

Additional safety rules for portable power drills

Do...

- Secure work using clamps, pliers or a vise—never use your hands to hold the work piece! This helps to avoid injury if the bit should bind during operation. It also frees both hands to operate the tool.
- Disconnect power cord before inserting or removing bits.
- Use sharp drill bits. Dull bits may damage gears or overload the motor.
- When working outdoors, use only extension cords marked as suitable for outdoor use.
- Protect the cord. Never use it to carry or disconnect the drill. Keep it from heat, oil, and sharp edges.
- Keep proper footing and balance at all times.
- Remove adjusting keys and wrenches from tool before turning it on.
- Keep inlet and outlet air passage clear to ensure a cool running motor. Blow out accumulated dust from the motor frame with a regulated air jet.
- If there is a reversing switch, make sure that motor is not running when switch is flipped. This avoids damaging the reversing mechanisms.
- If using a right-angle drill, remove the right-angle drive from the drill before removing the chuck from the drive.
- If using a hammer drill, make sure that the setting lever is not positioned while the drill is running.

Electric saws

Gas technicians/fitters often use electric saws of several different types. They allow for efficient, high-quality work. Removal of the burr, which is the sharp edge left by a saw, is recommended. Careful selection of saw type and blade can reduce burr to acceptable levels.

Cutting rates

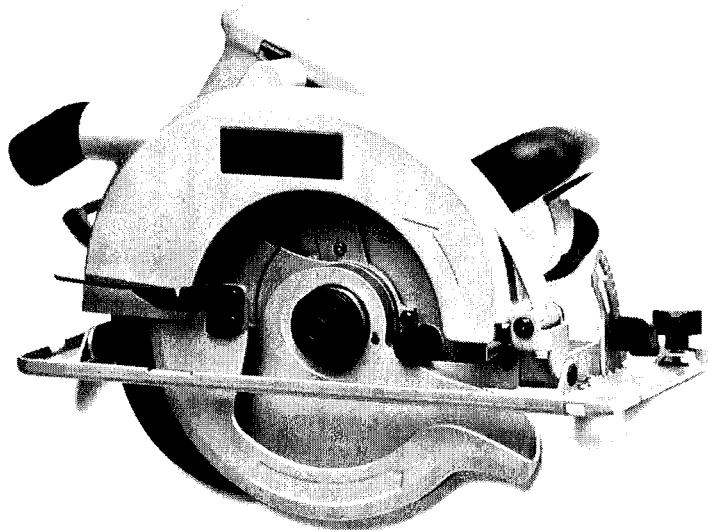
A feed that is too light overheats the wheel. Heavy feeding may cause the wheel to wear quickly or to break. Feed rates depend on the type of material to be cut, the type of wheel being used, the operating speed of the machine, and the condition of the abrasive sawing machine.

For most cutting operations, gas technicians/fitters use anti-welding lubricants. This reduces friction between the cutting blade and the cut material as well as the chances of burning or breaking the blade, giving a smoother, even cut.

Heavy-duty circular saws

Gas technicians/fitters use this most familiar type of circular saw (Figure 3-7) for making cuts along a marked line. They may help cut most shapes of plastic and non-ferrous metal stock such as pipe, tubing, and bars.

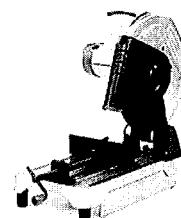
**Figure 3-7
Circular saw**



Chop saws

The chop saw (Figure 3-8) is a large cutting tool often used to cut steel. You can place it flat on the floor, on a bench, or on a sawhorse. Individual and gang cutting tasks are both possible with a chop saw. Pay special attention to the personal protective equipment required for safe use of the different saw blades, and always wear a full face shield approved for the use.

**Figure 3-8
Chop saw**
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Chop-saw blades

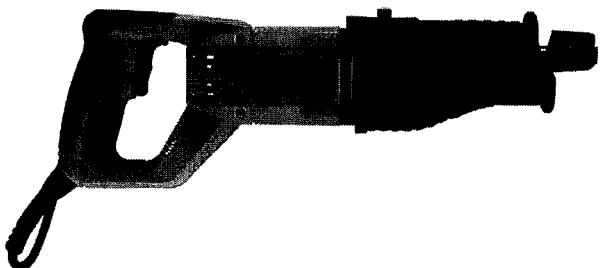
Some of the blades used on these saws are:

- steel-toothed, to cut thermoplastics
- carbide-tipped to cut non-ferrous metals and plastic;
- grit to cut fibre-reinforced plastic; and
- abrasives to cut steel pipe or rod.

