

**The Pennsylvania State University
Workforce Education and Development**

Lesson Plan Template

Name of Instructor: Brian Stevens
Program Title: Automobile/Automotive Mechanics Technology/Technician
Course Title: Automotive Mechanics
Unit Title: Automotive Fasteners
Lesson Title: Common Automotive Fasteners
Lesson Performance Objective: Given information on nuts, washers, and bolts. How to identify and measure for proper replacement and rethreading.
Time (length of lesson): 30-40 min.
Equipment and Materials needed: Information package and question sheet.
Technical Standard(s): 301,303
Academic Standard(s): CIP 47.0604 Follow information to find proper size and types of common automotive fasteners .
Introduction Students will read and answer questions to identify and use proper size and type of fasteners used for application.

Body: General information on common automotive fasteners,nuts,bolts,washers,screws,snap-rings,and rivets. How and where they are used. General information on how to re-thread or repair damaged threads and remove a broken bolt.

Summary: Given information on how to find proper fastener needed for application and how to repair if needed. Student will be able to use this task to properly use the write fasteners.

Student Assessment:

Formative Assessment(s)

Summative Assessment:

Universal Design for Learning (UDL)

Multiple Means of Engagement:

Multiple Means of Representation:

Multiple Means of Expression:

UNIT 5: FASTENERS

COMMON VEHICLE FASTENERS

- Nuts and Bolts
- Washers and Screws
- Other Fasteners
- Tap Procedures
- Thread Cutting and Repair
- Broken Bolt Removal

CHAPTER 1: FASTENERS

COMMON VEHICLE FASTENERS

NUTS AND BOLTS

Common Vehicle Fasteners

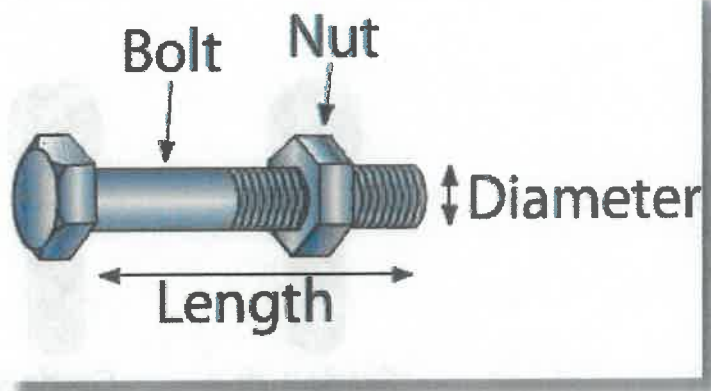
Note: Vehicles use many types of fasteners to hold various components together and technicians need to be familiar with each type. Some of the more common types of threaded fasteners include nuts and bolts, washers, screws, and studs. Other common fasteners include snap rings, rivets, and adhesives.

Note: American automobile manufacturers have largely switched to the metric system of sizing fasteners and threads.

Nuts and bolts in the U.S. Customary System (USCS)

Bolt diameters come in increments of $\frac{1}{16}$ in, starting with $\frac{1}{4}$ in. The measurement is the overall diameter of the bolt threads.

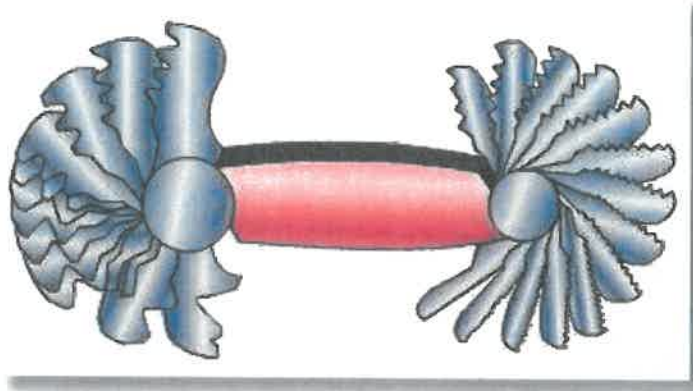
Note: It is easiest to measure the unthreaded or shank portion of the bolt.



