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Chapter 6
Basic Tools and Precision Measuring

NATEF

National Automotive Technicians Education Foundation

NATEF Tasks

- N06001 Demonstrate safe handling and use of appropriate tools.
- N06002 Utilize safe procedures for handling of tools and equipment.
- N06003 Identify standard and metric designation.
- N06004 Demonstrate proper use of precision measuring tools (i.e., micrometer, dial-indicator, dial-caliper).
- N06005 Demonstrate proper cleaning, storage, and maintenance of tools and equipment.

Knowledge Objectives
(1 of 5)

- K06001 Describe the safety procedures to take when handling and using tools.
- K06002 Describe how to properly lockout and tag-out faulty equipment and tools.
- K06003 Describe typical tool storage methods.
- K06004 Identify tools and their usage in automotive applications.
- K06005 Describe the type and use of wrenches.
- K06006 Describe the type and use of sockets.

Knowledge Objectives
(2 of 5)

- K06007 Describe the type and use of torque wrenches.
- K06008 Describe the type and use of pliers.
- K06009 Describe the type and use of cutting tools.
- K06010 Describe the type and use of Allen wrenches.
- K06011 Describe the type and use of screwdrivers.
- K06012 Describe the type and use of magnetic pickup tools and mechanical fingers.
- K06013 Describe the type and use of hammers.

Knowledge Objectives
(3 of 5)

- K06014 Describe the type and use of chisels.
- K06015 Describe the type and use of punches.
- K06016 Describe the type and use of pry bars.
- K06017 Describe the type and use of gasket scrapers.
- K06018 Describe the type and use of files.
- K06019 Describe the type and use of clamps.
- K06020 Describe the type and use of taps and dies.
- K06021 Describe the type and use of screw extractors.

Knowledge Objectives
(4 of 5)

- K06022 Describe the type and use of pullers.
- K06023 Describe the type and use of flaring tools.
- K06024 Describe the type and use of riveting tools.
- K06025 Describe the type and use of measuring tapes.
- K06026 Describe the type and use of steel rulers.
- K06027 Describe the type and use of outside, inside, and depth micrometers.
- K06028 Describe the type and use of telescoping gauges.

Knowledge Objectives
(5 of 5)

- K06029 Describe the type and use of split ball gauges.
- K06030 Describe the type and use of dial bore gauges.
- K06031 Describe the type and use of vernier calipers.
- K06032 Describe the type and use of dial indicators.
- K06033 Describe the type and use of straight edges.
- K06034 Describe the type and use of feeler gauges.
- K06035 Describe the importance of proper cleaning and storage of tools.

Skills Objectives

- There are no Skills Objectives for this chapter.

You Are the Automotive Technician

After finishing work on the last vehicle of the day, you are required to return your workstation back to order. You clean, inspect, and return tools and equipment to their designated place. You wipe up any spills, according to the shop procedure, and clear the floor of any debris, to avoid slips and falls. During your workspace inspection, you determine that the insulation on the droplight cord is frayed, and there are some tools that need to be cleaned and put away.

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- What needs to happen with the droplight?

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- What should you do to with a micrometer before storing it?

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- How do you check a micrometer for accuracy?

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- Describe a double flare and how it is different from a single flare.

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- What needs to happen with the droplight?
- What should you do to with a micrometer before storing it?
- How do you check a micrometer for accuracy?
- Describe a double flare and how it is different from a single flare.

Introduction

- Purchase, use, and maintenance of a variety of tools and shop equipment are important to the overall performance of the shop

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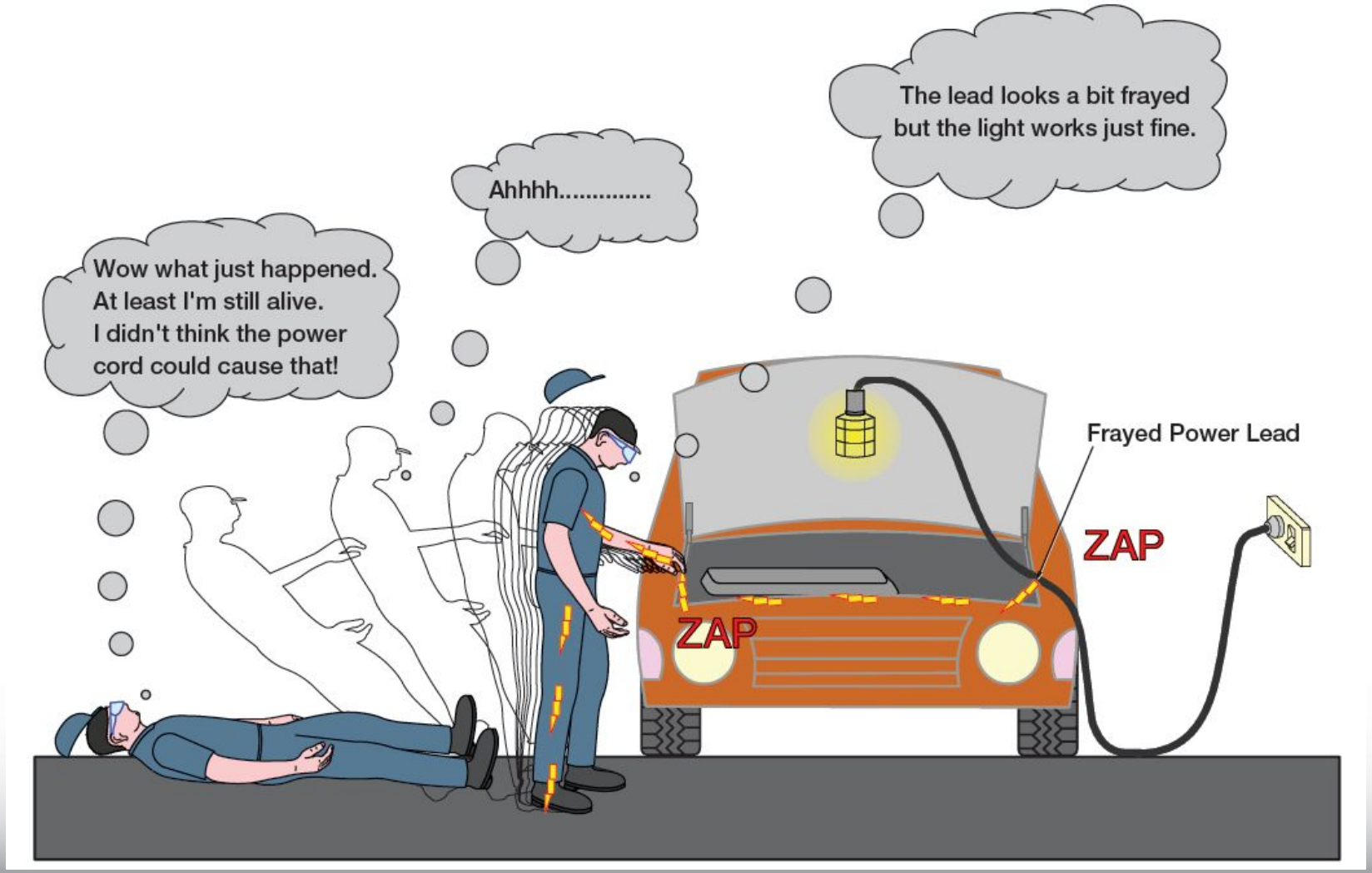
Technicians rely on tools to perform work.

General Safety Guidelines 1

- **N06001 Demonstrate safe handling and use of appropriate tools.**
- **N06002 Utilize safe procedures for handling of tools and equipment.**
- **K06001 Describe the safety procedures to take when handling and using tools.**
- Having a safe attitude helps to avoid accidents
- Pay attention to safety and operation procedures

General Safety Guidelines 2



Work Safe and Stay Safe

- Think safety first when using tools
- Incorrect usage of hand and power tools can lead to injury
- Use of recommended personal protective equipment (PPE)

Safe Handling and Use of Tools

- To prevent injury and damage
- Inspection of tools prior to and after use
- Checking of the manufacturer and the shop procedures
- Correct storage

Skill Drill 6-1 Safe Handling and Use of Tools

(1 of 4)

1. Select the correct tool(s) to undertake tasks.

2. Inspect tools prior to use to ensure they are in good working order. If tools are faulty, remove them from service according to shop procedures.

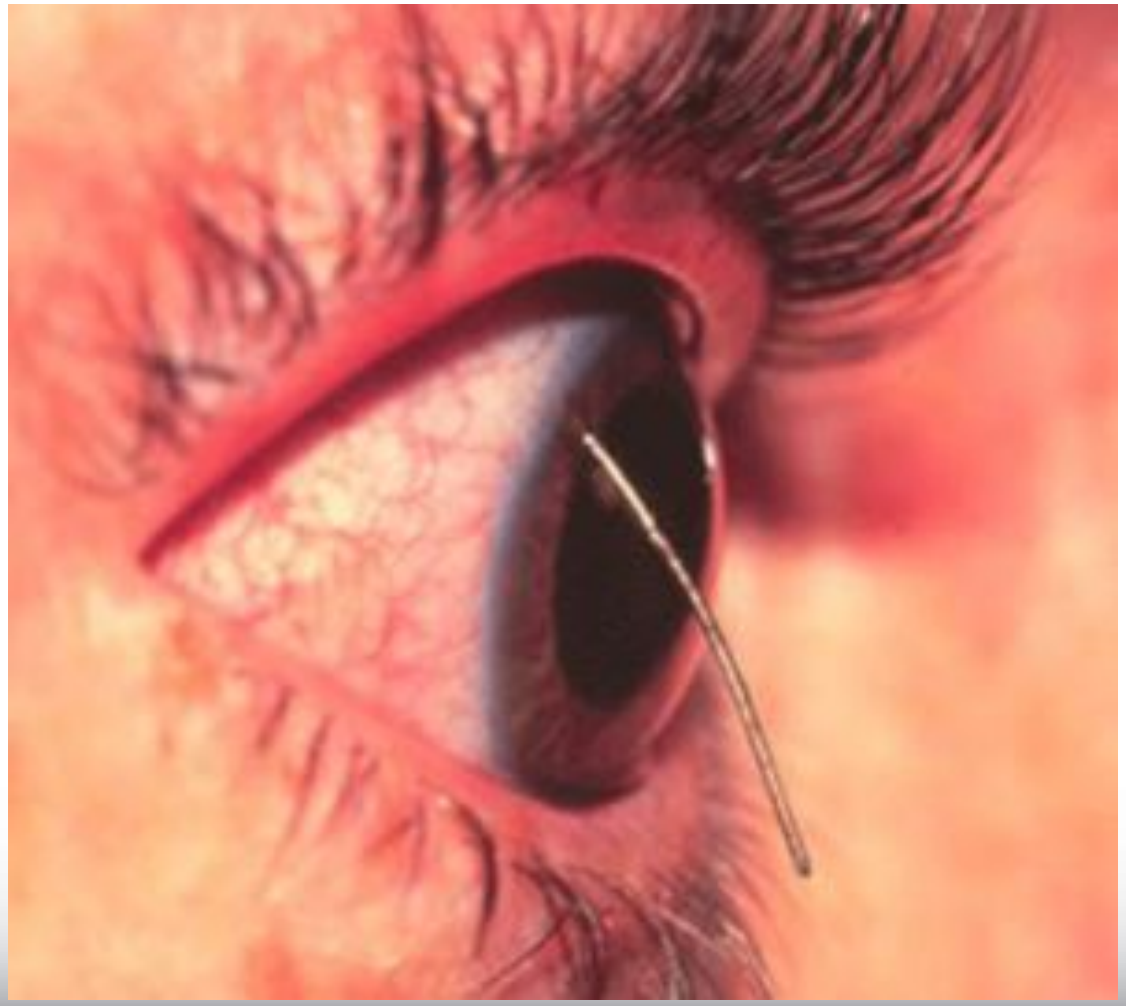
Skill Drill 6-1 Safe Handling and Use of Tools

(2 of 4)

3. Clean tools prior to use if necessary.

4. Use tools to complete the task while ensuring manufacturer and shop procedures are followed. Always use tools safely to prevent injury and damage.

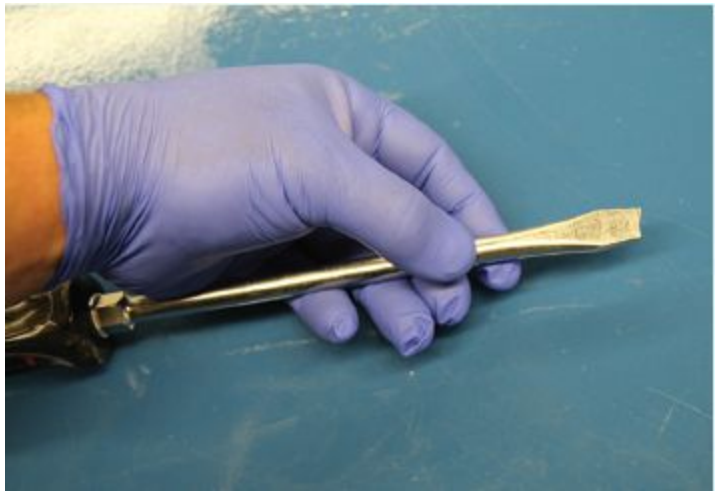
Skill Drill 6-1 Safe Handling and Use of Tools



Skill Drill 6-1 Safe Handling and Use of Tools

(3 of 4)

5. Ensure tools are clean and in good working order after use. Report and tag damaged tools, and remove them from service, following shop procedures.



