LAND SEA AIR SPACE

AEROSPACE STANDARD

Society of Automotive Engineers, Inc.
400 COMMONWEALTH DRIVE, WARRENDALE, PA. 15096

AS 611B

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TETRAFLUOROETHYLENE HOSE ASSEMBLY CLEANING METHODS

1. SCOPE

1.1 This specification describes cleaning methods for four cleanliness levels of tetrafluoroethylene hose assemblies for use in aerospace systems.

1.2 CLASSIFICATION:

Class 0 Cleaning, General Usage
Class I Cleaning, Hydraulic and similar application
Class II Cleaning, Oxygen and similar application
Class III Cleaning, Highly reactive fluid systems

2. APPLICABLE SPECIFICATIONS, OTHER PUBLICATIONS AND DRAWINGS

SAE PUBLICATIONS:

ARP 598	Procedure for the Determination of Particle Contamination of Hydraulic Fluids by the Particle Count Method
ASTM D 2109	Methods of Test for Non Volatile Matter in Halogenated Organic Solvents and Their Admixtures

FEDERAL SPECIFICATIONS:

O-T-236	Perchloroethylene (tetrachloroethylene); Technical Grade
O-T-620	Trichloroethane -1, 1, 1, Technical Inhibited (methyl chloroform)
O-T-634	Trichloroethylene; Technical Grade
O-E-760	Ethyl Alcohol (ethanol); Denatured Alcohol; Oral Proprietary solvent
P-D-680	Solvent, Dry Cleaning (Stoddard)
BB-N-411	Nitrogen, Technical
PPP-T-60	Tape, Pressure Sensitive Adhesive, Waterproof, for Packaging and Sealing
MSFC 237	Specification for Solvent, Freon, Precision Cleaning Agent
L-P-394	Specification for Polypropylene

MILITARY SPECIFICATIONS:

MIL-F-5556	Fluid, Anti-Icing (Isopropyl Alcohol)
MIL-D-16791	Detergent, Non-ionic
MIL-P-27401	Nitrogen Gas
MIL-C-81302	Cleaning Compound, Solvent, Trichlorotrifluoroethane

MILITARY STANDARDS:

MIL-STD-105	Sampling Procedures and Tables for Inspection by Attributes
MIL-STD-889	Metals, Definition of Dissimilar

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3. REQUIREMENT

3.1 CLEANING:

All cleaning and cleanliness requirements pertain only to the wetted surfaces (fluid passage) of the tetrafluoroethylene hose assemblies. Cleaning tools and equipment shall remove dirt, dust, grit, rust, corrosion, flux, oil, grease and other contaminants, to achieve the cleanliness levels specified under 4.2 and in Table IV. It is particularly important to avoid the entrapment of injurious particles or fluids.

3.1.1 CLEANING EQUIPMENT:

Equipment and fluids used for the final cleaning procedures shall be of such purity that they will not cause residual contaminant particles larger than final permitted particle size to be deposited in the final rinsing fluids and drying gases. Adequate cleanliness and filtration of new gases and liquids, as well as reusable materials, shall be maintained to insure the attainment of the above objective.

3.1.2 WATER:

Water used as a carrier for detergents shall be clean, grease-free water containing less than 50 parts per million suspended or dissolved solids. The use of water containing impurities which would react chemically with any part of the components, or with the dissolved cleaning compound, is prohibited. Water used for testing or for final flushing or cleaning of Class I, II or III hose assemblies shall be deionized or demineralized water and shall have a specific resistance of at least 50,000 ohms. Distilled water may be used as an acceptable alternate for deionized or demineralized water.

3.1.3 CLEANING FLUIDS

Cleaning fluids such as O-T-634 trichloroethylene, O-T-620 trichlorethane, O-P-191 perchloroethylene, MIL-C-81302 trichlorotrifluoroethane and P-D-680 Stoddard's Solvents are acceptable provided that the cleaned items meet the requirements listed in this specification. If a water soluble cleaning material (3.1.4) is used, it must be immediately followed by a thorough water rinse in sufficient quantity to remove all traces of the cleaning solution.

