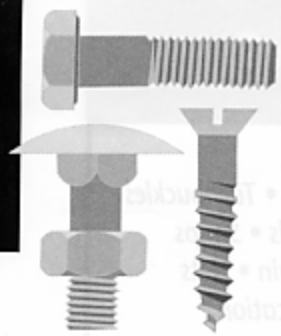


Torque Wrench Know-How Can Be Valuable To Fastener Suppliers

by Joe Greenslade

The discussion of torque comes up frequently for fastener suppliers. It is generally discussed between fastener suppliers and end users in the following two instances: 1) when the user is looking for guidance on how much torque to apply when installing a part they start buying or, 2) when a supplier is trying to determine if a user is applying too much torque in fasteners that are reported to be failing.

Torque is the force which causes an object to rotate about its axis. The application of torque is used during the installation and removal of all threaded fasteners. In the inch system torque is expressed in inch pounds or foot pounds. In the metric system torque is expressed in newton meters. A conversion chart for these units follows:

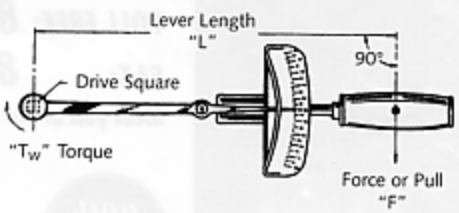
INCH SYSTEM	METRIC SYSTEM
1 inch pound	.11 newton meters
1 foot pound	1.4 newton meters
8.8 inch pounds	1 newton meter
.7 foot pounds	1 newton meter

TORQUE DISCUSSION SCENARIO #1:

When customers ask what torque values should be used in a given application for tightening a given fastener, the supplier has four options:

1. He can say, "I don't know."

TORQUE LAW



2. He can refer to one or more of the torque charts that are available from various sources.
3. He can calculate a value for the customer using the standard formula "T=PDK" (torque = pounds of stress × bolt diameter × K factor).
4. He can perform a simple torque analysis for the customer and provide the customer with the findings.

The first option ("I don't know.") is used by many fastener suppliers who are not providing their customers with any value-added technical support. This is the least desirable approach if the supplier wishes to establish a long-term relationship.

The second and third options are somewhat beneficial to the customer, but both the supplier and the user should understand that all of the available charts and the formula, T=PDK, provide just crude estimates of what torque should be applied. This is so because the formula and the charts derived from its use are based on the use of estimated "K factors," which are far from precise. Use of these charts and the formula are much better approaches than not establishing a torque value at all, but the fact remains that these values are very unlikely to be the "ideal" value for the customer's specific application.

The fourth option is, by far, the most beneficial approach for both the supplier and the user. In this approach, the supplier first obtains 10 to 25 sample applications from the customer and tightens the specified fasteners with a calibrated torque wrench until the application fails, bolts break, threads strip, etc. The torque failure value and mode of failure for each sample is recorded.

The failure values are then averaged and the suggested tightening value for this specific application is 57% to 65% of the failure average. This suggested range is based on the long-accepted tightening principle of stressing a bolt to 75% of its yield strength. The yield strength of most fasteners falls between 77% and 86% of the part's ultimate tensile strength. The chart on the next page shows these calculations.

If twelve 1/4-20 grade 5 bolts are broken in a customer's application at an average of 21 foot pounds, the suggested target tightening value for that particular style and type of bolt in that specific application would be 12 foot pounds.

It is important that the user understand that if anything changes in the application, this analysis should be done again to evaluate the effect of the change. The targeted value could change dramatically by any of the following application changes:

- Bolt finish
- Bolt grade
- Bolt head style
- Washer hardness and/or finish
- Surface finish of components
- Surface angularity of components
- Hardness of component material

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Joe is an inventor, author, and lecturer. He holds eleven U.S. Patents, has written over 80 technical articles for industrial trade journals, and has spoken frequently at trade association meetings and technical conferences on issues related to industrial quality for the past ten years.

He is an Associate Member of the Industrial Fastener Institute and a member of the American Society of Mechanical Engineers B1 Thread Specification Committee. In 1992, Joe was recognized for his technical and innovative contributions to the fastener industry when, at age 44, he became the youngest person to be inducted into the National Industrial Fastener Show "Hall of Fame."

