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

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

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Foreword

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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).

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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.

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.

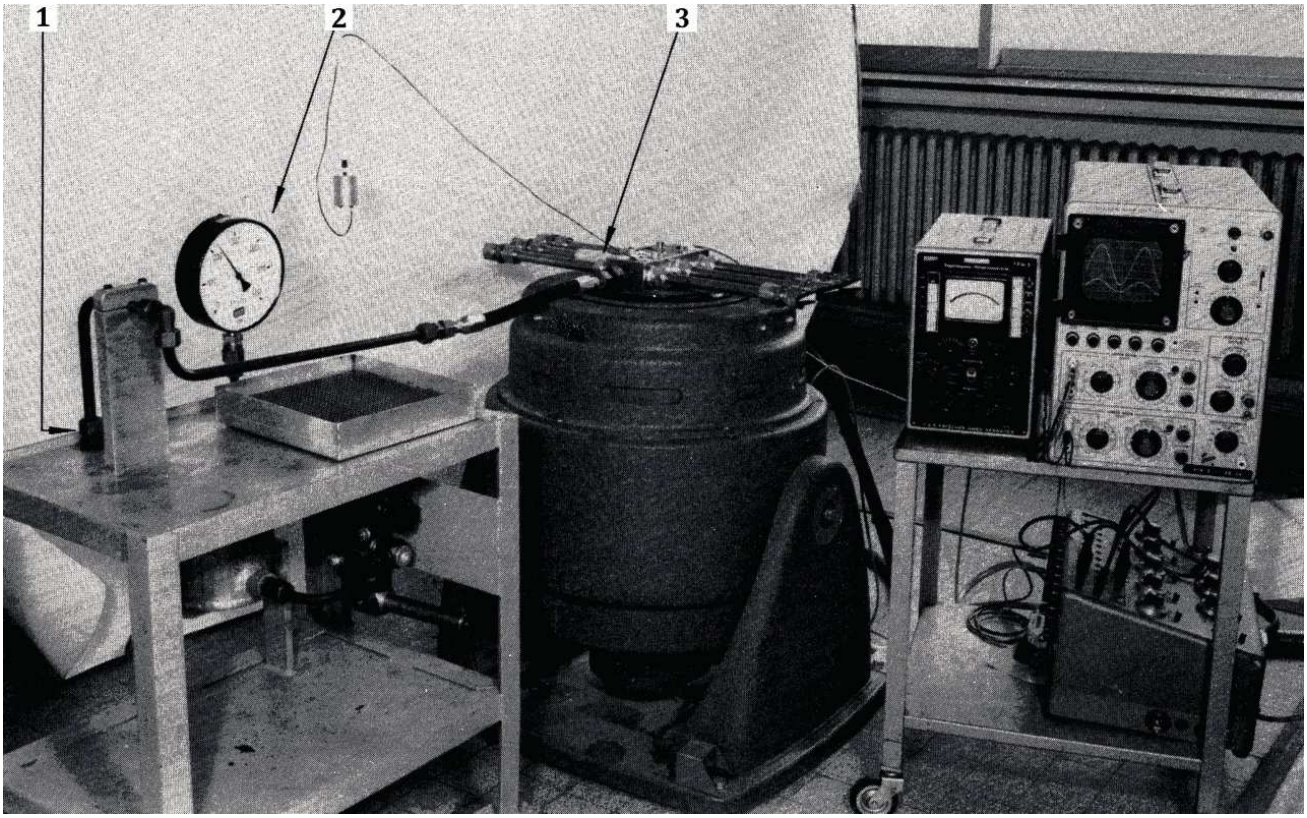
ISO and IEC maintain terminological databases for use in standardization at the following addresses:

