NEC/SCHOTT

SEFUSE™

THERMAL CUTOFF

SF/E SERIES TECHNICAL DATA

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Contents

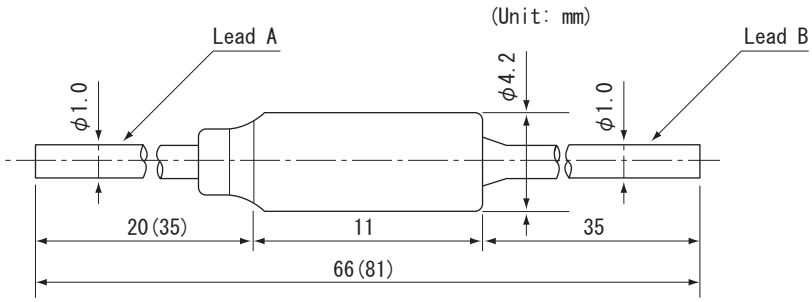
Section

Note The mark “ ⊕ ” on graph indicates maximum, minimum and mean values of the data with its parts of “ ⊤ ”, “ ⊥ ” and “ ⊕ ” respectively.

The **SEFUSE™** is a compact, durable and reliable thermal cutoff designed to protect domestic electrical appliances and industrial equipment from fire. These technical data present the basic characteristics of the **SEFUSE™** SF/E Series thermal cutoffs and test data under various usage conditions.

1. Specification Outline

(1) Dimensions



Note The dimensions for long lead devices are shown in parentheses.

(2) Ratings

Part Number	Rated Functioning Temperature	Operating Temperature
SF70E	73 ℃	70 ± 2 ℃
SE76E	77 ℃	76 $\pm^{0}_{4}$ ℃
SF91E	94 ℃	91 $\pm^{3}_{1}$ ℃
SF96E	99 ℃	96 ± 2 ℃
SF109E	113 ℃	109 $\pm^{3}_{1}$ ℃
SF119E	121 ℃	119 ± 2 ℃
SF129E	133 ℃	129 ± 2 ℃
SF139E	142 ℃	139 ± 2 ℃
SF152E	157 ℃	152 ± 2 ℃
SF169E	172 ℃	169 $\pm^{1}_{3}$ ℃
SF188E	192 ℃	188 $\pm^{3}_{1}$ ℃
SF214E	216 ℃	214 $\pm^{1}_{3}$ ℃
SF226E	227 ℃	226 $\pm^{1}_{3}$ ℃
SF240E	240 ℃	237 ± 2 ℃

Notes 1. The types are for standard lead. When long lead type is required, add “-1” at the end of type name.

2. Refer to latest cataloge for details of temperature ratings, electrical ratings and safety standard approvals.

2. Internal Resistance

(1) Method

By the voltage drop measuring method as shown in Fig. 1, measure the resistance between both lead wires at the distance of 25 mm including the casing.

The measurement is carried out below a current level of 100 mA.

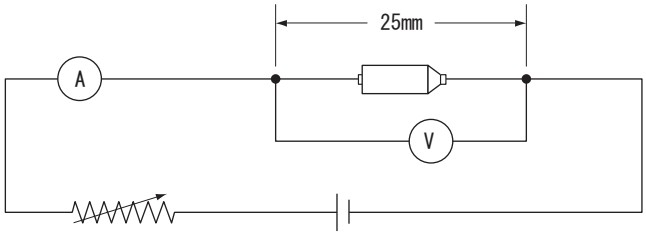


Figure 1 Test method

(2) Results

Table 1 Internal Resistance

Number of specimens 50 pcs. (Unit: m Ω)

Catalog number	All the types of SF/E Series
Standard	1.5 Max.
Mean	0.878
Standard deviation	0.037

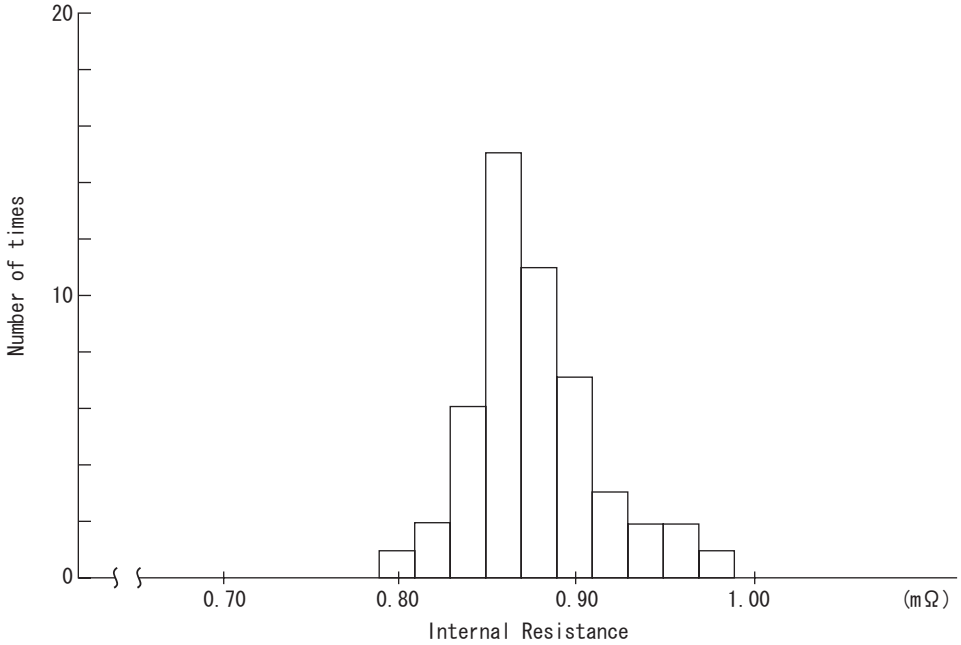


Figure 2 Internal Resistance

3. No-load-opening Temperature

(1) Method

A thermal cutoff test sample is placed in the condition shown in Fig. 3, and the temperature of a thermostatic oven is raised until 10℃ below the operating temperature of the test sample at optional rasing speed.

Then the temperature of the thermostatic oven is raised at the rate of 1℃ per minute, and measure the opening temperature. The current used for judging the opening is less than 100mA. And the distance between a thermometer and a test sample is less than 20mm.

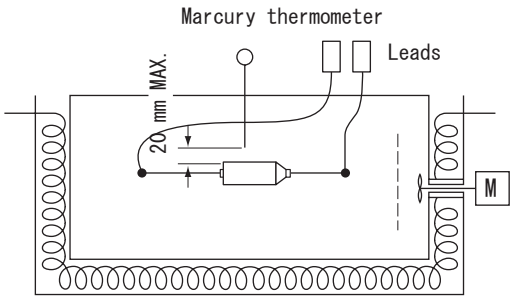


Figure 3 Test method

(2) Results

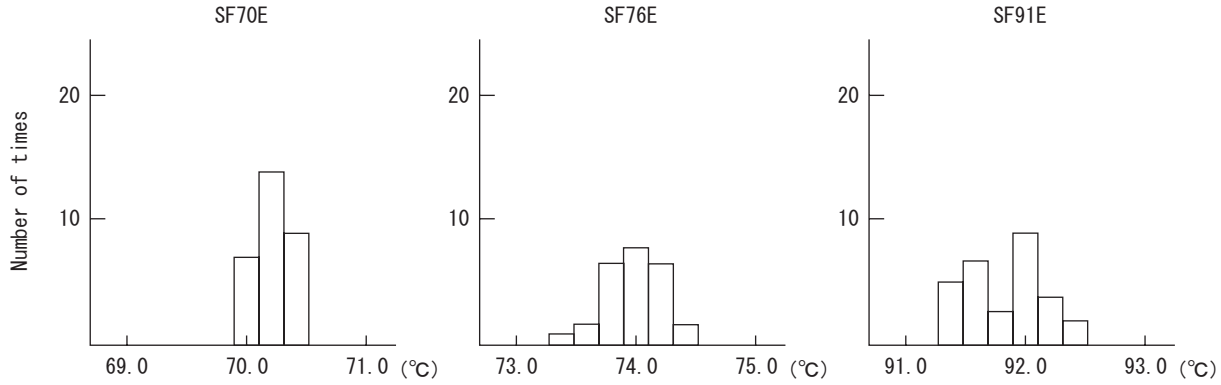
Table 2 Opening Temperature

Number of specimens 50 pcs. (Unit:℃)

Catalog number	SF70E	SF76E	SF91E	SF96E	SF109E
Standard	70±2	76^{0}_{-4}	91^{+3}_{-1}	96±2	109^{+3}_{-1}
Mean	70.26	73.94	91.79	95.79	111.00
Standard deviation	0.138	0.244	0.310	0.218	0.161

Catalog number	SF119E	SF129E	SF139E	SF152E	SF169E
Standard	119±2	129±2	139±2	152±2	169^{+1}_{-3}
Mean	118.82	129.98	138.95	153.31	167.98
Standard deviation	0.313	0.204	0.234	0.146	0.232

Catalog number	SF188E	SF214E	SF226E	SF240E
Standard	188^{+3}_{-1}	214^{+1}_{-3}	226^{+1}_{-3}	237±2
Mean	190.13	213.10	225.22	236.37
Standard deviation	0.218	0.204	0.272	0.339



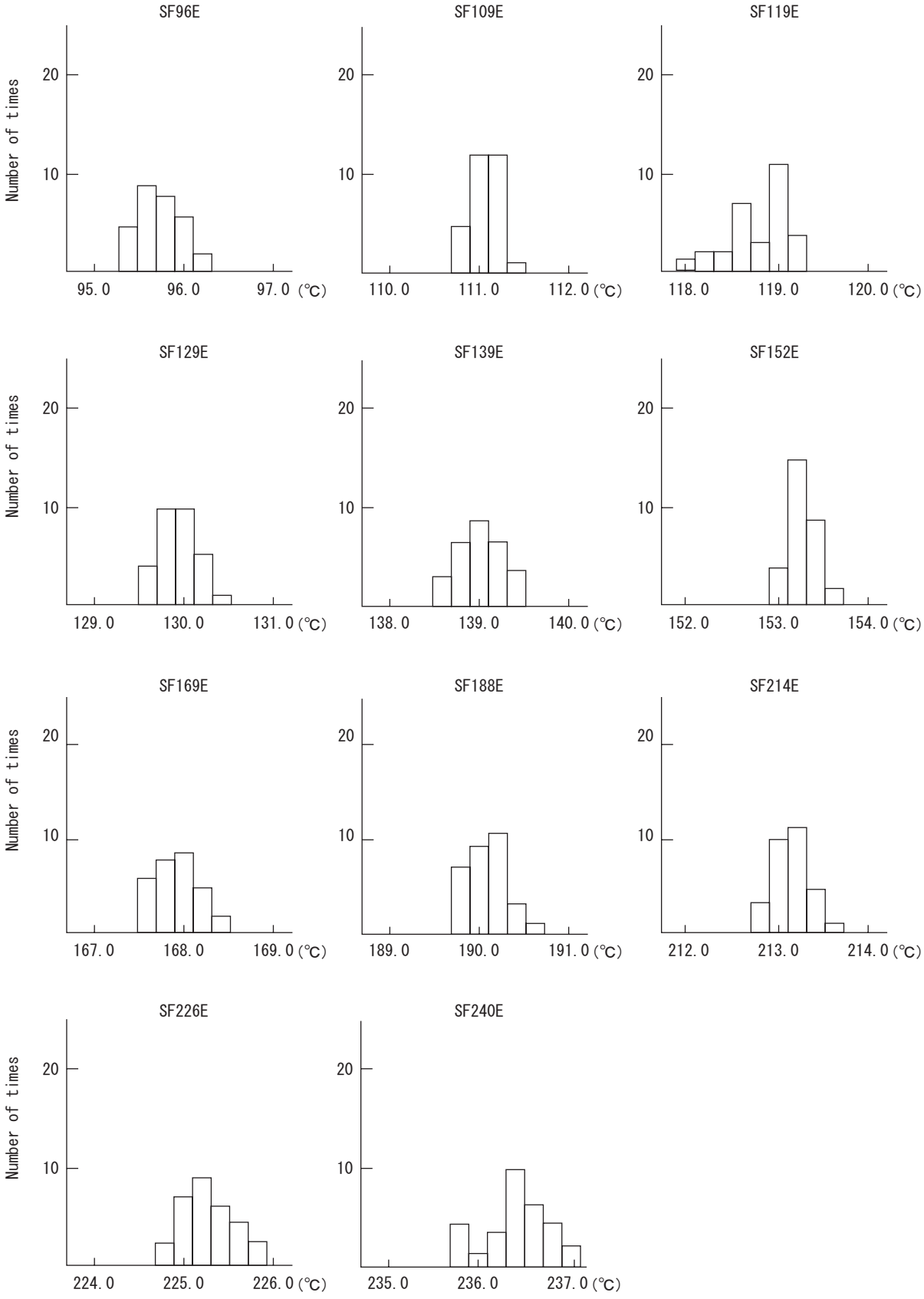


Figure 4　Opening Temperature

4. Insulation Resistance After Opening

(1) Method

Using the opened thermal cutoff by the section 3 test, measure the insulation resistance between both lead wires by an insulation resistance tester applying a terminal voltage of D.C.500V.

The test sample was kept in the oven for 1 minute after operation and was taken out to a room temperature.

(2) Results

Table 3 Insulation Resistance

Number of specimens 30 pcs. (Unit: M Ω)

Catalog number	All the types of SF/E Series
Standard	Must be more than 100
Measured value	All pieces were more than 1×10^5

5. Withstand Voltage After Opening

(1) Method

After the test of section 4, apply A.C.500V (60 or 50 Hz) for 1 minute between both lead wires.

If test sample withstands for 1 minute, the voltage should be elevated to breakdown voltage.

Raise voltage uniformly from 0V at a rate of 500 V per second. Set the sensitive leak current at 5 mA.

