Oxyfuel Welding Safety 105

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Class Outline

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Oxyfuel Welding Safety
Oxyfuel Welding Clothes
Face and Eye Safety: Welding Masks
Face and Eye Safety: Goggles
Oxyfuel Equipment Inspection
Torch Safety
Torch Malfunctions
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Summary

Lesson: 1/16

Objectives

- Explain the importance of safety during oxyfuel welding.
- Describe proper clothes to wear during oxyfuel welding.
- Explain filter plates and lenses.
- Describe the dangers of not wearing eye protection.
- Explain how to inspect an oxyfuel outfit.
- Explain how to handle a torch safely.
- Identify torch malfunctions.
- Describe how to safely maintain welding tips.
- Explain how to properly handle cylinders.
- Explain how to safely handle MAPP gas.
- Describe how to use hoses safely.
- Explain how welding fumes are vented.
- Identify locations for oxyfuel welding.
- Describe basic fire safety for oxyfuel welding.

Figure 1. Gloves are required for all oxyfuel processes.

Figure 2. Welding tips need to be cleaned regularly to ensure safety and a clean flame.

Lesson: 2/16

Oxyfuel Welding Safety

Oxyfuel is a versatile, cost-effective tool used for welding, cutting, and soldering in many different settings. Due to the low cost and high portability of oxyfuel equipment, it can be used effectively in many different locations. However, because oxyfuel welding procedures use an open flame, welders must take extreme caution to be as safe as possible. Because oxyfuel outfits can be used in a variety of settings, a welder must make certain to reduce the risks of fire in a variety of environments.

Oxyfuel welding safety requires some basic safety practices combined with an added awareness of the risks of flammable objects wherever welding is taking place. Additionally, oxyfuel equipment requires special methods for movement and storage that all welders must practice.

In this class, you will learn the basics of oxyfuel safety, including what personal protective equipment to wear and how to properly store and move equipment. You will also learn the proper methods for dealing with torch malfunctions and how to reduce the chances of fire in any location.

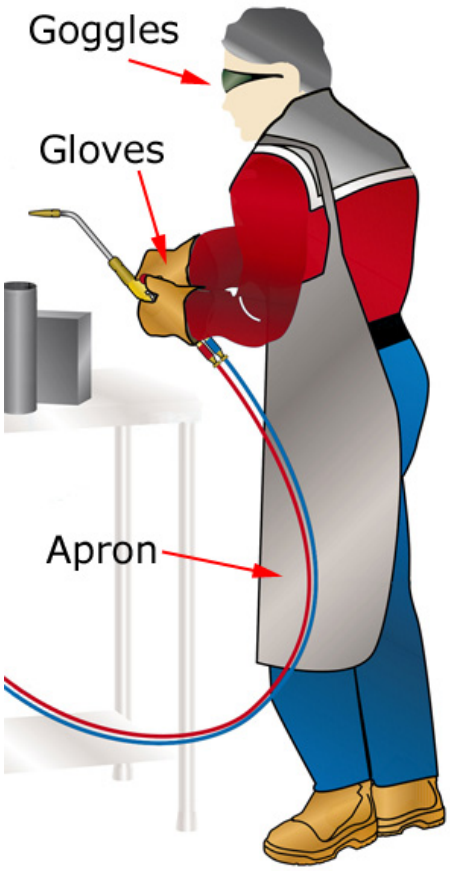

Figure 1. Oxyfuel safety requires proper personal protective equipment.

Lesson: 3/16

Oxyfuel Welding Clothes

Proper **personal protective equipment** (PPE) must be worn at all times when working with oxyfuel equipment. All clothing should be made of **fire-resistant** fabric, and be free of grease or oil. Oxyfuel PPE is the same as protective gear worn for other types of welding.

Welders must wear shirts with long sleeves and pants without cuffs. Cuffs can catch fire if they trap the burning hot particles that welding lets off. As you can see in Figure 1, leather jackets and pants offer the most protection but can be impractical for certain tasks. Also, you should never wear any synthetic fabrics such as **rayon** and **polyester**, which can melt when exposed to the extreme heat of an oxyfuel torch.

Heavy leather aprons are also worn by welders for extra safety. While these are recommended for all tasks, any heavy cutting done by an oxyfuel welder requires an apron for added protection. When cutting thicker metals, you should also wear leather leggings and high boots to protect from the added sparks.