Skill Drill 6-1 Safe Handling and Use of Tools

(4 of 4)

6. Return tools to ALWAYS correct storage locations.

Safe Procedures for Handling Tools and Equipment

- Seeking assistance with using heavy tools
- Correct manual handling techniques

Skill Drill 6-2 Safe Procedures for Handling Tools and Equipment

(1 of 6)

1. Seek assistance if tools and equipment are too heavy or too awkward to be managed by a single person.

Skill Drill 6-2 Safe Procedures for Handling Tools and Equipment

(2 of 6)

2. Inspect tools and equipment for possible defects before starting work. Report and/or tag faulty tools and equipment according to shop procedures.

Skill Drill 6-2 Safe Procedures for Handling Tools and Equipment

(3 of 6)

3. Select and wear appropriate PPE for the tools and equipment being used.

Skill Drill 6-2 Safe Procedures for Handling Tools and Equipment

(4 of 6)

4. Use tools and equipment safely.

Skill Drill 6-2 Safe Procedures for Handling Tools and Equipment

(5 of 6)

5. Check tools for faults after using them and report and/or tag faulty tools and equipment according to shop procedures.

Skill Drill 6-2 Safe Procedures for Handling Tools and Equipment

(6 of 6)

6. Clean and return tools and equipment to correct storage locations when tasks are completed.

Tool Usage

- Tools extend the ability to perform tasks
  - Hand tools: gripping, turning, tightening, measuring, and cutting
  - Electrical meters: measure resistance, voltage and current
  - Power and air tools: multiplication of strength for quick and efficient task performance

Tools extend our abilities.

Lockout/Tag-out
(1 of 2)

- **K06002 Describe how to properly lockout and Tag-out faulty equipment and tools.**
- Umbrella term describing a set of safety practices and procedures to reduce the risk of technicians inadvertently using unsafe tools
- Lockout example: physically securing an unsafe tool
- Tag-out example: affixing a label with the details

Lockout/Tag-out
(2 of 2)

A. An example of lockout would be physically locking out a tool or piece of equipment so that it cannot be accessed and used by someone who may be unaware of the potential danger of doing so.

B. An example of tag-out would be affixing a clear and obvious label to a piece of equipment that describes the fault found and that warns not to use the equipment.

Tool Storage

- **K06003 Describe typical tool storage methods.**
- Toolbox kept in the technician's work stall
- Specialty tools and equipment used on a shared basis and kept in a centralized location

Typical technician's toolbox.

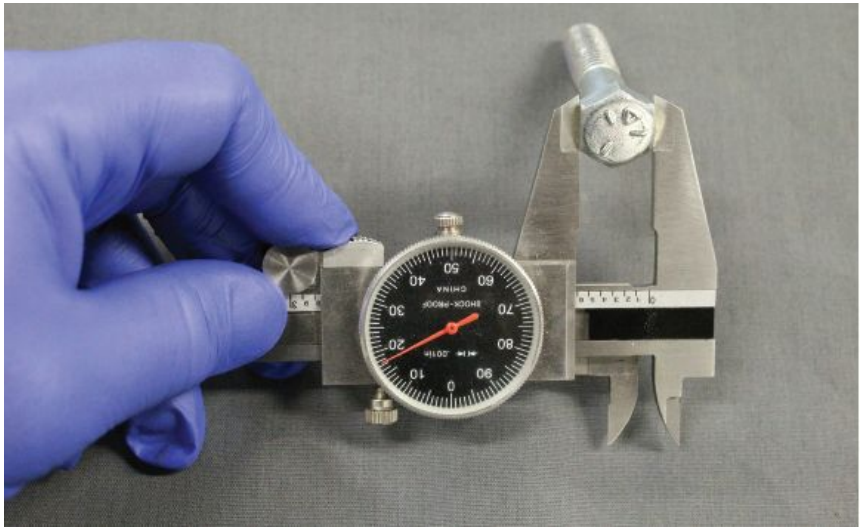
Manufacturer's special tools.

Standard and Metric Designations
(1 of 2)

- **N06003 Identify standard and metric designation.**
- Standard or metric: United States customary system (USCS) sizes
- Fasteners bought new: designations identified on the packaging
  - Vernier caliper to identify the designations of other fasteners
- Manufacturer's charts show thread and fastener sizing
  - Inch-to-metric conversion charts assist in identifying component designation

Standard and Metric Designations
(2 of 2)

Manufacturer specifications and shop manuals can be referred to and may identify components as standard or metric.



If no markings are available, use measuring devices to gauge the size of the item and compare thread and fastener charts to identify the sizing.

Basic Hand Tools
(1 of 2)

- **K06004 Identify tools and their usage in automotive applications.**
- Personal tools
- New fasteners, wire harness terminals, quick-connect fittings for fuel and other lines, and additional technologies require different types of hand tools
- Addition of updated tools to the toolbox

Basic Hand Tools
(2 of 2)

Hand tools.

Toolbox drawers need to open and close easily.

Wrenches
(1 of 6)

- **K06005 Describe the type and use of wrenches.**
- Used to tighten and loosen nuts and bolts
- Box-end wrench
  - Fits fully around the head of the bolt or nut and grips each of the six points at the corners
  - Ends are bent or offset
- Open-end wrench
  - Open on the end, and the two parallel flats only grip two points of the fastener

Wrenches
(2 of 6)

  - Have different-sized heads on each end or the same size with different angles
  - Good to use in tight spaces
  - Only on fasteners that are no more than firmly tightened
- Combination wrench
  - Versatile and popular among technicians
  - Same sized open-end head on one end and a box-end head on the other
- Flare nut wrench
  - Variation on the open-end wrench and not as strong as a box-end wrench
  - Also called a flare tubing wrench or line wrench

Wrenches
(3 of 6)

- Ratcheting box-end wrench
  - Useful tool in some applications as it does not require removal of the tool to reposition it
- Pipe wrench
  - Specialized wrench that grips pipes and can exert a lot of force to turn them
- Oil wrench
  - Specialized wrench that grabs the filter and gives extra leverage to remove an oil filter when it is tight

Wrenches
(4 of 6)

A. Box-end wrench. B. Open-end wrench. C. Combination wrench. D. Flare nut wrench. E. Ratcheting box-end wrench.

Box-end wrenches.

Types of open-end wrenches.

Combination wrenches.

Wrenches
(5 of 6)

Flare nut wrenches.

Open-end adjustable wrench.

Ratcheting box-end wrench.

Ratcheting open-end wrench.

Wrenches
(6 of 6)

Pipe wrench.

Oil filter wrenches.

Using Wrenches Correctly

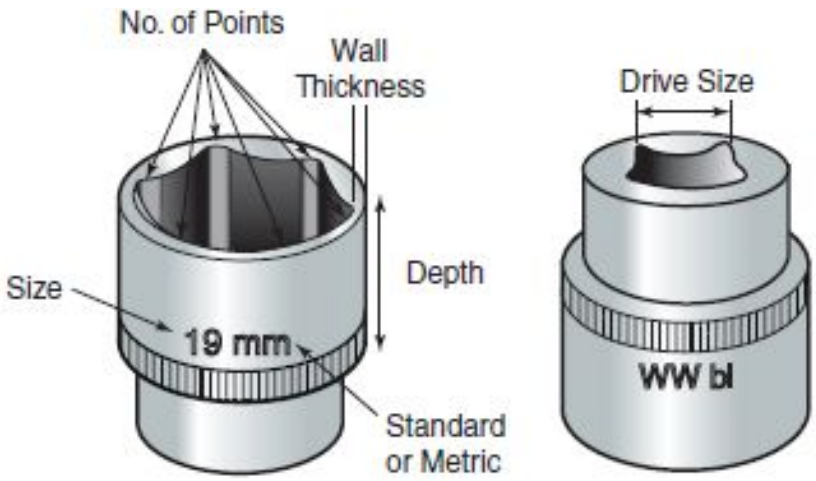
- Choosing the correct wrench depends on:
  - The tightness of the fastener
  - Available room to get the wrench onto the fastener and then to turn it

A. Pulling on a wrench is generally better than pushing on a wrench.

B. Pushing regularly results in bruised or broken knuckles.

Sockets
(1 of 6)

- **K06006 Describe the type and use of sockets.**
- Adaptable, easy to use, and a good choice when the top of the fastener is reasonably accessible
- Fits onto the fastener snugly and grips it on all six corners
- Individual sockets purchased in sets and fit a particular size nut or bolt

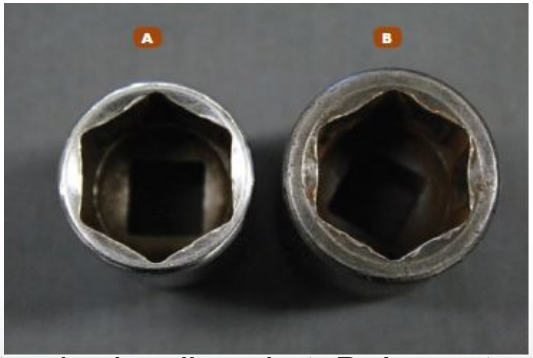


The anatomy of a socket.

Sockets
(2 of 6)

- Classification:
  - Standard or metric
  - Size of drive used to turn them
  - Number of points
  - Depth of socket
  - Thickness of wall

Sockets are designed to fit a matching drive on a ratchet.



A. Standard wall socket. B. Impact socket.

Sockets
(3 of 6)

A. Six- and 12-point sockets.

B. Four- and 8-point sockets.

A. Deep socket. B. Standard length socket.

Tools to turn sockets. A. Universal joint. B. Extension. C. T-handle. D. Breaker bar. E. Ratchet.

Sockets
(4 of 6)

- Ratchet
  - Most common socket handle
  - Makes easy work of tightening or loosening a nut where not a lot of pressure is involved
  - Too much pressure could strip the ratchet mechanism
- Sliding T-handle
  - Useful for heavier tightening and loosening
  - Connection between the socket and the accessory made by a square drive

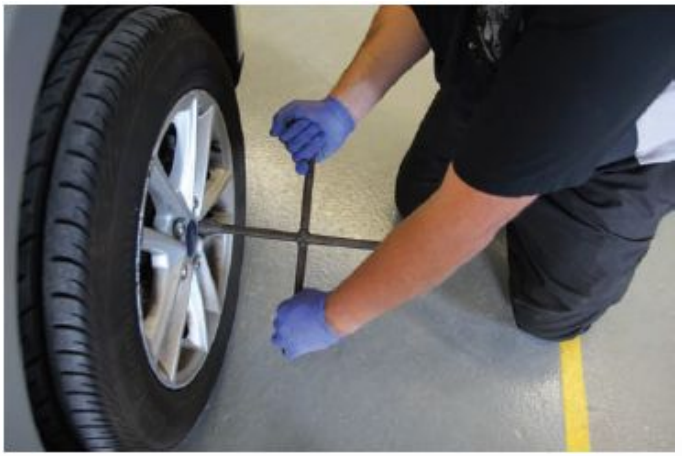
Sockets
(5 of 6)

- Speed brace
  - Fastest way to spin a fastener on or off a thread by hand
  - Used to remove an already loosened fastener or to run the fastener onto the thread until it begins to tighten
- Lug wrench
  - Has permanently attached special-sized lug nut sockets
  - Common model has four different-sized sockets
  - Impact wrench used when lug wrench does not remove nuts

Sockets
(6 of 6)

Flexible extensions. A. U-joint style. B. Wobble extension style. C. Cable extension style. D. Flex socket style.

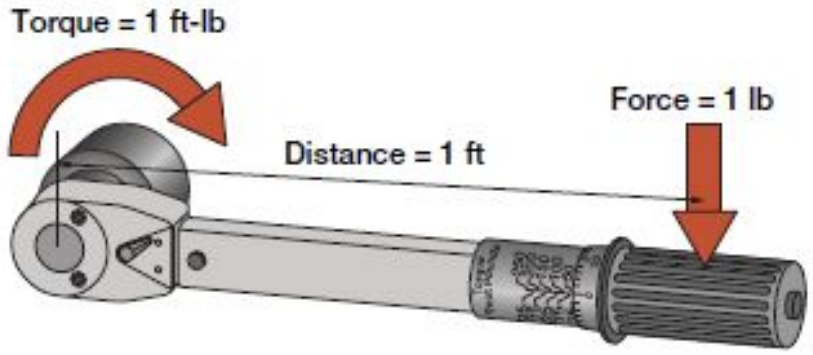
Speed brace.



Lug wrench.

