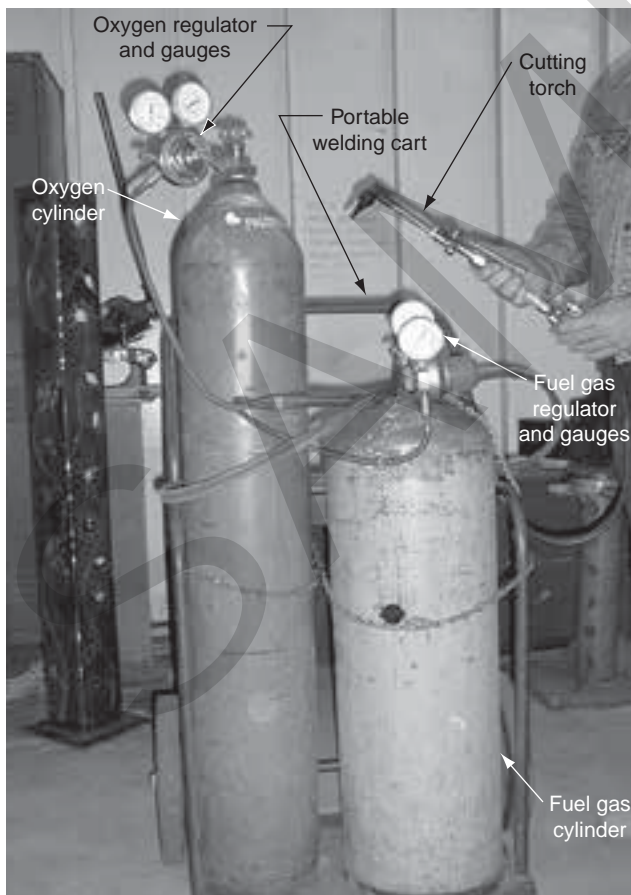


Cutting Equipment

Cutting Equipment versus Welding Equipment

Oxyfuel gas cutting equipment is used throughout the metal-working industries for cutting steel and ferrous (iron-based) metals. The equipment is basically the same for both oxyfuel gas cutting and oxyfuel gas welding, except for the torch, **Figure 21-1**. The cutting torch is a unique and invaluable tool that enables the operator to cut almost any thickness of steel to the required size and shape.



Goodheart-Willcox Publisher

Figure 21-1. The oxyfuel gas cutting outfit is the same as the welding outfit, except for the torch and a heavy-duty oxygen regulator.

Besides the torch, the oxygen regulator may differ between the oxyfuel gas welding outfit and cutting outfit. A high flow of oxygen is necessary to cut very thick metal. Therefore, a heavy-duty oxygen regulator with high-pressure indications and large-volume capacity may be needed.

Oxyfuel gas cutting is also referred to as flame cutting. *Flame cutting* is the process of cutting steel by removing material to form a slot, called the *kerf*. The metal is actually removed from the kerf by burning it away. Flame cutting is one of the fastest and most efficient methods for cutting thick metal.

Essential Elements for Burning

To understand how metal can be cut quickly with a flame, you must first understand how burning takes place. Three essential elements are needed for burning: fuel, oxygen, and heat. Fuel can be any material that will chemically combine with oxygen. In this case, the steel to be cut is the fuel.

Second, a large quantity of pure oxygen is needed to combine with the fuel. The more oxygen present, and the greater the oxygen's force, the faster burning will take place. Therefore, flame cutting requires a jet stream of pure oxygen directed onto the steel.

Third, heat is needed to raise the temperature of the steel until it reaches its ignition temperature. *Ignition temperature* is the temperature at which the material will burn when oxygen is present. The ignition (kindling) temperature of steel is 1500°F (816°C). At this temperature, steel turns cherry red. The stream of oxygen is directed onto the hot metal. The steel burns rapidly, and a slot is cut through the entire piece. The oxygen and hot steel are actually combining to form a chemical reaction called *oxidation*.

A variety of gases can be used for oxyfuel gas cutting. Acetylene is the most widely used. Propane, natural gas, and hydrogen are also used.