(2) Results

Table 4 Withstand Voltage

Number of specimens 30 pcs. (Unit: V.AC)

Catalog number	All the types of SF/E Series
Standard	Must withstand for 1 minute against A.C. voltage of 500 V
Measured value	All pieces withstood.

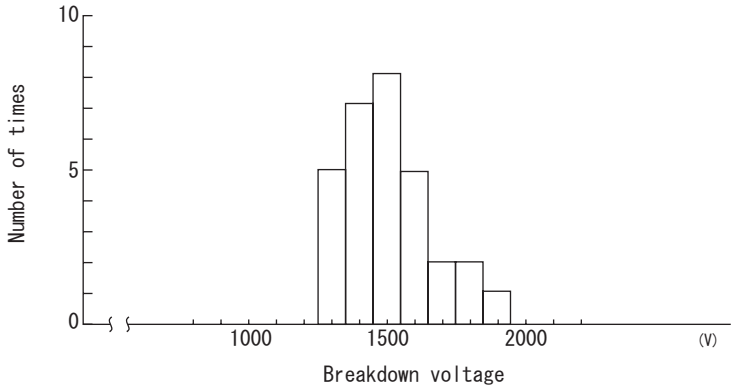


Figure 5 Withstand Voltage

6. No-load-opening Temperature (After High Temperature Holding)

(1) Method

Set the thermostatic oven to 20℃ (±3℃) lower than the operating temperature. Put the thermal cutoff in the thermostatic oven. Take it out each hour indicated in Fig. 6. Measure internal resistance, opening temperature, insulation resistance after opening and withstand voltage after opening. However, if the holding temperature (20℃ below the nominal opening temperature) exceeds 140℃ , it is set to 140℃ .

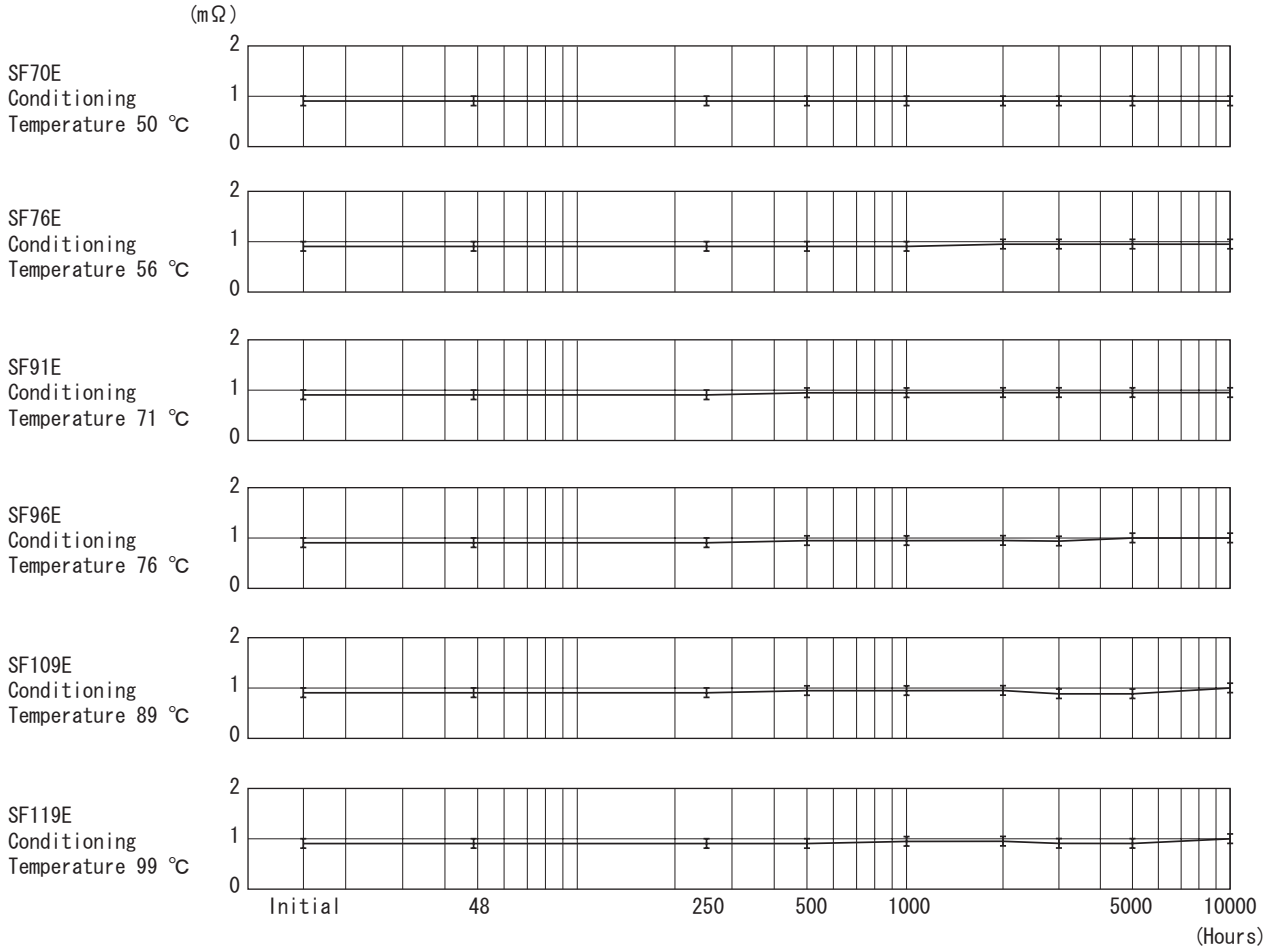
(2) Standards

After 48 hours and 500 hours, the test items shown in section 2, 3, 4 and 5 should be satisfied except the opening temperature after 500 hours. The opening temperature after 500 hours should be within ±5 ℃ of the operating temperature.

(3) Results

(a) Internal resistance

Number of specimens 10 pcs.



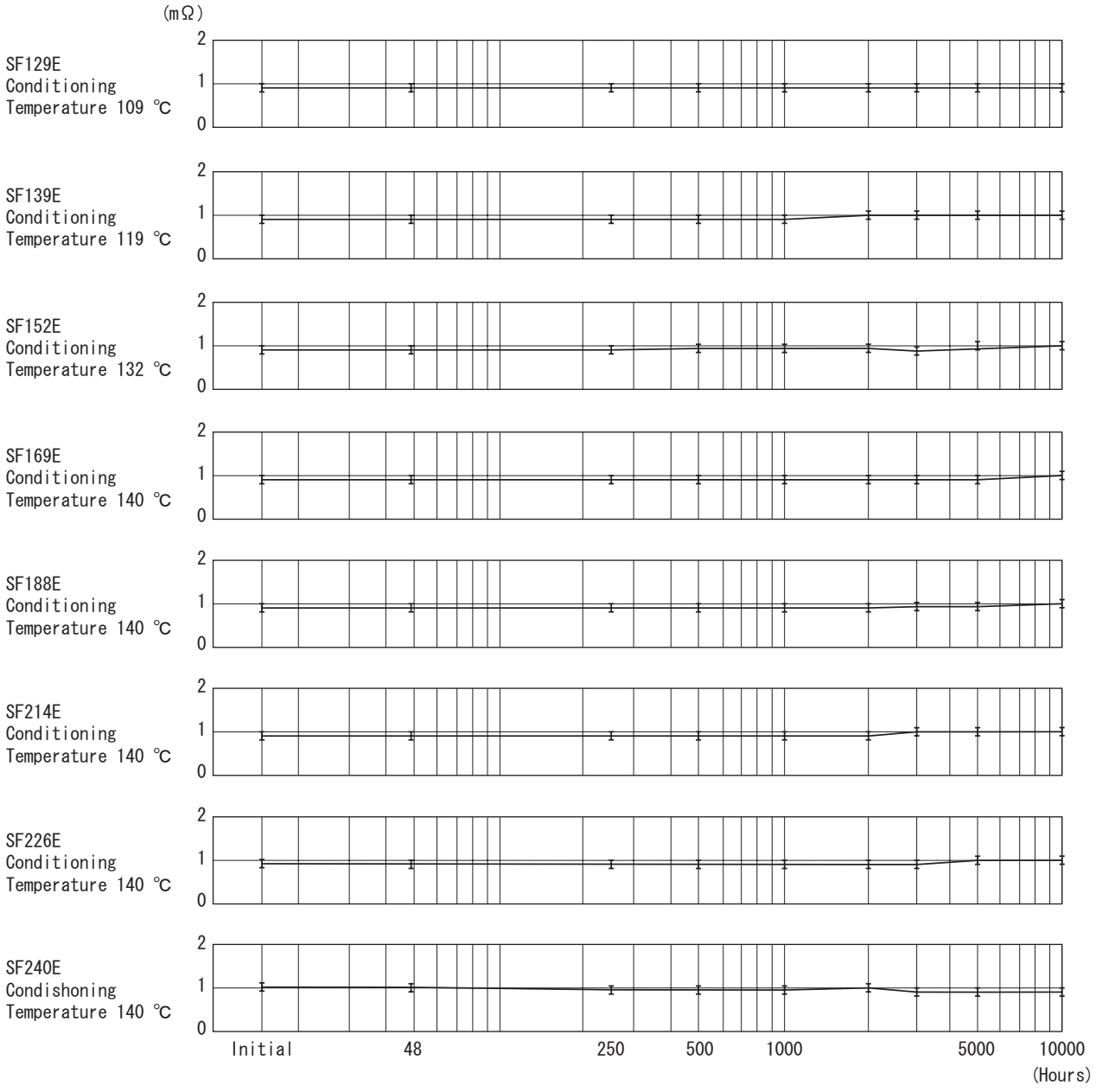


Figure 6 Internal Resistance After High Temperature Holding

(b) Insulation Resistance

Number of specimens 5 pcs.

