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Hydraulic fluid power -- Fatigue pressure testing of metal pressure-containing envelopes -- Part 1: Test method

Transmissions hydrauliques -- Essais de fatigue des enveloppes métalliques sous pression -- Partie 1: Méthode d'essai

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Hydraulic fluid power — Fatigue pressure testing of metal pressure-containing envelopes —

Part 1: Test method

Transmissions hydrauliques — Essais de fatigue des enveloppes métalliques sous pression —

Partie 1: Méthode d'essai

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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.

International Standards are drafted in accordance with the rules given in the ISO/IEC Directives, Part 3.

The main task of technical committees is to prepare International Standards. 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.

Attention is drawn to the possibility that some of the elements of this part of ISO 10771 may be the subject of patent rights. ISO shall not be held responsible for identifying any or all such patent rights.

ISO 10771-1 was prepared by Technical Committee ISO/TC 131, *Fluid power systems*, Subcommittee SC 8, *Product testing*.

ISO 10771 consists of the following parts, under the general title *Hydraulic fluid power — Fatigue pressure testing of metal pressure-containing envelopes*:

— *Part 1: Test method*

— *Part 2: Test rating* (in preparation)

Annexes A to D form a normative part of this part of ISO 10771.

Introduction

In hydraulic fluid power systems, power is transmitted and controlled under pressure within an enclosed circuit. It is important for the manufacturer and user of hydraulic components to have information on their global reliability because of the importance of the fatigue failure mode and the relationship this has with the functional safety and service life of such components. This part of ISO 10771 provides a method for fatigue testing the pressure-containing envelope provided by hydraulic components.

During operation, components in a system may be subjected to loads that arise from:

— internal pressure;

— external forces;

— inertia and gravitational effects;

— impact or shock;

— temperature changes or gradients.

The nature of these loads can vary from a single static application to continuously varying amplitudes, repetitive loadings and even shocks. It is important to know how a component can withstand these loads, but this part of ISO 10771 addresses only the loading due to internal pressure.

There are many ways in which internal pressure loads are imposed upon a component. This part of ISO 10771 considers a broad range of waveforms within prescribed time limits, temperatures and environmental conditions, and only upon metals. It is expected that these limitations could still provide sufficient common ground for a method of fatigue pressure testing metal pressure-containing envelopes in hydraulic fluid power components. This method, therefore, provides the system designer with certain information to assist in a selection of components for an application. The system designer still has the responsibility of considering the other loading characteristics described above and determining how they could affect the component's pressure-retaining capability.

Hydraulic fluid power — Fatigue pressure testing of metal pressure-containing envelopes —

Part 1: Test method

1 Scope

This part of ISO 10771 specifies a method of fatigue testing the pressure-containing envelopes of components used in hydraulic fluid power systems under sustained steady cyclic internal pressure loads.

This part of ISO 10771 is only applicable to component pressure-containing envelopes that:

— are manufactured from metals;

— are operated at temperatures that exclude creep and low-temperature embrittlement;

— are only subjected to pressure-induced stresses;

— are not subjected to loss of strength due to corrosion or other chemical action;

— may include gaskets, seals and other non-metallic components; however, these are not considered part of the pressure-containing envelope being tested, (see note 3 in 5.5).

This part of ISO 10771 does not apply to piping as defined in ISO 4413 (i.e. connectors, hose, tubing, pipe). See ISO 8434-5, ISO 6803 and ISO 6605 for methods of fatigue testing of piping devices.

This part of ISO 10771 establishes a general test method that is applicable for many hydraulic fluid power components, but additional requirements or more specific methods that may be required for particular components are contained in the annexes or other standards.

2 Normative references

The following normative documents contain provisions which, through reference in this text, constitutes provisions of this part of ISO 10771. For dated reference, subsequent amendments to, or revisions of, any of these publications do not apply. However, parties to agreements based on this part of ISO 10771 are encouraged to investigate the possibility of applying the most recent editions of the normative documents indicated below. For an undated reference, the latest edition of the normative document referred to applies. Members of ISO and IEC maintain registers of currently valid International Standards.

