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MILITARY SPECIFICATION

HOSE ASSEMBLIES, TETRAFLUOROETHYLENE, HIGH-TEMPERATURE, HIGH PRESSURE, 3000 PSI, HYDRAULIC AND PNEUMATIC

This specification is approved for use by all Departments and Agencies of the Department of Defense.

1. SCOPE

1.1 This specification covers hose assemblies suitable for use in high temperature, high pressure, hydraulic and pneumatic systems for aircraft and missiles (see 6.1).

2. APPLICABLE DOCUMENTS

2.1 The following documents, of the issue in effect on date of invitation for bids or request for proposal, form a part of this specification to the extent specified herein.

SPECIFICATIONS

Federal

P-D-680	Dry Cleaning Solvent
QQ-S-763	Steel Bars, Shapes, and Forgings, Corrosion-Resisting
QQ-W-423	Wire, Steel, Corrosion-Resisting
TT-I-735	Isopropyl Alcohol
PPP-B-566	Boxes, Folding, Paperboard
PPP-B-576	Box, Wood, Cleated, Veneer, Paper Overlaid
PPP-B-585	Boxes, Wood, Wirebound
PPP-B-591	Boxes, Fiberboard, Wood-Cleated
PPP-B-601	Boxes, Wood, Cleated-Plywood
PPP-B-636	Box, Fiberboard
PPP-B-665	Boxes, Paperboard, Metal Edged and Components
PPP-B-676	Boxes, Set-Up
PPP-T-60	Tape, Packaging, Waterproof

Beneficial comments (recommendations, additions, deletions) and any pertinent data which may be of use in improving this document should be addressed to: ASD/ENESS, Wright-Patterson AFB, Ohio 45433, by using the self-addressed Standardization Document Improvement Proposal (DD Form 1426) appearing at the end of this document or by letter.

FSC 4720

Military

MIL-P-116	Preservation-Packaging, Methods of
MIL-C-5501	Caps and Plugs, Protective, Dust and Moisture Seal
MIL-H-5606	Hydraulic Fluid, Petroleum Base, Aircraft, Missile and Ordnance
MIL-I-7808	Lubricating Oil, Aircraft Turbine Engine, Synthetic Base
MIL-H-8446	Hydraulic Fluid, Nonpetroleum Base, Aircraft
MIL-T-8808	Tubing, Steel, Corrosion-Resistant (18-8 Stabilized) Aircraft Hydraulic Quality
MIL-F-8815	Filter and Filter Elements, Fluid Pressure, Hydraulic Line, 15 Micron Absolute and 5 Micron Absolute, Type II Systems, General Specification for
MIL-S-8879	Screw Threads, Controlled Radius Root with Increased Minor Diameter; General Specification For
MIL-L-10547	Liners, Case, and Sheet, Overwrap Water-Vaporproof or Waterproof, Flexible
MIL-T-27602	Trichloroethylene, Oxygen Propellant Compatible (by Flushing Methods)
MIL-H-83282	Hydraulic Fluid, Fire Resistant Synthetic Hydrocarbon Base, Aircraft

STANDARDS

Military

MIL-STD-100	Engineering Drawing Practices
MIL-STD-105	Sampling Procedures and Tables for Inspection by Attributes
MIL-STD-129	Marking for Shipment and Storage
MIL-STD-130	Identification Marking of US Military Property
MIL-STD-831	Test Reports, Preparation of
MS 21900	Adapter, Flareless Tube to AN Flared Tube
MS 27363	Hose Assembly, Tetrafluoroethylene, Hydraulic and Pneumatic (3000 psi), Flared
MS 27364	Hose Assembly, Tetrafluoroethylene, Hydraulic and Pneumatic (3000 psi), Straight to Elbow 45°, Flared
MS 27365	Hose Assembly, Tetrafluoroethylene, Hydraulic and Pneumatic (3000 psi, Straight to Elbow 90°, Flared
MS 27366	Hose Assembly, Tetrafluorethylene, Hydraulic and Pneumatic (3000 psi), Elbow 45° to Elbow 45 °, Flared
MS 27367	Hose Assembly, Tetrafluoroethylene, Hydraulic and Pneumatic (3000 psi), Elbow 45° to Elbow 90°, Flared
MS 27368	Hose Assembly, Tetrafluoroethylene, Hydraulic and Pneumatic (3000 psi) Elbow 90° to Elbow 90°, Flared
MS 27369	Hose Assembly, Tetrafluoroethylene, Hydraulic and Pneumatic (3000 psi), Flareless
MS 27370	Hose Assembly, Tetrafluoroethylene, Hydraulic and Pneumatic (3000 psi), Straight to Elbow 45°. Flareless
MS 27371	Hose Assembly, Tetrafluoroethylene, Hydraulic and Pneumatic (3000 psi), Straight to Elbow 90°, Flareless
MS 27372	Hose Assembly, Tetrafluoroethylene, Hydraulic and Pneumatic (3000 psi), Elbow 45° to Elbow 45°, Flareless
MS 27373	Hose Assembly, Tetrafluoroethylene, Hydraulic and Pneumatic (3000 psi), Elbow 45° to Elbow 90°, Flareless

MS 27374	Hose Assembly, Tetrafluoroethylene, Hydraulic and Pneumatic (3000 psi), Elbow 90° to Elbow 90°, Flareless
MS 33514	Fitting End, Standard Dimensions for Flareless Tube Connection and Gasket Seal
MS 33656	Fitting End, Standard Dimensions for Flared Tube Connection and Gasket Seal

(Copies of documents required by contractors in connection with specific procurement functions should be obtained from the procuring activity or as directed by the contracting officer.)

2.2 Other publications. The following documents form a part of this specification to the extent specified herein. Unless otherwise indicated, the issue in effect on date of invitation for bids or request for proposal shall apply.

Uniform Classification Committee

Uniform Freight Classification Rules

(Application for copies of the above publication should be addressed to the Uniform Classification Committee, 202 Chicago Union Station, Chicago, Illinois, 60606.)

American Society for Testing and Materials

ASTM D 412	Tension Testing of Vulcanized Rubber
ASTM D 571	Testing Automotive Hydraulic Brake Hose
ASTM D 792	Tests for Specific Gravity and Density of Plastics
ASTM D 1457	Specification for T. F. E. - Fluorocarbon Resin Molding and Extrusion Materials

(Application for copies should be addressed to the American Society for Testing and Materials, 1916 Race Street, Philadelphia, Pennsylvania 19103.)

Society of Automotive Engineers

AMS 3380	Hose, Polytetrafluoroethylene, TFE Fluorocarbon Resin, Wire Braid Reinforced
AMS 5643	Steel Bars, Forgings, Tubing, and Rings, Corrosion Resistant 16.5Cr-4Ni-4Cu
AMS 5644	Steel, Bars and Forgings, Corrosion Resistant 17Cr-Ni-1A1
AMS 5689	Steel Wire, Corrosion and Heat Resistant 18Cr-9.5Ni-2.9Mo-0.10N
AMS 5743	Steel Bars and Forgings, Corrosion and Moderate Heat Resistant 15.5Cr-4.5Ni-2.9Mo-0.10N
ARP 611	Tetrafluroethylene Hose Assembly Cleaning Methods
ARP 1055	Fire Resistant and Fire Test Requirements
ARP 1153	Method for Determining Relative Specific Gravity, Polytetrafluorethylene Tubing

(Application for copies should be addressed to the Society of Automotive Engineers, Inc., 400 Commonwealth Dr., Warrendale, Pa., 15096.)

National Aerospace Standards

NAS 1760 Fitting End, Flareless Acorn, Standard Dimensions For

(Application for copies should be addressed to National Aerospace Standards Committee, 1725 De Sales St., N. W., Washington, D. C. 200360)

3. REQUIREMENTS

3.1 Qualification. The hose assemblies furnished under this specification shall be products which are qualified for listing on the applicable qualified products list at the time set for opening of bids (see 4.3 and 6.3).

