4 Hand Tools and Equipment

Objective

Students will be able to:

- Compare and contrast different types of automotive hardware.
- Recognize taps and dies, and interpret sizes.
- Identify automotive measuring tools, and provide examples of usage.
- Identify automotive hand tools, and provide examples of usage.
- Identify automotive power tools, and provide examples of usage.
- Distinguish and classify different types of shop equipment.
- Compare and contrast different types of automotive lifts.
- Compare and contrast general diagnostic equipment.
- Compare and contrast electronic diagnostic equipment.

Orienting Questions

- ✓ Can you explain what automotive hardware is?
- ✓ Do you know what common hand tools are?
- ✓ Can you explain the difference between hand tools, and shop equipment?
- ✓ Can you explain what automotive power tools are?
- ✓ Can you list some automotive measuring tools?

****Closed Captions and transcripts are available for all videos in this module. Click the CC button at the bottom right of the play menu to turn on closed captions in the language of your choice. You may also read a full transcript of the video by clicking the bottom of the play menu. If the YouTube closed captioning is not accurate, there will be an indication that the transcript is attached at the end of the module. *****

A black arrow pointing to the right inside a lavender circle is the symbol used for activities which are non-graded assignments.

A black arrow pointing to the right inside an orange circle is symbol for a graded assignment.

A black question mark in a lavender circle is the symbol for a practice test.

A black question mark in an orange circle is the symbol for a graded test.

PRE TEST

1. All the following are considered threaded fasteners except:
   A. Bolts
   B. Nuts
   C. Screws
   D. Rivets
2. The strength of a metric bolt is determined by counting the number of grade marks.
   A. True
   B. False
3. All of the following are considered hand tools except:
   A. Wrenches
   B. Hammers
   C. Torches
   D. pliers
4. Which of the following tools would not be used for precision measuring?
   A. Micrometers
   B. Dial Indicators
   C. Tape Measures
   D. Calipers
5. Which of the following hand tools would best remove a flared brake line?
   A. Socket Wrench
   B. Combination Wrench
   C. Line Wrench
   D. Pliers
6. Most power tools in an automotive repair shop or power by electricity.
   A. True
   B. False
7. What is the acronym for the agency that certifies automotive lifts?
   A. NTSB
   B. ALI
   C. CIA
   D. NRA
8. Which of the following items would not be considered shop equipment?
   A. Hydraulic press
   B. tire balancer
   C. impact wrench
   D. bench grinder

9. Automotive scan tools all operate the same and have the same capabilities.
   A. True
   B. False
10. Beam-type torque wrenches are more accurate than click-type torque wrenches.
   A. True
   B. False

INTRODUCTION

This module is designed to explore the hands-on or working end of the industry. In this module you will see the tools and hardware required to perform repairs and basic services. Throughout this module students will receive detailed operational instructions of tools, and hardware. The purpose of this module is to prepare students for future hands-on labs required in automotive programs.
Please watch Video 1 for an introduction to this module. You may access the video by clicking on the Video 1 image.

Video 1 – Introduction (York Technical College, Public Domain)
For a transcript of this video, please click on transcript.
For the embed code of this video, please click on embed.
Image: Man in-front of a brick wall

4.1 HARDWARE

Fasteners are the hardware used to hold automobiles and their components together. The most common fasteners used in automobiles are the threaded fasteners. Threaded fasteners include bolts, nuts, screws and others that allow removal and installation by turning the fasteners in one direction or the other. Threads are cut or rolled onto the fasteners. The threads may be coarse (furthers apart) or fine (close together) or even tapered such as pipe thread. Tapered pipe threads provide a good seal because they are compressed together as they tightened. Coarse threads allow faster removal and assembly but have less holding force and vibration resistance than fine threads. Fine threads

are not commonly used on aluminum or cast iron because these materials will allow the threads to strip easier.

Bolts have threads on one end and a head used to tighten and loosen it on the other. Bolts can be identified by their length, thread pitch, diameter, head type and size and grade. The listed size of a bolt is determined by its diameter, not its head size. The shank of the bolt is the non-threaded portion on the end toward the head. The diameter of a bolt is measured across the shank or threads of the bolt. The length is measured from under the head to the end of the bolt. The **thread pitch** of a bolt in the Imperial System is measured by the number of threads contained in one inch. A Unified National Coarse, or UNC, bolt with a 3/8 inch diameter is listed as a 3/8 x 16 bolt. This indicates that it has a 3/8 inch diameter and 16 threads per inch. A Unified National Fine, or UNF, bolt 3/8 inch in diameter would have 24 threads per inch and be listed as a 3/8 x 24 bolt.

Metric bolt thread pitch is measured by the distance in millimeters between two adjacent threads. Metric threads vary in spacing from 1.0 to 2.0 millimeters. A lower number means a finer thread. A metric bolt listed as 8 x 1.25 x 40 would have an 8 millimeter diameter, 1.25 millimeters between adjacent threads and a 40 millimeter length.

The **bolt's tensile strength** is the amount of stress it is able to withstand prior to breakage. The tensile strength is referred to as the grade of the bolt. The grade is determined by the diameter and the type of material the bolt is made of. The Imperial System identifies the grade of the bolt by a set of marks on the head of the bolt. These radial lines around the head are called "grade marks". The number of marks range from zero to six and adding two to the number of marks identifies the grade. If the bolt has six radial marks on its head then it would be a grade 8 bolt. Metric bolts have a property class number on their head that identifies the grade. Two numbers separated by a period or dot are on the head of each metric bolt. The first number represents the tensile strength of the bolt. Higher numbers mean higher strength. The second number indicates the percentage rating of the **yield strength**. This indicates how much stress the bolt can take before it cannot return to its original shape. A 10.9 bolt has 145,000 PSI tensile strength and yield strength of 130,500 PSI (90% of the tensile strength). A 10.9 metric bolt and a grade 8 Imperial bolt are similar in strength.

Please examine figure 1 which shows a variation of bolts, nuts and washers.

Figure 1 – bolts (Jonathan Stewart, CC BY – NC – ND – 2.0)
Image: Many types of bolts, nuts and washers

Nuts are graded in a similar manner as bolts and must match the grade of the bolt in order to maintain the proper grade of connection. When a bolt is tightened properly, it will hold with a "spring loaded" effect. This spring loaded effect is caused by the elastic stretching property of the bolt. Normally a bolt is tightened to 70% of its elastic limit. The elastic limit is the point of stretch that causes the bolt to not return to its original length and shape when removed. Passing the elastic limit reduces the bolts clamping force and distorts its threads.

Figure 2 shows a variety of nuts in various sizes and shapes.

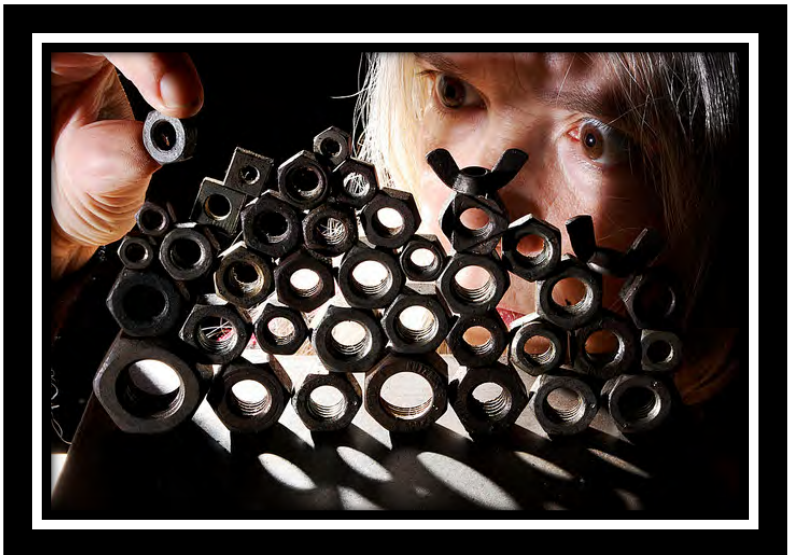


Figure 2 – Nuts (Aponid, CC BY – NC – ND 2.0)

Image: Variety of nuts of various shapes and sizes being stacked in a pyramid by a person

Several types of washers are used with bolts in automotive applications. Flat washers are used to spread the load of the clamping force of the bolt over a greater area. They also keep the head of the bolt from digging into the surface of the component it is holding. Copper and other soft type flat washers are often used to seal components together. Washers should always be reinstalled or replaced if necessary. Leaving a washer off can result in a poor repairs and possible failures.

