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SUPERSEDING
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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 procuring activity (see 6.1 and 6.2).

2. APPLICABLE DOCUMENTS

2.1 Government documents.

2.1.1 Specifications and standards. Unless otherwise specified (see 6.2), the following specifications and standards of the issue listed in that issue of the Department of Defense Index of Specifications and Standards (DoDISS) specified in the solicitation, form a part of this specification to the extent specified herein.

SPECIFICATIONS

FEDERAL

NN-P-530	Plywood, Flat-Panel
QQ-A-225/6	Aluminum Alloy Bar, Rod, and Wire; Rolled, Drawn or Cold Finished, 2024
QQ-A-225/9	Aluminum Alloy Bar, Rod, Wire and Special Shapes, Rolled, Drawn or Cold Finished, 7075
QQ-A-367	Aluminum Alloy, Forgings, Heat Treated
QQ-P-416	Plating, Cadmium (Electrodeposited)

Beneficial comments, (recommendations, additions, deletions) and any pertinent data which may be of use in improving this document should be addressed to the Naval Air Engineering Center, Engineering Specifications and Standards Department (Code 93), Lakehurst, NJ 08733, by using the self-addressed Standardization Document Improvement Proposal (DD Form 1426) appearing at the end of this document or by letter.

SPECIFICATIONS

FEDERAL (cont'd)

QQ-S-763	Steel Bars, Wire, Shapes and Forgings, Corrosion Resisting
PPP-B-566	Boxes, Folding, Paperboard
PPP-B-585	Boxes, Wood, Wirebound
PPP-B-591	Boxes, Fiberboard, Wood-Cleated
PPP-B-601	Boxes, Wood, Cleated-Plywood
PPP-B-621	Boxes, Wood, Nailed and Lock-Corner
PPP-B-636	Box, Fiberboard
PPP-B-665	Boxes, Paperboard, Metal Stayed (Including Stay Material)
PPP-B-676	Boxes, Setup
PPP-C-96	Can, Metal, 28 Gage and Lighter

MILITARY

MIL-P-116	Preservation, Methods of
MIL-P-130	Paper, Wrapping, Laminated and Creped
MIL-S-5002	Surface Treatments and Metallic Coatings for Metal Surfaces of Weapons Systems
MIL-H-5606	Hydraulic Fluid, Petroleum Base, Aircraft, Missile Ordnance
MIL-H-6083	Hydraulic Fluid, Petroleum Base, for Preservation and Testing
MIL-H-6088	Heat Treatment of Aluminum Alloys
MIL-S-6758	Steel, Chrome-Molybdenum (4130) Bars and Reforging Stock (Aircraft Quality)
MIL-T-6845	Tubing; Steel, Corrosion-Resisting (304) Aerospace Vehicle Hydraulic System, 1/8 Hard Condition
MIL-I-6866	Inspection Process, Penetrant, Method of
MIL-I-6868	Inspection Process, Magnetic Particle

SPECIFICATIONS

MILITARY (cont'd)

MIL-A-8625	Anodic Coatings, for Aluminum and Aluminum Alloy
MIL-S-8879	Screw Threads, Controlled Radius Root with Increased Minor Diameter, General Specification for
MIL-L-8937	Lubricant, Solid Film, Heat Cured, Corrosion Inhibiting, NATO Code Number S-1738
MIL-L-10547	Liners, Case and Sheet, Overwrap, Water-Vaporproof, or Waterproof Flexible
MIL-B-13239	Barrier Material, Waterproofed, Flexible All Temperature
MIL-P-17667	Paper, Wrapping, Chemically Neutral (Non-Corrosive)
MIL-H-46170	Hydraulic Fluid, Rust Inhibited, Fire-Resistant, Synthetic Hydrocarbon
MIL-H-83282	Hydraulic Fluid, Fire Resistant, Synthetic Hydrocarbon Base, Aircraft

STANDARDS

FEDERAL

FED-STD-66	Steel: Chemical Composition and Hardenability

MILITARY

MIL-STD-105	Sampling Procedures and Tables for Inspection by Attributes
MIL-STD-129	Marking for Shipment and Storage
MIL-STD-1655	Fittings, Flareless, Classification of Defects of
MS21902	Union, Flareless Tube
MS21908	Elbow, Bulkhead Universal, 90°, Flareless Tube
MS21912	Tee, Flareless Tube with Bulkhead on Run
MS21914	Cap, Pressure Seal, Flareless Tube Fitting
MS21921	Nut, Sleeve Coupling, Flareless

SPECIFICATIONS

MILITARY (cont'd)

MS21922	Sleeve, Coupling Flareless
MS33514	Fitting End, Standard Dimensions for Flareless Tube Connection and Gasket Seal
MS33515	Fitting End, Standard Dimensions for Bulkhead Flareless Tube Connections
MS33649	Bosses, Fluid Connection - Internal Straight Thread

(See Supplement 1A for list of additional applicable flareless fitting standards.)

(Copies of specifications, standards, handbooks, drawings, and publications required by manufacturers in connection with specific acquisition functions should be obtained from the contracting activity or as directed by the contracting officer.)

2.2 Other publications. The following document(s) form a part of this specification to the extent specified herein. Unless otherwise indicated, the issues of the documents which are indicated as DoD adopted shall be the issue listed in the current DoDISS and the supplement thereto, if applicable.

Uniform Classification Committee

Uniform Freight Classification Rules

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

Society of Automotive Engineers

AMS2241	Tolerances - Corrosion and Heat Resistant Steel, Iron Alloy, Titanium and Titanium Alloy Bars and Wire
AMS2486	Conversion Coating of Titanium Alloys, Fluoride Phosphate Type
AMS4928	Titanium Alloy Bars and Forgings, 6Al-4V, Annealed, 120,000 psi (827MPa) Yield
ARP603	Impulse Testing of Hydraulic Hose Assemblies, Tubing and Fittings

Society of Automotive Engineers (cont'd)

ARP891	Determination of Aluminum Alloy Tempers through Electrical Conductivity Measurement (Eddy Current)
AS1376	Wrench Pads for Fluid Fittings Machined from Alternate Shapes of Material

(Copies of SAE publications may be obtained from the Society of Automotive Engineers, Inc., 400 Commonwealth Drive, Warrendale, PA 15098.)

American Society for Testing and Materials

A108	Steel Bars, Carbon, Cold-Finished, Standard Quality Specification For
A576	Special Quality Hot-Rolled Carbon Steel Bars

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

American National Standards Insitute, Inc.

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

(Copies of the above publication may be obtained from the American National Standards Insitute, Inc., 1430 Broadway, New York, NY 10018.)

National Aerospace Standards Committee

NAS1760	Fitting End, Flareless Acorn, Standard Dimensions for

(Copies of the above publication may be obtained from Aerospace Industries Association of America, 1725 DeSales Street, N.W., Washington, DC 20036.)