3.2 Material. The hose assembly materials shall be uniform in quality, free from defects, consistent with good manufacturing practice and shall conform to applicable specifications and requirements specified herein. All materials not specifically described herein shall be of the highest quality and suitable for the purpose intended.

3.2.1 Metals. Metals used in the hose and fittings shall be corrosion resistant and shall conform to the following specifications:

Bars and forgings

QQ-S-763 Class 302 - Condition A and Condition B
QQ-S-763 Class 304 - Condition A and Condition B
QQ-S-763 Class 321 - Condition A
QQ-S-763 Class 347

AMS 5643 17-4PH
AMS 5644 17-7PH
AMS 5743 AM-355

Tubing

MIL-T-8808 Type I or Type II - Composition 304
MIL-T-8808 Type I or Type II - Composition 321
MIL-T-8808 Type I or Type II - Composition 347

Wire

QQ-W-423 - Composition 302
QQ-W-423 - Composition 304
QQ-W-423 - Composition 305
QQ-W-423 - Composition 316

AMS 5689 - Composition 321

3.3 Design and construction. The hose assembly shall consist of a seamless, tetrafluoroethylene inner tube, reinforced with corrosion resistant steel wire, with corrosion resistant steel end fittings suitable for the intended installation. The outlet design shall conform to MS 27363 through MS 27374, as applicable.

3.3.1 Inner tube. Inner tube shall be of seamless construction of virgin tetrafluoroethylene resin and uniform gage. It shall have a smooth bore and

shall be free from pitting or projections on the inner surface. Additives may be included in the compound from which the tube is extruded.

3.3.2 Reinforcement. The reinforcement shall consist of corrosion-resistant steel wires conforming to the applicable specifications listed in 3.2.1. The wires shall be so arranged over the inner tube as to provide sufficient strength to insure conformance with the requirements specified herein.

3.3.3 Interlayers. Interlayers, if used, shall be resistant to all fluids with which the hose may come in contact. They shall be capable of withstandanding temperatures of -65° to 400°F and pressures as listed in table I. Interlayers shall not extrude through the outer braid.

3.3.4 Fittings. The end fittings for the hose assembly shall be the permanent or field-attachable type. The materials shall be corrosion-resistant steel conforming to the applicable specifications listed herein. The outlet design shall conform to the applicable MS (see 6.2).

3.4 Dimensions. The hose assembly dimensions, except for length, shall be as specified on figure 1.

3.5 Performance. The hose assembly shall meet the following performance requirements.

3.5.1 Tube

3.5.1.1 Tube roll and proof pressure. The tube shall not leak, split, burst, nor show any other evidence of malfunction, when rolled through the sequence of rollers as specified in 4.6.2.

3.5.1.2 Tube proof pressure. When held at the proof pressure specified in the table in 4.6.2 for one minute, the tube, without reinforcement wires, shall not leak, burst, nor show any evidence of malfunction.

3.5.1.3 Tensile strength. When tested in accordance with 4.6.3.1, the longitudinal tensile strength for all sizes of tubes shall be 2,200 psi minimum at 77° ±2°F. The transverse tensile strength for sizes -10 and larger shall be 1,800 psi minimum at the same temperature.

3.5.1.4 Elongation. Elongation at 77° ±2°F shall be a minimum of 200 percent when tested in accordance with 4.6.3.2.

3.5.1.5 Specific gravity. The hose inner tube shall conform to the specific gravity values as required herein, When tested as specified in 4.6.3.3.

3.5.2 Hose assembly. The hose, complete with reinforcing wires and assembled with fittings, shall meet the following performance requirements.

3.5.2.1 Proof pressure. When tested as specified in 4.6.4, the hose assembly shall withstand the proof pressure listed in table I without malfunction or leakage.

3.5.2.2 Elongation and contraction. The hose assembly shall not change in length by more than ±0.20 inch in 10 inches of length, when subjected to the operating pressure shown in table I for a minimum of five minutes. Hose assembly shall be tested in accordance with 4.6.5.

3.5.2.3 Volumetric pressure. The volumetric expansion of the hose assemblies, when tested in accordance with 4.6.6, shall not exceed the limits specified in table I.

3.5.2.4 Leakage. The hose assembly shall not leak when subjected to two pressure cycles of 70 percent of minimum burst, when tested as specified in 4.6.7.

3.5.2.5 Room temperature burst pressure. When tested in accordance with 4.6.8, the hose assembly shall not leak nor burst at any pressure specified in table I.

3.5.2.6 Thermal shock. When pressure tested from -67°F to +400°F as specified in 4.6.9, the hose assemblies shall not leak nor show any evidence of malfunction.

3.5.2.7 Impulse. When tested in accordance with 4.6.10, the hose assemblies shall be capable of withstanding 250,000 impulse cycles at 400°F.

3.5.2.8 Assembly flexibility. The hose assembly shall not leak nor show any evidence of malfunction, when flex-cycle tested from -67°F to 400°F as specified in 4.6.11.

3.5.2.9 Stress degradation. The hose assembly shall not exceed the air leakage as specified, when tested in accordance with 4.6.12.

3.5.2.10 Pneumatic surge. The inner tube of the hose assembly shall not collapse or show evidence of degradation, when tested in accordance with 4.6.13.

3.5.2.11 Effusion. The hose assemblies, when tested in accordance with 4.6.14, shall not exceed the effusion rates specified therein.

3.5.2.12 Overtightening torque. The fitting shall withstand the overtightening torque values specified in table II, when tested in accordance with 4.6.15.

3.5.2.13 Conductivity. When tested as specified in 4.6.16 and figure 2, hose assemblies of size -4 through -8 shall be capable of conducting a direct current equal to or greater than 6 microamperes, and sizes -10 through -20, a current equal to or greater than 12 microamperes with a test potential of 1,000 volts dc.

3.6 Screw threads. All coupling nut threads shall be in accordance with MIL-S-8879, method B, with surface finish of the thread flanks being 125 RHR maximum. A 10 percent increase to MIL-S-8879 maximum thread tolerance is permissible for the coupling nut thread after proof pressure testing, i.e., maximum P. D. may be exceeded by 10 percent of the P. D. tolerance.

3.7 Length. Hose assembly lengths and tolerances shall be as specified in the applicable MS standards.

3.8 Part numbering of interchangeable parts.. All parts having the same manufacturer's part number shall be functionally and dimensionally interchangeable. The item identification and part number requirements of MIL-STD-100 shall govern the manufacturer's part numbers and changes thereto.

3.9 Identification of product. Equipment, assemblies, and parts shall be marked for identification in accordance with MIL-STD-130. The following special marking shall be added.

3.9.1 Fittings. The manufacturer's name or trade mark shall be permanently marked on all end fittings.

3.9.2 Assembly. A permanent marking on the fitting or a permanent band on the hose shall be used. The band shall be no wider than 3/4 inch and shall not impair the flexibility or the performance of the hose. The marking on the fitting or band shall include the following information;

a. Assembly manufacturer's name or trade mark

b. Hose manufactuer's Federal Code number

c. Complete hose assembly MS part number

Example: MSxxxxx-H-0164 which indicates a number for a hose assembly 16-1/2 inches long for a 1/2-inch tubing size

d. Operating pressure "3000 psi"

e. Pressure test symbol "PT"

f. Date of hose assembly manufacture expressed in terms of month and year.

3.10 Workmanship. The hose assembly, including all parts, shall be constructed in a thoroughly workmanlike manner. All surfaces shall be free from burrs. All sealing surfaces shall be smooth, except that annular tool marks up to 100 RHR maximum will be acceptable.

