SAE International™

SURFACE VEHICLE RECOMMENDED PRACTICE

SAE J1334 REV. OCT2003

Issued 1987-06
Revised 2003-10

Superseding J1334 JUN1987

(R) Hydraulic Cylinder Integrity Test

1. ***Scope***—Applies to hydraulic cylinders which are components of self-propelled work Machines defined in SAE J1116.

1.1 Purpose—To provide a laboratory method for determining the structural integrity of a double acting hydraulic cylinder. General seal performance is monitored during the cylinder cycle test.

2. ***References***

2.1 Applicable Publications—The following publications form a part of this specification to the extent specified herein. Unless otherwise indicated, the latest version of SAE Publications shall apply.

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

SAE J1116—Categories of Off-Road Work Machines
SAE J1165—Reporting Cleanliness Levels of Hydraulic Fluids
SAE J1176—External Leakage Classifications for Hydraulic Systems
SAE J1276—Standardized Fluid for Hydraulic Component tests
SAE J1336—Hydraulic Cylinder Leakage Test

3. ***Definitions***

3.1 Average Cylinder Rod Velocity—The sum of twice the stroke length divided by the sum of the movement time for the rod to extend and retract.

3.2 Cycle—One extension and retraction of the cylinder rod for a specified stroke length

3.3 Cycle Rate—The number of cycles per unit of time.

3.4 Proof Pressure—The maximum pressure which can be applied that will not cause any permanent set or deformation.

3.5 Rated Pressure—The continuous duty operating pressure specified by the manufacturer.

3.6 Rod Temperature—The temperature of the rod surface during or immediately after cycling. Record location and method of sampling.

TO PLACE A DOCUMENT ORDER:
Tel: 877-606-7323 (inside USA and Canada)
Tel: 724-776-4970 (outside USA)
Fax: 724-776-0790
Email: custsvc@sae.org
SAE WEB ADDRESS: http://www.sae.org

3.7 Side Load—A force which is in a direction, unless otherwise specified, perpendicular to the axial loading of the cylinder to simulate loading due to external forces on the cylinder as defined by the user.

3.8 Specified Functional Life—The number of cycles a cylinder can withstand and continue to function as specified.

3.9 Stroke Length—The total distance traveled by the piston in completing one-half cycle.

3.10 Cylinder Friction—Internal frictional force measured as the amount of pressure necessary to move the piston with all external (either mechanical or hydraulic) forces removed or in balance.

3.11 Specified Column Load—Maximum compressive load as specified by the test requester, including all appropriate Safety Factors required for the intended application.

3.12 Duty Cycle—The movement of the piston and rod from it's starting point and return to it's original position. The total number of duty cycles would be defined by the application and specified by the test requester.

4. Testing Conditions

4.1 Accuracy of Measurement—The accuracy of measurements, unless otherwise stated, shall be; Temperature ±3 °C, Pressure ±2%, Leakage ±2%, Time ±2%, and Length ±2%.

4.2 Test Fluid—The test fluid shall be according to SAE J1276 unless otherwise specified.

4.3 Test Pressure—The operational test pressure shall be the manufacturer's rated pressure and measured at the cylinder work ports. A 10% transient overshoot is permissible unless another amount is agreed upon by the user.

4.4 Pressure Rise Rate—The pressure rise rate shall be a minimum of 150 MPa per second.

4.5 Contamination Level—The test system shall have a contamination level not to exceed SAE J1165 ISO Code 17/14, or Solid Contaminant Code 19/16.

4.6 Stroke Length—The length of stroke for the cycle test procedure shall be equal to at least 15% of the maximum stroke length of the hydraulic cylinder.