The Cutting Torch

The oxyfuel gas cutting torch is an ideal tool for accurately controlling the heating and cutting action, **Figure 21-2**. The torch is designed to preheat the steel until it reaches the proper temperature. Then, the torch supplies a stream of oxygen to begin the burning (or oxidizing) process. The stream of oxygen that cuts the metal is referred to as *cutting oxygen*. The oxygen is released by pressing the *cutting oxygen lever*.

A cutting torch is similar to a welding torch. It provides a method of mixing oxygen and acetylene in proper proportions to produce the desired preheating flame. However, the cutting torch has two additional features:

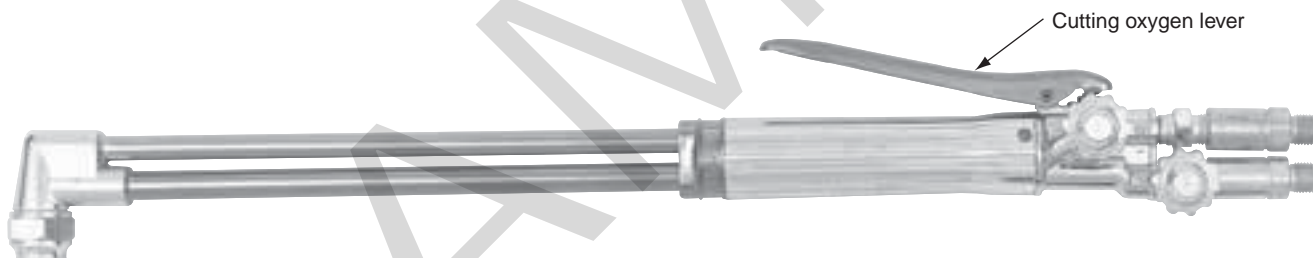
- A third passageway for high-pressure cutting oxygen, which is regulated by the cutting oxygen lever on the torch, **Figure 21-3**.
- A special cutting tip.

Two types of cutting torches are widely used. The first is a standard, one-piece cutting torch used only for cutting. The second is called a cutting torch attachment or two-piece combination torch.

The welding torch can be converted to a cutting torch by removing the welding tip from the torch body and directly fastening the cutting torch attachment, **Figure 21-4**. Notice the cutting torch attachment has an extra cutting oxygen valve. (The procedure for opening and closing the extra valve is described in Unit 22.) The advantage of the cutting torch attachment is that it can be quickly added and removed as needed, **Figure 21-5**. The cutting torch, on the other hand, must be connected to flashback arrestors and hoses before use.

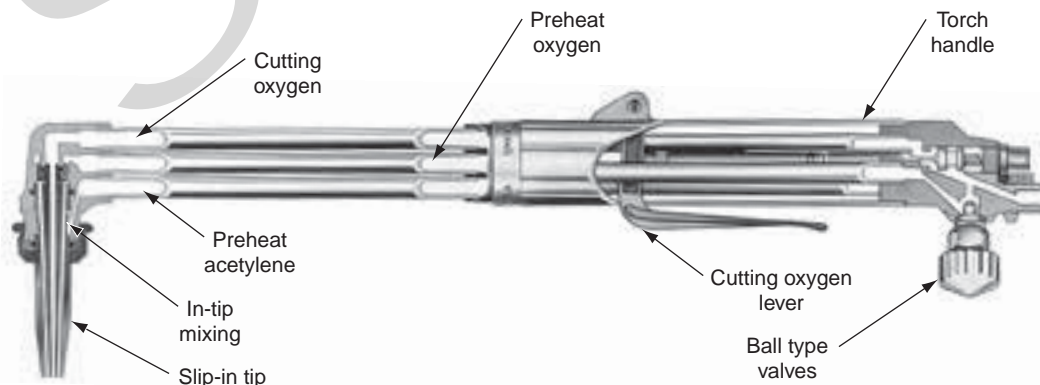
The Cutting Tip

Cutting torch tips are made of copper and are longer than welding tips, **Figure 21-6**. The diameter of the end of a cutting tip is much larger than the end of a welding tip. The cutting tip has a large orifice in the center through which the high-pressure oxygen flows. This opening is surrounded by smaller orifices, often in a circular pattern of four to eight holes for the preheating flames, **Figure 21-7**.



