

INTERNATIONAL
STANDARD

20
ISO
7169

Second edition
1993-05-15

**Aerospace fluid systems — Separable tube
fittings for 24° cone — General
specification**

*Circuits de fluides pour l'aérospatiale — Raccordements séparables de
tubes à cône de 24° — Spécifications générales*



Reference number
ISO 7169:1993(E)

Foreword

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Draft International Standards adopted by the technical committees are circulated to the member bodies for voting. Publication as an International Standard requires approval by at least 75 % of the member bodies casting a vote.

International Standard ISO 7169 was prepared by Technical Committee ISO/TC 20, *Aircraft and space vehicles*, Sub-Committee SC 10, *Aerospace fluid systems and components*.

This second edition cancels and replaces the first edition (ISO 7169:1984), of which it constitutes a technical revision.

Annex A of this International Standard is for information only.

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International Organization for Standardization
Case Postale 56 • CH-1211 Genève 20 • Switzerland

Printed in Switzerland

Introduction

This International Standard establishes the basic performance and quality criteria for screw-together tube fitting assemblies and port connectors used in aerospace fluid systems.

The test requirements are intended to satisfy the most strenuous demands encountered in a high-performance aircraft hydraulic system. The procurement requirements are intended to ensure that fittings, which are procured in accordance with this specification, are of the same quality as the fittings used during the original qualification testing. Compliance with these test and procurement requirements is necessary for fittings that are used in control systems where a malfunction would affect the safety of flight.

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Aerospace fluid systems — Separable tube fittings for 24° cone — General specification

1 Scope

This International Standard specifies performance and quality requirements for the qualification and manufacture of standard 24° cone fittings¹⁾ to ensure reliable performance in aircraft hydraulic systems.

This International Standard specifies baseline criteria for the design and manufacture of system fittings that are qualification tested on engines.

This International Standard covers fittings of the temperature types and pressure classes specified in ISO 6771.

2 Normative references

The following standards contain provisions which, through reference in this text, constitute provisions of this International Standard. At the time of publication, the editions indicated were valid. All standards are subject to revision, and parties to agreements based on this International Standard are encouraged to investigate the possibility of applying the most recent editions of the standards indicated below. Members of IEC and ISO maintain registers of currently valid International Standards.

ISO 468:1982, *Surface roughness — Parameters, their values and general rules for specifying requirements.*

ISO 2685:1992, *Aircraft — Environmental conditions and test procedures for airborne equipment — Resistance to fire in designated fire zones.*

ISO 2859-1:1989, *Sampling procedures for inspection by attributes — Part 1: Sampling plans indexed by acceptable quality level (AQL) for lot-by-lot inspection.*

ISO 6771:1987, *Aerospace — Fluid systems and components — Pressure and temperature classifications.*

ISO 6772:1988, *Aerospace — Fluid systems — Impulse testing of hydraulic hose, tubing and fitting assemblies.*

ISO 7257:1983, *Aircraft — Hydraulic tubing joints and fittings — Rotary flexure test.*

ISO 8575:1990, *Aerospace — Fluid systems — Hydraulic system tubing.*

ISO 9538:—²⁾, *Aerospace — Hydraulic tubing joints and fittings — Planar flexure test.*

ISO 10583:1993, *Aerospace fluid systems — Test methods for tube/fitting assemblies.*

3 Definitions

For the purposes of this International Standard, the definitions given in ISO 2859-1 and the following definitions apply.

3.1 Workmanship and surface defects

3.1.1 surface irregularity: Nonconformity with general surface appearance, possible defect.

1) The geometrical definition of a 24° cone fitting will be given in a future International Standard.

2) To be published.

3.1.2 crack: Clean (crystalline) fracture passing through or across the grain boundaries that possibly follows inclusions of foreign elements. Cracks are normally caused by overstressing the metal during forging or other forming operations, or during heat treatment. Where parts are subject to significant re-heating, cracks are usually discoloured by scale.

3.1.3 fold: Doubling over of metal, which can occur during the forging operation. Folds can occur at or near the intersection of diameter changes and are especially prevalent with non-circular necks, shoulders and heads.

