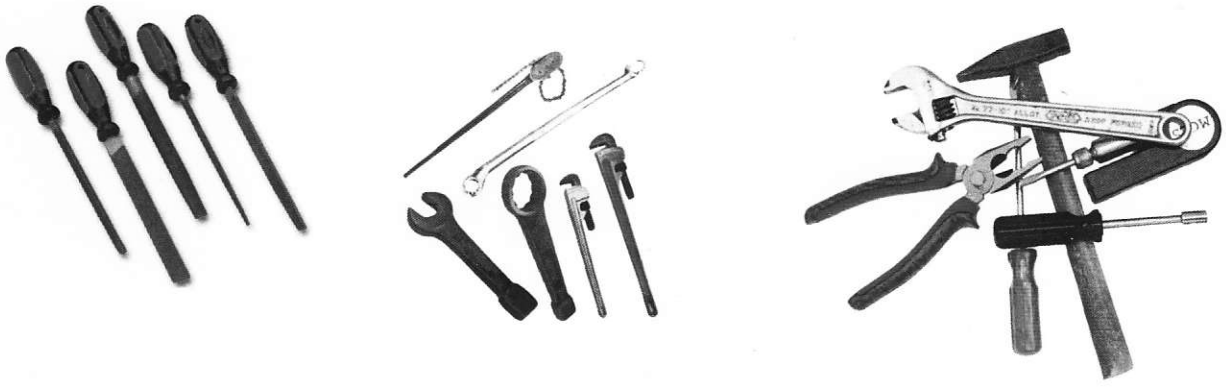
AVIATION MAINTENANCE TECHNICIAN HANDTOOLS

METHODICAL GUIDE



INFORMATION TECHNOLOGIES CENTER ITC

O. Tamargazin, L. Zhuravlova,
O.Rugayn, P. Chamegh, A. Eyo

AVIATION MAINTENANCE TECHNICIAN HANDTOOLS

Theory guide

KYIV
2013

UDC 378.14:629.735.083.002.54(076.5)

LBC 052-83p

A 95

Reader: Doctor of Science, *Andrey S. Kryzhanovsky*. – Associate Professor of Aerospace Institute of National Aviation University of Ukraine

A 95 Aviation Maintenance Technician Handtools/ O.A. Tamargazin, L.A. Zhuravlova, O.V.Rugayn, P. Chamegh, A. Eyo.-K.:Osvita Ukrainy, 2013.-42 p.

The Theory Guide contains general information about aviation maintenance technician hand tools. The Theory Guide is intended for the students of aviation specialties and should be also used during the familiarization and on-job summer practice.

LBC 052-083p

CONTENTS

INTRODUCTION

Mechanical engineering is the most broadly based branch of engineering offering diverse and rewarding employment opportunities that involve designing, testing, building and maintaining machinery or equipment.

Through the use of sophisticated design software, drawing equipment and hand tools, mechanical engineers determine how things work constantly seeking to improve both design and functionality of machinery.

Mechanical engineers may specialize in certain fields including mechanical handling, manufacturing, building services or focus on consumer products and domestic appliances.

It is almost impossible to do even the simplest repair without using some type of tool. Tools serve as extensions to parts of the human body. They increase the physical abilities of fingers, hands, arms, legs, eyes, ears, and back. A wellselected set of tools speeds up repairs, improves work quality, and increases profits.

The aviation maintenance technician (AMT) spends a major portion of each day using a wide variety of hand tools to accomplish maintenance tasks. An AMT encounters many special tools as their experience widens; large transport category aircraft have different maintenance tasks from those of a light airplane, and special hand tools are often required when working on complex aircraft.

Related tools are normally kept in the same toolbox drawer. For example, various types of hammers may be stored in one drawer and all screwdrivers in another. Small or delicate tools should *not* be kept with large, heavy tools to prevent damage. *Tool holders* help organize small tools. These include small clip or magnetic racks, cloth or plastic pouches, or socket trays. They are often used to protect tools and to keep them organized by size. Holders also allow a full set of tools to be taken to the job.

The time spent maintaining your tools and toolbox is time well spent. Well-organized tools will save time on each job and help you get more work done. Unorganized or poorly maintained tools will hurt your on-the-job performance.

1. HAMMERS AND MALLETS

Hammer is a tool with a heavy metal head mounted at right angles at the end of a handle, used for jobs such as breaking things and driving in nails.

Various types of hammers are used for operations that involve striking a tool or part. It is important to use the right hammer and to use it properly. Figure 1.1 shows some of the hammers that the aviation mechanic may be required to use.

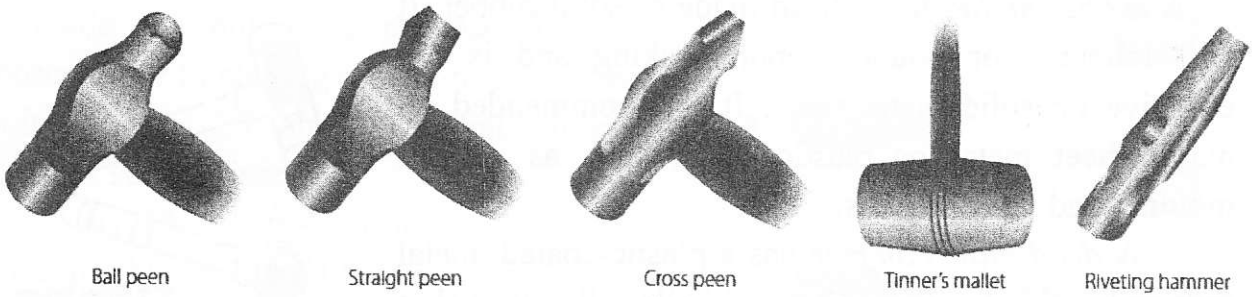


Figure 1.1– Hammers

A *ball peen hammer* is the most common type of hammer used in automotive work. It has a flat face for general striking. It also has a round end for shaping metal parts, such as sheet metal or rivet heads.

A *sledge hammer* has a very large head, Figure 1.2. It is usually the heaviest hammer and produces powerful blows. A sledge hammer is sometimes used to free frozen parts.

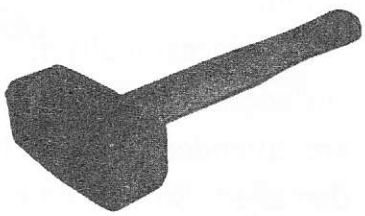


Figure 1.2– Sledge hammer

The *brass* has a soft, heavy head and is useful when scarring the surface of a part mu st be avoided, Figure 1.3. The relatively soft head deforms to protect the part surface from damage.

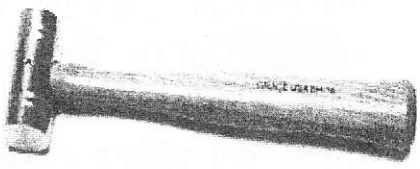


Figure 1.3– Brass hammer

A *plastic* or *rawhide hammer* is light and has a soft head, Figure 1.4. It is used where light blows are needed to prevent part breakage or damage to surfaces on small and delicate parts.

Figure 1.4– Rawhide hammer

A **mallet** is a hammer-like tool with a head made of hickory, rawhide, or rubber. It is handy for shaping thin metal parts without causing creases or dents with abrupt corners. Always use a wooden mallet when pounding a wood chisel or a gouge. Wooden mallet is a hammer with a large wooden head (Figure 1.5).

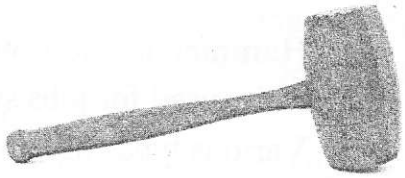


Figure 1.5– Wooden mallet

A *rubber mallet* has a head made of solid rubber. It will rebound, or bounce, upon striking and is not effective on solid metal parts. It is recommended on many sheet metal or plastic parts, such as garnish molding and wheel covers.

A *dead blow hammer* has a plastic-coated, metal face and is filled with small metal balls called lead shot (Figure 1.6).

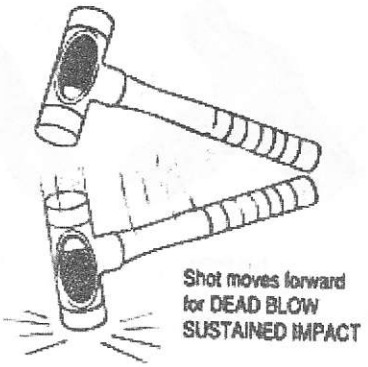


Figure 1.6– Dead blow mallet

Metal head hammers are usually sized according to the weight of the head without the handle.

The following are some general rules governing hammers.

Occasionally it is necessary to use a soft-faced hammer, which has a striking surface made of wood, brass, lead, rawhide, hard rubber, or plastic. These hammers are intended for use in forming soft metals and striking surfaces that are easily damaged. Soft-faced hammers should not be used for striking punch heads, bolts, or nails, as using one in this fashion will quickly ruin this type of hammer.

When using a hammer or mallet, choose the one best suited for the job. Ensure that the handle is tight. When striking a blow with the hammer, use the forearm as an extension of the handle. Swing the hammer by bending the elbow, not the wrist. Always strike the work squarely with the full face of the hammer. When striking a metal tool with a metal hammer, the use of safety glasses or goggles is strongly encouraged.

Always keep the faces of hammers and mallets smooth and free from dents, chips, or gouges to prevent marring the work.

2. SCREWDRIVERS

A **screwdriver** is a tool that is used for turning screws. It consists of a metal rod with a flat or cross-shaped end that fits into the top of the screw.

A *standard screwdriver* has a single blade that fits into a slot in the screw head (Figure 2.1,*A*).

The screwdriver can be classified by its shape, type of blade, and blade length. It is made for only one purpose, i.e., for loosening or tightening screws or screw head bolts. Figure 2.1 shows several different types of screwdrivers.

A *Phillips screwdriver* has two crossing blades that fit into a star-shaped screw slot, Figure 2.1,*B*.

A *Reed and Prince* screwdriver is similar to a Phillips, but it has a slightly different tip shape, Figure 2.1,*C*.

Torx and *clutch head* are special types of screwdrivers and are shown in Figures 2.1 *D* and *E*.

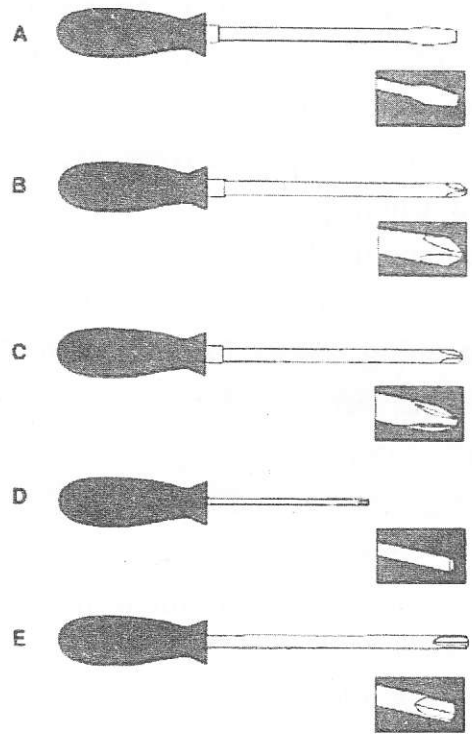


Figure 2.1 - Screwdrivers types. A-standard; B-Phillips; C-Reed and Prince; D-Torx; E-Clutch-Head

Torx is the trademark for a type of screw head characterized by a 6-point star-shaped pattern. A popular generic name for the drive is star, as in star screwdriver or star bits. The official generic name, standardized by the International Organization for Standardization as ISO 10664, is hexalobular internal. This is sometimes abbreviated in databases and catalogs as 6lobe (starting with numeral "6", not a capital "G"). Torx Plus is an improved head profile.

Torx screws are commonly found on automobiles, motorcycles, bicycle brake systems (disc brakes), hard disk drives, computer systems and consumer electronics (Figure 2.2).

