SAE The Engineering Society For Advancing Mobility Land Sea Air and Space®
INTERNATIONAL
400 Commonwealth Drive, Warrendale, PA 15096-0001

AEROSPACE INFORMATION REPORT

SAE AIR1176 REV. A

Issued 1974-08
Revised 1991-04-19

Submitted for recognition as an American National Standard

OXYGEN SYSTEM AND COMPONENT CLEANING AND PACKAGING

FOREWORD

The cleaning methods and agents described in this document are subject to change by regulatory decree.

The following agencies are known to affect the workplace:

Agencies Involved:

ACGIH	American Conference of Governmental Industrial Hygienists
AQMD	Air Quality Metropolitan District - Los Angeles Basin
CAL-OSHA	California Occupational Safety and Health Administration
EPA	Environmental Protection Agency
FDA	Food and Drug Administration
HESIS	Hazard Evaluation System and Information Service
IARC	Internal Agency for Research on Cancer
NIOSH	National Institute of Safety and Health
NTP	National Toxicology Program
OSHA	Occupational Safety and Health Administration

FOREWORD (Continued):

Items of Concern:

a. Phase-out of "FREON" and substitution of alternate materials. Alternate materials are predicted to be more costly by an order of magnitude and incompatible with existing machinery.

b. More restrictive regulations on release of volatile materials. (Example: Ban on use of hydrofluoric acid in oil refineries but approval to use sulfuric acid which will require 100 times more quantity.)

1. SCOPE:

This Aerospace Information Report (AIR) specifies work area details, cleaning methods, test methods, and specifications for oxygen clean parts and packaging materials.

1.1 Purpose:

This document provides minimum requirements for work areas, cleaning, and packaging of aircraft oxygen systems and components, the normal working pressures of which are 5 psig (0.34 bar) or greater.

2. REFERENCES:

FED-STD-313C Material Safety Data Transportation Data and Disposal Data for Hazardous Materials Furnished to Government Activities

USAF T.O.00-25-203 Contamination Control of Aerospace Facilities

3. GENERAL:

3.1 All oxygen systems and components must be free (less than 26.9 mg/m^2 of surface area) of incompatible oils and grease, or any other combustible fluid or compound. The components must also be free of oxidizable organic particles and shreds of easily oxidizable metals, such as aluminum, magnesium, iron, lint, excelsior, shredded paper, or any other combustible material.

3.2 Oxygen system components, including supply plumbing, can most effectively be cleaned when not installed in the system. Components containing plastic or elastomeric parts are subject to damage when exposed to some cleaning agents, and their resulting odors are difficult to satisfactorily remove. Contaminants such as oils, dust, metal chips, etc., cannot be easily removed by gas purging or liquid flushing within the installed system. Such contaminants can eventually become trapped in some narrow orifice causing either partial or complete failure of the system. In addition, if the contaminant is of a combustible type, the fire hazard is increased. Such contaminants can only be removed by complete disassembly of the affected components, followed by proper cleaning procedures and controlled handling of the clean components until reinstallation into the using system.

4. WORK AREA:

The room should be of adequate size, isolated from oil, grease, paper and lint particles, and other airborne contaminants. Work areas should be lighted to at least 100 ft candles. The relative humidity and temperature maintained at in the work area should be below 50% and 23.9°C ± 28 (75°F ± 5) for good working conditions. Where critical fits, such as metal-to-metal seats are involved, or the disassembly or buildup of high pressure oxygen components is performed, the work should be done on a laminar flow clean bench meeting the requirements of USAF Technical Order 00-25-203.

4.1 Ventilation:

Forced filtered air is preferred. Filtration should remove all airborne particles over 100 µm in size. Filtration or equivalent ventilation may be used, provided airborne particle size is limited to less than 100 µm size. The concentration of airborne particles should be held to the minimum possible.

NOTE: A high concentration of 10 µm airborne particles can cause more problems to components than will a low concentration of 100 µm particles.

4.2 Work Benches:

Work benches shall be covered with easily cleaned surfaces, such as synthetic rubber, vinyl linoleum, formica, or stainless steel.

4.3 Walls and Ceiling:

Walls and ceiling shall be covered with washable vinyl or painted with epoxy, latex paint, or polyurethane-based paints.

4.4 Floors:

Floors shall be nondusting. Covering may be vinyl linoleum or polyurethane paint.

4.5 Storage Areas:

Storage areas shall have easily cleaned surfaces.

4.6 Cleaning:

Work area, benches, floors, and storage areas shall be vacuum cleaned daily. Airborne particle size shall be checked with standard test equipment (Gelleman or equivalent) often enough to prove the airborne particle size in the general work area is less than 100 µm.