Torque and Torque Wrenches

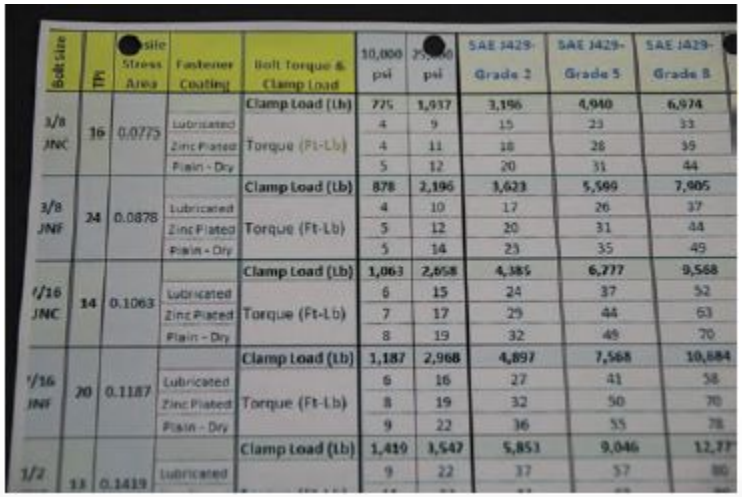
- **K06007 Describe the type and use of torque wrenches.**
- Torque: twisting force used to create bolt tension so that surfaces are clamped together with the proper force
- Torque value: amount of twisting force applied to a fastener by the torque wrench
  - pound-foot
  - Newton-meter



Torque is the measurement of twisting force. 1 ft-lb of torque.

Torque Charts

- Torque specifications contained within service information
- Bolt manufacturer's torque chart is the maximum recommended torque



Bolt size	TPI	Site Stress Area	Fastener Coating	Bolt Torque & Clamp Load	10,000 psi	25,000 psi	SAE J429-Grade 2	SAE J429-Grade 5	SAE J429-Grade 8
3/8	16	0.0775		Clamp Load (Lb)	775	1,937	3,196	4,940	6,974
UNC			Lubricated	Torque (Ft-Lb)	4	9	15	23	33
			Zinc Plated		4	11	18	28	39
			Plain - Dry		5	12	20	31	44
3/8	24	0.0878		Clamp Load (Lb)	878	2,196	3,623	5,599	7,905
UNF			Lubricated	Torque (Ft-Lb)	4	10	17	26	37
			Zinc Plated		5	12	20	31	44
			Plain - Dry		5	14	23	35	49
7/16	14	0.1063		Clamp Load (Lb)	1,063	2,658	4,385	6,777	9,568
UNC			Lubricated	Torque (Ft-Lb)	6	15	24	37	52
			Zinc Plated		7	17	29	44	63
			Plain - Dry		8	19	32	49	70
7/16	20	0.1187		Clamp Load (Lb)	1,187	2,968	4,897	7,568	10,684
UNF			Lubricated	Torque (Ft-Lb)	6	16	27	41	58
			Zinc Plated		8	19	32	50	70
			Plain - Dry		9	22	36	55	78
1/2	13	0.1419		Clamp Load (Lb)	1,419	3,547	5,851	9,046	12,77
			Lubricated		9	22	37	57	80

Bolt torque chart.

Torque Wrenches
(1 of 3)

- A tension wrench used to tighten fasteners to a predetermined torque
- Types
  - Beam style: simplest and least expensive, uses a spring steel beam that flexes under tension, and a smaller fixed rod then indicates the amount of torque on a scale mounted to the bar

A torque wrench.

Torque Wrenches
(2 of 3)

Torque wrenches. A. Beam style. B. Clicker style. C. Dial. D. Electronic.

Torque setting scale on the handle.

Dial torque wrench reading torque.

Torque Wrenches
(3 of 3)

- Clicker: uses an adjustable clutch inside that clicks when the preset torque is reached
- Dial: turns a dial that indicates the torque based on the torque being applied
- Electronic: uses a spring steel bar with an electronic strain gauge to measure the amount of torque being applied; when the preset torque is reached, it gives an audible signal such as a beep

Digital torque wrench displaying torque.

Checking torque wrench calibration.
© Joe Giddens/EMPPL PA Wire/AP Photo

Using Torque Wrenches

- Torque wrench is used to apply a specified amount of torque to a fastener
- Indications when the correct torque is reached: audible signal (beep or click) or visual signal (light or pin moving or clicking out)
- When using torque wrench, a deep socket to be used and not extensions

It may be necessary to support the torque wrench when using extensions.

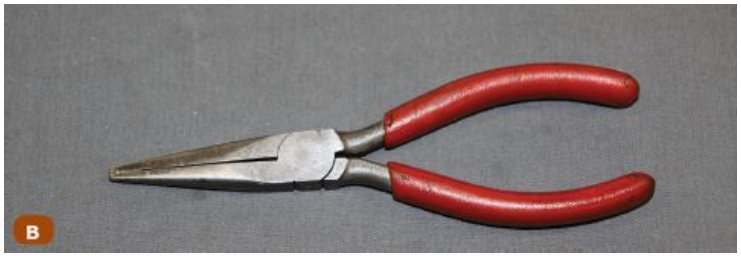
Pliers
(1 of 7)

- **K06008 Describe the type and use of pliers.**
- Hand tool designed to hold, cut, or compress materials
- Types include slip-joint, combination, arc joint, needle-nose, and flat-nose
- Combination pliers: commonly used with two gripping surfaces, for flat objects and rounded objects
- Arc joint pliers have moveable pivot, Channellocks
  - Useful for a wider grip and a tighter squeeze on parts too big for conventional pliers

Pliers
(2 of 7)

Pliers are used for grasping and cutting. These are slip-joint pliers.

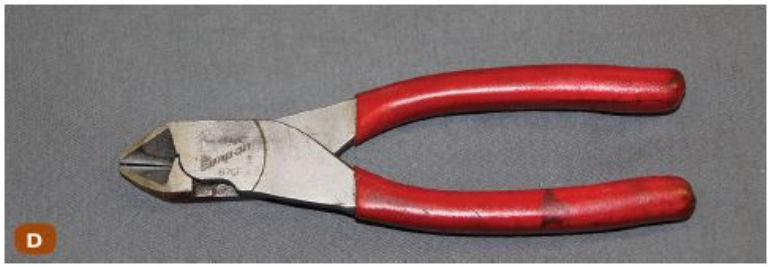
A. Combination pliers



B. Needle-nose pliers.

Pliers
(3 of 7)

C. Flat-nose pliers.



D. Diagonal cutting pliers.

E. Nippers.

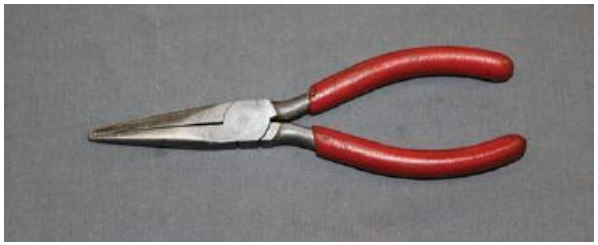
Pliers
(4 of 7)

F. Internal snap ring pliers.

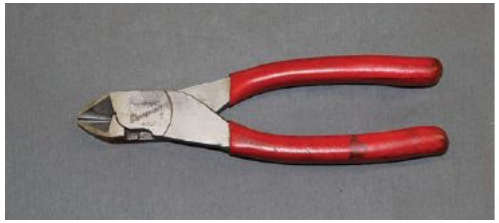
G. External snap ring pliers.

Pliers
(5 of 7)

Arc joint pliers.



Needle-nose pliers.



Diagonal side cutters.

Nippers, or end cutting, pliers.

Pliers
(6 of 7)

- Needle-nose pliers have long, pointed jaws and can reach into tight spots or hold small items that other pliers cannot
- Flat-nose pliers have an end or nose that is flat and square, which makes it possible to bend wire or even a thin piece of sheet steel accurately along a straight edge
- Diagonal cutting pliers used for cutting wire or cotter pins
- Nippers are the end cutting pliers
  - have a cutting edge at right angles to their length
  - designed to cut through soft metal objects sticking out from a surface

Pliers
(7 of 7)

- Snap ring pliers have metal pins that fit in the holes of a snap ring
  - Two types: internal and external
- Locking pliers
  - Vice grips are general-purpose pliers used to clamp and hold one or more objects

Snap ring pliers and snap ring.

Locking pliers.

Cutting Tools
(1 of 2)

- **K06009 Describe the type and use of cutting tools.**
- Bolt cutters
  - Cut heavy wire, non-hardened rods, and bolts
  - Their compound joints and long handles give the leverage and cutting pressure that is needed for heavy gauge materials
- Tin snips are nearest to a pair of scissors
  - Cut thin sheet metal and lighter versions make it easy to follow the outline of gaskets
  - Straight blades and a pair of left- or right-handed curved blades for unusual shapes to cut

Cutting Tools
(2 of 2)

- Aviation snips
  - Designed to cut soft metals
  - Handles are spring-loaded in the open position and double pivoted for extra leverage

A. Bolt cutters.

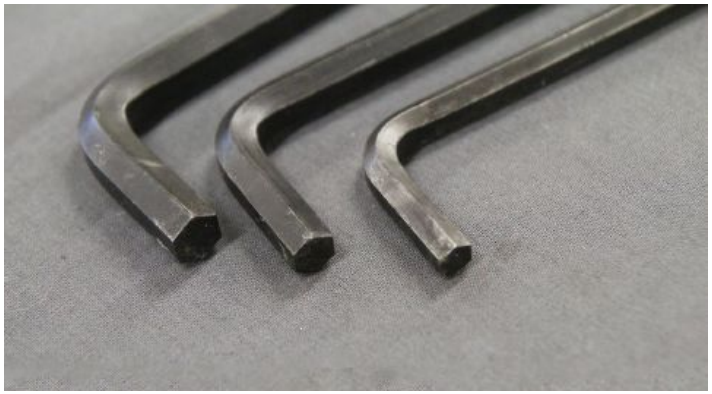
B. Tin snips.

C. Aviation snips.

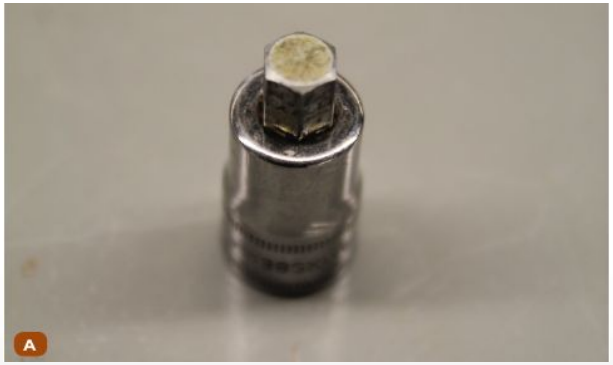
Allen Wrenches
(1 of 2)

- **K06010 Describe the type and use of Allen wrenches.**
- Allen or hex keys are tools designed to tighten and loosen fasteners with Allen heads
- Allen head fastener has an internal hexagonal recess that the Allen wrench fits in
- Give the best grip on a screw or bolt of all the drivers
- Traditional Allen wrench: a hexagonal bar with a right-angle bend at one end

Allen Wrenches
(2 of 2)



Typical Allen wrench head.



A. Allen socket.

B. T-handle Allen wrench.

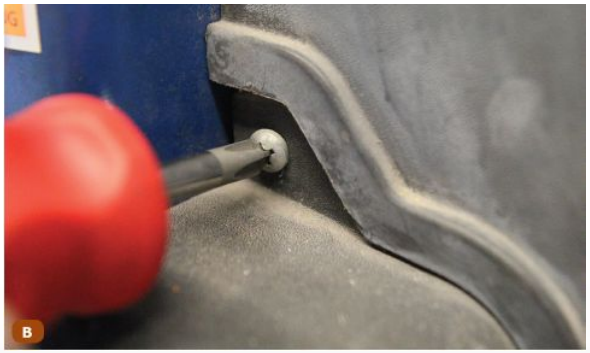
Screwdrivers
(1 of 4)

- **K06011 Describe the type and use of screwdrivers.**
- Match the tip of the screwdriver with the slot or recess in the head of a fastener
- Flat blade screwdriver
  - Most common and has a flat tip or blade
- Phillips head screwdriver
  - A Pozidriv screwdriver
  - Requirement of a screw or bolt with a cross-shaped recess
- Offset screwdriver
  - Useful where there is not much room to turn it

Screwdrivers
(2 of 4)

A. Slotted screw and screwdriver.

A. Flat blade screwdrivers. B. Phillips screwdriver. C. Pozidriv screwdriver.



B. Phillips screw and screwdriver.

Four sizes of Phillips screwdrivers.

