NORTHSTAR CHEVELLE CLUB

MINNESOTA'S '64 - '87 CHEVELLE and EL CAMINO CLUB™

November 2013

President: Stan Shinker
Vice President: Tom Brokaw
Treasurer: Mike Sabby
Webmaster: John Delke
Secretary: Chris Reid
Events: Chad & Shawna Linkert
Newsletter: Bryan Flattem
Merchandise: Craig Savina

As I write this, I have seen snow fall for the second time in 2 days. The last car show of the season was a bust for me, and it's time to put the car away for another season of projects. I'm a little depressed since the Frankensteiners show is such a big event and so many unique vehicles (to be read as: cars, trucks, zambonis, and uhhhh "kustoms") attend. This year, just over 500 total participants made it. Why less than half of a normal year's attendance? Rain, sleet, then snow. In fact, the forecast was so bad that our October meeting there was cancelled. Even after the skies dried up, it stayed cold and sloppy. Highlights included a 2500hp 1963 Valiant, a pair of Franken-dually trucks on Combine tires, and a pretty hot fire-throwing contest.

So, what's there to look forward to in the next few months? For me, it's attending SEMA again this year followed by a pretty cool upgrade to the fuel-management system of my Chevelle. If time and dollars permit, I also plan on saying goodbye to the factory shifter and console and welcoming in a cool custom setup. Don't forget that we do have a very important club meeting in November which will be held at the Tin Shed in Savage-just east of hwy 169 on Hwy 101. Please read the letter from Stan at the end of this newsletter.

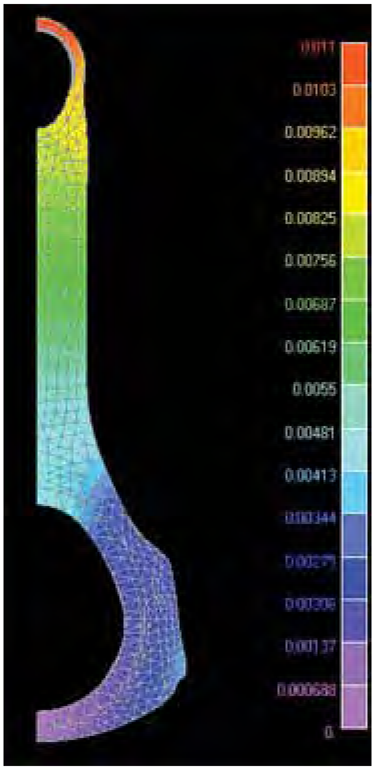
Tech time: Bolts and design factors (reprinted from the ARP website)

Design Procedures for Automotive Bolts

The design of automotive bolts is a complex process, involving a multitude of factors. These include the determination of operating loads and the establishment of geometric configuration.

Fastener Load

The first step in the process of designing a connecting rod bolt is to determine the load that it must carry. This is accomplished by calculating the dynamic force caused by the oscillating piston and connecting rod. This force is determined from the classical concept that force equals mass times acceleration. The mass includes the mass of the piston plus a portion of the mass of the rod. This mass undergoes oscillating motion as the crankshaft rotates. The resulting acceleration, which is at its maximum value when the piston is at top dead center and bottom dead center, is proportional to the stroke and the square of the engine speed. The oscillating force is sometimes called the reciprocating weight. It is seen that the reciprocating weight depends on the square of the RPM speed. This means that if the speed is doubled, for example, the design load is increased by a factor of 4.



Other Stresses

It must be realized that the direct reciprocating load is not the only source of stresses in bolts. A secondary effect arises because of the flexibility of the journal end of the connecting rod. The reciprocating load causes bending deformation of the bolted joint (yes, even steel deforms under load). This deformation causes bending stresses in the bolt as well as in the rod itself. These bending stresses fluctuate from zero to their maximum level during each revolution of the crankshaft.

Geometric Configuration

The next step is to establish the details of the geometric configuration. Here the major consideration is fatigue, the fracture that could occur due to frequent repetition of high stresses, such as the bending stresses described above. Several factors must be considered in preventing fatigue; attention to design details is essential.

