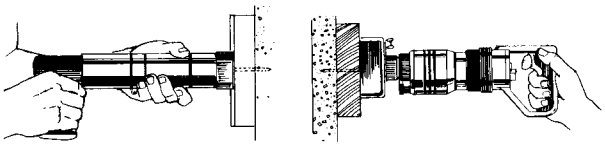
5 POWER TOOLS — EXPLOSIVE

Referred to as explosive-actuated or powder-actuated, these tools use a powder charge to fire a fastener into hard materials such as concrete, mild steel, and masonry. Used improperly, powder-actuated tools pose obvious hazards. The tools should be treated with the same respect as a firearm. Most jurisdictions – including Ontario – require that operators be trained before using the tools and carry proof of training on the job.



Hazards

Flying Particles – This is the major hazard. On impact, materials may break up, blow apart, or spall off. This often happens when fasteners are fired too close to a corner of masonry or concrete or when they strike materials such as glazed tile, hollow tile, or thin marble tile.

Ricochets – These usually result when the tool is not held at right angles to the base material, or the fastener hits a particularly hard material such as stone or hardened steel. Always check the base material to ensure that it can safely accept the fastening device.

Noise – Powder-actuated tools create an extreme pulse of sound when fired. Operators and others in the area should wear hearing protection – especially when the tool is operated in a confined space.

Sprains and Strains – These injuries usually result from using the tool repeatedly in awkward, cramped, or unbalanced positions. Operators should try to work from a balanced position on a solid surface.

Explosions – There is always the risk of explosion or fire when the tools are used in atmospheres contaminated by flammable vapour, mist, or dust. The work area must be ventilated – mechanically if necessary.

Blow-Through – When the base material does not offer enough resistance, the fastener may pass completely through and fly out the other side. This is particularly dangerous when fasteners penetrate walls, floors, or ceilings where others may be working. If necessary, areas behind, around, and under material should be kept clear of people.

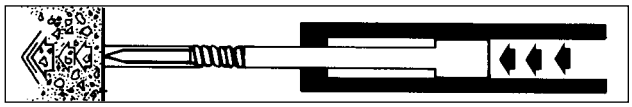
Protective Equipment

In addition to the standard personal protective equipment required on construction projects (see the Personal Protective Equipment chapter in this manual), the operator of a powder-actuated tool should wear hearing protection, eye protection, and a face shield. Heavy shirts and pants provide some protection against ricochets and flying fragments of material and fasteners.

Tool Types

High-Velocity — High-velocity powder-actuated tools use the expanding gases from the exploding cartridge to propel the fastener. The gases push directly against the fastener. These tools are rarely used in construction, except in special cases to penetrate thick steel or very hard material — they are usually used in military, salvage, or underwater applications. No one should operate high-velocity tools without special training.

Low-Velocity — Most powder-actuated tools used in construction are low-velocity. The expanding gases from the exploding cartridge push against a piston which in turn drives the fastener into the base material.



Many different low-velocity tools are available, from single-shot models to semi-automatic models using multiple cartridges in strip or disk holders. Some tools are specific to one size of fastener or type of cartridge. Most can be fitted with various pistons, base plates, spall stops, and protective shields for different jobs.

Pistons

Specialized pistons are available for different fasteners. Such pistons are designed for the fastener and should not be used with other types. Misusing a tool with a specialized piston can result in under- or over-driven fasteners or fasteners leaving the barrel misaligned, leading to ricochets. Some general-purpose tools can take various types of pistons.

Fasteners

Fasteners used with powder-actuated tools are made of special steel to penetrate materials without breaking or bending. Never use any kind of substitute for a properly manufactured fastener.

Generally pins and studs should not be used on hard, brittle, or glazed materials such as cast iron, marble, tiles, and most stone. The fastener will either fail to penetrate and ricochet or the base material will shatter.

