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JAPANESE INDUSTRIAL STANDARD

Electrical Comparators

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JAPANESE INDUSTRIAL STANDARD J I S

Electrical Comparators

B 7536-1982
(Reaffirmed: 1988)

1. Scope

This Japanese Industrial Standard specifies the electrical comparators of 0.1, 0.2, 0.5, 1, 2, 5, 10 and 20 μm in scale interval or those of 0.1 and 1 μm in minimum indication amount among electrical comparators.

Remark: The units and numerical values given in { } in this standard are in accordance with the Granimetric System of Units and are appended for reference.

2. Definitions

The definitions of main terms used in this standard shall be in accordance with JIS Z 8103 and JIS C 1002, and other definitions shall be as follows:

(1) electrical comparator The electrical comparator means the comparator with which minute displacement amount is converted to electric amount by the use of the detector having contact measuring device and is indicated by electrical amplification.

(2) electrical comparators of analog display type The electrical comparators of analog display type mean the electrical comparators representating displacement amount by the use of electrical indicating instrument specified in JIS C 1102.

(3) electrical comparators of digital display type The electrical comparators of digital display type mean the electrical comparators indicating displacement amount in digital display by the use of AD converter.

(4) detector The detector means the converter converting displacement or dimension change to electrical amount.

(5) indication range The indication range means the range capable of being indicated on indicating instrument within the measuring range.

(6) effective indication range The effective indication range means the range limited by the linearity of detector within the indication range.

(7) minimum indicating amount The minimum indicating amount means the minimum amount of variable one (equivalent to scale interval) in digital display. It is represented by unit digit.

(8) output signal The output signal means the output of electric amount having the correlation to indicating value.

(9) operation error The operation error means the difference between the value indicating not less than 2 measuring values with electric operation and the value obtained with calculation.

Applicable Standards: See page 16.

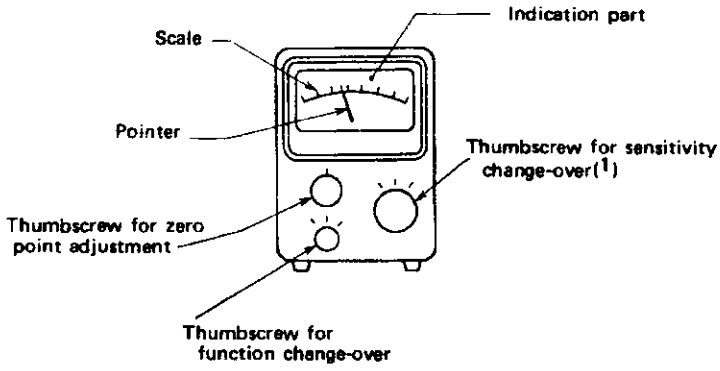
(10) instrumental error The instrumental error means the difference between the indicating value with the block gauge corresponding to an optional indicating value after correctly adjusting the sensitivity and zero point of electrical comparators and the true value to be indicated.

3. Names

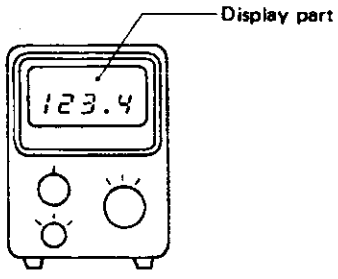
The names of the main parts of the indicator and detector of electrical comparator shall be in accordance with Fig. 1 and Fig. 2.

Fig. 1. Indicator

Electrical Comparator of Analog Display Type



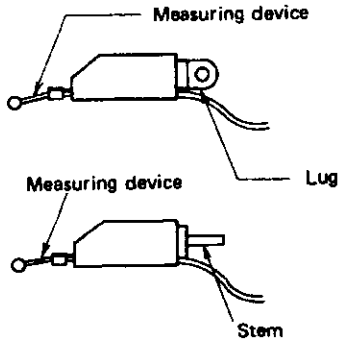
Electrical Comparator of Digital Display Type



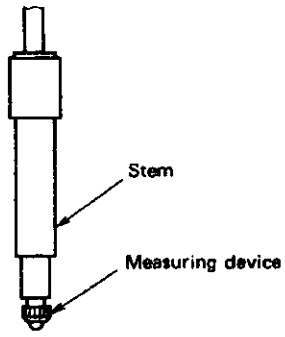
Note (1) For naming this thumbscrew, thumbscrew for range change-over or that for multiplying factor change-over may apply, too.