・All pieces were more than 1×10^5 MΩ

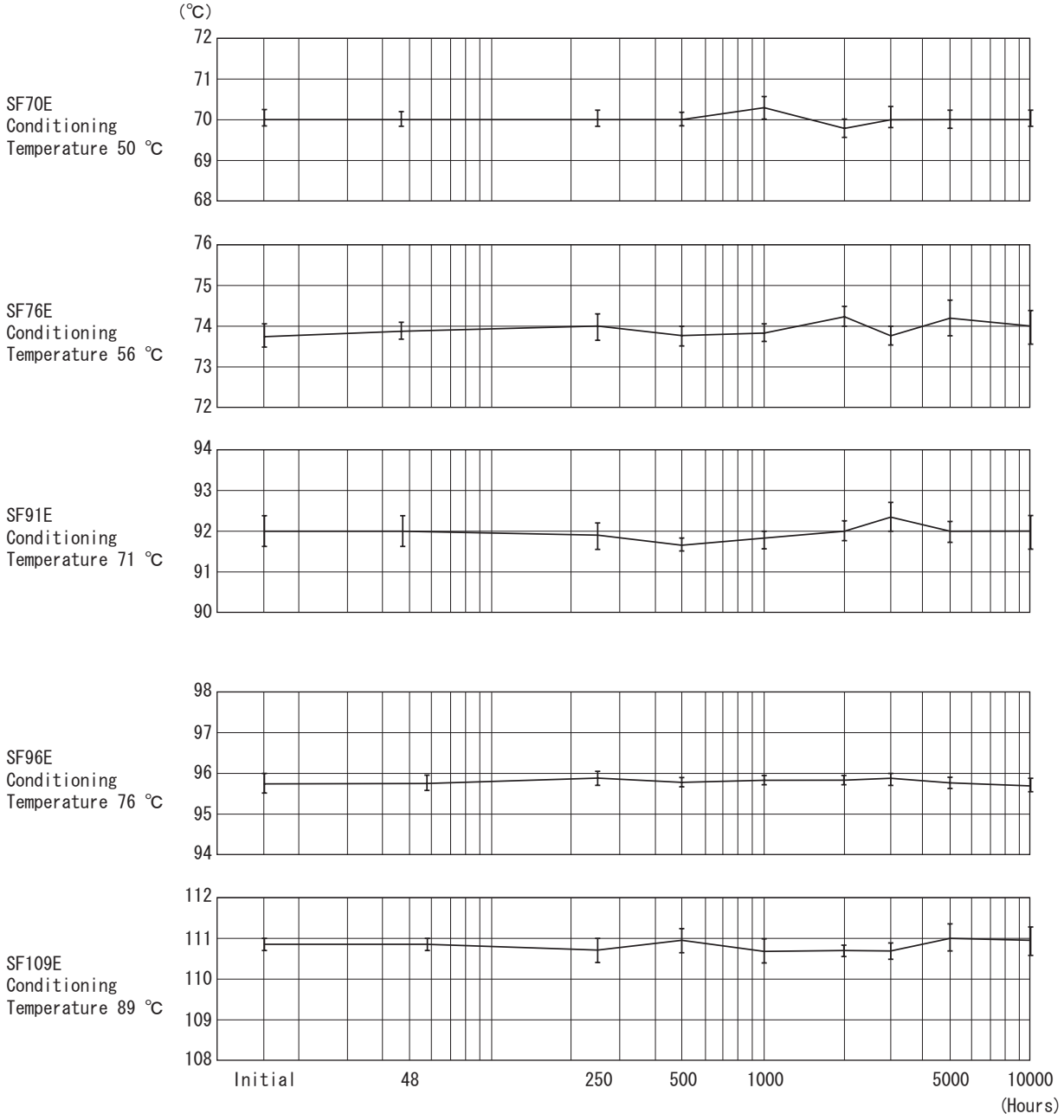
(c) Withstand voltage

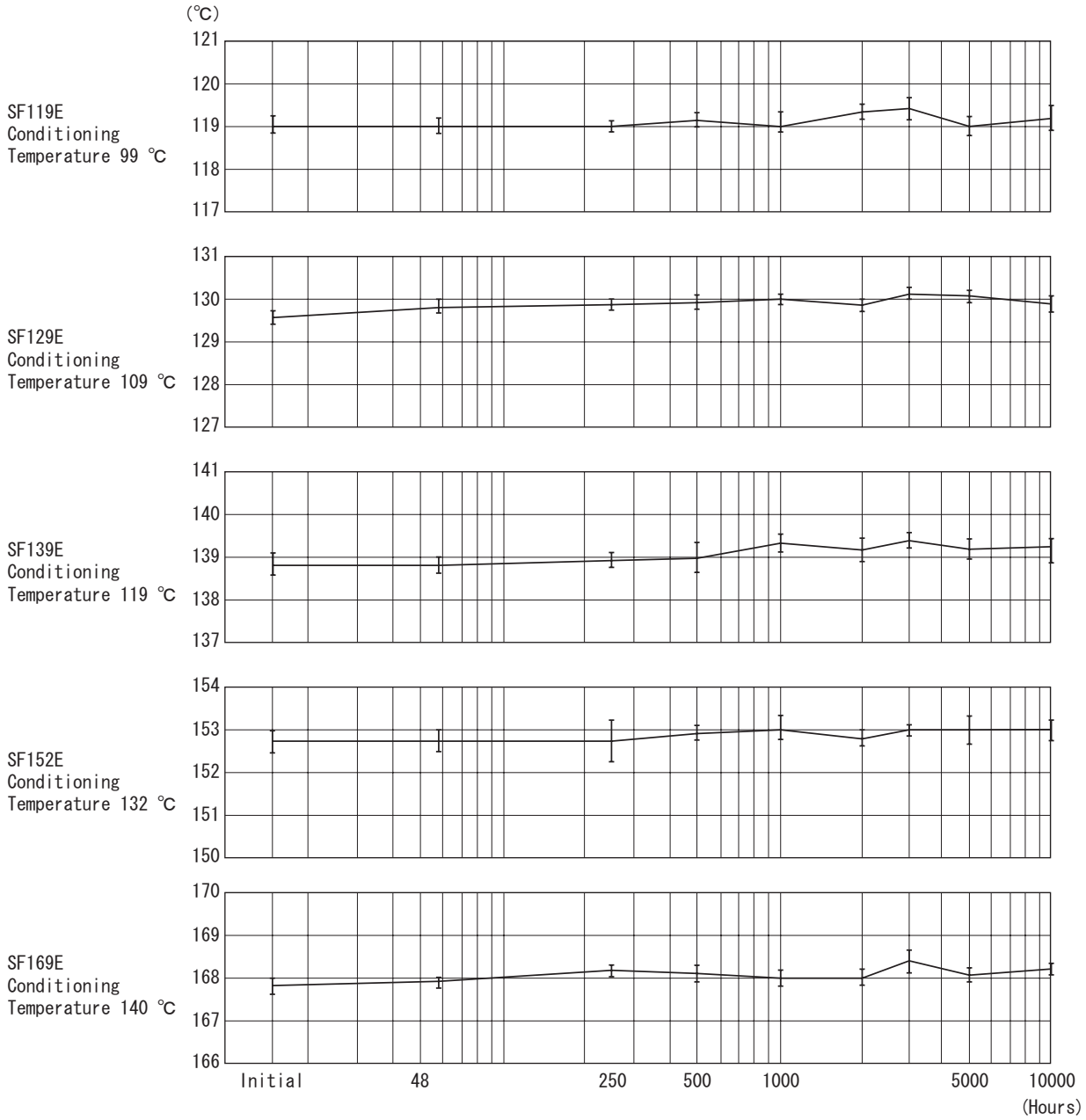
Number of specimens 5 pcs.

・All pieces withstood for 1 minute against A.C. voltage of 500 V.

(d) Opening temperature

Number of specimens 5 pcs.




(℃)
SF119E
Conditioning
Temperature 99 ℃
121
120
119
118
117
SF129E
Conditioning
Temperature 109 ℃
131
130
129
128
127
SF139E
Conditioning
Temperature 119 ℃
141
140
139
138
137
SF152E
Conditioning
Temperature 132 ℃
154
153
152
151
150
SF169E
Conditioning
Temperature 140 ℃
170
169
168
167
166
Initial
48
250
500
1000
5000
10000
(Hours)

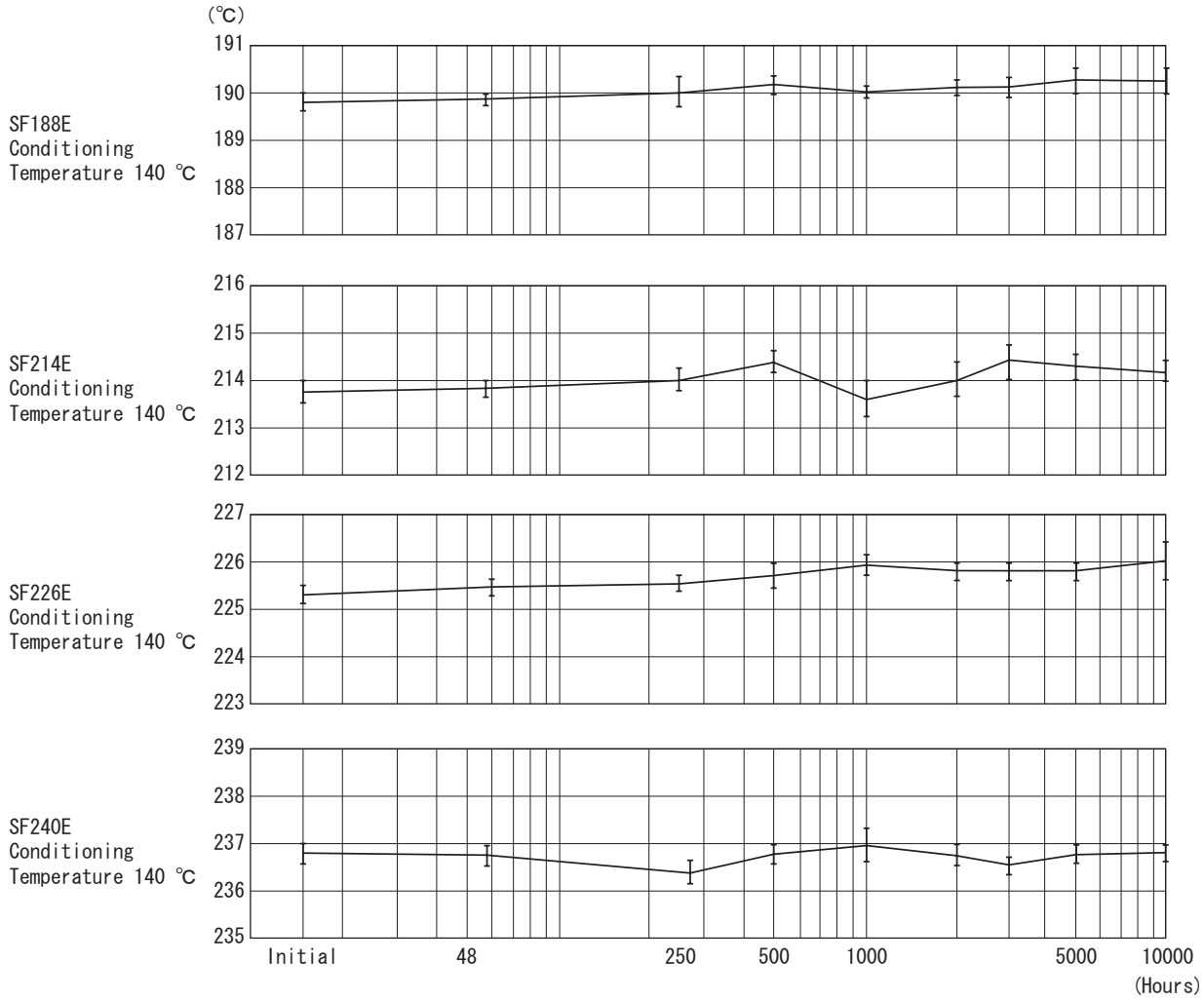


Figure 7　Opening Temperature After High Temperature Holding

7. Thermal pellet Size (After High Temperature Holding)

Since the thermal pellet of SF type shrinks depending on temperature and time experienced, malfunction can result even if a body temperature of the thermal cutoff is lower than its operating temperature. This data shows the relation between pellet size, temperature and time. Please make designs so that the body temperature of the thermal cutoffs does not exceed our recommendation maximum temperature. Refer to our catalogue for detailed information.

(1) Method

Set the thermostatic oven to described temperature (±3℃) in figure 8. Put the thermal cutoff in the oven. Take it out after keeping and measure the pellet size by X-ray observation.

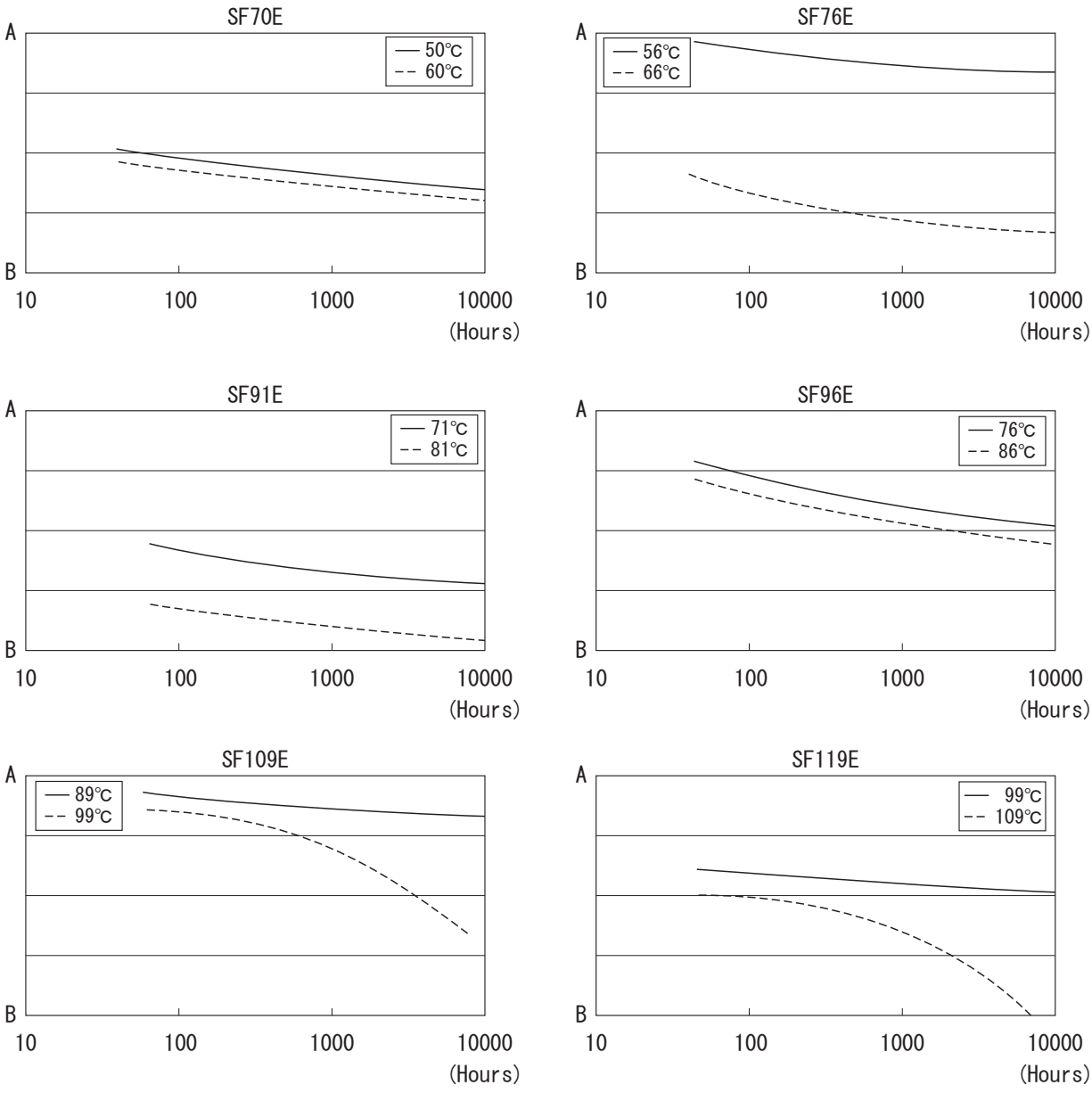
(2) Results

Number of specimens 10pcs.

Refer to Figure 8. The data is average value.

The vertical line shows pellet size.