3.1.4 DETERGENT SOLUTIONS:

Aqueous solutions of detergents such as trisodium phosphate or non-ionic wetting agents or combinations thereof may be used. The pH of the solutions should be maintained between 8.0 and 12.0. For most efficient operation foaming of the solutions should be kept to a minimum. When aqueous solutions are used for cleaning, a thorough rinse with water in accordance with 3.1.2 to remove all traces of water soluble compounds should follow immediately.

3.1.5 CAPS AND CLOSURES:

The type closure used for sealing shall be selected to resist corrosion, deterioration or loosening and shall prohibit installation unless the closure is removed. Fully threaded, hard plastic caps of a high density polyethylene or polypropylene in accordance with L-P-394 material are preferred. When metallic closures are used they shall have a machined thread or shall be fabricated of a hard material to prevent shaving. Metallic closures shall be of a metal similar to that of the hose fitting. Similar and dissimilar metals shall be as defined in MIL-STD-889.

3.1.6 PRESERVATION MATERIALS:

Material used to preserve the cleanliness of the cleaned hose assemblies shall be new or cleaned to the appropriate cleanliness level prior to use. Any materials listed herein may be used provided the requirements of 3.3.1 and 3.5 are met.

Film, TFE or FEP; two mil minimum thickness

Film, polyethylene plastic; four mil minimum thickness

Film or bags, nylon, plastic

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3.2 PURGING GASES:

Purging, drying and pressure testing of Class I, II and III hose assemblies after cleaning and prior to shipment or use of Class I, II and III hose assemblies shall be done with nitrogen in accordance with MIL-P-27401 or BB-N-411, Type I, Class I, Grade A. Clean, dry air may also be used if its purity conforms to the requirements in the following table:

TABLE I

PURITY REQUIREMENTS - AIR

TOTAL HYDROCARBONS (PPM MAX) BY WEIGHT AS CARBON	PARTICLES OVER 100 MICRON	MAX GRAMS OF WATER VAPOR PER LITER OF GAS AT 70 deg. F (21.1 C) AND 760 mm Hg.
3	0	.00002 *

* Equivalent dew point: at 760 mm Hg -63.5 deg. F (-53 deg. C).

3.3 HANDLING AFTER CLEANING:

3.3.1 All hose assemblies shall be sealed immediately or as specified after the level of cleanliness is achieved and testing, inspection and dryng are completed. All hose assemblies, except class 0 and I, must be sealed in accordance with 3.5.

3.3.2 All handling after cleaning and sealing shall be planned to maintain the clean condition of the hose assembly during the packaging, shipment and storge. Handling and packaging after cleaning shall be done in areas away from high manufacturing contamination, for example: areas of high solvent use, grinding, blasting or other abrasion processes.

3.3.3 Class II hose assemblies shall be processed after cleaning, in a dust control area as described in 3.3.4 or in a normal manufacturing area if hose assembly ports are sealed within ten minutes from the time the assembly was cleaned and dried.

3.3.4 Class III hose assemblies shall be processed after cleaning in a dust control area:

The area shall be enclosed and kept clean from dust, dirt, oil and such contaminants.

Smoking or eating shall not be allowed within the area.

A slight positive air pressure shall be maintained with respect to adjacent, lesser controlled areas. The input air shall be filtered.

Floor, walls and ceiling, benches and tables shall be painted or have non dusting, non flaking and easily cleanable surfaces.

Parts, solvents cleaners or other equipment not related to the work function shall be kept from the work area.

3.4 CLEANING PROCEDURES:

3.4.1 CLASS 0 CLEANING:

Hose assemblies for use in general systems (that require minimum cleaning) shall be cleaned in the following manner:

a. Immerse or flush the hose assemblies, using a suitable cleaning fluid or detergent solution in accordance with 3.1.3 or 3.1.4.

b. Drain hose assemblies and blow dry with shop air or gas in accordance with 3.2.

c. Protect the hose assembly bore and end fitting sealing surfaces with a snug fitting clean internal or external plastic closure in accordance with 3.1.5.

