unless otherwise shown; two (2) or three (3) internal vanes shall be provided as indicated on the drawings per Figure 4-9 and spaced per Chart 4-1.

      2) Rectangular square throat duct elbows shall be provided only where indicated and shall:

         a) Provide single thickness, 4.5" radius turning vanes for vane lengths up to 36 inches and double thickness, 4.5" radius turning vanes for vane lengths over 36 inches, in accordance with SMACNA Figure 4-2 Type RE-2 and Figure 4.3. Spot weld vanes to end runners and screw runners to elbow cheeks with screws on 8 inch centers. Support vanes per SMACNA Figure 4-4.

2.3 SINGLE WALL ROUND DUCT FABRICATION

A. Round ductwork shall be spiral lockseam construction as detailed in Fig. 3-1 of SMACNA 2005, unless otherwise indicated, and shall comply with minimum gauges indicated above and be reinforced per SMACNA 2005 Tables 3-5 through 3-13 for the pressure ratings indicated.
B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Lindab Inc.
2. McGill AirFlow LLC.
3. SEMCO Incorporated.
4. an approved local fabricator.

C. Except where interrupted by fittings, provide round ducts in lengths not less than 12 feet.

D. Transverse joints shall be beaded sleeve joints (type RT-1) as detailed in Fig. 3-1 of SMACNA 2005; vanstone flanges (type RT-2); welded, companion angle flanges (type RT-2A); or slip on flanges.
   1. Type RT-1 joints shall be secured with sheet metal screws as described in Fig. 3-1. Seal with joint and seam sealant.
   2. Type RT-1 joints shall be fabricated with factory installed EDPM O-ring seals mechanically fastened to factory-fabricated couplings and fittings. Seals shall be single or double lipped. Single lipped seals shall be sealed with joint and seam sealant after installation to achieve a leakage rate of SMACNA seal class rating of 3 cfm/100 sq. ft.
   3. Type RT-2 joints (vanstone angles) shall have a minimum 3/8" flange on the duct with a continuous, rolled, back up angle. Provide a 3/16" thick Flanged Joint Gasket between the flanges.
   4. Type RT-2A joints (companion angle) shall have a continuous weld at the end juncture of the duct and the flange and shall have tack welds on 8" centers at the back leg of the angle flange. Provide a 3/16" thick Flanged Joint Gasket between the flanges.
   5. Slip on flanges shall be Ductmate Econoflange, Semco Accuflange, or approved equal and shall only be used withing their ratings. Provide a 3/16" thick Flanged Joint Gasket between the flanges and apply Slip on Flange Joint Mastic.

E. Attach reinforcing angles as detailed in Fig. 3-1-RT-2A of SMACNA 2005. Reinforcing rings and companion flange joints shall be as indicated in Tables 3-2, 3-3, and 3-4.

F. Branch connections shall be made with 90° conical and 45° straight taps as shown on the drawings. All branch connections for new ducts shall be made as a separate fitting; saddle taps may be used for fittings that are added to existing ducts.
   1. Where saddle taps are installed on existing ducts, the opening in the main duct shall closely match the saddle tap inlet opening. The entrance to the saddle tap shall have no excess material projecting into branch tap entrance. No burrs or rough welds will be allowed.
   2. The saddle tap shall be attached to the main duct with welds or screws on 3" centers maximum and the joint shall be sealed.

G. Runouts to Air Devices:
   1. In lieu of spiral lockseam construction, runouts may be fabricated with snaplock longitudinal joints (type RL-8) as detailed in Fig. 3-1 of SMACNA 2005. Transverse joints
shall be either beaded sleeve joints (type RT-1) or crimp joints (type RT-5) as detailed in Fig. 3-1 and secured with sheet metal screws as indicated in the SMACNA details.

2. Elbows for Runouts to Air Devices: Adjustable (Gored) Elbows may be used for supply ducts only at maximum 2 inch pressure class, minimum 4 piece construction, and maximum 18" diameter.

3. Seal all joints. Fabricate with minimum 24 gauge galvanized steel.

H. Round Duct Fitting Fabrication:

1. Ductwork and fittings shall be by the same manufacturer.

2. Circumferential and longitudinal seams of all fittings shall be a continuous weld. All welds shall be painted to prevent corrosion.

3. 90-degree Tees and Laterals and Conical Tees: Fabricate to conform to SMACNA 2005 Figures 3-5 and 3-6 and with metal thicknesses specified for longitudinal seam straight duct. Where bullhead tees are provided, they shall be Semco type BHT, BHT-1R, or BHT-2R with turning vanes or approved equal.

4. Diverging-Flow Fittings: Fabricate with entrance to branch taps with no excess material projecting from the body onto branch tap entrance. No burrs or rough welds will be allowed.

5. Elbows: Fabricate with die-formed, pleated, segmented (welded) or adjustable gore construction. Fabricate the bend radius of die-formed, segmented and pleated elbows 1.5 times the elbow diameter. Fabricate the bend radius of adjustable gore elbows 1.0 times the elbow diameter. Unless elbow construction type is indicated, provide elbows meeting the following requirements.

a. Segmented Elbows:

1) Fabricate mitered elbows with continuous welded construction in gauges specified below.

2) Elbows Radius and Number of Pieces: Unless otherwise indicated, construct elbow to comply with SMACNA 2005 Table 3-1.

3) Elbows - Gauges: Provide minimum metal thickness listed below for pressure classes shown:

<table>
<thead>
<tr>
<th>Pressure Class Range Size</th>
<th>-2 to 2”</th>
<th>2” to 10”</th>
</tr>
</thead>
<tbody>
<tr>
<td>3 to 14 inches</td>
<td>24 gauge</td>
<td>24 gauge</td>
</tr>
<tr>
<td>15 to 26 inches</td>
<td>24 gauge</td>
<td>22 gauge</td>
</tr>
<tr>
<td>27 to 36 inches</td>
<td>22 gauge</td>
<td>20 gauge</td>
</tr>
<tr>
<td>37 to 50 inches</td>
<td>20 gauge</td>
<td>20 gauge</td>
</tr>
<tr>
<td>52 to 60 inches</td>
<td>18 gauge</td>
<td>18 gauge</td>
</tr>
<tr>
<td>62 to 84 inches</td>
<td>16 gauge</td>
<td>16 gauge</td>
</tr>
</tbody>
</table>

b. 90-Degree, 2-Piece, Mitered Elbows: Use only for supply systems, or exhaust systems for material handling classes A and B; and only where space restrictions do not permit the use of 1.5 bend radius elbows. Fabricate with single-thickness turning vanes. Equal to Semco model 902V. Elbows shall have a minimum number of vanes in accordance with the following:
c. For supply duct runouts to air devices only at maximum 2 inch pressure class, 24 gauge galvanized steel, Adjustable (Gored) Elbows with minimum 4 piece construction, and maximum 18" diameter may be used. Seal all joints.

d. For Pressure Class above 2 inch.

1) Round Elbows - 8 Inches and smaller shall be die-formed elbows for 45-and 90-degree elbows and pleated elbows for 30, 45, 60, and 90 degrees only. Fabricate nonstandard bend angle configurations or 1/2-inch-diameter (e.g. 3½ and 4½ inch) elbows with segmented construction. Die-Formed Elbows shall be 20 gauge with 2-piece continuous welded construction. Pleated Elbows shall be 26 gauge.

2) Round Elbows - 9 Through 14 Inches shall be segmented or pleated elbows for 30, 45, 60, and 90 degrees, except where space restrictions require a 2 piece mitered elbow. Fabricate nonstandard bend angle configurations or ½ inch-diameter (e.g. 9½ and 10½ inch) elbows with gored construction. Pleated Elbows shall be 26 gauge. Segmented elbows shall be as indicated in the next paragraph.

3) Round Elbows - 9 inches and Larger shall be segmented elbows with continuous welded construction, except where space restrictions require a 2 piece mitered elbow.

6. Couplings: Slip-joint construction per SMACNA 2005 Figure 3-2, detail RT-1 with a minimum of a 2-inch insertion length.

7. PVC-Coated Elbows and Fittings: Fabricate elbows and fittings as follows:

a. Round Elbows 4 to 8 Inches in Diameter: Two piece, die stamped, with longitudinal seams spot welded, bonded, and painted with a PVC aerosol spray.

b. Round Elbows 9 to 26 Inches in Diameter: Standing seam construction.

c. Round Elbows 28 to 60 Inches in Diameter: Standard gore construction riveted and bonded.

d. Other Fittings: Riveted and bonded joints.

e. Couplings: Slip-joint construction with a minimum 2-inch insertion length.

2.4 HANGERS AND SUPPORTS

A. Building Attachments: Concrete inserts, powder actuated fasteners, or structural steel fasteners appropriate for building materials and local authority having jurisdiction.

1. Powder actuated fasteners shall not be allowed where the piping, ductwork or equipment is required to meet seismic bracing requirements in Section 230020 or the Building Code and unless the powder actuated fasteners are rated for these seismic
loads. Powder actuated fasteners shall not be allowed in tension applications for Seismic Design Category D, E or F (as defined by the International Building Code).

2. Do not use powder actuated concrete fasteners unless approved by the Engineer in writing.

B. Hangers and support components shall be factory fabricated of materials, design, and manufacturer complying with MSS SP-58 and MSS SP-69 except as modified herein.

C. Upper attachments shall be as indicated in SMACNA 2005 Figures 5-1 through 5-4.

1. C-Clamps: Type 19 and 23 C-clamps shall be torqued per MSS SP-69 and have both locknuts and retaining devices, furnished by the manufacturer. Field-fabricated C-clamp bodies or retaining devices are not acceptable.

2. Structural Attachments shall be B-Line, Unistrut, Grinnel, or approved equal:

   - Beam clamps: B 3031, B 3033, B 3034, B 3050, B 3045
   - Angle Iron Beam Clamp: B 3046
   - Bar Joist: B 3059
   - Concrete Inserts: B 3500, B 2505 thru 2508, or B 3014
   - Drilled Inserts: Phillips Red-head, wedge anchors or equal.

D. Hangers:

1. Strap and band hangers shall be fabricated of the same material as the sheet metal ducts.

2. Hanger sizes shall be as indicated in SMACNA 2005 Tables 5-1 and 5-2 for sheet steel width and gauge and steel rod diameters.

3. Rod hangers shall be fabricated of round, cadmium-plated threaded steel rods and nuts.
   a. Rod hangers Installed in Corrosive Atmospheres: Electro-galvanized, all-thread rod or hot-dipped-galvanized rods with threads painted after installation.
   b. Hanger rods shall be threaded both ends, threaded one end, or continuously threaded.

E. Lower Attachments:

1. Duct attachments shall be sheet metal screws, blind rivets, or self-tapping metal screws; compatible with duct materials.

2. Lower attachment shall be as indicated in SMACNA 2005 Figure 5-5.

F. Trapeze and Riser Supports:

1. Trapeze sizes shall be as indicated in SMACNA 2005 Tables 5-3 and 5-4 and Figure 5-6 and 5-8 through 5-10.

2. Where trapeze or riser supports are a different material than the sheet metal duct, a minimum 1/16 inch thick isolation gasket shall be provided between the duct and the support.

2.5 FLEXIBLE ROUND DUCT
A. Low Pressure Flexible duct shall be UL 181, Class 1, black polymer film supported by helically wound, spring-steel wire coated to prevent corrosion; fiberglass insulation; and fiberglass reinforced aluminized vapor-barrier film and shall be used for systems up to 2" static pressure class.

1. Insulated, Flexible Duct: round duct shall be Thermaflex M-KM or by Flexmaster, Flexible Technologies, ATCO, or Quietflex.
2. Factory installed insulation shall be min. 3/4 pound density 1-1/2" thick, minimum R-4.2.
3. Exterior vapor barrier shall have maximum vapor barrier permeance of 0.05 perm per ASTM Method E96, Procedure A
4. Pressure Rating: 4-inch wg positive and 0.5-inch wg negative.
5. Rated Air Velocity (or higher): 4000 fpm.
6. Temperature Range: Minus 20 to plus 175 deg F.

2.6 FLEXIBLE CONNECTORS

A. Flexible connectors installed inside the building shall be heavy glass fabric, double coated with neoprene, of approximately 30 oz. per square yard, provided with 3" wide, 24 ga. metal mounting strips firmly attached to each edge. Connectors shall be suitable for pressure class of the air handling system. Flexible connectors shall be "Ventfab" by Ventfabrics, Inc. or equal.

B. Flexible connectors installed outside the building shall be heavy glass fabric, double coated with neoprene, of approximately 26 oz. per square yard, provided with 3" wide, 24 ga. metal mounting strips firmly attached to each edge. Connectors shall be suitable for pressure class of the air handling system. Flexible connectors shall Ventlong Hypalon by Ventfabrics, Inc. or equal.

2.7 DUCT LINER - Not allowed

2.8 External Duct Insulation: See Section 230200 - Mechanical Insulation.

2.9 AIR DEVICES

A. Model numbers for air devices are given in the Air Device Schedule. The model numbers and manufacturers listed are given to establish the desired style, quality, and performance. Products by the following manufacturers, equal to those scheduled and complying with these specifications, are equally acceptable.

1. Titus
2. Krueger
3. Nailor
4. Price
5. Tuttle & Bailey
6. Metal Aire

B. Diffuser and return air grille sizes given on the plans are neck sizes. Grille sizes are core sizes.

C. Air devices shall have an NC rating of NC30 or less at specified CFM.
D. Air devices shall be sized to match the ceiling grid. Furnish air devices for either regular grid ceilings or for narrow grid ceilings or for both types of grid; coordinate with the architectural reflected ceiling plans.

E. Air device finishes shall be as follows:
   1. Ceiling mounted - Flat White
   2. Wall mounted - Flat White, verify with Architect
   3. Floor mounted - Shall be coordinated with Architect
   4. Duct mounted - Light grey prime coat on steel materials and natural non-oxidizing finish on aluminum
   5. Opposed blade dampers - Black
   6. Other as called for in the Schedule

F. A sponge rubber gasket shall be provided on back side edge of all mounting frames to provide a snug tight fit to construction surfaces.

G. Where round ductwork is used, provide a square-to-round adapter with the air device.

2.10 CEILING RADIATION DAMPERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following.

B. Basis-of-Design Product: Subject to compliance with requirements, provide Titus or comparable product by one of the following:
   1. Air Balance Inc.; a division of Mestek, Inc.
   2. Nailor Industries Inc.
   3. Pottorff.
   4. Ruskin Company.

C. General Requirements:
   1. Labeled according to UL 555C by an NRTL.
   2. Comply with construction details for tested floor- and roof-ceiling assemblies as indicated in UL's "Fire Resistance Directory."

D. Frame: Galvanized sheet steel, round or rectangular, style to suit ceiling construction.

E. Blades: Galvanized sheet steel with refractory insulation.

F. Heat-Responsive Device: Replaceable, 212 deg F (100 deg C) rated, fusible links.

G. Fire Rating: 2 hours.

2.11 FIRE DAMPERS

A. General
1. Fire dampers in ducts connected to a fan shall be the UL labeled, dynamic rated fire dampers unless otherwise indicated on the plans. Fire dampers in transfer ducts not connected to a fan shall be the UL labeled, static rated fire dampers unless otherwise indicated on the plans. Dampers shall be the curtain type, except where the size is too large they shall be multi-blade type, unless otherwise indicated on the drawings.

2. Fire dampers shall be constructed and tested in accordance with UL Standard 555. Each damper shall have a 165 degrees F fusible link (see plans for dampers with link rating of 212 or 280 degrees F).

3. Dampers shall have Ductmate breakaway connections where either the height or width of the connecting duct is 48" or greater.

4. When the wall or floor opening exceeds the dampers maximum UL listed multiple section assembly size, provide mullions manufactured by the damper manufacturer where so approved by their UL rating.

5. Provide factory installed sleeves for fire dampers. Sleeves shall be the same thickness as the adjacent duct, or the minimum thickness required by governing code, but not less than the following:

<table>
<thead>
<tr>
<th>Max. Long Side of Duct or Diameter</th>
<th>Steel Gauge</th>
</tr>
</thead>
<tbody>
<tr>
<td>0-12 inches</td>
<td>26</td>
</tr>
<tr>
<td>13-30 inches</td>
<td>24</td>
</tr>
<tr>
<td>31-54 inches</td>
<td>22</td>
</tr>
<tr>
<td>55-84 inches</td>
<td>20</td>
</tr>
<tr>
<td>85 inches and above</td>
<td>18</td>
</tr>
</tbody>
</table>

6. Provide access doors to allow resetting of fire damper and replacement of the link.

7. Fire dampers shall be manufactured by Ruskin, Air Balance, Pacific, Phillips, Prefco, Nailor, Greenheck, or Airstream.

B. Curtain Type Fire Dampers

1. Curtain type fire dampers shall be type B (type C for round ducts) unless otherwise indicated on the drawings.

2. Curtain type dampers shall be gravity operated for vertical installations; dampers in a horizontal position shall have stainless steel closure spring and blade lock. Fire dampers shall be equipped for vertical or horizontal installation as required by the location indicated.

3. Curtain type fire damper pressure drop shall not exceed the following:

<table>
<thead>
<tr>
<th>VEL (FPM)</th>
<th>P.D. (W.C.)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1000</td>
<td>0.01</td>
</tr>
<tr>
<td>1500</td>
<td>0.015</td>
</tr>
<tr>
<td>2000</td>
<td>0.07</td>
</tr>
<tr>
<td>3000</td>
<td>0.15</td>
</tr>
</tbody>
</table>
C. Multi Blade Fire Dampers

1. Type A (type C for round ducts) unless otherwise indicated on the drawings.
2. Stainless steel closure spring and blade lock.
3. Equipped for vertical or horizontal installation as required by the location indicated.
4. Dynamically rated to close at 4,000 fpm and 4” differential static pressure.
5. Galvanized steel construction, except where otherwise indicated.
6. Blades: Airfoil design, double skin 16 gauge (14 gauge equivalent), max. 6-1/4” wide.
7. Frames: 16 gauge, 5” x 7/8” hat channel with reinforced corners.
9. Provide factory installed jack-shaft with spring closer. Linkage shall be concealed in frame.
10. Multi Blade fire damper pressure drop shall not exceed the following:

<table>
<thead>
<tr>
<th>VEL (FPM)</th>
<th>P.D. (W.C.)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1000</td>
<td>0.02</td>
</tr>
<tr>
<td>1500</td>
<td>0.04</td>
</tr>
<tr>
<td>2000</td>
<td>0.07</td>
</tr>
<tr>
<td>3000</td>
<td>0.15</td>
</tr>
</tbody>
</table>

D. Curtain type dampers shall be Ruskin model DIBD2 (1-1/2 hour) and DIBD23 (3 hour) for dynamic type and IBD2 (1-1/2 hour) and IBD23 (3 hour) for static type unless otherwise indicated on the plans. Multi-blade type dampers shall be Ruskin model FD-60 (1-1/2 hour) and FD-31 (3 hour) unless otherwise indicated on the plans.