(When requesting applicable documents, refer to both title and number. Copies of unclassified documents may be obtained from the Commanding Officer, Naval Publications and Forms Center, 5801 Tabor Avenue, Philadelphia, PA 19120. Requests for copies of classified documents should be addressed to the Naval Publications and Forms Center, via the cognizant Government representative.)

3. REQUIREMENTS

3.1 Qualification. The fittings, nuts and sleeves furnished under this specification shall be products which have been qualified for listing on the applicable Qualified Products List at the time set for opening of bids (see 4.4 and 6.3). 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(a)(1)). 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 agency 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.

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

3.2.1 Steel. All carbon steel used in these fittings, nuts or sleeves shall be made by the open-hearth or eletric-furnace process.

3.2.1.1 Bar stock. Bar stock for MS21921 nuts from 1137/1141 steel shall not have laps, surface cracks or other gross defects exceeding 0.010 inch deep detectable by magnetic particle inspection per MIL-I-6868. Surface imperfections due to tool or die marks of 0.010 inch or less are acceptable.

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 nut shall meet the electrical conductivity and hardness requirements of ARP891.

3.2.2.2 Steel. Mechanical properties of carbon steel and corrosion-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. Carbon steel fittings and nuts shall have a hardness of Rockwell B92 to C31. Corrosion-resistant steel fittings and nuts shall have a hardness of Rockwell B80 minimum (see 4.7.9).

3.2.2.2.2 Sleeves (carbon steel). Carbon steel sleeves shall be heat-treated to exhibit the following metallurgical properties (see 4.7.5.1).

a. Mean case depth of 0.0014 to 0.0020 inch. The mean is the average thickness of the case. When measuring the case thickness, random fissure like faults in the hardened case shall not be considered.

b. Case hardness of 576-754 Knoop hardness number (KHN).

c. Core hardess of 208-245 KHN.

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	1/ FORGINGS	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	3/ AMS4928 (6AL4V Annealed)	T
	SHAPE FITTINGS	BARS AND FORGINGS		
CARBON STEEL	STRAIGHT FITTINGS AND NUTS	BARS AND RODS	ASTM A108 (1137) ASTM A108 (1141) ASTM A576 (1137) ASTM A576 (1141) MIL-S-6758 (4130)	NONE
	SHAPE FITTINGS	BARS	MIL-S-6758 (4130)	NONE
		FORGINGS	MIL-S-6758 (4130)	F
	SLEEVES	BARS	ASTM A108 (1213), (12L14) & (1215) ASTM A576 (1213)	NONE
CORROSION RESISTANT STEEL	STRAIGHT FITTINGS AND NUTS	BARS	QQ-S-763, Class 304	J
			QQ-S-763, Class 316	K
			QQ-S-763, Class 347	S
	SHAPE FITTINGS	BARS AND FORGINGS	QQ-S-763, Class 304	J
			QQ-S-763, Class 316	K
			QQ-S-763, Class 347	S

1/ USE OF FORGINGS FOR NUTS IN SIZES SMALLER THAN -24 IS PROHIBITED.

2/ SUBSTITUTION OF PLATE MATERIAL FOR BARS, RODS AND FORGINGS FOR A SPECIFIC APPLICATION SHALL BE SUBJECT TO THE APPROVAL OF THE INDIVIDUAL PROCURING ACTIVITY. MACHINED SHAPES SHALL CONFORM WITH AS1376, IF APPLICABLE.

3/ TITANIUM HEX BAR SHALL BE COLD FINISHED WITH TOLERANCES PER AMS2241.

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 Forgings. Parting planes shall be free of tears and crack-like defect indications. Surface defects may be explored as specified under 3.7.

NOTE: 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 drawing minimum. The finish in the ground parting plane area shall not exceed 125 micro inches arithmetical average (R_a) as defined in ANSI 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 standard.

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 0.015 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 Cross-section at fluid path junctions. On angle fittings, the cross-sectional area at the junction of the fluid passages shall not be smaller than the cross-sectional area of the smaller passage.

3.3.1.3 Wall thickness. Except as otherwise specified on the applicable MS 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 carbon steel, CRES and titanium alloy shall be produced by roll forming, machining by single point method or grinding. External threads on aluminum alloy parts shall be produced by die cutting or machining by the single point method.

3.3.2.1 External threads (if rolled). The grain flows in rolled threads shall be continuous and shall follow the general thread contour, with the maximum density at the thread root (See Figure 2A). 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 (see Figure 2B). 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 thread root, or on the non-pressure thread flank in the area between the thread root and pitch diameter. Stress cracks are unacceptable.

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

Fitting size	Depth (inch) (Max.)
-2	0.006
-3	.006
-4	.007
-5	.007
-6	.008
-8	.009
-10 thru -32	.010

3.4 Finish.

3.4.1 Aluminum-alloy fittings and nuts. Aluminum-alloy fittings and nuts (2014, 2024) shall be anodized in accordance with MIL-A-8625, Type II, Class 1, dichromate sealed. Aluminum-alloy fittings and nuts (7075) shall be anodized in accordance wtih MIL-A-8625, Type II, Class 2, dye brown (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, powder coatings, discontinuities such as scratches or breaks and shall be uniform in appearance. Racking marks shall not be on seal areas, threads or on areas exposed to the atmosphere.

3.4.2 Carbon steel fittings. Carbon steel fittings and nuts shall be cadmium plated in accordance with QQ-P-416, Type II, Class 2. Carbon steel sleeves shall be cadmium plated 0.00030 inch minimum to 0.00050 inch maximum, accordance with QQ-P-416, Type II. All carbon steel fittings, except sleeves, shall be dipped in oil conforming to MIL-H-6083 or MIL-H-46170. Fluid passage holes, other openings and internal threads shall not be subject to a plating thickness requirements and may exhibit bare areas, provided they are protected by a light film of oil.

3.4.3 Corrosion-resistant steel fittings and nuts. Corrosion-resistant steel fittings and nuts shall be surface treated in accordance with MIL-S-5002. The inside only of sizes 16 thru 32 nuts shall be coated with dry film lubricant per MIL-L-8937. 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 AMS2486.

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 (see 4.7.1).

3.5.1 MS standard symbol and manufacturer's trademark. Unless otherwise specified, 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 forgings shall be marked with the forging manufacturer's trademark, code number or letter to identify forging source.

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 "S" if made from Class 347 corrosion-resistant steel. All 7075-T73 aluminum alloy parts shall be marked with the letter "W". The letter "D" on all aluminum alloy parts is optional. Titanium alloy parts shall be marked with the letter "T" (see Table I material code). Carbon steel forgings made from 4130 shall be marked with the letter "F".

3.5.3 Marking for part number and size. A numerical equivalent to the dash number indicating size is optional. All fittings and nuts larger than 3/8 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.

