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A New Prescription for Coupling Stress Relief



As seen in
Compressor Tech 2
August/September, 2018



A New Prescription for Coupling Stress Relief

Revolutionary advancement in disc technology improves high-performance coupling reliability.



Altra coupling brands have developed the Tri-Bushing™, a unique flex element/blade triangular bushing design that increases the axial capability of high performance flexible disc couplings used in turbomachinery applications.



Traditional round bushings installed on a scalloped flex element/disc pack.

Flexible couplings designed for critical turbomachinery must accommodate angular and axial movement due to thermal growth. In steam and gas turbine applications, for example, machinery shafts, casings and piping expand as their temperature increases.

When axial deflection is significant, spacers are purposely made short to stretch the coupling statically. A good “rule of thumb” is that when the thermal growth exceeds 25% of the coupling’s capacity, it is designed with “pre-stretch”. Where possible, couplings are designed to grow into their neutral, relaxed position. In many cases, however, couplings must operate in a compressed (or stretched) mode to accommodate this movement.

The API 671 standard for “Special-Purpose Couplings for Petroleum, Chemical, and Gas Industry Services” requires couplings to accommodate .20 degree of angular misalignment. In most cases, expensive turbomachinery drivetrain components are laser-aligned for maximum precision but, at 1/5 of a degree, the impingement of the flex element around the bushings does not typically result in failures due to the radius and low angle.

When approaching the axial limit of a disc coupling, while accommodating for angular offset, the disc packs become highly stressed at the bushings. Proper selection of turbomachinery couplings can sometimes be based on axial thermal growth rather than the torque requirement. A larger coupling may be needed to handle the axial growth.

Mark O’Neil, Chief Principal Engineer for Altra Industrial Motion’s coupling brands, discussed how his team, comprised of engineers from Ameridrives and Bibby Turboflex, dealt with issues experienced in developing improved disc coupling designs for high angular misalignment in certain applications.

“The focus of our team’s attention was on the coupling’s blade/flex elements. While developing coupling solutions for the turbomachinery market, we needed to ensure that our legacy disc coupling design could be retrofitted with a new flex element,” O’Neil said. “This meant that the flex element bolt circle was locked in from the start, which limited many of the design options we could explore”.

With this constraint, the design process was initiated, including finite element analysis and prototype testing. Historically, dynamic testing for new coupling designs is performed for 100 million cycles. Unfortunately, during the early prototype testing, coupling failures were consistently occurring between 40 million and 50 million cycles.

The engineering team attempted to solve the problem by varying the thickness of the blade/flex elements, but the failures continued. The blade failures were all in the areas where the disc material bent around the traditional round bushings positioned at the bolt holes (see Figure 1).

“Based on these findings, we looked at how we could eliminate or reduce the damaging impact on the disc coupling blades as they bent around the apex of the bushings at the tangents,” said O’Neil. “Ultimately, this led to the development of the revolutionary new Tri-Bushing™ design.”

The unique bushing design profile features two straight sides that significantly reduce and redistribute the stresses that typically occur around the disc pack bushings. The FEA results shown in Figure 2 provide a comparison of the stress reductions.

“Utilizing the new Tri-Bushing design can increase a couplings axial capability by more than 33%,” Oliver Doidge, Turbomachinery Business Development Manager at Altra explained. “Given this significant increase in axial growth capability, in many applications, coupling designers no longer need to upsize their coupling to accommodate this growth. In addition to the cost-saving benefit, lateral vibration problems may be avoided with a smaller coupling. A higher safety factor results regardless of the misalignment required.”

The new Tri-Bushing design from Altra is now available for use in all new Ameridrives, Bibby Turboflex, TB Wood’s and Lamiflex disc couplings. New disc packs with Tri-Bushing stress reduction technology can also be retrofitted into existing couplings as part of repair or rebuild services performed at various Altra coupling facilities around the world.



Figure 1: Blade failures where the disc material bent around the traditional round bushings.

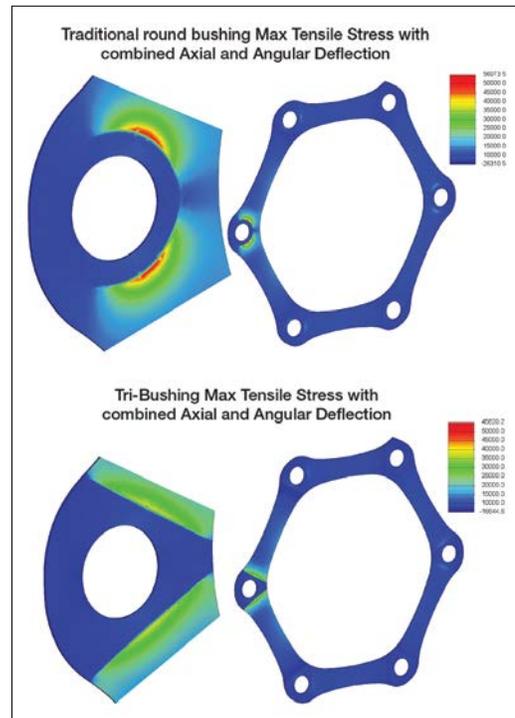


Figure 2: FEA stress comparison of a typical round bushing and a Tri-Bushing™.

About Altra Motion

Altra is a leading global designer and producer of a wide range of electromechanical power transmission and motion control components and systems. Providing the essential control of equipment speed, torque, positioning, and other functions, Altra products can be used in nearly any machine, process or application involving motion. From engine braking systems for heavy duty trucks to precision motors embedded in medical robots to brakes used on offshore wind turbines, Altra has been serving customers around the world for decades.

Altra's leading brands include Ameridrives, Bauer Gear Motor, Bibby Turboflex, Boston Gear, Delevan, Delroyd Worm Gear, Deltran, Formsprag Clutch, Guardian Couplings, Huco, Jacobs Vehicle Systems, Industrial, Kilian, Kollmorgen, Lamiflex Couplings, Marland Clutch, Matrix, Nuttall Gear, Portescap, Stieber, Stromag, Svendborg Brakes, TB Wood's, Thomson, Twiflex, Warner Electric, Warner Linear and Wichita Clutch.



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