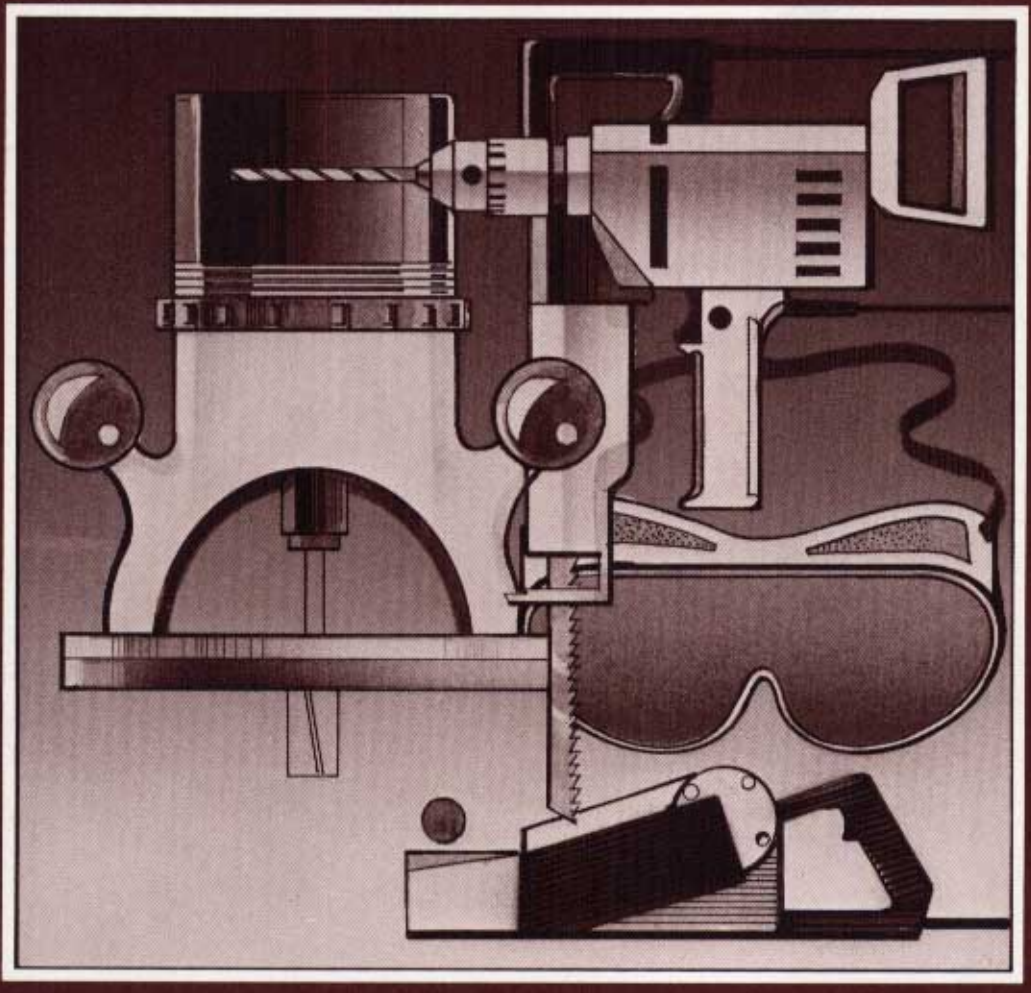
Electric Drills, Sabre Saws, Planes and Routers



Construction Safety Association of Ontario

Electric Drills, Sabre Saws, Planes and Routers

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In the past, members of the public have used printed information that was outdated by subsequent improvements in knowledge and technology. We therefore make the following statement for their protection in future.

The information presented here was, to the best of our knowledge, current at time of printing and is intended for general application. This publication is not a definitive guide to government regulations or to practices and procedures wholly applicable under every circumstance. The appropriate regulations and statutes should be consulted. Although the Construction Safety Association of Ontario cannot guarantee the accuracy of, nor assume liability for, the information presented here, we are pleased to answer individual requests for counselling and advice.

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Foreword

This manual is a companion volume to **Electric Circular Handsaws** (M006), **Chain Saws in Construction** (M016), and **Table Saws** (M023) published by the Construction Safety Association of Ontario. Together the books provide basic guidelines for the safe operation of power tools commonly used in the construction industry.

We trust that this manual, like its companion volumes, will be received by labour and management as a useful aid to on-site instruction, community college courses, union training programs and other forms of accident prevention education.

Portable power tools have become indispensable in the construction industry. But their full potential for saving time, effort and money can only be realized if they are operated safely and efficiently. We hope that our manuals will help labour and management to meet that objective.

Contents

Basic Safety with Electric Tools

Make sure that electric tools are properly grounded or double-insulated.

Never remove or tamper with safety devices.

Study the manufacturer's instructions before operating any new or unfamiliar electric tool.

Before making adjustments or changing attachments, always disconnect the tool from the power source.

When operating electric tools, **always** wear eye protection.

Make sure that the tool is held firmly and the material properly secured before turning on the tool.

Always use a ground fault circuit interrupter with any portable electric tool operated outdoors or in damp locations.

Protective Clothing and Equipment

Clothing

Clothing, especially sleeve and pant cuffs, should be snug-fitting to prevent entanglement and tripping.

When operating electric tools, do not wear finger rings or wristwatches. Neck chains are also hazardous and must be worn under clothing so that they don't hang out.

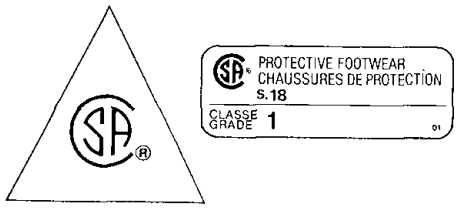
Head Protection

At all times on the job, construction workers must wear a Canadian Standards Association (CSA) approved Class B hard hat.

Foot Protection

At all times on the job, construction workers must wear CSA-approved Grade 1 footwear or CSA-approved footwear with heavy-duty toe and sole protection.

Workers purchasing new work boots should obtain CSA-approved Grade 1 footwear. Such boots bear a green triangular patch stamped with the registered trademark of the Canadian Standards Association on the outside and a rectangular green label on the inside. Grade 1 footwear conforms to the requirements for construction boots.



Hearing Protection

Workers operating electric tools in confined spaces or for prolonged periods of time should wear appropriate hearing protection.

Hearing protection is available in three general types:

- disposable earplugs (made of pliable material, one size fits all but can be used once only)
- permanent earplugs (must be fitted to provide a good seal but can be washed and reused)
- earmuffs (when properly fitted and worn, these generally provide more protection than earplugs).

Eye Protection

When operating any electric tool, workers should wear properly fitted industrial quality eye protection in the form of spectacles and side shields.

Cover goggles (for dust and splash) are recommended for workers drilling overhead or into concrete, masonry and drywall.

Optimum eye and face protection is provided by eyecup goggles or cover goggles worn with face shields.

Fall Protection

A worker must wear a safety belt with the lanyard tied off to either a fixed support or a lifeline whenever he is exposed to the hazard of falling

- more than 3 metres (10 feet)
- into operating machinery, or
- into hazardous substances or objects.

Precautions with Electrical Parts

Inspection

Tool cords, extension cords and electrical fittings should be inspected daily for damage. Check extension cords and outlets with a pocket circuit-tester before using (Figure 1). Damaged equipment must be repaired or replaced before operating any electric tool.

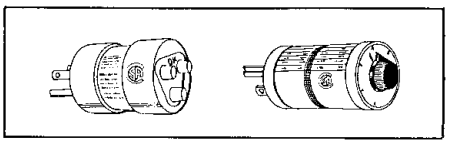


Figure 1

Grounding

Unless it is double-insulated, the electric tool must be grounded to protect the operator from electrical shock. The tool must have an approved three-wire cord with a three-prong plug so that it can be used only in a properly grounded three-pole receptacle.

Never cut off or bend back the ground pin on a three-prong plug to make it fit a two-pole receptacle. Never use a two-prong cheater or adapter. The three-wire cord on grounded saws must not be replaced with a two-wire cord. These practices are extremely dangerous and, in most jurisdictions, illegal.

Power Source

The power source must be the same voltage and current (alternating or direct) called for on the nameplate of the tool. Using higher voltage can cause serious injury to the operator as well as burn-out to the tool. Using lower voltage can also damage the tool motor.

Before any electric tool is connected to a power source, the switch on the tool must be OFF.

Many contractors use portable generators to power electric tools. Respect these generators as you would any power supply. The shock can be just as deadly.

Electric Cords

Never carry an electric tool by the cord or disconnect the plug by pulling or jerking on the cord. Such practices can damage the cord and loosen or separate connections.

Keep cords out of water and oil. If vehicles must pass over cords, the cords should be put in a conduit or be protected by planks.

Check cords frequently for such damage as kinks, cuts and cracked or broken outerjackets.

Any cord that feels more than comfortably warm to the touch should be checked by an electrician for overloading.

Knotting extension cords to tool cords can cause short circuits and shocks. Loop the cords (Figure 2) or use a twist lock plug.

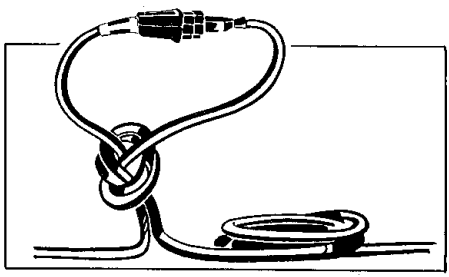


Figure 2

Place cords so that they will not trip the operator or other personnel on the jobsite.

Cords should be fitted with dead front plugs. These plugs are sealed and present less danger of shock or short circuit than open front plugs (Figure 3).

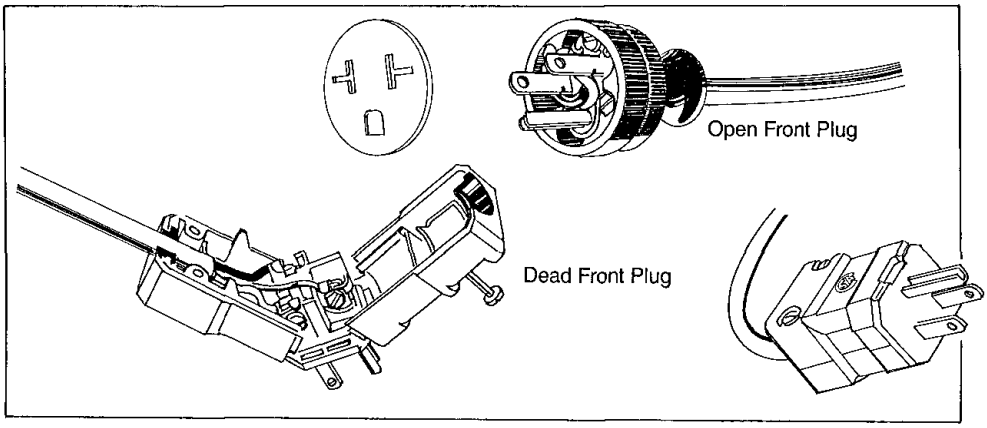


Figure 3

Make sure that the cord is clear of the tool when operating.

Undersized cords will cause a drop in line voltage, loss of power and overheating.

Extension cords should be of sufficient wire gauge for the voltage and amperage specified on the nameplate of the tool and for the length of run (see table below).