A: Initial pellet size. B: Pellet size leads to open



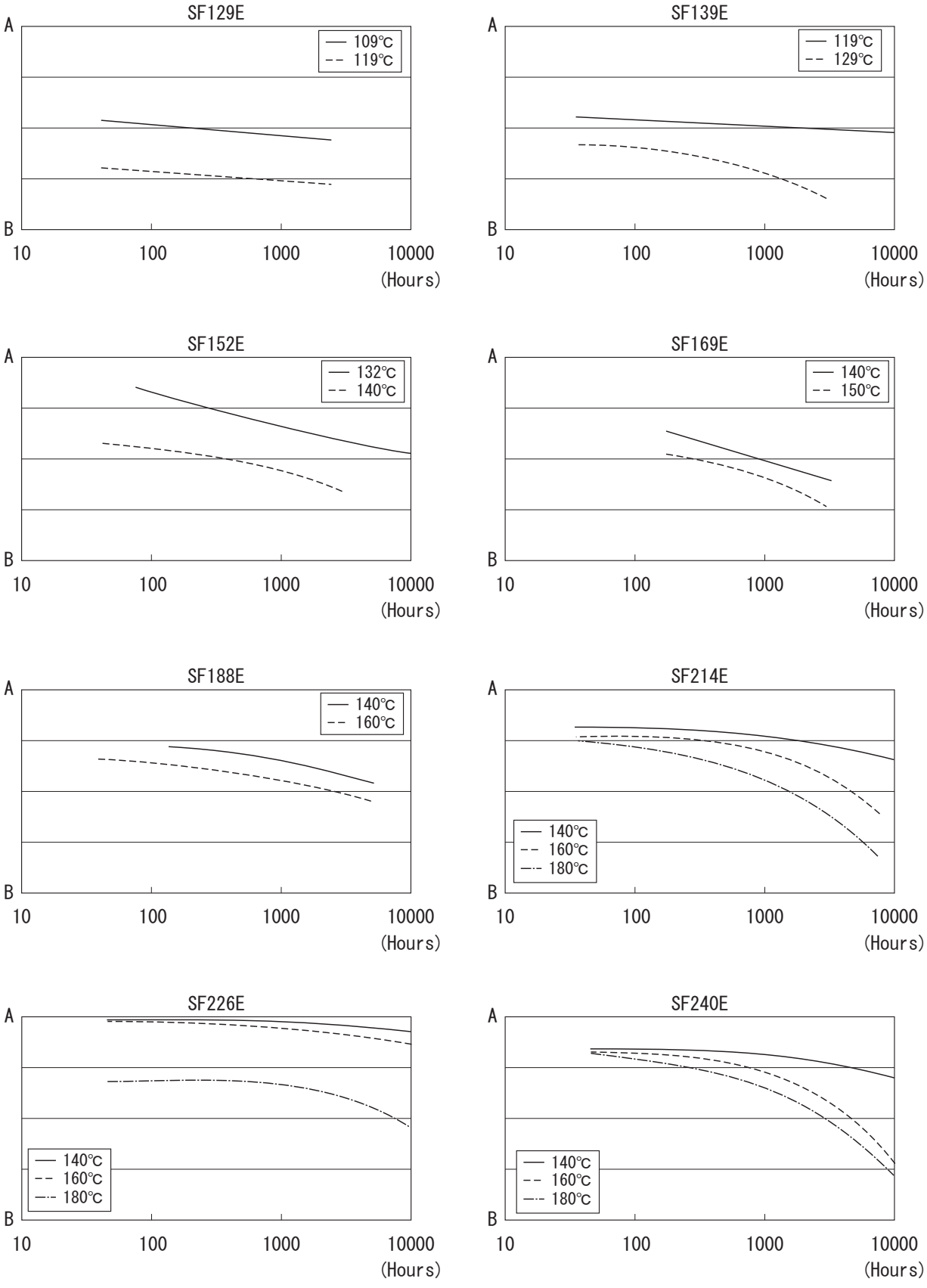


Figure 8 Thermel Pellet Size

8. Humidity Test

(1) Method

Put the thermal cutoff in the humidistatic oven. The test condition is shown in table 5. Take it out after 250 hours. After leaving the test sample in an atmosphere of normal temperature and humidity for 2 hours, measure its internal resistance, opening temperature, insulation resistance and withstand voltage.

Table 5 Conditions of Humidity Test

Classification (operating temperature)	Test Condition
Below 100℃	Temperature: 40 ± 3℃ Humidity: 90 ～ 95% RH
Over 100℃	Temperature: 65 ± 3℃ Humidity: 90 ～ 95% RH

(2) Standards

The test items shown in section 2, 3, 4, and 5 should be satisfied.

(3) Results

(a) Internal Resistance Number of specimens 5 pcs.

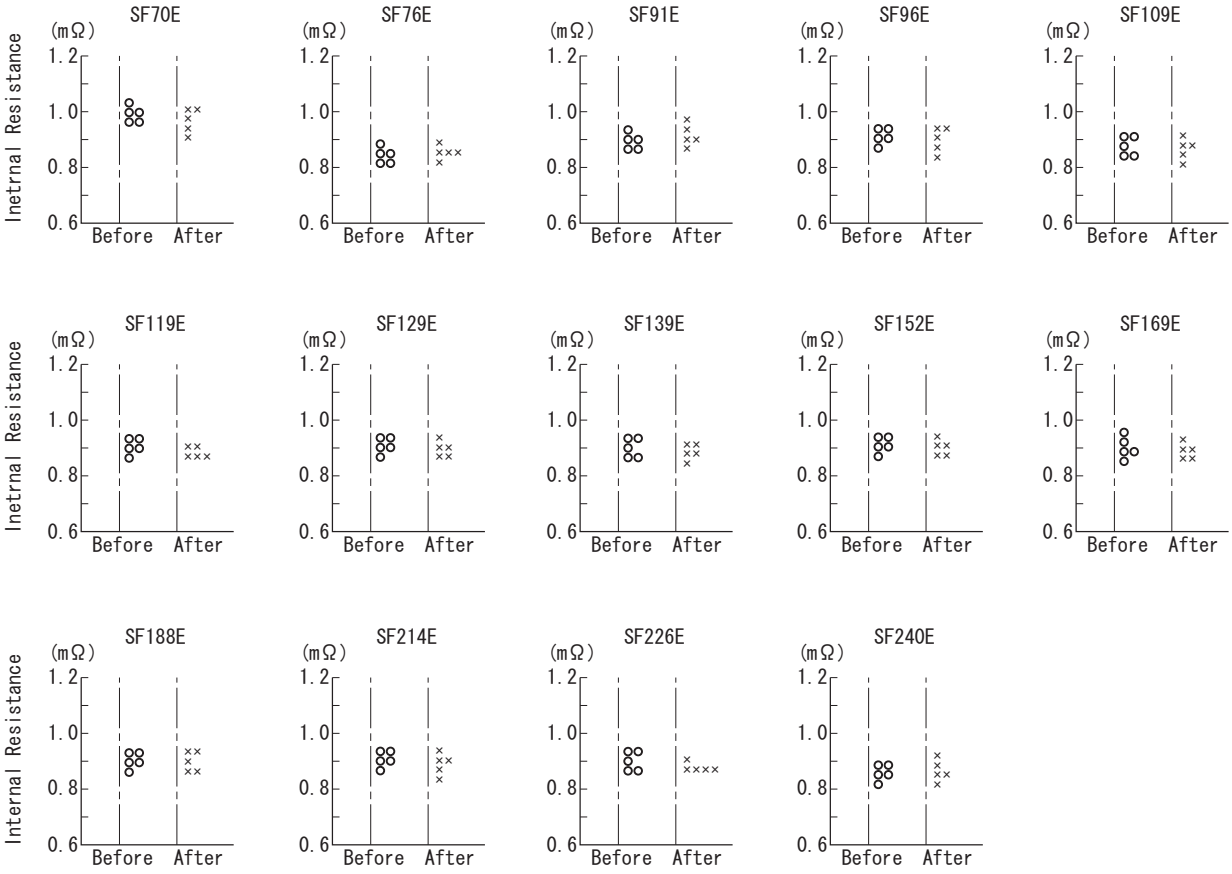


Figure 9 Internal Resistance After Humidity Test

(b) Opening Temperature Number of specimens 5 pcs.

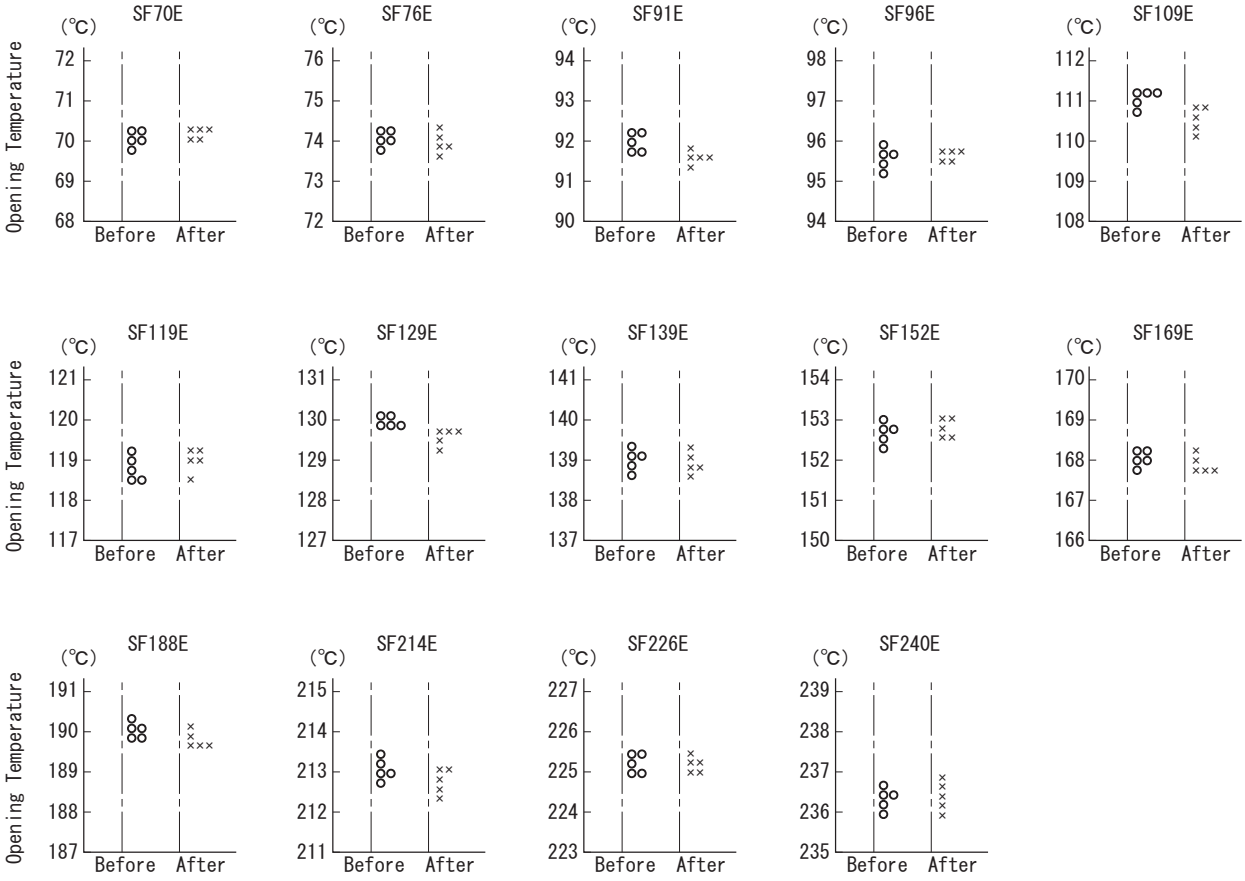


Figure 10 Opening Temperature After Humidity Test

(c) Insulation Resistance Number of specimens 5 pcs.

・All pieces were more than 1×10^5 MΩ

(d) Withstand voltage Number of specimens 5 pcs.

・All pieces withstood for 1 minute against 500 V ac.

9. Temperature Cycle

(1) Method

Put the thermal cutoff in a thermostatic oven kept -30℃ and remove it after 15 minutes. Then place it immediately into a thermostatic oven set 20℃ lower than the operating temperature and remove it after 15 minutes. Repeat the above cycle 10 times, and then measure internal resistance, opening temperature, insulation resistance after opening, and withstand voltage after opening.

If the high temperature (20℃ below the operating temperature) exceed 100℃ , make it 100℃ .

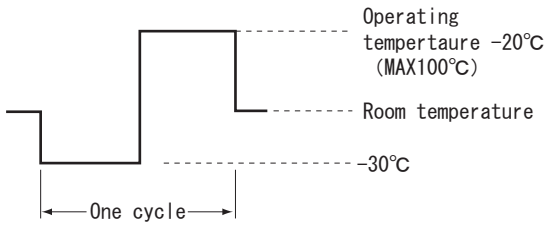


Figure 11 Temperature Cycle

(2) Standard

After the 10 cycles, the test conditions shown in section 2 and 3 should be satisfied.

(3) Results

(a) Internal Resistance Number of specimens 5 pcs.

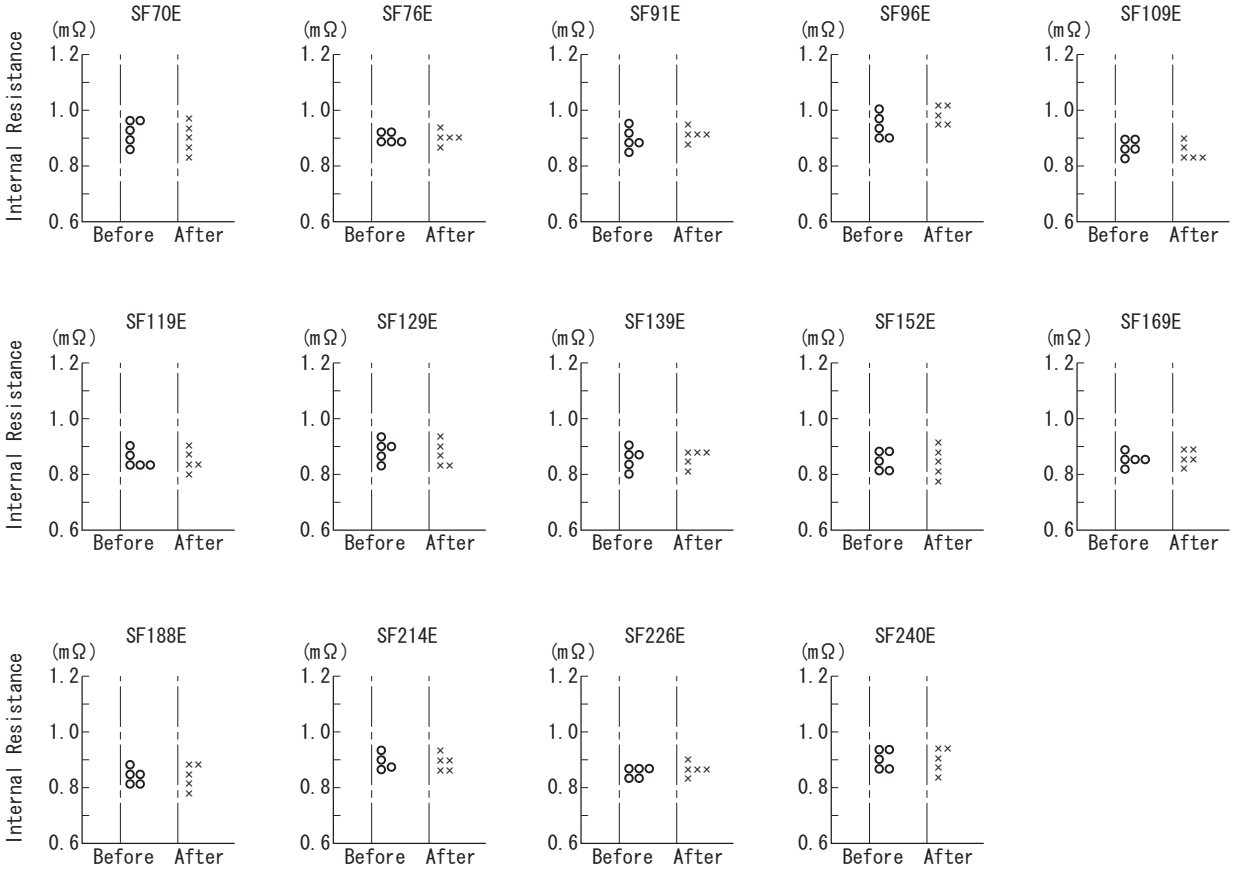


Figure 12 Internal Resistance After Temperature Cycle

(b) Opening Temperature Number of specimens 5 pcs.

