PIP INSA1000
Acoustic Insulation Systems Specification
PURPOSE AND USE OF PROCESS INDUSTRY PRACTICES

In an effort to minimize the cost of process industry facilities, this Practice has been prepared from the technical requirements in the existing standards of major industrial users, contractors, or standards organizations. By harmonizing these technical requirements into a single set of Practices, administrative, application, and engineering costs to both the purchaser and the manufacturer should be reduced. While this Practice is expected to incorporate the majority of requirements of most users, individual applications may involve requirements that will be appended to and take precedence over this Practice. Determinations concerning fitness for purpose and particular matters or application of the Practice to particular project or engineering situations should not be made solely on information contained in these materials. The use of trade names from time to time should not be viewed as an expression of preference but rather recognized as normal usage in the trade. Other brands having the same specifications are equally correct and may be substituted for those named. All Practices or guidelines are intended to be consistent with applicable laws and regulations including OSHA requirements. To the extent these Practices or guidelines should conflict with OSHA or other applicable laws or regulations, such laws or regulations must be followed. Consult an appropriate professional before applying or acting on any material contained in or suggested by the Practice.

This Practice is subject to revision at any time.

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1. Introduction

1.1 Purpose

This Practice provides requirements for acoustic insulation systems.

1.2 Scope

This Practice describes the requirements for the design, application, and extent of acoustic insulation on piping and equipment operating at high and low temperatures. Systems requiring additional insulation specifications beyond PIP Practices, such as ISO 15665, shall be covered by purchaser’s documentation.

Listing of or reference to supporting documents within this Practice does not imply suitability for specific designs.

Comment: Use of this Practice for contractual purposes requires the purchaser to make specific choices and assemble additional supporting documents.

2. References

Applicable parts of the following Practices and industry codes and standards should be considered an integral part of this Practice. The edition in effect on the date of contract award should be used, except as otherwise noted. Short titles will be used herein where appropriate.

2.1 Process Industry Practices (PIP)

- PIP INEG1000 - Insulation Design and Type Codes
- PIP INTG1000 - Insulation Inspection Checklist
- PIP INSC1000 - Requirements for Cold Service Insulation Materials
- PIP INSH1000 - Hot Service Insulation Materials and Installation Specification
- PIP INSA1001 - Various Acoustic Insulation Configurations
- PIP INSA1002 - Piping-Layer Staggering and Overlapping of Absorptive Barrier
- PIP INSA1003 - Piping-Sheet and Mastic Barrier Layer Attachment
- PIP INSA1004 - General Arrangement - Piping Insulation
- PIP INSA1005 - Piping-Flange Insulation
- PIP INSA1006 - Valves without Extended Bonnets

2.2 Industry Codes and Standards

International Organization for Standardization (ISO)

- ISO 15565 - Acoustics - Acoustic Insulation for Pipes, Valves and Flanges

3. Definitions

absorptive layer: Porous, resilient, low-density 48 to 128 kg/m³ (3 to 8 lb/ft³) material such as glass or mineral fiber applied to a sound-radiating surface to absorb sound
outer barrier layer: Impermeable, dense material such as loaded vinyl, elastomer, or mastic installed over the absorptive layer to provide a sound barrier

acoustic insulation: Insulation that attenuates acoustic energy radiating from surfaces by absorption and containment. Acoustic insulation can be used to reduce surface radiation from many different types of piping and equipment and to comply with regulatory requirements. Acoustic insulation is composed of a resilient sound-absorptive layer and an outer-barrier layer applied to noise-radiating surfaces.

transmission loss: Reduction in magnitude between the incident and transmitted sound for a given acoustic material

Noise Reduction (NR): Difference in noise, also known as sound pressure level, at a given point before and after acoustic treatment, measured in dBA

4. Requirements

4.1 Acoustic Insulation – General Design Information

4.1.1 The acoustic insulation type code is AC as defined in PIP INEG1000.

4.1.2 The general requirements for design and installation of insulation contained in PIP INEG1000 and PIP INSH1000 shall be followed.

4.1.3 Additional acoustic insulation type codes shall be required if two or more combinations of materials, layers, thicknesses, absorptive layers, or thermal designs are required.

4.1.4 Acoustic insulation is normally composed of a resilient sound-absorptive layer and an outer-barrier layer applied to noise-radiating surfaces.

4.1.5 Different combinations of absorptive layers, barrier layers, thermal insulation, and weatherproof finishes can be used.

Comment: PIP INSA1001 illustrates possible combinations.

4.1.6 The ultimate goal for installing acoustic insulation is to obtain a satisfactory noise reduction. In designing acoustic insulation treatments, care shall be taken to ensure that the absorptive layer adequately isolates the outer-barrier layer from surface vibrations at the frequencies of interest, which is the key factor in obtaining the required noise reductions at low frequencies.

4.1.7 The best material combination shall be one in which the transmission loss properties are matched to the sound spectrum of the source (i.e., attenuation is highest at the frequency having the highest sound pressure level.).

