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Expansion Joints: Growing The Technology

Advanced materials and innovative technology have transformed a common product into something extraordinary, further raising industry standards.

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with
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Elastomeric (rubber) expansion joints have long been recognized for their ability to reduce noise and vibration and accept fluctuating thermal movements in piping systems. Recent advances in engineered elastomers and textiles have led to the development of expansion joints with improved performance and operating life that benefit both new and existing construction. Equally valuable are application-based ratings and design tolerances built to accommodate moderate misalignment and/or brief excursions outside design ratings.

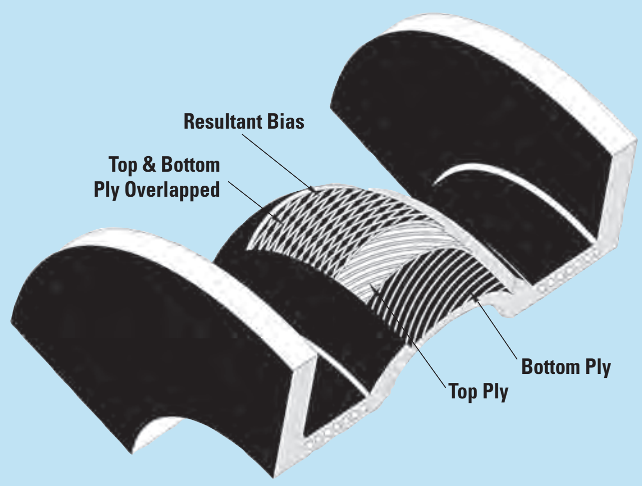

Fig. 1. Bias ply angle detail

Fig. 2. Field measuring offsets and building replacement expansions joints to fit the application's parameters not only minimizes installation time and expense, it ensures 100% of the joint's allowable movement capabilities and operating life.

One of the best strategies users can leverage involves engineered (i.e., custom) expansion joints—*unique products manufactured to spec for particular applications.* Custom-engineered solutions are ideal for operations taking a condition-based replacement approach, as opposed to the more common, and at times inefficient, practice of time-based replacement. Technological resources such as computer-aided design provide the tools needed to create these types of products for the most complex applications.

Advances in methods and materials of construction

The most common expansion-joint fabric reinforcement used to be square-woven cotton or polyester. "Square-woven" means the fabric strands are intertwined perpendicular to each other and have approximately the same strength in each direction. If greater strength were needed in one direction, engineers would have to increase the overall number of plies, thereby increasing the strength in both directions and—*consequently*—also increasing overall joint stiffness (which is loosely defined as the force needed to move the joint a fixed distance).

Today's expansion joints use modern engineering principles and materials developed largely in the tire industry—*including tire cord plied up on a specified bias angle*. General Rubber's design reflects a wide-flowing arch reinforced with polyester tire cord in just that type of bias ply arrangement (Fig. 1). Coated with the advanced adhesive resourcinol formaldehyde latex (RFL), the tire cord also ensures a superior rubber-to-fabric bond. (This RFL was developed by the tire industry to optimize bond strength between elastomer and fabric, preventing ply separation and delamination.) These advancements have resulted in higher expansion-joint tensile strength and increased all-directional movement. The bias angle can be adjusted to increase the strength in one direction versus the other—*a significant benefit since the resultant forces in an expansion joint are typically greater in the axial and not radial direction.* Bias-angle adjustment is even more important when a large arch is used for increased movement capabilities.

Advancements in engineered elastomers have made it possible to design expansion joints for continuous exposure to elevated temperatures (400 F), pressures in excess of 350 psi and a high resistance to chemical erosion and abrasion. Many of these designs incorporate DuPont Viton, Teflon liners and Kevlar tire-cord fabric reinforcement.

The combination of advanced elastomerics, superior bond strength between plies and optimal number of angle plies creates a homogenous composite with consistent and predictable engineering capabilities. The larger arch form and reduced overall number

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General Rubber Corp. (www.general-rubber.com) has been designing and developing a wide range of mechanical rubber products for the most demanding applications since 1950. Customer commitment is evi-dent in every aspect of its business. That includes maintaining a team of engineers who are prepared to discuss each application and identify the best solution at the best price. If an effective solution can't be obtained from its extensive product line, the company will custom-design that "best" solution. This attitude is ingrained throughout the organization and lies behind its tradition of releasing new products each year. General Rubber is a founding (and active) member of the Fluid Sealing Association (FSA). The company's leadership in technology and ability to consistently exceed customer expectations was validated when it became the first company in its industry to earn ISO-9001 certification.

of plies increase all-directional movement capabilities while minimizing stiffness. Increased flexibility, in turn, reduces stress on the piping system.

Custom-engineered-application success

Building expansion joints to exact field dimensions addresses another crucial problem in both replacement and retrofit projects. In the course of its life span—*typically 20 years*—piping settles and offsets at different rates. A large-diameter condenser, for example, can develop non-parallel flanges and large lateral offsets. This was the problem in a Northeast nuclear power plant, where a 108"-diameter pipe had lateral offsets in excess of 2" (see Fig. 2). As the condenser and piping system still had many years of life left, the question of how to fit in this offset was resolved by building the lateral offset into the replacement expansion joint. While the adjacent valve would usually be replaced or refurbished at the same time, in such a replacement it's often cost-prohibitive to realign the piping. It's also unrealistic to order a replacement valve with varying overall lengths and built-in lateral offsets. On the other hand, it's relatively inexpensive for the expansion joint manufacturer to incorporate these field variances in the replacement expansion joint.

Before this technique was developed, the installation crew could spend a great deal of time and effort forcing a straight standard product into an offset and misaligned position. After an exhausting installation process, the standard joint would have been substantially compromised, reducing the life due to permanent installation stresses. In many cases, the actual field-measured offsets exceed the allowable movement capability of the joint—*practically ensuring an imminent failure.* When the expansion joints are custom- built to fit the application parameters, it not only minimizes installation time and expense, it also ensures 100% of the allowable movement capabilities and operating life. The advanced features and improved safety factors actually increase reliability and life expectancy.

Retrofit applications are slightly different in that a complete section of equipment and piping is often replaced. Problems arise when the new equipment doesn't line up with old piping.

(Center-lines of the pump's suction and discharge may be different from the original equipment, etc.). An expansion joint can be used as a transition piece between new and old flanges. If a lateral offset is required, it can simply be manufactured into the expansion joint. This gives the design engineers greater flexibility when designing retrofit systems.

Expanded capabilities

New design features in piping expansion joints allow them to do more with less. Their expanded versatility includes the ability to accept greater all-directional thermal movements, plus more flexibility for reducing noise and vibration and excellent resistance to shock and fatigue. They also accommodate moderate misalignment and/or brief excursions outside design ratings with a longer useful life. Incorporating these advantages in custom expansion joints built to exact field dimensions offers greater opportunity for design engineers. Moreover, utilization of advanced engineered elastomers and textiles has made it possible for expansion joints to be used in a wider cross section of chemically abrasive and erosive mediums under higher system temperatures and pressures. **MT**

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