

JIS

JAPANESE INDUSTRIAL STANDARD

**Method for test of connectors
for use in electronic equipment**

JIS C 5402—1992

Translated and Published

by

Japanese Standards Association

Printed in Japan

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

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JAPANESE INDUSTRIAL STANDARD

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Method for test of connectors
for use in electronic equipment

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1. Scope This Japanese Industrial Standard specifies the methods for test of connectors and accessories mainly used for electronic equipment.

If there is any discrepancy, in the provisions, between this Standard and the detail specification, the provisions in the detail specification shall be followed.

Remarks: The Standards cited in this Standard and the international Standards corresponding to this Standard are shown in Attached Table 1.

2. Definitions For the main terms used in this Standard the definitions in JIS C 0010 and JIS C 5401 apply, and the rest of the terms shall be as follows:

- (1) male contact A contact which is inserted into a female contact and performs electrical connection through its outer surface.
- (2) female contact A contact which receives a male contact and performs electrical connection through its inner surface.
- (3) crimped contact A contact having a cable receiving region which connects the cable by plastic deformation mechanically applied (by crimping).
- (4) core grip The part of a crimped contact that clamps the conductor core of cable by crimping.
- (5) insulation grip The part of a crimped contact that clamps the insulating covering of cable.
- (6) probe damage The damage of a female contact in elasticity due to wrench by probe (test pin).
- (7) restricted entry The entry opening which is provided to eliminate the damage of female contact in elasticity due to insertion, wrench and so on of a probe (test pin) larger than the specified size.
- (8) gauge retention force of contact The force necessary to withdraw the specified gauge which has been inserted in an elastic contact.
- (9) contact arrangement The arrangement which defines the size, number and position of contacts to be located in an insulation body.

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- (10) insert The insulating body which locates and maintains a contact at a correct position.
- (11) grounding contact The contact provided on a connector shell to get electrical continuity of the connector shell when mated.
- (12) contact holder The part which holds a contact in the insulating body.
- (13) insert holder The part which holds an insert in a connector shell.
- (14) mal-connection preventive mechanism A structure which is provided to prevent touching of contacts before a connector mates at its correct position.
- (15) cable clamp A component located at the rear of a contact for fixing of the wire to protect the wire connected with the contact and the joint from the external force applied thereto.

3. Conditions for testing

3.1 Standard conditions for testing (Standard test conditions) The tests and measurements shall, unless otherwise specified in the detail specification, be carried out under the standard conditions for testing specified in 5.3 of JIS C 0010 (temperature 15 to 35°C, relative humidity 25 to 85 %, air pressure 86 to 106 kPa). In case of dispute on the decision based on the measured values under this standard test conditions or when especially required, the conditions shall be as specified in 3.2.

3.2 Conditions for refree test (Refree conditions) The refree condition shall be that of temperature grade 2 and humidity grade 2 in refree condition I specified in 5.2 of JIS C 0010 (temperature $20 \pm 2^\circ\text{C}$, relative humidity 60 to 70 %, air pressure 86 to 106 kPa).

3.3 Recovery conditions The recovery conditions shall be as specified below, based on the provision in 5.4 of JIS C 0010.

- (1) Standard recovery conditions The standard recovery conditions shall be as follows:

Temperature: A temperature within 15°C to 35°C. Allowable limits on actual laboratory temperature are $\pm 1^\circ\text{C}$.

Relative humidity: 73 % to 77 %

Air pressure: 86 kPa to 106 kPa

Recovery duration: The duration shall be 1 h to 2 h unless specified in detail specification.

- (2) Procedure of recovery The connector under test (specimen) shall be placed in a recovery chamber which satisfies the specified recovery conditions within 10 min from completion of the test. If measurements to be carried out immediately after recovery are specified in the detail specification, the measurement shall be carried out within 30 min after taken out of recovery chamber, and the test in which most rapid change is expected shall be carried out at first.

- (3) Temperature of recovery chamber At the time of taking out the specimens from the recovery chamber, the temperature of recovery chamber shall be controlled to a temperature close to the ambient temperature of laboratory to prevent absorption or discharge of moisture.
- (4) Special recovery conditions If there are special recovery conditions in the detail specification, such conditions shall be complied with.

4. Appearance, construction and dimension tests

4.1 Appearance, construction and finishing The tests for the appearance, construction and finishing shall be carried out visually on the following items:

- (1) Finished state (integrated state of components, uniformity)
- (2) Materials
- (3) Surface state (color deterioration, scratch, etc.)
- (4) Loosening and falling-off of components (especially after application of stress)

The interior shall be tested by disassembling the specimen, if specified in the detail specification.

If the detail specification specifies use of a magnifier and execution of surface treatment, such requirements shall be complied with.

4.2 Dimensions The dimension tests shall be carried out by means of the vernier callipers specified in JIS B 7507, the micrometers specified in JIS B 7502, gauges, projectors, measuring microscopes, etc. Screws shall be tested by means of the limit gauges for screw thread specified in JIS B 0251 and JIS B 0252.

However, other measuring instruments may be used, if no doubt arises on the decision.

4.3 Interchangeability The interchangeability test shall be carried out in such a way that a connector is engaged with and separated from the specimens optionally selected from connectors having appropriate mating part.

4.4 Marking The marking test shall be carried out visually unless otherwise specified.

4.5 Items to be specified in detail specifications The following items shall be specified in detail specifications:

- (1) Test items (see 4.1 to 4.4)
- (2) Internal structure (if necessary) (see 4.1)
- (3) Use of magnifier and the magnification (if necessary) (see 4.1)
- (4) Measuring instruments (if necessary) (see 4.2)
- (5) Marking (if necessary) (see 4.4)

5. Electrical performance tests5.1 Voltage proof

5.1.1 Equipment The equipment for this test shall be a withstand voltage tester which can raise and lower the voltage gradually to the specified voltages, set the leakage current and supply the test voltage with an accuracy of $\pm 5\%$.

5.1.2 Preparation The connection between the equipment and the part at which voltage proof is tested shall be made by using an appropriate connecting device.

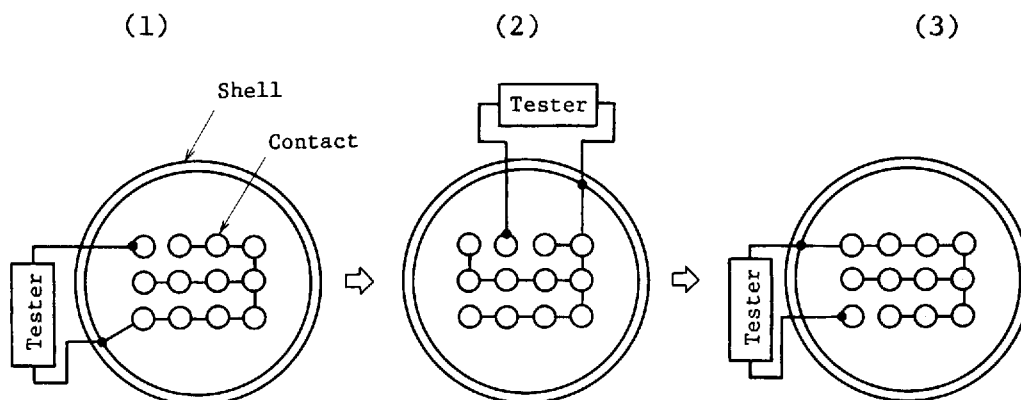
If the detail specification specifies special preparation before test, mounting of specimen, etc., such requirements shall be complied with.

5.1.3 Test Apply the test voltage of d.c. or power frequency a.c. (r.m.s. value) specified in the detail specification for $1 \text{ min} \pm 5 \text{ s}$ by Method A, Method B or Method C given below. Then examine existence or non-existence of dielectric breakdown, flashover and leakage current exceeding the specified value.

Apply the voltage gradually starting from 0 V and increase it to the specified value at a rate not exceeding 500 V per second.

- (1) Method A Connect all the contacts and other metal parts electrically together. At first separate a contact, and apply the specified test voltage between the said one contact and the group previously connected together. Change the said contact to the next one and apply the test voltage in the same way. Test all the contacts by turns applying the test voltage between each contact and the grouped metal parts in the same way (see Fig. 1).