Stress Riser Elimination

Fatigue failure is frequently caused by localized stress risers, such as sharp corners. In bolts, this would correspond to the notch effect associated with the thread form. It is well known that the maximum stress in an engaged bolt occurs in the last engaged thread. By removing the remaining, non-engaged threads, the local notch effect can be reduced. This leads to the standard configuration used in most ARP rod bolts: a reduced diameter shank and full engagement for the remaining threads. Providing a local fillet radius at the location of the maximum stress further reduces the local notch effect. Thus this configuration represents the optimum with respect to fatigue strength.

The reduced diameter shank is helpful in another sense. It reduces the bending stiffness of the bolt. Therefore, when the bolt bends due to deformation of the connecting rod, the bending stresses are reduced below what they would otherwise be. This further increases the fatigue resistance of the bolt. A typical bolt configuration is shown.

Engineering the Manufacturing Process

Once the bolt configuration has been established, the manufacturing process comes into play. This involves many facets, which are discussed in detail elsewhere. Here, however, one process is of primary interest. With respect to bolt fatigue strength, thread rolling is a major consideration. Threads are rolled after heat treating. This process, which deforms the metal, produces a beneficial compressive stress in the root of the thread. It is beneficial because it counteracts the fluctuating tensile stresses that can cause fatigue cracking. If heat-treatment were to occur after rolling, the compressive stresses would be eliminated. This would therefore reduce the fatigue resistance of the bolt.

Engaged Thread

An additional factor must be taken into account in defining the bolt configuration: the length of engaged thread. If too few threads are engaged, the threads will shear at loads that are lower than the strength of the bolt. As a practical matter, the thread length is always selected so that the thread shear strength is significantly greater than the bolt tension strength.

This problem is especially important in bolts used in aluminum rods because of the fact that the shear strength of aluminum is much lower than the shear strength of steel.

Pre-Load

Finally, although not a design parameter, the subject of bolt installation preload must be addressed. It is a fundamental engineering concept that the force in a bolt in an ideal preloaded joint will remain equal to the preload until the externally applied force exceeds the preload. Then the force in the bolt will be equal to the external force. This means that fluctuating external forces will not cause fluctuating forces in a preloaded bolt as long as the preload exceeds the external force. The result is that fatigue failure will not occur.

In a non-ideal joint, such as in a connecting rod, the bolt will feel fluctuating stresses due to fluctuating rod distortions. These are additive to the preload, so that fatigue could result. In connecting rods, precise preloads are required because if they are too low, the external forces (the reciprocating weights) will exceed the preloads, thus causing fatigue. If they are too high, they provide a high mean stress that combines with the fluctuating stresses due to rod distortion. Again, fatigue is promoted. The objective, then, is to preload a bolt so that it just exceeds the external load, and no higher.

To sum up: both insufficient preloads and excessive preloads can lead to fatigue failures.

Installation and Other Factors

Appropriate preloads are specified for each ARP bolt. These preloads can be attained in a connecting rod by applying proper torque using a torque wrench or by measuring the amount of stretch in the bolt using a stretch gauge (it is known that a bolt stretches in proportion to the tension in it). The torque method is sometimes inaccurate because of the uncertainty in the coefficient of friction at the interface between the bolt and the rod. This inaccuracy can be minimized by using the lubricant supplied by ARP.

Other factors, equally as important as design, include material selection, verification testing, processing, and quality control. These aspects of bolt manufacturing are discussed elsewhere in this document.

The foregoing discussion concentrated on the design of bolts. The same considerations apply in the design of studs.

