

# JIS

**JAPANESE INDUSTRIAL STANDARD**

**Test Methods for  
Electro-hydraulic Proportional  
Pressure Reducing Valves and  
Electro-hydraulic Proportional  
Pressure Reducing and  
Relieving Valves**

**JIS B 8652—1989**

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**by**

**Japanese Standards Association**

In the event of any doubt arising,  
the original Standard in Japanese is to be final authority.

## JAPANESE INDUSTRIAL STANDARD

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Test Methods for Electro-hydraulic  
Proportional Pressure Reducing Valves  
and Electro-hydraulic Proportional  
Pressure Reducing and Relieving Valves

B 8652-1989

1. Scope

This Japanese Industrial Standard shall be applied for the test methods to be conducted for the confirmation of the rated capacity or performance of electro-hydraulic proportional pressure reducing valves and electro-hydraulic proportional pressure reducing and relieving valves.

Remark: The units and numerical values given in { } in this Standard are based on the traditional units and are informative reference values.

Further, the conversion ratio shall be as follows.

$$1 \text{ MPa } (= 10.197 \text{ kgf/cm}^2) \approx 10 \text{ kgf/cm}^2$$

2. Definitions

For the purpose of this Standard, the following definitions apply. Other terms and definitions are given in JIS B 0142.

- (1) electro-hydraulic proportional pressure reducing valve Pressure reducing valve capable to control the pressure proportional to electrical analog input signal.
- (2) electro-hydraulic proportional pressure reducing and Relieving valve Reducing and relieving valve capable to control the pressure proportional to electrical analog input signal.
- (3) pressure adjustment range Range of adjustable pressure. This changes according to the conditions of flow-rate, oil temperature, etc.
- (4) minimum adjustable pressure The lowest value of adjustable pressure. This changes according to the conditions of flow rate, oil temperature, etc.

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Applicable Standards:

JIS B 0142-Glossary of Terms for Oil Hydraulics and Pneumatics

JIS D 0203-Method of Moisture, Rain and Spray Test for Automobile Parts

JIS D 1601-Vibration Testing Method for Automobile Parts

JIS K 2213-Turbine Oils

- (5) dead zone Range in which the output does not change when the input signal increases from zero. Indicate it by the value of input signal.
- (6) repeatability Dispersion of outputs when the same set input signal is applied repeatedly in the state where the working conditions such as oil temperature or the like are constant. Represent the maximum value of dispersion by the absolute value itself or represent by percentage to maximum control flow rate or highest working pressure.
- (7) load capacity Volume of pressurized oil of working oil including piping system connected directly with the apparatus.
- (8) solenoid Electromechanical transducer generating the force proportional to input electric current.
- (9) permissible back pressure Maximum pressure which does not break even by the continuous or repeated actuation on return side of apparatus or back of pressure working face.
- (10) input signal Effective signal to the valve or amplifier generating defined output.
- (11) absolute precision Precision of reading itself of measured values but not the precision of measuring range.
- (12) resolution Changed component of input signal necessary to generate the change of valve output at the defined signal level. Represent by the percentage of input signal at the time of maximum control flow rate or input signal at the time of maximum working pressure. The resolution is ordinarily determined as the minimum signal needed to increase or decrease the valve output. In the case where these signals are different, it is preferable to use the value either of the larger.
- (13) supply flow rate Amount of fluid flowing through the supply port of device or system.
- (14) internal leakage Flow in clearance of lumen of device.
- (15) external leakage To leak from the inside of device to outside air.

### 3. Classification of Tests The tests shall be the type test in all.

Remark: The delivery test shall be defined by the agreement between the parties of delivery basing on this Standard.

