There are four basic load conditions which promote the loss of clamp load and subsequent loosening: axial loading, bending, torsional loads and transverse loads. However, there are just as many such reasons why the fastener may become loose; not initially achieving preload during assembly, changing assembly procedures between production / assembly shifts, extreme temperature variations, severe vibration, embedment into softer materials, or a host of other reasons. It is for these reasons why supplemental thread locking devices have been developed and used: to keep the parts together.

Thread locking elements come in two forms: mechanical and chemical. Mechanical elements have been discussed previously and some mention has been made briefly of some chemicals but choosing the correct chemical for a particular application becomes overwhelming because there are so many good thread locking chemicals on the market.

Unfortunately, the term 'locking' implies a sense of permanency and security that one feels that when used, the parts will remain together. Therefore, the same type of chemical may be used on small screws, such as in eye glasses, to larger 1 ½" diameter bolts. Because of the heavy loads the larger bolts are subjected to, some chemicals may not work as well as others.

Thread Locking Chemicals

by Guy Avellon

Cyanoacrylates are strong, fast acting adhesives. Commonly referred to as 'Super Glues', these products will instantly bond a small fastener. However, due to its fast cure rate, production assembly of many fasteners may become a daunting task. Many of these products are sensitive to contaminants, such as tapping fluids and oils left on the threads of a tapped hole. Some newer formulations are more tolerant to these contaminants.

Newer generations of Cyanoacrylates have different viscosities which are thicker for controlled applications, such as the gel type thread lockers. The gel is a thicker nitrile rubber compound that is perfect for multiple bolts, vertical surfaces and porous materials. Operating temperatures range from -65° to 300° (-54° to 149° C), shear strengths up to 3,000 psi and are available in medium to high strengths.

Gels are used on bolts up to 1 ½" in diameter; plow blade bolts, ring gear bolts, truck transmission nuts, cylinder block studs, etc.

The bond may be broken with strong torsional loading or heat. Therefore, if disassembly is anticipated, a lower strength adhesive should be considered. The shelf life of these products is only 1 year when unopened, so stocking should be on a product rotation basis. This is a fast consumable product as the shelf life decreases to 1 month after opening the container.

Anaerobic chemicals remain in the fluid state until it becomes isolated from oxygen. When this occurs, as when mating between the threads under pressure, the chemical rapidly cures and hardens to form a cross-linked plastic. These are mildly tolerant of oil contamination. Because fasteners with anaerobic adhesives applied will not set up until installed, these are ideal for multiple fastener installations and for production assembly.

The anaerobic chemicals have evolved over the years to offer the user a variety of options for their applications. Cure times have been formulated to have shorter times or longer periods, for when multiple assemblies are used. These times range from 5 minutes, 10 minutes and broader ranges to one hour.

Different levels of strengths are also available from low to high strength. A low strength adhesive would be used for small screws up to ¼" and 6 mm, for screws into soft materials, such as aluminum, plastics and sheet metal. Low strength adhesives may also be used for fasteners which may require frequent removal or adjustment. The medium strength chemicals are for fasteners from ¼" – ¾" (6 – 20 mm). These medium strength adhesives are great for automotive applications; SEMS fasteners, water pumps, carburetor studs. Drive couplings, wheel joints and flange connections are subject to torsional loads, which are also dependent on perfectly aligned and flat surfaces.

High strength adhesives are not easily removable, if at all, and are recommended for fasteners greater than ¾" and 20 mm in diameter. Again, if you cannot initially attain the proper clamp load, this may not help. These types of adhesives will be helpful with non-ferrous fasteners, such as stainless steels, to prevent galling and keep the fastener and nut tight when high clamp loads and high torques are not possible. However, due to their high strength capabilities, the anaerobic thread locking chemicals will also provide exceptional resistance to vibration and axial loading, especially in heavy equipment where there are severe impacts, such as with plow bolts, locking pins, bushings to shafts, sleeves and Keps fasteners.

