NAIMA
North American Insulation Manufacturers Association

GUIDE TO INSULATING CHILLED WATER PIPING SYSTEMS WITH MINERAL FIBER PIPE INSULATION

33°F to 60°F (0.5°C to 15.6°C)

First Edition

INSULATE TODAY
SAVE TOMORROW

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CONTENTS

PREFACE

The North American Insulation Manufacturers Association (NAIMA) presents this Guide as a recommended method for insulating chilled water piping systems in mechanical systems using a vapor sealed mineral fiber pipe insulation. The insulation system recommendations in this guide are intended for use on cold or chilled water piping systems operating from 33°F to 60°F (0.5°C to 15.6°C) located within conditioned spaces in commercial and institutional buildings. When properly installed, a vapor sealed mineral fiber pipe insulation system will effectively control condensation, help maximize cooling system efficiency and save energy.

Mineral Fiber Pipe Insulation

For the purpose of this guide, mineral fiber pipe insulation consists of fiber glass or mineral wool (rock or slag fiber) with binders manufactured to fit standard pipe and tubing sizes. This definition is consistent with ASTM and U.S. building code terminology. The mineral fiber pipe insulation may be molded or precision v-grooved, with one or more of the insulation walls split longitudinally for easy application on pipes.

Fiber Glass Pipe Insulation

Fiber glass pipe insulation is manufactured from glass fibers bonded with a thermosetting resin and molded into one-piece sections that are 36" (0.92m) in length. These pipe sections are opened, placed over the pipe, closed and secured with a factory applied or field installed vapor-retarder jacketing system.

Mineral Wool Pipe Insulation

Mineral wool pipe insulation is manufactured into pre-formed, one- or multiple-piece sections. Mineral wool pipe insulation sections are 36" (0.92m) in length. They are applied by placing the one- or multiple-piece sections over the pipe and closing with either a factory applied or field installed vapor retarder jacketing system.

Vapor Retarder Jacketing Systems

All Service Jacketing (ASJ) is a flexible laminate composite of multiple layers typically consisting of foil, paper, film and reinforcements that meet the requirements listed in ASTM C547 for mineral fiber pipe insulation used on low temperature piping systems. ASJ protects the insulation, provides a vapor seal, and secures the insulation to the pipe. Pipe insulation generally comes with a factory applied ASJ jacket complete with a self-sealing lap system (SSL). The SSL is a self-sealing closure system that provides mechanical securement and vapor sealing of the longitudinal seam of the jacket. ASJ butt strip tape completes the jacketing system to seal the joints between sections of pipe insulation. The standard ASJ jacketing system has a maximum permeance of 0.02.

Mineral Fiber Pipe Insulation Standards

Standards for mineral fiber pipe insulation provide parties involved in the process with industry-accepted quality requirements. Adherence to the Standards helps to ensure the long-term performance and reliability of the system. The following ASTM Standards are relevant to mineral fiber insulation systems covered in this guide. Consult the manufacturers' submittal sheets for the full range of physical property and performance specifications.

ASTM C547	Standard Specification for Mineral Fiber Pipe Insulation
ASTM C585	Standard Practice for Inner and Outer Diameters of Rigid Thermal Insulation for Nominal Sizes of Pipe and Tubing
ASTM C921	Standard Practice for Determining the Properties of Jacketing Materials for Thermal Insulation
ASTM C1136	Flexible, Low Permeance Vapor Retarders for Thermal Insulation

Alternative Insulation System Strategies

This Guide addresses installation of the standard ASJ jacketed pipe insulation used in the field when applied to chilled water pipes. Several mineral fiber insulation manufacturers have additional custom solutions for insulating chilled water systems:

- Improved water vapor retarder jacketing systems.
- Wicking systems that collect condensed water on the pipe surface and transport it away from the pipe and out of the insulation allowing the water to evaporate.

Contact the fiber glass or rock and slag wool manufacturers listed in this Guide for specific information on other insulation systems for chilled water piping.

CertainTeed Corp.
certainteed.com
800-233-8990

Industrial Insulation Group
iig-llc.com
912-264-6372

Johns Manville Corp.
jm.com
800-654-3103

Knauf Insulation
knaufinsulation.us
800-825-4434

Owens Corning
owenscorning.com
800-GET-PINK

ROXUL USA Inc.
roxul.com
800-265-6878

How This Guide Was Developed

This Guide was developed using reliable engineering principles and research, plus consultation obtained from manufacturers, contractors, testing laboratories, and others having specialized experience.

This Guide is subject to revision as further experience and investigation may show it necessary or desirable. Installation methods and products that comply with this Guide will not necessarily be acceptable if when examined and tested, they are found to have other features which impair the result intended by these requirements.

In recent tests conducted on behalf of the North American Insulation Manufacturers Association (NAIMA) at Oklahoma State University (OSU), the thermal conductivity of mineral fiber pipe insulation was measured over time on piping that operated at below ambient temperature. The tests were conducted with the following criteria:

- The pipe temperatures on the chilled water HVAC systems were typical of those used in commercial construction.
- The ambient conditions for the temperature and humidity were set to those typically found in indoor, conditioned commercial building spaces.
- The tests were conducted over a continuous, extended period of time.
- The thermal conductivity of the pipe insulation was monitored over the duration of the test.

The OSU test results demonstrated that the thermal conductivity of the installed mineral fiber pipe insulation with an ASJ jacket system remained constant throughout the duration of the test. There were no signs of condensation on the surface of the ASJ jacket and no signs of increased moisture gain as demonstrated by the thermal conductivity.

Disclaimer

The North American Insulation Manufacturers Association assumes no responsibility and accepts no liability for the application of the principles or techniques contained in this Guide. In particular, NAIMA makes no warranty of any kind, express or implied or regarding merchantability or fitness for any particular purpose in connection with the information supplied herein.

This Guide is not intended to preclude alternate methods of installation when such methods and materials can be documented as providing equivalent performance.

SECTION 1
PERFORMANCE CRITERIA

SECTION I: PERFORMANCE CRITERIA

1.0 Role of Pipe Insulation

Pipe insulation is designed to do one or more of the following:

- Conserve energy and help reduce the building operating cost
- Control condensation
- Stabilize process performance (process control)
- Protect personnel by reducing surface temperatures
- Reduce emissions
- Reduce noise

2.0 Role of Pipe Insulation for Chilled Water Systems 33°F to 60°F (0.5°C to 15.6°C)

Pipe insulation for chilled water systems is specified and installed primarily for process control, condensation control and energy conservation. Insulating chilled water systems requires special attention. When piping and equipment operate at temperatures lower than the ambient air, moisture in the air can condense on the cold surface, or when insulated incorrectly, on or within the insulation system. The pipe system must be protected by an insulation system with sufficient insulation thickness, an adequate vapor retarder, and be installed correctly for the system to perform. If not, the insulation system can become wet, which can lead to a number of issues such as:

- A degradation of the insulation system service life and performance
- Corrosion of pipes, valves and fittings contained within the insulation system
- The potential for mold growth and water related damage to surrounding materials.

3.0 General Requirements for Mineral Fiber Pipe Insulation in Chilled Water Applications

ASTM C547	Standard Specification for Mineral Fiber Pipe Insulation
ASTM C921	Standard Practice for Determining the Properties of Jacketing Materials for Thermal Insulation

3.1 Description

Mineral fiber pipe insulation is a molded or v-grooved, one- or multiple-piece insulation made from fiber glass, rock or slag fibers bonded with thermosetting resins. It is produced in 36" (0.92m) lengths with or without a factory-applied jacket.

3.2 Standard Pipe and Tube Sizes

Mineral fiber pipe insulation is manufactured to fit a wide range of standard pipe and tube sizes.

- Standard Iron Pipe sizes: ½" to 24" (15mm to 610mm) nominal pipe size
- Standard Copper Tube sizes: from 3/8" to 6" (9.5mm to 150mm)

3.3 Insulation Wall Thickness

Mineral fiber pipe insulation comes in standard, single layer thicknesses from ½" to 6" (15mm to 150mm) in ½" (15mm) increments. Requirements for thicker wall materials can be achieved using multiple layers of insulation, commonly known as nesting.

3.4 Vapor Retarder Closure System

An All Service Jacket (ASJ) is the factory-applied vapor retarder covering. The jackets include an adhesive closure system that provides a positive, mechanical vapor sealing of the longitudinal jacket seam. Pressure sensitive butt strips are used to seal the circumferential joints between sections of pipe.

