

INCH-POUND

MIL-DTL-18866K  
 21 July 2020  
 SUPERSEDING  
 MIL-DTL-18866J  
 w/AMENDMENT 3  
 1 March 2018

## DETAIL SPECIFICATION

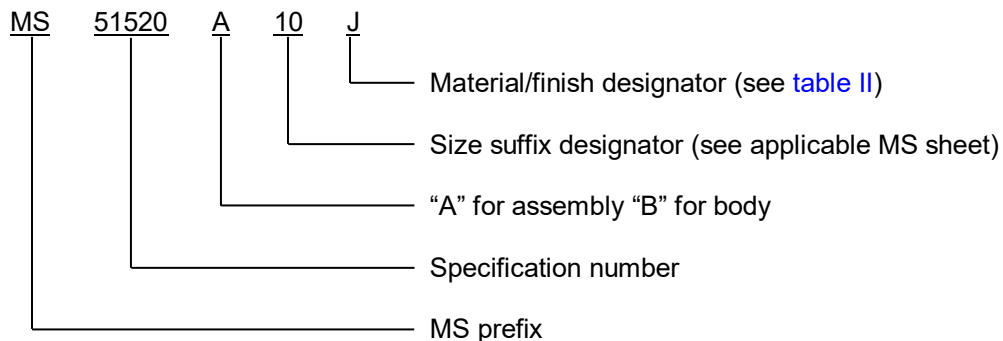
### FITTINGS, HYDRAULIC TUBE, FLARED, 37 DEGREE AND FLARELESS, GENERAL SPECIFICATION FOR

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

#### 1. SCOPE

1.1 Scope. This specification covers 37° flared and flareless steel tube fittings, 1500 and 3000 pounds per square inch (psi) maximum design pressure, -65°F to 250°F temperature range, for use in hydraulic or air systems.

1.2 Part or Identifying Number (PIN). The PIN consists of the letters “MS”, the specification number, a letter a letter for assembly or body, number for fitting size, and a letter for material/finish designator. See other MS sheets for PIN variations.



#### 2. APPLICABLE DOCUMENTS

2.1 General. The documents listed in this section are specified in sections [3](#) or [4](#) 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](#) or [4](#) of this specification, whether or not they are listed.

Comments, suggestions, or questions on this document should be addressed to: DLA Land and Maritime, Columbus, Attn: VAI, P.O. Box 3990, Columbus, OH 43218-3990, or emailed to [FluidFlow@dla.mil](mailto: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>.

AMSC N/A

FSC 4730



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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 SPECIFICATIONS

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

## DEPARTMENT OF DEFENSE SPECIFICATIONS

MIL-C-15726 - Copper-Nickel Alloy, Sheet, Plate, Strip, Bar, Rod, and Wire  
 MIL-DTL-16232 - Phosphate Coating, Heavy, Manganese or Zinc Base  
 MIL-PRF-32647 - Zinc-Nickel Electroplating for Fasteners  
 MIL-T-1368 - Tube and Pipe, Nickel-Copper Alloy, Seamless and Welded  
 MIL-T-8504 - Tubing, Steel, Corrosion-Resistant (304), Aerospace Vehicle Hydraulic Systems, Annealed, Seamless and Welded  
 MIL-T-16420 - Tube, Copper-Nickel Alloy, Seamless and Welded  
 MS51825 - Sleeves, Clinches, Tube Fitting, Flareless Type, Hydraulic  
 MS51889 - Washer, Back-Up, 37 Degree Flared and Flareless Type, Hydraulic

## DEPARTMENT OF DEFENSE STANDARDS

MIL-STD-889 - Dissimilar Metals

(See supplement 1 for list of specification sheets.)

(Copies of these documents are available online at <https://quicksearch.dla.mil>.)

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.

## ASME

ASME B1.1 - Unified Inch Screw Threads (UN, UNR, and UNJ Thread Forms)  
 ASME B1.20.3 - Pipe Threads, General Purpose, Inch

(Copies of these documents are available online at <https://asme.org>.)

## ASTM INTERNATIONAL

ASTM A29/A29M - Standard Specification for General Requirements for Steel Bars, Carbon and Alloy, Hot-Wrought  
 ASTM A182/A182M - Standard Specification for Forged or Rolled Alloy and Stainless Steel Pipe Flanges, Forged Fittings, and Valves and Parts for High-Temperature Service  
 ASTM A269/A269M - Standard Specification for Seamless and Welded Austenitic Stainless Steel Tubing for General Service  
 ASTM A276/A276M - Standard Specification for Stainless Steel Bars and Shapes  
 ASTM A479/A479M - Standard Specification for Stainless Steel Bars and Shapes for Use in Boilers and Other Pressure Vessels

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ASTM A564/A564M	-	Standard Specification for Hot-Rolled and Cold-Finished Age-Hardening Stainless Steel Bars and Shapes
ASTM A576	-	Standard Specification for Steel Bars, Carbon, Hot-Wrought, Special Quality
ASTM A582/A582M	-	Standard Specification for Free-Machining Stainless Steel Bars
ASTM A693	-	Standard Specification for Precipitation-Hardening Stainless and Heat-Resisting Steel Plate, Sheet, and Strip
ASTM B117	-	Standard Practice for Operating Salt Spray (Fog) Apparatus
ASTM B163	-	Standard Specification for Seamless Nickel and Nickel Alloy Condenser and Heat- Exchanger Tubes
ASTM B164	-	Standard Specification for Nickel-Copper Alloy Rod, Bar, and Wire
ASTM B165	-	Standard Specification of Nickel-Copper Alloy (UNS N04400) Seamless Pipe and Tube
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 B338	-	Standard Specification for Seamless and Welded Titanium and Titanium Alloy Tubes for Condensers and Heat Exchangers
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	-	Standard Test Methods for Rockwell Hardness of Metallic Materials
ASTM E60	-	Standard Practice for Analysis of Metals, Ores, and Related Materials by Spectrophotometry
ASTM E384	-	Standard Test Method for Microindentation Hardness of Materials
ASTM F1136/F1136M-	-	Standard Specification for Zinc/Aluminum Corrosion Protective Coatings for Fasteners
ASTM F1941/F1941M-	-	Standard Specification for Electrodeposited Coatings on Mechanical Fasteners, Inch and Metric
ASTM MNL37	-	Fuels and Lubricants Handbook: Technology, Properties, Performance, and Testing