Extension Cord Gauges for Electric Tools
(Based on 120 volt power supply)

Cord Length in Feet	Nameplate Amperes																			
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
25	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14
50	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14	12
75	14	14	14	14	14	14	14	14	14	14	14	14	12	12	12	12	12	12	12	12
100	14	14	14	14	14	14	14	14	14	12	12	12	12	12	12	10	10	10	10	10
125	14	14	14	14	14	14	14	12	12	12	12	12	10	10	10	10	10	10	10	8
150	14	14	14	14	14	14	12	12	12	12	10	10	10	10	10	10	8	8	8	8
175	14	14	14	14	14	12	12	12	10	10	10	10	10	10	8	8	8			
200	14	14	14	14	12	12	12	10	10	10	10	10	8	8	8					
225	14	14	14	14	12	12	10	10	10	10	8	8	8							
250	14	14	14	12	12	12	10	10	10	8	8	8								
275	14	14	14	12	12	10	10	10	8	8	8									
300	14	14	14	12	12	10	10	10	8	8										
325	14	14	12	12	10	10	10	8	8											
350	14	14	12	12	10	10	10	8												

American Wire Gauge (AWG), standard annealed copper wire, solid temperature 25°C (77°F).

Shaded area indicates combinations of amperage and length for which no extension cord gauge can be safely recommended.

For example, operating a 10-amp saw 100 feet from the power source would require a 12-gauge extension cord. At 200 feet a 10-gauge cord would be necessary. Gauges apply over the entire length of the run. Short cords of differing gauges should not be combined to make a longer run.

Switches

Never tamper with a broken switch. Have it repaired by a qualified repair shop. Never bypass the switch and operate the tool by connecting and disconnecting the cord. If the tool jams, it is practically impossible to turn it off by this method before damage or injury occurs.

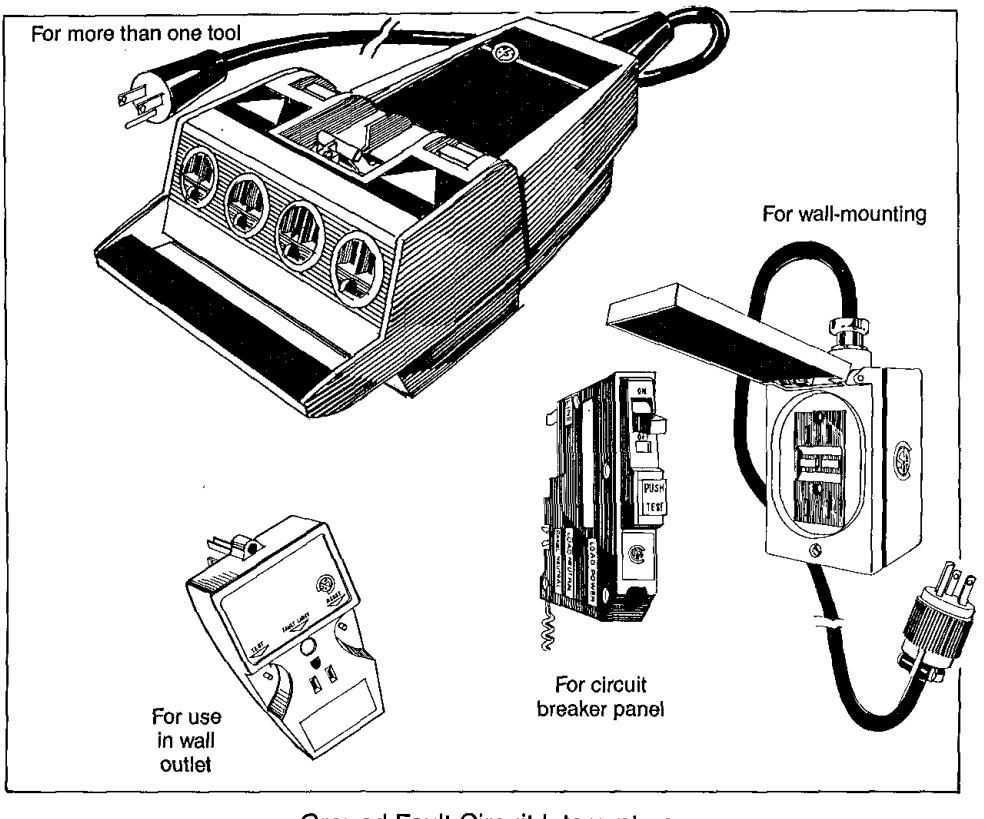
Shocks, Sparks and Moisture

No matter how minor, shocks from electric tools should always be reported to the supervisor. The tool must not be used until it has been checked for ground fault. Minor tingles or slight shocks can be a warning of fatal shocks later if the tool is not checked.

Remember that a shock of only 20 to 40 milliamperes can be lethal. That is only 20 to 40 **thousandths** of the one ampere required to keep a 100 watt lightbulb burning.

The motors in electric tools are not normally spark-proof. Never use any electric tools in areas where there may be exposure to flammable gases, liquids or explosives.

A ground fault circuit interrupter (GFCI) must be used with any portable electric tool operated outdoors or in damp locations (Figure 4). In fact a GFCI is advisable for use with portable electric tools under all conditions. This fast-acting device detects any current leaking to ground from an electric tool and quickly cuts off electricity before damage or injury can occur. GFCI's are activated by current leakage of 5 milliamperes – well below the 20 to 40 milliamperes that can be fatal.



Ground Fault Circuit Interrupters
Figure 4

The Electric Hand Drill

Types and Uses

The electric hand drill is probably used more often than any other portable power tool. It also comes in a greater variety of sizes and types. Drills can be used on wood, metal and other materials. With suitable attachments, the drill can be used for disc sanding, sawing holes, driving screws and grinding. However, when such applications are repeatedly or continuously required, tools specifically designed for the work should be used.

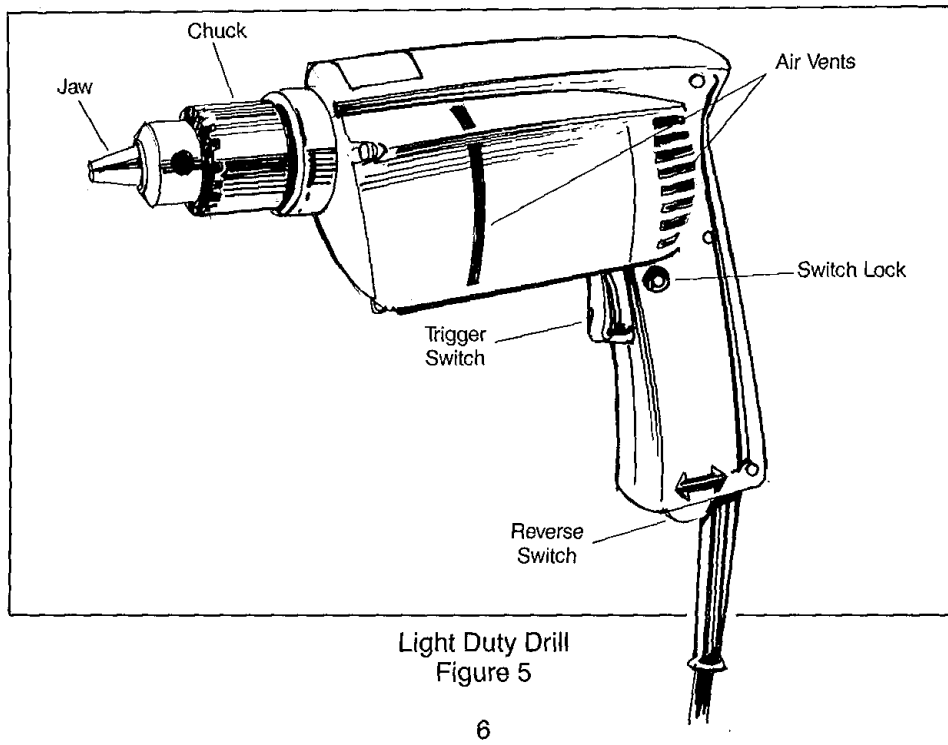
Trim carpenters will generally select a ¼ or ⅜ inch trigger-controlled variable speed drill (Figure 5). Simply by increasing pressure on the trigger, the operator can change drill speed from 0 to 2,000 rpm.

Carpenters working in heavy structural construction such as bridges, trusses and waterfront piers will usually select the slower but more powerful one or two speed reversible ½ or ¾ inch drill (Figure 6).

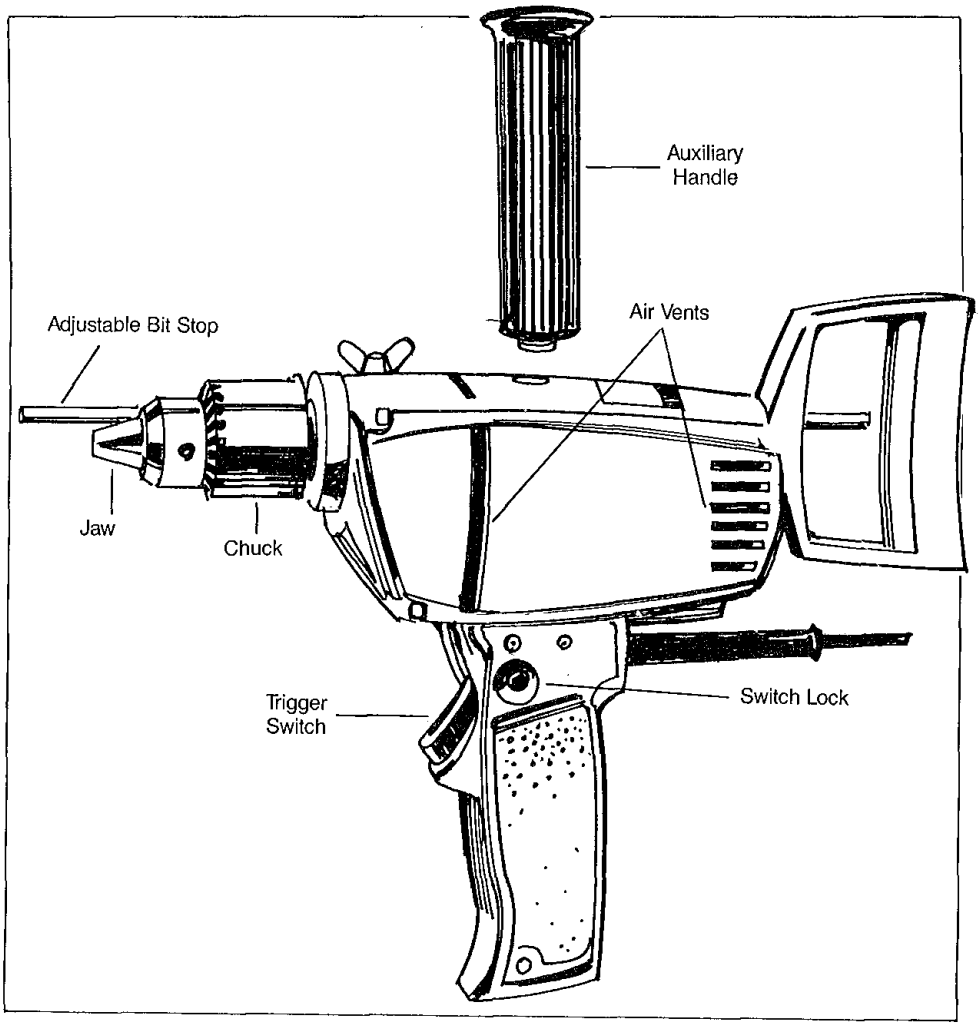
Size of the drill is determined by the maximum opening of the chuck. For instance, a ⅜ inch drill will take only bits or attachments with a shank up to ⅜ inch wide. Although the shank of a drill bit or attachment is ⅜ inch, the cutting end may be wider, as on a hole saw or speed bit. Such bits and attachments should be used with care because they can burden the tool, especially in drilling hard materials.

Switch Lock

Many electric hand drills are equipped with a switch lock (Figures 5 and 6). Pressing a small button at the side of the trigger switch will lock the switch into the ON position and allow the tool to run on its own. To stop the drill, simply press the trigger. The locking device can be useful and convenient for certain jobs. However, if there is any chance that the drill may run out of control, locking the switch can be dangerous. Use the device with caution.