Reciprocating saws (saber saw)

Gas technicians/fitters widely use reciprocating saws (Figure 3-9), which are often called power hacksaws. They cut long pieces of pipe, wood, and laminates into lengths suitable for machining as well as pipe chases and oddly shaped holes in wood frame construction. They cut nearly any shape if you use the correct blade. Many types of reciprocating saws have more than one speed.

Figure 3-9
Reciprocating saw



Saber saw blades

Blades for these saws are made from carbide steel and high-speed alloy steel. They are color coded according to their use. For example, a blade for cutting stainless steel may be coded bright blue, while a general-purpose blade for cutting wood that may contain nails may be black. Be sure to check that you have the correct blade for the job. The blades come in various lengths, pitches (number of teeth per inch), tooth shapes, and tooth patterns (sets).

Heavy-duty electric chain saws

You must use these saws with care. Aside from the hazards of any power tool with a cutting edge, there is a danger of kickback. It is advisable to use a hard hat when using a chain saw. This type of saw may easily cause flush cuts.

Sawing procedures

General safety procedures

Before you start:

Do...	Do not/never...
<ul style="list-style-type: none"> • Read the operator's manual carefully before using any saw. Be aware of the limitations of the machine. • Locate ON/OFF switches or triggers. • Wear safety footwear, a hard hat, and eye protection. If the cutting operation is dusty, as with concrete, wear a face or dust mask. Wear some sort of ear protection if exposed to long periods of noisy shop operation. • Select a saw that is suitable for the job at hand. • Use only recommended wheels or blades. Inspect the cutting edge of the wheel or blade for cracks, chips, and dullness. Discard if damaged. Check the wheel or blade for appropriate speed rating. • Make sure that the feed rate and speed of the machine are properly set. • Check that the environment is clean, dry, and well-lit. • If you are to cut materials that give off harmful vapours, check that ventilation is adequate. • When sawed, most metals give off dust and oxides that can be extremely hazardous to your health. If necessary, use a respirator. • Allow enough space to operate the saw properly and allow others to pass safely. • Keep bystanders a safe distance away from the work area. • Check regularly that the power cord is in good condition. Replace or repair damaged cords using appropriately sized wire. Keep the cord away from heat, oil, and sharp objects. • When working outdoors, use only extension cords marked suitable for outdoor use. • Before using saw, check to make sure the voltage agrees with the name plate rating. 	<ul style="list-style-type: none"> • Wear jewelry as it may catch on moving parts. • Use a small saw or attachment to do the job of a heavy-duty saw. • Operate the saw in an explosive environment.

As you work:

Do...	Do not/never...
<ul style="list-style-type: none"> Secure the work piece using clamps or a vise. Never use your hands to hold the work piece while cutting. Remove adjusting keys and wrenches from the saw before turning it on. Keep hands clear of moving parts. Take care when handling burred material. If cutting metal, allow cut off piece to cool before handling. Use a pipe support or a similar support stand to hold long, heavy material while cutting. Ask for help when lifting or carrying heavy material. When cutting into walls where electrical wiring may be concealed, use only the insulated switch handle and/or insulated auxiliary handle to control the operation of the saw. Disconnect the power saw when changing accessories or to adjust, service, or move the saw. 	<ul style="list-style-type: none"> Operate the saw with the guards raised, removed, cracked, or otherwise damaged. Carry a plugged-in tool with your finger on the switch. Be sure the switch is off when the tool is plugged in. Overreach when sawing. Keep proper footing and balance at all times. Force the saw against the work material. The machine will operate more efficiently and safely at the rate for which it was designed.

Maintenance:

Do...	Do not/never...
<ul style="list-style-type: none"> Maintain the saw by replacing worn and broken parts and keeping the blades sharp and clean. Use a brush, not your hands, to clean the machine. When servicing all double-insulated tools, use only identical replacement parts. Follow instructions for lubricating and changing attachments. Keep your work area clean. Cluttered benches and slippery floors lead to accidents. 	<ul style="list-style-type: none"> Leave tools in the way of the machine's moving parts if the saw is mounted on a bench

Additional safety procedures for chop saws

Installing blades

- 1) Unplug saw power cord before changing or installing blade.
- 2) Raise the motor mount.
- 3) Remove the hexagonal jam nut (left-hand thread), outer flange, and blade.
- 4) Check blade flanges to be sure they are clean and free of burrs and nicks.
- 5) Select the proper blade.
- 6) Install the blade matching the arrows on blade and saw guard.
- 7) Install the outer flange and hexagonal jam nut.