Screwdrivers
(3 of 4)

- Ratcheting screwdriver
  - Popular screwdriver handle with a selection of removable flat and Phillips tips
  - Has a ratchet inside the handle that turns the blade in only one direction, depending on how the slider is set
- Impact driver
  - Used when a screw or a bolt is rusted/corroded in place or over-tightened and needs a tool that can apply more force

Screwdrivers
(4 of 4)

A. Offset screwdriver.

B. Ratcheting screwdriver.

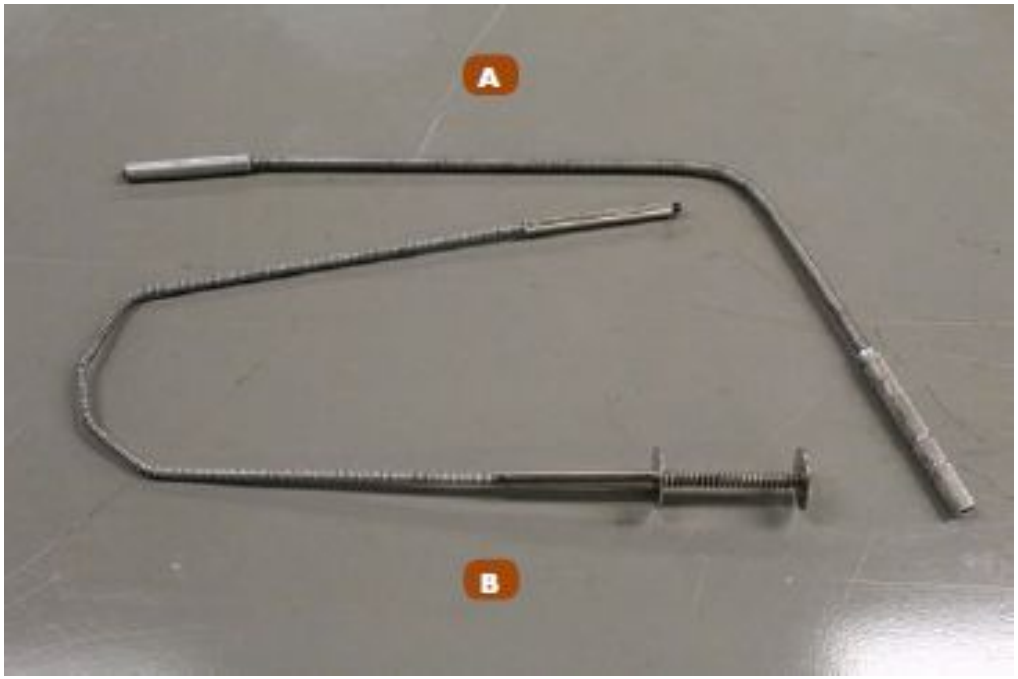
C. Impact driver.

Magnetic Pickup Tools and Mechanical Fingers

(1 of 2)

- **K06012 Describe the type and use of magnetic pickup tools and mechanical fingers.**
- Useful for grabbing items in tight spaces
- A telescoping stick having a magnet attached to the end on a swivel joint
- Mechanical fingers designed to extract or insert objects in tight spaces and can pick up nonmagnetic objects

Magnetic Pickup Tools and Mechanical Fingers
(2 of 2)



A. Magnetic pickup tools. B. Mechanical fingers.

Hammers
(1 of 2)

- **K06013 Describe the type and use of hammers.**
- Ball-peen (engineer's) hammer
  - Most common with a hardened steel head
  - Punch or chisel driven with the flat face
  - Used for flattening or peening a rivet
- Steel hammer
  - Used to hit chisels
  - Soft-faced hammers for softer metal

A. Ball peen hammer. B. Sledge hammer. C. Soft-faced hammer. D. Dead blow hammer.

Hammers
(2 of 2)

- Sledgehammer
  - Used when a large chisel needs a strong blow
  - Heaviest type of hammer used one-handed
- Dead blow hammer
  - Designed not to bounce back during a hit
  - Used when working on the vehicle chassis or when dislodging stuck parts
- Hard rubber mallet
  - Special-purpose tool with the head made of hard rubber
  - Used for moving things into place without causing damage

Chisels
(1 of 2)

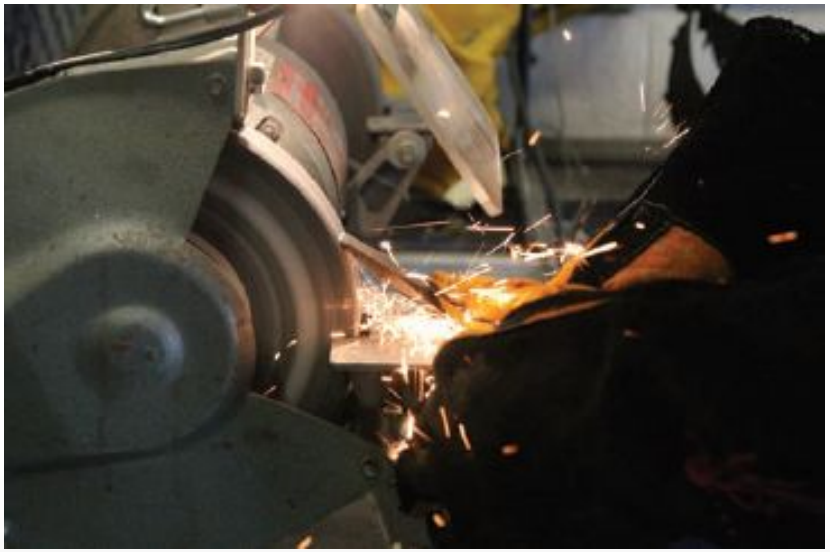
- **K06014 Describe the type and use of chisels.**
- Cold chisel
  - Most common; used to cut cold metals and to remove bolts with rounded-off heads
- Variation: Spring-loaded cold chisel
  - Works well in tight spaces
- Parts of chisel:
  - Chisel
  - Weighted hammerhead
  - Spring in tension

A. Cold chisel. B. Cross-cut chisel.

Chisels
(2 of 2)

- Cross-cut chisel
  - Sharpened edge across the blade width
  - Used for cleaning out or making key ways

Spring-loaded chisels.



Dressing a chisel.

Punches
(1 of 4)

- **K06015 Describe the type and use of punches.**
- Used when the head of the hammer is too large to strike the object being hit without causing damage to adjacent parts
- Types: prick punch, center punch, drift punch, and pin punch
- Prick punch
  - Used to mark the points needed to be drawn on an object and scribe intersecting lines between given points

Punches
(2 of 4)

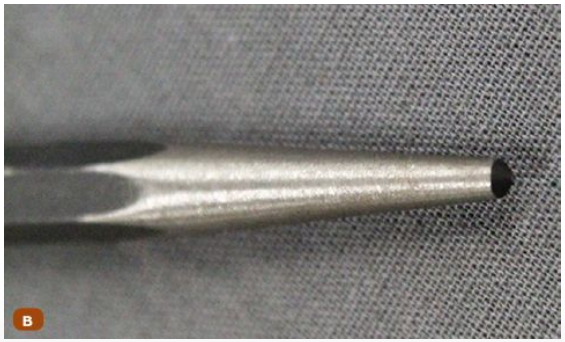
- Center punch
  - Makes a bigger indentation that centers a drill bit at the point where a hole is required to be drilled
  - Used with a hammer or some operate automatically
  - Has a spring and weighted hammer inside of the back end
- Drift punch
  - A starter punch that works well for aligning holes on two mating objects
- Pin punches
  - Used to drive out pins or rivets and designed to deal with tight pins
  - Available in various diameters having long slender shaft with straight sides

Punches
(3 of 4)

A. Prick punch.

C. Drift punch.

Internal workings of an automatic center punch.



B. Center punch.

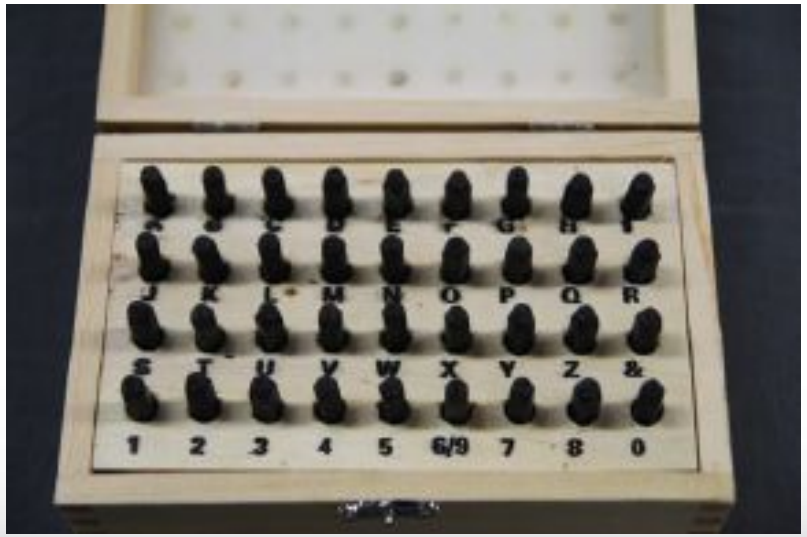
D. Pin punch.

Various pin punches.

Punches
(4 of 4)

- Wad punches/hollow punches
  - Most efficient tool to make a hole in the soft sheet material
  - End grain of a wooden block under the work
- Number and letter punches in boxed sets

Wad punch.



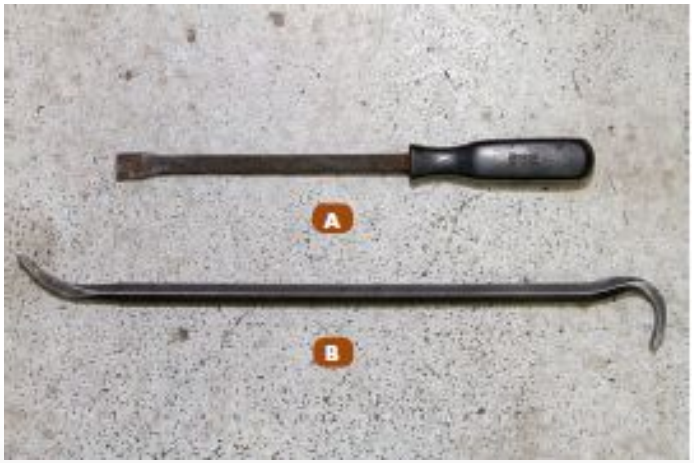
Number and letter punches.

Pry Bars
(1 of 2)

- **K06016 Describe the type and use of pry bars.**
- Tools constructed of strong metal
- Used as a lever to move, adjust, or pry
- Variety of shapes and sizes
- Tapered end bent slightly with a plastic handle on the other end

Pry Bars
(2 of 2)

- Design works well for applying force to tension belts or for moving parts into alignment
- Roll bar with a sharply curved and tapered end and tapered to a dull point end



A. Pry bar. B. Roll bar.

Gasket Scrapers

- **K06017 Describe the type and use of gasket scrapers.**
- Has a hardened, sharpened blade
- Comfortable handle on one end and a blade fitted with a sharp edge on the other
- To remove a gasket without damaging the sealing face of the component

A gasket scraper.

Files
(1 of 4)

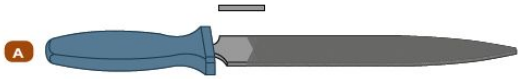
- **K06018 Describe the type and use of files.**
- Hand tools with teeth facing one direction to remove small amounts of material from the work piece surface
- List of grades in flat files from rough to smooth:
  - Rough files: used for the quick removal of a lot of material
  - Coarse bastard files: used to rough out or remove material quickly
  - Second-cut files: good all-round intermediary files leaving a smooth finish
  - Smooth files: finishing file used to provide a smooth final finish
  - Dead smooth files: used for very fine finish

Files
(2 of 4)

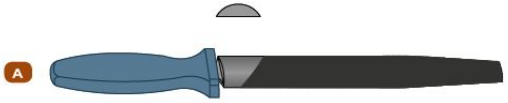
- Safe edge files are flat files with a smooth edge, without teeth
- Warding file used for working in narrow slots
- Square file used in a square or rectangular hole
- Three-sided triangular file to cut into corners without removing material from the sides
- Thread file to clean clogged or distorted threads on bolts and studs

Files
(3 of 4)

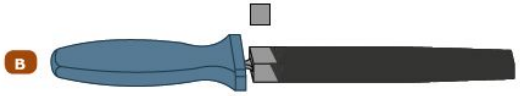
The teeth on a file determine how much material will be removed from the object being filed.



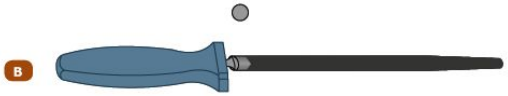
A. Warding file.



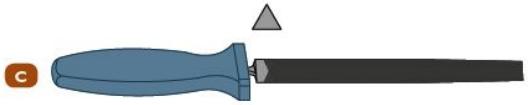
A. Half-round file.



B. Square file.



B. Round, or rat-tail, file.



C. Triangular file.

Files
(4 of 4)

Thread file.

File card.

Clamps
(1 of 2)

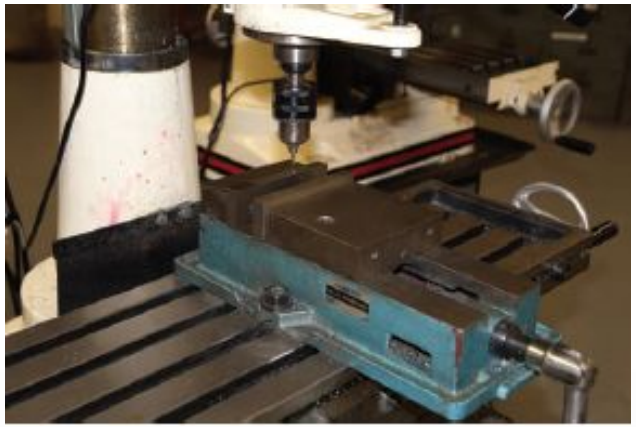
- **K06019 Describe the type and use of clamps.**
- Bench vice for sawing, filing, or chiseling
  - A pair of soft jaws to prevent damage
- Offset vice with jaws set to one side to allow long components to be held vertically

Bench vice.

