INACTIVE FOR NEW NAVY AIRCRAFT HYDRAULIC SYSTEMS DESIGN EFFECTIVE DATE 31 JULY 1995. FOR NEW DESIGN SEE MIL-F-85421 AND MIL-F-85720.

INCH-POUND
MIL-F-18280F
31 July 1995
SUPERSEDING
MIL-F-18280E
31 AUGUST 1983

MILITARY SPECIFICATION

FITTINGS, FLARELESS TUBE, FLUID CONNECTION

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

1. SCOPE

1.1 Scope. This specification establishes the requirements for flareless tube connection fittings, nuts and sleeves for use in fluid systems (see 6.1).

1.2 Classification. Fittings shall be furnished in the styles designated by the applicable MS standards as specified herein or other engineering standard drawings approved by the acquiring activity (see 6.1 and 6.2b).

2. APPLICABLE DOCUMENTS

2.1 Government documents.

* 2.1.1 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 listed in the issue of the Department of Defense Index of Specifications and Standards (DODISS) and supplement thereto, cited in the solicitation (see 6.2c).

SPECIFICATIONS

FEDERAL

QQ-A-225/6 - Aluminum Alloy 2024 Bar, Rod, and Wire; Rolled, Drawn or Cold Finished

Beneficial comments (recommendations, additions, deletions) and any pertinent data which may be of use in improving this document should be addressed to: Commander, Naval Air Warfare Center Aircraft Division, Code SSD, Highway 547, Lakehurst, NJ 08733-5100, by using the Standardization Document Improvement Proposal (DD Form 1426) appearing at the end of this document or by letter.

SPECIFICATIONS

FEDERAL (Continued)

QQ-A-225/9	-	Aluminum Alloy 7075 Bar, Rod, Wire and Special Shapes, Rolled, Drawn or Cold Finished
QQ-A-367	-	Aluminum Alloy Forging
QQ-P-35	-	Passivation Treatment for Corrosion-Resistant Steel
QQ-P-416	-	Plating, Cadmium (Electrodeposited)
QQ-S-763	-	Steel Bars, Wire, Shapes and Forging, Corrosion Resisting

MILITARY

MIL-H-5606	-	Hydraulic Fluid, Petroleum Base, Aircraft, Missile and Ordinance
MIL-H-6083	-	Hydraulic Fluid, Petroleum Base, for Preservation and Operation
MIL-H-6088	-	Heat Treatment of Aluminum Alloys
MIL-T-6845	-	Tubing, Steel, Corrosion-Resisting (530400), Aerospace Vehicle Hydraulic System, 1/8 Hard Condition
MIL-A-8625	-	Anodic Coatings, for Aluminum and Aluminum Alloys
MIL-S-8879	-	Screw Threads, Controlled Radius Root with Increased Minor Diameter, General Specification for
MIL-T-9046	-	Titanium and Titanium Alloy, Sheet, strip and Plate
MIL-L-46010	-	Lubricant, Solid Film, Heat Cured, Corrosion Inhibiting
MIL-H-46170	-	Hydraulic Fluid, Rust Inhibited, Fire-Resistant, Synthetic Hydrocarbon Base
MIL-H-83282	-	Hydraulic Fluid, Fire Resistant, Synthetic Hydrocarbon Base, Aircraft, Metric, NATO Code Number H-537

STANDARDS

FEDERAL

FED-STD-595	-	Colors Used in Government Procurement

MILITARY

MIL-STD-1655	-	Fittings, Flareless, Classification of Defects of
MIL-STD-6866		Inspection, Liquid Penetrant

(See supplement 1B for list of additional applicable flareless fitting standards.)

(Unless otherwise indicated, copies of federal and military specifications, standards, and handbooks are available from DODSSP - Customer Service, Standardization Documents Order Desk, 700 Robbins Avenue, Building 4D, Philadelphia, PA 19111-5094.)

* 2.2 Non-Government publications. The following document forms a part of this document to the extent specified herein. Unless otherwise specified, the issues of the documents which are DoD adopted are those listed in the issue of the DODISS cited in the solicitation. Unless otherwise specified, the issues of documents not listed in the DODISS are the issues of the documents cited in the solicitation (see 6.2c).

AMERICAN SOCIETY OF MECHANICAL ENGINEERS (ASME)

ASME-B46.1 - Surface Texture (Surface Roughness, Waviness, and Lay)

(Application for copies should be addressed to the American Society of Mechanical Engineers, 345 East 47th Street, New York, NY 10017.)

AMERICAN SOCIETY FOR QUALITY CONTROL (ASQC)

ASQC Z1.4 - Sampling Procedures and Tables for Inspection by Attributes

(Application for copies should be addressed to the American Society For Quality Control, P.O. Box 3005, 611 E. Wisconsin Avenue, Milwaukee, WI 53201-4606.)

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM-A576 - Standard Specification for Steel Bars, Carbon, Hot-Wrought, Special Quality (DoD adopted)

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

SOCIETY OF AUTOMOTIVE ENGINEERS (SAE)

SAE-ARP603 - Impulse Testing of Hydraulic Hose Assemblies, Tubing and Fittings (DoD adopted)

SAE-ARP891 - Determination of Aluminum Alloy Tempers Through Electrical Conductivity Measurement (Eddy Current) (DoD adopted)

SAE-AS1376 - Wrench Pads, Fluid Fitting, Alternate Machined Shapes of, Design Standard for (DoD adopted)

SAE-AMS2241 - Tolerances - Corrosion and Heat Resistant Steel, Iron Alloy, Titanium and Titanium Alloy Bars and Wire (DoD adopted)

SAE-AMS2486 - Conversion Coating of Titanium Alloys, Fluoride Phosphate Type

SAE-AMS2488 - Anodic Treatment, Titanium and Titanium Alloys

SAE-AMS4911 - Titanium Alloy Sheet, Strip and Plate 6AL-4V Annealed

SAE-AMS4928 - Titanium Alloy Bars, Forging, and Rings 6Al-4V, Annealed 120,000 PSI (825 MPA) Yield Strength (DoD adopted)

(Applications for copies should be addressed to the Society of Automotive Engineers, inc., 400 Commonwealth Drive, Warrendale, PA 15098.)

UNIFORM CLASSIFICATION COMMITTEE

Uniform Freight Classification

(Application for copies should be addressed to the Consolidated Classification Committee, Room 1150, 222 South Riverside Plaza, Chicago, IL 60606.)

(Non-Government standards and other publications are normally available from the organizations that prepare or distribute the documents. These documents also may be available in or through libraries or other informational services.)

* 2.3 Order of precedence. In the event of a conflict between the text of this specification and the references cited herein (except for related associated detail specifications, specification sheets or MS standards), the text of this document shall take precedence. Nothing in this document, however, supersedes applicable laws and regulations unless a specific exemption has been obtained.

3. REQUIREMENTS

* 3.1 Qualification. The fittings, nuts and sleeves furnished under this specification shall be products which are authorized by the qualifying activity for listing on the applicable Qualified Products List (QPL) at the time of award of contract (see 4.3 and 6.5). For shape fittings both forged shapes and machined shapes shall be qualified separately. In addition, the retention of the qualification for the fitting on the applicable qualified products list shall be dependent on periodic verification of continued compliance with the requirements of this specification (see 4.3.2). When there is no qualified source for a given size and material, a source listed on the qualified products list may be considered for approval in smaller sizes. Written approval must be obtained from the qualifying activity before this special qualification may be used for procurement. This special qualification may be used only where there is no qualified source for the size and material in the MS fitting being procured. The qualifying activity shall reserve the right to conduct whatever tests it deems necessary for this approval.

3.1.1 Qualification by association. Manufacturers who are listed in the latest revision of QPL-18280 may be qualified by association to manufacture and furnish the AS fittings which are listed in latest issue of MIL-F-18280 supplement sheet. Written approval must be obtained from the qualifying activity before this special qualification may be used for procurement.

3.2 Materials. Fittings, nuts and sleeves shall be manufactured from materials listed in table I, as specified on the applicable standards.

3.2.1 Steel. All carbon steel for manufacturing sleeves shall be made by the open-hearth or electric-furnace process.

3.2.2 Heat treatment.

3.2.2.1 Aluminum alloy. Aluminum alloy fittings and nuts shall be supplied in the final temper as shown in table I. Heat treatment shall be in accordance with MIL-H-6088.

3.2.2.1.1 Electrical conductivity and hardness. Aluminum alloy fittings and nuts shall meet the electrical conductivity and hardness requirements of SAE-ARP891.

3.2.2.2 Steel. Mechanical properties of carbon steel sleeves and corrosion-resistant steel fittings and nuts shall be as specified in 3.2.2.2.1 and 3.2.2.2.2.

3.2.2.2.1 Fittings and nuts. Corrosion-resistant steel fittings and nuts shall have a hardness of Rockwell B80 minimum.

3.2.2.2.2 Sleeves. Sleeves shall be heat treated to establish a case depth, case hardness, and core hardness to meet the performance requirements of the joint strength and metallurgical properties tests. Further information of the values for metallurgical properties is included in 6.6.

3.2.2.3 Titanium. Titanium alloy fittings and nuts shall be free of oxygen, hydrogen or nitrogen enriched surfaces.

3.2.3 Parting planes in aluminum forging. Parting planes shall be free of crack-like defects (see 6.4.2) and tears (see 6.4.6) indications. Surface defects shall be examined as specified in 3.7.

* 3.2.3.1 Parting plane removal. Parting planes of fittings having such defect indications shall be ground flush to blend with the forging body, without reduction of the forging body thickness below the minimum as specified in the forging drawing. The finish in the ground parting plane area shall not exceed 125 microinches (R_a) as defined in ASME B46.1 after grinding. Following anodizing, the part shall not exhibit cracks or crack-like defects.