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3.4.2 CLASS I CLEANING

Hose assemblies for use in hydraulic and/or other systems where a moderate degree of cleanliness is required shall be cleaned in the following manner:

a. Prior to assembly, all fittings shall be hot vapor degreased or cleaned in a cleaning fluid in accordance with 3.1.3 and dried with purging gas in accordance with 3.2 or by heating for 45 - 60 minutes at 250 to 300 F (121 to 149 C) in an oven free from all vapors except water and that of the solvent used in cleaning.

b. Immerse hose assemblies in a cleaning fluid in accordance with 3.1.3 and brush bore of fittings and first inch of hose with a nylon or similar synthetic bristle brush (Caution: Some brushes may leave contaminants in assembly) with a diameter at least 1/16 inch (1.59mm) larger than the fitting bore.

For hose sizes -8 and smaller, the brush size may be reduced but must be greater than hose bore. The brush should have a corrosion resistant core. On hose assemblies incorporating tight elbow end fittings, the brushing operation may be eliminated.

c. Subject hose assembly to a flood of cleaning fluid in accordance with 3.1.3 through the bore of the hose assembly for a minimum of one minute.

d. Dry the hose assembly with purging gas in accordance with 3.2 both internally and externally (the external drying need not coincide with that for internal surface) for a minimum of one minute or by heating for 45 - 60 minutes at 250 to 300 F (121 to 149 C) in an oven free of all vapors except water and that of the solvent used for flushing the hose assemblies.

e. Protect the hose assembly bore and end fitting sealing surfaces with a snug fitting clean internal or external plastic closure in accordance with 3.1.5.

3.4.3 CLASS II CLEANING:

Hose assemblies for use in cleanliness controlled systems or systems not compatible with oil, such as oxygen systems, shall be cleaned as follows:

a. Prior to assembly, all hose and fitting components shall be hot vapor degreased or cleaned in a cleaning fluid in accordance with 3.1.3 and dried with purging gas in accordance with 3.2 or by heating for 45-60 minutes at 250 to 300 F (121 to 149 C) in an oven free from all vapors except water and that of the solvent used in cleaning.

b. Handling practices shall be consistent with requirements under 3.3.3 or 3.3.4. Parts and assemblies shall be stored and handled during manufacture in clean, grease free and oil free containers.

c. Proof testing shall be done with clean water in accordance with 3.1.2. Any gas pressure testing shall be done with gases in accordance with 3.2 or equivalent.

d. Immerse hose assemblies in a cleaning fluid in accordance with 3.1.3 and brush bore of fittings and first inch of hose with a nylon or similar synthetic bristle brush (Caution: Some brushes may leave contaminants in assembly) with a diameter at least 1/16 inch larger than the fitting bore.

For hose size -8 and smaller, the brush size may be reduced but must be greater than hose bore. The brush should have a corrosion resistant core. On hose assemblies incorporating tight elbow end fittings, the brushing operation may be eliminated.

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3.4.3 (Cont'd)

e. Subject hose assembly to a flood of cleaning fluid in accordance with 3.1.3 through the bore of the hose assembly for a minimum of one minute. The minimum flow rate shall be in accordance with the following table:

TABLE II

MINIMUM FLOW RATES

SIZE	FLOW GPM	SIZE	FLOW GPM
-3	0.5	-10	6.0
-4	1.0	-12	9.5
-5	1.5	-16	19.0
-6	2.5	-20	30.0
-8	4.0	-24	40.0

f. Dry the hose assembly with purging gas in accordance with 3.2 both internally and externally (the external drying need not coincide with the internal) for a minimum of one minute or by heating for 45 - 60 minutes at 250 to 300 F (120 to 140 C) in an oven free of all vapors except water and that of the solvent used for flushing the hose assemblies.

g. Seal immediately in accordance with 3.5.2.

3.4.4 CLASS III CLEANING:

Hose assemblies for use in contaminant free or highly reactive fluid systems shall be cleaned in the following manner:

a. Follow steps a through e of 3.4.3.

b. Passivate assemblies internally with the following solution heated to 120 to 140 F (49 to 60 C) for 20 to 30 minutes:

Nitric Acid (Reagent grade 69-71 by weight)	25-35 percent by volume
Sodium Dichromate	1.5-2.5 perecent by weight
Water in accordance with 3.1.2	Remainder

NOTE: Sodium Dichromate may be omitted from the solution if only 300 series stainless steel metal components are to be passivated.

c. Rinse assemblies in 190 to 170 F (88 to 77 C) water in accordance with 3.1.2 for a minimum of five minutes. Parts should be agitated during rinsing.

d. Dry hose assemblies with drying gas in accordance with 3.2 or by heating for 45 - 60 minutes at 300 to 250 F (149 to 121 C) in an oven free from all vapors except water and that of the solvent used for flushing the hose assemblies.