Caps protect your hair from any sparks or burning particles. Caps are normally not required for welding. However, **overhead welding** requires wearing a cap for extra protection. Caps should always have the brim turned behind the welder's head.

Finally, a welder must wear gloves at all times while welding. The gloves should be made of leather or fire-resistant fabric and extend past the end of shirt sleeves to fully cover the arm, as shown in Figure 2.

Figure 1. Leather clothing offers the most protection for welders.

Figure 2. Leather gloves should be long enough to go over the cuffs of long-sleeved shirts.

Lesson: 4/16

Face and Eye Safety: Welding Masks

In addition to proper clothing, welders should wear goggles or welding masks with **filter plates**, such as the mask shown in Figure 1. A filter plate is the shaded protective lens inside the welder's helmet or goggles that filter out harmful rays and intense bright light. The filter plate is essential for protecting your face and eyes from the potential damages of welding.

Helmets are available with a wide variety of options. Some helmets have several different filter plates, which are typically numbered between 1 and 14. Plates with a lower number are darker and thus provide more protection. Oxyfuel welding usually requires a lens with a darkness rating between 3 and 6.

Some helmets are now equipped with **auto-darkening filter plates**, such as the helmet shown in Figure 1. These filter plates automatically adjust their darkness based on the intensity of the light being viewed by the welder. Though these helmets are slightly more expensive, they guarantee the proper amount of filtering in any welding situation. For welders who perform multiple types of welding, such as both oxyfuel and **arc welding**, auto-darkening filter plates are very convenient.

Figure 1. This older welding mask uses changeable filter plates.

Figure 2. This modern welding mask features auto-darkening filter plates.

Lesson: 5/16

Face and Eye Safety: Goggles

Goggles come in a variety of shapes and sizes. Goggles offer less protection, but are smaller and less expensive. As you can see in Figure 1, some goggles have changeable filter plates, but goggle designs have fixed lenses. If they have changeable filter plates, the plates will be numbered in the same way as helmet plates, and the guidelines for selection are the same.

Never look directly at any welding process without wearing the proper filter plates. Both oxyfuel flames and welding arcs release dangerous **ultraviolet** and **infrared** rays that can severely damage your eyesight, as shown in Figure 2.

Be certain to avoid wearing contact lenses when welding. Welding can release smoke and dust particles, which can get into your eyes and interfere with the contact lenses. Additionally, an **arc flash** can dry out the fluid in your eye, causing the contact to stick to the eye, possibly causing permanent damage.

Figure 1. These goggles have replaceable filter plates.

Figure 2. The intensity and brightness of the oxyfuel flame and the sparks it gives off can damage your eyes.

Lesson: 6/16

Oxyfuel Equipment Inspection

To improve safety in the workplace, you should regularly visually inspect each component of an oxyfuel rig for wear or damage. Figure 1 shows a rig that is certainly a candidate for visual inspection. Any visible damage can cause problems with the proper operation of the torch. Such problems can be very dangerous to the welder, as well as anyone else in the welding area.

The most important step in an inspection is testing for leaks. Leaks can be caused by actual holes in the hoses, or by improperly tightened nuts. A leak can cause problems when operating the torch. Even a small leak can release enough flammable gas to cause a major fire hazard.

To check for a leak in an assembled outfit, use **nonpetroleum soap** and a wet rag. Wipe all hoses and connections such as those in Figure 2 with the soap and observe. Any bubbles appearing in the soap indicate the presence of a leak. The gas escaping the leak causes the bubbles to form.

If you find any leaks, you must address these leaks before welding. If a hose is leaking, replace it with a newer hose. If a connection is leaking, try tightening and adjusting it. Then recheck the connection to be sure the problem is solved.

Inspection of equipment is a constant process. While assembling and using an oxyfuel outfit, you should constantly be aware of how well your equipment is functioning. If any part of the outfit is not working properly, you should attempt to resolve the problem right away.

Figure 1. Visible wear to an oxyfuel outfit should be inspected before use. You should be certain the wear does not affect the safe operation of the outfit.