Fastener Installation Overview

The importance of tightening fasteners to their required preload cannot be emphasized enough. If a fastener is not tightened properly, the fastener will not apply the required preload on the application it is being used for and may become susceptible to failure. Conversely, if a fastener is overtightened and stretched too much, it becomes susceptible to failure by exceeding it's maximum yield point. There are three generally accepted methods employed to determine how much tension is exerted on a fastener:

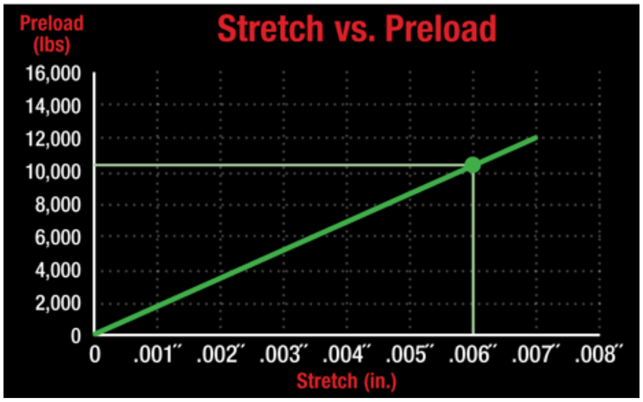
*Using a torque wrench

*Measuring the amount of stretch

*Torque angle (rotating the fastener a predetermined amount)

Of these methods, measuring the amount of stretch of a fastener has been proven to be the most accurate. However, since stretch can only be measured with the use of specialty type gauges or expensive ultra sonic measuring equipment, it is only practical for measuring the stretch on connecting rod bolts and other fasteners, where it is possible to monitor the overall length of a fastener, as it is being tightened. Since most fasteners are installed blind and can't be accessed from both ends to monitor stretch, one will most likely use a torque wrench or other torque angle monitoring device for the majority of assembly work.

The Stretch Factor



It is important to note that in order for a fastener to function properly it must be "stretched" a specific amount. The material's ability to "rebound" like a spring is what provides the clamping force. If you were to simply "finger-tighten" a bolt there would be no preload. However, when you apply torque or rotate a fastener a specific amount and stretch it, you will be applying clamping force. The amount of force or preload you can achieve from any bolt or stud depends on the material being used and its ductility, the heat treat, and the diameter of the fastener. Of course, every fastener has a "yield" point! The yield point or yield strength of a fastener is the point at which the fastener has been overtightened and stretched too much, and will not return to its original manufactured length. As a rule of thumb, if you measure a fastener and it is .0005″ (or more) longer than its original length it has been compromised and must be replaced.

Another factor that must be considered is heat! Heat, primarily in aluminum, is another problem area. Because the thermal expansion rate of aluminum is far greater than that of steel it is possible to stretch a fastener beyond yield as the aluminum expands under heat. An effective way of counteracting material expansion is through producing a more flexible bolt.

Using a Stretch Gauge

We highly recommend using a stretch gauge when installing rod bolts and other fasteners, where it is possible to measure the length of the fastener. It is the most accurate way of measuring preload of any bolt. Simply follow manufacturer's instructions, or use the chart in the our catalog for ARP rod bolts.

When using a stretch gauge it's best to measure the fastener prior to starting and monitor overall length during installation. When the bolt has stretched a specified amount, the correct preload or clamping force has been applied. We recommend that you maintain a chart of all rod bolts and make a note of the fastener length prior to installation and after any disassembly. If there is a permanent increase of .0005″ or more in length, there is a deformation and the bolt should be replaced.

Using a Torque Wrench

There are a number of things to consider when using a torque wrench. The "friction factor" changes from one cycle to the next. That is, friction is at its highest value when the fastener is first tightened. Each subsequent time the fastener is torqued and loosened, the amount of friction lessens. Eventually the friction levels out and becomes fairly consistent for all following repetitions.

Three basic elements that contribute to the friction factor:

