

LIQUID LOCKERS

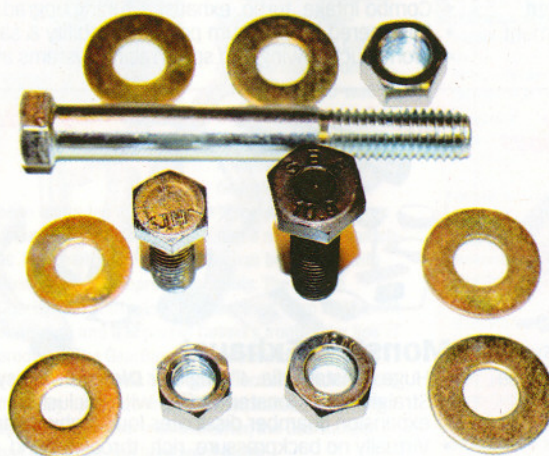
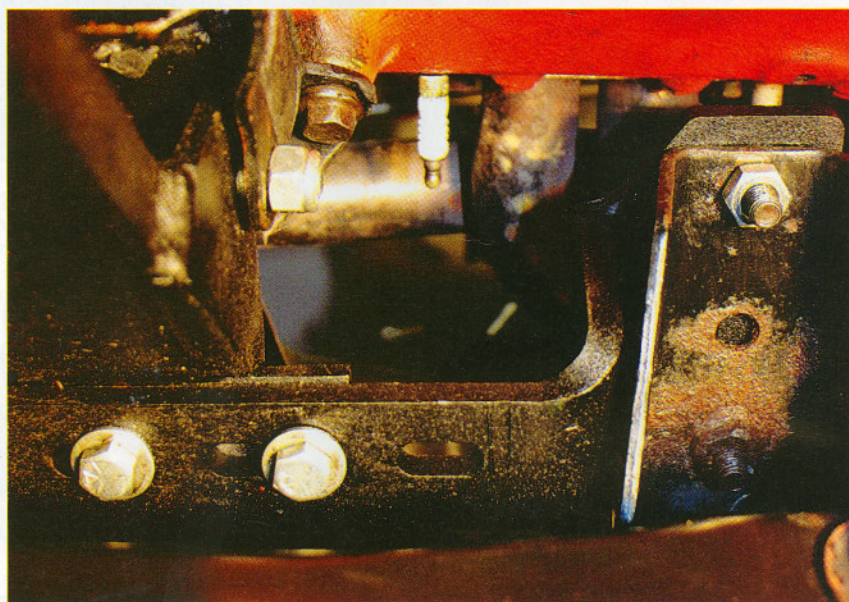
Threaded fasteners and threadlocking

By Andrew J. Newton

Photography: Andrew J. Newton

We'd come to love our Wrangler YJ. It had proven itself a likable and competent friend for family outings in the Adirondacks. Even my wife was beginning to understand this four-wheeling thing, having ignored my warning and burying the Jeep on the road to Otter Creek. She called me at camp for help, and I had to negotiate the trail in her mother's four-door Blazer to extricate the YJ. Heck, even her mother thought the whole thing was cool. It was with sentimental tears that I decided to sell the YJ to help fund the purchase of a TJ.

I had come across a half-completed TJ V-8 conversion project that needed a new home and seemed the perfect rig for our adventures. It ran and was driveable, but needed much buttoning up to be trailworthy. After all, this was someone else's idea,



Here are the new engine-mount fasteners. Grade 5 nuts and bolts, plus hardened flat washers for the Chevy side, and metric 10.2-grade hardware for the Jeep side. Lock washers are generally useless, while flat washers reduce friction and spread the force evenly. Find a hardware supplier who knows what he is talking about and has technical information on what he sells. Torque each bolt to specification based on fastener size and grade. Make sure you know whether it is a "wet" (oiled) or "dry" torque spec.

△ The previous owner had installed the engine. After careful inspection, it was apparent that everything had to be taken apart and reassembled. Why reuse a 30-year-old engine-mount-to-block bolt and then add a flat washer and a lock washer on top of the seated bolt head? Note the oversized washers and lack of washer on the engine-mount-to-frame-mount bolt, as well the unfilled gap between the parts. The gap will allow the metal to bend during torquing, thereby reducing tension in the bolt, and in a short time the metal will flex and fatigue, causing the bolt to quickly loosen. These errors exemplify what happens when you put a lot of money and effort into the big stuff and then cheap out on what keeps the whole thing together.



The Grade 2 flat washers had deformed during tightening. This deformation results in a false torque tension relationship and defeats the use of higher-grade bolts. Nylon insert nuts are good at keeping the nut from falling off but can easily loosen resulting in a loss of clamping force.

