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T-FIT® Clean

Technology, design & installation

T-FIT® INSULATION

Fit to perform. **Fit** to last

This document considers the use of PVDF (Polyvinylidene fluoride) as the base polymer in the manufacture of thermal insulation products.
The advanced material properties of PVDF are further enhanced through use of a propriety high pressure gassing process used to create a cellular material which provides market leading thermal insulation product performance.

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Engineering & Technology

PVDF is a highly non-reactive thermoplastic fluoropolymer, a specialty plastic used in applications requiring the highest purity, as well as resistance to solvents, acids, and hydrocarbons. Longevity and inherent flame retardancy make PVDF an outstanding polymer from which to make thermal insulation products.

Producing cellular foams (the basis of many thermal insulation materials) from PVDF can be achieved in a propriety high-pressure nitrogen gassing process. The process begins with extrusion of solid PVDF sheets, which are then crosslinked.
In the second stage, sheets are loaded into a high-pressure autoclave, and heated to above the melt point of the polymer. The vessel is pressurised with nitrogen over a long time period which diffuses the gas into the sheets. A rapid depressurisation destabilises the absorbed nitrogen, nucleating cells in the sheets. The sheets are then cooled under pressure in the autoclave, locking in the nitrogen in the unexpanded sheets, prior to being unloaded. Typical operating temperatures can reach 250°C/482°, with pressure reaching 675 bar/10,000 psi.
In the final stage the nitrogen charged sheets are loaded into a low-pressure autoclave, and under moderate pressure are heated to above the polymer melt point. The pressure is reduced, causing the nitrogen to expand, and turning the sheet into a larger foam sheet. The expansion process is unconstrained and so uniform in each dimension.

The combination of a high-pressure gassing/expansion process applied to PVDF polymers produces an outstanding insulation material with the following properties:

1. Material is closed cell, where the structure of the material comprises a network of completely disconnected cells. This means that the material will not absorb moisture, the major reason why insulation materials fail under condensation control applications, and key to the materials exceptional longevity and consistent performance over time.

2. Given the above, outer cladding systems are not required, as the insulation material is already an effective moisture vapour barrier.

3. The high-pressure gassing process creates a uniform fine cell structure throughout the material. This means thermal conductivity values are low, and consistent throughout the gauge of the material. Thermal conductivity values do not increase over the lifetime of the material.

4 High pressure gassing processes that convert solid polymers into cellular foams do not require blowing agents. This means there are zero residual chemicals left in the foam which create VOC's, an important consideration in many clean room environments.

5. The nature of foamed PVDF means the construction of the material does not release or contribute to any environmental pollution created by loose fibres, airborne particles, or dust.

6. Crosslinking of PVDF polymers creates a robust foam material that recovers to original thickness following compression. This means the product is not easily damaged in service or during installation.

7. The product is naturally highly flame retardant and does not rely on addition of fire-retardant additives. Independent reaction to fire testing and qualifications from market leading authorities are readily available.

8. PVDF polymers are naturally highly chemical resistant and impervious to most cleaning agents. This makes the product ideal for use in sterile and aseptic production environments where high levels of purity are required.

9. Insulation materials based on PVDF polymers are naturally resistant to fungal growth, and when tested at 30°C over 28 days show zero growth of fungal spores. Antimicrobial additives are not required.

10. PVDF foams are light weight, easy to handle, install and fabricate. Insulation supports on vertical pipelines are not required, reducing cost and complexity.

11. A range of accessories are available, including PVDF based tapes and approved adhesives/sealant products. Combined with moulded fittings for elbow and tee's, and insulation boxes designed to insulate valves, flanges and other pipeline equipment, the insulation system is both easy and quick to install.

