

SECTION 23 07 19 - HVAC PIPING INSULATION

PART I - GENERAL

1.1 SECTION INCLUDES

- A. Piping and Valve Insulation
- B. Insulation Jackets
- C. Insulation Lagging

1.2 RELATED SECTIONS

- A. Section 23 05 29 – Hangers and Supports for HVAC
- B. Section 23 07 16 – HVAC Equipment Insulation
- C. Section 23 21 13 – Hydronic Piping
- D. Section 23 21 16 – Hydronic Specialties
- E. Section 23 22 13 – Steam and Condensate Piping
- F. Section 23 22 16 – Steam and Condensate Specialties

1.3 REFERENCES

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

[Note to PSC: Any experienced insulation contractor should be familiar with this manual. It provides a comprehensive guide of installation practices for the mechanical insulation industry. By referencing this standard it becomes unnecessary to identify exhaustive and detailed installation procedures. These standards are to insulation what SMACNA standards are to ductwork.]

- B. *ASHRAE Standard 90.1 – Energy Standard for Buildings*
- C. *ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials*
- D. *IECC - International Energy Conservation Code*
- E. *Illinois Energy Conservation Code*
- F. *IMC - International Mechanical Code*

1.4 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

- A. Type F: Fiberglass, Semi-Rigid Premolded, ASTM C547 Type I
- B. Type M1: Mineral Wool, Semi-Rigid Premolded, 1,000 deg. F maximum service temperature, ASTM C547 Type IV
- C. Type M2: Mineral Wool, Semi-Rigid Premolded or Rigid Board, 1,200 deg. F maximum service temperature, ASTM C547 Type II-III

- D. Type C: Calcium Silicate, Rigid Premolded, 1200 deg. F maximum service temperature, ASTM C533
- E. Type E: **EPDM** Cellular Flexible Elastomeric Foam Tube and Sheet, 300 deg. F maximum service temperature, ASTM C534 Grade 1

- 1. **Not allowed: NBR/PVC blend**

- 2. Approved Products

- a. Aeroflex Aerocel
- b. Armacell
 - (a) AP Armaflex FS
 - (b) UT Solaflex

[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 all 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.]

- F. Type P: Polyisocyanurate, Rigid Premolded, ASTM C591
- G. Type PH: Phenolic, Rigid Premolded ASTM C1126 Type III
- H. Type CG: Cellular Glass, Rigid Premolded, ASTM C552 Type II

2.2 JACKETS, FACTORY APPLIED

- A. ASJ (All Service Jacket): White, kraft-paper, fiberglass-reinforced scrim with aluminum-foil vapor barrier backing
- B. PVDC: Polyvinylidene Chloride Film, 60 mil. Basis of design: Saran 560

2.3 JACKETS, FIELD APPLIED

- A. PVC: Polyvinyl Chloride, cut and curled sheet, 30 mil, solvent welded
 - 1. For protecting or securing insulation only, not for vapor barrier
- B. PVDC: Polyvinylidene Chloride Film, 60 mil. Basis of design: Saran 560
- C. FAC: Fiberglas Fabric with Adhesive Coating: 18 oz./sq. yd. fiberglass fabric, lagging adhesive and coating. Basis of design: Foster 81-42
- D. PW: Asphaltic laminate, fiberglass reinforcement with aluminum-foil vapor barrier, 125 mil heat seal. Basis of design: Pittsburgh Corning PITTWRAP

2.4 FITTING COVERS

- A. PVC, standard duty, factory fabricated, 20 mil, tape secured
 - 1. For protecting or securing insulation only, not for vapor barrier
- B. PVC, heavy duty, factory fabricated, 30 mil, solvent welded for use with field applied PVC jacket

2.5 LAGGING, FIELD INSTALLED

- ALUM: Aluminum, 016" thick, stucco embossed finish. Fasten with aluminum or stainless steel bands on 12" centers.
 - 1. For protecting or securing insulation only, not for vapor barrier

- B. FMAS (Flexible Metallic Adhesive System): Self-adhesive embossed multi-ply aluminum foil sheet, 6.0 mil minimum total thickness. Basis of design: 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 in any manner its approval will be revisited.]

2.6 LAGGING FITTING COVERS

- A. Aluminum, Factory Fabricated, .024" Thick

2.7 REMOVABLE COVERS, CUSTOM MANUFACTURED

- A. Standard Applications, Less than 450 Degrees F.

1. Jacket and Liner: 17oz Silicone Impregnated Fiberglass Fabric
2. Insulation: 2" Type E Glass Mat.
 - a. 1" allowed for constructability if approved by PSC
3. Fastening: 2" Nomex Velcro and/or Lace Hooks with Stainless Steel Wire
4. Thread: Kevlar/Stainless Steel Thread

- B. Acoustical Applications, Less than 450 Degrees F.