E. Ceiling Fire dampers shall be Ruskin Model CFD4W, and CFD(R) 3.5 W for passing through rated ceilings in wood construction. Provide insulation blanket for ceiling fire dampers.

2.12 SMOKE DAMPERS

A. Smoke damper shall be as scheduled to establish the desired type, style, and quality. Dampers shall be as scheduled or approved equal by Ruskin, NCA, Nailor, American Warming, Arrow, Penn, or Greenheck.

B. Rated per AMCA standard 500: Pressure drop rated in accordance with figure 5.3; leakage rated in accordance figure 5.5.

C. Smoke dampers for rectangular ducts shall comply with the following:

1. The dampers shall be Ruskin model SD-60 low leakage opposed blade dampers rated for use in smoke control systems under the latest version of UL 555S and shall bear the UL label.
2. Frame - 5” x 1” x 16 gauge galvanized steel hat channel.
3. Blades - Airfoil shaped, double skin construction of 14 gauge equivalent thickness, maximum 6” wide. Blade extensions may be used on top and/or bottom blades to meet damper size requirements without diminishing free area.
4. Seals - Silicone rubber blade edge seals and flexible metal compressible jamb seals.
5. Linkage - Concealed in frame with shaft extended to exterior of damper for damper actuator.
7. Axles - ½” plated steel hex.
9. Maximum allowable velocity - 4000 FPM.
10. Maximum pressure drop at 3000 fpm in a 24”x24” test duct shall not exceed 0.30” W.G.
11. Maximum temperature - 250°F.
12. Maximum Leakage: 4.0 CFM per Sq. Ft. of damper at 1” water gauge differential pressure.
13. Maximum single dampers section shall be 48” wide x 72” high.
14. For multiple section dampers, each section shall be operated by a separate actuator.
15. Mount actuators external to the duct unless otherwise indicated.

D. Smoke dampers for round ducts shall comply with the following:
   1. The dampers shall be Ruskin model SDRS-25 low leakage single blade dampers rated for use in smoke control systems under the latest version of UL 555S and shall bear the UL label. Maximum size shall be 24” diameter.
   2. Frame - 7” long x 20 gauge galvanized steel with 1.5 x 1.5 reinforcing ring for units over 20” diameter.
   3. Blades - Airfoil shaped, double skin galvanized steel construction of 14 gauge equivalent thickness.
   4. Seals - Silicone rubber blade edge seals sandwiched between two blade pieces.
   5. Bearings - Stainless steel sleeve.
   6. Axles - ½” plated steel hex.
   8. Maximum allowable velocity - 3500 FPM.
   9. Maximum pressure drop at 3000 fpm shall not exceed 0.50” W.G.
   10. Maximum temperature - 250°F.
   11. Maximum Leakage: 4.0 CFM per Sq. Ft. of damper at 1” water gauge differential pressure.
   12. Mount actuators external to the duct unless otherwise indicated.

E. Smoke Control Damper Actuators:
   1. The actuator shall be Belimo model FSMF-24 actuator. Or approved equal by Johnson Controls.
   2. The actuator shall be factory mounted and connected to the damper section.
   4. Run time - between 32°F and 350°F, 15 seconds. Spring return timing -with full load opposing spring approximately 15 seconds. Return to normal position when power is removed.
   5. Rated torque of each actuator shall be 70 in-lbs. Size all actuators to operate damper with reserve power. Size actuators for minimum of 130% of the torque required to operate the damper(s).
6. NEMA 1 enclosure.
7. Actuator shall comply with NFPA 555S and have a UL 873 listing.

2.13 MOTORIZED DAMPERS

A. Motorized Dampers shall be:

1. Rated per AMCA standard 500: Pressure drop rated in accordance with figure 5.3; leakage rated in accordance figure 5.5.
2. Rated for up to 180 degrees F.
3. 1/2" diameter x 2" long axles, cadmium plated steel (or hex or square).
4. Stainless steel axle bushings.
5. Blades securely attached to shaft.
6. Linkage shall be concealed in frame and shall be plated steel bars with stainless steel pivots.
7. Maximum pressure drop shall be rated for a 24"x24" test duct.

B. Type A Motorized Dampers shall be equal to Ruskin CD-60 with the following features: Nailor 1120, American Warming VC-27 or approved equal by Arrow, Penn, or Greenheck shall be equally acceptable.

1. Opposed blades.
2. Allowable velocity of 3000 FPM (48"- 60" long blades) and 4000FPM (max. 48" long blades) and differential pressure of 3.5" W.G.
3. Frame - 5" x 1" x 16 gauge galvanized steel hat channel.
4. Blades - Airfoil shaped, double skin galvanized steel construction of 14 gauge equivalent thickness, maximum 6" wide. Blade extensions may be used on top and/or bottom blades to meet damper size requirements without diminishing free area.
5. Seals - Extruded vinyl blade edge seals and flexible metal compressible jamb seals.
7. Maximum pressure drop at 3000 fpm shall not exceed 0.30" W.G.
8. Damper torque requirements shall not exceed 5 in-lbs per ft. for opposed blade dampers and 7 in-lbs per ft. for parallel blade dampers.
9. Maximum Leakage per Sq.Ft. at 1" W.G. differential pressure: 3.0 CFM for dampers 12" to 24" wide and 2.0 CFM for dampers greater than 24" wide.
10. Maximum single dampers section shall be 60" wide x 72" high.
11. For multiple section dampers, each section shall be operated by a separate actuator.
12. Mount actuators directly to a ½" diameter control shaft with outboard support bearing that extends 6" beyond the damper frame.

C. Type B motorized dampers shall be equal to Ruskin Model CD-35 with the following features: Nailor model 1022, American Warming model VC-2 or approved equal by Arrow, Penn, or Greenheck and shall be equally acceptable.

1. Opposed blades.
2. Structurally suitable for 2000 fpm and 2.5" w.g. differential pressure.
3. Frame - 5" x 1" x 16 gauge galvanized steel hat channel.
4. Blades - 6" wide, 16 gauge galvanized steel V-groove on approximately 6" centers.
5. Seals - Extruded vinyl blade edge seals and flexible metal compressible jamb seals.
6. Finish - Mill galvanized and/or aluminum.
7. Maximum pressure drop at 1,500 fpm shall not exceed 0.10" W.G.
8. Damper torque requirements shall not exceed 5 in-lbs per ft. for opposed blade dampers and 7 in-lbs per ft. for parallel blade dampers.
9. Maximum leakage at 1" w.g. differential - 12 CFM/Sq.Ft.
10. Maximum size - 48" wide x 72" high.
11. For multiple section dampers, each section shall be operated by a separate actuator.
12. Mount actuators directly to a ½" diameter control shaft with outboard support bearing that extends 6" beyond the damper frame.

D. Type C motorized dampers shall be equal to Ruskin Model CD-50 with the following features: Nailor model 2020, American Warming model VC-29 or approved equal by Arrow, Penn, or Greenheck and shall be equally acceptable.

1. Opposed blades.
2. Allowable velocity of 3000 FPM (48"- 60" long blades) and 4000FPM (max. 48" long blades) and differential pressure of 3.5" W.G.
3. Frames: 16 gauge galvanized steel, 5" x 7/8" hat channel or 0.125" thick 6063-T5 extruded aluminum, with reinforced corners.
4. Blades: Airfoil design, 0.081" thick 6063-T5 extruded aluminum, max. 6-1/4" wide.
5. Seals - Extruded vinyl blade edge seals and flexible metal compressible jamb seals.
6. Finish: Extruded aluminum, except where otherwise indicated.
7. Maximum pressure drop at 3000 fpm shall not exceed 0.15" W.G.
8. Damper torque requirements shall not exceed 3 in-lbs per ft. for opposed blade dampers and 5 in-lbs per ft. for parallel blade dampers.
9. Maximum Leakage per Sq.Ft. at 1" W.G. differential pressure: 3.0 CFM for dampers 12" to 24" wide and 2.0 CFM for dampers greater than 24" wide.
10. Maximum single dampers section shall be 60" wide x 72" high.
11. For multiple section dampers, each section shall be operated by a separate actuator.
12. Mount actuators directly to a ½" diameter control shaft with outboard support bearing that extends 6" beyond the damper frame.

E. Motorized damper actuators shall have the following features.

1. Actuators shall be Belimo model AF24-SR or equivalent by Siemens or Siebe. No other substitutions allowed.
2. Actuators shall be connected to the dampers as shown in details on the drawings. Provide all needed linkages and materials for a complete operating damper.
3. Actuators shall be factory mounted and connected to the damper section(s).
4. Size all actuators for minimum of 130% of the torque required to operate the damper(s).
5. Maximum time for full stroke or return of 135 seconds. The spring return running time shall be approximately 40 seconds.
6. Each actuator shall have a minimum torque of 133 in-lbs.
7. The actuator shall have spring return for fail-safe operation. During normal operation the actuator shall not work against the force of the spring.
8. The actuator shall be powered by either 24 VAC or 24 VDC. Power consumption shall not exceed 6 watts. Actuator control shall be proportional by a 0 to 10 VDC or 4 to 20ma signal, with the addition of a 500 ohm resistor.

9. Provide a conduit connection for actuators located in mechanical rooms or outdoors and a 1 foot long plenum rated cable for connection to a junction box for actuators located in ceiling plenums.

10. Actuator shall have built in overload protection to prevent damage to the actuator when the actuator or damper reaches its end position. End switches are not acceptable.

11. Actuator shall be UL listed and labeled.

12. Actuator shall be designed for a minimum 60,000 open-close cycles and 1000 spring return cycles.

2.14 BALANCE DAMPERS

A. General

1. All balance dampers occurring in concealed ductwork, except those above removable ceilings, shall be installed with shafts vertical.

2. Provide control rod extending beyond the duct with a single locking quadrant for all volume dampers. Locking quadrant shall be continuously adjustable throughout a 90 degree operating range.

3. For dampers in ducts with liner, provide hat channel to match liner thickness; for dampers in ducts with external insulation, provide hat channel under locking quadrant same thickness as insulation.

4. Blade extensions may be used on top and/or bottom blades of Multi-blade dampers to meet damper size requirements without diminishing free area. Multi-blade dampers shall have opposed blades and shall be tested in accordance with AMCA standard 500, figure 5.3.

B. Single Blade Dampers shall be allowed in ducts up to 2.25 sq. ft.

1. Single Blade Dampers shall have 16 gauge galvanized steel or 0.090" aluminum reinforced blades, 16 gauge galvanized steel or 0.090" aluminum frames, 1/2" diameter (or hex or square) shafts that are minimum 2" long, and nylon or bronze axle bushings. Securely attach blades to shaft. Dampers shall be rated for up to 1,500 fpm and 1" differential static pressure. Provide volume dampers integral with "spin-in" where appropriate or indicated. Single blade dampers shall be Vent Products model 5101 (rectangular), model 5301 (round), or approved equal by Ruskin, Nailor, or American Warming.

2. Alternate Single Blade damper Construction: Similar construction to above except blade and shaft may be shop fabricated and mounted in duct (or spin-in) without a separate damper "frame." Provide shaft continuously through duct with locking quadrant on one end and end bearing on other end. End bearing shall be Young Regulator No. 656 or approved equal.

C. Multi-blade Dampers shall be provided in ducts over 2.25 sq. ft. and shall be rated for 180 degrees F. Maximum pressure drop shall be rated for a 24"x24" test duct. Dampers shall be
materials indicated below with 1/2" diameter axles (or hex or square) that are min. 2" long with nylon or bronze axle bushings. Securely attach blades to shaft. Linkage shall be plated steel bars with bronze or stainless steel pivots and shall be concealed in frame. Jamb and blade seals are not required.

1. Multi-blade dampers for Ducts up to 4.5 sq. ft.
   a. Rated for 1,500 fpm and 2" differential static pressure.
   b. Maximum pressure drop at 1,500 fpm shall not exceed 0.10" W.G.
   c. Galvanized steel or aluminum.
   d. Blades: 16 gauge, max. 6" wide.
   e. Frames: 16 gauge, 5" x 7/8" hat channel with reinforced corners.
   f. Dampers shall be Nailor model 1022, American Warming model VC-2, Ruskin Model CD-35, or approved equal by Arrow, Penn, or Greenheck.

D. Where dampers occur in non-accessible space, such as above plaster ceilings, or within chases, extend damper rod to recessed cup with flush cover plate in the ceiling. Young Regulator #301, or equal. Alternately, provide rack and pinion controller with flexible wire connector to operate damper up to 50 feet away; provide all needed hardware at damper and remote location; provide 6 wrenches to Owner; for ceiling, wall or plenum mounting or as indicated on the plans; equal to Young Regulator Bowden Cable Controllers 270.

2.15 BACK DRAFT DAMPERS

A. Back draft dampers shall comply with the following:
   1. Shall have minimum 2", 0.125" thick extruded aluminum frame reinforced for rigidity.
   2. Aluminum blades of maximum 6" width.
   3. Adjustable counterweight.
   4. Cadmium plated steel shafts.
   5. Blade shafts shall operate in ball bearings.
   6. Hardware shall be cadmium plated steel with brass pins.
   7. Dampers shall include blade edge seals. Leakage shall be less than 12 cfm per sq. ft. at ½ inch W.G.
   8. Use multiple damper sections for sizes above 48" x 48".

B. Back draft dampers shall be Ruskin model BD-6 or approved equal by NCA, Greenheck, or Nailor.

2.16 ACCESS DOORS

A. Access doors for ductwork shall be minimum 22 gauge galvanized steel with a continuous piano type hinge and camlock(s) (1 for doors 16" and 2 for larger doors); air leakage shall not exceed 0.21 CFM per square foot at 1 inch static pressure. Doors shall be 24" x 24", except for small ducts, where doors shall be as large as practical. Doors shall include a seal between the door and frame and shall also include a seal between the frame and duct. Doors shall be Ruskin model ADH 12 or equal by Cesco Products (Minneapolis, Mn.), A.J Manufacturing, or approved equal.
3.1 HANGING AND SUPPORTING DUCT WORK

A. All ductwork shall be neatly supported and properly anchored to building construction so horizontal ducts are without sag or sway, vertical are without buckle and all are free from the possibility of deformation collapse or vibration.

B. Install rigid round, rectangular, and flat oval metal duct with support systems indicated in SMACNA 2005 Tables 4-1 through 4-3 and Figures 4-1 through 4-9.

C. Install single wall ductwork except where double wall ducts are indicated on the plans.

D. Support horizontal ducts within 2 feet of each elbow and within 4 feet of each branch intersection. Provide trapeze hanger diagonally under all elbows greater than 54 inches wide.

E. Support vertical ducts at a maximum interval of 16 feet and at each floor.

F. Upper attachments to structures shall have an allowable load not exceeding 1/4 of the failure (proof test) load.

G. Hanger rods shall have double nuts and lock washers at all connections.

H. Install concrete inserts prior to placing concrete.

I. Install drilled inserts and powder actuated concrete fasteners after concrete is placed and completely cured. Obtain approval of the Engineer prior to using powder actuated concrete fasteners.

J. Duct shall not be supported from metal roof deck.

3.2 DUCT INSTALLATION, GENERAL

A. Duct System Pressure Class: Construct and install each duct system for the specific duct pressure classification indicated.

B. Verify exact locations and space requirements of ducts at the site and coordinate work with other trades, before fabricating ductwork.

C. Install ducts with the fewest possible joints.

D. Use fabricated fittings for all changes in directions, changes in size and shape, and connections. Provide all drops, raises, transitions, or offsets as required, at no additional cost to the Owner, Architect or Engineer, due to obstructions. When additional offsets, etc., different from those shown are required, approval shall be obtained from the Engineer prior to proceeding. All size or shape transitions shall be made gradually with angle not to exceed 15 degrees on each side.

E. Install branch take-offs tight to duct wall with projections into main duct kept to a minimum. Ragged edges projecting into the main duct shall not be allowed.
F. Locate ducts, except as otherwise indicated, vertically and horizontally, parallel and perpendicular to building lines; avoid diagonal runs. Install duct systems in shortest route that does not obstruct usable space or block access for servicing building and its equipment.

G. Locate ducts with sufficient space around equipment to allow normal operating and maintenance activities. The sheet metal work shall be coordinated with that of other trades in such a manner that when the installation is complete, all items are properly installed and are serviceable.

H. Install insulated ducts with 1-inch clearance outside of insulation.

I. Conceal ducts from view in finished and occupied spaces by locating in mechanical shafts, hollow wall construction, or above suspended ceilings. Do not encase horizontal runs in solid partitions, except as specifically shown.

J. Coordinate layout with ceiling, lighting layouts, sprinklers and other piping.

K. Electrical Equipment Spaces: Route ductwork to avoid passing through transformer vaults and electrical equipment spaces and enclosures.

L. Non-Fire-Rated Partition Penetrations: Where ducts pass interior partitions and exterior walls, and are exposed to view, conceal space between construction opening and duct or duct insulation with escutcheon of sheet metal flanges of same gauge as duct. Overlap opening on 4 sides by at least 2 inches.

M. Branch Connections: Comply with SMACNA 2005 Figures 4-5 and 4-6.

1. Install radius elbows and vaned elbows where shown on the plans. Radius elbows may be substituted for vaned elbows, but vaned elbows shall not be substituted for radius type unless approved in writing by the Engineer. 45 degree taps and other taps shall not be substituted for elbows.

N. Outlet and Inlet Connections: Comply with SMACNA 2005 Figures 7-6, 7-7 and 10-1 and as indicated on plans.

O. Flexible Connections at Fans: Comply with SMACNA 2005 Figure 7-8.

P. Provide openings in ductwork where required to accommodate thermometers and temperature sensors.

Q. Clean duct system and force high velocity air through duct to remove accumulated dust. To obtain sufficient air, clean half the system at a time. Protect equipment which may be harmed by excessive dirt with filters, or bypass during cleaning.

R. During construction all open ends of installed ductwork shall be kept covered to prevent dirt and debris from entering ducts. Openings shall be covered with plastic sheeting held in place with duct tape. Any ducts stored on site shall be protected by keeping them raised off the ground.
S. Ducts shall be neatly finished on the outside with all sharp edges removed. Inside surfaces shall be smooth with no projections into the air stream.

T. All fasteners and attachments shall be made of the same material as the ducts or of corrosion-resistant material.

U. Ducts up through 2" pressure class shall have all transverse duct joints sealed in compliance with the sealant manufacturer's recommendations and SMACNA procedures for Seal Class C. Ducts over 2" pressure class shall have transverse and longitudinal joints sealed in compliance with the sealant manufacturer's recommendations and SMACNA procedures for Seal Class A.

