



COMPRESSED GAS ASSOCIATION, INC.

SAFETY BULLETIN

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RUPTURE OF OXYGEN CYLINDERS IN THE OFFSHORE MARINE INDUSTRY

There have been a number of incidents where oxygen cylinders have ruptured after having been used in offshore marine operations. Some member companies of the Compressed Gas Association have studied this problem. The results of the study show that the main cause of cylinder ruptures is the mishandling of oxygen cylinders by users who allow sea water to flow back into the cylinders once they are empty. Metallurgical tests show that sea water in a standard CTC/DOT 3A or 3AA or equivalent TC 3AM or 3AAM oxygen cylinder causes extremely rapid corrosion to the extent that the cylinder may rupture within 60 days depending on the oxygen pressure in the cylinder.

Industrial gas companies have included additional instructions in their filling procedures to check for the presence of sea water in returned cylinders. The potential for a cylinder rupture from rapid corrosion due to sea water is a hazard that not only puts the user at risk but also the producer who transports, handles, and refills the cylinders. Industrial gas companies may include the following additional procedures in prefill inspections:

- Check the weight of cylinders against their tare weights;
- Check for residual pressure;
- Analyze the residual contents of the cylinder for the presence of water;
- Invert a cylinder before discharging the residual product;
- Perform the hammer test and vent; and
- Evacuate the cylinder before filling.

Further, industrial gas companies have determined that by following a few simple procedures while using oxygen cylinders, users would be a tremendous help in solving this problem. The following recommendations to the offshore marine industry will assist the industrial gas industry to reduce the risk of rupture and potential injury from a ruptured cylinder due to rapid corrosion caused by sea water:

- If at all possible, do not attach an oxygen cylinder to a submersible and do not under any circumstances allow an oxygen cylinder to be submerged. If this happens, paint the word “submerged” in large letters down the side of the cylinder once it is emptied and before it is returned to the supplier;
- If a cylinder or bank of cylinders is kept on the surface and is used to supply oxygen to an underwater operation, do not allow the residual pressure in the cylinder or the bank of cylinders to fall below two times the equivalent “sea water” pressure at the depth where the oxygen is being used. Check valves and/or traps should be installed to prevent the backflow of sea water or other process materials;
- Transfill oxygen (or any other compressed gas) from one cylinder or bank of cylinders to another cylinder or bank of cylinders with the permission of the owner of the cylinders in accordance with Title 49 of the U.S. Code of Federal Regulations Part 173.301(e) and clause 5.1.1 of CSA B340 as adopted in the Canadian *Transportation of Dangerous Goods Regulations* and with the permission of the gas supplier in accordance with CGA P-1, *Safe Handling of Compressed Gases in Containers*; CGA P-2.5, *Transfilling of High Pressure Gaseous Oxygen Used for Respiration*; and CGA P-2.6, *Transfilling of Liquid Oxygen Used for Respiration* [1, 2, 3, 4, 5, and 6];
- The valves of all cylinders should be kept closed when not in use, after use, and when returned to the supplier. A survey conducted by gas suppliers found 25% of cylinders supplied for offshore marine service were returned with the cylinder valves open [7];
- Avoid rough handling of cylinders to prevent cylinder damage; and
- Minimize the exposure of cylinders to sea water on dry docks and the decks of ships.

References

Unless otherwise specified, the latest edition shall apply.

[1] *Code of Federal Regulations*, Title 49 (Transportation) Part 173.301(e), Superintendent of Documents, U.S. Government Printing Office, Washington, DC 20402. www.gpoaccess.gov

[2] CSA B340, *Selection and Use of Cylinders, Spheres, Tubes, and Other Containers for the Transportation of Dangerous Goods, Class 2*, Canadian Standards Association, 5060 Spectrum Way, Suite 100, Mississauga, ON L4W 5N6, Canada. www.csa.ca

[3] *Transportation of Dangerous Goods Regulations*, Transport Canada, Canadian Government Publishing, Public Works and Government Services Canada, Ottawa, ON K1A 0S9, Canada. www.tc.gc.ca

[4] CGA P-1, *Safe Handling of Compressed Gases in Containers*, Compressed Gas Association, 4221 Walney Rd, 5th Floor, Chantilly, VA 20151. www.cganet.com

[5] CGA P-2.5, *Transfilling of High Pressure Gaseous Oxygen Used for Respiration*, Compressed Gas Association, 4221 Walney Rd, 5th Floor, Chantilly, VA 20151. www.cganet.com

[6] CGA P-2.6, *Transfilling of Liquid Oxygen Used for Respiration*, Compressed Gas Association, 4221 Walney Rd, 5th Floor, Chantilly, VA 20151. www.cganet.com

[7] EIGA Doc 61/98, *Safe use of gas cylinders in marine service*, European Industrial Gases Association, Avenue des Arts 3-5, B-1210 Bruxelles, Belgium. www.eiga.org

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Safety and Health Committee

NOTE—No technical information has been changed from the 2003 edition. This reaffirmed edition may include minor editorial changes.

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