design FAQs

How and Why to Use Tolerance Rings in Your Application

FREQUENTLY ASKED QUESTIONS

Q: Can you explain what a tolerance ring is?
A tolerance ring is a circular spring-like frictional fastener used to mount round components together. The rings are made from a thin spring steel strip that has waves, corrugations, or bumps formed into the material. The strips are then curled into a ring shape with the waves facing either inward or outward depending on the application requirements.

Q: How does the tolerance ring work?
A: The waves that are formed into the ring exert a holding force that is less rigid than a press fit, allowing for future disassembly of components. When assembled between mating components, each bump is deflected, which results in a holding force due to the coefficient of friction of the mating components. Performance is dependent on the physical properties of the mating components, their tolerances, magnitude of applied loads, and the amount of growth/contraction due to temperature changes.

Q: What materials are tolerance rings made of?
A: Most tolerance rings are made of 301 stainless steel (SST) or hardened carbon steel. SST provides good corrosion resistance while the hardened carbon steel provides greater spring rates and radial capacities. Extreme temperatures can affect the spring-like properties of the materials used. For example, 301 SST is stable up to 450° F while the hardened carbon steel is stable only up to 250° F. Other materials include 316/316L SST (which is softer than 301 SST), Hastelloy C-276 and Monel K-500. Hastelloy and Monel are typically used for more extreme temperature ranges and corrosive environments.

Q: What is the difference in applying the corrugations facing inward versus when they are facing outward?
A: When the waves are facing inward, the tolerance ring is installed by inserting it into the outer component (i.e., housing). When the waves are facing outward, the tolerance ring is installed by sliding it over the inner component (i.e., shaft). These different installation methods provide engineers and designers with solution options for connecting circular components.

Q: What are some of the reasons why I might want to use a tolerance ring?
A: Tolerance rings can be used as a torque transmitting device, for centering components, and as a fastening solution. They are able to compensate for thermal growth, may reduce vibration, and resist corrosion. They can also be used to reclaim worn housings so that the original ball bearing size can be used. Tolerance rings eliminate the need for adhesives and keyways, can adjust for tolerance stack-up, protect against torque overload, and allow for lower installation forces when a press-fit is not desired.

Q: What types of applications can tolerance rings be used in?
A: Tolerance rings can be made strong enough for use in off-road equipment or delicate enough to hold miniature ball bearings. They are suitable for consumer products, automotive, vehicular and marine systems, electric motors, power tools, petroleum and gas industry, mining and construction equipment, satellites, appliances, food and beverage, medical instruments, pumps, compressors, communications, and many other industry sectors.

Q: What tolerance rings can be used in extreme conditions?
A: Tolerance rings made of Monel alloy K-500 have been used successfully up to 600° F and Hastelloy C-276 have been used successfully up to 900° F. They can survive in environments where elastomers would either fail or outgas, as well as in highly corrosive and oxidative situations. Because of this, they are suitable for mounting carbide journals or holding probes in place in high temperature conditions. Our Extreme Series tolerance rings are designed for oil and gas, chemical, food and beverage, automotive, and other industries that operate in harsh conditions.

Q: What if I have a unique application?
A: If a stocked tolerance ring suitable for the application is not available, custom tolerance rings specifically adapted for your application can be designed by USA Tolerance Rings. Because of the many different design constraints and parameters our customers encounter, an optimum tolerance ring configuration can be made by selecting the proper manufacturing tooling in combination with the appropriate materials.

Q: Will a tolerance ring keep components centered?
A: In most cases, the tolerance ring should maintain about 0.0008-inch concentricity for components up to 2 inches in diameter. The concentricity is also dependent on how accurate the center axes of the components (i.e., shaft, housing bore) were made.