Before you start:

Do...

- Check the condition and tension of the drive belt.
- Check that the direction/orientation of the saw blade is correct (Figure 3-10). Saw blades are normally installed with the teeth pointing in the direction of the cut (in the case of hand saws, in the direction of the forward stroke).
- Manually raise and lower saw blade guards to assure free movement.
- Check the power cord. The power cord is short in order to prevent possible contact with the blade. Supplying power requires the use of a grounded extension cord and receptacle.
- Plug power cord into grounded extension cord. When operating the chop saw, you should grind it to protect yourself from electric shock.

Figure 3-10
Correct direction/orientation of saw blade
Image courtesy of DeWalt



Operating the saw

- 1) Disengage lock holder from motor mount.
- 2) Raise saw blade and clamp material firmly in vise jaw. Make sure that long pieces are properly supported.
- 3) Press the switch and feed the blade through work piece. The desired pressure occurs just before the machine speed starts to slow down.
- 4) If the motor trips out from overheating, allow the motor to cool before pressing reset button. A thermal overload protector protects the saw motor from overheating and damage. If the motor overloads, it trips to disconnect motor from power source.
- 5) When cutting aluminum, apply a solid or liquid lubricant to the blade after every few cuts.
- 6) Loosen vise jaw and remove the material.
- 7) Unplug power cord.

Maintenance

You must inspect drive belt tension regularly. A low belt tension results in belt slippage and immediate damage to the belt. If there are signs of wear, replace the belt.

Additional safety procedures for reciprocating saws

Blade selection

- 1) Select the proper blade for material to be cut.
- 2) Insert the blade into front end of saw by loosening the appropriate screw with a blade wrench.
- 3) Insert blade and tighten screw. Make sure that the blade is held tightly.
- 4) When changing blades, disconnect the power cord.

Speed selection (available on some models—check instructions accompanying saw)

- 1) Depress the trigger to select the speed best suited for the job:

Trigger selection	Description
OFF	Full release of trigger.
LOW (LO)	Partial depression of trigger.
HIGH (HI)	Full depression of trigger.

- 2) You may lock the trigger in the high or low position using the lock button.

Power grinders

Gas technicians/fitters must often fabricate brackets, stands, supports, and hangers while installing equipment. They use power grinders to do this.

A power grinder helps:

- make cutting edges on cutting tools;
- cut metal to its desired shape and size; and
- make smooth, polished surfaces.

Power grinders may be stationary or portable.

Stationary grinders

The two most common types of stationary power grinders used in the piping trades are the bench (Figure 3-11) and pedestal grinders (Figure 3-12). These grinders are used to do off-hand grinding, that is, grinding that does not demand great accuracy of size or shape. The work is held in the hands and ground to the desired shape.