Please examine Figure 3 which shows several washers pf various sizes.

Figure 3 – Washers (Nicholas Doumani, CC BY –ND – 2.0)
Image: Washers of various sizes

Studs are like bolts without a head, but instead are threaded for a nut on the head end. Most studs are coarse thread on one end and a fine on the other. The coarse thread can be used in an aluminum or cast iron part while a fine thread nut can be used to achieve more clamping force on the part being attached. **Cap screws** are like bolts but are threaded from the end to the head, therefore having no shank. Cap screws should never be used in place of bolts. Set screws are used on pulleys and shafts to prevent rotary movement between the parts. They usually have an Allen wrench hole in them for tightening and are headless. Some sheet metal or plastic parts may be fastened with self-tapping screws. Theses screws form their own threads as they are screwed in. Sometimes threads need to be coated with a lubricant or sealant for proper torque or sealing. Anti-

seize compound may be needed on the threads of the bolts prone to seize or corrode making them difficult to remove. Too much lubricant on the threads may puddle in the bottom of a blind hole and cause hydrostatic lock. The oil will not compress so the bolt cannot be fully seated.

Figure 4 shows a variety of screws in many different sizes.

Figure 4 – Screws (nonebelow, CC BY – NC 2.0)
Image: Variety of screws

Please take a few minutes to watch Video 2 which reviews some automotive fasteners. To access the video, please click on the Video 2 image.

Video 2 – Automotive Fasteners (York Technical College, CC BY 2.0)
For a transcript of this video, please click on transcript.

4.2 TAPS AND DIES

Hand taps are small tools used to hand cut internal threads into a hole. Some taps are made to "chase" the threads. Chasing does not eat threads but instead cleans and restores previously existing threads. Taps must be selected to match the size and thread pitch needed when tapping threads the tap is turned clockwise but should be backed up counterclockwise about ¼ turn after every full clockwise rotation. This process will break off metal chips that accumulate in the threads. Hand dies cut external threads on bolts, rods or pipes. Dies must also match the size and thread pitch needed. Dies fit into die stocks which hold them and allow them to be turned by the die stock handles. Clockwise and then counterclockwise movement is used just like with taps.

Figure 5 shows a variety of taps and dies.

Figure 5 – tap die (Jonathan Stewart, CC BY – NC- ND 2.0)
Image: Tap and Die Set

Please take a view minutes to watch Video 3 which talks about taps and dies, and their purpose.

Video 3 – Taps and Dies (York Technical College, CC BY)
For a transcript of this video, please click on transcript.

4.3 MEASURING TOOLS

Automobile service work such as transmission and engine repair often requires exact measurements accurate to ten-thousandths of an inch, (0.0001) or thousandths of a millimeter, (0.001). Precision measuring tools are required for these measurements. Precision measuring tools are very delicate and must be handled with care. Rough handling or use will easily damage the tool.

Dial calipers can make inside, outside or depth measurements without any changes to the tool. Imperial Calipers usually measure from zero to six inches while metric calipers measure from zero to 150 millimeters. It is important to make sure the caliper jaws lay flat on or around the measured object. Tilted jaws will bead to inaccurate measurements. Dial calipers use a dial with a needle pointer. One Revolution of the dial equals one-tenth inch. Digital calipers have a numerical digital readout that eliminates the calculation required between the bar scale and the dial of dial calipers. Many digital calipers can be switched between Imperial and metric. These calipers are not as precise as micrometers and can only be considered accurate to within two-thousandths (+/- 0.002) of an inch.

Micrometers are used to measure inside or outside dimensions. Unlike calipers, micrometers are designed for either inside or outside measurements, so the proper tool has to be selected. Micrometers do not have the large six inch range of calipers. Each micrometer has a range of about one inch so it takes a set of six micrometers to be able to measure objects up to six inches. Micrometers have components and markings that include the frame, anvil, spindle, locknut sleeve, sleeve numbers, sleeve

long line, thimble marks, thimble and ratchet. Micrometers can be calibrated in either inch or metric graduations. Most micrometers measure to an accuracy of 0.001 inch but some are more precise measuring to 0.0001 inch. Digital micrometers are available also. They eliminate the math required on conventional micrometers. Outside micrometers can be used to measure the diameter (outside) or thickness of an object.

Figure 6 is an external micrometer. Notice the dial on the "handle" and the measure is made in the part of the micrometer that looks like a "C – clamp."

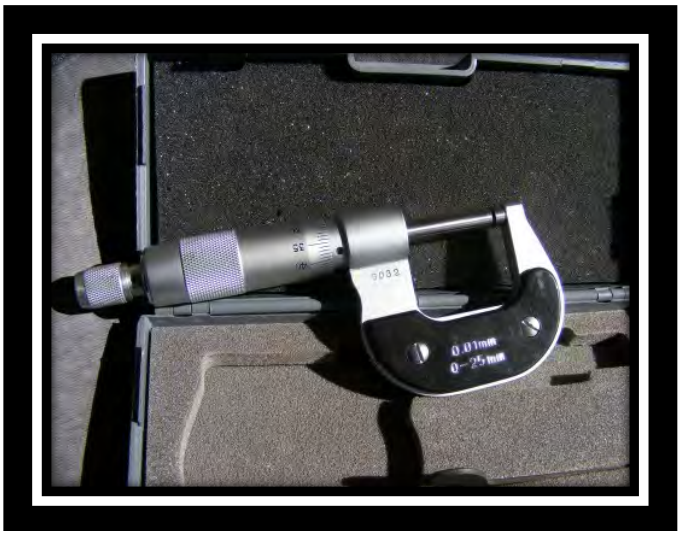


Figure 6 – External - Micrometer – Screw – Gauge_23114 – 480 x 360
(Emillan Robert Vicol, CC BY 2.0)
Image: External Micrometer

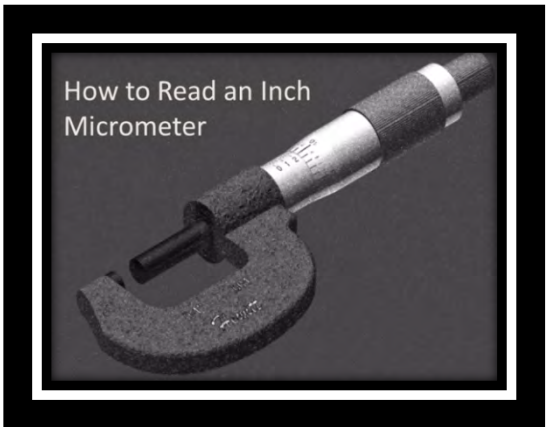
The proper procedure for measuring a piston for wear is outlined below.

- The piston to be measured for wear fits in a 3.5 inch bore cylinder. There is a maximum piston clearance of 0.002 inches. Therefore the minimum size of the piston skirt is 3.498 inches. To measure the piston the proper size micrometer must be selected, a 3 to 4 inch in this case because the piston is between 3 and 4 inches in diameter.
- The sleeve is marked with graduations that represent 0.025 inches. Every fourth set of graduations will also be marked with a number one through nine, with one representing 0.100 inches and nine representing 0.900 inches.
- The graduations on the thimble represent 0.001 inches each. There are 25 0.001 sections on the thimble and one full revolution of the thimble will move it from one sleeve mark to the next.

