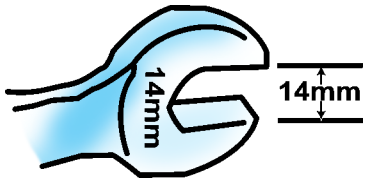
UNIT 4: BASIC HAND TOOLS

LESSON 1: TYPES OF WRENCHES

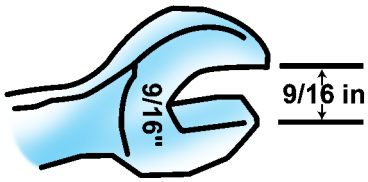
I. Metric and U.S. Customary System (USCS) wrenches

A. All technicians should have a set of both metric and USCS (also called SAE) wrenches for loosening and tightening bolts and nuts.

1. Metric wrenches are sized per the measurement in millimeters (mm) of the jaw opening, from face to face. The jaw size is actually a little larger than the bolt or nut of the same size to allow the jaw to fit around the bolt or nut.



2. USCS wrenches are sized per the measurement in fractions of an inch of the jaw opening, from face to face. The jaw size is actually a little larger than the bolt or nut of the same size to allow the jaw to fit around the bolt or nut.



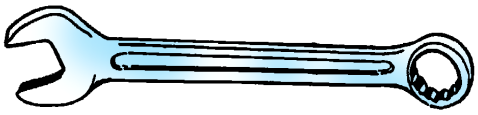
B. Metric and USCS wrenches are not interchangeable. For example, if removing a 14-mm nut, a 9/16-in wrench is close in size but is not the proper size to effectively remove the nut. The 9/16-in wrench may slip and round off the sides of the nut. A 14-mm wrench should be used.

II. Common wrenches

A. The open-end wrench turns nuts and bolts that have already been loosened. If too much torque or turning action is applied, it can round off the corners of nuts or bolts. The ends of the wrench are set at a 15° angle to reduce the distance the wrench is moved to grip the next side of the hex head.

B. The box wrench completely encircles the nut or bolt to grip all the corners, which allows considerably more torque to be applied without stripping the nut or bolt. This wrench is particularly useful for loosening tight bolts and nuts. More time is required to turn loose bolts with the box wrench.

C. The combination-end wrench is a combination open-end and box wrench. It is a favorite of technicians because of its multiple uses.



D. A tubing wrench, or flare nut wrench, has ends with a portion of one side cut away so that the wrench may be slipped over a steel line. Each end partially encircles the hex head of a nut or bolt. Steel line fittings are usually brass and require this type of wrench to loosen a tight fitting without causing damage.

NOTE: In addition to the tubing wrench, an open-end wrench is used to firmly hold the fitting while attaching it to the steel line. Do not allow the steel line to become twisted.

E. Maintenance

1. Wrenches should be kept free of dirt and grease and stored in a dry place to prevent rust.

2. Wrenches with distorted jaws should be discarded.

F. Safety

1. Always use the proper size wrench. Do not use metric wrenches on USCS bolts or vice versa.

2. Do not use a wrench as a hammer or pry bar.

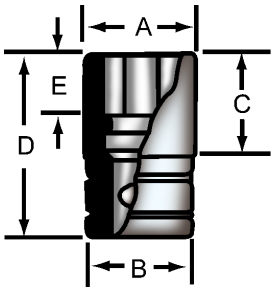
III. Socket wrenches

A. This wrench is so named because it has a cylindrical socket (in the size of the bolt) that fits down over the bolt, much like a box-end wrench.

B. The socket wrench is the preferred tool of most technicians when they work with nuts and bolts. Socket wrenches can be used in places that are inaccessible to common wrenches and are faster at removing bolts.

C. The two basic parts of a socket wrench are the socket and bar or handle.

1. Sockets come in metric and USCS sizes and are sized according to the size of the bolt head they fit and the size of the bar they take. They are available in four point types: 4 point, 8 point, 6 point, and 12 point, with the 6-point and 12-point sockets being the most commonly used.



A = Socket End Diameter
B = Drive End Diameter
C = Bolt Clearance Depth
D = Length
E = Opening Depth

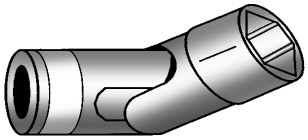
a. A shallow 12-point socket is used for turning hexagonal bolt heads in tight places because it offers twice as many starting positions.

b. A shallow 6-point socket is used for turning hexagonal bolt heads because it offers better grip and less chance of rounding off the bolt head when excess torque is used.

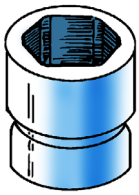
c. A deep-well 12-point socket is used to turn nuts when a bolt or stud protrudes through the nut enough to prohibit the use of the shallow socket.

d. A deep-well 6-point socket is used in the same situation as described above. It is particularly useful when there is a risk of rounding off tight nuts.

e. Swivel sockets, or universal sockets, have a universal joint built into the socket drive end that allows bolts and nuts to be turned when it is not possible to get straight onto the head.



f. Impact sockets are designed to withstand the great torque and impact delivered by air impact tools. An impact socket has thicker construction than a standard socket.



CAUTION: Do not use standard sockets on air impact guns because the socket may shatter.

2. Bars and handles are used to turn the sockets. The drive end is square and available in 1/4-in, 3/8-in, 1/2-in, and 3/4-in sizes.

