Sharpening Twist Drills

Twist drills become dull and must be resharpened. The preferred method of resharpening a twist drill is with the drill grinding machine, but this machine is not always available in field and maintenance units, so the offhand method of drill sharpening must be used (Figure 6-10). The off hand method requires that the operator have a knowledge of the drilling geometry (Figure 6-11) and how to change drill angles as needed for any drilling job (see Table 6-2 in Appendix A).

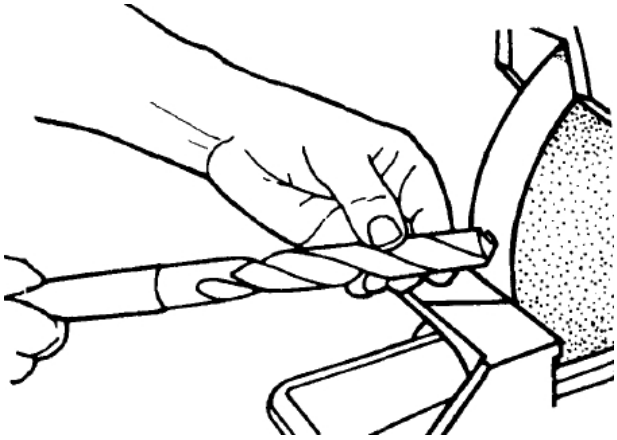


Figure 6-10. Off-Hand method of drill sharpening.

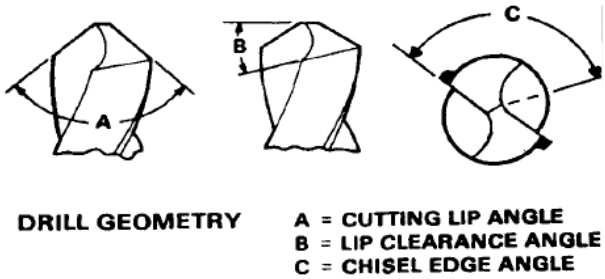


Figure 6-11. Drill geometry.

Tools needed are a utility or bench grinder with a dressed wheel and a drill point gage (Figure 6-12) or protractor head on the combination square. The drill point gage is set at 59° and adjusted along the steel rule to fit the drill to be sharpened. The cutting lips must be of the same angle, the lip clearance angle must be within a specific degree range, and the cutting lips must be of an equal length. There are several basic characteristics that all twist drills must have to cut properly. The following will cover those characteristics.

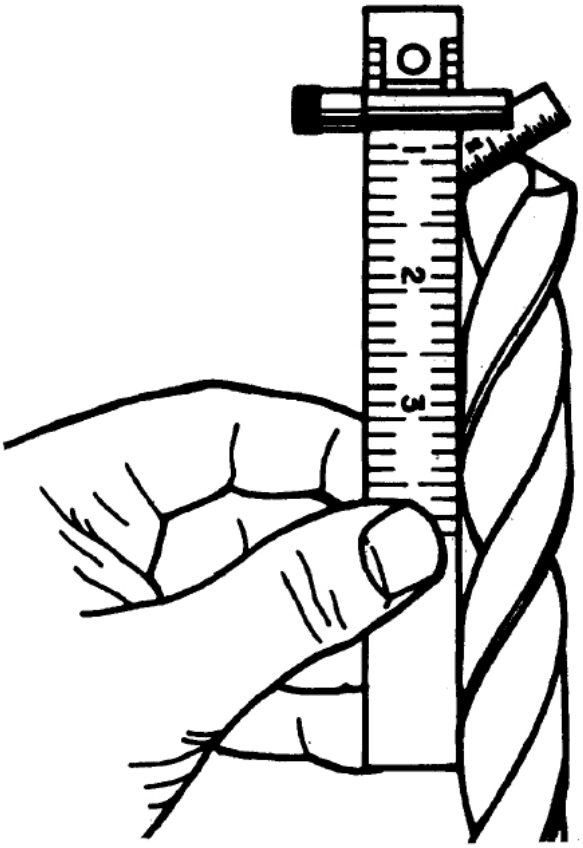


Figure 6-12. Checking the tip angle.