(Copies of these documents are available online at <https://www.astm.org>.)

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INTERNATIONAL ORGANIZATION FOR STANDARDIZATION (ISO)

ISO 17025/EC 17025 - General requirements for the competence of testing and calibration laboratories

(Copies of this document is available online at <https://www.iso.ch>.)

NCSL INTERNATIONAL

NCSL Z540.3 - Requirements for the Calibration of Measuring and Test Equipment

(Copies of this document is available online at <https://www.ncsli.org>.)

SAE INTERNATIONAL

SAE AMS-C-81562	- Coatings, Cadmium, Tin-Cadmium and Zinc (Mechanically Deposited)
SAE AMS-P-5510	- O-Ring, Preformed, Straight Thread Tube Fitting Boss, Type I Hydraulic (-65 to 160 °F)
SAE AMS-QQ-P-416	- Plating, Cadmium (Electrodeposited)
SAE-AMS-STD-595/36076	- Gray, Flat or Lusterless
SAE-AMS-STD-595/36081	- Gray, Flat or Lusterless
SAE-AMS-STD-595/36099	- Gray, Flat or Lusterless
SAE-AMS-STD-595/36118	- Gray, Flat or Lusterless
SAE-AMS-STD-595/36134	- Gray, Flat or Lusterless
SAE-AMS-STD-595/36152	- Gray, Flat or Lusterless
SAE-AMS-STD-595/36170	- Gray, Flat
SAE-AMS-STD-595/36173	- Gray, Flat or Lusterless
SAE-AMS-STD-595/36176	- Gray, Flat or Lusterless
SAE-AMS-STD-595/36231	- Gray, Flat or Lusterless
SAE-AMS-STD-595/36251	- Gray, Flat or Lusterless
SAE-AMS-STD-595/36270	- Gray, Flat or Lusterless
SAE-AMS-STD-595/36280	- Gray, Flat or Lusterless
SAE-AMS-STD-595/36293	- Gray, Flat or Lusterless
SAE AMS2417	- Plating, Zinc-Nickel Alloy
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 AMS4928	- Titanium Alloy Bars, Wire, Forgings, Rings, and Drawn Shapes 6Al - 4V Annealed - UNS R56400
SAE AMS4945	- Titanium Alloy Tubing, Seamless, Hydraulic 3Al - 2.5V, Controlled Contractile Strain Ratio Cold Worked, Stress Relieved - UNS R56320
SAE AMS5567	- Steel, Corrosion Resistant, Seamless or Welded Hydraulic Tubing 19Cr - 10Ni (304) Solution Heat Treated - UNS S30400
SAE AMS5604	- Steel, Corrosion Resistant, Sheet, Strip, and Plate 16.5Cr - 4.0Ni - 4.0Cu - 0.30Cb Solution Heat Treated, Precipitation Hardenable - UNS S17400
SAE AMS5639	- Steel, Corrosion-Resistant, Bars, Wire, Forgings, Tubing, and Rings 19Cr - 10Ni Solution Heat Treated - UNS S30400
SAE AMS5643	- Steel, Corrosion-Resistant, Bars, Wire, Forgings, Mechanical Tubing, and Rings 16Cr - 4.0Ni - 0.30Cb (Nb) - 4.0Cu Solution Heat Treated, Precipitation Hardenable - UNS S17400

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SAE AMS5645	- Steel, Corrosion and Heat Resistant, Bars, Wire, Forgings, Tubing, and Rings 18Cr - 10Ni - 0.40Ti (321) Solution Heat Treated - UNS S32100
SAE AMS5647	- Steel, Corrosion-Resistant, Bars, Wire, Forgings, Tubing, and Rings 19Cr - 9.5Ni Solution Heat Treated - UNS S30403
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 - UNS S35500
SAE AMS6370	- Steel, Bars, Forgings, and Rings 0.95Cr - 0.20Mo (0.28 - 0.33C) (SAE 4130) - UNS G41300
SAE AMS6382	- Steel, Bars, Forgings, and Rings 0.95Cr - 0.20Mo (0.38 - 0.43C) (SAE 4140) Annealed - UNS G41400
SAE AS28778	- Ring, Straight Thread Tube Fitting Box Molded from AMS-P-5510 Rubber
SAE J403	- Chemical Compositions of SAE Carbon Steels
SAE J514	- Hydraulic Tube Fittings
SAE J515	- Specification for O-Ring Materials Used with Hydraulic Connectors
SAE J524	- Seamless Low-Carbon Steel Tubing Annealed for Bending and Flaring
SAE J1926-1	- Connections for General Use and Fluid Power Ports and Stud Ends with ASME B1.1 Threads and O-Ring Sealing Part 1: Threaded Port with O-Ring Seal in Truncated Housing

(Copies of these documents are available online at <https://www.sae.org>.)