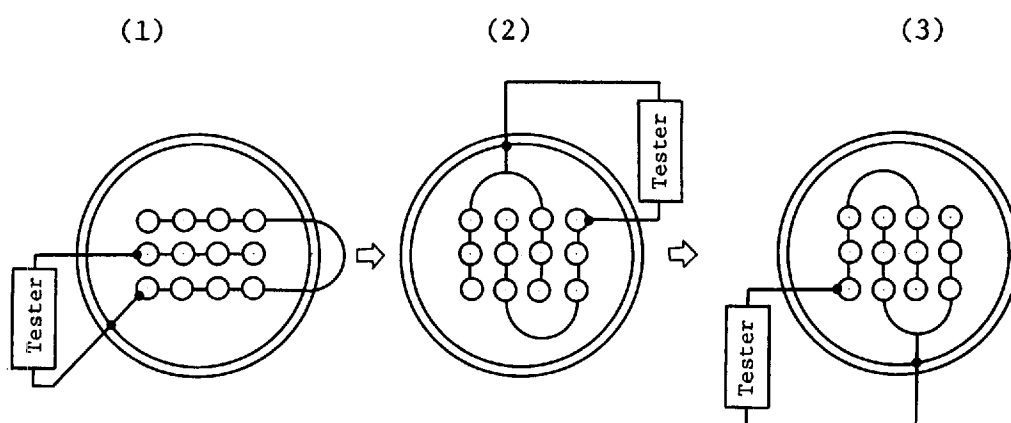
Fig. 1. Test method A



- (2) Method B Connect all parts into groups so that the test voltage is applied between adjacent contacts and between the contacts and other metal parts, and carry out the test by applying the specified test voltage.

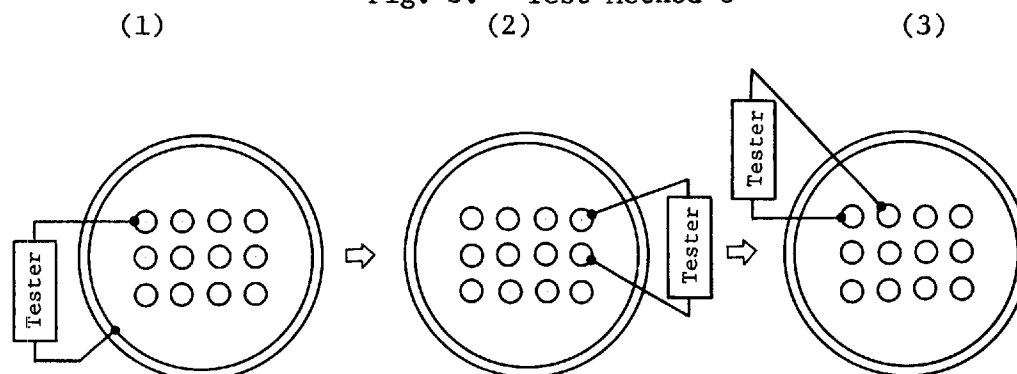
If it is impossible to apply the voltage between all the adjacent contacts and between contacts and metal parts by means of one grouping connection due to arrangement of the contacts, carry out the test by employing plural grouping connections as exemplified in Fig. 2.

Fig. 2. Test Method B



- (3) Method C Carry out the test by applying the specified voltage between adjacent contacts to each other and between a contact and other adjacent metal parts (see Fig. 3).

Fig. 3. Test Method C



5.1.4 Items to be specified in detail specifications The following items shall be specified in detail specifications:

- (1) Kind of test method (Method A, Method B or Method C) (see 5.1.3)
- (2) Contact No. or number of contacts to be tested (when method C is applied) (see 5.1.3)

- (3) Value and nature (a.c. or d.c.) of the test voltage (see 5.1.3)
- (4) Value of leakage currents (see 5.1.3)
- (5) State of specimen (mated or non-mated) (see 5.1.3)

5.2 Insulation resistance

5.2.1 Equipment The equipment used for this test shall be the insulation resistance testers specified in JIS C 1302 or the high insulation resistance meters specified in JIS C 1303 or measuring instruments at least equivalent in accuracy.

5.2.2 Preparation The connection between the equipment and the part at which insulation resistance is tested shall be made by using an appropriate connecting device.

If the detail specification specifies special preparation before test, mounting of specimen, etc., such requirements shall be complied with.

5.2.3 Test Apply the voltage selected from the voltages in Table 1 and specified in the detail specification for 1 min + 5 s by any one of Method A, Method B or Method C below, and then measure the insulation resistance. If the reading of measuring instrument stabilizes or tends to increase at a value exceeding the specified insulation resistance, such reading may measured.

Table 1. Test voltage (d.c.)
Unit: V

Test voltage (d.c.)			
10 + 1	100 + 10	500 + 50	1000 + 100

- (1) Method A As specified in 5.1.3 (1).
- (2) Method B As specified in 5.1.3 (2).
- (3) Method C As specified in 5.1.3 (3).

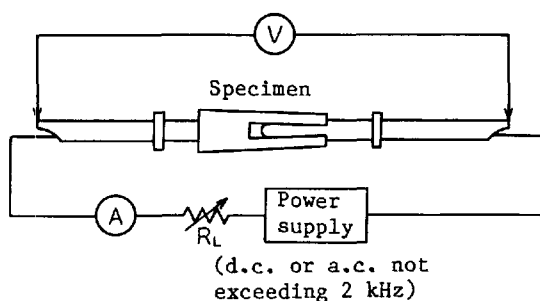
5.2.4 Items to be specified in detail specifications The following items shall be specified in detail specifications:

- (1) Kind of test method (Method A, Method B or Method C) (see 5.2.3)
- (2) Contact No. or number of contacts to be tested (when Method C is applied) (see 5.2.3)
- (3) Value of test voltage (see 5.2.3)
- (4) State of specimen (mated or non-mated) (see 5.2.3)

5.3 Contact resistance

5.3.1 Equipment The equipment used for this test shall consist of the measuring circuit as illustrated in Fig. 4, and shall have a measurement accuracy of contact resistance within $\pm 10\%$.

Fig. 4. Voltage drop method



(A) : ammeter specified in JIS C 1102 or at least equivalent

(V) : voltmeter having enough higher input resistance (impedance) as compared with the resistance (or impedance) of test circuit and necessary accuracy.

R_L : variable resistor

5.3.2 Preparation Connect the wires applicable to the contacts of specimen, mate the specimen as in normal service, and form the circuit shown in Fig. 4.

If the detail specification specifies special preparation before test, mounting of specimen, etc., such requirements shall be complied with.

5.3.3 Test The test current shall be a current of d.c. or a.c. not exceeding 2 kHz. Pass the current specified in the detail specification through the contact of specimen in the circuit configuration shown in Fig. 4. Under such state, measure the voltage drop between the points of measurement specified in the detail specification, and calculate the contact resistance from the said test current and the voltage drop. When measured by d.c. carry out the measurement in forward and reverse directions by changing over the direction of current, and calculate the contact resistance by averaging the test results.

Take care so that no abnormal force is applied to the contact and no tension is applied to the wire during the measurement.

5.3.4 Items to be specified in detail specifications The following items shall be specified in detail specifications:

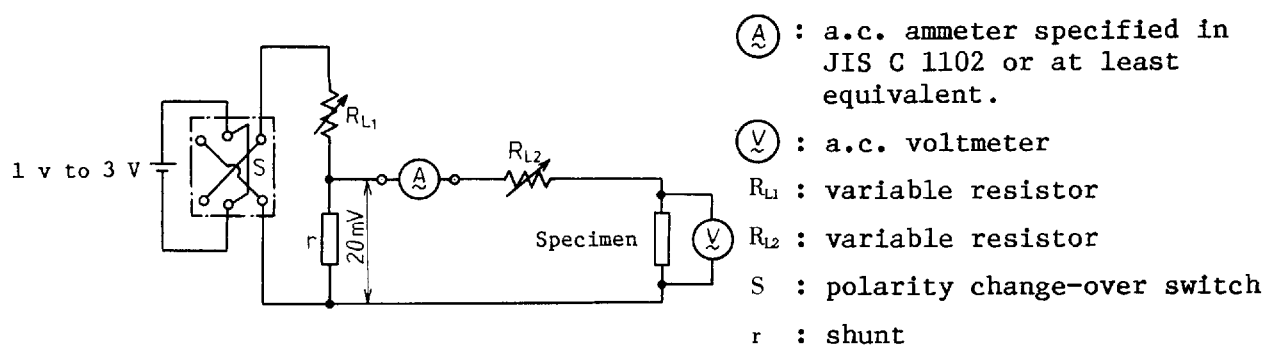
- (1) Connection points of measuring wires, type and size of wire (if necessary) (see 5.3.2)
- (2) Contact No. or number of contacts to be measured on mated connector set (see 5.3.3)
- (3) Number of contacts to be measured individually (see 5.3.3)
- (4) Treatment of contact before and/or during measurement (see 5.3.3)
- (5) Value and nature (d.c. or a.c.) of measuring current (see 5.3.3)

5.4 Contact resistance at low voltage and low current level

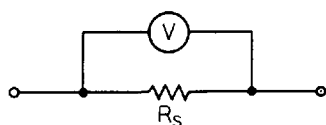
5.4.1 Equipment The equipment for this test shall be as follows:

- (1) When measured with d.c. The equipment shall consist of the circuit for voltage drop method illustrated in Fig. 5, shall be capable of supplying an optional d.c. current not exceeding 100 mA at an open circuit voltage of 20 mV and shall have a measurement accuracy of contact resistance within $\pm 10\%$.

