NAVISTAR®
EDUCATION

Torque Talk
Study Guide



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Course Introduction



THE INFORMATION PROVIDED WITHIN THIS COURSE IS FOR TRAINING PURPOSES ONLY. ALWAYS CONSULT THE LATEST SERVICE, DIAGNOSTIC, AND TOOL INFORMATION, LOCATED ON THE INTERNATIONAL® SERVICE PORTAL℠, PRIOR TO PERFORMING SERVICE ON ENGINES, VEHICLES, AND EQUIPMENT.

Welcome

Welcome to the Navistar® training course: Torque Talk

This course is intended to introduce torque, as well as demonstrate the variables that effect torque and the importance of using the proper torque procedures.

Objectives

Upon completion of this course, the viewer will be able to:

- Describe what torque is and what it does
- Explain the importance of torque
- Describe the importance of clamp load
- Describe why a torque wrench is used
- Identify the difference between torque and the torque plus angle method
- Identify the variables involved with applying torque
- Describe the best practices and proper torque procedures

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Module 1: Torque Introduction

What is Torque?

NOTE

REFER TO THE 'TORQUE TALK' REFERENCE GUIDE FOR ADDITIONAL INFORMATION.

NOTE

TOPICS COVERED IN THIS COURSE APPLY TO ALL TYPES OF TORQUE WRENCHES.

What is torque?

Torque is a measurement of force acting on an object, causing it to turn.

The torque that is applied to a fastener is distributed into three areas: friction under the head, friction on the threads, and the stretch or increased tension of the metal in the fastener.

Applying accurate torque to fasteners is critical to the correct operation of engine and vehicle components.

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What Does Torque Do

Specific torque procedures and specifications are created to ensure that components do not leak or fail when under the extreme stress and vibration of normal operation.

Torque procedures and specifications also ensure that the correct clamp load is established and maintained between components.

Calculations are made to determine the amount of clamp load that is required to maintain the connection during high load conditions. Fasteners are selected that are capable of withstanding the clamp load required.

A torque procedure and specification is then identified to achieve the required clamp load for the given component.

Tension and Clamp Load

There are two terms that should be understood when discussing fasteners: tension and clamp load.

Tension is the act of stretching or straining the fastener.

Clamp load is described as the result of two objects being forced together.

As torque is applied to a fastener, the components are drawn together. As the tension on the fastener is increased, the clamp load on the joint between components will also increase.

In most applications, the tension and clamp load cannot be monitored when tightening a joint. This is why specific torque procedures are developed to ensure proper tension and clamp load are established.

Torque Wrench Basics

There are various types of torque wrenches, which include: click, electronic, and dial.

Regardless of the type, each is designed to precisely apply a specified amount of torque to a fastener.

However, there are important steps and precautions that must be followed to achieve this which are covered later in this course.

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Module 2: Understanding the Variables

CAUTION

FAILURE TO FOLLOW THE PROCEDURE STATED IN THE APPROPRIATE MANUAL ON TORQUE VALUES AND FASTENER CONDITION CAN RESULT IN COMPONENT DAMAGE.

There are three main factors that affect the correct application of torque:

- fastener and component condition
- selection and accuracy of the torque tool
- the proper method of torque application

Fastener and component condition, and the selection and accuracy of the torque tool will be discussed in this module. Proper tightening procedures and best practices will be discussed in module three.

Fastener and Component Condition

It is important to inspect fastener and component condition prior to assembling any components or beginning the torque procedure.

Generally, 90 percent of the torque applied to a fastener is consumed by friction on the threads and under the head surface. Only ten percent of torque applied increases tension to the fastener.

To understand how much torque is consumed by friction, it is important to understand how damaged threads, dirt and debris, or dry unlubricated fasteners, will increase the amount of friction.

An increase in friction will reduce the amount of tension placed on the fastener as well as the clamp load that is applied to the joint.

Verify that there is no unintended debris, sealant, thread locking compound, or damage present on the threads of the fastener and the component.

Verify that the component mating surface is clean and free of physical damage.

Ensure the fastener is properly lubricated. Standard practice is to use 30 weight engine oil on the threads and face of the fastener, unless stated otherwise.

Only replace fasteners with OEM direct replacement parts. This will verify that the correct size and SAE grade, or metric class, of fastener is being used.

Improper fastener and component condition will increase the amount of friction on a fastener, requiring more torque to be applied to achieve the same clamp force as a clean, lubricated fastener.

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Torque Wrench Accuracy

There are many factors that contribute to the accuracy of a torque wrench.

Selecting the proper sized torque wrench within its accuracy range is important. Typically, a wrench should be within 20 to 100 percent of its operating range for click type, and within ten to 100 percent for an electronic type.

It is highly recommended to use a torque tester tool to verify the equipment is accurate before and after each use.

Torque testers can also be used to become familiar with how a particular torque wrench feels and responds when it reaches the intended torque.

Click type torque wrenches should be cycled before each use; clicking the mechanism three to four times is recommended.

With proper care, maintenance, and annual calibrations, a high-quality torque wrench should provide accurate measurements for many years. Always refer to the manufacturers' instructions for best maintenance and storage practices.

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Storage and Calibration

Always refer to the tool user manual for proper storage practices. Most mechanical torque wrenches should be set to 20% of their maximum setting before being stored.

The spring inside the wrench needs to be relaxed during storage, or it may stretch and skew the calibration of the wrench.