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Design Criteria

When specifying an insulation system, the following factors will be considered by an engineer:

a. Temperature pipeline contents (line temperature), which usually fall into the following application areas. Hot side applications describe pipework running at temperatures higher than 60°C, where personal protection and energy conservation are usually the reason to install insulation. Upper temperature limit for PVDF based foam insulation is 160°C peak, 145°C continuous. Contact temperature will not cause injury to an operator given minimum insulation thickness of ¼" (6.35mm).

b. Cold side applications describe pipework running at low temperate where in combination with environmental conditions, condensation will form on the uninsulated pipework. The function of insulation is to prevent condensation formation, by providing a surface temperature above the environments dew point. Being completely closed call, PVDF insulation is ideally suited to cold side applications, being able to resist water and vapour penetration through its closed cell construction.

c. Thermic shock applications cover processes that typically cycle through high and low temperatures, example CIP (clean in place) processes where high temperature steam is flushed through pipelines that otherwise transport cold dairy products. This rapid change in temperature has no impact on PVDF based insulation systems.

d Cladding systems acting as an outer water vapour barrier must be employed when open cell insulation products are considered. Usually of minimal gauge, they can be easily damaged allowing insulation to absorb and wick moisture into the material, which in some conditions can lead to water freezing in the insulation and rendering the material useless. PVDF based insulation, being completely closed cell do not require any outer cladding system.

e. Thermal conductivity values are largely governed by cell size. High pressure gassing processes produce foams with very small, uniform cell structures which lead to low thermal conductivity values. The nature of PVDF polymers mean conductivity values measured after production will remain the same during the service life of the product.

f. Blowing agents (Azodicarbonamide or ADC) are often used as foaming agents in insulation foams, where residual volumes remain in the materials after foaming, creating VOC's (volatile organic compounds) which can create environmental concerns. High pressure gassing processes do not require blowing agents and as such create extremely pure foams with negligible levels of VOC's.

g. Fibre and dust erosion can be of concern in many applications. Due to its nature PVDF based insulation foams will not emit or contribute to environmental pollution of any kind, either in service, installation, or during any maintenance of pipeline equipment.

h. Many insulation products will permanently deform when compressed, especially during installation. As PVDF foams are crosslinked, then the material will recover to its original thickness following compression, making the material particularly robust through the installation stage.

i. Reaction to fire performance of many insulation materials rely on the correct addition of fire-retardant chemicals. PVDF based foam materials exhibit naturally high levels of fire retardancy, archived without any fire-retardant chemicals, but reaching market leading reaction to fire certificaiton.

j. Applications where insulation with high chemical resistance is required are ideally suited to PVDF based foams, as fluoropolymers are particularly resistant to a wide range of chemicals.

k. Sterile, aseptic production areas require insulation that will prevent growth of fungal spores. PVDF is naturally resistant to fungal growth; antimicrobial additives are not required.

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Installation

Lightweight flexible insulation systems are generally easy to cut, quick to install by virtue of factory installed closure tapes, and do not require use of any personal protection equipment. When supplied with moulded fittings for elbows and tee pipe connections, and fabricated insulation boxes for valves, flanges and other pipeline equipment, such systems can be installed quickly, easily and with minimal training. Such insulation systems should be supplied with appropriate tapes, sealant, and adhesives, that ensure tight water vapour resistant joints, particularly important on low temperature applications, where condensation control is particularly important.

Installation drawings

https://t-fit.org/t-fit-clean/

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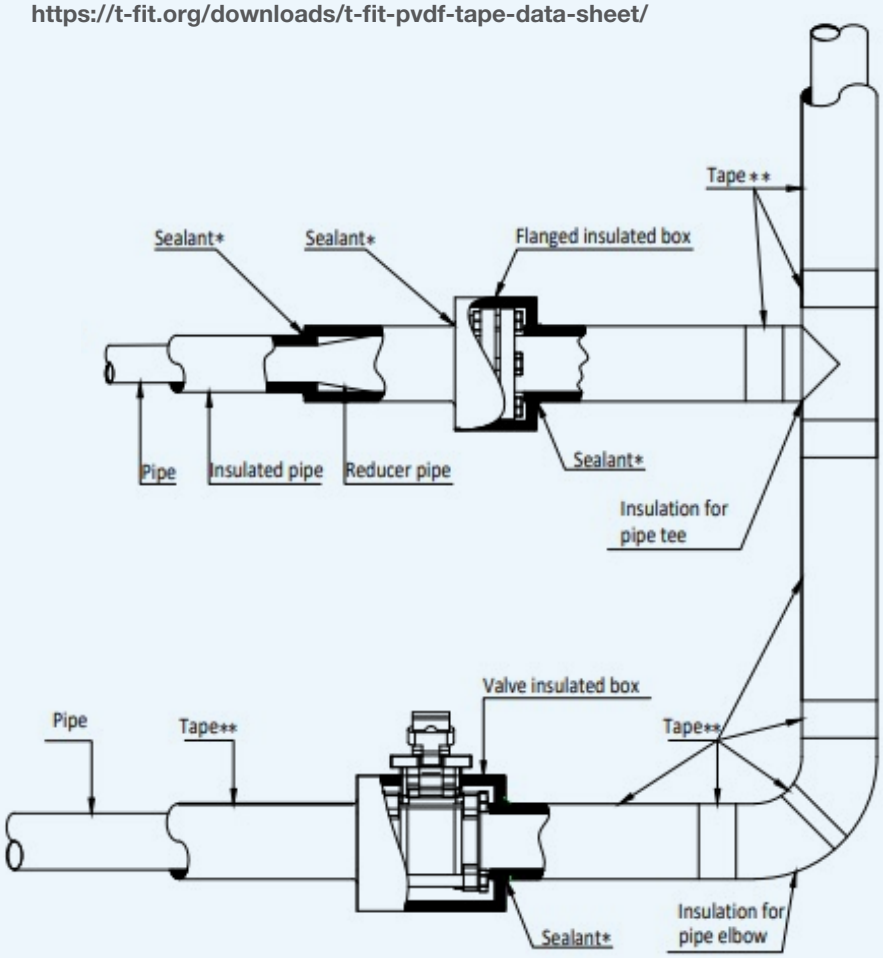
Installation: General arrangement