3.3 Design and dimensions. The design and dimensions of fittings, nuts and sleeves shall be in accordance with the applicable MS and AS standards.

3.3.1 Passages.

3.3.1.1 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. It shall be possible to pass through the fluid passage a tooling pin gage whose diameter is .020 inch less than the minimum diameter specified for the passage. This does not mean that the drilled passage may be smaller than that required by the MS standard.

* 3.3.1.2 Fluid passage on angle and shape fittings. On angle fittings and shape fittings the cross-sectional area at the junction of the fluid passages shall allow the passing, from end to end, of a ball whose diameter is not less than .7 times the minimum diameter specified for the smallest passage. This does not mean that the diameter of any passage may be smaller than that required by the MS standard.

3.3.1.3 Wall thickness. Except as otherwise specified on the applicable standard, the wall thickness at any point on the fittings, nuts or sleeves shall not be less than the thickness established by the dimensions and tolerances for the inside and outside diameters and eccentricities specified on the applicable standard.

* 3.3.2 Threads. All threads shall be per MIL-S-8879 except root radius is not required on incomplete threads. External threads on aluminum alloy, CRES and titanium alloy shall be produced by roll forming, machining by single point method or grinding.

* 3.3.2.1 Rolled thread defects. For rolled threads, laps and seams, whose depths are within the limits of table II, are acceptable on the crest and the non-pressure thread flank above the pitch diameter. Laps and seams are not acceptable on any part of the pressure thread flank, in the thread root, or on the non-pressure thread flank in the area between the thread root and pitch diameter (see figure 2). Stress cracks are unacceptable.

3.4 Finish.

* 3.4.1 Aluminum-alloy fittings and nuts. Aluminum-alloy fittings and nuts shall be anodized in accordance with MIL-A-8625, type II, class 2. Type 2014 and 2024 alloys shall be dyed green similar to color 14187 of FED-STD-595 and type 7075 alloy shall be dyed brown similar to color 10080 of FED-STD-595 (see 3.5.5).

3.4.1.1 Surface condition. The surface of aluminum-alloy parts, after anodizing, sealing and surface treatment, shall be free of pits, (see 6.4.1), powder coatings, discontinuities such as scratches or breaks and shall be uniform in appearance. Racking marks (see 6.4.5) shall not be on seal areas, threads or on areas exposed to the atmosphere.

* 3.4.2 Carbon steel sleeves. Carbon steel sleeves shall be cadmium plated .00030 inch minimum to .00050 inch maximum, in accordance with QQ-P-416, type II. All carbon steel sleeves shall be dipped in oil conforming to MIL-H-6083 or MIL-H-46170.

* 3.4.3 Corrosion-resistant steel fittings and nuts. Corrosion-resistant steel fittings and nuts shall be passivated per QQ-P-35. The inside only of sizes 16 thru 32 nuts shall be coated with dry film lubricant per MIL-L-46010, type I. Minor overspray of lubricant on the outside of the nut is permitted.

3.4.4 Titanium alloy fittings. Titanium alloy fittings and nuts shall be fluoride phosphate coated per SAE-AMS2486 or SAE-AMS2488.

3.5 Identification of product. All parts shall be identified in accordance with the instructions specified in 3.5.1, 3.5.2, 3.5.3, 3.5.4 and

3.5.5.

3.5.1 MS standard symbol and manufacturer's trademark. All fittings and nuts shall be marked with the letters "MS" and the manufacturer's identification or trademark. Sleeves shall be marked with the manufacturer's identification or trademark. Fitting forging shall be marked with the forging manufacturer's trademark, code number or letter to identify forging source.

TABLE I. Materials.

Material	Type of part	Form 2/	Specification	Material code
Aluminum alloy	Straight fittings and nuts	Bars and rod	QQ-A-225/6 (2024) Temper T6, or T851	D
			QQ-A-225/9 (7075) Temper T73	W
	Shape fittings and nuts	Forging 1/	QQ-A-367 (2014) Temper T6	D
			QQ-A-367 (7075) Temper T73	W
	Shape fittings	Bars	QQ-A-225/6 (2024) Temper T6 or T851	D
			QQ-A-225/9 (7075) Temper T73	W
Titanium alloy	Straight fittings and nuts	Bars	SAE-AMS4928 3/ (6Al-4V Annealed)	T
	Shape fittings	Bars, Plate and forging	SAE-AMS4928 AMS 4911 (6Al-4V Annealed) MIL-T-9046 Condition AB-1	T
Carbon steel	Sleeves	Bars, round	ASTM-A576 (1213) (12L14) & (1215)	None
Corrosion resistant steel	Straight fittings and nuts	Bars	QQ-S-763, Class 304 QQ-S-763, Class 316	J K
			QQ-S-763, Class 321 4/	R
	Shape fittings	Bars and forging	QQ-S-763, Class 304	J
			QQ-S-763, Class 316	K
			QQ-S-763, Class 321 4/	R

1/ Use of forging for nuts in sizes smaller than -24 is prohibited.

2/ Substitution of plate material for bars, rods and forging for a specific application shall be subject to the approval of the individual acquiring activity. Machined shapes shall conform with SAE-AS1376, if applicable.

3/ Titanium hex bar shall be cold finished with tolerances per SAE-AMS2241.

4/ 347 Code "S" material may be used until existing stock is depleted. 321 Code "R" material may be substituted wherever 347 Code "S" material is specified.

5/ Fittings code "F" made from carbon steel in inventory shall be used until depleted and code "J" and code "R" made from 304 and 321 CRES may be substituted wherever code "F" material is specified.

TABLE II. Depth of laps, seams, surface irregularities and discontinuities in rolled threads.

Fitting size	Depth (inch) (maximum)
-2	.006
-3	.006
-4	.007
-5	.007
-6	.008
-8	.009
-10 thru -32	.010

* 3.5.2 Material identification. Corrosion-resistant steel fittings and nuts shall be marked with the letter "J" if made from class 304, the letter "K" if made from class 316, the letter "R" if made from class 321 corrosion-resistant steel. All 7075-T73 aluminum alloy parts shall be marked with the letter "W". All 2014 and 2024 aluminum alloy parts shall be marked with the letter "D". Code "D" aluminum alloy parts already anodized yellow in color due to the dichromatic seal shall also be marked with green paint in accordance with 3.5.5. Titanium alloy parts shall be marked with the letter "T" (see table I material code).

3.5.3 Marking for part number and size. All fittings and nuts larger than .375 inch tube size (except MS21914 fitting) shall be marked with the part number, exclusive of size. MS21914 fitting may have "MS21921" marked on the nut. A numerical equivalent to the dash number indicating size is optional.

3.5.4 Size, method and location of marking. Marking shall be accomplished by embossing, chemical etching or impression stamping on the fitting or nut in a location not detrimental to the part or to its corrosion protection.

3.5.5 Color identification. MS fittings, nuts and sleeves shall also be identified by the following color or finish:

Carbon steel sleeves: No artificial dye; however, parts must be yellow in color as a result of the chromate phosphate treatment

Corrosion-resistant steel: Natural finish

Aluminum alloy 2014 and 2024 fittings and nuts: they shall be dyed green (see 3.4.1). The paint shall be resistant to both hydrocarbon and phosphate ester based hydraulic fluids and shall be applied uniformly. The letter "D" required in 3.5.2, if not already marked on the part, shall be permanently ink stamped on top of a green paint spot. Aluminum alloy 7075 fittings and nuts shall be dyed brown (see 3.4.1).

Titanium alloy fittings and nuts: Gray (results of fluoride phosphate coating.)

3.6 Performance.

3.6.1 Fitting, nut and sleeve assembly. The fitting, nut and sleeve, when assembled to tubing specified in table III, shall meet the following requirements.

3.6.1.1 Burst pressure. Burst pressure shall be as specified in 4.5.7. The fittings shall withstand burst pressure without leakage (see 6.4.3) or failure when tested as specified in 4.6.2.

3.6.1.2 Impulse. Fittings of all materials shall be capable of 200,000 impulse cycles without leakage or failure when tested as specified in 4.6.3.

3.6.1.3 Flexural strength. Six of the six samples of each of the assembly material combinations (tube, fitting, nut and sleeve) shown in table III shall withstand 10,000,000 cycles of flexure, without leakage or failure of the tube, fitting, nut or sleeve, when tested as specified in 4.6.5. Only samples that fail external to the sleeve due to a tube defect may be replaced with a new sample.

3.6.1.4 Repeated assembly. Fittings of all materials shall be capable of eight repeated assemblies, when applying both the minimum and maximum torque values per table X, without leakage or indication of failure of the nut, sleeve or fitting when tested as specified in 4.6.6.

3.6.1.4.1 Minimum opening. During any of the repeated assembly tests, the internal passage of neither the fitting nor the tubing shall be reduced to a value less than that shown in table IV and figure 1 when tested as specified in 4.6.6.1.

3.6.1.5 Pneumatic test. The fittings shall withstand pneumatic working pressure or system pressure without leakage or failure when tested as specified in 4.6.10.

3.6.1.6 Joint strength test (MS21922 sleeves only). Flareless tube fitting assemblies shall withstand, as a minimum, the loads as specified in table V without slippage of sleeve on tubing or cracking of sleeve when tested as specified in 4.6.11. To prevent yielding and stretching of the tubing at

the minimum required load, use MIL-T-6845 tubing with a wall thickness as specified in table V. Thicker wall of MIL-T-6845 tubing may be substituted based on availability. Yielding and stretching of sleeve failure shall not be attributed to other assembly components such as tubing, fittings and connectors. Fitting assemblies shall be installed in accordance with figure 6, corrosion resistant steel on MIL-T-6845 tubing. Joint strength test qualification and quality conformance tests are not required for -24 and -32 size sleeves.

