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Analysing Thread Treatment Options

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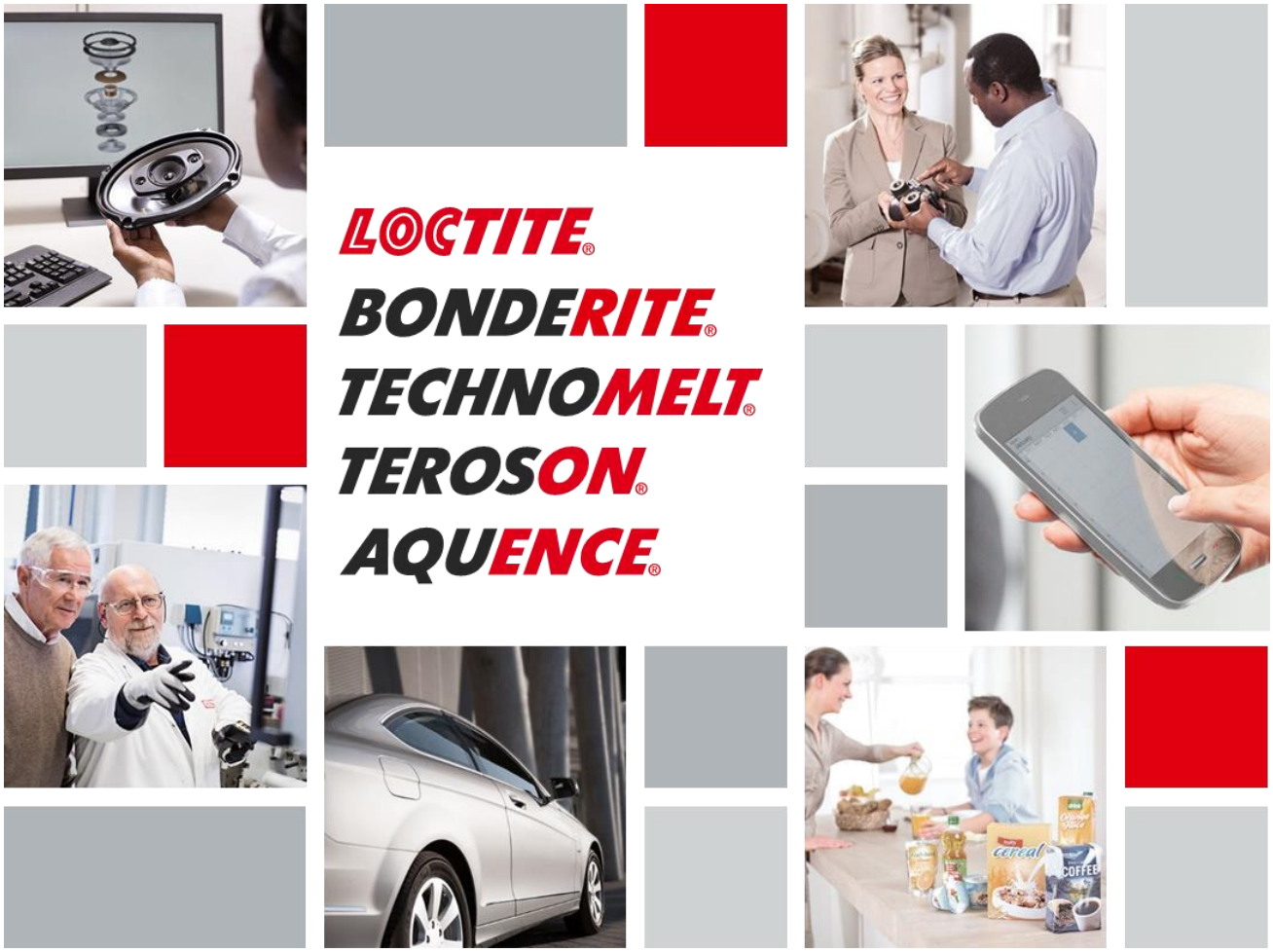

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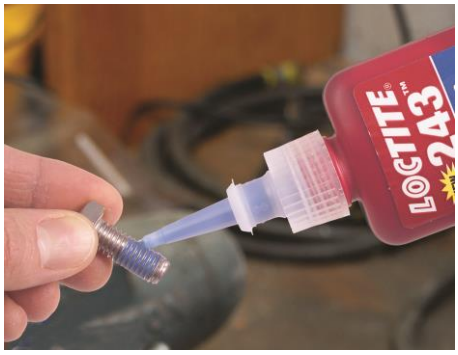
Abstract

Proactively treating threaded pipes and fastener with thread treatment products is critical to efficient and cost effective manufacturing. A major cause of industrial equipment failure, threaded fastener loosening results in millions of dollars of unscheduled downtime costs each year. Similarly, more than a billion gallons of industrial fluids are wasted through leakage each year. Beyond the value of lost fluids and gases, leaks affect toxicity, emissions, safety, contamination and personnel.