1. Insulation should be installed under compression at all times, and not stretched to make fit.
2. Sealant must be applied to all joints.
3. Detailed installation instructions can be found at **https://t-fit.org**
4. Installation videos can be found at **https://t-fit.org/t-fit-clean/**

* Approved sealant details can be found at **https://t-fit.org/downloads/t-fit-clean-recommend-sealant/**

** Approved all drawings tape details can be found at **https://t-fit.org/downloads/t-fit-pvdf-tape-data-sheet/**



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Installation: Layered construction

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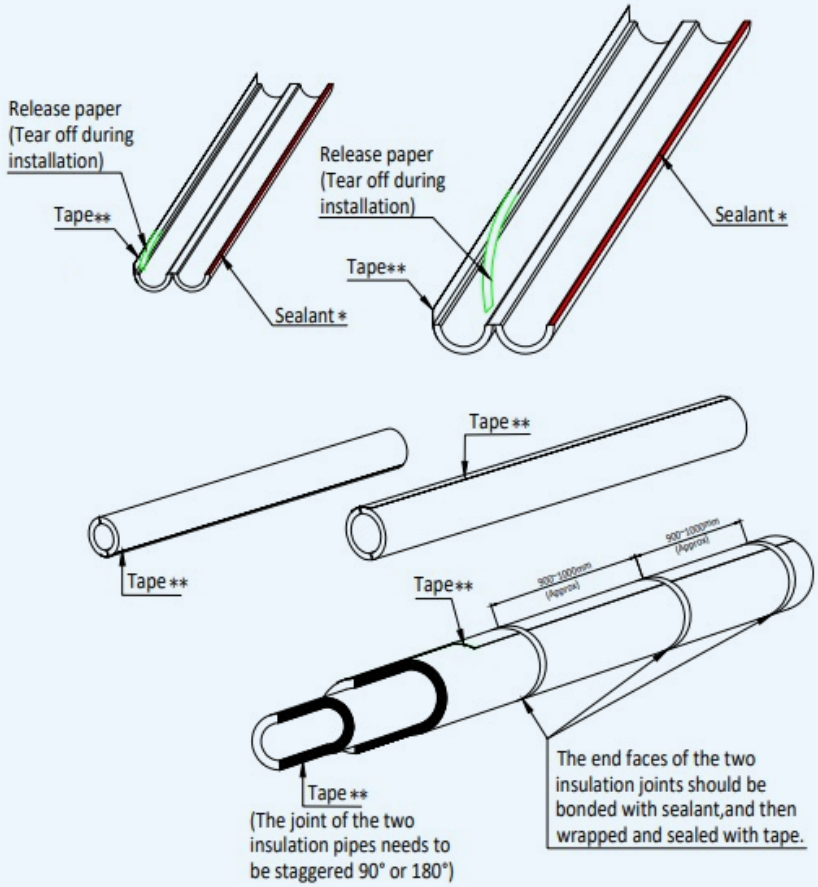