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 fittings, nuts and sleeves: No artificial dye; however, parts must be yellow in color as a result of the chromate postplate treatment (see 3.4.2).

Corrosion-resistant steel: Natural finish

Aluminum alloy 2014 and 2024: No artificial dye; however, parts must be yellow in color as a result of the dichromate sealer (see 3.4.1). Aluminum alloy 7075 fittings and nuts shall be dyed brown.

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

3.6 Performance. The fitting, nut and sleeve, when assembled to tubing specified in Table III, and tested in accordance with applicable procedures specified in Section 4, shall be capable of the performance specified in 3.6.1, 3.6.2, 3.6.3, 3.6.4, 3.6.5 and 3.6.6.

3.6.1 Burst pressure. Burst pressure shall be as shown in Table III. The fittings shall withstand burst pressure without leakage or failure (see 4.7.4).

3.6.2 Impulse. Fittings of all materials shall be capable of 200,000 impulse cycles without leakage or failure (see 4.7.3).

3.6.3 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 in accordance with 4.7.6. Samples that fail external to the sleeve due only to a tube defect may be replaced with a new sample.

TABLE III. Fittings, Tube Material, Pressures and Stresses.

Stainless-steel tube (MIL-T-6845) 1/8 hard						
Tube OD (in.)	Dash Size	Tube wall thickness (in.)	For use with carbon steel, stainless steel and titanium fittings and nuts, and only carbon steel sleeves		For use with aluminum-alloy fittings and nuts - 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
1/8	-2	0.012	3,000	30,000	3,000	14,000
3/16	-3	.016	3,000	30,000	3,000	14,000
1/4	-4	.020	3,000	30,000	3,000	14,000
5/16	-5	.020	3,000	30,000	3,000	14,000
3/8	-6	.028	3,000	30,000	3,000	14,000
1/2	-8	.035	3,000	30,000	3,000	14,000
5/8	-10	.042	3,000	30,000	3,000	14,000
3/4	-12	.058	3,000	25,000	3,000	14,000
1	-16	.065	3,000	25,000	1,500	13,000
1-1/4	-20	.049	1,500	25,000	1,500	13,000
1-1/2	-24	.065	1,500	25,000	1,500	13,000
2	-32	.065	1,500	25,000	1,500	13,000

1/ Qualification of one alloy (CRES 304, 316 or 347) constitutes qualification of the other CRES alloys.

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

3.6.4 Repeated assembly. Fittings of all materials shall be capable of eight repeated assemblies, at both the minimum and maximum torque values, without leakage or indication of failure of the nut, sleeve or fitting (see 4.7.7).

3.6.4.1 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 (see 4.7.7.1 and Figure 1).

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

Tube Size	Specification MIL-T-6845
2	0.070
3	.110
4	.165
5	.225
6	.290
8	.400
10	.485
12	.610
16	.840
20	1.048
24	1.330
32	1.780

3.6.5 Pneumatic test. The fittings shall withstand pneumatic working or system pressure without leakage or failure (see 4.7.11).

3.6.6 Joint strength. Flareless tube fitting assemblies shall be tensile tested per 4.7.12. The assemblies shall withstand, as a minimum, the loads as specified in Table V without slippage of the sleeve on the tubing or cracking of the sleeve. Sleeve failure shall not be attributed to other assembly components. Fitting assemblies shall be per Figure 6, carbon steel on MIL-T-6845 tubing. Joint strength test qualification and quality conformance tests are not required for -24 and -32 size sleeves.

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
Lbs.	400	800	1500	1800	2500	4200	6200	8800	10000	9500

3.7 Workmanship. Machined surfaces of fittings, nuts and sleeves, shall be free from burrs, longitudinal or spiral tool marks. Unless a finer finish is specified on applicable drawings, sealing surfaces shall be smooth, except that annular tool marks up to 100 microinches arithmetical average (R_a), as defined in ANSI B46.1, will be acceptable. All other machined surfaces shall not exceed 125 Ra. Unmachined surfaces, such as forging surfaces and bar stock flats, shall be free from blisters, fins, folds, seams, laps, cracks, segregations, spongy areas and except for forging parting lines, shall not exceed 250 Ra. Surface defects may be explored by suitable etching and if they can be removed so that they do not appear on re-etching and the required section thickness can be maintained, they shall not be cause for rejection.

4. QUALITY ASSURANCE PROVISIONS

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

4.2 Lot. A lot shall consist of all parts of a given part number made from the same batch of material and processed at the same time.

4.2.1 Record maintenance. The supplier shall maintain a record of inspections applied to each lot.

4.2.2 Material certification. Records of chemical composition analysis, magnetic particle inspection (3.2.1.1), 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 procuring activity for each lot of fittings.

4.3 Classification of inspections. The inspection and testing of flareless fittings, nuts and sleeves shall be classified as follows:

a. Qualification Inspection (4.4)

(1) Retention. 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 designation; 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 6.3).

b. Quality Conformance Inspection (4.5)

4.4 Qualification inspection.

4.4.1 Sampling instructions. Qualification inspection samples shall consist of the parts specified in Table VI, 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.

4.4.2 Tests. Qualification inspection shall consist of the following requirements and tests, as applicable, and as specified in sections 3 and 4.

(a)	All quality conformance inspection	(4.5.2)
(b)	Burst pressure	(3.6.1, 4.7.4)
(c)	Repeated assembly	(3.6.4, 4.7.7)
(d)	Flexural strength	(3.6.3, 4.7.6)
(e)	Impulse	(3.6.2, 4.7.3)
(f)	Grain flow	(3.3.2.1, 4.7.10)
(g)	Pneumatic Test	(3.6.5, 4.7.11)
(h)	Joint Strength Test (Sleeves only)	(3.6.6, 4.7.12)

4.5 Quality conformance inspection.

4.5.1 Sampling.

4.5.1.1 Non-destructive tests. Sampling for material, threads, finish, dimensions, marking, surface defects and workmanship shall be at random in accordance with MIL-STD-105 at an Acceptable Quality Level (AQL) of 4.0 percent unless otherwise specified in MIL-STD-1655.

4.5.1.2 Destructive tests. Sampling for tests specified in (d), (e), (g) and (h) of 4.5.2 shall be performed in accordance with MIL-STD-105, Inspection Level S-1, acceptance number zero.

4.5.2 Inspection. Each individual lot of fittings, nuts and sleeves shall conform to the following requirements and be subjected to the following examination and tests, as applicable, and as specified in sections 3 and 4:

(a)	Examination of product	(4.7.1)
(b)	Chemical composition	(3.2, 4.2.2)
(c)	Physical properties	(3.2.2, 4.2.2)
(d)	Metallurgical properties (sleeve only)	(3.2.2.2.2, 4.7.5)
(e)	Hardness	(3.2.2.2, 4.7.9)
(f)	Joint Strength Test* (sleeves only)	(3.6.6, 4.7.12)
(g)	Grain flow	(3.3.2.1, 4.7.10)
(h)	Electrical conductivity (aluminum alloy only)	(3.2.2.1.1)
(i)	Parting planes in aluminum forgings	(3.2.3, 4.7.13)
(j)	Bar stock magnetic particle inspection (MS21921 nuts only)	(3.2.1.1, 4.2.2)

*NOTE: 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 carbon steel straight fittings per Figure 6. Six sleeves shall be tested.