3.1.4 lap: Fold-like machining defect.

3.1.5 seam

(1) Usually a surface opening or crack resulting from a defect obtained during casting or forging.

(2) Extraneous material, stringer in the material, which is not homogeneous with base metal.

3.1.6 pit: Void or hole in the surface as caused, for example, by corrosion.

3.1.7 leakage

(1) Wetting or formation of a drop or drops of test fluid in pressure testing or of a bubble in pneumatic testing.

(2) Spillage of test fluid due to rupture.

3.2 Fitting components

Fitting components are designated as illustrated in figure 1.

3.3 Quality assurance

3.3.1 lot: Manufacturer's run of a given part number from the same batch of material, processed at the same time and in the same manner.

3.3.2 qualification test: Performance testing required to demonstrate successful performance of the fitting in simulated service and using overload, destructive and accelerated tests.

4 Requirements

4.1 Qualification

Fittings claiming conformity with this International Standard shall be representative of products which have successfully met the requirements and have passed the tests specified in this International Standard.

Fitting claiming conformity with this International Standard shall be representative of products which have successfully passed the tests specified in clause 5 of this International Standard.

4.2 Materials

4.2.1 Fittings

The fitting parts shall be manufactured from materials as given in table 1 or equivalents passing the specified qualification tests. The various materials shall be used according to the pressure and temperature requirements of the system (see table 1).

4.2.2 Tubing

The tubing used with the fittings shall be in accordance with ISO 8575 or equivalent tubing passing the specified qualification tests. Equivalent tubing shall have the mechanical characteristics given in table 1.

WARNING — Titanium fittings and tubing shall not be used in oxygen systems.

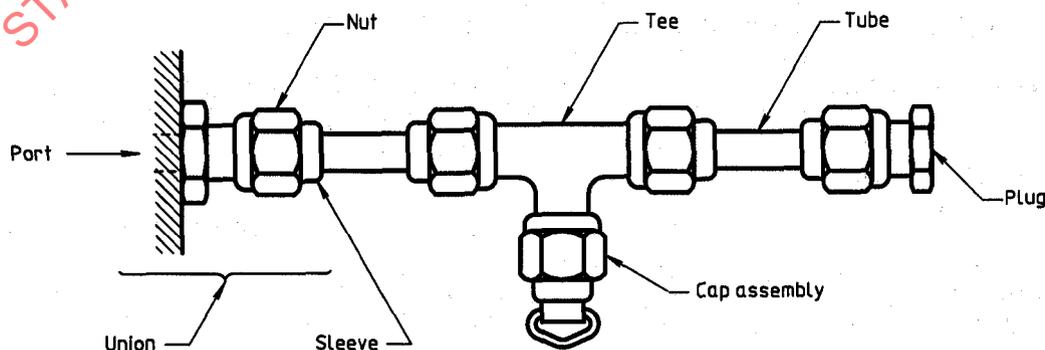


Figure 1 — Fitting assembly part designations

Table 1 — Materials, fittings and tubing

Part	Fittings					Tubing									
	Material	Type ¹⁾	Material code ²⁾	Starting stock	Material No. ³⁾	Material	R_m min. ⁴⁾ MPa	$R_{p0,2}$ min. ⁵⁾ MPa	A min. %	Material No. ³⁾					
Straight fittings and nuts	Aluminium alloy	I	D	Bar, rod	1	Aluminium alloy	290	241	10	13					
			W		2										
Shape fittings	Aluminium alloy	I	D	Bar and forgings	3										
			W		2										
Straight and shape parts	Carbon steel	II	F	Bar rod, forgings	4						Cold-worked corrosion-resistant steel	725	515	20	14
Straight and shape parts	Corrosion-resistant steel, stabilized	I	J	Bar and forgings	5						High-strength corrosion-resistant steel	980	825	20	15
			II		J	5									
			III		S	6									
			IV		K	7									
Straight and shape parts	Titanium alloy	IV	T	Bar and forgings	8	Titanium, unalloyed	350	250	28	16					
Sleeves (bite type)	Carbon steel	II	F	Bar	9										
Sleeves (swaged and brazed)	Corrosion-resistant steel	IV	P	Bar	10										
Sleeves (welded)	Corrosion-resistant steel	I, II, III, IV	C	Bar	11	Titanium, cold-worked and stress-relieved	860	720	10	17					
	Titanium alloy	I, II, III, IV	T		12										

1) Temperature types and system pressure classes are defined in ISO 6771.

