Equipment Operation SAFETY GUIDELINES

IT'S YOUR LIFE . . . Preserve it with Safety

This safety bulletin illustrates causes of industrial accidents with torches, hoses and regulator and shows the two ways in which these accidents can be prevented:

1. SAFE HANDLING OF TORCHES, REGULATORS, AND CYLINDERS
2. USE OF AVAILABLE MODERN SAFETY EQUIPMENT

Remember, safety is a full-time responsibility. Accidents don't need to happen. Understanding their cause and cure is the best prevention.

"BLOWN" REGULATORS . . .
Illustrate the type of serious accidents which can cause injury, lost time, liability, property damage, and administrative headaches. This is a typical accident that frequently occurs and can be prevented. Gases incorrectly mixed within the regulator and hose create an explosive mixture which can ignite.



The subsequent explosion is violent and injuries come from both the flames and the disintegrating metal.

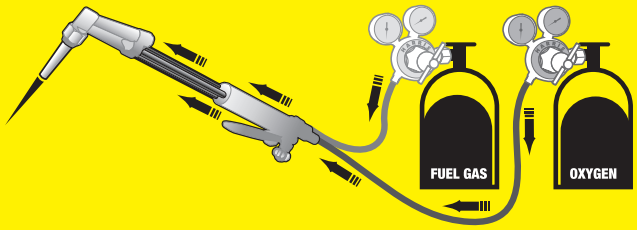
THE EXPLOSIVE FORCE . . .
Resulting from the incorrectly mixed gases which are lighted can be tremendous. Regulators can rupture. The letter, reprinted on this page, describes an accident where an oxygen cylinder exploded:

"A recent explosion of a single oxygen bottle killed three men and injured thirty others. The top of the bottle was found high in the plant roof; the bottom was buried deep in the ground. The center portion disintegrated in the form of shrapnel."

More frequently, the incorrectly mixed gases ignite in the hose; the injury to the operator is a burn. However, oxygen and fuel gas burn at 4000 -6000 F, so the burn injury frequently is severe.

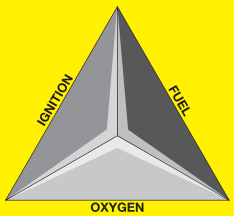
SAFETY IS A FULL-TIME RESPONSIBILITY

The accidents described so far could all have been prevented if the oxygen and fuel gas had been kept separated. The gases cannot cause trouble when correctly used. For example, each travels from its cylinder through its regulator and hose into the torch, and only become mixed in either a specially designed mixing chamber within the torch itself or in the tip. Danger occurs only when mixing takes place in some area other than the correct location.



TO START A FIRE . . .
You must have three things: fuel, oxygen and ignition.
No two will burn alone.

For example, a popular fire extinguisher is filled with carbon dioxide. It puts out a fire by smothering it. Smothering means it prevents atmospheric air, which has a 21% oxygen content, from getting to the flames. Without the oxygen, the fire extinguishes itself.



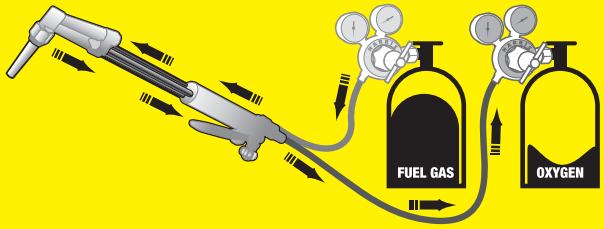
Combustion Triangle

On the other hand, you can't have a fire without fuel. An automobile won't run on an empty gas tank. Finally, a combustible mixture isn't dangerous until it's lighted. Mixed gases in a hose or regulator aren't hazardous until they're lighted. This ignition can occur several ways.

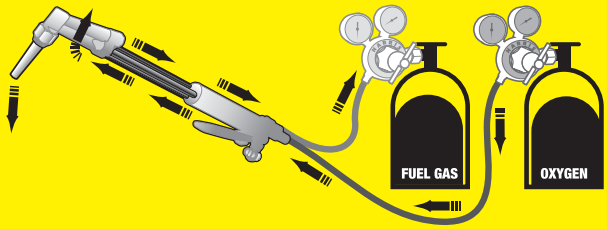
REVERSE FLOW CAUSES . . .
Reverse flow caused by unequal pressures can result in mixed gases in hoses and regulators.