4.6 Rejection and retest. Rejected lots shall be resubmitted for retest and acceptance in accordance with MIL-STD-105. 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.

4.6.1 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 immediately by telephone or message within 24 hours. Full particulars concerning action taken to correct the defects shall be submitted to the procuring agency in a written test report conforming to DI-R-5299A (see 6.2.1.). The lot represented by the unsatisfactory sample shall not be resubmitted until approval of resubmission has been issued by the procuring agency.

4.7 Inspections methods.

4.7.1 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, threads, wall thickness, surface defects, finish, marking and workmanship (see 3.2, 3.3, 3.4, 3.5 and 3.7).

4.7.2 General testing practice.

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

4.7.2.2 Tube preparation. Tubes shall be cut square within 1/2 degree 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.

4.7.2.3 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 VII, past the point of ring grip.

4.7.2.4 Fitting assembly. After presetting the sleeves as specified in 4.7.2.3, the nut shall be completely disengaged and then tightened to the minimum or maximum torque values, as applicable, in accordance with Table VIII.

4.7.2.5 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.

4.7.2.6 Proof pressure. Proof pressure shall be twice the working pressure specified in Table III.

4.7.2.7 Burst pressure. Burst pressure shall be four times the working pressure specified in Table III.

4.7.2.8 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.

TABLE VI. Qualification test samples. 1/

QUANTITY (EACH) 1/ 2/ 6/	FITTING PART NO.	MATERIAL	APPLICATION TEST
4	MS21908 MS21912	4/	Burst (see 3.6.1 & 4.7.4)
3	MS21908 MS21912	4/	Impulse (see 3.6.2 & 4.7.3)
6	MS21902 MS21921 MS21922	4/	Flexural strength (see 3.6.3 & 4.7.6)
6	MS21902	4/	Repeated assembly (see 3.6.4 & 4.7.7)
6	MS21902	3/	Grain flow (rolled threads) (see 3.3.2.1 & 4.7.10)
3	MS21922		Metallurgical properties (see 3.2.2.2.2 & 4.7.5)
3	MS21902	1/	Pneumatic test (see 3.6.5, 4.7.11)
6	MS21922	5/	Joint strength test (see 3.6.6 & 4.7.12)
6/	6/		Quality conformance tests (a), (b), (c) and (e) of 4.5.2 (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 forgings or bar stock, both forms of the material may be qualified, if desired.

3/ Carbon steel and all corrosion-resistant steels in sizes -2 to -16, inclusive.

4/ All materials as applicable (2014, 2024 and 7075 aluminum alloys) (class 316, 304, 347 corrosion-resistant steel (CRES)) (any allowable carbon steel) (AMS 4928 6AL-4V annealed titanium). Qualification test reports must identify the material used and the form used.

5/ To be tested with three straight carbon steel 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 the specified quality conformance inspection (a), (b), (c) and (f) of 4.5.2. Sleeves, however, shall not have been subjected to test (f).

TABLE VII. Preset - Tube Tightening Limits

Tube OD (In.)	1/8 Hard Corrosion Resistant Steel Tubing	
	Wall Thickness (In.)	Number of Turns 1/
1/8	0.012	1-1/6
3/16	.016	1-1/6
1/4	.020	1-1/6
5/16	.020	1-1/6
3/8	.028	1-1/6
1/2	.035	1-1/6
5/8	.042	1-1/6
3/4	.058	1
1	.065	1
1-1/4	.049	1
1-1/2	.058	1
2	.065	1

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

TABLE VIII. Torque values.

Size	Torque (Inch-Pounds)	
	Minimum	Maximum
-2	75	85
-3	95	105
-4	135	145
-5	170	190
-6	215	245
-8	470	510
-10	620	680
-12	855	945
-16	1140	1260
-20	1520	1680
-24	1900	2100
-32	2660	2940

4.7.3 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.

4.7.3.1 Impulse test. The assembly shall first be tested at proof pressure for 5 minutes. All impulse testing shall be performed in accordance with ARP 603, 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.

4.7.4 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 in 4.7.2.7, 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 pressured to burst, but they must be capable of withstanding four times nominal system operating pressure.

4.7.5 Metallurgical properties (sleeves only). Samples as required shall be subjected to the tests specified in 4.7.5.1 as applicable.

4.7.5.1 Carbon steel sleeves. Carbon steel sleeves, mounted as indicated on Figure 3, shall exhibit the metallurgical properties specified in 3.2.2.2.2, and as determined by the following methods:

a. Case depth: The case depth determination shall consist of microscopic measurement of the case depth on a polished and etched cross section of the sleeve. A minimum of five measurements shall 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 shall be taken perpendicular to the axis of the sleeve 0.03 to 0.06 inch back of the cutting edge, as illustrated on Figure 3.

b. Case hardness: The case hardness shall be measured at a point 0.0007 ±.0002 inch in depth below the surface of the sleeve material and within the same area defined in (a) above, as illustrated on Figure 3. The measurement shall be made with a Tukon hardness tester, using a Knoop indenter and a 100-gram load. A minimum of four readings shall be taken, with two on the inner case (ID) and two on the outer case (OD).

c. Core hardness: Core hardness shall be measured at a minimum of three places on the same samples used for core hardness and with the same equipment, except that the load shall be 500 grams.

4.7.6 Flexural strength. The flexural test may be performed in one of several ways. Any method may be used 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 3/16 ±1/32 inch from the tail of sleeve. The axial tensile stress due to internal pressure may be measured with the strain gages or calculated and added to the bending stress. If calculated, the following formula for axial tensile stress must be used.

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

where S_a = axial tensile stress due to internal pressure.

$\frac{Pd^2}{D^2-d^2}$ = axial 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 prior failure or leakage occurs. For purposes of stress calculations, the modulus of elasticity for MIL-T-6845 tubing will 28,000,000 psi.

4.7.6.1 Rotary beam method. Figure 4 shows one method wherein 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.

TABLE X. 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)

$$\frac{FLC}{I} = \text{Stress caused by bending}$$

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 4.7.6)

4.7.6.2 Cantilever beam method. Another method of obtaining the desired stress level of Table III may be accomplished by mounting a cantilever tube with fittings on a shaker table. The test fitting must 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 may be measured with the strain gage or calculated (see 4.7.7) and added to the bending stress. The tentative length, L, of the tubing may be calculated from the following formula:

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

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

D = displacement 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

The above formula was derived by combining the following formula:

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

$$D = 1/3\ \frac{FL^3}{EI}$$

4.7.6.3 Simple beam method. Figure 5 shows another method, wherein 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.

