TURN UP THE BRAZING HEAT

A discussion about oxygen/acetylene vs. air/acetylene torches, including applications, comparisons, and base and filler metal suggestions.

BY BOB HENSON AND MIKE SCRUGGS

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Air/acetylene equipment

When brazing and soldering, most HVACR technicians routinely use manual torches as their heat source. For brazing there are generally two equipment options to choose from: oxygen/acetylene or air/acetylene. While alternate fuel gases are available, most contractors still use acetylene. The equipment features and benefits of each type will be the focus in this article.

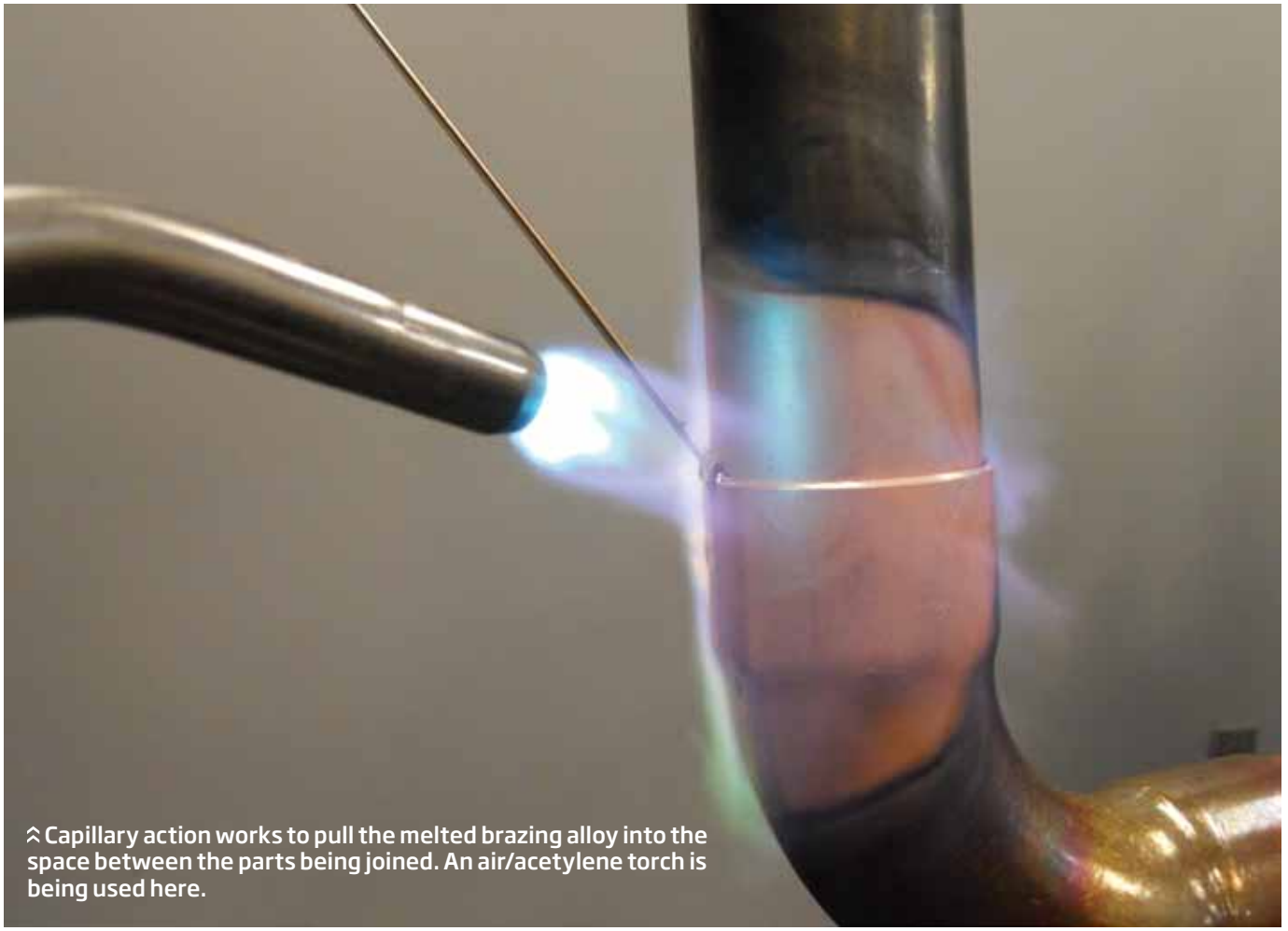
How they work

A major difference between the two setups is how acetylene is combusted. An oxygen/acetylene system requires a cylinder of compressed acetylene gas as well as a cylinder of compressed high-purity oxygen. It combines these gases to get an intense flame temperature. An air/acetylene system only requires the use of a single acetylene tank and gets oxygen from the atmosphere. Since air contains only about 21% oxygen, it was difficult for older air/acetylene torches to reach the higher flame temperatures necessary for brazing. This limitation made these torches suited more for low-temperature soldering.

To obtain a higher flame temperature with air, the ratio of air to acetylene must be increased. With the modern development of the swirl combustion design, air/acetylene systems became useable for high-temperature brazing. In these torches, acetylene gas traveling through the tip expansion chamber creates a Venturi effect siphoning more air into the tip. The larger air volume is mixed with the acetylene at increased velocity, and a rotor or vane homogenizes the gases. This creates a richer mixture that burns more efficiently. This unique tip design gives the flame its distinctive swirl pattern.

Temperature

Flame temperatures can vary as they are affected by several



» Capillary action works to pull the melted brazing alloy into the space between the parts being joined. An air/acetylene torch is being used here.

factors. Most oxygen/acetylene flames, however, measure close to 5,400°F at the end of the inner cone. Air/acetylene flames measured at a similar location typically reach 3,000°F. The fact that lower flame temperature does not necessarily mean reduced heating efficiency will be discussed later.

Portability/ease of use

Each system requires the use of regulators, hoses, torch handles and tips, but components are unique to each type of system.