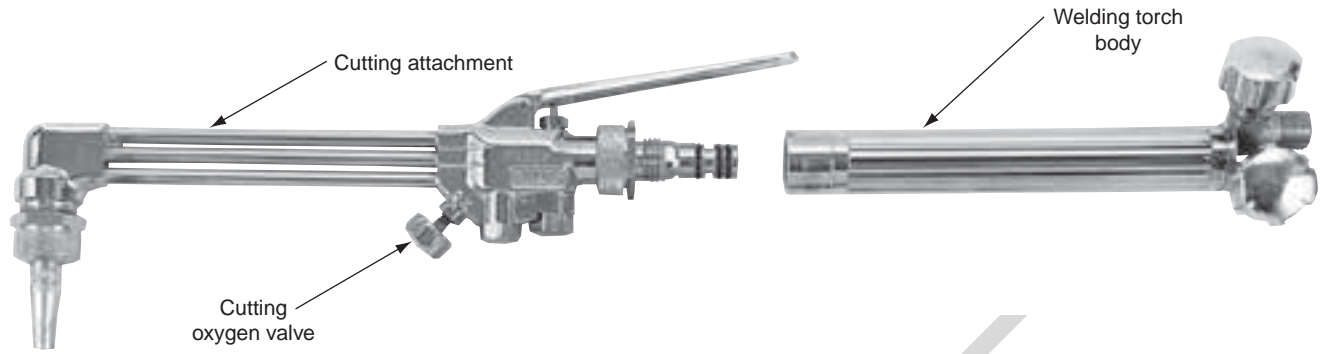
Uniweld Products, Inc.

Figure 21-2. A standard oxyfuel gas cutting torch.



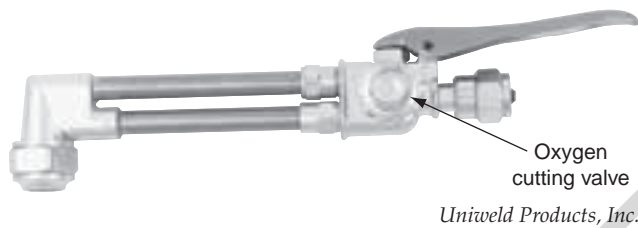
Miller Electric Mfg. LLC

Figure 21-3. Construction of a standard, one-piece cutting torch.



Miller Electric Mfg. LLC

Figure 21-4. A cutting attachment is connected directly to the welding torch body.



Uniweld Products, Inc.

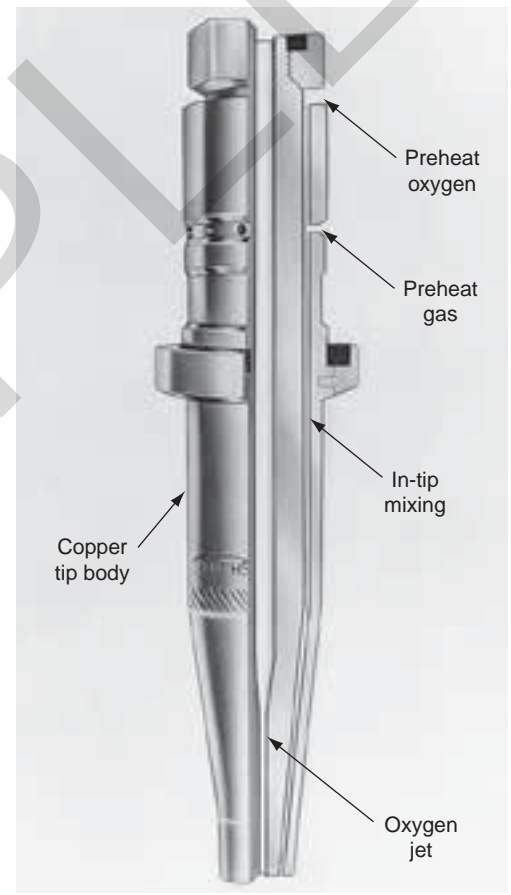
Figure 21-5. A standard cutting torch attachment that quickly attaches to a torch body.



American Torch Tip Co.

