

# CHAPTER 5



## POWER TOOLS AND SHOP EQUIPMENT

### OBJECTIVES

After studying Chapter 5, the reader will be able to:

1. Identify commonly used power tools.
2. Identify commonly used shop equipment.

3. Discuss the proper use of power tools and shop equipment.
4. Describe the safety procedures that should be followed when working with power tools and shop equipment.

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### KEY TERMS

Air-Blow Gun (p. 66)  
Air Compressor (p. 64)  
Air Drill (p. 65)  
Air Ratchet (p. 65)  
Bearing Splitter (p. 68)  
Bench Grinder (p. 67)  
Bench Vise (p. 67)  
Die Grinder (p. 65)  
Engine Stand (p. 69)

Hydraulic Press (p. 68)  
Impact Wrench (p. 64)  
Incandescent Light (p. 66)  
Light Emitting Diode (LED) (p. 67)  
Portable Crane (p. 68)  
Stone Wheel (p. 67)  
Trouble Light (p. 66)  
Wire Brush Wheel (p. 67)  
Work Light (p. 66)

## AIR COMPRESSOR

A shop air compressor is usually located in a separate room or an area away from the customer area of a shop. An **air compressor** is powered by a 220-V AC electric motor and includes a storage tank and the compressor itself, as well as the pressure switches, which are used to maintain a certain minimum level of air pressure in the system. The larger the storage tank, expressed in gallons, the longer an air tool can be operated in the shop without having the compressor start operating. See Figure 5-1.



**FIGURE 5-1** A typical shop compressor. It is usually placed out of the way, yet accessible to provide for maintenance to the unit.



**FIGURE 5-2** A typical air nozzle. Always use an air nozzle that is OSHA approved.



## REAL WORLD FIX

### THE CASE OF THE RUSTY AIR IMPACT WRENCHES

In one busy shop, it was noticed by several technicians that water was being pumped through the air compressor lines and out of the vents of air impact wrenches whenever they were used. It is normal for moisture in the air to condense in the air storage tank of an air compressor. One of the routine service procedures is to drain the water from the air compressor. The water had been drained regularly from the air compressor at the rear of the shop, but the problem continued. Then someone remembered that there was a second air compressor mounted over the parts department. No one could remember ever draining the tank from that compressor. After that tank was drained, the problem of water in the lines was solved. The service manager assigned a person to drain the water from both compressors every day and to check the oil level. The oil in the compressor is changed every six months to help ensure long life of the expensive compressors.

## Safe Use of Compressed Air

Air under pressure can create dangerous situations. For example, an object, such as a small piece of dirt, could be forced out of an air hose blow gun with enough force to cause serious personal injury. All OSHA approved air nozzles have air vents drilled around the outside of the main discharge hole to help reduce the force of the air blast. Also, the air pressure used by an air nozzle (blow gun) must be kept to 30 PSI (207 kPa) or less. See Figure 5-2.

## AIR AND ELECTRICALLY OPERATED TOOLS

### Impact Wrench

An **impact wrench**, either air (pneumatic) or electrically powered, is a tool that is used to remove and install fasteners. The air-operated 1/2-inch drive impact wrench is the most commonly used unit. See Figure 5-3.

The direction of rotation is controlled by a switch. See Figure 5-4.

Electrically powered impact wrenches commonly include:

- Battery-powered units. See Figure 5-5.



**FIGURE 5-3** A typical 1/2-inch drive impact wrench.



**FIGURE 5-4** This impact wrench features a variable torque setting using a rotary knob. The diameter of rotation can be changed by pressing the button at the bottom.



**FIGURE 5-5** A typical battery-powered 3/8-inch drive impact wrench.

- 110-volt AC-powered units. This type of impact wrench is very useful, especially if compressed air is not readily available.

**CAUTION:** Always use impact sockets with impact wrenches, and be sure to wear eye protection in case the socket or fastener shatters. Impact sockets are thicker walled and constructed with premium alloy steel. They are hardened with a black oxide finish to help prevent corrosion and distinguish them from regular sockets. See Figure 5-6.

### Air Ratchet

An **air ratchet** is used to remove and install fasteners that would normally be removed or installed using a ratchet and a socket. An air ratchet is much faster, yet has an air hose attached, which reduces accessibility to certain places. See Figure 5-7.