V. Duct accessories exposed to the air stream, such as dampers of all types (except smoke dampers) and access openings, shall be of the same material as the duct or provide at least the same level of corrosion resistance. Dissimilar metals shall be connected with flanged joints made up with neoprene gaskets to prevent contact between metals. Flanges shall be fastened with bolts protected by ferrules and washers made of the same material as the gaskets.

W. Where dampers are installed in ducts having external duct insulation, install damper locking quadrants with hat channel or of same depth as insulation to allow smooth operation of dampers.

X. 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.

3.3 INSTALLATION OF EXPOSED DUCTWORK

A. Protect ducts exposed in finished spaces from being dented, scratched, or damaged.

B. Provide hanging materials that match the appearance of the exposed ducts.

C. Remove any identification labels or markings from ducts so appearance of ducts at such locations matches the remainder of the ducts.

D. Trim duct sealants flush with metal. Create a smooth and uniform exposed bead. Do not use two-part tape sealing system.

E. Grind welds to provide smooth surface free of burrs, sharp edges, and weld splatter. When welding stainless steel with a No. 3 or 4 finish, grind the welds flush, polish the exposed welds, and treat the welds to remove discoloration caused by welding.

F. Maintain consistency, symmetry, and uniformity in the arrangement and fabrication of fittings, hangers and supports, duct accessories, and air outlets.

G. Repair or replace damaged sections and finished work that does not comply with these requirements.

3.4 LEAKAGE TESTING

A. At the beginning of the work, leak test representative samples of the duct construction for each pressure class greater than 3 inches w.g. The sample specimen shall be minimum 25% of
the ductwork of the selected system representing each pressure class, and shall include at least five transverse joints, typical seams, an access door, and at least two typical branch connections and an elbow. The sample specimen shall be part of the actual ductwork to be installed for the project.

B. The leakage amount shall not exceed the permissible leakage rate in CFM per 100 square feet of duct surface for the pressure and leakage classes shown in table below. The permissible leakage rate shall be calculated as per section 4 of SMACNA HVAC Air Duct Leakage Test Manual.

<table>
<thead>
<tr>
<th>DUCT CONSTRUCTION CLASS (Representing Pressure Class)</th>
<th>LEAKAGE CLASS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rectangular Ducts</td>
<td></td>
</tr>
<tr>
<td>4 inches w.g. &amp; higher</td>
<td>6</td>
</tr>
<tr>
<td>3 inches w.g.</td>
<td>12</td>
</tr>
<tr>
<td>2 inches w.g.</td>
<td>24</td>
</tr>
<tr>
<td>Round and Oval Ducts</td>
<td></td>
</tr>
<tr>
<td>3 inches w.g. &amp; higher</td>
<td>3</td>
</tr>
<tr>
<td>2 inches w.g. or less</td>
<td>12</td>
</tr>
</tbody>
</table>

C. Follow leakage testing procedures, test apparatus, and test reports to be submitted as per SMACNA HVAC Air Duct Leakage Test Manual. The Test and Balance agency shall measure and record duct leakage as specified herein, and shall report any unusual conditions to the Engineer and identify leakage sources.

1. Disassemble, reassemble, and seal segments of systems to accommodate leakage testing and for compliance with test requirements.
2. Conduct tests at static pressures equal to maximum design pressure of system or section being tested. If static-pressure classes are not indicated, test system at maximum system design pressure. Do not pressurize systems above maximum design operating pressure.
3. Give five working days advance notice for testing.

D. If a specimen fails to meet the permissible leakage level, the contractor shall modify all ductwork installed represented by this specimen to bring it into compliance and shall retest it until acceptable leakage is demonstrated.

E. Tests and re-tests and necessary repairs shall be completed prior to insulation and concealment of ducts.

3.5 DUCT CLEANING

A. Clean new duct system(s) to remove oil film and dust before testing, adjusting, and balancing.
B. See Section 230901, “Duct Cleaning” for additional requirements.

3.6 FLEXIBLE ROUND DUCT INSTALLATION
A. Application
   1. Flexible round ductwork may be used where shown on the drawings.
   2. Provide low pressure flex ducts in ducts rated 2” static pressure class or less.
   3. Provide high pressure flex ducts in ducts rated over 2” static pressure class.
   4. Flexible duct shall not pass thru any wall, floor or ceiling.

B. Slide vapor barrier and insulation away from ends. Secure flex duct to diffusers and main duct takeoff with flame retardant nylon or stainless steel draw bands. Slide vapor barrier and insulation back over flex duct and secure in place with draw band or duct tape. Apply duct sealer if necessary to obtain a leak tight connection. Nylon cable ties shall be 0.19 inch width minimum, with standard cross-section and shall comply with UL-181 or UL - 2043.

C. All flexible duct shall be routed and supported in such a manner that the duct is not flattened in any area and that full cross sectional area is maintained. All bends shall be made in such a manner that the ratio of the center line radius of the bend to the inside diameter of the duct is not less than 1. Support flexible ducts from building structures in accordance with SMACNA 2005 Figure 3-10 or 3-11. Provide a sheet metal saddle between the insulation and strap, to prevent duct from sagging excessively and from resting on lights, ceilings, etc.

D. Where flex duct turns 90°, provide a 90° sheet metal elbow or support the flex duct through the turn with a “Flex Flow Elbow” by Thermaflex or equal.

E. All bends shall be made so that the ratio of the center line radius of the bend to the inside diameter of the duct is not less than 3.

F. Maximum length of flexible ducts shall be 8 feet unless otherwise indicated.

3.7 FLEXIBLE CONNECTOR INSTALLATION
A. Flexible connectors shall be provided where fans, air handling units, fan terminal units, fan coil units, and rooftop units connect to ducts or casings to prevent transmission or vibration to ductwork.

B. Flexible connectors shall fit tightly around ducts and fans and shall be securely bolted in place.

C. Joints between flexible connectors and duct or fan shall be sealed with duct sealer.

3.8 RADIATION DAMPER INSTALLATION
A. Damper installation shall be in compliance with NFPA #90A, UL requirements and manufacturer's installation instructions.

B. Radiation dampers shall be installed in all ducts, grilles and openings through fire rated floor/ceiling membrane, where required by Code, and where indicated on plans.

C. Provide UL rated grille/damper assembly rated for wood construction where installed in wood joist or trusses.
D. Where radiation dampers installed in ducts, provide an access door in the duct and/or an access panel in the wall or ceiling to allow resetting the damper. All dampers must be installed so the fusible link is accessible. Radiation dampers shall be provided with an access panel with an exterior label having letters not less than 0.5" on height reading “Radiation Damper”. Where installed at grilles, the grilles shall be removed for access to resetting damper.

E. Radiation dampers shall be tested before work is concealed in accordance with local code requirements.

3.9 FIRE DAMPER INSTALLATION

A. Damper installation shall be in compliance with NFPA #90A, UL requirements and manufacturer's installation instructions.

B. Fire dampers shall be installed in all ducts and openings through fire rated partitions, ceilings and floors, where required by Code, and where indicated on plans.

C. Minimum fire damper width shall be 12" unless otherwise indicated. Provide duct transition if necessary to achieve the minimum width. Provide an access door in the duct and/or an access panel in the wall or ceiling to allow resetting the damper. All dampers must be installed so the fusible link is accessible.

D. Provide 1-1/2 and 3 hour rated fire dampers at locations shown on the drawings or as required by governing codes.

3.10 COMBINATION SMOKE-FIRE DAMPER INSTALLATION

A. Damper installation shall be in compliance with NFPA #90A, UL requirements and manufacturer's installation instructions.

B. Combination smoke-fire dampers shall be installed in all ducts and openings through fire rated shafts, where required by Code, and where indicated on plans.

C. Provide an access door in the duct and/or an access panel in the wall or ceiling to allow resetting the damper. All dampers must be installed so the electronic fusible link and actuator are accessible. Where a duct is not wide or high enough for the smoke detector to be installed, provide a transition in the duct to allow the smoke detector installation.

D. Provide 1-1/2 and 3 hour rated combination smoke-fire dampers at locations shown on the drawings or as required by governing codes.

3.11 BALANCE DAMPER INSTALLATION

A. Provide balancing dampers at points on supply, return, and exhaust systems where branches are taken from larger ducts. Install minimum 2 duct widths from duct take-off. Provide balance dampers where shown or where required to properly balance and direct air flow.

B. Every supply air outlet shall have a balance damper at the branch duct takeoff to the supply outlet regardless of whether dampers are specified as part of the diffuser, grille, or register assembly.
C. Exhaust grilles shall have a balance damper at the branch duct connection to the main duct.

D. Install damper control devices on stand-offs where required to allow complete coverage of insulation.

3.12 BACK DRAFT DAMPER INSTALLATION

A. Back draft dampers shall be installed on exhaust fans where scheduled and other locations where indicated on drawings.

3.13 MOTORIZED DAMPER INSTALLATION

A. Coordinate with Section 230960 for actuator requirements.

B. Install motorized dampers per manufacturer's instructions.

C. Actuators shall be installed on the outside of ducts unless otherwise indicated. Provide access doors where damper motors are concealed in ducts.

D. Install damper control devices on stand-offs where required to allow complete coverage of insulation.

3.14 SMOKE DAMPER INSTALLATION

A. Coordinate with Section 260980 for fire alarm and smoke detector requirements.

B. Install smoke dampers per manufacturer's instructions. Install damper within 24" of smoke rated partition. Provide access doors at damper and at smoke detector. Where a duct is not wide or high enough for the smoke detector to be installed, provide a transition in the duct to allow the smoke detector installation.

C. Actuators shall be installed on the outside of ducts unless otherwise indicated. Provide access doors where damper motors are concealed in ducts.

D. Install damper control devices on stand-offs where required to allow complete coverage of insulation.

3.15 ACCESS DOOR INSTALLATION

A. Provide access doors in ducts at fire dampers, where actuators for motorized dampers are concealed inside ducts, and at other items located in ducts or plenums where access into ductwork is required for maintenance or installation of work by other trades.

3.16 TEST OPENING INSTALLATION

A. Provide test openings in ductwork for testing and balancing.

B. Patch insulation, ductwork, and housings, using materials identical to those removed.

C. "Plastic Plugs" may be used to seal openings where duct traverses are made.
D. Provide Pitot tube openings where required for testing of systems. Where openings are provided in insulated ductwork, install insulation material inside a metal ring.

3.17 INSTALLATION OF DUCT SMOKE DETECTORS

A. Install duct detectors furnished in Section 260980 or Section 230960 per manufacturer’s instructions in ductwork or air handling units where indicated. Where a duct is not wide or high enough for the smoke detector to be installed, provide a transition in the duct to allow the smoke detector installation.

3.18 INSTALLATION OF DUCT MOUNTED CO2 SENSORS

A. Install duct mounted CO2 sensors furnished in Section 230960 in ductwork or air handling units where indicated per manufacturer's instructions.

3.19 AIR DEVICE INSTALLATION

A. Air direction patterns shall comply with those shown and adjustments shall be made to prevent impingement of moving air on walls. Coordinate locations of outlets and inlets with other contractors to avoid interferences and to effect proper installation. Outlets in lay-in ceilings shall be located as close to positions shown on plans as the ceiling grid will allow; notify Architect and Engineer before proceeding if ceiling grid will not allow layout shown.

B. Diffusers and grille layouts shown on the plans have been coordinated with the layout of the ceiling grid to establish the desired arrangement of grilles and diffusers. Prior to installing any ductwork which would be affected by the grid layout, verify the grid layout with the Architectural ceiling plans and the actual ceiling layout.

C. Provide a square-to-round or round-to-square adapter with the air device where necessary to connect to the ductwork shown.

D. Fasten air device frames and borders to drywall ceilings and walls where required.

E. Clean construction dirt from all air devices.

F. Provide extension duct collar from ductwork to air devices connected to rigid duct. Fasten with sheet metal screws and seal. Where air devices are installed on exposed ductwork, provide 4” extension collar with dimensions equal to the outside dimensions of the air device and mounting flange turned inward.

G. Diffusers shall be connected to flexible ductwork as follows:

1. Fasten frames and borders to drywall ceilings where required.
2. Slide flexible duct over collar of diffuser. Secure flexible duct to duct collar with flame retardant nylon cable tie(s) or stainless steel drawbands. Secure with an installation tool approved by the cable tie manufacturer. Nylon cable ties shall be 0.19 inch width minimum, with standard cross-section and shall comply with UL-181 or UL - 2043.
3. Clean construction dirt from diffusers.
4. Remove damper operator knob and turn over to Owner’s Representative.
H. Diffusers connected to rigid duct shall be installed as follows:
   1. Fasten frames and borders to drywall ceilings where required.
   2. Fasten extension duct collar to ductwork with sheet metal screws (and seal with approved duct sealer).
   3. Fasten duct ring to extension duct collar with sheet metal screws.
   4. Clean construction dirt from diffuser.

I. Grilles and Registers shall be connected to the ductwork as follows:
   1. Cut hole in return or exhaust duct.
   2. Fasten extension duct collar to ductwork.
   3. After ceiling or wall is installed, install register with sheet metal screws.
   4. Check to see if sponge rubber gasket is drawn up against wall or ceiling, forming an air tight seal. If not, reassemble and check.
   5. Clean construction dirt from register.
   6. Remove damper operator key from register and turn over to Owner's Representative.

J. All grilles, registers and diffusers shall be left in a wide open position.

K. Provide balancing dampers on duct take-off to diffusers, and grilles and registers, regardless of whether dampers are specified as part of the diffuser, or grille and register assembly.

L. Paint ductwork visible behind air outlets and inlets matte black.

M. Provide supplemental “tees” for the ceiling grid where diffusers are a different size than the ceiling tiles.

3.20 NOISE ENCLOSURE INSTALLATION AROUND DUCTS
A. Noise enclosures shall be installed per details on the drawings. Attach drywall directly to ductwork with screws. Seal joints in drywall with acoustical joint sealant.

B. Install where indicated on drawings.

3.21 PAINTING
A. Paint interior of metal ducts that are visible through registers and grilles and that do not have duct liner. Apply one coat of flat, black, latex paint over a primer that is compatible with the duct material.

3.22 SHOP APPLICATION OF LINER IN RECTANGULAR DUCTS
A. The duct liner shall be cut to assure snug corner joints and installed so the black surface of the liner faces the air stream. Fold and compress liner in corners to assure butted edge overlapping.

B. Adhere a single layer of indicated thickness of duct liner with 100 percent coverage of adhesive at liner contact surface area. Multiple layers of insulation to achieve indicated thickness is prohibited.
C. On horizontal runs, tops of ducts over 12" wide and/or sides over 16" high shall be additionally secured with Gripnail or welded pins and speed clips on a maximum of 15" centers.

D. On vertical runs, Gripnail or welded pins and speed clips shall be spaced on a maximum of 15" centers on all duct dimensions over 12".

E. Mechanical fasteners shall start within 2" of leading edge of each section, and within 3" of the leading edge of all cross joints within the duct sections. Mechanical fasteners shall be flush with the liner surface. Clips shall be drawn down flush only and not so as to compress the liner and cause the leading edge to raise up.

F. All exposed edges and the leading edge of all cross joints of the liner shall be sealed with edge sealer.

G. Butt transverse joints without gaps and coat joint with adhesive.

H. Longitudinal joints in rectangular ducts shall not occur except at corners of ducts, unless the size of the duct and standard liner product dimensions make longitudinal joints necessary.

I. Secure transversely oriented liner edges facing the airstream with metal nosings that are either channel or "Z" profile or are integrally formed from the duct wall at the following locations:

   1. Fan discharge and upstream edges of transverse joints within 40 feet of the fan discharge.
   2. Where lined ducts are preceded by unlined ductwork.

J. Ductwork Located Outdoors

   1. Exterior of ducts shall be insulated and jacketed as described in See Section 230200 - Mechanical Insulation.

END OF SECTION 230900
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SECTION 230910 – START-UP, CLEANING AND TESTING

PART 1 - GENERAL

1.1 WORK INCLUDED

A. Furnish all labor, services, materials and related items necessary to complete the start-up, cleaning and testing work indicated on the drawings and/or specified herein. Work to be performed shall include, but not be limited to, the following items:

1. All Air Systems
2. Natural Gas Piping
3. Condensate Drains

1.2 RELATED DOCUMENTS

A. All drawings and applicable provisions of Division 0 Bidding Requirements and Division 1 General Requirements apply to work of this Section.

B. Section 230000 - General Mechanical Conditions.

PART 2 - PRODUCTS

PART 3 - EXECUTION

3.1 START-UP OF SYSTEMS AND EQUIPMENT

A. Before any systems, or parts of systems are placed into unattended operation, they shall be completely installed, pressure tested, cleaned, flushed and balanced with all operating and safety controllers installed, calibrated and operational.

B. When started, all motors shall be checked for proper rotation, speed, and amperage. If overloading is indicated, immediate corrective measures shall be taken to prevent damage to the motor.

C. Before systems are operated, all bearings shall be lubricated and all other liquid levels and pressures checked and if necessary corrected.

D. Contractor shall start-up all systems and equipment and place all systems into operation. Any equipment, pieces of equipment, controls, etc., damaged or not operating properly shall be replaced at this contractor's expense.

E. Contractor shall verify proper and safe operation of all equipment, components, controls and control circuits before any system is left unattended.

F. Whenever air systems are operated, air filters shall be in place. Air systems shall not be operated at any time without filters.

3.2 PIPE SYSTEMS TESTING
A. Except for those pipes hereinafter listed, all piping installed by this Contractor shall be pressure tested. (See Plumbing Section for testing of plumbing piping.)

B. Perform the following tests on refrigerant piping:
   1. See test requirements in Section 230150 “Refrigerant Piping.”

C. The following pipes do not require a pressure test:
   1. Air Handling Unit and DX coil condensate drains.

D. Any item which might be damaged by the pressure test shall be removed from the system during the test, or isolated from the test.

E. Gauges used for testing shall be tested for accuracy, and then installed as close as possible to the low point of the system to be checked.

F. No leakage is permitted. Leaks shall be repaired and the lines retested.

G. Any lines changed after testing shall be retested.

H. Test data shall be recorded on a standard form.

I. While piping is under test, care shall be taken that excessive pressure does not occur due to increase of ambient temperature.

J. Test Pressure and Medium:

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3.3 CLEANING

A. Adequate precautions shall be taken during storage and installation to keep the inside of all pipes, valves and fittings free from foreign materials.

B. The inside of all pipes, valves, and fittings shall be smooth, clean, free from blister, loose mill scale, sand, dirt and other foreign material.

