PART I - GENERAL

1.1 RELATED DOCUMENTS
   A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this section.

   B. Section 23 31 00 – HVAC Ducts

1.2 SUMMARY
   A. This section includes the following:
      1. Ductwork Insulation
      2. Fan and Equipment Insulation
      3. Insulation Jackets
      4. Insulation Lagging

1.3 DEFINITIONS
   A. Manufacturers: In Part 2 articles where subparagraph titles below introduce lists, the following requirements apply for product selection:
      1. Basis of Design: Products indicated by manufacturer and model within the contract documents are considered the Basis of Design. This includes plan drawings, drawing details, schedules, specifications, etc. Subject to compliance with requirements, provide the basis of design products unless the manufacturer provisions (below) or substitution provisions within the contract documents are complied with.
      2. Manufacturers: Subject to compliance with requirements, provide products by the manufacturers specified. Non basis of design products which are listed by manufacturer name only may be considered for bid. By submitting a bid based on a non-basis of design product, the contractor acknowledges performance of a comprehensive review of the collateral impacts to themselves and to other trades. Contractor use of non-basis of design products shall not be the basis for additional time or costs to the Owner.
      3. Non-listed Products: Subject to compliance with requirements, Products not indicated within the Contract Documents shall not be used unless positively reviewed within a substitution request.

   B. Abbreviations:
      1. ALUM: Aluminum
      2. ASHRAE: American Society of Heating, Refrigeration, and Air-Conditioning Engineers
      3. ASJ: All-service jacket
      5. Cu.: Cubic
      6. EPDM: Ethylene propylene diene monomer rubber
      7. Etc.: Et cetera “and other similar things.”
      9. FMAS: Flexible metallic adhesive system
      10. FSK: Foil skrim kraft.
11. FT or ‘: Feet.
12. HVAC: Heating, Ventilating, and Air-conditioning
14. IMC: International Mechanical Code
15. In or ‘: Inches
16. Lb.: Pounds
17. MICA: Midwest Insulation Contractors Association
18. Mil: A thousandth of an inch
19. NIA : National Commercial and Industrial Insulation Association
20. NBR: Nitrile rubber
21. PSC: Professional Service Consultant such as engineer, architect, etc.
22. PVC: Polyvinyl chloride
24. UIUC or U of I: The University of Illinois at Urbana-Champaign.
25. UL: Underwriter’s Laboratories.

1.4 REFERENCES
A. National Commercial and Industrial Insulation Standards Manual, maintained by the Midwest Insulation Contractors Association (MICA)

[Note to PSC: Experienced insulation contractors are to be familiar with this manual. It provides a comprehensive guide of installation practices for the mechanical insulation industry. By referencing this standard exhaustive and detailed installation procedures are incorporated herein.]
C. Applicable SMACNA standards
E. IECC - International Energy Conservation Code
F. Illinois Energy Conservation Code
G. IMC – International Mechanical Code

1.5 QUALITY ASSURANCE
A. Products and execution shall be in compliance with applicable codes and standards including those referenced above in paragraph entitled REFERENCES.
B. Installation shall be in compliance with Manufacturer’s recommendations and installation instructions.

PART 2 - PRODUCTS
2.1 INSULATION MATERIALS
A. Type F: Flexible Fiberglass Wrap, 1.0-lb./cu. ft., ASTM-C553 Type I & II
B. Type R: Rigid Fiberglass Board, 3.0-lb./cu. ft., ASTM-C612 Type IA
C. Type L: Flexible Fiberglass Liner (for transfer ducts only); 1.5-lb./cu. ft.
D. Type P: Rigid Polyisocyanurate Board, ASTM-C591
E. Type PH: Rigid Phenolic Foam Board, ASTM-C1126 Type III

C. Type E: EPDM Cellular Flexible Elastomeric Foam Sheet, 300-degrees-F maximum service temperature, ASTM-C534 Grade 1

1. Basis of Design:
   a. Aeroflex / Aerocel
   b. Armacell / 
      (a) AP Armaflex FS
      (b) UT Solaflex

3. Disallowed: NBR/PVC blend

[Note to PSC: The University has experienced widespread failure of NBR/PVC blend insulation in recent years. This problem has been addressed by specifying EPDM elastomeric material exclusively in lieu of NBR/PVC blend. NBR/PVC blend is disallowed for insulation applications including piping, equipment and ductwork.

Note to PSC: Aeroflex and Armacell, the primary manufacturers of elastomeric insulation, both offer complete lines of EPDM elastomeric insulation products. However, standard AP Armaflex, given that it is NBR/PVC blend, is not allowed.]

