
**Aerospace series — Hydraulic tubing
joints and fittings — Planar flexure test**

*Série aéronautique — Joints et raccords des tuyauteries hydrauliques
— Essai de flexion plane*

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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 documents 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).

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. ISO shall not be held responsible for identifying any or all such patent rights. Details of any patent rights identified during the development of the document will be in the Introduction and/or on the ISO list of patent declarations received (see www.iso.org/patents).

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For an explanation on 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 the following URL: www.iso.org/iso/foreword.html.

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 9538:1996), of which it constitutes a minor revision.

The changes are as follows:

- the publication dates of ISO 7257 and ISO 7169 in the introduction were removed in order to reflect the most updated versions of those documents.

Introduction

This document describes a planar flexure test procedure for hydraulic tubing joints and fittings.

The test procedure can be applied as an alternative to the rotary test procedure specified in ISO 7257.

The qualification test procedures for tube fittings are specified in ISO 7169.

Other test methods can be used as long as they develop the same results as the procedure specified in this document.

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Aerospace series — Hydraulic tubing joints and fittings — Planar flexure test

1 Scope

This document specifies a flexure test procedure for reconnectable and permanent hydraulic tube joints.

This procedure is intended for conducting flexure tests on fittings with high-strength hydraulic tubes made of corrosion-resisting steel, titanium and aluminium for use on commercial and military aircraft.

2 Normative references

There are no normative references in this document.

3 Terms and definitions

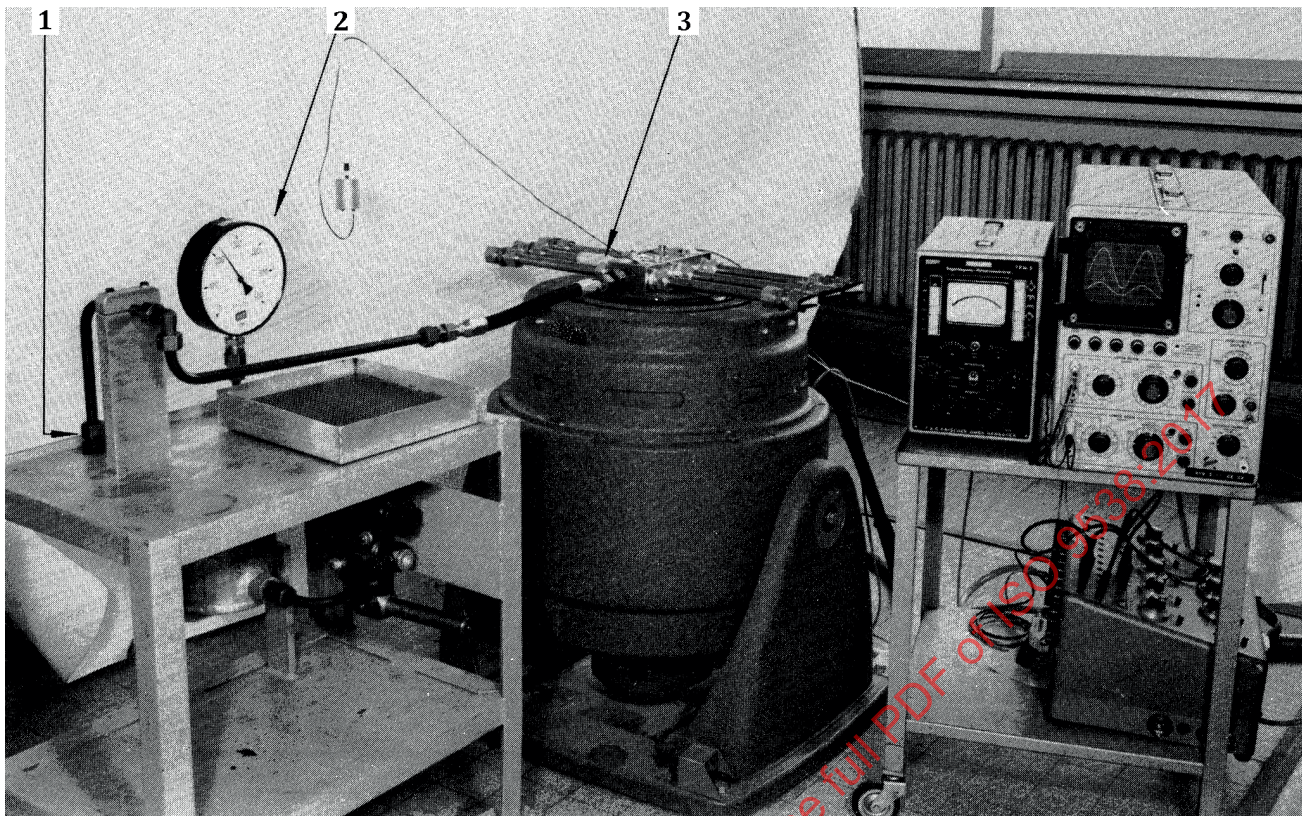
No terms and definitions are listed in this document.