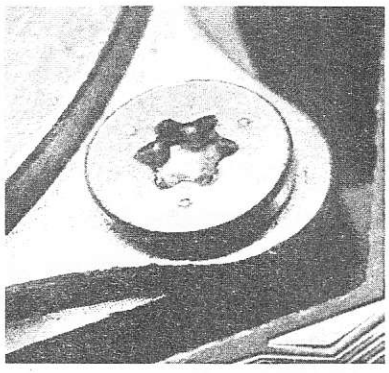
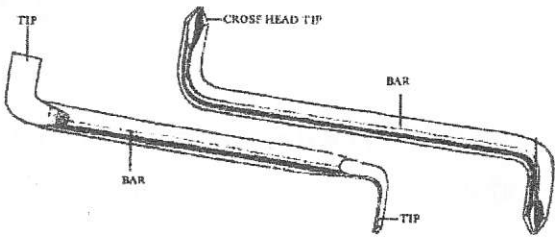


Figure 2.2 – Torx screw

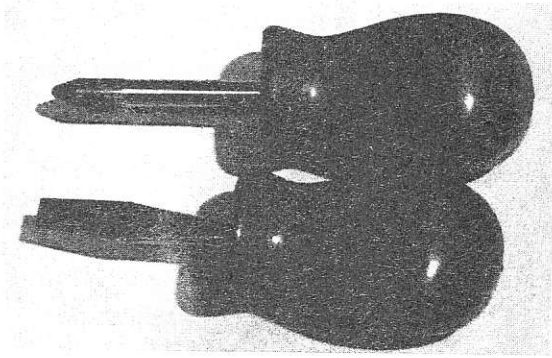
Offset and *stubby screwdrivers* are good in tight places, Figures 2.3, *A, B.*

An offset screwdriver may be used when vertical space is limited. Offset screwdrivers are constructed with both ends bent 90° to the shank handle. By using alternate ends, most screws can be seated or loosened even when the swinging space is limited. Offset screwdrivers are made for both standard and recessed head screws. Ratcheting right angle screwdrivers are also available, and often prove to be indispensable when working in close quarters.

A *stubby screwdriver* is needed for loosening screws inside a glove box. *Starting screwdrivers* hold the screw securely until started in its hole, they prevent the screw from being dropped and lost.



A



B

Figure 2.3 – Offset *(A)* and Stubby *(B)* screwdrivers

A *scratch awl* looks like a screwdriver, but it has a sharp, pointed tip, Figure 2.4. It is used for marking sheet metal and other parts.

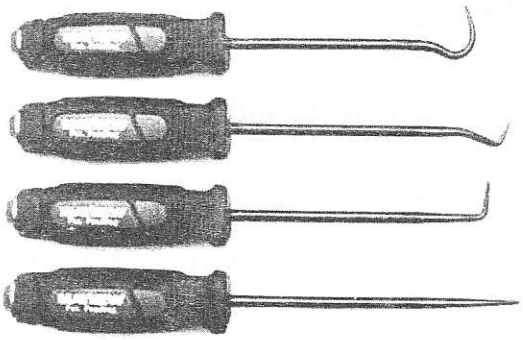


Figure 2.4 – Scratch Awl

Replaceable tip screwdrivers, commonly referred to as "10 in 1" screwdrivers, allow for the quick changing of a screwdriver tip, and economical replacement of the tip when it becomes worn (Figure 2.5).

A screwdriver should not be used for chiseling or prying. Do not use a screwdriver to check an electric circuit since an electric arc will burn the tip and make it useless. In some cases, an electric arc may fuse the blade to the unit being checked, creating a short circuit.

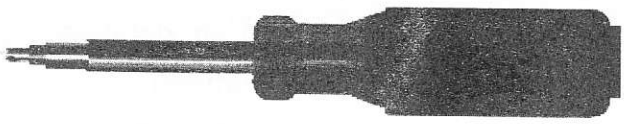


Figure 2.5-Replacable Tip Screwdriver

When using a screwdriver on a small part, always hold the part in the vise or rest it on a workbench. Do not hold the part in the hand, as the screwdriver may slip and cause serious personal injury.

3. PLIERS AND PLIER-TYPE CUTTING TOOLS

Pliers are a tool with two handles at one end and two hard, flat, metal parts at the other. Pliers are used to grip, cut, crimp, hold, and bend various parts. Different pliers are helpful for different situations. Several types of pliers are pictured in Figure 3-13. Never use pliers when another type tool will work. Pliers can nick and scar a part.

Combination pliers, or *slip-joint pliers,* are the most common pliers used by an automotive technician. The slip joint allows the jaws to be adjusted to grasp different size parts, Figure 3.1, *A*.

Rib joint pliers, also called *channel lock pliers* or *water pump pliers,* open extra wide for holding very large objects, Figure 3.1, *B*.

Needle nose pliers are excellent for handling extremely small parts or reaching into highly restricted areas, Figure 3.1, *C*.

Do *not* twist too hard on needle nose pliers, or the long thin jaws can be bent.

Diagonal cutting pliers are the most commonly used cutting pliers, Figure 3.1, *D*. Their jaw shape allows them to cut items flush with an adjacent surface. Diagonal cutting pliers are often used to cut off cotter pins, wires, and plastic ties.

Locking pliers, or *vise grips,* clamp onto and hold a part, Figure 3.1, *E*. This frees both hands to do other tasks. Because of their clamping power, vise grips can sometimes be used to unscrew fasteners with stripped or rounded heads. However, *never* use them on undamaged nuts or bolts.

Snap ring pliers have sharp, pointed tips for installing and removing special clips called snap rings. A pair of snap ring pliers is shown in Figure 3.1, *F*.

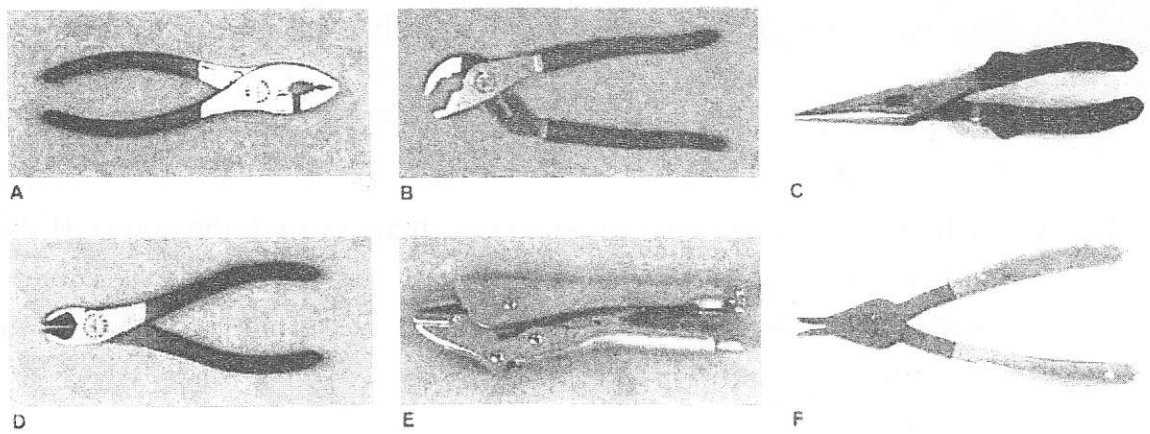


Figure 3.1 – Types of pliers. A – Slip joint; B – Rib joint; C – Needle –nose; D – Diagonal cutting; E – Vise grips; F – Snap ring

The pliers used most frequently in aircraft repair work are the diagonal, needlenose, and duckbill. The size of pliers indicates their length, usually ranging from 5 to 12 inches.

Roundnose pliers (Figure 3.2) are used to crimp metal. They are not made for heavy work because too much pressure will spring the jaws, which are often wrapped to prevent scarring the metal.

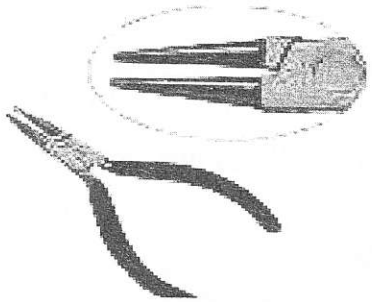


Figure 3.2 – Roundnose pliers

Needlenose pliers (Figure 3.1, *C*) have half round jaws of varying lengths. They are used to hold objects and make adjustments in tight places.

Duckbill pliers (Figure 3.3) resemble a "duck's bill" in that the jaws are thin, flat, and shaped like a duck's bill. They are used exclusively for twisting safety wire.

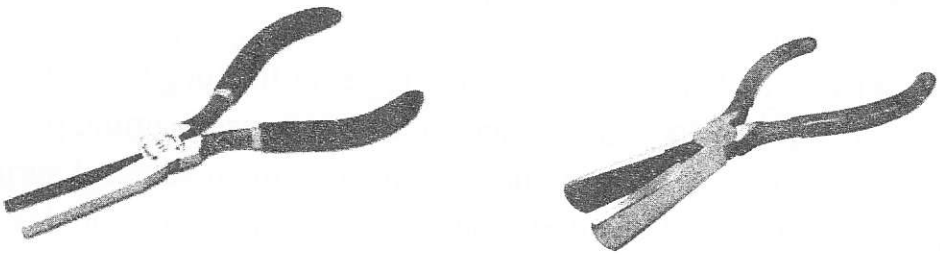


Figure 3.3 – Duckbill pliers

Diagonal pliers (Figure 3.1, *D*) are usually referred to as diagonals or "dikes." The diagonal is a short-jawed cutter with a blade set at a slight angle on each jaw. This tool can be used to cut wire, rivets, small screws, and cotter pins, besides being practically indispensable in removing or installing safety wire. The duckbill pliers and the diagonal cutting pliers are used extensively in aviation for the job of safety wiring.

Two important rules for using pliers are:

1. Do not make pliers work beyond their capacity. The long-nosed variety is especially delicate. It is easy to spring or break them, or nick the edges. If this occurs, they are practically useless.

2. Do not use pliers to turn nuts. In just a few seconds, a pair of pliers can damage a nut more than years of service.

4. PUNCHES

Punches are a type of technician's tool used to cut holes in material. It can be small and manually operated and hold one simple die set, or be very large. Punches are used to locate centers for drawing circles, to start holes for drilling, to punch holes in sheet metal, to transfer location of holes in patterns, and to remove damaged rivets, pins or bolts.

Punches also come in several configurations (Figure 4.1).

A *center punch* is frequently used to mark parts for reassembly and to start a hole before drilling. Look at Figure 3-16. The indentation made by a center punch will keep a drill bit from moving when first starting to drill.

A *pin punch* has a straight shank and is lighter than a starting punch. It is used *after* a starting punch to push a shaft or rod the rest of the way out of a hole.

A *starting punch,* or *drift punch,* has a shank tapered all the way to the end. It is strong and can withstand moderate blows. It is used to drive pins, shafts, and metal rods partway out of a hole.

An *aligning punch* has a long, tapered shaft and is handy for lining up parts during assembly. An aligning punch can be inserted into holes in mating parts and then wiggled to match up the holes. Never use an aligning punch as a center punch. Its tip is too soft and would be ruined.

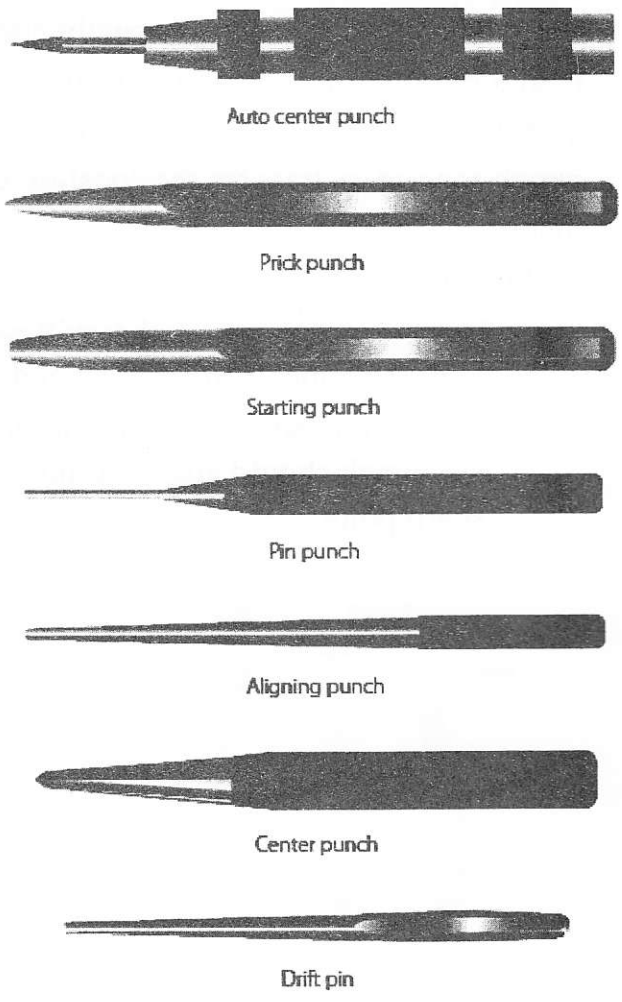


Figure 4.1.- Punches

Solid or hollow punches are the two types generally used. Solid punches are classified according to the shape of their points. Figure 4.1 shows several types of punches.

