

INCH-POUND

MIL-DTL-32460
22 May 2013

DETAIL SPECIFICATION

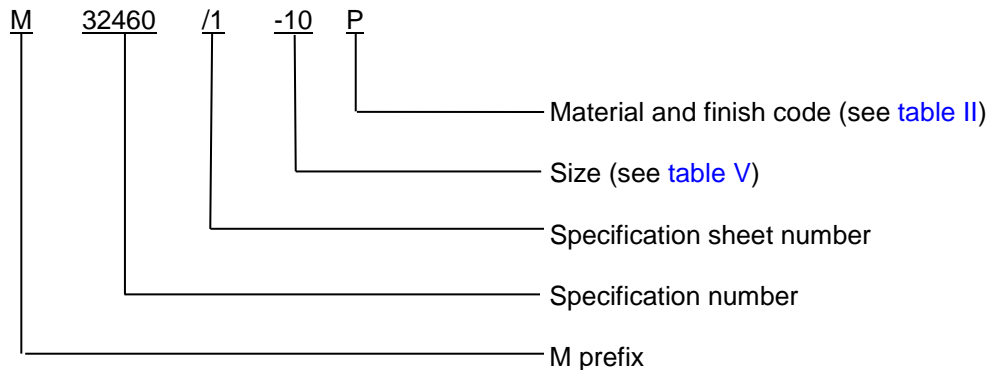
ADAPTER, HYDRAULIC AND PNEUMATIC, 37° FLARE TUBE FITTING TO ORFS
CONNECTORS, 1500 TO 3000 PSI AND -65°F TO 250°F,
GENERAL SPECIFICATION FOR

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

1. SCOPE

1.1 Scope. This specification covers fittings, adapter, hydraulic, pneumatic, and conveyance, 37° flared to O-ring face seal (ORFS) connectors, 1500 to 3000 psi, -65°F to 250°F temperature range, for use in hydraulic or pneumatic systems. The 37° flared connector ends are in accordance with SAE AS4395 connector ends, the ORFS end is in accordance with SAE J1453-3 connector ends.

1.2 Part or Identifying Number (PIN). The PIN consists of the letter M, the basic specification number, specification sheet number, a dash, a number for fitting size, and finish code.



PIN example: M32460/1-10P describes a straight male adapter (37° flared to ORFS) for 5/8 inch tube OD, steel with zinc phosphate finish.

Comments, suggestions, or questions on this document should be addressed to: DLA Land and Maritime, Attn: VAI, P.O. Box 3990, Columbus, OH 43218-3990, or emailed to FluidFlow@dla.mil. Since contact information can change, you may want to verify the currency of this address information using the ASSIST Online database at <https://assist.dla.mil>.

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2. APPLICABLE DOCUMENTS

2.1 General. The documents listed in this section are specified in sections 3, 4, or 5 of this specification. This section does not include documents cited in other sections of this specification or recommended for additional information or as examples. While every effort has been made to ensure the completeness of this list, document users are cautioned that they must meet all specified requirements documents cited in sections 3, 4, or 5 of this specification, whether or not they are listed.

2.2 Government documents.

2.2.1 Specifications, standards, and handbooks. The following specifications, standards, and handbooks form a part of this document to the extent specified herein. Unless otherwise specified, the issues of these documents are those cited in the solicitation or contract.

FEDERAL STANDARDS

- QQ-N-281 - Nickel-Copper Alloy Bar, Rod, Plate, Sheet, Strip, Wire, Forgings, and Structural and Special Shaped Sections

DEPARTMENT OF DEFENSE SPECIFICATIONS

- MIL-A-8625 - Anodic Coatings for Aluminum and Aluminum Alloys
 MIL-C-15726 - Copper-Nickel Alloy, Sheet, Plate, Strip, Bar, Rod, and Wire
 MIL-DTL-16232 - Phosphate Coating, Heavy, Manganese or Zinc Base
 MIL-DTL-25988 - Rubber, Fluorosilicone Elastomer, Oil-and-Fuel Resistant, Sheets, Strips, Molded Parts, and Extruded Shapes.
 MIL-DTL-81706 - Chemical Conversion Materials for Coating Aluminum and Aluminum Alloys
 MIL-PRF-5606 - Hydraulic Fluid, Petroleum Base, Aircraft, Missile and Ordnance
 MIL-PRF-7808 - Lubricating Oil, Aircraft Turbine Engine, Synthetic Base Hydraulic Fluid, Non-Petroleum Base, Aircraft
 MIL-PRF-83282 - Hydraulic Fluid, Fire Resistant, Synthetic Hydrocarbon Base, Metric, NATO Code Number H-537
 MIL-PRF-87257 - Hydraulic Fluid, Fire Resistant; Low Temperature, Synthetic Hydrocarbon Base, Aircraft and Missile

(See supplement 1 for list of specification sheets.)

DEPARTMENT OF DEFENSE STANDARDS

- MIL-STD-130 - Identification Marking of U.S. Military Property
 MIL-STD-889 - Dissimilar Metals

(Copies of these documents are available online at <http://quicksearch.dla.mil> or from the Standardization Document Order Desk, 700 Robbins Avenue, Building 4D, Philadelphia, PA 19111-5094.)

2.3 Non-Government publications. The following documents form a part of this document to the extent specified herein. Unless otherwise specified, the issues of these documents are those cited in the solicitation or contract.

ASTM INTERNATIONAL

- ASTM A276 - Standard Specification for Stainless Steel Bars and Shapes
 ASTM A564/A564M - Standard Specification for Hot-Rolled and Cold-Finished Age-Hardening Stainless Steel Bars and Shapes
 ASTM B117 - Standard Practice for Operating Salt Spray (Fog) Apparatus