### Die Grinder

A **die grinder** is a commonly used air-powered tool, which can also be used to sand or remove gaskets and rust. See Figure 5-8.

### Air Drill

An **air drill** is a drill that rotates faster than electric drills (up to 1800 RPM). Air drills are commonly used in auto body work when many holes need to be drilled for plug welding.



**FIGURE 5-6** A black impact socket. Always use impact-type sockets whenever using an impact wrench to avoid the possibility of shattering the socket, which can cause personal injury.

## Air-Blow Gun

An **air-blown gun** is used to clean equipment and other purposes where a stream of air would be needed. Automotive air blow guns should meet OSHA requirements and include passages to allow air to escape outward at the nozzle, thereby relieving pressure if the nozzle were to become blocked.

## Air-Operated Grease Gun

An air-operated grease gun uses shop air to operate a plunger, which then applies a force to grease a grease cartridge. Most air-operated grease guns use a 1/4-inch air inlet and operate on 90 PSI of air pressure.



**FIGURE 5-7** An air ratchet is a very useful tool that allows fast removal and installation of fasteners, especially in areas that are difficult to reach or do not have room enough to move a hand ratchet wrench.



**FIGURE 5-8** This typical die grinder surface preparation kit includes the air-operated die grinder, as well as a variety of sanding discs for smoothing surfaces or removing rust.

## Battery-Powered Grease Gun

Battery-powered grease guns are more expensive than air-operated grease guns but offer the convenience of not having an air hose attached, making use easier. Many use rechargeable 14- to 18-volt batteries and use standard grease cartridges.

## TROUBLE LIGHTS

### Incandescent

**Incandescent lights** use a filament that produces light when electric current flows through the bulb. This was the standard **trouble light**, also called a **work light** for many years until safety issues caused most shops to switch to safer fluorescent or LED lights. If incandescent light bulbs are used, try to locate bulbs that are rated “rough service,” which is designed to withstand shock and vibration more than conventional light bulbs.

**WARNING:** Do not use incandescent trouble lights around gasoline or other flammable liquids. The liquids can cause the bulb to break and the hot filament can ignite the flammable liquid.

### Fluorescent

A trouble light is an essential piece of shop equipment, and for safety, should be fluorescent rather than incandescent. Incandescent light bulbs can scatter or break if gasoline were to be splashed onto the bulb creating a serious fire hazard. Fluorescent light tubes are not as likely to be broken and are usually protected by a clear plastic enclosure. Trouble lights



**FIGURE 5-9** A fluorescent trouble light operates cooler and is safer to use in the shop because it is protected against accidental breakage where gasoline or other flammable liquids would happen to come in contact with the light.

are usually attached to a retractor, which can hold 20 to 50 feet of electrical cord. See Figure 5-9.

## LED Trouble Light

**Light emitting diode (LED)** trouble lights are excellent to use because they are shock resistant, long lasting, and do not represent a fire hazard. Some trouble lights are battery powered and therefore can be used in places where an attached electrical cord could present problems.

## BENCH/PEDESTAL GRINDER

A grinder can be mounted on a workbench or on a stand-alone pedestal.

### Bench- or Pedestal-Mounted Grinder

These high-powered grinders can be equipped with a wire brush wheel and/or a stone wheel.

- A **wire brush wheel** is used to clean threads of bolts as well as to remove gaskets from sheet metal engine parts.
- A **stone wheel** is used to grind metal or to remove the mushroom from the top of punches or chisels. See Figure 5-10.

**CAUTION:** Always wear a face shield when using a wire wheel or a grinder. Also keep the part support ledge (table) close to the stone.



**FIGURE 5-10** A typical pedestal grinder with a wire wheel on the left side and a stone wheel on the right side. Even though this machine is equipped with guards, safety glasses or a face shield should always be worn when using a grinder or wire wheel.

Most **bench grinders** are equipped with a grinder wheel (stone) on one end or the other of a wire brush. A bench grinder is a very useful piece of shop equipment and the wire wheel end can be used for the following:

- Cleaning threads of bolts
- Cleaning gaskets from sheet metal parts, such as steel valve covers

**CAUTION:** Only use a steel wire brush on steel or iron components. If a steel wire brush is used on aluminum or copper-based metal parts, it can remove metal from the part.