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Installation: Straight pipe

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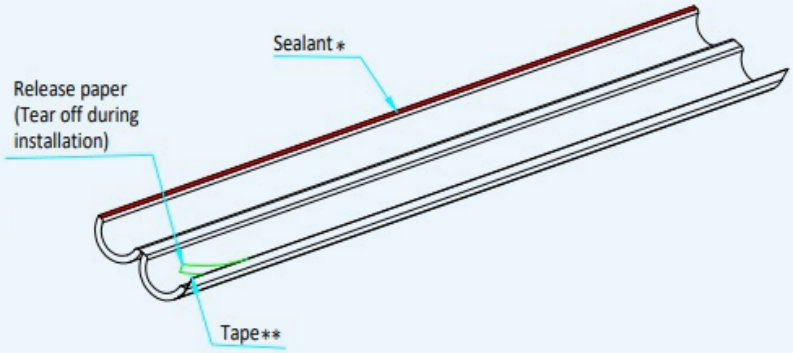

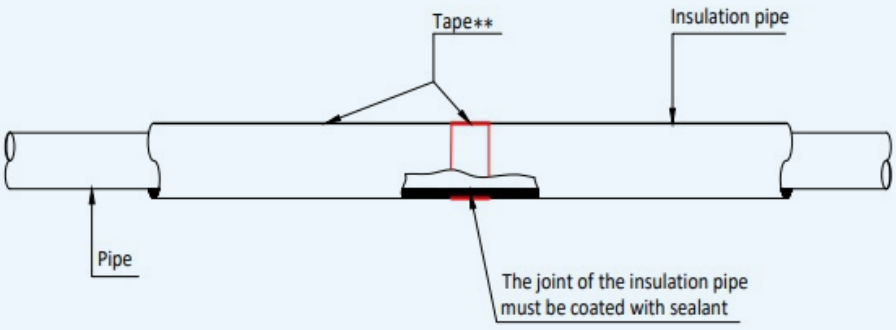

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Installation: Tee

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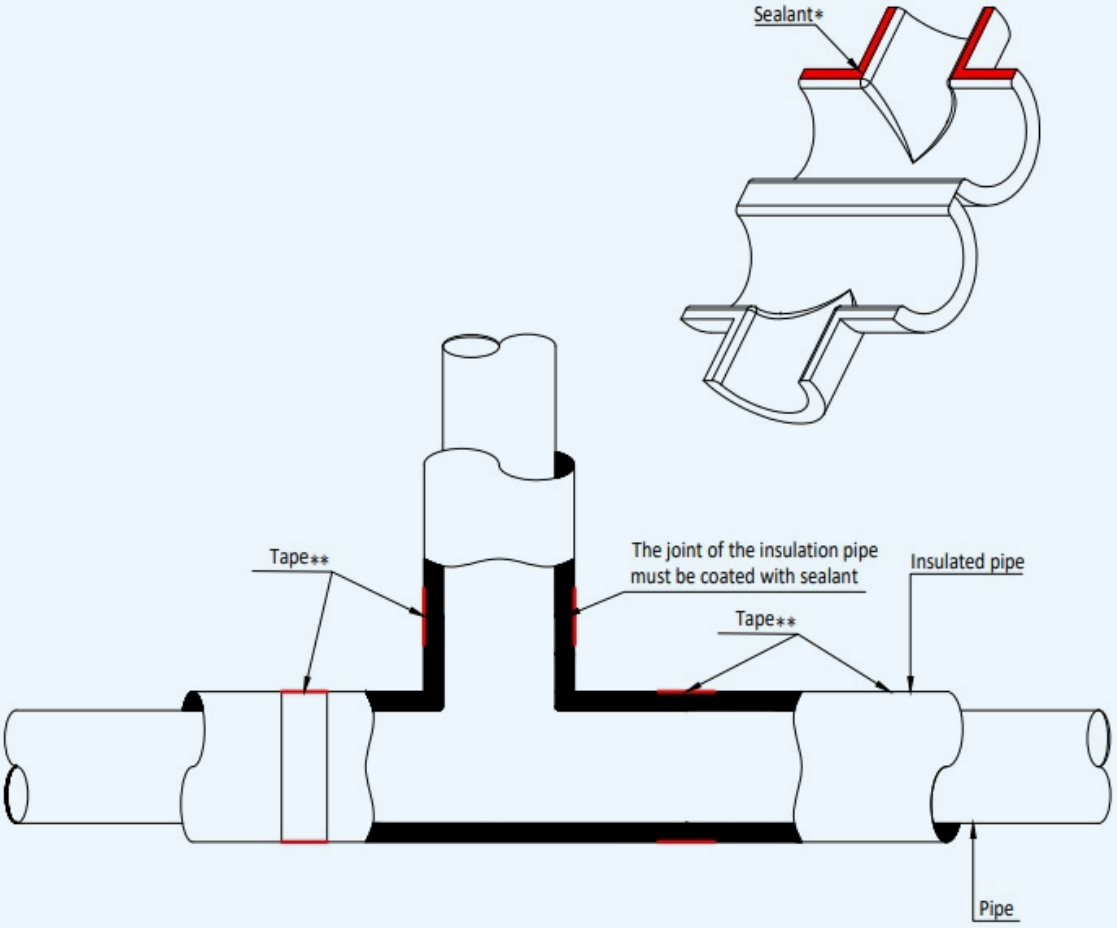

