INTERNATIONAL STANDARD

ISO 8574

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Aerospace — Hydraulic system tubing — Qualification tests

Aéronautique et espace — Tubes hydrauliques — Essais de qualification

Reference number
ISO 8574:1990(E)

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.

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.

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Aerospace — Hydraulic system tubing — Qualification tests

1 Scope

This International Standard specifies flexure, pressure impulse and burst test procedures for determining and classifying the fatigue strengths of bent aerospace hydraulic system tubing. The procedures are intended for high and low pressure system tubing qualification purposes or for the evaluation of new materials for hydraulic system tubing.

NOTE 1 Requirements for tubing used in aerospace hydraulic systems are given in ISO 8575:1990, *Aerospace — Fluid systems — Hydraulic system tubing*.

2 Normative reference

The following standard contains provisions which, through reference in this text, constitute provisions of this International Standard. At the time of publication, the edition indicated was 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 edition of the standard indicated below. Members of IEC and ISO maintain registers of currently valid International Standards.

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

3 Definitions

For the purposes of this International Standard, the following definitions apply.

3.1 proof pressure: The static pressure for testing hydraulic system tubing, a prescribed multiple of the nominal system or sub-system pressure.

3.2 tube failure: Leakage or rupture of the tube itself during test. Failure of a tube fitting or at the fitting sleeve interface shall not constitute a tube failure (see 7.1.2).

4 Test equipment

4.1 Flexure fatigue test equipment (see figure 1)

The test equipment shall incorporate an electromechanical vibrator or other facility capable of providing planar vibration at the required input within a frequency range of 5 Hz to 250 Hz. The equipment shall also be capable of maintaining constant pressures up to system pressure in the test specimen using the applicable hydraulic fluid. It shall also provide an automatic shut-down facility to actuate at the failure of a specimen or when significant leakage occurs. Facilities for operating at various constant temperatures shall also be available.

4.2 Pressure impulse equipment

The test equipment shall be capable of producing the pressure impulse curve specified in ISO 6772. (See 7.4.)

4.3 Burst pressure equipment

The test equipment shall be capable of producing the pressure requirements specified in 7.5.

5 Test specimens

5.1 Configuration

The test specimens shall consist of bent lengths of the relevant tubing of dimensions as given in figure 1 or figure 2, or in figure 3 and table 1, according to the case, manufactured using production techniques and requirements, plus test fittings and adaptors where required. Except where otherwise specified, the bend radius of the specimens shall be the minimum required for the particular aerospace project.

5.2 Pre-test checks

5.2.1 The outside diameter and wall thickness of the tubing shall be measured and recorded, together with the ovality of the bend.

5.2.2 Three straight samples of the test tubing shall also be checked to determine the basic material properties, i.e. yield tensile strength (0,2 % proof stress) and ultimate tensile strength and elongation.

6 Stress determination (flexure fatigue)

6.1 Type of strain gauges

The desired bending stress level for each specimen is induced by deflection of the specimen and shall be determined using strain gauges.

The type of the strain gauges shall be as follows:

— for tube sizes up to and including 16 mm outside diameter: approximately 4 mm gauge;

— for tube sizes above 16 mm outside diameter: approximately 6 mm gauge.

The width of the gauge must be compatible with the tube outside diameter, i.e. 25 % or less of the tube diameter.

Temperature effects shall be taken into account where necessary.

6.2 Position of strain gauges

The strain gauges shall be mounted in pairs 180° apart in the plane of maximum strain on the straight portion of the tube, at a distance of 4,5 mm $\pm$ 0,5 mm from the bend (see figure 1). The output of the gauges shall be conditioned and processed by suitable instrumentation to measure the bending stress only.

6.3 Monitoring

The stress levels shall be monitored at regular intervals of time throughout the test period and, if any reduction in stress levels is noted, then the lower value, prior to failure being evidenced, shall be used for plotting the S/N curve. (See figure 4.)