3.5 Mineral Fiber Insulation Without Factory Applied Jacketing

Some mineral fiber pipe insulations are available without a factory-applied jacket. These pipe insulations will have a shop or field-applied jacketing system. For the purpose of this guide, the shop or field-applied jacket must meet the same general requirements as the factory-applied ASJ jacket.

4.0 Thermal Conductivity*

ASTM C177	Standard Test Method for Steady-State Heat Flux Measurements and Thermal Transmission Properties by Means of the Guarded-Hot-Plate Apparatus
ASTM C335	Standard Test Method for Steady-State Heat Transfer Properties of Pipe Insulation

* The above listed ASTM test methods are used to determine the thermal conductivity of insulations depending on the form or shape. ASTM C177 is used to test flat insulation materials. ASTM C335 is used to determine the thermal conductivity for pipe insulation materials.

5.0 Standard Specification for Mineral Fiber Pipe Insulations (ASTM C547)	
Properties	**ASTM Reference**
Maximum Use Temperature	**ASTM C411**- Standard Test Method for Hot-Surface Performance of High Temperature Thermal Insulation **ASTM C447** - Standard Practice for Estimating the Maximum Use Temperature of Thermal Insulations
Dimensions	**ASTM C302** - Standard Test Method for Density and Dimensions of Preformed Pipe-Covering-Type Thermal Insulation **ASTM C450** - Standard Practice for Fabrication of Thermal Insulating Fitting Covers for Piping, and Vessel Lagging **ASTM C585** - Standard Practice for Inner and Outer Diameters of Rigid Thermal Insulation for Nominal Sizes of Pipe and Tubing (NPS System)
Dimensional Stability	**ASTM C356** - Standard Test Method for Linear Shrinkage of Preformed High-Temperature Thermal Insulation Subjected to Soaking Heat **ASTM C547** - Standard Specification for Mineral Fiber Pipe Insulation, Section 11.1.7.4 Procedure (for sag resistance)
Water Vapor Sorption	**ASTM C1104/C1104M** - Standard Test Method for Determining the Water Vapor Sorption of Unfaced Mineral Fiber Insulation
Water Vapor Permeance of Factory-Applied Jacketing for Below Ambient Applications	**ASTM E96/E96M** - Standard Test Method for Water Vapor Transmission of Materials
Corrosion of Austenitic Stainless Steel and Other Materials	**ASTM C692** - Standard Test Method for Evaluating the Influence of Thermal Insulations on External Stress Corrosion Cracking Tendency of Austenitic Stainless Steel **ASTM C795** - Standard Specification for Thermal Insulation for Use in Contact with Austenitic Stainless Steel **ASTM C871** - Standard Test Methods for Chemical Analysis of Thermal Insulation Materials for Leachable Chloride, Fluoride, Silicate, and Sodium Ions
Surface Burning Characteristics	**ASTM E84** - Standard Test Method for Surface Burning Characteristics of Building Materials **UL 723** - Test for surface Burning Characteristics of Building Materials **CAN/ULC-S102** - Method for Testing Surface Burning Characteristics of Building Materials and Accessories (for applications in Canada)
Thermal Conductivity	**ASTM C335** - Standard Test Method for Steady-State Heat Transfer Properties of Pipe Insulation

6.0 Specifications, Performance & Test Standards for Facings	
Properties	**ASTM Reference**
Properties	**ASTM C1136** - Flexible, Low Permeance Vapor Retarders for Thermal Insulation **ASTM C921** - Standard Practice for Determining the Properties of Jacketing Materials for Thermal Insulation
Burst Strength	**ASTM D774 / D774M** - Standard Method for Bursting Strength of Paper
Tensile Strength	**ASTM D828** - Standard Test Method for Tensile Properties for Paper and Paperboard Using Constant-Rate-of-Elongation Apparatus **ASTM D882** - Standard Test Method for Tensile Properties of Thin Plastic Sheeting
Dimensional Stability	**ASTM D1204** - Standard Test Method for Linear Dimensional Changes of Non rigid Thermoplastic Sheeting or Film at Elevated Temperature
Vapor Permeance	**ASTM E96** - Standard Test Method for Water Vapor Transmission of Materials
Flame Spread	**ASTM E84** - Standard Test Method for Surface Burning Characteristics of Building Materials **CAN/ULC-S102** - Method for Testing Surface Burning Characteristics of Building Materials and Accessories
Fungi Resistance	**ASTM C1338** - Standard Test Method for Determining Fungi Resistance of Insulation Materials and Facings

7.0 Insulation Thickness

7.1 Minimum Thickness

The ASHRAE Standard 90.1(Page A-3) and the International Energy Conservation Code (IECC) (Page A-4) requirements for pipe insulation thickness are intended to serve as the minimum standard for energy efficiency in commercial buildings. In some cases, increased thickness for greater energy efficiency can be justified. These minimum pipe insulation thicknesses as listed in ASHRAE 90.1 are not intended to prevent condensation or to achieve greater energy conservation. To specify the right insulation thickness for condensation control or energy conservation, use the NAIMA 3E Plus® insulation thickness software program. When using the program to determine the right insulation thickness for condensation control, use the design criteria (temperature and humidity) that represents the worst case scenario for the conditions.

The program can be downloaded free of charge from www.pipeinsulation.org or obtained from any NAIMA pipe insulation manufacturer.

8.0 Fittings and Hangers

8.1 Fittings

For the insulation system to perform, fittings must be insulated to at least the same thermal performance as the pipe insulation applied to the straight pipe section. See Figures 2-5 through 2.10.

8.2 Hangers

The pipe insulation should be continuous through hanging supports. In order to prevent damage to the insulation a rigid insert and/or metal saddle should be installed at hangers support. See Figures 2.11 through 2.13.

SECTION 2

INSULATION SYSTEM INSTALLATION

This section of the Guideline provides installation system recommendations for insulating piping systems in conditioned spaces.

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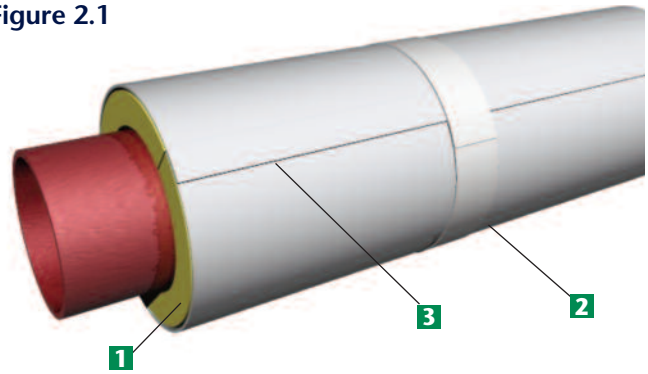
SECTION 2 - INSULATION SYSTEM INSTALLATION

Pipe Insulation With Factory Applied ASJ jacket —Straight pipe -Single Layer

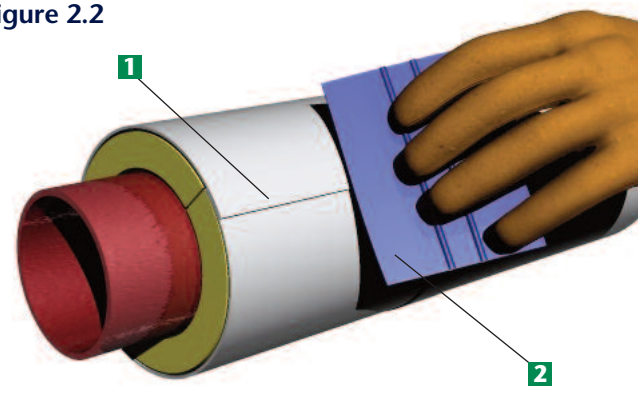
- Verify all inspection and acceptance testing of the piping as required by the specification has been completed and that the piping is ready for installation of insulation (e.g., leak/pressure tests).
- Verify all surfaces are clean, dry and free from dirt, scale, moisture, oil, grease and any required coatings are applied.
- Verify there is adequate clearance to install the mineral fiber pipe insulation in accordance with project drawings, operation performance parameters of the specification, such as access to controls, valves and for maintenance and repair.
- Install pipe insulation per Figure 2.1.
- Verify all pipe hangers, supports and anchors are installed in accordance with the project specification per Figures 2.11 through 2.13.
- All pipe insulation longitudinal and circumferential joints must be sealed using the self-seal lap and butt strips. All self seal-laps and butt strips must be firmly rubbed with a sealing tool such as a squeegee to assure proper adhesion. The butt strip must be centered on the circumferential joint and the end of the strip should overlap itself by a minimum of 1" (25.4mm). See Figures 2.1 and 2.2.
- Stapling of the ASJ jacket or self-sealing joints is not recommended. If staples are used they must be outward clinching staples that must then be sealed with a vapor retarder mastic or covered with an approved ASJ tape.
- The outermost ASJ vapor retarder must have a continuous, unbroken vapor seal. Hangers, supports, anchors, etc., that are secured directly to cold surfaces must be adequately insulated and vapor sealed to prevent condensation.
- The butt end of every fourth pipe insulation section, and the ends or raw edges of insulation terminations at equipment connections, fittings and fire stop systems shall be sealed with vapor retarder mastic.
- When a vapor retarder mastic is required, a maximum water vapor permeance of 0.02 per ASTM E-96 Procedure B must be achieved. Follow the mastic manufacturer's recommendations for application to achieve the 0.02 perm rating.