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Installation: Elbow

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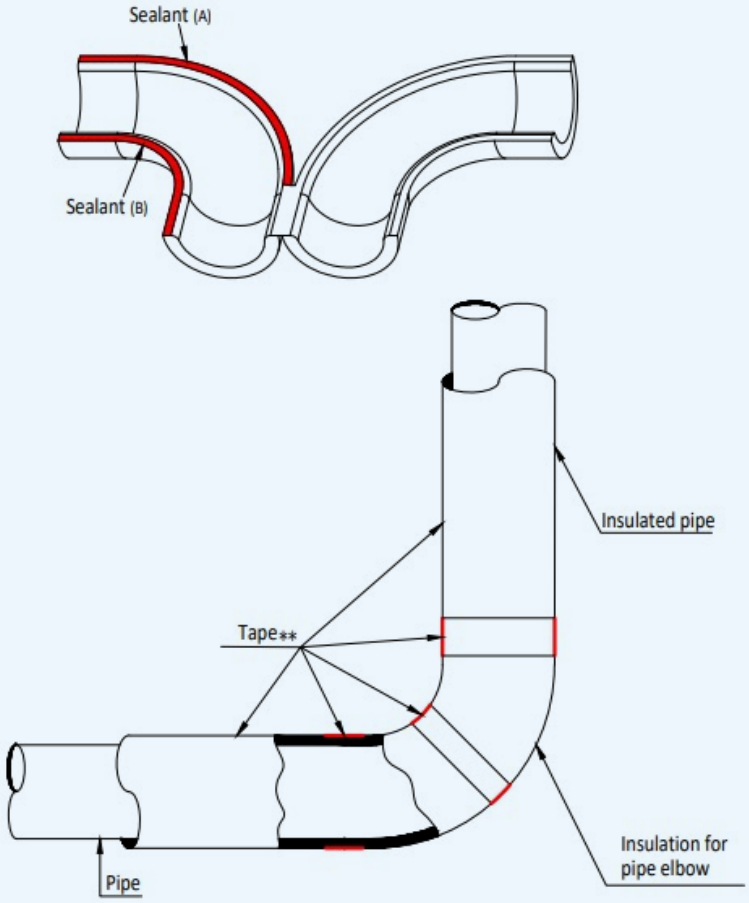

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Installation: Flange box

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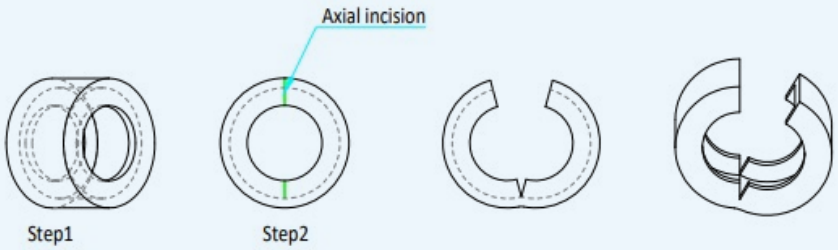

