23 07 16 - HVAC Equipment Insulation

1. Introduction

   A. This section covers insulation systems for building HVAC systems, including, but not limited to:

      1. Steam system piping
      2. Chilled water system piping
      3. Heating hot water
      4. HVAC ductwork
      5. Mechanical equipment

   B. Building Insulation Guidelines are listed in Division 07, Section 07 21 00 of the Duke University Design Guidelines.

   C. Designers should coordinate with Duke FMD to coordinate selection and execution requirements for insulation systems.

2. References

   A. ASHRAE Standard 90.1 – 2007

   B. NC State Energy Code, 2012

   C. NC State Mechanical Code, 2012

   D. USGBC LEED v3.0

   E. Duke University LEED+ Standard

   F. Duke University Design Guidelines, Section 33 63 00 Steam Energy Distribution

   G. Duke University Design Guidelines, Section 33 61 00 Hydronic Energy Distribution

3. Design Standards

   A. The following table illustrates desired insulation standards for different mechanical systems:

Service	Marker	Size	Location	Material	Thickness	Finish	Color

Service	Marker	Size	Location	Material	Thickness	Finish	Color
High Pressure Steam	HPS	3" and smaller	all	Flexible Aerogel	20 mm	Aluminum jacket	none
		4" and larger	all		30 mm	Aluminum jacket	
Medium Pressure Steam	MPS	3" and smaller	all	Fiberglass, Mineral Wool, or Flexible Aerogel	2"	Aluminum jacket	none
		4" and larger	all		3"	Aluminum jacket	
Low Pressure Steam	LPS	3" and smaller	all	Fiberglass, Mineral Wool, or Flexible Aerogel	2"	Aluminum jacket	none
		4" and larger	all		2"	Aluminum jacket	
High Pressure Condensate	HPC	2" and smaller	all	Flexible Aerogel	20 mm	Aluminum jacket	none
		2-1/2" and larger	all		30 mm	Aluminum jacket	
Medium Pressure Condensate	MPC	2" and smaller	all	Fiberglass, Mineral Wool, or Flexible Aerogel	1-1/2"	Aluminum jacket	none
		2-1/2" and larger	all		2"	Aluminum jacket	
Low Pressure Condensate	LPC	2" and smaller	all	Fiberglass, Mineral Wool, or Flexible Aerogel	1-1/2"	Aluminum jacket	none
		2-1/2" and larger	all		2"	Aluminum jacket	
Relief Vent	VENT	All	all	Fiberglass, Mineral Wool, or Flexible Aerogel	n/a	Color-coded PVC	gray
Chilled Water	CHW	1-1//2" and smaller	all	closed-cell elastomeric	1"	Color-coded PVC	blue
		2" and larger	all	polyisocyanurate	2"	Color-coded PVC	
Condenser Water	CW	All	all	none	n/a	enamel paint	dark green
Heating Water	HHW	1-1//2" and smaller	all	Fiberglass or Mineral Wool	1"	Color-coded PVC	red
		2" and larger	all	polyisocyanurate	2"	Color-coded PVC	
Reclaim/re-use/gray water	RECLAIM	All	all	none	n/a	enamel paint	gray
CHW Drain	DRAIN	All	all	closed-cell elastomeric	1”	NA	NA
Ductwork	n/a	16" x 16" and larger	exposed	fiberglass board	1"	Color-coded PVC or canvas	per architect
		All	concealed	fiberglass wrap	2"	none	none

Service	Marker	Size	Location	Material	Thickness	Finish	Color
Ductwork (cont.)		All	Outside	polyisocyanurate Foam board	2”	EPDM	per architect
		All	Mech. Rm.	fiberglass board	2"	Color-coded PVC	white
Refrigerant	n/a	All	all	closed-cell elastomeric	1"	none	none
Process Water	PCHW	All	all	closed-cell elastomeric	TBD	Color-coded PVC	light blue

B. Insulation thickness should comply at minimum with requirements of current version of ASHRAE standards/requirements. Increased insulation thickness should be utilized if justifiable per project Life Cycle Cost Analysis.