- Counting the sleeve graduations and then adding the thimble graduations read at the sleeve long line will give the proper measurement. This number must be added to three inches since a three to four inch micrometer is being used.
- Close the micrometer around the piston skirt keeping it square to the skirts surface. The micrometer must also be pulled back and forth across the skirt to find the outside diameter. It should have some drag at the point it crosses the diameter. If it cannot be pulled across the skirt it is closed too tight and is smaller than the actual diameter of the skirt. Some micrometers have a ratchet to tighten with, preventing over tightening and damage to the tool. If no ratchet is on the micrometer, care must be taken not to over tighten.
- Once the proper setting is achieved the lock lever is activated to prevent the reading from changing as the micrometer is moved away from the piston.
- The micrometer is this example has the end of the thimble crossing the sleeve after third mark past the fourth mark. The thimble mark that lines up with the sleeve long line is 21. The math to get the final answer for the skirt diameter:

  3.000 - 3 inches because of using a 3 to 4 inch micrometer
  0.475 - from the thimble crossing the sleeve after the 3rd line past the 4 mark
  0.021 - from the thimble mark lined up with the sleeve long line
  3.496 - Answer: The piston skirt is worn .002 inches past is minimum size of 3.498

Let's watch a video on how to read a micrometer. Please click on the Video 4 image to watch the video.



Video 4 – How to Read an Inch Micrometer.wmv (etprof, Standard YouTube license)
For a transcript of this video, please click on transcript.

Inside and Depth micrometers are read the same way as outside micrometers when the proper positioning has taken place. Telescoping Gauges sometimes called snap gauges are tools that come in various size ranges to match the size of the bore they will measure. They are inserted into a bore with the plungers locked into the smallest position. Then the lock screw is loosened allowing the telescoping plungers to snap against the bore. The lock screw is again tightened to hold the position and the gauge is removed to be measured with an outside micrometer.

Very similar to a telescoping gauge, the **small hole or ball gauge** has a split ball instead of telescoping plungers. The ball will fit into a small hole and is expanded with and locked with a lock screw just like the telescoping gauge.

Figure 7 is of a small hole gauge. Pay attention to the shape of the gauge.

Figure 7 – small hole guage [gauge] (Connie Posites, CC SA 2.0)
Image: Small hole gauge set

Feeler gauges are thin strips of metal with markings on them as to the precise thickness of the metal. These gauges are most often used to measure a clearance between parts. Selecting the thickest one that will fit in the clearance will indicate the size of the clearance simply be reading

the size on the feeler gauge. A bar of steel machined to be totally flat and straight is a straightedge. A straightedge can be used with feeler gauges to determine if a flat surface has any warpage and how much. The straightedge is placed on a flat surface and feeler gauges are used to try to slide between the two at various spots. The size of the feeler gauge that will slide under the straightedge indicates the amount of warpage.

Figure 8 shows several tools with the bottom tool being a feeler gauge.

Figure 8 – THOR's hammer and measuring tools DSC_2536 (el cajon yacht club, CC BY 2.0)
Image: Hammer, three gauges where the bottom gauge is a feeler gauge

Movement of parts such as end play, valve lift and gear backlash can be measured with a dial indicator. The tool can also be used to measure run out of rotating parts like brake rotors and crankshaft journal variance. Dial indicators are usually calibrated in 0.001 inch increments but are available in metric type as are other precisions measuring devices. The dial indicator has a rod that protrudes from its housing. The rod is spring loaded and can be pushed in and the returned by the spring so that it will follow movement of the service it is placed against. The rod can be positioned in a centered part of its travel when mounting the tool. The tool can then be set to zero for that position, allowing movement to be read in either direction. The range of movement of the doll indicator used must always be more than the movement of the measure object.

For a better visualization of this instrument, please see Figure 9.

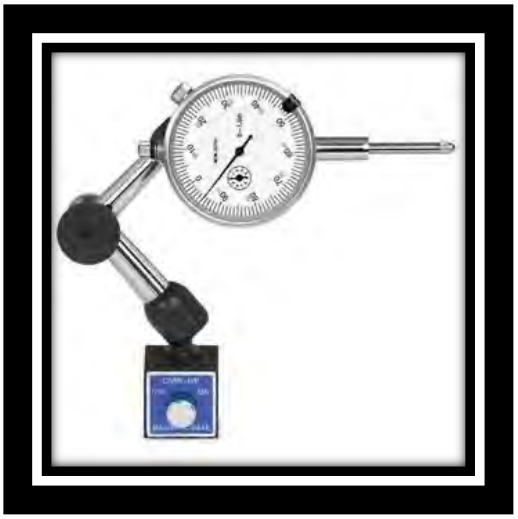


Figure 9 – dial indicator (Jonathon Stewart, CC BY NC – ND 2.0)
Image: Dial Indicator

ACTIVITY 1

Describe what is being measured in the image (Figure 10) below. What measuring tools are being used?

Figure 10 – photo7 Engine Repair (Jonathon Stewart, CC BY – NC – ND 2.0)
Image: Measure an engine part

4.4 HAND TOOLS

Hand tools are required or almost every automotive service procedure. A very large assortment of hand tools are required by today's service technicians. Most shops and garages require their technicians to have their own hand tools. These tools are very expensive and should be well-maintained and accounted for by the technician.

A **wrench** is a common hand tool used for twisting. Wrenches come in various types, shapes, and sizes. An open end wrench is a popular type of wrench that features two open jaws which can be slid over two flat sides of a bolt, nut, shaft or other object. Open end wrenches are used when there is not enough clearance to allow a box end wrench to be used. Open end wrenches lack the strength and grip of box end wrenches, and are more likely to round the head of a bolt. For this reason open end wrenches should only be used when clearance is an issue.

Box end wrenches are closed only end to fit completely around the head of a bolt or nut. This allows each point of fastener to be gripped instead of two points with the open end wrench. Box end wrenches are available in both six and twelve point types. Six point wrenches grip tighter and are less likely to damage the bolt head around it due to slippage. A 12 point wrench provides better rotational increments that often help in tight spaces that limit wrench swing.

Combination wrenches have a box end on one end and an open end on the other. Both ends are normally the same size. The line or flare nut wrench is used on brake, transmission, fuel, and other lines that use flare type fittings. Open end wrenches will fit over fittings but have a tendency to around the corners of the flare nut since they are made of softer metal. Flare nut wrenches are like six point box end wrenches with a slot cut in them to allow sliding over the tubing and then slipping on the nut. This allows the flair nut to be gripped on all of its corners.

Figure11 shows various sizes of combination wrenches.

Figure 11 – Combination wrenches (Jonathon Stewart, CC BY – NC – ND 2.0)
Image: 5 sizes of combination wrenches

Please watch Video 5 for a visualization of these wrenches. To access the video, please click on the Video 5 image.

Video 5 – Wrenches (York Technical College, CC BY)
For a transcript of this video, please click on transcript.

Allen wrenches are hex shaped and fit into, not around, a bolt or set screw. So Allen wrenches are L-shaped and others have a T handle all fit onto a square drive such as a ratchet.

Ratchet and sockets with extensions and swivels are the heart of most tool sets. A ratchet allows a bolt to be tightened or loosened without removing the tool to reset it. Most of the time using a socket wrench is safer, easier, and faster than the other types of wrenches. Basic socket wrench sets include several sizes of barrel shaped sockets and a ratchet handle and an assortment of extensions. Sockets have a square hole in one end to fit the square drive a ratchet and a 6, 8, or 12 point wrench end on the other. The socket properties for a 6 or 12 point socket are the same as those of a 6 or 12 point wrench. The square drive of a socket set can be 1/4inch, 3/8 inch, ½ inch, or ¾ inch. Breaker bars have a square drive like a ratchet but do not ratchet. Breaker bars are usually longer than a ratchet and are used when extra torque is required. For an idea of what a socket set looks like, please view Figure 12.

Figure 12 - socket set (Jonathon Stewart, CC BY – NC – ND 2.0)
Image: socket set with various size sockets, ratchet, and extender bars.