3.10.1 Dimensions and tolerances. All pertinent dimensions and tolerances, where interchangeability, operation, or performance of the hose assembly may be affected, shall be as specified on the applicable drawings.

3.10.2 Cleaning. All hose assemblies shall be free from oil, grease, dirt, or any other foreign materials both internally and externally. Unless otherwise specified, hose assemblies shall be cleaned to class I of ARP 611.

4. QUALITY ASSURANCE PROVISIONS

4.1 Responsibility for inspection. Unless otherwise specified in the contract or purchase order, the contractor is responsible for the performance of all inspection requirements as specified herein. Except as otherwise specified in the contract or order, the contractor may use his own or any other facilities suitable for the performance of the inspection requirements specified herein unless disapproved by the Government. The Government reserves the right to perform any of the inspections set forth in the specification where such inspections are deemed necessary to assure supplies and services conform to prescribed requirements.

4.2 Classification of inspections. The examining and testing of hose assemblies shall be classified as:

a. Qualification inspections (4.3)

b. Quality conformance inspections (4.4).

4.3 Qualification inspections (6.3). Qualification inspections shall consist of all the examinations and tests specified under 4.6.

4.3.1 Qualification test samples. Test samples shall consist of the number of samples and lengths specified in table III. The procedure used shall be as specified in table IV. The samples shall be in accordance with figure I and the outlet design capable of mating with fitting ends in accordance with MS33656 or MS33514.

4.3.2 Test report, test samples, and data for the procuring activity. When the tests are conducted at a location other than the laboratory of the procuring activity, the following shall be furnished to that activity.

a. Test report: Three copies of a test report in accordance with MIL-STD-831, which shall include a report of all tests and outline description of test conditions

b. Test sample: The samples that were tested and three untested samples of each size for which qualification is desired, if requested by the qualifying activity within one year subsequent to submittal of Qualified Products List request.

c. Three sets of engineering data in the form of detail and assemlby drawings. The assembly drawings shall have a cut-away section showing all details in their normal assembly position and shall carry part numbers of all details and subassemblies.

d. List of sources of hose or hose components including source's name and product identification for inner tube, hose, and assembly.

NOTE: Log sheets, containing required test data, shall remain on file at the source test facility and are not to be sent to the qualifying activity unless specifically requested.

4.4 Quality conformance inspections. Quality conformance inspections shall be sampled in accordance with the procedure in MIL-STD-105 and shall consist of the following tests:

a. Individual tests (4.4.1) (100 percent inspection)

b. Sampling tests (4.4.2)

c. Periodic control tests (4.4.3)

4.4.1 Individual tests. Each hose assembly shall be subjected to the following tests:

a. Examination of product (4.6.1)

b. Proof pressure tests (4.6.4).

NOTE: Production samples that are proof pressure tested with water should be air dried prior to capping (See 3.10.2).

4.4.2 Sampling tests. The following tests shall be performed on hose assemblies individually selected at random from each lot. A sampling test lot shall consist of nor more than 6,600 feet of hose all of one dash size.

4.4.2.1 Hose assemblies shall be subjected to the following tests in the order indicated:

a. Elongation and contraction test (4.6.5)

b. Leakage test (4.6.7)

c. Room temperature burst pressure test (4.6.8)

d. Specific gravity of tube (apparent and relative (4.6.3.3))

4.4.3 Periodic control tests. The following tests shall be performed on 8 assemblies (for each test) individually selected at random from each complete lot. A periodic control test lot shall consist of no more than 20,000 feet of hose, all of one dash size, manufactured under essentially the same conditions.

a. Impulse test (4.6.10) (unaged samples only)

b. Stress degradation test (4.6.12)

c. Conductivity test (4.6.16).

4.4.4 Rejection and retest. Where one or more items selected from a lot fails to meet the specification, all items in the lot shall be rejected.

4.4.1 Resubmitted lots. Once a lot (or part of a lot) has been rejected by procuring activity (government or industrial), before it can be resubmitted for tests, full particulars concerning the cause of previous rejection and the actions taken to correct the defects in the lot shall be furnished, in writing, by the contractor.

4.4.5 Switching procedures. Switching inspection severity levels, for example, from normal to tightened inspection, shall be in accordance with MIL-STD-105. All inspection plans shall be single sample plans with an AQL of 1.0 percent at special inspection level S-2.

4.4.6 Destructive test sample. Prior to testing, a letter (D) shall be impression stamped on each end fitting of those assemblies used for destructive tests (4.4.2 and 4.4.3).

4.5 Test conditions

4.5.1 Fitting ends. Qualification and quality conformance tests shall be conducted on assemblies using straight type swivel ends, except that samples 16 through 21 shall have a 90-degree swivel on one end. Satisfactory qualification tests on these hose assemblies shall constitute qualification approval on hose assemblies using other fittings that have an identical hose attachment method and design, as specified on the military standards of section 2 herein.

4.5.2 Preparation of specimen

4.5.2.1 Unless otherwise specified, length of sample assemblies shall be in accordance with table III.

4.5.2.2 The test hose assemblies may be made up with one end having a flared fitting to mate with parts in accordance with MS33656 and the other end having a NAS 1760 flareless fitting end to mate with parts in accordance with MS 33514.However, if the test samples are all with flared type end fittings, and qualification approval is desired also for the assemblies having flareless end fittings, the following procedures are required. Two additional assemblies have flareless style fitting ends of the size to be qualified shall be subjected to the examination of product test (4.6.1), proof pressure test (4.6.4), leakage test (4.6.7), and room temperature burst pressure test (4.6.8). Satisfactory test results on assemblies having these fitting ends (flareless) shall constitute qualification approval on hose assemblies (MS27369 through MS27374) in the sizes tested.

4.5.2.3 Oil aging. In all of the tests using oil-aged samples, the hose assemblies shall be filled with a high temperature test fluid and soaked in an air oven at a temperature of 400°F for 7 days. All air shall be excluded from the bore of the assembly during the test period. No pressure shall be applied to the assembly during the aging period.

4.5.2.4 Air aging. Air-aged samples shall be kept in air at a temperature of 400°F for 7 days.

4.5.2.5 Unaged assemblies. Unaged assemblies shall be as shipped from the hose assembly manufacturer.

4.5.3 Test fluids. Unless otherwise specified, the pressure test fluid shall be hydraulic oil conforming to MIL-H-5606 or water. When a high temperature test fluid is specified, the test fluid shall be MIL-H-8446 hydraulic fluid, MIL-L-7808 lubricating oil or one of the following:

a. General Electric F-50, or equal

b. Dow Chemical F-60, or equal

c. Oronite Chemical 8200, or equal

d. MIL-H-83282, or equal.

Unless otherwise specified, all pressure shall have a tolerance of ±100 psi.

4.5.4 Temperature measurements. Unless otherwise specified, temperature measurements shall be taken within six inches of the hose assemblies under test. Unless otherwise specified, all temperature shall have a tolerance of +15°, -5°F.

4.6 Inspection methods

4.6.1 Examination of products. Each length of tubing shall be examined to determine compliance with this specification with respect to material, size, workmanship, and dimensions.

4.6.1.1 All hose assemblies shall be visually inspected to determine conformance to this specification and inspected for broken or missing reinforcing wires or any other evidence of malfunction which shall be cause for rejection. Crossed-over reinforcing wires shall not be cause for rejection.

4.6.2 Tube roll and proof test. Each length of tubing shall be subjected to a tube roll and proof test in accordance with AMS 3380, except that the flattening gap, rounding gap, and proof pressure shall be as specified in table V. The test fluid shall be either air or water.

4.6.3 Tube tests

4.6.3.1 Tensile strength. Size -10 tubes and under shall be subjected to tensile strength tests in accordance with ASTM D412, except that the separation speed shall be two inches per minute. Tubes larger than -10 shall be tested in accordance with ASTM D1457. The longitudinal tensile strength for all sizes shall be a minimum of 2200 psi at 77° ±°F. In sizes under -10, the transverse tensile strength need not be tested.