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ASTM B164	- Standard Specification for Nickel-Copper Alloy Rod, Bar, and Wire
ASTM B166	- Standard Specification for Nickel-Chromium-Iron Alloys (UNS N06600, N06601, N06603, N06690, N06693, N06025, N06045, and N06696) and Nickel-Chromium-Cobalt-Molybdenum Alloy (UNS N06617) Rod, Bar, and Wire
ASTM B210	- Standard Specification for Aluminum and Aluminum-Alloy Drawn Seamless Tubes
ASTM B221	- Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes
ASTM B241/B241M	- Standard Specification for Aluminum and Aluminum-Alloy Seamless Pipe and Seamless Extruded Tube
ASTM B487	- Standard Test Method for Measurement of Metal and Oxide Coating Thickness by Microscopical Examination of Cross Section
ASTM B499	- Standard Test Method for Measurement of Coating Thicknesses by the Magnetic Method: Nonmagnetic Coatings on Magnetic Basis Metals
ASTM B564	- Standard Specification for Nickel Alloy Forgings
ASTM B567	- Standard Test Method for Measurement of Coating Thickness by the Beta Backscatter Method
ASTM B568	- Standard Test Method for Measurement of Coating Thickness by X-Ray Spectrometry
ASTM B633	- Standard Specification for Electrodeposited Coatings of Zinc on Iron and Steel
ASTM B695	- Standard Specification for Coatings of Zinc Mechanically Deposited on Iron and Steel
ASTM B748	- Standard Test Method for Measurement of Thickness of Metallic Coatings by Measurement of Cross Section with a Scanning Electron Microscope
ASTM E18	- Tests for Rockwell Superficial Hardness of Metallic Materials
ASTM E60	- Standard Practice for Analysis of Metals, Ores, and Related Materials by Molecular Absorption Spectrometry
ASTM E384	- Test Method for Microhardness of Materials
ASTM F1136/F1136M	- Standard Specification for Zinc/Aluminum Corrosion Protective Coatings for Fasteners

(Copies of these documents are available online at <http://www.astm.org> or from ASTM International, P.O. Box C700, 100 Barr Harbor Drive, West Conshohocken, PA 19428-2959.)

INTERNATIONAL ORGANIZATION FOR STANDARDIZATION (ISO)

ISO 17025	- General requirements for the competence of testing and calibration laboratories
ISO 19879	- Metallic tube connections for fluid power and general use Test methods for hydraulic fluid power connections

(Copies of these documents are available online at <http://www.iso.ch> or from the International Organization for Standardization American National Standards Institute, 11 West 42nd Street, 13th Floor, New York, NY 10036.)

NCSL INTERNATIONAL

NCSL Z540.3	- Requirements for the Calibration of Measuring and Test Equipment
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(Copies of these documents are available online at <http://www.ncsli.org> or from NCSL International 2995 Wilderness Place, Suite 107 Boulder, Colorado 80301-5404)

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SAE INTERNATIONAL

- SAE AMS-QQ-A-225/9 - Aluminum Alloy 7075, Bar, Rod, Wire, and Special Shapes; Rolled, Drawn, or Cold Finished
- SAE AMS-QQ-P-416 - Plating, Cadmium (Electrodeposited)
- SAE AMS-C-81562 - Coatings, Cadmium, Tin-Cadmium and Zinc (Mechanically Deposited)
- SAE AMS2417 - Plating, Zinc-Nickel Alloy
- SAE AMS2451/5 - Plating, Brush, Chromium Hard Deposit, Trivalent
- SAE AMS2451/9 - Plating, Brush, Zinc-Nickel Low Hydrogen Embrittlement
- SAE AMS2486 - Conversion Coating of Titanium Alloys Fluoride-Phosphate Type
- SAE AMS2488 - Anodic Treatment - Titanium and Titanium Alloys Solution pH 13 or Higher
- SAE AMS2700 - Passivation of Corrosion Resistant Steels
- SAE AMS4124 - Aluminum Alloy, Rolled or Cold Finished Bars, Rods, and Wire 5.6Zn - 2.5Mg - 1.6Cu - 0.23Cr (7075-T7351) Solution Heat Treated, Stress Relieved by Stretching, and Overaged
- SAE AMS4928 - Titanium Alloy Bars, Wire, Forgings, Rings, and Drawn Shapes 6Al - 4V Annealed
- SAE AMS5639 - Steel, Corrosion-Resistant, Bars, Wire, Forgings, Tubing, and Rings 19Cr - 10Ni Solution Heat Treated
- SAE AMS5643 - Steel, Corrosion-Resistant, Bars, Wire, Forgings, Tubing, and Rings 16Cr - 4.0Ni - 0.30Cb - 4.0Cu Solution Heat Treated, Precipitation Hardenable
- SAE AMS5645 - Steel, Corrosion and Heat Resistant, Bars, Wire, Forgings, Tubing, and Rings 18Cr - 10Ni - 0.40Ti (SAE 30321) Solution Heat Treated
- SAE AMS5647 - Steel, Corrosion-Resistant, Bars, Wire, Forgings, Tubing, and Rings 19Cr - 9.5Ni Solution Heat Treated
- SAE AMS5743 - Steel, Corrosion and Heat-Resistant, Bars and Forgings 15.5Cr - 4.5Ni - 2.9Mo - 0.10N Solution Heat Treated, Sub-Zero Cooled, Equalized, and Over-Tempered
- SAE AMS6370 - Steel, Bars, Forgings, and Rings 0.95Cr - 0.20Mo (0.28 - 0.33C) (SAE 4130)
- SAE AMS6382 - Steel, Bars, Forgings, and Rings 0.95Cr - 0.20Mo (0.38 - 0.43C) (SAE 4140) Annealed
- SAE AS4395 - Fitting End, Flared, Tube Connection, Design Standard
- SAE AS4396 - Fitting End, Bulkhead, Flared Tube Connection, Design Standard
- SAE AS8879 - Screw Threads - UNJ Profile, Inch Controlled Radius Root with Increased Minor Diameter
- SAE J403 - Chemical Compositions of SAE Carbon Steels
- SAE J514 - Hydraulic Tube Fittings
- SAE J1453-1 - Specification for O-ring Face Seal Connectors: Part 1—Tube Connection Details and Common Requirements for Performance and Tests
- SAE J1453-3 - Specification for O-ring Face Seal Connectors: Part 3-Requirements, Dimensions, and Tests for Steel Unions, Bulkheads, Swivels, Braze Sleeves, Connectors, Caps, and Connectors with SAE J1926-2 Inch Stud Ends

(Copies of these documents are available from SAE International, 400 Commonwealth Drive, Warrendale, PA 15096-0001, Tel: 877-606-7323 (inside USA and Canada) or 724-776-4970 of these documents (outside USA), www.sae.org.)