Figure 3-11
Bench grinder
Image courtesy of DeWalt

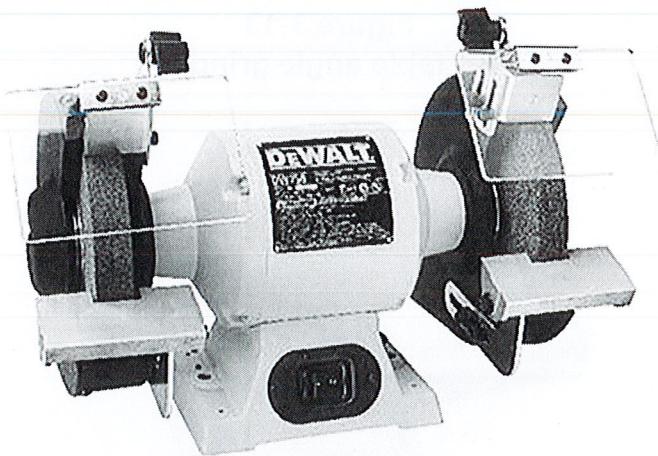
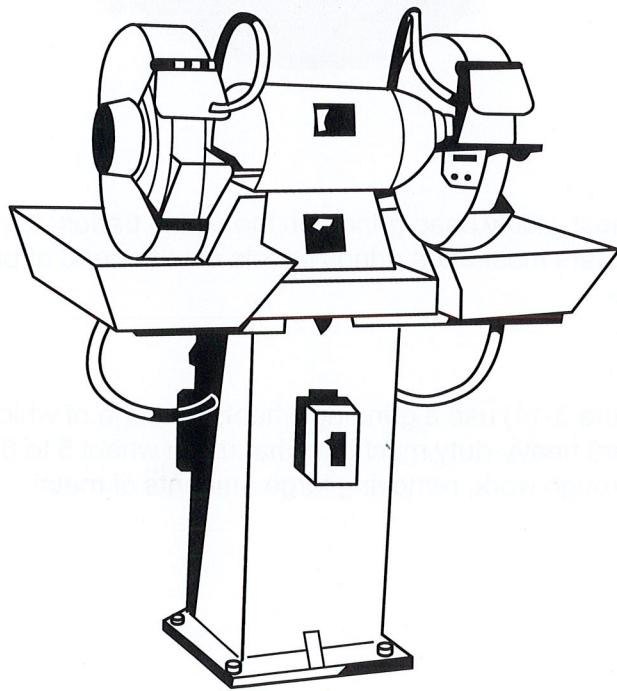


Figure 3-12
Pedestal grinder



Portable grinders

Gas technicians/fitters use portable power grinders when the work is too large or awkward to be held comfortably at a bench or pedestal grinder. Portable grinders are more practical than stationary grinders because they are light enough to be carried to the job and you can hold it by hand while grinding. Either electricity or air powers portable grinders. Both electrically operated and air-operated (pneumatic) grinders are available in light and heavy-duty models.

The selection of a grinder depends on the type of power outlet available, the type of job to be performed, and the dampness of the work area. The most common types of portable grinders are the angle grinder (Figure 3-13) and straight grinders (Figure 3-14).

Figure 3-13
Portable angle grinder



Angle grinders

The angle grinder is the most widely used grinder in the piping trades. It cleans and smooths metal surfaces. Angle grinders most often grinds bevels onto the end of pipes or cleans weld spatter off pipe and fittings.

Straight grinders

Straight grinders (see Figure 3-14) use a grinding wheel, the edge of which is used as the abrasive surface. These are heavy-duty machines that use a wheel 5 to 6 inches (125 to 150 mm) in diameter for fairly rough work, removing large amounts of metal.

Figure 3-14
Pneumatic straight grinder
Images courtesy of Milwaukee



The *pencil grinder* (Figure 3-15) is a light-duty straight grinder. Gas technicians/fitters use this for delicate work such as deburring holes, die finishing, removing slag from the insides of pipes, and trimming weld overlaps.

Figure 3-15
Pencil grinder
 Images courtesy of DeWalt and Milwaukee



Grinder abrasives

Crushing and grinding hard, tough materials make abrasives, which have many sharp cutting edges and points. Abrasives must be harder than the materials they cut.

Coated abrasives

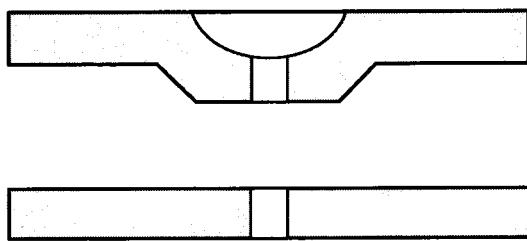
Gas technicians/fitters use these with portable and stationary grinders, usually for finishing. The two forms are disks—often called sanding disks—and belts.

Grinding wheels

The three basic types of grinding wheels are:

Type	Description
Mounted	Has a small stone point or wheel permanently attached to a shaft. It is used on small portable grinders and electric drills.
Regular	Used with portable and stationary grinders.
Disk	Thinner than regular wheels or stones. It has a wire backing that strengthens the disk so that it can stand up to the rough use it receives grinding with the side surface rather than the edge. The two kinds of grinding disks are the <i>flat disk</i> and the <i>depressed centre disk</i> (Figure 3-16). The most common, the depressed centre disk, has its central area depressed so that the spindle nut is less likely to touch the work.

