White Paper

Fabric Expansion Joints: The Modern Choice for Coal-Fired Power Plants

CECO
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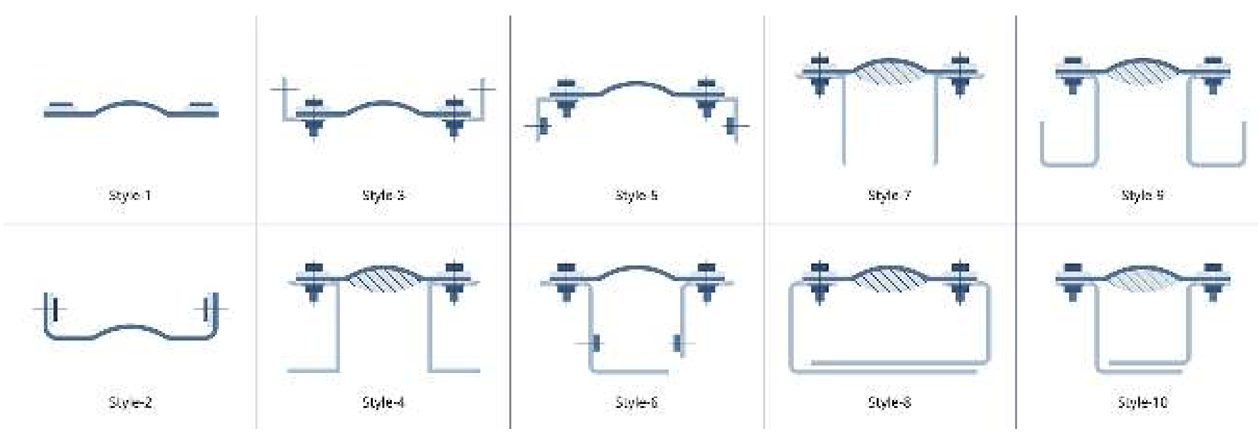
Historically, metallic expansion joints were the only option for the extreme temperature, pressure, and conditions of many applications in coal-fired power plants. Metallic joints could handle 750° Fahrenheit, for example, while fabric joints could only manage 350°F.

Recently, however, fabric technology and material has improved to such an extent that fabric expansion joints are now the clear choice for operators who are looking to maximize both flexibility and efficiency within their duct system. Further, the effects of elevated temperature, torsion, vibration, angular movement and corrosion can be mitigated when the correct expansion joint style is adapted to the right application.

1. The Anatomy of Fabric Expansion Joints

Fabric expansion joints have many configurations for different applications.



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Most fabric expansion joints consist of several layers with varying properties that provide compounding benefits as well:

1. Outside layer / cover

Single layer belt with the highest temperature capability for a gas seal layer. Fluoroplastic belts can handle a continuous 600°F.

2. TFE layer

Vapor barrier for applications that may cycle through dew point

3. Insulation layer

Fiberglass insulation thermally bonded to the outer cover to protect from heat degradation and eliminate "hot spots."

4. Reinforcing layer

Vermiculite-coated fiberglass fabric acts as an insulator and increases expansion joint strength and durability. Wire mesh layers may also be added for increased durability and abrasion resistance.

5. Additional insulation layers

The presence and thickness of this layer(s) is determined by the system temperature to ensure that the heat transfer from the flue gas is reduced to a point less than the maximum allowable temperature of the vapor barrier (600°F) and cover.

6. Inside layer / encasement

Close weave material binds the belt together, acts as an insulator, and adds strength for handling and service. A metal flow liner is required in applications where there is abrasion.

Together, a full layer buildup can handle 1400°F, but when refractory and other complementing technology is used, the joints can handle over 2000°F.

2. The Benefits of Fabric Expansion Joints

Unlike metallic expansion joints, fabric-based equipment can move in any direction: axial, lateral, angular, and rotational. They are very proficient at reducing sound transmission, isolating vibration, and absorbing shock to offset potential misalignments.

Fabric expansion joints also offer many other tangible benefits:

- **Cost-effective**
  Due to a design and fabrication process that is commonly less expensive than that for metallic-based joints.

- **Fewer maintenance costs**
  Because fabric joints are lighter and more flexible in comparison, they are easier to maintain.
- **Highly adaptive**
  Can be used in applications with temperatures ranging from -40°F to more than 2100°F.
- **Durability**
  Highly resistant to all types of abrasion and erosion and are not susceptible to fatigue / cycle failure.

3. Best Practices for Minimizing Joint Failure

Proper design

The longevity of an expansion joint depends on how well it is designed to meet and withstand the specific needs of its application. If the application exceeds the joint's design specifications, for example, problems such as extreme pressure, elevated temperatures, excessive movement, vibration and more can arise. As such, manufacturers should engineer each expansion joint for its specific service conditions. They should collect and analyze a variety of data points to develop and define the proper design, including the following:

Movements

- Operation, excursion and misalignment

Temperature

- Operating/design temperatures based on actual conditions
- Excursion temperatures with maximum intermittent conditions, frequency, and duration
- Ambient conditions at both low and high ends

Pressure

- Operating, design and excursion conditions

Media

- Chemical composition and particulate load

Duct material and insulation

- Match thermal properties

Size

- Inside dimensions, breach opening and flange configuration

Installation configuration

- Bolt-in or weld-in

The result of a meticulous design process led by an experienced team of experts will be an expansion joint that is precision-built and equipped to operate efficiently for the duration of its service life.

Superior quality

All machinery has a limited lifetime as its components will eventually wear out. But expansion joints that are developed and engineered using the most advanced technology and materials provide reliable operation over the course of its lifetime.

The following three materials and practices can significantly enhance fabric expansion joint performance:

- **Thermal bonding** of needled fiberglass insulation to the substrate to protect from hot spots and heat degradation.
- **Vermiculite-coated fiberglass** fabric that insulates and increases joint strength and durability.

- **Multiple layers of material** (as many as nine) bonded and sewn together to control tearing, cracking, and ripping.

When manufacturers use cutting-edge technologies and apply the highest process standards, the result is a superior product that will last longer.

Regular maintenance and testing

To ensure expansion joint longevity, it is important to follow a regular maintenance schedule and fix issues as soon as they are identified. Delaying repairs can lead to failures and inefficiencies that negatively impact production and operations. To be effective, a maintenance program should include a systematic survey of all expansion joints, a stock of critical replacement belts, regular follow-up inspections and ongoing training for plant personnel.

With fabric joints, there are usually visible signs that precede a joint failure. Such warning signs include exterior surface cracking, blistering, deformation and delamination, exposure of metal/fabric reinforcement, ply separation, and fabric deterioration. These signs, when identified early as part of a regular maintenance program, give plant personnel time to fix the joint before it fails.

Conclusion

Fabric materials are the best option for operators who are looking to maximize both flexibility and efficiency within their duct system in modern coal-fired power plants. Fabric joints can provide reliable, high performance over their lifetime even in the harshest temperatures, pressures, and stresses.

Reliable, durable joint solutions start with the proper specification and experienced design, as well as world-class materials, fabrication, delivery, and installation. Minimizing joint failure requires regular inspection and timely replacement as part of a standardized maintenance program.

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