2) See table 3.

3) See also table A.1.

4) R_m min. = Minimum ultimate tensile strength.

5) $R_{p0,2}$ min. = Minimum yield strength (0,2 % proof stress).

4.3 Design and manufacture

4.3.1 Threads

Threads may be cut, rolled or, except for titanium, ground. The external threads of fittings should be rolled and, if machined, shall have an arithmetical mean deviation, R_a , of the profile of $3,2 \mu\text{m}$ or smoother in accordance with ISO 468. The grain flow in rolled threads should be continuous and follow the general thread contour, with the maximum density at the thread root.

Laps, cracks, surface irregularities and seams (see 3.1) are not acceptable on any part of the pressure thread flank, in the threadroot or on the non-pressure thread flank. Laps and seams, whose depths are

within the limits of table 2, are acceptable on the crest and the non-pressure thread flank above the pitch diameter.

Table 2 — Maximum depth of laps and surface irregularities in rolled threads

Dimensions in millimetres

Size DN	Depth
05	0,15
06	0,18
08	0,18
10	0,2
12	0,23
14 to 40	0,25

4.3.2 Fluid passages

On fittings where the fluid passage is drilled from each end, the offset between the drilled holes at the meeting point shall not exceed 0,4 mm. It shall be possible to pass through the fitting passage a ball whose diameter is 0,5 mm less than the minimum diameter specified for the passage.

4.4 Surface protection and colour identification

4.4.1 Surface protection

The surfaces of fitting parts shall be protected in the following manner:

- a) **aluminium alloy fittings:** by sulfuric acid anodizing, then dyeing and dichromate or nickel acetate sealing;
- b) **carbon steel fittings and sleeves:** by cadmium plating 0,007 mm to 0,012 mm thick, followed by a chromate postplate treatment;
- c) **corrosion-resistant steel fittings:** by passivation treatment. Sleeves may be cadmium plated;
- d) **titanium fittings:** by a fluoride conversion coating or anodizing process.

4.4.2 Colour identification

As a reference, the material of the finished fitting may be distinguished by the colours as shown in table 3.

Table 3 — Material codes and colours

Material	Code	Colour
Aluminium	D	Yellow
Aluminium	W	Gold
Carbon steel	F	Gold brown
Corrosion-resistant steel	J	Bright metallic
Corrosion- and acid-resistant steel	K	Bright metallic
Heat-stabilized corrosion-resistant steel	S	Bright metallic
Corrosion-resistant stabilized steel	R	Bright metallic
Heat-treatable corrosion-resistant steel	P	Metallic
Titanium	T	Dull grey

4.5 Marking

Unless specified otherwise, parts shall be permanently identified with the complete part number and the manufacturer's trademark. The method of marking shall be laser marking, impression stamping or electro-etching, in that order of preference. When the complete part number cannot be used in DN08 size and under because of the size of the part, the marking may be limited to the basic part number, without size designation. The marking shall not be in a location detrimental to the part or its surface protection and should preferably be visible when the part is assembled. When material code letters are used, the code letter (see table 3) shall also be laser marked, electro-etched or impression stamped on the part.

4.6 Performance

The tubing/fitting assembly shall be capable of the performance specified in 4.6.1 to 4.6.9.

4.6.1 Proof pressure

When tested in accordance with ISO 10583:1993, subclause 5.1, the test assembly shall withstand pressure equal to twice the nominal pressure³⁾ without leakage, evidence of permanent deformation or other malfunction that might affect the ability to disconnect or connect using the specified range of torque values. All specimens, except tensile specimens, shall be proof tested.

4.6.2 Pneumatic pressure tightness

When tested in accordance with ISO 10583:1993, subclause 5.2, assemblies shall pass the gaseous pressure test to the specified nominal pressure without leakage or other failure. Six specimens shall be tested.