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

in which L = total length in inches

D = 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 4.7.6).

4.7.7 Repeated assembly.

4.7.7.1 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 VIII. 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 is not 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 (see 3.6.4.1) after the seventh repeated assembly. After the eighth operation, the MS21902 fitting assembly shall be subjected to the burst pressure test (see 3.6.1 and 4.7.4).

4.7.7.2 Maximum tightening. Three samples shall be tested. The test specified in 4.7.7.1 shall be performed, using new assemblies, with the maximum torque values specified in Table VIII.

4.7.8 Electrical conductivity. Aluminum alloy fittings and nuts shall be tested in accordance with ARP 891.

4.7.9 Hardness. Hardness reading shall be taken on a smooth flat surface of any unthreaded portion of the fitting or nut. Carbon steel fittings and nuts shall have the plating removed before taking hardness readings (see 3.2.2.2.1). Hardness of sleeves shall be taken in the location specified in 4.7.5.1.

4.7.10 Grain flow in threads. Grain flow in rolled threads shall be determined by macro examination of suitably 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 adequately.

4.7.11 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 4.7.2.1. When submerged in water, no leakage in the form of bubbles, shall be permitted.

4.7.12 Joint strength test. 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 (for qualification and quality conformance testing of MS21922 sleeves only). The test samples shall be torqued to minimum torque of Table VIII.

4.7.13 Parting planes in aluminum forgings. The flash lines shall be visually inspected for cracklike defects. Questionable or suspect type defects shall be subject to penetrant inspection per MIL-I-6866.

4.8 Packaging, packing and marking. Preparation for delivery shall be examined for conformance to Section 5 and 4.8.1.

4.8.1 Sampling. Sampling shall be performed in accordance with MIL-STD-1655, Inspection level S-3 and acceptable quality level (AQL) of 4.0 percent defective. Classification of defects shall be as shown in Table XI.

TABLE XI. Classification of Defects for Preparation for Delivery

Item	Defects
Exterior and interior markings	Missing, incorrect, incomplete, illegible, of improper size, location, sequence or method of application
Materials	Any nonconforming component; component missing, damaged, or otherwise defective
Workmanship	Inadequate assembly of components
Exterior and interior weight or content	Number per container is more or less than stipulated; gross or net weight exceeds the requirement

5. PACKAGING

5.1 Cleaning and preservation.

5.1.1 Cleaning. Before packaging, all parts shall be free from grease, oil, dirt or any other foreign matter, except as noted in 5.1.2.

5.1.2 Preservation. No preservative compound shall be applied to the fittings, except that cadmium-plated steel parts (except sleeves) shall be dipped in oil as specified in 3.4.2.

5.2 Preservation-Packaging. Packaging shall be level A or level C, as specified (see 6.2).

5.2.1 Level A.

5.2.1.1 Fitting unit containers. All fittings except nuts, sleeves and caps shall be unit packaged in accordance with Method IC-1 or MIL-P116, except as modified herein. The quantity per unit package shall be one. After bagging, fittings greater than 3-1/2 inches in any dimension shall be individually overpacked in cartons conforming to PPP-B-636, PPP-B-566, PPP-B-676 or PPP-B-665. If it is necessary to wrap the fittings prior to inserting in bags to prevent damage, fittings shall be wrapped with barrier materials in accordance with Method IC of MIL-P-116.

5.2.1.2 Alternate unit protection. Five fittings of one type and size, up to and including 1-1/2 inches in any dimension, may be packaged in perforated tear-apart cartons in accordance with Method III of MIL-P-116. Each carton shall have interior separations capable of supporting and separating each individual fitting in such manner as to prevent movement or contact of the fittings with each other. All surfaces of the carton coming in direct contact with the item shall be coated with a neutral barrier capable of withstanding slight abrasion. Fittings over 1-1/2 inches shall be packaged individually in accordance with 5.2.1.1.

5.2.1.3 Nuts, sleeves and caps, unit containers. Nuts, sleeves and caps of one type and size shall be unit packaged in accordance with Method IC-1 of MIL-P-116 or in friction-top hermetically sealed cans conforming to PPP-C-96. The quantity per unit container shall be as specified in Table XII. If it is necessary to wrap the nuts, sleeves and caps prior to inserting in bags to prevent damage, they shall be wrapped with barrier material in accordance with Method IC of MIL-P-116.

TABLE XII. Quantity per Unit Container.

Size (inches)	Number
1/8 to 1/2	25
5/8 to 1-1/4	10
1-1/2 to 3	5
over 3	1

5.2.1.4 Fitting intermediate containers. Unit packages shall be packed in intermediate containers conforming to PPP-B-636, class weather-resistant, style optional. The quantity of unit packages per intermediate container shall be as specified in Table XIII except that intermediate containers are not required for fittings individually packed in unit cartons in accordance with 5.2.1.1.

TABLE XIII. Quantity of Packages.

Size (inches)	Quantity of unit packages per intermediate container	Quantity of tear-apart cartons per intermediate container
1/8 through 1/4	100	20
5/16 through 1/2	25	10
5/8 through 1	10	5
1-1/4 & Over	5	1

5.2.2 Level C. All fittings shall be individually packaged. Nuts, sleeves and caps shall be packaged as necessary to prevent damage or deterioration during shipment. Fittings, nuts, sleeves and caps shall be cleaned and preserved as specified in 5.1.

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

5.3.1 Level A. All fittings, packaged as specified herein, shall be packed in snug fitting, overseas type, style optional, Grade B, shipping containers conforming to PPP-B-601 or PPP-B-621. Closure and strapping shall be in accordance with the box specification.

5.3.2 Level B. All fittings, packaged as specified herein, shall be packed as specified for Level A except domestic containers may be used, or packed in Class weather-resistant, style optional shipping containers conforming to PPP-B-636. Closure and strapping shall be in accordance with the box specification.

5.3.3 Level C. Fittings, packaged as specified herein, shall be overpacked in shipping containers in a manner that will assure acceptance by the carrier and safe delivery to the initial receiving activity.

5.4 Marking. In addition to any special marking required by the contract, each section of the tear apart container, unit package, intermediate container and shipping container shall be marked in accordance with the requirements of MIL-STD-129.

6. NOTES.

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 XIV 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 XIV. Pressure and Temperature Rating for Fittings

TUBE OD (NOM) SIZE	ALUMINUM ALLOY		CARBON STEEL		CORROSION RESISTANT STEEL		TITANIUM ALLOY 6AL4V	
	PRESSURE	TEMP.	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 +275°F	3000 psi	-65° to +450°F
-16	1500 psi		3000 psi		3000 psi		3000 psi	
-20 through -32 incl.	1500 psi		1500 psi		1500 psi		1500 psi	

6.2 Ordering data. Contracts or orders should specify the following:

a. Title, number and date of this specification.

b. Part No. required (see 1.2 and 3.3).

c. Applicable levels of preservation, packaging, and packing (see 5.2 and 5.3).

d. For shape fitting, if fitting shall be manufactured from a forging or machined from bar stock.