Fig. 5. Voltage drop method



Remarks: If there is any trouble in the measurement due to high internal resistance of the ammeter, the ammeter shall be replaced by the circuit given below:



R_s : standard resistor
 (V) : voltmeter

- (2) When measured by a.c. The equipment shall be such that the frequency is not exceeding 2 kHz, open circuit voltage is 20 mV, and optional a.c. current not exceeding 100 mA can be supplied to the specimen, and the accuracy of measuring contact resistance is within $\pm 10\%$.

5.4.2 Preparation The specimens shall be mated as in normal service, and then connected to the test circuit.

A voltage or current exceeding the value specified in the detail specification shall not be applied to the specimen before the test.

If the detail specification requires special preparation before test, mounting of specimen, etc. such requirements shall be complied with.

5.4.3 Test Connect the specimen to the equipment adjusted to have an open circuit voltage of 20 mV and pass the current specified in the detail specification. Under such state, measure the voltage drop across the measuring points specified in the detail specification, and then calculate the contact resistance from the said test current and the voltage drop. When measured by d.c. carry out the measurement in forward and reverse directions by changing over the direction of current, and calculate the contact resistance by averaging the test results.

Take care so that neither abnormal force is applied to the contact nor a tension is applied to the wire during the measurement.

5.4.4 Items to be specified in detail specifications The following items shall be specified in detail specifications:

- (1) Connection points of measuring wires, type and size of wire (if necessary) (see 5.4.2)
- (2) Contact No. or number of contacts to be measured on mated connector set (see 5.4.3)
- (3) Number of contacts to be measured individually. (see 5.4.3)
- (4) Treatment of contact before and/or during measurement (see 5.4.3)
- (5) The value and nature (d.c. or a.c.) of measuring current (see 5.4.3)

5.5 Chattering of contact

5.5.1 Equipment The equipment for this test is used to detect whether the current interruption occurs during such dynamic tests as resistance to vibration (see 6.1) and shock (see 6.2) or not, and shall have the performances given below.

- (1) Capable of supplying the d.c. power of 10 V and 150 mA to the specimen at the maximum.
- (2) Capable of detecting the point at which voltage drop exceeding 50 % of open circuit voltage as occurrence of interruption.
- (3) Capable of detecting the duration of interruption given in Table 2.

5.5.2 Preparation The connection between the parts at which the chattering of contact is picked up for test and the test equipment shall be securely made with an appropriate connecting device.

5.5.3 Connect the device of 5.5.1 which can detect the duration of interruption in Table 2 and specified in the detail specification to the specimen mounted to the dynamic testing device for vibration, shock, etc., and examine whether interruption of current exceeding the specified value exists or not during the dynamic test.

Table 2. Duration of interruption

1 μ s	10 μ s	100 μ s	1 ms	10 ms
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5.5.4 Items to be specified in detail specifications The following items shall be specified in detail specifications:

- (1) Amount of current to be passed through and amount of voltage to be applied to specimen (see 5.5.1)
- (2) Duration of current interruption (see 5.5.1 and 5.5.3)

5.6 Voltage standing wave ratio (VSWR)

5.6.1 Equipment The equipment for this test shall consist of a high frequency signal generator which can generate the signal individually or continuously over the frequency range specified in the detail specification and a device which can detect and display the voltage standing wave ratio of the specimen.

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The equipment and its components which have the same nominal impedance as that of the specimen and applied coaxial cable and very slight discontinuity shall be used.

The standard test connectors specified in the detail specification shall be used in the measuring circuit.

5.6.2 Preparation The applicable coaxial cable shall be connected to the specimen according to the method specified in the detail specification or recommended by the manufacturer.

A coaxial cable with very small reflection and uniform characteristics shall be used as the applicable coaxial cable.

5.6.3 Test Connect the specimen to the VSWR measuring circuit and then carry out the test covering the frequency range specified in the detail specification.

The details of the test method shall be as specified in Annex (measuring method of VSWR).

5.6.4 Items to be specified in detail specifications The following items shall be specified in detail specifications:

- (1) Method for connecting applicable coaxial cable and connector (see 5.6.2)
- (2) Frequency range or frequency interval for measurement (see 5.6.3)
- (3) Permissible residual standing wave ratio of measuring circuit configuration (see 5.6.1)
- (4) Details of standard test connector used in measuring circuit (see 5.6.1)

5.7 Contact resistance variation

5.7.1 Equipment Unless otherwise specified, the apparatus given below shall be used as the main equipment for this test.

- (1) **Oscilloscope** The oscilloscope shall be of long-persistence screen having a frequency characteristic which is flat within ± 3 dB between 400 Hz and 1 MHz, and the sensitivity shall, unless specified in the detail specification, be as given below:

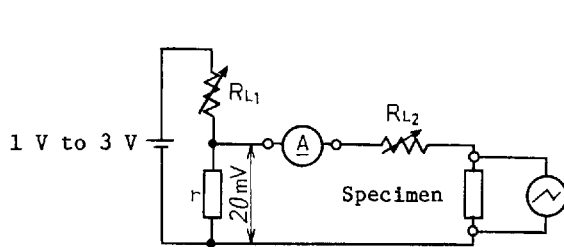
When contact resistance is up to and including 5 m Ω : 50 μ V/div min.,
up to 1 MHz

When contact resistance is to and excluding 30 m Ω : 500 μ V/div min.,
up to 1 MHz

When contact resistance is 30 m Ω or above: 1.0 mV/div min., up to 1 MHz

- (2) **Measuring circuit** The circuit shall be formed as illustrated in Fig. 6 or shall have at least equivalent performances. The current passed through the circuit shall be of d.c. not exceeding 50 mA and the open circuit voltage shall not exceed 20 mV.

Fig. 6. Voltage drop method



(A) : d.c. ammeter specified in JIS C 1102 or at least equivalent

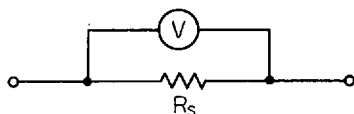
(~) : oscilloscope

R_{L1} : variable resistor

R_{L2} : variable resistor

r : shunt

Remarks: If there is any trouble in the measurement due to high internal resistance of the ammeter, the ammeter shall be replaced by the circuit given below:



R_s : standard resistor

(V) : voltmeter

5.7.2 Preparation The connection between the specimen and the measuring apparatus shall be securely and carefully made by means of an appropriate connecting device, to avoid errors in the measurements.

If the detail specification specifies special preparation before test, mounting of specimen, etc., such requirements shall be complied with.

5.7.3 Test Carry out this test during such a dynamic test as that for vibration (see 6.1) or for shock (see 6.2), connect the contact of specimen to the equipment of 5.7.1 and measure the variation in contact resistance by measuring the voltage drop between the positions where external wires are connected with the specimen.

5.7.4 Items to be specified in detail specifications The following items shall be specified in detail specifications:

- (1) Measuring equipment (including measuring circuit) and sensitivity of oscilloscope (if necessary) (see 5.7.1)
- (2) Contact No. or number of contacts to be tested (if necessary) (see 5.7.3)

5.8 Shell electrical continuity

5.8.1 Equipment The equipment for this test shall be either of the equipment specified in 5.3 or 5.7 as specified in the detail specification.

5.8.2 Preparation The receptacle connector (or shell) shall be mounted to a panel. Wires or cables shall be attached to the plug connector. The connection between the specimen and the measuring equipment shall be securely and carefully made by means of an appropriate connecting device, to avoid errors in the measurements.

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5.8.3 Test Carry out the test of 5.3 or 5.7 as specified in the detail specification, on a set of specimens with their shells mated, and measure the contact resistance or contact resistance variation between the specified parts.

The resistance shall be measured through all joints connected in series such as:

- (1) Between the cable braid or shell and the panel to which receptacle is fixed.
- (2) Between cable braids for a set of mated plug connectors
- (3) Between mounting panels when both fixed receptacles are connected.

5.8.4 Items to be specified in detail specifications The following items shall be specified in detail specifications:

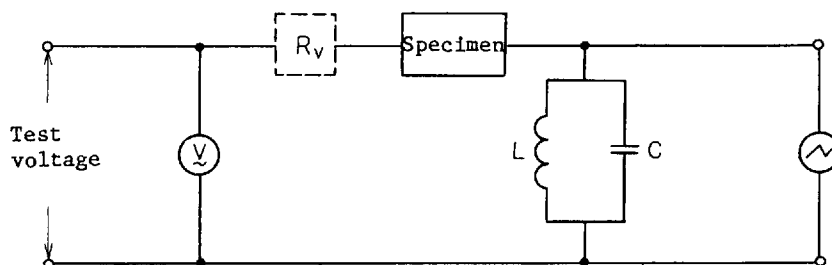
- (1) Method of mounting the specimen and associated cables (see 5.8.2)
- (2) Points at which the contact resistance or contact resistance variation shall be measured (see 5.8.3)
- (3) Applicable test method (contact resistance or contact resistance variation) and test current (see 5.8.3)

5.9 Partial discharge (corona discharge)

5.9.1 Method 1 Method 1 of partial discharge test is stated below.

- (1) **Equipment** The equipment for this test shall provide sufficient performance to carry out the test of (3) and shall consist of the circuit shown in Fig. 7. The test voltage shall be of a.c. (at power frequency).