— 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

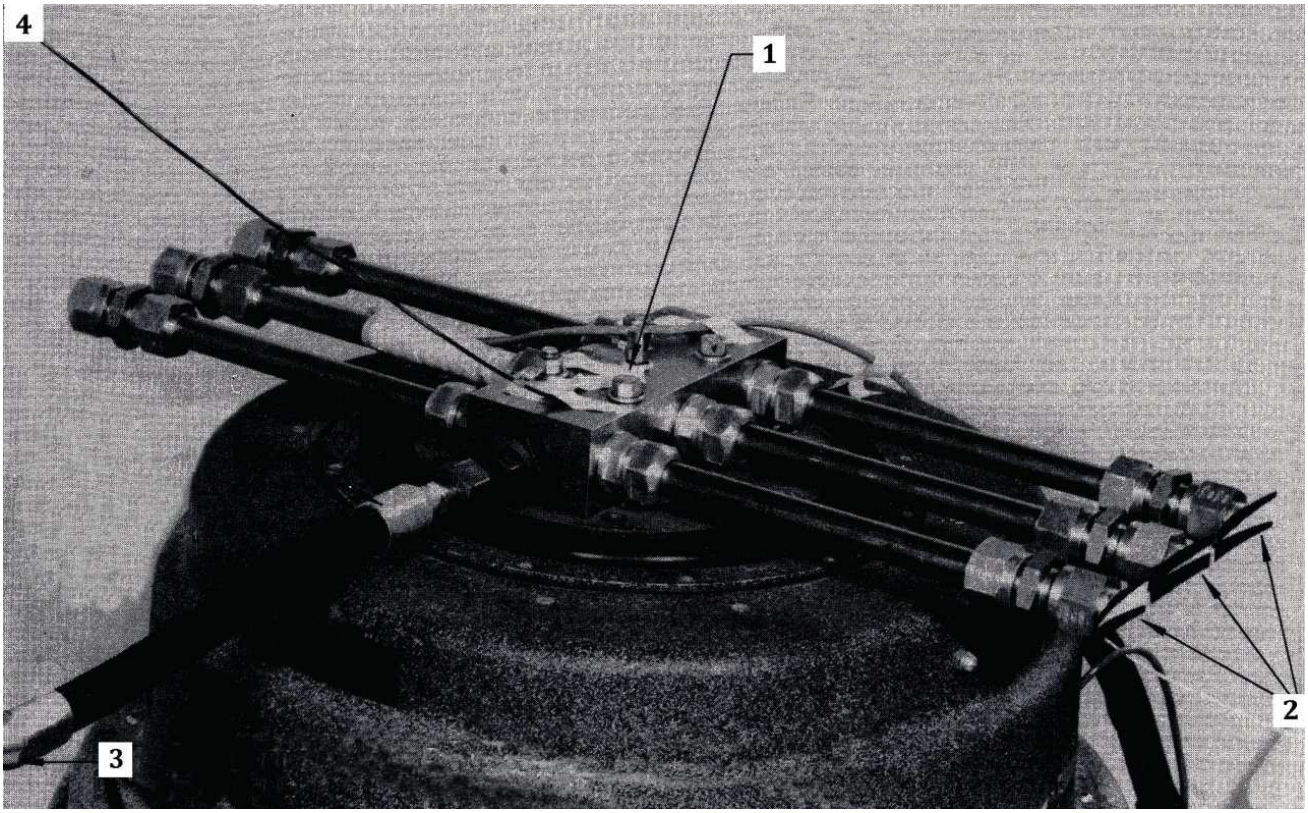
1 pressure supply
2 pressure gauge
3 test specimen

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

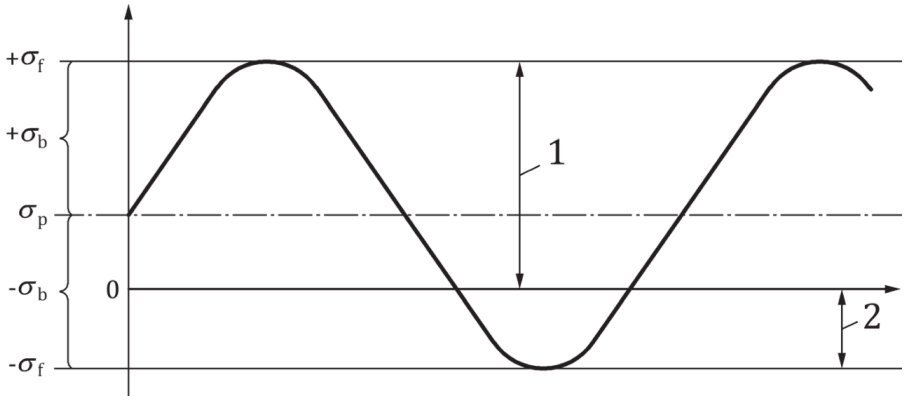
The maximum permissible flexure fatigue stress of the test tubing is determined for the combined stress level.

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

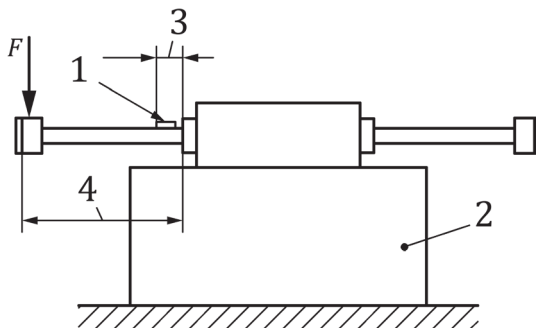
7.1 Instrumentation and strain gauges

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.

Bibliography

[1] ISO 7169, *Aerospace — Separable tube fittings for fluid systems, for 24 degree cones, for pressures up to 3 000 psi or 21 000 kPa — Procurement specification, inch/metric*

[2] ISO 7257, *Aircraft — Hydraulic tubing joints and fittings — Rotary flexure test*

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