Prick punches are used to place reference marks on metal. This punch is often used to transfer dimensions from a paper pattern directly on the metal. These

indentations can then be used as reference marks for cutting the metal. A prick punch should never be struck a heavy blow with a hammer because it may bend the punch or cause excessive damage to the material being worked.

In general practice, a pin or bolt which is to be driven out is usually started and driven with a drive punch until the sides of the punch touch the side of the hole. A pin punch is then used to drive the pin or bolt the rest of the way out of the hole. Stubborn pins may be started by placing a thin piece of scrap copper, brass, or aluminum directly against the pin and then striking it with a hammer until the pin begins to move.

Never use a prick punch or center punch to remove objects from holes because the point of the punch will spread the object and cause it to bind even more.

The transfer punch is usually about 4 inches long. It has a point that tapers, and then turns straight for a short distance in order to fit a drill locating hole in a template. The tip has a point similar to that of a prick punch. As its name implies, the transfer punch is used to transfer the location of holes through the template or pattern to the material.

Punch using rules

- Use the largest punch that will work. If a small punch is used on a very large part, the punch can rebound and fly out with tremendous force.
- Keep both ends of a punch properly ground and shaped. A starting punch or a pin punch should also be ground flat and square. A center punch should have a sharp point.

5. WRENCHES

A wrench (or spanner) is a tool used to provide grip and mechanical advantage in applying torque to turn objects—usually rotary fasteners, such as nuts and bolts—or keep them from turning.

In British English, spanner is the standard term. The most common shapes are called open-ended spanner and ring spanner. The term wrench refers to various types of adjustable spanner.

In American English, wrench is the standard term. The very most common shapes are called open-end wrench and box-end wrench. In American English, spanner refers to a specialized wrench with a series of pins or tabs around the circumference. (These pins or tabs fit into the holes or notches cut into the object to be turned.)

Higher quality wrenches are typically made from chromium-vanadium alloy tool steels and are often drop-forged. They are frequently chrome-plated to resist corrosion and ease cleaning.

The wrenches most often used in aircraft maintenance are classified as open-end, box-end, socket, adjustable, ratcheting and special wrenches. The Allen wrench, although seldom used, is required on one special type of recessed screw.

One of the most widely used metals for making wrenches is chrome-vanadium steel. Wrenches made of this metal are almost unbreakable. Solid, nonadjustable wrenches with open parallel jaws on one or both ends are known as open-end wrenches. These wrenches may have their jaws parallel to the handle or at an angle up to 90°; most are set at an angle of 15°. The wrenches are designed to fit a nut, bolt head, or other object, which makes it possible to exert a turning action.

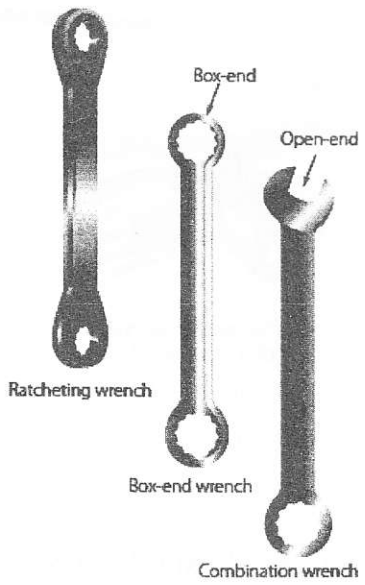


Figure 5.1.- Wrenches

Box-end wrenches are popular tools because of their usefulness in close quarters. They are called box wrenches since they box, or completely surround the nut or bolt head. Although box-end wrenches are ideal to break loose tight nuts or pull tight nuts tighter, time is lost turning the nut off the bolt once the nut is broken loose. Only when there is sufficient clearance to rotate the wrench in a complete circle can this tedious process be avoided.

After a tight nut is broken loose, it can be completely backed off or unscrewed more quickly with an opened than with a box-end wrench. In this case, a combination wrench can be used; it has a box end on one end and an open-end wrench of the same size on the other. Another option for removing a nut from a bolt is the ratcheting box-end wrench, which can be swung back and forth to remove the nut or bolt. The box-end, combination, and ratcheting wrenches are shown in Figure 5.1.

A *socket wrench* is made of two parts: (1) the socket, which is placed over the top of a nut or bolt head, and (2) a handle, which is attached to the socket. Many types of handles, extensions, and attachments are available to make it possible to use socket wrenches in almost any location or position. Sockets are made with either fixed or detachable handles. Socket wrenches with fixed handles are usually furnished as an accessory to a machine. They have a four, six, or twelve-sided recess to fit a nut or bolt head that needs regular adjustment.

Sockets with detachable handles usually come in sets and fit several types of handles, such as the T, ratchet, screwdriver grip, and speed handle. Socket wrench handles have a square lug on one end that fits into a square recess in the socket head. The two parts are held together by a light spring-loaded poppet. Two types of sockets, a set of handles, and an extension bar are shown in Figure 5.2.

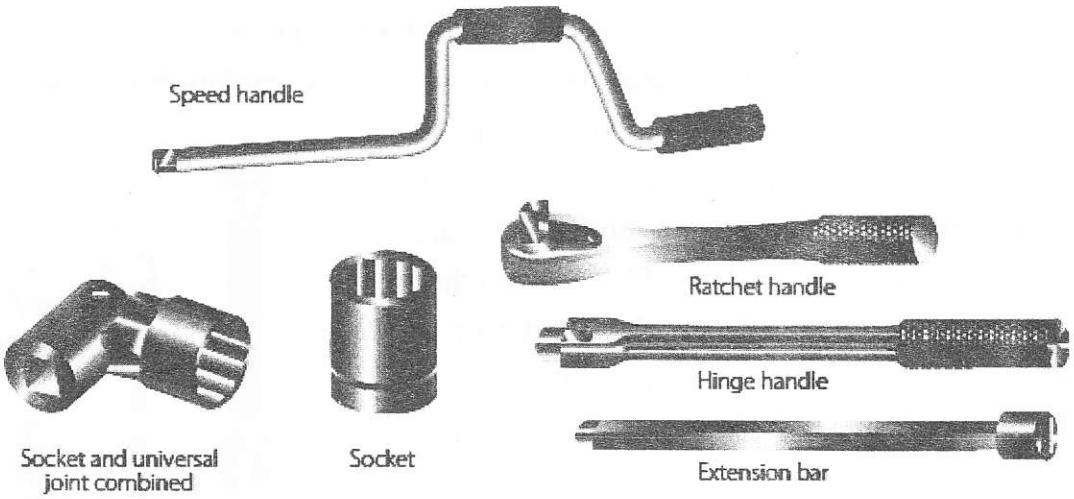


Figure 5.2.- Socket Wrench Set

The adjustable wrench is a handy utility tool that has smooth jaws and is designed as an open-end wrench. One jaw is fixed, but the other may be moved by a thumbscrew or spiral screwworm adjustment in the handle. One adjustable wrench does the work of several open-end wrenches.

Special Wrenches

The category of special wrenches includes the crowfoot, flare nut, spanner, torque, and Allen wrenches Figures 5.3 and 5.4.

The crowfoot wrench is normally used when accessing nuts that must be removed from studs or bolt that cannot be accessed using other tools. The flare nut wrench has the appearance of a box-end wrench that has been cut open on one end. This opening allows the wrench to be used on the B-nut of a fuel, hydraulic, or oxygen line. Since it mounts using the standard square adapter, like the crowfoot wrench, it can be used in conjunction with a torque wrench.

The hook spanner is for a round nut with a series of notches cut in the outer edge. This wrench has a curved arm with a hook on the end that fits into one of the

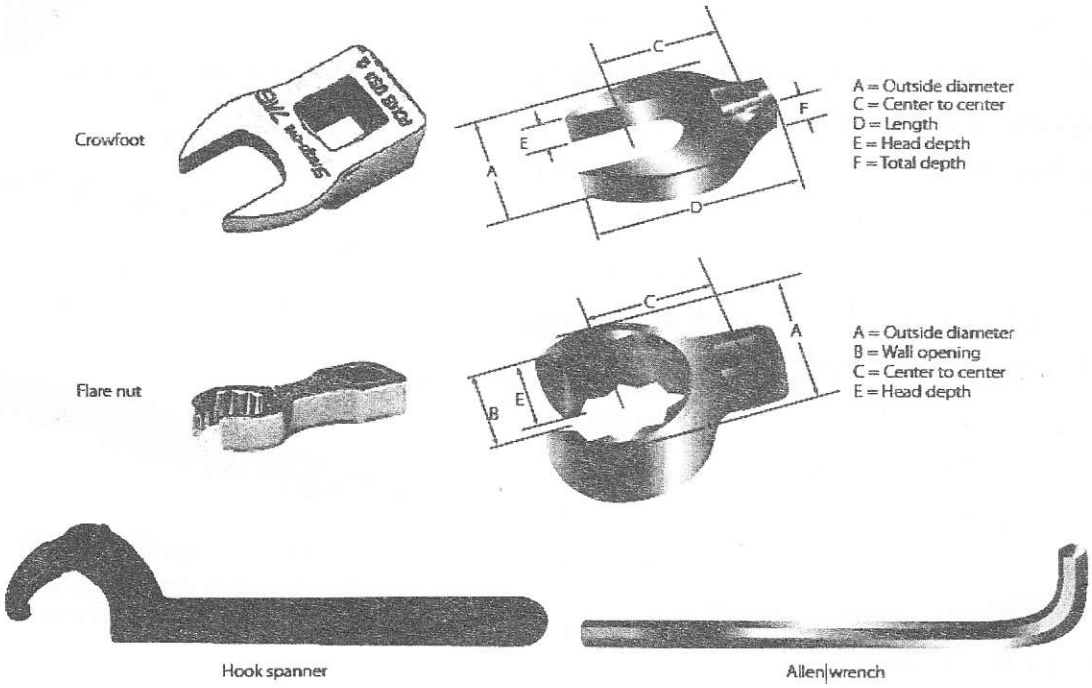


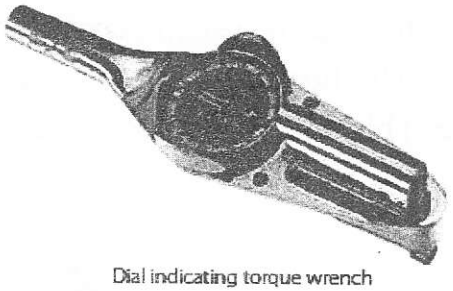
Figure 5.3.- Special Wrenches

Allen notches on the nut. The hook is placed in one of these notches with the handle pointing in the direction the nut is to be turned .Some hook spanner wrenches are adjustable and will fit nuts of various diameters. U-shaped hook spanners have two lugs on the face of the wrench to fit notches cut in the face of the nut or screw plug. End spanners resemble a socket wrench, but have a series of lugs that fit into corresponding notches in a nut or plug. Pin spanners have a pin in place of a lug, and the pin fits into a round hole in the edge of a nut. Face pin spanners are similar to the U-shaped hook spanners except that they have pins instead of lugs.

Most headless setscrews are the hex-head Allen type and must be installed and removed with an Allen wrench. Allen wrenches are six-sided bars in the shape of an L, or they can be hex-shaped bars mounted in adapters for use with hand ratchets. They range in size from 3⁄64 to 1⁄2 inch and fit into a hexagonal recess in the setscrew.