Fig. 2. Detector

Detector of Lever Type



Detector of Plunger Type



Remark: Those Figures are only used for giving names and not for giving the standard of shape and construction.

4. Classification

The electrical comparators shall be classified into the following 2 classes:

(1) Electrical comparator of analog display type

(2) Electrical comparator of digital display type

5. Performance

The performance of electrical comparator shall be tested according to the test method specified in 9., and shall be in accordance with Table 1 and Table 2.

Table 1. Performance 1

No.	Item	Electrical comparator of analog display type		Electrical comparator of digital display type	
		Applied scale interval μm	Tolerance scale division	Applied minimum indicating amount μm	Tolerance digit
1	Instrumental error	0.1, 0.2	± 1	0.1, 1	± (1 % of effective indication range + 1)
		0.5 min.	± 0.5		
2	Repeatability	All scale intervals	0.5	0.1	0.2 % of effective indication range + 2
				1	1
3	Stability of indication	All scale intervals	1	0.1, 1	2
4	Operation error	0.1, 0.2	± 1.5	0.1, 1	± (2 % of operation range + 1)
		0.5 min.	± 0.8		
5	Variation characteristics of indication due to the variation of alternating power source voltage	All scale intervals	± 0.3	0.1, 1	± (2 % of effective indication range + 1)
6	Deviation of zero point	All scale intervals of those capable of changing-over sensitivity	1	0.1 and 1 of that capable of changing-over sensitivity	1

Remark: The numerical values given in this Table mean those at the temperature of 20 °C.

Table 2. Performance 2

No.	Item	Applicable range		Allowable value
7	Measuring force	Detector of plunger type	Measuring force less than 0.5 N {about 50 gf} excl.	± 30 % of nominal value
			Measuring force not less than 0.5 N {about 50 gf}	± 20 % of nominal value
		Detector of lever type	Measuring force less than 0.1 N {about 10 gf} excl.	± 30 % of nominal value
			Measuring force 0.1 N {about 10 gf} and over up to 0.3 N {about 30 gf} excl.	± 25 % of nominal value
			Measuring force not less than 0.3 N {about 30 gf}	± 20 % of nominal value
8	Response time	Electrical comparator of analog display type Electrical comparator of digital display type		1 sec. max.
9	Range for zero point adjustment	Electrical comparator of analog display type		Not less than the indication range at the maximum sensitivity range
		Electrical comparator of digital display type		40 digits min.
10	Insulation	That using commercial power source		1 MΩ min.
11	Withstanding voltage	That using commercial power source		1 min min.

Remark: For the items of No. 10 insulation and No. 11 withstanding voltage, electrical comparator of battery type shall be excepted.

6. Shape and Dimensions

The shape and dimensions of the detector of electrical comparator shall be in accordance with Table 3 and Table 4 unless otherwise specified.

Table 3. Dimensions of Attachment Part of Detector of Plunger Type

Unit: mm

Item		Dimensions					Applicable Figure
Stem	Diameter d (2)	8	9.5	20	28	36	Fig. 3
	Length l	12 min.	15 min.	30 min.	40 min.		
Attachment part of measuring device	A	According to the dimensions of attachment part for measuring device given in JIS B 7509					Fig. 4
	B	According to the dimensions of attachment part for measuring device given in JIS B 7519					Fig. 5

Note (2) The tolerance of diameter shall generally be h 8 specified in JIS B 0401.

Table 4. Dimensions of Attachment Part of Detector of Lever Type

Unit: mm

Item	Dimensions	Applicable Figure
Lug	According to the dimensions of lug specified in JIS B 7509	Fig. 6
Stem	According to the dimensions specified in JIS B 7533	Fig. 7

Remark: The scale and pointer of the indication part of electrical comparator of analog display type shall be in accordance with JIS Z 8306 and JIS Z 8307.