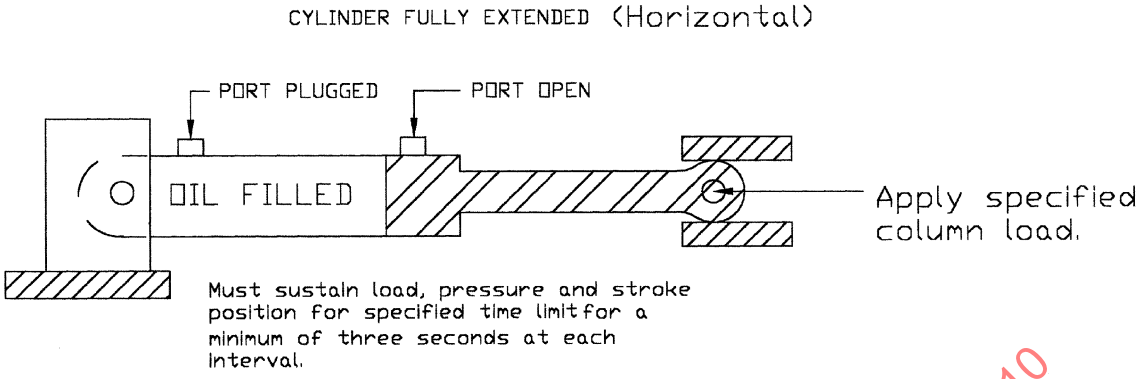
4.7 Cycle Rate—The cycle rate shall be as specified by the manufacturer.

4.8 Specified Functional Life Rating—The specified functional life rating as specified by the manufacturer.

4.9 Proof Pressure—The proof pressure shall be as specified by the manufacturer or 200% of the rated pressure if none is specified.

***5. Test Equipment*—**Use a suitable test fixture, for example, an oscillating beam type, a conventional in-line beam type, or a similar fixture, in which the test cylinder can be loaded and driven in either direction under both static and dynamic conditions.

***6. Buckling Test (See Figure 1)*—**The test cylinder shall be specially prepared to represent a working unit, I.E., while fully extended and supported on pins at end joints. Apply the specified column load to the extended piston rod. The load must be gradually applied and radial deflection should be measured at 20% intervals of the specified column load requirements. (See Figure 1.)



SPECIMEN PREPARATION PRIOR TO TEST

Mount cylinder as intended for its specific application. Measure radial deflection at midpoint of supports at full extension as a function of applied force. Measure at 20% intervals of specified column load requirements.

FIGURE 1—BUCKLING TEST

7. Cylinder Friction Test (See Figure 2)

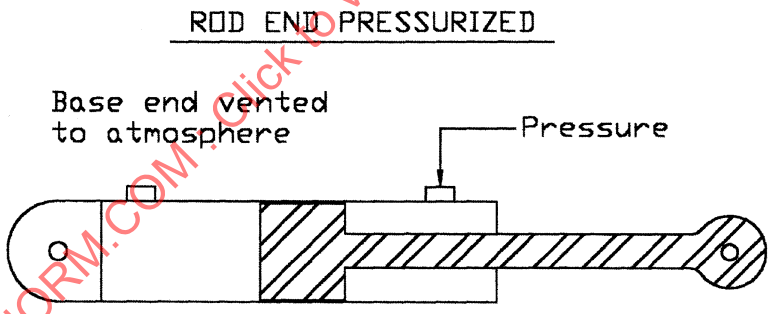


FIGURE 2A—CYLINDER FRICTION TEST
ROD END PRESSURIZED

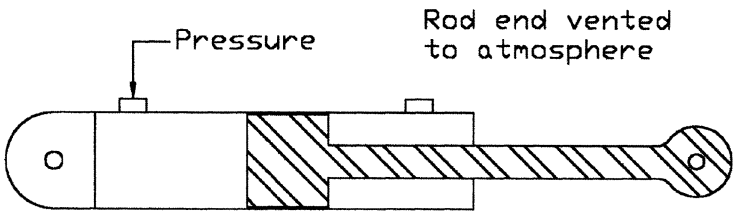


FIGURE 2B—CYLINDER FRICTION TEST
BASE END PRESSURIZED

7.1 Fill both sides of the cylinder with hydraulic fluid and vent the base end to atmosphere. Conduct the test at ambient temperature.

7.2 Position the piston at the midpoint of the cylinder under test.

7.3 Apply increasing pressure to the rod end of the cylinder under test. (See Figure 2A.)

7.4 Record on DATA sheet the minimum pressure at which the piston moves and also the pressure required to keep it moving. Record the temperature.

7.5 Repeat the previous test for the reverse direction by applying pressure to the base end and venting the rod end to atmosphere. (See Figure 2B.)