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2.4 Order of precedence. Unless otherwise noted herein or in the contract, in the event of a conflict between the text of this document and the references cited herein, (except for related specification sheets), the text of this document takes precedence. Nothing in this document, however, supersedes applicable laws and regulations unless a specific exemption has been obtained.

3. REQUIREMENTS

3.1 Specification sheets. The individual item requirements shall be as specified herein and in accordance with the applicable specification sheet. In the event of any conflict between the requirements of this specification and the specification sheet, the latter shall govern.

3.2 First article. When specified (see 6.2), samples shall be subjected to first article inspection in accordance with 4.5.

3.3 Materials. Materials shall be as specified herein and shall conform to all applicable specification sheets. When a definite material is not specified, a material shall be used which will enable the fitting to meet the requirements of this specification. Acceptance or approval of any constituent material shall not be construed as a guarantee of acceptance of the finished product.

3.3.1 Recycled, recovered, or environmentally preferable materials. Recycled, recovered, or environmentally preferable materials should be used to the maximum extent possible, provided that the material meets or exceeds the operational and maintenance requirements, and promotes economically advantageous life cycle cost.

3.3.1.1 Used, rebuilt or remanufactured components. Used, rebuilt or remanufactured components such as nuts and sleeves shall not be used in the fitting assembly design.

3.3.2 Dissimilar metals. When dissimilar metals are used in intimate contact with each other, protection against electrolysis and corrosion shall be provided. Dissimilar metals such as brass, copper or steel (except corrosion-resisting steel) shall not be used in intimate contact with aluminum or aluminum alloy. Corrosion-resisting steel shall be passivated in accordance with SAE AMS2700. Protective measures for dissimilar metals shall be in accordance with MIL-STD-889.

3.3.3 Fitting materials. Fitting materials shall be as specified in [table I](#).

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TABLE I. Fitting materials.

Material	Form	Specification	Alloy
Aluminum alloy	Bars	SAE AMS-QQ-A-225/9	7075- T73, T7351
		SAE AMS4124	7075-T7351
	Forgings	ASTM B221	7075-T73, T6, T62, or T651
	Seamless tubing	ASTM B210 or ASTM B241/B241M	5052 6061-T6
Carbon steel	Bar	SAE J403	1045, 1110, 1120, 1140, 1213, 1215, or 12L14
	Forgings		
Chrome-molybdenum steel	Bars	SAE AMS6370	4130
	Forgings	SAE AMS6382	
Corrosion resistant steel	Bars and forgings	ASTM A276	304, 316, or 321
		ASTM A564/A564M	XM-12 (15-5 PH) UNS S15500 or 603 (17-4 PH) UNS S17400
		SAE AMS5639	SAE 30304; UNS S30400
		SAE AMS5645	SAE 30321; UNS S32100
		SAE AMS5647	304L; UNS S30403
		SAE AMS5643	17-4PH
		SAE AMS5743	AM-355
Copper-nickel alloy	Bar	MIL-C-15726	C71500
Nickel-copper alloy	Bar	ASTM B164 QQ-N-281	UNS N04400
High-chromium nickel alloy	Bar	ASTM B166	UNS N06690
	Forgings	ASTM B564	
Titanium ^{1/}	Bars	SAE AMS4928	6Al-4V annealed
	Forgings		

^{1/} Titanium shall not be used in oxygen systems.

3.3.4 Finish.

3.3.4.1 Finish designation codes for materials and chemical finishes. Finish designation codes for materials and chemical finishes shall be in accordance with [table II](#). SAE nuts and sleeves shall be plated in accordance with MIL-DTL-32460.

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TABLE II. Material and chemical finish identification codes and chemical finish reference.

PIN code material/plating finish	Material	Plating finish requirement paragraph
Blank	Steel	3.3.4.1a <u>1/</u>
CN		3.3.4.1a, with 3.3.4.1c <u>1/</u>
E		3.3.4.1c
F	Steel	3.3.4.1b(4), 3.3.4.1b(5) or, 3.3.4.1b(2) with 3.3.4.1c
H	Steel	3.3.4.1b(3)
J	Steel	3.3.4.1b(5)
M	Nickel-copper alloy UNS N04400	No additional finish.
N	High-chromium nickel alloy UNS N06690	No additional finish.
P	Steel	3.3.4.1b(4)
R	Steel	3.3.4.1b(2) <u>2/</u>
S	Corrosion resistant Steel	3.3.4.2 passivated
T	Titanium <u>3/</u>	3.3.4.4
Z	Steel	3.3.4.1b(1)
ZN	Steel	3.3.4.1b(1) with 3.3.4.1c

1/ Hydrogen embrittlement relief test need not be run.

2/ Hexavalent chromium free.

3/ Titanium shall not be used in oxygen systems.

3.3.4.1 Steel fitting finish (except corrosion resistant steel).

a. Cadmium plating. Cadmium plating in accordance with SAE AMS-C-81562, type II, class 3 or SAE AMS-QQ-P-416, type II, class 2. Fluid passages, other openings and internal threads shall not be subject to the plating thickness requirement and may have bare areas provided they are protected with a light film of oil.

b. Zinc platings.

- (1) Zinc plating shall be in accordance with ASTM B633; type II or III, Fe/Zn 5, or ASTM B695, type II, class 5. Both zinc platings specified in ASTM B633 type III and ASTM B695 type II shall meet the same 96-hour salt spray test endurance as ASTM B633 type II zinc plating.
- (2) Zinc plating shall be in accordance with ASTM B633, type VI, Fe/Zn 5 and shall be hexavalent chromium free.
- (3) Aluminum-nickel in accordance with ASTM F1136/F1136M, grade 3, NC.
- (4) Zinc phosphate. Zinc phosphate shall be in accordance with MIL-DTL-16232, type Z.
- (5) Zinc nickel shall be in accordance with SAE AMS2417, type 2, grade B.

c. Chemical film. NAVAIR trivalent chromate pretreatment (TCP) in accordance with MIL-DTL-81706, type II, class 1A, material form (1 through 6), application method A, B, or C. Example of a PIN: M817062A3C.

Note: For new design it is recommended that phosphate coating shall be specified when electrodeposited zinc or mechanically-deposited cadmium plating is not required.

3.3.4.2 Corrosion resistant steel. Corrosion resistant steel shall be passivated in accordance with SAE AMS2700, type 6 or 7.