4.6.3 Hydraulic impulse resistance

When tested in accordance with ISO 6772 and ISO 10583:1993, subclause 5.3, the test assembly shall withstand 200 000 impulse pressure cycles without leakage. Six specimens shall be tested.

4.6.4 Minimum hydrostatic pressure capability

When tested in accordance with ISO 10583:1993, subclause 5.4, there shall be no leakage or burst at less than the specified minimum burst pressure. Tubing expansion is permissible. Six specimens shall be tested to failure.

3) In accordance with ISO 8574:1990, *Aerospace — Hydraulic system tubing — Qualification tests*.

4.6.5 Flexure resistance

4.6.5.1 Standard rotary flexure test, temperature type II, pressure class D

When tested in accordance with ISO 7257 and ISO 10583:1993, subclause 5.5, test assemblies shall not fail. Six specimens with straight unions shall be tested. Bulkhead tee fitting connections shall match the flexure fatigue life of straight unions. Two specimens with bulkhead tees shall be tested.

4.6.5.1.1 Basic qualification requirement for testing to 10^7 cycles

Steel 24° cone fittings shall be used with type II, class D, cold-worked corrosion-resistant steel tubing (material No. 14 in table A.1) and flexure fatigue tested to 135 MPa bending stress in sizes DN16 and under, and 108 MPa in sizes DN20 and over to a tolerance of $-10^0\%$.

NOTE 1 Under pressure and with dynamic load due to rotation, these stresses may be 172 MPa and 137 MPa respectively.

4.6.5.1.2 Alternative qualification test requirement

Modifications of 24° cone fittings, other fitting designs, new tubing materials or other attachment methods are to be qualified by comparing their fatigue life against that of the basic 24° cone fitting by testing to 10^7 cycles, to the same fatigue life measured in deflection as the basic fitting. The performance of such other designs, materials or joining methods shall meet or exceed that of the standard 24° cone type II, class D fitting and cold-worked corrosion-resistant steel tubing (material No. 14 in table A.1); that is, all six specimens shall withstand 10^7 flexure cycles without failure.

4.6.5.2 Rotary flexure test for other temperature types and pressure classes

Fitting assemblies of other temperature types and pressure classes (see ISO 6771) shall be qualified by testing to the same deflection levels as obtained for testing in accordance with 4.6.5.1. The performance shall meet or exceed that of the type II, class D fitting.

4.6.5.3 Planar flexure test

As an alternative to the rotary flexure test, the planar method given in ISO 9538 may be used.

4.6.6 Stress corrosion resistance

When tested in accordance with ISO 10583:1993, subclause 5.6, there shall be none of the following defects:

- indications of cracking or pitting of the exposed surfaces of the tube joint area when fittings and tubing are visually examined with $\times 10$ magnification and the joint area is compared to the remainder of the tubing;
- indications of intergranular or transgranular corrosive attack during metallurgical examination of longitudinal and transverse sections of the fitting and the fitting/tube junction.

Three specimens shall be tested.

4.6.7 Re-use capability

When tested in accordance with ISO 10583:1993, subclause 5.7, there shall be none of the following defects:

- leakage during any of the proof pressure tests;
- inability to assemble the fitting to the interface point by hand;
- nut deformation preventing engagement of the nut hexagon with an open-end wrench;
- gaseous leakage following final assembly, when tested in accordance with 4.6.2.

Because the same test assemblies may be used subsequently for the burst test, they shall also meet the requirements of 4.6.4 above. Three specimens shall be tested.

4.6.8 Tensile load capability

When tested in accordance with ISO 10583:1993, subclause 5.8, steel fitting assemblies of temperature type II, pressure class D shall withstand the axial loads specified in table 4 without rupture. Two specimens shall be tested.

Table 4 — Joint strength, steel 24° cone fitting on cold worked corrosion-resistant steel tubing

Values in kilonewtons

Size DN	Minimum axial load
05	1)
06	4,6
08	7,5
10	11
12	19
14	20
16	31
20	40
25	44
32	1)
40	1)

1) Values to be added when available.