7 Testing

7.1 General

7.1.1 Temperature

Unless otherwise specified [e.g. when testing to ISO 6772 (see 7.4)] testing shall be carried out at ambient temperature unless the fatigue characteristics of the material in question are significantly affected by the extreme temperature limit envisaged, in which case the temperature spectrum shall be as defined by the particular aerospace requirements.

7.1.2 Fitting failures

In the event of a failure during testing of a tube fitting or at the fitting sleeve interface, the fitting(s) shall be replaced and the test continued, or a new tube specimen shall be tested.

7.2 Proof pressure test

Prior to commencement of testing, all specimen tube assemblies shall be subjected to a proof pressure which, unless otherwise specified, shall be twice the system nominal operating pressure.

7.3 Flexure fatigue testing

7.3.1 A minimum of four sets of two specimens for each size required to be tested, mounted in a rig as specified in 4.1, shall be subjected to flexure testing. The tensile stress due to bending for each failure shall be plotted on a semi-log plot. The recommended sequence for each set of two specimens is given in 7.3.3, i.e. one set of two specimens at each of the flexure cycle ranges.

7.3.2 The specimens shall be pressurised to the system nominal operating pressure level before flexure is applied and a zero reading obtained from the strain gauges.

7.3.3 In order to obtain adequate definition of the S/N curve, the following minimum failure distribution is recommended:

5 000 to 50 000 cycles: 2 failures;

50 000 to 500 000 cycles: 2 failures;

500 000 to 5×10^6 cycles: 2 failures;

plus two specimens equalling or exceeding 10^7 cycles.

NOTES

2 When S/N curves have been established, a single point test to the requirements of 8.1.1 may be substituted.

3 An illustration of characteristic S/N curves is given in figure 4.

7.4 Pressure impulse testing

A minimum of six specimens for each size required to be tested, mounted as specified in figure 2 or in figure 3 and table 1, shall be subjected to pressure impulsing in accordance with ISO 6772.

7.5 Burst testing

At least two specimens of each size required to be tested, mounted as specified in figure 2, shall be subjected to hydraulic pressure. The pressure shall be increased at a rate of 150 000 kPa/min ± 37 500 kPa/min until the tube bursts.

Expansion of the tube before burst is permissible.

7.6 Dimensional check

On completion of the flexure fatigue and pressure impulse tests, the specimens shall be sectioned and the wall thickness around the bend(s) checked.

8 Requirements

8.1 Flexure fatigue test

8.1.1 The results obtained shall demonstrate a fatigue life of 10^7 cycles when specimens are subjected to a constant operating pressure plus alternating bending stresses of 100 MPa for steel, titanium and high-strength alloy tube materials, and of 36 MPa for aluminium alloy tube materials.

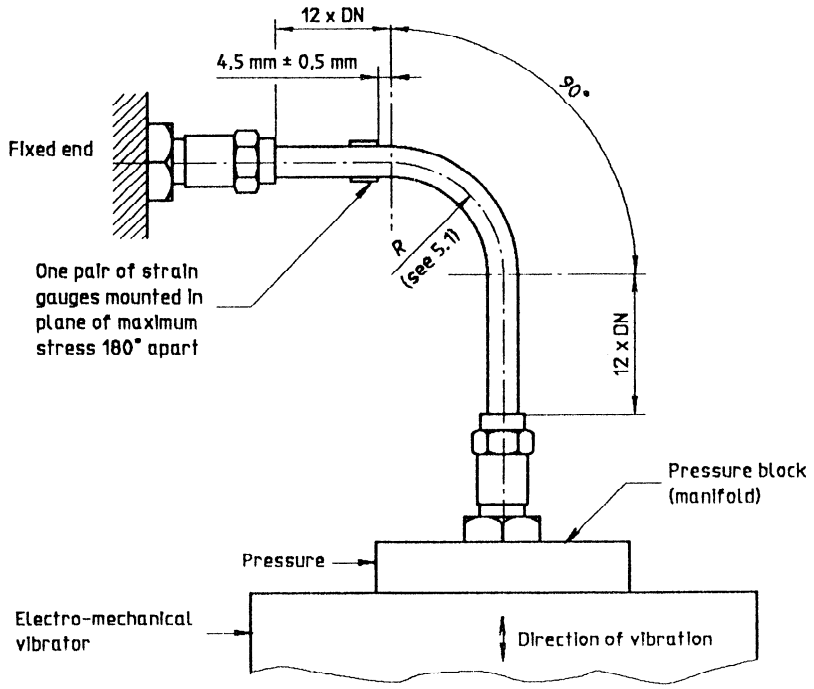
8.1.2 Alternatively, the S/N curve can be compared to previously used results in order to obtain a measure of acceptability.