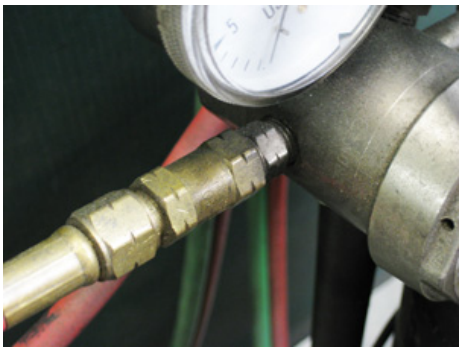

Figure 2. Hose connections should be wiped down to ensure that no gases are leaking from them.

Lesson: 7/16

Torch Safety

Oxyfuel welding involves the use of a torch with an open flame that can reach almost 6,000° F (3,300° C) in normal conditions. Safety should be a top concern in the use and storage of the torch.

The torch must be shut off whenever it is not being used. For times when you are not welding for a brief moment, you can extinguish the flame by first turning the acetylene torch valve all the way off. Then, once the flame has gone out, turn the oxygen torch valve off. Note that oxygen and acetylene will both continue to flow to the torch, but not to the tip or to a flame.

If you are not welding for an extended period of time, or if you are finished welding for the day, a full oxyfuel outfit shut off is required. To do this, follow these steps:

1. Turn the acetylene torch valve counterclockwise all the way to cut off the gas and extinguish the flame. Then, do the same to the oxygen torch valve. These valves are shown in Figure 1.
2. Fully close the oxygen and acetylene cylinder valves, as shown in Figure 2 .
3. Re-open the torch valves. This should allow the remaining gases in the hoses to drain out.
4. Observe the regulators to ensure the pressure in the hoses reads zero and the hoses are empty.
5. Close the torch valves.
6. Turn the regulator adjustment screws counterclockwise until they are loose, as shown in Figure 3.

By following these steps, you ensure that no gas is flowing from the cylinders and that there is no risk of possible ignition.

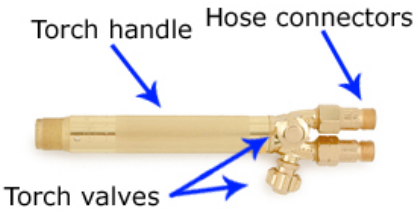

Figure 1. To shut down the torch, first turn off the torch vales.

Figure 2. Cylinder valves need to be closed fully.

Figure 3. Turn the regulator screws counterclockwise until they are loose to complete shutting the torch off.

Lesson: 8/16

Torch Malfunctions

Oxyfuel torches malfunction in three basic ways. You should pay attention to the flame and the torch and watch for symptoms of each of these problems before any potential hazards occur.

A **backfire** occurs when the flame momentarily moves up into the tip of the torch. During a backfire, you may hear a brief "pop" just before the torch's flame extinguishes. If this happens, reignite your torch. Backfire is considered a malfunction, but can occur regularly without being a safety hazard.

A **sustained backfire** occurs when the flame continually burns inside the torch. Usually the flame continues to burn inside the mixer, but it can move up into the handle of the torch. During a sustained backfire, you may hear a hissing or squealing sound coming from the torch, and the flame may become sharp and pointed. Immediately close all torch valves. A sustained backfire can damage a torch and potentially burn through the walls of the handle, burning the welder. Sustained backfire is considered extremely dangerous.

A **flashback** is a brief or continued movement of the flame up past the mixer into the torch and hoses. If the flame reaches the hoses, an explosion can occur. As shown in Figure 1, a **flashback arrestor** helps prevent the reverse flow of gases that causes flashback. Flashback is usually the result of poor startup and shutdown procedures, low pressure in the cylinders, or malfunctioning valves.

Though these oxyfuel torch malfunctions are rare, they can occur during normal welding operations. By recognizing these potential hazards ahead of time, you help avoid serious injury or even death.

Figure 1. Flashback arrestors prevent the flame from moving up into the hoses and causing an explosion.

Lesson: 9/16

Welding Tip Safety

Welding safety depends on the safe use of torch tips. Using only those tips designed to work with a specific torch ensures that the tip will not cause any problems. Always follow manufacturer recommendations for attaching tips. When specified, attach tips to torches using a box-end torch wrench. Be careful not to over-tighten the tips, which could cause O-rings inside the torch to crush and leak.

With normal use, a welding tip can accumulate pieces of metal, carbon, and dirt, among other particles. Acetylene in particular can cause massive amounts of carbon to build up on a torch tip. While this buildup can occur safely on the outside of the torch, as shown in Figure 1, these particles can cause unwanted effects like a misshapen flame or even a **backfire** if not cleaned out of the orifice.