Most importantly - The fastener assembly lubricant

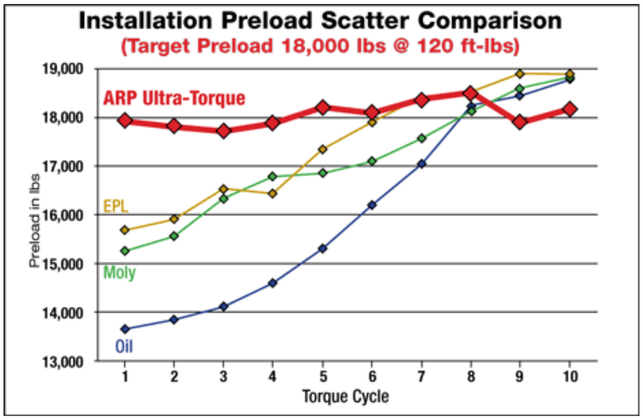
The condition of the receiving threads

The surface finish of the fastener

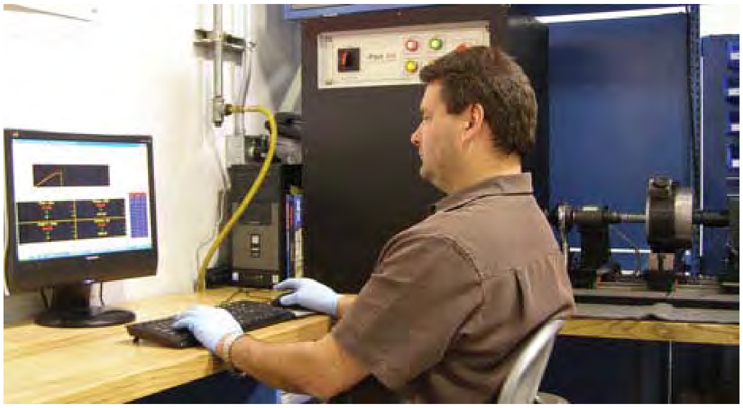
Because of these variables, a phenomenon known as "preload scatter" or preload error occurs. This is basically the difference between the amount of preload achieved on the first installation of the fastener and the amount of preload achieved on subsequent torque/loosen/re-torque cycles. It's not uncommon to see "preload scatter" in the range of 4,000-8,000 pounds between the first and tenth pull on a new fastener depending on the lubricant used.

The Lubricant is the Key

The main factor in determining friction in a threaded fastener is the lubricant used, and therefore influences the torque required for a particular installation. One of the most overlooked aspects of choosing a fastener assembly lubricant is…the lubricant's ability to "control" the normal function of friction inherent in all high performance engine fasteners. As discussed earlier in this section, friction is at its highest point when a new fastener is first tightened. This "friction" inhibits the fasteners ability to achieve the required preload on the first several cycles. In fact, ARP's in-house Research and Development department has proven that new fasteners using motor oil and other commonly used lubricants such as Moly and EPL typically require 5-7 cycles before final torquing to level out the initial friction and achieve the required preload. Slicker lubricants may reduce the required torque by as much as 20-30% to achieve the desired preload, but compromise in areas of major importance such as preload repeatability, and may yield the fastener prematurely. Typically, the slicker the lubricant, the greater the "preload scatter" or preload error there will be during installation.



The bottom line: Preload repeatability and preload consistency from a fastener to fastener perspective, should be the number one consideration when choosing a fastener assembly lubricant. Remember even the best fastener is only as good as its installation. Preload repeatability is the foundation for maintaining round housing bores, and preload consistency ensures the same preload from one fastener to another across a large area, such as the deck surface of a cylinder block. These two fundamentals are the cornerstone of every successful fastener installation and that's why ARP's engineering team set out to develop the "ultimate" fastener lubricant. The result of several years of extensive R&D is a remarkable new assembly lube called ARP Ultra-Torque®. As shown in the graph above, ARP Ultra-Torque® clearly provides the repeatability and preload consistency that no other fastener assembly lubricant on the market can provide today.



Fastener Surface Finish and Condition of Receiving Threads

In addition to the lubricant used, friction is affected by the surface finish of the fastener itself and the condition of the receiving threads. For example, black oxide behaves differently than a polished fastener so it's important to follow the torque recommendations with each fastener kit. Then there's the very real problem of burrs and debris in the bolt holes that can significantly affect the amount of torque required to achieve the recommended preloads. All bolt holes should be thoroughly cleaned using special "Chaser Taps" to optimize the threads before installation.