Materials whose hardness or ductility is unknown should be tested first. Try to drive a pin into the material with a normal hammer. If the pin point is blunted or fails to penetrate at least 2 mm (1/16"), a powder-actuated tool should **not** be used.

Fasteners are invariably fitted with a plastic guide device. Its purpose is twofold. When the fastener is inserted into the barrel the guide keeps the fastener from dropping out. It also aligns the fastener inside the barrel so it will penetrate the base material at right angles.

There are two basic types of fasteners – pins and studs.

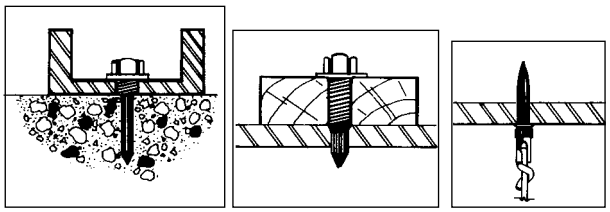
Pins are fasteners designed to attach one material to another, such as wood to concrete. They resemble nails, but there the similarity stops. Ordinary nails cannot be used as fasteners in powder-actuated tools.

Head diameters for pins are available between 7 mm (1/4") and 9 mm (3/8"). Lengths vary from 12 mm (1/2") to 76 mm (3"). Washers of various types and diameters are available for different applications.

Pins should be selected for appropriate length, head size, and application. As a general rule, pins need not be driven into concrete more than 25 mm (1"). Using a longer pin is generally unnecessary and also requires a stronger cartridge.

Follow the manufacturer's directions on length, penetration, and appropriate material. For example, one cut-nail fastener is available for fastening drywall to relatively soft base materials, but is recommended for virtually no other application. Testing may be necessary on some masonry materials that vary widely in hardness and durability.

Studs are fasteners consisting of a shank which is driven into the base material and an exposed portion to which a fitting or other object can be attached. The exposed portion may be threaded for attachments made with a nut. Studs are also available in an eye-pin configuration for running wire through the eye.



Clip Assemblies - Fastening to the base material is done by a pin, but the pin is attached to a clip assembly configured to secure a uniquely shaped item. Clip assemblies are available, for instance, to hold conduit. One ceiling configuration comes with pre-tied 12 gauge wire.

Cartridges

Manufacturers recommend certain cartridges for certain applications. Because recommendations cannot cover every possibility, testing may be required with unfamiliar base materials.

Cartridges come in .22, .25, and .27 calibre sizes. Larger calibres hold more powder which drives the fastener further – or into harder base materials. In addition, all three calibres are available with different levels of powder charge. For some tools there may be as many as six different powder charges available. Some manufacturers produce tools that use a long-case version of the .22-calibre cartridge. It is critical that operators understand cartridge selection and cartridge identification systems.

COLOUR	NUMBER	CARTRIDGE POWER
Grey	1	Lowest
Brown	2	
Green	3	
Yellow	4	
Red	5	
Purple	6	Highest

Shots may be packaged/loaded as single cartridges, strips of ten in a plastic holder, or a round disk holding ten cartridges. The tool model will determine the calibre and how the tool is to be loaded.

Number identifications are printed on the outside of cartridge packages. Cartridge tips are colour-dipped for identification. Some strip cartridges are held in a plastic strip the same colour as the cartridge tips.

The general rule is to start with the weakest cartridge and increase one cartridge colour/load number at a time to reach the penetration required. Too strong a charge may cause shattering, ricochets, or blow-through. Too weak a cartridge will keep the fastener from seating itself properly.

Tool Power Controls

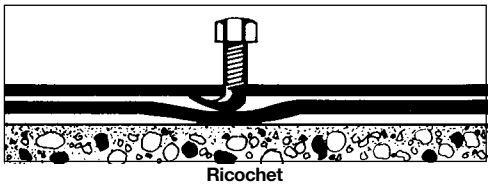
Many tools feature a “power control” device. This allows an operator to make a tool adjustment so that either all or only part of the available cartridge power is used. Power controls may ultimately let manufacturers market only one cartridge in each calibre. The goal would be to handle every application which the calibre is capable of performing with one cartridge, power-controlled to the appropriate driving force needed.