* 3.6.1.7 Ring cut (sleeves only). Sleeves shall be assembled onto tubing as indicated in 4.5.4. The resulting ring cut mark in the tube shall be a minimum of .002 inch deep extended around the circumference of the tube (see figure 7) when tested as specified in 4.6.4.

TABLE III. Fittings, tube material, pressures and stresses.

Stainless-steel tube (MIL-T-6845) 1/8 hard 1/						
Tube OD (inch)	Dash size	Tube wall thickness (inch)	For use with stainless steel and titanium fittings and nuts, and carbon steel sleeves		For use with aluminum-alloy fittings and nuts and carbon steel sleeves	
			Working pressure psi 2/	Total stress level in tube for flexure test +0 -10 % psi	Working pressure psi 2/	Total stress level in tube for flexure test +0 -10% psi
.125	-2	.012	3,000	30,000	3,000	14,000
.188	-3	.016	3,000	30,000	3,000	14,000
.250	-4	.020	3,000	30,000	3,000	14,000
.313	-5	.020	3,000	30,000	3,000	14,000
.375	-6	.028	3,000	30,000	3,000	14,000
.500	-8	.035	3,000	30,000	3,000	14,000
.625	-10	.042	3,000	30,000	3,000	14,000
.750	-12	.058	3,000	25,000	3,000	14,000
1	-16	.065	3,000	25,000	1,500	13,000
1.250	-20	.049	1,500	25,000	1,500	13,000
1.500	-24	.058	1,500	25,000	1,000	13,000
2	-32	.065	1,500	25,000	600	13,000

1/ Qualification of one alloy (CRES 304, 316 or 321) constitutes qualification of the other CRES alloys.

2/ Proof pressure is twice working pressure; burst pressure is four times working pressure.

* 3.7 Workmanship. Machined surfaces of fittings, nuts and sleeves, shall be free from burrs and tool marks as visible with the unaided eye. Unless a finer finish is specified on applicable MS, sealing surfaces shall be smooth, to 63 microinches Ra as defined in ASME B46.1. Annular tool marks, longitudinal tool marks, and spiral tool marks up to 100 microinches Ra shall be acceptable. All machined surfaces shall be smooth and roughness shall not exceed 125 microinches Ra. The roughness for unmachined surfaces shall be 250 microinches Ra per ASME B46.1 and shall be free from blisters, fins, folds, seams, laps, cracks, and segregation (see 6.4.1). Surface defects shall be examined by etching; if the defects can be removed, required section thickness is maintained, and defects do not appear upon retching, the original defect shall not be cause for rejection.

TABLE IV. Minimum opening in inches when using tubing specified in table III for the repeated assembly.

Tubing specification per MIL-T-6845		
Tube OD	Tube size Dash nos.	Minimum Opening
.125	-2	.070
.186	-3	.110
.250	-4	.165
.313	-5	.225
.375	-6	.290
.500	-8	.400
.625	-10	.485
.750	-12	.610
1.000	-16	.840
1.250	-20	1.048
1.500	-24	1.330
2.000	-32	1.780

TABLE V. Minimum joint strength, steel flareless fitting assembly on 304 1/8 hard CRES tube to MIL-T-6845.

Size	-2	-3	-4	-5	-6	-8	-10	-12	-16	-20
Wall Thickness (Inches)	.012	.016	.020	.020	.028	.035	.042	.058	.065	.049
Joint Strength (Lbs)	400	800	1300	1800	2500	4200	6200	8800	10000	9500

4. QUALITY ASSURANCE PROVISIONS

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

* 4.1.1 Responsibility for compliance. All items shall meet all requirements of sections 3 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 (see 6.3).

* 4.2 Classification of inspections. The inspection requirements specified herein are classified as follows:

a. Qualification inspection (4.3).
b. Quality conformance inspection (4.4).

* 4.3 Qualification inspection. Qualification inspection shall consist of all the examinations and tests specified in table VI.

4.3.1 Sampling instructions. Qualification inspection samples shall consist of the parts specified in table VII for each size and material for which qualification is desired. For shape fittings, samples of forged shapes and machined shapes shall be submitted if qualification for both types is desired.

* 4.3.2 Retention of qualification. The retention of qualification shall

consist of certification by the manufacturer to demonstrate compliance of the qualified fittings with the requirements of this specification. Certification shall be signed by a responsible official of management, attesting that the listed product(s) is still available from the listed plant, can be produced under the same conditions as originally qualified, i.e., same process, materials, construction, design, manufacturer's part number or designations, and meets the requirements of the current issue of the specification. Certification shall be conducted at intervals not exceeding two years. The activity responsible for certification approval is the qualifying activity (see 6.5).

* 4.4 Quality conformance inspection. The quality conformance inspection shall consist of all the examinations and tests specified in table VIII. The sampling plan and inspection levels shall conform to ASQC Z1.4 and acceptance criteria shall be as specified in the contract or order.

4.4.1 Sampling.

TABLE VI. Qualification inspection.

Inspection and test	Design requirement paragraphs	Inspection and test paragraphs
Quality conformance inspection	3.6	4.4
Burst pressure	3.6.1.1	4.6.2
Impulse	3.6.1.2	4.6.3
Flexural strength	3.6.1.3	4.6.5
Repeated assembly	3.6.1.4	4.6.6
Pneumatic test	3.6.1.5	4.6.10

4.4.1.1 Inspection lot. An inspection lot shall consist of all parts of a given part number made from the same materials and processed at the same time.

4.4.1.1.1 Non-destructive tests. Sampling for material, threads, finish, dimensions, marking, surface defects and workmanship shall be in accordance with ASQC Z1.4 and an Acceptable Quality Level (AQL) shall be as specified in the contract.

4.4.1.2 Destructive tests. Sampling for destructive tests (see table VIII) shall be performed in accordance with ASQC Z1.4, Inspection Level and acceptance number shall be as specified in the contract or order.

4.4.2 Manufacturer's data. The manufacturer shall maintain a record of the results of the manufacturer's tests as applied to each lot.

* 4.4.3 Material certification. Records of chemical composition analysis, mechanical property tests showing conformance to the applicable material specifications, and data showing conformance to the test requirements

specified in MIL-H-6088, shall be made available to the acquiring activity for each lot of fittings (6.3).

TABLE VII. Qualification test samples. 1/

Quantity (each) 1/ 2/ 6/	Fitting part no.	Material	Qualification test
4	MS21908 MS21912	4/	Burst pressure (see 3.6.1.1, 4.6.2)
3	MS21908 MS21912	4/	Impulse (see 3.6.1.2, 4.6.3)
6	MS21902 MS21921 MS21922	4/	Flexural strength (see 3.6.1.3, 4.6.5)
6	MS21902	4/	Repeated assembly (see 3.6.1.4, 4.6.6)
6	MS21902	3/	Rolled thread defect test (see 3.3.2.1, 4.6.9)
3	MS21922		Ring cut test (sleeves only) (see 3.6.1.7, 4.6.4)
3	MS21902	1/	Pneumatic test (see 3.6.1.5, 4.6.10)
6	MS21922	5/	Joint strength test (see 3.6.1.6, 4.6.11)
6	6/		Examination of product, chemical composition, physical properties and hardness (see table VIII) (see 2/)

1/ All fittings specified shall be assembled with applicable MS21921 nuts, MS21922 sleeves and tubing specified in table III.

2/ In each size and material for which qualification is desired. For qualification of each material, MS21908 and MS21912 parts shall be supplied in full unmixed sets of either forging or bar/plate stock. Both types of the material shall be qualified, if desired. Bar and plate shall be considered as interchangeable for qualification.

3/ All aluminum alloy and all corrosion-resistant steels in sizes -2 to -16, inclusive.

4/ All materials as applicable (2014, 2024 and 7075 aluminum alloys) (class 321, 316, 304, corrosion-resistant steel (CRES)); (MIL-T-9046, SAE-AMS 4911, AMS 4928 6Al-4V annealed titanium). Qualification test reports shall identify the material used and the form used.

5/ To be tested with three straight CRES fittings on 304 1/8 - hard tubing to MIL-T-6845. Six sleeves shall be tested.

6/ All samples subjected to qualification inspection tests shall be selected from a lot previously subjected to examination of product, chemical composition, physical properties and hardness of table VIII. Sleeves shall not be subjected to impulse test.

4.4.4 Rejection and retest. Rejected lots shall be resubmitted for retest and acceptance in accordance with ASQC Z1.4. Parts subjected to non-destructive tests and failing to conform to the requirements of these tests shall be rejected. Parts subjected to destructive tests shall be discarded (see 6.3).

4.4.5 Report of failure of sampling test. When a fitting fails to pass a sampling test, the entire lot represented by the sample shall be rejected. All failures of the tested units shall be reported to the qualifying activity immediately by telephone or message within 24 hours to the acquiring activity. Full particulars concerning action taken to correct the defects shall be submitted to the acquiring activity in a written test report. The lot represented by the unsatisfactory sample shall not be resubmitted until approval of resubmission has been issued by the acquiring activity (see 6.3).

TABLE VIII. Quality conformance inspection.

Item	Inspection	Design requirements paragraphs	Test paragraphs
a	Examination of product		4.6.1
b	Chemical composition	3.2	3/
c	Physical properties	3.2.2	
d	Electrical conductivity aluminum alloy only 2/	3.2.2.1.1	
e	Hardness 2/	3.2.2.2	4.6.8
f	Ring cut test (sleeve only) 2/	3.2.2.2.2	4.6.4
g	Parting planes in aluminum forging	3.2.3	4.6.12
h	Rolled thread defect test 2/	3.3.2.1	4.6.9
i	Joint strength test (sleeve only) 1/	3.6.1.6	4.6.11

1/ For quality conformance testing, the joint strength tests shall be limited to 3 assemblies using 304 1/8 hard tubing to MIL-T-6845, MS21922 sleeves and CRES straight fittings per figure 6. Six sleeves shall be tested.