PRECHECK

Before sharpening a twist drill, the operator must check the condition of the drill for chipped and cracked lips or edges that must be ground off during the sharpening process. The operator must also check the references for the proper lip angle and lip clearance angle for the material to be drilled. After setting up the bench grinder for offhand drill sharpening, the operator assumes a comfortable stance in front of the grinding wheel to sharpen the twist drill. The suggested method is to grind the lip angle first, then concentrate on grinding the lip clearance angle, which will then determine the lip length. The usual lip angle is an included angle of 118° (59° x 2) (Figure 6-13), which is the lip angle of general purpose drills. Use the drill point gage frequently to check lip angle and lip length. When grinding, do not allow the drill to become overheated. Overheating will cause the drill edges to become blue which is an indication that the drill's temper has been lost. The blue area must be ground completely away to reestablish the drill's temper. If a drill becomes too hot during sharpening, the lips can crack when dipped into cold water or coolant.

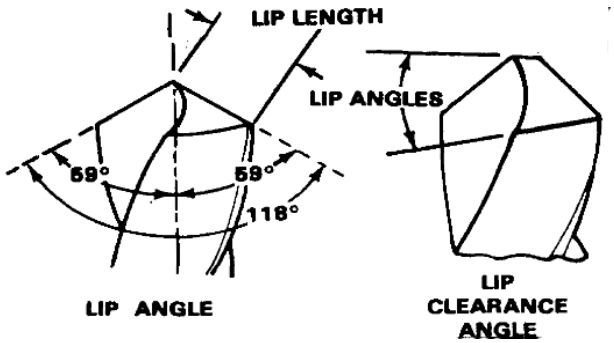


Figure 6-13. Twist drill angles.

DRILL POINT

When grinding the lip angle, use the drill point gage and grind one lip perfectly straight and at the required angle (usually 590). Then flip the drill over and grind the other lip. Once the angle is established, then the lip clearance angle and lip length

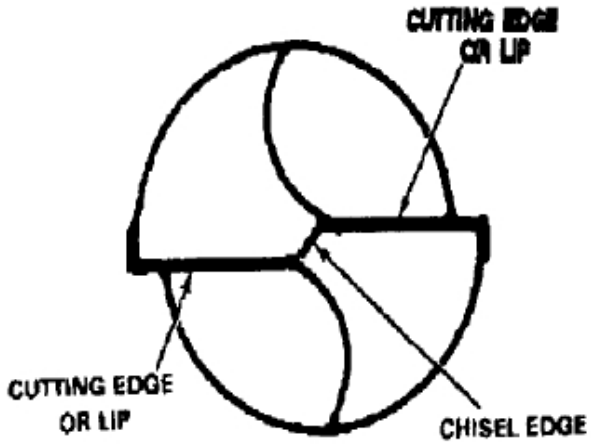


Figure 6-14. The drill point.

When both the angles and the length of the angles are incorrect, then excessive wear is put on both the drill and machine, which will result in poor workmanship (Figure 6-15)

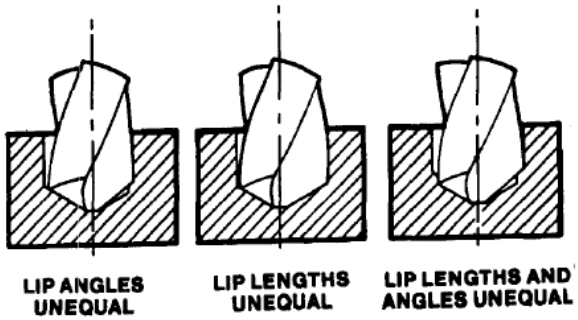


Figure 6-15. Results of improperly ground drills.

CLEARANCE ANGLE

When grinding the lip clearance angle, (Figure 6-13), relief must be given to both cutting edges allowing them to enter into the workpiece to do the cutting. General purpose drills have a clearance of 8° to 12°. The chisel edge of a correctly ground drill should be at an angle of about 455° with the line of the cutting edges. The angle of the chisel edge to the lips is a guide to the clearance (Figure 6-16). Too much clearance will cause the drill to break down because of insufficient