Always store torque equipment in a protective case. Excessive bumping or mishandling can cause a torque tool to lose calibration.

To avoid premature wear do not store a torque wrench in excessive heat or humidity. Fluid immersion should also be avoided.

Avoid dropping a torque wrench when possible. Dropping the wrench on a hard surface can cause it to lose calibration.

If a torque wrench has been dropped, have it inspected by the manufacturer or a manufacturer authorized calibration service center.

Most manufacturers recommend that torque wrenches be calibrated every 5,000 cycles or every 12 months.

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Module 3: Torque Procedures and Best Practices

Torque Plus Angle



THE TERMS "TORQUE PLUS ANGLE" AND "TORQUE TO YIELD" ARE OFTEN USED INTERCHANGEABLY AND BOTH REFER TO THE SAME METHOD OF TORQUEING.

As mentioned in module two, the use of proper tightening procedures is one of the main variables that affect the correct application of torque.

The biggest disadvantage of using only torque measurements to achieve a high clamp load is the variable amount of friction that is possible when torqueing the fastener. A high amount of friction could consume the majority of the torque that is applied to a fastener in this situation.

For critical joints, the torque plus angle method is required. This allows a lower torque value to be used initially to reduce the friction variable.

After the initial torque value is applied, a specified angle of rotation will bring the fastener from a set start point, or the initial torque, to the final desired clamp force.

Because the angle of the threads on a fastener is consistent, the clamp force added from a given degree of rotation can be calculated and will also be consistent, regardless of the amount of friction acting on the fastener.

The torque plus angle method allows for a more consistent and accurate clamp load to be achieved.

This method removes friction from the equation, since friction is often inconsistent, even on a clean, lubricated fastener.

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Torque Plus Angle Method

Tightening a fastener until it is stretched, or in its "yield zone", is critical in applications where extreme clamp load requirements utilize the fastener's maximum clamping capabilities.

Consider that a fastener under high tension is acting like a spring. A spring has a limit to how far it can be stretched before it is permanently deformed and will not return back to its original length.

Fasteners endure a very similar process. As a fastener is tightened, it begins to stretch. Eventually the fastener could be stretched to a point that the metal loses its tension holding and clamping capabilities.

The torque plus angle method is designed to prevent this by bringing a fastener as close to it's maximum clamping capability as possible, while still allowing some room for increased load during operation.

Consider that if a fastener is at its absolute maximum clamp load at rest, any additional load during operation will begin to over stretch the fastener and possibly lead to failure of the fastener or the joint.

This is why the fastener is brought near its point of maximum clamping capability, but leaves some tolerance to account for the additional tension that may act on the joint during normal operation.

Failure to torque a fastener adequately will result in the fastener not being in the yield zone, which means not enough tension will be applied by the fastener to overcome the load acting on the joint. This can cause the tension on the fastener to release and the joint to lose its clamp load.

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Best Practices

The following topics will cover the best practices to follow when applying torque to a fastener.

Applying Torque

For accuracy, use a slow, steady, and smooth motion when applying torque to a fastener.

Failure to do this will cause an incorrect application of torque.

Always apply force to the torque wrench in the center of the handle.

Not doing this will cause an incorrect application of torque.

Do not over-tighten a fastener. It will stretch too far causing it to weaken and potentially break.

Under-tightening a fastener may cause it to work loose from vibrations during normal operation.

If using a click type wrench, do not double click the wrench when torqueing a fastener.

Double clicking the wrench will over torque the fastener.

Always use the appropriate tool to loosen or tighten fasteners.

Using a torque wrench as a ratchet, especially to loosen fasteners, can damage the wrench and cause it to become uncalibrated over time.

Every time the torque mechanism within a mechanical torque wrench is actuated, or clicked, is considered a "cycle". Using a torque wrench as a ratchet adds unnecessary cycles to the tool, prematurely wearing it out. Damage to the wrench can also be caused if the fastener being loosened requires more torque to loosen than the wrench is capable of, overloading the wrench.

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Torque Ranges and Sequence

Always use a torque wrench with a working range appropriate to the torque being applied.

Do not exceed the recommended working range of the torque wrench.

Always follow the manufacturer's instructions regarding torque direction, proper force, and torque pattern or sequence.

Failure to follow the manufacturer's instructions will cause an incorrect application of torque.

Torqueing a Fastener

Fasteners should always be started by hand.

Never use a wrench or impact gun to start a fastener. This can cause cross threading as well as overtightening which will stretch, damage, or break the fastener.

When tightening a fastener, do not guess on torque specifications. Always refer to the specifications in the appropriate service information.

Guessing on torque specifications will cause an incorrect application of torque.

Extensions, Adapters, and Sockets

Occasionally a crow's foot or other adapter is necessary to access a fastener when using a torque wrench.

Adding adapters that alter the total length of the torque wrench will skew the torque applied to the fastener from what the torque wrench reads.

When using adapters, always use the Torque Wrench Adapter Formula to calculate the correct torque wrench setting in order to achieve the target torque value.

Only one adapter should be used on a torque wrench at a time.



DO NOT USE ANY KIND OF EXTENSION ON A TORQUE WRENCH HANDLE. DOING SO CAN DAMAGE COMPONENTS AND TOOLING.

Do not use any kind of extension on a torque wrench handle. This can cause damage to the wrench and make it inaccurate.

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Conclusion

This concludes the Navistar® training course: Torque Talk

Thank you for your participation.

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