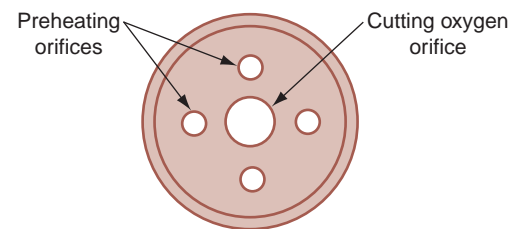
Figure 21-6. A wide variety of cutting tip sizes is available.

The size of the cutting tip is determined by the thickness and type of carbon or alloy steel to be cut. Cutting tips are designed and specified to provide the correct volume of heating and cutting gases for particular metal thicknesses. A wide variety of customized cutting tips is available for specific cutting jobs, **Figure 21-8**.



A

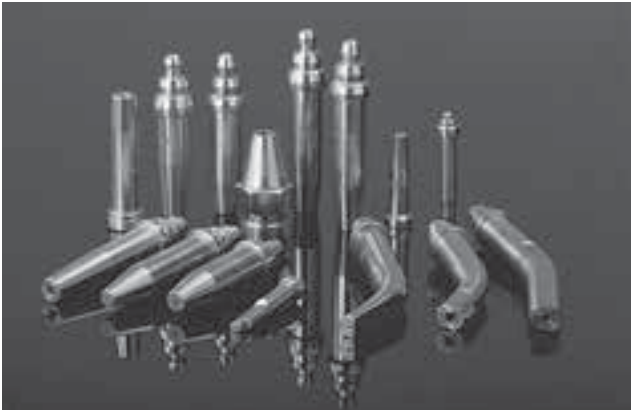
Miller Electric Mfg. LLC



B

Goodheart-Willcox Publisher

Figure 21-7. Cutting torch tip. A—Details of a typical cutting tip. B—Location of preheating and cutting oxygen holes.



American Torch Tip Co.

Figure 21-8. Assortment of specialty cutting tips.

Each cutting tip manufacturer has a different numbering system for identifying the type and style of tip. Always check the manufacturer's specifications to select the correct cutting tip. The manufacturer provides a chart with specific data on metal thickness, tip size, regulator pressure settings, and travel speed.

Safety Precautions

Flame cutting can be very hazardous if proper precautions are not taken. *Always wear goggles with suitable lenses to protect your eyes from the intense light and flying sparks.* Wear a welding cap to cover your hair. Gauntlet welding gloves and a long leather apron or welding outfit are needed to protect the body from hot slag.

Explosive or flammable materials must be removed from the cutting area. *Red hot particles of molten slag can splatter great distances from the high-pressure stream of oxygen.* A fire extinguisher should be readily available at all times.

Cutting operations should be performed in an area away from other persons to protect them from flying slag. Check equipment, protective clothing, and the cutting area before lighting the torch.

Name _____ Date _____ Class _____

Check Your Progress

Write your answers in the spaces provided.

1. What three elements are needed for burning to take place?

2. Steel can be cut when it reaches an ignition temperature of (*circle letter*):

- A. 1100°F (593°C).
B. 1500°F (816°C).
C. 2200°F (1205°C).

3. Name the two types of cutting torches, and explain how they differ.

4. A cutting tip has a center hole for high-pressure oxygen surrounded by smaller orifices for the _____.

5. The two factors on which selecting a cutting tip of the correct size is primarily based are:

Things to Do

1. Prepare a short research report on the chemical reaction that takes place during oxyfuel gas cutting. Gather information from the Internet, the library, a chemistry teacher, or people in the welding industry.
2. Secure literature from manufacturers of welding equipment, and study the sections on welding tips. Prepare a list of special-purpose cutting tips and the purposes for which they were designed. Example: Rivet-cutting tip—for removal of rivets.
3. Examine the cutting torches in your shop to determine if they are complete units or cutting attachments. Compare the two types of cutting torches and locate their valves.
4. Search the Internet and write or e-mail manufacturers of welding protective equipment to ask for literature. Prepare a short report on the recommended lens shades (depth of color) for goggles used when flame cutting.



Accurate cutting of thick steel can be achieved with practice.

Miller Electric Mfg. LLC