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

- IEC Electropedia: available at <http://www.electropedia.org/>
- ISO Online browsing platform: available at <http://www.iso.org/obp>

4 Device for flexure test

The test device should be similar to that shown in [Figure 1](#). It shall consist of a vibrator, a manifold to receive at least six test specimens, and a hydraulic supply unit capable of constantly maintaining the static operating pressure during testing, including monitors inducing the shutdown of the system in the event of pressure drop.



Key

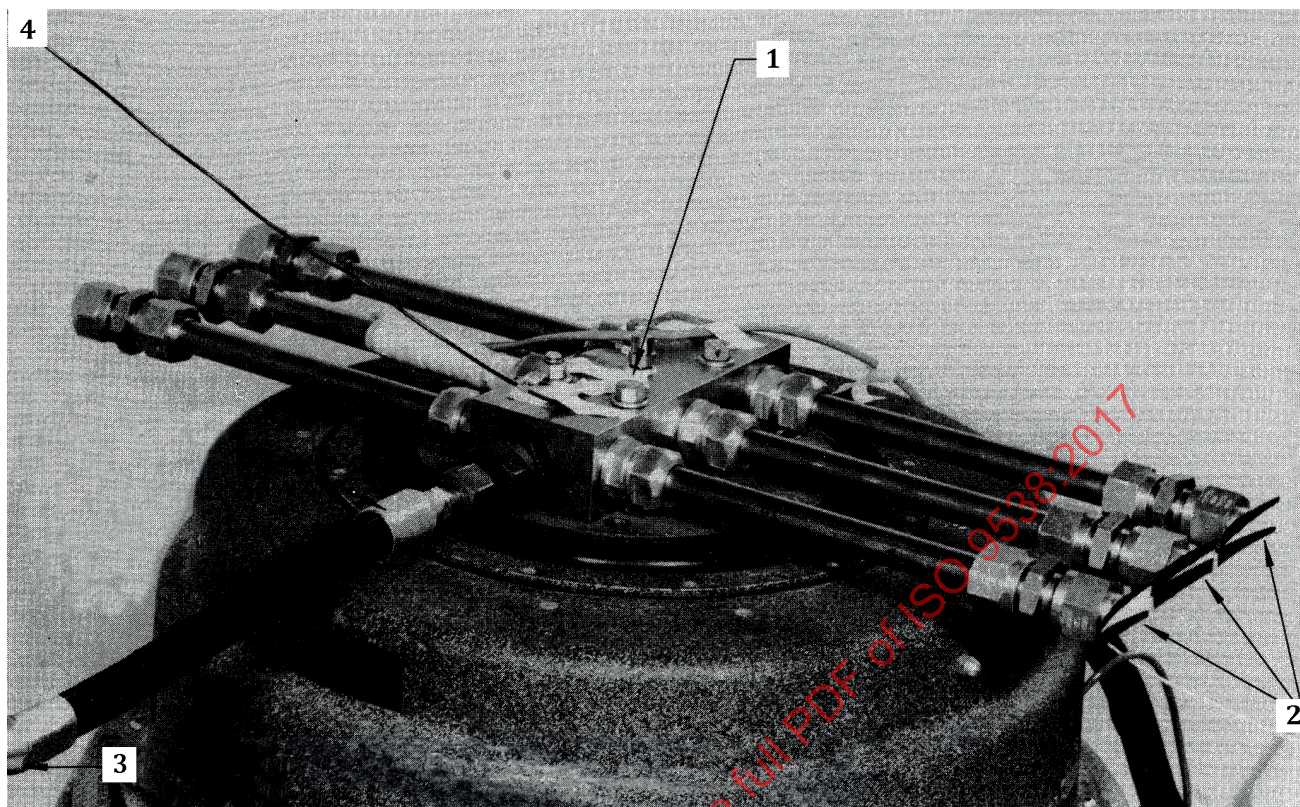
- 1 pressure supply
- 2 pressure gauge
- 3 test specimen

Figure 1 — Set-up of test drive

Three test specimens are attached to two opposite ends of the manifold, which is rigidly mounted on the vibrator. A hose assembly establishes the connection with the hydraulic supply unit.

The vibrator shall allow for vibration frequencies up to 300 Hz.

Details of the set-up are shown in [Figure 2](#).



Key

- 1 stress cycle in the tube during vibration
- 2 angle gauges for optical amplitude control
- 3 pressure generation and monitoring in the test specimen
- 4 acceleration cycle of vibrator

Figure 2 — Details of set-up

5 Flexure test specimens

The test specimens shall consist of the tube fitting to be tested (for example straight union), the test tube and the fitting to seal the tube.