Comment: A method of matching material properties to the noise to be controlled is to use laboratory test results of noise reduction for various insulation systems and field measurements of the sound to be reduced.
4.1.8 The following are general rules for predicting noise reduction that may be expected in actual field installations:

a. Normal thermal insulation systems or acoustic insulation with absorptive and standard weatherproof finish layer only: 5 dBA to 7 dBA

b. Acoustic insulation with absorptive, barrier, and weatherproof finish layers or thermal insulation with absorptive, outer barrier, and weatherproof finish layers: 7 dBA to 11 dBA

c. Multiple layers of absorptive and barrier material (two layers each) where it is known that all relevant radiating surfaces are covered, the outer barrier layer is adequately isolated from the vibrating surface and the system is completely sealed: 11 dBA to 15 dBA

Comment: These values assume that background noise has been compensated for and that the dominant noise is not at or below 250 Hz.

4.1.9 If the noise reduction properties cannot be rigorously matched to the noise source, the following rules may be used:

a. If the peak octave band sound pressure level is above 1000 Hz, use a minimum 25 mm thick (1-inch) absorptive layer.

b. If the peak octave band sound pressure level is between 250 Hz and 999 Hz, use a minimum 50 mm thick (2-inch) absorptive layer.

c. Use a nominal 4.9 kg/m² (1.0 lb/ft²) outer barrier layer if the peak octave band sound pressure level is at or above 2000 Hz.

d. Use a nominal 9.8 kg/m² (2.0 lb/ft²) outer barrier layer if the peak octave band sound pressure level is below 2000 Hz.

4.1.10 If insulation is required for reasons other than for acoustic control, the appropriate thickness table in PIP INEG1000 shall be used to determine the minimum insulation thickness. Acoustic requirements may call for additional thickness.

4.1.11 For cold service installations, the complete thermal system shall be applied according to the appropriate PIP cold service Practice before any acoustic absorptive material is applied.

4.1.11.1 Alternatively, the acoustic absorptive layer may be applied before the complete cold service thermal system is applied, followed by the outer barrier layer.

4.1.11.2 The complete thermal system shall be applied according to the appropriate PIP cold service Practice.

4.1.12 For hot service, the acoustic absorptive material may be applied directly to the piping or equipment if its maximum service temperature is not exceeded.

4.1.12.1 If surface temperatures exceed allowable service temperatures of the selected absorptive layer, a layer of appropriate thermal insulation shall be applied to reduce the interface temperature to within the range of the selected absorptive layer.
4.1.12.2 The thermal-insulating properties of the absorptive layer may be utilized to minimize overall insulation thickness.

4.1.13 An acoustic absorptive layer may be applied directly over existing thermal insulation without modification to the thermal system. Hangars or other supports shall be covered with the absorptive material.

### 4.2 Installation of the Absorptive Layer

4.2.1 Acoustic insulation shall cover all relevant radiating surfaces and shall be acoustically sealed.

*Comment:* Acoustic sealing means the insulating materials are free from gaps or open areas, which permit leakage of undiminished noise from the surface being insulated. Leaks can render acoustic insulation treatments ineffective.

4.2.2 All joints and interruptions of outer-barrier material at protrusions such as valve bonnets, hangers, etc., shall be sealed.

*Comment:* PIP INSA1004 shows the general arrangement for acoustic insulation applied to piping. PIP INSA1005 shows the acoustic insulation of piping flanges, and PIP INSA1006 shows the acoustic insulation of valves without extended bonnets.

4.2.3 Unless otherwise specified, all surfaces shall be covered, including valve bodies, flanges, fittings, supports, etc., on the piping or equipment to be acoustically insulated.

*Comment:* PIP INSA1002 shows the installation detail of the absorptive layer.

### 4.3 Installation of the Barrier Layer

4.3.1 When specified, a barrier layer shall be applied over all absorptive layer surfaces. The barrier layer shall be an impervious, dense sheet material or loaded mastic and shall not contain lead.

4.3.2 Sheet barrier materials shall be applied in a watershed fashion and stagger all joints of barrier material and absorptive material.

4.3.2.1 Circumferential and longitudinal joints of sheet barrier material shall be overlapped a minimum of 50 mm (2 inches).

4.3.2.2 On horizontal transitions between sheet barrier material and loaded mastics, sheet material shall be extended a minimum of 50 mm (2 inches) over the mastic.

4.3.2.3 If sheet barrier is applied after mastic has dried or if adhesion between sheet and mastic is in doubt, a suitable joint sealer shall be applied in the overlap area between sheet barrier and mastic.

4.3.2.4 On vertical transitions, mastic shall be extended 50 mm (2 inches) over the sheet material to provide proper watershed.

4.3.2.5 All sheet barrier materials shall be applied in an airtight, gapless fashion.

4.3.3 The continuity of the barrier layer shall not be broken. If it is impossible to fit the entire specified thickness of absorptive and barrier layers, the thickness of the absorptive layer may be decreased to provide clearance.
4.3.4 On sheet barrier materials and vinyl or elastomeric barrier materials over which an additional weatherproof finish is to be applied, bands, wire, tape, or adhesive bonding shall all be acceptable means of attachment.