Figure 2.1



1. **Preformed mineral pipe insulation with factory applied ASJ jacket**
2. **Butt strip tape, end of strip overlaps itself by a minimum of 1" (25.4mm)**
3. **Factory applied self-seal tape joint**

Figure 2.2



1. **Self seal lap and factory supplied butt strips must be firmly rubbed with sealing tool such as a plastic squeegee**
2. **Squeegee**

Installation Tips

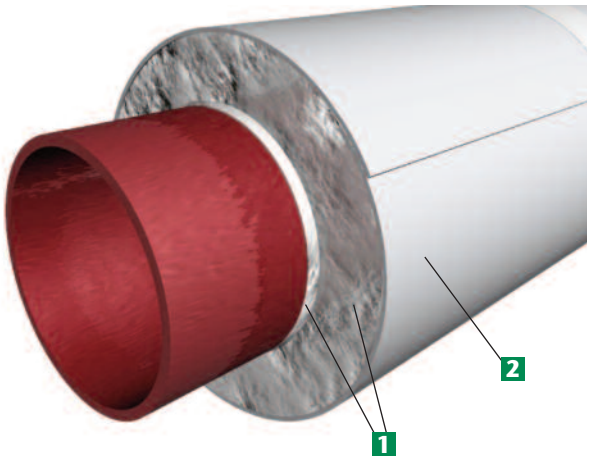
When the specification calls for a double layer insulation system, follow the same installation protocol as a single layer system. NAIMA recommends removing the facing on the inner layer of the pipe insulation before installing the second layer. Secure the inner layer with wire or tape.

In multiple layer applications, it is recommended that joints be staggered to minimize thermal shorts at through joints.

Vapor Dams —Straight Pipe (Single Layer and Multi-Layer)

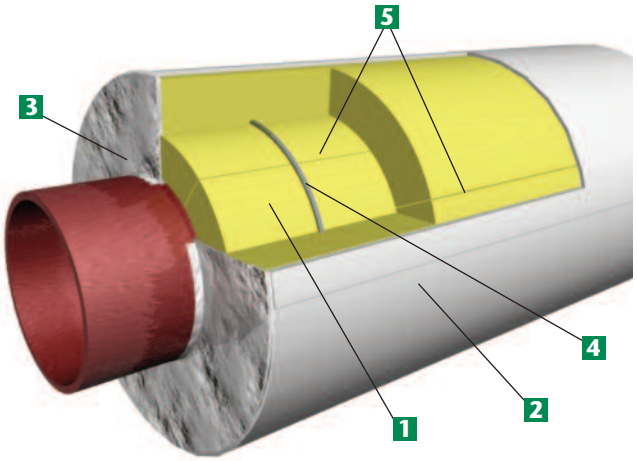
- Vapor dams should be used on all chilled water systems. Vapor dams or vapor seals shall be installed at every fourth section and at the termination of all fittings or as indicated in the project specifications.
- The butt end of every fourth pipe insulation section should have the ends of insulation terminations vapor sealed with vapor retarder mastic. Extend the mastic onto the pipe and extend the mastic up and onto the ASJ jacket.
- For multi-layer systems, the staggered ends must be terminated at the vapor dam and a vapor retarder applied to the entire exposed raw edges of the insulation as shown in the Figure 2.4.

Figure 2.3 Single Layer



1. Vapor retarder mastic (vapor dam every fourth section)
2. ASJ or vapor retarder jacket

Figure 2.4 Multi-Layer



1. Preformed pipe insulation without vapor retarder jacket
2. Preformed pipe insulation with factory applied vapor retarder jacket
3. Vapor retarder mastic
4. Secure the inner pipe insulation layer
5. Staggered insulation joints

Installation Tips

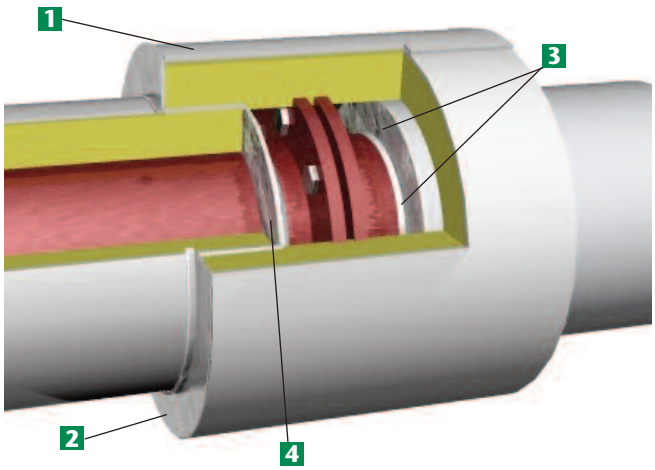
When installing the next section of insulation on the pipe, make sure the insulation butts up closely to the joint with the vapor dam. Seal the butt joint with butt strip tape.

At the termination, make sure that the vapor retarder mastic extends all the way to the ASJ jacket, assuring that all exposed insulation and the joint where the insulation meets the pipe are covered.

Insulation of Pipe System Fittings: Flanges, Couplings, Elbows, Tees, and Valves

Condensation control and energy conservation require that the insulation covers the entire length of the chilled water pipe distribution system including all fittings installed in the system. The thermal performance of the insulation at the fittings should be consistent with the insulation applied to the straight pipe section as indicated by the project specification.

Figure 2.5 Flanges

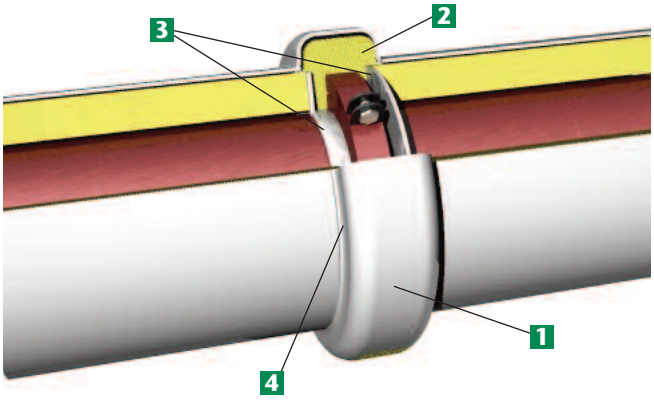


1. Factory applied jacket
2. Vapor dam
3. Vapor dam at straight section of pipe
4. Vapor retarder mastic on joints and terminations

Grooved Couplings

Grooved couplings are used to join sections of grooved pipe or tubing.

Figure 2.6



1. PVC molded fitting cover
2. Mineral fiber insulation
3. Vapor Dam
4. Vapor retarder mastic or PVC tape on joints

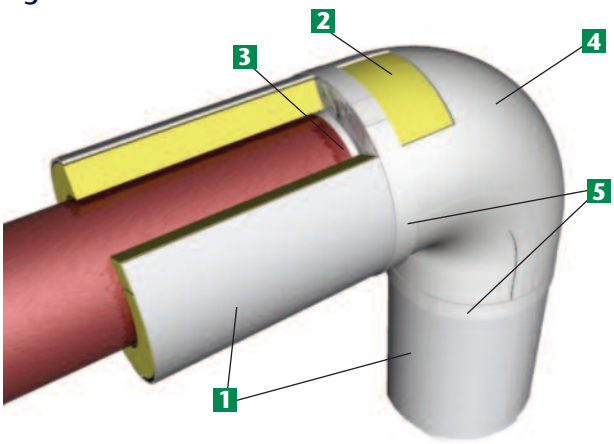
Installation Tip

A vapor dam or vapor seal must be installed at the terminations of all pipe sections, flanges or pipe joints connecting to a fitting or as indicated in the project specification.

