Reference

SAE ARP 1176, Rev A, Oxygen System and Component Cleaning
AVOX, S_0002W_QA_Supplier_Quality_Assurance_Requirements
AIGA 012/04, Cleaning Of Equipment for Oxygen Service
ASTM G127, Standard Guide for the Selection of Cleaning Agents for Oxygen Systems
CAAP No: 35-5, Design and Fitting of Oxygen Systems: Civil Aviation Advisory Publication.
SAE AIR1569, Handling and Installation Practice for Aerospace Hose Assemblies

Requirement

Cleaning method and preservation provided by AVOX suppliers must be; defined, documented, and qualified capable of meeting requirements specified in SAE ARP 1176, meeting requirements for White light, Black Light and Non-Volatile Residue (NVR). AVOX qualification approval is required.

904 OXYGEN CLEAN PRODUCTS

Code	Cleanliness Level	NVR
904A	**ARP 1176-3**	**3 mg/ ft²**
904B	**ARP 1176-1**	**1 mg/ ft²**

Components and/or assemblies being supplied have HIGH PRESSURE LIFE-SUPPORT BREATHING APPLICATION.
Therefore, at a minimum, prior to assembly, components must meet the requirements of SAE ARP 1176 (Oxygen System and Component Cleaning and Packaging).

- Cleanliness
- Non Volatile Residue, NVR ARP1176 per SAE ARP 1176, rev A,
- Visual inspection using black and white light is acceptable in lieu of particulate verification for size and count. (ref SAE ARP 1176, table 2)
- Equipment Cleaning Category
- Cleaning Level ARP1176 per rev A (ref. SAE ARP 1176, table 1)
- Work Area: (General Clean Room, Class B, or, Class C with Laminar Flow Bench) ref. SAE ARP 1176, 4.1.1

In the case of subassemblies, subsequent assembly and packaging processes containing these components must preserve the required cleanliness level.
In the event that the drawing specifies AVOX Systems' internal document SMP 7700009, the supplier is to comply for cleanliness requirements of ARP 1176-3.
Each shipment shall be accompanied by a signed Certificate of Conformance indicating that parts were cleaned, packaged, and labeled in accordance with SAE ARP1176.

ASSEMBLY NOTES: Components MUST be cleaned and verified meeting the requirements stated herein PRIOR to assembly.
Components used must be assembled in a clean environment; use of smocks and gloves is required. Prior to assembly, components will be subjected to "particle purge" pressure blow off with clean, dry, filtered air. The assembled components must comply to the cleanliness levels and preservation and packaging requirements of this document.

- Assembly Exception: Oxygen hose assemblies (both High and Low Pressure) shall be leak and pressure tested in accordance with the drawing requirements after final assembly. After testing, the hose assemblies shall be cleaned for oxygen per ARP1176-3.

Supplier Documented System requirements,
The documented system must include as a minimum;
Operator Training requirements and records,
Equipment List,
Equipment maintenance requirements,
Methods or procedures,
Periodic process verification,

Records,
Deliverable documents.

Process controls

No single method of cleaning will completely remove all types of contaminants, from all various component configurations. Therefore, the supplier is responsible to define and document the cleaning process that effectively cleans components meeting the verification methods and requirements stated herein, including records to assure process controls and methods to preserve the cleanliness have been completed. AVOX is required to participate in qualification of the process, validation and packaging.

NONMETALLIC MATERIALS CLEANING METHOD AND RINSE TEST

Non-metallic materials include natural rubber, polytetrafluoroethylene (PTFE), Teflon, Nylon, Kel-F, polyethylene, polycarbonates, and other plastic or synthetic rubber materials.
Caution shall be taken to ensure that the cleaning solution used in the method will not adversely affect the size, material properties, etc.; i.e., cause external damage or absorption of the cleaning solution and consequent outgassing. Care should also be taken to ensure that non-metallic materials are compatible with the cleaning fluid. (ref. ASTM G127, Standard Guide for the Selection of Cleaning Agents for Oxygen Systems)

Assemblies
Oxygen cleaned items shall be assembled in an appropriate class clean room or laminar flow clean work station.

Certified clean parts, shall be protected from re-contamination by interim packaging or other protection before and during assembly operations. Process controls, including use of clean rooms, laminar flow bench, clean work stations, particle purge gases, and strict personnel controls, shall be established as required to ensure that no contaminants are introduced into the component being assembled.
Visual inspections shall be performed during the assembly process to ensure that cleanliness has not been degraded. Parts and components shall be rejected if visible contaminants are detected during or after the assembly process.
Provided the above precautions have been exercised, re-cleaning after assembly is not required.