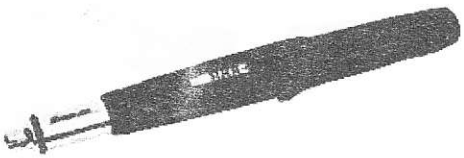
Torque Wrench

There are times when definite pressure must be applied to a nut or bolt as it is installed. In such cases a torque wrench must be used. The torque wrench is a precision tool consisting of a torque indicating handle and appropriate adapter or attachments. It measures the amount of turning or twisting force applied to a nut, bolt, or screw.



Dial indicating torque wrench

Micrometer "click-type" torque wrench



Electronic torque wrench

Figure 5.4.- Torque Wrenches

Before each use, the torque wrench should be visually inspected for damage. If a bent pointer, cracked or broken glass (dial type), or signs of rough handling are found, the wrench must be tested. Torque wrenches must be tested at periodic intervals to ensure accuracy. Commonly used torque wrenches include the deflecting beam (not shown), dial indicating, micrometer, and electronic setting types (Figure 5.4).

Strap Wrenches

The strap wrench can prove to be an invaluable tool for the AMT. By their very nature, aircraft components such as tubing, pipes, small fittings, and round or irregularly shaped components are built to be as light as possible, while still retaining enough strength to function properly. The misuse of pliers or other gripping tools can quickly damage these parts. If it is necessary to grip a part to hold it in place, or to rotate it to facilitate removal, consider using a strap wrench that uses a plastic covered fabric strap to grip the part (Figure 5.5).

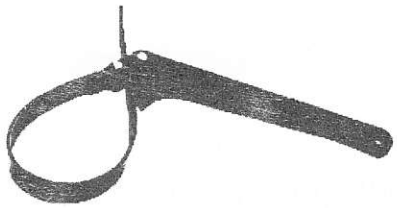


Figure 5.5.- Strap Wrenches

6. METAL CUTTING TOOLS

Hand Snips

Snips are a small pair of shears used for cutting sheet metal.

There are several kinds of hand snips, each of which serves a different purpose. Straight, curved, hawksbill, and aviation snips are in common use. Straight snips are used for cutting straight lines when the distance is not great enough to use a squaring shear and for cutting the outside of a curve. The other types are used for cutting the inside of curves or radii. Snips should never be used to cut heavy sheet metal (Figure 6.1).

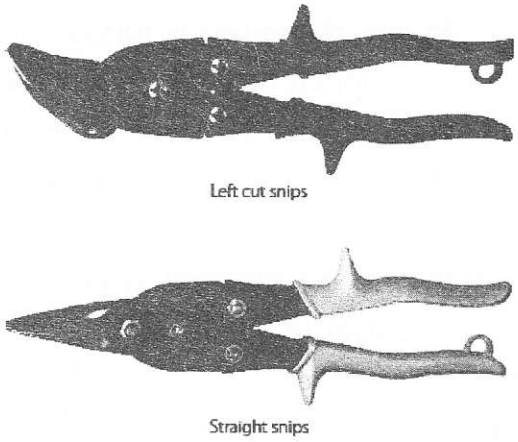


Figure 6.1- Typical Snips

Hacksaws

Hacksaw is a saw with a narrow fine-toothed blade set in a frame, used especially for cutting metal. The common hacksaw has a blade, a frame, and a handle. The handle can be obtained in two styles: pistol grip and straight (Figure 6.2).

Hacksaw blades have holes in both ends; they are mounted on pins attached to the frame. When installing a blade in a hacksaw frame, mount the blade with the teeth pointing forward, away from the handle.

Blades are made of high-grade tool steel or tungsten steel and are available in sizes from 6 to 16 inches in length. The 10-inch blade is most commonly used.

There are two types: the all-hard blade and the flexible blade. In flexible blades, only the teeth are hardened.

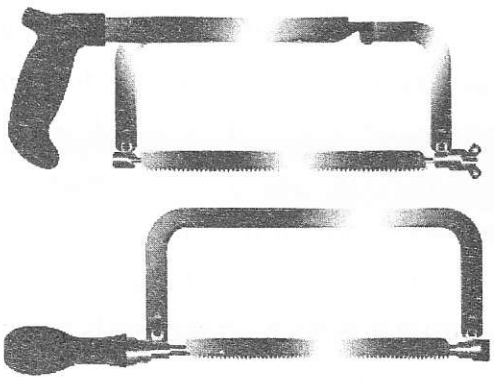


Figure 6.2 - Hacksaws

Selection of the best blade for the job involves finding the right type and pitch. An all-hard blade is best for sawing brass, tool steel, cast iron, and heavy cross-section materials. A flexible blade is usually best for sawing hollow shapes and metals having a thin cross section.

Chisels

A chisel is a tool with a characteristically shaped cutting edge (such that wood chisels have lent part of their name to a particular grind) of blade on its end, for carving or cutting a hard material such as wood, stone, or metal. The handle and blade of some types of chisel are made of metal or wood with a sharp edge in it.

In use, the chisel is forced into the material to cut it. The driving force may be manually applied or applied using a mallet or hammer. In industrial use, a hydraulic ram or falling weight ('trip hammer') drives the chisel into the material to be cut.

A gouge, one type of chisel, is used, particularly in woodworking, woodturning and sculpture, to carve small pieces from the material. Gouges are most often used in creating concave surfaces. A gouge typically has a 'U'-shaped cross-section.

A chisel is a hard steel cutting tool that can be used for cutting and chipping any metal softer than the chisel itself. It can be used in restricted areas and for such work as shearing rivets, or splitting seized or damaged nuts from bolts (Figure 6.3).

Cold chisel is a chisel used for cutting metal.

A *flat chisel* is a tool that typically has a handle, or shank, leading to a straight, sharp cutting edge with a bevel on the upper side. Generally, the back of this edge is smooth. These tools are usually made from forged steel and can be tipped with tungsten carbide.

Cape chisel is a cold chisel that has a long taper on the top and bottom of the cutting end and a narrow edge and is used for cutting keyways and similar flat grooves

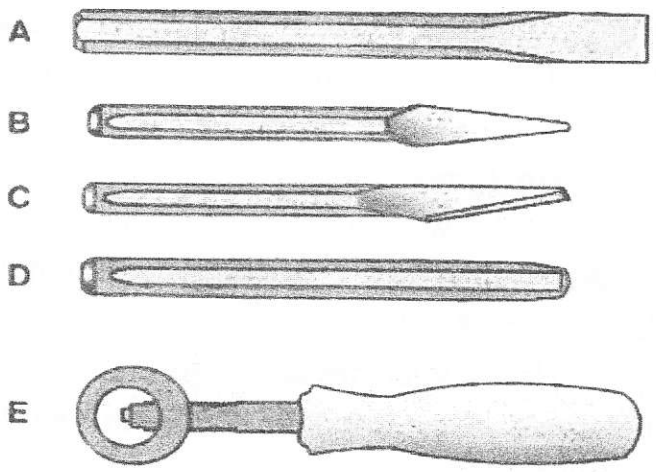


Figure 6.3 – Types of chisels. *A* – Flat chisel; *B* – Cape chisel; *C* – Round-nose cape chisel; *D* – Diamond-point chisel; *E* – Chisel or punch holder

The size of a flat cold chisel is determined by the width of the cutting edge. Lengths will vary, but chisels are seldom under 5 inches or over 8 inches long.

Chisel using rules

- Use the largest chisel that will work. If a small chisel is used on a very large part, the punch can rebound and fly out with tremendous force.
- Keep both ends of a chisel properly ground and shaped. A chisel's cutting edge should be sharp and square.

7. FILES

A **file** is a metalworking, woodworking and plastic working tool used to cut fine amounts of material from a workpiece. It most commonly refers to the hand tool style, which takes the form of a steel bar with a case hardened surface and a series of sharp, parallel teeth. Most files have a narrow, pointed tang at one end to which a handle can be fitted.A similar tool is the rasp. A **rasp** is a tool used for shaping wood or other material. It consists of a point or the tip, then a long steel bar or the belly, then the heel or bottom, then the tang. The tang is joined to a handle, usually made of plastic or wood. The bar has sharp teeth. Rasps generally cut more coarsely than files. This is an older form, with simpler teeth. As they have larger clearance between teeth, these are usually used on softer, non-metallic materials.

Related tools have been developed with abrasive surfaces, such as diamond abrasives or silicon carbide. Because of their similar form and function, these have also been termed 'files'.

Most files are made of high-grade tool steels that are hardened and tempered. Files are manufactured in a variety of shapes and sizes. They are known either by the cross section, the general shape, or by their particular use. The cuts of files must be considered when selecting them for various types of work and materials.

Files are used to square ends, file rounded corners, remove burrs and slivers from metal, straighten uneven edges, file holes and slots, and smooth rough edges.

Files have three distinguishing features: (1) their length, measured exclusive of the tang (Figure 7.1); (2) their kind or name, which has reference to the relative coarseness of the teeth; and (3) their cut.

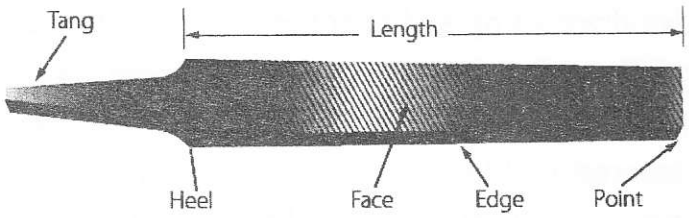


Figure 7.1.- Hand File

Files are usually made in two types of cuts: single cut and double cut. The single cut file has a single row of teeth extending across the face at an angle of 65° to 85° with the length of the file. The size of the cuts depends on the coarseness of the file. The double cut file has two rows of teeth that cross each other. For general work, the angle of the first row is 40° to 45°.

The first row is generally referred to as "overcut," and the second row as "upcut;" the upcut is somewhat finer and not as deep as the overcut.

Files and rasps are catalogued in three ways: •

Length. Measuring from the tip to the heel of the file. The tang is never included in the length.

• *Shape.* Refers to the physical configuration of the file (circular, rectangular, or triangular or a variation thereof).

• *Cut.* Refers to both the character of the teeth or the coarseness — rough, coarse, and bastard for use on heavier classes of work and second cut, smooth and dead smooth for finishing work.

Most commonly used files are shown on Figures 7.2-7.3).

Hand files—These are parallel in width and tapered in thickness. They have one safe edge (smooth edge) which permits filing in corners, and on other work where a safe edge is required. Hand files are double cut and used principally for finishing flat surfaces and similar work.

Flat files— These files are slightly tapered toward the point in both width and thickness. They cut on both edges as well as on the sides. They are the most common files in use. Flat files are double cut on both sides and single cut on both edges.

Mill files—These are usually tapered slightly in thickness and in width for about one-third of their length. The teeth are ordinarily single cut. These files are used for draw filing and to some extent for filing soft metals.

Square files—These files may be tapered or blunt and are double cut. They are used principally for filing slots and key seats, and for surface filing.

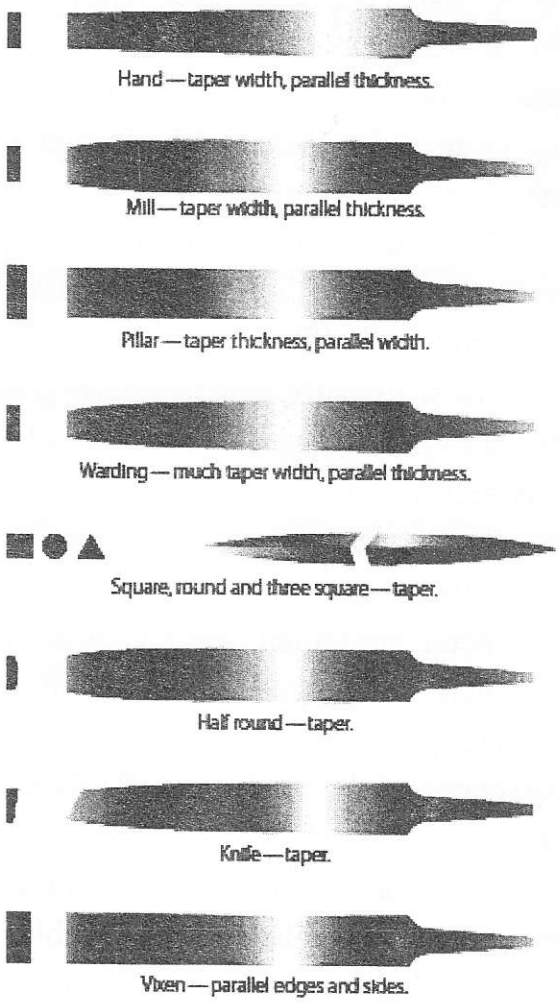


Figure7.2 - Types of Files

Round or rattail files—These are circular in cross section and may be either tapered or blunt and single or double cut. They are used principally for filing circular openings or concave surfaces.