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 4.3.

3.3 Order of precedence. In the event of a conflict between the text of this document and the references cited herein, the text of this document take precedence. Nothing in this document, however, supersedes applicable laws and regulations unless a specific exemption has been obtained.

3.4 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 or sleeve 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.

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3.4.1 Recycled, recovered, environmentally preferable, or biobased materials. Recycled, recovered, environmentally preferable, or biobased 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 costs.

3.4.1.1 Used, rebuilt, or remanufactured components. No used, rebuilt, or remanufactured components, pieces, or parts shall be incorporated in the fittings.

3.4.1.2 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.

3.4.1.3 Ozone depleting substances (ODS). Class I and II ozone depleting substances (ODS) shall not be used in MIL-DTL-18866 or any referenced procedures.

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

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TABLE I. Fitting materials.

Material	Form	Specification	Alloy
Carbon steel (flared ferrules) <u>1/</u>	Bar	SAE J403 ASTM A576	1008, 1010, 1015, 1020, 1213, 12L14, or 1215
		ASTM A29/A29M ASTM A576	1141
Carbon steel (flareless ferrules)	Bar	SAE J403	1010, 1020, 12L14, or 1215
Carbon steel for fitting bodies and nuts	Bar	N/A	Any carbon steel <u>4/</u>
Carbon steel for fitting bodies	Forgings	ASTM A29/A29M or SAE J403	1045, 1214, 1215 <u>4/</u>
Chrome-molybdenum steel	Bars	SAE AMS6370	4130
	Forgings	SAE AMS6382	
		SAE AMS6370	
Corrosion resistant steel (CRES) <u>2/</u>	Bars and forgings	ASTM A276/A276M ASTM A479/A479M	304, 304L, 316, 316L, or 321
		ASTM A564/A564M	XM-12 (15-5 PH) UNS S15500 or 630 (17-4 PH) UNS S17400
		SAE AMS5639	UNS S30400
		SAE AMS5645	UNS S32100
		SAE AMS5647	UNS S30403
		SAE AMS5743	UNS S35500
	Bar	ASTM A582/A582M	UNS S30300
	Forging	ASTM A182/A182M	316, 316L
CRES for flareless sleeves <u>3/</u>	Bar, tube, sheet, strip, or plate	SAE AMS5604	17-4PH (UNS S17400)
		SAE AMS5643	
		ASTM A693	
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	Bars	SAE AMS4928	6Al-4V annealed
	Forgings		

1/ Sleeves, flareless, carbon steel shall be case hardened, see [3.5.2](#).

2/ Hardness for finished corrosion-resisting steel parts, see [3.5.1](#).

3/ Sleeves, flareless, corrosion-resisting steel, see [3.5.3](#).

4/ Other low to medium carbon steels may be used provided they meet the working, proof, and burst requirements of SAE J514, except the working pressures shall be as specified in [3.6.1](#).

#### 3.4.4 Finish.

3.4.4.1 PIN codes for materials and chemical finishes. PIN codes for materials and chemical finishes shall be in accordance with [table II](#).

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TABLE II. Material and chemical finish identification codes.

PIN code material/plating finish	Material	Plating finish
Blank	Steel	Cadmium, see <a href="#">3.4.4.2</a> <u>1/</u>
FC	Steel	Zinc in accordance with ASTM F1941/F1941M type Fe/Zn 8C <u>4/ 6/ 7/</u>
FD	Steel	Zinc in accordance with ASTM F1941/F1941M type Fe/Zn 8D <u>4/ 6/ 7/</u>
H	Steel	Zinc-aluminum in accordance with ASTM F1136/F1136M, grade 3, NC. <u>4/</u>
J	Steel	Zinc-nickel in accordance with SAE-AMS2417, type 2, grade B. <u>2/ 4/</u>
KA	Steel	Zinc Nickel Electroplate, MIL-PRF-32647, Type K20 torque/tension modifier. <u>3/ 4/</u>
KB	Steel	Zinc Nickel Electroplate, MIL-PRF-32647, Type K16 torque/tension modifier. <u>3/ 4/</u>
M	Nickel-copper alloy UNS N04400	No additional finish.
N	High-chromium nickel alloy UNS N06690	No additional finish.
R	Steel	Zinc in accordance with ASTM F1941/F1941M type Fe/Zn 8ANS. <u>4/ 7/</u>
S	Corrosion resistant steel	No additional finish. Passivate, <a href="#">3.4.4.3</a>
T	Titanium	Anodize in accordance with SAE-AMS2488 type 2. <u>5/</u>
TF	Titanium	Fluoride phosphate in accordance with SAE-AMS2486. <u>5/</u>
Z	Steel	Zinc plating in accordance with ASTM B695, type II, class 8. <u>4/</u>
ZC	Steel	Zinc-nickel in accordance with SAE-AMS2417, type 2, grade B. with a colored chromate coating. <u>2/ 4/</u>
ZF	Steel	Zinc plating in accordance with ASTM B633, type VI, Fe/Zn 8. <u>3/ 4/</u>

1/ Embrittlement test need not be run. Cadmium shall not be used in oxygen or potable water systems.

2/ The zinc-nickel alloy plate shall contain 12% to 16% nickel. The coating thickness shall be 315µ inches (8µm) minimum.

3/ Salt spray requirements shall be in accordance with MIL-PRF-32647.

4/ Not for use in aircraft. Requires approval from the Program Office for all applications. Zinc-plated materials should be avoided in hydraulic systems with water-glycol fluids. Reference ASTM MNL37 - Fuels and Lubricants Handbook.

