Pipe Freeze Protection Insulation System

Patent Pending
US Patent Office Serial Number 12246588

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- President/Owner of ISE Engineering, Attleboro MA. Forensic Engineering firm investigating causes of damage to buildings as a result of frozen pipes, mold, fires, construction deficiencies and appliance failures.
- BS Marine Engineering Massachusetts Maritime Academy
- Registered Professional Engineer (Mechanical) MA, ME, NH, VT, RI, CT, NY, VA, MD
- Certified Fire and Explosion Investigator (CFEI)
- Licensed Pipe-fitter, Oil Burner Technician, Stationary Engineer.
- Author of several articles for plumbing & heating trade publications as well as technical paper entitled “Forensic Engineering Investigation into Freeze Damage to Buildings” for the National Academy of Forensic Engineers.

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Background
Water Damage due to frozen pipes is second only to Hurricane Damage to buildings.

Repair costs estimated over 4 billion dollars between 1995 and 2005.
Plumbing Codes Requires piping be protected from freezing however is vague in direction

**Water (Drinking) Piping**

**International Plumbing Code** – 305.6 Freezing. A water, soil or waste pipe shall not be installed outside of a building, in attics or crawl spaces, concealed in outside walls, or any other place subjected to freezing temperatures unless adequate provision is made to protect them from freezing by insulation, heat or both.

**Massachusetts Plumbing Code 248 CMR 2.05 (8) (C) Freezing.** No water supply and/or drainage piping shall be installed outside of, or under a building in an exposed, open and/or unheated area, or in an exterior wall unless adequate provision is made to protect such pipes from freezing.

The protection and covering of such pipes shall be the responsibility of the installing plumber.
Present methods to protect piping located in areas susceptible to freezing
Problems with Fiberglass Batting Insulation used as Pipe Insulation

- Cold Drafts
- Gaps in insulation
- Reduced Insulation effectiveness
Air gaps and voids are created when plumbers install pipes and wires in exterior walls disturbing insulation.
Wrap Insulation does not generate heat.

It will merely impede heat loss from within the pipe it encapsulates.
Electric “Heat Tape” or “Heat Tracing” anti-freeze systems consume electricity adding to building costs and have been linked to causing fires!
Would you want a pipe in your home protected from freezing with electrical resistance heat tape that is inaccessible, hidden behind sheetrock for years?
How Does it Work?
Design Wall Temperatures, Winter Conditions

- Interior temperature: 70 Degrees
- Heat Flow Path
- Outdoor Conditions: 5 Degrees, 15 MPH wind
- Design Wall Temperatures:
  - Inside: 66.6 Degrees
  - Outside: 38.26 Degrees
  - Sheathing & Siding: 9.3 Degrees
- R-13 Insulation
Feature 1

**Positioning** of pipe places the pipe at the warmest location in the wall cavity taking advantage of wall temperature conditions.
Places insulation where it is needed, however removing it where it will impede natural heat flow within the wall.

“Bias Insulation Placement”
Pipe positioning against interior sheathing (sheetrock/drywall) introduces **Conductive Heat Transfer** to the process.

Metallic /Aluminum film on contact surface of insulation block enhances this conductive heat transfer.

This has been tested to show that it adds 5 to 7 degrees of heat to the pipe while increasing **thermal inertia**.
Thermal Bridging identified through Infrared Imaging

The conductive coating on the insulation block increases thermal inertia within the piping allowing it to overcome breaks in the insulation length such as when a pipe passes through a wall stud or structural member.
Feature 4

Slightly over-sizing block to conventional widths of 2 by 4 and 2 by 6 wall cavities insures insulation block and pipe within slot are under slight compression.

This creates consistent contact enhancing conductive heat transfer while also creating an airtight seal that encapsulates pipe eliminating cold infiltration air drafts.

Contact surfaces will have adhesive strip to ensure airtight seal.
Design allows heat flow in the pipe direction allowing the pipe to be heated by wasted building heat, while providing maximum insulation from cold temperatures and encapsulating the pipe from drafts, protecting the pipe from freezing.
Prototype Testing Results

Summer 2008

Vertical Application
Thermocouples Measure Temperatures
Pipe Temperatures maintained less than 5 degrees below indoor temperatures!

