INTERNATIONAL STANDARD

ISO 7169

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

Aéronautique et espace — Raccordements séparables de tubes à cône de 24° pour circuits de fluides — Spécifications générales

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*, subcommittee SC 10, *Aerospace fluid systems and components*.

This third edition cancels and replaces the second edition (ISO 7169:1993), of which it constitutes a technical revision.

Annex A of this International Standard is for information only.

International Organization for Standardization
Case postale 56 • CH-1211 Genève 20 • Switzerland
Internet iso@iso.ch

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.

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

1 Scope

This International Standard specifies performance and quality requirements for the qualification and manufacture of standard 24° cone fittings[1)] 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 2859-1:— [2)], *Sampling procedures for inspection by attributes — Part 1: Sampling plans indexed by acceptable quality level (AQL) for lot-by-lot inspection*.

ISO 4287:1997, *Geometrical Product Specifications (GPS) — Surface texture: Profile method — Terms, definitions and surface texture parameters*.

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 9538:1996, *Aerospace — Hydraulic tubing joints and fittings — Planar flexure test.*

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

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

2) To be published. (Revision of ISO 2859-1:1989)

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

3.1.2
crack
clean (crystalline) fracture passing through or across the grain boundaries that possibly follows inclusions of foreign elements

NOTE — Cracks are normally caused by overstressing the metal during forging or other forming operations, or during heat treatment. Where parts are subject to significant reheating, cracks are usually discoloured by scale.

3.1.3
fold
doubling over of metal, which can occur during the forging operation

NOTE — 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.

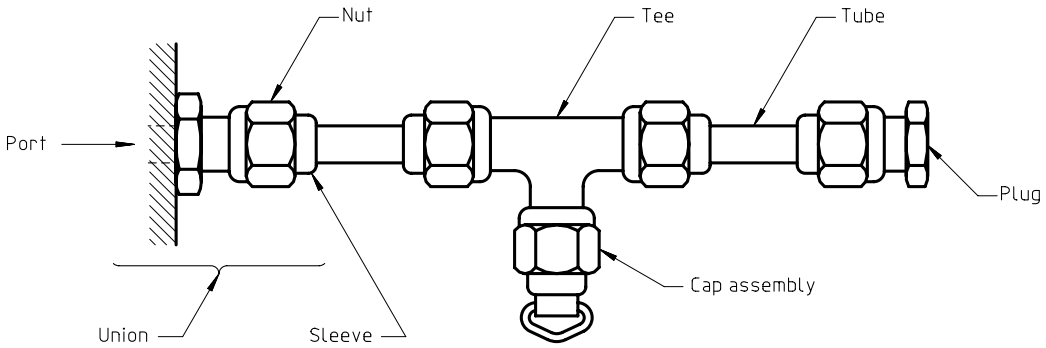

Figure 1 — Fitting assembly part designations

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.

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.

Table 1 — Materials for fittings

Part	Material	Type[1)]	Material code [2)]	Starting stock	Material No.[3)]
Straight fittings and nuts	Aluminium alloy	I	D	Bar, rod	1
			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
	Corrosion-resistant steel	I	J	Bar and forgings	5
		II	J		5
		III	R		6
		IV	K		7
	Titanium alloy	IV	T	Bar and forgings	8
Sleeves (bite type)	Carbon steel	II	F	Bar	9
Sleeves (swaged and brazed)	Corrosion-resistant steel	IV	V	Bar	10
Sleeves (welded)	Corrosion-resistant steel	I, II, III, IV	V	Bar	11
	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.

4.3 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, *Ra*, of the profile of 3,2 µm or smoother in accordance with ISO 4287.

For rolled threads, 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 (process No. 18 in table A.1);

b) **carbon steel fittings and sleeves:** by cadmium plating 0,007 mm to 0,012 mm thick, followed by a chromate postplate treatment (process No. 19 in table A.1);

c) **corrosion-resistant steel fittings:** by passivation treatment. Sleeves may be cadmium plated;

d) **titanium fittings:** by a fluoride conversion coating or anodizing (process No. 20 or No. 21 in table A.1).

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	Green
Aluminium	W	Brown
Carbon steel	F	Gold brown
Corrosion-resistant steel	J	Bright metallic
Corrosion- and acid-resistant steel	K	Bright metallic
Corrosion-resistant stabilized steel	R	Bright metallic
Heat-treatable corrosion-resistant steel	P[1)], V	Metallic
Titanium	T	Dull grey

1) P designates the same material as V, except it is cadmium plated.

4.5 Marking

Unless otherwise specified, 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.

Laser marking shall not be used on weldends of titanium weld fittings.

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, 5.1, the test assembly shall withstand pressure equal to twice the nominal pressure [3)] 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, 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, 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, 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.

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, 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 relative tolerance of $^{0}_{-10}$ %.

NOTE — 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.

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

4.6.5.1.3 Alternative qualification test requirement using S-N curve

The S-N method of testing eight specimens given in ISO 7257 may be used as an alternative to the method of testing six specimens to 10^7 cycles at a specified bending or stress level (4.6.5.1.1).

NOTE — The alternative method (ISO 7257) requires testing of at least eight specimens, two each at four stress levels, to produce a S-N curve. Such a curve shows cycles to failure for three sets of two specimens tested to different high stress levels, and one set of two specimens at one low stress level which lasts 10^7 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 Re-use capability

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

a) leakage during any of the proof pressure tests;

b) inability to assemble the fitting to the interface point by hand;

c) nut deformation preventing engagement of the nut hexagon with an open-end wrench;

d) gaseous leakage following final assembly, when tested in accordance with 4.6.2.

4.6.7 Tensile load capability

When tested in accordance with ISO 10583:1993, 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.

4.7 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 Ra value of 1,6 µm in accordance with ISO 4287. All other machined surfaces shall have a roughness value, Ra, of 3,2 µm 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