Light Duty Drill
Figure 5

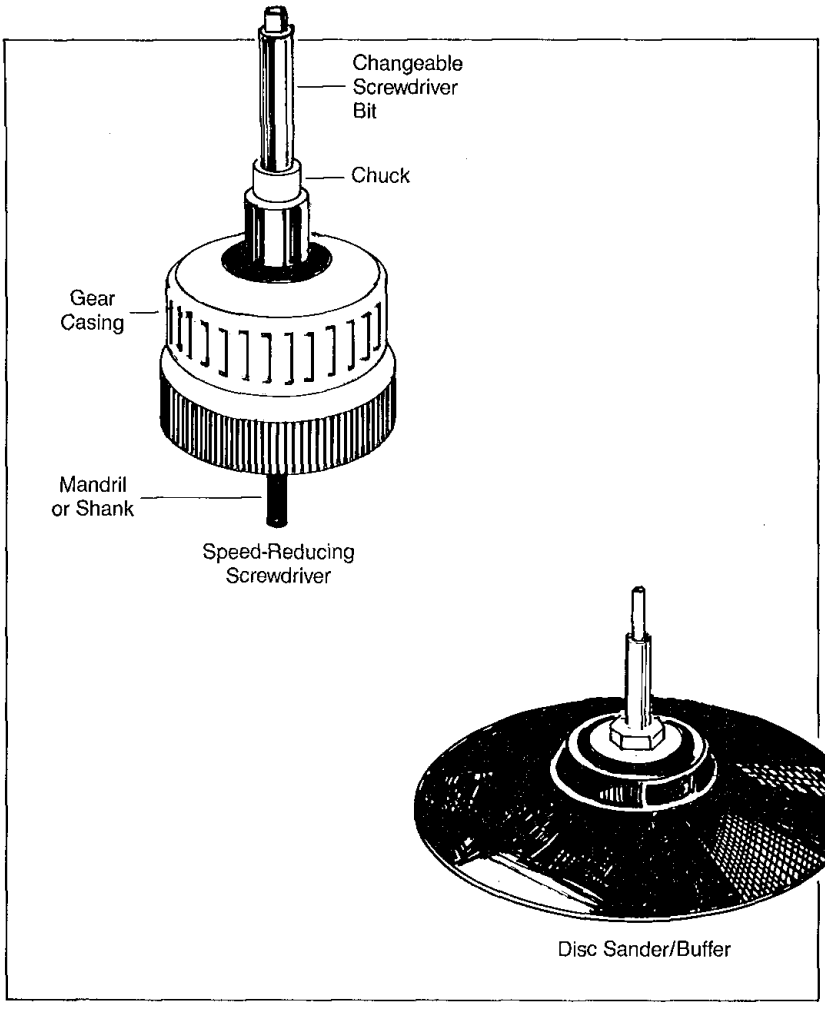


Heavy Duty Drill
Figure 6

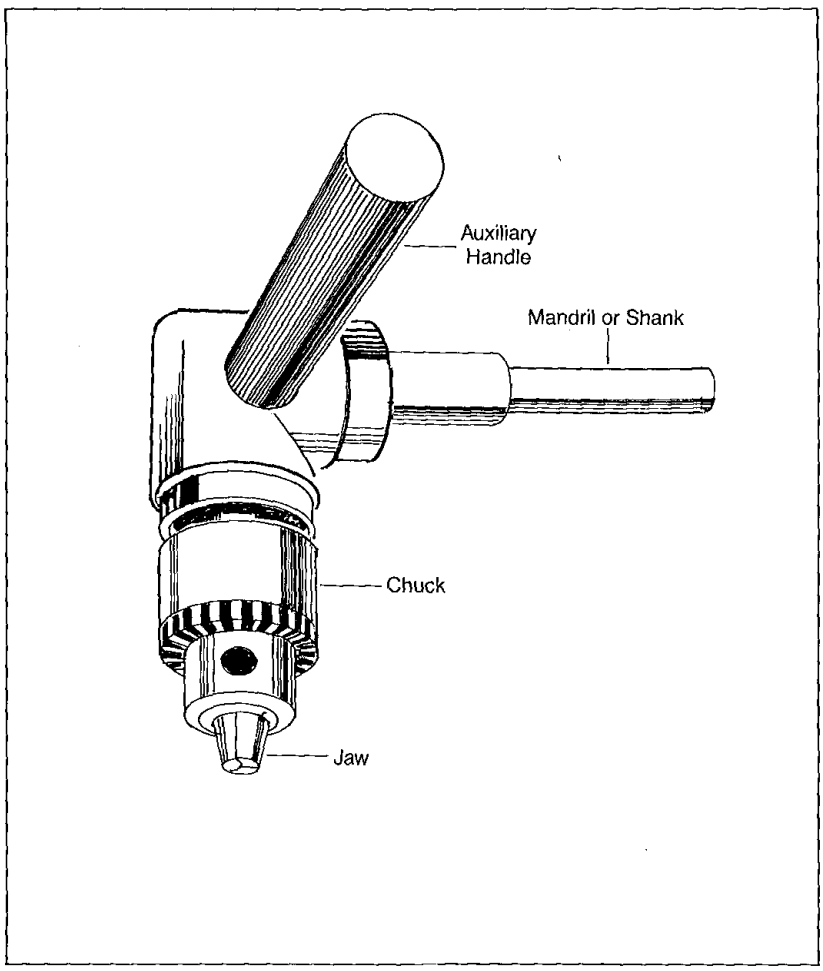
Attachments

Various attachments are available to save time and labour on the job. Attachments such as speed-reducing screwdrivers, disc sanders and buffers (Figure 7) can help to prevent fatigue and undue muscle strain. A right-angle drive attachment (Figure 8) is very useful in tight corners and other hard-to-reach places.

Cutting and drilling attachments must be kept sharp to avoid overloading the motor. Operators should not crowd or push the tool beyond capacity. Such handling can burn out the motor, ruin the material and injure the operator in the event of a kickback.



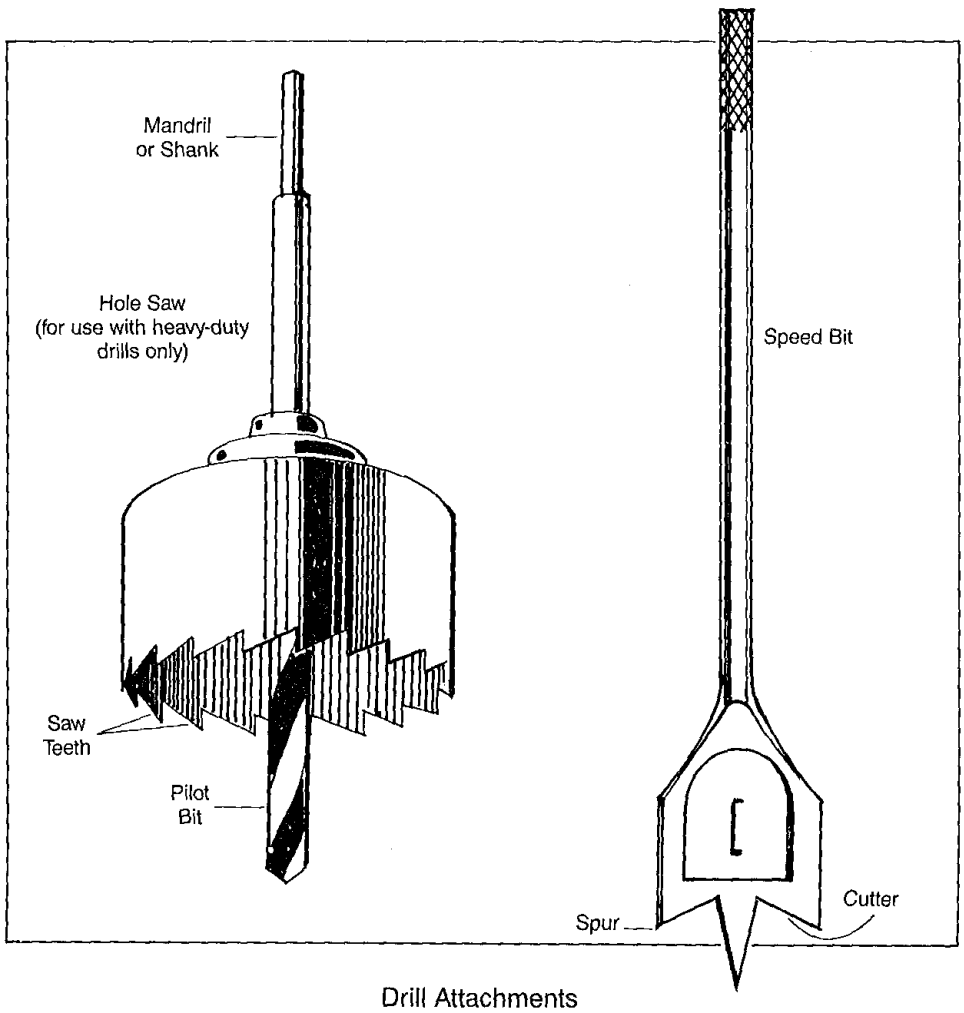
Drill Attachments
Figure 7



Right-Angle Drive Attachment
Figure 8

Some attachments, such as hole saws, speedbits and screwdrivers (Figure 9), require considerable control by the operator. If the operator does not feed the attachment slowly and carefully into the material, the drill can suddenly stop and severely twist or break the operator's arm. Stock should be clamped or otherwise secured to prevent it from moving. This will also enable the operator to control the tool with both hands and absorb sudden twists or stops caused by obstructions such as knots or hidden nails.

Operators must restrain the drill just before the bit or cutting attachment emerges through the material, especially when oversized speedbits are used. Sides of the bit often become hooked on the ragged edge of the nearly completed hole and make the drill come to a sudden



Drill Attachments
Figure 9

stop that can wrench the operator's arm. At the first sign of the bit breaking through the material, the operator should withdraw the drill and complete the work from the other side. This will produce a cleaner job and prevent the material from cracking or splintering. The same result can be obtained by clamping a back-up piece to the material and drilling into that.

Choosing the Proper Bit or Attachment

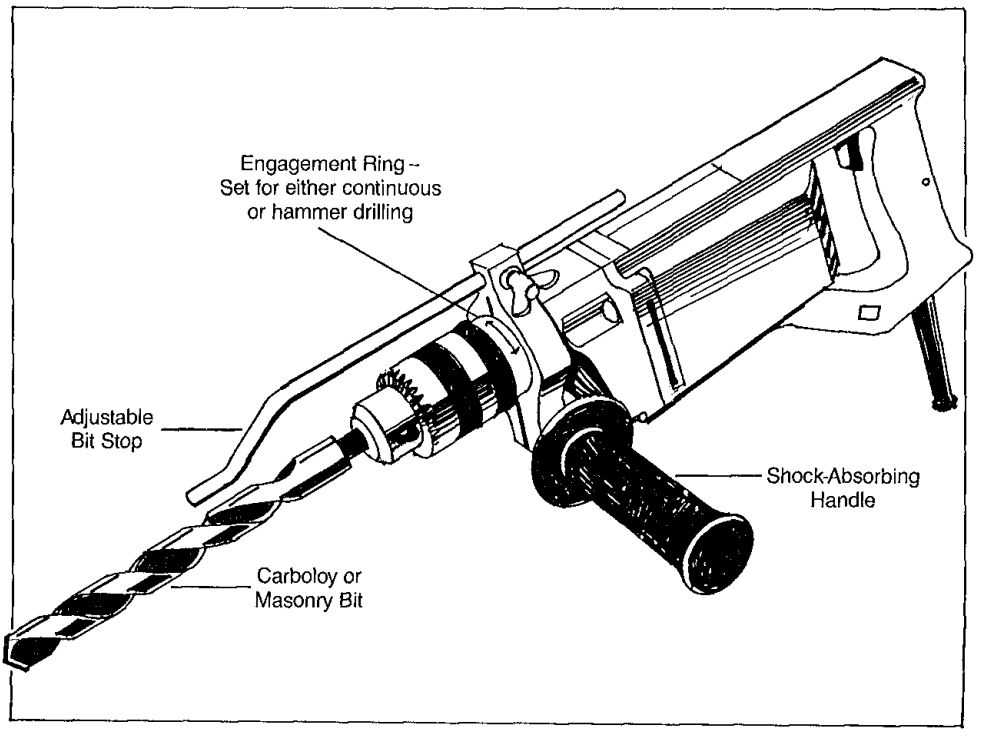
Select the bit or attachment suitable to the size of the drill and the work to be done.