4.6.3.2 Elongation. The tube shall be subjected to elongation tests in accordance with ASTM methods specified in 4.6.3.1. Elongation at a temperature of 77° ±2°F shall be a minimum of 200 percent.

4.6.3.3 Specific gravity of tube

4.6.3.3.1 Apparent specific gravity. Apparent specific gravity shall be determined in accordance with ARP 1153 method of ASTM D792, method A, and shall be from 2.125 to 2.155 at 77° ±2°F. Two drops of wetting agent shall be added to the water.

4.6.3.3.2 Relative specific gravity. Relative specific gravity shall be determined in accordance with ARP 1153 method, and shall not exceed a value of 2.210 for all sizes and types of tubes.

4.6.4 Proof pressure test. All hose assemblies shall be pressure tested to the values specified in table I for not less than 30 seconds and not more than five minutes. The test fluid may be either water of hydraulic oil conforming to MIL-H-5606 for tests conducted at room temperature. Proof pressure test of hose assemblies having fire sleeves shall be tested using water as the medium. Proof pressure shall be held a minimum of two minutes during which time the fire sleeves shall be pulled back from the end fittings. Any evidence of leakage from hose or fittings or any other evidence of malfunction shall constitute failure.

4.6.5 Elongation and contraction test. Two hose assemblies of each size shall be subjected to the elongation and contraction test. The hose shall not change in length by more than ±0.20 inch in 10 inches of length when subjected to the operating pressure shown in table I for not less than five minutes. With the hose held in a straight, unpressurized condition, a 10-inch gage length shall be marked off on the hose and the hose then pressurized. After 5 minutes, while still pressurized, the gage length shall be remeasured and the change in length calculated.

4.6.6 Volumetric expansion test. Two hose assemblies of each size shall be tested in accordance with ASTM D571. The volumetric expansion of the test assemblies shall be in accordance with values shown in table I. This test shall be performed at operating pressure.

4.6.7 Leakage test. Two hose assemblies of each size shall be pressurized to 70 percent of the minimum room temperature burst pressure shown in table I and held for five minutes minimum. The pressure shall then be reduced to zero psi,

after which it shall be raised to 70 percent of the minimum burst pressure for a final 5-minute check. Any evidence of leakage from hose or fittings, hose burst, fitting blow-off or any other evidence of malfunction shall constitute failure.

4.6.8 Room temperature burst pressure test. Two hose assemblies of each size shall be subjected to a pressure sufficient to burst the assemblies with a rate of pressure rise equal to 20,000 ±5000 psi per minute. The assemblies shall be observed throughout the test and the type of failure and the pressure at which failure occured shall be recorded. The assemblies shall not leak nor show any evidence of malfunction at any pressure below the specified pressure listed in table I.

4.6.9 Thermal shock test. The thermal shock test shall be as follows:

a. Two hose assemblies of each size shall be subjected to this test. One assembly shall be air-aged and one assembly shall be unaged. The assemblies shall be subjected to the proof pressure specified in table I for a minimum of five minutes.

b. The test assemblies shall then be mounted, empty, in a high temperature test setup (typical setup shown on figure 3) and the ambient temperature reduced to -65° ±2°F for a minimum of two hours. At the end of this period, while still at this temperature, high temperature test fluid at a temperature of 400°F shall be suddenly introduced at a minimum pressure of 50 psi. Immediately after the hot oil has filled the assembly, the pressure shall be raised to the proof pressure specified in table I for a minumum of five minutes. Not more than 15 seconds shall elapse between the introduction of the high temperature oil at 50 psi and the raising of the pressure to proof pressure.

c. The test assemblies shall then be filled with one of the high temperature test fluids at a pressure of 75 psi ±25 psi and soaked with fluid and ambient temperature maintained at 400°F for one hour. At the end of this period the assembly shall be pressurized to the proof pressure specified in table I for a minimum of five minutes. The pressure shall be released and while still maintaining 400°F, the pressure shall be increased at the same rate of rise as specified in 4.6.8 until failure is obtained. The hose assembly shall be under continuous observation during the preceding test and the pressure at which failure occurred and the type of failure shall be recorded.

d. During part b, and the proof portion of part c of the test, any evidence of leakage from the hose or fittings, hose burst, fitting blow-off or any other evidence of malfunction shall constitute failure. During the burst portion of c, any of the above occurring below the minimum high temperature burst pressure shown in table I shall constitute failure.

4.6.10 Impulse test. The impulse test shall be as follows:

a. Two test assemblies shall be oil-aged, two shall be air aged, and two shall be unaged. The assemblies shall then be subjected at room temperature to the proof pressure specified in table I for a minimum of five minutes.

b. The test assemblies shall be connected to rigid supports and bent in a U-shape with a bend radius at the apex of the bend as specified in table I.

c. Electronic measuring devices shall be used to determine and control the impulse pressure to the values specified in table I in the inlet manifold to

the magnitude shown by the graph on figure 4. The impulse shall occur at 70 ±10 cycles per minute (cpm). The test fluid shall be one of the high temperature test fluids at 400°F measured at the test manifold with the ambient air at 400°F. The test shall be run in such a manner that the assemblies shall be temperature cycled from room temperature to specified ambient and fluid temperatures a minimum of two times with a minimum of 200,000 impulses at 400°F. Any evidence of leakage from the hose or fittings prior to the completion of 250,000 cycles for all sizes shall constitute failure.

4.6.11 Assembly flex test. Two hose assemblies of each size shall be mounted in the assembly flex test setup as illustrated on figure 5 and subjected to the following test sequence. The assemblies shall be filled with oil as specified in 4.5.3. Temperature indicated is both fluid and ambient. Flexing shall occur at a rate of 70 ±10 cpm during portions c,d, and e.

a. The test assemblies shall be soaked with no pressure or flexing at a temperature of -67° ±2°F for a minimum of one hours.

b. With no flexing, the test assemblies shall be pressurized to the proof pressure as specified in table I with the temperature still at -67°F for a minimum of five minutes (first cycle only).

c. Flexing shall begin while the test assemblies are pressurized to the operating pressure as specified in table I with the temperature still at -67°F for a minimum of 4,000 cycles.

d. With the pressure reduced to zero psi, flexing shall continue for 1000 cycles at -67°F.

e. Increase the temperature to 400°F and flex 1,000 cycles with the pressure at zero psi. The pressure shall then be increased to the operating pressure as specified in table I with the temperature held at 400°F. Flexing shall continue until an accumulated total of 80,000 cycles is reached.

f. Steps a, c, d, and e shall be repeated for a total of five test sequences: i.e., 400,000 flexing cycles.

g. After completion of step f and with no flexing, the test assemblies shall be pressurized to the proof pressure specified in table I with the temperature still at 400°F for a minimum of five minutes (last cycle only).

Any leakage from the hose or fittings, hose burst, fitting blow-off, or any other evidence of malfunction during test shall constitute failure.

4.6.12 Stress degradation test

4.6.12.1 Two hose assemblies of each size shall be subjected to this test. The hose assemblies shall be filled with a high temperature test fluid as specified in 4.5.3.

4.6.12.2 The assemblies shall then be placed in an oven which shall be maintained at a temperature of 400°F. Precautions shall be taken to assure that the hose assemblies do not come in contact with parts of the oven that are at a higher temperature. A pressure equal to the rated operating pressure specified in table I shall be applied to the hose assemblies.

4.6.12.3 After a minimum of 20 hours at 400°F, the pressure shall be gradually released and the assemblies shall be removed from the oven, drained, and cooled to room temperature.