2.2 JACKETS, FACTORY APPLIED

   A. ASJ (All Service Jacket): White, kraft-paper, fiberglass-reinforced scrim with aluminum-foil vapor barrier backing
   B. FSK (Foil Scrim Kraft jacket): Aluminum-foil vapor barrier, fiberglass-reinforced scrim with kraft-paper backing

2.3 TAPE, ADHESIVES, COATINGS, FASTENERS

   A. Provide in accordance with insulation manufacturer's specifications and requirements.
   B. Sheet metal screws installed outdoors shall be stainless steel with rubber washers. Use of galvanized screws outdoors not allowed.

2.4 LAGGING, FIELD INSTALLED

   A. ALUM: Aluminum, 0.032" thick, stucco embossed finish
      1. For protecting or securing insulation only, not for vapor barrier
      1. Basis of design:
         a. VentureClad / 1577CWE

   [Note to PSC: FMAS appears to be a proven product in the industry. The University now approves it although the jury is still out to some degree. If it proves to be problematic, approval will be revisited.]

   [Note to PSC: Extensive installations of exterior ducts are discouraged at the University. However, in the case where these installations are dictated by Project specifics, double-wall ductwork may offer advantages to field insulated and lagged ducts. These include ease of installation, impact resistance, and aesthetic/quality of installation. Consider this, coordinate with, and reference section 23.31.00 – HVAC Ducts as appropriate.]

2.5 MATEIAL PROPERTIES

   A. Insulation material shall satisfy material property requirements of referenced ASTM standard. For convenient summary of referenced ASTM standards see Insulation Specification Materials Guide as presented by National Commercial and Industrial Insulation Association (NIA).
B. Duct insulation materials including jackets, tapes, adhesives and coatings shall meet ASTM-E84 25/50 Flame Spread/Smoke Development requirements.

C. Duct insulation located in ventilation air plenums shall be UL listed for application.

PART 3 – EXECUTION

3.1 INSTALLATION

A. General Requirements

2. Install insulation after ductwork has been inspected and tested unless otherwise authorized by the PSC. Ductwork shall be clean and dry.

3. Completely insulate ductwork conveying air unless specifically indicated otherwise.

4. Insulate components of duct system including but not limited to coil housings and damper frames.

5. Do not apply insulation on cold duct systems, vulnerable to condensation.

6. Provide continuity of insulation and vapor barrier through penetrations unless code prohibits. Ensure openings at penetrations adequate in size to accommodate such continuity.

7. Provide continuity of insulation and vapor barrier through hangers and at supports.

8. Provide high compressive strength inserts at supports and hangers, including trapeze hangers, to prevent compression of insulation.

9. Provide protection at each corner of insulated ductwork extending to or through floors or curbs. Construct of sheet metal angle. Extend minimum 12” above floor/curb.

B. Specific Requirements for Insulation Type

2. Type F - Flexible Fiberglass Wrap
   a. Mechanically attach at bottom of ducts over 12” wide and completely on the sides of vertical ducts.
   b. Include the use of staples in attaching adjoining insulation. Cover staples with adhesive tape.

3. Type R - Rigid Fiberglass Board
   a. Mechanically attach with welded pins and clips.

4. Type L - Flexible Duct Liner (for transfer ducts only)
   a. Mechanically fasten and fully adhere insulation to duct. Attachment with adhesive only is not allowed.
   b. Butt liner tight without gaps at transverse joints and completely coat edges with adhesive. Coat frayed edges and damaged areas with approved coating.
   c. Duct dimensions given are net inside dimensions. Ensure that duct size conforms to design dimensions.

5. Type P – Rigid Polyisocyanurate Board
   a. Mechanically attach. Secure with adhesive as needed.

6. Type PH – Rigid Phenolic Board
   a. Mechanically attach. Secure with adhesive as needed.

7. Type E – EPDM Cellular Flexible Elastomeric Foam
   a. Generously adhere insulation to duct or fan. Fully adhere at joints.

C. Additional Requirements for Outdoor Installations
1. Ensure openings in roof and exterior walls adequate in size to accommodate continuity of duct, insulation and vapor barrier.

2. Ensure insulation jacket is sealed waterproof, vapor tight.

3. Provide tightly fitted metal lagging with overlapped sections properly oriented for prevailing winter wind directions.


5. For insulated round duct, attach lagging sections with aluminum or stainless steel bands, 12” on center. Minimize use of screws. Seal seams and penetrations watertight.

6. With approval of PSC: In lieu of metal lagging provide FMAS flexible metallic adhesive system (specification provided above) with factory fabricated aluminum fitting covers. Apply pressure to FMAS with spreading tool to ensure maximum adherence.

[Note to PSC: Edit text above as required to ensure clarity of lagging requirements. If metal lagging is required delete references to FMAS or vice-versa. Or, allow FMAS as an approved option as stated/indicated. Discuss with Owner prior to finalizing design.]

