Expansion Joint Selection Optimizes Piping Systems

Different material and design combinations offer application-specific advantages.

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When discussing expansion joint selection, the conversation typically focuses on the quality, durability and capabilities of the expansion joint. However, the expansion joint's role in the overall energy efficiency and optimization of the piping system is often overlooked.

All piping systems require some degree of flexibility. Inadequate flexibility can lead to a catastrophic system failure that could even be life-threatening, making flexibility an important consideration in expansion joint selection.

Rubber expansion joints provide maximum flexibility with their resilient construction and all-directional movement capability. Rubber expansion joints can handle axial, lateral, angular and torsional movements. They can also absorb vibration and accommodate piping misalignment.

The rubber expansion joint provides these benefits in the smallest space possible, reducing the piping system's size and overall footprint for greater overall energy efficiency and system optimization. This level of performance cannot be achieved with alternatives such as large pipe loops, metal expansion joints or grooved couplings.

A typical expansion joint *(Article images courtesy of FSA.)*

Section-by-Section System Optimization

The expansion joint selection and application process often requires a systematic and sometimes tedious approach. First, the proposed piping should be divided into individual sections (straight runs or L- or Z-shaped bends) by choosing tentative anchor locations. Each section can then be optimized and later rejoined with the complete piping system, resulting in a completely optimized, efficient system. This process will require additional consideration for the following:

- Capabilities and limitations of different anchor types, including main, directional or intermediate
- Piping code (ASME B31.1, ASME B31.3 or others)
- Location of various equipment, branch connections and space restrictions
- Available support structure and load limitations on piping and equipment
- Operating conditions including temperature and pressure
- Amount of thermal and/or external movements anticipated
- Need to absorb noise and vibration and to compensate for misalignment
- Need to provide access to piping and equipment
- Need to absorb shock loads
- Required cycle life
- Capabilities and limitations

of different expansion joint designs, including unrestrained and restrained arrangements

The unrestrained expansion joint will commonly have a cycle life in the tens of millions.

Unrestrained Designs

Unrestrained designs are the simplest—and often most economical—solution to expansion joint selection.

These designs primarily relieve thermal stresses in rigid piping systems by absorbing axial movement. The use of main anchors with numerous guides at specific spacing becomes critical.

Lateral movements can be achieved by using a directional main anchor. The unrestrained expansion joint will commonly have a cycle life in the tens of millions.

A single-arch unrestrained rubber expansion joint

It also reduces noise and vibration, compensates for misalignment, and absorbs shock and anchor loading, provided the support structure and adjacent equipment does not have loading limitations. The joints can also provide access to piping and equipment when a self-retracting design or an adjustable installed length is not required.

Although this type of piping system uses a very traditional approach, other solutions are more efficient and eco-friendly. These systems tend to occupy a significant footprint and require more piping and greater support structure.

Restrained designs offer many of the same benefits of unrestrained designs, but they have improved energy efficiency and system optimization.

Restrained Designs

An alternative approach that uses restrained designs—including universal, hinged, gimbal, pressure balanced and dismantling expansion joints—may be used to absorb axial, lateral, angular, torsional and combined movements. The pressure thrust forces in these designs are often self-restrained, allowing for intermediate anchors and fewer guides. These designs are extremely helpful with space or structural limitations or with load limitations on piping and equipment. A universal restrained design, for example, relieves thermal stresses in perpendicular runs by absorbing lateral movements.

Restrained designs offer many of the same benefits of unrestrained designs, but they have improved energy efficiency and system optimization. Restrained designs can also provide access to piping and equipment in a self-retracting design while allowing for additional adjustments to the installed length. These systems tend to have a much smaller footprint because the piping length, pumping requirements and need for structural support are greatly reduced.

Conclusion

Each expansion joint arrangement has characteristics that make it particularly suitable for a given application. In some cases, two or more solutions may be possible, allowing the designer to maximize energy efficiency and system optimization. While the arrangements covered in this article are the most common, a combination of materials and designs is available to create the most effective solution for even the most demanding application. P&S

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Universal restrained design