Triangular and three square files—These files are triangular in cross section. Triangular files are single cut and are used for filing the gullet between saw teeth.

Three square files, which are double cut, may be used for filing internal angles, clearing out corners, and filing taps and cutters.

Half-round files—These files cut on both the flat and round sides. They may be single or double cut. Their shape permits them to be used where other files would be unsatisfactory.

Lead float files—These are especially designed for use on soft metals. They are single cut and are made in various lengths.

Warding file—Rectangular in section and tapers to narrow point in width. This file is used for narrow space filing where other files cannot be used.

Knife file—Knife blade section. This file is used by tool and die makers on work having acute angles.

Wood file—Same section as flat and half-round files. This file has coarser teeth and is especially adaptable for use on wood.

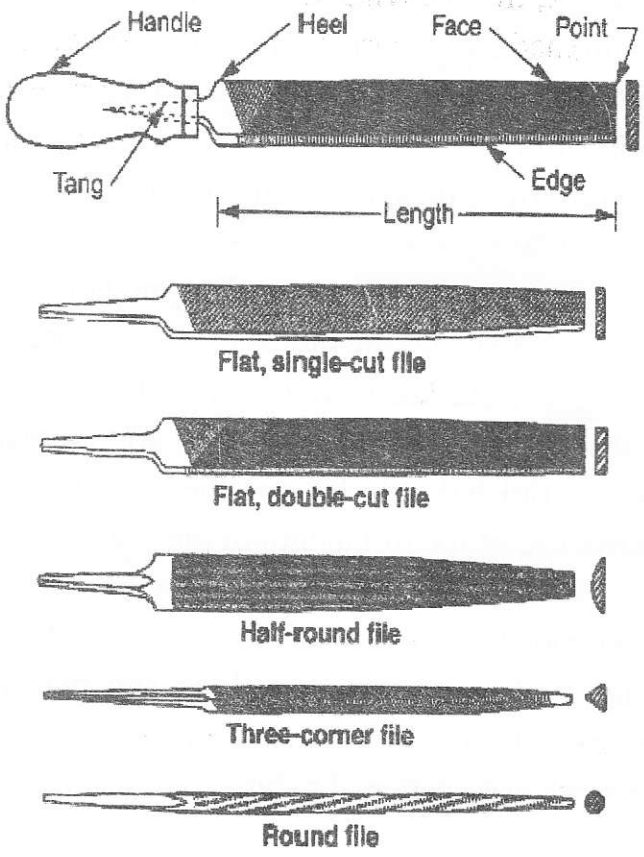


Figure7.3 - Types of Files

Vixen (curved-tooth files)—Curved-tooth files are especially designed for rapid filing and smooth finish on soft metals and wood. The regular cut is adapted for tough work on cast iron, soft steel, copper, brass, aluminum, wood, slate, marble, fiber, rubber, and so forth. The fine cut gives excellent results on steel, cast iron, phosphor bronze, white brass, and all hard metals. The smooth cut is used where the amount of material to be removed is very slight, but where a superior finish is desired. The following methods are recommended for using files:

1. *Crossfiling.* Before attempting to use a file, place a handle on the tang of the file. This is essential for proper guiding and safe use. In moving the file endwise across the work (commonly known as crossfiling), grasp the handle so that its end fits into and against the fleshy part of the palm with the thumb lying along the top of the handle in a lengthwise direction. Grasp the end of the file between the thumb and first

two fingers. To prevent undue wear of the file, relieve the pressure during the return stroke.

2. *Drawfiling.* A file is sometimes used by grasping it at each end, crosswise to the work, then moving it lengthwise with the work. When done properly, work may be finished somewhat finer than when crossfiling with the same file. In drawfiling, the teeth of the file produce a shearing effect. To accomplish this shearing effect, the angle at which the file is held with respect to its line of movement varies with different files, depending on the angle at which the teeth are cut. Pressure should be relieved during the backstroke.

3. *Rounding corners.* The method used in filing a rounded surface depends upon its width and the radius of the rounded surface. If the surface is narrow or only a portion of a surface is to be rounded, start the forward stroke of the file with the point of the file inclined downward at approximately a 45° angle. Using a rocking chair motion, finish the stroke with the heel of the file near the curved surface. This method allows use of the full length of the file.

4. *Removing burred or slivered edges.* Practically every cutting operation on sheet metal produces burrs or slivers. These must be removed to avoid personal injury and to prevent scratching and marring of parts to be assembled. Burrs and slivers will prevent parts from fitting properly and should always be removed from the work as a matter of habit.

File cards

A file card, which is a brush with metal bristles, is used to clean the file.

Particles of metal collect between the teeth of a file and may make deep scratches in the material being filed. When these particles of metal are lodged too firmly between the teeth and cannot be removed by tapping the edge of the file, remove them with a file card or wire brush. Draw the brush across the file so that the bristles pass down the gullet between the teeth (Figure 7.3).

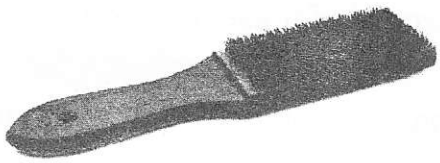


Figure 7.3.- File Card

8. DRILLS

A drill is a tool fitted with a cutting tool attachment or driving tool attachment, usually a drill bit or driver bit, used for drilling holes in various materials or fastening various materials together with the use of fasteners (Figure 7.1).

The attachment is gripped by a chuck at one end of the drill and rotated while pressed against the target material. The tip, and sometimes edges, of the cutting tool does the work of cutting into the target material. This may be slicing off thin shavings (twist drills or auger bits), grinding off small particles (oil drilling), crushing and removing pieces of the workpiece (SDS masonry drill), countersinking, counterboring, or other operations.

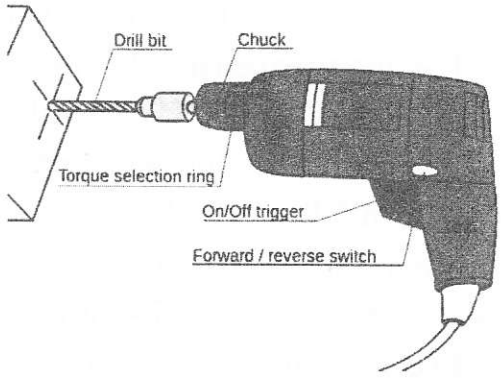


Figure 8.1 - Pistol-grip corded drill

Drills are commonly used in woodworking, metalworking, construction and do-it-yourself projects. Specially designed drills are also used in medicine, space missions and other applications. Drills are available with a wide variety of performance characteristics, such as power and capacity. There are generally four types of metal drills used in aviation for holding and turning twist drills (Figure 8.2).

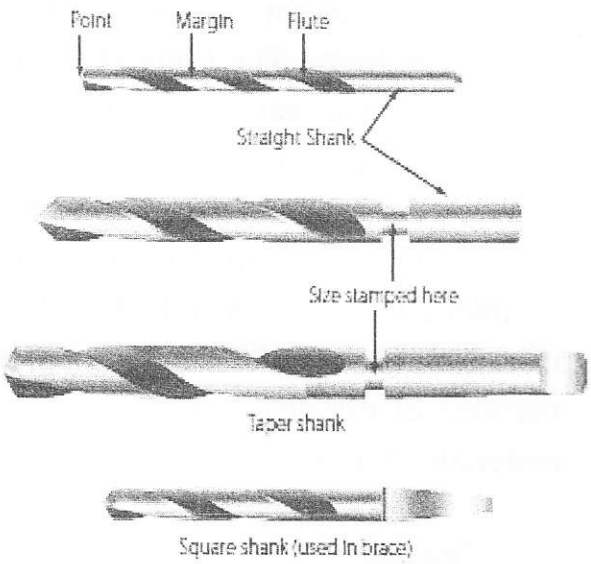


Figure 8.2.-Drill Types

Holes 1/4 inch in diameter and under can be drilled using a hand drill. This drill is commonly called an "egg beater." The breast drill is designed to hold larger size twist drills than the hand drill. In addition, a breastplate is affixed at the upper end of the drill to permit the use of body weight to increase the cutting power of the drill. Electric and pneumatic power drills are available various shapes and sizes to satisfy almost any requirement.

Pneumatic drills are preferred for use around flammable materials, since sparks from an electric drill are a fire or explosion hazard.

Twist Drills

A twist drill is a pointed tool that is rotated to cut holes in material. It is made of a cylindrical hardened steel bar having spiral flutes (grooves) running the length of the body, and a conical point with cutting edges formed by the ends of the flutes.

Twist drills are made of carbon steel or high-speed alloy steel. Carbon steel twist drills are satisfactory for the general run of work and are relatively inexpensive.

The more expensive high-speed twist drills are used for the tough materials such as stainless steels. Twist drills have from one to four spiral flutes. Drills with two flutes are used for most drilling; those with three or four flutes are used principally to follow smaller drills or to enlarge holes.

The principal parts of a twist drill are the shank, the body, and the heel. The drill shank is the end that fits into the chuck of a hand or power drill.

The two shank shapes most commonly used in hand drills are the straight shank and the square or bit stock shank. The straight shank generally is used in hand, breast, and portable electric or pneumatic drills; the square shank is made to fit into a carpenter's brace. Tapered shanks generally are used in machine shop drill presses.

The metal column forming the core of the drill is the body. The body clearance area lies just back of the margin; it is slightly smaller in diameter than the margin, to reduce the friction between the drill and the sides of the hole. The angle at which the drill point is ground is the lip clearance angle. On standard drills used to cut steel and cast iron, the angle should be 59° from the axis of the drill. For faster drilling of soft materials, sharper angles are used.

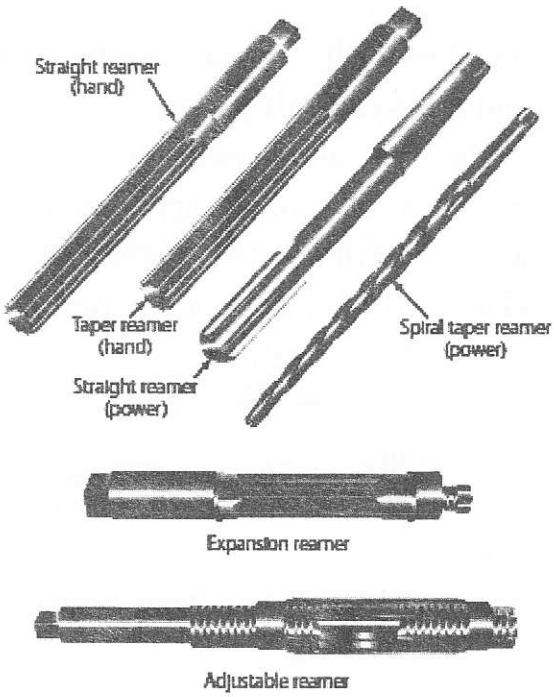


Figure 8.3 - Reamers

Reamers

Reamer is a steel tool with a cylindrical or tapered shank around which longitudinal teeth are ground, used for smoothing the bores of holes accurately to size

Reamers are used to smooth and enlarge holes to exact size. Hand reamers have square end shanks so that they can be turned with a tap wrench or similar handle. The various types of reamers are illustrated in (Figure 8.3).

Countersink

A countersink is a tool that cuts a cone shaped depression around the hole to allow a rivet or screw to set flush with the surface of the material. Countersinks are made with various angles to correspond to the various angles of the countersunk rivet and screwheads.