Fig. 7. Method 1 Test circuit for partial discharge



L: inductance 20 to 40 mH

C: capacitance (including capacitance of measuring system)
(80 pF to 120 pF)

(V): a.c. voltmeter specified in JIS C 1102 or at least equivalent

R_v : Current limiting resistor

(~): Oscilloscope

The oscilloscope shall have the following performances:

Frequency band: d.c. to 500 kHz

Sensitivity: 1 mV/div to 5 mV/div

Time axis: 2 ms/div



If required, a current-limiting resistor (R_v) may be used. To minimize the influence of the measuring set-up, low impedance coupling shall be used and, if necessary, an amplifier may be used.

The components of circuit and cables which are capable of meeting higher requirements than those for the specimen shall be used.

- (2) Preparation The specimen shall be mounted and wired as in normal service with its applicable cables or wires.

The state of specimen such as engaging or separating of connector set and attaching of accessories shall be as specified in detail specification.

- (3) Test Apply the test voltage, and increase it steadily up to a value where partial discharge is observed on the oscilloscope. In order to determine the partial discharge extinction voltage, decrease the test voltage until the discharge ceases and then note the value of test voltage.

The detail specification shall specify the test voltage within an extent not exceeding the test voltage of 5.1.

If no partial discharge occurs when the test voltage reaches the test voltage of 5.1, complete this test considering that the specimen satisfies the above requirements.

- (4) Items to be specified in detail specifications The following items shall be specified in detail specifications:

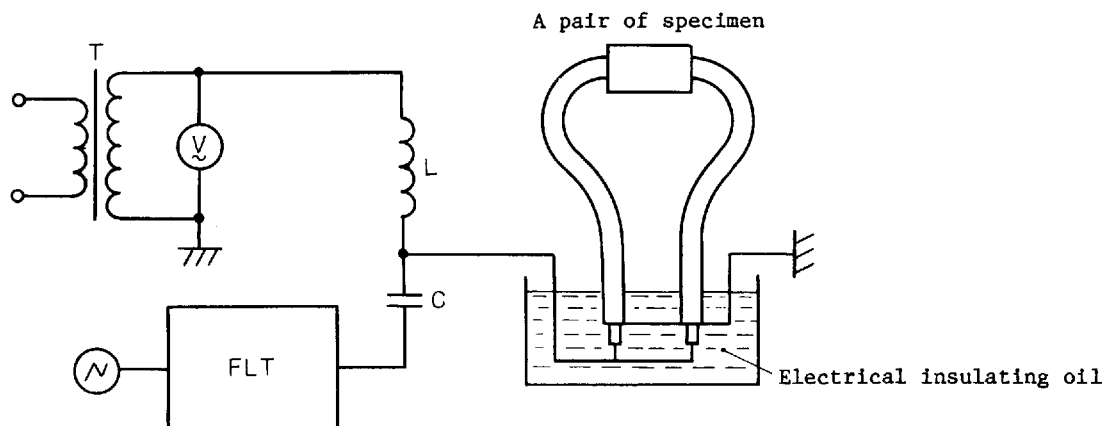
- (a) Preconditioning of specimen (including cable or wire to be used) [see (2)]
- (b) State of specimen [see (2)]
- (c) Test voltage [see (3)]

5.9.2 Method 2 Method 2 of partial discharge test is given below.

- (1) Equipment The equipment for this test shall consist of the circuit shown in Fig. 8 or that by which equivalent measurement results are obtained, and shall have sufficient performances to carry out the test of (3). The test voltage shall be of a.c. (at power frequency). The detector shall be a device which can detect the partial discharge of 5 picocoulomb (pC).

The components of circuit and cables which are capable of meeting higher requirements than those for the specimen shall be used.

Fig. 8. Method 2 Test circuit for partial discharge



L: inductance

C: capacitance

FLT: band-pass filter: 10 kHz to 50 kHz

T: transformer

⓪: a.c. voltmeter specified in JIS C 1102 or at least equivalent

Ⓜ: oscilloscope

- (2) Preparation An applicable cable shall be attached to each of specimens forming a pair in a normal way and the other end of cable shall be treated by a method to avoid generation of local discharge.

No grease, compound, etc. which suppress local discharge shall be used at the interior of specimen or mounting part of cable.

- (3) Test Apply a test voltage, and increase it gradually until continuous local discharge is observed on the oscilloscope which can detect 5pC. In order to determine the partial discharge extinction voltage, decrease the test voltage until the partial discharge is not observed on the oscilloscope, and then record the voltage.

The detail specification shall specify the test voltage within an extent not exceeding the test voltage of 5.1.

If no partial discharge occurs when the test voltage reaches the test voltage of 5.1, complete this test considering that the specimen satisfies the above requirement.

- (4) Items to be specified in detail specifications The following items shall be specified in detail specifications:

- (a) Preconditioning of specimen (including cable or wire to be used)
[see (2)]
- (b) Test voltage [see (3)]

5.10 Temperature rise

5.10.1 Equipment The equipment for this test shall be the indicating thermoelectric thermometer of Grade 2.0 specified in JIS C 1601, the indicating resistance thermometer of Grade 2.0 specified in JIS C 1603 or thermometers at least equivalent.

5.10.2 Preparation The mated specimen shall be so mounted in still air that it will not be influenced by external heat, and, unless otherwise specified, the sensing part of thermometer shall be fitted to the portion nearest to joint on the specimen contact appearing outside the insulating body. The specimen shall be wired with a minimum length of 500 mm of the wire specified in the detail specification. If there is no dispute, wires with a conductor diameter appropriate to the rated current may be used.

5.10.3 Test Carry out the test by either Method A or Method B below as specified in the detail specification.

- (1) Method A Pass the rated current through each contact of the specimen, and carry out the measurement until the values of temperature rise (temperature at measuring point - ambient temperature) measured consecutively three times at intervals of 10 min show a difference not exceeding 0.5°C to each other. Measure the ambient temperature at a position about 300 mm or more apart from the point of temperature measurement of specimen in horizontal direction.
- (2) Method B Pass the test current specified in the detail specification through each contact of the specimen for 5 h, and measure the temperature rises during the period.

5.10.4 Items to be specified in detail specifications The following items shall be specified in detail specifications:

- (1) Kind of thermocouple, position of temperature measurement and fitting method (if necessary) (see 5.10.2)
- (2) Value and nature (a.c. or d.c.) of test current (see 5.10.3)
- (3) Kind and size of connecting wire (see 5.10.2)
- (4) Contact No. or number of contacts through which test current is passed (see 5.10.3)
- (5) Mounting method of specimen (see 5.10.3)
- (6) Kind of test method (Method A or Method B) (see 5.10.3)

5.11 Electrical load and temperature

5.11.1 Equipment The equipment for this test shall be the indicating thermoelectric thermometer of grade 2.0 specified in JIS C 1601, the indicating resistance thermometer of Grade 2.0 specified in JIS C 1603, or thermometers at least equivalent.

5.11.2 Preparation The specimen shall be placed in a test chamber according to the mounting method specified in the detail specification.

5.11.3 Test Carry out the test as follows:

- (1) Place the specimen in a chamber maintained at 70 ± 5 % of the maximum operating temperature.
- (2) Pass the current through every contact, and increase it steadily until the temperature of point of measurement of specimen reaches the maximum operating temperature. However, do not increase the current until the point of measurement of specimen reaches thermal equilibrium. In no case during the adjustment shall the maximum operating temperature or the specified maximum load current of the specimen be exceeded.

When the maximum operating temperature has been reached, maintain the current to achieve this throughout the test.

- (3) If the maximum operating temperature of the specimen is exceeded by 5 % during the test, abandon the test and carry out the retest.
- (4) If the temperature rise due to the maximum load current flowing through the specimen does not cause it to reach the maximum operating temperature, increase the temperature of chamber until the specimen reaches the maximum operating temperature.
- (5) Carry out the test at the maximum operating temperature and the duration of the test shall be the one selected from the hours in Table 3 and specified in the detail specification.

Table 3. Duration of test

Unit: h

250	500	1000	2000
-----	-----	------	------

- (6) After the initial 10 h and at the end of the test, measure the insulation resistance at high temperature according to 5.2.
- (7) After completion of the test, allow the specimen to stand under the standard conditions for a time as stated in the detail specification.

5.11.4 Final measurement Carry out the final measurement on the following items:

- (1) Contact resistance (see 5.3)
- (2) Electrical continuity of shell (if necessary) (see 5.8)
- (3) Insulation resistance (see 5.2)
- (4) Voltage proof (see 5.1)
- (5) Appearance (see 4.1)
- (6) Sealing (if necessary) (see 7.6)

5.11.5 Items to be specified in detail specifications The following items shall be specified in detail specifications:

- (1) Preparation of the specimen, including type and size of wire, and position of temperature measurement (see 5.11.2)
- (2) Mounting method of specimen (see 5.11.2)
- (3) Maximum operating temperature (see 5.11.3)
- (4) Duration of test (see 5.11.3)
- (5) Maximum load current (see 5.11.3)
- (6) Recovery time (see 5.11.3)
- (7) Requirements for final measurements (see 5.11.4)

5.12 Capacitance

5.12.1 Equipment The equipment for this test shall be a capacitance bridge with an accuracy not exceeding $\pm 5\%$, or measuring apparatus with at least equivalent accuracy.

