Selecting the Correct Assembly Tool for Fasteners

by Guy Avellon

Using the wrong power tool by the assembler can cause many fasteners to fail. There are several new types of nut runners and socket drivers on the market that have a wide range of power and torque output options. Having too much torque can cause unwanted failures.

Modern assembly plants use the more sophisticated power tools than those used in maintenance. Most of these tools are digital and will indicate the sequence and pattern to tighten the bolts as well as the torque applied. For example, if #2 bolt is missed in a programmed sequence, the tool will not allow the #3 fastener to be tightened until the #2 fastener is tightened first. This is a well-designed program of sequence tightening for multiple fasteners in a connection.

Automotive assembly lines use these types of tools as well as gang nuts or socket runners. This is where several sockets are attached to multiple bolts in the assembly at the same time, such as head bolts on an engine or wheel nuts, then slowly torque all down at the same time. This reduces elastic rebound on critical part assemblies.

Nut runners and powered screw drivers are power assisted tools driven either by pneumatic or electrical energy. The nut runners produce low torque that can be very accurate. These are used to tighten nuts, flanged head screws and small socket head fasteners below ½" or 12 mm on sheet metal parts.

///// DC Electric Tools /////

Many earlier nut runners were corded but the DC powered battery tools are more portable and ergonomically easy to use in tight areas.

The more sophisticated DC electric tools are programmable, stores multiple torque values, has a data base used for error-proofing and some models will have linear translators for x-y positioning.

The more common and less expensive DC power tools are powered by 20 volt rechargeable Lithium batteries. These tools are mostly used by contractors and maintenance and the majority of which are not adjustable for output speed. If the user is not careful, the heads of small screws can easily become twisted off, such as deck screws and wood screws. If the user is tightening deck screws, etc. with a ½" 20v drill body, there could be many failures.

Comparing the specifications of different well known manufacturers; one ½" drive 20v power tool has an RPM range of 400-1200-1900 and delivers initial impacts of 700-1200 lb-ft of torque, another will deliver 600 lb-ft of torque but only 330 lb-ft initial torque adjustable in pre-set ranges from 0-900-2,000 RPM.

Other models will provide their torque output in inch-pounds, such as 1825 lb-in (152 lb-ft.) or 1400 lb-in (116 lb-ft). There are even ¼" drive 12v models which produce 1300 lb-in (108 lb-ft) that are very adequate to do the job quickly and efficiently for smaller fasteners.

Nutrunners

Torque wrench

Impact wrench

///// Pneumatic Power Tools /////

Most pneumatic power tools are commonly known as impact wrenches. These are air driven power tools which produce repeated output blows on an output anvil. The ½" drive models are commonly used in automotive repair shops, truck shops for glider kit (frame) building and tire mounting shops. Some larger models are used to tighten large bolts up to 1 ½" (38 mm).

The advantages of pneumatic power tools are their high torque and high speed. A ½" drive medium duty air driver will produce 600 lb-ft of torque at 7,300 RPM with 1,000 beats per minute (BPM). This is enough torque to destroy any Grade 8 bolt up to 7/8". The ½" Heavy Duty model will produce 650 lb-ft of torque at 7,500 RPM with 1,100 BPM. There are some older models which produce 450 lb-ft of torque.

A ¾" drive air impact wrench will produce 1,000 lb-ft of torque at 6,200 RPM with 750 BPM. On the smaller side, the 3/8" air ratchet will produce 65 lb-ft of torque.

The disadvantage of pneumatic power wrenches is that there are no torque controls on the more common and less expensive models. The output is inaccurate and can change while using. There are more expensive models that can adjust the output torque. The advantage is power and speed for larger fasteners and for removing rusty, old bolts.

The air supply for these power tools comes from a generator which compresses air into a storage tank. The air is held at a certain pressure, usually around 115-120 pounds-per-square-inch (psi). When the air tool demands power, the compressor tank delivers the air at the stored pressure. The pressure will naturally drop while being used to a pre-determined amount, usually around 90 psi, at which point the compressor starts up again to regenerate the pressure to 120 psi.

It should be noted that tightening several fasteners at this time will result in unequal assembly torques. If another air tool or vehicle lift is operated at the same time, the pressure drops more rapidly and the torque disparity is even greater. Larger shops will probably employ the industrial heavy duty two-stage compressor that will keep more of a constant pressure than the common single stage shop compressor.

///// Torque Wrenches /////

Torque wrenches are available in two categories: manual and torque angle. The manual wrench is the most common and is available in many styles: the basic style has a moveable arm against a scale, some have an adjustable spring that is calibrated to dial in a torque value to where the wrench produces a 'click' when the value has been reached, some have a dial gauge that measures and marks on and off-torque which can be read after torquing and another type that is electronic which translates data into a control module for error-proofing.

Most are low in cost, portable and can get into tight areas. The accuracy will range from ± 2-20% depending on model and cost. Calibration on the click-type will be lost if dropped, others may be damaged beyond normal repair.

All manual wrenches depend upon the operator and installation variables. The wrench will always 'see' 100% of the torque. It does not detect variations of friction. The operator can go fast or slow or vary the speed between bolts. The operator may switch from torquing the nut to torquing the bolt head. All of these have a direct response to accuracy and clamp load.

All torque values are to be used as a guide only. Most are determined of clean and dry threads or 'as received'. The only accurate use of any manual torque wrench is when the bolt threads are lubricated with a known lubricant.

Torque is a function of friction. Friction can come from debris, burrs, etc. A lubricant will overcome most types of assembly friction encountered and produce consistent clamp loads.

All engine torque values cited in repair manuals are considered 'wet' torques, yet the head bolts, connecting rod bolts, etc. do not loosen because the clamp loads are all equal and consistent using the oil as a lubricant. Products like C5A, Moly-Lube, etc. will accomplish the same type of consistency and are very accurate. Just be sure the proper lower torque values are used for the type of lubricant used.

///// Torque Angle Wrenches /////

This type of wrench is connected to a data processor which measures the torque applied to the rotational angle that the nut or bolt has turned. This is a most accurate tool used for solid and stiff joints. In most cases the turn will negate friction variables, which is why a pre-torque is first applied to establish a hard base without any further joint compression.

However, in some cases it will not always mean that the preload has been achieved. This depends upon how the data is monitored. If the torque and angle have been achieved within a certain percent window, then the joint is good.

However, if the angle goes significantly beyond the expected tolerance to achieve the proper torque, this means the joint was not solid and there was interference between the joint, such as a burr or even non-conforming part that produced compression or resistance. If the torque becomes high and the angle was not reached, then this could mean debris in the threads, cross threading or something else that needs to be investigated. If none of these anomalies are noticed and the operator just inputs on torque alone, then there are problems later.

///// Conclusion /////

Naturally, if there are complaints of fasteners failing or an assembly failing, check the type of tool used and compressor if it is a pneumatic tool. The bottom line is, when there becomes a rash of failures on a certain product line, without any other complaints, always ask how it was installed and what tools were used. The majority of times it is operator and equipment error. ■