ISO 4413:1998, *Hydraulic fluid power — General rules relating to systems*

ISO 5598:1985, *Fluid power systems and components — Vocabulary*

ISO 9110-1:1990, *Hydraulic fluid power — Measurement techniques — Part 1: General measurement principles*

ISO 9110-2:1990, *Hydraulic fluid power — Measurement techniques — Part 2: Measurement of average steady-state pressure in a closed conduit*

3 Terms and definitions

For the purposes of this part of ISO 17701, the terms and definitions given in ISO 5598 and the following apply.

3.1
upper cyclic test pressure
p_U
minimum value of the highest level of the specified test pressure cycle

3.2
lower cyclic test pressure
p_L
maximum value of the lowest level of the specified test pressure cycle

3.3
cyclic test pressure range
Δ_p
difference between the upper and lower cyclic test pressures during a fatigue test

3.4
pressure-containing envelope
elements of a component that contain the pressurized hydraulic fluid, and the means to secure the elements (bolts, welds, etc.)

NOTE 1 Gaskets and seals are not considered as part of the pressure-containing envelope.

NOTE 2 See annexes for component definitions.

4 Test conditions

4.1 Remove entrapped air from the test component and circuit before starting each test.

4.2 The temperature of the hydraulic fluid in the component shall be in the range 15 °C to 80 °C. The temperature of the component shall be a minimum of 15 °C.

5 Test equipment and preparation

5.1 The test equipment and circuit shall be able to generate and repeat the pressure cycle as specified in 7.1.

5.2 Pressure transducer(s) shall be mounted directly into the test component, or as near as possible, so as to record the internal conditions applied to the component. Any restrictions between the transducers and the pressure-containing envelope being tested should be avoided.

5.3 Any non-corrosive hydraulic fluid that has a kinematic viscosity not greater than 60 mm^2/s at the test temperature shall be used as the pressurizing medium.

5.4 Different pressures shall be applied to separate portions of the test components as dictated by design specifications.

5.5 It shall be verified that the ratio of induced stress to pressure, under static loading conditions, is also attained at the test cycling rate, especially when:

— pressures have to penetrate between close-fitting parts;

— large components are tested;

— hysteresis in joints can significantly affect stresses.

NOTE 1 Strain gauges may be used to verify this ratio and, if used, should be located externally in an area of high strain.

NOTE 2 It is permissible to make modifications to the test samples to facilitate cyclic or burst tests, providing such modifications do not increase the pressure capabilities of the pressure-containing envelope.

NOTE 3 It is permissible to replace gaskets and seals that fail during the test, as long as preloads in stressed elements are the same after reassembly as they were before disassembly. It is possible that fastener preloads may decrease during fatigue testing. Fastener preloads should be set to this reduced level when seals or gaskets are replaced.

5.6 Safety procedures shall be followed in order to protect personnel and test equipment during the test (see ISO 4413).

6 Accuracy

6.1 Instrumentation shall be accurate to within the following limits:

— pressure: ± 1,0 % of the upper cyclic test pressure;

— strain: ± 1 % of the value obtained at the upper cyclic test pressure;

— time: ± 0,002 s resolution;

— temperature: ± 2 °C.

6.2 Use pressure transducers, amplifiers and recording devices with a combined system frequency response such that in the frequency range 0 kHz to 2 kHz, the amplitude ratio is within 0 dB and –3 dB.

6.3 Instruments and procedures shall conform to ISO 9110-1 and ISO 9110-2.

7 Test procedure

7.1 Cyclic pressure test

7.1.1 Test pressure waveform

The test pressure waveform shall achieve the upper and lower levels for the time periods as specified in 7.1.2. For the purposes of illustration only, a typical test pressure waveform is shown in Figure 1.