Safety Flash A12-01

Issued: **17th February 2012**
Subject: **Incorrect oxygen bottle operation and 'near adiabatic compression'**

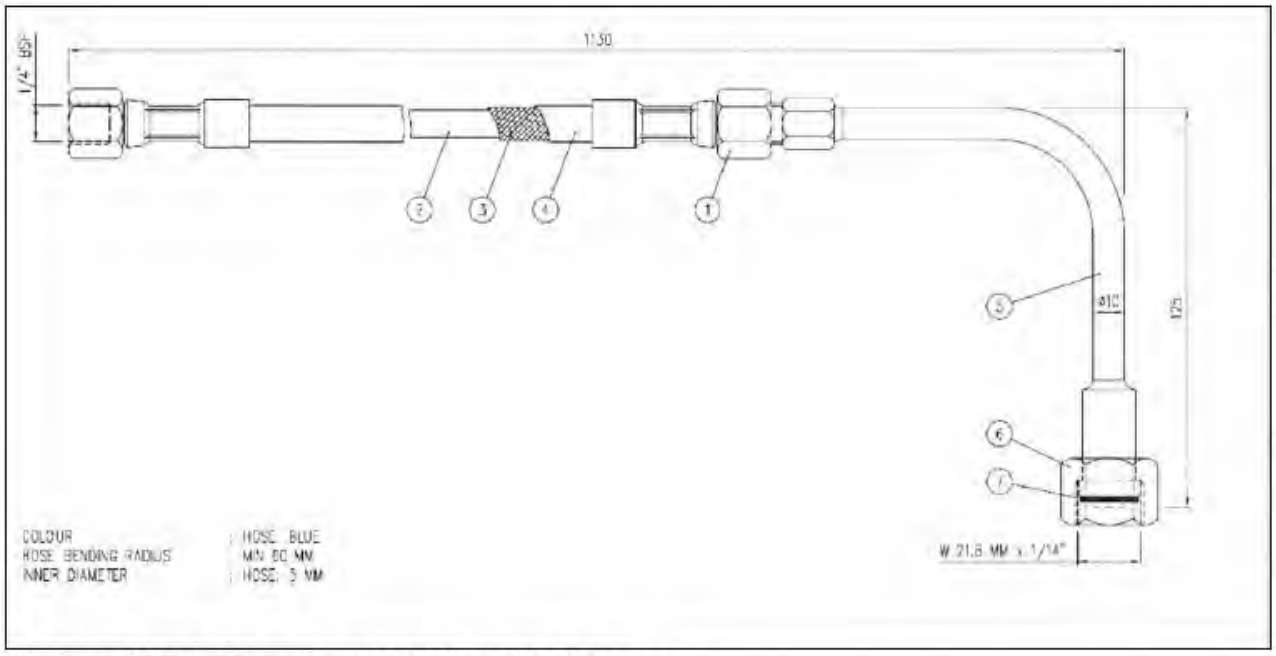
There was an incident on a vessel concerning an oxygen blowback down the high pressure hose linking the oxygen cylinder and the regulator assembly. During this process a considerable amount of stored energy was converted to thermal energy resulting in the hose rupturing and blowing off the elbow fitting attached to the oxygen cylinder.

Fortunately there was no injury however there was a high potential for serious injury to have been sustained.

The C/E and 2/E wished to use the oxy acetylene equipment. With the 2/E standing behind him, the C/E reached into the oxygen locker and opened the valve on the oxygen bottle by one complete turn. He then reached up and opened the regulator assembly valve and at that point he observed a blue and yellow flash/flame running along and under the Hytrel PTFE sheathing which is the outer insulation cover of the high pressure hose joining the bottle to the regulator. Almost immediately afterwards a small explosion occurred as the hose blew off the ferruled fitting of the elbow at the oxygen bottle end (Please see figs 1 & 2).