4.6.9 Fire resistance

When tested in accordance with ISO 2685, tubing and fittings manufactured from steel or titanium shall not leak. Two specimens shall be tested.

This test shall be conducted for fittings used in fire zones.

4.7 Workmanship

Fitting parts shall conform with the requirements specified on the drawing and in this International Standard and shall be free of burrs and slivers. Sealing surfaces shall be machined smooth to a finish with an R_a value of $1,6 \mu\text{m}$ in accordance with ISO 468. All other machined surfaces shall have a roughness value, R_a , of $3,2 \mu\text{m}$ maximum. Unmachined surfaces of forgings or bar stock flats shall be of uniform quality and condition and shall be free of cracks, folds, fissures, pits or defects, as visible to the unaided eye or by magnetic or dye-penetrant inspection, that could affect the serviceability of the part (see 3.1). Defects in the shear area along forging parting planes of aluminium alloy fittings may be explored by grinding (to a maximum roughness, R_a , of $6,5 \mu\text{m}$) and etching. If the defects can be removed so that they do not reappear on re-etching and the required section thickness can be maintained, they shall not be considered as grounds for rejection.

5 Quality assurance provisions

5.1 Responsibility for inspection

Unless otherwise specified in the contract or purchase order, the manufacturer is responsible for the performance of all inspection requirements as specified in this International Standard. Unless otherwise specified, the manufacturer may use his own facilities or any commercial laboratory acceptable to the purchaser. The purchaser has the right to perform any inspection specified in this International Standard, whenever such inspections are deemed necessary to ensure that supplies and services conform to the prescribed requirements.

5.2 Classification of inspections and tests

The inspection and testing of fittings, nuts and sleeves shall be classified as follows:

- a) qualification inspection (see 5.2.1);
- b) quality conformance inspection (see 5.2.2).

5.2.1 Qualification inspection

Test assemblies shall consist of the parts specified in 5.5.2. Tests shall be conducted in accordance with 5.6 for each size and material for which qualification is required.

5.2.2 Quality conformance inspection

5.2.2.1 Non-destructive tests

Inspection for material, threads, finish, dimensions, marking, surface defects and workmanship shall be conducted on a sampling basis in accordance with ISO 2859-1.

5.2.2.1.1 Classification of defects

Fitting defects are classified in table 5 according to the effect they have on safety and usability. Definition of classes is as follows:

- a) Major: will cause malfunction or will make the part unusable;
- b) Minor A: may have a slight effect on usability; and
- c) Minor B: has no effect on usability.

5.2.2.1.2 Acceptable quality level

The following acceptable quality levels (AQLs) apply to the defect classifications (see 5.2.2.1.1) shown in table 5.

- a) Major: AQL 0,015
- b) Minor A: AQL 0,040
- c) Minor B: AQL 0,065

All defects not identified in table 5 shall be inspected in accordance with the Minor B classification (AQL 0,065).

5.2.2.2 Destructive tests

Sampling for all destructive tests [that is, burst pressure, grain flow, intergranular corrosion resistance of non-stabilized corrosion-resistant steel, tube cut (sleeves only) and tensile load capability (sleeves only)] shall be performed in accordance with ISO 2859-1, inspection level S-1, acceptance number 0.