4.6.12.4 The hose assemblies shall then be filled with fluid conforming to MIL-H-5606. A pressure equal to the rated operating pressure specified in table I shall be applied and held for a minimum of two hours at room temperature.

4.6.12.5 The procedure specified in 4.6.12.1, 4.6.12.2, 4.6.12.3, and 4.6.12.4 shall be repeated for a total of three times.

4.6.12.6 After the final two-hour pressurization period, the hose assemblies shall be drained and flushed with trichloroethylene conforming to MIL-T-27602, and then placed in an oven for one hour. The temperature of the oven shall be maintained at 160° ±10°F.

4.6.12.7 The hose assemblies shall be removed from the oven, cooled to room temperature, and then subjected to an air-underwater test. To conduct this test, the hose shall be installed in an apparatus similar to that shown on figure 6.

4.6.12.8 The apparatus with the hose assembly installed shall be immersed in water containing no wetting agent. A pressure equivalent to the rated operating pressure specified in table I shall be applied for 15 minutes to allow any entrapped air in the hose to escape.

4.6.12.9 The pressure shall be held an additional five-minute period during which time the effused gas shall be collected from the test sample, including the junoture of the hose to the fitting, but not including the "B" nut. After the five-minute period of pressurization, the average rate of effusion through the hose and two fittings shall be computed into cc/in./min. If the average rate of effusion exceeds 2.0 cc/in./min. for any size, it shall be cuase for rejection and considered failure to qualify.

4.6.13 Pneumatic surge test. Two hose assemblies that were subjected to the stress degradation test (4.6.12) shall be used for this test. The hose asssemblies shall be installed in the test apparatus in accordance with figure 7.

The assemblies shall be subjected to the rated operating pressure as specified in table I for 25 minutes at room temperature. After this period of pressurization, the exhaust valve shall be opened within 50 milliseconds to permit rapid discharge of the compressed gas. After five minutes, the valve shall be closed and the pressure recycled. This sequence of 25 minutes at operating pressure and five minutes at zero pressure shall be repeated a total of 16 times. At the end of this period, the hose shall be sectioned and examined for evidence of tube collapse, sponging of the inner tube, etc., and the filter downstream of the hose examined for evidence of inner tube degradation. Any evidence of degradation shall constitute failure.

4.6.14 Pneumatic effusion test. Two hose assemblies of each size shall be used for this test. The assemblies shall be subjected to the operating pressure specified in table I for one hour at room temperature. Air effusion shall be collected using the water displacement method and air collecting device similar to that depicted in figure 6. The total amount of effusion

through the hose and two fittings shall be collected over the last 1/2 hour of testing. Total effusion shall not exceed 8.0 cc/ft of hose assembly for any size hose.

4.6.15 Overtightening torque test. Two flared type end fittings of each size shall be assembled on a fitting end of corrosion resistant steel construction designed in accordance with MS33656. Prior to this test the fitting shall be lubricated with oil conforming to MIL-H-5606. The fittings shall be tightened to the applicable torque specified in table II and then loosened. This sequence shall be repeated 15 times. After this sequence, there shall be no evidence of failure or deformation of the fitting assemblies, and the swivel nuts shall be free enough to permit turning on the nipple by hand. Overtightening torque shall also be applied to two flareless type and fittings of each size by assembling on a fitting end of corrosion-resistant steel construction in accordance with MS33514. Lubrication test sequence and conditions for the flareless fittings shall be the same as specified for the flared type fittings. After the above tightening torque test sequence, the tested end fittings shall be coupled to a length of hose and subjected to the proof pressure specified in table I for five minutes without leakage.

4.6.16 Conductivity test. The conductivity test shall be conducted as follows:

a. The test specimen shall be a length of hose (with braid and one end fitting) as shown on figure 7. The inner surface of the tube shall be washed first with solvent conforming to P-D-680 and then with isopropyl alcohol conforming to TT-I-735 to remove surface contamination and thoroughly dried at room temperature. The wire shall flare out as shown on figure 2 to prevent contact with the end of the tetrafluoroethylene tube. One MS21900 steel fitting of appropriate size shall be assembled to the hose end fitting as shown on figure 2.

b. The test specimen shall then be arranged vertically as shown on figure 2. The relative humidity shall be kept below 70 percent and room temperature between 60° and 90°F. One thousand volts maximum, dc, shall be applied between the upper mercury electrode and the lower (MS21900 fitting) electrode.

c. The current shall be measured with an instrument with a sensitivity of at least one microampere (1×10^{-6} ampere). The current shall conform to 3.5.2.13.

5. PACKAGING

5.1 Preservation and packaging. Preservation and packaging shall be level A or C, as specified (see 6.2).

5.1.1 Level A. Hose assemblies shall be preserved in accordance with method III of MIL-P-116. All openings shall be sealed with caps or plugs conforming to MIL-C-5501. Hose assemblies shall be unit packaged in containers conforming to PPP-B-566, PPP-B-636, PPP-B-665, or PPP-B-676. The gross weight of the boxes shall not exceed the weight limitations of the applicable container specification.

5.1.2 Level C. Hose assemblies shall be preserved and packaged in accordance with the manufacturer's commercial practice.

5.2 Packing. Packing shall be level A, B, or C as specified (see 6.2).

5.2.1 Level A. Hose assemblies preserved and packaged to meet 5.1.1 shall be packed in exterior-type shipping containers conforming to PPP-B-585, PPP-B-591, PPP-B-601, PPP-B-636, or PPP-B-576. Insofar as practicable, exterior containers shall be of uniform shape and size, of minimum cube and tare consistent with the protection required and shall contain identical quantities. The gross weight of each pack shall be limited to approximately 200 pounds. Containers shall be closed and strapped in accordance with the applicable container specification or appendix thereto. Containers shall be provided with a case liner conforming to MIL-L-10547 and shall be sealed in accordance with the appendix thereto. The case liner will not be required when the unit, intermediate, or exterior container conforms to PP-B-636 and is sealed at all joints and seams, including manufacturer's joint, with tape conforming to PPP-T-60.

5.2.2 Level B. Hose assemblies preserved and packaged to meet 5.1.1 shall be packed in domestic-type exterior containers conforming to PPP-B-585, PPP-B-591, PPP-B-601, PPP-B-636, or PPP-B-576. Exterior containers shall be of minimum cube and tare consistent with the protection required. Insofar as practicable, exterior containers shall be of uniform shape and size and shall contain identical quantities. The gross weight of each pack shall be limited to approximately 200 pounds. Containers shall be closed and strapped in accordance with the applicable container specification or appendix thereto. When fiberboard containers are used, the fiberboard shall conform to the special requirements of PPP-B-636.

5.2.3 Level C. Packages which require over-packing for acceptance by the carrier shall be packed in exterior type shipping containers in a manner that will insure safe transportation at the lowest rate to the point of delivery. Containers shall meet Uniform Freight Classification Rules or regulations of other common carriers as applicable to the mode of transportation.

5.3 Marking. Interior and exterior containers shall be marked in accordance with MIL-STD-129.

5.3.1 Packing date. The date of packing shall be marked on all interior and exterior containers.

6. NOTES

6.1 Intended use. The hose assemblies are intended for use in aircraft and missile high pressure (3,000 psi) hydraulic and pneumatic systems operating in a temperature range of -65° to +400°F. High pressure pneumatic storage system applications are not recommended. Installation in which the limits specified herein are exceeded or in which the application does not conform to the requirements of this specification will be subject to the approval of the procuring activity. The end fittings of these hose assemblies are not intended for reuse. For procurement, this is a critical application item.

6.1.1 Fire resistance. Where fire resistance or fire proofing is a requirement, the tests should be conducted to the procedures and requirements specified in ARP 1055.