Offset vice being used to hold a pipe.

Clamps
(2 of 2)

- Drill vice to hold material on a drill worktable
- C-clamp to hold parts together while they are assembled, drilled, or welded
  - Portable and used to retract disc brake caliper pistons



Drill vice on a drill worktable.

C-Clamp.

Taps and Dies

- **K06020 Describe the type and use of taps and dies.**
- Companion tools used to form threads in metal to fasten things together
- Tap cuts female threads and die cuts male threads

A. Tap.

B. Die.

Taps
(1 of 2)

- Taper Tap
  - Narrows at the tip and easy to start straight when cutting threads in a new hole
- Intermediate Tap
  - Plug tap used as a starter tap for a new hole
  - Aggressive than a taper tap

Taps
(2 of 2)

- Bottoming Tap
  - To cut threads to the bottom of a blind hole and in holes with already started threads that need extension
- Thread Chaser
  - To clean up the existing threads of a hole

A. Taper tap. B. Intermediate tap. C. Bottoming tap. D. Thread chaser.

Dies

- Used to cut external threads on a metal shank or bolt
- Adjust thread fit by adjusting the die
  - Loose-fitting threads strip easily
  - Tight-fitting threads increase the torque required to turn the bolt

A. Die nut.

B. Split die.

Proper Use of Taps and Dies
(1 of 2)

- Wear resistant and brittle
- Tap handle: to turn taps
  - T-shaped tap handle to cut a thread in an awkward space
- A die held in a die stock is used to cut a new thread on a blank rod or shaft

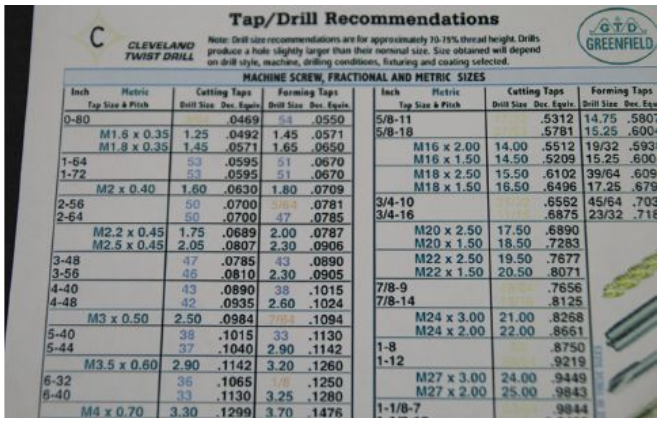
Tap handle.

T-shaped tap handle.

Proper Use of Taps and Dies

(2 of 2)

Die stock.



C

CLEVELAND TWIST DRILL

Tap/Drill Recommendations

Note: Drill size recommendations are for approximately 70-75% thread height. Drills produce a hole slightly larger than their nominal size. Size obtained will depend on drill style, machine, drilling conditions, fixturing and coating selected.

GTD GREENFIELD

MACHINE SCREW, FRACTIONAL AND METRIC SIZES

Inch / Metric Tap Size & Pitch	Cutting Taps Drill Size	Cutting Taps Dec. Equiv.	Forming Taps Drill Size	Forming Taps Dec. Equiv.
0-80		.0469	54	.0550
M1.6 x 0.35	1.25	.0492	1.45	.0571
M1.8 x 0.35	1.45	.0571	1.65	.0650
1-64	53	.0595	51	.0670
1-72	53	.0595	51	.0670
M2 x 0.40	1.60	.0630	1.80	.0709
2-56	50	.0700	48	.0781
2-64	50	.0700	47	.0785
M2.2 x 0.45	1.75	.0689	2.00	.0787
M2.5 x 0.45	2.05	.0807	2.30	.0906
3-48	47	.0785	43	.0890
3-56	46	.0810	2.30	.0905
4-40	43	.0890	38	.1015
4-48	42	.0935	2.60	.1024
M3 x 0.50	2.50	.0984	2.70	.1094
5-40	38	.1015	33	.1130
5-44	37	.1040	2.90	.1142
M3.5 x 0.60	2.90	.1142	3.20	.1260
6-32	36	.1065	1/8	.1250
6-40	33	.1130	3.25	.1280
M4 x 0.70	3.30	.1299	3.70	.1476

Inch / Metric Tap Size & Pitch	Cutting Taps Drill Size	Cutting Taps Dec. Equiv.	Forming Taps Drill Size	Forming Taps Dec. Equiv.
5/8-11		.5312	14.75	.5807
5/8-18		.5781	15.25	.6004
M16 x 2.00	14.00	.5512	19/32	.5937
M16 x 1.50	14.50	.5209	15.25	.6004
M18 x 2.50	15.50	.6102	39/64	.6094
M18 x 1.50	16.50	.6496	17.25	.6791
3/4-10		.6562	45/64	.7031
3/4-16		.6875	23/32	.7187
M20 x 2.50	17.50	.6890		
M20 x 1.50	18.50	.7283		
M22 x 2.50	19.50	.7677		
M22 x 1.50	20.50	.8071		
7/8-9		.7656		
7/8-14		.8125		
M24 x 3.00	21.00	.8268		
M24 x 2.00	22.00	.8661		
1-8		.8750		
1-12		.9219		
M27 x 3.00	24.00	.9449		
M27 x 2.00	25.00	.9843		
1-1/8-7		.9844		

Tap drill chart.

Screw Extractors
(1 of 2)

- **K06021 Describe the type and use of screw extractors.**
- To remove screws, studs, or bolts that have broken off in threaded holes
- Common type of extractor uses a coarse left-hand tapered thread formed on its body

Screw extractors.

Screw Extractors
(2 of 2)

- Marked with two sizes showing,
  - Size range of screws
  - Size of the hole that needs to be drilled
- Some use a hardened, tapered square shank
- Straight-sided, vertically splined, round shaft screw extractor type

Straight-sided screw extractor.

Pullers
(1 of 3)

- **K06022 Describe the type and use of pullers.**
- Used for removing bearings, bushings, pulleys, and gears
- Most common pullers have two or three legs that grip the part to be removed
- Gear pullers to connect to the component either externally or internally
  - Three main parts: jaws, cross-arm, and forcing screw

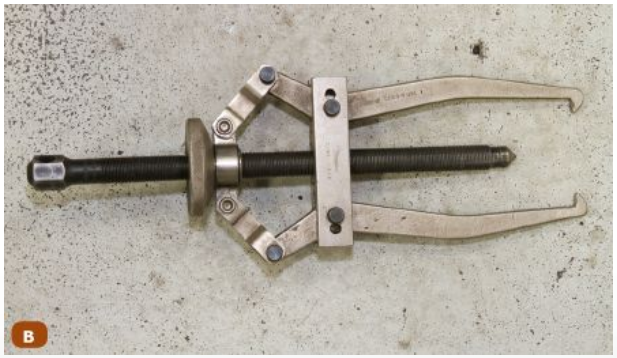
Pullers
(2 of 3)

- Forcing screw: a long, fine-threaded bolt applied to the center of the cross-arm
  - Interchangeable feet: tapered cone-style foot, flat-style foot
- Cross-arm has four arms
  - Three arms spaced 120 degrees apart and fourth arm positioned 180 degrees apart from one arm
  - Used as either a two- or a three-arm puller

Pullers
(3 of 3)

A. Puller.

Interchangeable feet for the gear puller.



B. Gear puller.

Four-arm puller.

Using Gear Pullers

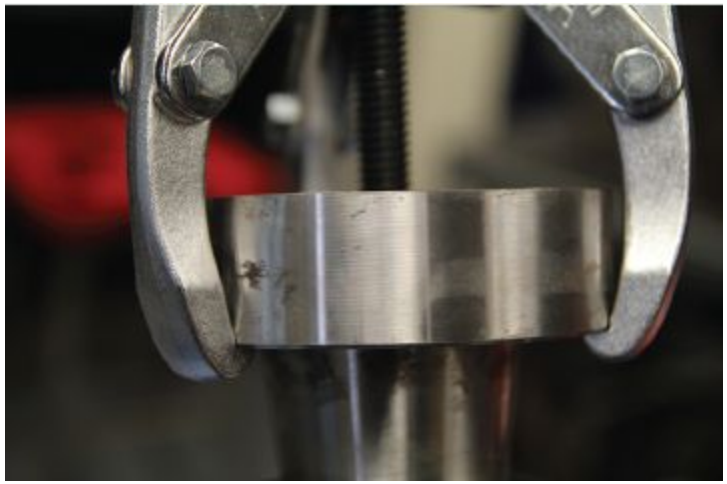
- To remove a gear, pulley, or bearing from a shaft
- To remove a shaft from inside a hole

Skill Drill 6-3 Using Gear Pullers
(1 of 5)

1. Examine the gear puller you have selected for the job. Identify the jaws; there may be two or three of them, and they must fit the part you want to remove. The cross-arm enables you to adjust the diameter of the jaws. The forcing screw should fit snugly onto the part you are removing. Finally, select the right wrench or socket size to fit the nut on the end of the forcing screw.

Skill Drill 6-3 Using Gear Pullers
(2 of 5)

2. Adjust and fit the puller. Adjust the jaws and cross-arms of the puller so that it fits tightly around the part to be removed. The arms of the jaws should be pulling against the component at close to right angles.



Skill Drill 6-3 Using Gear Pullers
(3 of 5)

3. Position the forcing screw. Use the appropriate wrench to run the forcing screw down to touch the shaft. Check that the point of the forcing screw is centered on the shaft. If not, adjust the jaws and cross-arms until the point is in the center of the shaft. Also be careful to use the correct foot on the end of the puller.

Skill Drill 6-3 Using Gear Pullers
(4 of 5)

4. Tighten the forcing screw slowly and carefully onto the shaft. Check that the puller is not going to slip off center or off the pulley. Readjust the puller if necessary.

5. If the forcing screw and puller jaws remain in the correct position, tighten the forcing screw, and pull the part off the shaft.

Skill Drill 6-3 Using Gear Pullers
(5 of 5)

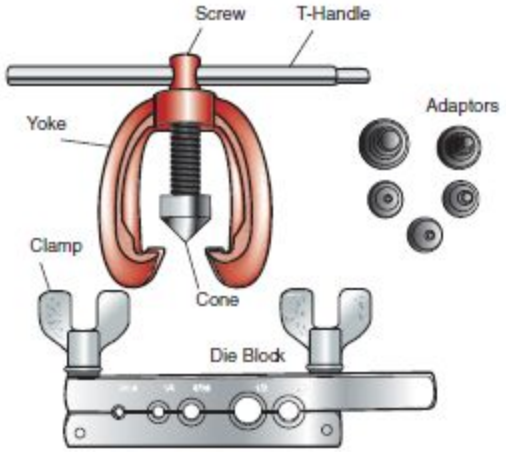
6. You may sometimes have to use a hammer to hit directly on the end of the forcing screw to help break the part loose.

Flaring Tools
(1 of 3)

- **K06023 Describe the type and use of flaring tools.**
- Tube flaring tool used to flare the end of a tube so that it can be connected to another tube or component
- Single flare: for tubing carrying low pressures like a fuel line
- Double flare: for higher pressures such as in a brake system
- ISO flare: bubble flare is the metric version used in brake systems

Flaring Tools
(2 of 3)

Single flare, double flare, and ISO flare.



Components of a flare tool.

Flaring Tools
(3 of 3)

- Tubing cutter: for cutting pipes and metal tubing

Tubing cutter.