5/ A pretreatment, a modification of the fluoride treatment, or a post treatment shall be applied so the final color of the fittings shall be similar to SAE-AMS-STD-595 colors 36076 through 36293. Titanium shall not be used in oxygen or potable water systems.

6/ Type C uses a yellow or an opaque hexavalent conversion coating. Type D uses an olive green to brown hexavalent conversion coating.

7/ Salt spray requirements shall be in accordance with ASTM F1136/F1136M.



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3.4.4.2 Cadmium plating. Cadmium plating in accordance with SAE AMS-C-81562, type II, class 2 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.

3.4.4.2.1 Cadmium is not recommended. 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). Cadmium shall not be used in oxygen or potable water systems.

3.4.4.3 Passivation (CRES). Passivation shall be in accordance with SAE-AMS2700, method 1, type 6 or 7. UNS S30300 Passivation in accordance with SAE AMS2700, method 1, type 2 or 4.

NOTE: The following restrictions do not apply to manufactures of the fittings and is applicable only to OEM's and users.

3.4.4.4 Army and Marine ground vehicles cadmium restriction. The use of cadmium plating for Army and Marine ground vehicles is prohibited unless otherwise explicitly stated in the contract as a requirement.

3.4.4.5 Army and Marine ground forces zinc plating restrictions. PIN codes FC, FD, Z, and ZC finishes have a chromate conversion coating which includes hexavalent chromium and are not recommended for Army and Marine ground systems. The use of coatings depositing hexavalent chromium for Army vehicles is prohibited unless otherwise explicitly stated in the contract as a requirement. For new designs PIN codes FC, FD, Z, and ZC are not to be supplied to Army and Marine ground forces. MIL-PRF-32647 Type KA is intended as a hazardous free plating material and is a direct replacement for zinc plating with a hexavalent chromium conversion coating. KA has an equivalent torque/tension as the plating's replaced.

3.4.4.6 Army ground vehicle applications cadmium plating alternative. Pin code J or KB may be substituted for cadmium ("Blank" PIN code) for Army ground vehicle applications. MIL-PRF-32647 Type KB is intended as a hazardous free plating material and is a direct replacement for cadmium plating ("Blank" PIN code). KB has an equivalent torque/tension as cadmium.

3.4.4.7 NAVSEA shipboard owned systems cadmium restriction. Cadmium is prohibited from use in NAVSEA-owned shipboard systems, unless otherwise approved by NAVSEA, see 6.4.

3.4.5 Finish salt spray test, except CRES. Unless otherwise specified, all plating's shall be capable of meeting the 96 hour salt spray test in accordance with ASTM B117, see 4.6.5. The fittings shall show no evidence of red corrosion after 96 hours of salt spray. Fluid passages, other openings, and internal threads not be subjected to the salt spray and the plating thickness requirements and may have bare areas provided they are protected with a light film of oil. Interior threads are not expected to be exposed to the environmental conditions that the salt spray test simulates.

3.4.5.1 Effectiveness of the CRES passivation treatment. CRES 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.

3.4.6 Plating thickness verification (cadmium and zinc plating's). Plating thickness shall be measured in accordance with 4.6.2 and shall meet the chemical finish requirements of 3.4.4.1.

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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, other than flareless sleeves (see 3.4.3) shall be Rockwell B80, Rockwell B75 for forgings, and the maximum hardness shall be Rockwell C32.

3.5.2 Sleeves, flareless, carbon steel. Unless otherwise specified in the contract or order (see 6.2), carbon steel flareless sleeves shall be case hardened to a depth of .0010 to .0019 inch (25.4µm to 48.3µm). The hardness of the core shall not exceed Rockwell B99.5.

3.5.3 Sleeves, flareless, corrosion-resisting steel. Unless otherwise specified in the contract or order, corrosion-resisting steel flareless sleeves shall be treated in such a manner as to produce a minimum through-hardness of Rockwell C41.8 or 423 KHN (Knoop) (see 6.2).

3.6 Design.

3.6.1 Design and construction. Fittings, when properly assembled, shall insure 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). 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 -4 (1/4-inch) fittings may have an increased working pressure up to 5000 psi (35 MPa) maximum. Prior to such use, supporting test data shall be approved by both the procuring agency and the manufacturer.

3.6.2 Design and dimensions. Fittings shall be in accordance with the applicable MS sheets, see supplement 1. If a specification does not exist the fitting or sleeve dimensions shall be in accordance with SAE J514 (see 3.1).

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, will be permissible.

3.6.2.2 Boss. Straight thread O-ring bosses, for swivel and adjustable fittings, shall be in accordance with SAE J1926-1, part 1.

3.6.2.3 O-Rings. When O-rings are required, they shall be in accordance with SAE AMS-P-5510 (reference SAE AS28778 for PIN's) or SAE J515, type 1. O-rings shall not be furnished with the fittings.

3.6.2.4 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.

3.6.2.5 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.

3.6.2.6 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 the applicable detail specification sheets (MS sheets) given herein (see 1.2).

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3.6.2.7 Straight threads. Straight threads shall conform to ASME B1.1 Class 2A and 2B, UN and UNR threads.

3.6.2.8 Taper pipe threads. Taper pipe threads shall conform to ASME B1.20.3.

3.6.2.9 Sleeve design. Flareless sleeves shall be in accordance with MS51825 style A or B, as specified (see 6.2).

3.6.3 Back-up washers. MS51889 back-up washers shall be furnished on all adjustable fittings. Washers are to be installed on fittings by the manufacturer.