Reverse flow can happen when:

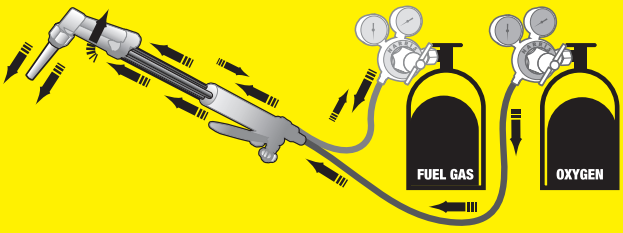
1. The oxygen cylinder empties in use and with the oxygen needle valve on the torch opened, fuel gas can reverse flow into the oxygen hose and regulator.



2. Both cylinder valves are closed with unequal pressures in the regulators and the torch valves closed. If the operator opens both torch needle valves simultaneously to bleed off the oxygen and fuel gas, typically higher pressure oxygen may reverse flow into the typically lower pressure fuel gas hose, regulator and upstream gas supply.



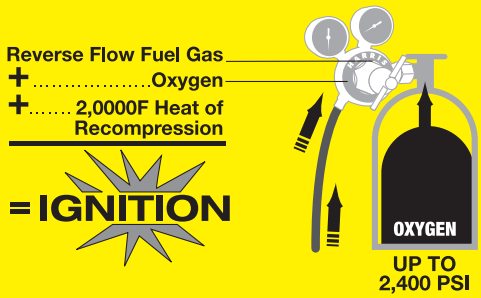
3. The operator opens both torch valves and attempts to light both gases at once. If more oxygen is flowing than can flow through the tip, the system is back-pressured and oxygen can reverse flow into the fuel gas hose and regulator.



With reverse flow, two of the three ingredients necessary for a fire are present. All that is lacking is the source of ignition.

IF REVERSE FLOW . . .
puts mixed gases into the oxygen hose and regulator, an explosive mixture may result which could cause serious personal injury or fire.

1. The oxygen torch valve is opened and the mixed gases meet the fuel gas flame.
2. The cylinder valve of an oxygen regulator with pressure up to 2,400 psi is quickly opened and the "heat of recompression" (approx 2000 F) raises the mixed gases to ignition temperature.



IF REVERSE FLOW . . .

has put mixed gases into the fuel gas hose and regulator, a dangerous explosion can occur when:

1. The fuel gas torch valve is opened and gases are lighted before the mixed gases are completely bled off. With a small tip this can be several seconds.

THESE ACCIDENTS . . .

can be prevented if the equipment is properly used.

1. An oxygen cylinder never should be completely emptied. It should be considered empty when the pressure drops to approximately 50 psi.

2. The operator should always independently bleed his hoses before lighting the torch. This bleeds off any combustible mixture that may be present.

3. The operator should never light both gases at once. The only exception is a universal pressure torch. Universal pressure equipment is designed to prevent reverse flow, except when the tip is obstructed.

4. Equipment must be in good condition. If a torch tip is plugged, the higher pressure gas will always back up into the lower pressure line.

IF TORCHES ARE CORRECTLY USED . . .

accidents won't happen. However, all of us occasionally are careless. Many years of field experience have shown the various oxy-fuel gas torches to be reliably safe pieces of equipment when operated in accordance with the instructions recommended by the manufacturer. Under certain circumstances, the users fail to follow these instructions. Failure to follow these instructions can cause the backflow of unwanted gas into the hose lines.

"Flash-guard" check valves can provide a measure of protection to prevent reverse flow. To maintain this protection, a routine inspection program must be followed to ensure that the check valves are still functional. These are available in two styles. The torch type is mounted on the torch and fits any torch with standard hose connections. Their large capacity flows enough volume to cut 12" steel plate or handle Harris' largest heating torch. These are preferred for stopping REVERSE FLOW at the point of origin. They are easily tested and easily seen.

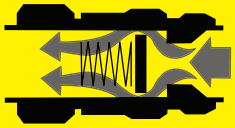
FLASHGUARD®
CHECK VALVES



The regulator type is mounted on the regulator outlet nipple. They have the same capacity as the torch type, and their effective service life is expected to be longer than the torch type. This is because they are subject to less abuse and installed in a clean area (upstream of the hoses). They effectively prevent REVERSE FLOW into the regulator and cylinder and prevent dangerous quantities of mixed gases from entering into the hoses. These are sometimes preferred for the practical value of longer service life.