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3.3.4.3 Aluminum. Aluminum shall be anodized in accordance with MIL-A-8625, type II, class 2.

3.3.4.4 Titanium. Titanium shall be anodized in accordance with SAE AMS2488, type 2 or fluoride phosphated in accordance with SAE AMS2486. Titanium shall not be used in oxygen or potable water systems.

3.3.5 Finish. All platings shall be capable of meeting the 96 hour salt spray test in accordance with 4.7.5. Fluid passages, other openings, and internal threads shall not be subject to the plating thickness requirement and may have bare areas provided they are protected with a light film of oil. The following exceptions shall apply:

- a. Phosphate coated fittings shall be subjected to all tests as specified in MIL-DTL-16232, Class 1, except for the salt spray test. The salt spray test is required only to verify/recertify the phosphating process or changes thereto.
- b. Passivated fittings shall be subjected only to the copper sulfate tests as specified in SAE AMS2700, method 102. Fittings passing this test shall be returned to stock for usage after each fitting is thoroughly rinsed in deionized water and thoroughly dried.

3.3.6 Trivalent wrenchability. When the finish has been damaged due to poor wrenchability, the surface of the connector shall be touched up using the brush plating process below. The term "trivalent wrenchability" is used to evaluate the ability of the finish to withstand abrasion from an excessive amount of wrenching.

- a. Brush plating of hard chromium by electrodeposition shall be in accordance with SAE AMS2451/5.
- b. Brush plating of medium-hardness, low stress nickel by electrodeposition shall be in accordance with SAE AMS2451/9.
- c. Brush plating of NAVAIR TCP shall be in accordance with MIL-DTL-81706, type 2, class 1A, material form 1 through 6, application method B. Example of a PIN: M817062A6B.

3.3.7 Cadmium. Carbon steel material with cadmium plating shall only be used when other materials and finishes specified in this document cannot meet performance requirements (see 6.5).

3.3.8 Plating thickness verification (cadmium and zinc plating's). Plating thickness shall be measured in accordance with 4.7.2 and shall meet the requirements of 3.3.4.1.

3.4 Interface. The 37° flared fittings are intended for use with steel tubing or hoses in hydraulic systems or pneumatic systems for use in hydraulic, pneumatic, fuel, and oil lines.

3.5 Hardness (steel).

3.5.1 Finished corrosion-resisting steel parts. Unless otherwise specified in the contract or order (see 6.2), the minimum hardness for finished corrosion-resisting steel parts, shall be Rockwell B80 and the maximum hardness shall be Rockwell C32.

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3.6 Design.

3.6.1 Design concept. The 37° flared to O-ring face seal design is to bring together two technologies to obtain a leak proof fluid conveyance. The 37° flared connection is an old technology. The ORFS connector sealing end provides the technology of an elastomeric seal on the connection in line with the fluid flow to account for surface imperfections to give a tight seal.

3.6.1.1 Working pressures (see 6.7). Fittings, when properly assembled, shall ensure a leak-proof full-flow connection up to 3000 psi (20.7MPa) working pressure or 6000 psi (41 MPa) proof pressure for sizes -2 through -16 (1/8 through 1 inch) and 1500 psi (10 MPa) working pressure or 3000 psi (21 MPa) proof pressure for sizes -20 through -32 (1-1/4 through 2 inch).

3.6.1.2 Operating temperature. Fittings shall operate in a hydraulic fluid with temperature range -65°F to 400°F (-53.9°C to 204.4°C) and pneumatic with temperature range -65°F to +160°F (-53.9°C to 71°C).

3.6.2 Design and dimensions. Fittings shall be in accordance with the applicable slash sheets, see supplement 1. For features not specified on the individual slash sheets design and dimensions shall be in accordance with SAE J514 or SAE J1453-3. The 37° flared end shall be in accordance with SAE AS4395 for non-bulkheads or SAE AS4396 for bulkheads.

3.6.2.1 Surface finish. Unless otherwise specified all sealing surfaces shall be smooth, except that annular tool marks up to 100 micro-inch (2.54 µm) maximum, peak to valley, shall be permissible.

3.6.2.2 ORFS end. The ORFS end shall be in accordance with SAE J1453-3 for both non-bulkheads and bulkheads, and swivel.

3.6.2.3 O-rings. When O-rings are required, they shall be in accordance with MIL-DTL-25988.

3.6.2.4 Back-up washers. All carbon steel back-up washers shall be steel alloy 1010 or 1015 in accordance with SAE J403. Back-up washers shall be furnished on adjustable fittings that require the use of a lock nut. Washers are to be installed on fittings by the manufacturer.

3.6.2.5 Shape and form restrictions. Abrupt reductions of section shall be avoided. Small external sections adjoining relatively heavy body sections shall be shaded into the heavier sections by means of ample fillets. There shall be no sharp corners or inadequate fillets, excessive undercuts, or excessive grooves at the junction of such small sections with large sections of fittings.

3.6.2.6 Drill offset. On straight fittings where the fluid passage is drilled from each end, the offset between the drilled holes at the meeting point of the drills shall not exceed .015 inch (0.38 mm). It shall be possible to pass through the fluid passage a ball whose minimum diameter is .020 inch (0.51mm) less than the minimum diameter specified for the passage. On angle fittings, the cross-sectional area at the junction of the fluid passage shall be not smaller than the cross-sectional area of the smaller passage.

3.6.2.7 Wall thickness. The wall thickness at any point on the fitting shall be not less than the thickness established by the dimensions, tolerances and eccentricities for the inside and outside diameters specified in SAE AS4395, SAE J1453-3 or the applicable slash sheet (see 1.2).

3.6.2.8 37° flared end threads. The 37° flared end threads shall be in accordance with SAE AS8879.

3.6.2.9 ORFS end threads. ORFS end threads shall be in accordance with SAE J1453-1.

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3.7 Performance.

3.7.1 Lubricant wear. The fittings when tested in accordance with 4.7.7 shall be assembled and disassembled 15 times and the final torque readings shall not exceed the values specified in table III or table IV.