To operate safely and efficiently, the shanks of bits and attachments must turn true.

Make sure that the bit or attachment is properly seated and tightened in the chuck.

Some operations require the use of an impact or hammer drill. For instance, drilling large holes in concrete or rock with a carboloy bit should be done with an impact drill (Figure 10).

Follow manufacturers' instructions when selecting and using a bit or attachment, especially with drills or work unfamiliar to you.



Impact or Hammer Drill
Figure 10

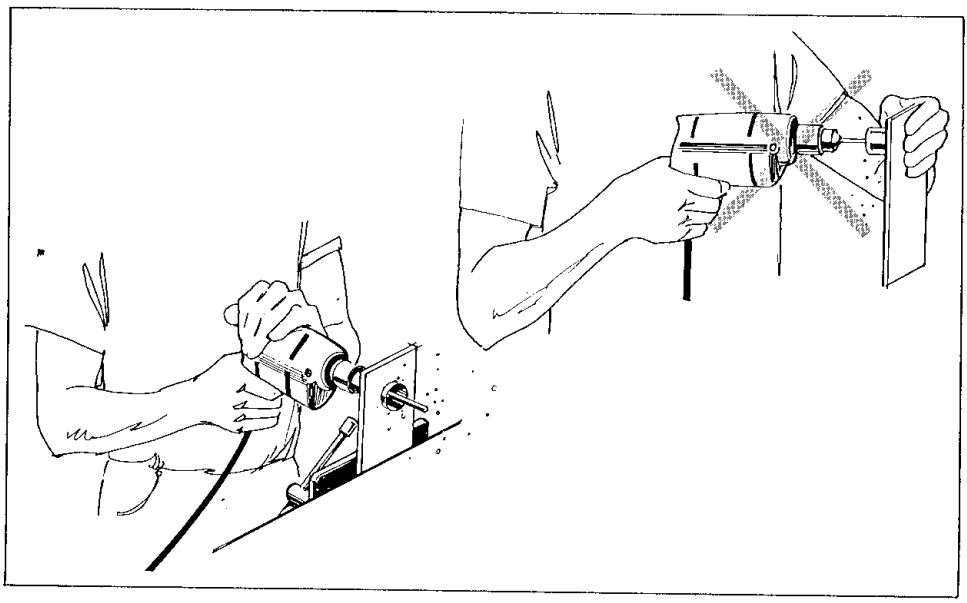
Case History

A worker was using a ½ inch drill to make ⅝ inch holes in a concrete ceiling for pipe hangers. To exert more pressure on the bit, he held the drill on his shoulder and pushed upward. When the carboloy bit struck a reinforcing rod, the drill twisted violently and the crossbar hit his forehead. Ten stitches were required to close the wound.

Use the bit suited to the size of the drill and the requirements of the job. When necessary, use an impact drill. It requires less manual force and works faster than an ordinary drill. Whenever possible, control any electric drill with both hands for accuracy and safety.

Working with Small Pieces

Drilling into small pieces of material may look harmless, but if the pieces are not clamped down and supported, they can spin with the bit before the hole is completed. If a small piece held by hand starts to twist or spin with the drill, the operator can be injured. Small work pieces should be properly secured and supported. Never try to drill with one hand and hold a small piece of material with the other (Figure 11).



Right and Wrong Ways of Drilling Small Pieces
Figure 11

Case History

An apprentice was holding a piece of 38 mm x 89 mm (2″ x 4″) lumber in one hand and an electric drill in the other hand. Because the bit was dull, he had to force the drill through the wood. He lost his grip on the lumber and drilled into his thigh. Fabric from his blue jeans was left unnoticed in the wound. He contracted blood poisoning from dye in the jeans and was hospitalized. Doctors had great difficulty saving his leg.

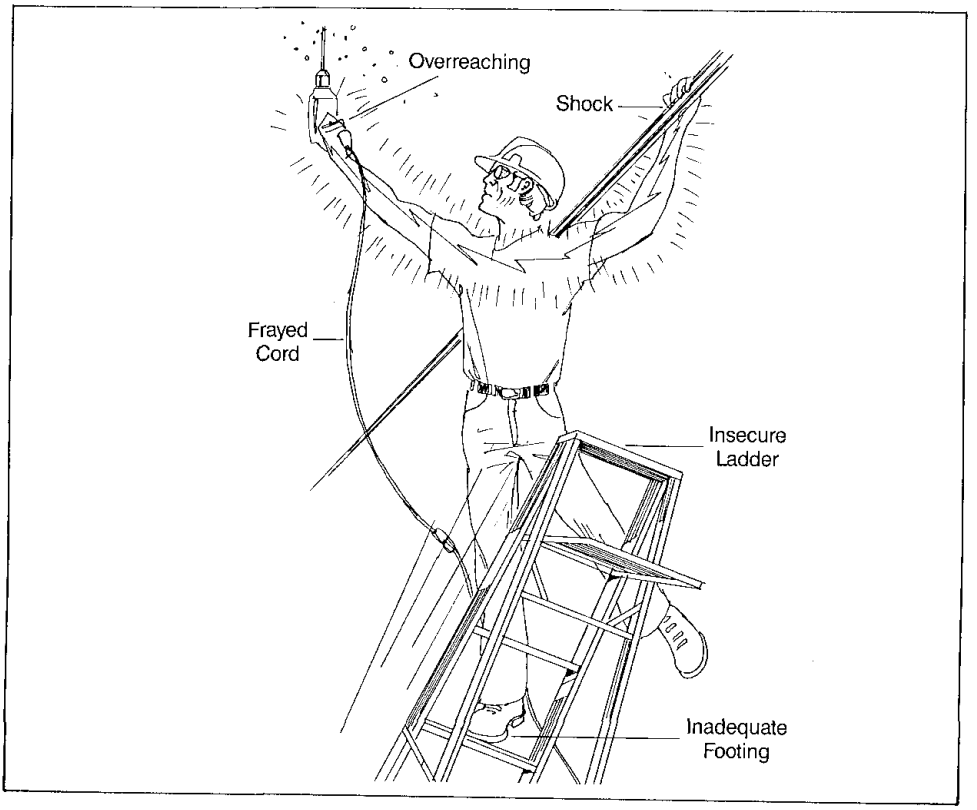
Always select a sharp bit suitable for the job. Never push the drill beyond capacity. Use proper supports for the material so that both hands can control the tool if necessary.

Drilling from Ladders (Figure 12)

Standing on a ladder to drill holes in walls and ceilings can be hazardous. The top and bottom of the ladder must be secured to prevent the ladder from slipping or sliding when the operator puts pressure on the drill.

When drilling from a ladder, never reach out to either side. Overreaching can cause the ladder to slide or tip.

Never stand on the top step or the paintshelf of a stepladder. Stand at least two steps down from the top. When working from an extension ladder, stand no higher than the fourth rung from the top.



Drilling and Ladder Hazards
Figure 12

When drilling from a ladder, never support yourself by holding onto a pipe or any other grounded object. Electric current can travel from the hand holding the drill through your heart to the hand holding the pipe. A minor shock can startle you enough to lose your balance. A major shock can badly burn or even kill you.

Ladders provide adequate support for work of brief duration and limited extent. Scaffolds or other work platforms should be used wherever possible for longer, more extensive jobs at heights.

Case History

Working from a ladder, an operator was drilling holes in a concrete ceiling with an impact drill. He reached out too far from the ladder and lost his balance. The ladder tipped over and he hit the floor with his foot caught between the rungs, breaking his ankle.

When drilling from a ladder, always work as close to your body as practical. It is less tiring and hazardous than reaching out to either side.

Operating Procedures

Always plug in the drill with the switch OFF.

Before starting to drill, turn on the tool for a moment to make sure that the shank of the bit or attachment is centred and running true.

Punch a layout hole or drill a pilot hole in the material so that the bit won't slip or slide when you start drilling. A pilot hole is particularly important for drilling into hard material such as concrete or metal.

With the drill OFF, put the point of the bit in the pilot hole or punched layout hole.

Hold the drill firmly in one hand or, if necessary, in both hands at the correct drilling angle (Figure 13).

Turn on the switch and feed the drill into the material with the pressure and control required by the size of the drill and the kind of material.

Don't try to enlarge a hole by reaming it out with the sides of the bit. Switch to a larger bit.

While drilling deep holes, especially with a twist bit, withdraw the drill several times with the motor running to clear the cuttings.

Never support material on your knee while drilling. Material should be firmly supported on a bench or other work surface for drilling.

Remove the bit from the drill as soon as you have finished that phase of your work.

When drilling into floors, ceilings and walls, beware of plumbing and wiring, especially electrical wiring (Figure 13).

Remember that the longer you work the heavier the drill feels, particularly when working overhead. Take a breather now and then to relax your arms and shoulders.