The grinding stone end of the bench grinder can be used for the following:

- Sharpening blades and drill bits
- Grinding off the heads of rivets or parts
- Sharpening sheet metal parts for custom fitting
- Cleaning threads using the wire brush wheel

## BENCH VISE

A **bench vise** is used to hold components so that work can be performed on the unit. The size of a vise is determined by the length of the jaws. Two common sizes of vises are 4-inch and 6-inch models. The jaws of most vises are serrated and can cause damage to some components unless protected. Many types of protection can be used, including aluminum jaw covers or by simply placing wood between the vise jaws and the component being held. See Figure 5-11.



**FIGURE 5-11** A typical vise mounted to a workbench.

## Safe Use of Vises

The jaws of vises can cause damage to the part or component being held. Use pieces of wood or other soft material between the steel jaws and the workpiece to help avoid causing damage. Many vises are sold with optional aluminum jaw covers. When finished using a vise, be sure to close the jaws and place the handle straight up and down to help avoid personal injury to anyone walking near the vise.

## HYDRAULIC PRESSES

**Hydraulic presses** are hand-operated hydraulic cylinders mounted to a stand and designed to press bearings on or off of shafts, as well as other components. To press off a bearing, a unit called a **bearing splitter** is often required to apply force to the inner race of a bearing. Hydraulic presses use a pressure gauge to show the pressure being applied. Always follow the operating instructions supplied by the manufacturer of the hydraulic press. See Figure 5-12.

## PORTABLE CRANE AND CHAIN HOIST

A **portable crane** is used to remove and install engines and other heavy vehicle components. Most portable cranes use a hand-operated hydraulic cylinder to raise and lower a boom that is equipped with a nylon strap or steel chain. At the end of the strap or chain is a steel hook that is used to attach around a bracket or auxiliary lifting device. See Figure 5-13.



### COVER WORK WHILE PRESSING

Whenever pressing on a bearing or other component, use an old brake drum over the shaft and the bearing. In the event the bearing shatters during the pressing operation, the brake drum will prevent the parts of the bearing from flying outward where they could cause serious personal injury.

## Safe Use of Portable Cranes

Always be sure to attach the hook(s) of the portable crane to a secure location on the unit being lifted. The hook should also be attached to the center of the weight of the object so it can be lifted straight up without tilting.



**FIGURE 5-12** A hydraulic press is usually used to press bearings on and off on rear axles and transmissions.



**FIGURE 5-13** A typical portable crane used to lift and move heavy assemblies, such as engines and transmissions.

**CAUTION:** Always keep feet and other body parts out from underneath the engine or unit being lifted. Always work around a portable crane as if the chain or strap could break at any time.

## ENGINE STANDS

An **engine stand** is designed to safely hold an engine and to allow it to be rotated. This allows the technician to easily remove, install, and perform service work to the engine. See Figure 5-14.

Most engine stands are constructed of steel and supported by four casters to allow easy movement. There are two basic places where an engine stand attaches to the engine depending on the size of the engine. For most engines and stands, the retaining bolts attach to the same location as the bell housing at the rear of the engine.

On larger engines, such as the 5.9 Cummins inline six-cylinder diesel engine, the engine mounts to the stand using the engine mounting holes in the block. See Figure 5-15.

### Safe Operation of an Engine Stand

When mounting an engine to an engine stand, be sure that the engine is being supported by a portable crane. Be sure

the attaching bolts are grade 5 or 8 and the same thread size as the threaded holes in the block. Be sure that all attaching bolts are securely tightened before releasing the weight of the engine from the crane. Use caution when loosening the rotation retaining bolts because the engine could rotate rapidly, causing personal injury.