5.12.2 Preparation Care must be taken on connection between the measuring apparatus and the specimen to minimize errors in the measurements.

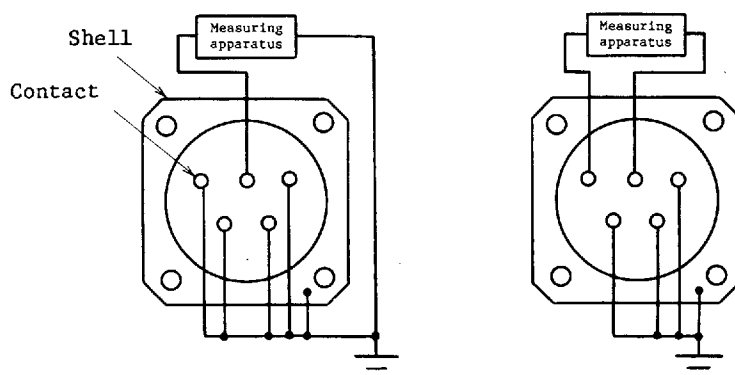
If the detail specification specifies special preparation before test, mounting of specimen, etc., such requirements shall be complied with.

5.12.3 Test Measure the capacitance with an a.c. voltage of $1\text{ kHz} \pm 200\text{ Hz}$ or of $1\text{ MHz} \pm 200\text{ kHz}$. In this procedure, the a.c. voltage shall have a possible lower value which will not result in any trouble in the test.

Carry out the test on the positions given in (1) to (3) below as specified in the detail specification (see Fig. 9).

- (1) Between one contact, and all other contacts connected together with metallic parts at a common point and earthed.
- (2) Between any two adjacent contacts, with all other contacts and metallic parts are connected to earth at a common point.
- (3) Other measuring positions specified in the detail specification.

Fig. 9. Measuring position of capacitance



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5.12.4 Items to be specified in detail specifications The following items shall be specified in detail specifications:

- (1) Measuring apparatus and its accuracy (if necessary) (see 5.12.1)
- (2) Test frequency (if necessary) (see 5.12.3)
- (3) Position of measurement (see 5.12.3)

5.13 Derating of current carrying capacity due to temperature

5.13.1 Equipment The equipment for this test shall be the indicating thermoelectric thermometer of grade 2.0 specified in JIS C 1601, the indicating resistance thermometer of Grade 2.0 specified in JIS C 1603, or thermometers at least equivalent.

5.13.2 Preparation Unless otherwise specified in the detail specification the mounting method and wired states of the specimen shall be as stated below during this test.

- (1) The specimen shall be mounted in the still air inside a vessel which can protect the specimen from receiving external heat.

The size of the vessel shall be such that the distance from the end of specimen to the side of vessel is at least 200 mm, that to the bottom is at least 50 mm and that to the top is at least 150 mm.

- (2) The specimen shall be as free as possible in the vessel.

The specimen may be mounted by a heat insulating material of thermal conductivity not exceeding 2 W/mK in contact with the specimen at an area not exceeding 20 % of all the surface areas of the specimen.

- (3) Connect wires which can pass the maximum current applicable to the contact to the specimen. The wires connected to the specimen shall be placed in the measuring vessel by 250 mm or more.

In the case of a multi-pole connector every contact shall be connected in series and the length of the wire shall be about 250 mm.

- (4) The sensing part of thermometer shall be fitted to the portion nearest to joint on the specimen contact appearing outside the insulating body.

5.13.3 Test Carry out the test as follows:

(1) Test method

- (a) Pass the current specified in the detail specification through the contact of the specimen for a duration not exceeding 1 h, and measure the temperature t_b of the temperature measurement position. Measure the ambient temperature t_u inside the measuring vessel at the same time. Calculate the temperature rise Δt from t_b and t_u by means of the following formula:

$$\Delta t = t_b - t_u$$

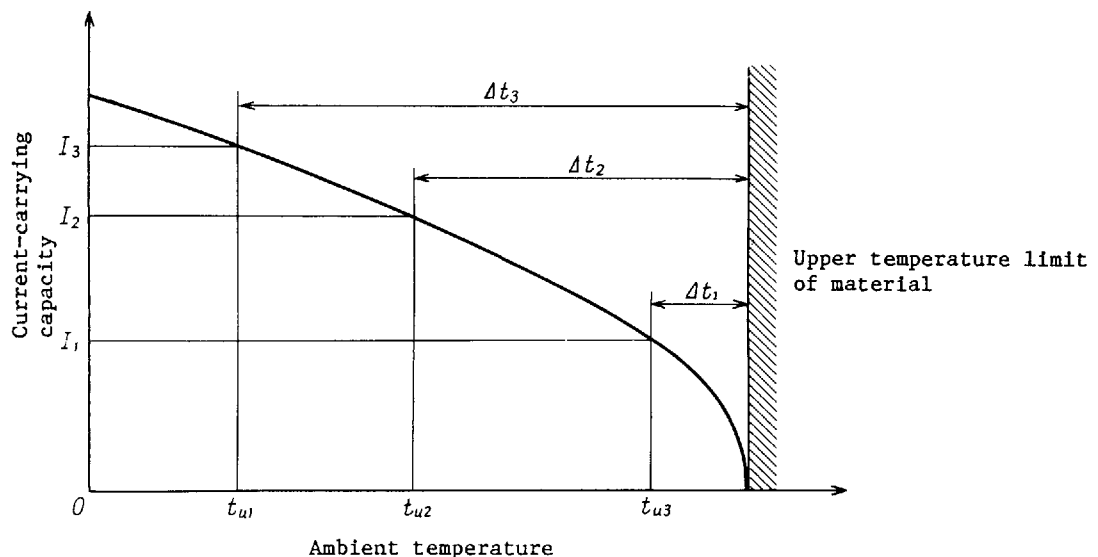
The test current may be either of d.c. or a.c., but in the case of a.c. the current shall be that expressed in r.m.s. value.

- (b) Unless specified in the detail specification, the number of specimens shall be 3, and the current levels shall be not less than 3 levels.
- (c) Unless specified in the detail specification, the temperature rise Δt means the average value on 3 specimens.
- (d) Unless specified in the detail specification, the measurement position of ambient temperature shall be a position on the plane passing the axis of specimen and about 50 mm apart from the center of the longitudinal plane.

(2) Determination of derating curve

- (a) Illustrate the results obtained from the measurement of (1) as shown in Fig. 10 by plotting the current on the ordinate and the temperature on the abscissa.

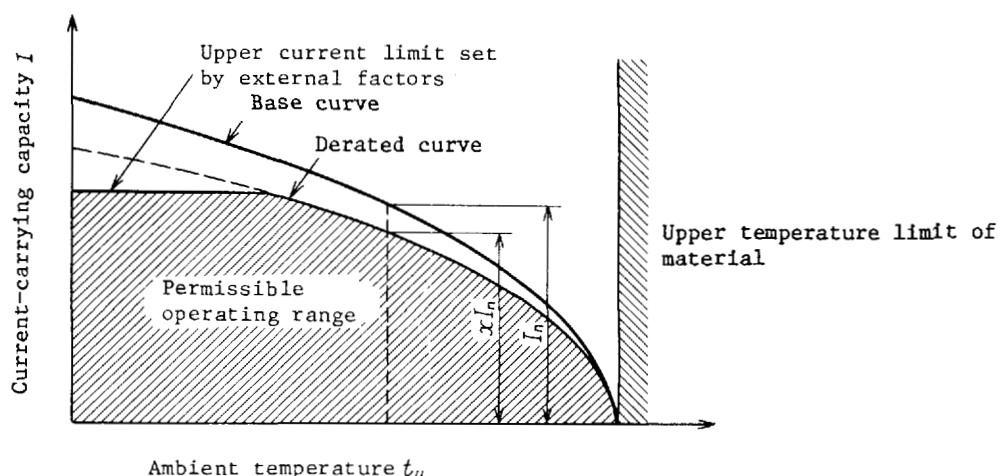
Fig. 10. Example of a current-carrying capacity



- (b) Determine the derating curve according to the provision of detail specification employing the curve shown in Fig. 11 as the base curve.

Specify the derating factor x in xI_n shown in Fig. 11 in the detail specification by taking the dispersion from the base curve due to specimen and the error in temperature measurement by the measuring device into consideration.