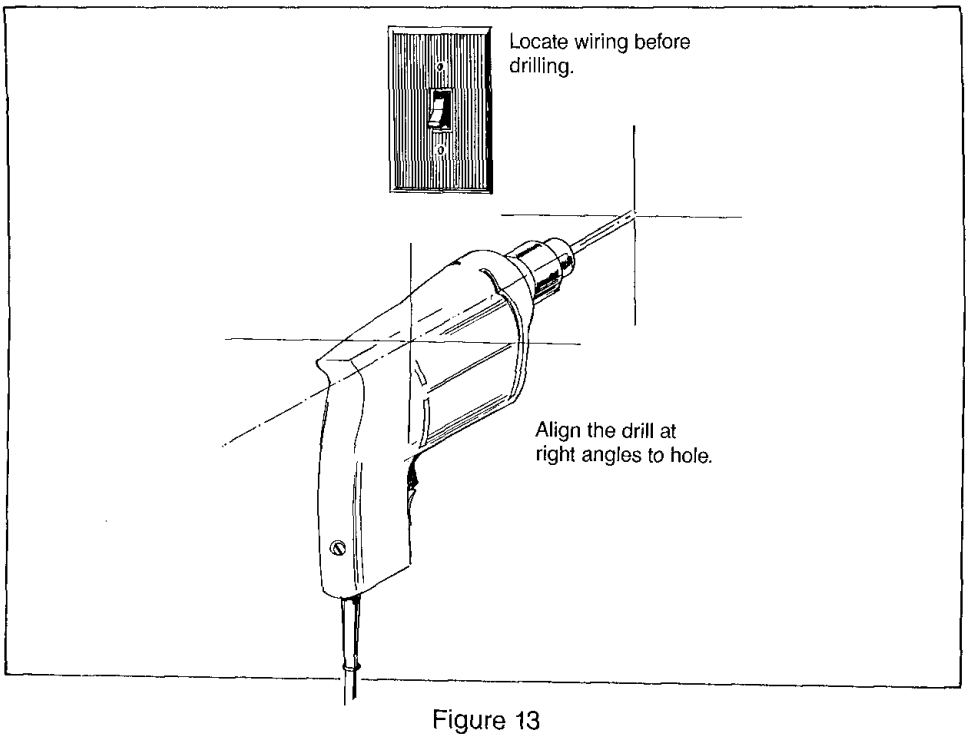


Figure 13

Case History

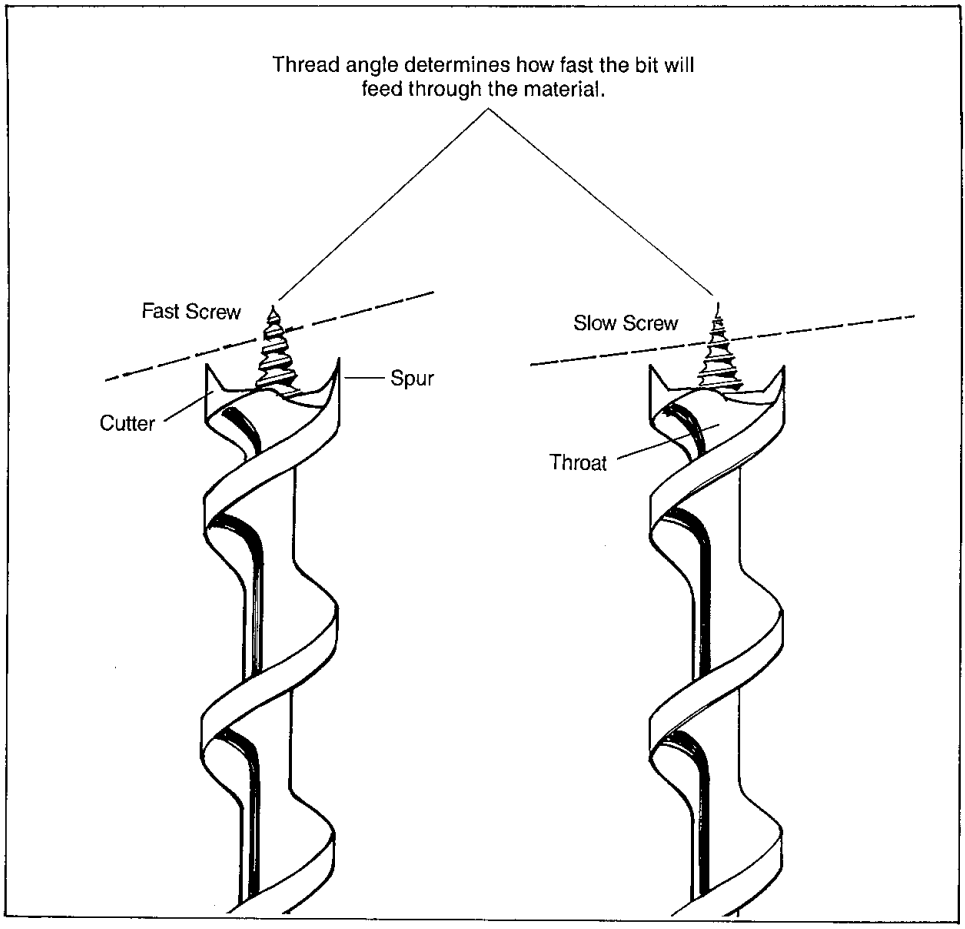
A worker standing on a scaffold was drilling holes in a ceiling. He lost control of the drill when the bit struck a hidden nail. The man's arms were too tired to absorb the sudden impact. He dropped the drill and, in trying to catch it, fell from the scaffold, injuring his back, hip and shoulder.

Whenever possible, hold the drill in both hands. When necessary, take a rest. On ladders, scaffolds and other elevated work platforms, be particularly careful to control the drill and keep your balance.

Drilling Timbers

When drilling timbers with a self-feeding auger bit (Figure 14), do not underestimate the physical pressure required to maintain control of the tool. Such work calls for a heavy-duty low-rpm drill, one-half or three-quarter inch in size.

Never attempt to drill heavy timbers by yourself, especially when working on a scaffold or other work platform. If the self-feeding auger bit digs into a hidden knot or other obstruction, the sudden torque can twist or wrench the operator's arm and throw him off balance.



Self-Feeding Auger Bits
Figure 14

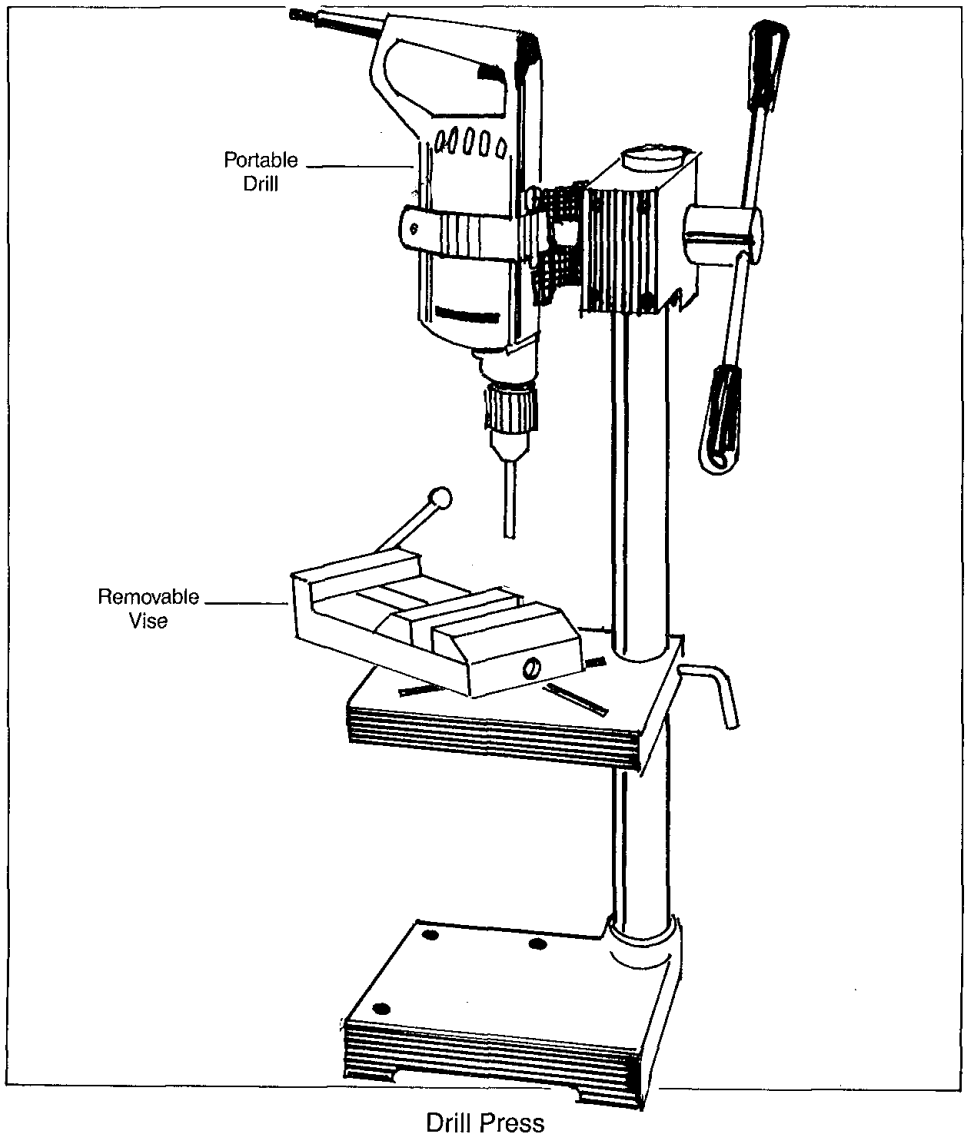
Drilling Materials Other Than Wood

The main cause of concern in drilling materials other than wood is leaning too heavily on the tool. This can not only overload and burn out the motor but also cause injury if the operator is thrown off balance by the drill suddenly twisting or stopping.

Always use a drill powerful enough for the job and a bit or attachment suited to the size of the drill and the nature of the work. As at other times, punching a layout hole or drilling a pilot hole can make the job safer and more efficient.

The drill press stand (Figure 15) is ideal for drilling holes in metal accurately and safely. Small pieces can be clamped in a vise and bolted to the table. This prevents the workpiece from spinning when the drill penetrates the metal.

The drill press can also be used for cutting large holes in wood with a hole saw or speed bit. The stability of the press and the operator's control over cutting speed eliminate sudden torque.



Drill Press
Figure 15

The Sabre Saw

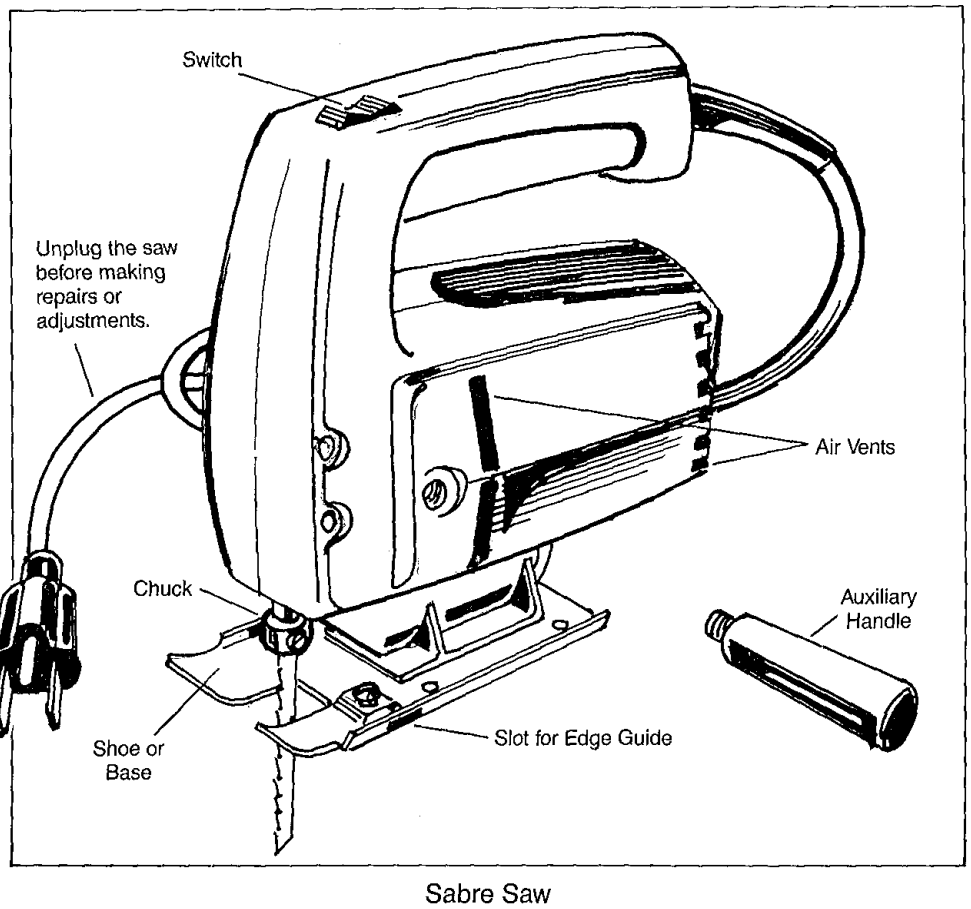
The sabre saw, or portable jigsaw (Figure 16), is designed for cutting external or internal contours. The saw should be used for this purpose and not for the continuous or heavy cutting that can be done more safely and efficiently with a circular saw.

The stroke of the sabre saw blade is about ½ inch for the light-duty model and about ¾ inch for the heavy-duty model. The one-speed saw operates at approximately 2,500 strokes per minute. The variable-speed saw can operate from 0 to 2,500 strokes per minute.

