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Slow Blow Fuse L TYPE

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Issued by *H. Shibata*

SERVICE CONDITIONS

(Table 1)

Item	Details
<ul style="list-style-type: none"> Actual-vehicle mounting position Service power supply Ambient temperature 	Fuse box from the engine compartment and passenger compartment 12V and 36V battery -40 to 100 degC

RATINGS

(Table 2)

Item	Specifications																				
<ul style="list-style-type: none"> Rated voltage Rated current 	58V DC or less <table border="1"> <thead> <tr> <th>Rated current A</th> <th>Color of case</th> </tr> </thead> <tbody> <tr><td>30</td><td>Orange</td></tr> <tr><td>40</td><td>Green</td></tr> <tr><td>50</td><td>Red</td></tr> <tr><td>60</td><td>Yellow</td></tr> <tr><td>70</td><td>Brown</td></tr> <tr><td>80</td><td>White</td></tr> <tr><td>100</td><td>Blue</td></tr> <tr><td>125</td><td>Pink</td></tr> <tr><td>150</td><td>Gray</td></tr> </tbody> </table>	Rated current A	Color of case	30	Orange	40	Green	50	Red	60	Yellow	70	Brown	80	White	100	Blue	125	Pink	150	Gray
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125	Pink																				
150	Gray																				
<ul style="list-style-type: none"> Shape 	<Reference> In according with product drawings. 																				

CHARACTERISTICS

During each test, the fuse is to satisfy the performance requirements as set forth in Table 3, Table 4, and Table 5.

1. General Characteristics

(Table 3)

Item	Performance	Test method																							
(1) Voltage drop	<table border="1"> <thead> <tr> <th>Rated current A</th> <th>Maximum voltage drop mV</th> </tr> </thead> <tbody> <tr> <td>30</td> <td>105</td> </tr> <tr> <td>40</td> <td>90</td> </tr> <tr> <td>50</td> <td rowspan="3">80</td> </tr> <tr> <td>60</td> </tr> <tr> <td>70</td> </tr> <tr> <td>80</td> <td rowspan="4">75</td> </tr> <tr> <td>100</td> </tr> <tr> <td>125</td> </tr> <tr> <td>150</td> </tr> </tbody> </table> <p>To satisfy the requirements as shown in Table.</p>	Rated current A	Maximum voltage drop mV	30	105	40	90	50	80	60	70	80	75	100	125	150	1-(1)								
Rated current A	Maximum voltage drop mV																								
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(2) Operating time rating	<table border="1"> <thead> <tr> <th rowspan="2">Test current A</th> <th colspan="2">Operating time</th> </tr> <tr> <th>Minimum</th> <th>Maximum</th> </tr> </thead> <tbody> <tr> <td>500% of the rated current</td> <td>0.1 s</td> <td>1 s</td> </tr> <tr> <td>300% of the rated current</td> <td>0.3 s</td> <td>3 s</td> </tr> <tr> <td>200% of the rated current</td> <td>3 s</td> <td>100 s</td> </tr> <tr> <td>150% of the rated current</td> <td>90 s</td> <td>3600 s</td> </tr> <tr> <td>110% of the rated current</td> <td>4 h</td> <td>-</td> </tr> <tr> <td>100% of the rated current</td> <td>100 h</td> <td>-</td> </tr> </tbody> </table> <p>· Fusing must occur within the above-mentioned times. Furthermore, there is to be no breakage of the fuse body upon fusing. · The inter-terminal insulation resistance after fusing has occurred is to be 3 Mohm or more.</p>	Test current A	Operating time		Minimum	Maximum	500% of the rated current	0.1 s	1 s	300% of the rated current	0.3 s	3 s	200% of the rated current	3 s	100 s	150% of the rated current	90 s	3600 s	110% of the rated current	4 h	-	100% of the rated current	100 h	-	1-(2)
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500% of the rated current	0.1 s	1 s																							
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110% of the rated current	4 h	-																							
100% of the rated current	100 h	-																							
(3) Breaking capacity	<p>· After the occurrence of fusing, there is to be no generation of continuous arcs or damage to insulators. · The inter-terminal insulation resistance after fusing has occurred is to be 1 Mohm or more. · There is to be no indecisive marking or coloring.</p>	1-(3)																							
(4) Temperature rise	To be 50 degC or less	1-(4)																							
(5) Strength of terminals	There is to be no fall-in or buckling at 60 N.	1-(5)																							
(6) Ratio of temperature variation in rated current	To be 0.18% or less per 1 degC.	1-(6)																							
(7) Appearance	<p>· There are to be no defects which would be detrimental to usage. · The fusing section is to be visible from the outside.</p>	-																							