C. This Contractor shall clean all piping installed by him.

D. Natural gas piping shall be cleaned with compressed air. Piping shall be thoroughly blown clean. When complete, all dirt legs, strainers, etc., shall be cleaned. Any items in the piping system, such as gas trains or equipment, which could be affected by either the pressure or dirt shall be disconnected during the cleaning operation.

3.4 TURN OVER TO OWNER

A. Perform the following before operating the system:
   1. Open manual valves fully.
2. Inspect pumps for proper rotation.
3. Set makeup pressure-reducing valves for required system pressure.
4. Inspect air vents at high points of system and determine if all are installed and operating freely (automatic type), or bleed air completely (manual type).
5. Set temperature controls so all coils are calling for full flow.
6. Inspect and set operating temperatures of hydronic equipment, such as boilers, chillers, cooling towers, to specified values.

B. When the system is turned over to the Owner, all systems shall have been started, tested, balanced and checked and proven to be fully operational in every respect.

C. When the system is turned over to the Owner, all bearings shall have been recently lubricated, oil levels checked and oil added if necessary, liquid levels and pressures checked and corrected, flow rates checked and corrected, R.P.M.'s verified, belts tightened and aligned, and all controls and control sequences checked, verified operational and if necessary, corrected.

D. When the system is turned over to the Owner, all air filters shall be replaced with clean filters.

END OF SECTION 230910
SECTION 230930 – TEST-ADJUST-BALANCE

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of Contract, including General and Special Conditions apply to this section.

1.2 DESCRIPTION OF WORK

A. This scope of services specifies the requirements and procedures for mechanical systems testing, adjusting, and balancing. Requirements include measurement and establishment of the fluid quantities of the mechanical systems as required to meet design specifications, and recording and reporting the results. The test and balance work will be performed by the Owner’s personnel. It is the Contractor’s responsibility to assist as outlined below.

B. Test, adjust and balance the following mechanical systems which are shown in the construction documents.
   1. Supply air systems, all pressure ranges, including variable volume and constant volume systems.
   2. Return air systems.
   3. Exhaust air systems.
   4. Hydronic systems.
   5. Steam distribution systems.
   6. Cooling towers.
   7. Verify temperature control system operation.

C. The contractor’s responsibilities are as follows:
   1. Notify the Owner’s Representative fourteen (14) days prior to the schedule date for balancing the system.
   2. Schedule a two (2) week allowance for the testing and balancing firm to complete the testing and balancing work when scheduling completion of all work required of the Contractor by the contract documents.
   3. Cooperate with the testing and balancing firm and shall make all necessary preparations for the TAB efforts.
   4. Complete the following work prior to requesting the TAB effort.
      a. Clean and flush all piping systems.
      b. Leak test and make tight all piping systems.
      c. Fill all piping systems with clean water.
      d. Clean and seal all ductwork systems.
      e. Service and tag all equipment.
      f. Set and align all motors and drives.
      g. Start up and prove all equipment and systems.
      h. Make preliminary settings on all control devices and have all systems operational.
      i. Operate all systems successfully for twenty-four (24) hours minimum.
   5. Lubricate all motors and bearings.
   6. Check fan belt tension.
   7. Check fan rotation.
8. Patch insulation, ductwork and housing, using materials identical to those removed.
9. Seal ducts and piping, and test for and repair leaks.
10. Seal insulation to re-establish integrity of the vapor barrier.
11. Attend a coordination meeting prior to the balancing of the system and a coordination meeting following the balancing of the system.
12. Provide a complete set of as-built drawings prior to the TAB effort.
13. Provide craftsmen of the proper trade to work with the TAB firm to make adjustments and installation changes as required.
14. Change out fan sheaves when and if required by the TAB firm.
15. Dedicate the resources to accommodate all changes identified by the test and balance firm in a timely manner.
16. If a significant rebalance (Owner’s determination) of the HVAC system is required due to the Contractor’s failure to properly install and check out the HVAC system, the cost of rebalancing the system shall be borne by the Contractor.

1.3 PRE-BALANCING CONFERENCE

A. Prior to beginning of the testing, adjusting and balancing procedures, a conference with the Owner’s representative, Engineer and the Test and Balance Agency’s representative will be held. The objective of the conference is final coordination and verification of system operation and readiness for testing, adjusting and balancing.

1.4 SEQUENCING AND SCHEDULING OF SERVICES

A. Test, adjust and balance the air conditioning systems during summer season and heating systems during winter season. This includes at least a period of operation at outside conditions within 5 deg. F wet bulb temperature of maximum summer design condition, and within 10 deg. F dry bulb temperature of minimum winter design conditions. Take final temperature readings during seasonal operation.

PART 2 – PRODUCTS

2.1 PRODUCTS (Not applicable)

PART 3 – EXECUTION

3.1 GENERAL (Not applicable)

END OF SECTION 230930
SECTION 230960 – TEMPERATURE CONTROLS

PART 1 GENERAL

1.01 SUMMARY

A. University of Missouri Controls Specification.
B. This section contains requirements for electric control systems as indicated on the contract drawings.
C. Contractor is responsible for providing, installing and connecting all sensors, actuators, control dampers, electrical components and all electrical wiring between these devices and up to the Direct Digital Controller (DDC), unless stated otherwise on the drawings.
D. DDC controllers consist of Johnson Controls METASYS controllers, type NAE, DX, FEC, IOM, AHU, VAV, VMA, or UNT controllers. Owner will provide Johnson Controls METASYS thermostat controllers for the contractor to install and wire.
E. After all equipment has been installed, wired and piped, Owner will be responsible for all termination connections at the DDC controller’s and for checking, testing, programming and start-up of the control system. Contractor must be on site at start-up to make any necessary hardware adjustments as required.
F. Once each mechanical system is completely operational under the new control system, contractor shall make any final connections and adjustments. For controls renovation jobs, contractor shall remove all unused sensors, operators, panels, wiring, tubing, conduit, etc. Owner shall have the option of retaining any removed pneumatic controls.

1.02 RELATED SECTIONS

A. Drawings and general provisions of Contract, including General and Special Conditions apply to work of this section.

1.03 QUALITY ASSURANCE

A. Contractor's Qualifications:
   1. Contractor shall be regularly engaged in the installation of digital control systems and equipment, of types and sizes required. Contractor shall have a minimum of five years experience installing digital control systems. Contractor shall supply sufficient and competent supervision and personnel throughout the project in accordance with General Conditions section 3.4.1 and 3.4.4.

B. Codes and Standards:
   1. Electrical Standards: Provide electrical components of control systems which have been UL-listed and labeled, and comply with NEMA standards.
   2. NEMA Compliance: Comply with NEMA standards pertaining to components and devices for control systems.
   3. NFPA Compliance: Comply with NFPA 90A "Standard for the Installation of Air Conditioning and Ventilating Systems" where applicable to controls and control sequences.
   4. NFPA Compliance: Comply with NFPA 70 "National Electric Code".
1.04 SUBMITTALS

A. Shop Drawings: Submit shop drawings for each control system, containing the following information:

B. Product data for each damper, valve, and control device.

C. Schematic flow diagrams of system showing fans, pumps, coils, dampers, valves, and control devices.

D. Label each control device with setting or adjustable range of control.

E. Indicate all required electrical wiring. Clearly differentiate between portions of wiring that are factory-installed and portions to be field-installed.

F. Provide details of faces on control panels, including controls, instruments, and labeling.

G. Include written description of sequence of operation.

H. Provide wiring diagrams of contractor provided interface and I/O panels.

PART 2 PRODUCTS

2.01 MATERIALS AND EQUIPMENT

A. Conduit and Raceway:
   1. Electrical Metallic Tubing: EMT and fittings shall conform to ANSI C80.3.
   2. Surface Metal Raceway and Fittings: Wiremold 500, Ivory, or approved equal.
   3. Flexible Metal Conduit: Indoors, per National Electric Code for connection to moving or vibrating equipment.
   4. Liquidtight Flexible Conduit: Outdoors, per National Electric Code for connection to moving or vibrating equipment.

B. Control Dampers: Ruskin CD-50 or approved equal.
   1. Provide dampers with parallel blades for 2-position control.
   2. Provide opposed blades for modulating control.
   3. Dampers shall be low leakage design with blade and edge seals.
   4. Provide multiple sections and operators as required by opening size and sequence of operations, as indicated on the contract drawings.

C. Electric Actuators: Johnson Controls, Bray, Belimo, TAC or approved equal. KMC actuators are not approved. Size electric actuators to operate their appropriate dampers or valves with sufficient reserve power to provide smooth modulating action or 2-position action as specified. If mixed air AHU has return air, exhaust air and outside air dampers that are not mechanically linked then static safety switch must be installed and wired to safety circuit. Spring return actuators should be provided on heat exchanger control valves or dampers or as specified on the drawings. Control signal shall be 0 to 10 VDC unless otherwise specified on drawings. Actuators with integral damper end switch are acceptable.

D. Air and Hot Water Electronic Temperature Sensors:
   1. All electronic temperature sensors shall be compatible with Johnson METASYS systems.
   2. Sensors shall be 1,000 ohm platinum, resistance temperature detectors (RTDs) with two wire connections. Duct mounted sensors shall be averaging type. Contractor may install probe type when field conditions prohibit averaging type, but must receive permission from Owner's Representative.
3. Coordinate thermowell manufacturer with RTD manufacturer. Thermowells that are installed by the contractor, but are to have the RTD installed by owner, must be Johnson Controls Inc. series WZ-1000.

E. Relays Used for Fan Start/Stop: Must have LED indication and be mounted externally of starter enclosure or VFD
1. Kele, RIBU1C or approved equal.

F. Power Supply Used to Provide Power to Contractor-Provided Control Devices: Shall have adjustable DC output, screw terminals, overload protection and 24 VAC and 24 VDC output.
1. Kele, DCPA-1.2 or approved equal

G. Pressure Differential Switch:
1. Fans: NECC model DP222 or approved equal.

H. Differential Pressure Transmitter: Provide units with linear analog 4-20mA output proportional to differential pressure, compatible with the Johnson METASYS Systems.
1. Air: Units shall be capable of measuring a differential pressure of 0 to 5 in. WC. Accuracy shall be +/- 1.0% full scale with a compensated temperature range of 40 to 149 deg F and a maximum working pressure of 250 psig.
   a) Setra model 267, or approved equal.
   b) Shall be installed in control panel and piped 2/3 down the duct unless shown otherwise or approved by owners representative.

PART 3 EXECUTION

3.01 INSTALLATION OF CONTROL SYSTEMS

A. General: Install systems and materials in accordance with manufacturers instructions, roughing-in drawings and details shown on drawings.

B. Raceway: Raceway is to be installed in accordance with the National Electric Code. Use of flexible metal conduit or liquidtight flexible conduit is limited to 36" to connect from EMT to devices subject to movement. Flexible raceway is not to be used to compensate for misalignment of raceway during installation.

C. Control Wiring: Install control wiring in raceway, without splices between terminal points, color-coded. Install in a neat workmanlike manner, securely fastened. Install in accordance with National Electrical Code.
1. Install circuits over 25-volt with color-coded No. 12 stranded wire.
2. Install electronic circuits and circuits under 25-volts with color-coded No. 18 stranded twisted shielded pair type conductor.
3. N2 communications bus wire shall be 18 AWG, plenum rated, stranded twisted shielded, 3 conductor, with blue outer casing, described as 18-03 OAS STR PLNM NEON BLU JK distributed by Windy City Wire, constructed by Cable-Tek, or approved equivalent.
   a) Metastat wiring shall be minimum 20 AWG, plenum rated, stranded, 8 conductor stranded wire.
4. FC communications bus wire shall be 22 AWG, plenum rated, stranded twisted shielded, 3 conductor, with blue outer casing, described as 22-03 OAS STR PLNM NEON BLU JK distributed by Windy City Wire, constructed by Cable-Tek, or approved equivalent.
   a) Network sensor wiring (SA Bus) shall be 22 gauge plenum rated stranded twisted wire, 4 conductor.
5. All control wiring at control panel shall be tagged and labeled during installation to assist owner in making termination connections at control panel. Label all control wires per bid documents.
D. All low voltage electrical wiring shall be run as follows:
1. Route electrical wiring in concealed spaces and mechanical rooms whenever possible.
2. Provide EMT conduit and fittings in mechanical rooms and where indicated on drawings.
3. Low voltage electrical wiring routed above acoustical ceiling is not required to be in conduit, but wire must be plenum rated. Clip wire to structural ceiling.
4. Provide surface raceway, fittings and boxes in finished areas where wiring cannot be run in concealed spaces. Route on ceiling or along walls as close to ceiling as possible. Run raceway parallel to walls. Diagonal runs are not permitted. Paint raceway and fittings to match existing conditions. Patch/repair/paint any exposed wall penetrations to match existing conditions.

E. All devices shall be mounted appropriately for the intended service and location.
1. Wall mounted sensors and thermostats shall be provided with base and covers in occupied areas and mounted 4'-6" above finished floor. Tubing and/or wiring shall be concealed within the wall up to the ceiling where ever possible. Surface raceway may only be used with approval of Owners Representative.
2. Duct mounted sensors shall be provided with mounting brackets to accommodate insulation. Mounting clips for capillary tubes for averaging sensors are required.
3. All control devices shall be tagged and labeled for future identification and servicing of control system.
4. Preheat and mixed air discharge sensors must be of adequate length and installed with capillary tube horizontally traversing face of coil, covering entire coil every 24 inches bottom to top.
5. All field devices must be accessible or access panels must be installed.

F. Install magnehelic pressure gage across each air handling unit filter bank. If the air handling unit has a prefilter and a final filter, two magnehelic pressure gages are required.

3.02 ADJUSTING AND START-UP
A. Start-Up: The start-up, testing, and adjusting of pneumatic and digital control systems will be conducted by owner.

3.03 CLOSEOUT PROCEDURES
A. Contractor shall provide complete diagrams of the control system including flow diagrams with each control device labeled, a diagram showing the termination connections, and an explanation of the control sequence. The diagram and sequence shall be framed and protected by glass and mounted next to controller.

END OF SECTION 230960
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SECTION 260000 – BASIC ELECTRICAL REQUIREMENTS

PART 1 - GENERAL

1.1 WORK INCLUDED

A. Applicable provisions of Bidding Requirements and Division 1 General Requirements apply to work of this Section.

B. Should a conflict arise between this section and other Sections, the General and Supplementary Conditions of Division 1 shall take precedence.

C. The submittal of a proposal carries with it the agreement to all items and conditions referred to in the specifications and accompanying drawings.

1.2 RULES AND REGULATIONS - See Division 1

1.3 PERMITS, LICENSES AND INSPECTION FEES - See Division 1

1.4 PLANS AND SPECIFICATIONS

A. Data given herein and on the drawings is as exact as could be secured. Their absolute accuracy is not guaranteed. Obtain and verify exact locations, measurements, levels, space requirements, etc., at the site, and adapt the work to actual conditions at the building as constructed.

B. The drawings shall be considered schematic and are not intended to indicate all required materials. Conduit, wiring, equipment, etc., shall be installed so all items clear the structure and other building elements and maintain appropriate clearances for access, service and maintenance.

C. Some of the details on the drawings are schematic or diagrammatic. These details are not intended to show all materials, etc., required to achieve the arrangement shown. Adapt these details to the actual conditions of the job.

D. Routing of conduit and location of equipment and other devices are shown on plans for general guidance. This Contractor shall coordinate his work with other Contractors and shall provide necessary deviations in routing as far as 10 feet from those shown to provide systems as specified or implied, without interference and pursuant to these requirements at no additional cost to the Owner, Architect or Engineer.

E. Contractor shall not scale the drawings. Refer to architectural and structural drawings for building construction and dimensions and to room finish schedule on architectural drawings for material, finish and construction method of walls, floors and ceilings in order to insure proper rough-in and installation of contractor's work.

F. Changes, modifications or variations to the plans and specifications will be issued by the Engineer in writing.

G. Coordinate arrangement, mounting and support of electrical equipment.

1. To allow maximum possible headroom, unless specific mounting heights are indicated.
2. To provide for ease of disconnecting equipment with minimum interference to other installations.
3. To allow right-of-way for piping and conduit installed at slopes.
4. So connecting raceway will be clear of obstructions and of the working and access space of other equipment.

H. All mechanical, electrical, plumbing, fire protection, and HVAC work shall be coordinated by the contractor and any correction to any of the above work shall be at the contractor’s expense.

1.5 DISCREPANCIES OR OMISSIONS

A. During construction, should a discrepancy or omission be found, it shall be brought to the attention of the Engineer at once for resolution.

B. No changes in contract price will be allowed for minor changes in layout or location required to avoid interferences, obstructions, etc. Contract price changes will be considered only for changes in the scope of the project requirements. All such scope changes and price revisions must be authorized in writing.

C. If discrepancies are found within the contract documents, the most demanding requirement shall take precedence unless otherwise agreed by the engineer in writing.

1.6 VISITING THE SITE – See Division 1.

1.7 SHOP DRAWINGS – See Division 1.

1.8 RELEASE OF CADD FILES

A. See “Release of Cadd Files Form” at the end of this section.

1.9 MAINTENANCE AND OPERATING INSTRUCTIONS AND MANUALS

A. See Division 1.

B. Upon completion of the job, the installing contractors and major suppliers shall instruct the Owner's representatives in the proper operation and maintenance of the systems installed. The installing Contractors shall submit documentation indicating the date of instruction; names and organization of persons providing and receiving the instructions; systems the instructions covered; and materials received.

1.10 TEMPORARY POWER – EXISTING FACILITIES

A. The Owner’s existing electrical distribution system shall be used for temporary power required for temporary lighting, 120 volt GFI receptacles and power to all construction equipment in accordance with NEC Article 527. Coordinate details of existing service and metering for job site and construction offices with local utility company. Energy charges shall be paid by the General Contractor. If portions of the existing building remain in use by the Owner, then the Owner shall pay the energy charges.

B. Temporary lighting shall consist of protected incandescent, LED, HID or fluorescent fixtures symmetrically spaced to produce a minimum of 5 footcandles throughout the work areas.

C. Stairs and other enclosed areas shall have adequate lighting.
D. The service shall be available during all working hours and scheduled overtime hours and otherwise as necessary for security and safety purposes, with security lighting to be provided during all hours of darkness. All such facilities shall conform to all requirements of the National Electrical Code, the local utility, and all other governmental authorities having jurisdiction.

E. Temporary power shall be provided for all construction trailers.

F. Comply with NECA 200-2010, “Recommended Practice for Installing and Maintaining Temporary Electric Power at Construction Sites.”

1.11 AS-BUILT RECORD DRAWINGS

A. During construction, maintain a separate set of drawings at the jobsite to keep a record of all changes of locations. See additional requirements in General Conditions and Supplementary Conditions.