2/ This is a destructive test and shall not be considered as part of the contract or order.

3/ Manufacturer's certificate of compliance (see 4.4.3) showing conformance to this requirement is acceptable.

* 4.5 Test conditions and procedures.

4.5.1 Thread lubricant. No thread lubricant shall be used other than hydraulic fluid conforming to MIL-H-5606, MIL-H-6083, MIL-H-46170, MIL-H-83282 or lubricant specifically approved by the acquiring activity.

4.5.2 Tube preparation. Tubes shall be cut square within .5 degrees and all burrs removed from inside and outside of the tube ends. The break of chamfer on either the outside diameter or inside diameter shall not exceed 25 percent of thickness of the tube wall.

TABLE IX. Preset tube tightening limits.

Tube OD (In.)	1/8 hard corrosion resistant steel tubing	
	Wall thickness (In.)	Number of turns 1/
.125	.012	1.167
.188	.016	1.167
.025	.020	1.167
.313	.020	1.167
.375	.028	1.167
.500	.035	1.167
.625	.042	1.167
.750	.058	1.000
1.000	.065	1.000
1.250	.049	1.000
1.500	.058	1.000
2.000	.065	1.000

1/ Number of turns to preset tubing (without mandrels).

4.5.3 Presetting of sleeves. Sleeves shall be preset on the tubing before assembly using a presetting machine, or with the fitting, by tightening the nut to the number of turns specified in table IX, past the point of ring grip.

4.5.4 Fitting assembly. After presetting the sleeves as specified in 4.5.3, the nut shall be completely disengaged and then tightened to the minimum or maximum torque values, as applicable, in accordance with table X.

4.5.5 Tube material and working pressure. Fittings, nuts and sleeves shall be tested with MIL-T-6845, 1/8 hard stainless steel tubing. Working pressure shall be as specified in table III.

4.5.6 Proof pressure. Proof pressure shall be twice the working pressure specified in table III.

4.5.7 Burst pressure. Burst pressure shall be four times the working pressure specified in table III.

4.5.8 Test fluids. Unless otherwise specified, fluid conforming to MIL-H-5606, MIL-H-6083, MIL-H-46170 or MIL-H-83282, shall be the test fluid.

4.6 Inspections methods.

4.6.1 Examination of product. Each lot of fittings will be examined to determine conformance with this specification and the applicable standard with respect to material, dimensions, passages, threads, wall thickness, surface defects, cross-section at fluid path junctions, finish, marking and workmanship. MIL-STD-1655 shall be used to classify the defects.

4.6.2 Burst pressure test. MS21908 elbows, MS21912 tees and MS21902 unions (repeated assembly samples only), shall be used in this test. Fittings shall be assembled so that at least 8 inches of free tubing extends between the two end fittings. One-half the samples shall be assembled with minimum torque and the remaining samples assembled with maximum torque. Pressure shall be raised to the proof pressure for 5 minutes. Pressure shall then be increased at a rate of 20,000 ±5,000 psi per minute to the burst pressure, as specified herein, or until burst or leakage occurs. No burst or leakage shall occur at a pressure less than the specified burst pressure. It is not essential that the assembly actually be pressurized to burst, but they shall be capable of withstanding four times nominal system operating pressure and pass the requirements specified in 3.6.1.1.

4.6.3 Impulse. Three samples each of MS21908 elbows and MS21912 tees shall be mounted on tubing of the type designated in table III for the fitting materials under test. The tube shall be joined with minimum torque values and subjected to the following tests.

4.6.3.1 Impulse test. The assembly shall first be tested at proof pressure for 5 minutes. All impulse testing shall be performed in accordance with SAE-ARP603, except temperature shall be at 100 +30° F. The impulse rate shall be 70 ±5 cycles per minute (cpm). The rate of pressure rise shall be 125,000 psi/sec to 300,000 psi/sec. Hydraulic fluid shall be used as the testing media. Fittings shall complete 200,000 impulse cycles, after which they shall again be tested at proof pressure for 5 minutes.

TABLE X. Torque values.

Fitting size	Torque (inch-pounds)		Fitting size	Torque (inch-pounds)	
	Minimum	Maximum		Minimum	Maximum
-2	50	60	-10	620	680
-3	195	105	-12	855	945
-4	135	145	-16	1140	1260
-5	170	190	-20	1520	1680
-6	215	245	-24	1900	2100
-8	470	510	-32	2660	2940

4.6.4 Ring cut test (sleeves only). Sleeves shall be assembled onto tubing conforming to MIL-T-6845. Either machine presetting or hand presetting methods shall be used. After presetting, the fitting and B-nut shall be removed from the assembly, exposing the preset sleeve. The sleeve shall be carefully cut longitudinally until completely severed and then slipped back from the ring cut area. The ring cut shall be examined for complete depth around 360 degrees of the tube circumference. A comparator or other measuring device shall be used to determine the depth of the ring cut in accordance with figure 7. The sleeve shall pass the requirements specified in 3.6.1.7.

4.6.5 Flexural test. The flexural test shall be performed in one of the following methods provided that the stress level indicated in table III is imposed and measured at a point adjacent to a MS21902 union and MS21922 sleeve (figure 4). The total stress indicated in table III is defined as the dynamic tensile bending stress plus the axial tensile stress due to the internal pressure. The bending stress must be measured by one or more strain gages placed on the tube .188 ±.031 inch from the tail of sleeve. The axial tensile stress (S_a) due to internal pressure shall be measured with the strain gages or calculated and added to the bending stress. If calculated, the following formula for axial tensile stress shall be used.

$$S_a = \frac{Pd^2}{D^2-d^2}$$

where S_a = axial tensile stress due to internal pressure.

P = Internal pressure (table III).

D = Tube outside diameter.

d = Tube inside diameter.

During testing, a constant pressure equal to the working pressure, noted in table III, shall be imposed. Frequency of flexing may be any rate from 30 to

500 cycles per second, depending on the method selected. The specimens shall be assembled with maximum torque values. Duration of testing shall be 10 million cycles or until failure or leakage occurs. The assembly shall pass the requirements specified in 3.6.1.3. For purposes of stress calculations, use the modules of elasticity for MIL-T-6845 tubing as 28,000,000 psi.

4.6.5.1 Rotary beam method. Figure 4 shows one method where the flexural requirements are obtained by imposing a concentrated rotating load on the free end of the tube assembly. For this method, the following tube length L is recommended (see table XI).

TABLE XI. Recommended test specimen.

Length, cantilever beam flexure test									
Tube size	-4	-5	-6	-8	-10	-12	-16	-20	-24
Length L(inches)	6	7	7.5	9	10	11.5	12.5	14	15

If a different test specimen length is desired, L should be determined by the following formula:

$$S = \frac{FLC}{I} + S_a$$

where S = total stress (see table III)

$$\frac{FLC}{I} = \textit{stress caused by bending}$$

in which F = concentrated load applied and measured at L as shown in figure 4.

I = moment of inertia

C = one-half tube outside diameter (inches), and

S_a = axial tensile stress due to internal pressure (see 4.6.5)

4.6.5.2 Cantilever beam method. Another method of obtaining the desired stress level of table III shall be obtained by mounting a cantilever tube with fittings on a shaker table. The test fitting shall be rigidly mounted to shaker table so that the free end of the tubing is unrestrained. The bending stress shall be measured with a strain gage. The axial tensile stress shall be measured with the strain gage or calculated (see 4.6.6) and added to the bending stress. The tentative length, L, of the tubing may be calculated from the following formula:

$$L = \sqrt{\frac{3KEC}{S_b}}$$

in which L = length in inches from ℄ strain gage to point of deflection

K = displacement in inches

E = modules of elasticity (28,000,000 psi for corrosion-resistant steel)

C = one-half tube outside diameter (inches)

S_b = bending stress in tube at strain gage

The above formula was derived by combining the following formula:

$$S_b = \frac{MC}{I} = \frac{FLC}{I}$$

$$K = \left(\frac{1}{3}\right) \frac{FL^3}{EI}$$

4.6.5.3 Simple beam method. Figure 5 shows another method, where the test arrangement is essentially a simple beam, with a concentrated load (test fitting weight times acceleration) at the center mounted on a "shaker". Both supports should provide free swivelling action. In order to eliminate side loads on the shaker table, it is recommended that the static pressure be applied to both ends of the test specimen. Tentative length "L" may be calculated, from the following formula and then adjusted to provide the desired resonant frequency.

$$L = \sqrt{\frac{12KEC}{S_b}}$$

in which L = total length in inches

K = displacement at center in inches

E = modulus of elasticity (28,000,000 psi for corrosion-resistant steel)

C = one-half tube outside diameter (inches)

S_b = bending stress in tube at strain gage (value in table III minus the calculated axial tensile stress from 4.6.5).

4.6.6 Repeated assembly.

4.6.6.1 Minimum tightening. Three samples shall be tested. The tube and fitting assembly shall be assembled and disassembled eight successive times, using minimum torque values specified in table X. Each repeated assembly operation shall include the assembly and complete removal of the tube from the fitting body and reassembly 90 degrees out of previous tube-to-fitting phase

relationship (sleeve shall not be removed from tube). After each third and final tightening operation, the assembly shall be subjected to the proof pressure for 5 minutes. The tubing shall be examined for tube collapse after the seventh repeated assembly and shall pass the requirements specified in 3.6.1.4.1. After the eighth operation, the MS21902 fitting assembly shall be subjected to and pass the burst pressure test.