2. Strength Characteristics

(Table 4)

Item	Performance	Test method
(1)Cover latching strength	10 N or more	2-(1)
(2)Element latching strength	60 N or more	2-(2)
(3) Drop impact strength	There is to be no terminal bending, housing breakage, or any other factors which would be detrimental to usage.	2-(3)
(4) Compression fracture strength	200 N or more	2-(4)

3. Durability Characteristics

(Table 5)

Item	Properties	Test method
(1) Transient current cycling	The requirements of voltage drop, operating time rating, terminal strength and appearance from (Table 3) are to be satisfied.	3-(1)
(2) Vibration durability		3-(2)
(3) Accelerated ageing		3-(3)
(4) Temperature/vibration		3-(4)
(5) Dust resistance		3-(5)
(6) Fuel resistance		3-(6)
(7) Oil resistance	There is to be no corrosion, cracking, deformation, or any other factors which would impair functionality.	3-(7)
(8) Thermal shock resistance	The requirements of voltage drop, operating time rating, terminal strength and appearance from (Table 3) are to be satisfied.	3-(8)

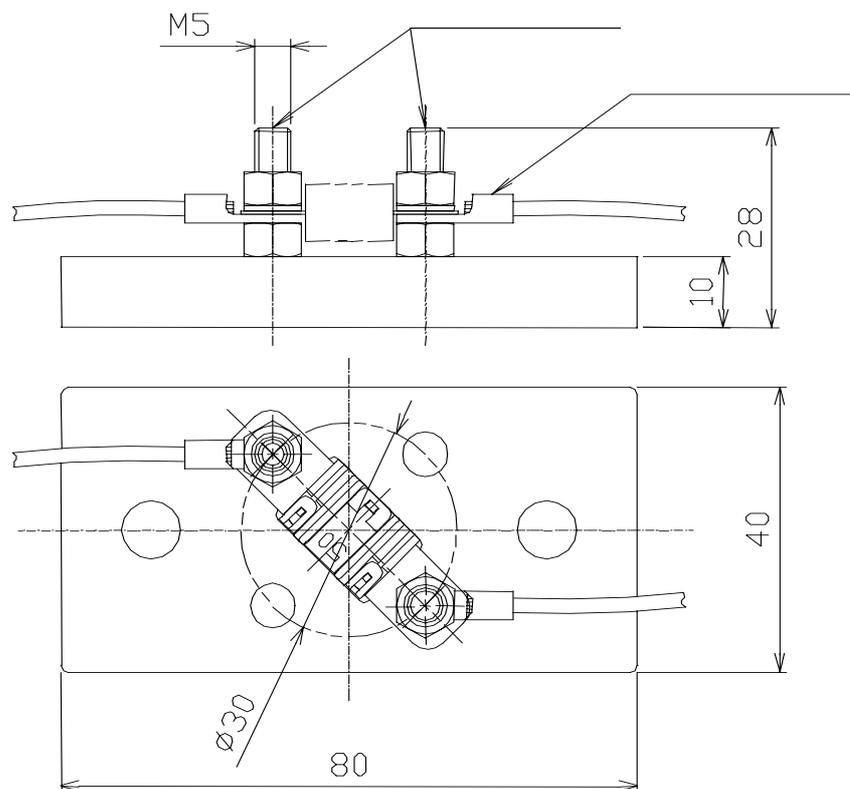
TEST METHODS FOR FUSE BLOCK

TEST CONDITIONS

Unless otherwise specified, the following conditions are to be implemented in the testing of fuses.