45 and 90 Degree Elbows

Elbows can be insulated using preformed or molded insulation, or field fabricated from a straight section of pipe insulation, or insulated using mineral fiber blanket inserts.

Figure 2.7



1. **Preformed mineral fiber pipe insulation with vapor retarder jacket**
2. **Fabricated or mitered or molded mineral fiber pipe insulation**
3. **Vapor dam**
4. **PVC fitting cover (See Photo 2.1)**
5. **Apply PVC vapor seal tape or adhesive/solvent to all joints**

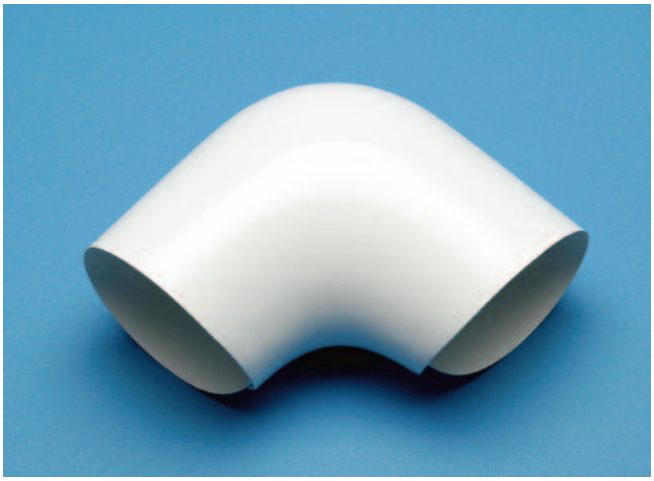
General Recommendations

Insulate fittings to the same thermal performance as the adjacent insulation with either pre-cut mineral fiber inserts or molded segmented pipe insulation that has been mitered to conform to the PVC fitting cover. Next, apply a vapor retarder mastic around the edges of the adjoining pipe insulation and on the fitting cover throat overlap. Install a PVC cover as recommended by the manufacturer. After the cover is in place, seal the throat seam and circumferential edges with PVC vapor seal or adhesive/solvent to all joints.

All surfaces to be taped should first be cleaned with a cloth to remove all dust, dirt and grease in order to provide the pressure-sensitive adhesive with a good bonding surface.

Note: Do not pull too hard when applying PVC tape as it has a tendency to creep. Apply the tape to bridge or cover the gap or contour and give it a smooth, flat finish.

Photo 2.1



Installation Tip

A vapor dam or vapor seal must be installed at the butt joint at every fourth section, and at the termination of all fittings or as indicated in the project specification.

Figure 2.8 Tees

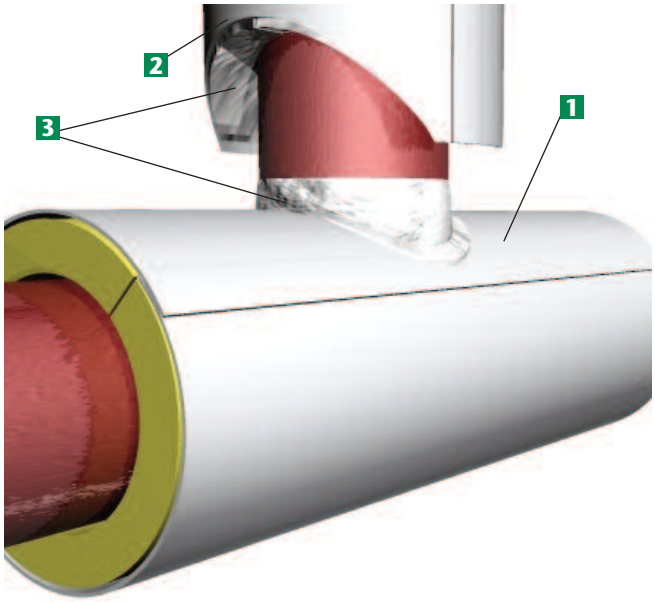
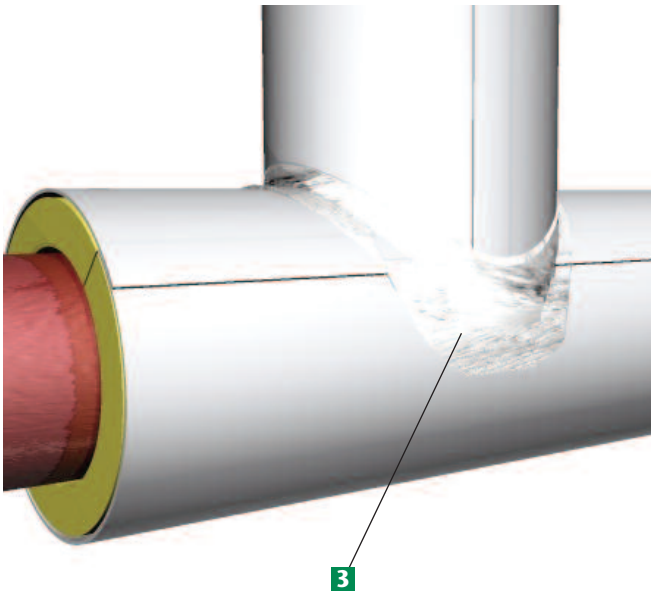


Figure 2.9 Finished Tees

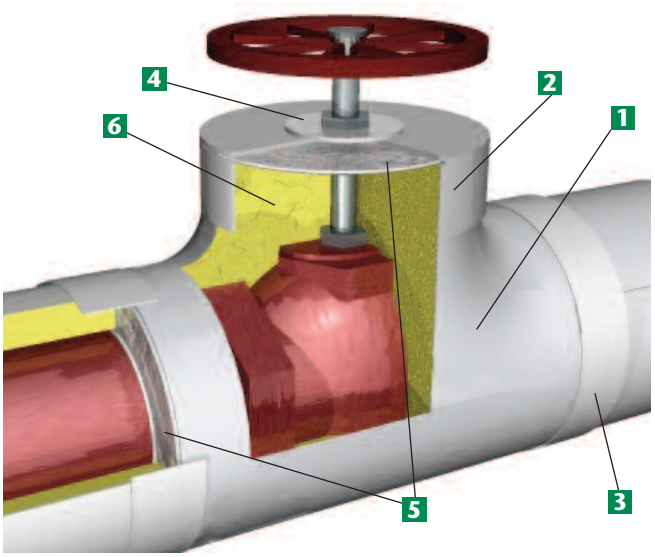


1. **Preformed pipe insulation should be continued through the tee. The insulation and jacket in straight sections should be cut to fit around the vertical pipe.**
2. **Vertical section of pipe insulation should be cut to fit flush with the straight pipe insulation. The ASJ jacket should then be sealed with vapor retarder tape and finished with vapor retarder mastic.**
3. **All terminations must be finished with vapor dams**

Installation Tip

A vapor dam must be installed at the butt joint at every fourth section, and at the termination of all fittings or as indicated in the project specification.

Figure 2.10 Valves



1. Molded PVC valve fitting cover. (See Photo 2.3)
2. Molded PVC end cap. (See Photo 2.4) It is possible for the PVC valve cover to incorporate an end cap. If the end cap has a penetration to accomodate the valve stem, the hole must then be sealed with a vapor retarder mastic.
3. PVC vapor seal tape
4. Vapor retarder mastic
5. Vapor dam applied at ends of preformed mineral fiber insulation
6. Mineral fiber insulation wrapped around valve filling void space

Installation Tip

A vapor dam or vapor seal must be installed at the butt joint at every fourth section, and at the termination of all fittings or as indicated in the project specification.