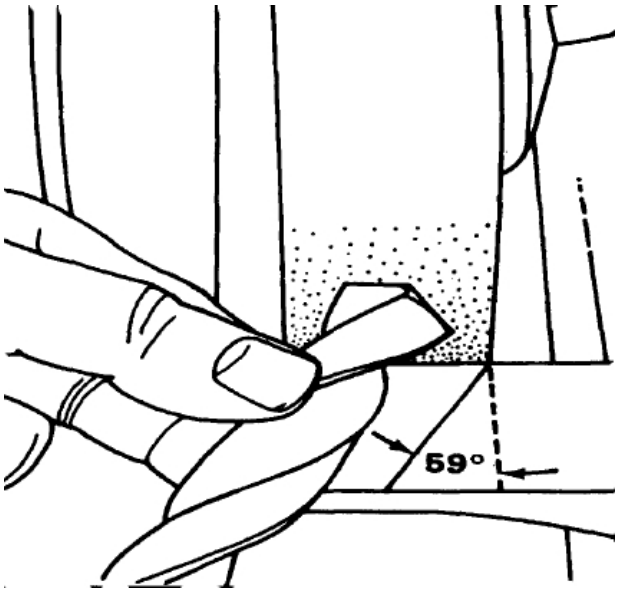
can be ground. If both lips are not straight and of the same angle, then the chisel edge (Figure 6-14) will not be established. It is it important to have a sharp and centered chisel edge or the drill will not rotate exactly on its center and the hole will be oversized. If the drill point is too flat, it will not center properly on the workpiece. If the drill point is too steep, the drill will require more power and cut slowly. When the angles of the cutting lips are different, then the drill will only have one lip cutting as it revolves. The hole will be oversized and the drill will wear very rapidly.

support of the lip, and there will not be enough lip thickness to carry away the generated heat.

Too little clearance will result in the drill having little or no cutting edges, and the increased pressure required to feed it into the hole will cause the drill to break. By looking straight onto the cutting tip of the drill, the operator can see if the chisel edge is correct. If the chisel edge is correct at 45° to the lips, then it is an indication that the lip clearance angle is correct. An incorrect chisel edge is usually produced by holding the drill at an incorrect angle to the wheel (Figure 6-17) when grinding. A good guide is to hold the drill parallel to the ground, and make slight adjustments.

RAKE ANGLE

The angle between the flute and the axis of the drill that forms the cutting edge is known as the rake angle (Figure 6-18). Generally, the rake angle is between 180 and 450, with 30° being the most common. Drills used on armor plate or other very hard materials need a reduced rake angle to increase the support behind the cutting edge. Soft materials, like brass and bronze, also use a reduced rake angle to prevent the drill from grabbing. The rake angle partially governs the tightness with which the chips curl and the amount of space they occupy. If the rake angle is too small, the lips may be too thin and break under the strain of drilling. Too large of a rake angle makes the drill chatter and vibrate excessively.



Figurer 6-17. Adjusting the drill for grinding the tip angle.

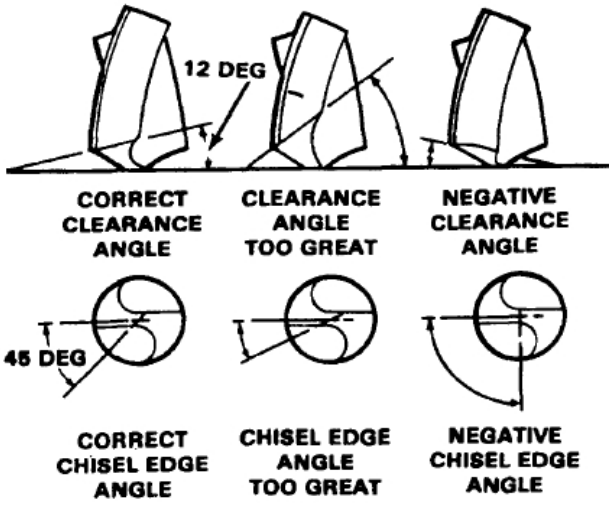


Figure 6-16. Lip clearance angle is direcly proportional to the chisel point.

The web of a drill is made thicker toward the shank to strengthen the tool. In smaller size drills, the difference is not noticeable, but in larger drills, when the point is ground back by repeated sharpening, the thickness of the web becomes greater and the chisel edge of the drill becomes wider. This causes the chisel edge to scrape on the bottom of the hole and requires excessive pressure to be applied to the drill. This can be corrected by thinning the web (Figure 6-19). The point is ground thinner on a thin grinding wheel with a rounded face to fit into the flute. An equal amount of metal should be ground from each flute. The web should not be ground too thin as this may weaken the web and cause the drill to split in the middle.

DRILL GRINDING MACHINES

Drill grinding machines (Figure 6-20) make the accurate grinding of all types and sizes of drills an easy job. Comparatively little skill is required to sharpen drills with these machines while following the operating instructions.

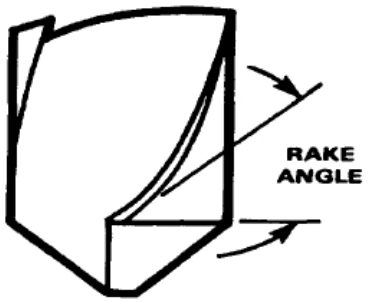


Figure 6-18. Rake angle.