4.3.5 If vinyl or elastomeric sheet material is the finished surface, bands shall be used for attachment.

4.3.5.1 If metallic jacket and barrier material laminate is to be applied, bands shall be used for attachment.

4.3.5.2 All joints in the laminate shall be sealed with a suitable joint sealer to ensure an airtight installation.

4.3.5.3 To ensure gapless joints on vinyl or elastomeric sheet applications, all joints shall be adhesively bonded.

4.3.5.4 Sheet metal screws shall not be used on vinyl or elastomeric sheet barrier materials.

Comment: PIP INSA1003 shows the barrier layer attachment detail.

4.3.6 Loaded mastic shall be applied directly to absorptive materials and reinforced with glass cloth following the manufacturer’s recommended procedures.

4.3.6.1 Conflicts between this Practice and the manufacturer’s recommended procedure shall be submitted in writing to Purchaser for clarification and resolution before proceeding with the installation.

4.3.6.2 A tack coat of mastic shall be applied to approximately half the desired finish thickness with sufficient pressure to assure impregnation of the absorptive layer.

4.3.6.3 Reinforcing fabric shall be embedded in the wet tack coat, and then the final coat shall be applied to the specified wet thickness.

4.3.6.4 Adjacent pieces of reinforcing fabric shall be lapped a minimum of 50 mm (2 inches).

4.3.6.5 The installed reinforcing fabric shall be free of wrinkles and protruding edges.

4.3.6.6 In multiple coat applications, the reinforcing fabric shall be applied to the middle coating.

4.3.7 Barrier layer applications of loaded vinyl or elastomers can be left unfinished if all lap joints are adhesively bonded, and the insulated item is not exposed to direct sunlight or the weather. If such layers are so exposed, an additional weatherproof finish cover shall be required over vinyl and elastomer barrier materials.

4.3.8 A 6 mm (1/4-inch) bead of caulking compound shall be applied to all joints in the outer weatherproof finish to prevent acoustic leakage or moisture penetration.

Comment: Examples include any interruptions of the weatherproof finish or barrier layer at joints or between finish or barrier layers and protrusions such as valve bonnets, hangers, and instrument connections.

4.3.9 Caulk shall be applied to all removable cover joints.
4.4 Data Sheets

Project specific requirements for acoustic insulation on piping and equipment shall be specified on the purchaser’s data sheet(s) contained in *PIP INSH1000* or *PIP INSC1000*.

4.5 Inspection

Inspection of acoustic insulation shall be in accordance with *PIP INTG1000*.

4.6 Documentation

Documents required to define the scope of work shall be listed on Documentation Requirements Sheet *PIP INSA1000-D1*. 
# Acoustic Insulation Systems Specification

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- **INSC1000**
- **INSH1000**
- **INTG1000**

## Acoustic Insulation Installation Details

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<thead>
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## Notes:

- Additional notes on acoustic insulation systems can be added here.
- Space for further comments or specifications.
VARIOUS ACOUSTIC INSULATION CONFIGURATIONS

**Figure 1A:** Absorptive Layer Only

**Figure 1B:** Absorptive and Outer Barrier Layers

**Figure 1C:** Multiple Absorptive/Outer Barrier Layers

**Figure 1D:** Thermal Insulation

**Figure 1E:** Absorptive / Thermal / Outer Barrier Layers

**Notes:**
1. Weatherproof finish required for all applications, unless specifically noted otherwise by purchaser.

Dimensions are given in millimeters. Dimensions in parentheses are in inches, unless noted otherwise.
NOTES:

1. WEATHERPROOF FINISH REQUIRED FOR ALL APPLICATIONS, UNLESS SPECIFICALLY NOTED OTHERWISE BY PURCHASER.
NOTES:

1. WEATHERPROOF FINISH REQUIRED FOR ALL APPLICATIONS, UNLESS SPECIFICALLY NOTED OTHERWISE BY PURCHASER.

DIMENSIONS ARE GIVEN IN MILLIMETERS. DIMENSIONS IN PARANETHESIS ARE IN INCHES, UNLESS NOTED OTHERWISE.

CAD FILENAME: INSA1003M.DWG
WEATHERPROOF JACKETING
ACOUSTIC BARRIER
BAND (TYPICAL)
MULTI-LAYER
SEE DETAIL 1
STUD LENGTH PLUS 25 (1")
(BOO TH SIDES OF FLANGE)

ACOUSTIC BARRIER
SOUND ABSORBANT INSULATION

ABSORPTIVE LAYER
THERMAL INSULATION
ACOUSTIC BARRIER
WEATHERPROOF JACKETING

DETAIL 1
MULTI-LAYER

DIMENSIONS ARE GIVEN IN MILLIMETERS. DIMENSIONS IN PARENTHESES ARE IN INCHES, UNLESS NOTED OTHERWISE.

CAD FILENAME: INSA1005M.DWG