Fig. 3

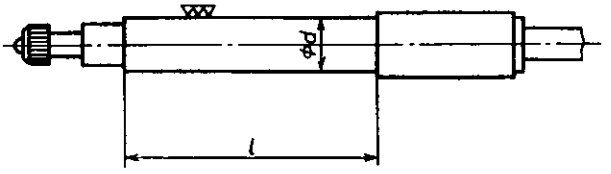


Fig. 4

Unit: mm

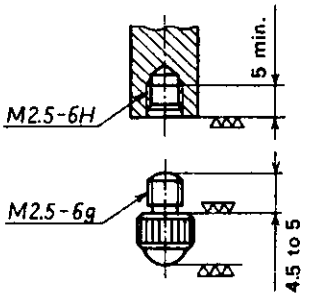


Fig. 5

Unit: mm

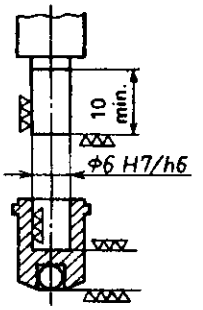


Fig. 6

Unit: mm

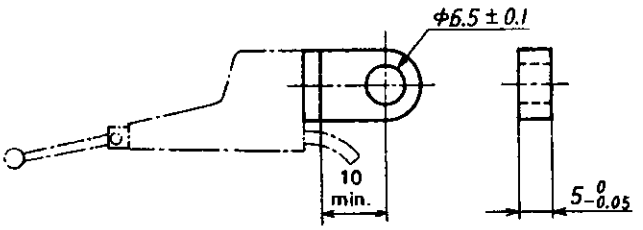
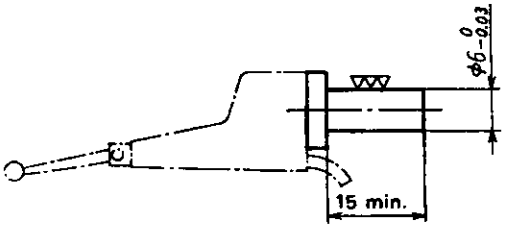


Fig. 7

Unit: mm



7. Appearance and Function

The appearance and function of electrical comparators shall be as follows:

(1) The outer painting and plating shall be rigid and shall not easily generate colour fade-out, peeling-off or rust.

(2) The shape and finishing of main part, stamping, marking, graduation, etc., shall not have defects deterious to practical use.
Furthermore, the finishing of attachment part and measuring device shall be in accordance with Figs. 3 to 5 and Fig. 7.

(3) For that having output signal, voltage value or current value in full scale in the case of analog output, on the type of digitalized code and the signal strength shall be clearly indicated.

(4) Each part shall not generate disorder injurious to use in the change of temperature and humidity under ordinary using conditions.

(5) The actuation of thumbscrew for sensitivity change-over, switch for power source, etc., shall be reliable.

(6) When detector is kept under using condition and measuring device is several times operated through whole process, the operation in this case shall be smooth.

(7) For the detector of lever type, that capable of changing the angle of measuring device shall have stable friction force not interfering measurement.

8. Material and Hardness of Measuring Device

The material of the tip of measuring device of electrical comparators shall be SKS 3 in JIS G 4404, S 3 or D 3 in JIS H 5501, or those equal or superior thereto in performance, and the hardness in the case of using SKS 3 shall be not less than HV 750.

Further, in the case of using steel ball for the tip of measuring device, the material and hardness of it shall be in accordance with JIS B 1501.

9. Test Methods

The test methods for the performance of electrical comparators shall be in accordance with Table 5 and Table 6. The test conditions shall be as given in the following 3 classes:

(1) Test Condition 1 The test conditions of instrumental error, repeatability, stability of indication and operation error shall be as follows:

(a) Temperature The temperature shall be the standard temperature condition of Grade 1 specified in JIS Z 8703, $20 \pm 1\,^{\circ}C$.

(b) Humidity The humidity shall be 45 to 75 %.

(c) Power Source Voltage The power source voltage shall be the designated power source voltage ± 1 %.

(d) Power Source Frequency The power source frequency shall be the designated power source frequency ± 1 %.

(e) Power Source Waveform The power source waveform shall be the waveform near sine wave including no pulse wave.

(f) External Magnetic Field and Electric Field For the external magnetic field and electric field, there shall be no variation of magnetic field and of electric field influencing on test results.

(g) Vibration and Shock There shall be no vibration, nor shock influencing on test results.

(h) Posture of Measurement For the posture of measurement, displacement shall be vertically downwards taken beneath the measuring device.

(i) Preparation Period of Time The test designated on preparation period of time shall be carried out after the specified period has passed.

(2) Test Conditions 2 The test conditions for the variation characteristics of indication due to the variation of alternating power source voltage shall be the same condition as those of Test Conditions 1 excepting (1)(c) power source voltage. In this case, the power source voltage shall be the designated power source voltage ± 10 %.