TABLE III. Torque 37° flared end. 1/

Fitting dash size	Torque lbs-ft (Nm)		SAE dash size	Torque lbs-ft (Nm)	
	Min	Max		Min	Max
-2	6 (8)	7 (9)	-12	79 (107)	88 (119)
-3	8 (11)	9 (12)	-14	94 (127)	103 (140)
-4	11 (15)	12 (16)	-16	108 (147)	113 (154)
-5	14 (19)	15 (21)	-20	127 (172)	133 (181)
-6	18 (24)	20 (28)	-24	158 (215)	167 (226)
-8	36 (49)	39 (53)	-32	245 (332)	258 (350)
-10	57 (77)	63 (85)			

1/ Metric equivalents are given for information only.

TABLE IV. Torque ORFS end. 1/

Fitting dash size	Torque lbs-ft (Nm)	SAE dash size	Torque lbs-ft (Nm)
	+10% -0		+10% -0
-2	11 (15)	-12	66 (90)
-3	15 (20)	-14	85 (115)
-4	18 (25)	-16	92 (125)
-5	22 (30)	-20	125 (170)
-6	26 (35)	-24	148 (200)
-8	40 (55)	-32	200 (270)
-10	44 (60)		

1/ Metric equivalents are given for information only.

3.7.2 Proof pressure. The fittings when subjected to the proof pressure testing in accordance with 4.7.8 at the proof pressure specified in table V shall show no evidence of leakage or other malfunctioning during this test.

3.7.3 Leakage. The fittings shall not leak, when tested in accordance with 4.7.9.

3.7.4 Room temperature burst. The fittings shall not leak, rupture, or blow off the tube at any pressure below the minimum room temperature burst pressure specified in table V, when tested in accordance with 4.7.10.

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TABLE V. Performance requirements of high pressure, high temperature fittings. 1/ 2/

Fitting dash size	Fitting ID inches (mm)	Max. operating pressure psi (MPa)	Proof pressure psi (MPa)	Min. burst pressure at room temp psi (MPa)	Min. burst pressure at high temp psi (MPa)	Minimum bend radius (inside of bend) inch (mm)
-4	.2500 (6.350)	3000 (21)	6000 (41)	16,000 (110)	12,000 (83)	3.00 (76)
-6	.3750 (9.525)	3000 (21)	6000 (41)	14,000 (97)	10,500 (72)	5.00 (127)
-8	.5000 (12.700)	3000 (21)	6000 (41)	14,000 (97)	10,500 (72)	5.75 (14.6)
-10	.6250 (15.875)	3000 (21)	6000 (41)	12,000 (83)	9,000 (62)	6.50 (165)
-12	.7500 (19.050)	3000 (21)	6000 (41)	16,000 (110)	9,000 (62)	7.75 (197)
-16	1.0000 (25.400)	3000 (21)	6000 (41)	16,000 (110)	9,000 (62)	9.63 (245)
-20	1.2500 (31.750)	1500 (10)	3000 (21)	6,000 (41)	6,000 (41)	10.00 (254)
-24	1.5000 (38.100)	1500 (10)	3000 (21)	6,000 (41)	6,000 (41)	11.00 (279)

1/ Dimensions are in inches.

2/ Metric equivalents are given for information only.

3.7.5 Over-tightening torque. The fittings shall withstand over-tightening torque 15 times, when tested in accordance with 4.7.11.

3.8 Interchangeability. Parts having the same slash number shall be functionally and dimensionally interchangeable. All parts manufactured to the same military PIN shall be functionally interchangeable.

3.9 Marking.

3.9.1 Identification of product. Fittings shall be marked as specified in 3.9.2 and 3.9.3. Stamped markings shall be applied in a location not detrimental to the function of the fittings prior to the application of the corrosion-protective finish specified in 3.3.4.

3.9.2 Trademark. Unless otherwise specified, all fittings shall be stamped with manufacturer's name or trademark (see 6.2).

3.9.3 PIN marking. Fittings shall be marked for identification in accordance with MIL-STD-130 with the applicable specification sheet PIN (see 3.1).

3.10 Lubrication. During assembly, an anti-friction compound, oil or petroleum lubricant may be used on the sleeves and threads of carbon steel and of corrosion-resisting steel fittings. A dry film lubricant, a lubricous coating, may be added to the threads of corrosion-resisting steel nuts. Lubricate the O-ring with a light coat of system fluid or compatible oil.

3.11 Cleanliness. All fittings and sleeves shall be free of oil, grease, dirt, moisture, cleaning solvents and foreign materials both internally and externally.

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3.12 Workmanship. Workmanship shall conform to the best commercial practice to produce high quality fittings. Fittings shall be free from all hanging burrs, loose scale and slivers which might become dislodged in usage and all other defects which might affect their performance. The fittings shall be examined for the following defects as specified in [table VI](#).

TABLE VI. Workmanship defects.

Examination	Requirement paragraph
Type, size, style, or configuration not in conformance with the applicable individual specification sheet.	3.1
Shape and form reduction abrupt: Small external visual sections not shaded into heavy body section by fillets: fittings have sharp corners; inadequate fillets; excessive undercuts or grooves.	3.6.2.5
Bores drilled from each end exceed specified tolerance at drill meeting point; size of fluid passage of angle fittings, not as specified.	3.6.2.6
Wall thickness of fittings, less than dimensions and tolerances specified.	3.6.2.7
Machined surface finish.	3.6.2.1
Material not as specified.	3.3.3
Threads not as specified.	3.6.2.8 , 3.6.2.9
Sealing surface, not as specified.	3.6.2
Finish not as specified.	3.3.4
Contractor does not have documentation available for identification of material.	3.3.3
Contractor does not have documentation available for identification of finishes or treatment.	3.3.4
Used, rebuilt or remanufactured components, pieces, or parts incorporated in the fittings.	3.3.1.1
Dissimilar metals are not treated or effectively insulated from each other.	3.3.2
Nuts, or washers missing or not as specified.	3.1
Marking missing, illegible, or not as specified.	3.9

4. VERIFICATION

4.1 Classification of inspection. The inspection requirements specified herein are classified as follows:

- a. First article inspection (see [4.5](#)).
- b. Conformance inspection (see [4.6](#)).

4.2 Test equipment and inspection facilities. Test and measuring equipment and inspection facilities of sufficient accuracy, quality, and quantity to permit performance of the required inspection shall be established and maintained or identified by the contractor. The establishment and maintenance of a calibration system to control the accuracy of the measuring and test equipment shall be in accordance with ISO 17025 and NCSL Z540.3 as applicable.