Table 5 — Classification of defects

Fitting end — design standard		Fitting — union	
Class	Defects 1)	Class	Defects 1)
Major	Depth, seal diameter to the tube stop Finish of seal area (cone and O-ring) Squareness, thread to hexagon face Concentricity, thread to conical seal	Major	Incomplete holes, internal burrs Perpendicularity, thread to hexagon face
Minor A	Thread fit Seal angle Fluid bore diameter O-ring seal diameter Machining finish Diameters Thread, length, size and form Marking	Minor A	Thread size and form Concentricity of threads, seat and face Hexagon dimension Marking
		Minor B	Overall length Surface finish, radii, chamfer, colour and identification Bore diameter O-ring seal diameter
Sleeve		Fitting — tee elbow	
Class	Defects 1)	Class	Defects 1)
Major	Finish, seal area Cutting edge, sharpness	Major	Holes — incomplete or missing, internal burrs Wall thickness and depth of bore
Minor A	Bore diameter Outside diameters Concentricity of ID and OD Surface finish, marking	Minor A	Fluid passage diameter Leg length, overall length, angle between legs Wrench pad dimension Marking
Minor B	Turn length Overall length Width of shoulder Surface finish and colour	Minor B	Diameter of seat, leg angularity
Nut		Preparation for delivery	
Class	Defects 1)	Class	Defects 1)
Major	Thread, concentricity, thread to tube bore, distance across hexagon	Minor B	Marking: missing, incorrect, incomplete, illegible, of improper size, location, sequence or method of application
Minor A	Thread length, size and form Small bore diameter Hexagon dimension Concentricity of threads, minor diameter and small ID Marking		Any nonconforming components: component missing, damaged or otherwise defective Inadequate assembly of components Number per container is more or less than stipulated Gross or net weight exceeds the requirement (as specified by the part standard)
Minor B	Minor diameter and depth Countersink dimension Turned diameter and length Overall length Surface finish, radii, chamfer, colour		

1) Refer to design standards and part standards for the 24° cone fitting for explanations of the terms used in this column.

5.2.2.3 Inspection

Each individual lot of fittings, nuts and sleeves shall be subjected to the following examinations and tests, as specified in clauses 4 and 5:

- a) examination of product;
- b) material certification (chemical composition and mechanical properties), for raw material as long as the product is not subjected to thermal treatment;
- c) grain flow;
- d) internal fluid passages.

5.2.2.4 Rejection and retest

Rejected lots shall be resubmitted for retest and acceptance in accordance with ISO 2859-1. 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.

5.3 Quality control records

The supplier shall maintain a record of inspection applied to each lot for a minimum of 5 years. Records of chemical composition analysis, mechanical property tests showing conformance with the applicable material specifications and metallurgical tests should be made available to the purchaser of each lot of fittings upon request.

5.4 Quality conformance inspection procedures

5.4.1 Examination of product

Each lot of fittings shall be examined to determine conformance with this International Standard and the applicable standards with respect to material, dimensions, threads, wall thickness, surface defects, finish, marking and workmanship.

5.4.2 Material certification

The manufacturer shall ensure that all materials meet the requirements for chemical composition and mechanical properties, as specified in the applicable material and heat treatment specifications (see 5.3).

5.4.3 Grain flow in threads

The grain flow in rolled threads shall be determined by macro-examination. Specimens shall be taken from the finished part by sectioning on a longitudinal plane

across the threaded area. The specimens shall be etched to reveal the macro-structure adequately.

5.4.4 Fluid passages

Each lot of fittings shall be inspected to determine conformance with 4.3.2. The offset between drill holes at intersections shall be inspected by rolling a steel ball with a diameter as specified in 4.3.2 through the fitting.

5.4.5 Sampling instructions

Sampling shall be as specified in 5.2.2.1 for non-destructive tests and 5.2.2.2 for destructive tests.

5.5 Test conditions

5.5.1 Test fluids

Test fluids shall be in accordance with ISO 10583.

For reasons of safety, the pneumatic testing shall be limited to leakage and/or proof testing. All other pressure tests shall be conducted with a liquid.

5.5.2 Specimen preparation

Test specimens shall be assembled as illustrated in table 6. Sleeve installations on the tube end shall be in accordance with user instructions. The fitting shall be assembled to tightening torques as given in table 7, using the maximum installing torque for half of the test specimens and the minimum torque for the other half.

5.5.3 Lubricants

Hydraulic system fittings shall be assembled using system fluid as lubricant, or another lubricant that is compatible with the system fluid and that has essentially the same lubricity characteristics.