Indoor Temperatures

Simulated Outdoor Temperatures between -20 and –50 degrees!

Vertical Orientation
Horizontal Application Testing
Horizontal Application allows pipes to be installed within floors over unheated spaces such as garages and cantilever construction.

The horizontal test was conducted on _ inch flooring sheathing and carpeted floors.

Additional flooring surface material increases resistance to heat flow.
Overhead horizontal applications such as running a pipe across an attic floor would perform even better!
Simulated Outdoor Temperature – 32 Degrees

Indoor Temperature 70 Degrees, (Tested at 50 Degrees also)

Pipe Temperature held at 60 Degrees (70 Degree ID Ambient) and 40 Degrees (50 Degree ID Ambient)

Simulated Outdoor Temperature – 32 Degrees

Horizontal Orientation
Side by Side Comparison of Conventional insulation performance and Insulation Block Design, Horizontal Orientation

Indoor Temperature

Insulation Block Temperatures

Conventional Wrap Insulation Performance

Outdoor Temperatures

– 30F
Is condensation a problem?

- By sealing the pipe ends which prevents humid air movement into piping slot, condensation is eliminated.
- When used on Hydronic (heating) system piping as well as domestic how water piping, inherently condensation does not occur.
- Testing has shown that condensation does not occur in summertime conditions on piping insulated in this manner for typical durations of cold water flow.
- This product is not intended for chilled water systems as would be used in commercial air conditioning plants.
Problem areas for piping installations are no longer...

- Heated interior tested down to 50 degrees
- Open or unheated garage
- Applicable to Vertical and Horizontal piping
Actual Residential Installation Performance January 2009

Indoor Temperatures
Insulation Performance temperatures
Outdoor temperatures
Energy Star and Owens Corning’s Energy Complete program insulated walls can be built more consistently and reliably using this pipe insulation methodology.

Plumbers are provided with a more direct specification as to how pipes are to be installed and insulated making sure their work to be done in conjunction with these program goals.
Air gaps and voids are created when plumbers install piping in exterior walls disturbing insulation.
Compressed insulation due to pipe placement within the wall cavity will cause air gaps and voids within the wall cavity that can lead to mold formation and result in excessive heat loss!
A pipe in contact with batting insulation will cause air gaps and voids which are thermally inefficient and will allow humid air to enter into the wall cavity.

This humid air will cool and condense when it encounters indoor air conditioned surfaces and moisture will form within the wall cavity.

This moisture will quickly turn to mold.
Piping insulated with this system enhances the consistency and quality of construction in accordance with the Energy Star and EnergyComplete program goals.

It also adds the inherent benefits of this insulation method making the building not only more energy efficient but more impervious to frozen pipes!
Air gaps and voids caused by pipes compressing insulation in fiberglass insulated wall cavities are eliminated.

Simultaneously, domestic and Hydronic piping is heated to prevent them from freezing!

A counter to criticism from the Cellulose Insulation Industry!
Actual Installation showing pipe in place. Air gaps and voids in wall construction are eliminated in accordance with Energy Star program goals!
Ease of Installation

Just like ordinary piping
Pipe hole is drilled 5/8\textsuperscript{th} of an inch from the edge of the stud. On edge is permitted if non structural wall.
Stud Penetrations are required by code to be no more than 5/8 of an inch from the edge in structural walls. A simple coupling of two, 45 degree elbows allows easy plumbing adjustments! It is even easier if PEX tubing, hand bent tubing or crimped copper piping methods are used!
Pipe Penetrations are sealed and Insulation Block is placed behind pipe.
Sheetrock/Drywall is placed over pipe and insulation block.
Production Design of Insulation System

4 Basic Components
Component 1

Throughway Piece
Since the pipe penetration hole through a structural "2 by" member cannot be closer than 5/8 of an inch from the edge, piping must be transitioned from the plane of the sheetrock and through this opening.