Q: Will tolerance rings act as dampers and reduce vibration/noise?
A: Tolerance rings behave like springs and will not dissipate energy. As springs, however, they will shift the vibrational frequencies occurring at the components. If the shift is away from the natural vibrational frequencies of the system, then there will be a decrease in vibration/noise. If the shift is closer to the natural vibrational frequencies of the system, then there will be an increase in vibration/noise. The best way to confirm either is by testing prototypes. ■

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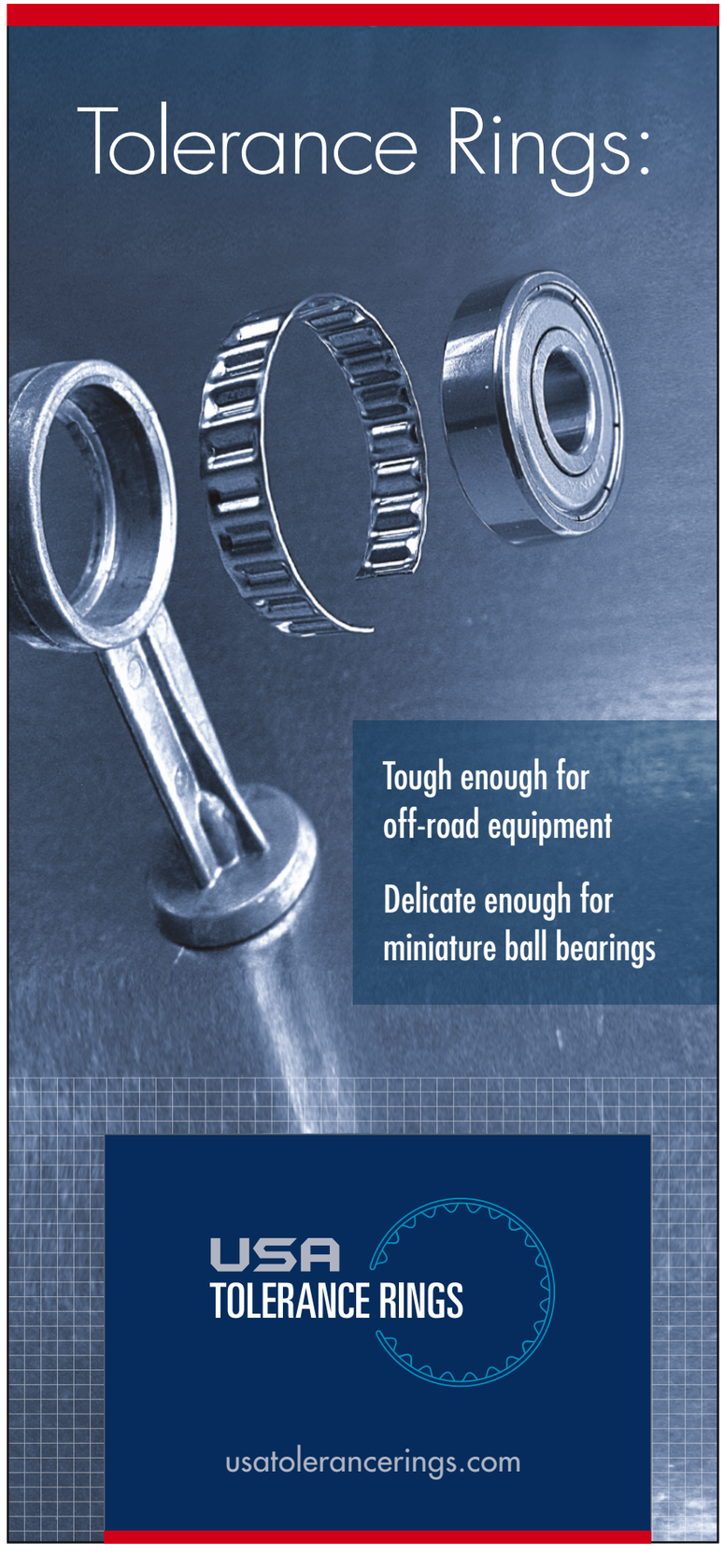
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