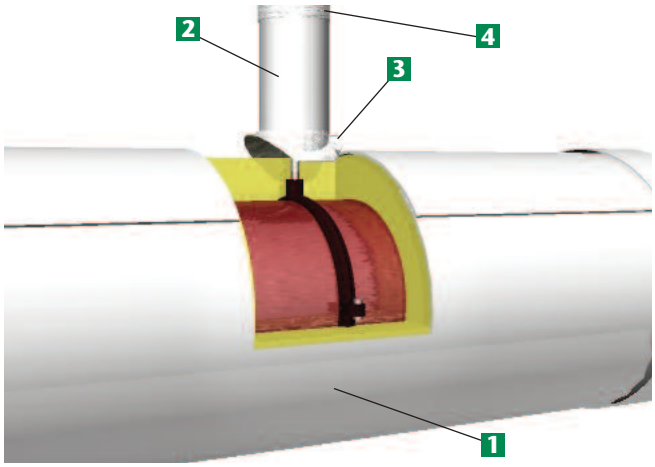
The void around the valve stem must be filled with insulation.

Photo 2.3

Photo 2.4

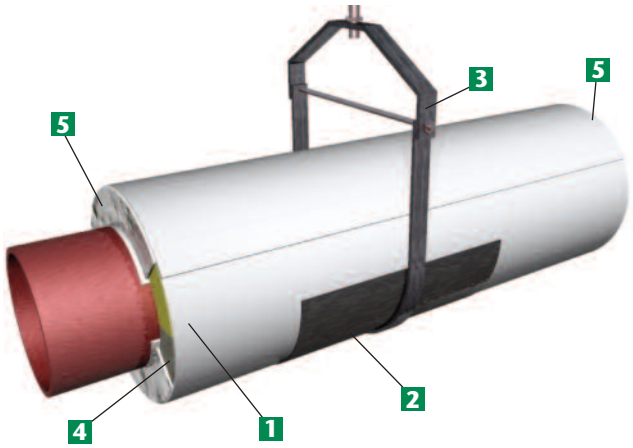
Pipe Supports

Figure 2.11 Split Ring Hanger



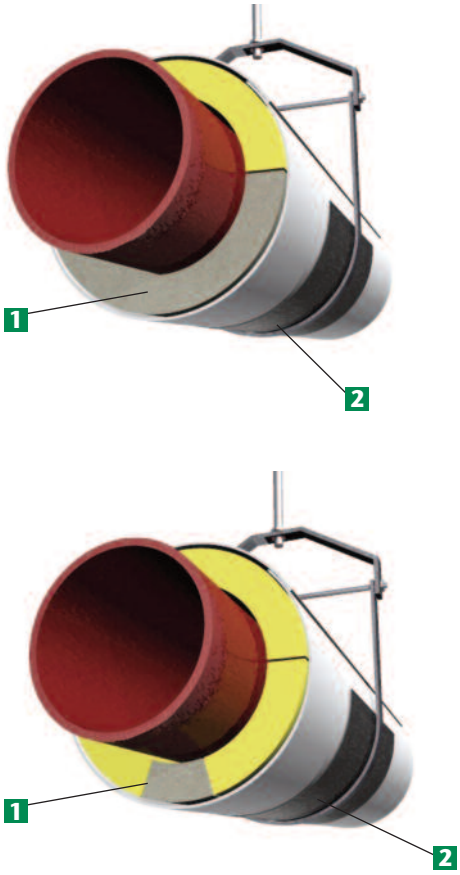
1. Preformed mineral fiber pipe insulation with factory applied ASJ jacket
2. Insulate support rod with preformed mineral fiber pipe insulation as required to prevent condensation
3. Vapor retarder mastic
4. Add vapor dam at butt joints of pipe section and termination of insulation on support rod

Figure 2.12 Clevis Hanger



1. Preformed mineral fiber pipe insulation with factory applied ASJ jacket
2. Metal pipe saddle
3. Clevis hanger
4. High density insulation insert as required
5. Add vapor dam at butt joints of pipe section

Figure 2.13 Clevis Hanger High Density Insulation / Insert Detail



1. High density insulation half section insert (top) or high compression structural calcium silicate insert (bottom)
2. Metal pipe saddle

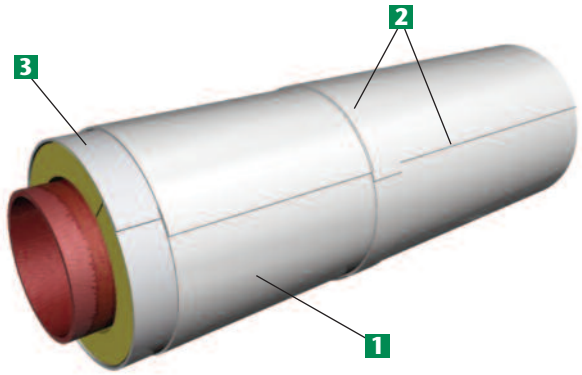
Installation Tip

At a minimum, the high density insert must be at least as long as the saddle

Field Applied Jackets

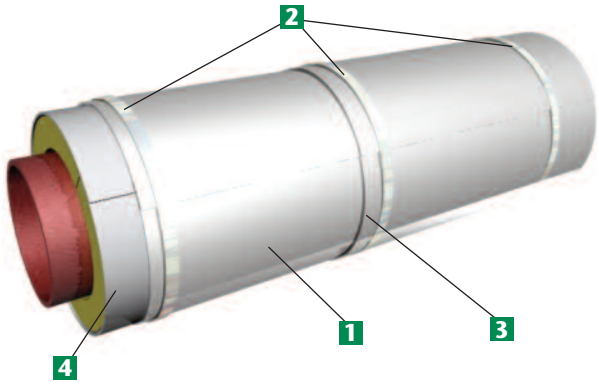
Install PVC or metal jacket as indicated in the project specification. PVC or metal jackets are installed over factory applied ASJ jacket in order to provide abuse protection, cleanable surface or a specific appearance as required by the space or area of the installation.

Figure 2.14 PVC Jacket



1. Field applied PVC jacket
2. PVC jacket with overlap at all joints. Secure and seal joints with PVC tape or solvent weld adhesive
3. ASJ jacket

Figure 2.15 Metal Jacket



1. Field applied metal jacket
2. Metal jacket secured using bands per manufacturer's instructions (typically three per section)
3. Installed metal jacket with overlap at all joints
4. ASJ jacket

SECTION 3
GUIDE SPECIFICATIONS

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SECTION 3: GUIDE SPECIFICATIONS

Guide Specification – Chilled Water Pipe System Insulated With Mineral Fiber Pipe Insulation And Factory Applied All Service Jacket (ASJ)

SECTION 23 07 19* – Piping Insulation

PART 1.00 – GENERAL

1.01 SCOPE

A. The work covered by this specification consists of furnishing all labor, equipment, materials and accessories, and performing all operations required for the correct installation of insulation on chilled water operating at a temperature range of 33°F to 60°F (0.5°C to 15.6°C) and located in indoor conditioned spaces.
B. Insulation thickness for all piping systems must be specified

1.02 References

- ASTM C547 Specification for Mineral Fiber Pipe Insulation
- ASTM C585 Practice for Inner and Outer Diameter of Rigid Thermal Insulation for Nominal Sizes of Pipe and Tubing (NPS System)
- ASTM C795 Specification for Thermal Insulation for Use in Contact with Austenitic Stainless Steel
- ASTM C1136 Specification for Flexible, Low Permeance Vapor Retarders for Thermal Insulation
- ASTM E84 Test Method for Surface Burning Characteristics of Building Materials
- NFPA 90A Standard for the Installation of Air-Conditioning and Ventilating Systems
- CAN/ULC S102 Standard Method of Test for Surface Burning Characteristics of Building Materials and Assemblies
- GREENGUARD Certification Standards for Products with low chemical emissions for use indoors

* *MasterFormat®*
- *Construction Specification Institute*
- *Construction Specifications of Canada*

1.03 SUBMITTALS

A. Product Data: Provide product description, list of materials and thickness for each pipe section or equipment scheduled to be insulated.
B. Shop Drawings: Include installation details for valves, fittings, pipe and all other items to be insulated.
C. Samples: Submit samples of each insulation system to be used.

1.04 Quality Assurance

A. Insulation materials shall be manufactured at facilities with an acceptable quality control program.
B. All installation work shall conform with the information in the NAIMA Guide for Chilled Water Pipe Systems Insulated with Mineral Fiber Insulation or other accepted industry and trade installation standards for commercial and industrial insulations, or shall conform with manufacturer's recommendations.
C. Insulation materials that are damaged, wet or contaminated shall be replaced.
D. Installation shall be performed by qualified applicators.