1. Jacket: 17oz Silicone Impregnated Fiberglass Fabric
2. Liner: 17oz Teflon Impregnated Fiberglass Fabric
3. Insulation: 2" Type E Glass Mat.
4. Fastening: 2" Nomex Velcro or Lace Hooks with Stainless Steel Wire
5. Thread: Kevlar/Stainless Steel Thread
6. 2 lb. mass loaded vinyl

- C. Provide where shown on drawings or otherwise indicated.

[Note to PSC: Clearly indicate location and type of custom covers on drawings and/or elsewhere within documents. Use sparingly; custom covers are costly and typically have long lead times.]

2.8 TAPES, 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. Galvanized screws shall not be used outdoors.

2.9 MATERIAL PROPERTIES

- A. Insulation material shall satisfy material property requirements of referenced ASTM standards. For convenient summary of referenced ASTM standards see *Insulation Specification Materials Guide* as presented by *National Commercial and Industrial Insulation Association (NIA)*.
- B. All insulation materials including jackets, tapes, adhesives and coatings shall meet *ASTM E84 25/50 Flame Spread/Smoke Development* requirements.
- C. Piping insulation located in ventilation air plenums shall be UL listed for application.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. General Requirements.
 1. Install insulation after piping has been inspected and tested unless otherwise authorized by Engineer. Piping shall be clean, dry and free of rust.

2. Insulate all piping systems conveying fluids with temperature above 105 deg. F, below 60 deg. F or below dew point of ambient air. When fluid is below 60 deg. F or below dew point of ambient air insulation shall have uninterrupted vapor barrier.
3. Insulate all components of piping systems for both cold and hot applications. This includes fittings, unions, flanges, strainers, expansion joints and specialties. This includes valve bodies, bonnets, control valves and pressure regulating valves. The common practice of leaving valves, unions, flanges and strainers uninsulated in hot piping systems is not allowed.
 - a. Exceptions: Steam traps, steam condensate pump bodies, coil headers, HW "coil packs", control valves and balance valves at small terminal heating units (e.g. reheat coils, fin tube,) CHW components above drain pans (e.g. fan coil units), instrumentation and associated piping beyond 24" from main. Other appropriate exceptions may be presented to PSC for approval prior to proceeding with work.
4. Do not apply insulation on cold active piping systems, vulnerable to condensation.
5. Do not allow insulation to remain unsealed, vulnerable to entrance of moisture.
6. Provide continuity of insulation and vapor barrier through penetrations unless code prohibits. Ensure openings at penetrations, including roofs and exterior walls, adequate in size to accommodate such continuity.
7. Provide continuity of insulation and vapor barrier through hangers and at supports.
8. Do not use staples or screws to fasten insulation on chilled water or other cold piping.
9. Insulate valves in manner that allows full operation without damaging or compromising insulation or vapor barrier.
10. Install metal shields at all hangers and supports. Shields shall be galvanized sheet metal, half round with flared edges. Length and thickness gauge shall be as follows:

Pipe Size	Shield Size
2" and smaller	12" long x 20 gauge
2 ½" to 6"	12" long x 18 gauge
8" to 14"	18" long x 16 gauge
16" to 24"	24" long x 14 gauge

[Note to PSC: The University takes exception to MSS Standards as applied to insulation shields. Such requirements are viewed to be excessive.]

11. Provide high compressive strength inserts or welded steel shoes at hangers and supports to prevent compression of insulation. Inserts shall be same thickness as insulation. Inserts shall be 180 degree minimum cylindrical segments same length as associated metal shield. Rectangular blocks, plugs, or wood material not acceptable unless approved by PSC for specific application. Inserts and associated jacketing shall be as follows:
 - a. Chilled water applications
 - (1) ≤ 4 " Pipe, metallic and non-metallic
 - (a) Phenolic (2.5 lb./SF) or cellular glass
 - (b) 6 mil PVDC jacket (e.g. Saran 560)

- (2) ≥ 6 " Pipe, metallic and non-metallic
 - (a) Phenolic (5.0 lb./SF) or cellular glass
 - (b) 6 mil. PVDC jacket (e.g. Saran 560)
- b. Hot water applications
 - (1) ≤ 4 " Pipe, metallic and non-metallic
 - (a) Phenolic (2.5 lb./SF) or calcium silicate
 - (b) ASJ or 6 mil. PVDC jacket (e.g. Saran 560)
 - (2) ≥ 6 " Pipe, metallic
 - (a) Welded shoe with insulation fill
(See Section 23 05 29 – Hangers and Supports for HVAC)
 - (b) ASJ jacket
 - (3) ≥ 6 " Pipe, non-metallic (e.g. polypropylene)
 - (a) Phenolic (5.0 lb./SF) or cellular glass
6 mil. PVDC jacket (e.g. Saran 560)
- c. Steam applications
 - (1) ≤ 4 " Pipe, metallic
 - (a) Calcium silicate
 - (b) ASJ jacket
 - (2) ≥ 6 " Pipe, metallic
 - (a) Welded shoe with insulation fill
(See Section 23 05 29 – Hangers and Supports for HVAC)
 - (b) ASJ jacket