Special stop countersinks are available. Stop countersinks are adjustable to any desired depth, and the cutters are interchangeable so that holes of various countersunk angles may be made. Some stop countersinks have a micrometer set arrangement (in increments of 0.001 inch) for adjusting the cutting depths (Figure 8.4).

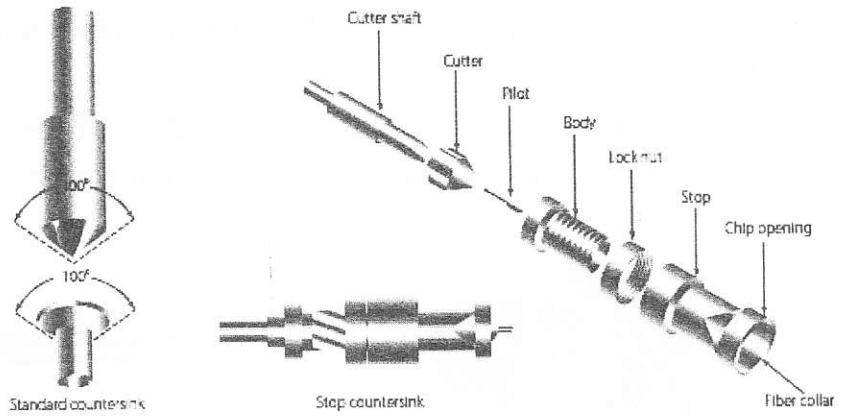


Figure 8.4 - Countersinks

Taps and Dies

Taps and dies are cutting tools used to create screw threads, which is called threading. A tap is used to cut the female portion of the mating pair (e.g., a nut). A die is used to cut the male portion of the mating pair (e.g., a screw). The process of cutting threads using a tap is called tapping, whereas the process using a die is called threading. Both tools can be used to clean up a thread, which is called chasing.

A tap is used to cut threads on the inside of a hole, while a die is for cutting external threads on round stock. They are made of hard tempered steel and ground to an exact size.

Hand taps are usually provided in sets of three taps for each diameter and thread series. Each set contains a taper tap, a plug tap, and a bottoming tap. The taps in a set are identical in diameter and cross section; the only difference is the amount of taper (Figure 8.5).

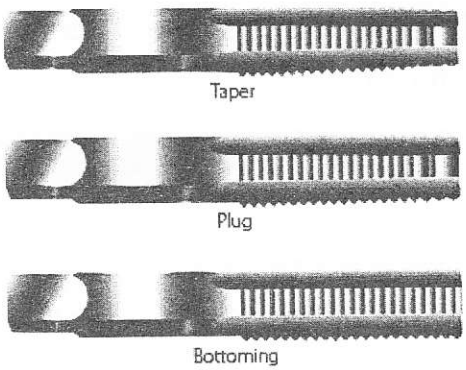


Figure 8.5.- Hand Taps

The taper tap is used to begin the tapping process, because it is tapered back for 6 to 7 threads. This tap cuts a complete thread when it is cutting above the taper. It is the only tap needed when tapping holes that extend through thin sections. The plug tap supplements the taper tap for tapping holes in thick stock. The bottoming tap is not tapered. It is used to cut full threads to the bottom of a blind hole.

Dies may be classified as adjustable round split die and plain round split die. The adjustable split die has an adjusting screw that can be tightened so that the die is spread slightly. By adjusting the die, the diameter and fit of the thread can be controlled (Figure 8.6).

The T-handle, the adjustable tap wrench, and the diestock for round split dies shown in Figure 8.7 are a few of the more common types.

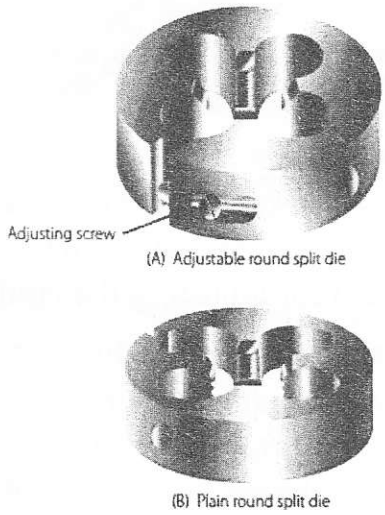


Figure 8.6 - Types of Dies

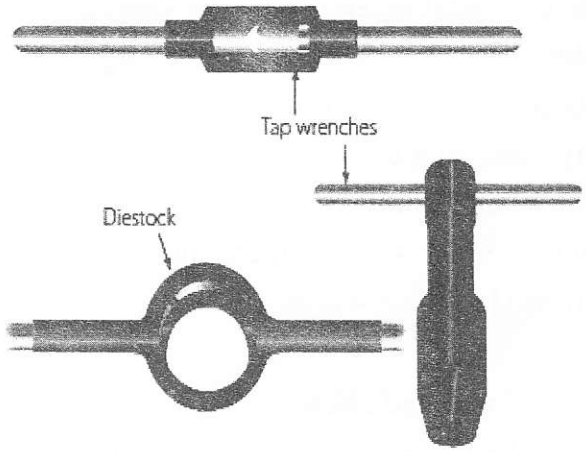


Figure 8.7 - Diestocks and Tap Wrenches

Solid dies are not adjustable; therefore, a variety of thread fits cannot be obtained with this type. There are many types of wrenches for turning taps, as well as turning dies.

9. MEASURING TOOLS

Measuring tools or measuring instrument is a device for measuring a physical quantity. Layout and measuring devices are precision tools. They are carefully machined, accurately marked and, in many cases, are made up of very delicate parts.

When using these tools, be careful not to drop, bend, or scratch them. The finished product will be no more accurate than the measurements or the layout; therefore, it is very important to understand how to read, use, and care for these tools.

Rules

Rule is a strip of wood or other rigid material used for measuring length or marking straight lines. Rules are made of steel and are either rigid or flexible. The flexible steel rule will bend, but it should not be bent intentionally as it may be broken rather easily.

In aircraft work, the unit of measure most commonly used is the inch. The inch may be divided into smaller parts by means of either common or decimal fraction divisions. The fractional divisions for an inch are found by dividing the inch into equal parts: halves (1/2), quarters (1/4), eighths (1/8), sixteenths (1/16), thirty-seconds (1/32), and sixty-fourths (1/64). The fractions of an inch may be expressed in decimals, called ***decimal equivalents of an inch***; for example, 1/8 inch is expressed as 0.0125 (one hundred twenty-five ten-thousandths of an inch).

Rules are manufactured in two basic styles — those divided or marked in common fractions and those divided or marked in decimals or divisions of one onehundredth of an inch. A rule may be used either as a measuring tool or as a straightedge Figure 9.1).

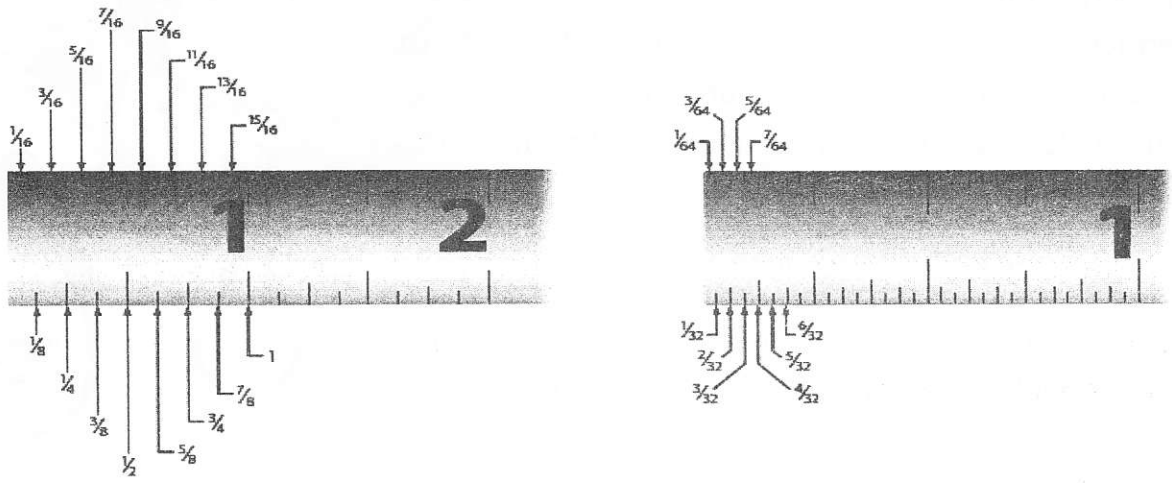


Figure 9.1.- Rules

Scriber

Scriber is a pointed steel tool used to score materials as a guide to cutting, etc.

The scriber is designed to serve the aviation mechanic in the same way a pencil or pen serves a writer. In general, it is used to scribe or mark lines on metal surfaces.

The scriber is made of tool steel, 4 to 12 inches long, and has two needle pointed ends. One end is bent at a 90° angle for reaching and marking through holes (Figure 9.2).

Figure 9.2.- Scriber

Dividers and Pencil Compasses

Dividers is a measuring compass, especially one with a screw for making fine adjustments. Dividers and pencil compasses have two legs joined at the top by a pivot. They are used to scribe circles and arcs and for transferring measurements from the rule to the work.

Pencil compasses have one leg tapered to a needle point; the other leg has a pencil or pencil lead inserted.

Dividers have both legs tapered to needle points.

Calipers

Calipers is an instrument for measuring external or internal dimensions, having two hinged legs resembling a pair of compasses and in-turned or out-turned points (also caliper rule); also a measuring instrument having one linear component sliding along another, with two parallel jaws and a vernier scale. Vernier - a small movable graduated scale for obtaining fractional parts of subdivisions on a fixed main scale of a barometer, sextant, or other measuring instrument.

Calipers are used for measuring diameters and distances or for comparing distances and sizes. The three common types of calipers are inside, outside, and hermaphrodite calipers, such as gear tool calipers (Figure 9.3).

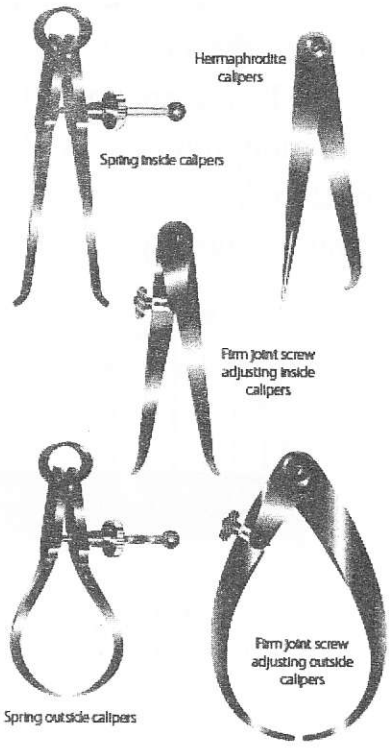


Figure 9.3.- Calipers

Outside calipers are used for measuring outside dimensions — for example, the diameter of a piece of

round stock. Inside calipers have outward curved legs for measuring inside diameters, such as diameters of holes, the distance between two surfaces, the width of slots, and other similar jobs. A hermaphrodite caliper is generally used as a marking gauge in layout work. It should not be used for precision measurement.

Micrometer Calipers

There are four types of micrometer calipers, each designed for a specific use: outside micrometer, inside micrometer, depth micrometer, and thread micrometer.

The AMT will use the outside micrometer more often than any other type. It may be used to measure the outside dimensions of shafts, thickness of sheet metal stock, the diameter of drills, and for many other applications.

Micrometer Parts

The fixed parts of a micrometer are the frame, barrel, and anvil. The movable parts of a micrometer are the thimble and spindle. The thimble rotates the spindle which moves in the threaded portion inside the barrel.

Turning the thimble provides an opening between the anvil and the end of the spindle where the work is measured. The size of the work is indicated by the graduations on the barrel and thimble (Figure 9.4).