### 4. Test Items

4.1 Solenoid Test The solenoid test shall be conducted on the following items:

- (1) Test of insulation resistance and withstand voltage
- (2) Coil resistance test
- (3) Temperature rise test

4.2 Static Characteristic Test The static characteristic test shall be conducted on the following items:

- (1) Test of characteristic for control pressure relative to input signal
- (2) Resolution test
- (3) Test of characteristic for control pressure change relative to the flow rate change
- (4) Test of characteristic for control pressure relative to supply pressure change
- (5) Repeatability test
- (6) Test of characteristic for control pressure change relative to oil temperature change
- (7) External drain test
- (8) Internal leakage test
- (9) External leakage test
- (10) Proof pressure test
- (11) Relief characteristic test
- (12) Pressure drop characteristic test
- (13) Free (reverse) flow pressure drop characteristic test

4.3 Dynamic Characteristic Test The dynamic characteristic test shall be conducted on the following items:

- (1) Step response test
- (2) Frequency response test

4.4 Environmental Test The environmental test shall be conducted on the following items:

- (1) Oscillation proof test
- (2) Moisture and water proof test

## 5. Test Conditions and Tolerances of Measurements

5.1 Test Conditions The test conditions shall be as follows:

- (1) Classification of Working Oil Class 2 of JIS K 2213 corresponding to ISO VG 46.
- (2) Oil Temperature  $50 \pm 5^{\circ}\text{C}$

- (3) Degree of Contamination This shall be in the range of grades 9 to 11, when the size and number of grains of contaminant in 0.1 l of working oil are divided into grades as given in the Table.

Table. Division of Degree of Contamination

| Degree of contamination                 |              | Grade 4 | Grade 5 | Grade 6 | Grade 7 | Grade 8 | Grade 9 | Grade 10 | Grade 11 | Grade 12  |
|-----------------------------------------|--------------|---------|---------|---------|---------|---------|---------|----------|----------|-----------|
| Size of grain (μm) and number of grains | 5 to 15 μm   | 4 000   | 8 000   | 16 000  | 32 000  | 64 000  | 128 000 | 256 000  | 512 000  | 1 024 000 |
|                                         | 15 to 25 μm  | 712     | 1 425   | 2 850   | 5 700   | 11 400  | 22 800  | 45 600   | 91 200   | 182 400   |
|                                         | 25 to 50 μm  | 126     | 253     | 506     | 1 012   | 2 025   | 4 050   | 8 100    | 16 200   | 32 400    |
|                                         | 50 to 100 μm | 22      | 45      | 90      | 180     | 360     | 720     | 1 440    | 2 880    | 5 760     |
|                                         | 100 μm min.  | 4       | 8       | 16      | 32      | 64      | 128     | 256      | 512      | 1 024     |

- (4) Mounting Attitude In the case specially indicated for use, comply with the conditions defined by the agreement between parties of delivery.
- (5) Input Signals The input signals (electric current, voltage, dither, etc.) shall comply with conditions defined for specimen valve in each.
- (6) Tolerances of Test Pressure, Test Flow Rate and Input Signal
- (a) Test Pressure  $\pm 2.5 \%$  However, the minimum value shall be 0.1 MPa (1 kgf/cm<sup>2</sup>).
- (b) Test Flow Rate  $\pm 5 \%$
- (c) Input Signal  $\pm 1 \%$  However, the minimum value shall be 0.1 % of input signal for highest working pressure.

5.2 Tolerances of Measurements The tolerances of measurements shall be as follows.

- (1) Pressure  $\pm 2.5 \%$  Absolute precision. However, the minimum value shall be 0.1 MPa (1 kgf/cm<sup>2</sup>).
- (2) Flow Rate  $\pm 2.5 \%$  Static absolute precision. However, the minimum value shall be 1 % of maximum controlled flow rate.
- (3) Temperature  $\pm 2^\circ\text{C}$
- (4) Input Signal  $\pm 2.5 \%$  Absolute precision
- (5) Electric Resistance  $\pm 2.5 \%$  Absolute precision

