Design of Non-Metallic Expansion Joints for Low Temperature Applications

The technology of non-metallic expansion joints is continually developing to meet the requirements of today's evolving industrial applications. The nature of the material allows it to cover a wide range of installations in air-, exhaust-, and environmental systems where low spring rates and highest flexibility are required.

Further design criteria are temperature, media, and the tightness class according to the ESA Engineering Guide.[1]

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Contrary to the assumption that the only critical factor of material selection for expansion joints is high temperature, it is actually the chemical resistance of the fabric material at low operation temperatures. Below the dew point, gaseous media may develop highly corrosive acids or bases that destroy the inner layers of fabric and cause early leakage in the system. Consequently, it is necessary to select corrosion-resistant and liquid-tight fabric for the layers that come into direct contact with media.

PTFE (Poly-Tetra-Fluor-Ethylene) is a common material as it provides chemical resistance to nearly all critical chemistries. The amorphous structure of PTFE however requires combining multi-laminated PTFE films with fabric reinforcement layers. Both materials are sintered together to avoid delamination. PTFE-coated materials or skived PTFE films and combinations are not recommended as it does not provide liquid tightness in the long run.

Besides PTFE compounds, there are different elastomer rubber materials available such as EPDM Viton, Hypalon, and Neoprene. ESA members and expansion joint manufacturers will select the technically sound and most economical materials based on the customers' operation specs.

The RAL has introduced different tightness classes and described the method of testing for non-metallic expansion joints. For low temperature and wet applications, "nekal tightness" is mandatory (refer to ESA Engineering Guide section 11).

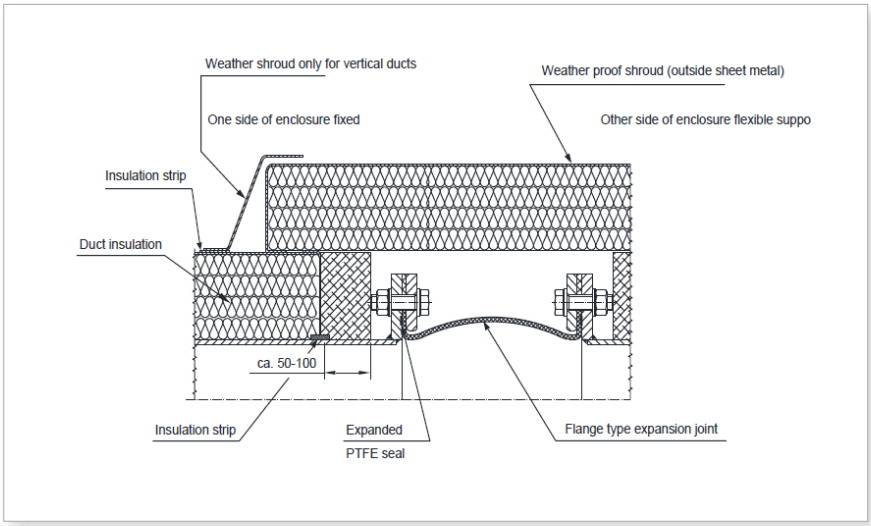

Figure 1: Clamp area of PTFE laminated with expanded PTFE seal and external shroud.

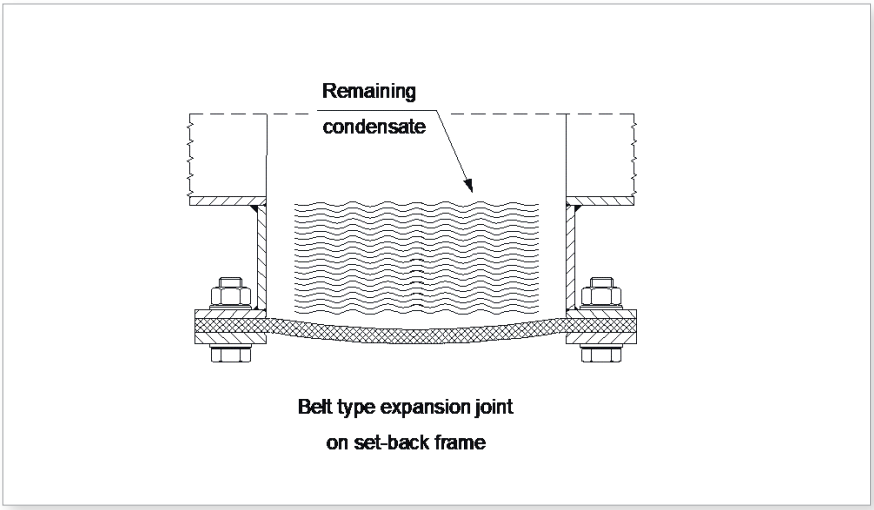

Figure 2: Build up of liquid at belt-type and flanged expansion joints.

For convenient installation, to control the surface pressure, and due to the setting of the fabric flange as well as to avoid a large accumulation of liquid acid, the ESA recommends flanged type expansion joints, according to ESA Engineering Guide section 3.2.2. Single-layer PTFE compound expansion joints will be supplied with an additional PTFE gas seal to achieve the required setting and tightness.

Flanged expansion joints in horizontal

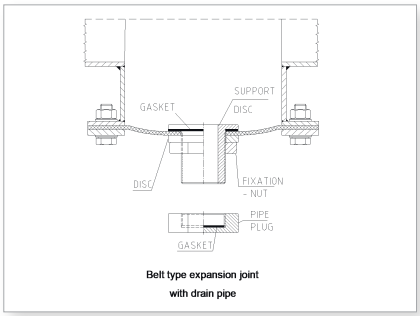

Figure 3: Drain at bottom side of belt-type expansion joint.

ducts accumulate less condensate compared to belt-type expansion joints on set-back frames (refer to Graph 2). For belt-type applications, drains should be considered to control the buildup of liquid. The limited flexibility at the area of the drains should be respected. The collection and handling of condensate requires further technical solutions.

Due to the thermal resistance of PTFE laminated materials, the maximum peak temperature of low-temperature applications is limited to 300 ° C. Low temperature application means that the permanent operating temperature of a system is below or close to the dew point of the media, whereas with high temperature applications the media temperature is significantly higher.

To reduce the amount of condensate, it is recommended to insulate expansion joints for low temperature applications from outside. For the design of correct execution of external insulation, refer to Graph 1. The separation of the cladding of the duct insulation, and the weatherproof shroud at the expansion joint, prevents the media from penetrating and corroding the entire duct insulation and cladding when the expansion joint reaches its performance life. The shroud is to be designed to allow the specified moves of each expansion joint.

For more information, kindly refer to https://europeansealing.com/en and other ESA publications at https://europeansealing.com/en/publications.

REFERENCE

1. https://www.esaknowledgebase.com/engineering-guide-english/.

ABOUT THE AUTHOR

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