Fastening Steel

Low-velocity powder-actuated tools should not be used on hardened steels, tool steels, or spring steels. Where the grade of steel is unknown, test by trying to hammer the fastener in. If the pin is blunted, bent, or fails to enter at least 2 mm (1/16"), do not use a low-velocity powder-actuated tool – it's not up to the job.

Don't try to fire a fastener any closer than 13 mm (1/2") to the free edge of steel. Keep in mind that this applies only to steel. When fastening steel to concrete, you must consider the allowable margin for concrete as well: 63 mm (2½").

When fastening two pieces of thin sheet steel to a base material, hold the sheets together. Gaps caused by bending may lead to ricochets.



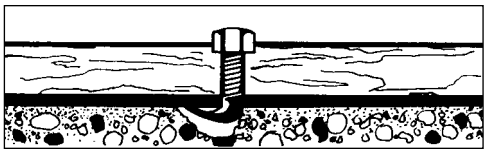
Ricochet

Special spall stops or protective shields are required for applications such as fastening sheet metal to masonry or sheet metal to structural steel. Consult the operating manual or the manufacturer to ensure that the right components are being used for the job.

Fastening Concrete and Masonry

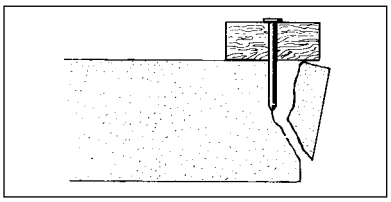
Concrete and masonry materials are not always uniform in consistency or hardness. As a result, they may spall, chip, or cause a ricochet when the fastener strikes a spot or layer harder than the rest. Use the spall guard recommended by the manufacturer.

Once material is spalled or left with a ricochet hole, do not fire a second pin any closer than 50 mm (2") to the damaged area. The area may be weakened and spall further or cause a ricochet off its sloped edge.



Ricochet off a sloped edge.

Pins tend to cause breaks near the edges of concrete and masonry. Don't drive pins closer than 63 mm (2½") to a free edge.



Misfires

With misfired cartridges, follow the procedures stated in the operating manual for the tool you are using. Because of the wide variety of tools available, procedures for misfires may differ. When such information is not available, take the following steps.

- Continue to hold the tool against the base material for at least 30 seconds. This protects against a delayed discharge of the cartridge.
- Remove the cartridge from the tool. During removal keep the tool pointed safely toward soft material such as wood. Never use any kind of prying device to extract the cartridge from the chamber. If the cartridge is wedged or stuck, tag the tool “DEFECTIVE and LOADED” and lock it in its storage container. Never try to dismantle a tool with a cartridge stuck or wedged in it. Again, tag it “DEFECTIVE and LOADED,” lock it away, and call the manufacturer's representative for help.
- Regulations require that a misfired cartridge be placed in a container of water.
- Keep the misfired cartridge separate from unused cartridges and return it to the manufacturer for disposal. Never throw misfired cartridges in the garbage.
- Be cautious. The problem may be a misfired cartridge, but the tool may also be defective. Check the tool for obvious damage, perform function tests, and use the tool only if it operates properly.