### 3.7 Marking.

3.7.1 Identification of product. Fitting assemblies shall be marked with "J" or JAN" and the complete PIN. When applicable only bodies of assemblies shall require marking. Additional marking requirements are specified in 3.7.2, 3.7.3 and 3.7.5. 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 3.4.4.

3.7.2 Trademark. Unless otherwise specified, all fittings shall be stamped with manufacturer's name or trademark, except for sleeves. Sleeves shall be stamped at the option of the manufacturer (see 6.2).

3.7.3 Additional marking. If specified, all fittings made from corrosion-resisting steel, except sleeves, shall be permanently stamped with the composition number of steel (see 6.2).

3.7.4 Sleeve marking. All flareless sleeves made from corrosion-resisting steel shall be marked with a light knurl on the perimeter of the largest O.D.

3.7.5 JAN Brand. The United States Government has adopted, and is exercising legitimate control over the certification marks, "JAN" and "J", respectively, to indicate that items so marked or identified are manufactured to, and meet all the requirements of defense specifications. Accordingly, items acquired to, and meeting all the criteria specified herein and in applicable defense specifications shall bear the certification mark "JAN" except that items too small to bear the certification mark "JAN" shall bear the letter "J". The "JAN" or "J" shall be placed immediately before the part number except that if such location would place a hardship on the manufacturer in connection with such marking, the "JAN" or "J" may be located on the first line above or below the part number. Items furnished under contracts or orders which either permit or require deviation from the conditions or requirements specified herein or in applicable defense specifications and standards shall not bear "JAN" or "J". In the event an item fails to meet the requirements of this specification and the applicable defense specification sheets or associated defense specifications, the manufacturer shall remove completely the military part number and the "JAN" or "J" from the sample tested and also from all items represented by the sample. The "JAN" or "J" certification mark shall not be used on products acquired to contractor drawings or specifications. The United States Government has obtained Certificate and Registration Number 504,860 for the certification mark "JAN" and Registration Number 1,586,261 for the certification mark "J".

Note: The "J" or "JAN" marking is not part of the PIN but indicates a certification.

3.8 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.

3.9 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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3.10 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 and sleeves shall be examined for the following defects as specified in table III.

TABLE III. Workmanship defects.

Examination	Requirement paragraph
Type, size, termination, 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 (3.4.3)	3.6.2.4
Bores drilled from each end exceed specified tolerance at drill meeting point; size of fluid passage of angle fittings, not as specified.	3.6.2.5
Wall thickness of fittings, less than dimensions and tolerances specified	3.6.2.6
Machined surface finish	3.6.2.1
Material not as specified	3.4.3
Threads not as specified	3.6.2.7, 3.6.2.8
Sealing surface, not as specified	3.6.2.1
Finish not as specified	3.4.4
Contractor does not have documentation available for identification of material	3.4.3
Contractor does not have documentation available for identification of finishes or treatment	3.4.4
Dissimilar metals are not treated or effectively insulated from each other	3.4.1.2
Used, rebuilt or remanufactured components, pieces, or parts incorporated in the fittings.	3.4.1.1
Nuts, or washers missing or not as specified	3.1 and 3.6.3
Marking missing, illegible, or not as specified	3.7

## 4. VERIFICATION

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

- a. First article inspection (see 4.3).
- b. Conformance inspection (see 4.4).

4.2 Inspection conditions. Unless otherwise specified, all required inspections shall be performed in accordance with the test conditions specified in 4.6.

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4.2.1 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 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/EC 17025 and NCSL Z540.3 as applicable.

4.3 First article. First article inspection shall be performed at a laboratory acceptable to the Government on sample units produced with equipment and procedures used in production.

4.3.1 Samples for first article. Unless otherwise specified, after award of the contract or order, the manufacturer shall forward, from randomly selected samples, 3 fittings and sleeves. The samples shall be representative of the construction, workmanship, components, and materials to be used during production. When a manufacturer is in continuous production of fittings and sleeves from one contract to another or has demonstrated within the past 2 years the capability to meet the requirements of this specification, inspection of additional first article samples for a new contract may be waived at the discretion of the acquiring activity (see 6.2). Approval of the first article samples or the waiving of first article inspection does not preclude the requirements for performing conformance inspection. First article samples shall be furnished to the Government as directed by the contracting officer (see 6.2).

4.3.2 Inspection routine. Samples randomly selected from each lot (see 4.3.2.1) shall be subjected to the first article inspections specified in table IV.

4.3.2.1 Lot. A lot shall consist of all fittings and sleeves of the same type, size, material, and manufactured under essentially the same conditions and submitted for acceptance at one time, see 6.2.

4.3.3 Failures. One or more failures shall be cause for refusal to grant first article approval.

4.3.4 Disposition of samples. First article samples shall be furnished to the Government as directed by the contracting officer (see 6.2). Unless otherwise specified, after award of the contract or order, the manufacturer shall forward, from randomly selected samples, 1 fitting. The sample shall be representative of the construction, workmanship, components, and materials to be used during production.

4.3.5 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.

4.3.6 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](mailto:Fluidflow@dla.mil).

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TABLE IV. First article inspections.

Inspection	Inspection paragraph	Test paragraph	Number of samples
Visual inspection	3.1, 3.6.2, 3.7, 3.9, and 3.10	4.6.1	All
Tests of design capability		4.6.7.1	---
Design capability test - 37° flared	3.6.1	4.6.7.2	5
Design capability test - flareless	3.6.1	4.6.7.3	5
Plating verification (cadmium or zinc) <u>1/</u>	3.4.6	4.6.2	2 minimum
Hardness test	3.5	4.6.3	2 minimum
Chemical analysis <u>2/</u>	3.4.3	4.6.4	2 minimum
Corrosion resistance	3.4.5	4.6.5	2 minimum
Tests for sleeves		4.6.6	---
Case depth and hardness test	3.5	4.6.6.1	2
Cut tests	---	4.6.6.2	2

1/ May be supplied by the plating manufacturer.