Figure 3-16
Grinding disks



When ordering a grinding wheel, consider the following factors:

- shape of wheel;
- type of wheel face;
- diameter of wheel;
- thickness of wheel;
- diameter of wheel hole;
- revolutions per minute (rpm) of the machine and the manufacturer's maximum speed rating for the wheel (which should be higher than the machine's rpm); and
- type of material to be ground.

Grinding wheel holes

The hole in a grinding wheel should be 0.02 in (0.5 mm) larger than the diameter of the shaft on which it is mounted. This allows it to slide freely but not loosely on the shaft.

Grinding procedures

General safety rules

Before you start:

Do...

- Wear protective clothing (snug-fitting coveralls, goggles or ear plugs, safety boots, and gloves).
- Always ensure that the grinder is off before mounting a new wheel. Before turning the grinder on, check the wheel for defects (cracks, chips, etc.), make sure that the wheel surface is sharp, and check that the sides are straight.
- Lubricate parts of the grinder according to the manufacturer's specifications.
- Choose the correct wheel. Grind soft materials such as copper, brass, lead, or aluminum with wheels made for that use.
- Work in a well-lit area.

As you work:

Do...	Do not/never...
<ul style="list-style-type: none"> • Stand to the side of a stationary machine when it is first turned on until operating speed is reached. As you work, stand away from the discarded material. • Keep machine guards, work rests, and safety shields in position and tightened. • Make sure that the material is clear of the wheel before starting the machine. • Maintain a grinding wheel speed below the maximum revolutions per minute specified by the manufacturer. • Hold work tightly at all times. Use a vise grip if the work is too small to hold safely by hand. Do not use pliers. • Move the work back and forth across the face of the wheel to avoid grooving of the wheel. • Keep hands away from the spinning grinding wheel. • If you damage a wheel, remove it, even if it does not appear to be cracked or broken. 	<ul style="list-style-type: none"> • Make adjustments or take measurements while the machine is running. • Force the work piece against the grinding wheel. • Grind on the side of a straight grinding wheel.

Procedure for using stationary grinders

- 1) Select a grinding wheel. Make sure that:
 - a) the rpm rating of the wheel is higher than that of the machine;
 - b) the wheel hole matches the shaft size;
 - c) wheels are not cracked (test by lightly tapping the wheel with a screwdriver handle. If the wheel is not cracked, it will ring clearly. If it is cracked, it will sound dull); and
 - d) wheels are not chipped (look for chips that show lack of symmetry).
- 2) If a wheel is already mounted on the machine, remove the grinding wheel after making sure that the power is turned off.
- 3) Mount the wheel onto the shaft, placing safety washers a little larger than the diameter of the flanged collars between the sides of the wheel and the collars. Tighten the nut enough to hold the wheel firmly in place. Do not over tighten.
- 4) Lower the guard, stand to one side, and turn the power on. Let the wheel run at full speed for at least one minute. Then turn the power off.
- 5) Adjust the tool rest to have clearance of no more than 1/16 in.
- 6) Turn power on and grind the material along layout lines.

Procedure for using portable grinders

The following instructions apply to both electric and pneumatic portable grinders:

- 1) Select the appropriate electric or pneumatic grinder.
- 2) Check wheel or disk for any defects.
- 3) Position and secure safety guards.
- 4) If the work piece is small, secure it using a vise or C-clamp.
- 5) Turn on the machine and bring the machine into contact with the material. Apply even, moderate pressure throughout the grinding operation. Hold the grinder in such a way that the material being removed flies away from you.
- 6) Do not force the machine against the material. This would damage the wheel, the machine mechanism, and the work piece.
- 7) Continue grinding until the desired edge, corner, or finish is reached. Turn off the machine and clean it.
- 8) When sharpening a tool, dip it frequently into water during the grinding operation. This avoids overheating and subsequent softening of the tool.
- 9) Observe these additional safety rules for using portable grinders:
 - a) Never grind in a slot with a portable grinder.
 - b) When grinding, sanding, or wire brushing into corners or on edges of material, ensure that the machine is not wrenched from your hands.

In addition, when using a portable electric grinder:

- make sure that the power cord is in good condition; and
- perform work in a dry location.

When using a portable pneumatic grinder, make sure that:

- the air pressure is set at the recommended level by adjusting the pressure reducing valve (PRV);
- there is an adequate supply of oil in the oiler, as this will prolong the life of the tool; and
- the air supply hose is in good condition.

Powder-actuated tools

Every manufacturer's tool is slightly different, and you must study each separately before use. Study the manufacturer's specifications when deciding the type, size, and charge for use in a situation. Note the general safety instructions given in Unit 1 Safety.