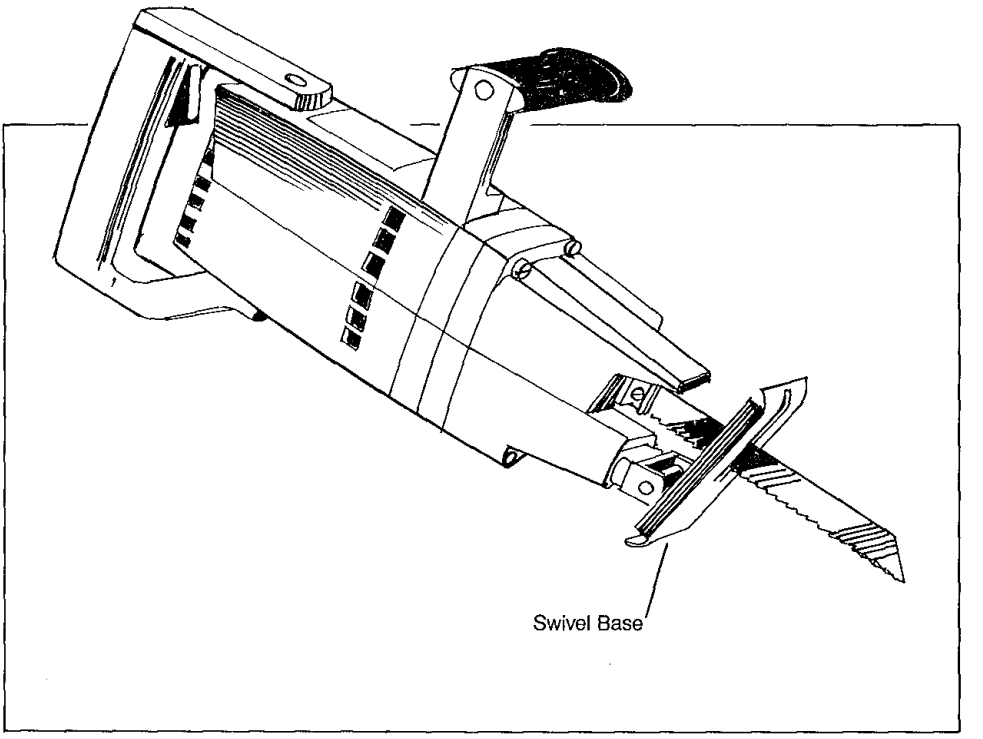
The reciprocating saw (Figure 17) is a heavier type of sabre saw with a larger and more rugged blade. The tool is often used by drywall and acoustical workers to cut holes in ceilings and walls. Equipped with a small swivel base, the saw can be used in corners or free-hand in hard-to-reach places. The reciprocating saw must be held with both hands to absorb vibrations and to avoid accidental contact.

Choosing the Proper Blade

Various blades ranging from 7 to 32 teeth per inch are available for cutting different materials. For the rough cutting of stock such as softwood and composition board, a blade with 7 teeth per inch will cut the fastest. For all-round work with most types of wood, a blade with 10 teeth per inch is satisfactory.



Sabre Saw
Figure 16



Reciprocating Saw
Figure 17

Cutting

The sabre saw cuts on the upstroke. Splintering will therefore occur on the top side of the material being cut. Consequently the good side should be facing **down**. Degree of splintering depends on the type of blade, the vibration of the material and the feed of the saw.

To avoid vibration, the material should be clamped or otherwise secured and supported as close to the cutting line as possible. If the material vibrates excessively or shifts during cutting, the saw can run out of control, damaging the blade and injuring the operator.

Before starting a cut, make sure that the saw will not make contact with clamps, vise, workbench or other support.

Never reach under the material being cut.

Never lay down the saw until the motor has stopped.

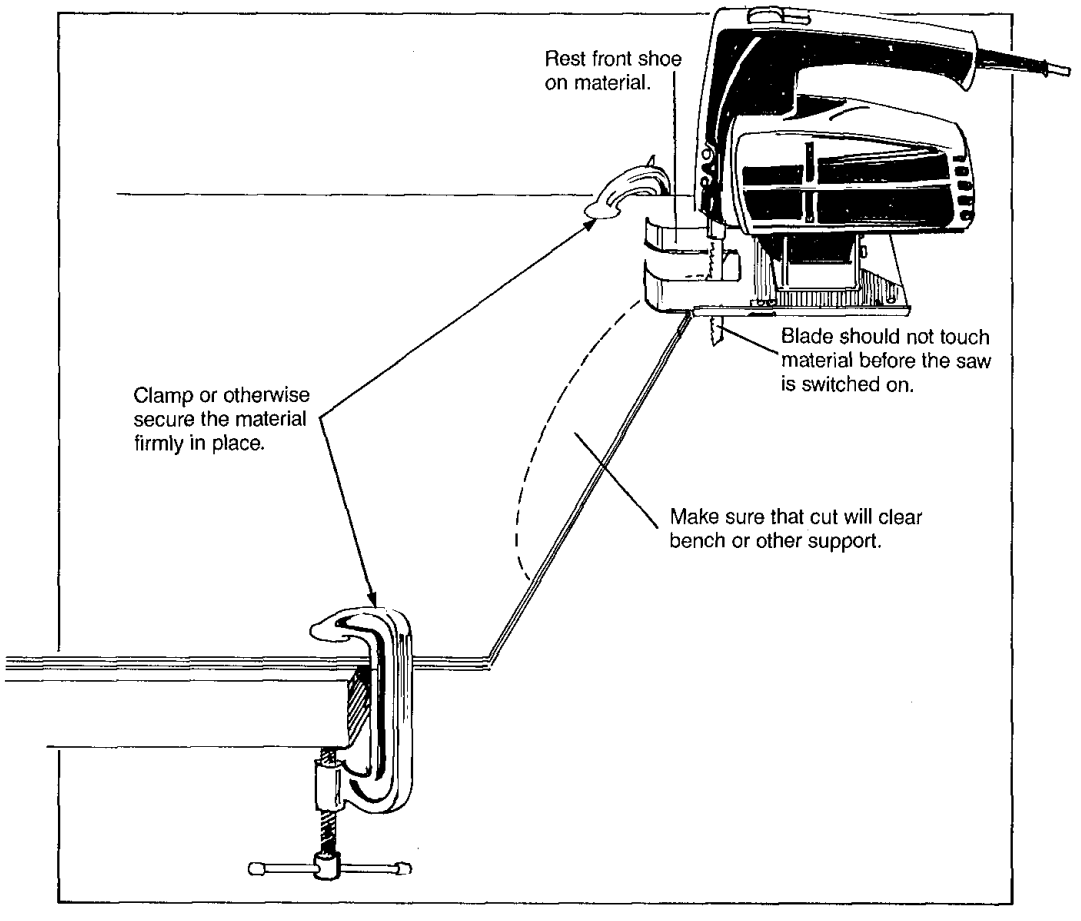
Do not try to cut curves so sharp that the blade will twist and break.

The base or shoe of the saw should always be held in firm contact with the material being cut.

Starting an External Cut (Figure 18)

To start an external cut (from the outside in), place the front of the shoe on the material. Make sure that the blade is not in contact with the material or the saw will stall when the motor starts.

Hold the saw firmly and switch it on. Feed the blade slowly into the material and maintain an even pressure. When the cut is complete, do not lay down the saw until the motor has stopped.



Starting an External Cut
Figure 18

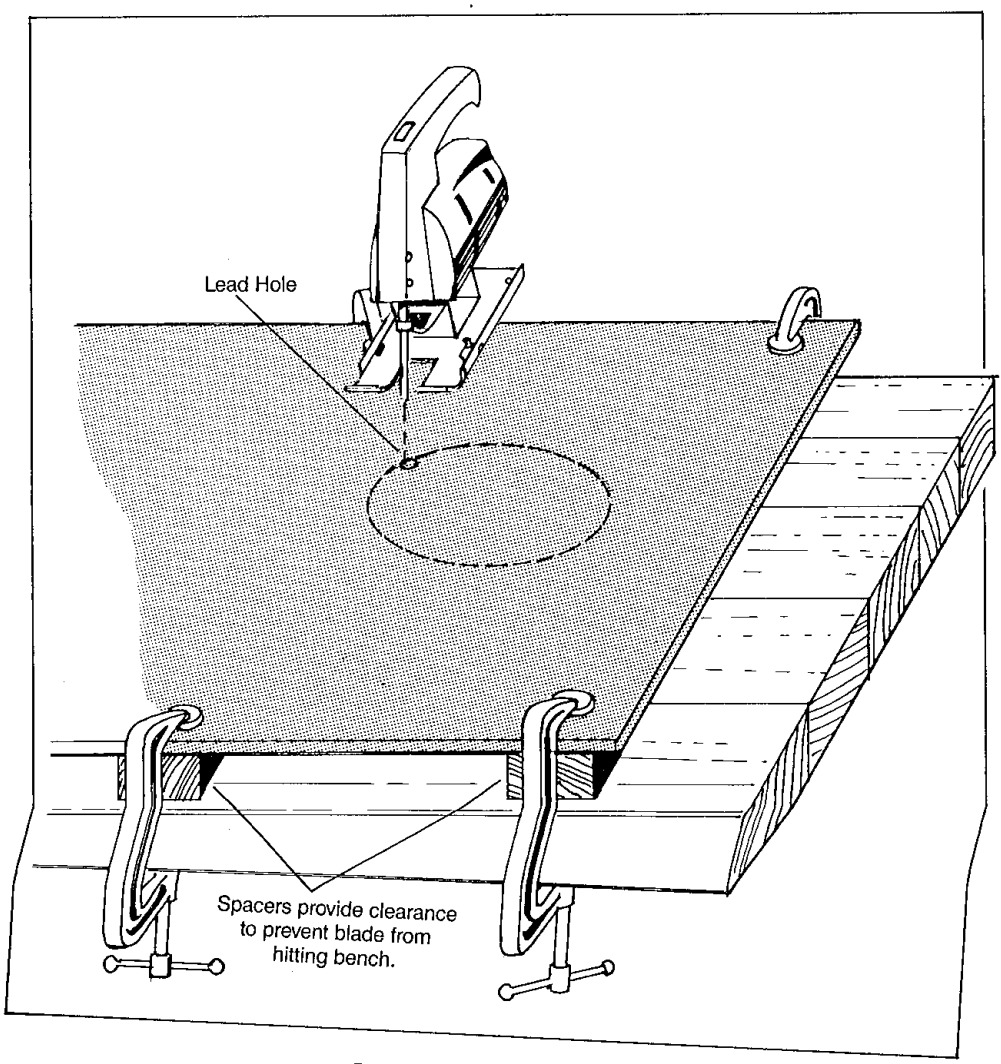
Starting an Inside Cut (Figure 19)

To start an inside cut (pocket cut), first drill a lead hole slightly larger than the saw blade. With the saw switched off, insert the blade in the hole until the shoe rests firmly on the material. Do not let the blade touch the material until the saw has been switched on.

When absolutely necessary, it is possible to start an inside cut without drilling a lead hole first. To do this, rest the front edge of the shoe on the material with the saw tipped backward. Keep the blade out of contact with the material. Switch on the saw and slowly feed the blade into the material while lowering the back edge of the shoe. When the shoe rests flat on the material and the blade is completely through, proceed with the cut. Any deviation from this procedure can cause the blade to break and injure the operator or workers nearby.

While the motor is running, never try to insert a blade into, or withdraw a blade from, a cut or lead hole.

Never reach under the material being cut.



Starting an Inside Cut
Figure 19

Case History

A tradesman cutting wood with a sabre saw lifted the tool from the work before the motor had stopped running. The blade struck the wood and was bent. When the tradesman tried to straighten the blade, he accidentally switched on the saw. The blade severed tendons and nerves in his fingers.

Always wait until the sabre saw stops before removing it from the work. Before making adjustments or repairs to any electric tool, always disconnect it from the power source.

The Electric Plane

Electric planes produce finished surfaces with speed and accuracy. They require less physical effort to operate than ordinary planes, but can also cause more serious injuries.

Consult the manufacturer's instructions before adjusting or operating any electric plane.

Electric planes are available in various types and sizes. Operating procedures are generally similar, but adjustments between models often differ, depending on specific features. For instance, planes can be equipped with

- outfeed tables (back shoes) that are either fixed or movable
- infeed tables (front shoes) that move straight up and down or move up and down on an angle to keep the gap between the cutter head and table as small as possible
- cutter heads with two or more straight blades (also called "knives" or "cutter blades")
- cutter heads with two curved blades.

While operating any electric plane, never wear scarves, open jackets or other loose clothing that can get caught in the cutter head.