4.6.6.2 Maximum tightening. Three samples shall be tested. The test specified in 4.6.6.1 shall be performed, using new assemblies, with the maximum torque values specified in table X.

4.6.7 Electrical conductivity. Aluminum alloy fittings and nuts shall be tested in accordance with SAE-ARP891.

4.6.8 Hardness. Hardness reading shall be taken on a smooth flat surface of any unthreaded portion of the fitting or nut. Hardness of sleeves shall be taken in a minimum of five different points on the sleeve with at least two readings on the inner case (ID) and two in the outer case (OD). The fitting, nut or sleeve shall pass the requirements specified in 3.2.2.

* 4.6.9 Rolled thread defect test. Rolled thread defects shall be determined by the rolled thread defect test on prepared and etched specimens. Specimens shall be taken from the finished part by sectioning on a longitudinal plane across the threaded area. The specimen shall be suitably etched for sufficient time to reveal the macrostructure. Examine microscopically the thread area for defects (see figure 2) and shall pass the requirements specified in 3.3.2.1.

4.6.10 Pneumatic test. For qualification MS21902 unions and MS21922 sleeves shall be used for this test. Three samples each shall be tested. The tube assemblies shall be joined with minimum torque values and be subjected to working or system pressure for 5 minutes with nitrogen. Test fitting sealing surfaces and threads shall be lubricated with thread lubricant specified in 4.5.1. When submerged under at least 1 inch of water, no leakage in the form of bubbles, shall be permitted and shall pass the requirements specified in 3.6.1.5.

4.6.11 Joint strength test (MS21922 sleeves only). Three fitting assemblies as shown in figure 6 shall be mounted in a tensile test machine and strained to rupture at a speed of .15 inch/minute. Presetting of sleeves may be done by hand or machine. The test samples shall be torqued to minimum torque of table X. The sleeves shall pass the requirements specified in 3.6.1.6.

* 4.6.12 Parting planes in aluminum forging. The flash lines shall be visually inspected for crack like defects. Defects shall be subject to penetrant inspection per MIL-STD-6866 and shall pass the requirements specified in 3.2.3.

5. PACKAGING

The packaging requirements shall be as specified in the contract or order (see 6.2).

* 6. NOTES

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

6.1 Intended use. Fittings covered by this specification are intended for use in aeronautical fluid systems (see 1.1). Since fittings of several materials are described in this specification, and various tube-fitting material combinations can be selected for various systems, table XV and the following information are offered.

a. Under some circumstances, the fittings above may be used successfully at temperature and pressure ranges beyond those listed. Prior to such use, supporting test data should be approved by the procuring activity.

b. Use of a single material by type for a corrosion resistant steel fitting assembly combination is not a recommended practice, as freezing or galling of threads with mating parts may result, and removal or disassembly cannot be accomplished without injury to the parts affected.

c. Qualification approval of the product specified herein approves the product only for use in such manner as defined in the qualification tests.

TABLE XII. Pressure and temperature rating for fittings.

Tube OD (NOM) size	Aluminum alloy		Corrosion resistant steel		Titanium alloy 6Al-4V	
	pressure	temp	pressure	temp	pressure	temp
-2 through -12 incl.	3000 psi	-65° to +275°F	3000 psi	-65° to +275°F	3000 psi	-65° to +450°F
-16	1500 psi		3000 psi		3000 psi	
-20	1500 psi		1500 psi		1500 psi	
-24	1000 psi		1500 psi		1500 psi	
-32	600 psi		1500 psi		1500 psi	

* 6.2 Acquisition requirements. Acquisition documents should specify the following:

a. Title, number and date of this specification.
b. Part number required (see 1.2 and 3.3).
c. Issue of DODISS to be cited in the solicitation, and if required, the specific issue of individual documents referenced (see 2.1.1 and 2.2).
d. For shape fitting, if fitting shall be manufactured from a forging or machined from bar or plate stock (see table 1).
e. Acceptable Quality Level (AQL) required

f. Whether certification of compliance is required (see 4.4.3).
g. Fittings subjected to destructive tests (see table VIII) should not be shipped as part of the acquisition quantity.
h. Items of data required (see 6.3).

* 6.3 Consideration of data requirements. The following data requirements should be considered when this specification is applied on a contract. The applicable Data Item Descriptions (DID's) should be reviewed in conjunction with the specific acquisition to ensure that only essential data are requested/provided and that the DID's are tailored to reflect the requirements of the specific acquisition. To ensure correct contractual application of the data requirements, a Contract Data Requirements List (DD Form 1423) must be prepared to obtain the data, except where DOD FAR Supplement 227.405-70 exempts the requirement for a DD Form 1423.

Reference Paragraph	DID Number	DID Title	Suggested Tailoring
4.1.1	DI-NDTI-80809A	Test/Inspection report	10.2.7
4.4.3	DI-E-2121	Certificate of compliance	Use contractor format
4.4.4, 4.4.5	DI-R-21597	Failure analysis and correction reports	Use contractor format

The above DID's were those cleared as of the date of this specification. The current issue of DOD 5010.12-L, Acquisition Management Systems and Data Requirements Control List (AMSDL), must be researched to ensure that only current, cleared DID's are cited on the DD Form 1423.

* 6.4 Definition.

6.4.1 Surface defects. Refer to SAE-ARP4784 for the definition of the following surface defects:

a. Annular tool marks
b. Blisters
c. Burrs
d. Cracks
e. Fins
f. Folds
g. Laps
h. Longitudinal tool marks
i. Pits
j. Seams
k. Segregation
l. Spiral tool marks

6.4.2 Crack-like defects. Small thin shallow lines found on finished metal surfaces. This defect looks similar to a crack but its depth is superficial and not deep enough to define as a crack.

6.4.3 Leakage. The escape of fluid (gases or liquid) from any point of the fitting assembly including the fitting tube junction. This junction is defined to include one tube outside diameter in length beyond the fitting envelope. The envelope is the area from free parent tube material to free parent tube material or boss.

6.4.4 Macro examination. Inspection or examination of material surfaces at a magnification not exceeding 25X.

6.4.5 Racking marks. Surface imperfection such as superficial dents, gouges, or scratches from normal handling, shipping and storage. The imperfection shall not be considered as detrimental defects provided the imperfections are removable within the diameter and wall thickness specified herein.

6.4.6 Tears. Ragged edges along a seam or along in a straight line of fitting surfaces which pull apart, separate into pieces or split.

* 6.5 Qualification. With respect to products requiring qualification, awards will be made only for products which are at the time set for opening of bids, qualified for inclusion in the applicable Qualified Products List whether or not such products have actually been so listed by that date. The attention of the suppliers is called to this requirement, and manufacturers are urged to arrange to have the products that they propose to offer to the Federal Government tested for qualification in order that they may be eligible to be awarded contracts or orders for the products covered by this specification. The activity responsible for the Qualified Products List is: Naval Air Systems Command, AIR-4.1C, 1421 Jefferson Davis Hwy, Arlington VA 22243-5110; however, information pertaining to qualification of products should be obtained from the Naval Air Warfare Center, Aircraft Division, Warminster, Pennsylvania 18974-5000, Attention: Code 4.3.5.1.

* 6.6 Typical metallurgical properties for carbon steel sleeves. In order to meet the performance requirements of the joint strength and metallurgical properties tests for carbon steel sleeves, the following metallurgical properties have been found acceptable, and previous to this revision, were a performance requirement. These metallurgical properties are now suggested as nominal values to assist in manufacturing sleeves that will meet the performance requirements.

6.6.1 Sleeve case depth. A mean case depth of .0014 to .0020 inch should be maintained when determined by microscopic measurement. A minimum of five measurements should be taken at different points on the sleeve with at least two readings on the inner case (ID) and two in the outer case (OD). The cross section should be taken perpendicular to the axis of the sleeve .03 to .06 inch back of the cutting edge, as illustrated on Figure 3.

6.6.2 Sleeve case hardness. A case hardness of 576-754 Knoop hardness number (KHN) should be maintained when measured as indicated. Measure the hardness at a point .0007± .0002 inch below the surface of the sleeve material and within the same area as defined in 6.6.1, as illustrated on Figure 3. Use a Tukon hardness tester with Knoop indenter and 100 gram load. A minimum of 4 readings should be taken with two on the inner case (ID) and two on the outer case (OD).

6.6.3 Sleeve core hardness. The sleeve core hardness should be maintained between 208 and 245 and KHN when measured at a minimum of three places on the same samples used for core hardness and with the same equipment, except that the load should be 500 grams.

6.7 International standardization agreement. Certain provisions of this specification are the subject of international standardization agreements of ASCC AIR STANDARDS 17/15 and 17/18. When amendment, revision or cancellation of this specification is proposed international agreement concerned, the preparing activity will take appropriate action through international standardization channels, including departmental standardization offices, to change the agreement or make other appropriate accommodations.

6.8 Subject term (key word) listing.

Aerospace hydraulic systems
Hydraulic system junctures
joints
3000 psi operating pressure
-65° to +275°F operating temperature
Nuts
Sleeves

* 6.9 Changes from previous issue. The margins of this specification are marked with asterisks to indicate where changes (additions, modifications, corrections, deletions) from the previous issue were made. This was done as a convenience only and the Government assumes no liability whatsoever for any inaccuracies in these notations. Bidders and contractors are cautioned to evaluate the requirements of this document based on the entire content irrespective of the marginal notations and relationship to the past previous issue.