7.6 Test may be conducted at other stroke positions. Record position and pressure.

8. Cycle Test Procedure (See Figure 3)

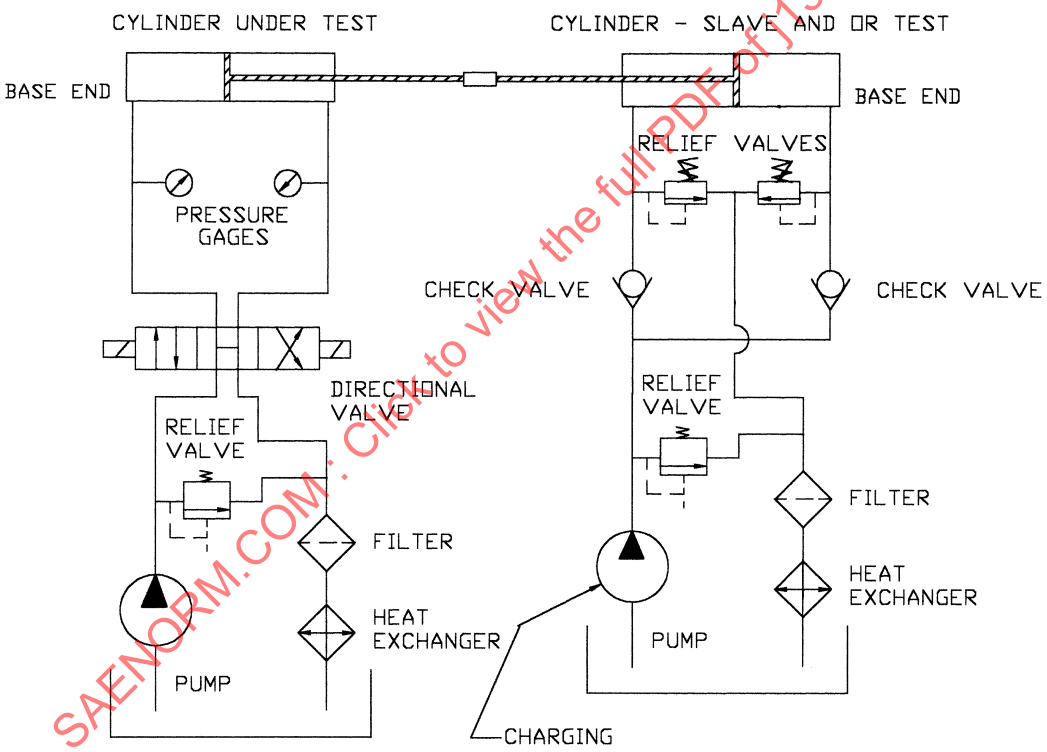


FIGURE 3—TYPICAL TEST SETUP FOR ENDURANCE TESTING

8.1 Install test cylinder in cycle test stand.

8.2 Connect test cylinder to a fluid power source and cycle maximum stroke to displace the trapped air.

8.3 Fully extend the cylinder rod and pressurize the cap port to the specified proof pressure. Hold one minute minimum. (For initial startup only.)

8.4 Fully retract the cylinder rod and pressurize the rod end port to the specified proof pressure. Hold one minute minimum. (For initial start up only.)

8.5 Position the cylinder rod to cycle within ±20% of the middle section of the stroke.

8.6 Cycle the test cylinder for one hundred cycles at rated pressure to simulate a Break-in period.

8.7 Conduct leakage test per SAE J1336 on both internal and external seals.

8.8 Cycle the cylinder against the external load at the specified operational test pressure and cycle rate. Fluid test temperature, measured in the supply line, shall be 50 °C and/or 110 °C, or as agreed to between the user and supplier. If more than one temperature is used they shall be alternated at each leakage check point as specified in 8.9.

8.9 Continue the specified cycling for 100% of the duty cycles desired, or until malfunction occurs. Measure drift rates of piston seal leakage every 50 000 cycles or at agreed upon intervals per SAE J1336, Section 6. Obtain accumulated rod seal leakage per SAE J1336, Section 7, and record during cycle test and calculate Kc, Dynamic Leakage Coefficient. Classification of leakage shall be per SAE J1176.