(3) Test Conditions 3 The test conditions of zero point deviation, measuring force, response time, zero point adjusting range, insulation and withstanding voltage shall be the same conditions as those of (1) Test Conditions 1 excepting temperature. In this case, the temperature condition shall be the ordinary temperature (5 to 35 °C) specified in JIS Z 8703. However, when there is any question about the determination, the test shall be carried out under the test condition near the temperature of Test Conditions 1.

Table 5. Test Method of Performance 1

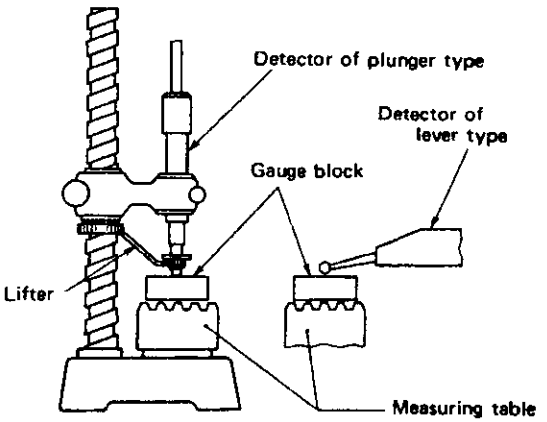
<table>
<tr><th>No.</th><th>Item</th><th>Test method</th><th>Figure</th><th>Test apparatus and devices</th></tr>
<tr><td>1</td><td>Instrumental error</td><td>(1) Closely attach a block gauge to the upper surface of measuring table and touch a measuring device to it. Correctly align the indicated value with zero point.
(2) Replace with the gauge block having the step difference given in Table 5-A depending on an effective indication range, and obtain the difference between the measured value in turn and the true value to be indicated.
(3) For that capable of changing-over sensitivity, carry out the test in every range.
Remark: In the case of electrical comparator of digital display type, the test at intermediate position should preferably be carried out together, also.
Table 5-A
<table>
<tr><th>Effective indication range (operation range)(3) μm</th><th>Difference of gauge block μm</th></tr>
<tr><td>4 to 8 excl.</td><td>1</td></tr>
<tr><td>8 to 20 excl.</td><td>2</td></tr>
<tr><td>20 to 40 excl.</td><td>5</td></tr>
<tr><td>40 to 80 excl.</td><td>10</td></tr>
<tr><td>80 to 200 excl.</td><td>20</td></tr>
<tr><td>200 to 400 excl.</td><td>50</td></tr>
<tr><td>400 and over</td><td>100</td></tr>
</table></td><td rowspan="2">Fig. 8
 
</td><td>Gauge block of not inferior to Grade 0 specified in JIS B 7506, and calibrated (applicable range: 0.1 μm and 0.2 μm in scale interval).
Gauge block Grade 0 specified in JIS B 7506 (applicable range: 0.5 μm or more in scale interval).
Stand.</td></tr>
<tr><td>2</td><td>Repeatability</td><td>(1) Closely attach a gauge block to the upper surface of measuring table and touch a measuring device to it. Let an optional value be indicated.
(2) Slowly get the measuring device up and down not less than 10 times with a lifter, etc. at that time, and measure the gauge block.
(3) For that capable of changing-over sensitivity, carry out the test within the maximum sensitivity range.
(4) Obtain the difference between the maximum value and the minimum one among the indicating values of not less than 10 times.</td><td>Gauge block of Grade 0 specified in JIS B 7506.
Stand.</td></tr>
</table>

Table 5 (Continued)