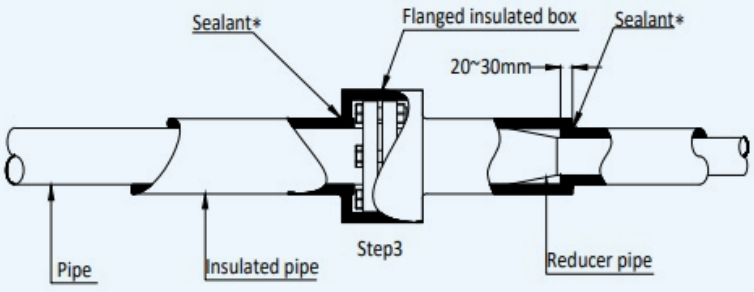

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Installation: Valve box

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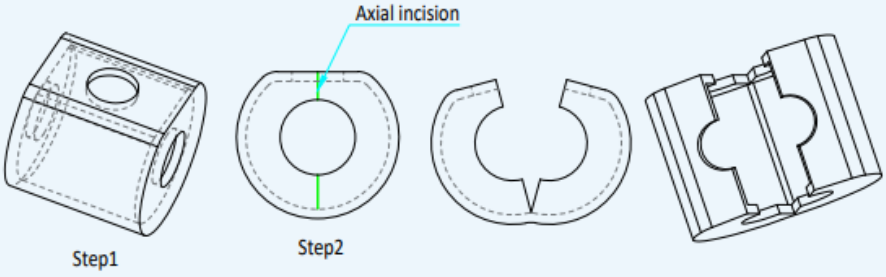

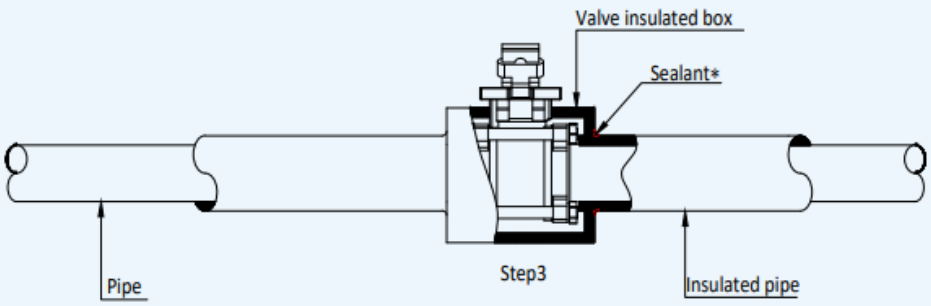

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Installation: Pipe support

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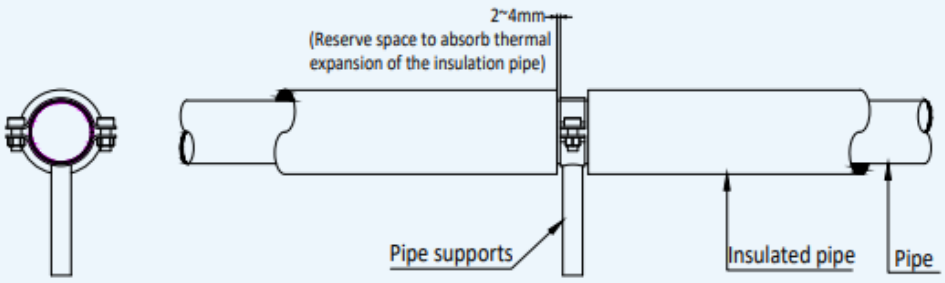

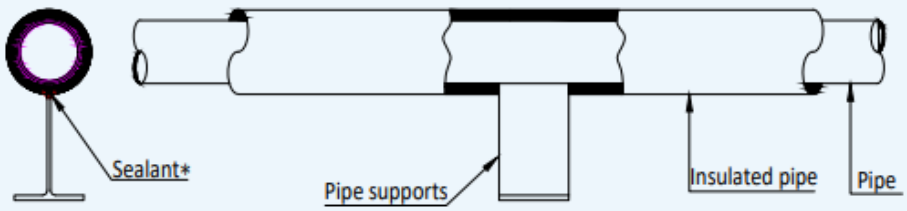

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AEO UK Authorised Economic Operator

Quality
FM 01870
ISO 9001:2015

Safety
OHS 52538
ISO 45001: 2018

Environment
EMS 36270
ISO 14001:2015

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