Using Flaring Tools

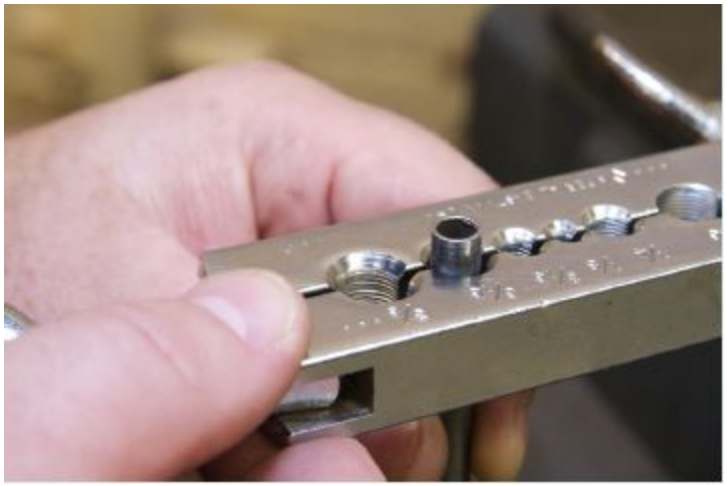
- Correct amount of tube protruding before clamping
- Correctly sized button for the tubing size
- Tool sufficiently tight around the tube before starting to create the flare

Skill Drill 6-4 Using Flaring Tools
(1 of 6)

1. Choose the tube you will use to make the flare, and put the flare nut on the tube before creating the flare.

Skill Drill 6-4 Using Flaring Tools
(2 of 6)

2. Match the size of the tube to the correct hole in the tubing clamp.

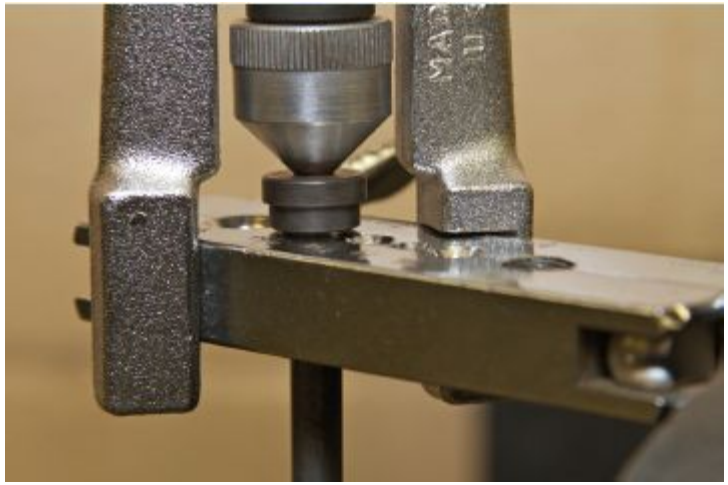


Skill Drill 6-4 Using Flaring Tools
(3 of 6)

3. Holding the flaring tool, put the tube into the clamp. Position the tube so the correct amount is showing through the tool. If you are conducting a double flare, use the correctly sized button to ensure the proper amount of the tube is sticking up above the top of the clamp. Tighten the two halves of the clamp together using the wing nuts. Make sure the tool is tight enough to clamp the tube so it will not slip.

Skill Drill 6-4 Using Flaring Tools
(4 of 6)

4. Put the cone and forming tool over the clamp, and turn the handle to make the flare. If you are doing a double flare or ISO flare, place the button in the end of the tube, install the cone and forming tool, and turn the handle to make the bubble. Remove the button from the tube.



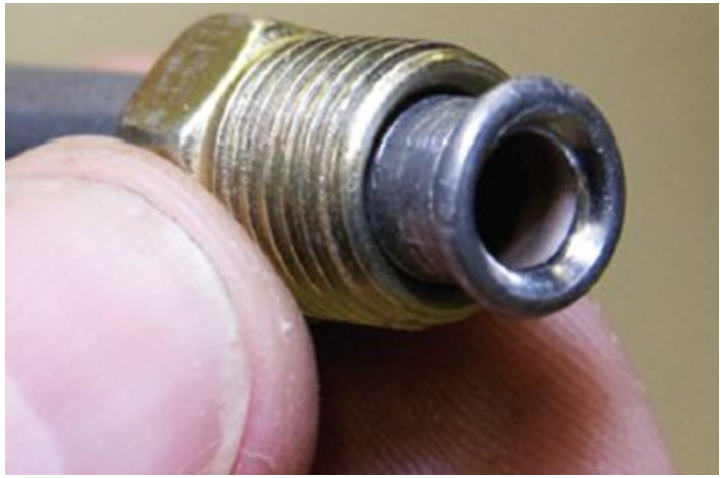
Skill Drill 6-4 Using Flaring Tools
(5 of 6)

5. If this is an ISO flare, inspect it to see if it is properly formed. If it is a double flare, put the cone and forming tool back on the clamp, and tighten the forming tool handle to create the double flare.

6. Remove the forming tool.

Skill Drill 6-4 Using Flaring Tools
(6 of 6)

7. Remove the tube from the clamp, and check the flare to ensure it is free of burrs and is correctly formed.

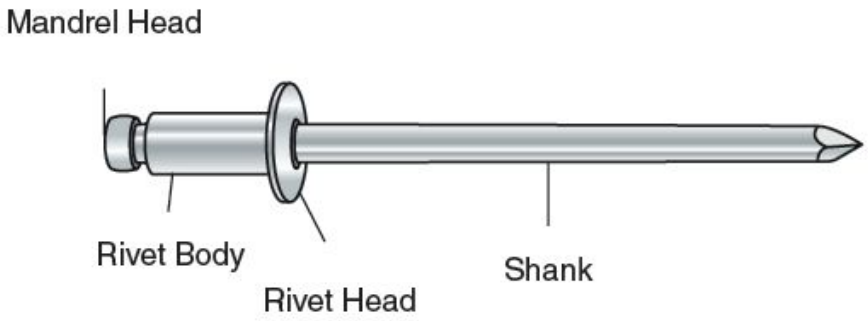


Riveting Tools
(1 of 2)

- **K06024 Describe the type and use of riveting tools.**
- Used where there is a need for a fastener that doesn't have to be easily removed
- Pop rivet guns for occasional riveting of light materials
- Blind rivet has a body that forms the finished rivet and a mandrel discarded after riveting
- Mandrel head: bigger than the hole through the body, makes the body swell tightly against the hole

Riveting Tools
(2 of 2)

Pop rivet guns.



Anatomy of a rivet.

Using Riveting Tools
(1 of 2)

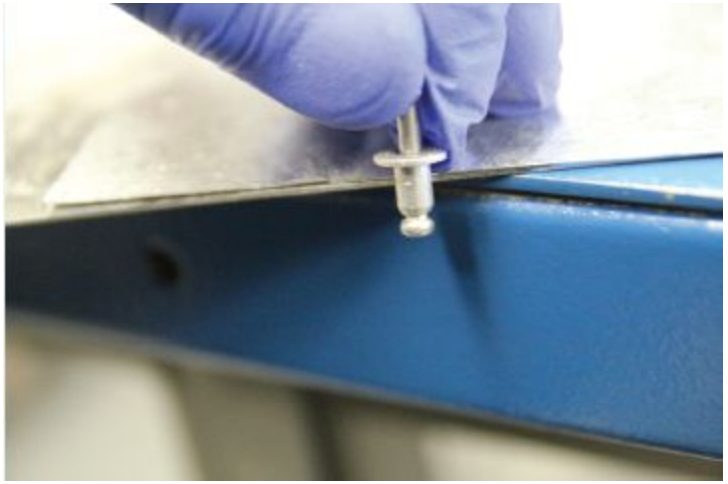
- Rivet tools are used to join two pieces of material together
- Things needed to perform a riveting operation:
  - Rivet gun
  - Rivets
  - Drill
  - Properly sized drill bit
  - Materials to be riveted

Using Riveting Tools
(2 of 2)

- When selecting rivets, the diameter, length, and rivet material to be considered
- Pilot holes must be drilled through the metal to be riveted

Skill Drill 6-5 Using Riveting Tools
(1 of 6)

1. Select the correct rivet for the material you are riveting. Make sure the rivet is the correct length.



Skill Drill 6-5 Using Riveting Tools
(2 of 6)

2. Drill pilot holes in the material to be riveted. Remove any burrs. Ensure that the pilot hole is the correct size—not too large or too small.

Skill Drill 6-5 Using Riveting Tools
(3 of 6)

3. Make sure the correctly sized nosepiece for the rivet size is fitted to the rivet tool.

Skill Drill 6-5 Using Riveting Tools
(4 of 6)

4. Insert the rivet into the gun, and push the rivet through the materials to be riveted. Hold firm pressure while pushing the rivet into the work.

Skill Drill 6-5 Using Riveting Tools
(5 of 6)

5. Squeeze and release the rivet tool handle to compress the rivet. Continue this process until the rivet stem or shank breaks away from the rivet head.

Skill Drill 6-5 Using Riveting Tools
(6 of 6)

6. Check the rivet joint to ensure the pieces are firmly held together.

Precision Measuring Tools
(1 of 2)

- **N06004 Demonstrate proper use of precision measuring tools (i.e., micrometer, dial-indicator, dial-caliper).**
- Accurate to much smaller dimensions such as a micrometer
- Classified according to the type of measurements they can make
  - Measuring tape: useful for measuring longer distances and is accurate to a millimeter or fraction of an inch
  - Steel rule: capable of accurate measurements on shorter lengths, down to a millimeter or a fraction of an inch

Precision Measuring Tools
(2 of 2)

A. Measuring tape.

B. Steel rule.

Measuring Tapes
(1 of 2)

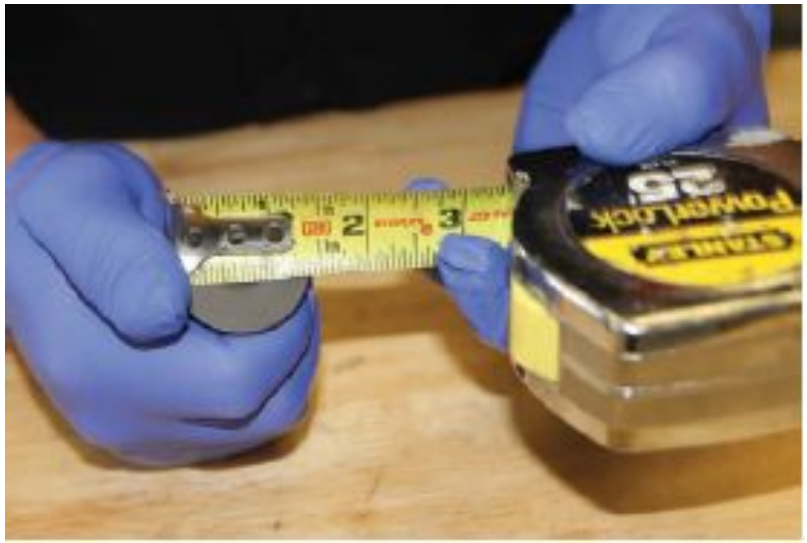
- **K06025 Describe the type and use of measuring tapes.**
- Flexible type of ruler and a common measuring tool
- Most common type found in shops: a thin metal strip about 0.5" to 1" wide that is rolled up inside a housing with a spring return mechanism
- Various lengths, with 16' or 25' (5 or 8 m) being very common
- Housing has a built-in locking mechanism

Measuring Tapes
(2 of 2)

The hook makes it easy to take a measurement with one hand.

Steel Rulers

- **K06026 Describe the type and use of steel rulers.**
- Made of steel in 12", 24", and 36" lengths
- Used to measure and mark out items
- Has precision markings and resists damage



Tipping a steel rule on its side to get a more accurate reading.

Outside, Inside, and Depth Micrometers
(1 of 5)

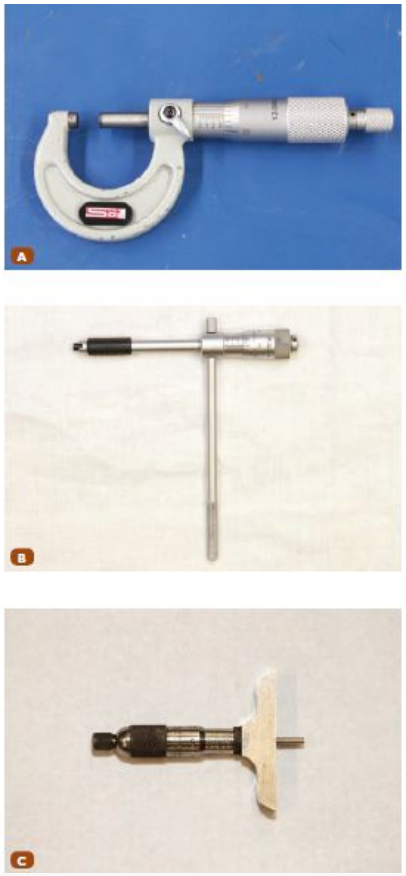
- **K06027 Describe the type and use of outside, inside, and depth micrometers.**
- Precise measuring tools designed to measure small distances
  - Available in both inch and millimeter calibrations
- Outside micrometer measures the outside dimensions of an item
- Inside micrometer measures inside dimensions

Outside, Inside, and Depth Micrometers
(2 of 5)

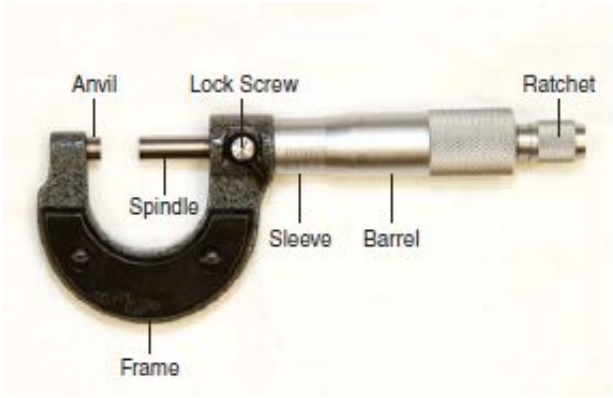
- Depth micrometers measure the depth of an item
- Lock nut to lock the thimble in place while reading the micrometer
- Metric micrometer uses the same components as the standard micrometer
  - Uses different thread pitch on the spindle and sleeve

Outside, Inside, and Depth Micrometers

(3 of 5)



A. Outside micrometer. B. Inside micrometer. C. Depth micrometer.



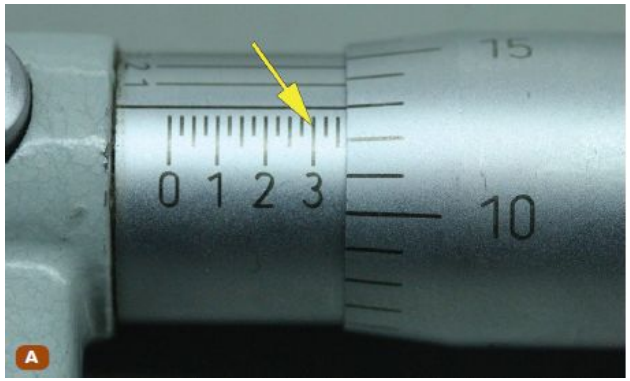
Parts of an outside micrometer.