6.2 Ordering data. Procurement documents should specify:

a. Title, number, and date of this specification

b. The applicable MS part number required (see 3.3.4)

c. Applicable levels of preservation and packaging and packing (see 5.1 and 5.2)

d. Samples subjected to destructive testing are not to be considered or shipped as part of the contract

e. When fire resistance or fire proofing is required (see 6.1.1).

6.3 Qualification. With respect to products requiring qualification, awards will be made only for products which are at the time set for opening of bids, qualified for inclusion in the applicable Qualified Products List whether or not such products have actually been so listed by that date. The attention of the contractors is called to this requirement, and manufacturers are urged to ~~arrange to have the products that they propose to offer to the Federal~~ Government tested for qualification in order that they may be eligible to be awarded contracts or orders for the products covered by this specification. The activity responsible for the Qualified Products List is the Aeronautical Systems Division, ATTN: ENFEM, Wright-Patterson Air Force Base, Ohio 45433, and information pertaining to qualification of products may be obtained from that activity.

Custodians:
Army - ME
Navy - AS
Air Force - 11

Reviewers:
Army - AV, MI
Air Force - 99
DOD - CS

Preparing activity:
Air Force - 11

Project No. 4720-0386

Table I. Physical Requirements of High Pressure Hose Assemblies

Size dash No.	Operating pressure (max psi)	Proof pressure (min psi)	Burst Pressure room temp. (min psi)	Burst Pressure high temp. (min psi)	Min. bend radius (inside of bend) (inches)	Elongation contraction for a 10-in. sample (inch)	Cubical expansion (cc/in.)
-4	3000	6000	16,000	12,000	3	±0.20	0.065
-6	3000	6000	14,000	10,500	5	±0.20	.085
-8	3000	6000	14,000	10,500	5-3/4	±0.20	.135
-10	3000	6000	10,000	9,000	6-1/2	±0.20	.220
-12	3000	6000	12,000	9,000	7-3/4	±0.20	.300
-16	3000	6000	12,000	9,000	9-5/8	±0.20	.750
-20	3000	6000	12,000	9,000	12	±0.20	1.000

Table II. Overtightening Torque Values

Fitting Size	Pound-Inches
-4	160
-6	300
-8	560
-10	700
-12	1,000
-16	1,550
-20	1,550

Table III. Length of Hose Assemblies for Test (in inches)

Hose Assembly Size	Six Assemblies for Impulse Test	Two Assemblies for Flex Test	Eight Assemblies for Other Tests 1/
-4	16	20	18
-6	21	27	18
-8	24	30	18
-10	30	33	18
-12	33	37	18
-16	41	45	18
-20	52	56	18

1/ One additional sample of each size in lengths as shown on figure 2 shall be used for examination and conductivity tests (sample No. 22 of table IV.)

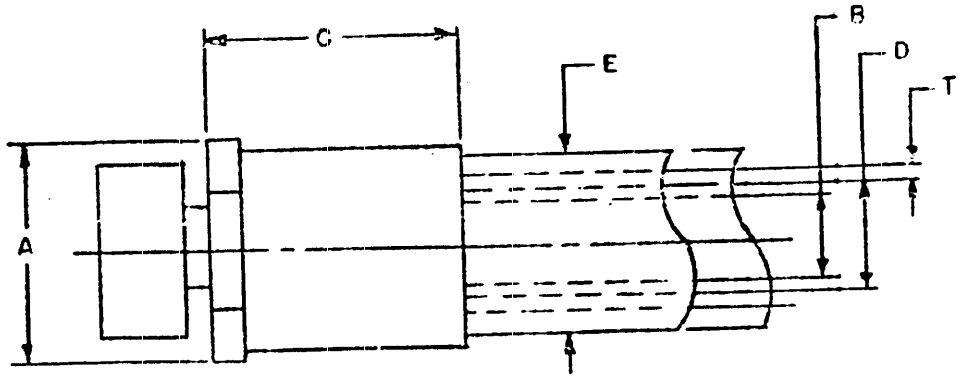
Table IV. Qualification Test Schedule

	Tube	Fittings	Assemblies										
Sample No.	1	2 thru 1/ 5	6	7	8	9	10	11	12	13	14 and 2/ 15	16 thru 3/ 21	22
Paragraph	4.6.1 4.6.2 4.6.3	4.6.1 4.6.15	4.6.1 4.6.2 4.6.4 4.6.5 4.6.11	4.6.1 4.6.2 4.6.4 4.6.5 4.6.11	4.6.1 4.6.2 4.6.4 4.6.6 4.6.14 4.6.8	4.6.1 4.6.2 4.6.4 4.6.6 4.6.14 4.6.8	4.6.1 4.6.2 4.6.4 4.6.7 4.6.9	4.6.1 4.6.2 4.6.4 4.6.7 4.6.9	4.6.1 4.6.2 4.6.4 4.6.12 4.6.13	4.6.1 4.6.2 4.6.4 4.6.12 4.6.13	4.6.1 4.6.4 4.6.7 4.6.8	4.6.1 4.6.2 4.6.4 4.6.10	4.6.1 4.6.16

1/ Two samples flared type fittings. Two samples flareless type fittings.
2/ These samples are with flareless fittings.
3/ These samples shall have a 90-degree elbow fitting on one end of the hose, and a straight type fitting on the other end of the hose. If approval is being sought for both the bent tube and the forged elbow configuration, then one-half of the samples (3) shall use one type configurated elbow, while the other half of the samples shall use the other type.

Table V. Tube Proof Pressure

Size	Flattening Gap Max (Inches)	Rounding Gap Min (Inches)	Proof Pressure (psi)
-4	0.281	0.250	380
-6	.281	.328	280
-8	.328	.469	220
-10	.328	.578	170
-12	.328	.688	130
-16	.328	.828	95
-20	.438	1.000	95



HOSE SIZE	RIGID TUBING O.D. (Ref)	FITTING O.D. (MAX) A	FITTING I.D. (MIN) B	SOCKET LENGTH (MAX) C	HOSE I.D. (MIN) D	HOSE WIRE BRAID (MAX) E	INNERTUBE WALL THICKNESS - T (MIN)
-4	1/4	0.875	0.141	2.250	0.212	0.507	0.035
-6	3/8	1.000	.250	2.500	.298	.656	.035
-8	1/2	1.200	.360	2.750	.391	.765	.045
-10	5/8	1.406	.455	3.000	.485	1.015	.045
-12	3/4	1.687	.568	3.250	.602	1.140	.045
-16	1	2.000	.760	3.750	.852	1.390	.045
-20	1-1/4	2.100	.925	3.875	1.101	1.600	.045