8.2 Pressure impulse test

The required use is dependent on the life of the aerospace vehicle, but as a minimum requirement the results shall demonstrate a life of 200 000 cycles when the specimens are subjected to maximum impulse pressures as specified for the system.

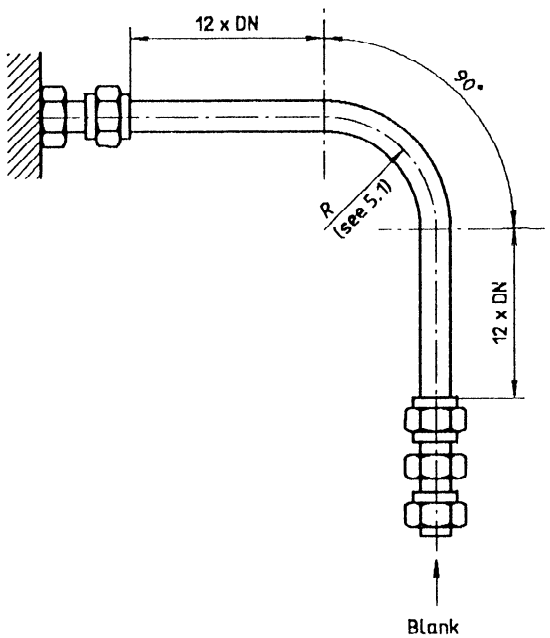
8.3 Burst test

As a minimum requirement, each tube shall withstand, without failure, a burst pressure related to the system operating pressure plus any safety factor required for the particular application.



Notes
1) DN = Nominal outside diameter of tube.
2) One specimen only is shown for clarity.

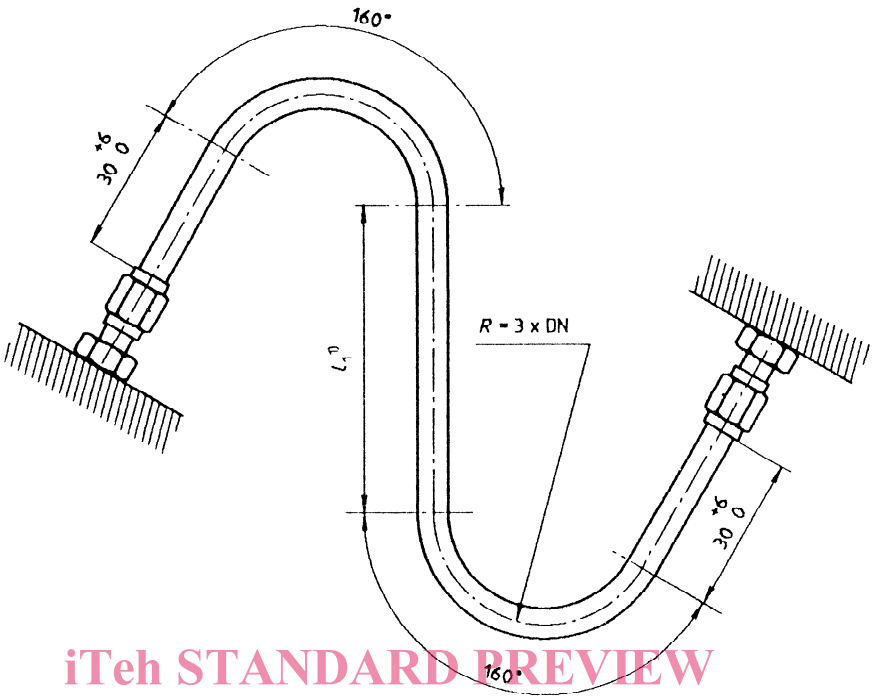
Figure 1 — Flexural fatigue test — Mounting arrangement, specimen dimensions and strain gauge configuration