The length of a bolt is its effective length measured from under the head to the end of the threads. Bolt lengths usually come in $\frac{1}{4}$ -in increments, starting from $\frac{1}{2}$ in. The longest bolts normally used in the field are 6 in. Thread type is either fine or coarse. Do not thread fine-threaded bolts into coarse threads or vice versa.

Note: Nuts are very difficult to measure for diameter, so it is usually best to trial fit the nut onto a bolt and then measure the bolt.

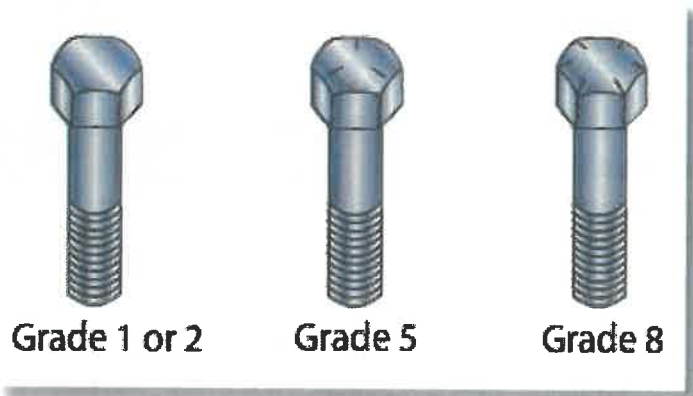
Thread size is determined by measuring the number of threads per inch. A **thread gauge**, available in both metric and USCS, can be used to determine the thread size of bolts.



The strength of a bolt is important. A bolt that is not strong enough can break. The strength or hardness of a bolt is determined by counting the points or slashes on the head of the bolt.

CAUTION: Never substitute a bolt with one of less strength. A lower strength bolt may break and cause injury and system failure.

Grade 1 or 2 bolts have no points and are unsuitable for automobile assembly due to their unknown and possibly low strength. Grade 5, or 3-point, bolts have three points on the head. These bolts are the most common in automobile assembly. Grade 8, or 6-point, bolts have six points on the head. These bolts are expensive but very strong and are used in high-stress conditions. Examples of grade 8 bolts include harmonic balancer bolts, flywheel bolts, and steering linkage bolts. Never substitute a lower grade bolt for a grade 8.

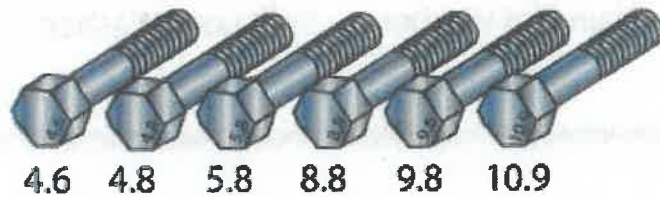


Right-hand thread nuts and bolts are the most common and turn clockwise to tighten. Left-hand thread nuts and bolts also are available that turn the opposite way. Left-hand nuts and bolts have notches cut at the corners of the hex head or the letter "L" stamped on them.

Metric Nuts and Bolts

The diameter of a metric bolt or nut is measured in the same way as in the USCS; however, the diameter of a metric bolt is expressed in millimeters. The bolt is measured for its effective length from under the head to the end of the threads. Thread size in the metric system is determined by measuring the distance from the crest of one thread in millimeters to the crest of the next thread. Metric bolt strength is indicated by a number stamped on the bolt head. This number is called the property class. Examples of property class numbers include 4.6, 4.8, 5.8, 8.8, 9.8, and 10.9. The higher the number, the stronger the bolt.

CAUTION: Never substitute a bolt with one of less strength. A lower strength bolt may break and cause injury and system failure.



WASHERS AND SCREWS

Washers

Washers are frequently used with threaded fasteners. They fit onto a bolt or screw between the surface being fastened and the nut, or under the bolt or screw head. Washers have two main functions. They improve the fastening ability by increasing the area that is clamped, and they prevent the bolt or nut from damaging the part surface.