Custodians:
Army - AV
Air Force - 99
Navy - AS

Review activities:
Air Force 82
Army - AR, AT, GL,
DLA - CS
Navy - OS, MC

International interest

Preparing activity:
Navy - AS

(Project No. 4730-0365)

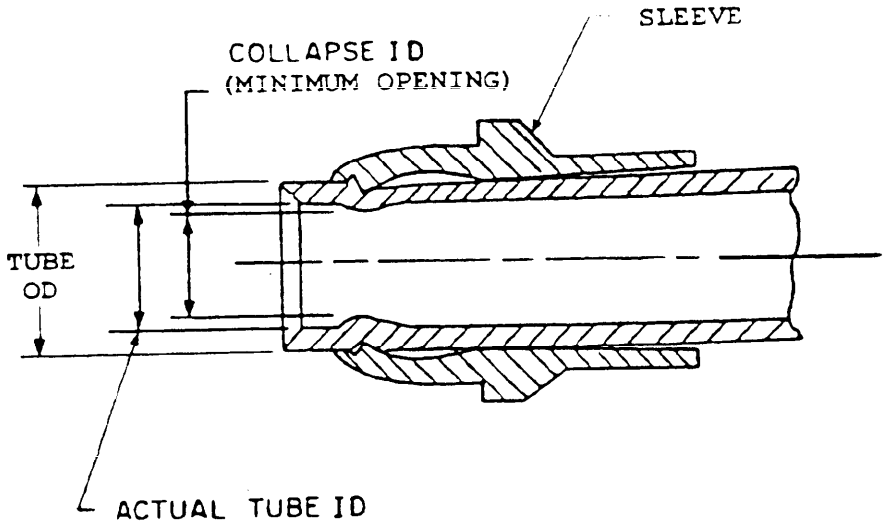
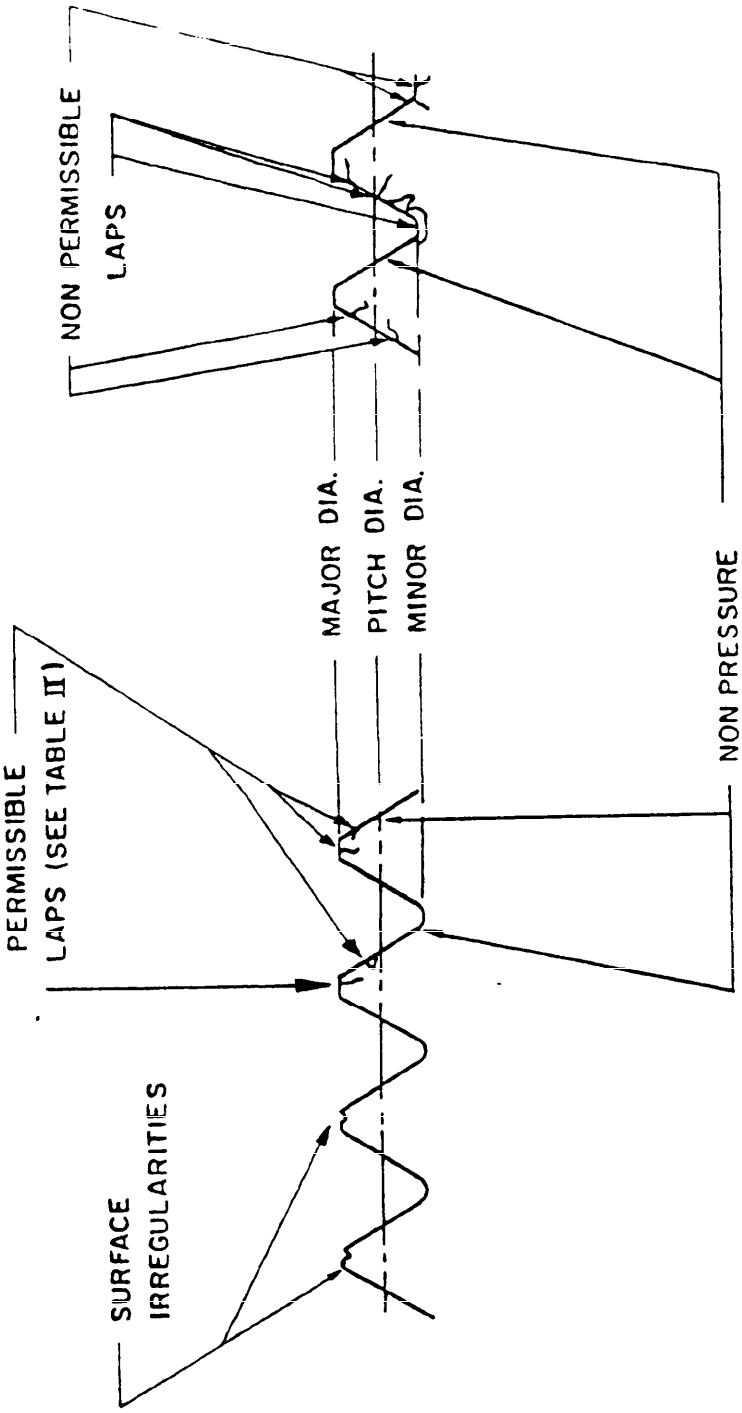


FIGURE 1. Permissible tube collapse.



NOTE:

LAPS NOT EXCEEDING 0.0008 INCH IN DEPT
ARE PERMISSIBLE IN THREAD RUNOUT AREA.

FIGURE 2. Laps and surface irregularities in threads.

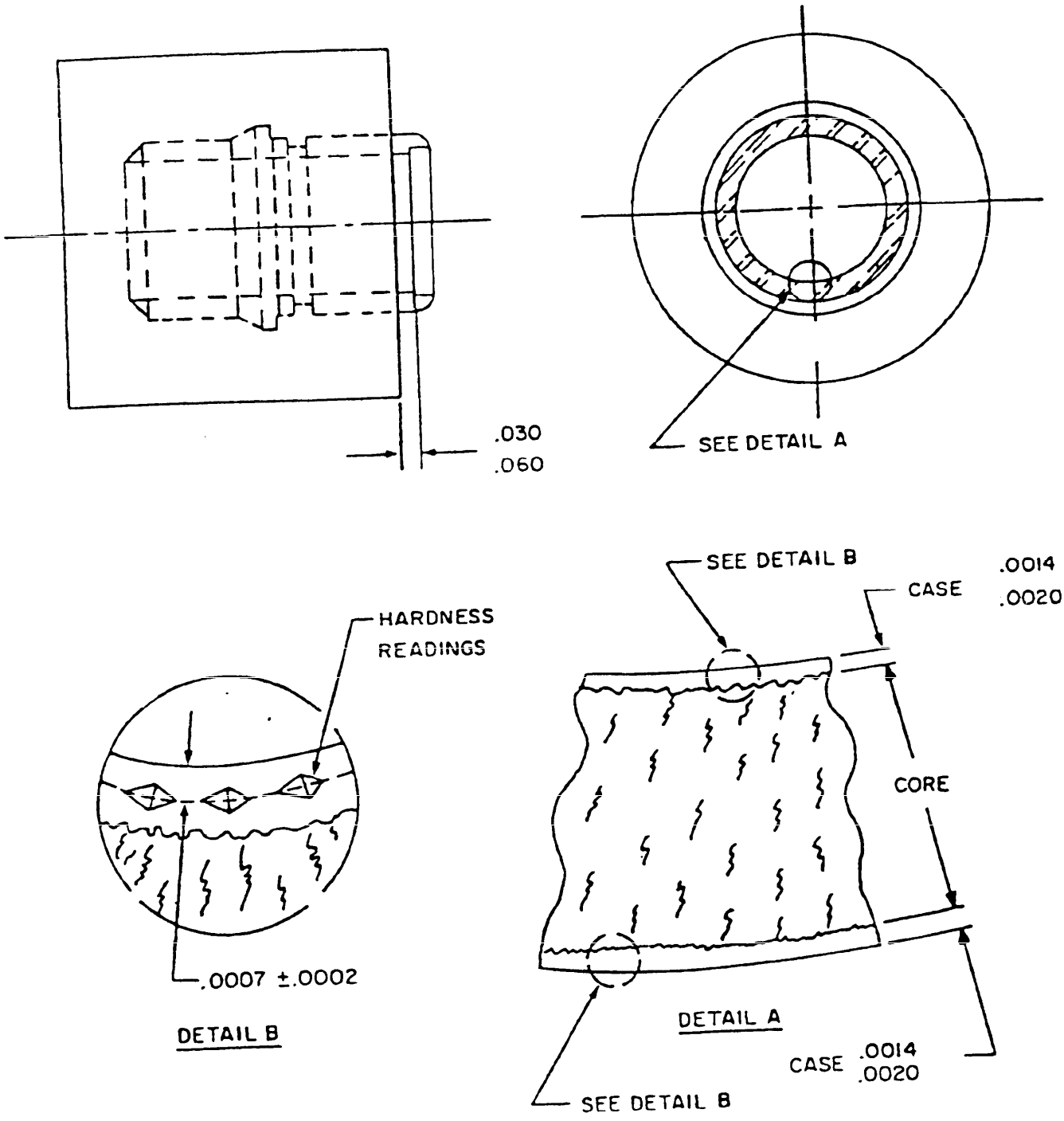


FIGURE 3. Case and core hardness.

