Lesson Title: Torque Techniques for Critical Fasteners

Delivery Method: On-Line Presentation / Webex Presentation

Date: May 15, 2020

1. Introduction to Torque:
   "Torque" is a measurement of force and distance. The force is the amount of pushing or pulling applied at the end of the lever. Distance is the length of the lever that is being used.

   Torque values are given in the following units: NEWTON meters (N·m), pound inches (lb in), and pound feet (lb ft).

Note: Do not use sealants that are not specified in the service manual. Do not use compounds that are not specified in the service manual. Always clean old compounds from the bolt and from the hole before installation.

2. Safety is a critical part of the workplace, the responsibility of everyone, and need to be an active part of the work environment.
   a. Always set the parking brake, block the wheels to prevent the vehicle from moving.
   b. When tightening any fastener position your stance in such a way to prevent falling if the torque wrench or fastener fails.
   c. Always use the personal protective equipment mandated by the work facility, safety glasses, protective foot ware, and gloves.
   d. Please follow all safety rules outlined by the facility you are working in.

3. What is the technician attempting to achieve with a torque wrench?

   The torque wrench is used to apply a specific amount of turning force to critical fasteners on engine or vehicle components. The reason for the application of bolt torque is to create the clamping force by the engineer to correctly assemble the components.

4. Currently the manufactures have introduced torque to yield fasteners, these fasteners are designed to stretch when torqued to a specific value. With this type of fastener, it is critical that the amount of torque applied to the bolt is consistence across the component. The procedure use to create a consistence clamping force is referred to as the Torque Turn method.

5. Torque-Turn

The torque-turn method is used when precise control over clamping force is required. There is an initial torque and an additional turn. The initial torque is required to bring all parts of the joint into contact. The additional turn provides the desired clamping force. Ensure that all fasteners have been torqued before you perform the additional turns. Turn the fastener according to the specified amount. The specified amount will normally be equal to or greater than 90°. The specified amount will normally be in 30° increments. Turns of 120° or 180° are preferred. Turns of 120° or 180° are easily measured by the points of the hex head of the fastener.

The use of the torque-turn method will allow the following;

- Increase the life of the fastener.
- Maximize the potential clamping force of a fastener.
- Minimum the friction between the bolt and component.

Note: Too much tension on the bolt will cause the bolt to be stretched beyond the yield point. The bolt will be permanently stretched and not retain it elasticity. The bolt will loosen the grip on the parts that are being fastened. If the bolt is tightened again, the bolt will break. Do not reuse bolts that have been permanently stretched.

6. Torque Sequence:

Unless the bolt tightening sequence is specified by the Service Manual, the fasteners should be tightened in a cross pattern. Use Step 1 through Step 5 unless the tightening sequence is specified:

1. Hand tighten all fasteners. Larger fasteners may require the use of a small hand wrench.
2. Torque all fasteners to 40% of full torque.
3. Torque all fasteners to 70% of full torque.
4. Torque all fasteners to full torque by using a cross pattern. Large flanges may require additional passes.
5. Apply at least one final full torque to all fasteners in a clockwise direction until all torque is uniform. Large flanges may require additional passes.

Note: Final torque may be a turn.

7. Torque-Turn

Torque-Turn applies to fasteners that need turned to a set angle after the initial torque is applied.

1. Torque the fastener to the initial torque.
2. Mark a line on the fastener and on the abutment.

3. Mark another line in a different color at the required angle on the abutment.
4. Turn the fastener to the appropriate torque angle.
5. Verify the mark on the fastener is in-line with the torque angle mark.

Note: Marking the socket and aligning the mark on the socket with the original starting mark can aide in turning the fastener to the correct angle.

8. Overcoming the variables that can affect achieving the proper torque.

   There are a few things that need to be considered when assembling a component with critical fasteners.

   - Component cleanliness/condition: Verify there is no dirt, old sealant, old thread locking compound or damaged threads.
   - Verify the component mating surface is clean.
   - Lubrication: Standard practice is to always use 30-wt engine oil on the threads and washer face of the bolt or nut, unless stated otherwise.
   - Proper torqueing technique and using a calibrated torque wrench is crucial for maintaining accuracy.

   Typically, about 90% of the effort required to turn a fastener is used to overcome the friction. You can imagine that any additional friction will greatly affect the accuracy of using a torque value to achieve of using a torque value to achieve the desired clamping force.

9. Torqueing demonstration:
   a. Phosphate and Oil coated bolt Dry
   b. Oil lubricated bolt
   c. Moly-50 (Molybdenum Disulfide)

10. Bolt Coating:
    a. Phosphate and Oil coating provides better clamp loads and torque retention (Caterpillar Use Bolt)
    b. Zinc Plating provides better long-term corrosion resistance

11. Using the proper size torque wrench is important. A click-type torque wrench has a range is 20 to 100%, while an electronic torque wrench has a range of 10 to 100%. An example for 100 lb. ft. click-type wrench would be used to apply a torque from 20 to 100 lbs. ft. of torque. If you need to apply a 10 lb. ft. of torque to a fastener you would have to use an inch pound torque wrench and set the value to 120 lbs. in.

12. Common Mistakes:

    a. Not following proper torque wrench maintenance or annual calibration.
    b. Using short strokes or a jerky motion.
    c. Double clicking the wrench.
    d. Dirty threads and/or components.
    e. Not applying lubrication when and where needed.
    f. Improper hand position on the wrench.
    g. Using too small or too large of a torque wrench for the intended torque, out of the accuracy range.
    h. Improper storage: not in a protective case, not backed off to the lowest torque setting.
    i. Using the torque wrench to break fasteners loose.
    j. Re-using a fastener that is intended for one-time only use (torque-to-yield fasteners)
    k. Not accounting for increase in length when using an adapter.