Plain Flat Washer



Split Lock Washer

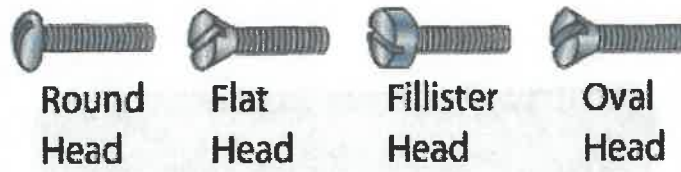
Star washers have several purposes, such as keeping components attached to vehicles while being manufactured and as a locking device to keep parts securely fastened. The star washer teeth allow clamping pressure to be maintained by preventing rotation of the bolt and or nut.



Screws

Many sizes and types of screws are used to fasten automotive parts. Two of the more common types are the following:

Machine screws are used in threaded holes to clamp small parts together.



Self-tapping screws (also called sheet metal screws) have hard, tapering threads that make their own threads when driven into a surface.



OTHER FASTENERS

Studs

Studs have threads on each end and no head. Some studs have threads throughout their length. Fastening with studs is accomplished by threading one end of the stud into a part, placing another part over the stud, and fastening the other end of the stud with a nut. Studs are useful for achieving accurate alignment of parts.



Snap rings

Snap rings (also called **retaining rings**) are used to hold components such as shafts, bearings, and gears in place. Internal snap rings fit in a groove inside an opening and external snap rings fit in a groove on the outside of a part. Snap-ring pliers are required for installing and removing snap rings.



Pop Rivets

A pop rivet is a non-threaded metal pin with a head on one end. Rivets are available in different designs and are typically made of copper, steel, or aluminum. Rivets are used to fasten parts that are not usually taken apart. Parts are joined together with a rivet by putting the rivet through a hole in the parts and hammering the headless end with a ball peen hammer or hammer and rivet set until the end is rounded. Rivets are removed by drilling then cutting off the head with a chisel and driving out the pin with a punch.



Adhesives

Various types of **adhesives**, or glues, are used to bond parts together. Parts that may be glued include trim, moldings, and various plastic and rubber parts.

CAUTION: When using adhesives, it is important to follow the manufacturer's specifications because some adhesives are toxic, flammable, and harmful if inhaled.

TAP PROCEDURE

Four types of taps are commonly used in the automotive industry to cut/repair threads: starter tap, bottom tap, pipe tap, and thread chaser. The picture below shows assorted taps.

General procedure for using a tap

CAUTION: Before drilling a hole to cut threads, choose the correct drill bit size for the thread size. Failure to use the correct drill bit size can result in a broken tap or inadequate thread depth.

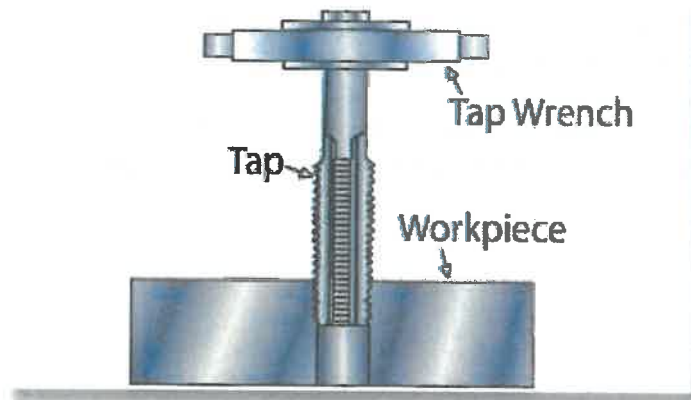
First apply a thread cutting oil.

Start the handle with the tap straight and then make a half turn.



After each partial turn, back the tap off until the metal chips begin to break loose.