This fitting allows this transition while maintaining insulation integrity.
Direction changes in piping are accommodated by a "90 Degree Block" that can be rotated for either right or left hand 90 degree turns.
Component 4

Terminates run of pipe behind sheetrock and begins transition out of wall.

End Cap
Determine Method and costs of Manufacturing

- Extrusion
- Injection Molding
- Hot Wire Fabrication
Direct Product Benefits

• Far superior performance to current state of the art.
• A Natural enhancer of Energy Star and Energy Complete Program Goals
• Prevents cold infiltration air drafts within walls from contacting piping.
• Increases Building architectural and plumbing design flexibility.
• Heats pipe without the use of electric resistive heat tape.
• Vertical and horizontal Application
• Provides a product and direction to plumbers who previously had none.
• Lower (vacant building) maintained temperatures result in significant fuel cost savings!

(4 to 6% fuel savings per degree of thermostat setback.
10 Degrees F saves 40% of fuel costs)
Market Development

• Independent Testing
• Code Acceptance
• Sales & Advertising
• Installation & Training
Market Development
Independent Laboratory Testing

• American Association of Home Builders
  Estimated Cost, $20,000 - $25,000

• ASHRAE Sponsored Testing

• Underwriters Laboratory etc..
Market Development
Code Acceptance

• International Code Council (ICC) Acceptance
  Demonstrate insulation’s performance and ability to conform to International, State and Federal Code requirements.

• State Codes
  Many (most) adopt or begin with ICC codes

  See North Carolina Building Code
either a public water-supply or sewer system, or both, are not available, or connection thereto is not feasible, an individual water-supply or individual (private) sewage-disposal system, or both, shall be provided.

SECTION P-2003 – STRUCTURAL AND PIPING PROTECTION

P-2003.1 General: In the process of installing or repairing any part of a plumbing and drainage installation, the finished floors, walls, ceilings, tile work or any other part of the building or premises which must be changed or replaced shall be left in a safe structural condition in accordance with the requirements of the building portion of this code.

P-2003.2 Drilling and notching: Wood-framed structural members shall not be drilled, notched or altered in any manner except as provided in Sections R-402.5, R-402.5.1, R-602.5, R-602.6, R-702.5 and R-702.6.

P-2003.3 Breakage and corrosion: Pipes passing under or through walls shall be protected from breakage. Pipes passing through or under cinder or concrete or other corrosive material shall be protected against external corrosion by preventative coating, wrapping or other means which prevent such corrosion.

P-2003.4 Sleeves: Annular spaces between sleeves and pipes shall be filled or tightly caulked as approved by the administrative authority.

Annular spaces between sleeves and pipes in fire-rated assemblies shall be filled or tightly caulked in accordance with the building portion of this code.

P-2003.5 Pipes through footings or foundation walls: DELETED

P-2003.6 Freezing: The top of water pipes, installed below grade outside the building, shall be below the frost line or a minimum of 12 inches below finished grade whichever is greater. Water pipes installed in a wall exposed to the exterior shall be located on the heated side of the wall insulation. Water piping installed in an unconditioned attic or unconditioned utility room shall be insulated with an insulation having a minimum R factor of 6.5 determined at 75°F in accordance with ASTM C-177.

Note: These provisions are minimum requirements which have been found suitable for normal weather conditions. Abnormally low temperatures for extended periods may require additional provisions to prevent freezing.

Figure No. P-2003.7
 PIPE LOCATION WITH RESPECT TO FOOTINGS

[Diagram showing pipe location with respect to footing lines and angles]
My previous submissions to ICC’s Mechanical Code
### Design’s Conformance to International Code