Sockets are available in various sizes and lengths. Deep well sockets are made extra-long to clear protruding studs. Deep well sockets should not be used when standard that sockets will work. Deep well sockets will slip off much easier than standard sockets. Impact sockets are heavy walled six point sockets made for use with impact wrenches. Impact sockets as they are called are not chrome plated like most other sockets. Only impact sockets should be used with high torque impact wrenches. Swivel sockets are sockets with a flexible joint made on driving. They help when the angle

of the fastener is not straight. Extensions are used to space the socket away from the ratchet to allow more swing room for ratchet. Extensions are available for all drive sizes in a variety of lengths. Swivels or flexible joints can be used with extensions and sockets to gain access to difficult to reach places.

Please watch this video on ratchet sets to get a better visualization of the tool. To access the video, please click on the Video 6 image.

Video 6 – Ratchet Sets (York Technical College, CC BY)
For a transcript of this video, please click on transcript.

Torque wrenches are used to tighten a bolt or nut to a specified amount. Many bolts and nuts have a torque specification that should be followed for proper tightening. Torque is expressed in Newton meters for metric and foot-pounds for Imperial. Torque wrenches are like ratchets they can indicate the amount of force applied to a bolt or nut. There are several types of torque wrenches:

- Beam-type torque wrenches have a metal order that points to a rating only scale as torque is applied. This is the most common but least accurate of all the torque wrenches.
- Click-type torque wrenches or set to a certain torque by twisting the handle to a certain torque specification. When the set torque is reached the wrench will click indicating the torque specification has been met and signal the technician to stop turning. Click-type torque wrenches are highly accurate and at times can be highly priced.

- Dial-type torque wrenches are used to measure rotational torque or continuous torque as it is applied. The torque amount can be viewed on the dial face of the wrench. Some can be set to signal a light or buzzer to activate at a desired torque.
- Digital readout torque wrenches display the torque measurement numerically and a digital display window.

Please view Figure 13, a set of screwdrivers, before reading about them.

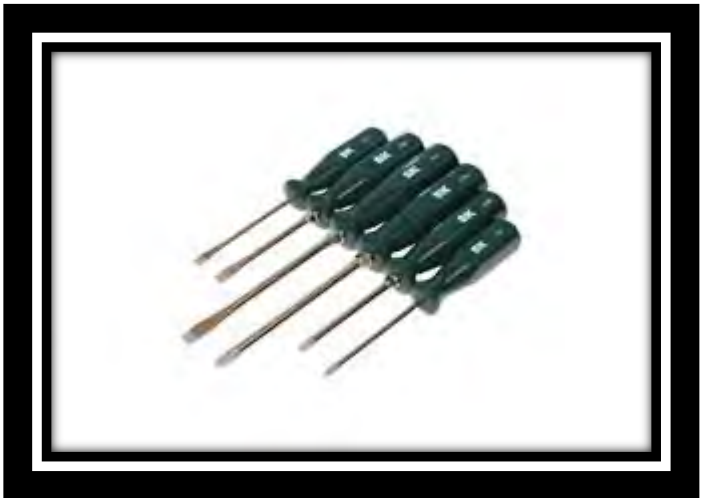


Figure 13 – screwdriver (Jonathon Stewart, CC BY – NC – ND – 2.0)
Image: A set of screwdrivers in various sizes.

Screwdrivers drive various types of threaded fasteners by turning with the wrist. Each fastener must be driven with the specific type of screwdriver required to fit properly. The type of tip, the size, and the length are the primary factors that define the type of screwdriver. A good tool set will include screwdrivers of several sizes, types, and lengths. Blade tip or regular screwdrivers are used on slotted screw heads. The largest blade tip that will on in the slot is the best choice to remove and install slotted screws. Phillips screwdrivers have four prongs that it into a four slotted head and sizes zero through four from the smallest to largest. Torx Screwdrivers has six prongs to fit six prongs Torx screw heads. Torx Screwdrivers provide greater turning power with less slippage. Torx Screwdrivers are available in sizes from the smallest T 15 to the largest T 27. Please watch the following video on screwdrivers. To access the video, please click on the Video 7 image.

Video 7 – Screwdrivers (York Technical College, CC BY)
For a transcript of this video, please click on transcript.

Impact screwdrivers remove screws that are too tight for removal with a hand with screwdriver. Impact screwdriver sets come with various bits that can be installed on the driver. With the proper bit installed the impact driver must be twisted while at the same time struck with a hammer simultaneously. The force exerted by the tool can typically loosen stubborn bolts or fasteners without stripping the head.

ASSIGNMENT 1

Tool Association Exercise: Name the correct tool or tools used to remove corresponding screw heads.

	Screw Head Image	Tool Used to Remove this Screw Head
1.	 Figure 14 – name omitted (Jonathon Stewart, CC BY – NC – ND 2.0) Image: Screw head with one horizonal slot	

	Screw Head Image	Tool Used to Remove this Screw Head
2.	 Figure 15 – name omitted (Jonathon Stewart, CC BY – NC – ND 2.0) Image: Screw head with 6-sided indented hole	
3.	 Figure 16 – name omitted (Jonathon Stewart, CC BY – NC – ND 2.0) Image: Screw head with 6 sides. PC 5.6 is written on the top of the screw head.	
4.	 Figure 17 – name omitted (Jonathon Stewart, CC BY – NC – ND 2.0) Image: Screw head with a "+" indented into it.	
5.	 Figure 18 – name omitted (Jonathon Stewart, CC BY – NC – ND 2.0) Image: Screw head with 6 pointed star indented into it.	

Before reading about pliers, please take a moment to examine the pliers shown in Figure 19.

Figure 19 – pliers (Jonathon Stewart, CC BY – NC – ND 2.0)
Image: Three types of pliers

Pliers are tools used for gripping. Several different types of pliers are required to do automotive service work. Combination pliers have both flat and curved sections on their jaws and are the most commonly used pliers. The slip joint at the pliers pivot allows the size of the jaw opening to be changed as needed. These pliers are often referred to as slip joint pliers. Adjustable or channel lock pliers have multi-adjusting slip joints and jaws that are usually at an angle to the handles.

Needle nose pliers have very long gels that taper to near a point. They are useful in getting the tight spots or holding very small parts. Many needle nose pliers have a wire cutter made into the base of the jaws. Needle nose pliers are available in many sizes with both straight and angle designs. Locking pliers can be locked tightly onto an object allowing it to be held without continuous pressure from the handle grip. They can be used for holding parts together or gripping rounded off fasteners. Locking pliers sometimes called vice grips are available in many sizes and jaw styles.

Diagonal cutting pliers are used to cut the pins, wires, cable ties, and other objects. The jaws of diagonal cutters are both sharp and hardened. Snap ring pliers have jaws that are designed to hold the ends of a snap ring while it is spread by the pliers to be removed or installed. Retaining ring pliers have pointed tips to fit the holes found in retaining rings. Snap ring and retaining ring pliers are available in various sizes and shapes often with interchangeable tips.
Now that you have read about several types of pliers, please watch Video 8 on pliers. To access the video, please click on the Video 8 image.

Video 8 – Pliers (York Technical College, CC BY)
For a transcript of this video, please click on transcript.

Hammers are used regularly in automotive service at are needed in various weights, sizes, and face materials. Steel – faced hammers have high-grade alloy heads that can take a lot of punishment. Soft faced hammers with brass or plastic faces should be used on machine services and other objects where marring or denting a surface will ruin it.

Figure 20 shows a soft faced hammer being used by two toys. Notice the hammer head and how it a hard plastic.

Figure 20 – Hammer Time (Zhao!, CC BY – 2.0)

Chisels are used with a hammer to be driven into metal for the purpose of cutting or shearing it. Chisels are regularly used for moving rivet hands,

splitting stubborn nuts, and cutting spot welds or sheet metal. Chisels come in a variety of sizes and tip styles. Figure 21 shows two types of chisels.

Figure 21 – chisels (Brian (Ziggy) Lilola, CC BY – NC – 2.0)
Image: Two chisels. One is flat and the other is multisided as the tip.