3.2 APPLICATION SCHEDULE (Not applicable to laboratory or specialty ductwork)

<table>
<thead>
<tr>
<th>SERVICE</th>
<th>INSULATION TYPE</th>
<th>JACKET TYPE</th>
<th>LAGGING</th>
<th>MINIMUM THICKNESS*</th>
</tr>
</thead>
<tbody>
<tr>
<td>Outside and Mixed Air Ducts and Plenums, Exposed</td>
<td>R</td>
<td>ASJ</td>
<td>None</td>
<td>2”</td>
</tr>
<tr>
<td>Outside and Mixed Air Ducts and Plenums, Concealed</td>
<td>R</td>
<td>FSK</td>
<td>None</td>
<td>2”</td>
</tr>
<tr>
<td>Exhaust Air Ducts and Plenums from Damper to Outlet, Exposed</td>
<td>R</td>
<td>ASJ</td>
<td>None</td>
<td>2”</td>
</tr>
<tr>
<td>Exhaust Air Ducts and Plenums from Damper to Outlet, Concealed</td>
<td>R</td>
<td>FSK</td>
<td>None</td>
<td>2”</td>
</tr>
<tr>
<td>Supply, Return, Relief, and Other Ducts and Plenums, Exposed</td>
<td>R</td>
<td>ASJ</td>
<td>None</td>
<td>1-1/2”</td>
</tr>
<tr>
<td>Supply, Return, Relief, and Other Ducts and Plenums, Concealed</td>
<td>F</td>
<td>FSK</td>
<td>None</td>
<td>1-1/2”</td>
</tr>
<tr>
<td>Transfer Air Ducts</td>
<td>L</td>
<td>NA</td>
<td>NA</td>
<td>1”</td>
</tr>
<tr>
<td>Fans and Equipment Exposed</td>
<td>R</td>
<td>ASJ</td>
<td>None</td>
<td>Same as Duct</td>
</tr>
<tr>
<td>Fans and Equipment Concealed</td>
<td>R</td>
<td>FSK</td>
<td>None</td>
<td>Same as Duct</td>
</tr>
<tr>
<td>Ducts and Fans in Wet or Humid Indoor Environments</td>
<td>E</td>
<td>None</td>
<td>None</td>
<td>1”</td>
</tr>
<tr>
<td>Exterior Ductwork, Plenums and Housings Option 1</td>
<td>P</td>
<td>Integral Moisture Barrier</td>
<td>ALUM or FMAS</td>
<td>2”</td>
</tr>
<tr>
<td>SERVICE</td>
<td>INSULATION TYPE</td>
<td>JACKET TYPE</td>
<td>LAGGING</td>
<td>MINIMUM THICKNESS*</td>
</tr>
<tr>
<td>-------------------------------------</td>
<td>-----------------</td>
<td>-------------</td>
<td>---------------</td>
<td>--------------------</td>
</tr>
<tr>
<td>Exterior Ductwork, Plenums and Housings Option 2</td>
<td>E</td>
<td>None</td>
<td>ALUM or FMAS</td>
<td>2&quot;</td>
</tr>
<tr>
<td>Exterior Ductwork, Plenums and Housings Option 3</td>
<td>R</td>
<td>FSK</td>
<td>ALUM or FMAS</td>
<td>2&quot;</td>
</tr>
</tbody>
</table>

[Note to PSC: Evaluate required insulation thickness requirements for project-specific temperature and humidity conditions. Increase scheduled insulation thickness as required.]

[Note to PSC: Application of rigid fiberglass board to Exterior Ductwork and Plenums (Option 3) is generally discouraged. This product has been included in the Application Table for infrequent applications where particularly appropriate. For a given project, non-applicable options should be deleted from table.]

[Note to PSC: Edit text above as required to ensure clarity of lagging requirements. If metal lagging is required delete references to FMAS or vice-versa. Or, allow FMAS as an approved option as stated/indicated.]

[Note to PSC: There may be applications where it is acceptable to provide uninsulated ductwork exposed within a conditioned area. In such case ductwork must be located openly within conditioned space, not within a plenum. Use caution when considering such design. Edit Application Schedule accordingly.]

[Note to PSC: Extensive installations of exterior ducts are discouraged at the University. However, in the case where these installations are dictated by Project specifics, double-wall ductwork may offer advantages to field insulated and lagged ducts. These include ease of installation, impact resistance, and aesthetic/quality of installation. Consider this, coordinate with, and reference section 23 31 00 – HVAC Ducts as appropriate.]

*Notes*

1. Manufacturer’s thickness guide or calculation shall be used to determine required minimum insulation thickness for ambient temperature and humidity conditions. Applied insulation thickness shall meet or exceed this value. Thickness may exceed scheduled value. Discuss with PSC prior to bidding.

[Note to PSC: Perform required calculations, edit schedule accordingly and delete this note. Note is provided for projects with no PSC.]

2. Insulation thickness and R value shall satisfy ASHRAE Standard 90.1 at a minimum.

3. For repairs, insulation thickness shall match existing.

END OF SECTION 23 07 13

This section of the *U of I Facilities Standards* establishes minimum requirements only. It should not be used as a complete specification.