<table>
<thead>
<tr>
<th>Type of Service</th>
<th>IMC</th>
<th>IPC</th>
<th>IECC</th>
<th>Conform</th>
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<tbody>
<tr>
<td><strong>Hydronic (Heating)</strong></td>
<td>X</td>
<td>X</td>
<td></td>
<td>Yes</td>
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<td><strong>International Mechanical Code (IMC) – 1206.6</strong></td>
<td><strong>Contact with building material. A Hydronic system shall not be in direct contact with building materials that cause the piping material to degrade or corrode or interfere with the operation of the system.</strong></td>
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<td>1204.2 <strong>Insulation thickness as required by International Energy Conservation Code (IECC)</strong></td>
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<td><strong>International Energy Conservation Code (IECC) – 504.5 Exception- Piping insulation is not required when the heat loss of the piping without insulation does not increase the annual energy requirements of the building.</strong></td>
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<td><strong>Domestic Hot &amp; Cold</strong></td>
<td>X</td>
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<td><strong>International Plumbing Code – 305.6 Freezing. A water, soil or waste pipe shall not be installed outside of a building, in attics or crawl spaces, concealed in outside walls, or any other place subjected to freezing temperatures unless adequate provision is made to protect them from freezing by insulation heat or both.</strong></td>
<td>Yes</td>
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<td><strong>Structural Safety [B] F101.3 Bored Holes- ..In no case shall the edge of the bored hole be nearer than 5/8 inch to the edge of the stud.</strong></td>
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Market Development
Sales & Advertising

• Trade Magazines, Plumbing, Engineering & Architectural

• Focus Group Analysis

• Trade Associations

• Trade Shows.

• Piping Manufacturers, Victaulic etc

• Insurance Industry Engineering Underwriters, Hartford Steam Boilers, FM Global, Travelers Commercial Lines, etc.. *(Explain inherent reduction in loss potential with this product in use).*
OVERVIEW OF PUBLICATIONS SERVING THE PLUMBING AND HEATING MARKET
Prepared for Industrial Services & Engineering, Inc. by NewsLynx

The following publications are among those that serve the plumbing and heating industry. There are numerous other local and regional magazines not shown here. In addition, there are digital versions of these publications that provide other advertising opportunities. There are many trade associations, trade shows, and other groups that provide further opportunities to contact this market. Ad rates are shown using a 1/2 page black and white ad as a basis. Color rates are also shown. Press releases and feature stories should also be examined as an efficient and cost-effective way to reach this market.

**PLUMBING & MECHANICAL**  Distributed to 50,000 plumbing, piping, and Hydronic heating contractors. 6x rate for 1/2 pg. b&w ad: $3,810. Add $2,150 for 4-color. Web site: pmmag.com.

**PLUMBING ENGINEER**  Distributed to 26,000 designers and specifies of plumbing and heating systems. 6x rate for 1/2 pg. b&w ad: $2,160. Add $1,450 for 4-color. Web site: plumbingengineer.com.

**PHC NEWS** (Plumbing & Hydronic Contractor News)  Distributed to 47,000 professionals involved in plumbing, heating, and piping. 6x rate for 1/2 pg. b&w ad: $3,610. Add $1,450 for 4-color. Web site: phcnews.com.

**THE WHOLESALER**  Distributed to 31,500 decision makers in wholesale plumbing and heating industry. 6x rate for 1/2 pg. b&w ad: $2,335. Add $1,450 for 4-color. Web site: thewholesaler.com.

**PLUMBING SYSTEMS & DESIGN**  Distributed to 55,000 professionals involved in plumbing systems and design. 6x rate for 1/2 pg. b&w ad: $1,960. Add $1,450 for 4-color. Web site: psdmagazine.com.

**PM ENGINEER**  Distributed to 26,500 engineers or engineering management in the plumbing, heating, and piping fields. 6x rate for 1/2 pg. b&w ad: $2,020. Add $1,675 for 4-color. Web site: pmengineer.com.

**CONTRACTOR**  Distributed to 42,000 mechanical contractors. 6x rate for 1/2 pg. b&w ad: $4,900. Add $1,760 for 4-color. Web site: contractormag.com.

**JOBSITE PLUMBING**  Distributed to 47,000 plumbing and heating professionals. 6x rate for 1/2 pg. b&w ad: $3,610. Add $1,450 for 4-color. Web site: jobsitemagazine.com.
Steps to bring product to Market

• Training Regarding Installation

Web based video showing proper installation techniques.

Nationwide seminars on installation method
Other possible system uses

- Residential Fire Sprinkler Systems
- Radiant Flooring/ Reverse Effect