1.05 Delivery, Storage and Handling

A. Deliver all materials (insulation, coverings, tapes, cements, adhesives, coatings, etc.) to the jobsite in factory containers with manufacturer's label showing manufacturer, product name and product fire hazard information.
B. Protect the insulation from dirt, water, chemical attack and mechanical damage before, during and after installation. Damaged or contaminated insulation should discarded and removed from job site.

1.06 Project/Site Conditions

A. Maintain jobsite temperature and conditions before, during and after installation as required by the manufacturers of insulation adhesives and coatings.

PART 2.00 – PRODUCTS

2.01 Manufacturers Requirements

A. Preformed mineral fiber pipe insulation with factory applied all-service vapor-retarder jacket (ASJ) jacket with a self-sealing longitudinal closure lap (SSL) and butt strips or approved alternate to seal butt joints. Preformed mineral fiber pipe insulation shall conform to ASTM C547. The ASJ facing shall conform to ASTM C1136 Type I or Type II.
B. Preformed mineral fiber pipe insulation with factory applied all-service vapor-retarder jacket (ASJ) jacket shall have a flame spread rating not greater than 25 and a smoke developed rating not greater than 50 when tested as in accordance with ASTM E84, UL 723 or CAN/ULC S102 (Canada).
C. Preformed mineral fiber pipe insulation shall have a water vapor sorption of less than 5% by weight as tested in accordance ASTM C 547.
D. All service jacket (ASJ) shall have a water vapor permeance of 0.02 perms or less as tested in accordance to ASTM E96, procedure "A".
E. When a vapor mastic is required, a water vapor permeance of 0.02 per ASTM E-96 Procedure B must be achieved.
F. All accessories materials such as field installed jackets, mastics, coatings, tapes, fasteners shall be recommended by each component manufacturer for the specified application or as listed in the NAIMA Guide to Insulating Chilled Water Systems with Mineral Fiber Pipe Insulation.

PART 3.00 – EXECUTION

3.01 EXAMINATION

A. Verify that pressure testing of piping and equipment connections has been completed and that the pipe system is ready for installation of insulation.
B. Verify surfaces are clean and dry.
C. Verify that it is physically possible to install the mineral fiber pipe insulation in accordance with project drawings, operation performance parameters and limitations of this specification.
D. Verify that damage to insulation facing, jacket, or vapor barrier coating has been repaired or replaced prior to starting chilled water system.

Chilled Water Pipe System Insulation Installation Check List

Project Name and Number: _____

Insulation/Mechanical Contractor:

_____

Builder: _____

Engineer: _____

Checklist Completed by: _____

Date: _____

Reference Materials

- Latest edition, *NAIMA Guide to Insulating Chilled Water Piping Systems with Mineral Fiber Pipe Insulation*
- *National Commercial and Industrial Insulation Standards* published by the Midwest Insulation Contractors Association
- Project specifications
- Manufacturers literature and SDS
- Submittal sheets for the job

If a check mark appears in the "NO" column, bring it to the attention of the contractor. For fabrication, installation, pipe supports, and other details, refer to the current edition of the *NAIMA Mineral Fiber Chilled Water Pipe Insulation Standard.*

Description	YES	N/A	NO
Product			
Is the product used identified on the carton?	☐	☐	☐
Do the labels on the package indicate that the material meets ASTM C547?	☐	☐	☐
Is the factory applied facing adequately attached to pipe insulation?	☐	☐	☐
Are the butt strip tapes supplied?	☐	☐	☐
Does the pipe insulation supplied meet the project specification?	☐	☐	☐
Does the vapor retarder jacket and mastic supplied meet the required perm rating?	☐	☐	☐
General			
Have pipes been pressure tested and accepted prior to the installation of the insulation?	☐	☐	☐
Have all materials transported and stored at job site been handled per the specification?	☐	☐	☐
Were all pipes and equipment surfaces dry and clean when installing insulation and accessory materials?	☐	☐	☐
Was the correct insulation thickness installed in each section of the project per the specifications and drawings?	☐	☐	☐
Were the insulation jackets and accessories installed in each area of the project per the specification and drawings?	☐	☐	☐
Has damaged insulation facing or jacket been repaired or replaced prior to starting chilled water system?	☐	☐	☐
Installation Straight Pipe (See section II of *NAIMA Guide to Insulating Chilled Water Piping Systems with Mineral Fiber Pipe Insulation*)			
Are sections of straight pipe installed as indicated in Figure 2.1?	☐	☐	☐
Have butt strips been applied to butt joints on all sections of pipe insulation?	☐	☐	☐
Have all self-sealing laps along the longitudinal joints and butt strips at each joint been properly sealed?	☐	☐	☐
Have metal and PVC jackets been installed with proper overlap?	☐	☐	☐
Was a vapor dam applied at the butt joint after every fourth insulation sections as indicated in Figures 2.3 and 2.4	☐	☐	☐
Have insulation in fittings (elbows, tees, valves, etc) been installed as indicated in Section 2?	☐	☐	☐
Have mastics, caulks, facings, and other accessories been installed as indicated in Section 2?	☐	☐	☐
Have pipe supports been installed and insulated as indicated in Figures 2.11, 2.12, and 2.13?	☐	☐	☐

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APPENDIX

Information Sources and References

The following may be used as references when working with information in this Standard. NOTE: Current editions of some references may differ from editions of listed date.

ASHRAE - American Society of Heating, Refrigerating, and Air-Conditioning Engineers, Inc.

1791 Tullie Circle, N.E., Atlanta, GA 30329-2305

- 2011 ASHRAE Handbook - Heating, Ventilating, and Air-Conditioning Applications
- 2012 ASHRAE Handbook - Heating, Ventilating, and Air-Conditioning Systems and Equipment
- 2013 ASHRAE Handbook - Fundamentals
- 2014 ASHRAE Handbook - Refrigeration
- ASHRAE/IES 90.1-2013, Energy Efficient Design of New Buildings (Except Low Rise Residential Buildings)
- A Practical Guide to Noise and Vibration Control for HVAC Systems: Mark E. Schaffer

ASTM - American Society for Testing and Materials

100 Barr Harbor Drive, West Conshohocken, PA 19428-2959

- Source for copies of ASTM test methods referenced throughout this Guide
- ASTM Volume 04.06 Thermal Insulation; Building and Environmental Acoustics

Construction Specifications Canada

120 Carlton St, Suite 312 Toronto, ON M5A 4K2 Canada

- *MasterFormat®* 23 07 19 Piping Insulation

The Construction Specifications Institute

110 South Union Street, Suite 100, Alexandria VA 22314

- *MasterFormat®* 23 07 19 Piping Insulation

ICC - International Code Council, Inc.

- Eastern Regional Office: 900 Montclair Rd., Birmingham, AL 35213-1206
- Central Regional Office: 4051 Flossmoor Road, Country Club Hills, IL 60478
- Western Regional Office: 3060 Saturn Street, Suite 100, Brea, CA 92821

Midwest Insulation Contractors Assoc. (MICA)

16712 Elm Circle, Omaha, NE 68130

- National Commercial and Industrial Insulation Standards – 7th Edition

The National Research Council (NRC)

1200 Montréal Road Ottawa, Ontario K1A 0R6

- National Building Code of Canada 2010

NAIMA - North American Insulation Manufacturers Association

11 Canal Center Plaza, Suite 103, Alexandria, VA 22314

- Facts #86: Mineral Fiber Pipe Insulation for Chilled Water Piping (CI227)
- Facts #82: Mineral Fiber Insulation Products for Commercial and Industrial Applications: Codes and Standards for Insulation Used on Pipes (CI225)
- Facts #85: Facts About Insulation Requirements for Plastic Piping (CI226)
- Facts #72: Mineral Fiber Insulation Products for Commercial and Industrial Applications: The Facts About Mold Growth (CI217)
- 3E Plus Computer Program (CI219)
- Facts #81: Thermal Performance of Coatings Used to Insulate Pipes, Ducts, and Equipment (CI224)
- Green and Competitive - The Energy, Environmental, and Economic Benefits of Fiber Glass and Mineral Wool Insulation Products (GREEN)
- Facts #62: Health and Safety Facts for Fiber Glass (N040)
- Facts #63: Health & Safety Facts for Rock & Slag Wool (N041)
- Facts #78: Exposure Data For Fiber Glass, Rock Wool & Slag Wool (N062)
- Fiberglass Insulation No Longer on Cancer Concern List (RP057)
- Working Smart with Fiber Glass, Rock Wool and Slag Wool Products (N059)
- Facts #45: Fiber Glass and Slag Wool Insulations - Materials for a Sustainable Planet (N012)