6 Stress determination

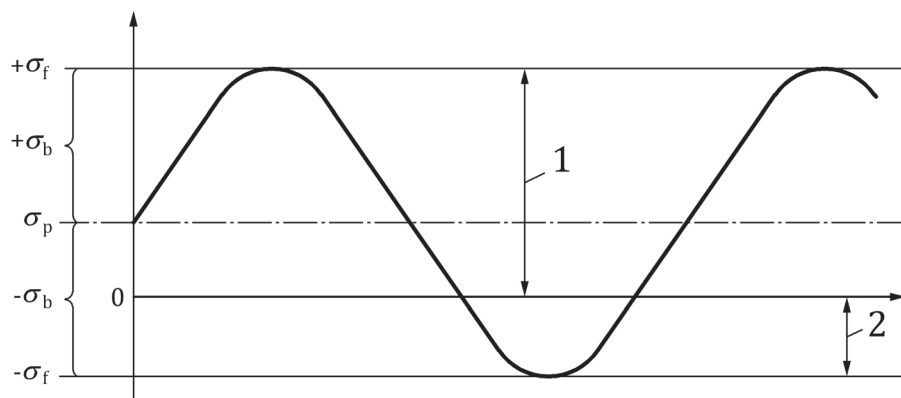
The maximum permissible flexure fatigue stress of the test tubing is determined for the combined stress level.

The combined stress, σ_f , is composed of the tensile stress, σ_p , resulting from the internal pressure and the wall thickness of the tube, and the bending stress, σ_b .

Strain gauges shall be used to demonstrate the bending stress, and the deflection can be checked during testing by means of angle gauges.

A typical stress cycle is illustrated in [Figure 3](#).

The bending stress, σ_b , is determined by the maximum permissible flexure fatigue stress of the test tube and shall be specified for each application.

**Key**

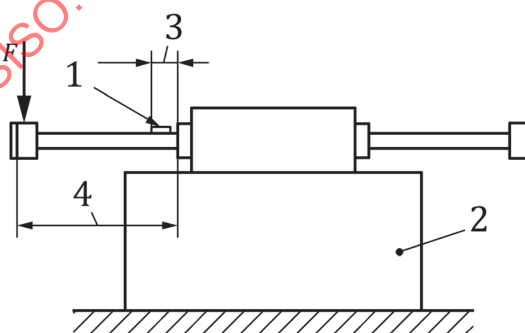
- 1 maximum stress
- 2 minimum stress
- σ_p mean axial stress produced by internal pressure
- σ_b stress caused by bending
- σ_f combined stress, $\sigma_p + \sigma_b$

Figure 3 — Typical test cycle**7 Procedure****7.1 Instrumentation and strain gauges**

A strain gauge shall be mounted on each test specimen.

They shall be mounted as shown in [Figure 4](#). Their location should be as follows.

- a) For tube sizes to DN 16: approximately 4 mm from the attachment-point tube to fitting.
- b) For tube sizes to DN 20 and above: approximately 8 mm from the attachment-point tube to fitting.

**Key**

- 1 strain gauge
- 2 vibrator
- 3 see [7.1](#)
- 4 length giving natural frequency of between 110 Hz and 120 Hz

Figure 4 — Location of gauges

7.2 Frequency

7.2.1 Test frequency

It is recommended to perform the test at approximately 100 Hz.

7.2.2 Natural frequency of the specimens

To minimize the power input of the vibrator used, the natural frequency of the specimens should be within the frequency range 110 Hz to 120 Hz.

The test frequency shall be approximately 10 % to 20 % below the natural frequency of the specimens to prevent their resonance range from being reached.

7.2.3 Determination of tube length

Screw the fully assembled tube, fitted with strain gauges, into the header in order to determine the tube length required. Connect the strain gauges, apply the nominal pressure and vibrate the tube. The tube length shall be adjusted until the natural frequency of the specimen is between 110 Hz and 120 Hz.

7.3 Bending stress calibration of test specimen

Submit the prepared tube to a static load (F) corresponding to the specified bending stress (see [Clause 4](#)) in order to produce the required moment. After the tube bending setting is complete, introduce the specified pressure and read the stress transmitted by the strain gauge on an oscilloscope.

Start the vibrator and increase the vibration amplitude of the vibrator until the oscillograph shows the previously determined stress value.

The angle gauge allows the deflection(s) to be read for further control. The angle gauge shall be mounted at the end cap of the test specimen. To control the deflection of the test specimen, a suitable stroboscope with variable flash frequency shall be used.

8 Requirements

The flexure test specimens shall withstand 10⁷ cycles.

Leakages and failures are not acceptable.