4.7 Tools and Solvent Storage:

Tools used for handling oxygen components should be kept in a clean, oil free condition at all times. Solvents, cleaners, or other equipment not related to the immediate work effort should be kept away from the work area.

4.8 Work Clothes and Rules:

Minimum lint producing clothes shall be worn by all personnel. (Angora, wool, and other fuzzy sweaters shall be prohibited). There shall be no smoking, drinking, or eating in the work area. Parts shall be transported and cleaned in lint-free containers. Lint-producing clothes and dunnage shall be prohibited in the work area. Hands must be clean and free of hand creams and other combustible products. Workers' hair should be free of flammable hair sprays. Outside personnel traffic through the area shall be kept to a minimum. The use of a cap and gloves should be considered when working on or handling moderate to high pressure oxygen components.

4.9 Cleaning Agents:

Detergents or solvents in accordance with the following listed specifications are recommended:

a. Nonionic detergent MIL-D-16791
b. Trichlorotriflouroethane MIL-C-81302, Type I or II

5. COMPONENT CLEANING PROCEDURE:

5.1 Method 1 - Cleaning Process for Metallic Articles:

CAUTION: NONMETALLIC O-RINGS, GASKETS, AND OTHER NONMETALLIC MATERIALS SHOULD NOT BE EXPOSED TO THE EFFECTS OF SOLVENT. COMPONENTS, VALVES, REGULATORS, ETC., WHICH CONTAIN SUCH NONMETALLIC MATERIALS, AND WHEN SUCH MATERIALS CANNOT BE REMOVED, SHOULD BE CLEANED PER 5.2.

a. Step 1

Preparatory cleaning, if required. Hand clean by wiping, brushing, descaling, rinsing, etc., to remove all external grease, oil, and contaminants.

b. Step 2

Ultrasonic clean with solvent, or vapor degrease with solvent, or flush with filtered (5 µm nominal) solvent, at a circulation rate of 20 component volumes per minute, minimum flow for 5 min. (When "flush" procedure is used, heated solvent of 49 to 60°C (120 to 180°F) is desired, but in no case should the temperature be less than 16°C (61°F).

c. Step 3

Thoroughly flush with fresh filtered 5 µm nominal solvent.

5.1 (Continued):

d. Step 4

Dry thoroughly with a stream of oil free filtered (5 µm, nominal), dry air, or nitrogen gas heated to a minimum temperature of 82°C (180°F) for a minimum period of 1 h. All metallic components coming into contact with oxygen in a chemical oxygen generator shall be heated to a temperature of 191 to 218°C (376 to 424°F) for a minimum period of 1 h to remove all traces of cleaning agent residue.

e. Step 5

Perform "halogen detector" sniff check, or equivalent, to assure that all traces of solvent or other halogen vapors are removed. When using H-1 Leak Detector (General Electric Company, West Lynn, Mass., or equivalent) for detecting presence of halogen materials in breathing O_2 components or systems, set up detector per manufacturer's installation pamphlet and perform tests with range selector on "high", balance control on "automatic", and ammeter balanced to 0.1 A. Any rise in ammeter reading during sniff check is cause for nonacceptance of the item under test.

Corrective action may include redrying, partial reprocessing or a combination of actions resulting in an acceptable item which passes the sniff check.

f. Step 6

Package components in accordance with the recommendations contained in Section 8 for storage until installation into an oxygen system is accomplished.

5.2 Method 2 - Cleaning Process for Nonmetallic Articles:

The following procedure should be utilized for cleaning all nonmetallic articles including nonmetallic oxygen hoses.

a. Step 1

Using a fresh, hot 49 to 60°C (120 to 140°F) 1% solution of nonionic detergent and water (the use of isopropyl alcohol is not recommended for cleaning nonmetallic articles because they may absorb the alcohol and create a hazard when installed in the oxygem system), (approximately 1 oz of detergent per gallon, 6.3 g/dm^3 of water), thoroughly clean the part by one of the following procedures:

(1) Scrub with a soft nonmetallic brush in the detergent solution. (Brushes should be checked regularly for loose bristles.)

(2) Flush with the detergent solution at a flow rate of 20 component volumes per minute for 3 min minimum, or longer, if necessary to assure proper cleaning.

5.2 (Continued):

(3) Ultrasonic clean in the detergent solution.

(4) Ultrasonic clean with Freon TF, or equivalent, on materials which are compatible with Freon.

b. Step 2

Remove from the solution and immediately blow off all the free liquid with clean filtered, oil free, dry nitrogen gas or air.

c. Step 3

Rinse thoroughly in heated demineralized or distilled water 49 to 60°C (120 to 140°F).

d. Step 4

Thoroughly dry by use of one of the following methods:

(1) Purge with dry, oil free nitrogen, or air filtered through a 5 µm nominal rated filter.