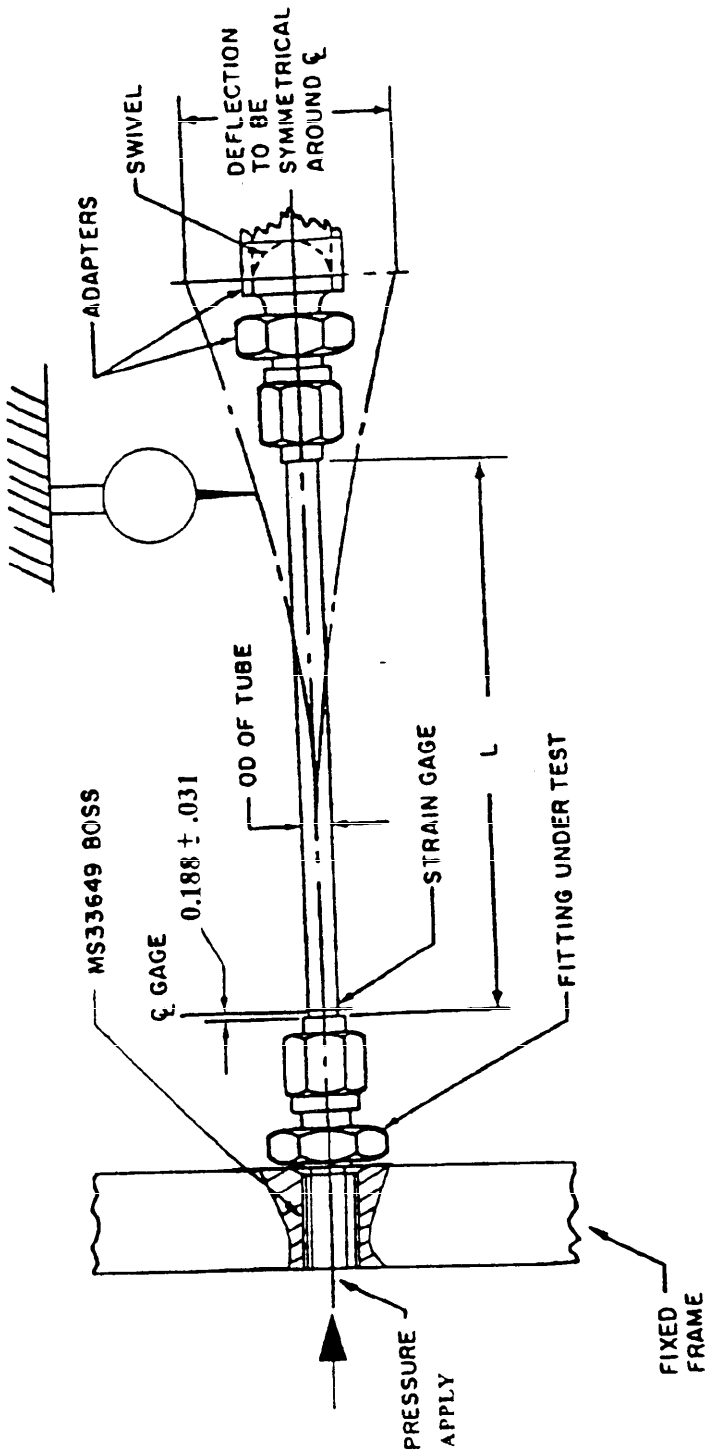


FIGURE 4. Rotary beam method.

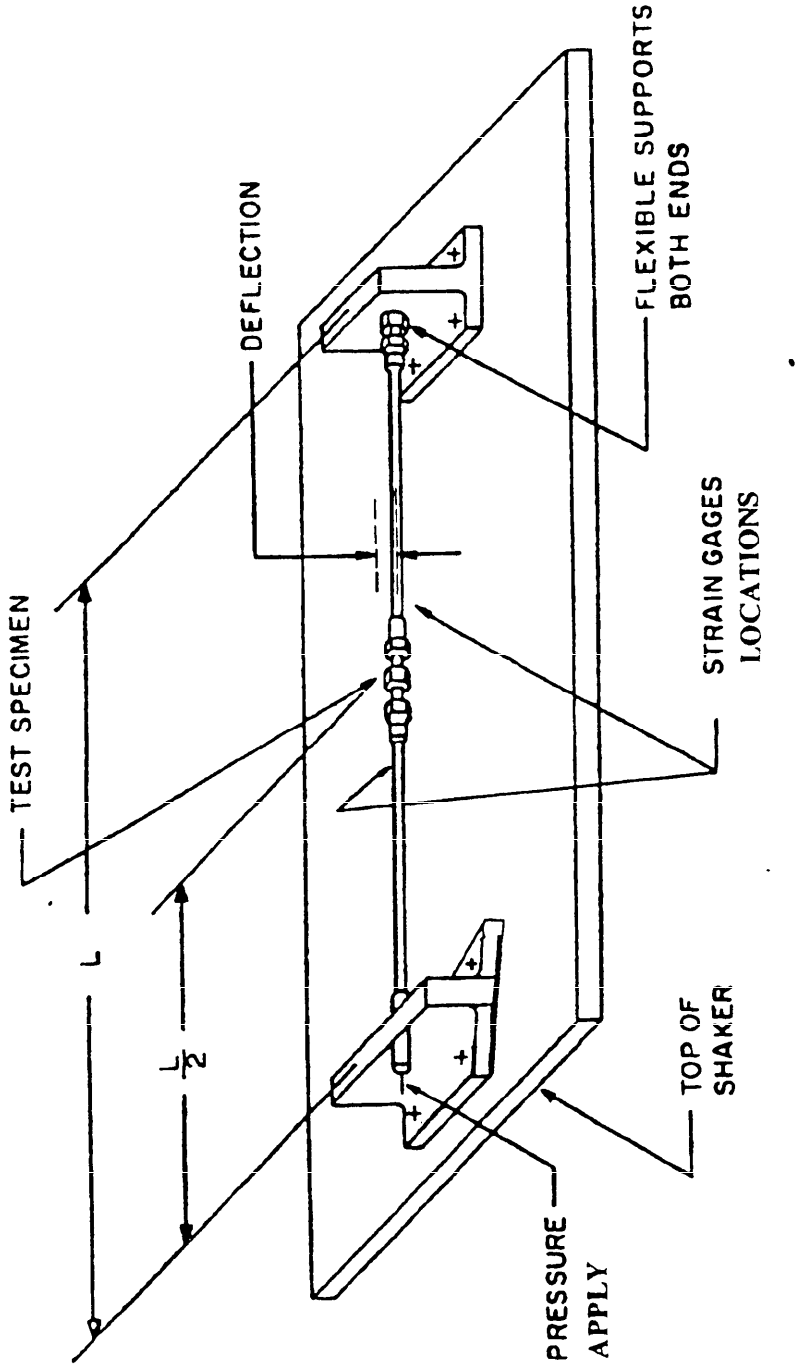
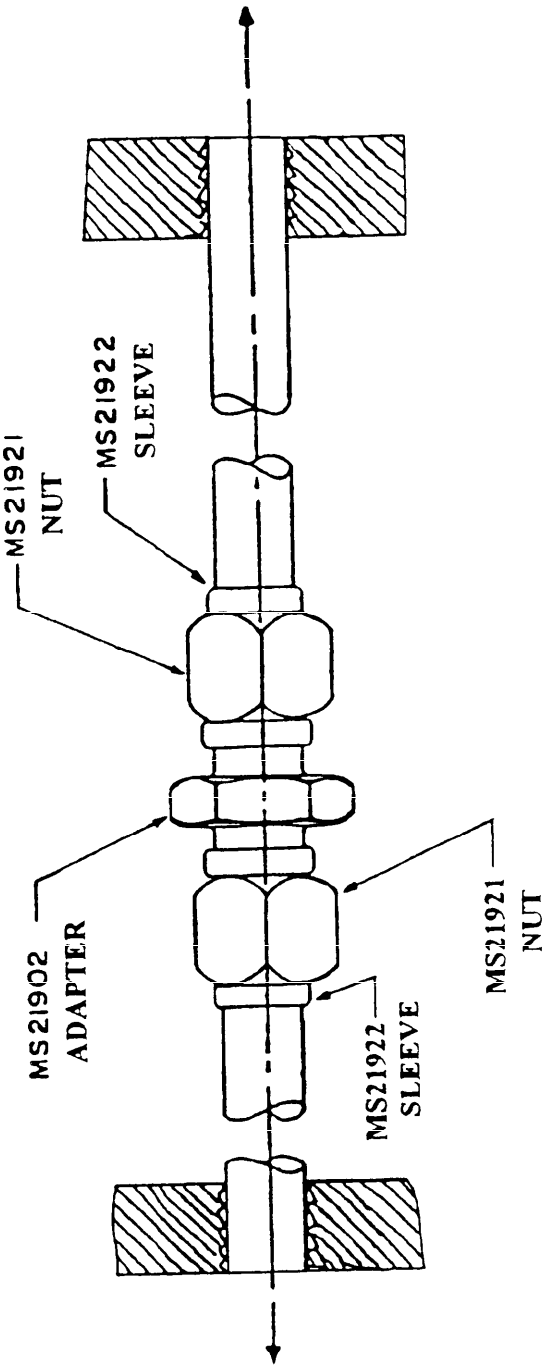


FIGURE 5. Simple beam method.

subjected to the following



Alternate test configurations are allowed, such as attaching fitting to tensile test machine instead of tubing. However test conditions of paragraph 4.6.11 must be met.

FIGURE 6. Joint strength test specimen.