Note – DN = Nominal external diameter of the tube.

Figure 2 — Specimen for pressure impulse and burst tests

Dimensions in millimetres



1) See table 1.

Figure 3 — Alternative specimen (S-tube) for impulse testing

Table 1 — Length, alternative specimen for impulse testing (see figure 3)

Dimensions in millimetres

Nominal tube size	l_1 $^{+13}_{0}$	Total tube length $^{+25}_{0}$
DN06	65	300
DN10	65	300
DN12	90	400
DN16	140	510
DN20	140	570
DN25	140	670

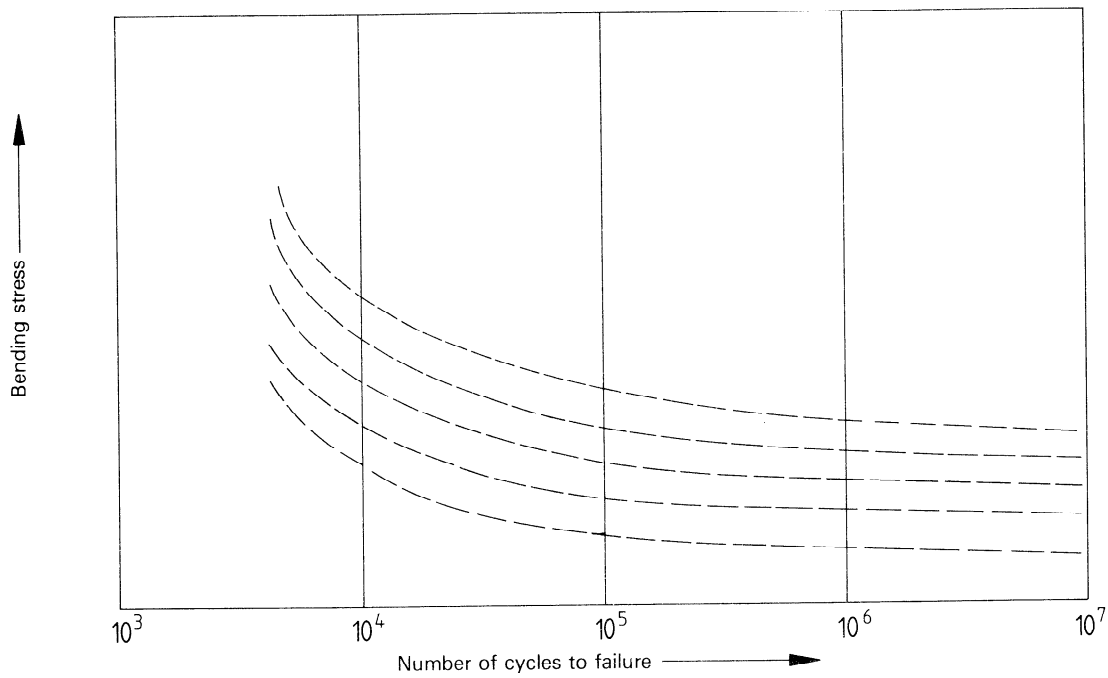


Figure 4 — Characteristic S/N curves

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Descriptors: aircraft, aircraft equipment, hydraulic equipment, hydraulic systems, pipes (tubes), tests.

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