- (1) All electrical testing is to be carried out with DC which is maintained within a $\pm 1\%$ tolerance range and in an environment at a temperature of 23 ± 5 degC; furthermore, fuses are to be mounted on a test fixture as shown in Figure 1.
- (2) Connection cables which are used in electrical testing are to satisfy JIS C 3406, JASO D611, or ISO 6722.
- (3) The connection to fuses is to be carried out using connection cables as shown in (Table 7) and which have a length of at least 600mm; furthermore, when testing is to be carried out using multiple fuses in series, these are to be mounted with spacing of at least 150mm.
- (4) Vibration testing, thermal shock testing, and environmental testing* is to be carried out with the fuses in a non-electrified condition. (*:With the exception of 3-(4): Temperature/vibration test.)
- (5) Fuses are to be vertically oriented in all except vibration testing.
- (6) Test voltage must not exceed the rated voltage of the fuses.

Figure 1 Test Fixture



Test Sequence and Check Items

Test Sequence

(Table 6)

Test Item	Item number	Test group and number of test pieces											
		1	2	3	4	5	6	7	8	9	10	11	
Voltage drop test	1-(1)	X											
Terminal strength test	1-(5)	X	X										
Strength characteristics	2-(1) (2) (3) (4)			X									
Accelerated ageing test	3-(3)				X								
Fuel resistance test	3-(6)					X							
Vibration durability test	3-(2)						X						
Transient current cycling	3-(1)							X					
Temperature/vibration test	3-(4)								X				
Temperature rise test	1-(4)									X			
Thermal shock resistance test	3-(8)									X			
Dust resistance test	3-(5)										X		
Oil resistance	3-(7)											X	
Breaking capacity test	1-(3)	X											
Voltage drop test	1-(1)				X	X	X	X	X	X	X	X	
Operating time rating test	1.0 × In ⁽¹⁾		X		X	X	X	X	X	X	X	X	
	1.1 × In ⁽¹⁾		2		2	2	2	2	2	2	2	2	
	1.5 × In ⁽¹⁾		2		2	2	2	2	2	2	2	2	
	2.0 × In ⁽¹⁾		2		2	2	2	2	2	2	2	2	
	3.0 × In ⁽¹⁾		2		2	2	2	2	2	2	2	2	
	5.0 × In ⁽¹⁾		2		2	2	2	2	2	2	2	2	
Terminal strength					X	X	X	X	X	X	X	X	
Appearance	-	X	X	X	X	X	X	X	X	X	X	X	X

Note(1): The entry "in " refers to the rated current.

[Additional] The entry "X" for each of the test sample groups indicates that 10 fuses are to be used.

Connection cable

(Table 7)

Rated current A	Connecting cable nomenclature
30	2.0
40	3.0
50	5.0
60	5.0
70	8.0
80	10.0
100	15.0
125	20.0
150	

CHARACTERISTICS

1. General characteristics

1-(1) Voltage drop test

A current equal to 100% of the rated current is to be allowed to flow for a period of 15 minutes, and then the voltage drop (mV) is to be measured at the voltage-drop points between the fuse terminals as shown in Figure 1.