C. Removable / Reusable Insulation:

1. Components requiring frequent maintenance should be covered with re-usable insulation jackets. Jackets should be fabricated of non-porous Teflon-impregnated woven Nomex cloth, with double wove stitching. Blankets should contain fiberglass mat suitable for service temperature range. Thermal conductivity ratings should be sufficient to maintain a surface temperature of no more than 120°F with an ambient temperature of 80°F.

   Applications for removable insulation jackets may include:

   a. Steam pressure reducing valves
   b. Pressure-powered pumps
   c. Control valves
   d. Small-volume receiver and flash vessels
   e. Ultrasonic flow meters
   f. Other components or equipment for which pre-formed insulation block shapes are not available.

2. Removable jackets should be equipped either with D-links and strapping material. Jacket must draw tight when installed, leaving no gaps. No wire draw material is acceptable for enclosing removable jackets.

D. Specific installation situations:

1. Any insulation installed outdoors must be jacketed and sealed to prevent moisture penetration.

2. Outside ductwork must be installed with EPDM rubber covering and sealed for weather protection.

3. Generally, interior ductwork and piping must be concealed in finished spaces. Flexible HVAC ducts must always be concealed. Exposed interior piping and rigid ductwork are permissible only when specified by the Architect for aesthetic effect and approved by the Owner.

4. Fiberglass insulation board applied on HVAC ductwork must utilize weld pins as for attaching the insulation to ductwork. Any changes to this method must be approved by DUES.

5. Closed-cell elastomeric insulation must be mitered at changes of direction in piping or tubing. Do not bend insulation.

6. The use of HVAC duct liner is generally discouraged. If liner must be used, only closed cell material approved by FMD should be selected.

7. All piping, ductwork and equipment jacketing must adhere to Duke University Design Guideline regarding Identification of Mechanical Systems (see Section 3A of this section).

8. Underground utility piping insulation is not covered in this Design Guideline, as insulation of those systems is typically integral an engineered piping system and must be coordinated and engineered on a project-specific basis.

E. Documentation and Review Requirements:

1. Analysis of the thermal systems insulation should be considered in the Life Cycle Cost analysis required for project approval.

2. Provide estimated energy usage calculation for all considered insulation systems. This calculation should compare energy usage and estimated costs for baseline (ASHRAE 90.1-compliant) insulation versus proposed higher efficiency models.

3. Insulation selection and specification must be reviewed by Duke FMD and the Commissioning Agent (when applicable) on a project-by-project basis.

4. Specifications shall include an insulation schedule in table format.

F. Installation and Performance Requirements:

1. Confirm installation responsibilities at outset of project. Installation services will be provided in-house or contracted out.

2. Coordinate all required tie-in points with Duke Utilities and Engineering Services (DUES).

3. Coordinate all commissioning efforts with DUES.

4. Provide identifying list for all valves. Coordinate with DUES for formatting and compliance with existing recordkeeping.

5. Provide identifying list for all steam traps. Coordinate with DUES for formatting and compliance with existing recordkeeping.

G. Piping Insulation:

1. The Consultants shall evaluate thermal insulation properties and moisture migration to prevent surface condensation. Piping that carries chilled water is often subject to surface sweating. To decrease vapor permeability for chilled water piping, polystyrene or polyisocyanurate insulation shall be used for piping 2 inches in diameter and larger. Piping under 2 inch diameter shall be insulated with Armaflex or equal or polyisocyanurate. Fiberglass insulation is not acceptable for chilled water piping.

2. All valves and fittings shall be insulated with preformed fitting insulation. Also provide preformed insulation for all cold and hot surfaces of equipment when available from the manufacturer. Extensions should be installed on small ball valves so that the handle is extended beyond the insulation and is visible and operational.