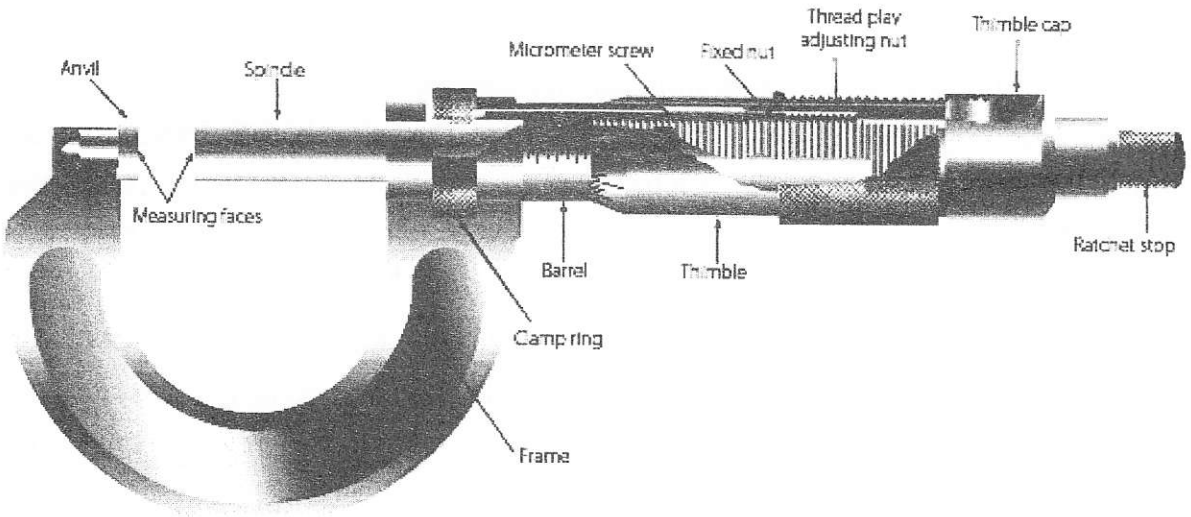


Figure 9.4.- Outside Micrometer Parts

Slide Calipers

Often used to measure the length of an object, the slide caliper provides greater accuracy than the ruler. It can, by virtue of its specially formed jaws, measure both inside and outside dimensions. As the tool's name implies, the slide caliper jaw is slid along a graduated scale, and its jaws then contact the inside or outside of the object to be measured. The measurement is then read on the scale located on the body of the caliper, or on the LCD screen (Figure 9.5). Some slide calipers also contain a depth gauge for measuring the depth of blind holes.

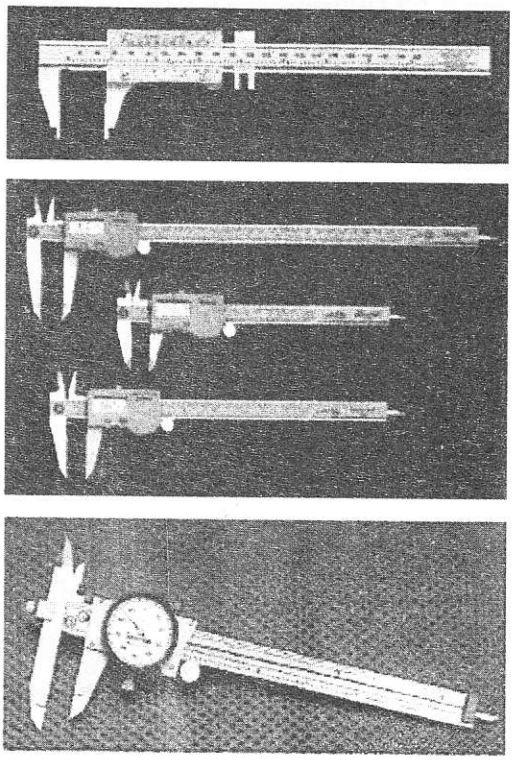


Figure 9.5.- Electronic and Dial Indicator Slide Calipers

10. SAFETY RECOMMENDATIONS

Professional auto technicians invest thousands of dollars on tools, and for good reason. It is almost impossible to do even the simplest auto repair without using some type of tool. Tools serve as extensions to parts of the human body. They increase the physical abilities of fingers, hands, arms, legs, eyes, ears, and back. A wellselected set of tools speeds up repairs, improves work quality, and increases profits.

This chapter will cover the basic hand tools commonly used in the shop. Specialized hand tools are covered in later chapters. Use the index to locate these tools as needed.

Tool Rules

There are several basic tool rules that should be remembered. These are as follows.

- Purchase quality tools-With tools, you usually get what you pay for. Quality tools are lighter, stronger, easier to use, and more dependable than off-brand, bargain tools. Many manufacturers of quality tools provide guarantees. Some are for the lifetime of the tool. If the tool fails, the manufacturer will replace it free of charge. This can save money in the long run.

- Keep tools organized-A technician has hundreds of different tools. For the tools to be located quickly, they should be neatly arranged. There should be a place for every tool, and every tool should be in its place. If tools are just thrown into the toolbox, time and effort are wasted "digging and searching" instead of fixing the vehicle.

- Keep tools clean-Wipe tools clean and dry after each use. A greasy or oily tool can be dangerous! It is very easy to lose a grip on a dirty tool, cutting or breaking a finger or hand.

- Use the right tool for the job-Even though several different tools may be used to loosen a bolt, usually one will do a better job. It may be faster, grip the bolt better, be less likely to break, or require less physical effort. A good technician knows when, where, and why a particular tool will work better than another.

Keep this in mind as you study automotive tools.

VOCABULARY

	English	Russian	Ukrainian
1	Accessory	Дополнительное оборудование, приспособление	Додаткове обладнання
2	Adapter	соединительное устройство, деталь; переходная муфта, патрон	3
3	Adjacent	Смежный	
4	Aircraft	Воздушное судно	
5	Angle	Угол	
6	Anvil	упор; упорный стержень/ измерительный наконечник/ опора	
7	Arc	дуга	
8	Attachment	присоединение; прикрепление; закрепление	
9	Automatic	автоматический	
10	Aviation	авиация	
11	Avoid	Избегать/ аннулировать, отменять, делать недействительным	
12	Backstroke	Обратный ход	
13	Barrel	гильза; втулка; пиноль 2) цилиндр; барабан; цилиндрическая деталь 3) бобина, катушка 4) шейка вала 5) нониус микрометра, стебель микрометра 6) вал-шестерня; вал-червяк 7) бочкообразность (при измерениях цилиндрических деталей)	
14	Bend	изгибать	
15	Blade	лезвие; режущая пластина 2) ножовочное полотно 3) резец, вставной резец; нож (напр. фрезы) 4) лопатка; лопасть; крыло 5) нож (рубильника) 6) ребро 7) линейка (угольника) 8) лепесток (цанги)	
16	Blunt	тупой, тупоконечный	
17	Bolt	болт; винт; палец || скреплять болтами, закреплять болтами, сболчивать 2) стержень; шпилька; шкворень 3) засов; задвижка; язычок 4) сито || просеивать через сито 5) монтировать, устанавливать (узел)	
18	Brass	1) латунь 2) вкладыш; прокладка; вкладка	
19	Burr	1) заусенец; грат 2) борфреза; небольшая фреза 3) треугольное зубило 4) оселок 5) ротационный напильник 6) ролик для правки шлифовального круга	
20	Cam	1) кулачок; эксцентрик; выступ на валу, выступ на распределительном валу 2)	

		лодыжка (в кулачных молотах) 3) копир; шаблон; лекало 4) криволинейный паз 5) криволинейная поверхность; планка со скошенным пазом 6) синусная линейка 7) приводить в движение от кулачка	
21	Capacity	1) основная характеристика (напр. станка) 2) ёмкость, вместимость; объём 3) мощность; производительность; пропускная способность 4) наибольшие размеры, габаритные размеры 5) ёмкость 6) информационная ёмкость (ЗУ) 7) допустимый диапазон чисел (устройства, аппарата) ; разрядность 8) способность; возможность 9) нагрузка, допустимая нагрузка 10) грузоподъёмность	
22	Chisel	зубило; стамеска; долото || рубить зубилом; строгать стамеской; долбить долотом	
23	Chrome-Vanadium	Хром-ванадиевый	
24	Classify	классифицировать	
25	Clutch	1) муфта; соединение; сцепление 2) захват 3) схватывание; захватывание; фиксация	
26	Coarse	1) грубый (напр. о регулировке) ; черновой; предварительный (об обработке) 2) шероховатый; необработанный; сырой 3) с крупным шагом (напр. о резьбе)	
27	Cone	1) конус || придавать коническую форму; обрабатывать на конус 2) конический палец, конический установочный палец 3) конический фрикцион 4) ступенчатый шкив 5) коническое сопло; раструб; конический насадок	
28	Cordless	беспроводной	
29	Countersink	1) коническая зенковка; центровочная зенковка || зенковать коническое отверстие 2) фаска	
30	Cowling	Капот, кожух	
31	Crimp	1) отогнутая кромка; буртик; борт || отгибать кромку; отбортовывать 2) складка; гофр || делать складки; гофрировать	
32	Cross-thread	Завинчивать с перекосом	
33	Cut	1) разрез; надрез; срез; прорезь; пропил || разрезать; надрезать; срезать; прорезать 2) резание, обработка резанием; проход (при обработке резанием) ; резка, отрезка 3) обрабатываемый участок; участок обработки (детали) 4) стружка 5) насечка (напильника)	

34	Damage	повреждение	
35	Dent	1) выемка; углубление 2) насечка; зарубка 3) зуб, зубец	
36	Depression	Выбоина, 1) выемка; углубление 2) оседание 3) разрежение, вакуум	
37	Design	1) конструкция; компоновка; проект || конструировать; компоновать; проектировать || проектный 2) конструирование; проектирование 3) расчёт || рассчитывать || расчётный 4) дизайн, художественное конструирование 5) чертёж; эскиз, схема	
38	Diagonal	диагональный, идущий наискось	
39	Diameter	диаметр	
40	Die	1) штамп; матрица; пуансон 2) винторезная головка 3) плашка; лерка; клупп 4) пресс-форма 5) форма, металлическая форма; кокиль 6) кузнечная оснастка; кузнечный инструмент 7) боёк молота 8) обжимка 9) волочильная доска; волока 10) накатный ролик; резьбонакатный инструмент	
41	Dimension	размер	
42	Divider	1) делительное устройство, делитель, разделитель 2) сепаратор 3) элемент деления (с частным от деления на выходе) 4) делитель (напряжения) 5) делительный циркуль	
43	Draw	1) тяга || тянуть 2) вытягивание, вытяжка 3) протягивание; раскатка 4) волочение 5) извлечение модели из формы 6) отпускать (сталь) 7) чертить	
44	Drill	1) сверло 2) сверлильный станок 3) сверлильная головка 4) сверление || сверлить; высверливать 5) дрель 6) плоский тупоносый надфиль	
45	Duckbill	конвейер с качающейся головкой	
46	Edge	кромка	
47	Effect	эффект; влияние; действие	
48	Equivalent	1) эквивалент || эквивалентный, равнозначный	
49	Exert	Приводить в действие, напрягать	
50	Extension	1) удлинение; расширение; добавление 2) удлинитель	
51	Extractor	Клещи, 1) выталкиватель; съёмник; экстрактор; выбрасыватель 2) разъединитель	
52	Fastener	Крепеж, 1) крепёжная деталь, деталь крепления 2) зажим; замок; скоба, авиационная заклепка	

53	Files	1) напильник; надфиль || опиливать, обрабатывать напильником	
54	Fix	1) фиксировать; устанавливать 2) затормаживать	
55	Flat	1) лыска; плоский срез; плоская площадка 2) плоскость, плоская поверхность || плоский; плоскостный; ровный 3) полосовой прокат; листовой прокат || полосовой (о стали) 4) плоский боёк 5) плющить; выпрямлять; выравнивать; разглаживать	
56	Float	1) быть шарнирно закреплённым; закреплять шарнирно; свободно вращаться 2) поплавок || плавать; всплывать; флотировать, флотироваться 3) боковое отклонение 4) смещение; податливость || смещаться	
57	Fraction	1) дробь 2) часть, дробная часть 3) мантисса	
58	Frame	1) рама; станина 2) каркас; остов; корпус 3) державка; обойма; скоба	
59	Frequently	часто	
60	Fuel	топливо	
61	Furnish	Заполнеять, оснащать	
62	General	общего применения; универсальный	
63	Goggle	Защитные очки	
64	Gouge	1) полукруглое долото; канавочное зубило; канавочник; крейцмейсель; полукруглая стамеска || долбить долотом или зубилом 2) канавка; выемка (полученные выдалбливанием) 3) рез (при поверхностной кислородной резке или строжке)	
65	Hacksaw	1) ножовочный станок; ножовочная пила 2) ножовка 3) ножовочное полотно	
66	Hammer	молоток	
67	Handle	1) ручка; рукоятка 2) поручень 3) крючок для вынимания модели 4) управлять; манипулировать 5) обслуживать (напр. машину) 6) загружать; разгружать; перегружать 7) транспортировать	
68	Handy	Ручной, подручный	
69	Hexagon	шестиугольник	
70	Hole	Отверстие	
71	Hollow		
72	Hook	1) крючок; крюк; гак || подвешивать на крюке; зацеплять крюком 2) передний угол (режущего инструмента) ; вогнутость	