Standard Power Plane (Figure 20)

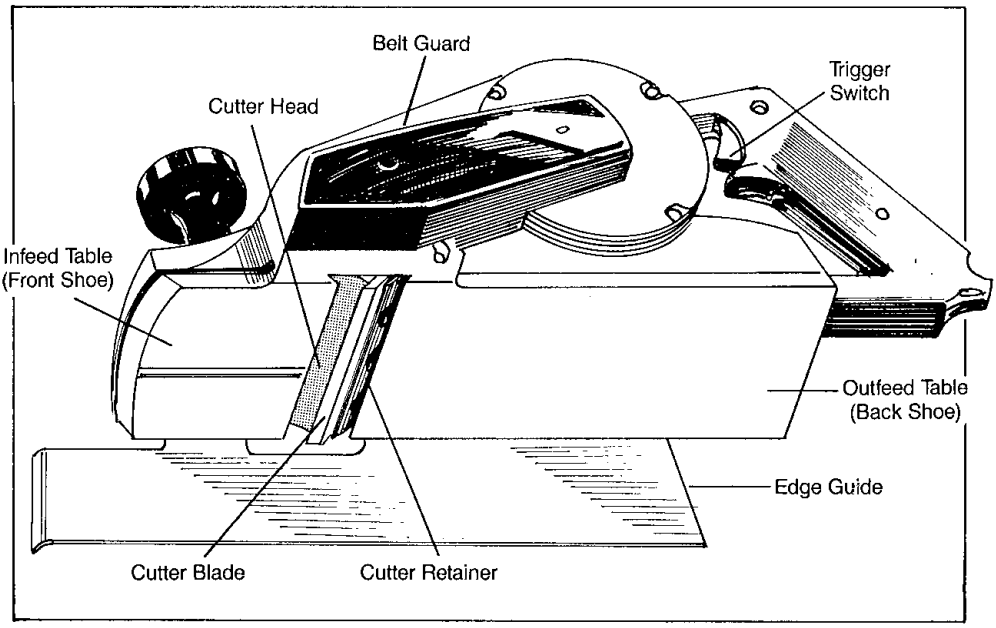
The standard power plane must be held with both hands to avoid accidental contact with the cutter blades. Always keep both hands on the plane until the motor has stopped.

The standard power plane is equipped with a removable edge guide that can be adjusted to plane bevels and chamfers. Use the guide to direct the plane along the desired cut. Never guide the plane along the work with your fingers. If the plane encounters an obstruction or starts to vibrate, your fingers can slide into the unprotected cutter head.

Electric Block Plane

The electric block plane is designed for use on small surfaces and must necessarily be operated with one hand. It is a convenient and useful tool, but more dangerous than the larger power plane.

Operators tend to support the work with one hand while operating the block plane with the other hand. Any unexpected twist or movement during planing can force either the plane or the material to kick back and injure the operator. Keep your free hand well out of the way, in case the plane slips inadvertently.



Standard Power Plane
Figure 20

Maintaining Cutter Blades

Cutter blades are often damaged when the plane strikes staples, nails, sand or other foreign material. The first step in maintaining blades is making sure that surfaces are clean and free of obstructions before being planed.

Cutter blades properly maintained will stay sharp longer than blades poorly cared for. As long as the cutting edge is not nicked or cracked, blades can be restored several times to their original sharpness on a fine grit oilstone.

Blades often have a bevelled edge on both sides so that they can be turned around when one side becomes dull or damaged.

Planing with dull cutter blades is time-consuming and produces a rough, unprofessional job. It can also be the cause of accidents. Instead of cutting, a tool with dull blades tends to float over the work and can easily bounce off the material and injure the operator.

Changing Cutter Blades

Raising or replacing cutter blades in the cutter head requires time and patience. Blades must be of the same weight and be seated at exactly the same height to prevent the cutter head from vibrating. Any deviation in blade height can cause the cutter head to run off balance. As a result, the blades can fly out, ruining the tool and injuring the operator or fellow workers.

Procedures for replacing cutter blades involve two operations: removing and installing.

Removing Cutter Blades

1) Always disconnect the tool from the power source before raising, replacing or adjusting cutter blades.
2) Turn the plane upside down and secure it in a fixed position.
3) Hold the cylinder head stationary by tapping a softwood wedge between the cutter head and the bearing. (Some tools are equipped with a locking device.)
4) Loosen all the screws and lift out one blade and throat piece.
5) Turn the cutter head and repeat this procedure with other blades.
6) If necessary, clean parts thoroughly with kerosene.

Installing Cutter Blades

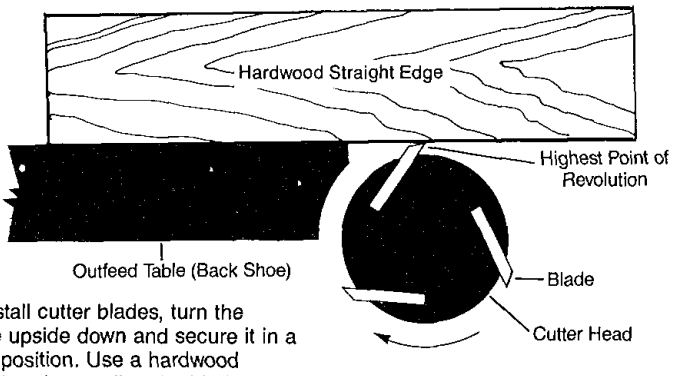
1) Replace one throat piece and blade.
2) Tighten the two end screws lightly.
3) Take a hardwood straight edge and use the outfeed table (back shoe) as a gauge. Raise or lower the blade until both ends are level with the outfeed table at the blade's highest point of revolution.
4) Tighten up the remaining screws.
5) Set the rest of the blades in the same way.
6) Turn the cylinder head and make sure that all blades are the same height.
7) Tighten up all the screws.
8) Doublecheck the height of all blades. Tightening can sometimes shift the set.
9) Doublecheck all the screws.
10) Turn the tool right side up and plug it in.
11) Hold the tool in both hands with the cutter blades facing away from you and switch it on.

Operating Procedures

Always disconnect the tool from the power source before making any adjustments to the cutter head or blades.

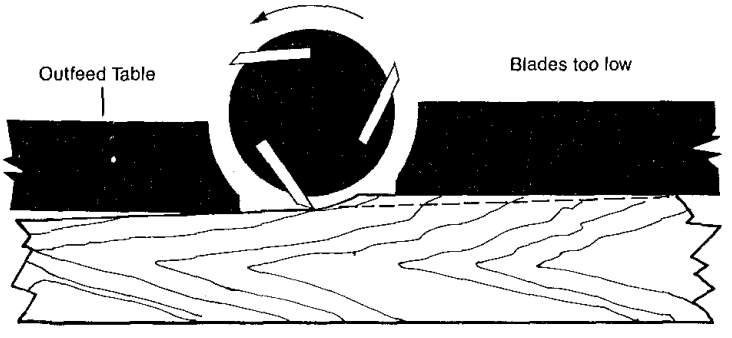
At their highest point of revolution, blades must be exactly flush with the outfeed table (Figure 21).

Material to be planed should be rigidly supported in the best position for doing the job safely and accurately.

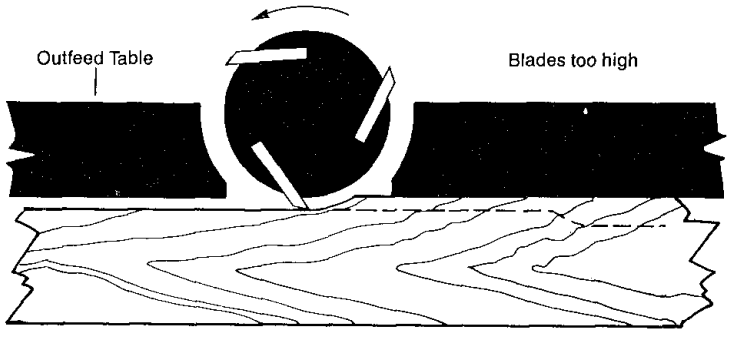


To install cutter blades, turn the plane upside down and secure it in a fixed position. Use a hardwood straight edge to align the blades flush and level with the outfeed table. Do not test or operate the plane upside down unless it is designed for such service.

At their highest point of revolution, blades must always be exactly flush with the outfeed table.



When cutter blades are installed lower than the level of the outfeed table, the plane hobbles over the material and the cut is uneven.



When cutter blades are installed higher than the level of the outfeed table, the plane gouges the material.

Figure 21

When planing doors and large pieces of plywood, use a jack (Figure 22). The jack stops the work from shifting and keeps the edges free of sand, grit and other foreign material on the floor or ground.

When using an electric block plane, clamp or fasten the material to be planed, whenever possible. Keep your free hand well away from the plane and the material.

Before using the standard power plane, adjust the edge guide to provide the desired guidance.

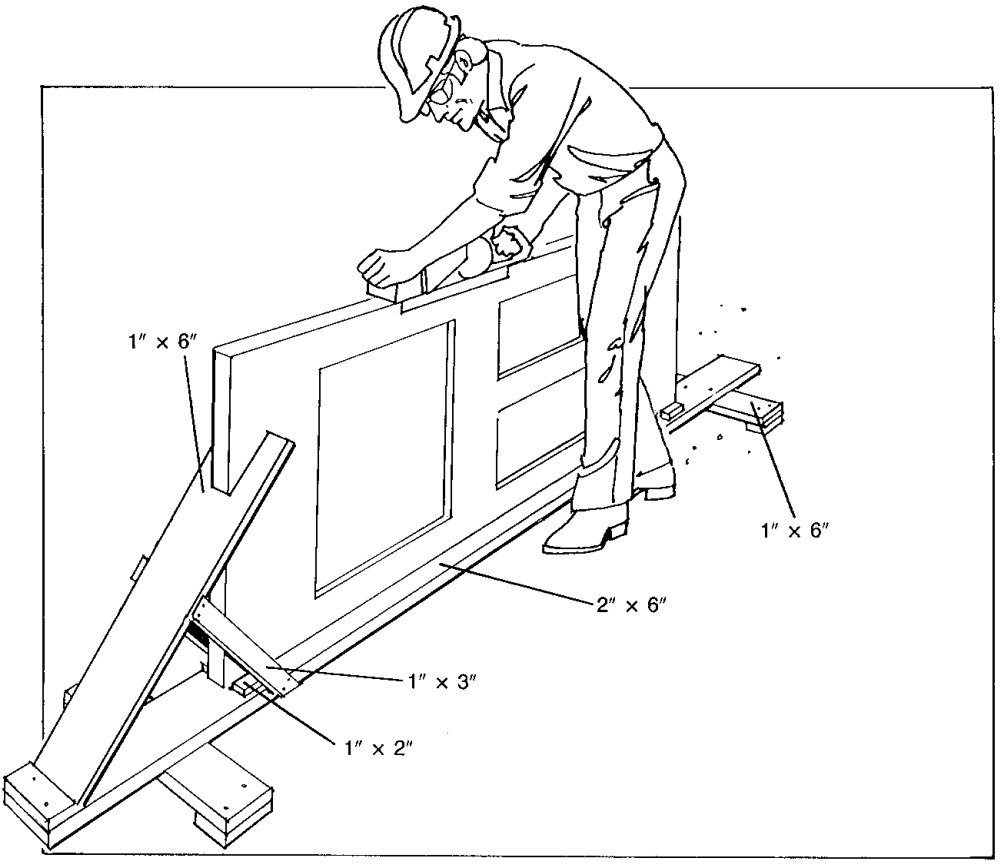
Depth of cut should be carefully adjusted to suit the type and width of wood to be planed.

To start a cut, the infeed table (front shoe) should rest firmly on the material with the cutter head slightly behind the edge of the material. After a cut is finished, hold both hands on the plane until the motor has stopped.

Case History

An apprentice carpenter was given the job of bevelling door edges with an electric plane. He held the handle of the plane in his right hand but cupped the fingers of his left hand under the plane and guided it along the door with his fingertips instead of using the edge guide. When the blades cleared a knot in the wood, the plane suddenly raced forward and cut his fingers.

