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# Aerospace series — Titanium ~~Tube~~tube for 35 MPa operating pressure —

# Part 1: Inch ~~Series~~series

*Série aérospatiale— — Tubes en titane — — Pression de service : 35 MPa— —*

*Partie 1: Série en inches*

# FDIS stage

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## Foreword

ISO (the International Organization for Standardization) is a worldwide federation of national standards bodies (ISO member bodies). The work of preparing International Standards is normally carried out through ISO technical committees. Each member body interested in a subject for which a technical committee has been established has the right to be represented on that committee. International organizations, governmental and non-governmental, in liaison with ISO, also take part in the work. ISO collaborates closely with the International Electrotechnical Commission (IEC) on all matters of electrotechnical standardization.

The procedures used to develop this document and those intended for its further maintenance are described in the ISO/IEC Directives, Part 1. In particular, the different approval criteria needed for the different types of ISO documentsdocument should be noted. This document was drafted in accordance with the editorial rules of the ISO/IEC Directives, Part 2 (see www.iso.org/directives).

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Any trade name used in this document is information given for the convenience of users and does not constitute an endorsement.

For an explanation onof the voluntary nature of standards, the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the World Trade Organization (WTO) principles in the Technical Barriers to Trade (TBT)), see www.iso.org/iso/foreword.htmlthe following URL: .

This document was prepared by Technical Committee ISO/TC 20, *Aircraft and space vehicles*, Subcommittee SC 10, *Aerospace fluid systems and components*.

This second edition cancels and replaces the first edition (ISO 1849718487-1:2017), of which it constitutes a minor revision.

The main changes compared to the previous edition are as follows:

— — Normative Reference changed from dated, to undated edition.

— the normative reference to ISO 4287, which is withdrawn, has been replaced by ISO 21920-2;

— the normative reference to ISO 8575:2016, which is withdrawn, has been replaced by ISO 8575:2024.

A list of all the parts in the ISO 18487 series can be found on the ISO website.

Any feedback or questions on this document should be directed to the user's national standards body. A complete listing of these bodies can be found at www.iso.org/members.html.

# Introduction

This document is intended to harmonize the technical requirements for titanium tubes used in aerospace with design operating pressure of 35 MPa.

It is noted that, while ISO standards should normally refer only to SI units, large segments of the aerospace industry refer to other measurement systems as a matter of common working practice. The mention of "inch series" in the title of this document reflects this. It recognizes the fact that the nominal sizes referred to in the document, which are in common use in the aerospace industry, were originally defined in terms of fractional inches.

Although the tube sizes were originally defined, and are frequently referred to, in terms of non-SI units, all dimensions used in this document are in SI units with inch units given in addition for the convenience of those users more familiar with these.

It is further noted that the standard ISO decimal symbol "," (comma) is not used as common working practice for inch dimensions. A decimal point is used in the inch dimensions in this document as in many other aerospace standards.

NOTE The use of non-SI units and the decimal point in this document does not constitute general acceptance of measurement systems other than SI within International Standards.

# Aerospace series — Titanium ~~Tube~~tube for 35 MPa operating pressure — ~~Part 1: Inch Series~~

## Part 1: Inch series

## 1 Scope

This document is applicable to seamless tubing of circular cross-section made from titanium alloy and intended for use primarily in systems with system operating pressure of 35 MPa (5 080 psi) (Pressure Class J), but usage is not limited to such applications.

## 2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

ISO ~~4287~~21920-2, *Geometrical ~~Product Specifications~~product specifications (GPS) — Surface texture: Profile ~~method —~~ — Part 2: Terms, definitions and surface texture parameters*

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

ISO 8492, *Metallic materials — Tube — Flattening test*

ISO 8575:2024, *Aerospace series — Fluid systems — Hydraulic system tubing*

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

ISO 12573, *Aircraft — Tubing tolerances — Inch series*

EN 2003-~~-~~010, *Aerospace series — Titanium and titanium alloys — Test methods — Part 010: Sampling for determination of hydrogen content*

EN 3718, *Aerospace series — Test method for metallic materials — Ultrasonic inspection of tubes*

AS 4076, *Contractile strain ratio testing of titanium hydraulic tubing*

AMS 2634, *Ultrasonic inspection, thin wall metal tubing superseding*

ASTM E112, *Standard test methods for determining average grain size*

ASTM E1409, *Standard test method for determination of oxygen and nitrogen in titanium and titanium alloys by inert gas fusion*

ASTM E1941, *Standard test method for determination of carbon in refractory and reactive metals and their alloys by combustion analysis*

ASTM E1447, *Standard test method for determination of hydrogen in titanium and titanium alloys by the inert gas fusion thermal conductivity/infrared detection method*

ASTM E2371, *Standard test method for analysis of titanium and titanium alloys by direct current plasma and inductively coupled plasma atomic emission spectrometry (Performance-based test methodology)*

## 3 Terms and definitions

For the purposes of this document, the following terms and definitions apply.