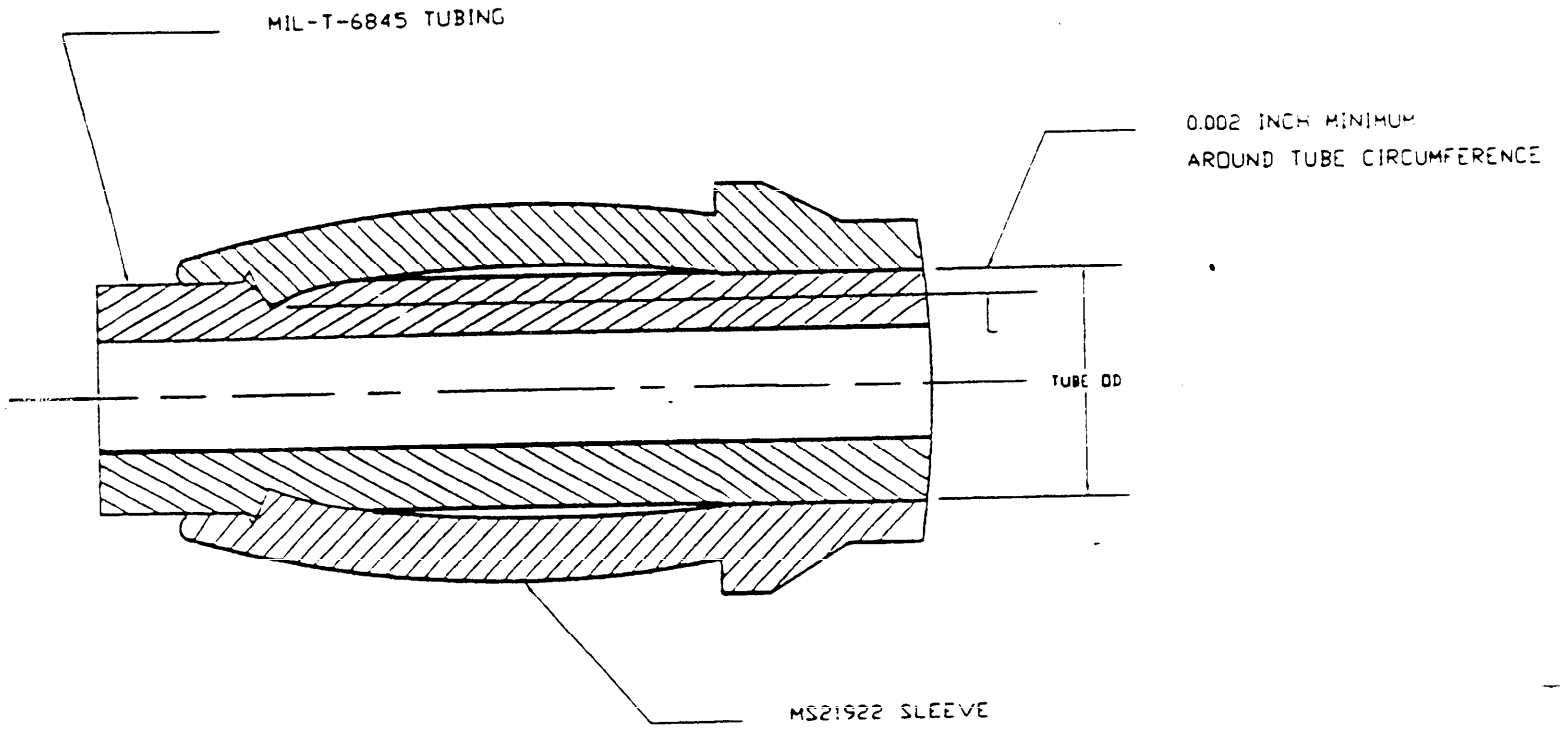


FIGURE 7. Ring cut depth.

STANDARDIZATION DOCUMENT IMPROVEMENT PROPOSAL

INSTRUCTIONS

1. The preparing activity must complete blocks 1, 2, 3, and 8. In block 1, both the document number and revision letter should be given.
2. The submitter of this form must complete blocks 4, 5, 6, and 7.
3. The preparing activity must provide a reply within 30 days from receipt of the form.
   NOTE: This form may not be used to request copies of documents, nor to request waivers, or clarification of requirements on current contracts. Comments submitted on this form do not constitute or imply authorization to waive any portion of the referenced document(s) or to amend contractual requirements.

I RECOMMEND A CHANGE:	1. DOCUMENT NUMBER MIL-F-18280F	2. DOCUMENT DATE (YYMMDD) 950731

3. DOCUMENT TITLE
FITTINGS, FLARELESS, TUBE, FLUID CONNECTION

4. NATURE OF CHANGE (*Identify paragraph number and include proposed rewrite, if possible. Attach extra sheets as needed.*)

5. REASON FOR RECOMMENDATION

6. SUBMITTER

a. NAME (*Last, First, Middle Initial*)	b. ORGANIZATION	
c. ADDRESS (*Include Zip Code*)	d. TELEPHONE (*Include Area Code*) (1) Commercial: (2) DSN: (*If Applicable*)	7. DATE SUBMITTED (YYMMDD)

8. PREPARING ACTIVITY

a. NAME COMMANDER NAVAL AIR WARFARE CENTER AIRCRAFT DIVISION	b. TELEPHONE NUMBER (*Include Area Code*) (1) Commercial: (908) 323-7488 (2) DSN: 624-7488
c. ADDRESS (*Include Zip Code*) CODE 5R3 HIGHWAY 547 LAKEHURST, NJ 08733-5100	IF YOU DO NOT RECEIVE A REPLY WITHIN 45 DAYS, CONTACT Defense Quality and Standardization Office, 5203 Leesburg Pike, Suite 1403, Falls Church, VA 22041-3466 Telephone (703) 756-2340 DSN 289-2340

INCH-POUND

MIL-F-18280F
SUPPLEMENT 1
31 JULY 1995
SUPERSEDING
MIL-F-18280E
SUPPLEMENT 1A
11 May 1987

MILITARY SPECIFICATION

FITTINGS, FLARELESS TUBE, FLUID CONNECTION

This supplement forms a part of MIL-F-18280F, dated 31 JULY 1995.

MS STANDARDS

MS21900	-	Adapter, Flareless Tube to a Flared Tube
MS21902	-	Union, Flareless Tube
MS21904	-	Elbow, Flareless Tube, 90 degrees
MS21905	-	Tee, Flareless Tube
MS21906	-	Cross, Flareless Tube
MS21907	-	Elbow, Bulkhead Universal, 45°, Flareless Tube
MS21908	-	Elbow, Bulkhead Universal, 90°, Flareless Tube
MS21909	-	Tee, Bulkhead and Universal, Flareless Tube
MS21910	-	Tee, Bulkhead, Flareless Tube, Internal Thread on Side
MS21911	-	Tee, Bulkhead, Flareless Tube, Internal Thread on Run
MS21912	-	Tee, Flareless Tube with Bulkhead on Run
MS21913	-	Plug, Flareless Tube
MS21914	-	Cap, Pressure Seal, Flareless Tube Fitting
MS21915	-	Adapter, Straight, Tube to Boss
MS21916	-	Reducer, External Thread, Flareless Tube
MS21921	-	Nut, Sleeve Coupling, Flareless
MS21922	-	Sleeve, Coupling, Flareless
MS21923	-	Adapter, Flareless Tube, Bulkhead and Universal to Flared Tube
MS21924	-	Union, Flareless Tube, Bulkhead and Universal
MS21925	-	Elbow, 90° Universal, Flareless Tube, High Profile
MS21926	-	Elbow, 90° Universal, Flareless Tube, Low Profile
MS21937	-	Nut, Cluster Fitting Retainer
MS21938	-	Bolt, Cluster Fitting, Single Port, Flareless

MS21939	-	Bolt, Cluster Fitting, Single Port, Through, Flareless
MS21940	-	Bolt, Cluster Fitting, Double Port, Flareless
MS21941	-	Bolt, Cluster Fitting, Double Port, Through, Flareless
MS21942	-	Body, Cluster Fitting, One Way, Flareless
MS21943	-	Body, Cluster Fitting, Two Way, 90°, Flareless
MS21944	-	Body, Cluster Fitting, Two Way, 180°, Flareless
MS21945	-	Body, Cluster Fitting, Three Way, Flareless
MS24405	-	Adapter, Flareless Tube to Flared Tube, Precision Type
MS24651	-	Elbow, Tube - 90°, Bulkhead, Flareless Tube, Universal to Flared Tube
MS24652	-	Elbow, Tube - 90°, Bulkhead, Flared Tube, Universal to Flareless Tube
MS24654	-	Elbow, Tube - 45°, Bulkhead, Flareless Tube Universal to Flared Tube
MS33514	-	Fitting End, Standard Dimensions for Flareless Tube Connection and Gasket Seal
MS33515	-	Fitting End, Standard Dimensions for Bulkhead Flareless Tube Connections
MS33566	-	Fittings, Installation of Flareless Tube, Straight-Threaded Connectors
MS33649	-	Bosses, Fluid Connection - Internal Straight Thread

AS STANDARDS (SAE)

SAE-AS1001	-	Tee, Reducer, Bulkhead on Run, Internal Port on Side, Flareless Tube
SAE-AS1002	-	Tee, Reducer, Bulkhead and Internal Port on Run, Flareless Tube
SAE-AS1003	-	Tee, Reducer, Bulkhead on Run, Flareless Tube
SAE-AS1004	-	Elbow, 90°, Reducer, Flareless Tube
SAE-AS1005	-	Tee, Reducer, Flareless Tube
SAE-AS1006	-	Cross, Reducer, Flareless Tube
SAE-AS1007	-	Union, Reducer, Flareless Tube
SAE-AS1008	-	Elbow, 90°, Reducer, Bulkhead, Flareless Tube
SAE-AS1009	-	Tee, Reducer, Bulkhead on Side, Flareless Tube
SAE-AS1010	-	Elbow, 45°, Reducer, Flareless Tube
SAE-AS1376	-	Wrench Pads, Fluid Fitting, Alternate Machined Shapes of, Design Standard For

Preparing Activity:
Navy - AS