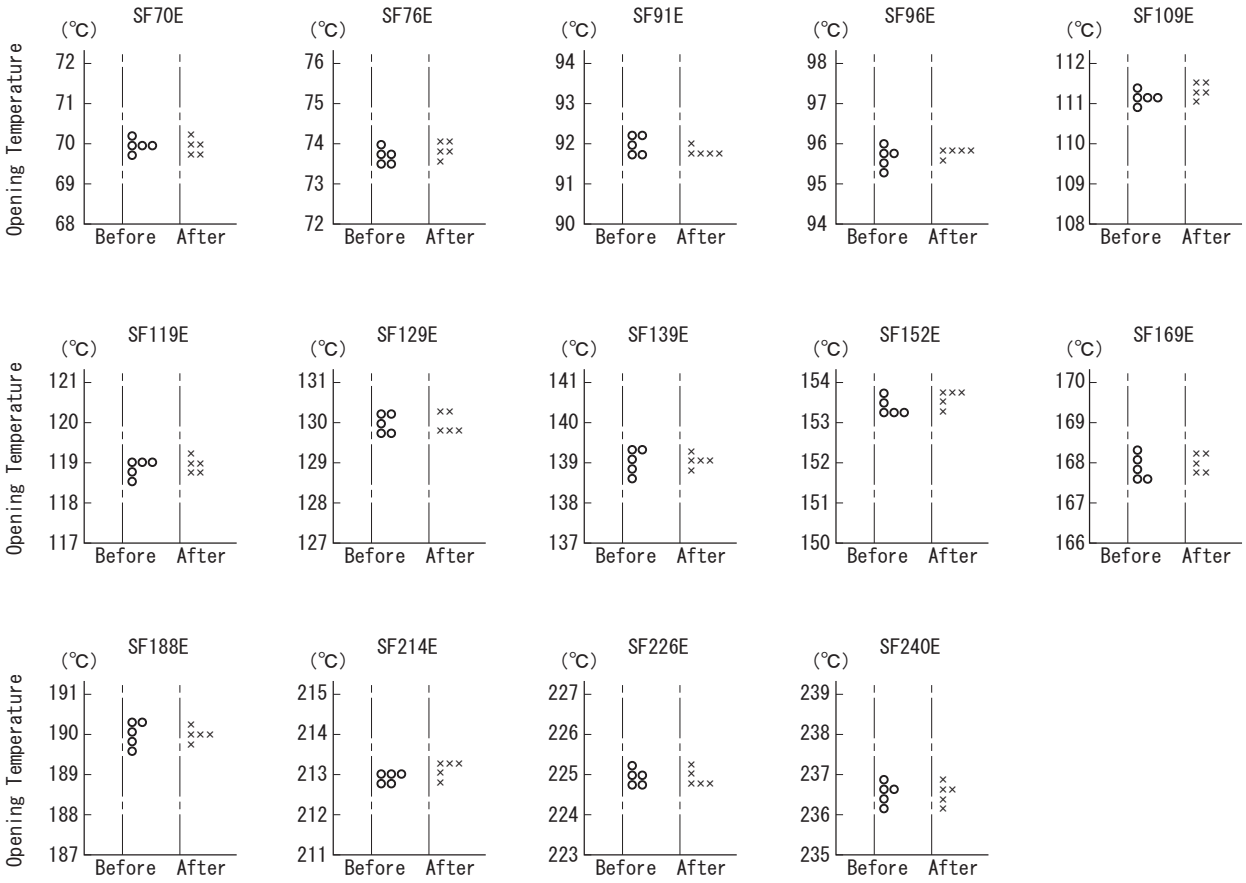


Figure 13 Opening Temperature After Temperature Cycle

(c) Insulation Resistance Number of specimens 5 pcs.

・All pieces were more than 1×10^5 M Ω

(d) Withstand Voltage Number of specimens 5 pcs.

・All pieces withstood for 1 minute against 500 V ac.

10. Mechanical Strength

10.1 Lead Tension Strength

(1) Method

Tension is applied to lead wires of the thermal cutoff by the method shown in Fig. 14. Measure the value that lead wire is cut.

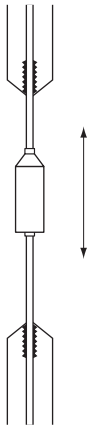


Figure 14 Testing Method Of Lead Tension Strength

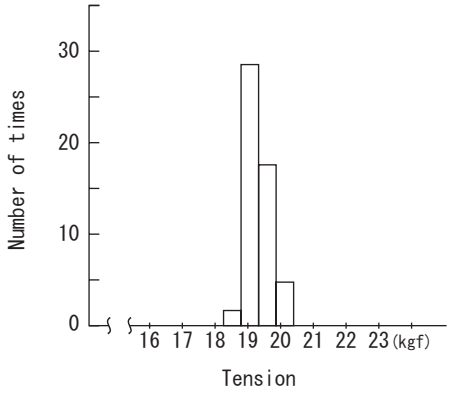


Figure 15 Lead Tension Strength

(2) Results

Refer to Figure 15.

Number of specimens 50 pcs.

10.2 Operating Characteristics After Lead Tension Strength Test

(1) Method

The body casing of a thermal cutoff is fixed. A 5kg tension is applied for 10 seconds between both leads to the axial direction.

(2) Standard

The lead wire should be neither broken nor loosened, and the section 2 should be satisfied.

(3) Results

(a) Outward

The lead wire neither broken nor loosened.

(b) Internal Resistance

Number of specimens 5 pcs.

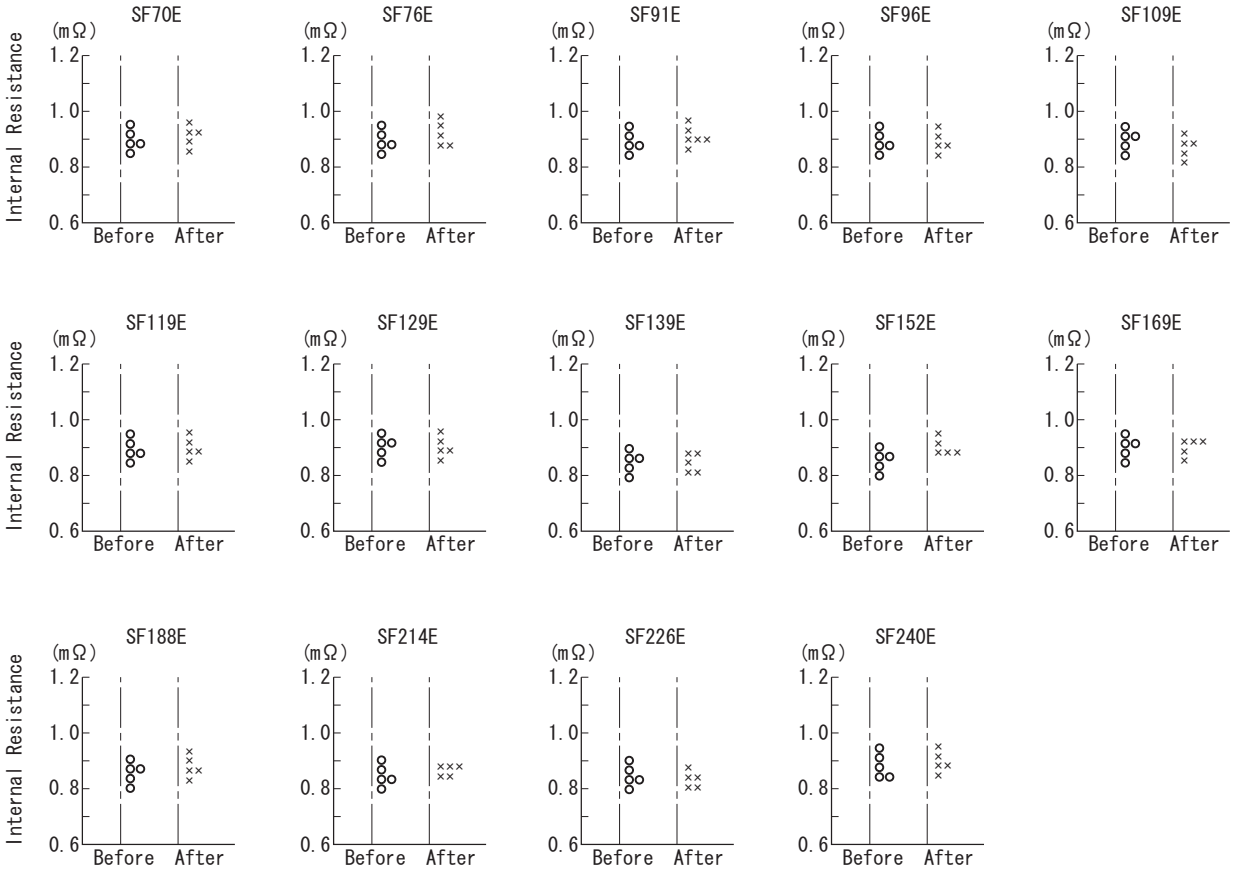


Figure 16 Internal Resistance After Lead Tension Strength Test

(c) Opening Temperature

Number of specimens 5 pcs.

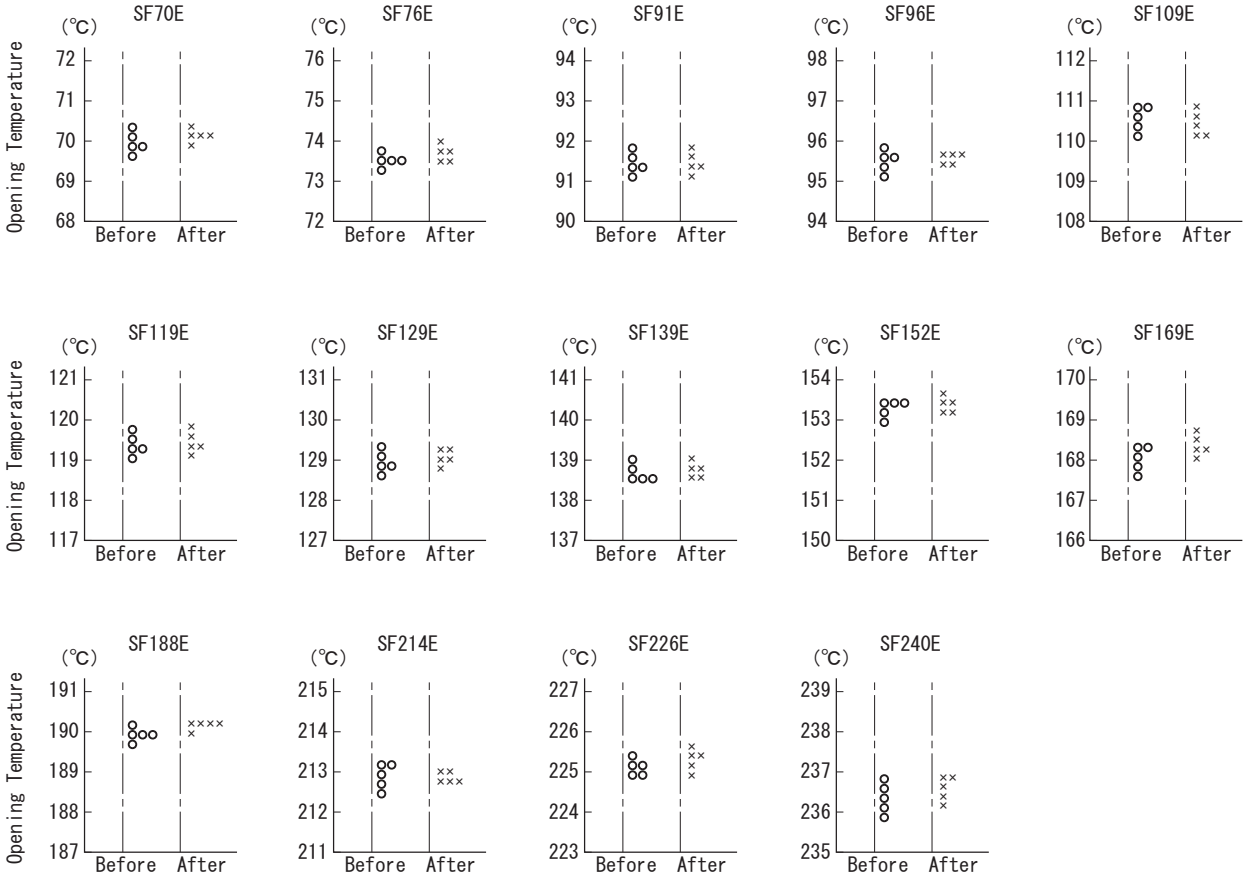


Figure 17 Opening Temperature After Lead Tension Strength Test

10.3 Lead Bending

(1) Method

Hang a 1 kg load from the tip pf the lead as shown in Fig. 18. Hold the body and bend it 90 ° , then return it to its original position. This counts as one cycle. One cycle takes about five seconds. Repeat the cycle and count the number of it until the lead wire is torn.