Threaded fasteners set and hold tolerances on assemblies ranging from light-duty equipment to heavy machinery. To ensure reliable performance, it's imperative that the specified tolerances hold during the equipment's entire service life. To lubricate, protect, seal and hold threaded fasteners to their original tolerances, various forms of thread treatments are used to increase an assembly's reliability. Thread treatments are placed into three categories: thread sealants, thread lockers and anti-seize materials.

Threadlockers



Threaded fasteners continually receive various types of differential stress. Stresses such as vibration and shock, thermal expansion and contraction, and micro-movement of the fastened parts all can reduce clamping force and, ultimately, cause machine failure. Many mechanical devices such as spring washers, wire retainers and locking bolts were created in an effort to prevent uncontrolled fastener loosening. These mechanical locking methods add significant cost to the fastener assembly, yet can't reliably prevent loosening due to the side-sliding motion that causes self-loosening. They also don't seal or prevent corrosion within the assembly and must be sized appropriately for the specific fastener.

Liquid threadlocking adhesives are one of the most reliable and inexpensive ways to ensure that a threaded assembly remains locked and leak-proof for its full service life. Applied drop-wise to fastener threads, liquid anaerobic products fill the grooves of the threads and cure to a hard thermoset plastic when exposed to active metal ions in the absence of air. Locking the threads together prevents unwanted movement or loosening of the fastener and seals the threads, preventing leakage or corrosion. Excess threadlocker that overflows the threads is easily wiped away since it remains liquid.

Although a properly prepared surface ensures the most consistent threadlocker performance on bonded assemblies, advancements in anaerobic technology have delivered unique products that limit the need for thorough cleaning and surface preparation. New threadlocker formulations now cure on inactive metal surfaces, tolerate oily surfaces and allow cure speed to be specified. Surface primers are only required when using conventional liquid products on challenging applications and substrates. Threadlockers can help prevent common failures such as misalignment (where there is a loss of clamp load). When shafts for gearboxes and motors are aligned, you must properly torque the mounting bolts to maintain proper alignment. However, over time these

mounting bolts can loosen due to vibration, thermal expansion and contraction, or shock. This results in a loss of clamp load and, ultimately, misalignment. Proactive use of liquid threadlockers helps to maintain clamp load in this example and prevent misalignment.

Threadlockers, available in different strengths for different applications, allow threaded fasteners to maintain critical clamp load pressures even in extreme environments. These adhesives offer high shear strength, very good temperature resistance, rapid cure, easy dispensing and excellent vibration resistance. New anaerobic formulations are available including surface-insensitive varieties, high-temperature formulations for exposures up to 450 degrees F, chemically resistant materials and formulations engineered to withstand severe vibration.

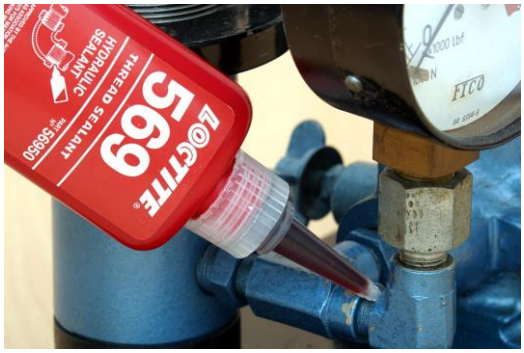
Consider several factors in order to select the right threadlocking adhesive for an application. Contrary to common belief, any bolt previously locked with threadlocking adhesive may be reused simply by removing old adhesive before applying new threadlocking material and reassembling. Threadlockers are available in low-strength formulations for easy removal, medium-strength grades that can be removed using common hand tools, and high-strength formulations that offer the highest holding abilities. However, no threadlockers are completely permanent; even the highest-strength threadlockers can be removed using standard hand tools following direct exposure to 450 to 500 degrees F for about five minutes.

You can remove significant amounts of old threadlocker residue by using a stiff brush. Light levels of threadlocker residue are compatible with the next application of threadlocker, as long as they do not restrict the re-installation of the fastener.

Thread Sealants

The potential for costly, dangerous leaks exists in all fluid systems – gas, vapor or liquid. The degree to which a leak is tolerated varies significantly with each application. For example, you may ignore a few drops of water per hour leaking from a pipe fitting in a drainage hose. However, allowing a similar amount of water leakage into an electrical switchboard could be disastrous.

Most leaks are traced to pipe joints. Threaded joints in piping are necessary evils. Pipe system designers seek to reduce the number of joints wherever possible, but without joints that can be dismantled, each repair would require the removal of massive pipe links. Despite the standards created to maintain uniform fittings, tapered pipe threads are imprecise; and during the course of use and repair, the threads can become damaged and even more vulnerable to leakage. The area where the crest and the root of the thread meet forms a spiral leak path. No amount of tightening will eliminate this. Thread sealing is an attempt to block this leak path in pipe connections. Mechanical thread sealants include a variety



of products such as sealing tapes, dopes, pastes, O-rings and cone fittings. While effective, these pipe sealing methods create problems over time.