		передней поверхности (инструмента)	
73	Hydraulic	гидравлический	
74	Illustrate	иллюстрировать, оформлять	
75	Inch	дюйм	
76	Indentation	отступ	
77	Indicate	1) указывать; показывать 2) обозначать; означать	
78	Indispensable	обязательный, не допускающий исключений	
79	Install	устанавливать; монтировать, собирать,	
80	Intentionally	умышленно	
81	Invert	1) переворачивать; кантовать 2) изменять направление	
82	Jaw	1) кулачок (зажимного патрона) ; губка; щека (тисков) 2) шпонка (разжимной оправки) 3) зев (напр. ключа) 4) захватное устройство (напр. робота) ; захват 5) тиски; зажимное приспособление; клещи 6) сборный кулачок	
83	Layout	1) расположение; компоновка; планировка 2) разметка; разбивка 3) схема; план 4) оригинал-макет	
84	Length	длина	
85	Locate	располагать	
86	Lug	1) выступ; прилив; бобышка 2) ушко; проушина; хомутик 3) шип 4) зуб (муфты) 5) кулак (напр. муфты) 6) ручка, грибовидная ручка 7) язычок 8) тащить; тянуть	
87	Maintenance	Техническое обслуживание	
88	Mallet	деревянный молоток; киянка	
89	Manufacture	производить	
90	Mark	Маркировка 1) знак; метка, отметка; риска 2) марка; клеймо	
91	Material	материал	
92	Metal	металл	
93	Micrometer	микрометр	
94	Mill	1) завод; фабрика 2) фрезерный станок 3) фреза || фрезеровать 4) прокатный стан; прокатный цех || прокатывать 5) дробилка || дробить; размалывать	
95	Mutilation	1) повреждение; деформация 2) искажение 3) подрезание, срезание	
96	Nail	1) гвоздь || соединять на гвоздях, прибивать гвоздями 2) ударять	
97	Needle	1) игла 2) игольчатый ролик 3) надфиль 4)	

		стрелка (индикатора) 5) игольчатый клапан; игольчатый регулятор 6) измерительный наконечник (напр. датчика)	
98	Nut	1) гайка 2) резьбовая муфта	
99	Object	объект; предмет; тело || предметный	
100	Offset	1) смещение; сдвиг; гипоидное смещение (при зубонарезании) || смещать; сдвигать; выносить || смещённый; сдвинутый; вынесенный 2) межосевое расстояние 3) отклонение 4) компенсация; коррекция || компенсировать; корректировать 5) ответвление; отвод (трубы) 6) уступ; зубец	
101	Outline	1) контур; профиль; очертание || очерчивать контурной линией; очерчивать снаружи 2) план; схема	
102	Paper	Бумага, бумажный	
103	Parallel	параллельный	
104	Part	часть	
105	Pattern	1) образец; эталон; калибр; модель; шаблон || формировать по образцу, формировать по шаблону; моделировать 2) конфигурация; профиль, контур 3) картина, рисунок; фигура; узор || наносить рисунок или узор 4) схема; диаграмма 5) характеристика 6) структура; строение 7) изображение; образ || формировать изображение 8) копия || копировать 9) сетка || наносить сетку 10) кодограмма	
106	Pencil compass	карандашный циркуль	
107	Pin	1) штифт; шпилька; палец; штырь; шкворень || закреплять штифтами или шпильками; штифтовать 2) шейка; цапфа 3) болт 4) ось; стержень || устанавливать на оси 5) упор; кулачок 6) направляющая колонка (пресс-формы) 7) зашплинтовывать	
108	Pistol		
109	Plate	плоскость	
110	Plier		
111	Plug	1) пробка; заглушка; затычка || затыкать пробкой, затыкать отверстие пробкой 2) промежуточная втулка (для крепления инструментов) 3) калибр-пробка 4) пуансон (пресс-формы) 5) цилиндрическая шлифовальная головка 6) штепсель; штепсельная вилка; штекер 7) запальная свеча 8) разъём	

112	Power	Сила, мощность	
113	Precision	точность	
114	Pressure	давление	
115	Prick	1) укол, прокол || прокалывать 2) прочищать отверстие острым предметом	
116	Principal	1) главный элемент несущей конструкции 2) строительная ферма	
117	Punch	штамп || штамповать 2) пробойник; перфоратор 3) дыропробивной пресс	
118	Rasp	Рашпиль	
119	Ratchet	трещотка, храповик 2) собачка 3) ; = ratchet effect необратимые перемены к худшему, "маховик регресса" , неумолимое "храповое колесо" 2. а) изменяться постепенно; осуществлять пошаговое продвижение б) постепенно изменять; передвигать, фиксируя каждое новое положение	
120	Reamer	1) развёртка || развёртывать 2) станок для развёртывания отверстий	
121	Receptacle	1) приёмник; резервуар 2) отверстие	
122	Recommend	рекомендовать	
123	Reference	1) база отсчёта; опорная точка; репер || базировать || базовый; опорный; реперный 2) эталон; стандарт || эталонный; образцовый; стандартный	
124	Removable	подвижный	
125	Repair	ремонт; исправление, починка || ремонтировать; исправлять, чинить || ремонтный	
126	Replace	Заменять, менять местами	
127	Reverse	1) реверс, обратная сторона, задняя сторона || обратный; перевёрнутый; задний 2) реверси рование, изменение направления движения на обратное || реверсировать, изменять направление движения на обратное || реверсивный 3) переключение; изменение полярности	
128	Rivet	заклепка	
129	Rough	1) обрабатывать начерно; обдирать || черновой; обдирочный 2) придавать шероховатость, придавать шероховатость поверхности || грубый; неровный, шероховатый 3) крупнозернистый (напр. о шлифовальном круге)	
130	Ruler	Линейка	
131	Safety	1) безопасность; надёжность 2) предохранительное устройство ||	

		предохранительный, защитный	
132	Sawing	1) пилка, распиловка, распиливание; резка пилой; разрезание; раскрой	
133	Screen	1) экран; щит; козырёк; ширма || экранировать; защищать	
134	Screw	1) винт; болт; шуруп || завинчивать; ввинчивать; скреплять винтами или болтами 2) червяк; шнек 3) винтовая линия || винтовой 4) нарезать резьбу	
135	Screwdriver	1) отвёртка 2) винтовёрт 3) шуруповёрт	
136	Screwworm	Механическое устройство, содержащее винт	
137	Scribe	1) чертилка; разметочный инструмент || размечать; отмечать чертилкой 2) перо (самописца)	
138	Scriber	чертилка; разметочный инструмент	
139	Service	услуга	
140	Shape	Форма	
141	Shear	1) срезающее усилие; срез; скалывание || срезать; скалывать 2) усилие сдвига; сдвиг 3) врезание режущей кромки в металл, постепенное врезание режущей кромки в металл 4) лезвие (ножниц) 5) направляющая (станка) 6) резать (ножницами)	
142	Sheet	1) лист; листовой материал, тонколистовой материал	
143	Size	размер	
144	Slight	хрупкий, непрочный	
145	Slot	1) паз; прорезь; канавка; шлиц; желобок; щель || прорезать пазы, канавки или желобки; шлицеватьб гнездо, разъем	
146	Snip	1) ножницы 2) резать ножницами (для жести)	
147	Socket	1) гнездо; углубление || вставлять в гнездо 2) подпятник; башмак 3) переходный патрон; втулка, переходная втулка 4) муфта, соединительная муфта; гильза; стакан; патрубок 5) штепсельная розетка; цоколь	
148	Solid	твердый	
149	Spindle	1) шпиндель; вал, валик; ось 2) пиноль 3) стержень; палец 4) шейка вала; цапфа 5) микрометрический винт; измерительный наконечник (напр. индикатора) 6) ходовой винт 7) вращающийся центр	
150	Spiral	1) винтовая линия; винтовая поверхность, геликоидальная поверхность || винтовой; геликоидальный 2) спираль || спиральный;	

		спиралеобразный 3) змеевик	
151	Spring	пружина	
152	Standard	1) стандарт; норма, норматив || стандартный; типовой; нормализованный; серийно выпускаемый 2) эталон; образец || эталонный; образцовый 3) стандартный формат (языка для подготовки УП) 4) технические условия; технические требования 5) колонна; стойка; опора 6) начало отсчёта	
153	Steel	сталь	
154	Strap	1) планка; полоса; лента; ремень || соединять планками; стягивать ремнём 2) накладка || накладной 3) скоба; хомут; бугель; прихват || скреплять скобой	
155	Sufficient	Удовлетворительный, достаточный	
156	Swing	1) колебание; качание; размах; амплитуда колебания || колебать, колебаться; качать, качаться; раскачивать, раскачиваться 2) поворот; разворот || поворачивать, поворачиваться 3) наибольший диаметр (устанавливаемого изделия) 4) наибольшее расстояние между центрами (станка)	
157	Taper	1) сужение || сужать(ся) 2) конус || сводить на конус || конический 3) конусность; конусообразность; коническая форма 4) уклон (калибра) 5) ослабление, спад 6) плавный переход	
158	Technician	а) техник, технический специалист; механик, ремонтник, технический персонал	
159	Thimble	1) гильза; стакан; втулка; муфта 2) кольцо; коуш 3) наконечник, кабельный наконечник 4) барабан (микрометра)	
160	Thin	а) делать тонким, утончать, истощать, заострять	
161	Thumbscrew	винт с накатанной головкой, винт с накатанной рифлёной головкой, барашковый винт	
162	Tip	1) конец, кончик; вершина (напр. зуба) ; гребень (витка резьбы) ; кромка, край; продольная кромка (зуба) 2) наконечник; мундштук; крышка 3) режущая пластина; режущая кромка (инструмента) 4) рабочий конец (электрода) 5) наклон; опрокидывание || наклонять, наклоняться; опрокидывать, опрокидываться 6) носок (литейного ковша) 7) лезвие (отвёртки)	
163	Tool	1) инструмент; орудие, орудие производства 2) резец; инструмент, режущий инструмент; черновой резец	

		(зубострогального станка) 3) приспособление; оснастка 4) инструментарий; средства; совокупность инструментов 5) обрабатывать инструментом 6) налаживать (станок)	
164	Top	Вершина, головка	
165	Transfer	1) перемещение; перенос; передача; транспортировка || перемещать; переносить; передавать; транспортировать 2) транспортное устройство; транспортёр; конвейер 3) механическая рука 4) агрегатный станок с многопозиционным поворотным столом	
166	Triangular	треугольный; трёхсторонний; трёхгранный	
167	Tungsten	вольфрам	
168	Twist	1) кручение; скручивание || крутить; скручивать 2) шаг винта 3) угол скручивания 4) поворот (рабочего органа робота) вокруг горизонтальной оси в поперечной плоскости 5) свивать 6) спиральный (о сверле)	
169	Unbreakable	небьющийся, неломкий, нехрупкий	
170	Utility	комплектующие, комплектующие изделия	
171	Vary	1) менять(ся); изменять(ся) 2) регулировать	
172	Versatile	1) универсальный; широкого назначения 2) эксплуатационно гибкий; переналаживаемый; приспособляемый	
173	Wire	1) проволока || скреплять проволокой 2) тонкий пруток 3) проволочная сетка 4) провод; кабель 5) проводник 6) шина 7) проволочный калибр 8) нитка резьбы, виток резьбы	
174	Wooden	деревянный	
175	Wrench	гаечный ключ; гайковёрт; динамический винт || заворачивать, отворачивать ключом	