To ensure your torch works properly, clean your welding tips regularly. Any welding shop should have a standard set of welding tip cleaners, which are shown in Figure 2. Be sure to pick the proper size cleaner to match the orifice. Cutting tips, such as those shown in Figure 3, require careful cleaning of each orifice. When cleaning any tip, avoid expanding or otherwise changing the shape of an orifice. Proper care and cleaning of welding tips ensures the best welds and extends the life of the tip itself.

Figure 1. Welding tips may darken on the exterior with normal use.

Figure 2. Tip cleaners offer a range of sizes to clean every size of tip.

Figure 3. Cutting tips have multiple orifices that each need to be cleaned carefully.

Lesson: 10/16

Proper Cylinder Handling

Oxyfuel welding gases can be dangerous if not properly handled and stored. Oxygen and acetylene are both explosive gases that are risks to personnel safety if not properly maintained.

When moving your equipment, you should use a **cylinder truck**, like the device in Figure 1. If a cylinder truck is not available, a skilled person may use both hands to tip the cylinder slightly and roll it along the edge of the bottom. This should not be done often, and the person who does it should be extremely careful.

Oxygen cylinders and acetylene cylinders should be clearly labeled and stored separately and away from any **combustible** materials. **Valve caps** should be secured on all cylinders at all times when they are not in use, as shown in Figure 2. Valve caps help to prevent valve damage if the cylinder is tipped over or hit at all. Caps also prevent gas from flowing out of the cylinder when not in use. Cylinders should be fastened in an upright position to a wall or post at all times to ensure they cannot move or fall over.

All oxygen hoses, cylinders, and valves must be free of oil and grease. Oil and grease can combine with oxygen to create a dangerous flammable mixture.

Figure 1. A cylinder truck should be used to transport all oxygen and fuel gas cylinders.

Figure 2. Valve caps should be kept on all cylinders when they are not being used.

Lesson: 11/16

MAPP Gas Safety

The use of methyl acetylene propadiene and petroleum gas or **MAPP gas** for oxyfuel welding is increasing. Though it costs more than acetylene, MAPP gas burns cleaner, releasing less carbon. Additionally, MAPP gas offers a few safety advantages over other gases.

As shown in Figure 1, MAPP gas comes in a different type of cylinder than oxygen or acetylene. MAPP gas cylinders are more stable than oxygen or acetylene cylinders. They are much less explosive and do not detonate if dropped or dented. Since MAPP gas is stored as a liquid, it is insensitive to shock. MAPP gas can be stored at higher pressure without causing any risks to safety. If MAPP gas is leaking, it has a strong smell, which makes it easier to find a MAPP leak.

MAPP gas does have its own particular safety concerns. MAPP gas is stored as a liquid. If released into the air, the liquid boils instantly at a very cold temperature. A person exposed to MAPP gas leaks can get severe frost-like burns. If too much MAPP gas leaks, it can cause unconsciousness if inhaled. Fortunately, the odor of MAPP gas is noticeable well before it reaches this level.

The main drawback of MAPP gas is that it is not reliable for welding steel. MAPP gas produces high hydrogen content in welds, which can cause steel to become brittle or to crack.

Figure 1. MAPP gas is an alternative to acetylene for oxyfuel welding.

Lesson: 12/16

Hose Safety

Hoses require attention and care beyond routine inspection for leaks. Properly maintained hoses such as those in Figure 1 last longer and allow gases to flow freely. On the other hand, poorly maintained hoses are a safety hazard to the welder.

Before using a hose, you should use compressed air to eliminate any buildup of dust or other particles in the hose. Dust and other particles can obstruct the flow of gas through a hose, and can eventually cause problems with the flame.

If a hose has developed a leak, a brass fitting may be inserted into the hose to replace the leaking section. To do this, cut the section of the hose where the leak is located and insert the brass fitting to connect the remaining pieces. Be certain to only use brass splices, and never use copper tubing. If copper tubing is used, acetylene will combine with the copper to create **acetylide**, a dangerous explosive.

When connecting a hose to a torch, make sure a **flashback arrestor** is installed between the hose and the torch. Figure 2 shows these important devices. Flashback arrestors prevent **flashback** from occurring while you work. However, since flashback arrestors can lower the pressure of gas flowing into the mixing chamber of a torch, they can lead to **sustained backfires**. If sustained backfires occur at all, stop welding immediately, and adjust your gas pressures.