Fig. 11. Example of a derating curve



5.13.4 Items to be specified in detail specifications The following items shall be specified in detail specifications:

- (1) Kind of temperature sensor (see 5.13.1)
- (2) Size of measuring vessel and mounting method of specimen (if necessary) (see 5.13.2)
- (3) Kind and size of connecting wire (if necessary) (see 5.13.2)
- (4) Position of temperature measurement (if necessary) (see 5.13.2)
- (5) Value and nature (d.c. or a.c.) of test current (see 5.13.3)
- (6) Number of specimens, if it is other than three (if necessary) (see 5.13.3)
- (7) Derating factor of base curve to obtain derated curve (see 5.13.3)

6. Mechanical performance tests

6.1 Resistance to vibration (see JIS C 0040)

6.1.1 Equipment The equipment for this test shall be a testing machine having sufficient performances to obtain the required characteristics given below.

- (1) Required characteristics The characteristics required of the vibration tester and mounting jig with the specimen mounted to the tester are as follows:

- (1.1) Basic motion The basic motion shall be sinusoidal related to time and such that the fixing points of the specimen are moving substantially in phase and in straight parallel lines within the restriction resulted from (1.2) and (1.3).
- (1.2) Transverse motion The maximum vibration amplitude at the observing points in any direction perpendicular to the specified axis shall not exceed 50 % of the specified amplitude for vibration frequencies up to 500 Hz, and 100 % for frequencies exceeding 500 Hz.
- (1.3) Distortion The distortion at the reference point shall not exceed 25 % covering the frequency range up to 50 kHz or five times the driving frequency, whichever is the larger.
- (1.4) Vibration amplitude tolerances The tolerances on vibration amplitude at the observing point and the reference point shall be as given below. Errors in the measurements are included in the above tolerances.
- (a) Reference point The tolerances on control signals at the reference point shall be $\pm 15 \%$.
- (b) Observing point The tolerances on vibration amplitude at the observing point shall be as follows:
- | | |
|-----------------------------|-------------|
| Up to and including 500 Hz: | $\pm 25 \%$ |
| Over 500 Hz: | $\pm 50 \%$ |
- (1.5) Frequency tolerances The tolerances on frequencies shall be as follows:
- | | |
|---------------------------------------|--------------------|
| Over 10 Hz up to and including 50 Hz: | $\pm 1 \text{ Hz}$ |
| Over 50 Hz: | $\pm 2 \%$ |
- (1.6) Sweeping The sweeping shall be made continuously and its frequency shall be changed as exponential function of time. The rate of sweeping shall be one octave/min and the tolerance on it is $\pm 10 \%$.
- 6.1.2 Preparation The specimen shall be mounted as specified in the detail specification.

When the cable is connected to the specimen, the cable shall be so installed that the specimen receives the same restraint and mass as those in normal service. To accomplish the above it is necessary that the cables are securely attached to the mounting jig.

Unless otherwise specified, all the contacts under test shall be connected in series because they are subjected to chattering test in accordance with 5.5.

6.1.3 Test Carry out the test as follows:

- (1) Severities A vibration severity shall be selected from Table 4 and specified in the detail specification.

Table 4. Severities

Vibration frequency range Hz	Number of sweeping cycles in each axial direction			Examples of application
	Zero-to-peak amplitude or acceleration			
	0.35 mm or 49 m/s ²	0.75 mm or 98 m/s ²	1.5 mm or 196 m/s ²	
10 to 55	10	10	-	Components used in large industrial power supply, heavy rotating machinery, steel rolling mills, large merchant ships and naval vessels.
10 to 500	10	10	-	Components used in general installation on ground, general land transportation, high speed small vessels and general aircraft.
10 to 2000	-	10	10	Components mounted to space craft launcher (196 m/s ²), and aircraft engines.
55 to 500	10	10	-	Applicable to similar components as that in category 10 to 500 Hz. However, at frequencies less than 55 Hz, this is applicable to small and rigid components without resonance response.
55 to 2000	-	10	10	Applicable to similar components to that in category 10 to 2000 Hz. However, at frequencies less than 55 Hz, this is applicable to small and very rigid components without resonance response.
100 to 2000	-	10	10	Applicable to similar components as that in category 55 to 2000 Hz. However, this is applicable to small components with high rigidity due to their construction such as transistors, diodes, resistor elements and capacitors which are sealed with resin.

- (2) Preconditioning As specified in the detail specification.
- (3) Initial measurements Examine the appearance, electrical and mechanical performances as specified in the detail specification.
- (4) Testing conditions Apply the vibration in three directions mutually at right angle including the mating axis direction.
- (5) Intermediate measurements Carry out the test of 5.5 throughout the test duration. Carry out the test of 5.7, if the provision of detail specification requires so.
- (6) Recovery As specified in the detail specification.
- (7) Final measurements Examine the appearance, electrical and mechanical performances as specified in the detail specification.

6.1.4 Items to be specified in detail specifications The following items shall be specified in detail specifications:

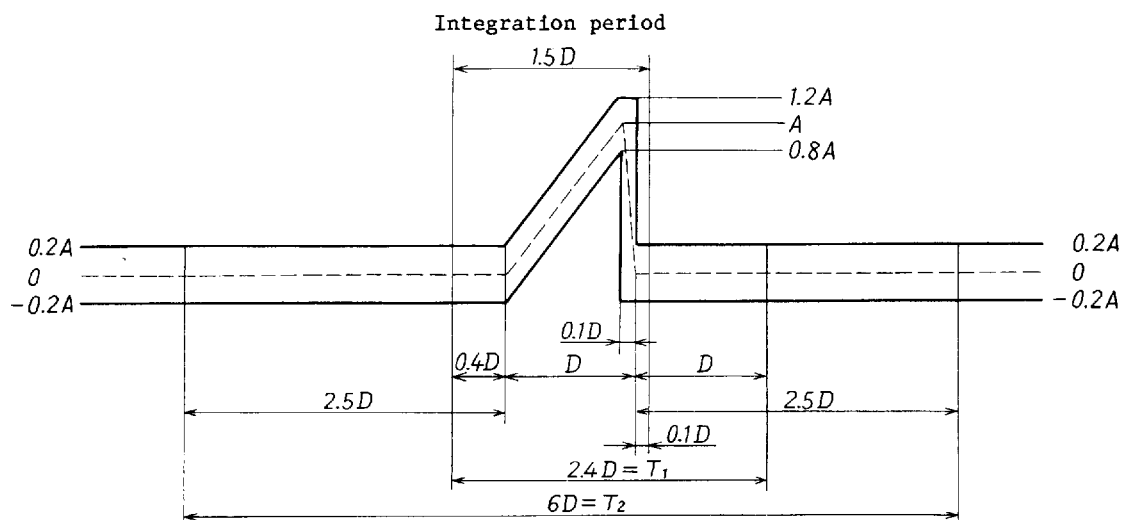
- (1) Mounting jig and mounting method of specimen (see 6.1.2)
- (2) Kind and size of cable to be used (if necessary) (see 6.1.2)
- (3) Mounting jig and mounting method of cable (if necessary) (see 6.1.2)
- (4) Vibration frequency range [see 6.1.3 (1)]
- (5) Vibration amplitude [see 6.1.3 (1)]
- (6) Duration of endurance test (if necessary) [see 6.1.3 (4)]
- (7) Preconditioning (if necessary) [see 6.1.3 (2)]
- (8) Initial measurement items [see 6.1.3 (3)]
- (9) Connecting method of contacts to be tested (if necessary) (see 6.1.2)
- (10) Chattering of contacts and shells during test [see 6.1.3 (5)]
- (11) Contact resistance variation (if necessary) [see 6.1.3 (5)]
- (12) Recovery (if necessary) [see 6.1.3 (6)]
- (13) Final measurement items [see 6.1.3 (7)]
- (14) Maximum magnetic interference (if necessary)

6.2 Shock (see JIS C 0041)

6.2.1 Equipment The equipment for this test shall be a testing machine having sufficient performances to obtain the required characteristics.

- (1) Required characteristics The shock to be applied to the observing point, with the specimen mounted to the shock tester and mounting jig, shall be a pulse approximate to one of the ideal curves of acceleration vs. time shown by broken lines in Figs. 12, 13 and 14.