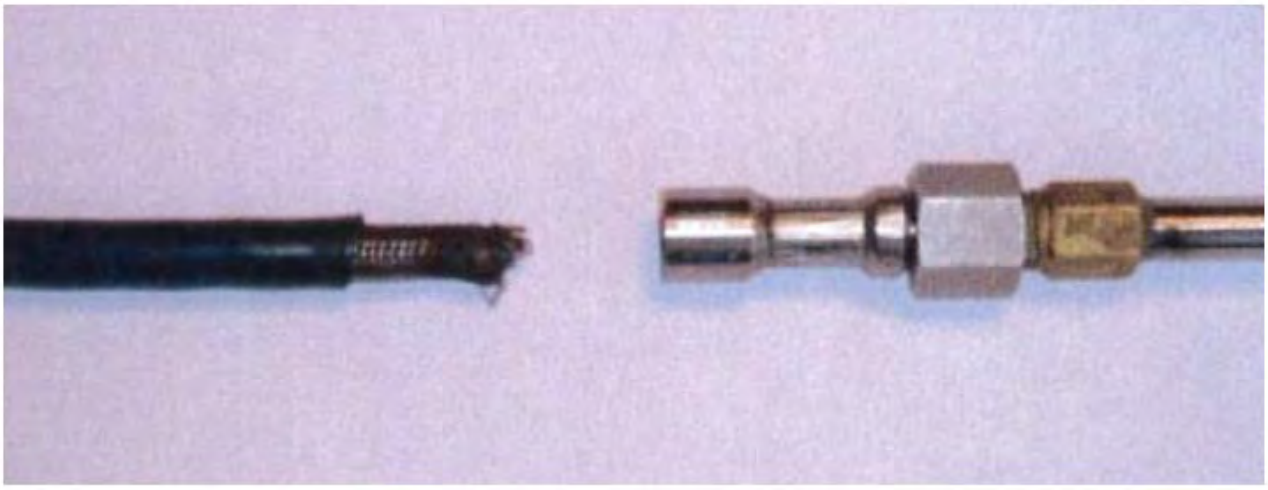
Due to release of pressure when the hose blew off the flame was extinguished and the C/E was able to close the oxygen cylinder valve without further mishap.

Fig 1



The hose failed at the elbow socket (position 4 above)

Fig 2



Following the review of an independent post-incident hose inspection report undertaken by the hose supplier, and analysis of historical data from previous accidents of this nature; it has been concluded that the primary cause of the blowback was due to “near adiabatic compression” occurring in the high pressure hose when the C/E quickly opened the cylinder valve against a closed regulator assembly valve.

Adiabatic Compression in this instance can be defined as when the oxygen within a system is compressed rapidly with virtually no heat loss to the surrounding material, it will cause the oxygen temperature to rise rapidly. This can occur with all gases, however in the case of oxygen self or auto-ignition may occur. When oxygen is pressurised in excess of 200 bar and is suddenly volume-altered, adiabatic compression / heating can be expected.

It is also most likely that, as the high pressure hose had been in service for 5 years (it was due to be replaced within days of the accident occurring) and no doubt numerous oxygen cylinders had been changed out on this hose assembly, there had been local weakening of the hose at the elbow connection. This would have been due in no small part to stresses introduced at cylinder changes and possibly due to incorrect bending causing local stresses in the braiding at the elbow connection. This can only be an assumption as the hose as previously stated had been removed from the installation after the incident, and before investigation, such that the actual bending stresses on the high pressure hose cannot be conclusively determined. The point of local weakening, however, can most likely be attributed to the cumulative effect of associated oxygen bottle removal / replacements over the life of the hose.

Corrective Action/Lessons Learnt

Precise instructions have been posted on the bulkhead and written into procedures that under no circumstance is the oxygen bottle valve to be opened rapidly against a closed regulator assembly. These valves should be ‘cracked’ and very slowly opened to introduce the oxygen in a controlled and stable manner.

That all oxy-acetylene systems should be checked immediately with a special emphasis on reducing any bending stresses on the high pressure hoses, and that they should be installed exactly as shown in Figure 3. Additionally, hoses to be replaced every 5 years or as per manufacturer’s instructions and only correct type of hose to be used. It is very important that no substitutes of any description are used.

Fig 3