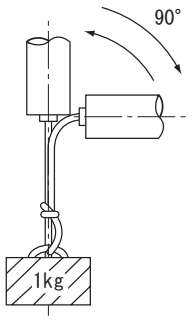


Figure 18 Testing Method of Lead Bending

(2) Results

Refer to Fig. 19.

Number of specimens 50 pcs.

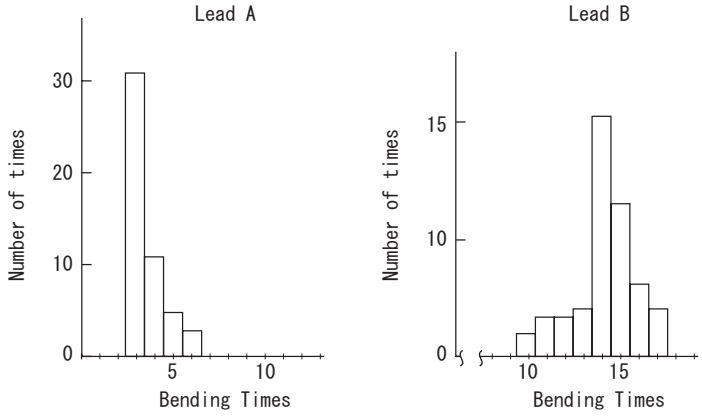


Figure 19 Strength of Lead Bending

10.4 Operating Characteristics After Lead Bending Test

(1) Method

Repeat the method shown in Fig. 18 three times. This test applies only to the lead B.

(2) Standard

The lead wire should be neither broken nor loosened.

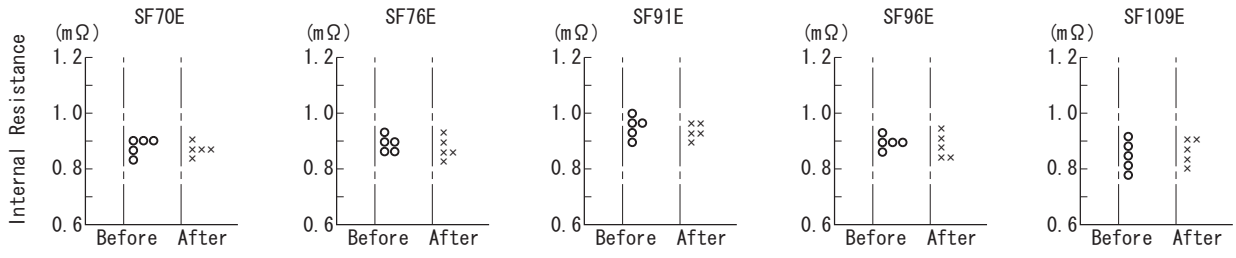
(3) Results

(a) Outward

The lead wire neither broken nor loosened.

(b) Internal Resistance

Number of specimens 5 pcs.



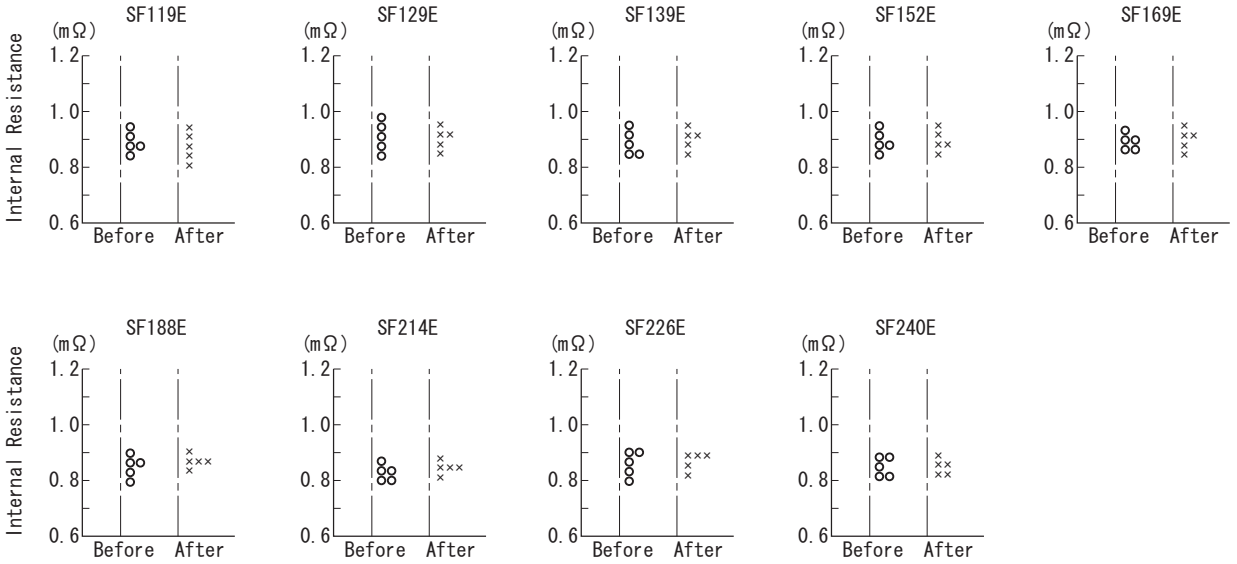


Figure 20 Internal Resistance After Lead Bending Test

(c) Opening Temperature Number of specimens 5 pcs.

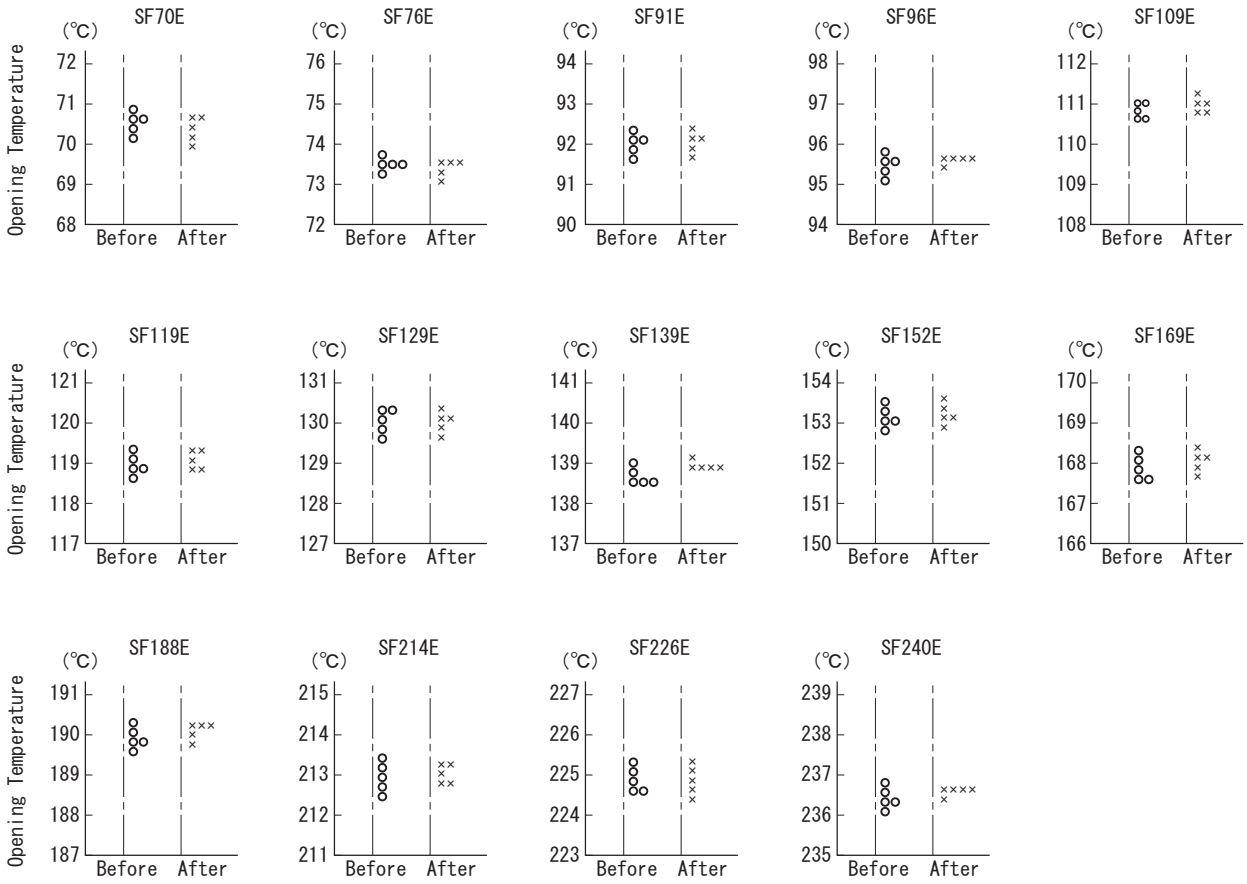


Figure 21 Opening Temperature After Lead Bending Test

10.5 Dropping Test

(1) Method

From a height of one meter, drop a thermal cutoff onto a concrete floor twice, one vertically and one horizontally.

(2) Standard

Any damage shall not appear on the thermal cutoff, and the items of section 2 and 3 should be satisfied.

(3) Results

(a) Outward

No sign of damage to either of the specimens is visible.

(b) Internal Resistance Number of specimens 5 pcs.

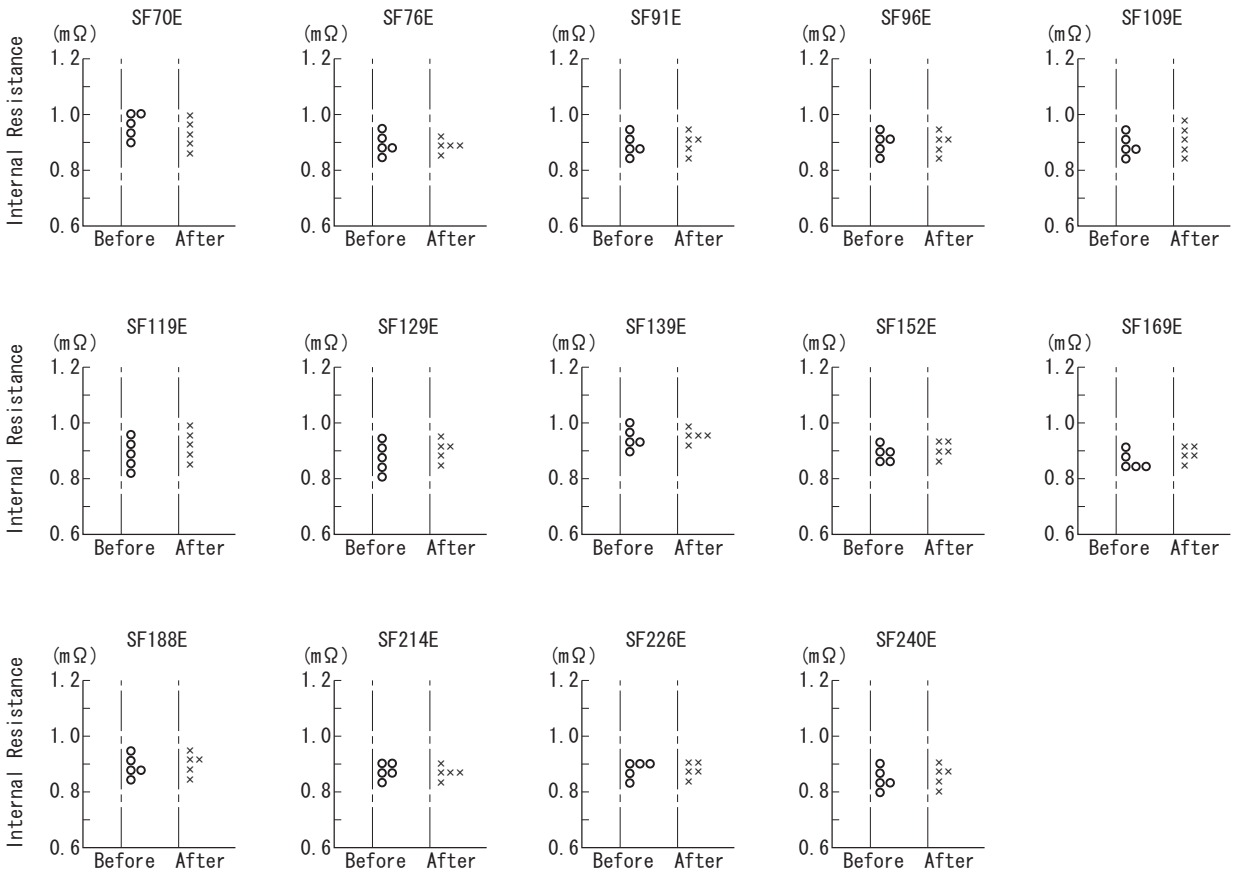


Figure 22 Internal Resistance After Dropping Test

(c) Opening Temperature Number of specimens 5 pcs.