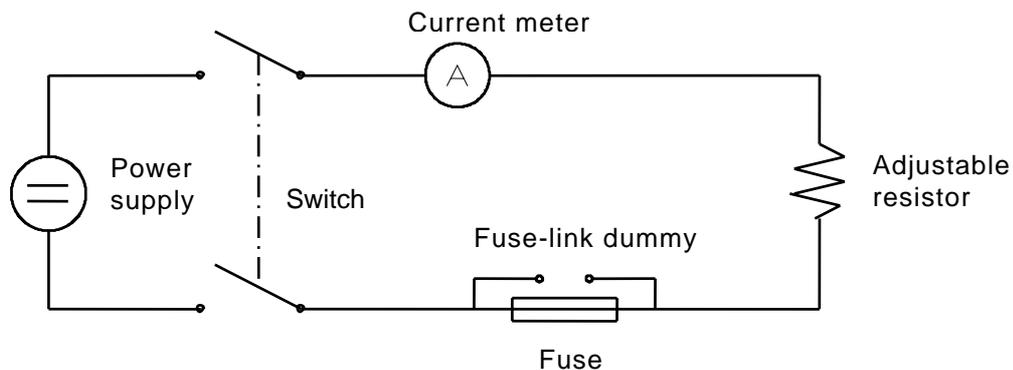
1-(2) Operating time rating test

Before carrying out the operating time rating test, the test equipment and fuses are to be allowed to stabilize at 23 ± 5 degC. After then matching the power supply to the test current as set forth in (Table 3), this current is to be applied to the fuse, and the time taken until fusing is to be measured. Particularly in cases where a large number of fuses are being tested, sufficient cooling time is to be provided in order to prevent over-heating of the test equipment. After the completion of the operating time rating test, the insulation resistance between the two terminals is to be measured using a 500-V insulation resistance meter.

1-(3) Breaking capacity

The breaking capacity test is to be carried out using the circuit shown in Figure 2, and the fuse is to be provided with a current of $1,000\pm 50$ A by a 58 ± 2 , 0V test voltage with a time constant of 2.5 ± 1.0 ms. After the completion of testing, the insulation resistance between the two terminals is to be measured using a 500-V insulation resistance meter.

Figure 2 Breaking capacity test circuit



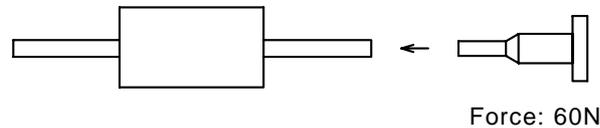
1-(4) Temperature rise test

A current equal to 60% of the rated current is to be allowed to flow for a period of 40 minutes, and then the temperature rise is to be measured at the temperature-rise measuring point as shown in Figure 1.

1-(5) Terminal strength test

Terminal strength is to be tested by applying a force of 60 N as shown in Figure 3.

Figure 3 Terminal Strength Test



1-(6) Test for temperature variation in rated current (current capacity)

Testing of the ratio of temperature variation in the rated current is to be carried out by subjecting the fuse to operating time rating tests in environments at -30, 23, and 70 degC; furthermore, the result is to be calculated by dividing the degC of variation in the rated current by the difference in temperature.

$$\text{Sigma} \frac{I_1 - I}{T - T_1} \times \frac{100}{1}$$

$$\text{Sigma} \frac{I - I_2}{T_2 - T} \times \frac{100}{1}$$

Where sigma is the ratio of temperature variation (% / degC)

T is 23 degC,

T₁ is -30 degC,

T₂ is 70 degC,

I is the rated current value (for 23 degC),

I₁ is the rated current value for -30 degC, and

I₂ is the rated current value for 70 degC.

[Additional] Operating time rating tests are to be carried out in environments at -30 and 70 degC, and the current values for -30 and 70 degC which show the same fusing characteristics as for 23 degC are to be calculated and defined as I₁ and I₂.

2. Strength Characteristics

2-(1) Cover latching strength

The housing is to be secured and a tensile load is to be applied to the cover at a speed of 200 mm/minute.

2-(2) Element latching strength

The terminals are to be secured and tensile load is to be applied to the housing at a speed of 200 mm/minute.

2-(3) Drop impact strength

After standing the test piece for 2 hours in an environment at 0 degC and removing it, the test piece is to be allowed to free fall from a height of 1 meter onto a concrete floor.