Fig. 12. Saw-tooth pulse



----- Nominal pulse

———— Tolerance boundaries

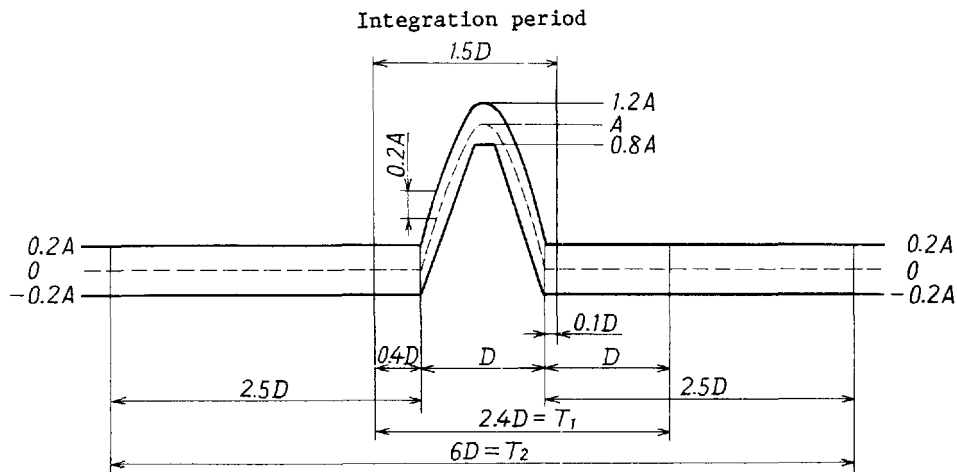
D : Duration of nominal pulse

A : Peak acceleration of nominal pulse

T_1 : Minimum time during which the shock should be monitored, when an ordinary shock tester is employed

T_2 : Minimum time during which the shock should be monitored, when a vibration tester is employed

Fig. 13. Half-sine pulse

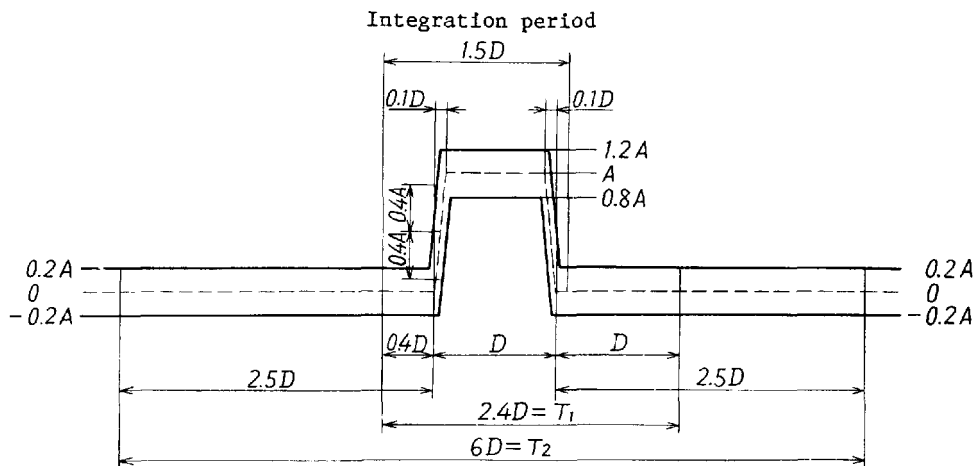


----- Nominal pulse

——— Tolerance boundaries

 D : Duration of nominal pulse A : Peak acceleration of nominal pulse T_1 : Minimum time during which the shock should be monitored, when an ordinary shock tester is employed T_2 : Minimum time during which the shock should be monitored, when a vibration tester is employed

Fig. 14. Trapezoidal pulse



----- Nominal pulse

——— Tolerance boundaries

 D : Duration of nominal pulse A : Peak acceleration of nominal pulse T_1 : Minimum time during which the shock should be monitored, when an ordinary shock tester is employed T_2 : Minimum time during which the shock should be monitored, when a vibration tester is employed

- (a) Waveform of basic pulse The true values of actual pulse waveform shall fall within the tolerance boundaries shown by continuous lines in respective figures. The waveforms to be specified are shown below.

Unless otherwise specified in the detail specification, the half-sine wave shall be used in the test.

Saw-tooth wave: An asymmetric triangle with a short rise time as shown in Fig. 12

Half-sine wave: One half cycle of sine wave as shown in Fig. 13

Trapezoidal wave: A symmetrical trapezoid with short rise and fall times as shown in Fig. 14

- (b) Velocity change tolerance For all pulse shapes, the actual velocity change shall be within + 15 % of the value corresponding to the nominal pulse. To determine the velocity change by integration, the actual pulse shall be integrated from 0.4 D before the pulse to 0.1 D beyond the pulse.

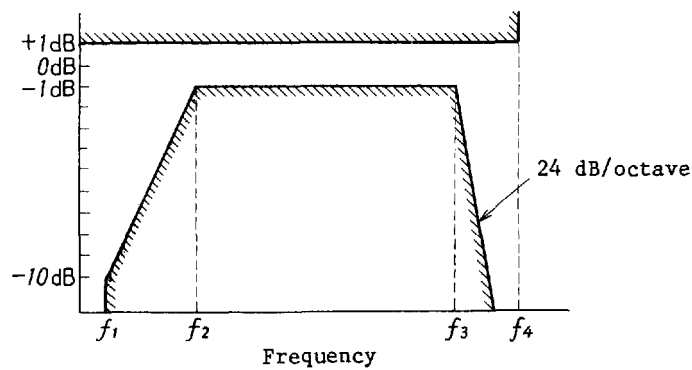
The D is the duration of the nominal pulse.

- (c) Transverse motion The positive or negative peak acceleration at the monitoring point, perpendicular to the intended shock direction, shall not exceed 30 % of the peak acceleration of the nominal pulse in the intended direction, when measured with the measuring system stated in (2).

- (2) Measuring system The characteristics of measuring system shall be such that it can determine that the true value of pulse actually measured at the monitoring point in the intended direction falls within the tolerance boundaries required by the relevant one of Figs. 12, 13 or 14.

The frequency response of the overall measuring system, including the accelerometer, shall be within the limits shown in Fig. 15, since it influences the measurement accuracy significantly.

Fig. 15. Frequency characteristics of measuring system



Duration of pulse D ms	Low-frequency cut-off Hz		High-frequency cut-off kHz	Frequency beyond which the response may rise above ± 1 dB kHz
	f_1	f_2	f_3	f_4
0.2	20	120	20	40
0.5	10	50	15	30
1	4	20	10	20
3	2	10	5	10
6	1	4	2	4
11	0.5	2	1	2
18	0.2	1	1	2

6.2.2 Preparation The specimen shall be mounted as specified in the detail specification. When the cable is connected to the specimen, the cable shall be so installed that the specimen receives the same restraint and mass as those in normal service. To accomplish the above it is necessary that the cables are securely attached to the mounting jig.

Unless otherwise specified in the detail specification, all the contacts under test shall be connected in series because they are subjected to the test of 5.5.

6.2.3 Test Carry out the test as follows:

- (1) **Severities** The severity shall be selected from Table 5 and specified in the detail specification.

Table 5. Severities

Peak acceleration A m/s ²	Duration D ms	Velocity change V m/s		
		Half-sine wave $V = \frac{2}{\pi}AD$	Saw-tooth wave $V = 0.5AD$	Trapezoidal wave $V = 0.9AD$
294	18	3.4	2.6	4.8
490	11	3.4	2.7	4.9
981	6	3.7	2.9	5.3
4900	1	3.1	—	—
14700	0.5	4.7	—	—

- (2) Preconditioning As specified in the detail specification.
- (3) Initial measurements Examine the appearance, electrical and mechanical performances as specified in the detail specification.
- (4) Testing conditions Unless otherwise specified, apply three successive shocks in each of six directions along three mutually perpendicular axes, including two directions along the axis of mating, i.e. 18 shocks in total.

Carry out the test of 5.5 throughout the test duration. Carry out the test of 5.7, if the provision of detail specification requires so.

- (5) Recovery As specified in the detail specification.
- (6) Final measurements Examine the appearance, electrical and mechanical performances as specified in the detail specification.

6.2.4 Items to be specified in detail specifications The following items shall be specified in detail specifications:

- (1) Mounting jig and mounting method of specimen (see 6.2.2)
- (2) Kind and size of cable to be used (if necessary) (see 6.2.2)
- (3) Mounting jig and mounting method of cable (if necessary) (see 6.2.2)
- (4) Severity (peak acceleration, duration and waveform of pulse) [see 6.2.3 (1)]
- (5) Preconditioning (if necessary) [see 6.2.3 (2)]
- (6) Initial measurement items [see 6.2.3 (3)]
- (7) Connecting method of contact to be tested (if necessary) (see 6.2.2)
- (8) Chattering of contacts and shells during test [see 6.2.3 (4)]
- (9) Contact resistance variation (if necessary) [see 6.2.3 (4)]

- (10) Direction and number of shocks (if necessary) [see 6.2.3 (4)]
- (11) Recovery (if necessary) [see 6.2.3 (5)]
- (12) Final measurement items [see 6.2.3 (6)]

6.3 Mechanical operation (repeated)

6.3.1 Equipment The equipment shall have a mechanism which can perform the test stated in 6.3.3 and can confirm the number of operating cycles by an adequate means.

6.3.2 Preparation The specimens shall be prepared as specified in the detail specification.

6.3.3 Test Carry out the test as follows:

- (1) Initial measurements Examine the appearance, electrical and mechanical performances as specified in the detail specification.
- (2) Test procedure
 - (a) Number of operating cycles Mount the specimen according to the method stated in the detail specification and then subject it to engagement and disengagement in the normal manner, for the number of cycles selected from Table 6 and specified in the detail specification.

Table 6. Number of operation cycles

							Unit: cycle
50	100	250	500	1000	2000	5000	10000

A device which can mate and separate the specimen may be used, if the detail specification permits use of the device.