B. Locations of conduit and other concealed facilities shall be shown if and when they differ from the drawings.

1.12 GUARANTEE AND WARRANTY – See Division 1.

PART 2 - PRODUCTS

2.1 MATERIAL SUBSTITUTION – See Division 1.

PART 3 - EXECUTION

3.1 RESPONSIBILITY

A. Provide material, equipment, labor, services, supplies, etc., required to execute to completion work shown on the drawings, described in these specifications, or made necessary by the work shown on the drawings and/or described in these specifications.

B. Schedule work and furnish the required materials in such a manner that the work may progress from start to finish in an expeditious and efficient manner without undue interruption. Schedule the work to coordinate with the construction.

3.2 COORDINATION OF TRADES

A. Prior to the installation of any materials, review the drawings indicating work to be performed by each trade. If conflicts occur, they shall be brought to the attention of the Engineer for resolution.

B. Work installed without coordinating with the other trades, which causes interferences, shall be removed and reworked, at no cost to the Owner.

C. Coordinate sleeve selection and application with firestopping specified in Division 7.

3.3 PROTECTION OF EQUIPMENT AND WORK

A. Protect and preserve materials, supplies, equipment, piping, etc., from damage due to weather, corrosion, dirt, vandalism, theft, etc. Provide enclosures or special protection as indicated by circumstances.
B. Should any of the materials, equipment, etc., be damaged as a result of their negligence, then this Contractor shall be held responsible for all such damage and costs incurred for repair or replacement.

3.4 CONSTRUCTION STAGING – See Division 1.

3.5 DEMOLITION OF FACILITIES

A. GENERAL

1. The demolition work shall consist of removal of electrical equipment and materials pertaining to the existing electrical systems as indicated on the drawings.

2. Demolition drawings provided are representative of existing conditions, prepared from previous design drawings and field surveys, but may not be all inclusive of existing conditions at the present time. Field verify actual existing conditions and remove all items, whether indicated on drawings or not, as required for new work.

3. Include in the bid all demolition work as required and as shown on the drawings.

4. Where items are removed, utilities and the area from which the items have been removed shall be left in such a manner that they are safe to both people and property.

5. Before disconnection of any systems, advance approved arrangements shall be made to prevent interference with utility services to rooms and structures not otherwise affected by work under this contract.

6. Equipment to be reused shall be disconnected, marked and protected where necessary.

B. EXISTING CONDITIONS

1. Exercise great caution when performing demolition work so as not to damage existing systems or items of work that are to remain. If the Contractor damages, destroys or removes an existing system which is to remain, the Contractor shall be responsible to repair or replace that system to its original condition.

2. Unless specifically stated otherwise on the drawings, where access to electrical items is required, provide the required access by removing ceiling, walls and other obstructions, cutting openings, etc., as required. Prior to cutting openings, outline the openings and obtain approval from the Contractor and cut openings in the manner directed by the Owner’s Representative. Demolition work shall also include the removal and replacement of walls as required for installation or removal of equipment.

3. Provide repair and replacement of openings. Materials which are removed and are damaged or soiled shall be replaced with new materials. Ceilings, walls, conduits, etc., shall be properly repaired and restored to as close to the original condition as possible. Replacement of surface finish materials such as paint, ceiling tile, flooring materials, etc., shall be provided by the Contractor.

4. Provide repair of floor opening. Floors shall be repaired to match the level and surface finish of the existing concrete.

5. Areas shall be repaired with materials matching those which have been removed.
C. PROTECTION

1. During demolition operations, all persons and property shall be protected. Provide erection of any barriers, fences, guard rails, enclosures, chutes, and shoring to protect all persons and property.

2. The work shall proceed in a manner to minimize any spread of dust, debris and flying particles, and so that any related effects of demolition do not interfere with the surrounding equipment, personnel, or buildings.

3. Where necessary, provide temporary enclosures to be sure that the area is secured, safe and weatherproofed.

D. DISPOSITION OF MATERIAL:

1. Those items of material and equipment to be removed and designated to become the property of the Owner, shall be delivered to an on-site location designated by the Owner. All other materials and equipment removed shall become the property of this Contractor and shall be removed from the job site and legally disposed of.

3.6 EQUIPMENT FURNISHED BY OTHERS

A. Some pieces of equipment, as indicated on the drawings, will be furnished by the Owner and/or under other Divisions of these specifications. Provide electrical work as shown for connections to this equipment.

B. Start-up of equipment furnished by the Owner or under other Divisions of these specifications shall be the responsibility of this Contractor under the Section assigned the responsibility to receive and set in place or to move and set in place.

C. Warranties for equipment furnished shall be by the equipment manufacturer.

3.7 MAINTENANCE OF WORK AREAS

A. This Contractor shall maintain the work area in an organized manner, shall not allow debris to accumulate, and shall store equipment, tools and supplies in a manner which shall not cause interference with the activities of others engaged on the project.

B. Open ends of conduit, equipment and specialties shall be kept properly closed during construction and installation so as to avoid contamination.

3.8 CLEANING AND CLEANUP

A. See Drawings and Division 1.

B. Upon completion of this work, clean all panels, fixtures, and equipment. Leave all work in a finished, clean, and satisfactory working condition.

END OF SECTION 260000
RELEASE OF CADD FILES

The drawings prepared by SSC Engineering have been prepared using AUTOCAD 2018. Files for plan drawings prepared by SSC Engineering will be made available to the successful HVAC, plumbing, electrical and fire protection contractor by email; no other drawings will be released. The files will have background files bound in, borders and title blocks removed, and all notes, details, diagrams, and schedules removed. A release form must be signed. Utilization of these documents for the development of shop drawings and submittals does not relieve the contractor from any of his responsibilities herein.

Release form that must be signed:
As requested, SSC Engineering will provide ______________________ (name of contractor) with electronic CADD files of the requested (M, E, P, FP) floor or ceiling plans on the terms set forth below. While SSC is not required under its contract to provide or update these electronic files for this purpose, they are being made available as a convenience to the contractor and as a substantial time saver in the preparation of submittals for this project.

The files contain information through the date when the drawings were issued for bidding and may or may not contain information from the addenda. The company using these files shall be responsible for the coordination of the information contained therein with the Plans, Specifications and other Contract Documents. In the event of any ambiguity, discrepancy or conflict between the information within the electronic files and the Contract Documents, the Contract Documents shall be used.

SSC will not be responsible for any error or malfunction in the translation, interpretation or use of this electronic information once it has been provided to the contractor. SSC does not assume any responsibility arising out of the use or adaptation of the information contained in these files or the sufficiency of any drawings prepared based upon the information included within. By accepting these drawing files, the contractor agrees to hold the Engineer harmless with regard to any errors or omissions in the drawing files. Nothing included in this release shall modify any requirements or responsibilities of either party under their respective contracts.

Signing below indicates understanding and acceptance of these terms. Upon receipt of a signed letter or fax, SSC will release the electronic CADD files.

Project Name and Number: ______________________________________________________

Specific Drawings Request: ______________________________________________________

Acknowledged and Agreed:

__________________________________ ___________________________________________
Company     Version of AutoCAD used

__________________________________ ___________________________________________
Name (Must be an officer of the Company) E-mail address

__________________________________ ___________________________________________
Title        Maximum e-mail attachment size

__________________________________ 
Date
SECTION 260010 – BASIC ELECTRICAL MATERIALS AND METHODS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Applicable provisions of the General Conditions, Supplementary General Conditions and Special Conditions shall govern work performed under this section.

B. Section 260000 - Basic Electrical Requirements.

1.2 SCOPE OF WORK

A. This section supplements all sections of this Division and shall apply to all phases of work hereinafter specified, shown on the drawings, or required to provide a complete installation of electrical systems.

1.3 QUALITY ASSURANCE

A. Electrical work including, but not limited to, installation, materials, equipment and wiring methods, shall comply with the applicable National Electrical Code, NFPA 70.

B. Equipment and materials shall comply with the applicable requirements of the following:

1. National Electrical Manufacturer Association (NEMA).
2. Institute of Electrical and Electronic Engineers (IEEE).
5. Underwriters Laboratories (UL).


PART 2 - PRODUCTS

2.1 Provide products, components and materials which are listed and labeled by Underwriters Laboratories (UL).

2.2 EQUIPMENT IDENTIFICATION LABELS

A. Self-Adhesive, Engraved, Laminated Acrylic or Melamine Label: Adhesive backed, with white letters on a black background. Minimum letter height shall be 3/8 inch.

B. Engraved, Laminated Acrylic or Melamine Label: Punched or drilled for screw mounting. White letters on a black background. Minimum letter height shall be 3/8 inch.
PART 3 - EXECUTION

3.1 Install equipment and materials in a neat and workmanlike manner and align, level, and adjust for satisfactory operation. Install equipment so that all parts are easily accessible for inspection, operation, maintenance and repair.

3.2 SUPPORTS

A. Provide the design, fabrication, and erection of supplementary structural framing required for attachment of hangers or other devices supporting electrical equipment.

B. Provide members welded to structural members equal to the specification for the main structural member. Provide "simple beam" type framing with end connections welded or bolted for shear loads. Use cantilevers only when detailed or specifically approved by the Engineer. The Engineer's approval is required for location of supplementary framing.

C. Design framing members for their actual loads, with allowable stresses specified by AISC, without excessive deflection and with consideration for rigidity under vibration, in accordance with standard structural practices.

D. When supplementary framing is indicated, verify that dimensions are suitable for the equipment furnished. Provide additional strength when equipment furnished is heavier than that specified.

E. Fire alarm conduit shall be red in color with red junction boxes to identify wiring contained within.

3.3 WIRING DEVICE LOCATION

A. Position of Outlets: Center all outlets with regard to paneling, furring and trim. Symmetrically arrange outlets in the room. Satisfactorily correct outlets improperly located or installed. Repair or replace damaged finishes. Set outlets plumb and extend to the finished surface of the wall, ceiling, or floor without projecting beyond same. Install symmetrically all receptacles, switches, and outlets shown on the trim or casework. Where necessary set the long dimension of the plate horizontal, or ganged in tandem.

B. Mounting heights, to center of box above finished floor, shall be as follows, unless otherwise indicated. Other mounting heights are indicated on the drawings by detail or by a plus dimension shown adjacent to the symbol:

<table>
<thead>
<tr>
<th>Device Type</th>
<th>Height</th>
</tr>
</thead>
<tbody>
<tr>
<td>Switches</td>
<td>46 inches</td>
</tr>
<tr>
<td>Receptacles and similar devices</td>
<td>18 inches</td>
</tr>
<tr>
<td>Motor controllers and disconnect switches</td>
<td>60 inches to top</td>
</tr>
<tr>
<td>Exterior WP convenience outlets</td>
<td>24 inches above grade</td>
</tr>
</tbody>
</table>

3.4 IDENTIFICATION

A. General

1. All electrical equipment and devices shall be identified by nameplates or labels.
2. Labels (Stencils) - Shall be Brady or Westline and shall be color coded in accordance with ASA-Z34-1-53 "SAFETY COLOR CODE" to include system voltage, abbreviations of service, etc. For example: "Fire Alarm", "120/208V", etc.
   a. In general, all exposed feeders, conduits, raceways, pull boxes, and junction boxes shall be identified.
   b. For conduit systems installed for future wiring installations, all conduits and pull boxes, both exposed and above ceiling, shall be identified.
   c. Labels shall be used on all bare or smooth painted surfaces. For rough textured surfaces, such as wrinkle painted surfaces or plastic materials where sticking labels would not be permanent, stencils or screwed on letters shall be used.

3. Label all low voltage wiring at both ends with Brady tags. Identify data and telephone cables by cable number and document on As-Built documents.

4. Provide identification of circuit numbers on each receptacle.

5. Nameplates shall be provide for panelboards white core, black face, plastic with engraved letters. Attachment to equipment shall be done by means of screws, 2-1/4" high with information as follows. The name of the equipment in ½" high bold letters followed by the source feeding the equipment or the equipment that it is feeding with room # letters in 1/4" bold. Labels may be on smaller stock and lettering may be smaller where space does not permit size shown above. See examples below:

   Panel P1
   Fed From Meter Bank
   Located On North Exterior Wall of Building

B. Equipment Identification

1. Panelboard - Nameplate shall designate panel number, upstream panel and voltage. Nameplate shall be mounted on the inside of panel door when the panel is located in finished areas and on the front of door when located in mechanical equipment rooms; typewritten branch circuit connection sheet shall be inserted within the panelboard manufacturer’s' card holder.

2. Disconnect Switches and Motor Starters - Nameplates shall describe the equipment to be controlled and power circuit number.

3. Pushbutton Stations - Label shall identify the equipment controlled.

4. Transformers - Nameplate shall identify the equipment by plan designation, primary and secondary voltages, and KVA rating.

5. Auxiliary System Equipment - The control cabinets for auxiliary systems, such as fire alarm, P.A., intercom, program, etc., shall be identified with nameplate describing the system by designation, power circuit and voltage.
6. Fusible Switches - In addition to the nameplate, there shall be labeled on the inside of switch door, the fuse size required for equipment served.

7. Junction and Pull Boxes - Identify the function of the box such as "208 volt," "Telephone," "Fire Alarm," etc., with nameplates.

C. Raceway Identification
   1. In general, all exposed feeder conduits, wireways, etc., shall be identified. Branch circuit designations shall be made only after the load balancing of the panelboards has been completed and shall be approved by Owner's representative. In general, designations shall include the area name and lighting type (e.g., Down Lights).
   2. The identification labels shall be located at intervals of 50 feet or less and at every point where a conduit or raceway is entering and leaving a room.

D. Device Circuit Identification
   1. Receptacles connected to emergency power shall be identified by panel name and circuit number, with labels adhered to the device cover plate.
   2. Receptacles connected to normal power shall be identified by panel name and circuit number, with labels adhered to the device cover plate.

3.5 TEST
   A. Provide the tests as outlined hereinafter and other tests necessary to establish the adequacy, quality, safety, completed status and suitable operation of each system.
   B. Balance phase currents of all distribution panels and branch circuit panels within plus or minus 10 percent variation between average phase current and measured individual phase currents.
   C. Written test record shall be supplied to the Owner to show compliance with governing codes for grounding continuity.
   D. Final Corrections: Correct promptly any failure or defects revealed by these tests as determined by the Engineer. Reconduct tests on these corrected items as directed by the Engineer.

3.6 ALTERATIONS
   A. The Owner intends to make continued use of existing facilities during the construction period. Utilities and services to existing facilities shall not be interrupted without the Owner's approval. Organize the work as to cause a minimum of interference with the normal routine activities of the facilities. Interruptions shall be scheduled at the convenience of the Owner.
   B. Remove, cap and/or relocate equipment, outlets, conduit, wire, etc., as shown and specified on drawings. Examine all existing walls designated for removal, to determine the conduit and the wiring that will require capping and/or removal, whether or not such conditions are indicated on the drawings.
C. Lighting fixtures, switches, receptacles, telephone outlets, fire alarm outlets, special outlets, etc., which are shown on the demolition plans shall be removed.

D. Concealed conduit for circuits which are partially or completely abandoned may remain in place. Exposed conduit for abandoned circuits shall be removed unless otherwise noted.

E. Wiring for existing circuits which must be re-routed, or which are partially abandoned, shall be reconnected to service the remaining outlets on the circuit.

F. Wiring for a circuit which is to be abandoned shall be removed back to the panel which supplied the circuit.

G. Refer also to specification 260000 for demolition requirements.

3.7 CUTTING AND PATCHING

A. Provide openings for conduit, by means of sleeves.

B. Provide cutting required for conduits if sleeves or openings are not properly provided. Under no circumstances shall any structural members, load bearing walls or footings be cut without first obtaining written permission from the Structural Engineer.

C. Cutting shall be limited to the size necessary for working conditions. When cutting surfaces are difficult or costly to replace, such as marble, glazed tile, wood paneling, etc., obtain the Owner’s approval in advance of the cutting and patching.

D. Before cutting or drilling holes in floors, verify the location of reinforcing steel bars and embedded electrical conduits to avoid cutting same. X-ray floors where necessary to verify such locations. Contact the Engineer before proceeding with cutting if such obstructions interfere with the locations of planned holes.

3.8 ROOF OPENINGS

A. Provide cutting, patching and flashing of roof for conduits through roof. Roof cutting and patching shall be coordinated with the roof installer. The original roof warranty shall be maintained.

3.9 PAINTING

A. Electrical equipment shall be factory finished standard color as furnished by the manufacturer. Scratches shall be touched up in the field after equipment is installed with paint which matches the original color.

END OF SECTION 260010
SECTION 260070 – ELECTRICAL CONNECTIONS FOR EQUIPMENT

PART 1 - GENERAL

1.1 SUMMARY

A. This section covers electrical connections to equipment.

1.2 EQUIPMENT CONNECTIONS

A. Extent of electrical connections for equipment is indicated by drawings and schedules. Electrical connections are hereby defined to include connections used for providing electrical power to equipment.

B. Refer to drawings for additional requirements.

C. Applications of electrical power connections specified in this section include the following:
   1. From electrical source to motor starters/VFDs.
   2. From motor starters/VFDs to motors.
   3. From electrical source to equipment with pre-wired control panels.

D. Provide electrical connections for equipment, specified in Division 21, 22, & 23 and in other Division 26 sections.

E. Provide motor starters and controllers, not furnished as part of equipment.

F. Refer to Motor and Equipment Schedule on drawings and Division 21, 22, & 23 sections for motor starters and controllers furnished with equipment.

G. Provide disconnect switches and junction boxes required for connecting motors and other electrical units of equipment.

H. Variable Frequency Drives (VFD) will be furnished under Division 22 & 23. Install VFDs and provide wiring and connections. Include wiring between VFD and safety switch to shut down VFD when safety switch is turned off and circuit is open.

I. Provide electrical identification for wire/cable conductors.

J. Provide raceways and wires/cables required for connecting motors and other electrical units of equipment.

K. Temperature control system wiring will be provided under Division 23.

L. Refer to sections of other divisions for specific individual equipment power requirements requiring electrical connections.

1.3 QUALITY ASSURANCE

A. ANSI Compliance: Comply with applicable requirements of ANSI/NEMA and ANSI/EIA standards pertaining to products and installation of electrical connections for equipment.
B. U.L. Compliance: Comply with U.L. Std. 486A, “Wire Connectors and Soldering Lugs for Use with Copper Conductors” including, but not limited to, tightening of electrical connectors to torque values indicated. Provide electrical connection products and materials which are U.L. listed and labeled.

C. Comply with NFPA 70 “National Electrical Code” for components and installation.

PART 2 - PRODUCTS

2.1 Provide products, components and materials which are listed and labeled by UL.

PART 3 - EXECUTION

3.1 INSPECTION

A. Inspect area and conditions under which electrical connections for equipment are to be installed and notify Contractor in writing of conditions detrimental to proper completion of the work. Do not proceed with the work until unsatisfactory conditions have been corrected in a manner acceptable to Installer.