SAE Grade	yield KSI/ tensile KSI	percentage: yield/tensile	Targeted stress: 75% of yield	Targeted stress as a % of tensile strength
2	57/74	77%	75%	58%
5	92/120	76%	75%	57%
8	130/150	86%	75%	65%

TORQUE DISCUSSION SCENARIO #2:

The second situation in which the fastener supplier and user get into a discussion of torque values is when the customer complains of failing fasteners. The supplier should immediately review the quality records of the parts in question and possibly again subject the parts to the applicable tests. In at least four out of five cases the fasteners will prove to be within specification so other possible reasons for the failures must be examined.

It is known fact that the majority of all fastener failures are the result of improper installation and not fastener quality. Tactfully and professionally explaining this to the complaining customer is highly important, because a customer usually is not interested in hearing that he might be at fault. In many situations, the customer believes the supplier is simply trying to shirk his responsibility.

The way to professionally handle this is to say to the customer, "I am a little confused at this point. After we reviewed the quality data associated with these parts and have re-tested the parts, they appear to be in compliance with the applicable specifications. I would like to ask a few questions and maybe do a little analysis of the application for you to see if we can get to the bottom of this for you."

At this point, the following questions should be asked:

1. What torque value is specified for tightening these parts?
2. What means do you use for insuring this value is used?
3. Can we go to the point of installation and observe the operation and possibly do some simple torque analysis?

The answers to these questions will generally head the supplier and user in the direction of the true source of the fastener failure.

Frequently the user will not have a torque value specified. They just "tighten them until they are tight." It is obvious if they do not have a specified value the amount they are tightening may be too great for the given parts in this application, but this must be tactfully demonstrated.

Frequently the user will have a torque value specified that appears, from charts and calculations, to be reasonable, but further examination will indicate there is no means of insuring that the specified value is what is applied. The user may not have torque-controlled installation tools or they do not audit the torque value in some means after installation, such as using a torque wrench.

Ever though the user states he has torque-control and/or audits the torque, when the operation is observed first-hand it is learned the tools and/or audit procedures are not being followed and excessive torque is being applied.

If a fastener supplier owns and knows how to use torque wrenches properly, they can be very professional in the analysis of fastener failure problems. Even if the user states they have a reasonable torque specification, has torque-controlled installation tools, and audits the torque periodically after installation, a simple torque review of a supplier using a torque wrench properly can show that an inappropriate torque is actually being applied to the parts in the assembly.

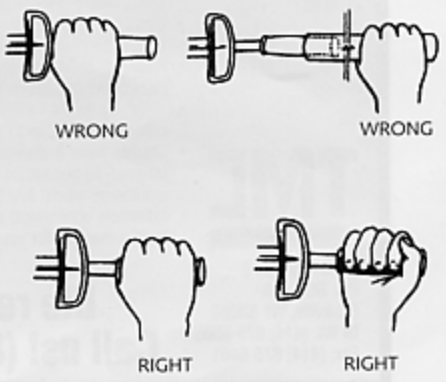
The simple method of analysis is for the supplier to place a torque wrench having the correct range on the parts in question and applying torque in the tightening (clockwise) direction. The value at which the part first rotates must be observed and recorded. The observed value is approximately the torque value to which the parts were initially seated.

This simple audit should be done on 10 or more assemblies to be able to see a range and an average rather than only one value. It may be discovered that the applied torque is not always wrong, but rather, the tightening is inconsistent with only some parts being inappropriately tightened.

TORQUE WRENCH BASICS

Using a torque wrench properly is simple. A torque wrench is based on the fundamental mechanical principle of the lever. It is an indicator of how much force is exerted at the point of rotation when a force is applied to a lever of a precise length. To be exact ,when one pound of force is exerted against a torque wrench having exactly a one foot long lever length the torque is equal to one foot pound.

All laboratory grade torque wrenches have a handle design which indicates where the force must be applied for the wrench's reading to be correct. The handles usually have a pivot, a line or band, or a grip type handle that just fits the hand. As long as the user of the wrench applies the force at the correct point on the wrench the indicator on the wrench will be accurate. Those who "choke-up" (shorten) on the lever length



and those who apply "cheaters" (lengthen) the lever length destroy the precise lever principle and the indicated value on the wrench is meaningless.

When a fastener supplier uses torque wrenches to help a customer decide what torque to use in their application or when he use the wrenches to "problem solve," the supplier should always use calibrated, laboratory grade wrenches with some type of memory needle device.

Fastener suppliers who own torque wrenches and know how to use them can benefit themselves and their customers by supplying logical assembly advice and by professionally discovering the causes of fastener failures. Having this simple, relatively inexpensive capability can make a supplier stand out from the crowd. Customers need help and those who are capable of supplying that help in a professional way differentiate themselves in a very positive way. This is an important ingredient in developing long term, profitable relationships. ■