Punches are used for various operations in automotive service. Pin punches or drips are used to remove roll and drift pins. Center punches have a sharp point and are used to make an indention usually to center drill bit. Tapered punches are commonly used to line up corresponding holes. Figure 22 shows a center punch.

Figure 22 – My Studio (Mauro Careb, CC BY – 2.0)
Image: Ring clamp, center punch, and jog for tube cutting

Hacksaws are used for cutting metal. Hacksaws have replaceable blades that come in several tooth counts. Fine tooth counts like 32 teeth per inch are best for cutting thin metal, while a coarse blade should be used on thicker metal. The blade should be installed with the T point away from the handle. The forward stroke is only for cutting and little pressure should be applied on the reverse stroke. Figure 23 shows a man using a hacksaw.

Figure 23 – Daffy: Hacksaw (Dave Wild, CC BY – NC 2.0)
Image: man cutting a Daffy Duck coffee mug into using a hacksaw.

Files are used to remove burrs, smooth surfaces or slightly shape metal. Different shape files are available to match the service being filed. Files come in square, triangle, round, half – round, and in the most common – rectangle – flat shape. Double cut files and diagonal cutting lines in both directions across the surface. Double-click files remove larger amounts of metal and or use first for a rough-cut on a desired shape. Single cut files have diagonal cutting lines in only one direction and remove less metal producing a smoother surface. They are used as finishing files. File should always be used with a handle and only used to cut on the forward stroke. A special tool called a file card is used to clean the teeth of file.

Figure 24 shows various files. Please take a moment to examine the figure.

Figure 24 – Files (Arjun, CC BY 2.0)
Image: 4 metal files of different types

Technicians also use a variety of specialty tools for automotive service. Specialty tools are tools designed to perform a specific task. Gear and bearing **pullers** are commonly used to remove items that are installed with a pressed fit. Pullers can be job specific or universal in design. Pullers are used in areas where hammering or prying make cause damage to the working surfaces. Pullers operate by holding the inside or outside of be part being removed while a threaded shaft is turned in the opposite direction. Please a few minutes to watch this video on pullers. To access the video, please click on the Video 9 image.

Video 9 – Pullers (York Technical College, CC BY – 2.0)
For a transcript of this video, please click on transcript.

Bearing in seal drivers are also specially tools used with a hammer on services a hammer alone would damage. Drivers are available both job specific and universal in design. Driver sets contain multiple sizes of driver faces designed to fit smoothly and square atop bearings and seals.

One of the most important specialty tools in a technician's arsenal is the flashlight or service light. Many areas of an automobile lack the proper amount of light needed to adequately see and perform service tasks. Service lights are normally small flexible flashlights with bright direct light beams. Service lights are normally battery-powered or power via shop electricity. LED and florescent lights have replaced unreliable and dangerous incandescent lights. Incandescent lights should not be used in the shop environment as they are considered an explosion hazard around flammable vapors. Corded lights should also be used carefully around moving parts to prevent accidental electrocution.

ACTIVITY 2 - RESEARCH

Use the internet or other sources to identify three to five companies that sell high quality hand tools for automotive technicians.

4.5 POWER TOOLS

Power tools were designed to increase the speed and productivity of technicians. Power tools provide instant speed and torque on demand. These tools receive power from multiple sources such as compressed air (pneumatic), electricity AC or DC, or hydraulically. Power tool operation is easy and effective but requires much higher safety consciousness than basic hand tools. Power tools for automotive use come in many shapes and sizes with uses from light to heavy duty.

While recent technological advancements have increased the popularity of cordless electrical powered devices, amongst technicians the tool of choice remains air (pneumatic). Pneumatic tools provide technicians with a compact and universal product for use in the automotive industry. Pneumatic tools are strong lightweight and very durable. They require little maintenance, are reasonably priced, and have a higher power to weight ratio than their electrical counterpart. Pneumatic tools are also are much safer to operate in a shop eliminating the risk of electrocution and limiting the ignition of flammable vapors. Pneumatic tools require an adequate supply of compressed air to operate, and connect using a flexible hose with quick connect fittings. Please take a few moments to examine Figure 25 which is a pneumatic impact wrench.

Figure 25 – impact gun (Jonathon Stewart, CC BY – NC – ND – 2.0)

Image: Pneumatic impact wrench

There are two different designs of pneumatic wrenches that are commonly used. The first type is an air motor connected directly to a drive device. This air motor tool is designed to deliver high speed with low power. Grinders, cutting tools, drills, and air ratchets are all examples of this type of air tool. Figure 26 shows an air ratchet.

Figure 26 – air ratchet (Jonathon Stewart, CC BY – NC – ND – 2.0)
Image: Air Ratchet

In situations that require less speed and more torque or power an air impact tool is the answer. Air impact tools consist of an air motor connected to a reaction force or hammer and anvil assembly that connects to the drive device. This tool uses speed built momentum stored until the tool meets resistance at which a rotation hammering devices takes over to deliver high force bursts of torque. Air impact wrenches and hammer drills are examples of this type of tool.

To learn more about pneumatic tools, please watch Video 10. To access the video, please click on the Video 10 image.

Video 10 – Air Tools (York Technical College, CC BY – 2.0)
For a transcript of this video, please click on transcript.

Hydraulic tools such as portable power jacks and presses are also commonly used. AC or corded electrical tools such as drills, grinders, and saws are commonly used by automotive technicians.

4.6 SHOP EQUIPMENT

Shop equipment is the name traditionally given for larger tools needed for automotive service and repairs. In a modern shop this type of equipment rather large or small is typically owned by the shop and shared by the technicians. In the past larger shop equipment such as a hydraulic press, engine lifts, and brake lathes were provided by the shop mainly to save space by only having one of each. Additionally the high cost of shop equipment makes it impractical for an individual technician of purchase. Most shop equipment while durable requires regular preventative maintenance, as well as safety inspections. The following items are examples of common shop equipment:

- Air Compressors
- Tire Equipment
- Presses
- Bench Grinders
- Welders
- Exhaust Equipment
- Brake Lathes
- Oil Drains
- Jacks, Lifts, and Stands
- Engine Hoists

- Benches and Vices
- Air Conditioning Recovery Equipment

Figure 27 – 158 (Jonathon Stewart, CC BY – NC – ND 2.0)
Image: Shop Equipment – Automobile lift

4.7 LIFTS

Most shops install fixed vehicle lifting equipment to increase productivity and allow easy access to the underside of a vehicle. Automotive lifts come in many styles and sizes, from light duty to heavy duty.

Lifts come in three categories:

- Frame
- Wheel
- Axle

The categories establish what part of the vehicle the lift comes in contact with in order to raise a vehicle. Lift capacity is determined by vehicle class and weight. Lifts operate hydraulically using either electrically powered pumps or in combination with shop compressed air. Because of the weight of a vehicle being lifted, safety mechanisms are installed to prevent hydraulic bleed down. Lift manufacturers recommend that once a vehicle reaches its service height that it be lowered down resting on the safety locks.

One of the most popular lifts used commercially is known as the twin post. Twin post lifts operate using two large posts connected either at the bottom or top with four movable lift arms to contact the vehicles frame. Twin post lifts are durable as well as versatile for use on any vehicles in its weight class. As stated earlier lifts come in many sizes and also by many manufacturers. Some lifts are designed for hobbyists and should not be used in a commercial environment.

Please take a few minutes to watch Video 11 which illustrates various lifts. To access the video, please click on the Video 11 image.

Video 11 – Lifts (York Technical College, CC BY 2.0)
For a transcript of this video, please click on transcript.

Lifts used commercially should be certified by the Automotive Lift Institute or ALI. ALI certified lifts are required to pass strenuous safety and weight tests before receiving accreditation. The ALI certification label can be found attached to the lift. Automotive lifts have proven to be extremely safe when used properly and or maintained. It's important for lift users to read the manufacturers operating instructions prior to raising a vehicle. It is also important to find a vehicles manufacturer recommended lifting spots, failure to do so can result in vehicle damage or injury.