## CARE AND MAINTENANCE OF SHOP EQUIPMENT

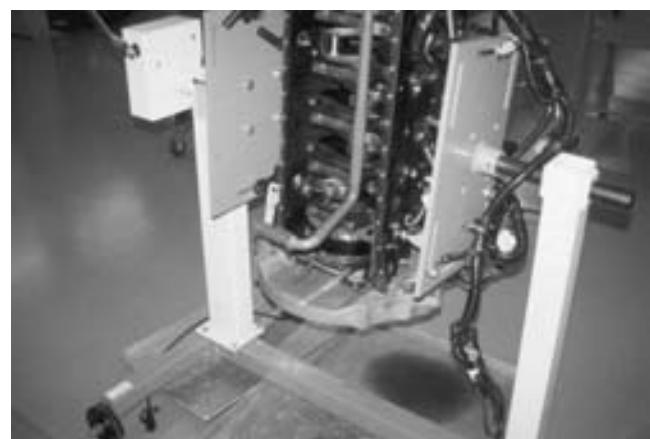
All shop equipment should be maintained in safe working order. Maintenance of shop equipment usually includes the following operations or procedures:

- **Keep equipment clean.** Dirt and grime can attract and hold moisture, which can lead to rust and corrosion. Oil or grease can attract dirt.
- **Keep equipment lubricated.** While many bearings are sealed and do not require lubrication, always check the instructions for the use of the equipment for suggested lubrication and other service procedures.

**CAUTION:** Always follow the instructions from the equipment manufacturer regarding proper use and care of the equipment.



**FIGURE 5-14** Two engines on engine stands. The plastic bags over the engines help keep dirt from getting onto these engines and engine parts.



**FIGURE 5-15** An engine stand that grasps the engine from the sides rather than the end.

## SETUP AND LIGHTING A TORCH Step-by-Step



### STEP 1

Inspect the cart and make sure the bottles are chained properly before moving it to the work location.



### STEP 2

Start by attaching the appropriate work tip to the torch handle. The fitting should only be tightened hand tight.



### STEP 3

The high pressure gauge shows bottle pressure, and the low pressure gauge indicates working pressure.



### STEP 4

Open the oxygen bottle valve fully open, and open the acetylene bottle valve 1/2 turn.



### STEP 5

Open the oxygen valve on the torch handle 1/4 turn in preparation for adjusting oxygen gas pressure.



### STEP 6

Turn the oxygen regulator valve clockwise and adjust oxygen gas pressure to 20 PSI.

**SETUP AND LIGHTING A TORCH continued**

**STEP 7** Open the acetylene valve on the torch handle 1/4 turn and adjust acetylene gas pressure to 7 PSI. Close the acetylene valve on the torch handle.



**STEP 8** Open the oxygen valve on the torch handle 1/4 turn and use an appropriate size tip cleaner to clean the tip orifice. Finish by closing the oxygen valve.



**STEP 9** Put on leather gloves and open the acetylene valve on the torch handle 1/4 turn. Use a flint striker to ignite the acetylene gas exiting the torch tip.



**STEP 10** Slowly open the oxygen valve on the torch handle and adjust for a neutral flame (blue cone is well-defined).

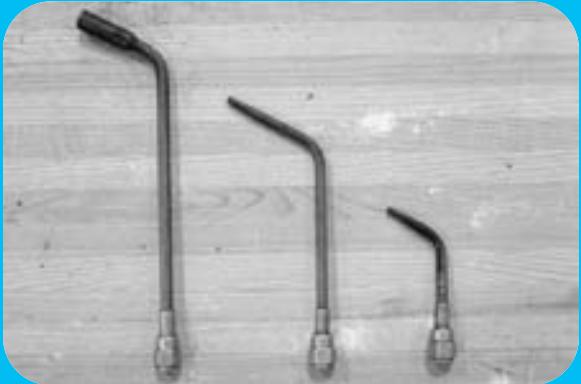


**STEP 11** Once work is complete, extinguish the flame by quickly closing the acetylene valve on the torch handle.



**STEP 12** Close the valves on both bottles and turn the regulator handles CCW until they no longer contact the internal springs.

## HEATING METAL Step-by-Step



### STEP 1

Heating attachments include ordinary heating tips (middle and right) and a "rosebud" (left). Ordinary heating tips work fine for most purposes.



### STEP 2

Note that while acetylene bottle pressures are relatively low, the oxygen bottle can be filled to over 2000 PSI. Be absolutely certain that the bottles are chained properly to the cart before attempting to move it!



### STEP 3

A fire blanket may be placed over floor drains or other objects to prevent fires. A fire extinguisher should be on hand in case of an emergency.