It is very important to know the procedure for misfire. Read the manufacturer's instructions. The speeds given are measured 2 m (6 ft) in front of the tool.

For general safety principles go to: http://www.ccohs.ca/oshanswers/safety_haz/power_tools/powder.html

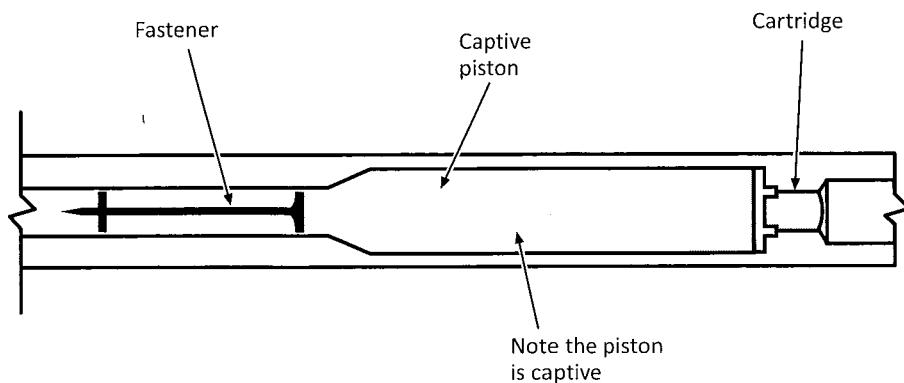
Types of powder-actuated tools

Low-velocity (Hilti type)

Gas technicians/fitters mostly use the Hilti brand of low-velocity tool. It operates on the captive piston principle (Figure 3-17). In this type, both the fastening pin and the driving piston move at less than 100 m (325 ft) per second.

A built-in device prevents this type from firing if its flat end is held at more than 7° off the work surface. The fastener must be close to vertical to the work surface.

Figure 3-17
Low-velocity, captive-piston mechanism



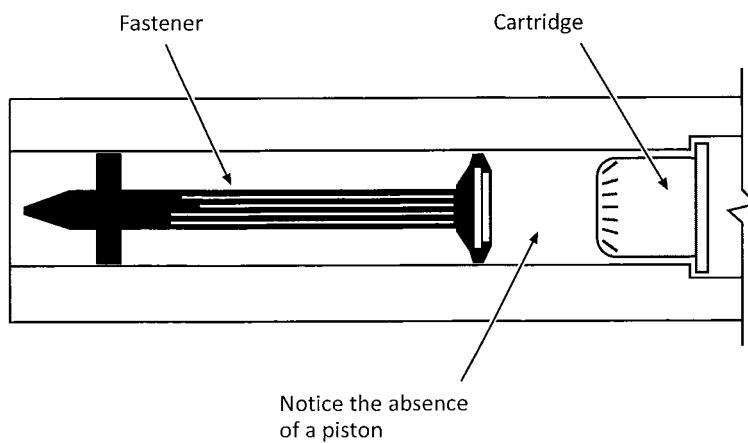
Medium-velocity (Ramset type)

When fired, the fastening pin travels at about 325 to 500 ft (100 to 150 m) per second.

High-velocity (Omark, Remington, and Philips)

High-velocity tools (Figure 3-18) have limited application. They have no piston, and the pin is discharged at a velocity above 500 ft (150 m) per second often up to 1500 ft (450 m) per second.

Figure 3-18
High-velocity mechanism



Propulsion methods

Impact propulsion

In this method, a gap exists between the fastener and the piston. A stop ring absorbs impact. For the tool to function properly, you must replace the stop ring when it becomes deformed. Hilti tools use this method.

Contact propulsion

In this method, the work surface, fastener, and piston are in direct contact.

Co-acting propulsion

Only the piston and fastener are in contact. They are away from the work surface.

Cartridge types and powder loads

You can distinguish low- and high-velocity cartridges by their cases:

- Low-velocity cartridges have brass cases.
- Higher-velocity cartridges have nickel cases.

They are rated according to the same colour code. The weakest is gray, and the strongest purple. Table 3-1 shows the cartridge colour code.

Table 3-1
Hilti cartridge colour code

Weakest	Strongest
Grey	Purple
Brown	
Green	
Yellow	
Red	

When selecting a cartridge for a powder load, start with the weakest load for the tool, then increase strength a step at a time until the proper fastening is obtained.