Figure 28 shows a Twin Post Lift. Please take a couple of minutes to examine the image.

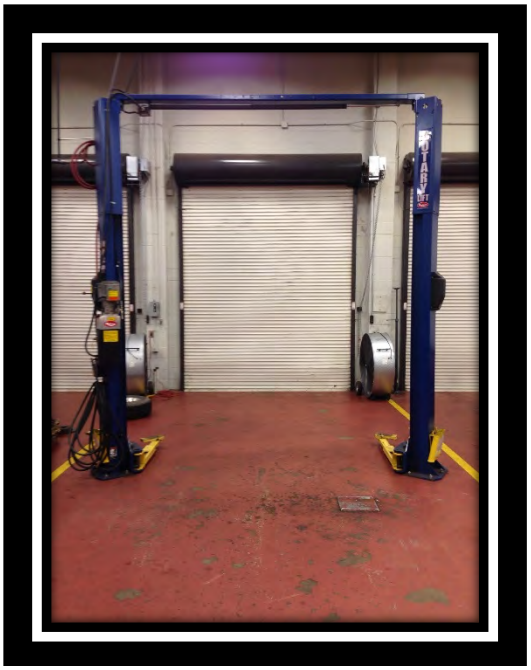


Figure 28 – 157 (Jonathon Stewart, CC BY – NC – ND 2.0)
Image: Twin Post Lift

4.8 DIAGNOSTIC EQUIPMENT

Modern vehicle diagnosis requires a wide array of specialty tools and equipment. A technician must have equipment capable of testing the latest electronic automotive operating systems as well as perform simple tasks on internal combustion engines. In the past, diagnostic equipment could be easily classified by the vehicle systems such as engines or air-conditioning. Modern vehicles operate using sophisticated electronic control systems that monitor nearly every aspect of an automobile. These systems require similarly advanced diagnostic equipment with the capability of communicating data and information throughout the various control modules. These technological improvements have made a technician's scan equipment the most important tool they own.

Automotive scan tools come in many shapes and sizes and are also available from different manufacturers. Scan tools range from simple inexpensive devices, with limited use, to expensive complex devices with unlimited capabilities. Scan tools are available in two different categories: OEM and generic. OEM scan tools are those created by the vehicle manufacturer for use on their specific vehicles. Examples of OEM scan tools are the GM Tech II System and the Ford IDS System. These tools were created by Ford and GM specifically to be used on their vehicles by

their dealers. Generic scan tools are considered to be universal with the ability to communicate with all vehicle manufacturers. Generic scan tools such as the OTC Genesis and Snap-on Verdict have the ability to communicate with any vehicle sold in North America.

Unfortunately, when referencing scan tools the words generic and universal also mean limited capabilities. While both the OTC and Snap-on are both excellent tools it is important for a technician to understand their limitations. To put these limitations in perspective think of them as language barriers. All modern vehicles are equipped with various computers performing numerous tasks. Unfortunately, federal law only requires the electronic engine control systems on North American vehicles to communicate using the same language. The limitations occur when a vehicle manufacturer allows computers other than the engine control systems to speak another language such as Spanish or German. Unfortunately, because the generic scan tool only speaks English is unable to communicate properly with the other languages. Another limitation that can be explained, using the same language analogy, is the fact that manufacturers may use their own version of slang in their operating systems communication. The slang communication may not be recognized by the generic scan tool because it's only capable of speaking proper English. With these limitations in mind technicians quickly adapt by using more than one generic tool or are purchasing OEM tools as needed. Along with scan tools many other devices and tools are essential for technicians to perform necessary repairs.

Please watch Video 12 for an introduction to automotive diagnostic equipment. To access the video, please click on the Video 12 image.

Video 12 – Diagnostic Tools (York Technical College, CC BY – 2.0)

For a transcript of this video, please click on transcript.

Automotive electrical repair require an assortment of tools to be used for proper diagnosis. Tools such as a digital volt ohm meter or DVOM along with more sophisticated equipment such as oscilloscopes are used daily in automotive repair shops. Diagnostic equipment for specific testing such as battery, charging system, and even tire pressure monitoring systems are also important tools for technicians. Automotive diagnosis also requires the use of simple mechanical testing devices such as gauges. Gauges are used to test for pressure or vacuum and are available for specific and universal use. Specialty gauges include compression, fuel pressure, and air conditioning gauges which all have one specific use. Electronic and general diagnostic equipment both require regular updates to provide the best service.

Figure 29 shows a generic scan tool, and Figure 30 is an OEM scan tool.

Figure 29 – 161 (Jonathon Stewart, CC BY – NC – ND 2.0)
Image: Generic Scan Tool

Figure 30 – 161 (Jonathon Stewart, CC BY – NC – ND 2.0)
Image: OEM Scan Tool

Instructor: Select one of the two discussion prompts below:

DISCUSSION #1 SHOP EQUIPMENT (ASSIGNMENT 2)

Imagine you are starting a shop; discuss what equipment your new shop will need with the other students. Select and estimate the cost of the equipment you will need. Be careful your business plan says you cannot exceed $50,000 so shop wisely. You need at least ten pieces of equipment. Create a spreadsheet that includes the brand, description, and cost of each item

DISCUSSION #2 DIAGNOSTIC TOOLS (ASSIGNMENT 2)

Imagine you are starting a shop; discuss which diagnostic tools your new shop will need with the other students. Select and estimate the cost of the equipment you will need. Be careful your business plan says you cannot exceed $20,000 so shop wisely. You need at least ten pieces of equipment. Create a spreadsheet that includes the brand, description, and cost of each item.

Students and instructors have tool boxes which may contain the diagnostic equipment. Please watch Video 13 which talks about the student tool box. To access the video, please click on the Video 13 image.

Video 13 – Toolbox (York Technical College, CC BY – 2.0)
For a transcript of this video, please click on transcript.

ASSIGNMENT 3

In this assignment student must select, and estimate the price of purchasing a beginners hand tool set. Click on Tool List for the YTC Tool list. (Link 1, York Technical College, Public Domain) For this assignment you have a budget of $1375.00 to purchase the entire list. Use the internet or any other tool sources to help. All of the tools on the list must be included in your estimate.

MAJOR CONCEPTS

KEY CONCEPTS

- Compare and contrast different types of automotive hardware.
- Recognize taps and dies, and interpret sizes.
- Identify automotive measuring tools, and provide examples of usage.
- Identify automotive hand tools, and provide examples of usage.
- Identify automotive power tools, and provide examples of usage.

- Distinguish and classify different types of shop equipment.
- Compare and contrast different types of automotive lifts.
- Compare and contrast general diagnostic equipment.
- Compare and contrast electronic diagnostic equipment

KEY TERMS

- Allen Wrench
- Bolts
- Cap Screws
- Chisel
- Combination Wrench
- Fasteners
- Files
- Hand Taps
- Micrometers
- Pliers
- Pullers
- Screwdriver
- Shop Equipment
- Small Hole Gauge
- Studs
- Tensile Strength
- Torque Wrench
- Wrench
- Yield Strength

GLOSSARY

The glossary below has links to more information. You can access the links by clicking on the vocabulary word(s).

- Allen Wrench –wrench with that is hex shaped and fits into, not around, a bolt or set screw.
- Bolts – fasteners with threads on one end and a head used to tighten and loosen it on the other.
- Cap Screws – fastener similar to bolts but are threaded from the end to the head, therefore having no shank.
- Chisel – tool used with a hammer to be driven into metal for the purpose of cutting or shearing it.
- Combination Wrench – wrench that has a box end on one end and an open end on the other.