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started with great gusto, but the job was far from finished. No transfer-case linkage, no gauges, leaking a little here and there. Almost done, no big deal, right? Well, you know how it goes.

Once I had the TJ in the garage and took a close look, it became obvious I'd need to take a few steps back. Good intentions are not enough when you're talking safety, reliability, and money. The previous owner had put together the right parts: low-mileage TJ, small-block Chevy, TH400 tranny, Advance Adapters transfer case/transmission mount, engine mount, and headers. The problem was that all the parts had been assembled using questionable hardware and assembly methods in an otherwise stout drivetrain arrangement. So out came all the fasteners from the motor mount to the driveshafts. Every nut and bolt was scrutinized and replaced with the correct size and grade, then reassembled with a liberal dose of Loctite.

Hardware: What's the Big Deal?

The nut-and-bolt combination has two main functions: to provide a clamping force, and the ability to remove that force when required. The clamping force is generated through tension in the bolt, which occurs as the bolt stretches during the tightening process. Removing the force requires breaking the friction between the threads and allowing the nut to unscrew.

The amount of available clamping force is determined by the grade of fastener and how far it will stretch before losing elasticity. Generally speaking, Grade 5 is adequate for automotive applications. Sometimes, Grade 8 is used. Grade 2, typical of hardware-store bolt bins, is questionable for structural assemblies. Matching the material

Washers are sized to either USS or SAE standards. USS-sized washers have a larger ID than the SAE, sometimes too large for the bolt. Though harder to find, a good supplier will stock a wide variety of hardened SAE washers.



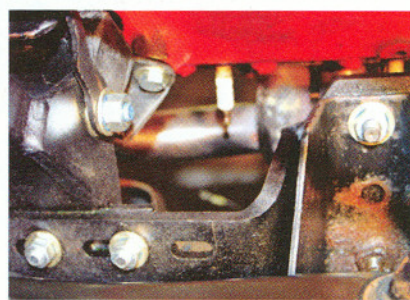
The new hardware was installed using removable threadlocker on all the bolts. Notice that the edge of the flat washer has been ground for clearance around a weld. If the flat washer does not seat correctly, the torque tension relationship will be askew. Threadlockers lubricate the fastener and reduce friction. Wet torque values should be used.

and size of the flat washer to the nut and bolt is very important. The key to a reliable bolted joint is generating adequate clamping force and then locking the nut in place to maintain tension in the bolt.

The chart on page 66 displays the SAE torque values of the most popular grades and sizes, which should help you decide what you need for any application. There are differences in torque values for bolts based on materials (high-carbon, copper, zinc, and so on) and construction (heat-treated, quench-tempered, case-hardened, and so on), so use this chart only as a ballpark estimate. Remember, too, that stronger is not always better, as some bolts are intentionally designed to fail before extreme torsional stresses can be transferred to other (more expensive) components.

Threadlocking: Keeping It All Together

Vibration and thermal cycling can cause a threaded fastener to come loose with sometimes devastating results. There are many mechanical devices designed to keep



A hardened flat washer was used to fill the gap between the engine mount and frame mount. The threadlocker will effectively hold the nut in place until you purposely break it free. The majority of the time, removable (blue) threadlocker is adequate. In severe vibration circumstances, permanent (red) threadlocker can be used. To disassemble the red, you need to heat the parts to 500 degrees for five minutes.



Here is the transmission-to-transfer-case adapter. The adapter is bolted to the transmission with hardened socket-head cap screws with a black oxide finish. You can't torque the cap screws too much, or you risk damaging the 30-year-old aluminum TH400 transmission case. Removable threadlocker from a stick was applied to the cap screw prior to assembly, and the bolt holes in the transmission were primed with 7649 since both the bolts and transmission case are relatively inactive surfaces. The cap screws were adequately snugged, and the threadlocker will ensure they won't back out.

a nut or bolt from coming apart. Some work, some don't. The split-ring lock washer is not very effective. Nylon insert nuts have been known to loosen just enough to reduce effective clamp force. The easiest way to ensure the nut stays put is through the use of a liquid chemical threadlocker such as Loctite.

The benefits of using a liquid threadlocker include preventing rust and corrosion and easy removal in the future through the use of force or heat. We've all been there before, fighting with that rusted or heat-seized nut or stud that refuses to come loose. Along with busted knuckles, the scene generally degrades to Vise-Grips, drilling, cutting, or torching. Threadlocker will minimize the aggravation factor.

Unitizing

Welding, bonding, or use of a rivet is a way of unitizing parts and preventing unwanted disassembly, without the benefit



of easy removal. A liquid threadlocker unites the nut-and-bolt assembly by filling the air space between the threads with a chemical resistant plastic.