NOTE: The 3/4-in size is used for large, heavy-duty bolts that are found in trucks. The 1/2-in size is used on large automotive bolts. The 3/8-in size is the most commonly used by technicians. For very small work, the 1/4-in size is used because of its compactness.

a. The breaker bar is a sturdy handle that is used when great torque is required to loosen bolts and nuts. The end of the breaker bar can swing to allow clearance.

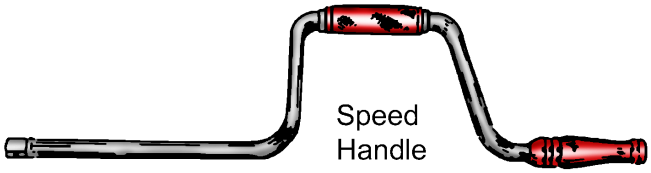
NOTE: The length of the handle on the breaker bar provides superior leverage for tight nuts and bolts.

b. The ratchet is the most commonly used handle for turning sockets. By rotating back and forth, the ratchet turns nuts and bolts in areas of limited access without being removed after each partial turn.

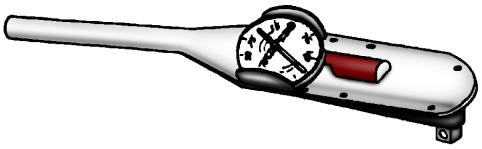
- The ratchet is not intended for use under extreme torque because the teeth on the ratchet mechanism may strip.
- Some ratchets have heads that swivel, which allows clearance while turning.

c. Extension bars aid in reaching recessed bolts and nuts by extending the ratchet drive end. Common extension lengths include 3 in, 6 in, and 12 in. Many other lengths are also available.

d. Speed handles and T-handles are occasionally used to speed assembly. One advantage of these handles is they do not place side stress on the extension and socket. These handles are not used for the final tightening.



e. A torque wrench is a special handle that indicates the amount of twisting force (torque) that is being applied in tightening a bolt.



- This wrench is necessary when the torque of bolts must meet manufacturer's specifications.
- Some models have a scale or dial to indicate torque.
- Others click or release momentarily when the preset torque is reached.
- Most recently, electronic versions are available that have easily programmable and accessible torque settings and indicate torque by vibrating, producing an audible signal, and providing a digital display.

NOTE: Specifications for the torque of bolts are extremely important. If too much torque is applied, the surfaces being joined or the bolt/nut will be damaged. If too little torque is applied, the bolt may work loose.

D. Occasionally, the technician must use a socket adapter on a socket to ease bolt removal.

NOTE: The torque capacity of the socket and ratchet must be considered so that the tool is not damaged or broken.

1. A size adapter allows the technician to use a different drive size socket on the ratchet or torque wrench.

   NOTE: Care must be exercised when adapting large breaker bars down to smaller drive sockets because the torque capacity of the small socket may be exceeded.

2. A universal adapter operates best when a socket has limited access that prevents the ratchet and extension from engaging straight onto the socket. These adapters cannot withstand great amounts of torque.

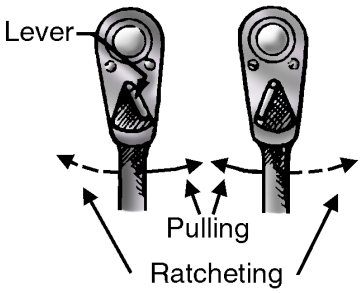
E. Maintenance

1. Sockets and handles should be kept free of dirt and grease and stored in a dry place to avoid rust.

2. Ratchet handles can become worn and should be reconditioned if the ratchet starts to slip.

F. Safety

1. Ratchet handles can turn both counterclockwise and clockwise and the lever that switches the direction should be firmly and fully placed into its proper position.



2. Do not use a ratchet handle as a hammer or pry bar.

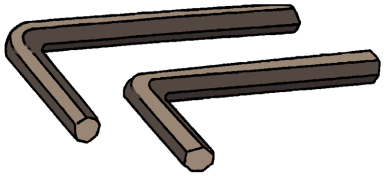
3. The exact size socket must always be used. Damaged sockets should be discarded, because they can slip off a bolt.

a. When using a socket on a damaged bolt head, be especially careful so the wrench does not slip off and cause an injury to the knuckle or hand.

b. Always be sure the socket is completely over the bolt head. If the bolt head is so damaged that the socket cannot fit completely over the head, use another method of removal.

IV. Other wrenches

A. An Allen wrench is used on hex head fasteners, which contain a cavity with six sides. A torx wrench is used on torx bolts, which contain a cavity of six rounded points. This design reduces the risk of stripping or disengaging the threads of small fasteners.



Allen Wrenches

B. An adjustable wrench has a screw that allows the jaw to adjust to different sizes. Under normal circumstances, technicians do not use an adjustable wrench for turning nuts and bolts.

1. It has the disadvantage of not gripping as solidly as box-end wrenches, and unless properly adjusted and in good condition, may not grip as solidly as open-end wrenches.

2. An adjustable wrench may be used if the technician does not have immediate access to the proper wrench and if torque requirements are not too high.

C. Standard wrenches cannot be used on pipes because of the round shape of pipes. The pipe wrench has teeth that dig in as the wrench turns the pipe. The risk of scarring the pipe can be reduced by placing a leather strap between the pipe and the wrench teeth.