2-(4) Compression fracture strength

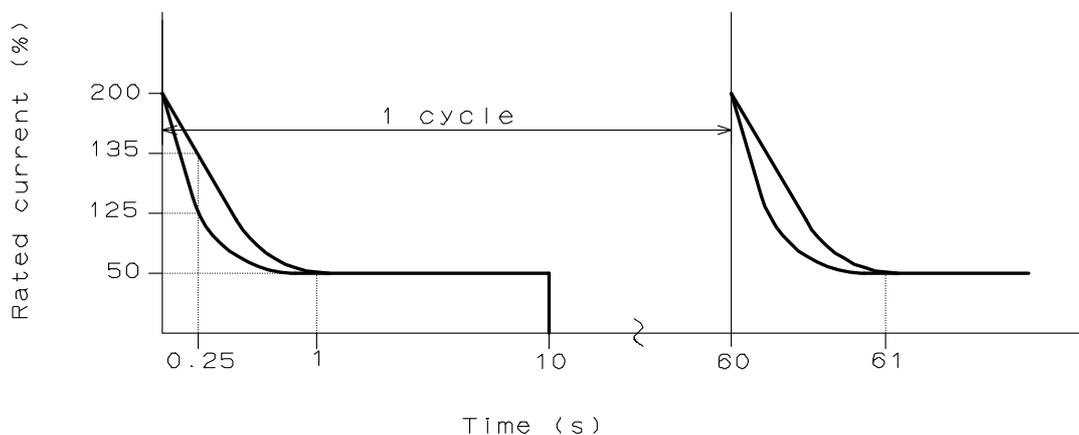
A compressive load is to be applied at a speed of 200 mm/minute to the upper and lower ends of the fuse (with the exception of the terminals).

3. Durability Characteristics

3-(1) Durability test for transient current cycling

Testing for durability to transient current cycling is to be carried out on the test piece by performing 50,000 interruptions of a transient current which follows the pattern from Figure 4 between 200% and 60% of the rated current. A DC voltage of $14\pm 0.2V$ is to be used for testing.

Figure 4 Transient current cycling



3-(2) Vibration durability test

Vibration durability testing is to be carried out by securing the fuse on the test fixture and by applying simple harmonic motion with an amplitude of 0.75 mm (i.e., 1.5 mm peak-to-peak). The vibration frequency is to be increased from 10 Hz to 55 Hz, and then returned to 10 Hz over a period of approximately 1 minute; furthermore, the variation in frequency is to take place at a uniform rate. Each test piece is to be tested for 2 hours in each of three mutually-perpendicular directions.

3-(3) Accelerated ageing test

Accelerated ageing test is to be carried out by subjecting the test piece to 15 repetitions of the following temperature and humidity cycle (see Figure 5).