Never put your fingers under a running plane. Whenever possible, use the edge guide for accuracy and safety. Novices should always be instructed to operate electric tools properly.



Door Jack
Figure 22

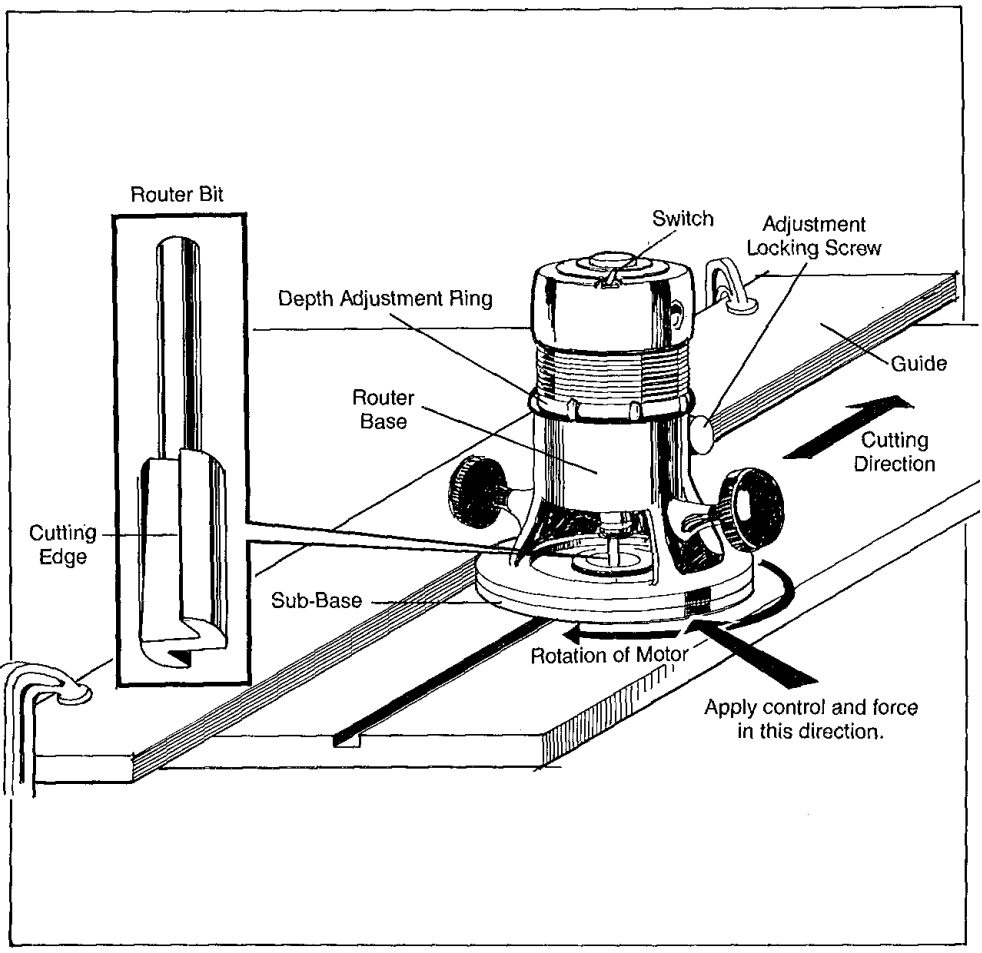
The Portable Router

The portable router is a versatile tool (Figure 23). With special guides and bits, it can be used to cut dadoes, grooves, mortises, dovetail joints, moldings and external or internal curves. Carpenters find routers particularly useful for mortising stair stringers and recessing hinges and lockplates on doors.

The router motor operates at an extremely high speed (up to 25,000 rpm) and turns in a clockwise direction.

The speed and power of the tool require that it be operated with both hands. When starting a router with a trigger switch in the handle, the operator can keep both hands on the tool to absorb the counterclockwise starting torque. If the machine has a toggle switch on top of the motor, then the operator must hold the router firmly with one hand and turn on the power with the other. Once the tool is running, however, operate it with both hands for control and accuracy.

As with other electric tools, always wear eye protection when using the router and never make adjustments or change bits without first disconnecting the tool from the power source.



Router Parts and Operation
Figure 23

Proper Support

Material must be safely supported and secured to keep it from moving during routing. The method of securing the material must be mechanical.

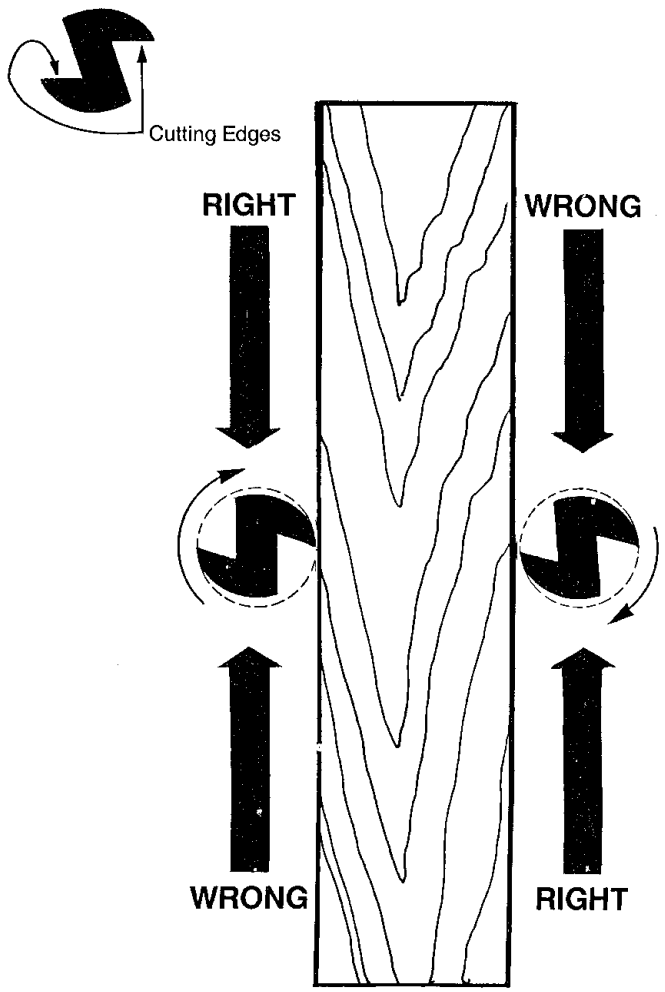
Never try to hold the work down with your knee. Never rely on a second person to support or hold the material. Sudden torque or kickback from the router can cause damage and injury.

Operating Procedures

Make sure that the bit is securely mounted in the chuck and the base is tight.

Put the base of the router on the work, template or guide and make sure that the bit can rotate freely before switching on the motor.

For routing bevels, moldings and other work along edges, the cutting edge of the router bit must contact the material to the **left** of the cutting direction (Figure 24). Otherwise the router will kick back or fly away from the operator.



For work along edges such as bevelling, the cutting edge of the bit must contact the material to the left of the cutting direction.

Figure 24

When routing outside edges, guide the router around the work in a counter-clockwise sequence (Figure 25). Splinters left at corners by routing **across** the grain will be removed by the next pass **with** the grain.

For safe operation and professional work, feed the router bit into the material at a firm but controllable speed. There is no set rule on how fast to cut.

When working with softwood, the router can sometimes be moved as fast as it can go. But with hardwood, knotty and twisted wood or with larger bits, cutting may be very slow.

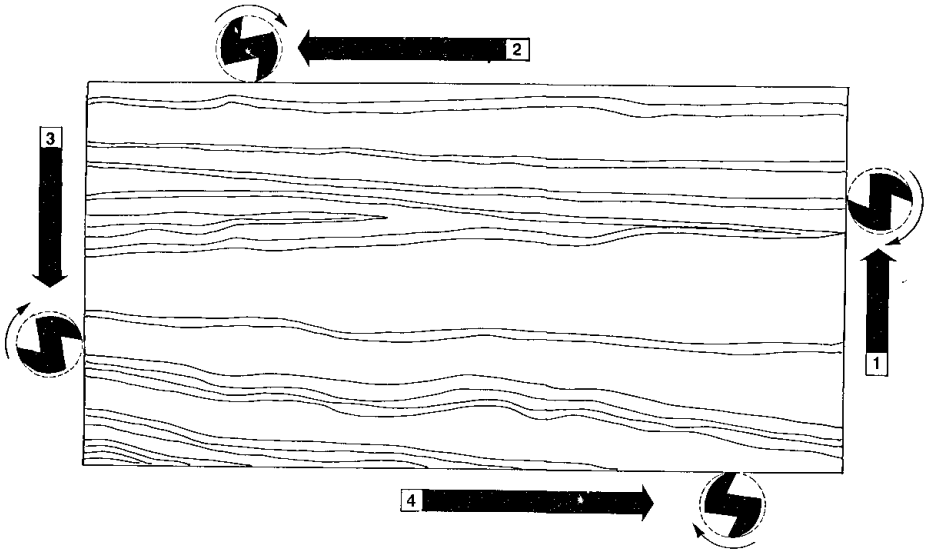


Figure 25

One indication of safe speed is the sound of the motor. When the router is fed into the material too slowly, the motor makes a high-pitched whine. When the router is pushed too hard, the motor makes a low growling noise. Both situations can cause burnout or kickback.

When the type of wood or size of the bit necessitates slow going, the operator should make two or more passes to prevent the router from burning out or kicking back.

With a sharp bit, not too much splintering will occur at the end of the cross grain. To prevent any splintering at all, put a scrap piece of lumber behind the work and continue the cut past the cross grain of the work (Figure 26).

To determine the depth of cut and how many passes to make, test the router on a scrap piece of lumber similar to the work.

When a cut is complete, switch off the motor and keep both hands on the router until the motor has stopped. When lifting the tool from the work, avoid accidental contact with the bit.

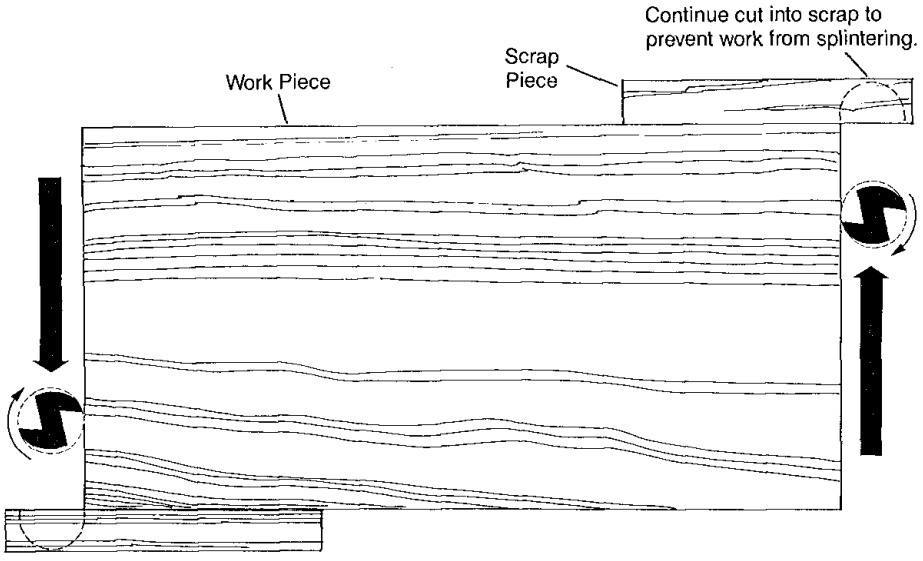


Figure 26

Case History

A carpenter was using a router to shape a contour in wood. He bent down to take a closer look at the work while the router was running. A wood chip flew into his right eye, resulting in a 40% loss of vision in the eye.

Always wear eye protection when operating a router or any electric tool. Goggles provide the best protection against flying chips and sawdust.