3.2 INSTALLATION OF ELECTRICAL CONNECTIONS

A. Install electrical connections as indicated, in accordance with equipment manufacturer’s written instructions and with recognized industry practices and complying with applicable requirements of U.L., NEC and NECA’s “Standard of Installation” to ensure that products fulfill requirements.

B. Coordinate with other work, including wire/cables, raceway and equipment installation, as necessary to properly interface installation of electrical connections for equipment with other work.

C. Connect electrical power supply conductors to equipment conductors in accordance with equipment manufacturer’s written instructions and wiring diagrams. Mate and match conductors of electrical connections for proper interface between electrical power supplies and installed equipment.

D. Cover splices with electrical insulating material equivalent to, or of greater insulation resistivity rating than, the electrical insulation rating of those conductors being spliced.

E. Prepare cables and wires by cutting and stripping covering armor, jacket and insulation properly to ensure uniform and neat appearance where cables and wires are terminated. Exercise care to avoid cutting through tapes which will remain on conductors. Also avoid “ringing” copper conductors while skinning wire.

F. Trim cables and wires as short as practicable and neatly arrange routing to facilitate inspections, testing and maintenance.

G. Tighten connectors and terminals, including screws and bolts, in accordance with equipment manufacturer’s published torque tightening values for equipment connectors. Accomplish tightening by utilizing proper torquing tools, including torque screwdriver, beam-type torque...
wrench and ratchet wrench with adjustable torque settings. Where manufacturer’s torqueing requirements are not available, tighten connectors and terminals to comply with torqueing values contained in U.L.’s 486A.

H. Provide flexible conduit for motor connections and other electrical equipment connections, where subject to movement and vibration.

I. Provide liquid-tight flexible conduit for connection of motors and other electrical equipment where subject to movement and vibration, and also where connections are subjected to one or more of the following conditions:

1. Exterior location

J. Fasten identification markers to each electrical power supply wire/cable conductor which indicates their voltage, phase and feeder number in accordance with Division 26, Sections 260010 and 260120, Part 3.4. Affix markers on each terminal conductor, as close as possible to the point of connection.

3.3 FIELD QUALITY CONTROL

A. Upon completion of installation of electrical connections, and after circuitry has been energized with rated power source, test connections to demonstrate capability and compliance with requirements. Ensure that direction of rotation of each motor fulfills requirement. Correct malfunctioning units at site, then retest to demonstrate compliance.

END OF SECTION 260070
SECTION 260110 – RACEWAYS, FITTINGS AND BOXES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Applicable provisions of the General Conditions, Supplementary General Conditions and Special Conditions shall govern work performed under this section.

1.2 SUMMARY

A. This section includes raceways, fittings and outlet boxes.

1.3 QUALITY ASSURANCE

A. Comply with NFPA 70 “National Electrical Code” for components and installation.
B. Comply with NECA 101, “Standard for Installing Steel Conduit (Rigid, IMC, EMT).”
C. Comply with NECA 111, “Standard for Installing Non Metallic Raceways (RNC, ENT and LFNC).”
D. Comply with NECA 120, “Standard for Installing Armored Cable (Type AC) and Metal Clad Cable (Type MC).”
E. Comply with NECA 605, “Recommended Practice for Installing Underground Nonmetallic Utility Duct.”

PART 2 - PRODUCTS

2.1 RACEWAYS (Raceways shall be new and shall bear the UL label)

A. Electrical Metallic Tubing: Shall be cold rolled welded steel conduit, galvanized on both the outside and inside. Connectors and couplings shall be steel alloy. Setscrew connectors and couplings are approved for indoor exposed or concealed (but not encased in concrete or masonry) work only. Gland compression connectors and couplings are approved for all locations. Indenter type connectors and couplings are not approved. Connectors up to and including size 1-1/2" shall be with insulated throat. Connectors shall be terminated with a bonding type locknut and for conduit sizes 2" and larger, a plastic insulated bushing. Threaded steel insulated grounding bushings having solderless lugs shall be used where required. Comply with ANSI C80.3. Connectors shall be steel; die-cast is not acceptable.


C. Rigid Steel Conduit: Shall be zinc-coated rigid steel conduit and conduit fittings. Comply with ANSI C80.1 and UL 6. Couplings and fittings shall be of the threaded type. Threadless fittings shall be used only when specific approval is given by the engineer.

D. Use Anaconda "Sealtite" flexible, liquid-tight conduit in damp or wet locations.

E. Wireway: Shall be constructed of code gauge steel and shall be in accordance with Underwriters Laboratories Standard UL-870 for Wireways, Auxiliary Gutters and Associated
Fittings. Wireway shall be lay-in type (no cross bars or straps) with hinged cover. Indoor wireway shall be constructed with knockouts. Outdoor wireway shall be rain tight with no knockouts. Sheet metal parts shall be coated with a rust inhibiting primer and a gray baked enamel finish. Hardware shall be plated to prevent corrosion. Wireway shall be of standard dimensions and sized in accordance with the National Electrical Code for the particular installation. Wireway shall be Square D "SQUARE-DUCT" or approved equivalent.

2.2 OUTLET BOXES

A. Provide outlet boxes; pull boxes, and conduit fittings as described below. Catalog numbers shown are those of Appleton Electric Company. Steel City, National Electric Products Corp., and Raco are equally acceptable. Comply with NEMA OS-1 and FB

1. Lighting Boxes (concealed) - No. 40-3/4
2. Lighting Boxes (concrete) - No. OCR Series
3. Lighting Boxes (exposed) - No. 4S-3/4 or 40-3/4
4. Switch, Receptacle, Telephone and Junction Boxes (flush) - No. 4S-3/4 or No. 225 where separate extension or plaster ring cannot be used.
5. Switch, Receptacle, Telephone and Junction Boxes (exposed) - FS Series
6. Switch and Telephone Boxes (concealed in narrow mullions) - Bell Electric Co. No. 447, 448, or 449.
7. Weatherproof or Exterior Boxes - FS Series with weatherproof while-in-use cast metal cover and neoprene gasket.

B. Where space is limited, No. 4CS-3/4 handy boxes may be used for a switch, receptacle, telephone or other outlet.

C. Provide extension and plaster rings as required.

D. Size outlet boxes in accordance with the allowable fill permitted by the National Electrical Code.

2.3 PULLBOXES

A. Provide code gauge galvanized sheet metal pull boxes sized as per the National Electrical Code or as shown on the drawings. Provide a removable cover on the largest access side of the box unless otherwise detailed. Where cast boxes are specified, provide conduit entrances with threaded hubs. Provide stainless steel screws in all exterior locations and in wet or damp locations.

2.4 CONDUIT FITTINGS

A. UL-514B, NEMA FB-1 and NEMA TC-3 listed. Steel material, die-cast is not acceptable.

B. EMT Couplings:

1. Series 95T gland compression (all locations).
2. Series TWC set screw (indoor only but not encased in concrete or masonry)
3. Steel material, die-cast is not acceptable.
C. EMT Connectors:
   1. Series 86T gland compression (all locations)
   2. Series TW set screw (indoor only - but not encased in concrete or masonry)
   3. Steel material, die-cast is not acceptable.

D. Insulating Bushings (1-1/4 inch rigid conduit and larger) - Series BBU

E. Straight Box Connectors (flexible conduit) - Series 728 9V

F. Angle Box Connectors (flexible conduit) - Series 738 2V

G. Sealing Gland Assembly - OZ, Type FSK

H. Expansion Joints - OZ, Type AX or TX with bonding jumpers and clamps.

I. Expansion and Deflection Fittings - OZ, Type DX

J. Cast Metal Conduit Fittings - Crouse-Hinds, Condulets form 7 with wedge nut cover.

PART 3 - EXECUTION

3.1 RACEWAYS - GENERAL
   A. Install all wiring, including telephone, low voltage, etc., in raceways as indicated on the plans and in this specification.
   B. Install raceways concealed, except in mechanical equipment rooms or where indicated on the plans.
   C. Minimum raceway size shall be ½" for interior applications and 1" for exterior applications.

3.2 APPLICATION
   A. Conduits located exposed, concealed inside shafts or column enclosure and all homeruns shall be EMT. PVC shall be used in concrete slabs, but last elbow out of floor slab shall be IMC. Minimum 2" concrete above conduit.
   B. Conduits run horizontally between boxes containing wiring devices in walls shall be EMT.
   C. Exterior conduits exposed above grade shall be galvanized rigid steel, 1" minimum.
   D. Sleeves and conduits for feeders over 600 volts shall be rigid steel conduit.
   E. Conduits and junction boxes for fire alarm wiring shall be red in color.
   F. Conduits for connection to vibrating equipment such as motors, transformers, etc., shall be weatherproof Sealtite shall be used in damp or wet locations.
   G. Any type of conduit or raceway that is specifically labeled on the plans shall take precedence over the specification. Obtain written permission from the Engineer for any other deviation from the specification requirements.
3.3 INSTALLATION

A. Continuity. Provide metallic raceways continuous from outlet to outlet, and from outlets to cabinets, junction or pull boxes. Enter and secure conduit to all boxes to provide electrical continuity from the point of service to outlets. Provide double locknut and bushing on terminations of metallic conduits.

B. Raceways Exposed. Run exposed raceways in straight lines at right angles or parallel with walls, beams or columns.

C. Sleeves: Sleeves through floors and walls shall be not less than three diameters on centers. Conduit sleeves in floors shall be steel and shall extend 3 inches above the finished floor and flush with the underside of the floor slab. Size sleeves to provide ¼” annular clear space (interior sleeves) or 1” (exterior sleeves) between sleeve and raceway.

D. Sealing of Sleeves: Openings and sleeves through which a conduit passes in non-fire rated walls, floors, and ceilings shall be properly sealed after the conduit is installed to prevent transmission or leakage of liquids, smoke, and sound. Conduit passing through drywall construction or sleeves shall be sealed both sides of the opening shall be caulked with a resilient non-hardening caulking such as U.S.G. Acoustical Sealant, Tremco, or approved equal.

E. Sealing of Sleeves: Conduit passing through fire rated floors, walls and ceilings shall be sealed by a UL Listed System with hourly rating equivalent to fire rated floors, walls or ceilings. Fire proofing materials by S.T.I., U.S.G., Tremco, 3M and Hilti must be installed according to UL Listed Systems.

F. Sleeves for fire rated walls and ceilings where data, voice, etc., cables penetrate fire walls or fire rated ceilings provide a fire stopping system as manufactured by STI EZ-Path, Wiremold FlameStopper or equal. Fire stopping system shall be UL classified and FM approved in accordance with ASTM E814 (UL1479).

G. Raceways through Exposed Roof: Where raceways penetrate the roof seal, provide suitable pitch pockets of lead flashing or flexible boot-type flashing units applied in coordination with roofing work.

H. Raceways Entering the Building Below Grade: Provide raceways with stainless steel plates and hardware with EDPM or NBR links and wall entrance mechanical sleeve seals having a water tight sealing gland assembly where the raceways enter into a dry area. Use OZ Gedney type FSK or equivalent seal. Following installation of conductors, cables and pull tapes in raceways, provide water stop inside conduits equivalent to Tyco RDSS and RDSS-Clip inflatable sealing bladders.

I. Bends. Where more than one conduit in a bank of exposed conduit changes direction, all bends shall be concentric. Conduit bends shall not be less than standard radius. Conduit bends for power feeders over 600 volts and for telephone feeders shall be long radius.

J. Threads. Clean all threads of rigid conduit. Coat all male threads of all steel conduit installed underground or in or under concrete slabs with teflon immediately before being coupled together.
K. Running Threads. Use "Erickson" type couplings in lieu of running threads.

L. Protection. Cap raceways stubbed up, including those in cabinets, immediately upon their installation. The use of paper or rag wads will not be permitted.

M. Expansion Joints. Provide raceways crossing expansion joints with Type BJ bonding jumper for bonding conduit or tubing together. Where differential settlement may occur, use deflection fittings.

N. General Location Requirements. Raceway runs shown are diagrammatic. Determine exact locations in the field except where otherwise noted or where dimensions are specified on the drawings. Conduits shall not run within 12 inches of pipes carrying hot liquids, steam, or gases.

O. Pull Tapes. Empty conduits shall be provided with a pull tape.

P. Provide accessories as required for a complete installation, including insulated bushings and inserts where required by the manufacturer or NEC. Provide insulated bushings on all conduit stub-ups, where conduit does not terminate in a box or enclosure, and on all enclosure openings where cables enter or exit unprotected by conduit.

Q. Install no more than the equivalent of three 90-degree bends in any conduit run except for communication conduits. Communications conduits shall have a maximum of two 90-degree equivalent bends for each raceway. Communication conduits 3/4" and less shall be installed in maximum lengths of 50 feet and 1" and larger at 75 feet maximum lengths.

3.4 RACEWAYS SUPPORTS

A. Supports. Install raceway supports in accordance with the requirements of the National Electrical Code. Do not anchor or strap conduits to the ceiling furring channels or attach to ceiling hanger wires.

B. Straps and Hangers. Conduit shall be supported from building structure on approved types of galvanized brackets, ceiling trapeze or pipe straps, or hangers secured by means of toggle bolts on hollow masonry; or expansion bolts in concrete or brick; or machine screws on metal surfaces; or wood screws on wood construction. Conduits shall be attached to the hanging systems by fittings equal to those manufactured by Caddy Fasteners. Nails shall not be used as a means of fastening boxes or conduits. Perforated flat steel straps shall not be used for supporting conduit. Conduits shall not be supported from ductwork or ductwork supports. Conduit shall be properly supported in order to deter any possible vibration, noise, or chatter.

3.5 JOINTS AND CONNECTIONS

A. Metal Conduits. Make watertight all couplings and threaded connections in threaded conduit. Cut all joints square, ream smooth, and properly thread. Fit all box connections with a minimum of two approved locknuts and one steel, plastic or fiber bushing forming an approved tight bond with box. Provide locknuts both inside and outside of the enclosure to which the conduit is attached. Use rain tight compression type fittings for electrical metallic
tubing systems and use at least one locknut on the inside of each enclosure entry. Provide grounding locknuts or bushings where required in Section 260455 GROUNDING SYSTEMS.

B. Join raceways with fittings designed and approved for the purpose and make joints tight. Make raceway terminations tight. Use bonding bushings or wedges at connections subject to vibration. Use bonding jumpers where joints cannot be made tight. Use insulating bushings to protect conductors.

C. Tighten set screws of threadless fittings with suitable tool.

D. Terminations: Where raceways are terminated with locknuts and bushings, align the raceway to enter squarely, and install the locknuts with dished part against the box.

E. Where terminating in threaded hubs, screw the raceway or fitting tight into the hub so the end bears against the wire protection shoulder. Where chase nipples are used, align the raceway so the coupling is square to the box, and tighten the chase nipple so no threads are exposed.

F. Flexible Connections: Use maximum of 6 feet (1830 mm) of flexible conduit for; for equipment subject to vibration, noise transmission, or movement; and for all motors. Use liquidtight flexible conduit in wet or damp locations. Install separate ground conductor in flexible connections.

3.6 BOX APPLICATIONS

A. Outlet Boxes and Fittings: Install outlet and device boxes and associated covers and fittings of materials and NEMA types suitable for each location and in conformance with the following requirements:
   1. Interior Dry Locations: Sheet steel, NEMA type 1.
   2. Locations Exposed to Weather or Dampness: Cast metal, NEMA type 3R.
   3. Wet Locations: NEMA type 4X enclosures.

B. Through-wall boxes are not permitted. Offset back-to-back boxes in the same wall not less than 3". If boxes are in fire rated partitions, offset boxes a minimum of 24" or provide fire rated “putty pads” on boxes. If boxes are in the same stud cavity and open to opposite sides of the wall, provide “putty pads” on boxes.

C. Pull and Junction Boxes: Install pull and junction boxes of materials and NEMA types suitable for each location, except as otherwise indicated.

3.7 OUTLET BOX INSTALLATION

A. Install items where indicated and where required to suit code requirements and installation conditions.

B. Cap unused knockout holes where blanks have been removed and plug unused conduit hubs.

C. Support and fasten items securely in accordance with Division 26 Section “Supporting Devices.”
D. Sizes shall be adequate to meet NEC volume requirements, but in no case smaller than sizes indicated.

E. Remove sharp edges where they may come in contact with wiring or personnel.

F. Mounting: Mount outlet boxes for switches with the long axis vertical. Mount boxes for receptacles vertically. Three or more gang boxes shall be mounted with the long axis horizontal. Locate box covers or device plates so they will not cover different types of building finishes either vertically or horizontally. Locate boxes for switches near doors on the side opposite the hinges.

G. Ceiling Outlets: For fixtures, where wiring is concealed, use outlet boxes 4-inches square by 1-1/2 inches deep, minimum.

H. Protect outlet boxes to prevent entrance of plaster and debris. Thoroughly clean foreign material from boxes before conductors are installed.

END OF SECTION 260110
SECTION 260120 - CONDUCTORS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Applicable provisions of the General Conditions, Supplementary General Conditions and Special Conditions shall govern work performed under this section.

1.2 SUMMARY

A. This section includes conductors, wires, cables and associated splices, connections and terminations for wiring systems rated 600V or less.

1.3 QUALITY ASSURANCE

A. Conductors and cable shall conform to UL, NEMA WC70, NECA 120, NFPA 70 and ICEA S-95-658 requirements.

B. Comply with NECA 120, “Standard for Installing Armored Cable (Type AC) and Metal Clad Cable (Type MC).”


PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Wires and Cables

1. Alcan Products Corporation; Alcan Cable Division
3. BICC Brand-Rex Company
4. Carol Cable Co., Inc.
5. Service Wire Company
6. Southwire Company
7. Alflex Corporation
8. AFC Cable Systems, Inc.
9. Colonial Wire and Cable Co., Inc.
10. General Cable Corporation
11. Okonite Company
12. Pirelli Cable Company
13. Superior Essex

B. Connectors for Wires and Cables

1. AMP Inc.
2. General Signal; O-Z/Gedney Unit
3. Tyco Electronics Corporation
4. Square D Co.; Anderson
5. 3M Company; Electrical Products Division
6. AFC Cable Systems, Inc.
7. Erico, Inc.
9. ILSCO Corporation
10. Thomas & Betts Corporation

2.2 CONDUCTORS

A. Provide 98% conductivity copper conductors with insulation rated for 600 volts, type THHN or THWN-2 for interior use and type XHHW-2 for exterior installation.