NFPA - National Fire Protection Association

1 Batterymarch Park, P.O. Box 9101, Quincy, MA 02269

- NFPA 90A - Standard for the Installation of Air Conditioning and Ventilating Systems, 2015 Edition

National Institute of Building Sciences

1090 Vermont Ave., NW, Suite 700, Washington DC 20005

- Mechanical Insulation Design Guide

National Insulation Association

12100 Sunset Hills Road, Suite 330, Reston, VA 20190

- Mechanical Insulation Design Guide

ASHRAE Standard 90.1 Minimum Pipe Insulation Thickness Recommendations

TABLE 6.8.3-1 Minimum Piping Insulation Thickness Heating and Hot Water Systems [a,b,c,d,e] (Steam, Steam Condensate, Hot Water and Domestic Hot Water Systems)

Fluid Operating Temperature Range (°F) and Usage	Insulation Conductivity		Nominal Pipe or Tube Size, In.				
			<1	1 to <1½	1½ to <4	4 to <8	≥8
	Conductivity, Btu·in/(h·ft²·°F)	Mean Rating Temp., °F	Insulation Thickness, In.				
>350	0.32 to 0.34	250	4.5	5.0	5.0	5.0	5.0
251 to 350	0.29 to 0.32	200	3.0	4.0	4.5	4.5	4.5
201 to 250	0.27 to 0.30	150	2.5	2.5	2.5	3.0	3.0
141 to 200	0.25 to 0.29	125	1.5	1.5	2.0	2.0	2.0
105 to 140	0.22 to 0.28	100	1.0	1.0	1.5	1.5	1.5

a. For insulation outside the stated conductivity range, the minimum thickness (T) shall be determined as follows: $T = r\{(1 + t/r)^{K/k} - 1\}$ where T = minimum insulation thickness (in.), r = actual outside radius of pipe (in.), t = insulation thickness listed in this table for applicable fluid temperature and pipe size, K = conductivity of alternate material at mean rating temperature indicated for the applicable fluid temperature (Btu·in./h·ft²·°F); and k = the upper value of the conductivity range listed in this table for the applicable fluid temperature.

b. These thicknesses are based on energy efficiency considerations only. Additional insulation is sometimes required relative to safety issues/surface temperature.

c. For piping smaller that 1½ inch (38mm) and located in partitions within conditioned spaces, reduction of these thicknesses by 1 inch (25mm) shall be permitted (before thickness adjustment required in footnote [a]) but not to thicknesses below 1 inch (25mm).

d. For direct-buried heating and hot water system piping, reduction of these thicknesses by 1½ inch (38mm) shall be permitted (before thickness adjustment in footnote [a]) but not to thicknesses below 1inch (25mm).

e. The table is based on steel pipe. Nonmetallic pipes schedule 80 thickness or less shall use the table values. For other nonmetallic pipes having thermal resistance greater than that of steel pipe, reduced insulation thicknesses are permitted if documentation is provided showing that the pipe with the proposed insulation has no more heat transfer per foot than a steel pipe of the same size with the insulation thickness shown in the table.

TABLE 6.8.3-2 Minimum Piping Insulation Thickness Cooling Systems [a,b,c,d] (Chilled Water, Brine, and Refrigerant)

Fluid Operating Temperature Range (°F) and Usage	Insulation Conductivity		Nominal Pipe or Tube Size, In.				
			<1	1 to <1½	1½ to <4	4 to <8	≥8
	Conductivity, Btu·in/(h·ft²·°F)	Mean Rating Temp., °F	Insulation Thickness, In.				
40 to 60	0.21 to 0.27	75	0.5	0.5	1.0	1.0	1.0
< 40	0.20 to 0.26	50	0.5	1.0	1.0	1.0	1.5

a. For insulation outside the stated conductivity range, the minimum thickness (T) shall be determined as follows: $T = r\{(1 + t/r)^{K/k} - 1\}$ where T = minimum insulation thickness (in.), r = actual outside radius of pipe (in.), t = insulation thickness listed in this table for applicable fluid temperature and pipe size, K = conductivity of alternate material at mean rating temperature indicated for the applicable fluid temperature (Btu·in./h·ft²·°F); and k = the upper value of the conductivity range listed in this table for the applicable fluid temperature.

b. These thicknesses are based on energy efficiency considerations only. Issues such as water vapor permeability or surface condensation sometimes require vapor retarders or additional insulation.

c. For direct-buried cooling system piping, insulation is not required.

d. The table is based on steel pipe. Nonmetallic pipes schedule 80 thickness or less shall use the table values. For other nonmetallic pipes having thermal resistance greater than that of steel pipe, reduced insulation thicknesses are permitted if documentation is provided showing that the pipe with the proposed insulation has no more heat transfer per foot than a steel pipe of the same size with the insulation thickness shown in the table.

These insulation tables are contained in ASHRAE 90.1-2013 Energy Standard for Buildings Except Low-Rise Residential Buildings.

ASHRAE, founded in 1894, is a global society advancing human well-being through sustainable technology for the built environment. The Society and its members focus on building systems, energy efficiency, indoor air quality, refrigeration and sustainability within the industry. Through research, standards, writing, publishing and continuing education, ASHRAE shapes tomorrow's built environment today. ASHRAE's mission is to advance the arts and sciences of heating, ventilating, air conditioning and refrigerating to serve humanity and promote a sustainable world.

IECC Minimum Pipe Insulation Thickness Recommendations

TABLE C403.2.8 Minimum Pipe Insulation Thickness (thickness in inches)[a,b,c]

Fluid Operating Temperature Range (°F) and Usage	Insulation Conductivity		Nominal Pipe or Tube Size, In.				
			<1	1 to <1½	1½ to <4	4 to <8	≥8
	Conductivity, Btu·in/(h·ft²·°F)	Mean Rating Temp., °F	Insulation Thickness, In.				
>350	0.32 to 0.34	250	4.5	5.0	5.0	5.0	5.0
251 to 350	0.29 to 0.32	200	3.0	4.0	4.5	4.5	4.5
201 to 250	0.27 to 0.30	150	2.5	2.5	2.5	3.0	3.0
141 to 200	0.25 to 0.29	125	1.5	1.5	2.0	2.0	2.0
105 to 140	0.22 to 0.28	100	1.0	1.0	1.5	1.5	1.5
40 to 60	0.21 – 0.27	75	0.5	0.5	1.0	1.0	1.0
< 40	0.20 – 0.26	75	0.5	1.0	1.0	1.0	1.5

a. For piping smaller than 1½ inch (38mm) and located in partitions within conditioned spaces, reduction of these thicknesses by 1 inch (25mm) shall be permitted (before thickness adjustment required in footnote b) but not to a thickness less than 1 inch (25mm).

b. For insulation outside the stated conductivity range, the minimum thickness (T) shall be determined as follows:

$T = r \{(1 + t/r)^{K/k} – 1\}$

where:

T = minimum insulation thickness.

r – actual outside radius of pipe.

t – insulation thickness listed in the table for applicable fluid temperature and pipe size.

K – conductivity of alternate material at mean rating indicated for the for the applicable fluid temperature (Btu·in/h·ft²·°F) and

k = the upper value of the conductivity range listed in the table for the applicable fluid temperature.

c. For direct-buried heating and hot water system piping, reduction of these thicknesses by 1 ½ inches (38 mm) shall be permitted (before thickness adjustment required in footnote b but not to thicknesses less than 1 inch (25mm).

IECC

The International Energy Conservation Code (developed by the ICC) establishes minimum regulations for energy efficient buildings using prescriptive and performance-related provisions. It is founded on broad-based principles that make possible the use of new materials and new energy efficient designs.

ICC

The International Code Council is a member-focused association. It is dedicated to developing model codes and standards used in the design, build and compliance process to construct safe, sustainable, affordable and resilient structures. Most U.S. communities and many global markets choose the international Codes - http://www.iccsafe.org/gr/Pages/adoptions.aspx

The International Codes, or I-Codes, published by ICC, provide minimum safeguards for people at home, at school and in the workplace. The I-Codes are a complete set of comprehensive, coordinated building safety and fire prevention codes. Building codes benefit public safety and support the industry's need for one set of codes without regional limitations.