(2) Heat in a temperature controlled oven at 40 to 60°C (104 to 140°F) maximum.

(3) Vacuum evacuation.

NOTE: Nonmetallic gaskets or parts, such as O-rings and diaphragms, should not be subjected to temperatures above 60°C (140°F).

e. Step 5

Package components in accordance with the recommendations contained in Section 8 for storage until installation into an oxygen system is accomplished.

6. OXYGEN SYSTEM CLEANING:

Breathing oxygen is an extremely dry and absorbent gas that readily mixes with all odors and liquids that are commonly used in an airplane. If one or more sections of an oxygen system have been opened and unprotected for a period of time of more than a few minutes, there is a high probability that the system is contaminated with undesirable odors and residue. Oxygen system components, including supply and distribution plumbing, can most effectively be cleaned when not installed in the system. However, where necessary, the following procedures may be employed:

NOTE: Solvent-type cleaning fluids have an adverse effect on plastic and elastomeric materials after a prolonged exposure. Components containing such materials or possessing cavities, which might entrap cleaning fluid should be removed from the system before proceeding with the cleaning operation.

6.1 Procedure:

a. Step 1

Remove all pressure and flow control components, including oxygen cylinders, regulators, shutoff valve, oxygen service units, oxygen masks, pressure transducers, pressure gauges and/or flow indicators. These components should be cleaned using proper cleaning and handling procedures as specified in Section 5.

b. Step 2

Plug or cap all open ends with nonshredding appropriate closure fittings.

c. Step 3

Connect a 20 psig (1.38 bar) clean and oil free Freon 113 or Freon TF source with shutoff valve and pressure gauge to an open end near the system supply cylinder.

d. Step 4

Open Freon supply source shutoff valve to fill the system with Freon 113 or Freon TF. Allow all trapped air to be thoroughly vented out.

e. Step 5

Close Freon supply source shutoff valve to allow Freon cleaning fluid to set for 2 min. Drain Freon cleaning fluid from system to a separate container. Refill with new Freon and maintain a Freon pressure of 20 psi (138 bar) in the system.

f. Step 6

Open fittings at system extremities and allow Freon cleaning fluid at supply pressure of 20 psi (1.38 bar) to flow for 1 min, one location at a time until all extremities have been thoroughly flushed. Use suitable container to collect flushing fluid from openings. Reopen each extremity to allow for complete draining.

g. Step 7

After Freon cleaning fluid has been completely drained, purge systems with oil free, filtered 5 µm nominal clean dry air or nitrogen to ensure that all entrapped cleaning fluid is out of the system. The use of a warm gas will speed up purging.

h. Step 8

Perform halogen sniff test (same as Step 5 of 5.1).

6.1 (Continued):

i. Step 9

Refit all cleaned components back into the system or replace dirty components with clean components as appropriate.

j. Step 10

Perform system functional test where necessary to reinstate system.

7. TEST METHODS:

The maximum level of incompatible oil contamination for oxygen pressure cylinders in the 1800 to 2100 psi (124.1 to 144.7 bar) range shall be determined by the following formula:

0.0461 (0.0071 cm) times inside cylinder diameter in inches (cm) times length of cylinder in inches (cm) (to four places) - maximum acceptable oil content in milligrams for the specified cylinder.

Assembled components shall be disassembled and tested as in 7.1, 7.2, and 7.3. It is recommended that these tests be used as sampling procedures only. Records of the quantitative analysis for oil contamination will be kept as required by applicable policy.

7.1 Metallic Components:

7.1.1 Immerse components in a container of solvent and allow to stand for 5 min.

7.1.2 Remove the metallic components with a pair of stainless steel tongs taking care not to remove any fluid from the container.

7.1.3 Filter the extracting solution to remove solid and insoluble products and wash the filter three times with clean solvent.

7.1.4 The filtrate and the three wash solutions are placed in a preweighed Erlenmeyer flask and then placed in a water bath and boiled at 87°C (189°F)until all the solvent has evaporated to dryness.

7.1.5 Place Erlenmeyer flask in a desiccator and cool for 1 h and then weigh.

7.1.6 Estimate the total internal and external surface area of oxygen system components extracted to within 5% and record oil contamination as milligrams per square feet of area (mg/m^2).

7.1.7 Perform halogen sniff check (same as Step 5 of 5.1).

7.2 Nonmetallic Components:

Synthetic rubber, natural rubber, nylon, polyvinyl chloride fabric, teflon, Kel F, polyimides, phenolics, and viton. Solvent type cleaning fluids have an adverse effect on plastics and elastomeric materials after prolonged exposure. Use method 7.3 if in doubt.