Torque Wrench Accuracy

It is possible for even the most expensive torque wrenches to lose accuracy over time. Rough use or repeated loosening of fasteners using your torque wrench as a "breaker bar" will exacerbate the loss of accuracy. In fact, ARP field technicians have seen a wide range of torque wrench reading errors as much as 15-30%. This just emphasizes the importance of treating torque wrenches with the utmost of respect and having them checked periodically for accuracy.

The Torque Angle Method

Since the amount that a bolt or nut advances on the thread per degree of rotation is determined by the thread pitch, it would appear that any amount of stretch in a given bolt or stud can be accurately predicted be measuring the degrees of turn from the point where the underside of the bolt head or nut face contacts the work surface. Termed the "torque angle" method, this procedure has long been the standard of civil engineering. It has been suggested that torque angle is a relatively simple and valid procedure to use in "blind" installations—where it is not possible to physically measure the actual bolt stretch.

ARP has conducted extensive evaluations of the torque angle method, and concluded that – for high performance engine applications – it is suitable only when calibrated for each installation.

Our investigation has proven that installed stretch is dependent not only on the pitch of the thread and the degree of rotation, but also on the amount of compression of the clamped components, the type of lubrication, the length of the male fastener, and the amount of engaged thread. It's important to note that for the same degree of rotation, the amount of bolt stretch will be critically different between an aluminum or cast iron cylinder head, or when installing a steel main cap on a cast iron or aluminum block. Furthermore, there is a significant difference in stretch between the long and short cylinder head bolts or studs on the same head. The torque angle method can be accurate – but only if each individual application has been previously calibrated by direct measurement of bolt stretch. If you do employ the torque angle method, it's best to begin calibrating rotation from some small measured torque rather than the first point of contact with the work face. To achieve optimum accuracy, always use ARP Ultra-Torque® fastener assembly lubricant whenever possible.

Next month, we'll get into metallurgy,

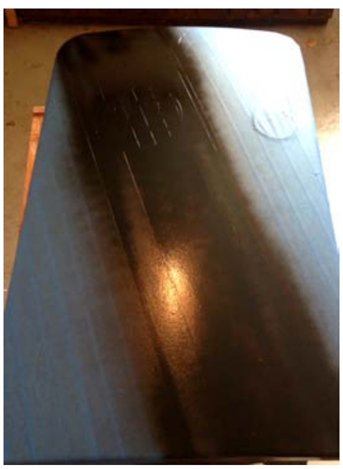
materials, and common failures.

Cool Project: Hot Rod garage Fridge

A few months ago on our club forums, I briefly mentioned an upcoming garage project. Last spring, I was searching Craigslist and found an ad for an old 1951 Frigidaire that ran for $60. It was only a few blocks from work and I stopped by to check it out. It was in good shape, but hadn't been plugged in for a while. We plugged it in while I was checking it out just so I knew it would run and get cold. The body was good, though it needed a thorough cleaning from being kept in the home's dirty motorcycle repair garage for years. The door was solid and the seal was still decent. The latch held tight and there was a little character to the shape. After about 10 minutes of looking, I went home to get my trailer. When I got it home, the fun began. I took it apart for cleaning and paint prep, and that's where the fun began.

I spent a month or so working out different paint schemes. I wavered between solid colors, different stripe themes, having one of those wrap things made up, and even a pretty cool '55/'56 Chevy 2-tone design. I finally turned the corner at the Car Craft show while looking through one of the vendor trailers. I saw a 4 speed shift knob and thought how cool it would be if the pull-down handle was a shifter. By the end of the day, I knew what I wanted and Scott Parkhurst volunteered an almost new genuine Hurst shifter arm and knob to the cause.

Fast-forward to post-clean up, prep and painting time. I have a siphon feed paint gun I bought for painting my engine compartment, and I figured it would work well here too. I picked up a quart of cherry red enamel from Menard's and did a final wipe-down of the case. After a light pass over the entire thing, I came back in about 20 minutes to re-shoot a little heavier coat. Little did I know (but probably every else did), that you can't really do that without creating some nasty runs. In simple terms, it turns out the solvents in the enamel start evaporating so the paint can set very quickly and when the second wet coat is applied, it starts to "eat" the first coat. I let it dry, then tried to cut out and fix just the runs. The short version is that I ended up wet sanding the ENTIRE fully cured enamel paint job by hand to try and fix everything I had done. Next was a guide coat of black to then re-sand so I could find the high and low spots, followed by several spot shots of primer filler. After re-applying the cherry red (moderately successfully with a foam roller this time), I let it sit for a week to cure and try to figure out the exact layout for the second coloring.