6.2.1 Contract data requirements. Items of deliverable data required by this specification are cited in the following paragraph.

Paragraph	Data Requirement	Applicable DID
4.6.1	Report of failure of Sampling Test	DI-R-5299A

Such data will be delivered as described on approved (numbered) DID's (Data Item Description/DD Form 1664) when specified on DD Form 1423 (Contract Data Requirements List) and incorporated into the applicable contract.

6.3 Qualification. With respect to products requiring qualification, awards will be made only for products which are at the time set for opening of bids, qualified for inclusion in the applicable Qualified Products List whether or not such products have actually been so listed by that date. The attention of the contractors is called to this requirement, and manufacturers are urged to arrange to have the products that they propose to offer to the Federal Government tested for qualification, in order that they may be eligible to be awarded contracts or orders for the products covered by this specification. The activity responsible for the Qualified Products List is the Naval Air Systems Command (AIR-530312), Department of the Navy, Washington, DC 20360; however, information pertaining to qualification of products such as test reports, test fees and test samples may be obtained from the Commander, Naval Air Development Center (60611), Warminster, PA 18974.

6.4 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 which will affect or violate the international agreement concerned, the preparing activity will take appropriate reconciliation action through international standardization channels, including departmental standardization offices, is required.

6.5 Changes from previous issue. Asterisks are not used in this revision to identify changes with respect to the previous issue, due to the extensiveness of the changes.

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

Preparing activity:
Navy - AS
Project No. 4730-0515

Reviewer activities:
Army - AR, MI
Navy - AS
Air Force - 11, 82
DLA - CS

User activities:
Navy - OS
Army - GL, ME, AT

International interest (see 6.4)

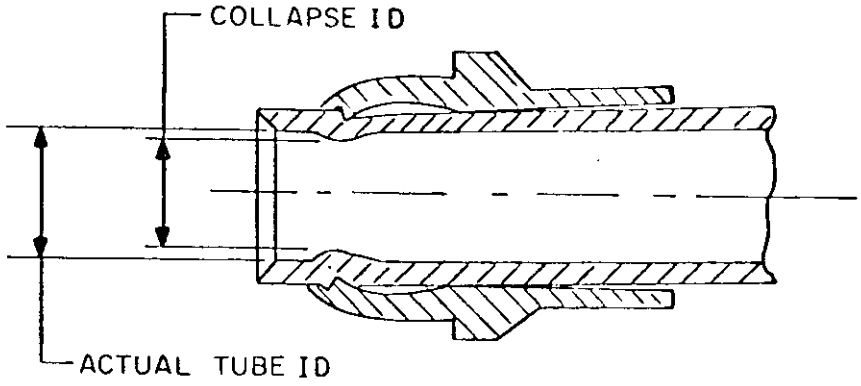


Figure 1. Permissible tube collapse

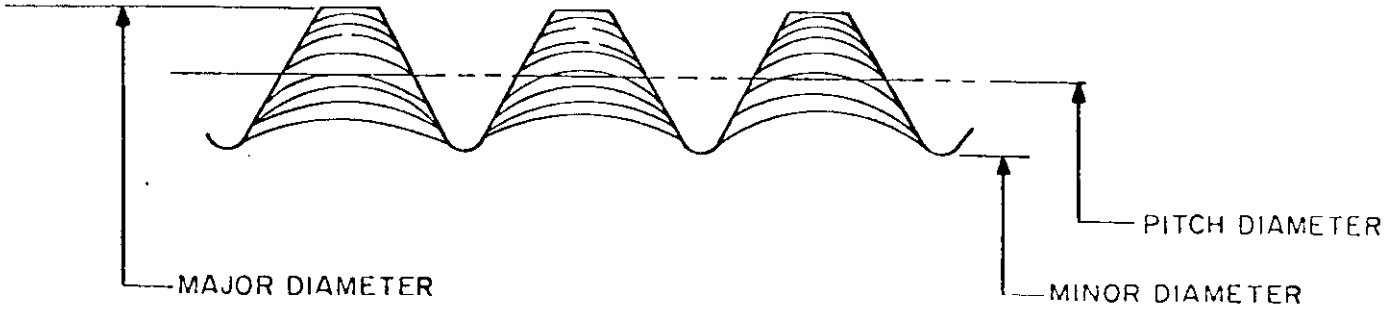
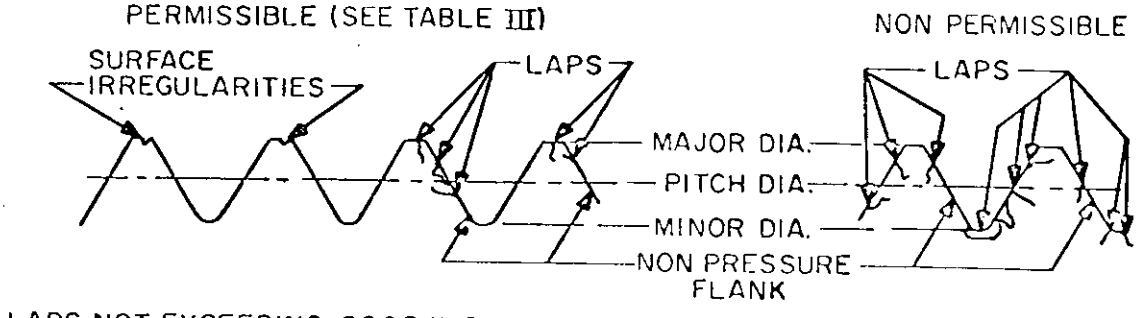


Figure 2A. Grain flow in rolled threads



LAPS NOT EXCEEDING .0008 IN DEPTH
ARE PERMISSIBLE IN THREAD RUNOUT AREA.