2/ This test shall be performed when specified by the acquiring activity (see 6.2).

#### 4.4 Conformance inspection.

4.4.1 Inspection of product for delivery. Inspection of product for delivery shall consist of individual inspections in table V.

TABLE V. Individual inspection.

Inspection	Requirement paragraph	Test method paragraph
Visual inspection	3.6.2	4.6.1 (a, b)
Cleanliness	3.9	4.6.1e
Hardness	---	4.6.6

4.4.2 Sampling for individual inspections. Fittings for sampling shall be selected from a production lot (see 4.4.2.1) and shall be subjected to the individual inspections. The sampling size shall be as specified in 4.4.2.2.

4.4.2.1 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.

4.4.2.2 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 VI.

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TABLE VI. 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

4.4.3 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.

4.5. Tube materials. To facilitate testing the tube shall be of like material of the body, nut, and sleeve.

- Seamless low carbon steel tubing shall be in accordance with SAE J524.
- Corrosion resistant steel shall be in accordance with ASTM A269/A269M, SAE AMS5567, or MIL-T-8504.
- Copper-nickel tubing in accordance with MIL-T-16420, class 200 (70/30).
- Nickel-copper alloy tube shall be in accordance with MIL-T-1368 or ASTM B165.
- High-chromium nickel alloy tube shall be in accordance with ASTM B163.
- Titanium alloy tubing in accordance with SAE AMS4945 or ASTM B338.

#### 4.6 Test methods.

4.6.1 Visual inspection. Tube fittings and sleeves shall be examined to ensure conformance with this specification. Continuous examination shall be performed to assure compliance with the following requirements:

- Specification sheets (see 3.1).
- Design, construction and physical dimensions (see 3.6.2).
- Materials (see 3.4.3) and finishes (see 3.4.4).
- Marking (see 3.7).
- Cleanliness (see 3.9).
- Workmanship (see 3.10).

4.6.2 Verification of fitting plating thickness cadmium or zinc (see 3.4.6). 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 by ASTM B487 or ASTM B748, can also be used as a referee method to confirm the precision when thicknesses of 30 microinches (0.76  $\mu\text{m}$ ) 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:

- When applicable a minimum of five points shall be measured on the fitting surface. The fitting may be rotated, but measurement points shall be progressively further from the last point. Readings shall not be averaged. Measurements shall be as follows:



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- (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.

4.6.3 Hardness test (see 3.5). 2 fittings minimum randomly selected in accordance with 4.3.2 shall be tested for hardness in accordance with ASTM E18 or ASTM E384 to determine conformance to 3.5.

4.6.4 Chemical analysis. 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).

4.6.5 Corrosion resistance (cadmium or zinc plated parts only) (see 3.4.5). Corrosion resistance testing shall be in accordance with ASTM B117 and shall meet the requirements of 3.4.5.

4.6.6 Tests for sleeves. 2 samples minimum flareless sleeves, randomly selected in accordance with 4.3.2 shall be tested in accordance with 4.6.6.1 and 4.6.6.2.

4.6.6.1 Case depth and hardness test. Case depth and hardness test shall be conducted as follows:

- a. Remove plating, grind and polish end of sleeve perpendicular to sleeve axis. In this manner, the cutting edge is removed.
- b. Immerse samples in etchant (2 percent Nital) for a sufficient length of time for the desired etch, about 8 to 10 seconds.
- c. Wash in hot water, immerse in alcohol and blow dry.
- d. Take at least three measurements at different points on the sleeve. The case depth and hardness shall be in accordance with 3.5.

4.6.6.2 Cut tests. Tubing selected in accordance with 4.5 shall be used for cut tests of sleeves and performance test for fittings. The following details shall apply:

- a. The sleeves shall be assembled to the tubing in accordance with 4.6.8.3a and table VIII.
- b. After disassembly, each sleeve shall be driven back to expose the ring cut for examination.
- c. The cut shall completely encircle the periphery of the tube.
- d. There shall be no longitude or circumferential cracks on the sleeve before driving back.
- e. Circumferential crazing marks on the end of the sleeve in the neighborhood of the cutting edge are permitted.

4.6.7 Design capability testing of fittings.

4.6.7.1 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 4.6.8.2 and 4.6.8.3.

4.6.7.2 Design capability test - 37° flared. When specified, a minimum of five 37° flared fittings of each size, shape and material, after being lubricated, shall be assembled with mating fittings in a manner similar to figures 1, 2, and 3 as applicable (see 6.2). The following details shall apply:

- a. To facilitate testing the tube shall be of the like material of the body, nut, and sleeve, see 4.5.
- b. The tube nut shall be tightened to the minimum torque load specified in table VII for the applicable assembly size.
- c. The pipe threaded end, or straight thread with O-ring end fitting or straight thread fitting, whichever is applicable, 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



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MPa) for size -20 through -32. under this pressure, there shall be no leakage or distortion of the assembly.

- d. The assembly shall then be pressurized to the point at which leakage or rupture occurs and the results shall be recorded.

TABLE VII. Torque load for tightening 37° flared tube nut.