Oxygen/acetylene: Most setups used in the HVACR industry are of the compact portable-torch style. The operator must carry and refill two cylinders so the additional cost of the oxygen cylinder must be considered. The cylinders are usually industry standard "MC" acetylene (10 cu ft) and "R" oxygen (20 cu ft). A neutral flame uses close to a 1.1:1 ratio of oxygen to acetylene. Since cylinder volumes are different, the draw off is unequal. This means contractors may often make extra trips to the gas distributor or carry backup cylinders.

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Air/acetylene: These systems require only the use of a single "MC" or "B" (40 cu ft) size acetylene cylinder. The single cylinder and simpler torch/regulator components make the system easy to carry. Another advantage of an air/acetylene

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setup is the ability to run different tip sizes at a single pressure setting. This eliminates the need to remember and adjust the pressure for both gases for different tip sizes—a requirement with oxygen/acetylene.

Safety

Since two gases are being mixed in an oxygen/acetylene system there is potential for a flashback, which is the ignition of mixed gases. This safety concern is reduced with an air/acetylene torch since only a single gas is being used.

Versatility

Oxygen/acetylene systems are a popular choice because of their ability to work on a wide range of applications. For example, steel can be welded with standard tips or cut with a cutting attachment. Large-diameter tubing can also be heated using a multi-flame tip.

« Oxygen/acetylene equipment

For soldering, air/acetylene systems are preferred. The flame characteristics allow lower heat input and reduce the risk of overheating solder and flux.

Flame characteristics and brazing

The fact that an oxygen/acetylene flame has a higher temperature has already been mentioned. The important consideration is not temperature by itself, but how heat is distributed.

In welding or cutting, the oxygen/acetylene-focused flame is necessary because the heat needs to be concentrated at a small point. For brazing, a different mechanism called "capillary action" is required to pull melted brazing alloy into the space between the parts. To achieve uniform capillary action, both parts must be evenly heated before adding rod. This broad preheat promotes heat conduction through the joint and brings both pieces to correct brazing temperature.