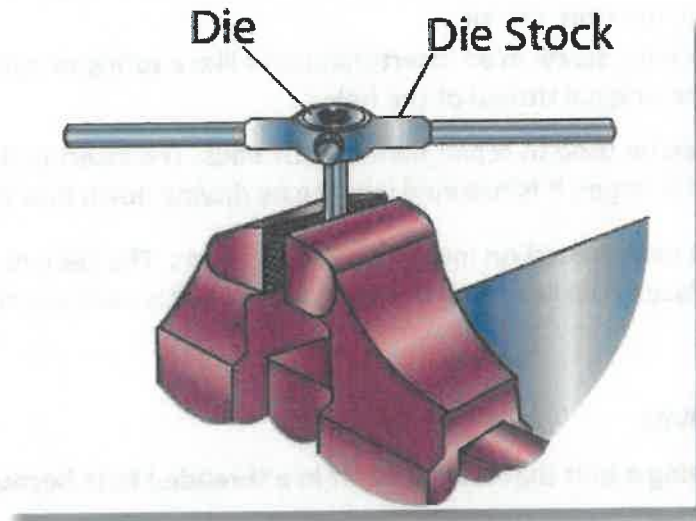
Repeat this process until all of the needed threads are cut. Add oil as needed during the process.



THREAD CUTTING AND REPAIR

Using a die to cut threads onto a rod

A special die stock holds the die for the cutting process.



Dies are selected in the same manner as taps, but the die can be improperly placed in the die stock. The die should be positioned in the die stock so that the tapered end engages the rod first.

General procedure for using a die

1. Apply a thread cutting oil.
2. Put the tapered side of the die on the rod.
3. Start the die stock with the die straight and then make a half turn.
4. After each partial turn, back the die off until the metal chips begin to break loose.
5. Repeat this process until all of the needed threads are cut. Add oil as needed during the process.

Procedures for repairing damaged or stripped threads

Chasing threads involves using a standard tap or die to run through existing threads of the same size. The purpose of this procedure is to correct small imperfections that interfere with the threading of the nut or bolt.

Note: Use a thread cutting oil during this procedure.

When threads in a hole are so severely damaged that they cannot be adequately repaired by chasing, a **helicoil** can be installed to restore the threads back to their original sizes. The basic steps for this procedure are as follows:

- Completely drill out the old, damaged threads with a drill bit supplied in the helicoil kit.
- Tap with a special tap from the kit.
- With a special handle, screw in an insert that looks like a spring or coil. The inside of this coil is the same as the original thread of the hole.

A **thread insert** can also be used to repair damaged threads. The insert is almost identical to the helicoil but is somewhat larger. It is retained in place by driving down four pins around the insert.

Thread repair cement can be used on low-torque applications. The cement is applied to the bolt, and the bolt is then placed back into the damaged hole. New threads are molded as the glue-like substance hardens.

BROKEN BOLT REMOVAL

Procedures for removing a bolt that is broken off in a threaded hole because of overtightening

A **screw extractor** can be used to remove bolts. The screw extractor has flutes or grooves that spiral in a counterclockwise direction.

- Drill a hole in the center of the broken bolt.
- Insert a screw extractor in the hole.
- Use the tap handle to rotate the extractor and bolt counterclockwise and remove them as a unit from the bolt hole.

Use the following procedure to remove a bolt that is not bound to the threaded hole.

- Drive a sharp punch into the center of the bolt.
- Use pliers to retrieve the bolt.

Note: Breakage due to the wrong thread design, a cross-threaded bolt, or a bolt that is bottomed out in the hole can make removal difficult. Drill out the bolt and retap the hole. Use the correct bolt and start it into the hole with the fingers.

Fasteners

Name _____

1. Some of the most common types of threaded fasteners include _____ and _____.
2. The length of a bolt is its effective length measured from under the _____ to the end of the _____.
3. A _____ can be used to determine thread size of a bolt,
4. Right-hand thread nuts and bolts are the most common and turn _____ to tighten.
5. Never substitute a bolt with one of less _____.
6. _____ are frequently used threaded fasteners. They fit onto a bolt or screw between the surface being fastened and the nut, or under the bolt or screw head.
7. _____ screws are used in threaded holes to clamp small parts together.
8. _____ - _____ screws have hard, tapering threads that make their own threads when driven into a surface.
9. A _____ is a non-threaded metal pin with a head on one end.
10. Various types of _____ or glues, are used to bond parts together.