Tapes act as a lubricant only and can shred, may clog pipes or even cause over-tightening, which can damage threads. Tapes are manually applied, limiting automation of the application, and offer poor vibration resistance due to their slick surface. Most pastes contain solvents and exhibit creeping and shrinking problems as they dry. Such problems limit their chemical and vibration resistance. O-rings require large inventories and a special joint design, and may be easily damaged during handling or assembly. Machined cone fittings require costly machining and are easily damaged.

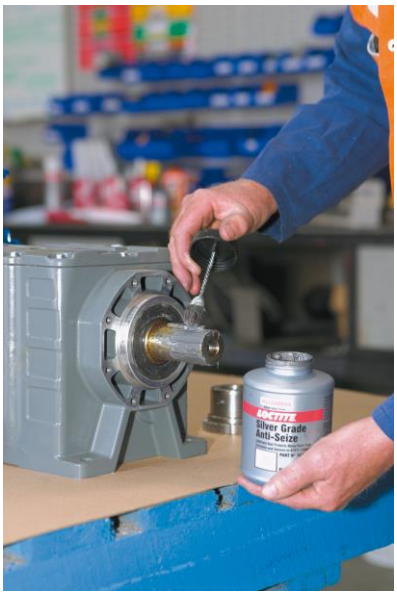
Thread sealant adhesives are liquid to past-like products that are easily applied, and cure through an anaerobic reaction. Like anaerobic threadlockers, thread sealant formulations don't contain any volatile solvents that evaporate out of the threads over time and affect the long-term performance of a sealed joint. These materials use plasticizers and formulation modifiers to lubricate and instantly seal the joint while the cure is in process.

Once cured, anaerobic thread sealants won't melt, eliminating leak paths. These materials seal and lock threads at the same time, and act as a lubricant during assembly to promote tightening while ensuring consistent assembly torque. Uncured thread sealant dissolves, eliminating the potential for contamination. Once applied, these materials provide instant low-pressure (500 psi) seals. After cure, many formulations are rated to seal to pressures of 10,000 psi. Thread sealants also can seal pipe unions and compression fittings, and provide exceptional fluid compatibility and sealing ability.

Threaded hydraulic fittings are a common place for leakage. This is because alternative sealing products fail over time because of shrinkage (which results in a leak path) or loosening because the alternative sealant is really just a lubricant and does not seal the voids. Anaerobic thread sealants provide the best of both worlds by providing lubrication to help assemble the fittings and by sealing without shrinking to provide long-term seals.

Anti-Seize

Anti-seize materials protect threaded and slip-fitted metal parts from rust, corrosion, galling and seizing at high temperatures. They also reduce friction, wear, and breakage on critical parts in the most severe operating environments.

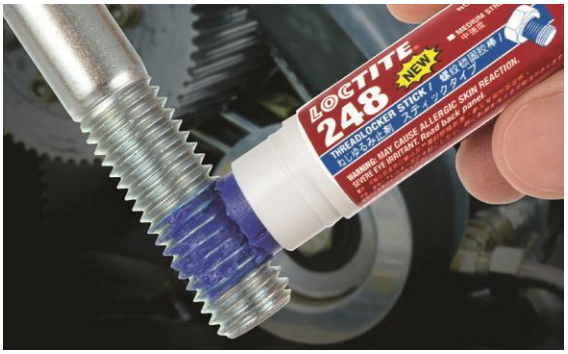


These high performance greases (formulated with or without specific types of metal flake) help ensure that fasteners are easy to assemble and disassemble. At the same torque, a consistent bolt tension is always achieved using anti-seize materials, even in performance extremes. Specific formulations cater to the type of metal used for the threads, as well as temperature extremes. Many products perform well in

excess of 1,000 degrees and some perform in temperature extremes up to 2,400 degrees. Anti-seize can be used on a furnace door hinge, for example, preventing the hinge from seizing in the harsh environment.

These products are typically brush-applied to parts. This requires a reservoir and a separate applicator to spread the material. Dipping a fastener into the material isn't recommended since since it results in over-application, contamination and an inconsistent, messy assembly.

New Technology



Recent advances in the stability and reactivity of threadlocking and thread-sealing materials have allowed the development of semi-solid "stick" formulations that complement liquid counterparts. Semi-solid threadlocking, thread-sealing, and anti-seize products work well in applications not previously considered because the liquid was considered too messy or could potentially migrate into areas where a cured adhesive could create problems. For example, sealant sticks are excellent alternatives in overhead or difficult-to-see areas where fluids and tapes are cumbersome to use. Anti-seize stick technology allows dispensing directly into a part and minimizes over-application.

The sticks are very useful when an assembly operation is time-sensitive or must be staged. Here, the threadlocking material is applied in advance without having to worry about it running off the part. Treated parts are then assembled all at once without time- consuming matching of mechanical locking devices or drop-wise application of liquid thread treatment.

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