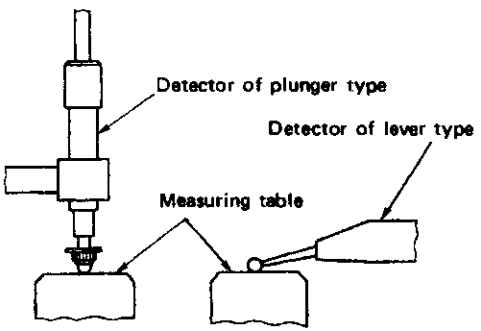
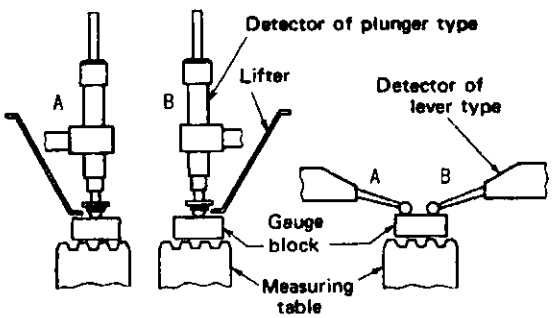
<table>
<tr><th>No.</th><th>Item</th><th>Test method</th><th>Figure</th><th>Test apparatus and devices</th></tr>
<tr><td>3</td><td>Stability of indication</td><td>(1) Touch a measuring device on the upper surface of a measuring table and fix it at the point where the test point becomes about 80 % of the upper limit value of effective indication range within the maximum range.
(2) Measure the changing amount of indication in the designated period of time given in Table 5-B. For measurement, automatic measuring record with recording instrument may be applied.
(3) Obtain the difference between the maximum value and the minimum one of indications.
Table 5-B
<table><tr><th>Scale interval of applied scale</th><th>Designated period of time</th><th>Measurement interval</th></tr><tr><td>0.1 μm, 0.2 μm</td><td>30 min</td><td>Not less than once for every 5 min</td></tr><tr><td>0.5 μm min.</td><td>4 h</td><td>Not less than once for every 30 min</td></tr></table></td><td>Fig. 9
 
</td><td>Stand, watch, recorder of Grade 1.5 specified in JIS C 1203 and printer.</td></tr>
<tr><td>4</td><td>Operation error</td><td>(1) Carry out the test of operation error for each range with subtraction mode.
(2) Set two detectors of A and B to respective stands and closely attach a gauge block to the upper surface of each measuring table. Touch a measuring device to it and correctly align the indicating value with zero point.
(3) Convert the switch for changing function to subtraction (A - B).
(4) Add or reduce the gauge blocks of the step difference given in Table 5-A concerning A and B by the same amount depending on the operation range (3) and measure them. Obtain the difference between those values and the zero point.
(5) For that capable of changing-over sensitivity, carry out the test for each range.</td><td>Fig. 10
 
</td><td>Gauge block of Grade 0 specified in JIS B 7506 Stand 2 pieces</td></tr>
</table>

Table 5 (Continued)

No.	Item	Test method	Figure	Test apparatus and devices
5	Variation characteristics of indication due to variation of alternating power source voltage	(1) Touch a measuring device to the upper surface of measuring table and fix it to the point where the test point becomes about 80 % of the upper limit value of effective indication range. (2) Obtain the change of indication in the case of slowly changing alternating power source voltage by ± 10 % of its rated value.	According to Fig. 9.	Stand, variable transformer and alternating voltmeter of Grade 0.5 specified in JIS C 1102
6	Deviation of zero point	(1) Touch a measuring device to the upper surface of measuring table and correctly align the indication value with zero point within the maximum sensitivity range. (2) Thereafter, change-over it to lower sensitivity range in turn and obtain the deviation of the indicating value at that time.		Stand

Note (3) The operation range described herein means the range capable of obtaining the sum or the difference of output signal of not less than 2 detectors, the results of which are within the effective indication range.

Remark: Figure given herein means an example for describing the test method, and does not specify it.