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4.3 Inspection conditions. Unless otherwise specified, all testing shall be conducted at atmospheric pressure within the range of 28 to 31 inches of mercury (71.1 to 78.4 centimeters of mercury), a temperature between 60°F and 100°F (15.6°C to 37.8°C), and a relative humidity of not more than 90%. Tolerances of the test conditions shall be as follows:

- a. Temperature tolerances: +10°F, -5°F (+5.55°C, -2.8°C)
- b. Pressure (gauge): ±5%

4.3.1 Stabilization of test temperatures. Unless otherwise specified, the test temperature in the chamber shall be stabilized before conducting the test.

4.3.2 Test fluids. Unless otherwise specified, the test fluid shall be hydraulic oil in accordance with MIL-PRF-5606, MIL-PRF-83282, MIL-PRF-87257, or water (proof test, burst test, and leakage test only). When a high temperature test fluid is specified, the test fluid shall be lubricating oil in accordance with MIL-PRF-7808.

4.4 Responsibility for compliance. All items shall meet all requirements of sections 3, 4, and 5. The inspection set forth in this specification shall become a part of the contractor's overall inspection system or quality program. The absence of any inspection requirements in the specification shall not relieve the contractor of the responsibility of ensuring that all products or supplies submitted to the Government for acceptance comply with all requirements of the contract. Sampling inspection, as part of manufacturing operations, is an acceptable practice to ascertain conformance to requirements, however, this does not authorize submission of known defective material, either indicated or actual, nor does it commit the Government to accept defective material. The supplier's inspection and test records shall clearly demonstrate the products conformance to technical specifications.

4.4.1 Lot records. Manufacturers shall keep lot records for 3 years minimum. Manufacturers shall monitor for compliance to the prescribed procedures, and observe that satisfactory manufacturing conditions and records on lots are maintained for these hose assemblies. The records, including as a minimum, an attributes summary of all quality conformance inspections conducted on each lot, shall be available to review by customers at all times.

4.5 First article inspection. First article inspection shall consist of the examinations and tests specified in [table VII](#) performed on samples which are representative of the production item, after award of the contract, to determine that the production item meets the requirements of this specification.

4.5.1 Samples for first article inspection. Samples for first article inspection shall be representative of the products proposed to be furnished to this specification. Test samples, consisting of 43 fittings for each dash size shall be examined and tested in accordance with this specification. Fittings shall be assembled on the tube assembly and tested. Test results shall be submitted to the acquiring activity. All assemblies shall be identified with the manufacturer's name and the slash sheet PIN.

4.5.2 First article inspection routine. All adapter samples shall be subjected to first article testing in accordance with [table VII](#) and in the sequence specified in [table VIII](#).

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TABLE VII. First article inspection requirements.

Inspection	Requirement paragraph	Test paragraph	Number of samples
Visual inspection	3.1 , 3.6.2 , 3.9 , 3.11 , and 3.12	4.7.1	All
Plating verification (cadmium or zinc only) <u>1/</u>	3.3.8	4.7.2	2 minimum
Hardness test	3.5	4.7.3	2 minimum
Chemical analysis	3.3.3	4.7.4	2 minimum
Corrosion resistance	3.3.5	4.7.5	2 minimum
Design capability test	3.6	4.7.6.1	6 tube assemblies
Functional test <u>2/</u>	3.7.1	4.7.7	8 tube assemblies
Proof pressure	3.7.2	4.7.8	
Leakage <u>2/</u>	3.7.3	4.7.9	6 tube assemblies
Burst pressure <u>2/</u>	3.7.4	4.7.10	6 tube assemblies
Over-tightening torque <u>2/</u>	3.7.5	4.7.11	2 tube assemblies

1/ May be supplied by the plating manufacturer.

2/ These are destructive tests.

TABLE VIII. First article test sequence.

Tube assembly number (28)	Test sequence - paragraph numbers				
1 through 6 <u>1/</u>	4.7.1	4.7.6.1	4.7.8	4.7.10	—
7 through 14	4.7.1	4.7.7	—	—	—
15 through 20	4.7.1	4.7.9	—	—	—
21 through 26	4.7.1	4.7.10	—	—	—
27 and 28 <u>2/</u>	4.7.1	4.7.11	4.7.8	—	—

1/ Two samples (5 and 6) shall have a 90° elbow fitting on one end of the assembly.

2/ These samples shall have a 90° elbow fitting on one end of the assembly.

4.5.3 Waivers or deviations to specification requirements. All waivers or deviations to specification requirements shall be coordinated through the preparing activity; DLA Land and Maritime, Attn: VAI, P.O. Box 3990, Columbus, OH 43218-3990, or emailed to Fluidflow@dla.mil.

4.5.4 Failures. All samples shall meet all of the contract requirements. Failure of a sample unit to pass any test shall be cause for rejection of the entire lot and refusal to grant first article approval.

4.5.5 First article information. Upon completion of first article inspection, the Government activity responsible for conducting the inspection program (see [6.2](#)), shall report the results of the inspection, with appropriate recommendation, to the contracting officer. Approval of the first article samples or the waiving of first article inspection does not preclude the requirements for performing conformance inspection.

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4.5.6 Submission of samples. First article samples shall be furnished to the Government as directed by the contracting officer (see 6.2). The sample shall be representative of the construction, workmanship, components, and materials to be used during production. When a manufacturer is in continuous production of fittings from one contract to another, submission of additional first article samples for a new contract may be waived at the discretion of the acquiring activity (see 6.2).

4.6 Conformance inspection.

4.6.1 Inspection of product for delivery. Inspection of product for delivery shall consist of individual inspections in [table IX](#).

TABLE IX. Individual inspections.

Inspection	Requirement paragraph	Test method paragraph
Dimensional and visual inspection	3.1 , 3.6.2 , 3.9 , 3.11 , and 3.12	4.7.1
Proof pressure	3.7.2	4.7.8
Leakage ^{1/}	3.7.3	4.7.9

^{1/} Destructive test.

4.6.2 Sampling for individual inspections. Fittings for sampling shall be selected from a production lot (see [4.6.2.1](#)) and shall be subjected to the individual inspections. The sampling size shall be as specified in [4.6.2.2](#).

4.6.2.1 Production lot. A production lot shall consist of all fittings of the same PIN which have been manufactured under the same conditions and on the same continuous run.