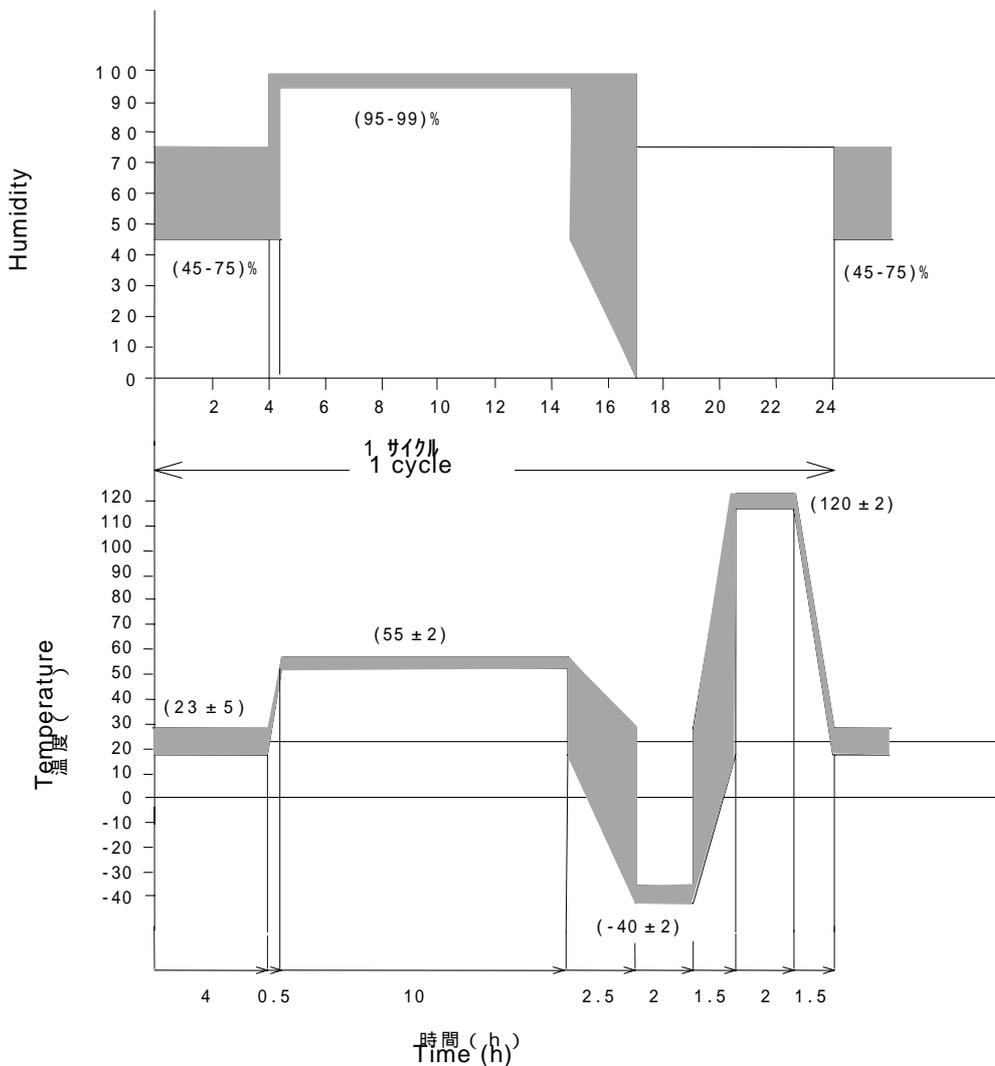
- (1) The test piece is to be allowed to stand at a temperature of 23 ± 5 degC and at a relative humidity of 45% to 75% RH for a period of 4 hours.
- (2) The temperature and relative humidity are to be raised to 55 ± 2 degC and 95% to 99% RH respectively within a period of 0.5 hours.
- (3) The test piece is to be allowed to stand under these conditions (i.e., 55 ± 2 degC and 95% to 99% RH) for 10 hours.
- (4) The temperature is to be lowered to -40 ± 2 degC over a period of 2.5 hours.

- (5) The test piece is to be allowed to stand under these conditions (i.e., -40 ± 2 degC) for 2 hours.
- (6) The temperature is to be raised from -40 ± 2 degC to 120 ± 2 degC over a period of 1.5 hours.
- (7) The test piece is to be allowed to stand under these conditions (i.e., 120 ± 2 degC) for 2 hours.
- (8) The temperature is to be returned to 23 ± 5 degC within a period of 1.5 hours.

Note that 1 cycle is 24 hours in length.

[Additional] There is to be no adjustment of humidity after the 14.5-hour point of the 24-hour cycle.