- 12. Provide high compressive strength inserts at strut-mount pipe clamps to prevent compression of insulation. Inserts shall be phenolic or calcium silicate as appropriate for application. Inserts shall be same thickness as insulation. Insert shall be 360 degree cylindrical segment extending beyond pipe clamp on each side. 180 degree cylindrical shields shall be provided. "Cush-clamps" (e.g. *Unistrut Cush-a-Clamp*) not allowed unless approved by PSC for specific application. In no case shall such be used on cold piping applications.
- 13. As an alternate to specified support system for strut-mount pipe clamps *Aeroflex Aerofix-U* polymeric inserts with integral vapor barrier may be used. Such applies to strut-mount clamps only.
- 14. As an alternate to specified support system, Hydra-Zorb Klo-Shure insulation coupling may be used. Insulation shall be adhered within coupling to maintain vapor barrier.
- 15. Ensure piping is supported by specified inserts only. Piping shall not be in direct contact with metallic hangers/supports. Exception: Welded shoe pipe supports on hot piping applications.
- 16. Provide heavy duty protective lagging on insulated piping extending to or through floors or curbs. Lagging shall be .032" thick aluminum sheet, mechanically secured. Extend minimum 12" above floor/curb.
- 17. Provide protective 30 mil solvent-welded PVC jacket on exposed interior horizontal piping below 2' AFF level and exposed vertical piping below 8' AFF level. Also provide 30 mil solvent-welded PVC jacket on any horizontal piping above 2' AFF that is

vulnerable to damage by climbing or stepping as determined by PSC. Example: Branch run-outs to coils.

- a. Exception: In cases where temperature rating of PVC jacket is deemed inadequate for high temperature application, .024" thick aluminum lagging with safety break shall be provided.

B. Specific Requirements for Insulation Type

1. Type F: Fiberglass, Semi-Rigid Premolded
 - a. Insulate fittings with field or factory cut fiberglass inserts, multiple inserts may be required. Install PVC fitting covers over insulation. Fasten fitting covers to pipe jacket with PVC tape, both ends. Tacks or staples not allowed.
2. Type M1: Mineral Wool, Semi-Rigid Premolded
 - a. Insulate fittings with field or factory cut fiberglass inserts, multiple inserts may be required. Install 20 mil PVC fitting covers over insulation. Fasten fitting covers to pipe jacket with PVC tape, both ends. Tacks or staples not allowed.
3. Type M2: Mineral Wool, Semi-Rigid Premolded
 - a. Insulate fittings with like material, factory or field fabricated. Flexible inserts not allowed. Install aluminum lagging.
4. Type CS: Calcium Silicate; Rigid Premolded
 - a. Attach with 18 gage SS tie wires on 12" centers
 - b. Use single layer for less than 3" thick. For thickness 3" and greater, use two layers, stagger jointed. Wire each layer individually.
 - c. Install lagging as indicated in *Application Schedule* below.
5. Type E: **EPDM** Elastomeric Foam, Flexible Tube and Sheet
 - a. Fully adhere insulation to pipe at joints and terminations to prevent moisture transfer along pipe. Adhere around entire circumference of pipe.
 - b. Form fit and fully adhere insulation at valves, strainers, specialties, instrumentation and appurtenances. Fully adhere insulation at all points vulnerable to ingress of moisture.
6. Type P: Polyisocyanurate, Rigid Premolded
 - a. Use fittings of like material, factory or field fabricated.
 - b. Place vapor barrier over fitting; install finished fitting cover (i.e. tape fitting before installing cover).
 - c. Fill any voids in insulation that result from custom fit-up.
 - d. Seal all openings in Saran vapor barrier with approved mastic.
7. Type PH: Phenolic, Rigid Premolded.
 - a. Use fittings of like material, factory or field fabricated.
 - b. Place vapor barrier over fitting; install finished fitting cover (i.e. tape fitting before installing cover).
 - c. Fill any voids in insulation that result from custom fit-up.
 - d. Seal all openings in Saran vapor barrier with approved mastic.
8. Type CG: Cellular Glass, Rigid Premolded.
 - a. Install above ground CG insulation with ASJ jacket and vapor barrier mastic.