B. Conductors No. 12 AWG and smaller shall be solid. Conductors No. 10 AWG and larger shall be stranded.

C. Provide single copper conductors throughout. Provide No. 12 AWG minimum branch circuit wire size.

D. Provide No. 14 AWG THHN for control circuits, unless otherwise specified or required by overcurrent protection.

2.3 CONNECTORS FOR CONDUCTORS

A. Provide UL-listed factory-fabricated, solderless metal connectors of sizes, ampacity ratings, materials, types and classes for application and for service indicated. Use connectors with temperature ratings equal to or greater than those of the wires upon which used.

2.4 CABLES

A. Type MC cable for health care facilities shall have separate green insulated ground conductor, as well as a bonding wire. Armored metal jacket shall have a continuous green marketing stripe. This cable shall be AFC cable systems type HFC-90, or equal.

1. Types MC, Healthcare MC and AC cables shall not be used for Emergency Power System wiring except as permitted by NEC Article 517.

B. Connectors and fittings for type MC cable shall be manufactured and listed for that purpose.

2.5 TYPE NOT PERMITTED

A. The following wire and cable types are not permitted to be used:

1. BX
2. NM/NME
3. TW

PART 3 - EXECUTION

3.1 CONDUCTOR SIZES AND TYPES
A. Wire size and insulation type entering any lighting fixture or equipment shall be as recommended by the manufacturer and as minimally required by the codes. Where no recommendation is given by the manufacturer, the wire size and insulation type shall meet the minimum rating of the wiring or terminations used in the fixture or equipment.

B. Conductor sizes for motors, equipment and feeders shall be as indicated. See Schedules on drawings.

C. MC cable shall not be used for homeruns. Use EMT conduit for all homeruns and connection to Electrical Panels.

D. Patient Care Areas shall be permitted to use conductors in conduit or Type Healthcare MC only. Standard MC Cable is not permissible.

3.2 INSTALLATION

A. Wire and cable shall be installed in conduit, duct, wireway, surface raceway or other raceway specified. No conductors or cables shall be installed in conduits, ducts or raceways until the raceway system has been completed and free of any dirt or water. When installing conductors, exercise due care to prevent damage to conductors and insulation.

B. Wire 10 gauge or smaller shall be spliced, tapped or joined in outlet or junction boxes with solderless spring-type connectors. Bakelite insulated wire nuts are not approved.

C. Conductors 8 gauge and larger shall be terminated using bolted pressure or compression type connectors. They shall be specifically designed for use with the type conductors being installed in compliance with manufacturer’s recommendations.

D. Uninsulated splices, joints and free ends of conductors shall be covered with rubber and friction tape or high dielectric polyvinylchloride Scotch No. 33 Plus electrical tape.

E. Feeder cables shall be continuous from origin to panel or equipment termination without splices in intermediate pull or splice boxes or raceway runs. Where taps and splices are necessary, they shall be made in approved splice boxes with suitable compression type connectors.

F. Fixture and branch circuit wiring joints in exterior junction and outlet boxes shall be made with waterproof connectors rated at 600 volts maximum (1,000 volts when enclosed in fixture or sign).

G. Exterior branch circuit conductor splices below grade shall occur only in gasketed weatherproof junction boxes. Use split bolt connector with Okonite self-fusing tape #35, wrapped by Scotch #33 Plus tape and sealed with 3M High Gel Re-enterable Encapsulant #8882.

H. Coordinate wire installation with other work. Support cables in accordance with Section 260190.
I. Pull conductors simultaneously where more than one is being installed in same raceway. Use UL listed pulling compound or lubricant, where necessary. Perform pull tension calculations and do not exceed those values.

J. Use pulling means including fish tape, cable, rope and basket weave wire/cable grips which will not damage cable or raceways. Do not use rope hitches for pulling attachment to wire or cable. Do not exceed manufacturer’s recommended maximum pulling tensions and sidewall pressure values.

K. Keep conductor splices to a minimum. Provide splice and tap connectors which possess better mechanical strength and insulation rating than conductors being spliced. Use splice and tap connectors which are compatible with conductor materials.

L. Provide adequate length of conductors within electrical enclosures and train the conductors to terminal points with no excess. Make terminations so there is no bare conductor at the terminal. Bundle conductor sizes #12 and #10 together. Bundle individual circuits larger than #10 separately.

M. Tighten electrical connectors and terminals, including screws and bolts, in accordance with manufacturer’s published torque tightening values. Where manufacturer’s torquing requirements are not indicated, tighten connectors and terminals to comply with tightening torques specified in UL 486A and UL 486B.

N. Connect wiring devices, light fixtures, panelboard devices and other electrical equipment to the wiring systems as indicated and in accordance with manufacturer’s instructions.

O. Leave a minimum of 12" pigtail at each outlet for termination purposes.

P. Home runs shall be in conduit. Not more than three (3) branch circuits may be grouped in one homerun to a branch circuit panelboard. Derate conductors per NEC requirements and count the neutral as a current carrying conductor.

Q. Through-wiring is not permitted for recessed lighting fixtures. Each recessed lighting fixture shall be connected by flexible metal-clad cable to a separate junction box mounted above ceiling, which may serve no more than four fixtures. This flexible cable shall be Type MC or AC cable, with ground.

R. Through-wiring is permitted for continuous rows of surface-mounted or pendant-mounted light fixtures. Fixture rows, pendant or surface-mounted, shall be fed through a flush ceiling-mounted outlet box. Branch circuit conductors for through-wiring shall have a minimum temperature rating of 90°C, or higher, if required by lighting fixture manufacturer.

S. Install conductors with compression type motor pigtail connectors of sizes as required for motors and mechanical equipment. Connectors shall be rated for 600V, 90 degrees C, and tin plated copper with the thermoplastic elastomer insulator.

T. Where lugs or termination points are not sized to accommodate the wire size specified or are not listed for the conductor material, provide pin connectors rated for use with
copper/aluminum conductors and terminate with a tool and die size recommended by the connector manufacturer.

U. Keep emergency conductors independent and separate from all other conductors. Do not route emergency conductors and normal conductors in the same raceway.

3.3 FIELD QUALITY CONTROL

A. Prior to energizing, check installed wires and cables with megohm meter to determine insulation resistance levels to assure requirements are fulfilled. Visually inspect all terminations are tight and proper and materials installed are in accordance with the specification section.

B. Prior to energizing test wires and cables for electrical continuity and for short-circuits and proper phase relationship. Verify conductors are appropriately color coded.

C. Subsequent to wire and cable hook-ups, energize circuits and demonstrate proper functioning. Correct malfunctioning units, and retest to demonstrate compliance.

D. Torque all connections/lugs in accordance with manufacturer instructions. Where torque valves are absent, follow ANSI/NETA Standard for acceptance testing specifications.

3.4 COLOR CODING FOR PHASE IDENTIFICATION

A. Color code secondary service, feeder and branch circuit conductors with factory applied color as follows:

<table>
<thead>
<tr>
<th>208Y/120 Volts</th>
<th>Phase</th>
</tr>
</thead>
<tbody>
<tr>
<td>Black</td>
<td>A</td>
</tr>
<tr>
<td>Red</td>
<td>B</td>
</tr>
<tr>
<td>Blue</td>
<td>C</td>
</tr>
<tr>
<td>White</td>
<td>Neutral</td>
</tr>
<tr>
<td>Green</td>
<td>Ground</td>
</tr>
</tbody>
</table>

B. Conductors manufactured in only one color shall be marked with colored tape at each termination to identify each conductor as phase, neutral or ground.

C. Ungrounded conductors supplied from more than one nominal voltage system shall be separately identified where accessible.

END OF SECTION 260120
SECTION 260140 – WIRING DEVICES

PART 1 - GENERAL

1.1 SUMMARY
A. This section covers wiring devices, including floor boxes and outlets, and multi-outlet surface metal raceways.

1.2 RELATED DOCUMENTS
A. Applicable provisions of the General Conditions, Supplementary General Conditions and Special Conditions shall govern work performed under this section.

1.3 RELATED SECTIONS
A. Provide boxes and raceways as specified in Section 260110 - RACEWAYS, FITTINGS AND BOXES.

1.4 QUALITY ASSURANCE
A. Wiring devices shall comply with NEMA Standards WD-1 and WD-6.
B. Comply with NECA 130, “Standard for Installing and Maintaining Wiring Devices.”

PART 2 - PRODUCTS

2.1 RECEPTACLES
A. Receptacles shall be NEMA 5-20R, grounding type, rated 20 amperes, 125 volt, color as selected by architect (provide gray for WP cover plates), types as listed below:

<table>
<thead>
<tr>
<th>Type</th>
<th>HUBBELL</th>
<th>COOPER</th>
<th>P&amp;S</th>
<th>LEVITON</th>
</tr>
</thead>
<tbody>
<tr>
<td>Duplex</td>
<td>HBL5362-*</td>
<td>5362*</td>
<td>5362-A*</td>
<td>5362-*</td>
</tr>
<tr>
<td>Ground Fault Weather</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Resistant</td>
<td>GFR5362SG*</td>
<td>---</td>
<td>2095TRWR*</td>
<td>WT899-KW*</td>
</tr>
</tbody>
</table>

B. Manufactured modular connector devices equivalent to Pass Seymour Plug Tail shall be acceptable.

2.2 COVERPLATES
A. Provide coverplates of the appropriate type and size on all devices.
B. Coverplates shall be the same color as the device, smooth thermoplastic nylon, as manufactured by Cooper, P&S, Hubbell or Leviton.
C. Where devices are installed in exposed fittings or boxes, use Appleton "FSK" covers.
D. Install blank covers on boxes without devices.
E. Weatherproof Cover Plates (WP Designation)
1. Receptacles in Damp Locations shall have an enclosure for the receptacle that is weatherproof when the receptacle is covered (attachment plug cap not inserted and receptacle covers closed).
2. Receptacles in Wet Locations shall have an enclosure that is weatherproof whether or not the attachment plug cap is inserted. An outlet box hood installed for this purpose shall be listed and shall be identified as “extra-duty”.
4. Horizontal Mounting: Cast aluminum, mounted on FS/FD box, suitable for GFI receptacle: TayMac MX3300, Hubbell WP26M, P & S WIUC10CABRH, Cooper WIUMH-1W.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install devices and assemblies plumb and secure.
B. Install wall plates when painting is complete.
C. Arrangement of Devices: Except as otherwise indicated, mount flush, with long dimension vertical and grounding terminal of receptacles on top. Group adjacent devices under single, multi-gang wall plates.
D. Protect devices and assemblies during painting.
E. Adjust location where floor service outlets and telephone/power service poles are installed to suit the indicated arrangement of partitions and furnishings.
F. Receptacles shall be repositioned not more than 10 feet from location indicated, when so directed by the Architect, at no cost to the owner.
G. Barriers: Provide compartment and/or outlet box barriers between device for the following conditions:
   1. Where devices, receptacles or switches are served by normal and emergency power sources.
   2. Where devices operate at different voltage.
   3. Multiple wall switches operating at 120V and 277V and multiple 277V switches.
H. Install exterior GFI receptacles horizontally, with weatherproof cover plate.

3.2 MOUNTING HEIGHTS TO CENTERLINE OF DEVICE

A. Receptacles: 18” above floor.

3.3 GROUNDING

A. Receptacle ground terminal: Connect ground terminal to grounding conductor routed with circuit conductors.
3.4 FIELD QUALITY CONTROL

A. Testing: Test wiring devices for proper polarity and ground continuity.

B. Test ground-fault circuit interrupter operation according to manufacturer recommendations.

C. Replace damaged or defective components.

3.5 CLEANING

A. General: Internally clean devices, device outlet boxes and enclosures. Replace stained damaged or improperly painted wall plates or devices. Devices with drywall mud, spackle, and caulk, adhesive or other foreign material shall be considered damaged and replaced.

END OF SECTION 260140
SECTION 260160 – SAFETY SWITCHES

PART 1 - GENERAL

1.1 GENERAL
   A. This section covers Safety Switches.
   B. Furnish and install safety disconnect switches where indicated on the drawings, in the equipment schedules and as specified elsewhere herein.

1.2 RELATED DOCUMENTS
   A. Applicable provisions of the General Conditions, Supplementary General Conditions and Special Conditions shall govern work performed under this section.

1.3 RELATED SECTIONS
   A. Fuses are covered in Section 260180, LOW VOLTAGE FUSES.
   B. Refer to Section 260010, Basic Electrical Materials and Methods, for Nameplates.

1.4 QUALITY ASSURANCE

PART 2 - PRODUCTS

2.1 MANUFACTURERS
   A. Safety Switches shall be as manufactured by Square D, Eaton, General Electric or Siemens.

2.2 SAFETY SWITCHES
   A. Disconnect safety switches shall be single-throw, positive quick-make, quick-break contact mechanism, fusible or non-fusible as indicated, heavy duty, horsepower rated, dead front, and front accessible. The switch handle shall physically indicate the ON and OFF positions. Such handles shall also be able to accept a padlock having heavy duty industrial type shackles, and be padlocked either in the ON or the OFF position. Covers shall be interlocked with the switch handles to prevent opening in the ON position. An interlock override device shall be provided to allow authorized personnel to release the interlock for inspection purposes when the switch is in the ON position. Switch ampere rating and number of poles shall be as indicated on the drawings or as required. Fuse clips shall be positive pressure cartridge type and shall accommodate the classification of fuses as indicated on the drawings and/or as specified.

   B. The disconnect handle shall be attached to the box or enclosure base, and not to the cover. Terminal lugs shall be Underwriter’s Laboratories listed for copper and aluminum cables and shall be front removable. All current carrying parts shall be plated by electrolytic processes.

   C. Switch enclosures for indoor locations shall generally be NEMA 1 heavy duty, code gauge sheet steel. Switches located outdoors or in wet locations shall be NEMA 3R rain tight, code gauge
galvanized steel and are identified on the drawings as weatherproof (WP). Exterior switches located at cooling towers shall be NEMA 4 watertight, stainless steel. Switches located in food service preparation and dishwashing areas shall be NEMA 4 watertight, stainless steel. Switches located in hazardous areas shall have enclosures of the proper NEMA type construction for the location and application and will be so indicated on the drawings. Enclosures shall meet Underwriter’s Laboratories Standard 98, and shall be treated with a rust-inhibiting phosphate and finished in gray baked enamel paint.

D. Heavy duty switches shall have permanently attached arc suppressors hinged or otherwise attached to permit easy access to line-side lugs without removal of the arc suppressors.

E. Switches used in circuits having a neutral conductor shall be provided with an insulated (isolated) ground able solid neutral terminal bar.

F. Provide an internally mounted ground bus kit labeled for copper ground conductors in all safety switches.

PART 3 - EXECUTION

3.1 Properly align Safety Switches and adequately support independent of the connecting raceways. Provide steel straps and appurtenances necessary for the support of the equipment.

3.2 Furnish and install fuses in fusible safety switches where required. Verify rating of installed fuses.

A. Comply with NECA 1, NEMA PB1.1 and PB 2.1.

B. Install wall mounted switches with tops at uniform height, unless noted otherwise.

3.3 On completion of installation, vacuum dirt and debris from interiors. DO NOT use compressed air to assist in cleaning.

END OF SECTION 260160
**SECTION 260190 - SUPPORTING DEVICES**

**PART 1 - GENERAL**

1.1 SECTION INCLUDES

A. Conduit and equipment supports.
B. Anchors and fasteners.

1.2 RELATED DOCUMENTS

A. Applicable provisions of the General Conditions, Supplementary General Conditions and Special Conditions shall govern work performed under this section.

1.3 REFERENCES

A. NECA 101- “Standard for Installing Steel Conduit (Rigid, IMC, EMT).”
C. Refer to 260025, SEISMIC RESTRAINTS Section for additional requirements.

**PART 2 - PRODUCTS**

2.1 Materials and Finishes: Provide adequate corrosion resistance.

2.2 Provide material, sizes and types of anchors, fasteners and supports to carry the loads of equipment and conduit. Consider weight of wire in conduit when selecting products. System shall be adequate in tension, shear and pullout forces to resist maximum loads calculated or imposed with a minimum structural safety factor of four times the applied force. Minimum static design load shall be the weight of supported components, plus 200 lbs.

2.3 Anchors and Fasteners:

A. Concrete structural elements: Use expansion anchors.
B. Steel structural elements: Use beam clamps, spring steel clips, steel ramset fasteners, or welded fasteners.
C. Concrete surfaces: Use self-drilling anchors and expansion anchors.
D. Hollow Masonry, plaster, and gypsum board partitions: Use toggle bolts and hollow wall fasteners.
E. Solid masonry walls: Use expansion anchors.
F. Sheet Metal: use sheet metal screws.
G. Wood elements: Use wood screws.

2.4 Steel strut framework: Provide 12 gauge minimum size framework similar and equivalent to B-line or Unistrut for supporting electrical enclosures where noted or where necessary for a rigid installation.
PART 3 - EXECUTION

3.1 INSTALLATION

A. Install products in accordance with manufacturer’s instructions.

B. Provide anchors, fasteners, and supports in accordance with NECA “Standard of Installation”, NECA 1 and 101. Space supports as scheduled in NECA 1 where Table 1 lists maximum spacings less than those listed in NFPA 70.

C. Do not fasten supports to pipes, ducts, mechanical equipment, and conduit.

D. Do not drill or cut structural members.

E. Fabricate supports from structural steel or steel channel. Rigidly weld members or use hexagon head bolts to present neat appearance with adequate strength and rigidity. Use spring lock washers under all nuts.

F. Install surface-mounted equipment enclosures with minimum of four anchors.

G. In wet and damp locations use steel channel supports to stand equipment enclosures one inch off wall.

H. Use sheet metal channel to bridge studs above and below cabinets and panelboards recessed in hollow partitions.

I. Install trapeze-type supports fabricated with steel slotted support system. Secure raceways to supports with two-bolt conduit clamps.

END OF SECTION 260190
SECTION 260455 – GROUNDING SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS
A. Applicable provisions of the General Conditions, Supplementary General Conditions and Special Conditions shall govern work performed under this section.

1.2 SUMMARY
A. This Section includes grounding of electrical systems and equipment and basic requirements for grounding for protection of life, equipment, circuits and systems. Grounding requirements specified in this section may be supplemented in other sections of these specifications.

1.3 SUBMITTALS
A. General: Submit each item in this Article according to the Conditions of the Contract and Division 1 Specification Sections.
B. Product Data for grounding rods, connectors and connection materials, and grounding fittings.
C. Field tests and observation reports indicating and interpreting the test reports for compliance with performance requirements.

1.4 QUALITY ASSURANCE
A. Comply with NFPA 70.
B. Comply with UL 467.
C. Listing and Labeling: Provide products specified in this section that are UL listed and labeled.
D. Comply with NECA 331, “Standard for Building and Service Entrance Grounding and Bonding.”