- Fasteners – the hardware used to hold automobiles and their components together.
- Files – tools that are used to remove burrs, smooth surfaces or slightly shape metal.
- Hand Taps – small tools used to hand cut internal threads into a hole.
- Micrometers – instrument used to measure inside or outside dimensions
- Pliers – tools used for gripping
- Pullers – tool commonly used to remove items that are installed with a pressed fit.
- Screwdriver – tool that drives various types of threaded fasteners by turning with the wrist.
- Shop Equipment – name traditionally given for larger tools needed for automotive service and repairs.
- Small Hole Gauge – gauge that has a split ball instead of telescoping plungers.
- Studs – fastener similar to bolts without a head, but instead are threaded for a nut on the head end.
- Tensile Strength – measurement indicating the amount of stress a bolt is able to withstand prior to breakage.
- Torque Wrench – wrench used to tighten a bolt or nut to a specified amount.
- Wrench – a common hand tool used for twisting
- Yield Strength – measurement that indicates how much stress the bolt can take before it cannot return to its original shape.

FURTHER STUDY

You may find these websites beneficial:

- Snap-On (Link 2, Snap-On, All Rights Reserved)
- Mac Tools (Link 3, Mac Tools, All Rights Reserved)
- Matco (Link 4, Matco, All Rights Reserved)
- Craftsman (Link 5, Craftsman/Sears Brands LLC, All Rights Reserved)

POST TEST

1. Fine thread bolts work best in aluminum parts.
   A. True
   B. False

2. An imperial system bolt with three grade marks is considered which of the following?
   A. Grade 3
   B. Grade 5
   C. Grade 6
   D. Grade 8

3. Which of the following tools would not be used for precision measuring?
   A. Micrometers
   B. Dial Indicators
   C. Tape Measures
   D. Calipers

4. The strength of a metric bolt is determined by counting the number of grade marks.
   A. True
   B. False

5. Precision measuring tools are required to be accurate within ____ of an inch
   A. 0.01
   B. 0.010
   C. 0.001
   D. 0.0001

6. Dial indicators are used to measure which of the following items.
   A. Thickness
   B. Depth
   C. Movement
   D. Strength

7. All the following are considered threaded fasteners except:
   A. Bolts
   B. Nuts
   C. Screws
   D. Rivets

8. All of the following are considered hand tools except:
   A. Wrenches
   B. Hammers
   C. Torches
   D. Pliers

9. Micrometers can only be calibrated in inches.
   A. True
   B. False

10. Which of the following hand tools would best remove a flared brake line?
   A. Socket Wrench
   B. Combination Wrench
   C. Line Wrench
   D. Pliers

11. Which of the following items would not be considered shop equipment?
   A. Hydraulic press
   B. tire balancer
   C. impact wrench
   D. bench grinder

12. A straightedge and a feeler gauge are used to measure which of the following?
   A. Thickness
   B. Depth
   C. Warpage
   D. Out of Round

13. Beam-type torque wrenches are more accurate than click-type torque wrenches.
   A. True
   B. False

14. Deep well sockets can be used in place of standard sockets.
   A. True
   B. False

15. What is the acronym for the agency that certifies automotive lifts?
   A. NTSB
   B. ALI
   C. CIA
   D. NRA

16. Impact wrenches can be used with any type of sockets.
    A. True
    B. False

17. Tight screws can be removed with which of the following tools?
    A. Screwdriver
    B. Wrench
    C. Impact Driver
    D. Torx Driver

18. Steel faced hammers can be used to remove delicate parts.
    A. True
    B. False

19. What is the acronym for the agency that certifies automotive lifts?
    E. NTSB
    F. ALI
    G. CIA
    H. NRA

20. OEM scan tools are designed to work on all vehicles.
    A. True
    B. False

21. What tool can be used to help center a drill bit.
    A. Chisel
    B. Center Punch
    C. Drift
    D. Tapered Punch

22. Which tool would best remove a press fit part?
    A. Hammer
    B. Puller
    C. Punch
    D. Screwdriver

23. Corded electrical tools pose an electrocution hazard around moving parts.
    A. True
    B. False

24. Technicians regularly purchase shop equipment.
    A. True
    B. False

25. Which of the following is not true about pneumatic tools?
    A. Durable
    B. Lightweight
    C. Cordless
    D. Powerful

26. What is the best brand of automotive hand tools? Why?

27. Which power tool is better electric or pneumatic? Why?

ASSESSMENT SOLUTIONS

ANSWERS TO ACTIVITIES

ACTIVITY # 1

A straightedge and feeler gauges are being used to check for warpage.

ACTIVITY #2

Answers will vary; popular brands include MAC, Snap-on, MATCO, Cornwell, Craftsman, SK Tools, KD Tools along with many others.

ASSIGNMENTS

ASSIGNMENT 1 – TOOL ASSOCIATION

1. Flat head Screwdriver
2. Allen Wrench
3. Wrench
4. Phillips Screwdriver
5. Torx Screwdriver

DISCUSSION PROMPT 1 – (ASSIGNMENT 2)

Answers will vary.

Rubric for Assignment 2

Item	Meets Requirements	Does not Meet Requirements	Points
Discussion of choices of equipment	Gives a reason explaining why each piece is chosen 15 – 25 points	Does not give a reason for each piece of equipment chosen 0 – 14 points	
Tools	Selects a variety of tools and has at least 10 tools 15 – 25 points	Does not select a variety and/or less than 10 tools 0 – 14 points	

Item	Meets Requirements	Does not Meet Requirements	Points
Cost	Does not exceed $50,000 and gives the individual cost/tool 15 – 25 points	Exceed $50,000 or does not include the cost/tool or total cost 0 – 14 points	
Spreadsheet	Includes brand/item, description/item, cost/item 15 – 25 points	Does not include brand/item, or description/item, or cost/item 0 – 14 points	
Comments		Total Points	

DISCUSSION PROMPT 2 (ASSIGNMENT 2)

Answers will vary.

Rubric for Assignment 2

Item	Meets Requirements	Does not Meet Requirements	Points
Discussion of choices of diagnostic tools	Gives a reason explaining why each diagnostic tool is chosen 15 – 25 points	Does not give a reason for each diagnostic tool chosen 0 – 14 points	
Tools	Selects a variety of tools and has at least 10 tools 15 – 25 points	Does not select a variety and/or less than 10 tools 0 – 14 points	
Cost	Does not exceed $20,000 and gives the individual cost/tool 15 – 25 points	Exceed $20,000 or does not include the cost/tool or total cost 0 – 14 points	
Spreadsheet	Includes brand/item, description/item,	Does not include brand/item, or	

Item	Meets Requirements	Does not Meet Requirements	Points
	cost/item 15 – 25 points	description/item, or cost/item 0 – 14 points	
Comments		Total Points	

ASSIGNMENT 3 - CRITICAL THINKING

Answers will vary.

Rubric for Assignment 3

Criteria	Meets Expectations	Partially Meets Expectations	Does not meet expectations	Total points
Knowledge	Student has a clear understanding of the topic (40-30)	Student exhibits some understanding of the topic (29-16)	Student shows little to no understanding of the topic (15-0)	
Analysis	Student offers a concise rationale for their choices (40-30)	Student offers some rationale for their choices (29-16)	Student shows little to no rationale for their choices (15-0)	
Spelling and Grammar	Sentences are coherent; grammar/spelling errors are absent or rare (20-15)	Most sentences are coherent; few grammar/ spelling errors (14-6)	Sentences are incoherent; numerous grammar/spelling errors (5-0)	
Comments:			**Total Points:**	

PRE TEST ANSWERS

1. D
2. B
3. C
4. C
5. C

6. B
7. A
8. C
9. B
10. B

POST TEST ANSWERS

1. B
2. B
3. C
4. B
5. D
6. C
7. D
8. C
9. B
10. C
11. C
12. C
13. B
14. B
15. B
16. B
17. C
18. B
19. F
20. B
21. B
22. B
23. A
24. B
25. C
26. Answers will Vary; expect Snap-on, Mac, Matco, Cornwell, and Craftsman. Why is based on opinion or may be learned doing research.
27. Answer will vary; no truly correct answer, can be the students opinion with justification.

TRANSCRIPTS AND EMBED CODES

VIDEO 1 – INTRODUCTION – TRANSCRIPT

In this module we will discuss tools and hardware required to perform repairs and basic services. You will receive detailed operational instructions on tools and hardware. The purpose of this module is to prepare you for future hands-on labs required in automotive programs. Let's get started.