Table 6. Test Method of Performance 2

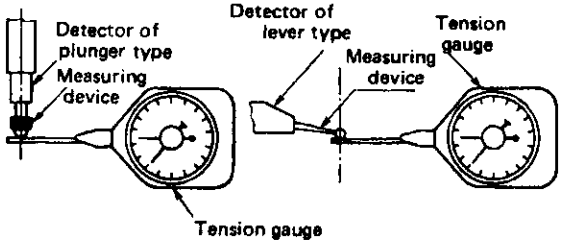
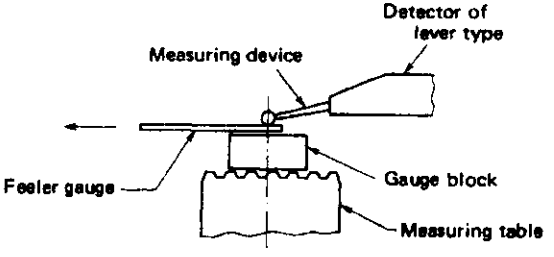
No.	Item	Test method	Figure	Test apparatus and devices
7	Measuring force	(1) Keep a detector at the posture setting the displacement direction of measuring device vertically downwards, and touch the tip of measuring device to a definite position of tension gauge or dynamometer. Continuously and slowly transfer the measuring device upwards. (2) Obtain the value of tension gauge or dynamometer when the lower and upper limit values of effective indication range is indicated within the lowest sensitivity range of electrical comparator. (3) Let it be represented by the percentage of the maximum value of differences between the respective measured values and the nominal value to the nominal value.	Fig. 11. In the Case of Tension Gauge 	Tension gauge or dynamometer and stand
8	Response time	(1) Closely attach a gauge block to the upper surface of measuring table and pile up the feeler gauge equivalent to about one half of effective indication range thereon. Touch the measuring device to it and fix this so that the indicating value becomes not less than the centre value of indication range. (2) Rapidly pull out the feeler gauge. (a) (For analog display type) obtain the time until the pointer goes within 1 scale division of the last indicating value. (b) (For digital display type) obtain the time until the indication reaches ± 1 digit of the last indicating value. (3) For that capable of changing-over sensitivity, carry out the test at the lowest sensitivity (the maximum value within the indication range).	Fig. 12 	Gauge block of Grade 0 specified in JIS B 7506 Feeler gauge of Regular Grade specified in JIS B 7524 Watch and stand

Table 6 (Continued)

No.	Item	Test method	Figure	Test apparatus and devices
9	Range of zero point adjustment	(1) Touch a measuring device to the upper surface of measuring table and fix it so that the indicating value becomes near the centre of indication range. (2) Rotate the whole angle of the thumbscrew for zero point adjustment and obtain the difference between the maximum value and the minimum one of indication. (3) Confirm that the indication can simultaneously and smoothly be fixed at an optional value.	Accoranding to Fig. 9.	Stand
10	Insulation	(1) Test position: the test position shall be between the power source terminal and the case or outer conductor. (2) Test voltage: DC 500 V (3) The insulation value shall be based on the indicated value of insulation-resistance tester.		Insulation-resistance tester specified in JIS C 1301 or JIS C 1302.
11	Withstanding voltage	(1) Test position: the test position shall be between the power source terminal and the case or outer conductor. (2) Test voltage: effective value of commercial alternating power source, 1000 V. Further, applied voltage shall slowly be increased to the test voltage at a rate of about 0 V to 500 V incl. (effective value) per second. (3) After applying the test voltage for specified period of time, whether there is any abnormality or not shall be examined.		Power transformer of Grade X 1000 V specified in JIS C 6436, variable transformer, alternating voltmeter specified in JIS C 1102 and watch

10. Inspection

The inspection of electrical comparators shall be carried out concerning performance, shape and dimensions, appearance, performance and material of measuring device, and shall conform to the requirements specified in 5. to 8. including.

11. Designation

The electrical comparators shall be designated by JIS number or name, scale interval and classification of indicators.

Example: JIS B 7536 0.1 μm digital display type

Electrical comparator analog display type 1 μm

12. Marking

The electrical comparators shall clearly be marked with the following information:

(1) Indicator

(a) Rated power source voltage

(b) Manufacturing number

(c) Manufacturer's name or its mark

(2) Detector

(a) Manufacturing number

(b) Manufacturer's name or its mark

Applicable Standards:

JIS B 0401-Limits and Fits for Engineering

JIS B 1501-Steel Balls for Ball Bearings

JIS B 7506-Gauge Blocks

JIS B 7509-Dial Gauges Reading in 0.001 mm

JIS B 7519-Microindicators

JIS B 7524-Feeler Gauges

JIS B 7533-Lever Type Dial Test Indicators

JIS C 1002-Glossary of Terms Used in Electronic Measuring Apparatus

JIS C 1102-Electrical Indicating Instruments

JIS C 1203-Direct-Acting Electrical Recording Instruments

JIS C 1301-Insulation Resistance Testers (Magneto Generator Operated)

JIS C 1302-Insulation Resistance Testers (Battery Operated)

JIS C 6436-Power Transformer for Electronic Equipment

JIS G 4404-Alloy Tool Steels

JIS H 5501-Cemented Carbide Alloy of Tip

JIS Z 8103-Glossary of Terms Used in Instrumentation

JIS Z 8306-General Rules for Scale of Industrial Instruments

JIS Z 8307-General Rules for Pointers of Industrial Instruments

JIS Z 8703-Standard Atmospheric Conditions for Testing

B 7536-1982
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