VERIFICATION
All verification tests that follow will be performed on the sample of components representing approximately 1 ft^2 cleaned surface area, per SAE ARP 1176.
The following methods for verification of cleaning are defined in SAE-ARP-1176.

Visual inspection (white light & black light) shall be performed prior to solvent extraction; the residue from the solvent extraction shall also be evaluated to identify particulate and any hydrocarbon removed from inaccessible areas.

Direct Visual Inspection with White Light

This is the most simple inspection method used to detect the presence of contaminants on equipment of accessible surfaces. This method will detect without magnification small particulate matter, dust, oil, grease and moisture in amounts, which could be too high. It shall be used in conjunction with other verification methods.
It is important to have a sufficiently bright level of artificial or natural daylight.

Acceptance criteria:

Visual inspection of the surfaces under bright light shall show no evidence of:
- organic material such as oil, grease, paint, etc.
- cleaning agents including detergents
- rust and loose scale, weld spatters, particles dust, fibers or other foreign matter
- flux residues from welding, brazing or soldering
- moisture, etc.

Direct Visual Inspection with UV Light (Black Light)

An UV-light with a wavelength of about 0,37 um is used in dark or near darkness at a distance of about 10 to 20 cm (4-8 inches) from the surface or piece being examined. Many common but not all hydrocarbons or organic oils fluoresce under UV-light.
The intensity of the fluorescent reflection from various oils is very different. For some vegetable and chemical oils it is zero. *Therefore it is important not to rely solely on the result of this test in evaluating the cleanliness of equipment cleaned for oxygen service. This qualitative method can better be used, if the contaminating oil and its reflecting capacity are known. The method shall be used in conjunction with a quantitative NVR test.*

Acceptance criteria:

Small particles detected by the U.V. (black light) test indicates the need for further evaluation and/or re-cleaning.

NOTE: Any contamination detected by the visual inspection or black light inspection shall be cause for re-cleaning. If re-cleaning fails to remove fluorescent indications, an investigation should be made to determine if the item material is naturally fluorescent.

Non-Volatile Residue (NVR) test (Solvent Extraction)

Solvent extraction is one of the methods giving quantitative results regarding the amount of soluble contaminants. The method is used especially for inaccessible surfaces and/or as verification of the effectiveness a cleaning process or of other qualitative methods.

The method is based on the comparison of used and unused solvent. The level of or freedom from contamination present during solvent cleaning can be closely followed by taking successive solvent samples during the entire cleaning process until inspection confirms that the acceptance standard is reached. Checking the amount of contaminants in a used sample is a good indication of the cleanliness level reached.

The amount of contaminants in a sample can be determined by weight of residue (laboratory test)
This method is accurate in determining low amounts of oil or grease residues with small tolerances.

Acceptance criteria:
Non-Volatile Residue (NVR),

Code	Cleanliness Level	NVR
904A	ARP 1176-3	3 mg/ ft^2
904B	ARP 1176-1	1 mg/ ft^2

Preservation and Packaging

Use of trays or individual bags
Particle purge of parts, trays,
Use 4 mil (0.102 mm) minimum thick polyethylene or 3 mil (0.076 mm) minimum thick transparent Polyamide (nylon) to package components.

General Packaging Requirements:
Immediately after the final drying operations, all openings (where configuration permits) should be sealed using clean aluminum or non shredding plastic caps or plugs. Oxygen components, such as regulators,

gauges, and valves shall have all open ports closed with oxygen clean and non-shredding polyethylene plugs, caps or bags. Caps and plugs should be green as an indication of "Cleaned for Oxygen Service". High-density clean plastic closures such as Teflon or polyethylene are acceptable.
The cleanliness level (i.e. ARP1176-3) must be marked on the outside of the sealed package to clearly identify components.

NOTE: After the openings are sealed, the components shall be packaged and sealed in a bag, and a green "Cleaned of Oxygen Service" label applied.

Records

Cleaning Verification Test record
Include identification of the cleaning lot, part numbers, quantity, etc.
Test results for each of 3 tests
White Light, Pass / Fail, operator name and date,
Black Light, Pass / Fail, operator name and date,
NVR, original weight, final weight, surface area, calculated NVR (mg/ft2), Pass / Fail, operator name and date.

Quality Assurance for Cleanliness when Buying Equipment or Components:

This document shall be flowed down to any supplier O2 cleaning has been contracted to provide.
Quality records of acceptable suppliers and sub-contractors shall be maintained.
Evaluation and records shall include, where appropriate:
- Cleaning methods, equipment and fluids.
- Method(s) used to evaluate cleanliness.
- Training and experience of operators.
- Methods used to ensure and maintain cleanliness during storage, assembly and/or testing.

Records of inspections for cleanliness witnessed or subsequently carried out by the purchaser (if cleaning has been sub-contracted).