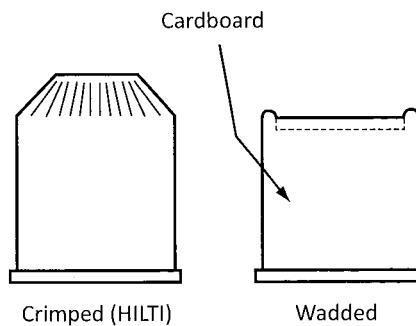


Do not re-drive a fastener—it may damage the tool and weaken the grip of the fastener.

Cartridges

Cartridges may be crimped or wadded (Figure 3-19). Both provide the same power. They may be rim-fired or centre-fired.

Figure 3-19
Crimped and wadded cartridges



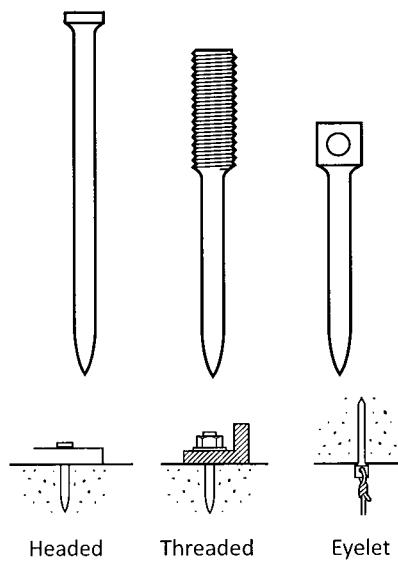
Hilti uses crimped cartridges and paints the tip to identify the strength of powder load. This paint also keeps the cartridge dry.

Wadded cartridges are not used in low-velocity tools or captive piston tools because they could plug the vent ports.

Fasteners

Powder-actuated tools fire three basic types of fasteners as shown in Figure 3-20.

Figure 3-20
Three basic fasteners for powder-actuated tools



The point of the fastener forces the work material aside just enough to let the fastener penetrate and "seat" properly, without deforming the material excessively. The compressive force produced in the material then squeezes the shank of the fastener, providing holding strength.

Some fasteners have their basic thread design slightly altered to increase strength. Also, some types of fasteners have guides to give greater holding strength or to prevent over-penetration.

Power threaders

“Hand-held” power-driven threading machines

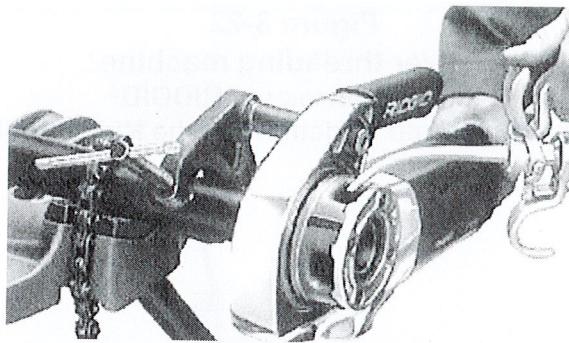
These electrically powered machines are convenient for small jobs and are powerful enough (depending on the model/manufacturer) to thread pipe and/or rod utilizing ratchet type dies from 1/8" up to 2". They are light-weight in comparison to general, full-sized powered threading machines. However, you should use them in conjunction with an approved vice with support arm assembly.

Figure 3-21

“Hand-held” power-driven threading machine

Image courtesy of RIDGID®

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Powered threading machines

These electrically powered machines are convenient for medium to large jobs and are typically powerful enough (depending on the model/manufacturer) to thread pipe and/or rod of any required size used for gas piping. There are many options for dies including ratchet type, mono as well as quick-opening, self-opening, and semi-automatic universal dies. They are substantially heavier than “hand-held” power threaders; however, they offer advantages in production once set up.