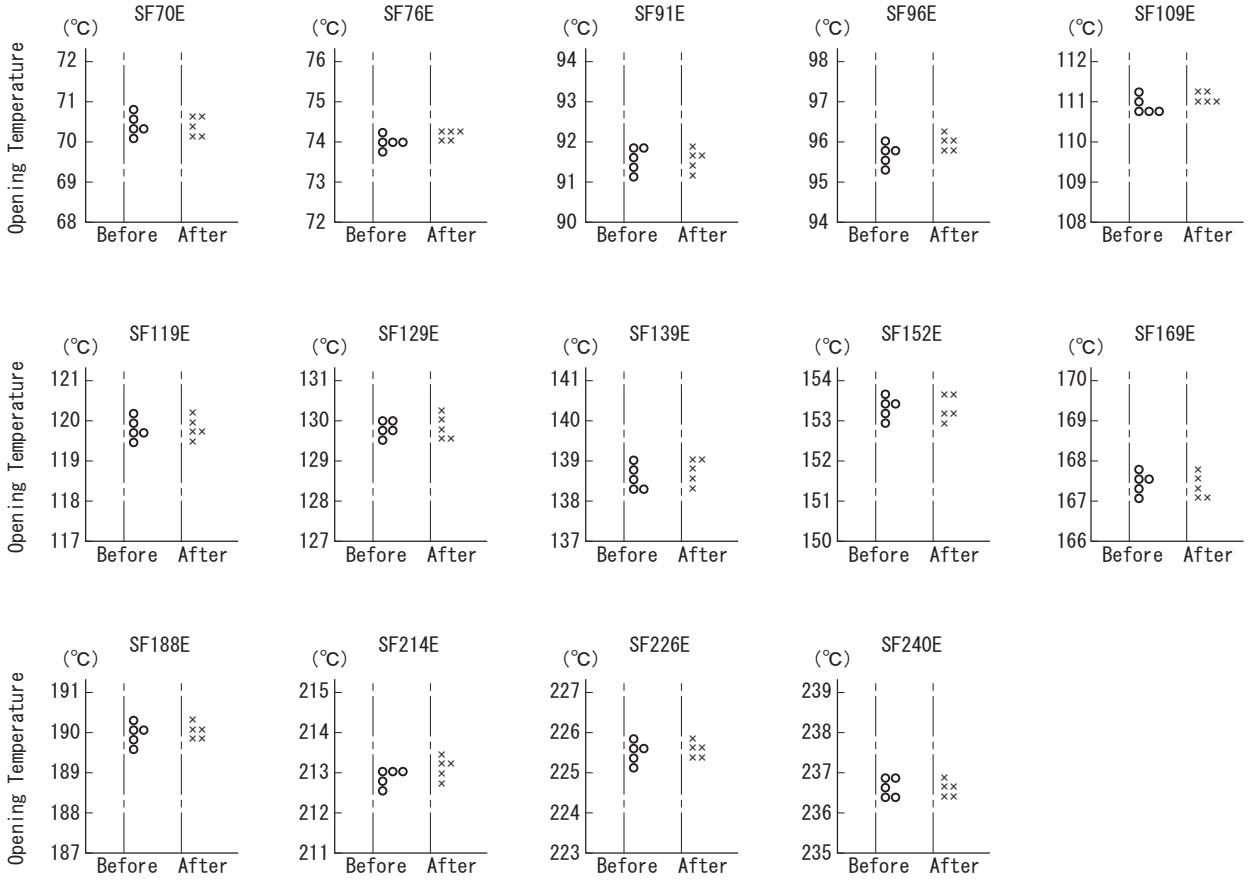


Figure 23 Opening Temperature After Dropping Test

10.6 Case Strength

(1) Method

Stress is applied to a thermal cutoff by the method shown in Fig. 24. Measure the value that the case is transformed.

(2) Results

Number of specimens 40 pcs.

Refer to Fig.25

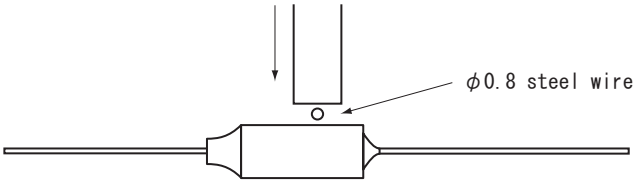


Figure 24 Testing Method of Case Strength

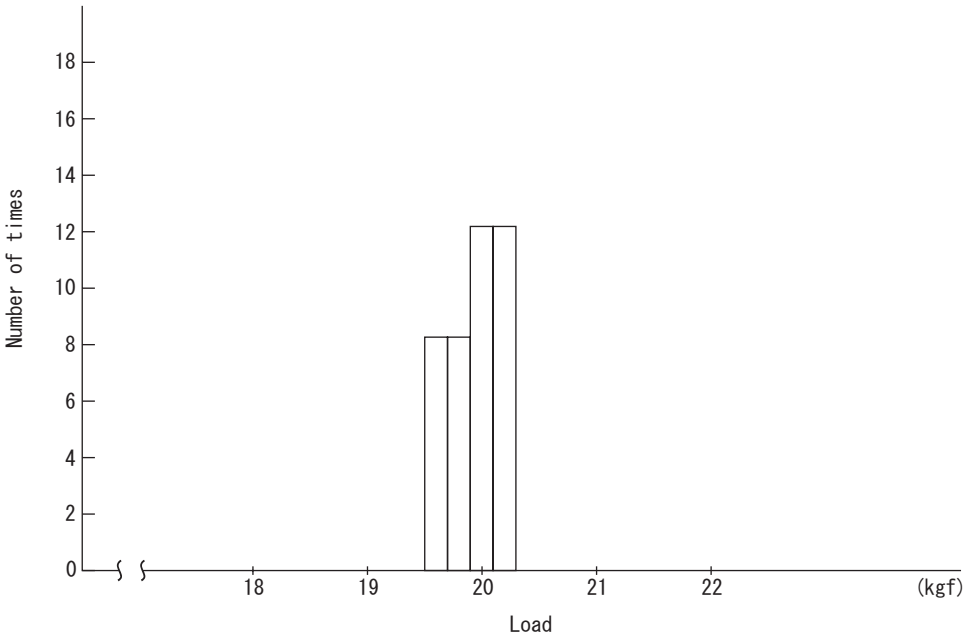


Figure 25 Case Strength

11. Rated Load Temperature Rise

(1) Method

Set a thermal cutoff to the measuring stand as shown in Fig. 26 in windless condition of temperature 25±5℃ and load the current. After the temperature of thermal cutoff body become constant, measure the temperature by thermocouple. The temperature rise is computed from the difference between surrounding temperature and body temperature.

(2) Standard

Load the rated current (10 A) through, the temperature rise should be 10℃ or less.

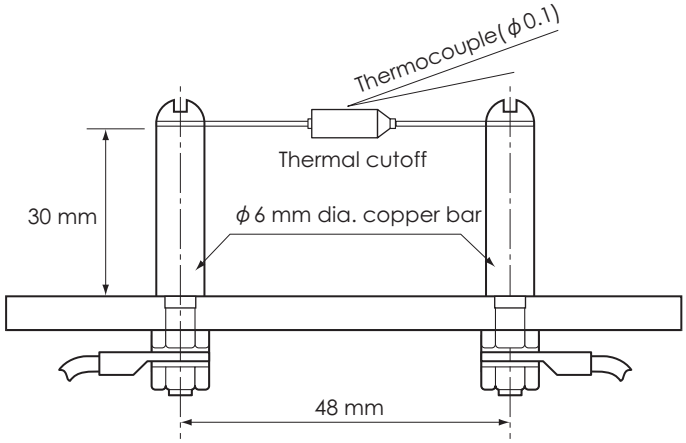


Figure 26 Testing Method of Rated Load Temperature Rise

(3) Results Number of specimens 5 pcs.

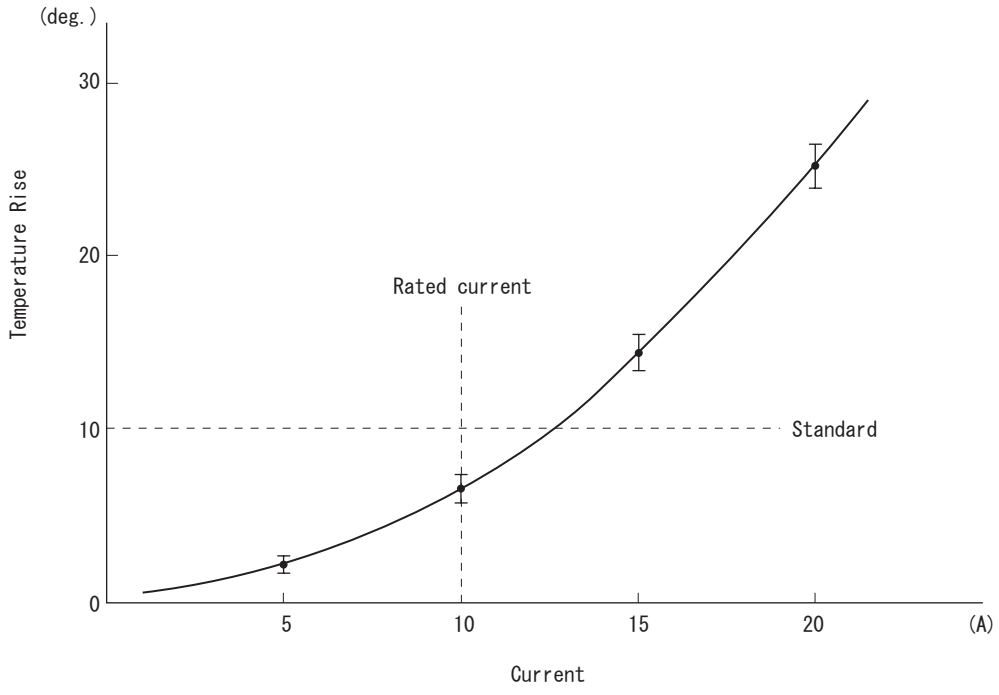


Figure 27 Rated Load Temperature Rise

12. Aging Test (Rated Load)

(1) Method

Put a thermal cutoff in a thermostatic oven to 10℃ lower than the conditioning temperature of section 6. Load the rated current (10 A) continuously. Take it out after 500 hours, and measure internal resistance, opening temperature, insulation resistance after opening and withstand voltage after opening.

(2) Standard

The test condition shown in section 2, 3, 4 and 5 should be satisfied. However, opening accuracy of section 3 should be within ±5℃ .

(3) Results

Number of specimens 5 pcs.

