



DEFINITION OF A THRESHOLD OXYGEN-MIXTURE CONCENTRATION REQUIRING SPECIAL CLEANING OF EQUIPMENT

Scope

This position statement defines the threshold oxygen-mixture concentration above which special cleaning requirements should be implemented to prevent combustion in equipment systems. This threshold does not address all hazards and precautions associated with oxygen-enriched atmospheres. Examples of potential hazards not considered in determining this threshold concentration are as follows:

- use of hand and power tools or other motor-powered equipment in oxygen-enriched atmospheres;
- potential combustion of clothing exposed to oxygen-enriched atmospheres;
- harmful effects of oxygen-enriched atmospheres on human health; and
- oil lubricated compression in which high pressure air or an inert gas with traces of oxygen can create a potential combustion risk with the oil mist/droplets normally present in the system.

Question

What threshold oxygen-mixture concentration shall be used as the basis for requiring special system cleanliness?

Answer

Equipment systems that are exposed to oxygen concentrations of 23.5 mole % or greater should be specially cleaned of residues or contaminants present to reduce the risk of fire, explosion, or promotion of combustion of other system components.¹

Cleanliness requirements are established in CGA G-4.1, *Cleaning Equipment for Oxygen Service* [1]. U.S. Department of Transportation (DOT) aluminum oxygen cylinders shall be cleaned to the requirements of the Title 49 of the U.S. *Code of Federal Regulations* (49 CFR) Part 173.302(b) [2].

To further reduce the risk of oxygen-enhanced combustion when special cleaning is required, it may be necessary to install specific materials of construction or permit only certain lubricants in valves and machinery as a function of oxygen-mixture concentration and process conditions.

Background

Organic and inorganic contamination in oxygen-enriched and pure oxygen systems has been known to cause combustion reactions. Because of this, oxygen and oxygen-enriched systems have more stringent cleanliness requirements than other services such as inert gas and air.

Various organizations, including CGA, have established the need for special cleaning when a process or equipment system contains an oxygen-enriched gas in excess of a threshold concentration. This oxygen-enriched threshold has generally varied between 21 mole % and 25 mole % oxygen. In contrast, some organizations have imposed special cleanliness requirements only above 40 mole % oxygen concentrations as indicated Title 29 of U.S. *Code of Federal Regulations* (29 CFR) Part 1910.430 (h)(2)(i) [3]. It has also been inter-

¹ For oxygen concentrations less than 23.5 mole %, similar cleaning requirements might apply at high pressure.

preted as requiring breathing equipment to be designed for oxygen service, including special cleaning, when the oxygen concentration exceeds 23.5 mole %. See 29 CFR Part 1910.134 (i)(3) [3]. In Canada, CSA B340, *Selection and Use of Cylinders, Spheres, Tubes, and Other Containers for the Transportation of Dangerous Goods, Class 2*, which is referenced by Transport Canada's *Transportation of Dangerous Goods Regulations*, requires cleaning in accordance with CGA G-4.1 [4, 5, 1].

Special cleaning for oxygen-enriched service is defined as the methods used to initially remove contamination and residues from the surfaces of equipment that will contain an oxygen-enriched fluid before the first introduction of the oxygen-enriched fluid. Special cleaning for oxygen-enriched service shall also be used to regain the initial cleanliness of the system before reintroducing the oxygen-enriched fluid any time equipment is exposed to potentially contaminating conditions, either from misoperation, maintenance, inspection, or other causes.

References

Unless otherwise specified, the latest edition shall apply.

[1] CGA G-4.1, *Cleaning Equipment for Oxygen Service*, Compressed Gas Association, Inc., 4221 Walney Rd., 5th Floor, Chantilly, VA 20151. www.cganet.com

[2] *Code of Federal Regulations*, Title 49 (Transportation) Parts 100-180, Superintendent of Documents, U.S. Government Printing Office, Washington, DC 20402. www.gpoaccess.gov

[3] *Code of Federal Regulations*, Title 29 (Labor), Superintendent of Documents U.S. Government Printing Office, Washington, DC 20402. www.gpoaccess.gov

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

[5] *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

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