0.100" and 0.025" markings on the sleeve.

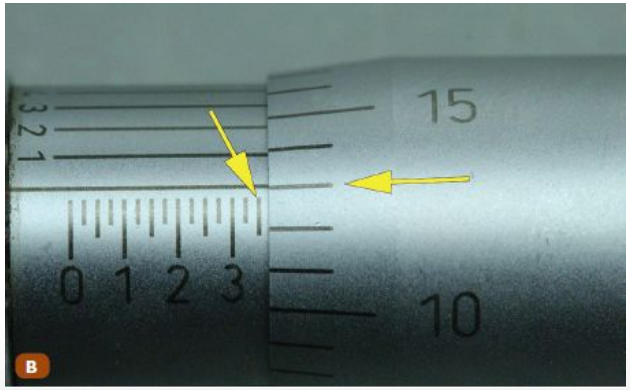
Outside, Inside, and Depth Micrometers

(4 of 5)

Markings on the thimble.



A. Read how many 0.100" marks the thimble has uncovered.



B. Read the number on the thimble that lines up with the zero line on the sleeve.

Outside, Inside, and Depth Micrometers

(5 of 5)

Metric markings on the sleeve.

Markings on the thimble.

Vernier scale on a micrometer showing 7 on the sleeve lined up the best with a line on the thimble.

Using Micrometers

- Clean micrometer and the items to be measured
- Micrometer zeroes before taking measurements
- No over-tightening or storing it with measuring surfaces touching
- Use ratchet to tighten it
- Take measurement a number of times and compare results

Skill Drill 6-6 Using Micrometers
(1 of 6)

1. Select the correct size of micrometer. and that it is calibrated properly. Clean the surface of the part you are measuring. Verify that the anvil and spindle are clean

Skill Drill 6-6 Using Micrometers
(2 of 6)

2. In your right hand, hold the frame of the micrometer between your pinky, ring finger, and the palm of your hand, with the thimble between your thumb and forefinger.

Skill Drill 6-6 Using Micrometers
(3 of 6)

3. With your left hand, hold the part you are measuring, and place the micrometer over it.

Skill Drill 6-6 Using Micrometers
(4 of 6)

4. Using your thumb and forefinger, lightly tighten the ratchet. It is important that the correct amount of force is applied to the spindle when taking a measurement. The spindle and anvil should just touch the component with a slight amount of drag when the micrometer is removed from the measured piece. Be careful that the part is square in the micrometer so the reading is correct. Try rocking the micrometer in all directions to make sure it is square.

Skill Drill 6-6 Using Micrometers
(5 of 6)

5. Once the micrometer is properly snug, tighten the lock mechanism so the spindle will not turn. Read the micrometer and record your reading.

Skill Drill 6-6 Using Micrometers
(6 of 6)

6. When all readings are finished, clean the micrometer, position the spindle so it is backed off from the anvil, and return it to its protective case.

Telescoping Gauges

- **K06028 Describe the type and use of telescoping gauges.**
- Has spring-loaded plungers to measure distances in awkward spots
- Variety of sizes to fit various sizes of holes and bores

Telescoping gauge.

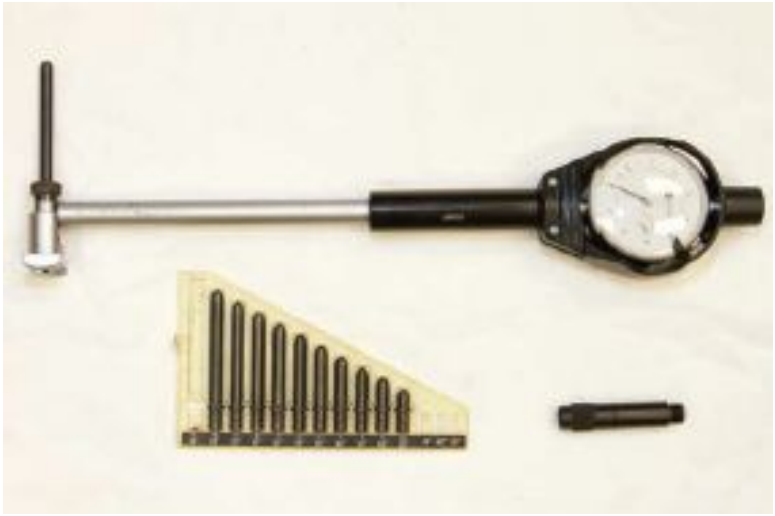
Split Ball Gauges

- **K06029 Describe the type and use of split ball gauges.**
- Small-hole gauge to measure small holes where telescoping gauges cannot fit
- Measuring head uses a split ball mechanism
- Ideal for measuring valve guides on a cylinder head for wear

Split ball gauges.

Dial Bore Gauges

- **K06030 Describe the type and use of dial bore gauges.**
- To measure the inside diameter of bores with a high degree of accuracy and speed
- Combines a telescoping gauge and dial indicator in one instrument
- Determines if the diameter is worn, tapered, or out-of-round



A dial bore gauge set.

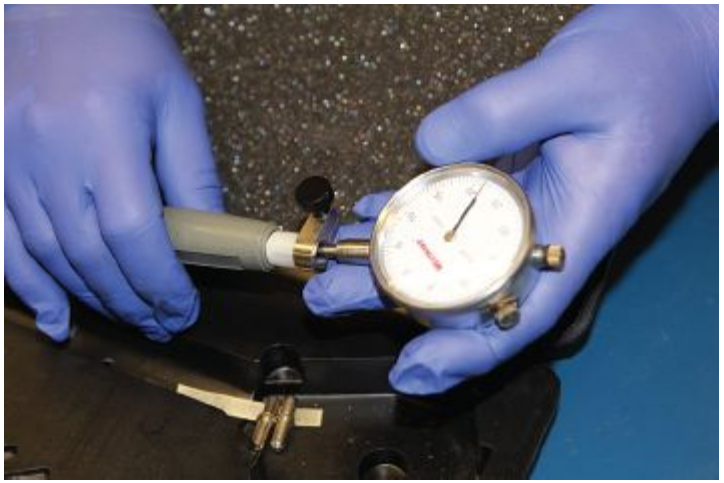
Using Dial Bore Gauges

- Appropriate-sized adapter to fit the internal diameter of the bore and installing it to the measuring head
- Ensure that the locking mechanism is released while in storage
- Gauge at a 90-degree angle to the bore while measuring

Dial bore gauge being calibrated to a predetermined size.

Skill Drill 6-7 Using Dial Bore Gauges
(1 of 5)

1. Select the correct size of the dial bore gauge you will use, and fit any adapters to it. Check the calibration and adjust it as necessary. Insert the dial bore gauge into the bore. The accurate measurement will be at exactly 90 degrees to the bore. To find the accurate measurement, rock the dial bore gauge handle slightly back and forth until you find the centered position.

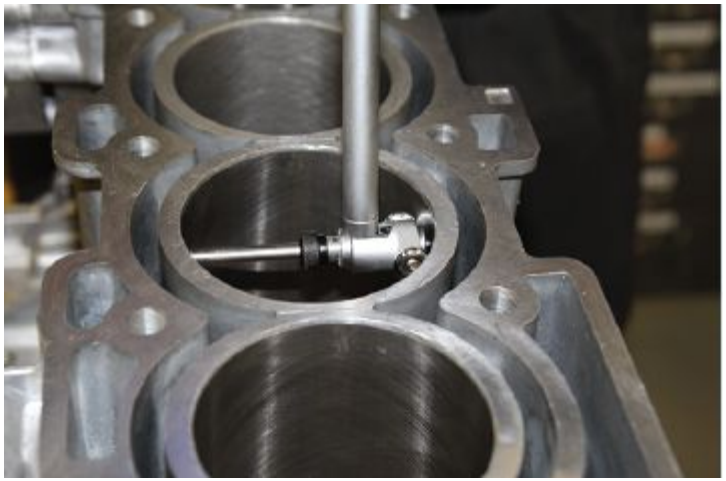


Skill Drill 6-7 Using Dial Bore Gauges
(2 of 5)

2. Check the calibration and adjust it as necessary.

Skill Drill 6-7 Using Dial Bore Gauges
(3 of 5)

3. Insert the dial bore gauge into the bore. The accurate measurement will be at exactly 90 degrees to the bore. To find the accurate measurement, rock the dial bore gauge handle slightly back and forth until gauge handle slightly back and forth until you find the centered position.

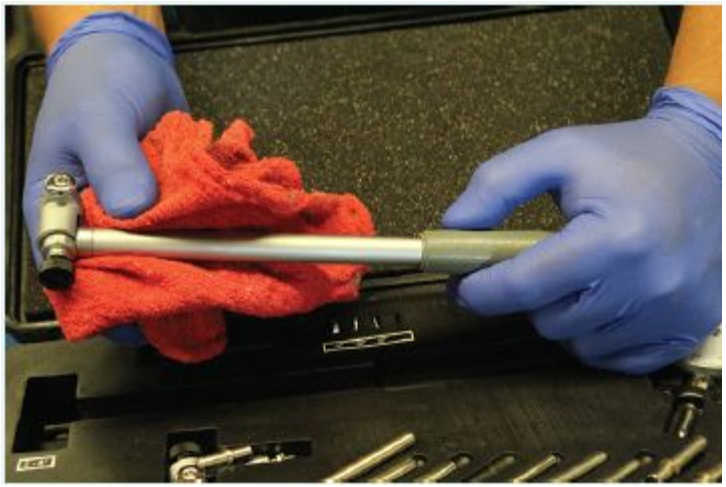


Skill Drill 6-7 Using Dial Bore Gauges
(4 of 5)

4. Read the dial to determine the bore measurement.

Skill Drill 6-7 Using Dial Bore Gauges
(5 of 5)

5. Always clean the dial bore gauge, and return it to its protective case when you have finished using it.



Vernier Calipers
(1 of 2)

- **K06031 Describe the type and use of vernier calipers.**
- Precision instrument used for measuring outside dimensions, inside dimensions, and depth measurements
- Graduated bar with markings like a ruler and sliding sleeve with jaws for taking inside or outside measurements

Vernier calipers can take three types of readings.

Vernier Calipers
(2 of 2)

- To measure length and diameters of bolts and pins or the depth of blind holes in housings
- Newer versions with dial and digital scales

Dial vernier caliper.

Digital caliper.

Using Vernier Calipers

- Storage box protection
- Clean measuring surfaces for accurate measurement
- At right angles to the surfaces to be measured
- Take measurement a number of times and compare results

Skill Drill 6-8 Using Vernier Calipers
(1 of 3)

1. Verify that the vernier caliper is calibrated (zeroed) before using it.

Skill Drill 6-8 Using Vernier Calipers
(2 of 3)

2. Position the caliper correctly for the measurement you are making. Internal and external readings are normally made with the vernier caliper positioned at 90 degrees to the face of the component to be measured. Length and depth measurements are usually made parallel to or in line with the object being measured. Use your thumb to press or withdraw the sliding jaw to measure the outside or inside of the part.

Skill Drill 6-8 Using Vernier Calipers
(3 of 3)

3. Read the scale of the vernier caliper, being careful not to change the position of the moveable jaw. If using a non-digital caliper, always read the dial or face straight on. A view from the side can give a considerable parallax error. Parallax error is a visual error caused by viewing measurement markers at an incorrect angle.

Dial Indicators
(1 of 2)

- **K06032 Describe the type and use of dial indicators.**
- Dial gauges with a dial and needle
- Dial displays the movement of the plunger
- Crankshaft: dial indicator can measure the roundness
  - Can be rotated in a set of V blocks
- Amount of movement from the measuring component determines the type

Dial Indicators
(2 of 2)

Dial indicator.

A dial indicator being used to measure crankshaft runout.

Using Dial Indicators

- Used in many types of service jobs
- In determining run-out on rotating shafts and surfaces
- Short support arms, tight attachments, plunger positioned at 90 degrees, and reading the dial face straight on
- Zeroing the dial indicator

Skill Drill 6-9 Using Dial Indicators
(1 of 6)

1. Select the gauge type, size, attachment, and bracket that fit the part you are measuring. Mount the dial indicator firmly to keep it stationary.