Tubing O.D.	Torque Inch-pounds (Nm)		Tubing O.D.	Torque inch-pounds (Nm)	
Inches	Min	Max	Inches	Min	Max
1/8	75 (8)	85 (10)	3/4	855 (97)	945 (107)
3/16	95 (11)	105 (12)	7/8	1050 (119)	1200 (136)
1/4	135 (15)	145 (16)	1	1140 (129)	1260 (142)
5/16	170 (19)	190 (21)	1 1/4	1520 (172)	1680 (190)
3/8	215 (24)	245 (28)	1 1/2	1900 (215)	2100 (237)
1/2	430 (49)	470 (53)	2	2660 (301)	2940 (332)
5/8	620 (70)	680 (77)			

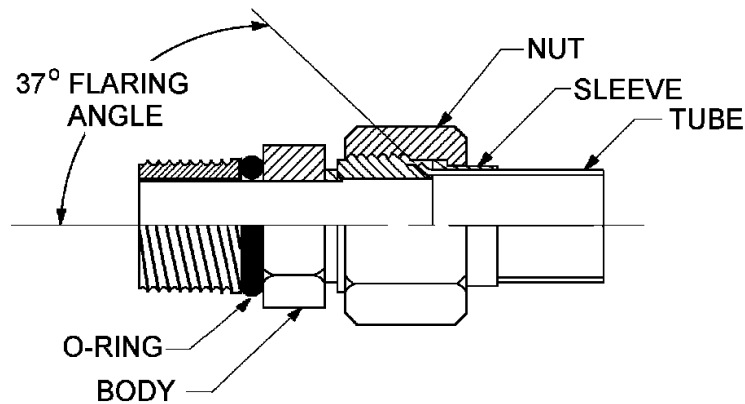


FIGURE 1. Typical flared fitting assembly showing body, O-ring, nut, sleeve and tube

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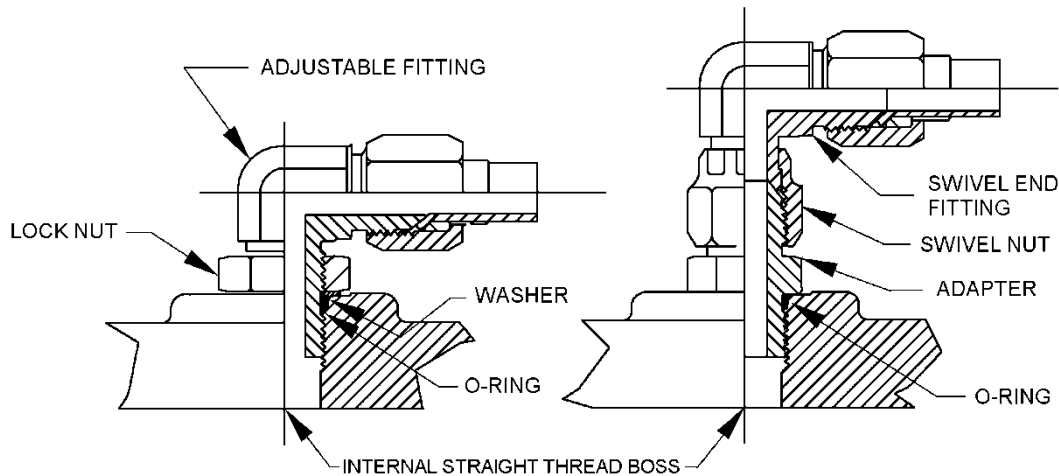


FIGURE 2. Adjustable fitting  
Typical installation.

FIGURE 3. Swivel and fitting  
typical installation.

4.6.7.3 Design capability test - flareless. When specified, a minimum of five flareless fittings in each size, shape and material shall be assembled with mating fittings in a manner similar to figures 4, 5, and 6 as applicable (see 6.2). To facilitate testing the tube shall be of the like material of the body, nut, and sleeve, see 4.5. The following details shall apply:

- Sleeves shall be preset on tubing before assembly using a presetting machine, or the fitting, by tightening the nut to the number of turns specified in table VIII, past the point of ring grip.
- After presetting the sleeve the nut shall be completely disengaged, inspect sleeve for proper bite, reassemble to fitting body wrenching the nut 1/6 to 1/4 turn, maximum, beyond the point where a sudden increase in torque is noted.
- The pipe threaded end, or straight thread with O-ring end fitting or straight thread fitting, whichever is applicable, shall be tightened to the point where leakage shall not occur, at a proof pressure of 6000 psi (41 MPa) for sizes -2 through -16 and proof pressure of 3000 psi (21 MPa) for sizes -20 through -32. Under this pressure, there shall be no leakage or distortion of the assembly.
- The assembly shall then be pressurized to the point at which leakage or rupture occurs and the results shall be recorded.

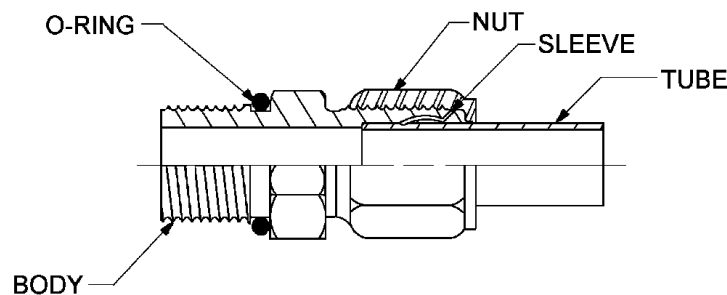


FIGURE 4. Typical flareless fitting assembly showing  
body, O-ring, nut, sleeve and tube.