Figure 2B. Laps & surface irregularities in threads

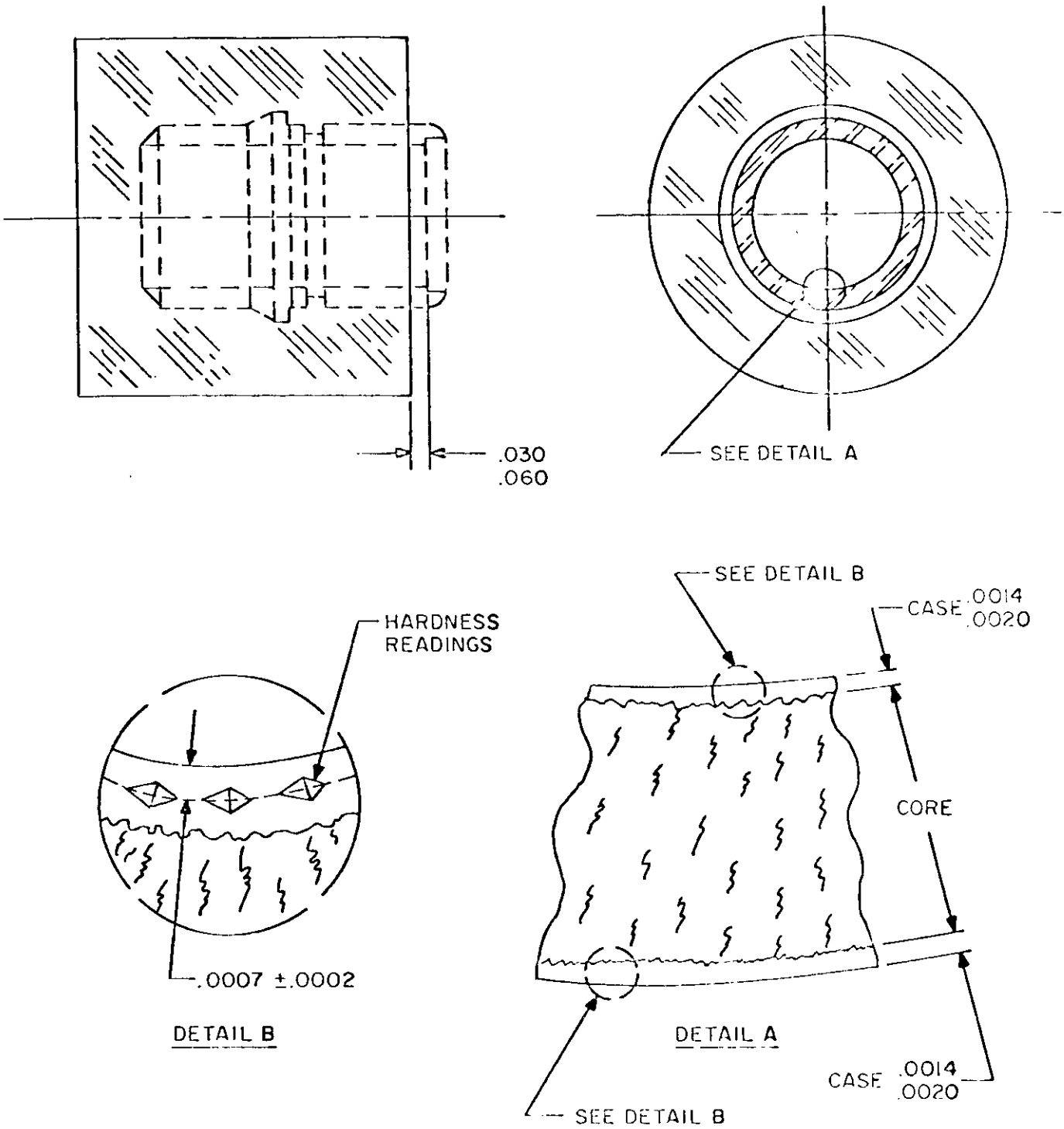


Figure 3. Case and core hardness

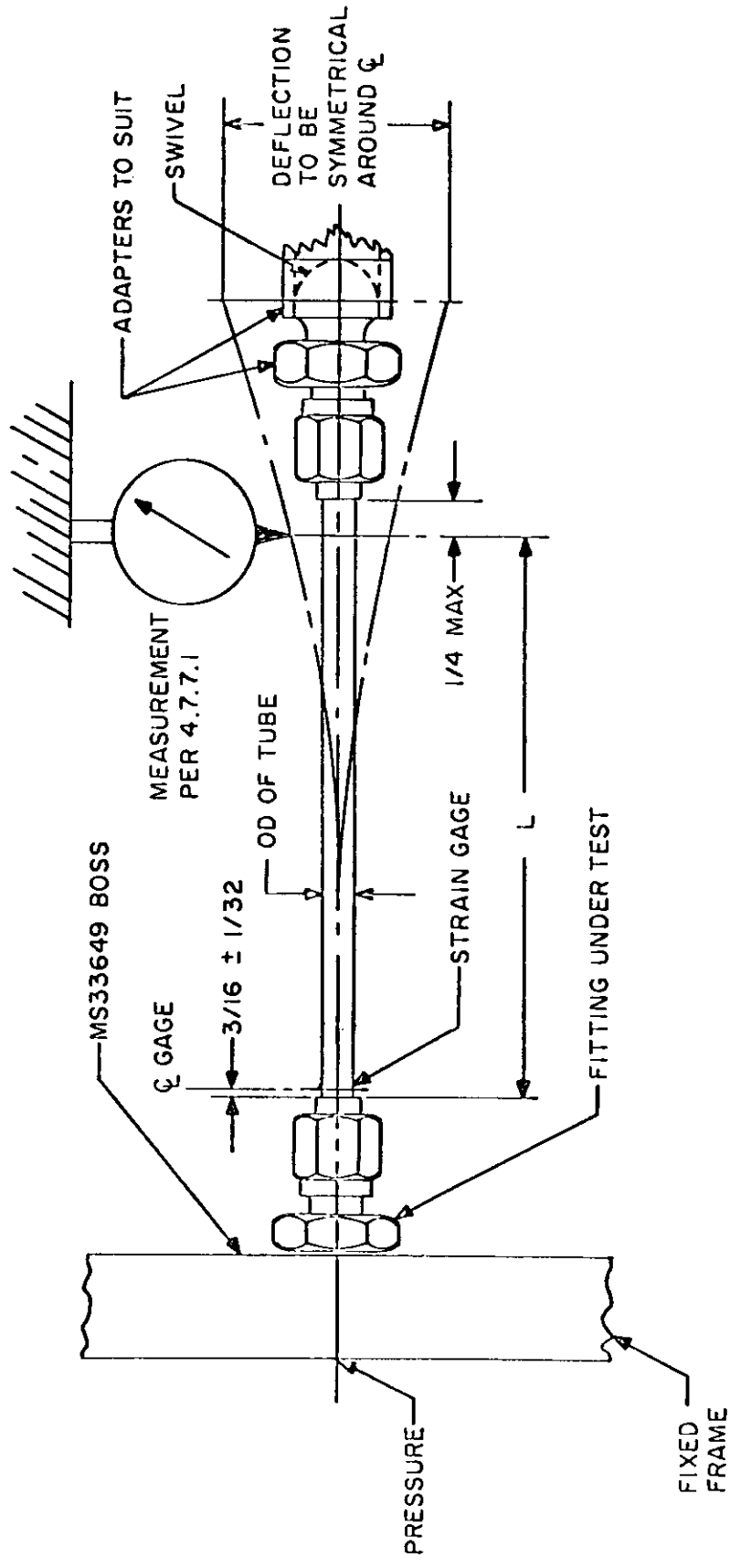


Figure 4. Rotary beam method

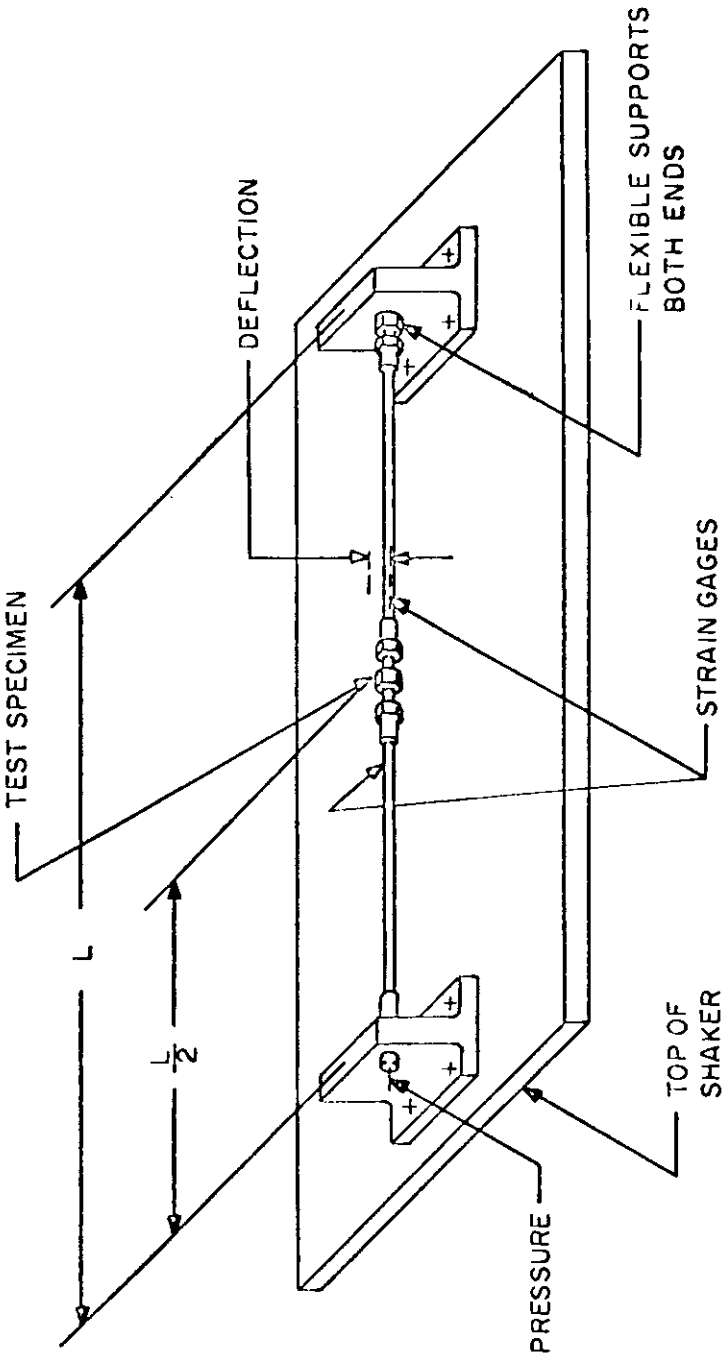
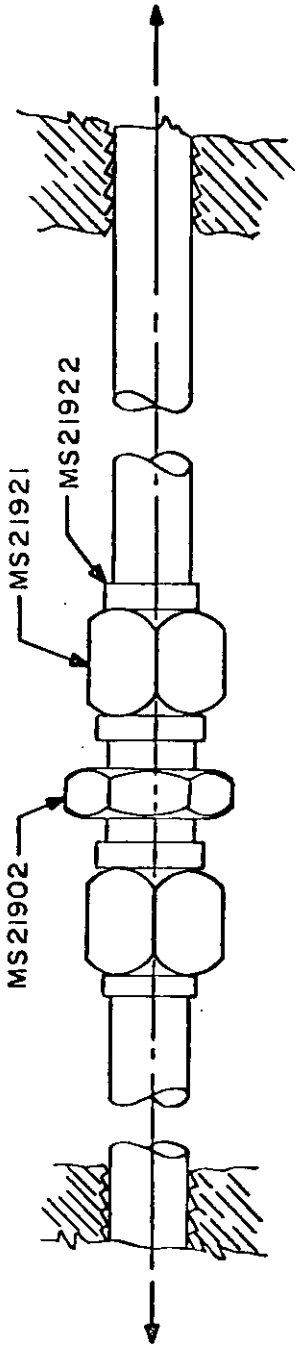


Figure 5. Simple beam method



Alternate test configurations are allowed, such as attaching fitting to tensile test machine instead of tubing. However test conditions of paragraph 4.7.12 must be met.

Figure 6. Joint strength test specimen.

INSTRUCTIONS: In a continuing effort to make our standardization documents better, the DoD provides this form for use in submitting comments and suggestions for improvements. All users of military standardization documents are invited to provide suggestions. This form may be detached, folded along the lines indicated, taped along the loose edge *(DO NOT STAPLE)*, and mailed. In block 5, be as specific as possible about particular problem areas such as wording which required interpretation, was too rigid, restrictive, loose, ambiguous, or was incompatible, and give proposed wording changes which would alleviate the problems. Enter in block 6 any remarks not related to a specific paragraph of the document. If block 7 is filled out, an acknowledgement will be mailed to you within 30 days to let you know that your comments were received and are being considered.

NOTE This form may not be used to request copies of documents, nor to request waivers, deviations, or clarification of specification 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.

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STANDARDIZATION DOCUMENT IMPROVEMENT PROPOSAL

(See Instructions - Reverse Side)

1. DOCUMENT NUMBER	2. DOCUMENT TITLE
MIL-F-18280E	Fittings, Flareless Tube, Fluid Connection

3a. NAME OF SUBMITTING ORGANIZATION	4. TYPE OF ORGANIZATION *(Mark one)*
	☐ VENDOR ☐ USER ☐ MANUFACTURER ☐ OTHER *(Specify)*:
b. ADDRESS *(Street, City, State, ZIP Code)*	

5. PROBLEM AREAS

a. Paragraph Number and Wording

b. Recommended Wording.

c. Reason/Rationale for Recommendation:

6. REMARKS

7a. NAME OF SUBMITTER *(Last, First, MI)* – Optional	b. WORK TELEPHONE NUMBER *(Include Area Code)* – Optional
c. MAILING ADDRESS *(Street, City, State, ZIP Code)* – Optional	8. DATE OF SUBMISSION *(YYMMDD)*

(TO DETACH THIS FORM, CUT ALONG THIS LINE.)

DD FORM 82 MAR 1426

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