General Safeguards

- Workers who pick up a powder-actuated tool must immediately prove to themselves that the tool is not loaded. This action must become instinctive and be carried out before anything else is done with the tool. Even after watching someone else handle the tool before passing it on, make sure that it's not loaded.
- Powder-actuated tools should be used, handled, and stored properly.
- Never put your hand or fingers over the end of the muzzle for any reason, even when the tools are not loaded with fasteners.
- Tools must be inspected and function-tested before work starts. Proper training and the operator's manual will describe how to carry out both of these requirements.
- Operators must be trained on the powder-actuated tools they are using and must wear all the required personal protective equipment.
- Fasteners should not be fired through pre-drilled holes for two reasons:
  1) Unless the fastener hits the hole accurately, it will probably shatter the edge.
  2) The fastener derives its holding power from compressing the material around it. A pre-drilled hole reduces this pressure and therefore the fastener's holding power. (This is why studs and pins driven into steel should penetrate completely through the metal. Otherwise the compressed steel trying to regain its original position can loosen the fastener by pushing against the point. With the tip completely through the metal the same pressure only works to squeeze the pin tighter.)
- Firing explosive-actuated tools from ladders is not recommended. From a ladder it can be difficult to press the tool muzzle against the base material with enough pressure to fire. For tasks overhead or at heights, work from a scaffold or another approved work platform to ensure solid, balanced footing. As an alternative use a manufacturer's pole accessory if the reach is normal ceiling height (8-10 feet). The pole secures the tool and permits firing by the operator standing below.
- Do not leave the tool unattended unless it's locked in a box.
- Load the tool immediately before firing. Don't walk around with the tool loaded.
- Do not use powder-actuated tools in areas where there may be exposure to explosive vapours or gases.

Maintenance

Tools in regular use should be cleaned daily. Tools used intermittently should be cleaned after firing.

All parts of the tool exposed to detonation gases from the cartridge should be cleaned and lightly oiled according to the manfuacturer's instructions. The cartridge magazine port, cartridge chamber, and piston sleeve should be wiped clean but **never** be oiled.

The tool brush supplied is adequate for most fouling. Stubborn carbon should be loosened with a manufacturer's spray detergent oil. Tools being checked for immediate use should be wiped dry of oil.

Failure to clean the tool as recommended can lead to corrosion, pitting, fouling, and failure to work properly. Ideally, the tool should be cleaned before being returned to storage.

Tools with a power control adjustment will accumulate additional powder residue from firing–especially when the control is set to restrict the amount of cartridge strength being used. Semi-automatic tools may also accumulate powder residue. These tools need to be cleaned more often.

Sluggish performance may indicate that a tool needs cleaning. Tool action will slow to the point where a competent operator can detect the difference. Most manufacturers recommend major maintenance, inspection, and cleaning every six months. This involves stripping, inspecting, and cleaning parts not covered in daily maintenance.

Storage

Regulations require that both the tool and the cartridges be stored in a locked container with explosive loads of different strengths in separate containers. Cartridges should only be removed from the locked container when they are going to be used immediately.

Regulations

- Any worker using an explosive-actuated tool must be instructed in its safe and proper use.
- Before using the tool, the operator must check to ensure that it is in good working order. This means inspection and function testing.
- Tools firing fasteners at a velocity of more than 90 metres/second must have a protective guard at least 75 mm in diameter, mounted at right angles to the barrel of the tool and centered on the muzzle end of the tool, if practical.
- The tool must require two separate actions before it will fire:
  1) pressure against the surface of the material
  2) action of the trigger.
- Explosive-actuated tools must be stored in a locked container when not in use or when left unattended.
- The tool must not be loaded until ready for immediate use.
- Whether loaded or unloaded, the tool must never be pointed at anyone.
- Cartridges must be marked or labelled for easy identification. Cartridges of different strengths must be stored in separate containers.
- Misfired cartridges must be placed in a container of water and be removed from the project.

6 WELDING AND CUTTING

Welding is a process which uses heat and/or pressure to join metals.

Arc welding is by far the most commonly used in construction. Molten metal from the workpiece and a filler metal from an electrode form a common puddle which cools to form a weld.

Flame cutting is an allied process that requires the use of a torch, fuel gas, and oxygen to cut metals – primarily steel.

For some of the information in this chapter, the Construction Safety Association of Ontario gratefully acknowledges its use of the Canadian Standards Association standard CAN/CSA-W117.2 *Safety in Welding, Cutting and Allied Processes*, copyright CSA.