4.6.2.2 Inspection sample. The inspection sample shall be product selected at random from the production lot without regard to quality and shall be the size specified in [table X](#).

TABLE X. Inspection sample.

Production lot size	Sample size
1 to 8	All
9 to 90	8
91 to 150	12
151 to 280	19
281 to 500	21
501 to 1,200	27
1,201 to 3,200	35
3,201 to 10,000	38
10,001 to 35,000	46

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4.6.2.3 Nonconformance of individual inspection tests. If one or more defects are identified, then the entire production lot shall be screened for that defect and all defects shall be removed. A second inspection sample shall then be selected from the different lot and the individual inspection tests shall be performed again. If one or more defects are identified from the second inspection lot, then the entire production lot shall be rejected and not supplied to this specification.

4.7 Test methods.

4.7.1 Visual inspection. Fittings shall be examined to ensure conformance with this specification. Continuous examination shall be performed to assure compliance with the following requirements:

- a. Specification sheets (see [3.1](#)).
- b. Design, construction and physical dimensions (see [3.6.2](#)).
- c. Materials (see [3.3.3](#)) and finishes (see [3.3.4](#)).
- d. Marking (see [3.9](#)).
- e. Cleanliness (see [3.11](#)).
- f. Workmanship (see [3.12](#)).

4.7.2 Verification of fitting plating thickness cadmium or zinc (see [3.3.8](#)). Verification of under plating and finish plating shall be measured in accordance with ASTM B499, ASTM B567, or ASTM B568. A cross-sectioning method, such as that specified in ASTM B487 or ASTM B748, can also be used as a referee method to confirm the precision when thicknesses of 30μ inches (0.76 μm) or above are used. The zinc plating thickness may also be measured in accordance with ASTM B633 or ASTM B695 as applicable. The following details shall apply:

- a. When applicable a minimum of five points shall be measured on the adapter surface. The adapter may be rotated, but measurement points shall be progressively further from the last point. Readings shall not be averaged. Measurements shall be as follows:
 - (1) One measurement shall be taken at a point on the front radius and rear radius.
 - (2) Three measurements shall be taken in the middle areas.
- b. Plating thickness shall meet the requirements of [3.3.8](#).

4.7.3 Hardness test (see [3.5](#)). 2 fittings minimum randomly selected in accordance with [4.6.2](#) shall be tested for hardness in accordance with ASTM E18 or ASTM E384 and shall meet the requirements of [3.5](#).

4.7.4 Chemical analysis (see [3.3.3](#)). When requested by the acquiring activity, certification showing conformance with the applicable material specification, see [table I](#), shall be made available. When specified, spectrochemical analysis shall be in accordance with ASTM E60 (see [6.2](#)).

4.7.5 Corrosion resistance (cadmium or zinc plated parts only) (see [3.3.5](#)). Two adapter samples shall be corrosion resistance tested in accordance with ASTM B117 and shall meet the requirements of [3.3.5](#).

4.7.6 Design capability testing of fittings.

4.7.6.1 Design certification. In order to provide a basis for certifying to the design requirements of [3.6](#), fitting manufacturers shall pressure test each of their product designs as outlined in [4.7.6.2](#).

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4.7.6.2 Design capability test. When specified, a minimum of 6 fittings shall be tested on tube assemblies. The fittings of each size, shape and material, after being lubricated, shall be assembled with mating fittings. The following details shall apply:

- a. The tube assembly shall be tightened to the adapter with a minimum torque load specified in [table III](#) and [table IV](#) for the applicable assembly size, fitting end and adapter type.
- b. The straight thread with O-ring end adapter shall be tightened to the point where leakage shall not occur, at a proof pressure of 6000 psi (41 MPa) for size -2 through -16 or a proof pressure of 3000 psi (21 MPa) for size -20 through -32. Under this pressure, there shall be no leakage or distortion of the assembly.
- c. The tube assembly with adapter shall then be pressurized to the point at which leakage or rupture occurs and the results shall be recorded.

4.7.7 Functional test. The fittings shall be assembled to the tube and subjected to the lubricant wear test as specified in [4.7.7.1](#). Any fitting failing to pass this test is counted as a defective unit and is cause for rejection of a lot. Fittings, or parts thereof, subjected to the lubricant wear test shall not be delivered to the acquiring activity.

4.7.7.1 Lubricant wear (see [3.7.1](#)). Fittings when subjected to the lubricant wear test shall meet the requirements of [3.7.1](#). The following details shall apply:

- a. The adapter and fittings shall be lubricated with hydraulic oil in accordance with MIL-PRF-5606, MIL-PRF-83282, or MIL-PRF-87257 prior to this test.
- b. Tube method:
 - (1) The adapter shall be assembled to the tube and disassembled.
 - (2) A new end or tube assembly shall be used for each assembly.
- c. This sequence shall be repeated 15 times.
- d. During the last assembly, the torque reading shall be recorded.

4.7.8 Proof pressure (see [3.7.2](#)). The fittings when assembled to a tube assembly shall be tested as specified in ISO 19879. When subjected to the rated proof pressure specified in [table V](#) the adapter assembled to the tube assembly shall meet the requirements of [3.7.2](#).

4.7.9 Leakage tests (see [3.7.3](#)). The fittings when installed on tube assemblies shall be tested as specified in ISO 19879 and meet the requirements of [3.7.3](#).

4.7.10 Burst pressure testing (see [3.7.4](#)). Tube assemblies shall be tested using both the 2 piece and 3 piece tube assembly fittings (3 fittings for each type) and shall meet the requirements of [3.7.4](#). The following details shall apply:

- a. Testing shall be in accordance with ISO 19879.
- b. The tube fittings with fittings installed shall be capable of withstanding an internal hydrostatic pressure to a minimum of four times the intended working pressure specified in [table V](#) without failure.

4.7.11 Over-tightening torque (see [3.7.5](#)). Tube assemblies with fittings when subjected to over-tightening torque testing shall meet the requirements of [3.7.5](#). The following details shall apply.

- a. Two tube assemblies with fittings of each size shall be subjected to the following tests.
- b. The threads of the fittings shall be lubricated with oil in accordance with MIL-PRF-5606, MIL-PRF-87257 or MIL-PRF-83282 prior to this test.
- c. All fittings and both ends shall be tightened to the appropriate over-tightening torque specified in [table XI](#) or [table XII](#) and then loosened. This sequence shall be repeated 15 times for the 37° flare and ORFS ends.
- d. On the 15th over-tightening torque application, the tube assemblies with adapter shall be subjected to the proof pressure test specified in [4.7.8](#).