PART 2 - PRODUCTS

2.1 MANUFACTURERS
A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. Chance: A. B. Chance Co
   2. Erica, Inc.; Electrical Products Group
   3. Ideal Industries, Inc
   4. ILSCO
   5. O-Z/Gedney Co
   6. Raco, Inc
   7. Thomas & Betts

2.2 GROUNDING AND BONDING PRODUCTS
A. Governing Requirements: Where types, sizes, ratings and quantities indicated are in excess of National Electrical Code requirements, the more stringent requirements and the greater size, rating and quantity indications govern.

B. Grounding Bus: Rectangular bar of annealed copper with tapped holes and insulated spacers.

2.3 WIRE AND CABLE GROUNDING CONDUCTORS
A. Comply with Division 26 Section 260120, “Conductors”. Conform to NEC Article 250, except as otherwise indicated, for conductor properties, including stranding.

B. Material: Use only copper wire for both insulated and bare grounding conductors and similar materials.

C. Equipment Grounding Conductors: Insulated with green color insulation, Type THW, THHN or THWN insulation.

2.4 MISCELLANEOUS CONDUCTORS
A. Braided Bonding Jumpers: Copper tape, braided No. 3/0 AWG bare copper wire, terminated with copper ferrules.

B. Bonding Straps: Soft copper, 0.05 inch (1 mm) thick and 2 inches (50 mm) wide, except as indicated.

2.5 CONNECTOR PRODUCTS
A. Pressure Connectors: High conductivity plated units.

B. Bolted Clamps: Heavy duty type or Hammer Lock. Acorn clamps are not acceptable.

PART 3 - EXECUTION

3.1 GENERAL
A. The entire electrical system and all electrical equipment shall be grounded in strict accordance with the National Electrical Code and as shown on the drawings.

B. The grounding system shall be continuous throughout the electrical system. Route along shortest and straightest paths possible. Avoid obstructing access or installing where they may be subjected to strain, impact or damage.

C. Neutral conductors shall be continuous throughout the electrical system and shall be grounded only at the service neutral at the service switch, or at the center point of a transformer secondary winding for a separately derived system as indicated on the drawings.

D. When the service entrance switch or switchboard has a neutral bus bar, this bus bar shall be bonded to the ground bus bar in the service entrance or switchboard.

E. When a steel conduit contains only ground wires, the ground wires shall be bonded to the conduit at both ends of the conduit run.
F. Cabinets, panels, boxes, appliance frames, conduits and other non-current carrying metallic objects shall be grounded as required by the National Electrical Code.

G. Install metallic raceways mechanically and electrically secure at all joints and at all boxes, cabinets, fittings and equipment.

3.2 APPLICATION

A. Equipment Grounding Conductors: Comply with NEC Article 250 for types, sizes and quantities of equipment grounding conductors, except where specific types, larger sizes or more conductors than required by NEC are indicated.

1. Install equipment grounding conductor with circuit conductors for the items below in addition to those required by Code:
   a. Feeders and branch circuits.
   b. Receptacle circuits.
   c. Single-phase motor or appliance branch circuits.
   d. Three-phase motor or appliance branch circuits.
   e. Flexible raceway runs.
   f. Armored and metal-clad cable runs.

B. Nonmetallic Raceways: Install an equipment grounding conductor in nonmetallic raceways unless they are designated for telephone or data cables.

3.3 EQUIPMENT GROUNDING

A. Provide an equipment bonding jumper from the grounding terminals of switches and receptacles to the grounded box that they are mounted in, unless the device is listed for self-grounding.

B. At motors, connect the ground conductor to the conduit with an approved grounding bushing, and to the metal frame with a bolted solderless lug. Bolts, screws and washers shall be bronze or cadmium plated steel.

C. Provide a flexible bonding strap, No. 6 AWG equivalent, across each flexible duct connection at each air handler, exhaust fan, supply fan, etc., and install to preclude vibration.

D. Exposed non-current-carrying metal parts of transformer installations shall be connected to the equipment grounding system.

E. Provide a flexible bonding strap, #6 AWG or equivalent, to each water heater and other piece of plumbing equipment that may become energized.

END OF SECTION 260455
SECTION 260573 – ARC FLASH HAZARD ANALYSIS / SHORT-CIRCUIT / COORDINATION STUDY

PART 1 - GENERAL

1.1 WORK INCLUDED

A. The contractor shall furnish short-circuit and protective device coordination studies as prepared by a Licensed Professional Electrical Engineer as detailed in Qualifications paragraph below.

B. The contractor shall furnish an Arc Flash Hazard Analysis Study per the requirements set forth in the 2018 version of NFPA 70E - Standard for Electrical Safety in the Workplace. The arc flash hazard analysis shall be performed according to the IEEE Standard 1584 - 2018, the IEEE Guide for Performing Arc-Flash Calculations.

C. The scope of the studies shall include the existing and new distribution equipment installed by Contractor under this contract.

1.2 RELATED SECTIONS

A. Drawings and general provisions of the Contract.

1.3 REFERENCES

A. Institute of Electrical and Electronics Engineers, Inc. (IEEE):

1. IEEE 141 - Recommended Practice for Electric Power Distribution and Coordination of Industrial and Commercial Power Systems
2. IEEE 242 - Recommended Practice for Protection and Coordination of Industrial and Commercial Power Systems
3. IEEE 399 - Recommended Practice for Industrial and Commercial Power System Analysis
4. IEEE 241 - Recommended Practice for Electric Power Systems in Commercial Buildings
6. IEEE 1584 - Guide for Performing Arc-Flash Hazard Calculations

B. American National Standards Institute (ANSI):

1. ANSI C57.12.00 - Standard General Requirements for Liquid-Immersed Distribution, Power, and Regulating Transformers
2. ANSI C37.13 - Standard for Low Voltage AC Power Circuit Breakers Used in Enclosures
3. ANSI C37.010 - Standard Application Guide for AC High Voltage Circuit Breakers Rated on a Symmetrical Current Basis

C. The National Fire Protection Association (NFPA)

1. NFPA 70 - National Electrical Code, latest edition
2. NFPA 70E - Standard for Electrical Safety in the Workplace
1.4 SUBMITTALS FOR REVIEW / APPROVAL

A. The studies shall be submitted to the design engineer prior to receiving final approval of the distribution equipment shop drawings and/or prior to release of equipment drawings for manufacturing. If formal completion of the study may cause delays in equipment shipments, approval from the Engineer may be obtained for a preliminary submittal of data to ensure that the selection of device ratings and characteristics will be satisfactory to properly select the distribution equipment. The formal study will be provided to verify preliminary findings.

1.5 SUBMITTALS FOR CONSTRUCTION

A. The results of the short-circuit; protective device coordination and arc flash hazard analysis studies shall be summarized in a final report. A minimum of one (1) bound copies of the complete final report shall be submitted.

B. The report shall include the following sections:

1. Executive Summary including Introduction, Scope of Work and Results/Recommendations.
2. Short-Circuit Methodology Analysis Results and Recommendations
3. Short-Circuit Device Evaluation Table
4. Protective Device Coordination Methodology Analysis Results and Recommendations
5. Protective Device Settings Table
6. Time-Current Coordination Graphs and Recommendations
7. Arc Flash Hazard Methodology Analysis Results and Recommendations including the details of the incident energy and flash protection boundary calculations, along with Arc Flash boundary distances, working distances, Incident Energy levels and Personal Protection Equipment levels.
8. Arc Flash Labeling section showing types of labels to be provided. Section will contain descriptive information as well as typical label images.
9. One-line system diagram that shall be computer generated and will clearly identify individual equipment buses, bus numbers used in the short-circuit analysis, cable and bus connections between the equipment, calculated maximum short-circuit current at each bus location, device numbers used in the time-current coordination analysis, and other information pertinent to the computer analysis.

1.6 QUALIFICATIONS

A. The short-circuit, protective device coordination and arc flash hazard analysis studies shall be conducted under the responsible charge and approval of a Registered Professional Electrical Engineer licensed in the state of Missouri and skilled in performing and interpreting the power system studies.

B. The Registered Professional Electrical Engineer shall be an employee of the equipment manufacturer or an approved engineering firm.

C. The Registered Professional Electrical Engineer shall have a minimum of five (5) years of experience in performing power system studies.
D. The calculations shall be signed and sealed by a registered professional engineer of the state in which the project occurs.

1.7 COMPUTER ANALYSIS SOFTWARE

A. The studies shall be performed using SKM Systems Analysis Power*Tools for Windows (PTW) software program.

PART 2 - PRODUCT

2.1 STUDIES

A. The contractor shall furnish an Arc Flash Hazard Analysis Study per NFPA 70E - Standard for Electrical Safety in the Workplace, reference Article 130.3 and Annex D. This study shall also include short-circuit and protective device coordination studies. All studies to be prepared by the Licensed Professional Electrical Engineer.

2.2 DATA

A. Contractor shall furnish all data as required for the power system studies. The Engineer performing the short-circuit; protective device coordination and arc flash hazard analysis studies shall furnish the Contractor with a listing of required data immediately after award of the contract. The Contractor shall expedite collection of the data to assure completion of the studies as required for final approval of the distribution equipment shop drawings and/or prior to the release of the equipment for manufacturing.

B. Source combination may include present and future motors and generators.

C. Load data utilized may include existing and proposed loads obtained from Contract Documents provided by Owner, or Contractor.

D. If applicable, include fault contribution of existing motors in the study. The Contractor shall obtain required existing equipment data, if necessary, to satisfy the study requirements.

2.3 SHORT-CIRCUIT ANALYSIS

A. Transformer design impedances shall be used when test impedances are not available.

B. Provide the following:

1. Calculation methods and assumptions
2. Selected base per unit quantities
3. One-line diagram of the system being evaluated that clearly identifies individual equipment buses, bus numbers used in the short-circuit analysis, cable and bus connections between the equipment, calculated maximum short-circuit current at each bus location and other information pertinent to the computer analysis
4. The study shall include input circuit data including electric utility system characteristics, source impedance data, conductor lengths, number of conductors per phase, conductor impedance values, insulation types, transformer impedances and X/R ratios, motor contributions, and other circuit information as related to the short-circuit calculations.
5. Tabulations of calculated quantities including short-circuit currents, X/R ratios, equipment short-circuit interrupting or withstand current ratings and notes regarding adequacy or inadequacy of the equipment rating.
6. Results, conclusions, and recommendations. A comprehensive discussion section evaluating the adequacy or inadequacy of the equipment must be provided and include recommendations as appropriate for improvements to the system.

C. For solidly-grounded systems, provide a bolted line-to-ground fault current study for applicable buses as determined by the engineer performing the study.

D. Protective Device Evaluation:
   1. Evaluate equipment and protective devices and compare to short circuit ratings
   2. Adequacy of switchgear, motor control centers, and panelboard bus bars to withstand short-circuit stresses
   3. The contractor shall notify the Engineer in writing, of any circuit protective devices improperly rated for the calculated available fault current.

2.4 PROTECTIVE DEVICE TIME-CURRENT COORDINATION ANALYSIS

A. Protective device coordination time-current curves (TCC) shall be displayed on log-log scale graphs.
B. Include on each TCC graph, a complete title with descriptive device names.
C. Terminate device characteristic curves at a point reflecting maximum symmetrical or asymmetrical fault current to which the device is exposed.
D. Identify the device associated with each curve by manufacturer type, function, and, if applicable, tap, time delay, and instantaneous settings recommended.
E. Plot the following characteristics on the TCC graphs, where applicable:
   1. Electric utility's overcurrent protective device
   2. Low voltage fuses including manufacturer's minimum melt, total clearing, tolerance, and damage bands
   3. Low voltage equipment circuit breaker trip devices, including manufacturer's tolerance bands
   4. Transformer full-load current, magnetizing inrush current, and ANSI through-fault protection curves
   5. Pertinent motor starting characteristics and motor damage points, where applicable
   6. Pertinent generator short-circuit decrement curve and generator damage point
   7. The largest feeder circuit breaker in each motor control center and applicable panelboard.
F. Provide adequate time margins between device characteristics such that selective operation is provided, while providing proper protection.
G. Provide the following:
1. A One-line diagram shall be provided which clearly identifies individual equipment buses, bus numbers, device identification numbers and the maximum available short-circuit current at each bus when known.

2. A sufficient number of log-log plots shall be provided to indicate the degree of system protection and coordination by displaying the time-current characteristics of series connected overcurrent devices and other pertinent system parameters.

3. Computer printouts shall accompany the log-log plots and will contain descriptions for each of the devices shown, settings of the adjustable devices, and device identification numbers to aid in locating the devices on the log-log plots and the system one-line diagram.

4. The study shall include a separate, tabular printout containing the recommended settings of all adjustable overcurrent protective devices, the equipment designation where the device is located, and the device number corresponding to the device on the system one-line diagram

5. A discussion section which evaluates the degree of system protection and service continuity with overcurrent devices, along with recommendations as required for addressing system protection or device coordination deficiencies.

6. The contractor shall notify the Engineer in writing of any significant deficiencies in protection and/or coordination. Provide recommendations for improvements.

2.5 ARC FLASH HAZARD ANALYSIS

A. The arc flash hazard analysis shall be performed according to the IEEE 1584 equations that are presented in NFPA70E-2009, Annex D. The arc flash hazard analysis shall be performed in conjunction with the short-circuit analysis (Section 2.3) and the protective device time-current coordination analysis (Section 2.4)

B. The flash protection boundary and the incident energy shall be calculated at significant locations in the electrical distribution system (switchboards, switchgear, motor-control centers, panelboards, busway and splitters) where work could be performed on energized parts.

C. Working distances shall be based on IEEE 1584. The calculated arc flash protection boundary shall be determined using those working distances.

D. When appropriate, the short circuit calculations and the clearing times of the phase overcurrent devices will be retrieved from the short-circuit and coordination study model. Ground overcurrent relays should not be taken into consideration when determining the clearing time when performing incident energy calculations

E. The short-circuit calculations and the corresponding incident energy calculations for multiple system scenarios must be compared and the greatest incident energy must be uniquely reported for each equipment location in a single table. Calculations must be performed to represent the maximum and minimum contributions of fault current magnitude for normal
and emergency operating conditions. The minimum calculation will assume that the utility contribution is at a minimum. Conversely, the maximum calculation will assume a maximum contribution from the utility. Calculations shall take into consideration the parallel operation of synchronous generators with the electric utility, where applicable as well as any stand-by generator applications. The Arc-Flash Hazard Analysis shall be performed utilizing mutually agreed upon facility operational conditions, and the final report shall describe, when applicable, how these conditions differ from worst-case bolted fault conditions.

F. The incident energy calculations must consider the accumulation of energy over time when performing arc flash calculations on buses with multiple sources. Iterative calculations must take into account the changing current contributions, as the sources are interrupted or decremented with time. Fault contribution from motors should be decremented as follows:

1. Fault contribution from induction motors should not be considered beyond 5 cycles.

G. For each piece of ANSI rated equipment with an enclosed main device, two calculations shall be made. A calculation shall be made for the main cubicle, sides, or rear; and shall be based on a device located upstream of the equipment to clear the arcing fault. A second calculation shall be made for the front cubicles and shall be based on the equipment's main device to clear the arcing fault. For all other non-ANSI rated equipment, only one calculation shall be required and it shall be based on a device located upstream of the equipment to clear the arcing fault.

H. When performing incident energy calculations on the line side of a main breaker (as required per above), the line side and load side contributions must be included in the fault calculation.

I. Miscoordination should be checked amongst all devices within the branch containing the immediate protective device upstream of the calculation location and the calculation should utilize the fastest device to compute the incident energy for the corresponding location.

J. Arc Flash calculations shall be based on actual overcurrent protective device clearing time. A maximum clearing time of 2 seconds will be used based on IEEE 1584-2002 section B.1.2. Where it is not physically possible to move outside of the flash protection boundary in less than 2 seconds during an arc flash event, a maximum clearing time based on the specific location shall be utilized.

K. Provide the following:

1. Results of the Arc-Flash Hazard Analysis shall be submitted in tabular form, and shall include device or bus name, bolted fault and arcing fault current levels, flash protection boundary distances, working distances, personal-protective equipment classes and AFIE (Arc Flash Incident Energy) levels.
2. The Arc-Flash Hazard Analysis shall report incident energy values based on recommended device settings for equipment within the scope of the study.
3. The Arc-Flash Hazard Analysis may include recommendations to reduce AFIE levels and enhance worker safety.
PART 3 - EXECUTION

3.1 FIELD ADJUSTMENT

A. Contractor shall adjust relay and protective device settings according to the recommended settings table provided by the coordination study. Field adjustments to be completed by the Contractor.

B. Contractor shall make minor modifications to equipment as required to accomplish conformance with short circuit and protective device coordination studies.

C. The Contractor shall notify the Engineer in writing of any required major equipment modifications.

3.2 ARC FLASH LABELS

A. The Contractor shall provide a 4.0 in. x 4.0 in. Label of high adhesion polyester for each work location analyzed.

B. The labels shall be designed according to the following standards:
   1. UL969 - Standard for Marking and Labeling Systems
   2. ANSI Z535.4 - Product Safety Signs and Labels
   3. NFPA 70 (National Electric Code) - Article 110.16

C. The label shall include the following information:
   1. System Voltage
   2. Flash protection boundary
   3. Personal Protective Equipment category
   4. Arc Flash Incident energy value (cal/cm²)
   5. Limited, restricted, and prohibited Approach Boundaries
   6. Study report number and issue date

D. Labels shall be printed by a thermal transfer type printer, with no field markings.

E. Arc flash labels shall be provided for equipment as identified in the study and the respective equipment access areas per the following:
   1. Floor Standing Equipment - Labels shall be provided on the front of each individual section. Equipment requiring rear and/or side access shall have labels provided on each individual section access area. Equipment line-ups containing sections with multiple incident energy and flash protection boundaries shall be labeled as identified in the Arc Flash Analysis table.
   2. Wall Mounted Equipment - Labels shall be provided on the front cover or a nearby adjacent surface, depending upon equipment configuration.
   3. General Use Safety labels shall be installed on equipment in coordination with the Arc Flash labels. The General Use Safety labels shall warn of general electrical hazards
associated with shock, arc flash, and explosions, and instruct workers to turn off power prior to work.

F. Labels shall be field installed by the Contractor. The technician providing the installation shall have completed an 8-Hour instructor led Electrical Safety Training Course which includes NFPA 70E material including the selection of personal protective equipment.

3.3 ARC FLASH MODEL

A. Provide project SKM model to Owner using the project backup command in SKM.

3.4 ARC FLASH TRAINING

A. The vendor supplying the Arc Flash Hazard Analysis shall train the owner’s qualified electrical personnel of the potential arc flash hazards associated with working on energized equipment (minimum of 4 hours). The trainer shall be an authorized OSHA Outreach instructor.

B. The vendor supplying the Arc Flash Hazard Analysis shall offer instructor led and online NFPA 70E training classes.

END OF SECTION 260055