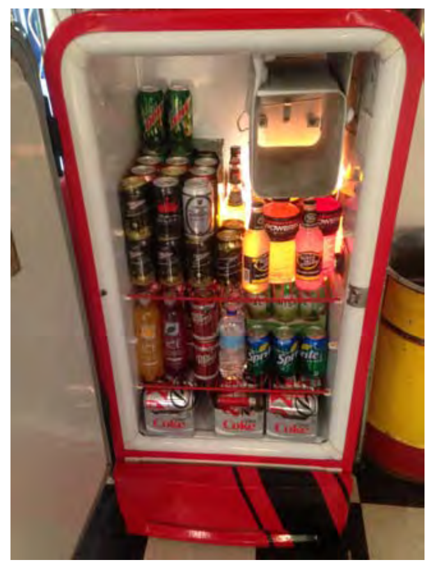


While working on designs, I kept coming back to a fairly traditional 2 color design with a simple white circle and number. After a little computer mocking up, it just looked too much like a Coke-inspired fridge instead of an Italian racer. Ready to completely re-think things, I walked out to the garage to look at it again. Before I could even get through the doorway it hit me: I had changed the Chevelle to red with black and it looked so different, what would the fridge look like with black instead of white? Taking the circled number one step farther, I added a little attitude with some stripes and number style.

Once painted, I still had one significant modification to make: How to attach the shifter and still make the latch mechanism work? The original design was quite simple: pull down on handle, the part below the pivot pushes in on a button which then releases the latch. A spring returns the lever back into position. I thought I could just re-use one of the Hurst mounting holes and voila`, but no. The angle of the lever and total length wasn't going to allow that. After some second and third guessing, I grabbed a sharpie, made a mark and hit the chop saw. Sometimes you need to just do it. With the length more appropriate, I saw that the latch button prevented the arm from being anywhere but pushing the knob onto the door. I notched the arm so it

could have a nice resting position and still have travel. The return spring just needed a slight tweak and it was all set, except it wanted to force the arm too far. Luckily, I found that I could trim the pivot mechanism cover enough to use that as a return stop and cure the issue.

The last obstacle I ran into was a simple fix caused by some lack of foresight. The original pivot was a mushroomed pin that went though the mounting base, the lever and the spring. I had been using a small machine bolt in it's place thinking that I could just trim it short and throw a lock nut on it. At the final assembly, I had the painted cover in place and realized that the cover was just wide enough to clear the main base. I looked at rivits, but I didn't have any long enough, and I figured disassembly might also be necessary later, so I looked at cotter pins. There was enough room for the tip side to clear, but the head would protrude. I ended up putting the cotter pin into a vise and tapping the head down to make a T or nail head. Upon reassembly, everything fit well and with a slight latch adjustment, it's worked well for almost a month now.



Another letter from the Prez...

As has been noted via email and on the forum, the Nov. NCC Meeting is the club Officer nomination and election meeting. Many of the current Officers have decided to not run again for next year. It is CRITICAL that other members step up and take the reigns, or the club WILL go back to being an internet only social group.

This is your chance to give back, or pay it forward for the club and the membership. Like a lot of clubs, there are a core group of people that are the ones doing a large portion of the work, and being an Officer has rotated through that group, and it's time for some new blood to take the reins and keep us going.

Don't feel like you will be in it alone if you step up. All the past Officers, and other members are willing and able to help during the transition, and getting things started, myself included. If you have ANY interest in becoming an Officer and would like to discuss it further, please contact any of the current officers (John D., Tom B., Mike S., or Chris R.), and they can discuss it with you, and potentially nominate you as well.

PLEASE step up and take action now!

Thank you, Stan