- (b) Speed of operation The speed of operation shall be as specified in the detail specification.
- (3) Final measurements Examine the appearance, electrical and mechanical performances as specified in the detail specification.

6.3.4 Items to be specified in detail specifications The following items shall be specified in detail specifications:

- (1) Mounting method of specimen (see 6.3.2)
- (2) Initial measurement items [see 6.3.3 (1)]
- (3) Number of operation cycles [see 6.3.3 (2)]
- (4) Use or non-use of mating and separating device [see 6.3.3 (2)]
- (5) Speed of operation [see 6.3.3 (2)]
- (6) Final measurement items [see 6.3.3 (3)]

6.4 Gauge retention force (resilient contact)

6.4.1 Equipment The equipment for this test shall consist of gauges and a tensile tester having enough performances to carry out the test of 6.4.3.

6.4.2 Preparation The maximum size gauge specified in the detail specification shall be inserted into the female contact of the specimen to a depth in normal use and withdrawn three times unless otherwise specified.

For the male contact similar preparation shall be made by means of minimum size gauge.

6.4.3 Test Insert the minimum size gauge specified in the detail specification into the female contact and then measure the retention force in the direction of withdrawal. For the male contact, measure the force in a similar way by applying the maximum size gauge.

6.4.4 Items to be specified in detail specifications The following items shall be specified in detail specifications:

- (1) Mounting method of contact to be tested (see 6.4.2)
- (2) Number of contacts to be tested (see 6.4.2)
- (3) Number of insertion and withdrawal cycles (if necessary) (see 6.4.2)
- (4) Details of gauges to be used (see 6.4.2 and 6.4.3)

6.5 Probe damage

6.5.1 Equipment The equipment for this test shall consist of the test jigs shown in Figs. 16 to 18, and a tester having enough performance for carrying out the test.

Unless specified in the detail specification, the test pin to be used shall comply with the following requirements:

- (1) The pin shall be made of hardened steel, shall have spherical end and polished surface.
- (2) The length shall be $\frac{3}{4}$ of the minimum depth of normal insertion at the maximum. (dimension A in Fig. 16)
- (3) The diameter shall be equal to the nominal diameter of applicable male contact (dimension B in Fig. 16)

6.5.2 Preparation The cylindrical female contact to be tested (specimen) shall be fixed to the jigs which can rotate during the test as illustrated in Figs. 17 and 18 with its mating axis horizontal.

When the contact integrated in a connector is tested as shown in Fig. 18, the contact shall be locked to prevent its rotation in the connector.

6.5.3 Test Insert the jig which can exert the specified moment to the specimen to the specified depth, and rotate the specimen steadily around its axis through 360° . Repeat such operation by changing the depth in the specified sequence. Unless such depth and sequence are specified in the detail specification, insert the jig to $3/4$ of the depth at normal insertion (consider this depth as the specified dimension A), and then insert to a depth $2/3A$ and $1/3A$ in the given order. After application of the moment, carry out the test of 6.4.

6.5.4 Items to be specified in detail specifications The following items shall be specified in detail specifications:

- (1) Length A of test pin (if necessary) (see 6.5.1)
- (2) Shape of end and finish of test pin (see 6.5.1)
- (3) Value of the bending moment (see 6.5.3)
- (4) Details of jig which exerts bending moment (see 6.5.1)
- (5) Depth and sequence of insertion of jig which exerts bending moment (if necessary) (see 6.5.3)

Fig. 16. Jig which exerts bending moment

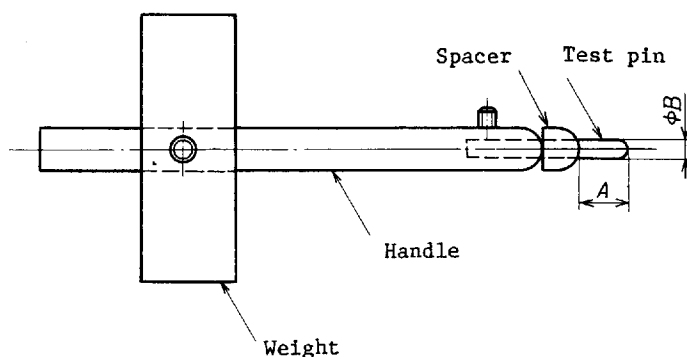


Fig. 17. Holding jig to test individual contact (An example)

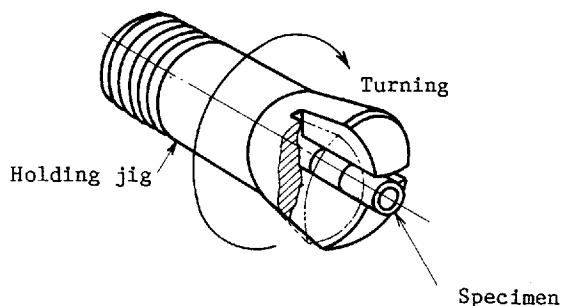
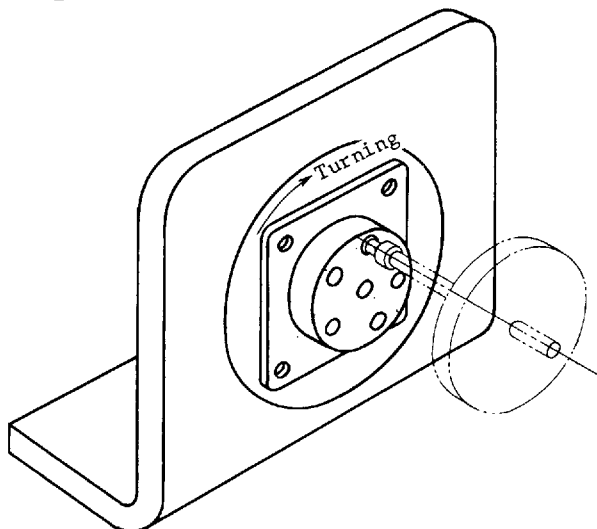


Fig. 18. Jig to test contact built in connector (An example)



6.6 Insertion and withdrawal forces

6.6.1 Equipment The equipment for this test shall be a tensile tester having enough performances for carrying out the test of 6.6.3.

6.6.2 Preparation Such unnecessary parts for test as accessories which assists insertion and withdrawal operations, shall be removed, and the specimen shall be mounted to the testing machine as specified in the detail specification.

An applicable gauge may be used instead of one of the contacts of the specimen.

6.6.3 Test Measure the insertion and withdrawal forces, consecutively five times by inserting and withdrawing the mating component or applicable gauge into and from the connector at a constant rate in the axis direction.

6.6.4 Items to be specified in detail specifications The following items shall be specified in detail specifications:

- (1) Mounting method of specimen (see 6.6.2)
- (2) Parts unnecessary for test (see 6.6.2)
- (3) Details of applicable gauge (if necessary) (see 6.6.2)
- (4) Rates of insertion and withdrawal (if necessary) (see 6.6.3)

6.7 Cable clamp robustness (against cable pull)

6.7.1 Equipment The equipment for this test shall be a tensile tester having enough performances for carrying out the test of 6.7.3.

6.7.2 Preparation An applicable cable to the specimen is fitted in the normal manner to the specimen by means of the clamping device, and the assembly shall be mounted as specified in the detail specification.

Unless otherwise specified in the detail specification, the cables shall not be connected to the contacts.

6.7.3 Test Fix the specimen to a mounting stand so that the cable is in a vertical position, and apply a tensile force to the free end of cable axially. Increase the tensile force to the specified value gradually at a rate not exceeding 20 N/s, hold the force at that value for 1 min, and then examine existence or non-existence of cable displacement and of any abnormality on the cable and cable clamp.

6.7.4 Items to be specified in detail specifications The following items shall be specified in detail specifications:

- (1) Applicable cable (see 6.7.2)
- (2) Connection between cable and contact (if necessary) (see 6.7.2)
- (3) Mounting method of specimen (see 6.7.2)
- (4) Magnitude of tensile force (see 6.7.3)

6.8 Effectiveness of connector coupling devices

6.8.1 Equipment The equipment for this test shall be a tensile tester having enough performances for carrying out the test of 6.8.3.

6.8.2 Preparation The specimen shall be mated in the normal manner by means of the coupling device, and the assembly shall be mounted to the tester as specified in the detail specification.

6.8.3 Test Apply a tensile force to the specimen along its mating axis gradually at the specified rate up to the specified value, maintain the force for 15 s. Examine whether the connector is enough mating during the tensile force application.

Remove the tensile force, and then examine existence or non-existence of any abnormality on the coupling device.

6.8.4 Items to be specified in detail specifications The following items shall be specified in detail specifications:

- (1) Mounting method of specimen (see 6.8.2)
- (2) Position to which tensile force is applied (see 6.8.3)
- (3) Value of tensile force and rate of application (see 6.8.3)

6.9 Robustness of mounting part (static load, axial and torque)

6.9.1 Equipment The equipment for this test shall consist of a testing machine and a set of jigs which can apply the force and/or torque continuously to the specimen and have enough performances for carrying out the test of 6.9.3.