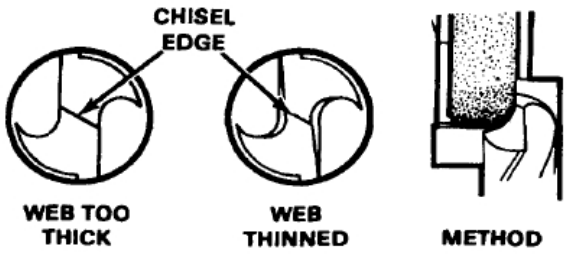


Figure 6-19. Thinning the web.

They are particularly valuable when a large number of the same general type of drills are to be sharpened. Two basic designs for the bench-type drill grinding machines are available. Both perform the same operations but use different drill holding devices. The capacity of these machines is stated in the horsepower of the electric motor and the sizes of drills which can be accommodated by the drill holding devices.

SINGLE WHEEL FIXTURE

One kind of bench-type drill grinding machine consists of an electric motor, a grinding abrasive wheel attached to the motor shaft, and fixtures to hold and position all types of twist drills for drill grinding. A web thinning drill grinding attachment, drill holder assembly, and swinging arm hold the drill in a fixed position for each grinding operation and permit the cutting edge lips to be ground symmetrically at the correct angle and with the correct clearance to ensure long life and efficient cutting. Collets and bushings are supplied with the drill grinding machine to hold a wide range of different sized drills. The grinding machine has a diamond set in the wheel-dressing arm to dress the grinding wheel as necessary.

DOUBLE WHEEL SWING ARM

Another kind of bench type drill grinding machine is equipped with two grinding abrasive wheels, one at each end of the motor shaft. One wheel is beveled for thinning the web of the drill at the point. The other wheel is used for lip grinding. The grinder includes a wheel holder assembly for mounting the drill and providing a means for bringing the drill into contact with the grinding wheel at the correct angle and feed to obtain proper clearance angles. A thinning drill point rest is mounted forward of the beveled grinding abrasive wheel to rest and guide

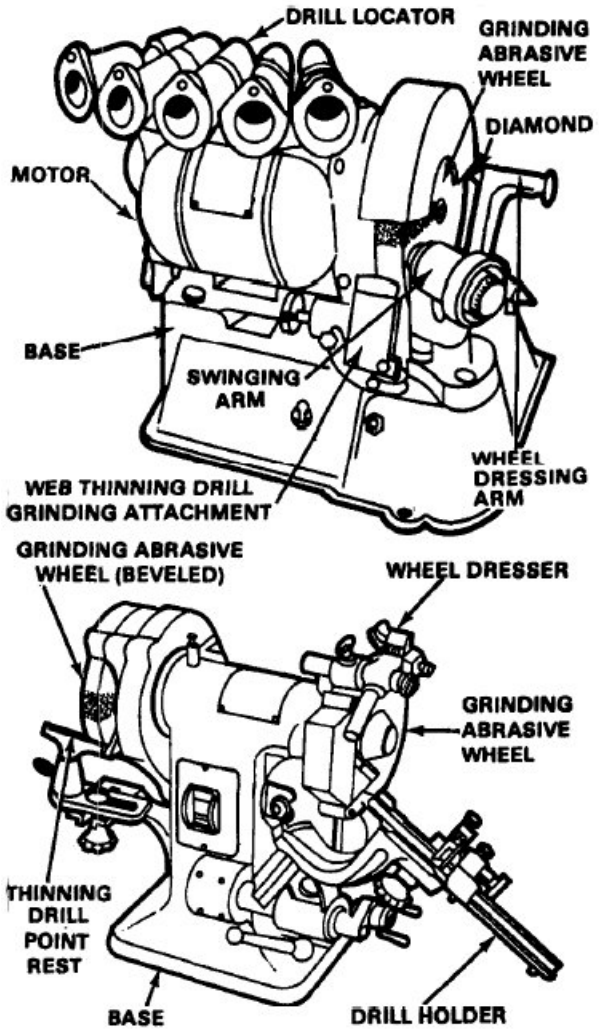


Figure 6-20. Drill grinding machines.

Drilling machines use cutters, that are not drills, to produce special holes. Below are listed the most common types.

the drill during web thinning operations. A wheel dresser is provided to dress the grinding wheel as necessary.