## 6. Test Devices and Test Methods

### 6.1 Solenoid Test

6.1.1 Test of Insulation Resistance and Withstand Voltage As for the test of insulation resistance and withstand voltage, the oil pressure is not needed to be applied to the specimen valve, but for the specimen valve structured so that the internal electrical part (solenoid) contacts with working oil, test in the state where the specimen valve has been filled with working oil as follows:

- (1) Apply between either one of electric input terminals of specimen valve and specimen valve body AC 1500 V (commercial frequency) by withstand voltage tester for 60 s and confirm that the leakage current is 1 mA or under.
- (2) In the connection same as in the above clause, measure the insulation resistance with using DC 500 V insulation resistance tester. The insulation resistance is desirable to be 100 MΩ or over.
- (3) In the solenoid of two coil type, conduct these tests together mutually with two coils.

6.1.2 Coil Resistance Test As for the coil resistance test, measure the coil resistance between electric input terminals of specimen valve by DC resistance tester. At the time of measurement, measure room temperature, describe clearly the test result and also indicate the value converted to that at 20°C.

6.1.3 Temperature Rise Test The temperature rise test shall be as follows:

- (1) Place the specimen valve on the heat insulated stand.
- (2) Apply to the specimen valve the input signal corresponding to the maximum working pressure.
- (3) After the time during which the temperature has risen to saturate elapsed sufficiently, measure the surface temperature of solenoid by surface thermometer and the temperature of solenoid by resistance method. At the time of measurement, measure room temperature to record in the test results.

Determine the value of temperature rise by the resistance method by the following formula:

$$\theta = \left( \frac{R_2}{R_1} - 1 \right) (234.5 + t_1) - (t_2 - t_1)$$

where,  $\theta$  : value of temperature rise (°C)

$R_1$  : value of initial resistance (Ω)

$R_2$  : value of resistance at the time of temperature saturation (Ω)

$t_1$  : initial ambient temperature (°C)

$t_2$  : ambient temperature at the time of saturation (°C)

## 6.2 Static Characteristic Test

6.2.1 Test of Characteristic for Control Pressure Relative to Input Signal  
The test of characteristic for control pressure relative to input signal shall be as follows:

- (1) The test (hydraulic) circuit shall comply with Attached Fig. 1.

- (2) The measuring circuit shall comply with Attached Fig. 2.
- (3) The set pressure of hydraulic power source in test (hydraulic) circuit shall be the highest working pressure of specimen valve.
- (4) In the case where the safety valve is combined with specimen valve, the safety valve shall be fully closed.
- (5) The throttle valve ⑫ in Attached Fig. 1 shall be fully closed.
- (6) Conduct once the going and returning of the procedure in which the input signal of specimen valve goes between zero and highest working pressure of specimen valve by signal generator (triangular wave generator) in speed not affecting dynamically the specimen valve and measuring device and record the input signal in X axis of X-Y recorder (or that substitutable this) and control pressure of specimen valve in Y axis.
- (7) Read out the following characteristic values from the test results on the base of Attached Fig. 2.
  - (a) Hysteresis

$$\text{However, hysteresis (\%)} = \frac{\Delta P_{\max}}{\text{Highest working pressure}} \times 100$$

where,  $\Delta P_{\max}$ : maximum of difference of control pressure of specimen valve in the procedure of one going and returning of input signal of specimen valve.

- (b) Pressure control range
- (c) Value of input signal at the time of highest working pressure
- (d) Minimum control pressure
- (e) Dead zone

#### 6.2.2 Resolution Test The resolution test shall be as follows:

- (1) The test (hydraulic) circuit shall comply with Attached Fig. 1.
- (2) The measuring circuit shall comply with Attached Fig. 2.
- (3) The set pressure of hydraulic power source in the test (hydraulic) circuit shall be the highest working pressure of specimen valve.
- (4) In the case where the safety valve is combined with specimen valve, the safety valve shall be fully closed.
- (5) The throttle valve ⑫ in Attached Fig. 1 shall be fully closed.