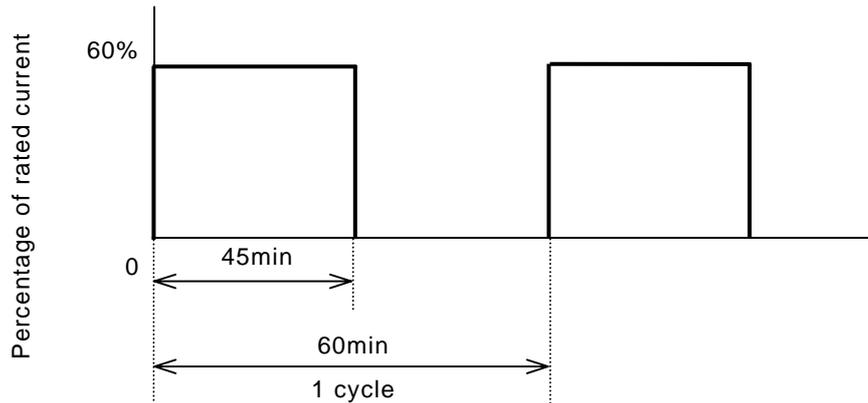
Figure 5 Accelerated ageing test



3-(4) Temperature/vibration test

Temperature/vibration test is to be carried out by subjecting the test piece to a 3-minute logarithmic sweep comprising simple harmonic motion with a vibration acceleration of 44.1 m/s^2 and a frequency of 20 to 200 Hz; furthermore, this testing is to be carried out at a temperature of $80 \pm 2 \text{ degC}$ and in accordance with JIS D 1601. In addition, the test piece is to be subjected to 300 repetitions of the current cycle as shown in Figure 6.

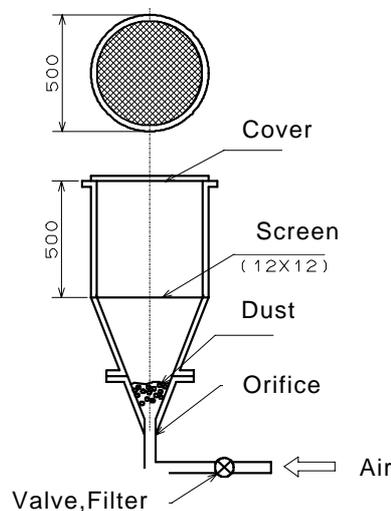
Figure 6 Current cycling at temperature/vibration test



3-(5) Dust Test

The fuse is to be placed horizontally on the screen of a dust chamber which has been filled with approximately 1 kg of dust conforming with SAEJ726a as shown in Figure 7. At intervals of 20 minutes, the dust is to be agitated for 3 seconds using oil and moist compressed air which is delivered at a gauge pressure of $548.8 \pm 5.88 \text{ kPa}$ via an orifice of $1.5 \pm 0.1 \text{ mm}$ in diameter. The test piece is to be exposed to these conditions for a total of 5 hours.

Figure 7 Dust Test Method



3-(6) Fuel resistance test

Fuel resistance testing is to be carried out by immersing the fuse for a period of 1 minute in type-C test oil (i.e., fuel oil) which is at a temperature of 23 ± 5 degC and which conforms with Section 5.4.1 of JIS K6258. After removal of the fuse, it is to be allowed to dry for a period of 1 hour at a temperature of 90 ± 2 degC.

3-(7) Oil resistance test

After wiping test piece with engine oil from JIS K2215 and anti-freezing fluid from JIS K2234, it is to be allowed to stand for a period of 24 hours in an environment at 100 degC. Following this, its appearance is to be examined.

3-(8) Thermal-shock resistance test

Testing of thermal-shock resistance is to be carried out by subjecting the test piece to 1,000 repetitions of the following thermal-shock cycle (see Figure 8).

- (1) Allow the fuse to stand for a period of 30 minutes in a room at -30 ± 2 degC.
- (2) Relocate the fuse to another room at 100 ± 2 degC within 15 seconds, and allow it to stand for a period of 30 minutes.
- (3) Return the fuse to the room at -30 ± 2 degC within 15 seconds. Note that 1 cycle is 60 minutes in length.

Figure 8 Thermal-shock cycle