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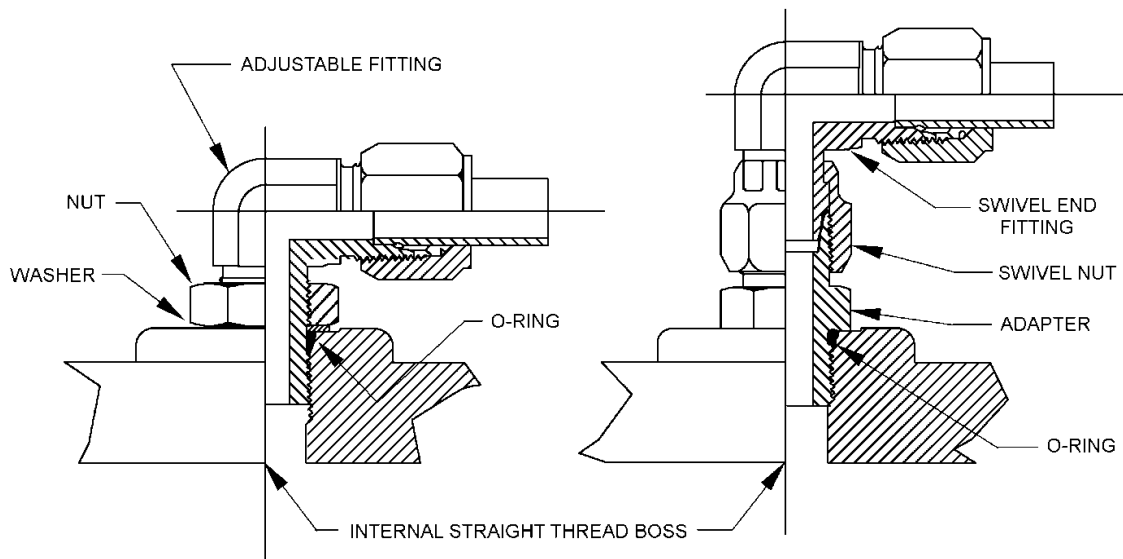


FIGURE 5. Adjustable fitting.  
Typical installation.

FIGURE 6. Swivel and fitting.  
Typical installation.

4.6.7.4. Results of design capability. Results of design capability tests shall be maintained on file by the fitting manufacturers, available for review by the Government upon request.

TABLE VIII. Preset - tube tightness limits.

Tubing O.D inches	Number of turns	Tubing O.D inches	Number of turns
1/8	1 1/16	3/4	1
3/16	1 1/16	7/8	1
1/4	1 1/16	1	5/6
5/16	1 1/16	1 1/4	1
3/8	1 1/16	1 1/2	1
1/2	1 1/16	2	1
5/8	1		

## 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 activity within the Military Service or Defense Agency, or within the Military Service's System Commands. 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.

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## 6. NOTES

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

6.1 Intended use. 37° flared fittings are intended for use with steel tubing in hydraulic systems. Flareless fittings are intended for use in hydraulic or air 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 copper-nickel-, 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 with existing military designs, the fittings have dimensions that conform to pressure ratings and flow rates required for aerospace applications. The fittings have plating finishes that are military unique and can withstand 96 hours or more of salt spray testing, commercial equivalents cannot meet these requirements.

6.2 Acquisition requirements. Acquisition documents should specify the following:

- a. Title, number and date of this specification.
- b. MS PIN (1.2).
- c. Hardness requirement, if different (3.5)
- d. Material certification and/or plating thickness (4.6.4 and 3.4.8).
- e. Style of flareless sleeve required (3.6.2.9).
- f. Marking (3.7)
- g. Additional marking (3.7.3).
- h. If first article is required (see 3.2).
- i. Name and address of the first article inspection test facility to which first article samples are to be forwarded (see 4.3.1) and the name and address of the Government activity responsible for conducting the first article inspection program (see 6.3).
- j. Name and address of the Government activity responsible for receiving a production sample (see 4.3.4).
- k. 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 3 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 NAVSEA-owned shipboard systems. Cadmium is prohibited from use in NAVSEA-owned shipboard systems in accordance with the requirements of T9070-AL-DPC-020/077-2, unless otherwise approved by NAVSEA.

6.4.1 Naval Sea Systems Command (NAVSEA) Publications. Copies of T9070-AL-DPC-020/077-2 are available online via Technical Data Management Information System (TDMIS) at <https://mercury.tdmis.navy.mil/> by searching for the document number without the suffix. Refer questions, inquiries, or problems to: DSN 296-0669, Commercial (805) 228-0669. T9070-AL-DPC-020/077-2 is available for ordering (hard copy) via the Naval Logistics Library <https://nll.ahf.nmci.navy.mil>. For

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questions regarding the NLL, contact the NLL Customer Service at <mailto:nllhelpdesk@navy.mil>, (866) 817-3130, or (215) 697-2626/DSN 442-2626.

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.

6.5.1 Environmentally preferable material. Environmentally preferable materials should be used to the maximum extent possible to meet the requirements of this specification.

6.6 Subject term (key word) listing.

Adapters  
Cadmium  
Chromate  
Copper Sulfate  
Fluid  
Hexavalent chromium  
Hydraulic connector  
Nickel  
Pneumatic

6.7 Changes from previous issue. Marginal notations are not used in this revision to identify changes with respect to the previous issue due to the extensiveness of the changes.

CONCLUDING MATERIAL

Custodians:

Army - AR  
Navy - OS  
Air Force - 71  
DLA - CC

Preparing activity:  
DLA - CC

(Project 4730-2020-061)

Review activities:

Army - AT, AV, GL, MI  
Navy - AS, MC, SH, YD

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 data at <https://assist.dla.mil>.