Figure 1. Hoses connect the torch to the gas cylinders and must be inspected before use.

Figure 2. Flashback arrestors are a necessary precaution to protect welders from possible explosions.

Lesson: 13/16

Ventilation

For the safety of a welder, all welding should be performed in a well-ventilated area. The welding process generates a variety of **fumes** that are hazardous to the welder if not properly vented from the area.

Proper ventilation depends on the environment. If you are working in a smaller area, opening nearby doors and windows may be enough to properly remove dangerous gases from the air. Setting up fans can help improve the ventilation as well.

However, larger areas may have specific ventilation systems, such as a **welding hood** with a **fume extractor** as shown in Figure 1. These systems force the contaminated air out of the welding environment, ensuring the welder can breathe well. Many welding environments also feature **downdraft tables** to enable proper ventilation. Figure 2 shows one of these tables.

Occasionally, welding may require working in an environment with poor ventilation, with no access to a ventilation system. In these situations, a welder should wear a **respirator** or an **air purifier**.

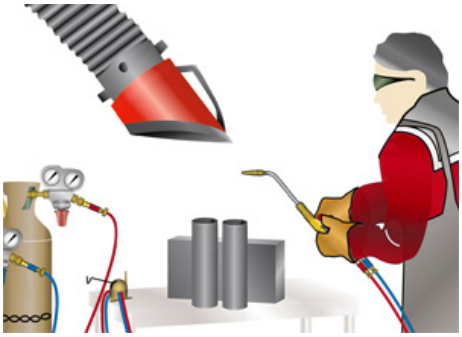

Figure 1. Fume extractors suck contaminated air away from the welder.

Figure 2. This downdraft table sucks the fumes generated by welding down and away from the welder.

Lesson: 14/16

Locations for Oxyfuel Welding

One of the biggest advantages of oxyfuel welding is the portability of the oxyfuel outfit. Oxyfuel equipment can be used in a wide variety of settings, without electrical power. Oxyfuel equipment can be easily transported by a truck and used anywhere.

With different locations come a variety of potential hazards. In any welding situation, the most important environmental concern is the removal of any flammable objects. Be sure to notice any signs such as those shown in Figure 1 that would indicate the area is unsafe for welding. If you cannot remove a flammable object, use a fire-resistant shield to protect the object. If you are working on a platform or a ladder, be certain there are no flammable objects below that may ignite.

Oxygen and fuel cylinders must be securely stored on a stable surface. Be sure your welding area is separated from anyone else and that people will not be entering the area while you are working. Use warning signs to alert people that they should stay away while welding is in progress.

Additionally, consider where you are positioning your equipment in relation to the people who work in the welding area. If possible, do not obstruct any commonly used paths. If you are required to work in a high traffic area, keep your equipment as out of the way as much as possible. Lastly, outdoor areas are often safest for oxyfuel welding if possible, as shown in Figure 2.

Figure 1. These signs warn that an area is unsafe for welding.

Figure 2. Working in an outdoor environment can cut down on the dangers of oxyfuel welding.

Lesson: 15/16

Fire Safety

Since oxyfuel welding uses a live flame, you must constantly be aware of basic fire safety. Learn the fire safety procedures of the location where you are working. Make sure you know where emergency exits are located before beginning any work. Also be certain to locate the closest fire alarm for use in an emergency.

To be prepared for a fire, you should know the location of the nearest **fire extinguisher** and check that it is full and regularly maintained. Figure 1 shows an extinguisher in good working condition. A spark from a welding torch can cause any flammable objects to ignite, but a properly used fire extinguisher can help prevent such small fires from causing excess damage.

Some locations for oxyfuel welding may not have convenient fire extinguishers available. If you are required to work in such an area, make sure you have access to fire hoses, fire-resistant blankets, **fire shields** such as those in Figure 2, and any other fire-fighting equipment.

Ideally, fires should never happen. However, preparation is essential for the safety of yourself and others.

Figure 1. Fire extinguishers should be located before any welding begins. (Courtesy of NMC.)

Figure 2. Fire shields prevent sparks from escaping the welding area.

Lesson: 16/16

Summary

Oxyfuel welding demands proper safety procedures to avoid injury. Proper personal protective equipment (PPE) must be worn at all times when working with oxyfuel equipment. Leather jackets and pants offer the most protection. In addition to proper clothing, welders must wear goggles or welding masks with filter plates.