(a) Internal Resistance

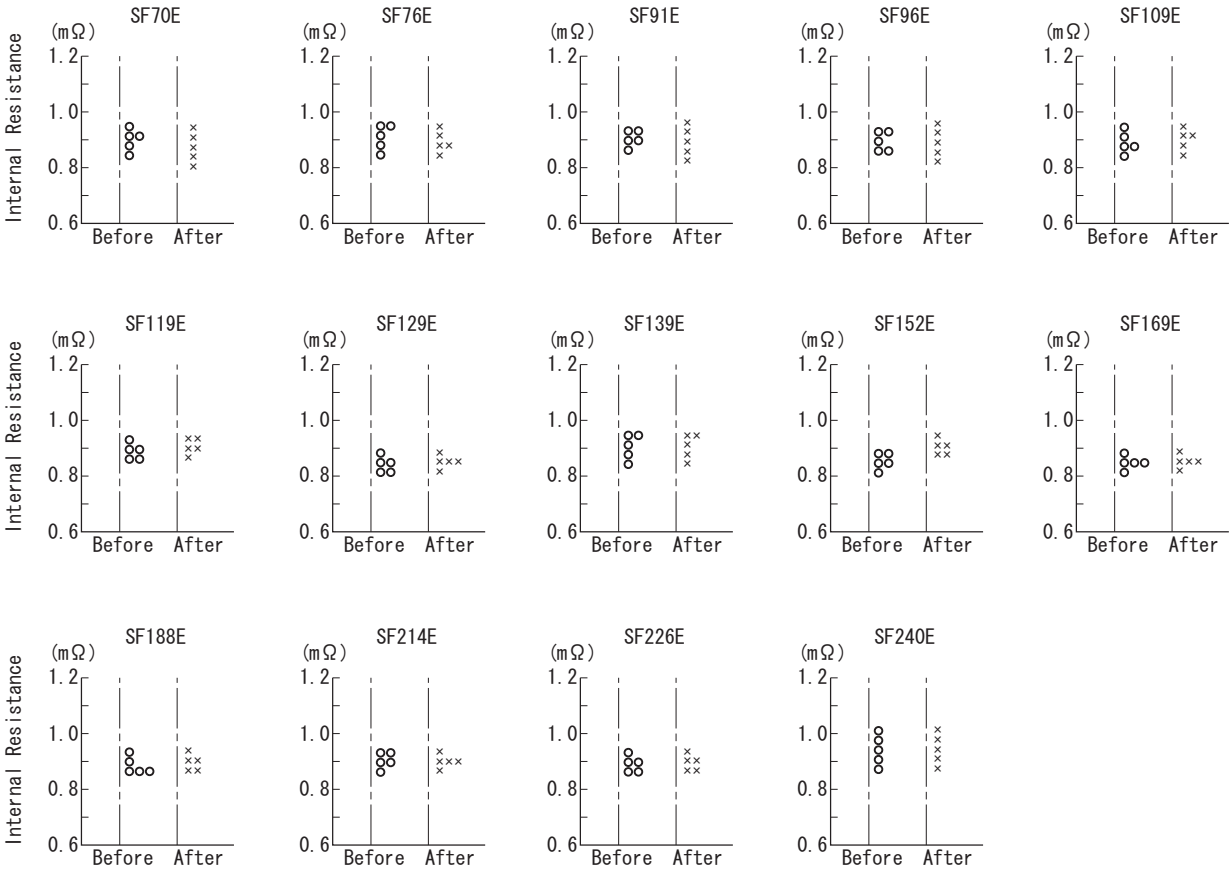


Figure 28 Internal Resistance After Aging Test

(b) Opening Temperature

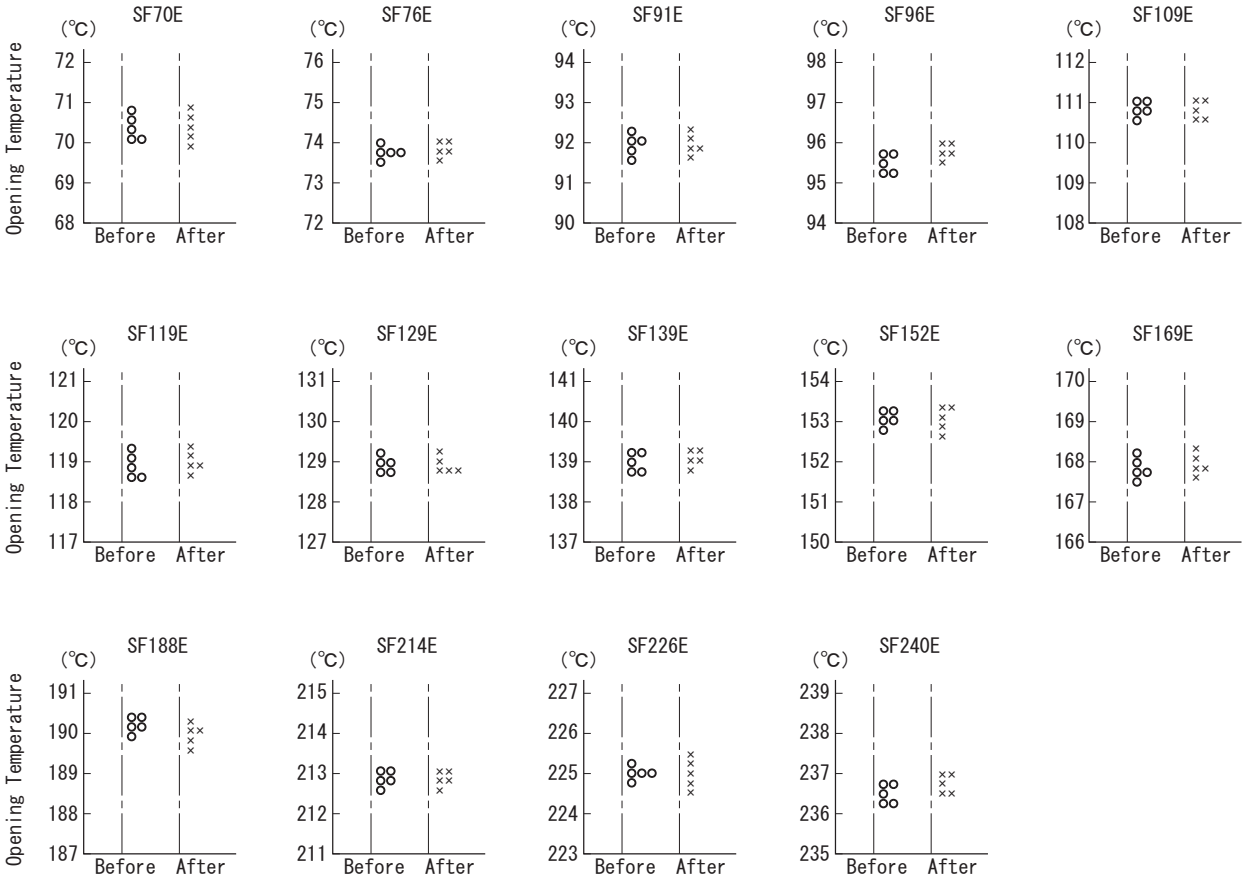


Figure 29 Opening Temperature of Aging Test

(c) Insulation Resistance

Number of specimens 5 pcs.

・All pieces were more than 1×10^5 M Ω

(d) Withstand Voltage

Number of specimens 5 pcs.

・All pieces withstood for 1 minute against 500 V ac.

13. Transient Overload Current Test

(1) Method

Each specimen is to be subjected to 100 current pluses having 225A and duration of 0.03 seconds.

The time interval between each pulse is to be 10 seconds.

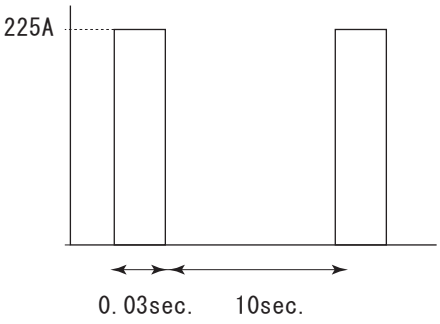


Figure 30 Test Condition

(2) Standards

The specimen shall not open as a result of the test.

(3) Results

(a) Internal resistance

Number of specimens 5 pcs.

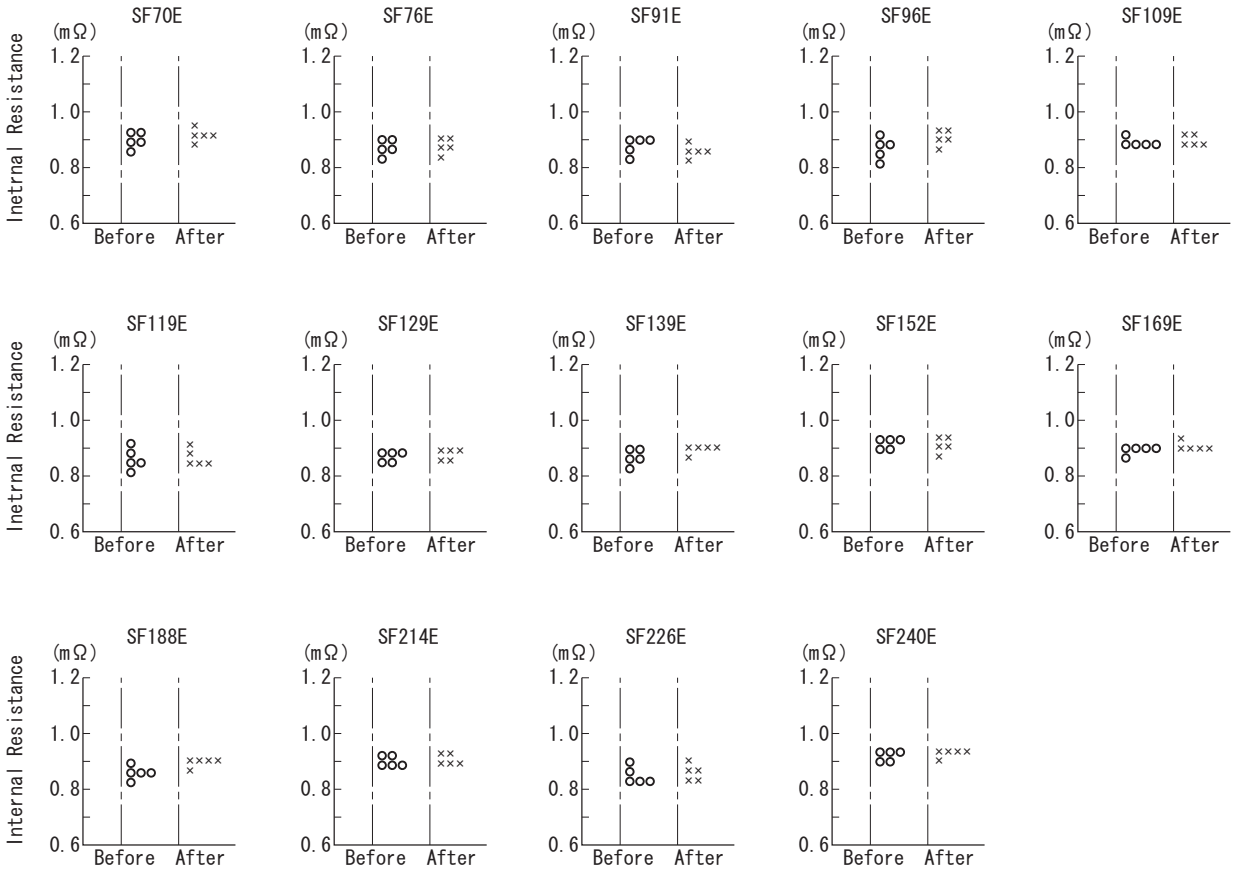


Figure 31 Transient Overload Current Test

(b) Opening Temperature

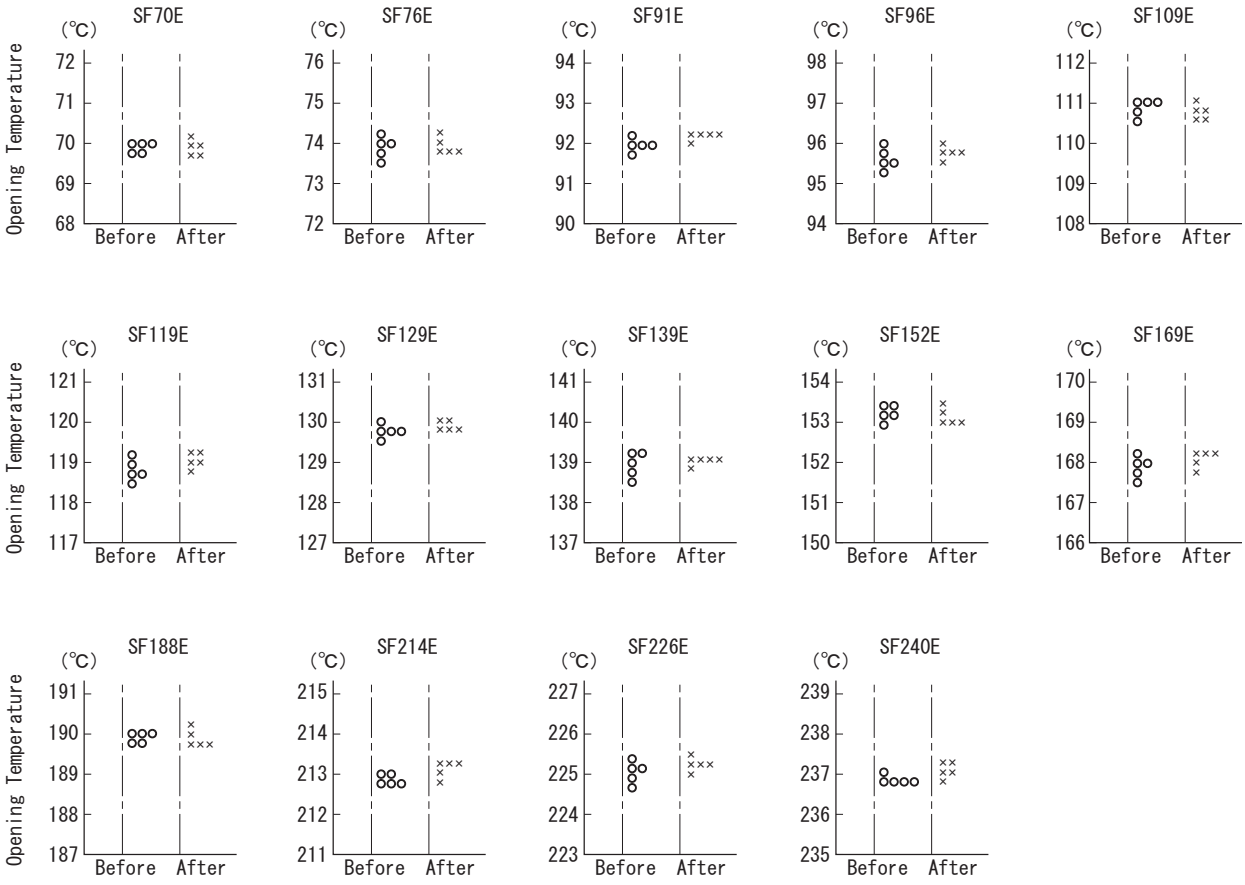


Figure 32 Transient Overload Current Test

14. Response Speed

(1) Method

Put the thermal cutoff into hot silicon oil of its temperature as stated below. And measure the response time until operation.

(2) Results

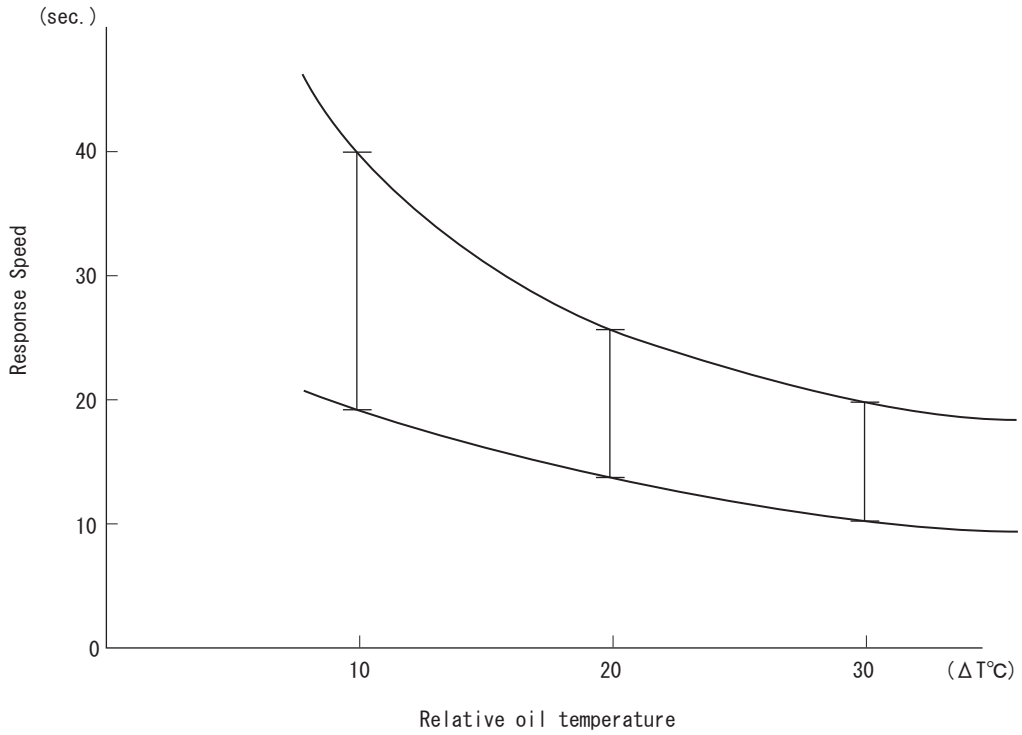


Figure 33 Response Speed

Note Relative oil temperature

Δ T℃ =(Silicon oil temp.)-(operating temp.)

● The information herein is based on the documents as of Feb. 2002, and is subject to change without notice. Therefore it is recommended to refer to latest individual information such as drawing for mass production designing.

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