Welding Methods

Shielded Metal Arc Welding (SMAW) is the most common arc welding process in construction (Figure 20.1).

SMAW uses a short length of consumable electrode which melts as it maintains the arc. Melted metal from the electrode is carried across the arc to become the filler metal of the weld.

The electrode is coated with a complex mix of chemicals that releases a shielding gas such as carbon dioxide to keep air out of the arc zone and protect the weld from oxidation. The composition of the coating varies with the metal being welded.

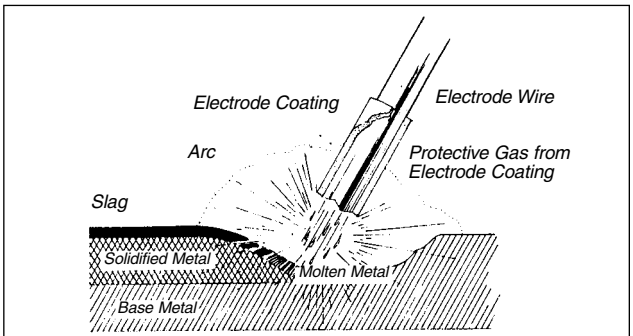


Figure 20.1

Gas Metal Arc (GMAW) or Metal Inert Gas Welding (MIG) uses an uncoated consumable wire that is fed continuously down the middle of the welding torch. A ring-like tube around the wire transports an inert gas such as argon, helium, or carbon dioxide from an outside source to the arc zone to prevent oxidation of the weld (Figure 20.2).

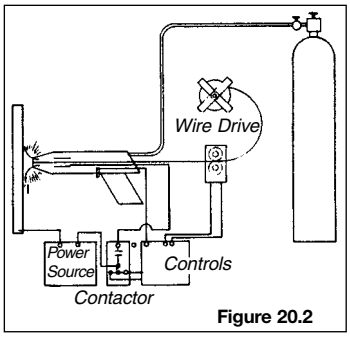


Figure 20.2

Flux Cored Arc Welding (FCAW) is a variation of MIG welding. It uses a hollow consumable wire whose core contains various chemicals that generate shielding gases to strengthen the weld (Figure 20.3).

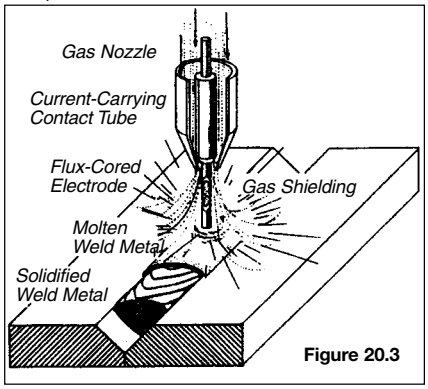


Figure 20.3

Gas Tungsten Arc Welding (GTAW) or **Tungsten Inert Gas Welding (TIG)** uses a non-consumable tungsten electrode that maintains the arc and provides enough heat to join metals (Figure 20.4). Filler metal is added in the form of a rod held close to the arc. The rod melts and deposits filler metal at the weld. Shielding gases may or may not be used, depending on the metal being welded.

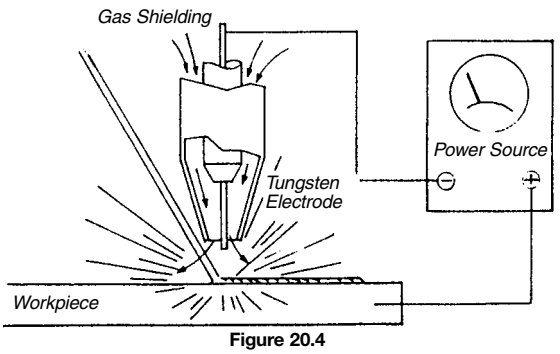


Figure 20.4