The next three steps (e, f, and g) to take place in a dust control area.

e. Flush assemblies internally with clean, filtered or distilled O-E-760 ethyl alcohol, MIL-F-5566 anti-icing fluid, O-T-236 perchloroethylene, O-T-634 trichloroethylene, O-T-620 1,1,1 trichloroethane, freon in accordance with MSFC 237 or equivalent.

f. Dry hose assemblies with drying gas in accordance with 3.2 or by heating for 45-60 minutes at 250 to 300 F (121 to 149 C) in a clean, vapor-free oven.

g. Seal immediately in accordance with 3.5.2.

3.5 SEALING AND PRESERVATION PROCEDURE:

The object of sealing and preservation is to have the cleaned hose assembly arrive at the point of usage in an identifiably clean condition. Subsequent packaging should provide seal integrity throughout shipment and storage. Sealing and preservation operations rather than packaging procedures are defined herein.

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3.5.1 Seals or caps shall be selected in accordance with 3.1.5 and installed hand tight. Class II and III assemblies shall be purged with nitrogen in accordance with 3.2 prior to installing the caps.

3.5.2 Sealing and preservation of the cleaned hose asesmblies shall be accomplished in the following manner:

a. Place bag made from TFE, FEP or nylon C (3.1.6) over each end of the hose and secure with heat shrinkable sleeving or tape.

b. Place the hose with sealed end component inside a bag made from TFE, FEP or nylon (3.1.6).

c. Heat seal leaving a small opening with a continuous 1/16 inch (1.59 mm) minimum width seam.

d. Purge the partially sealed bag interior with nitrogen in accordance with 3.2. Remove as much gas as practical from bag. Heat seal the small opening.

e. Add required information to identification tag in accordance with Table III and seal in a separate compartment of the inner bag (item b. above).

TABLE III

IDENTIFICATION

CLASS	IDENTIFICATION TAG COLOR	IDENTIFICATION TAG LEGEND
II	GREEN	NOT TO BE OPENED EXCEPT BY AUTHORIZED PERSONNEL - THIS ASSEMBLY IS SPECIALLY CLEANED IN ACCORDANCE WITH ARP 611, CLASS II
III	TAN	NOT TO BE OPENED EXCEPT BY AUTHORIZED PERSONNEL - THIS ASSEMBLY SPECIALLY CLEANED IN ACCORDANCE WITH ARP 611, CLASS III

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4. QUALITY ASSURANCE PROVISIONS

4.1 FREQUENCY OF TESTS:

Each lot of hose asemblies shall be subjected to the conformance tests shwon in 4.2 as specified in 4.3.

A lot consists of all hose assemblies processed at one time, not to exceed 100 pieces.

If the tested assembly fails to pass the conformance test requirements, the entire lot of assemblies shall be recleaned and a new sample taken for test. This procedure is to be followed until the conformance test is passed.

4.2 CONFORMANCE TESTS:

4.2.1 PARTICLE SIZE DETERMINATION TEST:

Particle size determination shall be performed on Classs III hose assemblies as specified below. For more detailed description of apparatus, see ARP 598.

a. Fill the cleaned hose assembly with cleaning fluid in accordance with 3.1.3, agitate vigorously and drain into a clean beaker which has been previously rinsed at least three times with small volumes of the cleaning fluid. If the test is not to be conducted immediately the hose may be drained into a clean, pre-rinsed Erlenmeyer flask fitted with a standard taper glass stopper.

b. Filter the entire sample through an appropriate Millipore filter (or equivalent) into a clean pre-rinsed flask or beaker. Care shall be exercised to prevent contamination of the filter from airborne particles during filtering. Vacuum may be employed to increase filtration rates.

c. The filters shall be thoroughly dried being careful to protect the filter from airborne contamination both during the filtering and drying process.

d. The dried filter should be protected by sandwiching between clean glass plates and taping the edges or by enclosing in appropriate clean glass or disposable plastic Petri dishes.