



AEROSPACE STANDARD

MA2006
(ISO/DIS 8574)

Issued 1988-08
Reaffirmed 2015-08

Hydraulic Tubing - Qualification Test Requirements

RATIONALE

MA2006 has been reaffirmed to comply with the SAE five-year review policy.

FOREWORD

This standard is a word-for-word equivalent of ISO/DIS 8574 with the exception of (1) deleting the option for torsion test, (2) adding subtitles, and (3) adding inch size tubing sizes and specimen lengths to Table I.

Changes in this reaffirm are format/editorial only.

1. SCOPE:

1.1 Scope and Field of Application:

This international standard establishes flexure and pressure impulse test procedures for determining and classifying the fatigue strengths of bent aircraft hydraulic tubing. The procedures are intended for use with high- and low-pressure system assemblies for evaluation of new materials or for qualification purposes.

2. REFERENCE:

2.1 SAE Publications:

Available from SAE, 400 Commonwealth Drive, Warrendale, PA 15096-0001.

MA2002 (ISO 6772) Impulse testing of hydraulic hose, tubing, and fitting assemblies

3. DEFINITIONS:

3.1 Terminology:

Tube failure: Leakage or rupture of the tube itself during test. Failure of the tube coupling or at the coupling sleeve interface shall not constitute a tube failure.

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3.2 Fitting Failure:

In the event of such a failure, the fittings shall be replaced and the test continued or a new specimen shall be tested.

4. TEST EQUIPMENT:

4.1 Flexure Test Equipment:

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 - 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 shutdown facility to actuate at the failure of the specimen or significant leakage, and facilities for operating at various constant temperatures shall be available.

4.2 Pressure Impulse Equipment:

The test equipment shall be capable of producing the pressure impulse curve specified in MA2002 (ISO 6772).

5. TEST SPECIMENS:

5.1 Specimens for Flexure Testing:

Test specimens shall consist of 90-degree bent lengths of the relevant tubing, as shown in Figure 1, manufactured using production techniques and requirements, plus test fittings and adaptors where required.

5.2 Specimens for Impulse Testing:

S-shaped specimens as shown in Figure 2 and Table 1 shall be used for impulse testing.

5.3 Tube Bend and Material Data:

The outside diameter and wall thickness of the tubing shall be measured and recorded, together with the ovality at the bend. The bend radius of the specimens shall be the minimum required by the particular aircraft project. In addition, test samples after failure shall be sectioned and the wall thickness around the outside of the bend checked. Three samples of the test tubing shall also be checked to determine the basic material properties, that is, yield tensile strength (0.2% proof stress) and ultimate tensile strength and elongation.

6. STRESS DETERMINATION (FLEXURE FATIGUE):

6.1 Strain Gages, Type and Location:

The desired bending stress level for each specimen is induced by deflection of the specimen and shall be determined using strain gages. The type and location of the strain gages shall be as follows:

Type: For the tube sizes up to and including 16 mm (5/8 in) outside diameter, use 4 mm (0.156 in) gage, maximum width. For tube sizes above 16 mm (5/8 in) outside diameter, use 6 mm (0.234 in) gage, maximum width.

NOTE: the width of the gage must be compatible with the tube outside diameter, that is 25% or less of tube diameter. Temperature effects shall be taken into account where necessary.

Location: Two gages shall be mounted 180 degrees apart in the plane of maximum strain.

6.2 Strain Gages, Position and Monitoring:

The strain gages shall be positioned on the straight portion of the tube at a distance of $4.5 \text{ mm} \pm 0.5 \text{ mm}$ ($0.177 \text{ in} \pm 0.02 \text{ in}$) from the bend as shown in Figure 1. Each pair of gages shall form half of a wheatstone bridge and shall measure bending stress only. The stress levels shall be monitored at regular intervals 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.

7. TESTING:

7.1 General:

7.1.1 Proof Test: Prior to commencement of testing, the specimen tube assemblies shall be subjected to a proof pressure as required for the system operating pressure.

7.1.2 Temperature: Unless otherwise specified (for example, MA2002 (ISO 6772), see clause 7.3), 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 aircraft requirements.

7.2 Flexure Fatigue Testing:

7.2.1 Number of Specimens, Plotting Bend Stress: A minimum of four sets of two specimens in each size shall be subjected to flexure testing, and the tensile stress due to bending for each failure shall be plotted on a semilog plot. The recommended sequence for each set of two specimens is given in 7.2.3 (that is, one set of two specimens at each of the flexure cycle ranges).