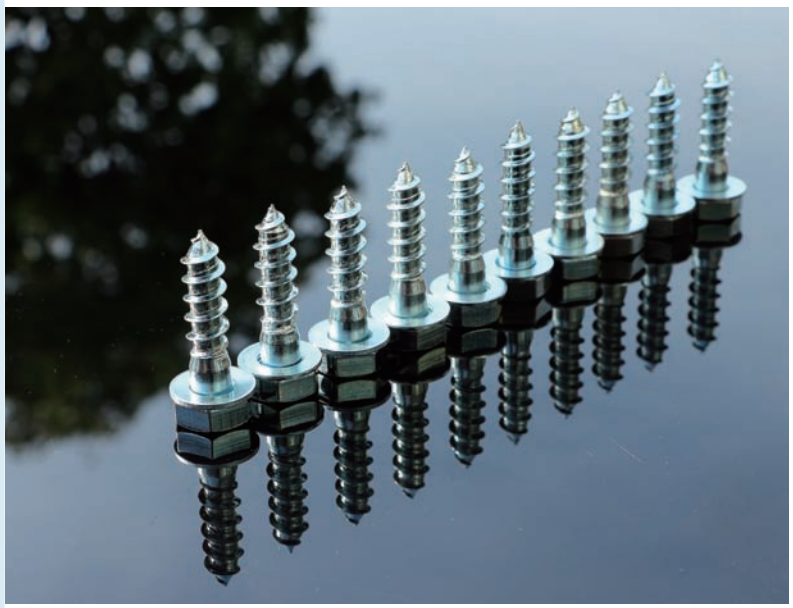
Most of this genre of chemical thread lockers have a shear strength of 3,000 psi and a high temperature limit of 300° F (150° C). There are some chemicals available which do offer higher strength, up to 4,500 psi and higher temperature resistance properties, up to 815° F (435° C).

Another type of formulation is designed as a penetrating fluid with capillary action to wick into threads which have already been assembled. This allows for fine adjustments to be made, then are set in place by externally applying the chemical to the threads. This type of chemical will seal the threads and prevent corrosion.

Microencapsulated adhesives are excellent for placing them on the threads and storing the fasteners for later use. The adhesive is either painted on or dipped and remains non-tacky until use. Pressure between the threads and contact with metal creates an electrochemical bond. This is an excellent locking / sealer for threads being tightened into a tapped hole.

Many manufacturers will not apply these to their products due to liabilities. Companies who make up after-market kits will have fasteners with this adhesive on the threads. The chemical suppliers will also apply the adhesive at the request of purchasers.

Recently, there was an issue in an assembly plant where the second shift was breaking fasteners at assembly. Of course, the manufacturer and distributor were blamed. However, upon close investigation it was verified that both shifts were using the same fasteners, the same torque specifications and the same tooling. It was revealed that unknowingly, the second shift was using a different thread locking chemical than the first shift.



RTV silicone products are used as adhesives and gasket makers for many products; differential housings, valve covers, drive train, leak proof gaskets and sealants, etc. Operating temperatures range from 500° to 600° F (260° to 315° C).

The only problem with using these products around fasteners is to make sure the silicone does not get onto the threads of the fastener. It has been found that during tightening, the silicone product was being compressed between the threads and the applied torque was not actually causing the bolt to stretch and produce the proper clamping tension. The silicone compression was even fooling the torque-angle assembly machines, as the angle was met but not the torque nor the tension on the fastener. The compressed silicone made it appear that the fastener was being tightened into yield since there was no gain in clamp load as the fastener was turning to a specific angle.

With all of the chemical choices we have, make sure each one is compared with the properties applicable for its application. Once determined, keep the products consistent and have similar products kept in another location to avoid cross use with another assembly. Also, keep in mind that some chemicals will act as a lubricant and may significantly lower the installation torque value. Always perform a torque test before using a new chemical. ■