

Equipment Alert – November 4, 2011

2nd Update on Failure of High Pressure Gas Fittings and Valves in Refuge Alternatives

An Equipment Alert and an update have been issued regarding valve and fitting failures on breathable air components of refuge alternatives. On Sunday, January 9, 2011, a catastrophic failure occurred in an oxygen cylinder fitting connected to the breathable air system in a refuge alternative located in an underground coal mine. On January 21, 2011, A. L. Lee reported a second CGA 701 brass fitting failure in a refuge alternative that had been returned to their shop.

Following the January 9, 2011, failure, MSHA issued the Equipment Alert regarding a catastrophic failure that occurred in an oxygen cylinder fitting in an A. L. Lee refuge alternative in an underground coal mine ([Click here to view January 25, 2011, Alert](#)). The investigation revealed that the failed fitting did not meet the dimensional specifications of the applicable Compressed Gas Association (CGA) standard. (See Figure 1)

Following the second reported failure of a refuge alternative fitting ([Click here to view updated alert of February 10, 2011](#)) MSHA issued an updated Equipment Alert. This fitting met the dimensional specifications of the CGA standard. On February 3, 2011, A. L. Lee reported that cracks had been discovered in both the brass fittings and cylinder valves of a third refuge alternative that had been returned to their shop. (See Figure 2) These fittings also met the dimensional specifications of the CGA standard. These fitting failures demonstrated that the problem extended beyond dimensionally incorrect fittings.

Because the subsequent failures involved dimensionally correct fittings, MSHA and A. L. Lee investigated several factors that may have individually or collectively contributed to the failures. Additionally, samples of the fittings were sent to metallurgical labs for analysis.

In an effort to determine the mode of failure and possible causes, MSHA sent representative samples to the OSHA Salt Lake City Technical Center (SLTC) laboratory in Salt Lake City, UT. Quoting from the OSHA report, “The analysis performed at the SLTC revealed that the cracks are a result of stress-corrosion cracking (SCC) and the evidence suggests that dezincification is a contributing factor. The stress-corrosion cracks that have formed in the fittings and valves indicate that they are on the path to failure. The demonstrated short and unpredictable service life of the CGA brass valves and fittings is troublesome. The current situation left unchecked represents a safety hazard.”

A copy of the [OSHA report](#) is attached.



Figure 1 Measured length (shown upright) on CGA compliant and non-compliant high pressure oxygen fitting (nut)



Figure 2 – View of cracked cylinder valve. Arrow points to crack.

Recommended Actions

Some of the recommended actions in both the first and updated alert were that:

1. All refuge alternatives should be physically examined to ensure correct fittings are installed on compressed gas systems. Operators were advised to contact the refuge alternative manufacturer to assist in the examinations. Additionally the operator was advised to ensure that the refuge alternative manufacturer performs all necessary repairs to the refuge alternative. The examination was to include removing access doors, if necessary, to measure and examine each fitting to verify compliance with the applicable CGA standard. The examination may have required removal of fittings to take necessary

measurements. A fitting identified with a CGA standard number does not guarantee that the fitting complies with the CGA standard. MSHA advised that the fittings should be physically examined to verify compliance.

2. Operators were advised to request the refuge alternative manufacturer to verify that the fittings meet the appropriate Compressed Gas Association (CGA) standard.
- 2a. Operators were advised to request that the refuge alternative manufacturer verify that the CGA standard pressure range corresponds with the pressurized gas system within the refuge shelter. For example: CGA standard "Connection No. 701" is used for standard cylinder valve outlet connections for pressures ranging from 4,001 to 5,500 psig on compressed oxygen systems. CGA standard "Connection No. 347" is used for standard cylinder valve outlet connections for pressures ranging from 3,001 to 5,500 psig on compressed air systems.

As part of the updated Equipment Alert of February 10, 2011, MSHA again recommended that mine operators contact their refuge alternative manufacturers and request that the manufacturers conduct a prompt and thorough examination of their units for interior and exterior cracks on fittings and cylinder valves. MSHA advised that, if this examination identified any fittings or valves exhibiting cracking, the refuge alternative should be removed from service until it can be repaired or replaced. These steps are necessary to assure that all refuge alternatives can be safely used in underground coal mines.

Based on subsequent investigations, analyses, the information contained in the OSHA report, and the West Virginia Order to Refit Underground Mine Shelters, MSHA has issued a Program Policy Letter (P11-V-17) which addresses further inspection and refit requirements applicable to all refuge alternatives, including: prefabricated refuge alternatives with approval granted in accordance with WV Code of State Rules §56-4-8 and accepted by MSHA in emergency response plans; prefabricated refuge alternatives without state approval but accepted by MSHA in emergency response plans and in use prior to March 2, 2009; and refuge alternatives constructed from 15-psi stoppings and accepted by MSHA in emergency response plans.

It is reiterated that prior to the movement, examination, or repair of any refuge alternative, the MSHA Safety Hazard Alert relative to "Oxygen Safety in Refuge Alternatives" (<http://www.msha.gov/Alerts/OxygenSafety11202009.pdf>) should be reviewed and all precautions and warnings observed.

Portable oxygen detectors/meters should be used during pre-shift examinations and maintenance examinations to monitor for elevated levels of oxygen in and around the refuge alternative.