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Mazdoor Kisan Shakti Sangathan
"The Right to Information, The Right to Live"

"पुराने को छोड़ नये के तरफ"
Jawaharlal Nehru
"Step Out From the Old to the New"


"ज्ञान एक ऐसा खजाना है जो कभी चुराया नहीं जा सकता है"
Bhartrhari—Nitisatakam
"Knowledge is such a treasure which cannot be stolen"
Indian Standard

METHOD OF TEST FOR CYLINDERS FOR OIL HYDRAULIC SYSTEMS

(First Revision)

ICS 23.100.20
FOREWORD

This Indian Standard (First Revision) was adopted by the Bureau of Indian Standards, after the draft finalized by the Hydraulic Fluid Power Systems Sectional Committee had been approved by the Basic and Production Engineering Division Council.

In hydraulic fluid power systems, power is transmitted and controlled through a liquid under pressure in an enclosed circuit. One component of such systems is the hydraulic fluid power cylinder. This is a device that converts power into linear mechanical force and motion. It consists of a movable element, that is a piston and piston rod, operating within a cylindrical bore.

This standard was first published in 1983. This revision has been taken up to include cushioning test in line with ISO 10100: 1990 ‘Hydraulic fluid power — Cylinders — Acceptance test’ issued by the International Organization for Standardization (ISO). This revision also includes Amendment No. 1 to IS 10585 : 1983.

For the purpose of deciding whether a particular requirement of this standard is complied with, the final value, observed or calculated, expressing the result of a test or analysis, shall be rounded off in accordance with IS 2 : 1960 ‘Rules for rounding off numerical values (revised)’. The number of significant places retained in the rounded off value should be the same as that of the specified value in this standard.
Indian Standard

METHOD OF TEST FOR
CYLINDERS FOR OIL HYDRAULIC SYSTEMS
(First Revision)

1 SCOPE

This standard prescribes the method of test for evaluating the performance requirements of double acting cylinders used in oil hydraulic systems.

NOTE — While the variation in the standard refers to a single-rod-ended cylinder, the test procedure is applicable to double-rod-ended type also.

2 REFERENCE

The following Indian Standard contains provisions which through reference in this text, constitute provisions of this standard. At the time of publication, the edition indicated was valid. The standard is subject to revision and parties to agreements based on this standard are encouraged to investigate the possibility of applying the most recent edition of the standard indicated below:

<table>
<thead>
<tr>
<th>IS No.</th>
<th>Title</th>
</tr>
</thead>
<tbody>
<tr>
<td>10416 : 1992/</td>
<td>Fluid power systems and components</td>
</tr>
<tr>
<td>ISO 5598 : 1985</td>
<td>vocabulary (first revision)</td>
</tr>
</tbody>
</table>

3 DEFINITIONS

3.1 Rated Pressure

The qualified maximum operating pressure which is recommended for a component or a system by the manufacturer.

3.2 Proof Pressure

Test pressure, in excess of the rated operating pressure, which causes no permanent deformation, excessive external leakage or other malfunction.

3.3 Static Friction (Packing Drag)

The breakaway force (pressure) required to move the piston with all external forces (either mechanical or hydraulic) removed or in balance.

3.4 Other terms/definitions used shall be as per IS 10416.

4 TEST CONDITIONS AND EQUIPMENT

4.1 Suitable test rigs shall be made to carry out the different tests specified in this standard.

4.2 The test cylinder shall be mounted as per manufacturer’s recommendation.

4.3 The test fluid shall be as per manufacturer’s recommendation. The proof pressure and static friction characteristics may be tested at ambient conditions. The internal leakage and endurance test shall be carried out at 50 ± 2°C of the test fluid in the case of mineral oil. In case of other fluids the temperature for test shall be as agreed to between the manufacturer and the user.

4.4 The requirement of filtration of the test fluid in the circuit shall be as per manufacturer’s recommendation.

4.5 The accuracy of measurement of pressure shall be ± 3 percent.

5 TEST PROCEDURE

5.1 Proof Pressure Test

Keeping the piston at its mid-stroke and the rod secured to a test fixture, each end of the piston shall in turn be pressurized gradually to 1.5 times the rated pressure and held there at for a duration of 3 min. The other port shall be vented during this period.

Check for external leakage at ports, end weldments ‘O’ rings rod seal.

NOTE — For routine inspection tests, the proof pressure test may be limited to check cylinders as pressure vessels, on mutual agreement between the manufacturer and the user. The cylinders shall then be tested at end positions only without anchoring the rod.

5.2 Static Internal Leakage

5.2.1 A cylinder which has successfully completed the proof pressure test in accordance with 5.1 shall qualify for this test.

5.2.2 The test cylinder shall be stroked adequately prior to test run to eliminate entrapped air and to establish the test temperature.

