Title: **Drill and Tap** Job: 1

Course: Electrical Applications Unit: Electrical Shop CLO: 7

**Objectives**

1. Student shall measure, mark, drill and tap an aluminum bar to obtain a working knowledge of a tape measure, drills, a drill press and taps.
2. Student shall identify safety regulations and adhere to them.

**Assessment**

Students shall demonstrate a comprehension of the objectives listed above by scoring a minimum of 75% on this Job. Grading shall be based on instructor evaluation.

**Materials**

|  |  |
| --- | --- |
| Student Provided Materials | **Department Provided** |
| Hammer | 1½” x 6” Aluminum stock |
| Center punch | Number/Letter punches |
| Ruler & Straight edge | Drill Bits & Drill Press |
| Necessary Taps and handles |  |
| Flat metal file (i.e., bastard file) |  |

**Information**

*Twist Drills*

Twist drills are “end” cutting tools used to produce holes in most types of material. On standard drills, two helical grooves, or flutes, are cut lengthwise around the body of the drill. They provide cutting edges and space for the cuttings to escape in the drilling process. Most twist drills used today are made of high-speed steel. High-speed drills are always stamped with the letters “H.S.” or “H.S.S.” A drill bit is divided into three main parts: shank, body, and point.

Drills up to ½” in diameter have straight shanks, while those over this diameter usually have tapered shanks. Straight-shank drills are held in a drill chuck; tapered-shank drills fit into the internal taper of the drill press spindle.

The drill body is the portion of the drill between the shank and the point. It consists of many parts important to the efficiency of the cutting action.

1. The flutes are two or more helical grooves cut around the body of the drill. They form the cutting edges, admit cutting fluid, and allow the chips to escape from the hole.
2. The margin is the narrow, raised section on the body of the drill. It is immediately next to the flutes and extends along the entire length of the flutes. Its purpose is to provide a full size to the drill body and cutting edges.
3. The body clearance is the undercut portion of the body between the margin and the flutes. It is made smaller to reduce friction between the drill and the hole during the drilling operation.

The point of a twist drill consists of the chisel edge, lips, lip clearance, and heel. The chisel edge is the chisel-shaped portion of the drill point. The lips (cutting edges) are formed by the intersection of the flutes. The lips must be of equal length and have the same angle so that the drill will run true and will not cut a hole larger than the size of the drill.

Drill sizes are designated under four systems: Fractional, Number, Letter, and Millimeter (metric) sizes.

The *Fractional* size drills range from 1/64” to 3.25” varying in steps of 1/64” from one size to the next.

The *Number* size drills range from #1, measuring 0.228” to the #97, which measure 0.0059”.

The *Letter* size drills range from A to Z. Letter-A drill is the smallest in the set (.234”) and Z is the largest (.413).

The Millimeter (metric) drills are produced in a variety of sizes. Miniature metric drills range from 0.04 to 0.09 mm in steps of 0.01 mm. Straight-shank standard metric drill are available in sizes from 0.5 to 20 mm. Taper-shank metric drills are manufactured in sizes from 8 up to 80 mm.

*Taps*

Taps are cutting tools used to cut internal threads inside of a drilled hole, whereas a Die cuts external threads on the outer surface of a rod. Taps are made from high-quality tool steel that has been hardened and ground.

NOTE: hardening of the metal results in a tool that is very brittle and is easily broken, especially when the Tap is NOT kept perpendicular to the metal being tapped and/or when the Tap is allowed “wobble” (even a very small amount of wobble will result in breakage). Depending on the size of the Tap, two, three or four flutes (grooves) are cut lengthwise across the threads to form cutting edges provide room for the chips, and to allow cutting fluid to be inserted for lubrication. The end of the shank is square so that a tap wrench can be used to turn the Tap into a hole. For inch Taps, the major diameter, number of threads per inch, and type of thread is usually found on the shank of a Tap.

For example: 6-32 UNC represents:

1. 6 = major diameter of the Tap.
2. 32 = number of threads per inch.
3. UNC = Unified National Coarse (a type of thread)

Hand Taps are usually made in sets of three: called Taper, Plug, and Bottoming.

A Taper Tap is tapered from the end. Approximately six threads are used to start a thread easily. It can be used for tapping a hole, which goes through the work, as well as starting a blind hole (a blind hole does not penetrate completely through the work).

A Plug Tap is tapered for approximately three treads. Sometime the Plug Tap is the only Tap used to thread a hole going through a piece of work.

