Registration No. 1094

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25 July 2013

Superseding
JAXA-QTS-2210
Cancelled
25 July 2013

FUSES,
HIGH RELIABILITY, SPACE USE,
GENERAL SPECIFICATION FOR

JAXA
JAPAN AEROSPACE EXPLORATION AGENCY
This document is the English version of JAXA QTS/ADS which was originally written and authorized in Japanese and carefully translated into English for international users. If any question arises as to the context or detailed description, it is strongly recommended to verify against the latest official Japanese version.
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<th>Rev.</th>
<th>Date</th>
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<td>NC</td>
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<tr>
<td>A</td>
<td>25 July 2013</td>
<td>Added the requirements for Surface mount fuses</td>
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1. GENERAL

1.1 Scope
This specification establishes the general requirements and quality assurance provisions for space use, high reliability fuses (hereinafter referred to as “fuses”) used for electronic equipment installed on space systems.

1.2 Terms and Definitions
The definitions for terms used herein are as shown in JAXA-QTS-2000, JEITA RCR-4800 and JIS C 6575-1.

1.3 Classification
Fuses covered by this specification shall be classified as specified in Table 1.

<table>
<thead>
<tr>
<th>Table 1 Classification</th>
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<tbody>
<tr>
<td>Classification</td>
</tr>
<tr>
<td>Subminiature current-limiting fuse</td>
</tr>
<tr>
<td>Surface mount, miniature current-limiting fuse</td>
</tr>
</tbody>
</table>

1.4 Part Number
The part number shall be given in the following form. The detail information shall be as specified in the detail specification

(Example)
JAXA(1) 2210/ 101 - A 72V 7.5A L

Individual Characteristics Rated voltage Rated current Terminal structure identification (paragraph 1.4.1) (paragraph 1.4.2) (paragraph 1.4.3) (paragraph 1.4.4)

Note: (1) “JAXA” indicates the part is for space use and may be abbreviated “J”.

1.4.1 Characteristic
The characteristic is identified by a single capital letter and indicates the relative overload interrupt time in accordance with Table 2.
Table 2. Characteristics

<table>
<thead>
<tr>
<th>Symbol</th>
<th>Relative overload interrupt time</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>Normal or fast acting</td>
</tr>
<tr>
<td>B</td>
<td>Time lag</td>
</tr>
</tbody>
</table>

1.4.2 Rated Voltage
The rated voltage shall be identified by a numerical value in units of volts (V) followed by the letter “V”.

1.4.3 Rated Current
The rated current shall be identified by a numerical value in units of amperes (A) followed by the letter “A”.

1.4.4 Terminal Structure
The terminal structure shall be identified by a single capital letter in accordance with Table 3.

Table 3. Terminal Structure

<table>
<thead>
<tr>
<th>Symbol</th>
<th>Terminal type</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>Cu/Fe/P/Zn alloy (Alloy 194), solder plated finish</td>
<td>---</td>
</tr>
<tr>
<td></td>
<td>of a minimum of 7.62μm thick over a minimum of 2.54μm thick Ni plating</td>
<td></td>
</tr>
<tr>
<td>L</td>
<td>Tough pitch copper, solder finish of 1.52μm min. thick</td>
<td>L52 type specified in MIL-STD-1276</td>
</tr>
</tbody>
</table>

2. APPLICABLE DOCUMENTS

2.1 Applicable Documents
The documents listed below form a part of this specification as specified herein. These documents are the latest issues available at the time of contract award or application. If it is necessary to designate an issue, the issue shall be specified in the detail specification.

a) JAXA-QTS-2000 Common Parts/Materials, Space Use, General Specification for
b) MIL-STD-202 Test Method Standard, Electronic and Electrical Component Parts
c) MIL-STD-1276 Leads for Electronic Component Parts
d) MIL-STD-1580 Destructive Physical Analysis for Electronic, Electromagnetic and Electromechanical Parts
f) JEITA RCR-4800 Safety application guide on fuse for use in electronic and electrical equipments
<table>
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<tr>
<td>g) JIS C 6575-1</td>
<td>Miniature fuses -- Part 1: Definitions of miniature fuses and general requirements for miniature fuse-links</td>
<td></td>
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<td>h) JIS C 60068-2-21</td>
<td>Environmental testing -- Part 2-21: Tests -- Test U: Robustness of terminations and integral mounting devices</td>
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<td>i) JIS Z 9015-1</td>
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<td>j) UL 248-1</td>
<td>Standard for Low-Voltage Fuses, Part 1: General Requirements</td>
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</table>

2.2 Reference Document

The following documents are reference documents.

a) JERG-0-035 NASA Parts Application Handbook
b) MIL-PRF-23419G Fuse, Cartridge, Instrument Type, General Specification for
c) MIL-PRF-23419/12D Fuses, Instrument Type, Style FM12 (Subminiature-High Performance)
d) ESCC Generic specification No. 4008, Issue 1 Fuse
e) EEE-INST-002 Instructions for EEE Parts Specification, Screening, Qualification, and Derating
f) MSFC-STD-3012 EEE Parts Management and Control for MSFC Space Flight Hardware
g) ECSS-Q-ST-60-14C Relifing Procedure – EEE Components

2.3 Order of Precedence

In the event of a conflict between the text of this specification and the applicable documents, the following order of precedence shall apply.

a) Detail specification
b) This specification
c) JAXA-QTS-2000
d) Applicable documents of this specification (paragraph 2.1, except for JAXA-QTS-2000)

2.4 Detail Specification

Detailed requirements for the type and performance of fuses are specified in each detail specification.