5.2.3 The piston rod shall be positioned fully extended, the rod end port shall be vented and the cap end port shall be pressurized to the rated working pressure.

5.2.4 The oil flow from the open port over a period of 3 min, starting from 30 s after attaining the required test pressure shall be measured and recorded.

5.2.5 The pressure behind the piston shall be reduced to 3 percent of the rated pressure and the measurement
in accordance with 5.2.4 shall be repeated.

5.2.6 The port connections shall be interchanged and the tests in accordance with 5.2.3 to 5.2.5 shall be repeated with the piston rod fully retracted.

NOTE — For strokes longer than 200 mm, the internal leakage test shall be carried out at mid-stroke also.

5.3 Static Friction/Packing Drag (Breakaway Pressure)

5.3.1 A cylinder which has successfully passed the proof pressure test in accordance with 5.1 and the static internal leakage test in accordance with 5.2 shall be used for this test.

5.3.2 The cylinder shall be connected to a pressure source and reciprocated in the test rig for a proper run-in and ensure defined breakaway pressure.

5.3.3 The piston rod shall be fully retracted and the pressure source connected to the cap end port. The rod end port shall be vented. Two minutes after so positioning, the cap end shall be gradually pressurized to initiate the piston rod movement. The breakaway pressure shall be recorded.

5.3.4 The piston rod shall be positioned fully extended. The rod end port shall be connected to the pressure source and the other port shall be vented. The measurement in accordance with 5.3.3 shall be repeated to obtain the breakaway pressure on the rod end.

5.4 Cushioning Test

When the throttle screws or damping valves are closed on commencement of cushioning, the cylinder rod should show a marked deceleration before the end stroke is reached.

5.5 Endurance Test

5.5.1 A cylinder which has successfully passed the proof pressure test shall be used for this test.

5.5.2 The cylinder shall be subjected to an internal leakage test in accordance with 5.2.

5.5.3 The cylinder shall be mounted in an endurance test rig and cycled end to end excluding cushion region at 130 percent of rated pressure. Another hydraulic cylinder connected in line can be used conveniently for loading the test cylinder externally (Fig. 1). The rate of pressure rise in the cylinder, the cycling rate and the total number of cycles shall be as agreed upon between the manufacturer and the user.

5.5.4 External leakage shall be measured and recorded after the run-in test end subsequently at every 10 000 cycles till completion of endurance test.

Fig. 1 Schematic Diagram for Endurance Test
5.5.5 The cylinder shall be subjected to an internal leakage test in accordance with 5.2 at midway through and at the end of endurance test.

NOTE — The test cylinder shall not be modified or repaired before or during the endurance test. Pin joints at mounting shall however be greased or oiled if necessary.

6 TEST RESULTS

6.1 The cylinder shall be considered as having successfully passed the proof pressure test, if no evidence is recorded of any permanent deformation, structural failure or external loss of fluid other than through vented port during the proof pressure test.

6.2 From the values measured in 5.2, the static internal leakage shall be computed and presented in terms of cubic centimetre/min (see Table 1).

6.3 The break away pressure in either direction shall be presented as the static friction characteristics of the cylinder (see Table 1).

6.4 The behaviour of the cylinder over the period of endurance test may be presented by plotting internal and external leakage or rod leakage against the number of cycles, along with the test conditions.

7 CLASSIFICATION OF TESTS

7.1 Routine Inspection Tests

Routine inspection tests shall constitute the modified proof pressure test given in 5.1 and internal leakage test given in 5.2.

7.2 Type Tests

Type tests shall constitute all the tests specified at 5.1 to 5.5.

Table 1 Proforma for Test Results
(Clause 6.2 and 6.3)

<table>
<thead>
<tr>
<th>SI No.</th>
<th>Test</th>
<th>Measured Value or Observation</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Proof pressure Test pressure, bar (kgf/cm²)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2.</td>
<td>Static friction, bar (kgf/cm²) or N (kgf) Rod end</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Cap end</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Mid-stroke — Rod end</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Mid-stroke — Cap end</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3.</td>
<td>Internal leakage, cm³/min: Rod end — Cylinder retracted</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Cap end — Cylinder extended</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Rod end — Mid-stroke</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Cap end — Mid stroke</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Test pressure, bar (kgf/cm²)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>4.</td>
<td>Cushioning test Test pressure, bar (kgf/cm²)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>5.</td>
<td>Endurance test Test pressure, bar (kgf/cm²) Rate of pressure, bars (kgf/cm²/s) Cycle ratio/min No. of cycles</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Graphs: Internal leakage versus number of cycles. Rod leakage versus number of cycles
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Amendments Issued Since Publication

<table>
<thead>
<tr>
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<th>Date of Issue</th>
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