VIDEO 1 – INTRODUCTION – EMBED CODE

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VIDEO 2 – AUTOMOTIVE FASTENERS – TRANSCRIPT

The nut, blot and washer [hand holding these items] are very common automotive fasteners. They work fairly simply. Washers are installed [put 2 washers on the bolt shaft] and then the nut is installed [nut is screwed on bolt] squeezing two components together tightly. Another common automotive fastener is the pop rib-its. Pop rib-its are specialty fasteners that require a special tool to be crimped. Inside the pop rib-it tool [pop rib-it tool] using your hands, you'll squeeze this tool between two pieces of metal and you can see it

tighten up the pop rib-it [at the end of tool – pop rib it fires out of tool] closing it up.

VIDEO 3 – TAPS AND DIES – TRANSCRIPT

The tools below are known as taps and dies. Taps and dies are used to create threads in metal or on metal. The tap [lifts the tap] is used to create threads inside of a hole in the metal. [Puts tap down] A die, on the other hand, [lifts a die] is used to create threads on the outside of metal, such as a bolt or stud.

VIDEO 4 – HOW TO READ AN INCH MIRCOMETER.WMV – TRANSCRIPT

Okay, this is how to read a inch micrometer. Before we start talking about how to read micrometer, especially an inch micrometer, we want to think in thousandths of an inch. So this is three decimal places, if we just always set our thought process to three decimal places, we will see that our micrometer will work pretty easily.

This is the way the machinists think. So unit think a point zero zero one is one one-thousandth, .020 is twenty- thousandths, .9 would be nine hundred-thousandths. A quarter of an inch, you would say is 250, .375, Think of that as 735. So how much is a thousandth of an inch anyway.

OK, kinda some rules of thumb, if you think a piece a paper that's out for these [thousandths] .004 or four thousandths. A [US} quarter is about seventy-thousandths. .070
The pencil, normal wooden pencil, is about a quarter of an inch, think of that as about two hundred fifty-thousandths .25 is a quarter of an inch. Ok, so there are two scales to look at on micrometer the barrel scale [scale on the handle closest the part that looks like a C-Clamp] and the thimble scale [scale below the barrel scale] We'll look at the barrel scale first.

So, so here's a barrel scale up close, uh, you notice that it's Got some numbers across here and some tick marks. Now if an inch micrometer's reading from say 0 to 1 inch, then the scale now is, uh, Well there tenths of an inch so this will be a half an inch so [the 5 on the barrel scale] that's .5 or .500. This first main graduation here, [the 1 on the barrel scale] the first big division from 0 to 1 this is .1, so it's a tenth of an inch, or if were

thinking in thousandths of an inch, that's a hundred. [0.100].. The next big mark, 200 or .2 so .200. So we'll say that is two hundred, and that'll make it easy to keep the decimal place straight.

Down here [the 5 on the barrel scale], that's a half an inch, .5. Now if if this first mark is .1 or 100, half of that would be 50, or .050, so the halfway between 0 and .1 is 50 or fifty-thousandths. Half of that distance would be a quarter. So if you think in terms of thousandths, this would be a hundred [1 on scale], 25 [first mark past 0], 50 [second mark past 0] and then this mark, obviously be 75, .0 75. The main scale, if we wanna read these together, is .1 [1 on scale] somewhere out[fist mark past 4 on the scale] here this will be .4 or 425, .425. Down here can you guess what this would be? [third mark past 6 on the scale] This would be .675 or six hundred seventy-five-thousandths.

Now, the other scales the thimble scale and you see that it starts at zero and goes from 1,2,3,4 all the way around to 20, 21, 22, 23, 24, and this would be the twenty-fifth [space between 24 and 0 on the scale. So are these are thousandths of an inch. So if this says one, this is one-thousandth .001, 5 would be .005, 17 is seventeen-thousandths .017. Now let's look at a reading on here. This mark that you see there [mark on connection of barrel gauge to thimble gauge – third mark past 3 on barrel] that tells us that we're at .3 and then.325, .350, and end up at .375 [counting marks past 3] So that mark represents .375. The reading from the thimble scale is zero [line on barrel lines up with 0 on the thimble], so we don't add anything to the .375, and so the reading is.

Okay, so here I have taken the micrometer and I have moved it just a little bit back, so we're just a little bit less than .375. So the question is what's the reading now? Well we were not reading from this mark [.375 on the barrel] anymore. This mark is not actually showing, even though you can kind of see it. The fact is if this mark were to show, it would be a brand new mark, and so the reading on the thimble scale would be a very small reading, as you can see we're reading 24 which is almost a completely all the way around. So this is a very high number, so that means working of the older mark, which would be this one [0.350 on barrel] and that mark would read .350. Now, we can get the next decimal place by reading the thimble scale and that would be, Remembers this one is [thimble] reading in thousandths of an inch, so this is twenty-thousandths, 21, 22, 23, This is twenty-four-thousandths [line on barrel to line on thimble], so that's .024. So the reading of this micrometer is the .350 plus the .024 think of this as adding 350 and 24. You get a reading of .374. Now on this slide we can see that we've gone past the zero mark [line from barrel to thimble] so we're working off a brand new number, It's a on brand new mark. It's just gonna be a small number, since is brand new. We've moved from .3.

.325, .350, .375 and to that were gonna add .001 [line on barrel to thimble is at 1] So if I asked you what is 375 plus one you'd be able to tell me 376. So that's the reading. [.376]

VIDEO 5 – WRENCHES – TRANSCRIPT

These are examples of automotive wrenches. The wrench at the top is known as an adjustable wrench. The wrench in the middle is known as a combination wrench, and the wrench at the bottom is called an open end wrench.

VIDEO 6 – RATCHET SETS – TRANSCRIPT

One of the most popular tools in automotive technology is the ratchet wrench set. [Ratchet set is shown on table]These sets come in all shapes and sizes. They're adaptable and extendable. Common sizes are the quarter-inch drive, the three-eighths drive, and the half-inch drive.

VIDEO 7 – SCREWDRIVERS – TRANSCRIPT

Screwdrivers are also a very popular automotive tool. They, like socket sets, come in various shapes and sizes, lengths, and colors. Common screwdrivers are the Phillips and flathead. Also available are Allen or hex, and torx and torx plus.

VIDEO 8 – PLIERS – TRANSCRIPT

Pliers are commonly used tools in the automotive industry. The examples below, starting from the top down illustrate a pair of slip joint pliers, a combination pliers set, a diagonal cutting pliers set, and a needle noise pliers set.

VIDEO 9 – PULLERS – TRANSCRIPT

These tools are known as specialty pullers. The puller at the top is a gear puller. It is used to remove gears. The puller in the middle is what is known as a bearing splitter, which is obviously used to remove bearings. And the puller at the bottom is a specialty puller for steering and suspension, called a Pitman Arm puller.

VIDEO 10 – AIR TOOLS – TRANSCRIPT

Pneumatic tools similar to the air ratchet and air drill, illustrated in this video, are a popular item among technicians in the automotive industry because of their ability to increase speed and productivity.

VIDEO 11 – LIFTS – TRANSCRIPT

The two lifts side by side here are a Twin Post lift made by Rotary and a drive on four post lift alignment rack combo made Hunter Technology. These lifts are an important part of everyday automotive work and increase productivity and efficiency.

VIDEO 12 – DIAGNOSTIC TOOLS - TRANSCRIPT

Scan tools come in many shapes and sizes. These specialty diagnostic tools are used to pull trouble codes, and do electronic diagnosis in today's modern vehicles. The three scan tools below are examples of different manufactures: two by the company OTC and one by Snap-on. Independent shops may require many scan tools to perform the various tasks they need to be profitable.

VIDEO 13 – TOOLBOX – TRANSCRIPT

The student box in this video, as you can see, is much smaller than the instructor box or technician box. This is because students' only tools to meet the bare minimum for the NATEF required pass lists.

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