- b. Install buried CG insulation with PW jacket per manufacturer's instructions to maintain warranty. Install to adequately accommodate pipe movement. Provide joint sealant (e.g. Pittsburgh Corning PITTCOTE) at joints, changes in insulation thickness and terminations.

C. Additional Requirements for Outdoor Installations

1. Ensure insulation jacket is sealed waterproof, vapor tight.
2. Provide tightly fitted metal lagging with overlapped sections properly oriented for prevailing weather.
3. Mechanically attach lagging sections with aluminum or stainless steel bands, 12" on center. Minimize use of screws. Seal all seams and penetrations watertight.
4. 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

[Note to PSC: Edit Schedules as appropriate for project.]

Application	Insulation	Thickness Ref.# (see Thickness Schedule)	Jacket, Covering	Lagging
Steam, Condensate and Pumped Condensate in Walk-through Tunnel	M2	(1) Steam (2) Cond.	ASJ	ALUM
Insulation to Match Existing in Walk-through Tunnel	CS	(1) Steam (2) Cond.	FAC	None
Steam Expansion Joint - Provide custom manufactured removable cover	Per Spec.	Integral	Integral	None
Steam, Condensate and Pumped Condensate in Shallow Trench Tunnel	M2	(1) Steam (2) Cond.	None	ALUM
Steam, Condensate and Pumped Condensate in Building	F or M1	(1) Steam (2) Cond.	ASJ	None*
Steam Vent Above 8' AFF level	None	NA	NA	NA
Steam Vent Below 8' AFF level (for burn protection)	F or M1	1" All Pipe Sizes	ASJ	None*
Perimeter, Preheat, Reheat Water > 140F	F or M1	(3)	ASJ	None*

Perimeter, Preheat, Reheat Water < 140F	F or M1	(4)	ASJ	None*
Chilled Water	E or PH	(6)	E: None PH: PVDC	None*
Chilled Beam	E	(6)	None	None*
Cooling Coil Condensate Drain	E	(7)	None	None*
Piping with Temperature 60F–105F (e.g. Chilled Beam, Condenser Water)	None	NA	NA	NA
Piping with Temperature 0-40F (e.g. Refrigerant for Walk-In Cooler/Freezer)	E or PH	(8)	E: None PH: PVDC	None*
Chilled Water, Buried (Ductile Iron)	None	NA	NA	NA
Other Buried Piping, Not Preinsulated	CG	(1)	PW	None
Cold Piping Outdoors, Above Ground Option 1	P or E	(6)	E: None P: PVDC	ALUM or FMAS
Cold Piping Outdoors, Above Ground Option 2	CG	(6)	ASJ	ALUM or FMAS*
Hot Piping Outdoors, Above Ground Option 1	M1	(2)	ASJ	ALUM or FMAS*
Hot Piping Outdoors, Above Ground Option 2	CG	(2)	ASJ	ALUM or FMAS*

* Provide lagging in areas specified for protection from physical damage.

[Note to PSC: Where multiple options are indicated for insulation type, thickness, jacket and/or lagging type, edit as appropriate for project. CG is preferred for outdoor piping above ground if economically viable.]

[Note to PSC: Edit Schedule 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.]

3.3 THICKNESS SCHEDULE

Application Schedule Reference#	Temp Reference	Minimum Insulation Thickness for Pipe Size					
		3/4" & Smaller	1 - 1 1/4"	1 1/2 - 2"	2 1/2 - 3"	4 - 6"	8" & Larger
(1)	250-350F	3.5	4.0	4.5	4.5	4.5	4.5
(2)	200-250F	2.5	2.5	3.0	3.0	3.0	3.0
(3)	140-200F	1.5	1.5	2.0	2.0	2.0	2.0
(4)	105-140F	1.0	1.0	1.5	1.5	1.5	1.5
(5)	60-105F	NA	NA	NA	NA	NA	NA
(6)	40-60F	1.0	1.0	1.5	1.5	1.5	2.0
(7)	40-60F	0.5	0.5	0.5	0.5	0.5	0.5
(8)	<40F	1.0	1.0	1.5	1.5	1.5	2.0

[Note to PSC: For several pipe sizes thickness schedule indicates required minimum thickness in excess of that required by ASHRAE Standard 90.1]

[Note to PSC: Thicknesses indicated in schedule are minimum values. Use Manufacturer's thickness calculation tool to determine required insulation thickness for project-specific temperature and humidity conditions. Increase scheduled insulation thickness as required.]

[Note to PSC: ASHRAE Standard 90.1 applies to building systems only. Insulation thickness may be reduced within steam tunnels to accommodate dimensional limitations as required. Edit thickness schedule accordingly.]

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 19

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