Skill Drill 6-9 Using Dial Indicators
(2 of 6)

2. Adjust the indicator so that the plunger is at 90 degrees to the part you are measuring, and lock it in place.

Skill Drill 6-9 Using Dial Indicators
(3 of 6)

3. Rotate the part one complete turn, and ocate the low spot. Zero the indicator.

Skill Drill 6-9 Using Dial Indicators
(4 of 6)

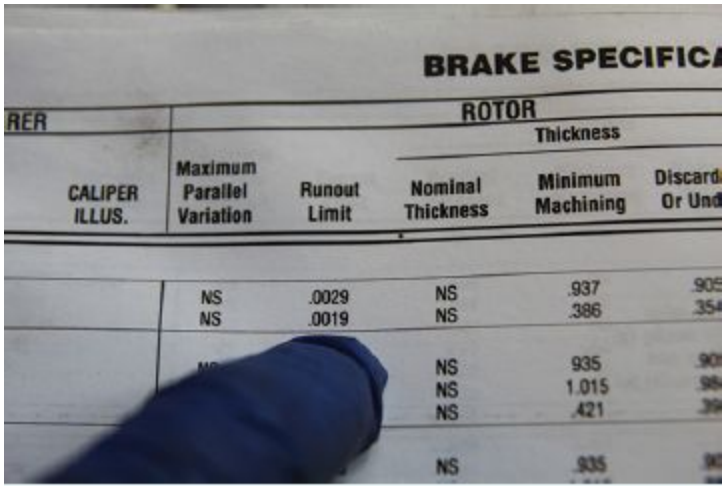
4. Find the point of maximum height and note the reading. This indicates the runout value.

Skill Drill 6-9 Using Dial Indicators
(5 of 6)

5. Continue the rotation, making sure the needle does not go below zero. If it does, re-zero the indicator and remeasure the point of maximum variation.

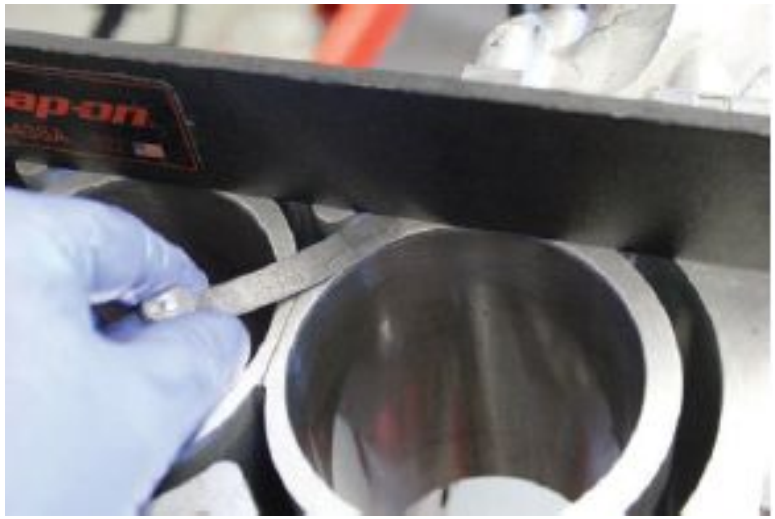
Skill Drill 6-9 Using Dial Indicators
(6 of 6)

6. Check your readings against the manufacturer's specifications. If the deviation is greater than the specifications allow, consult your supervisor.



Straight Edges

- **K06033 Describe the type and use of straight edges.**
- Made from hardened steel
- Machined to a perfectly straight edge
- Feeler gauges to measure the gap between the straight edge and the surface
- Used to measure the amount of warpage the surface of a cylinder head has



Straight edge being used to measure the flatness of a surface.

Feeler Gauges
(1 of 2)

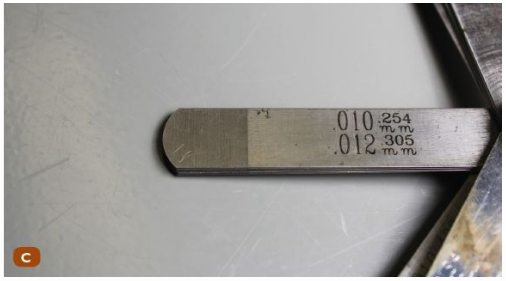
- **K06034 Describe the type and use of feeler gauges.**
- To measure the width of gaps
- Flat metal strips of varying thicknesses
- Brass feeler gauge: to take measurements between magnetic components
- To measure surface irregularities on a cylinder head in conjunction with a straight edge

Feeler Gauges
(2 of 2)

Feeler blade set. A. Straight.

Feeler blade set. B. Bent.

Stepped feeler blade being used during a valve adjustment.



Feeler blade set. C. Stepped.

Feeler blade set. D. Wire gauge.

Using Feeler Gauges

- Selection of the right size if the gauge is too tight or loose
- When measuring a spark plug gap, feeler gauge should not be used
  - Wire feeler gauge to be used

Wire feeler gauge used to check a spark plug gap.

Skill Drill 6-10 Using Feeler Gauges
(1 of 4)

1. Select the appropriate type and size feeler gauge set for the job you are working on.

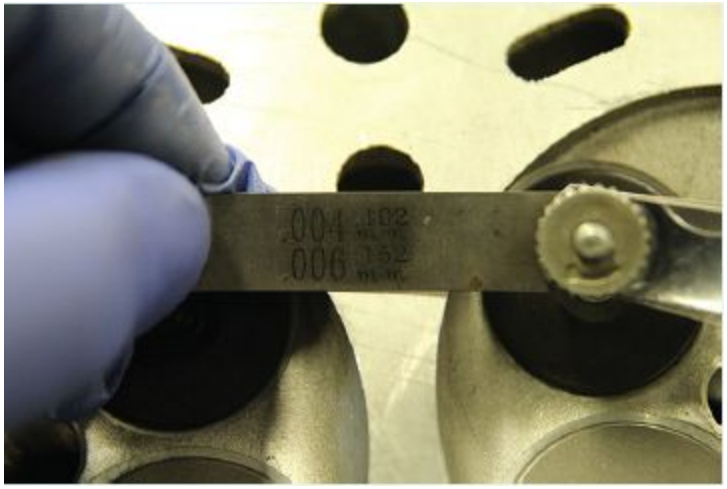
2. Inspect the feeler gauges to make sure they are clean, rust-free, and undamaged, but slightly oiled for ease of movement.

Skill Drill 6-10 Using Feeler Gauges
(2 of 4)

3. Choose one of the smaller wires or blades, and try to insert it in the gap on the part. If it slips in and out easily, choose the next size up. When you find one that touches both sides of the gap and slides with only gentle pressure, then you have found the exact width of that gap.

Skill Drill 6-10 Using Feeler Gauges
(3 of 4)

4. Read the markings on the wire or blade, and check these against the manufacturer's specifications for this component. If gap width is outside the tolerances specified, inform your supervisor.



Skill Drill 6-10 Using Feeler Gauges
(4 of 4)

5. Clean the feeler gauge set with an oily cloth before storage to prevent rust.

Cleaning Tools and Equipment
(1 of 2)

- **N06005 Demonstrate proper cleaning, storage, and maintenance of tools and equipment.**
- **K06035 Describe the importance of proper cleaning and storage of tools.**
- If any damage, tag the tool as faulty and organize a repair or replacement
- Electrical power tools should be free from oils and grease

Cleaning Tools and Equipment
(2 of 2)

- Maintenance schedule
- Storing in easy-to-reach location and tidy work area
- Supplier's recommendations for collection or disposal
- Wearing chemical gloves and appropriate protection

Skill Drill 6-11 Tool and Equipment Cleaning

(1 of 6)

1. Clean hand tools. Keep your hand tools in good, clean condition with two types of rags. One rag should be lint-free to clean or handle precision instruments or components. The other should be oily to prevent rust and corrosion.

Skill Drill 6-11 Tool and Equipment Cleaning

(2 of 6)

2. Clean floor jacks. Wipe off any oil or grease on the floor jack, and check for fluid leaks. If you find any, remove the jack from use, and have it repaired or replaced. Occasionally, apply a few drops of lubricating oil to the wheels and a few drops to the posts of threaded jack stands.

Skill Drill 6-11 Tool and Equipment Cleaning

(3 of 6)

3. Clean electrical power tools. Keep power tools clean by brushing off any dust and wiping off excess oil or grease with a clean rag. Inspect any electrical cables for dirt, oil, or grease, and for any chafing or exposed wires. With drills, inspect the chuck and lubricate it occasionally with machine oil.

Skill Drill 6-11 Tool and Equipment Cleaning
(4 of 6)

4. Clean air-powered tools. Apply a fewdrops of oil into the inlet of your air tools every day. Although these tools have no electrical motor, they do need regular lubrication of the internal parts to prevent wear.

Skill Drill 6-11 Tool and Equipment Cleaning

(5 of 6)

5. Clean hoists and heavy machinery. Locate the checklist or maintenance record for each hoist or other major piece of equipment before carrying out cleaning activities.

Skill Drill 6-11 Tool and Equipment Cleaning
(6 of 6)

6. You should clean equipment operating mechanisms and attachments of excess oil or grease.

Summary
(1 of 13)

- Tools and equipment should be used only for the task they were designed to do.
- Always have a safe attitude when using tools and equipment.
- Do not use damaged tools; inspect before using, then clean and inspect again before putting them away.
- Lockouts and tag-outs are meant to prevent technicians from using tools and equipment that are potentially unsafe.

Summary
(2 of 13)

- Many tools and measuring instruments have USCS or metric system markings to identify their size.
- Torque defines how much a fastener should be tightened.
- Torque specification indicates the level of tightness each bolt or nut should be tightened to; torque charts list torque specifications for nuts and bolts.
- Torque (or tension) wrenches tighten fasteners to the correct torque specification.

Summary
(3 of 13)

- Torque value—the amount of twisting force applied to a fastener by the torque wrench—is specified in foot-pounds (ft-lb), inch-pounds (in-lb), or newton meters (N·m).
- Torque wrench styles are beam (simplest and least expensive), clicker, dial, and electronic. Each gives an indication of when proper torque is achieved.
- Bolts that are tightened beyond their yield point do not return to their original length when loosened.

Summary
(4 of 13)

- Common wrenches include box end, open end, combination (most popular), flare nut (or flare tubing), open-end adjustable, and ratcheting box end.
- Box-end wrenches can loosen very tight fasteners, but open-end wrenches usually work better once the fastener has been broken loose.
- Use the correct wrench for the situation, so as not to damage the bolt or nut.

Summary
(5 of 13)

- Sockets grip fasteners tightly on all six corners and are purchased in sets.
- Sockets are classified as follows: standard or metric, size of drive used to turn them, number of points, depth of socket, and thickness of wall.
- The most common socket handle is a ratchet; a breaker bar gives more leverage, or a sliding T-handle may be used.
- Fasteners can be spun off or on (but not tightened) by a speed brace or speeder handle.

Summary
(6 of 13)

- Pliers hold, cut, or compress materials; types include slip-joint, combination, arc joint, needle-nose, flat, diagonal cutting, snap ring, and locking.
- Always use the correct type of pliers for the job.
- Cutting tools include bolt cutters, tin snips, and aviation snips.
- Allen wrenches are designed to fit into fasteners with recessed hexagonal heads.

Summary
(7 of 13)

- Screwdriver types include flat blade (most common), Phillips, Pozidriv, offset, ratcheting, and impact.
- The tip of the screwdriver must be matched exactly to the slot or recess on the head of a fastener.
- Magnetic pickup tools and mechanical fingers allow for the extraction and insertion of objects in tight places.
- Types of hammers include ball peen (most common), sledge, mallet, and dead blow.

Summary
(8 of 13)

- Chisels are used to cut metals when hit with a hammer.
- Punches are used to mark metals when hit with a hammer and come in different diameters and different points for different tasks; types of punches include prick, center, drift, pin, ward, and hollow.
- Pry bars can be used to move, adjust, or pry parts.
- Gasket scrapers are designed to remove gaskets without damaging surrounding materials.

Summary
(9 of 13)

- Files are used to remove material from the surface of an automotive part.
- Flat files come in different grades to indicate how rough they are; grades are rough, coarse bastard, second cut, smooth, and dead smooth.
- Types of files include flat, warding, square, triangular, curved, and thread.
- Bench vices, offset vices, drill vices, and C-clamps all hold materials in place while they are worked on.

Summary
(10 of 13)

- Taps are designed to cut threads in holes or nuts; types include taper, intermediate, and bottoming.
- A die is used to cut a new thread on a blank rod or shaft.
- Gear and bearing pullers are designed to remove components from a shaft when considerable force is needed.
- Flaring tools create flares at the end of tubes to connect them to other components; types include single, double, and ISO.

Summary
(11 of 13)

- Rivet tools join together two pieces of metal; each rivet can be used only once.
- Measuring tapes and steel rules are commonly used measuring tools; more precise measuring tools include micrometers, gauges, calipers, dial indicators, and straight edges.
- Micrometers can be outside, inside, or depth.

Summary
(12 of 13)

- Learn to read micrometer measurements on the sleeve/barrel and thimble; always verify the micrometer is properly calibrated before use.
- Gauges are used to measure distances and diameters; types include telescoping, split ball, and dial bore.
- Vernier calipers measure outside, inside, and depth dimensions; newer versions have dial and digital scales.
- Dial indicators are used to measure movement.

Summary
(13 of 13)

- A straight edge is designed to assess the flatness of a surface.
- Feeler blades are flat metal strips that are used to measure the width of gaps.
- Keep work area, tools, and equipment clean and organized.

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