Harris check valves open wide for full flow at only four ounces of pressure; but if REVERSE FLOW starts, the valve closes instantly. Each valve is individually tested at the Harris factory for positive shut-off at only 10 ounces of backpressure.

HOW THEY WORK . . .



Normal Flow - Valve Open

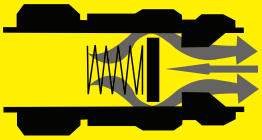


Reverse Flow - Valve Closes

Check valves are designed to stop REVERSE FLOW. They are not designed to stop a flame. However, many equipment fires and explosions are caused by reverse flow. Check valves stop trouble before it starts by stopping reverse flow the moment it begins. Pipeline systems using oxygen and fuel gases, in accordance with NFPA-51, will require back flow checkvalves independent of any installed on hoses.

EXTERNAL CHECK VALVES . . .

We are frequently asked why check valves are not built into the torches. The reason is Harris Flash-Guard Check Valves are manufactured for a recommended 5 years service life. They should be checked regularly, at least every 6 months. They should be replaced if found defective.

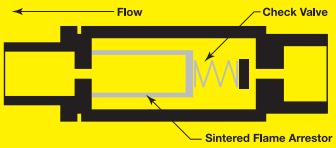


GASES...Separate - Safe.
Combined - Hazardous!

FOR ADDITIONAL PROTECTION . . .

especially in situations where check valves fail to function properly due to abuse or failure to perform periodic inspection and maintenance, Harris Flashguard® Flashback Arrestors should be installed. Flashback arrestors offer an additional measure of protection from accidents caused by reverse flow.

FLASHGUARD®
FLASHBACK ARRESTORS



TWO SAFETY FEATURES IN ONE UNIT . . .

gives the added measure of safety. First, flashback arrestors include a built-in check valve to prevent reverse flow, the major cause of flashback explosions. Second, they have incorporated, in the same unit, a soutered metal filter to extinguish the flame should a flashback occur due to the failure of a check valve or some other such unpreventible condition.

REGULATOR AND TORCH MOUNTED . . .

versions of flashback arrestors are available. Torch types are mounted on the torch inlets and fit any torch with standard “B” type hose connections. These are preferred because they offer protection at the most common point of origin. They are easily seen and offer protection from hose explosions, a very common occurrence in equipment of this type.
The regulator type is mounted on the regulator outlet nipple. The effective service life of this type is generally longer because they are subject to less abuse, and are installed in the clean area upstream of the hoses. They are sometimes preferred when the extra weight and/or inconvenience of the torch type cannot be tolerated. They effectively protect the regulator and the gas supply system and in some instances include thermal shutoff devices reducing certain hazards associated with hose fires.

FLOW CAPACITIES . . .

of Harris Flashguard® Flashback Arrestors are high enough to cut up to ten inches steel plate when used properly. Operating pressures must be increased slightly, however, to compensate for pressure drops through the arrestor.

CAUTION SHOULD BE USED . . .

however, when selecting or using any device such as flashback arrestors on oxy-fuel equipment requiring large volumes of gases to work properly and safely. Large cutting tips and heavy heating equipment are extremely sensitive to flow restrictions created by add-on equipment. Always remember to read the manufacturer’s instructions and/or contact a properly trained representative when using this type of equipment.

TEST FLASHBACK ARRESTORS AT REGULAR INTERVALS . . .

for body leakage and for leaks across the check valve. Dirt and contaminants should be kept from building up on the flame arrestor filter. This condition further restricts flow and it cannot safely be cleaned or repaired. The flashback arrestor must be replaced.

HEAT OF RECOMPRESSION FIRES

As mentioned above, mixed gases can reach ignition temperature due to heat of recompression when the oxygen cylinder valve is opened too quickly. However, mixed gases are only one type of flammable

that can ignite within a regulator when subjected to the high temperature following a sudden exposure to extreme pressure. Combustible contaminant's can be present inside a regulator and cause a fire when subjected to recompression heat and oxygen.

SAFETY IS A FULL-TIME RESPONSIBILITY . . .
and we urge you always to follow these simple safety rules:

1. Chain cylinders to prevent their falling over. An oxygen cylinder with over 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:

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 25-50 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.

IN CONCLUSION . . .

follow these suggestions! Treat your gas apparatus with respect. All manufacturers try to produce the safest equipment possible; but when it is not properly used, serious accidents do occur. Also, make sure check valves and or flashback arrestors are on every torch. They will help you during those times when your hands are working, but your head isn’t.

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