Figure 1. Hose and Fitting Dimensions

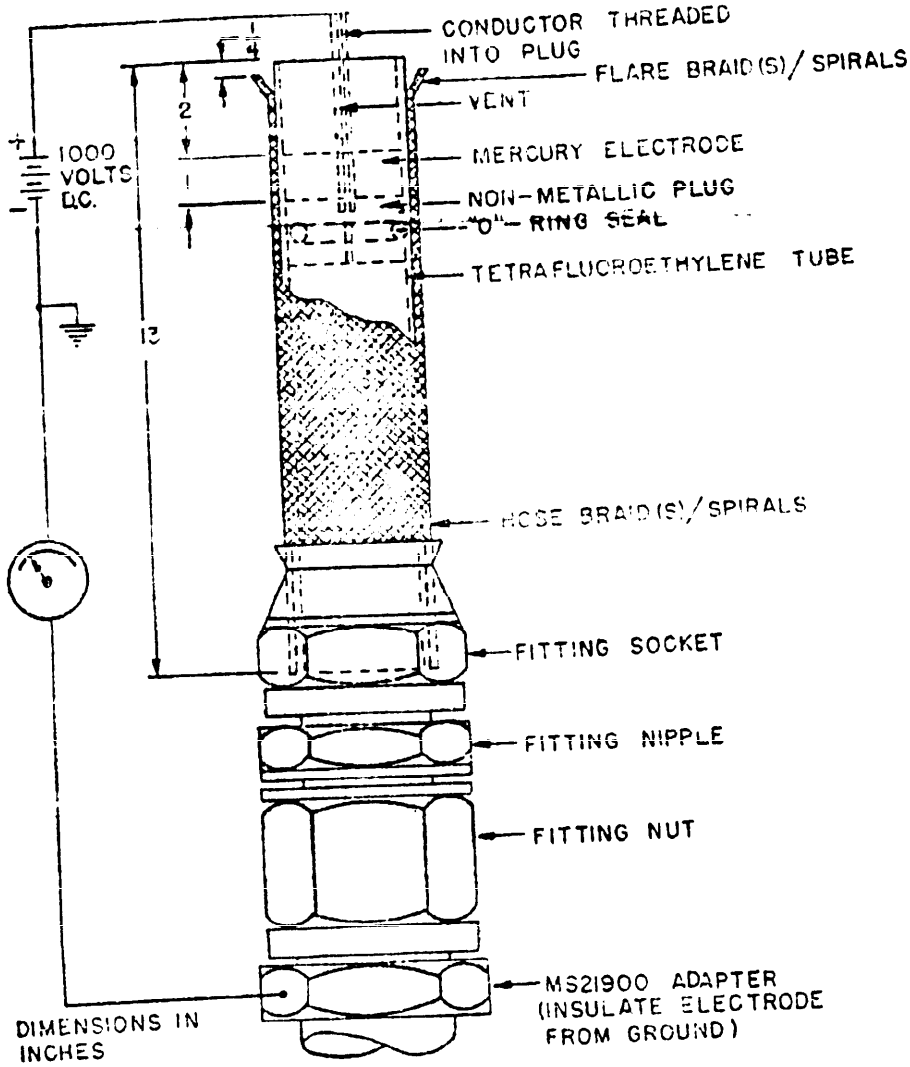


Figure 2. Conductivity Test Diagram

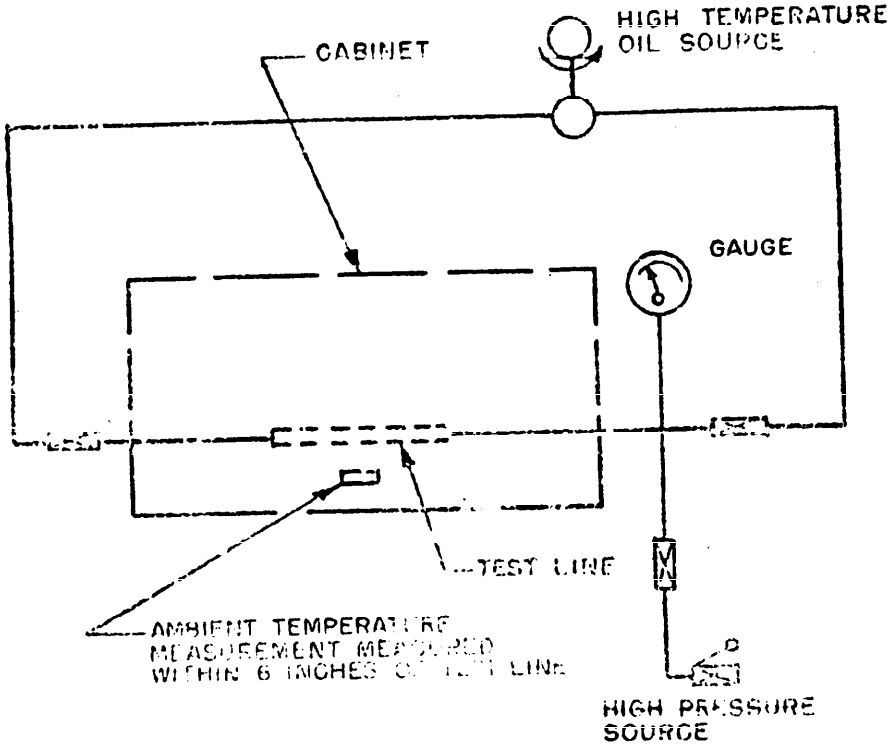
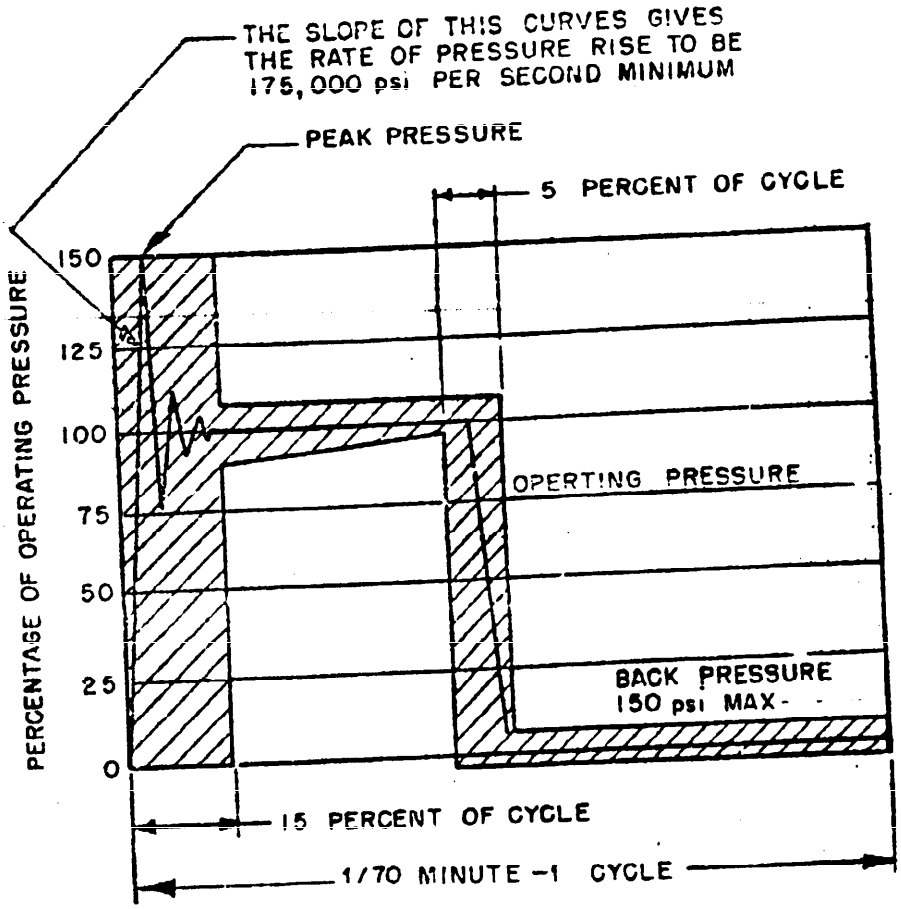