NAIMA 3E Plus® Insulation Thickness Calculation Program

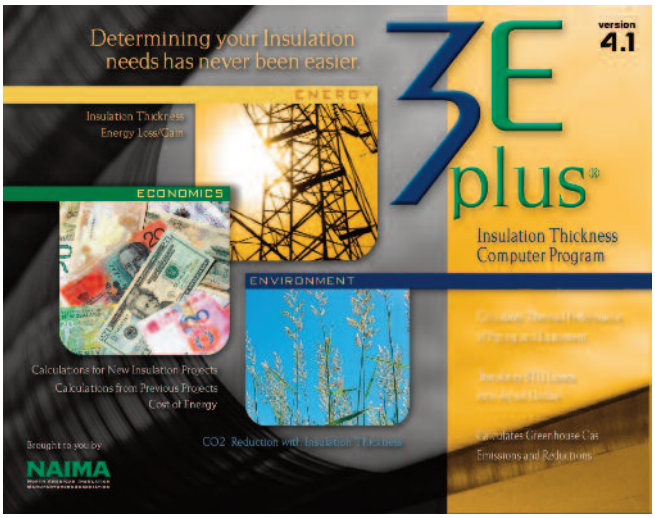
The NAIMA 3E Plus® Insulation Thickness Software Program is a software tool developed by NAIMA to simplify the task of determining how much energy, cost and pollution can be saved using insulation. The program is also is a valuable commercial and industrial facility energy management tool that can be used to improve system process efficiency. 3E Plus quickly and accurately determines where additional insulation can improve the process efficiency of pipes, boilers, tanks and ducts. By calculating the potential energy and cost savings over time, users can gauge the return on investment for first time insulation costs and insulation upgrades.

The 3E Plus program can:

- Calculate the thermal performance of both insulated and uninsulated piping, ducts and equipment including tanks and vessels
- Calculate energy savings in dollars or other monetary units
- Calculate greenhouse gas emissions and reductions

3E Plus Program Features:

- Runs on Windows XP, Vista, Windows 7 and Windows 8
- Automatically calculates thickness tables
- Calculates in both inch-pound (IP) and metric (SI) units
- Determines economic thickness of insulations based on return on investment for chosen fuel cost, installed cost, tax rates, maintenance, etc.
- Calculates the amount of insulation needed for personnel protection for various design conditions
- Calculates the thickness of insulation needed for condensation control to reduce the likelihood of condensation
- Calculates greenhouse gas emissions (pollutant) and reductions
- Determines surface temperature and heat loss/gain calculations of individual insulation thickness up to 10 inches (250 mm)
- Calculates heat loss/gain and exterior surface temperatures for any insulation material provided the thermal conductivity, associated mean temperatures, and temperature limit are entered by the user
- Calculates the outside insulated surface temperatures for all types of insulation applications at different process temperatures and various configurations
- Calculates bare vs. insulated heat loss efficiency percentages for horizontal and vertical piping, ducts, flat surfaces and other commonly insulated components
- Performs calculations for most types of insulation materials and accepts performance data provided by the user for other materials
- Provides calculations for many fuel types and five different surface orientations. Users can add their own types of fuel
- Uses calculations and default values from independent sources. Contains methodology from the most recent version of ASTM C 680 Standard Practices for Determination of Heat Gain or Loss and the Surface Temperature of Insulation Piping on Equipment Systems by the Use of a Computer System
- Customized program details including insulation materials, jacketing, fuel types and base metals can be saved
- Can easily data to an Excel spreadsheet for users wanting to manipulate the data for insulation audits of plants or other insulated systems



Free program and screen-by-screen user guide can be downloaded from www.pipeinsulation.org

Recommended Work Practices for Fiber Glass & Rock Wool Insulation

Health & Safety Aspects of Fiber Glass, Rock Wool & Slag Wool Insulation

NAIMA and its members are committed to protecting the health and safety of consumers, employees and workers who manufacture and install fiber glass, rock wool, and slag wool insulation products. NAIMA cooperates with government organizations to provide documentation that demonstrates that the products are safe to manufacture, install and use. NAIMA and its members have invested tens of millions of dollars in independent health and safety research projects in the United States and abroad.

Fiber glass, rock wool and slag wool insulation products are supported by over 75 years of scientific research. This research, aimed at investigating the possible human health effects of insulation products, includes epidemiological studies, worker health studies, research with laboratory animals, exposure studies, and fiber biosolubility studies.

NAIMA member companies continue to support ongoing scientific investigations into the health and safety aspects of glass wools as part of their comprehensive product stewardship program. NAIMA is dedicated to providing up-to-date information on the results of these studies as they become available.

Recommended Work Practices

These recommendations are applicable to all work involving fiber glass, rock wool and slag wool products.

Wear Appropriate Clothing

- Loose-fitting, long-sleeved and long-legged clothing is recommended to prevent irritation.*
- A head cover is also recommended, especially when working with material overhead.
- Gloves are also recommended. Skin irritation cannot occur if there is no contact with the skin.
- Do not tape sleeves or pants at wrists or ankles.
- Remove Synthetic Vitreous Fiber (SVF) dust from the work clothes before leaving work to reduce potential for skin irritation.

* This is a mechanical irritation and does not meet the U.S. OSHA Hazcom definition of “Irritation” specified in Appendix A TO 29C.F.R. §1910.1200

Wear Appropriate Personal Protective Equipment

- To minimize upper respiratory tract irritation, measures should be taken to control the exposure. Such measures will be dictated by the work environment and may include appropriate respiratory protective equipment. It is recommended that workers wear a NIOSH certifed dust respirator (certified 95 or greater) when removing synthetic vitreous fiber products during significant repair or demolition activity. See OSHA’s Respiratory Protection Standard.
- When appropriate, eye protection should be worn whenever SVF Products are being handled.
- Personal protective equipment should be properly fitted and worn when required.

Removal of Fibers From the Skin and Eyes

- If fibers accumulate on the skin, do not rub or scratch. Never remove fibers from the skin by blowing with compressed air.
- If fibers are seen penetrating the skin, they may be removed by applying and then removing adhesive tape so that the fibers adhere to the tape and are pulled out of the skin.
- SVF may be deposited in the eye. If this should happen, do not rub the eyes. Flush them with water or eyewash solution (if available). Consult a physician if irritation persists.

Fiber glass and rock and slag wool insulation products are safe to manufacture, install and use when recommended work practices are followed to reduce temporary mechanical irritation. Complete details on work practices and exposure guidelines are contained in NAIMA’s Product Stewardship Partnership Program and can be obtained in written or video form by contacting NAIMA or online at www.naima.org.

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About NAIMA

NAIMA is the association for North American manufacturers of fiber glass, rock wool, and slag wool insulation products. Its role is to promote energy efficiency and environmental preservation through the use of fiber glass, rock wool, and slag wool insulation, and to encourage the safe production and use of these materials.

NAIMA, continuing its members' commitment to safety, has established a renewed Product Stewardship Program, which embodies the components of the earlier OSHA-NAIMA Health and Safety Partnership Program (HSPP). The HSPP was a comprehensive eight-year partnership with OSHA, which NAIMA completed in May 2007, and now NAIMA incorporates these safe work practices in NAIMA's Product Stewardship Program.

For More Information

NAIMA
11 Canal Center Plaza, Suite 103 Alexandria, VA 22314
Tel: 703-684-0084 Fax: 703-684-0427
E-mail: insulation@naima.org
Website: www.naima.org

NAIMA Commercial & Industrial Committee Member Companies:

CertainTeed Corporation
750 E. Swedesford Road, Valley Forge, PA 19482
www.certainteed.com
800.233.8990

Industrial Insulation Group, LLC
2100 Line Street, Brunswick, GA 31520
www.iig-llc.com
912-264-6372

Johns Manville Corporation
717 17th Street, Denver, CO 80202
www.jm.com
800.654.3103

Knauf Insulation
One Knauf Drive, Shelbyville, IN 46176
www.knaufinsulation.us
800.825.4434

Owens Corning
One Owens Corning Parkway, Toledo, OH 43659
www.owenscorning.com
800-GET-PINK

ROXUL USA Inc.
8024 Esquesing Line
Milton, Ontario L9T 6W3 Canada
www.roxul.com
800-265-6878

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