5.6 Qualification test procedures

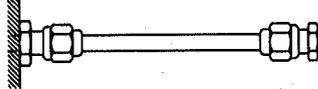
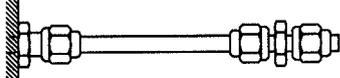
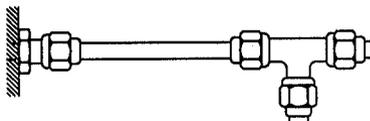
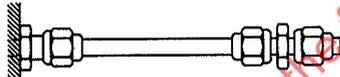
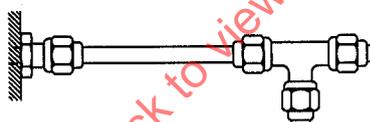
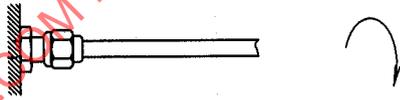
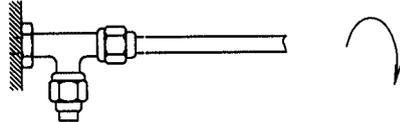
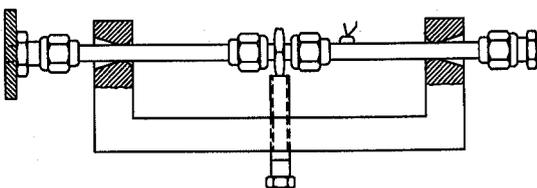
Qualification test procedures shall be in accordance with ISO 10583.

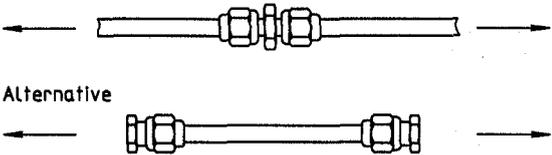
5.7 Sampling instructions

Qualification inspection samples shall consist of the component parts, as shown in table 6, and shall be tested in the quantities shown in table 6. Qualification tests are required for each size and material for which qualification is desired.

NOTE 2 The stabilized and non-stabilized corrosion-resistant steels are to be regarded as the same basic material, not requiring separate qualification testing.

Table 6 — Testing and test samples for qualifications

Test	Test procedure	Specimen	Quantity	Specimen number	Sizes	See foot-notes
Inspection	5.4.1	All parts and assemblies				
Proof pressure	4.6.1	All assemblies				
Gaseous pressure	4.6.2		6	1 to 6	All	1)
Impulse	4.6.3		3	7 to 9	All	1), 2)
			3			
Minimum burst pressure	4.6.4		3	13 to 15	All	2), 3)
			3			
Flexure	4.6.5		6	19 to 24	All	1), 4)
			2			
Stress corrosion	4.6.6		3	27 to 29	DN16	
Re-use	4.6.7		3	30 to 32	All	

Test	Test procedure	Specimen	Quantity	Specimen number	Sizes	See foot-notes
Tensile	4.6.8		2	33 to 34	All	
Fire	4.6.9		2	35 to 36	DN16	

1) Half of the port fittings in each size, except for the largest, shall be reducer unions with the end inserted in the port one size larger than the end connected to the tube.
 2) Same specimens may be tested as those used in the re-use test.
 3) Same specimens may be tested as those used in the impulse test.
 4) Six specimens are used for basic qualification (see 4.6.5.1) with unions and two specimens with tees.

Table 7 — Range of tightening torques for 24° cone fitting

Torque values in newton metres (N·m)

Size DN	Torque	
	Material	
	Steel and titanium	Aluminium alloy
05	10,7 to 12	8,6 to 9,5
06	15,2 to 17	10,7 to 13
08	19,2 to 21,4	15,5 to 16,6
10	24,3 to 27,2	18,23 to 20,1
12	53 to 57,6	30 to 33,2
14	61 to 67	34 to 37,5
16	70 to 76,7	38,6 to 42,7
20	96,5 to 106,7	47,9 to 53,3
25	128,7 to 142,2	80,4 to 88,9
32	171,6 to 189,6	97,5 to 106,7
40	214,4 to 237	97,5 to 106,7

6 Preparation for delivery

6.1 Cleaning

Before packaging, all parts shall be free from grease, oil, dirt or other foreign matter. No preservative compound shall be applied; except that cadmium-plated steel fittings and nuts, but excluding cadmium-plated, bite-type sleeves, shall be dipped in oil prior to packaging.