A Bottoming Tap is not tapered but chamfered at the end of one thread. It is used for threading to the bottom of a blind hole. When tapping a blind hole, first use the Taper Tap, then the Plug Tap, and complete the hole with a Bottoming Tap.

Extreme care must be used when tapping a hole to prevent breakage (see the NOTE above). A broken tap in a hole is difficult (if not impossible) to remove and often results in scraping the work.

To tap a hole by hand:

1. Select the correct Tap and tap wrench for the job
2. Apply a suitable cutting fluid to the Tap
3. Place the Tap in the hole as vertically as possible (perpendicular), press downward on the wrench applying equal pressure on both handles, and turn clockwise for about two turns
4. Check the Tap to verify it is at the desired angle
5. When the Tap has been properly started, feed it into the hole by turning the tap wrench
6. Turn the Tap clockwise one-quarter turn and then turn it backward about ½ turn to break the chip. Repeat this process by using steady motion to prevent breakage
7. Once the Tap has exited the work, back the Tap out. Then chase the threads by running the Tap slowly all the way through the hole

The table below shows the correct size drill bit to use with the Taps common in the electrical field. This table gives the Number Drill and the closest usable Fractional Drill bit needed to do the job. The first choice is the Number Drill.

Tap Size Number Drill Fractional Drill

6-32 35 7/64

8-32 29 9/64

10-24 25 5/32

10-32 21 5/32

¼-20 7 13/64

*Screws*

Electricians must be familiar with the standard machine screws used with electrical devices, such as receptacles, switches, plates, boxes, and terminals. A terminal is the screw that is used to connect the conductor to the device.

Machine screws commonly used by the electrician are 6-32, 8-32, 10-24, 10-32, and the 1/4-20. The numbers have a specific designation. The first digit denotes the size as it is listed in the American Screw Gauge. The second and third digits indicate the number of threads per inch.

Example: 6-32; the number six (6) is the American Screw Gauge size; the second and third digits are the number thirty-two (32) which indicate there are 32-threads per inch cut into the shaft. It is important that the electrician be able to quickly identify by sight the various sizes of machine screws used.

A 6-32 screw is used to fasten electrical devices such as switches and receptacles to their outlet boxes. These boxes have their fastening holes tapped (threaded) to accept the 6-32 screw. Sizes 8-32 and 10-32 machine screws are used with fixture-mounting hardware and terminal screws. Sizes 10-24 and 1/4-20 are used with fastening other common electrical equipment such as beam clamps and covers.

The types of machine screw heads are: Flat, Round, Oval, and Binder.

The Flat head screw is used to fasten the mounting ears of a switch or receptacle to its outlet box. The Flat head screw permits the decorative cover plate used with the device to make flush contact with the finished wall.

Binder head screws are used on electrical terminals to achieve a broader and better contact between the screw head and the wire to be fastened. The common Round head screw may be used in any situation where space is not a factor. By design, the Round head is a better screw to use where objects must be tightened to a maximum degree.

The threads on machine screws are rather fine and can be stripped if the newly made tapped hole is abused. The damaged threads will make it impossible to fully tighten it.

In the field, the tapped holes in electrical hardware are sometimes filled with plaster, concrete, or rust that has accumulated during construction. In these cases, the threads within the tapped hole must be chased (renewed) to accept the machine screw.

Name \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ Grade \_\_\_\_\_\_\_ Date \_\_\_\_\_\_\_\_\_\_\_\_\_\_



**Instructions**

1. Using a piece of 1½” x 6” aluminum stock (see diagram above), round the corners and smooth the edges using the flat file.
2. Using a pencil and straight edge, layout the aluminum to the specifications given on the diagram. The drawing on this page IS *very near* to scale; the dimensions are correct.
3. Center punch all drill locations using a hammer and center punch.
4. Using the drill press, drill all holes with specified drill bits as shown on the diagram.
5. Tap the bottom holes with tap specified on the diagram.
6. Use letter/number punches to stamp the words and numbers specified on the diagram. Stamp your name on the *back* of the project.
7. Clean your project and insert the proper screws into the tapped holes. (Do not tighten completely)
8. Turn your project in to the instructor for grading.

**Grading Sheet**

1. Corners rounded, edges smooth Yes / No
2. Spacing of drilled holes is correct Yes / No
3. Holes tapped to diagram specifications Yes / No
4. Threads are square (perpendicular to surface) Yes / No
5. Screws can be threaded in by hand Yes / No
6. Words/numbers stamped to diagram specifications Yes / No
7. Letters/numbers are double struck Yes / No
8. The overall appearance of project is in a neat and workman like manner Yes / No