Since the highest temperature is focused at the end of the inner cone, if oxygen/acetylene is being used for brazing, the torch must be kept in motion to evenly distribute heat. The torch also needs to be located farther away or the flame intensity will overheat the part—especially troublesome on brass or aluminum.

The air/acetylene flame is more forgiving. The inner cone can be placed closer to the part and be left there longer with less chance of burn through. The broader flame tends to wrap around the tube/fitting and provides wider heat distribution. Many in the industry feel these features make brazing easier, especially for new technicians.

Aluminum

When brazing copper, phosphorus-copper-silver rods melt at a temperature significantly below the base metal's 1,981°F melting point. An industry shift to aluminum coils and other components is being seen. Repairing aluminum is different.

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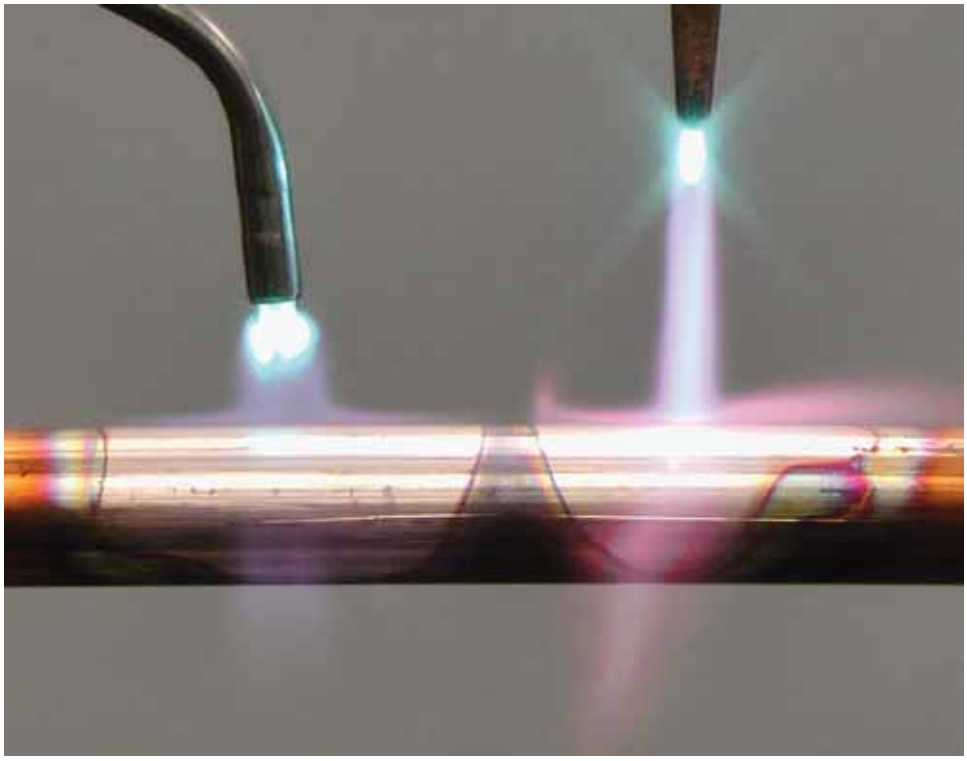

» Air/acetylene (left) and oxygen/acetylene (right) heat spread pattern.

The base metal melts at approximately 1,200°F, but most filler metals used for aluminum melt just below this temperature, often providing only a 130°F difference.

> **Use oxygen/acetylene with care—the higher flame temperature, especially close to the inner cone, can quickly melt the aluminum tube.**

The lower aluminum-melting temperatures means the heat input must be reduced and focusing the flame on one spot must be avoided. Use oxygen/acetylene with care—the higher flame temperature, especially close to the inner cone, can quickly melt the aluminum tube. Air/acetylene's lower heat input and wider flame pattern often makes this job easier.