### STEP 4

Be sure to wear appropriate personal protective equipment during heating and cutting operations.



### STEP 5

Note that heating operations should be performed over steel or firebrick. Never heat or cut steel close to concrete, as it could cause the concrete to explode.



### STEP 6

When heating steel, move the torch in a circular pattern to prevent melting of the metal.

## CUTTING METAL Step-by-Step



### STEP 1

Affix the cutting attachment to the torch handle. Note that the cutting attachment has a cutting handle and a separate oxygen valve.



### STEP 2

Fully open the oxygen valve on the torch handle. Oxygen flow will now be controlled with the valve on the cutting attachment.



### STEP 3

Oxygen gas pressure should be adjusted to 30 PSI whenever using the cutting attachment. Acetylene pressure is kept at 7 PSI.



### STEP 4

Open the acetylene valve on the torch handle 1/4 turn and light the torch. Slowly open the oxygen valve on the cutting attachment and adjust the flame until the blue cone is well-defined.



### STEP 5

Direct the flame onto a thin spot or sharp edge of the metal to be cut. This will build the heat quicker in order to get the cut started.



### STEP 6

When the metal glows red, depress the cutting handle and move the torch to advance the cut.

## SUMMARY

1. Most shops are equipped with a large air compressor that supplies pressurized air to all stalls for use by the technician.
2. An air impact wrench is the most commonly used power tool in the shop. It is used mostly to remove fasteners. Caution should be exercised not to overtighten a fastener, using an air impact wrench.
3. Other air-operated tools include an air ratchet and a die grinder.
4. A bench or pedestal grinder usually has both a grinding stone and a wire brush wheel.
5. Trouble lights should be fluorescent or LED for maximum safety in the shop.
6. A hydraulic press is used to remove bearings from shafts and other similar operations.
7. A portable crane is used to remove and install engines or engine/transmission assemblies from vehicles.
8. Engine stands are designed to allow the technician to rotate the engine to get access to the various parts and components.

## REVIEW QUESTIONS

1. List the tools used by service technicians that use compressed air.
2. Which trouble light design(s) is (are) the recommended type for maximum safety?
3. What safety precautions should be adhered to when working with a vise?
4. When using a blow gun, what precautions need to be taken?

## CHAPTER QUIZ

1. When using compressed air and a blow gun, what is the maximum allowable air pressure?
  - a. 10 PSI
  - b. 20 PSI
  - c. 30 PSI
  - d. 40 PSI
2. Which air impact drive size is the most commonly used?
  - a. 1/4 inch
  - b. 3/8 inch
  - c. 1/2 inch
  - d. 3/4 inch
3. For safe use of compressed air using a blow gun, the pressure should not exceed \_\_\_\_.
  - a. 10 PSI
  - b. 20 PSI
  - c. 30 PSI
  - d. 40 PSI
4. What can be used to cover the jaws of a vise to help protect the object being held?
  - a. Aluminum
  - b. Wood
  - c. Plastic
  - d. All of the above
5. Technician A says that impact sockets have thicker walls than conventional sockets. Technician B says that impact sockets have a black oxide finish. Which technician is correct?
  - a. Technician A only
  - b. Technician B only
  - c. Both Technicians A and B
  - d. Neither Technician A nor B

6. Two technicians are discussing the use of a typical bench/pedestal-mounted grinder. Technician A says that a wire brush wheel can be used to clean threads. Technician B says that the grinding stone can be used to clean threads. Which technician is correct?
- Technician A only
  - Technician B only
  - Both Technicians A and B
  - Neither Technician A nor B
7. A hydraulic press is being used to separate a bearing from a shaft. What should be used to cover the bearing during the pressing operation?
- A shop cloth
  - A brake drum
  - A fender cover
  - A paper towel
8. Which type of trouble light is recommended for use in the shop?
- Incandescent
  - Fluorescent
  - LED
  - Either b or c
9. When mounting an engine to an engine stand, what grade of bolt should be used?
- 5 or 8
  - 4 or 7
  - 3 or 5
  - 1 or 4
10. Proper care of shop equipment includes \_\_\_\_.
- Tuning up every 6 months
  - Keeping equipment clean
  - Keeping equipment lubricated
  - Both b and c