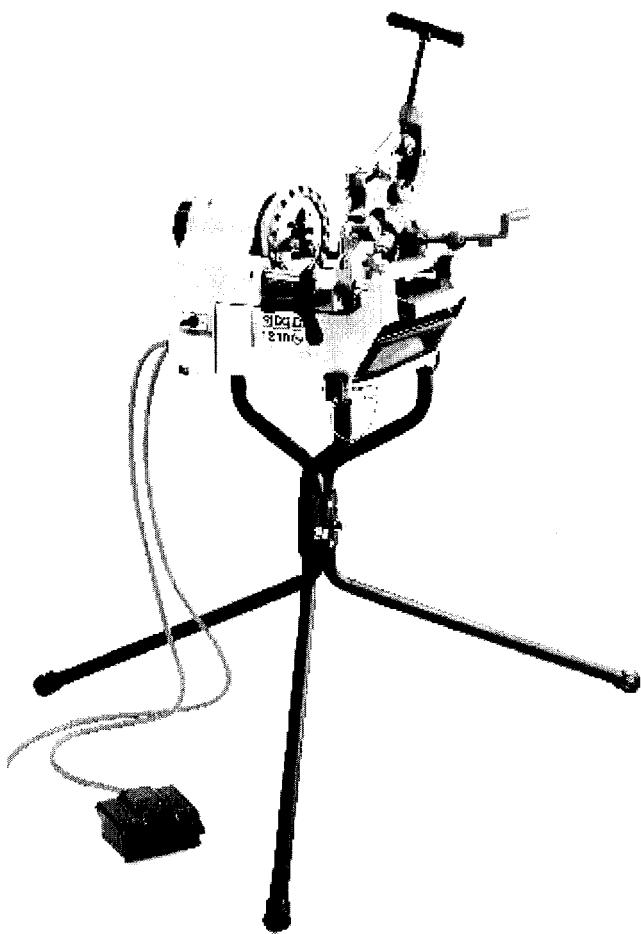
It is noteworthy that a gas technician/fitter should undergo training on the safe use of this equipment and become familiar with the manufacturer’s instructions. Otherwise, due to the very high torque capabilities, these machines can cause severe injury.

Consult your supervisor for details regarding the safe operation of any powered threader.

*Note these common requirements for most powered threaders (always read manufacturer’s instructions for any additional specific requirements):

Do...	Do not/never...
<ul style="list-style-type: none"> • Keep sleeves and jackets buttoned. • Keep working area clear and free of slippery materials. • Keep machine handles dry and clean. • Ensure that power supply is adequate for device and use it without excessive or under-sized extension cords. • Support long lengths of pipe with additional pipe stands. 	<ul style="list-style-type: none"> • Wear gloves or loose clothing when operating. • Use dull or damaged dies. • Use if machine is damaged. • Use stationary machines without a properly working “dead-man switch”.

Figure 3-22
Power threading machine
Image courtesy of RIDGID®
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Ratchet, drop-head, hand threaders

As discussed in the Chapter 4. *Hand Tools > Hand Threaders* section, you can use drop-head threaders with certain power vises (such as the threading machine shown in Figure 3-22).

Quick-opening threader

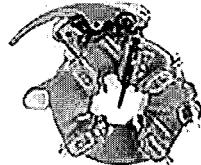
Various styles of quick-opening threaders (Figure 2-44 in the Chapter 4. *Hand Tools > Hand Tools* section) are designed for use on power equipment such as a power threading machine. They attach to a carriage assembly that also hosts a reamer and cutter.

These types of die heads have a lever to release the dies from the pipe when the thread has been cut to the required length, eliminating the need to stop and back off after the thread has been cut. You can automatically set some to automatically release at a given length of thread.

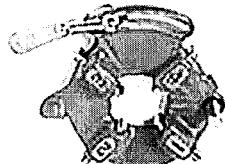
The die head is available in two general styles:

- a mono-die head, which threads just one size of pipe
- a universal-die head, which can be adjusted to use the same set of dies to thread NPS 1 to NPS 2 pipe, or fit two other die sets to thread NPS 1/2 to NPS 3/4 pipe or NPS 1/4 to NPS 3/8 pipe.

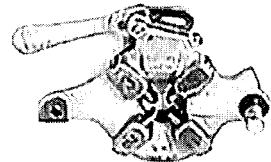
Figure 3-23
Various quick-release die-heads
Image courtesy of RIDGID®
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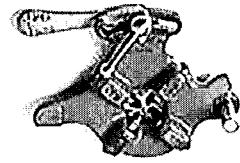
No. 815A Self-opening die head



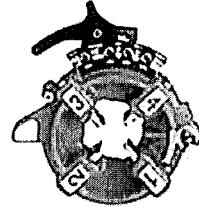
No. 811A Quick-opening die head



No. 532 Bolt die head



Mono die head



No. 816/817 Semi-automatic
die head