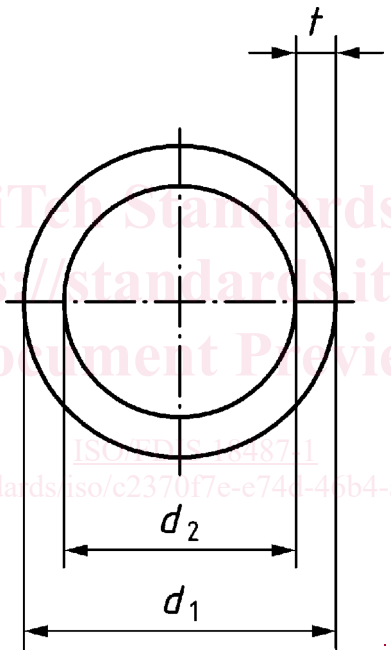
ISO and IEC maintain ~~terminological~~terminology databases for use in standardization at the following addresses:

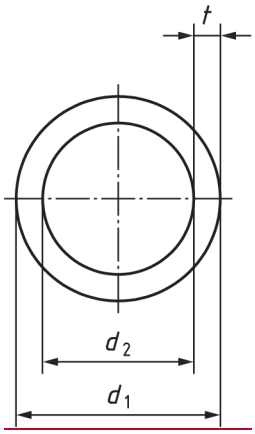
~~— — IEC Electropedia: available at~~

— ~~—~~ISO Online browsing platform: available at https://www.iso.org/obp

— ~~3.1~~IEC Electropedia: available at https://www.electropedia.org/

**3.1**
**outside diameter**
$d_1$
distance between any two points at 180° to each other around the outside of a single section across the tube






**Key**

$d_1$ outside diameter
$d_2$ inside diameter
$t$ wall thickness

**Figure 1 — Outside diameter, inside diameter and wall thickness**

### 3.2 3.2
**inside diameter**
$d_2$
distance between any two points at 180° to each other around the inside of a single section across the tube

### 3.3 3.3
**wall thickness**
$t$
thickness measured at a right angle across the tube wall

## 4 Dimensions

Unless otherwise specified by the purchaser, dimensions shall conform to ISO 8575:20162024, Table 2 that is relevant to Pressure Class J.

## 5 Tolerances

Unless otherwise specified by the purchaser, dimensional tolerances shall conform to ISO 12573.

## 6 Technical requirements

### 6.1 General

Except as otherwise mentioned in 6.2 to 6.13below, testing to establish compliance conformity with all of the technical requirements belowin this clause shall be conducted on a single sample per batch of tubes.

### 6.2 Composition

Chemical composition shall conform to the percentages by weight given mass fractions (in per cent) given in Table 1Table 1. Suitable methods of determination of composition are also given in Table 1Table 1. Other analytical methods may be used by agreement with the purchaser.

**Table 1 — Chemical composition**

Values in percentagesper cent

| Element | Al | V | Fe | $O_2$ | $N_2$ | $H_2$ | C | Y | Others | | Ti |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | Each | Total | |
| Minimum | 2,50 | 2,00 | | | | | | | | | Remainder |
| Maximum | 3,50 | 3,00 | 0,3 | 0,120 | 0,020 | 0,005 0 | 0,05 | 0,005[a] | 0,10[a] | 0,40[a] | |
| Method of determination | ASTM E2371 | | | ASTM E1409 | | ASTM E1447 or EN 2003–10010 | ASTM E1941 | ASTM E2371 | | | |

a Determination not required for routine acceptance.

## 6.3 Melting practice

Multiple melts are required. Inert gas flooding shall be used for all steps. Open air furnace melting is not permitted. Only vacuum arc remelting (VAR) is permissible for second and subsequent melts.

## 6.4 Heat treatment and delivery condition

Cold worked and stress relieved by heating in vacuum or inert atmosphere at a temperature of at least 370 °C and maintained for 30 min minimum.

Rotary straightening after final heat treatment is not permitted.

## 6.5 Tensile properties

Tensile properties at 15 °C for four samples per batch taken in the longitudinal direction shall meet the requirements set out in Table 2~~Table 2.~~ Test method should be according to EN 2002-~~-~~001 (or ASTM E8a). The method used shall be reported in the certificate. The length of the sample between the clamping jaws of the test equipment shall be at least 300 mm.

**Table 2 — Tensile properties**

| Property | | For tubing of diameter in mm (in) | |
|---|---|---|---|
| | | $6{,}35 < d_1 \leq 38{,}1$ ($0.250 < d_1 \leq 1.500$) | $d_1 = 6{,}35$ ($d_1 = 0.250$) |
| Tensile strength MPa (ksi) | Maximum | 1 030 (149) | 920 (133) |
| | Minimum | 870 (126) | 690 (100) |
| 0,2 % Proof stress MPa (ksi) | Minimum | 730 (106) | 655 (95) |
| Elongation %[a] | Minimum | 16[b] | 14 |

a Measured over 50 mm or 50,8 mm (2 inches).

b For tube diameters ≤ 9,53 mm, 14 % elongation is permissible.



## 6.6 Microstructure

### 6.6.1 General

Microstructure shall be determined by microscopic examination at a minimum of 400× magnification of both longitudinal and transverse sections. The microstructure shall consist of a stretched wrought structure with some areas of partially transformed beta. There shall be no oxygen rich layer such as alpha case or other surface contamination.

### 6.6.2 Grain size

The grain size shall be determined in accordance with ASTM E112 in the stress-relieved condition. If this is impossible due to excessive grain elongation caused by cold working, complete recrystallization heat treatment prior to grain size determination is permitted. Annealing temperature and holding time shall be stated in the certificate.

### 6.6.3 Contractile strain ratio (CSR)

When required by the purchaser, the CSR value shall be determined on the finished tube size by the method defined in AS 4076.