Summary

In most parts of the United States, oxygen/acetylene equipment maintains its industry dominance. For many air-conditioning brazing applications, however, air/acetylene torches are a logical alternative. Contractors who try air/acetylene torches often find their portability and lower operating cost easily offset the potential of a slightly longer heating time.

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For more information, visit www.harrisproductsgroup.com.

Following are a few considerations to keep top of mind for the safe handling of torches, regulators and cylinders. Remember, safety is a full-time responsibility. Accidents can be prevented by understanding their cause, and the best cure is prevention.

1. Chain cylinders to prevent their falling over. An oxygen cylinder with more than 2,000 psi in it becomes a lethal projectile if it falls over and its cylinder valve is sheared.

2. Vent the oxygen-regulator valve before attaching the regulator to the cylinder. This blows any dust or dirt (which may be combustible) off the cylinder valve. Dust and dirt in the regulator inlet provides the fuel that can be ignited by the heat of recompression in an oxygen atmosphere. Inspect the filter in the regulator inlet, if so equipped, to ensure it is in place and it is clean.

3. Open the oxygen cylinder valve slowly, and always stand to one side while doing this. This prevents the sudden pressure surge, which is accompanied by substantial heat, and also prevents unnecessary strain on the regulator.

4. Purge the system by bleeding off each hose independently. If reverse flow has occurred, this precaution safely bleeds off the mixed gases.

5. When using oxy/acetylene, always light the acetylene first, when using alternate-fuel gases with oxygen, it is permissible to light the torch with both gases flowing. Always check with the manufacturer or other authorities first before attempting to operate oxy-fuel equipment.

6. Use the correct tip size and pressure. Each tip is designed to operate at a specific pressure. If too much pressure is used, the system can be back-pressured and reverse flow occurs. If too little pressure is used, the tip will sputter and pop and perhaps encourage backfire or flashback.

7. Keep heat and flames away from combustibles. Obviously, if torch flames and sparks are around combustible materials, they can be ignited easily.

8. Do not use oxygen as a substitute for air. If clothing is blown off with oxygen, the clothing will absorb the oxygen. Then if a spark or other source of ignition touches the clothing, the three necessary ingredients for a fire are present. Combustible material burns more vigorously in an oxygen enriched atmosphere than in air. Serious injury may result.

9. The expression "use no oil" is printed on every regulator gauge. Oil is a combustible material with an extremely low flash point. An oxygen regulator frequently has two of the three necessary ingredients for a fire. If the cylinder valve is opened quickly, the heat of recompression creates an ignition temperature. Oxygen is present, and if oil is also in the area, a combustion triangle is complete and a dangerous explosion can occur.

DO NOT attempt to repair or substitute parts on equipment, particularly the regulators. Special techniques and tools are needed to safely repair oxy-fuel gas welding and cutting apparatus.

DO NOT handle oxygen regulators, oxygen cylinders, valves, or any other equipment with oily or greasy hands or gloves. Oxygen will react with oil and grease in such a manner that will easily result in fire or explosion.

DO NOT lay or store oxygen regulators or other oxygen equipment on oily or greasy surfaces. The equipment can become contaminated with oil or grease, which might result in a fire or explosion.

DO NOT use acetylene pressure above 15 psig. Acetylene pressures above 15 psig can result in a fire or explosion.

DO NOT empty the oxygen cylinder below 25 psig–50 psig. If the oxygen cylinder is allowed to become completely empty, it will lose its positive pressure, and contamination may enter the cylinder and create an unsafe condition.

DO NOT change regulators from one gas service to another or replace a pressure gauge with one taken from any other service. Contamination resulting in a fire or explosion can take place by changing pressure gauges or regulators from one service to the other.

DO NOT leave pressure on a regulator, hose or torch when not in use for an extended period of time.

Source: "Equipment Operation Safety Guidelines," Harris Products Group, www.harrisproductsgroup.com.