Anaerobic Chemistry

Liquid threadlockers are anaerobic adhesives used on metal fasteners. The liquid cures to solid plastic in the absence of air. If you leave a puddle of threadlocker exposed to the air it will never harden. If you remove all the air, such as between two parts, the liquid will solidify. The presence of active metal such as copper or steel will speed the cure, while inactive metals such as stainless steel or cadmium plating cure slowly and may need to be primed. Loctite 7649 Primer N is a copper-filled spray that is applied to inactive surfaces to ensure cure, speed the cure, and cure to greater depths.

What to Choose

Threadlockers are formulated for different removal strengths: 222, or purple, is low strength designed for use on small fasteners that allow disassembly with a screwdriver; 242, 243, and 248 are blue, medium strength and can be removed with handtools; 262, 271, and 268 are red and considered permanent, designed to withstand tremendous removal forces; 220 low strength and 290 medium strength are wicking types designed for post-assembly application; and 272 is a high-temperature permanent version that withstands temperatures up to 450 degrees. By comparison, most other grades of threadlockers withstand temperatures of 300 degrees.

Why Not?

OEM's have used threadlockers for years. They are dependable, provide predictable removal, and are easy to use. Understanding the properties of your fastener is the first step in achieving maximum performance. Utilizing a liquid threadlocker takes it to the next level through maximum reliability. In most instances, these gas-, oil-, and chemical-resistant threadlockers are well worth the few cents it costs per application.

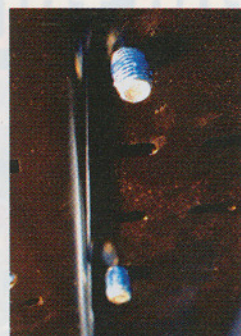
SAE Max Torque Values (lb-ft)

Bolt size (in.)†	Grade 2*	Grade 5*	Grade 8*
1/4 - 20	6	10	14
5/16 - 18	12	19	29
3/8 - 16	20	33	47
7/16 - 14	32	54	78
1/2 - 13	47	78	119
9/16 - 12	69	114	169
5/8 - 11	96	154	230
3/4 - 10	155	257	380
7/8 - 9	206	382	600
1 - 8	310	587	880
1 1/8 - 7	480	794	1,430
1 1/4 - 7	675	1,105	1,975
1 3/8 - 6	900	1,500	2,650
1 1/2 - 6	1,100	1,775	3,200
1 5/8 - 5 1/2	1,470	2,425	4,400
1 3/4 - 5	1,900	3,150	5,650
1 7/8 - 5	2,360	4,200	7,600
2 - 4 1/2	2,750	4,550	8,200±

†Coarse thread per inch

*Minimum tensile strength

Grade 2= 74,000 psi, Grade 5= 120,000 psi, Grade 8= 150,000 psi



A used skidplate had to be sourced, as the original unit had been pretty well butchered because the new transmission mount sent two large bolts through a contoured section of the plate. The washers were angled on the contour, and holes had been cut with a torch for clearance.

Modifications were made to the transmission/transmission-mount positioning the bolts through a flat part of the replacement plate. Fastener length was critical for ground clearance and required sourcing both 2.5- and 2.75-inch bolt lengths. A removable threadlocker stick worked well and did not drip.



The OEM skidplate bolts had begun to rust-seize. In the East, winter driving will cause severe corrosion, making fastener removal very difficult. Threadlocker will seal the mated threads and prevent rust seizing.



The transfer-case studs were slid into the adapter, and 243 liquid threadlocker was applied to each stud. Enough threadlocker was applied to fill the cleaned threads at the point where the nut will reside. The nuts were then torqued to the OEM specs listed for the stock NPG231 case and the excess liquid wiped away. **FW**

Liquid Threadlockers

No.	Type	Color	Form	Use
220	Low strength	Purple	Liquid	Wicking grade for small pre-assembled fasteners
222	Low strength	Purple	Liquid	For fasteners under 1/4 inch
242	Removable	Blue	Liquid	General purpose, easy removal
243	Removable	Blue	Liquid	Oily fasteners, cures faster, remove with handtools
248	Removable	Blue	Stick	Paste, won't run or drip, remove with handtools
262	Permanent	Red	Liquid	Fasteners under 3/4 inch, remove with heat
271	Permanent	Red	Liquid	Fasteners over 3/4 inch, remove with heat
268	Permanent	Red	Stick	Paste, remove with heat
272	Permanent	Red	Liquid	Withstands 450 F, remove with heat
290	High strength	Green	Liquid	Wicking grade, may require heat to remove, seals welds
7649	Primer	Lt. Gn.	Spray	For inactive surfaces, speed the cure, cure deep gaps, 30-day on part life