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- e. After this sequence, there shall be no evidence of failure, leakage, or deformation of the adapter assemblies.

TABLE XI. Over-tightening torque values for 37° flared. 1/ 2/

SAE dash size	Torque		SAE dash size	Torque
	lbf-ft (Nm)			lbf-ft (Nm)
-2	11 (15)		-12	118 (160)
-3	14 (19)		-14	138 (186)
-4	18 (24)		-16	158 (214)
-5	23 (31)		-20	200 (271)
-6	31 (42)		-24	250 (339)
-8	59 (80)		-32	367 (497)
-10	85 (114)			

1/ Metric equivalents are given for information only.

2/ 37° flare end swivel nut.

TABLE XII. Over-tightening torque values for ORFS. 1/

SAE dash size	Torque		SAE dash size	Torque
	lbf-ft (Nm)			lbf-ft (Nm)
-2	15 (20)		-12	133 (180)
-3	18 (25)		-14	170 (230)
-4	24 (32)		-16	200 (270)
-5	33 (45)		-20	280 (380)
-6	40 (54)		-24	332 (450)
-8	60 (81)		-32	450 (610)
-10	100 (136)			

1/ Metric equivalents are given for information only.

5. PACKAGING

5.1 Packaging. For acquisition purposes, the packaging requirements shall be as specified in the contract or order (see 6.2). When packaging of material is to be performed by DoD or in-house contractor personnel, these personnel need to contact the responsible packaging activity to ascertain packaging requirements. Packaging requirements are maintained by the Inventory Control Point's packaging activities within the Military Service or Defense Agency, or within the Military Department's System Command. Packaging data retrieval is available from the managing Military Department's or Defense Agency's automated packaging files, CD-ROM products, or by contacting the responsible packaging activity.

6. NOTES

(This section contains information of a general or explanatory nature which may be helpful, but is not mandatory).

6.1 Intended use. The 37° flared fittings are intended for use with steel tubing or hoses in hydraulic systems or pneumatic systems. Carbon steel sleeves may be used only with fully annealed 70-30 copper-nickel or carbon steel tubing. Corrosion-resisting steel sleeves may be used with fully annealed 70-30 copper-nickel, 70-30 nickel-copper, corrosion-resisting steel or carbon steel tubing. These fittings are not intended for use in aircraft. These fittings are military unique because they are intended to mate and integrate new design possibilities with existing military designs. These fittings will allow retrofitting of new hydraulic and pneumatic controls, without redesign, to existing military systems.

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6.2 Acquisition requirements. Acquisition documents should specify the following:

- a. Title, number and date of this specification.
- b. PIN (see 1.2).
- c. Hardness requirement, if different (see 3.5.1).
- d. First article (see 4.5) or whether first article inspection is waived (see 6.3.1).
- e. Lot records if required (see 4.4.1).
- f. Name and address of the first article inspection test facility to which first article samples, if required, are to be forwarded (see 4.5.5) and the name and address of the Government activity responsible for conducting the first article inspection program (see 6.3).
- g. Working pressure (see 3.6.1.2).
- h. Packaging requirements (see 5.1).

6.3 First article. The contracting officer should include specific instructions in acquisition documents regarding arrangements for examinations, approval of first article test results, and disposition of first article samples. Invitations for bids should provide that the Government reserves the right to waive the requirement for samples for first article inspection to those bidders offering a product which has been previously acquired or tested by the Government, and that bidders offering such products, who wish to rely on such production or test, must furnish evidence with the bid that prior Government approval is presently appropriate for the pending contract.

6.3.1 Defense Logistics Agency (DLA) waiver of first article test. A waiver of a first article testing will only be considered by DLA when the contractor has delivered the same item within the last three years, has no unfavorable quality history, has not changed processes, or changed any subcontractors. DLA will not accept first article testing results outside the stated requirements.

6.4 Environmentally preferable material. Environmentally preferable materials should be used to the maximum extent possible to meet the requirements of this specification. As of the dating of this document, the U.S. Environmental Protection Agency (EPA) is focusing efforts on reducing 31 priority chemicals. The list of chemicals and additional information is available on their website at <http://www.epa.gov/osw/hazard/wastemin/priority.htm>. Included in the list of 31 priority chemicals are cadmium, lead, and mercury. Use of these materials should be minimized or eliminated unless needed to meet the requirements specified herein (see section 3).

6.5 Guidance on use of alternative parts with less hazardous or nonhazardous materials. This specification provides for a number of alternative plating materials via the PIN. Users should select the PIN with the least hazardous material that meets the form, fit and function requirements of their application.

6.6 Cadmium plating replacements.

6.6.1 Zinc coatings. It is recommended that zinc coating be specified in place of cadmium plating whenever contact with salt atmosphere is not a problem.

6.6.2 Phosphate coatings. It is recommended that phosphate coating be specified when electrodeposited zinc or mechanically-deposited cadmium plating are not required.

6.7 Working pressure. Working pressure is the established recommended pressure based on a safety factor of 4 to 1. However, fittings may have an increased working pressure based on any or all of the following factors: reduced tube size, increased tube wall thickness and reduced safety factor. The sealing of ORFS is made by the contact between two metal surfaces, with no deformation of the single components, plus an elastomeric sealing (O-ring) placed into a groove on the front part of the fitting.

6.7.1 Fittings 1/4 inch. The 1/4-inch (6.35 mm) fittings may have an increased working pressure up to 5000 psi (35 MPa) maximum. Prior to such use, supporting test data will be approved by both the procuring agency and the manufacturer.

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6.8 Subject term (key word) listing.

Cadmium
Fluid

CONCLUDING MATERIAL

Custodians:

Army - AT
Navy - AS
Air Force - 99
DLA - CC

Preparing activity:
DLA - CC

(Project 4730-2012-055)

Review activities:

Army - AR
Navy - CG, MC, SA, SH
Air Force - 71

NOTE: The activities listed above were interested in this document as of the date of this document. Since organizations and responsibilities can change, you should verify the currency of the information above using the ASSIST Online database at <https://assist.dla.mil>.