6.2 Packaging

All fittings shall be individually packaged to prevent damage or deterioration during shipment and storage. Unless otherwise agreed, nuts, sleeves and caps of one type and size shall be unit packaged in the quantity per unit as specified in table 8.

Table 8 — Quantity per unit container

Tubing size DN	Number
05 to 14	100
16 to 40	25

6.3 Marking

The complete part number shall appear on the part container. The list of identifications to packing shall be in accordance with the product standard.

6.4 Intermediate container

Unit packages, as described in 6.2, shall be packaged in intermediate containers. The quantity of unit packages per intermediate container shall not exceed the quantities specified in table 9.

Table 9 — Quantity of unit packages

Tubing size DN	Quantity of unit packages per intermediate container
05 to 06	100
08 to 14	25
16 to 25	10
32 and above	5

6.5 Shipping containers

Packages that require overpacking for acceptance by the carrier shall be packed in commercial exterior shipping containers in a manner that will ensure safe transportation to the point of delivery.

6.6 Inspection

Packaging, packing and marking shall be sample inspected for those defects identified in table 6 in the preparation for delivery column. Sampling shall be in accordance with ISO 2859-1, inspection level S-3, AQL 4.0.

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Annex A (informative)

Equivalent materials and processes

International Standards giving specifications for appropriate materials or processes to be used in tube fitting assemblies in aircraft fluid systems are not currently available. For the time being, materials specified in national standards are given in table A.1. Materials of equivalent properties and characteristics and processes as specified in other national standards may be used; however, it should be borne in mind, when selecting materials and components, that non-

equivalent materials and processes can cause differences in test results and, more importantly, in the performance of fitting assemblies. Eventually, references to national standards will be deleted and replaced by references to International Standards when they become available — some specifications for materials and forms have reached the stage of draft proposal and reference is made to these for information purposes in the far right column of table A.1.

Table A.1 — Equivalent materials

Material No.	Equivalent materials						ISO Draft Proposal No.
	France		UK		USA		
	National standards applicable	Description	National standards applicable	Description	National standards applicable ¹⁾	Description	
1	—	—	—	—	QQ-A-225/6 (2024 T6, T851)	Aluminium Alloy Bar, Rod, and Wire; Rolled, Drawn or Cold Finished, 2024	—
2	—	—	—	—	QQ-A-225/9 (7075 T73)	Aluminium Alloy Bar, Rod, Wire and Special Shapes, Rolled, Drawn or Cold Finished, 7075	—
3	—	—	—	—	QQ-A-367 (2014 T6)	Aluminium Alloy, Forgings, Heat Treated	—
4	—	—	—	—	MIL-S-6758 (4130)	Steel, Chrome-Molybdenum (4130) Bars and Reforging Stock (Aircraft Quality)	—
5	—	—	—	—	QQ-S-763 (304)	Steel Bars, Wire Shapes and Forgings, Corrosion Resisting	—
6	—	—	—	—	QQ-S-763 (347)	Steel Bars, Wire Shapes and Forgings, Corrosion Resisting	—
7	—	—	—	—	QQ-S-763 (316)	Steel Bars, Wire Shapes and Forgings, Corrosion Resisting	—
8	—	—	—	—	MIL-T-9046 (6AL-4V)	Titanium and Titanium Alloy Sheet, Strip and Plate	—
9	—	—	—	—	ASTM A108 (1213, 1214)	Steel Bars, Carbon, Cold-Finished, Standard Quality Specification For	—
10	—	—	—	—	(17-4)	TBD	—
11	—	—	—	—	AMS 5659 (15-5)	Steel Bars, Forgings and Rings 15Cr5Ni0,03(Cb + Ta)4Cu Cons. Elect. Melted	—
12	—	—	BS Aerospace Series 2TA 11, 2TA 12 and 2TA 13	Bar and Section for Machining / Forging Stock / Forging of Titanium, Aluminium-Vanadium Alloy (Tensile Strength 900 MPa to 1 160 MPa)	AMS 4928 (6AL-4V)	Titanium Alloy Bars and Forgings, 6AL-4V, Annealed, 120 000 psi (825 MPa) Yield	ISO/DP 9600 (forgings)