Figure 3. Typical Setup for High Temperature Pressure Testing

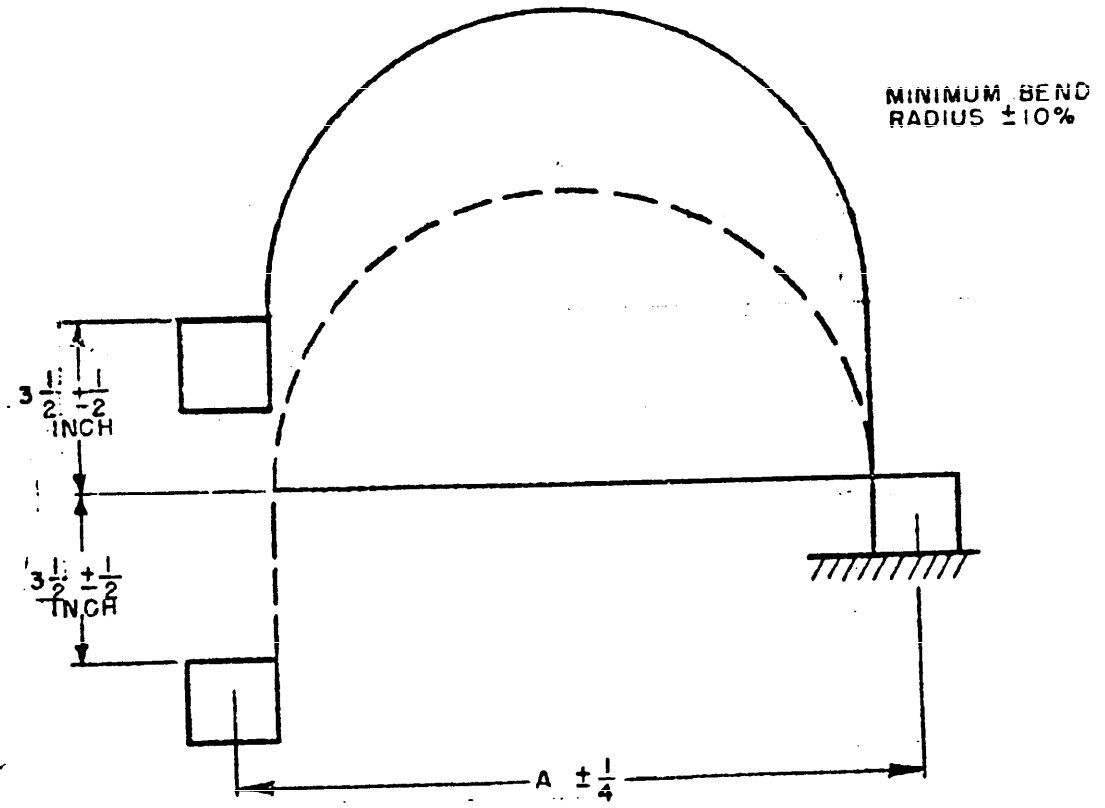


THE CURVE SHOWN ABOVE IS THE APPROXIMATE PRESSURE-TIME CYCLE DETERMINED TO BE OF PROPER SEVERITY FOR IMPULSE TESTING OF HYDRAULIC HOSE. THE PRESSURE-TIME CURVE SHALL BE CONFINED TO THE SHADED AREA INDICATED. RATE OF RISE IS DEFINED AS THE SLOPE OF THE PRESSURE-TIME CURVE. FOR PURPOSES OF DEFINITION, THE SLOPE SHALL BE DETERMINED BY USE OF A STRAIGHT LINE BETWEEN 10 PERCENT AND 90 PERCENT OF PEAK PRESSURE. RATE OF RISE WILL BE CALCULATED AS FOLLOWS:

$$\text{RATE OF RISE (PSI/SEC)} = \frac{.9P - .1P}{T_2 - T_1}$$

WHERE: P = PEAK PRESSURE IN PSI
T_1 = TIME AT 10% P (SEC)
T_2 = TIME AT 90% P (SEC)

Figure 4. Dynamic Pressure Impulses



HOSE SIZE	A INCHES
-4	6-1/2
-6	10-5/8
-8	12-1/4
-10	14
-12	16-5/8
-16	20-3/4
-20	25-3/4

Figure 5. Assembly Flex Test Setup

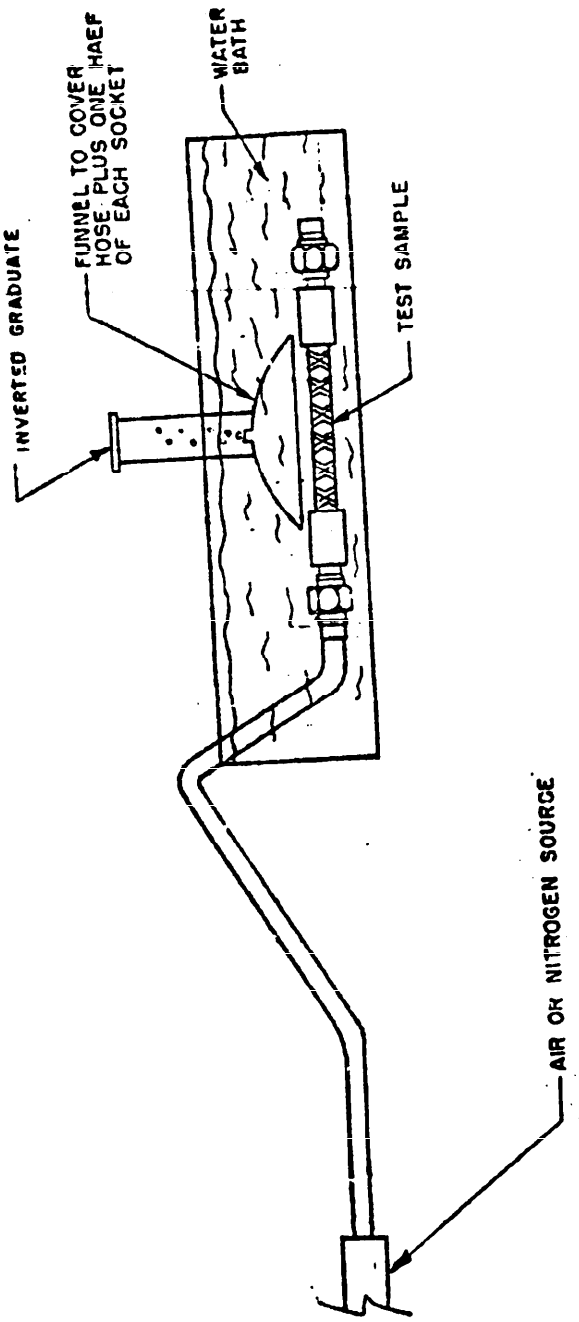


Figure 6. Test Setup for Pneumatic Effusion Tests

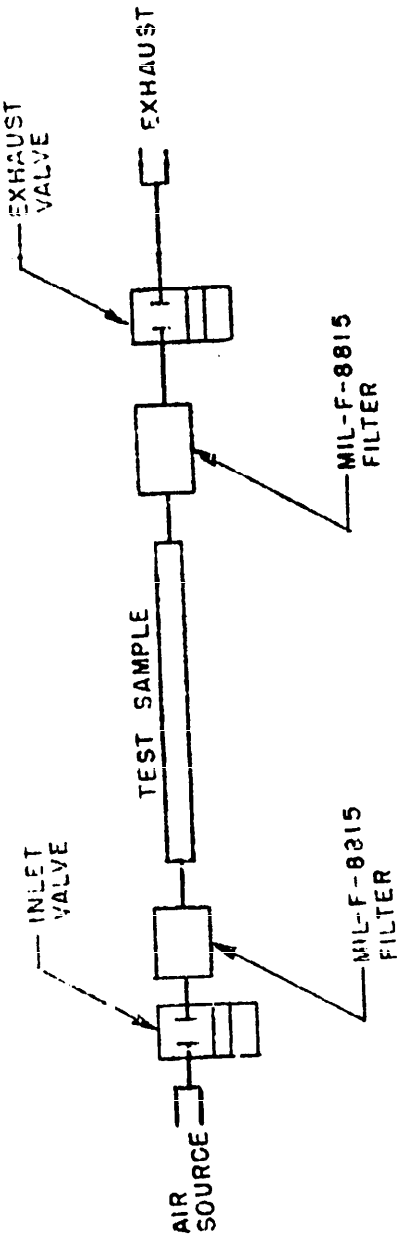


Figure 7. Test Setup for Pneumatic Surge Test

TANDARDIZATION DOCUMENT IMPROVEMENT PROPOSAL

OMB Approval
No. 22-R255

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