8.10 No modifications or repairs shall be made during the operational test.

8.11 Pin joints shall be greased when necessary.

9. Impulse Endurance Test (See Figure 4)

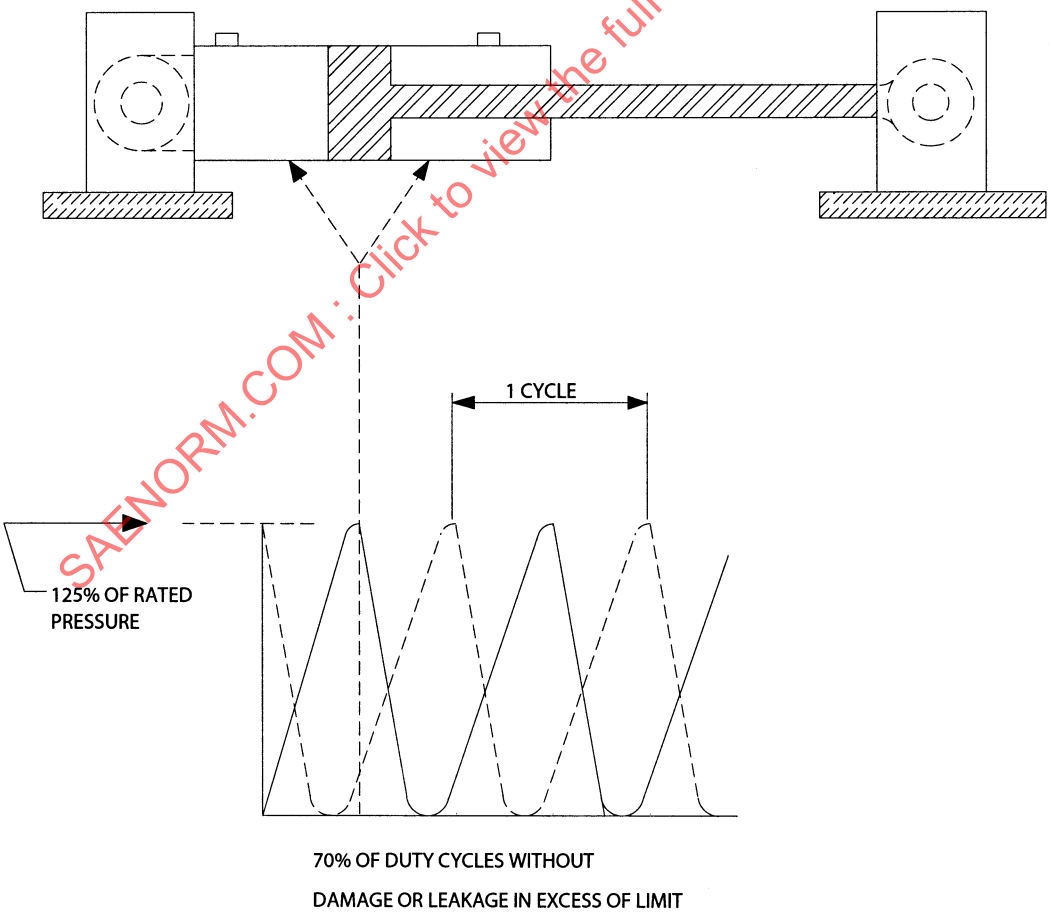


FIGURE 4—IMPULSE ENDURANCE TEST

9.1 Position and mechanically hold cylinder at approximately mid-stroke extension and pressure cycle alternately the base end and the rod end from a minimum pressure to a pressure limited to 125% of the rated pressure (each direction) of the cylinder assembly at a minimum rate of 60 pressure cycles per minute. Pressure cycle test cylinder for 70% of the total number of duty cycles specified. Note the pressure in the cylinder should return to zero, or no more than 10% of test pressure, before pressurizing the opposite side on every cycle.

10. Presentation Of Results

10.1 Record general data shown in Appendix A.

10.2 Record cycles, fluid temperature, and rod temperature.

10.3 Record drift rate per SAE J1336, Section 6.

10.4 Record external leakage during cycling portion of test per SAE J1336, Section 7.

10.5 Report and failures or external leakage.

11. Notes

11.1 **Marginal Indicia—**The change bar (l) located in the left margin is for the convenience of the user in locating areas where revisions have been made to the previous issue of the report. An (R) symbol to the left of the document title indicates a complete revision of the report.

PREPARED BY THE SAE COMMON TESTS TECHNICAL COMMITTEE SC1—HYDRAULIC SYSTEMS