To improve safety in the workplace, you should regularly visually inspect each component of an oxyfuel rig for wear or damage. For safety, a torch should be shut down whenever not in use. Torches malfunction due to a relatively predictable list of causes: backfire, sustained backfire, and flashback. Flashback arrestors prevent flashback from occurring, but the other possible hazards require careful monitoring of the operation.

Welding safety depends on the safe use of all parts of the oxyfuel outfit. Torch tips must be regularly cleaned and maintained. Oxyfuel welding gases can be dangerous if not properly handled and stored. MAPP gas is somewhat safer than acetylene, but has limited uses. Hoses should be properly cleaned and regularly checked for leaks.

Oxyfuel welding should only be done in areas with proper ventilation. Flammable objects should be removed from the work space if possible. You should know where all fire safety equipment is located wherever you are working.

Figure 1. Safe oxyfuel welding requires proper clothing and awareness of your environment.

Figure 2. Well-maintained oxyfuel hoses and torches are essential to welder safety.

Class Vocabulary

acetylide A highly explosive chemical compound that is created by the interaction between acetylene and copper. Copper tubing should never be used to splice oxyfuel hoses due to the risk of creating acetylide.

air purifier A device which removes contaminants from air. When working in enclosed spaces, welders may need an air purifier or a respirator to provide clean air for breathing.

arc flash An extremely painful condition that results from excess exposure to UV rays. Arc flash can feel like sunburn on the eye; it is usually a temporary condition.

arc welding A fusion welding process that uses electricity to generate the heat needed to melt the base metals.

auto-darkening filter plate A type of filter plate that automatically adjusts to the proper amount of shading for any welding process.

backfire A torch malfunction in which the flame moves up into the tip of the torch. Backfire is fairly common and is not a major safety concern.

combustible Any substance that is capable of igniting and burning.

cylinder truck A two-wheeled dolly used to safely move gas cylinders. Cylinder trucks can be used to safely store gas cylinders temporarily as well.

downdraft table A table for welding which uses suction to pull fumes downward through the table, away from the welder.

filter plate The shaded protective lens inside the welder's helmet that filters out harmful rays and intense bright light. The amount of shading required depends on the welding process.

fire extinguisher A portable device that uses a rapid spray of chemicals to put out small fires.

fire shield A large, flame-resistant screen. Fire shields are placed around the area of welding to protect bystanders from spatter, the arc's harmful rays, and bright light.

fire-resistant Made of materials which are designed to resist burning and withstand heat.

flashback A torch malfunction in which the flame briefly or continually moves up into the torch and hoses. If a flame reaches the hoses, an explosion can occur.

flashback arrestor A part of an oxyfuel outfit that is installed between the hoses and the torch. A flashback arrestor reduces the chances of flashback occurring while a torch is used.

fume Metallic vapor that is emitted during the weld process. The metallic vapor solidifies to form tiny particles of metal.

fume extractor Any device that uses suction to remove from the environment the smoke and gases generated by welding.

infrared Invisible rays emitted during the welding process. Infrared rays can damage vision.

MAPP gas A liquefied petroleum gas that can be used in oxyfuel processes. Some disadvantages of MAPP gas include high cost and inability to work with steel.

nonpetroleum soap Soap that does not contain petroleum, which can be flammable.

overhead welding Welding that is done above eye level. This type of welding requires extra safety precautions.

personal protective equipment Any example of various safety equipment that workers wear or use to prevent injury in the workplace. Safety glasses are common personal protective equipment (PPE).

polyester A fabric made of man-made materials that can melt in the presence of the torch's extreme heat. Jerseys are sometimes made of polyester.

rayon A fabric made of man-made materials that can melt in the presence of the torch's extreme heat. Button-down shirts are sometimes made of rayon.

respirator A gas mask that filters out harmful dust, fumes, and gases from the air being breathed.

sustained backfire A torch malfunction in which the flame continually burns inside the torch, sometimes moving as far into the torch as the handle. Sustained backfire is considered extremely dangerous.

ultraviolet Harmful invisible rays emitted by the torch during welding. UV rays can damage a welder's vision and burn skin.

valve cap A device used to prevent the flow of gas from a cylinder while not in use.

welding hood A stationary ventilation device installed above the weld area. The welding hood sucks up harmful fumes in its surrounding area.