The detail specification shall be prepared and established by a manufacturer in accordance with Section A.4 of JAXA-QTS-2000. The detailed specification shall also be registered with the Japan Aerospace Exploration Agency (hereinafter referred to as “JAXA”).

2.4.1 Detail Specification Number

The detail specification number shall be indicated in the following form in accordance with paragraph A.2.2.2 of JAXA-QTS-2000.
2.4.2 Revision Letter of Detail Specification

A revision letter in the detail specification number shall be assigned in accordance with paragraph A.2.2.2.4 of JAXA-QTS-2000.

2.4.3 Independency of Detail Specification

The detail specification shall be a stand-alone document with a unique number defined in accordance with paragraph 2.4.1.

2.4.4 Format of Detail Specification

The detail specification format shall be in accordance with A.6 b) of JAXA-QTS-2000 and shall specify each requirement in accordance with A.4 of JAXA-QTS-2000.

3. REQUIREMENTS

3.1 Certification

3.1.1 Qualification Coverage

The qualification coverage shall be limited to fuses that are produced by the manufacturing line that conforms to materials, designs, constructions, ratings, and performance specified in paragraphs 3.3 to 3.11 of this specification. The qualification coverage shall be fully represented by samples that have passed the qualification test. Within this coverage, the manufacturer is allowed to supply qualified products in accordance with the detail specification. If necessary, additional definitions of qualification coverage shall be specified in the detail specification.

3.1.2 Initial Qualification

To acquire certification of the fuses in compliance with this specification, a manufacturer shall establish a quality assurance program in accordance with paragraph 3.2.1 of this specification, perform the qualification tests specified in paragraph 4.4, and acquire a certification status from JAXA as specified in paragraph 3.4.1 of JAXA-QTS-2000. The manufacturer shall be listed on the Qualified Manufacturer List of the Japan Aerospace Exploration Agency (JAXA QML).

3.1.3 Retention of Qualification

To continue supplying fuses in accordance with this specification, a manufacturer must apply for QML certification retention in accordance with paragraph 3.4.2.1 of JAXA-QTS-2000 commencing between 30 and 60 days prior to the expiration date of the certification period (paragraph 3.1.4).
If products were not shipped during the effective period of certification and a quality conformance inspection was not conducted, the manufacturer may apply for retention of certification without conducting the quality conformance inspection.

### 3.1.4 Effective Period of Certification

The effective period of certification granted in compliance with this specification shall be three years.

### 3.1.5 Change of Qualification Coverage

To change the qualification coverage, the manufacturer shall perform procedures for re-certification in accordance with paragraph 3.4.3 of JAXA-QTS-2000.

### 3.2 Quality Assurance Program

#### 3.2.1 Establishment of a Quality Assurance Program

To acquire certification in compliance with this specification, the manufacturer shall be responsible for establishing a quality assurance program that satisfies the requirements specified in paragraph 3.3.1 of JAXA-QTS-2000 and this specification. The manufacturer shall generate a Quality Assurance Program Plan in accordance with paragraph 3.3.2 of JAXA-QTS-2000 and provide the plan to JAXA for review in accordance with paragraph 3.3.6 of JAXA-QTS-2000.

#### 3.2.2 TRB Formation

To acquire a certification status in compliance with this specification, the manufacturer shall form and operate the Technical Review Board (TRB) in accordance with paragraph 3.3.5 of JAXA-QTS-2000.

### 3.3 Materials

Materials used for manufacturing fuses shall be specified in this specification. If a specific material is not specified, a material which enables the fuses to satisfy the requirements of this specification shall be used. The tin content of material and solder used for fuses shall be less than 97wt%, and the tin shall be alloyed with 3wt% of lead or more. Those materials shall be specified in the document defining the manufacturing conditions of the quality assurance program.

#### 3.3.1 Substrates

The substrates shall consist primarily of alumina (nominal 96% or more) and the rest shall be other oxides, which shall be calcined at high temperature.

#### 3.3.2 Fuse Elements

The fuse elements shall be as specified in the detail specifications.

#### 3.3.3 Terminals

The terminals shall be as specified in Table 3.
3.3.4 Internal Solder
The solidus temperature of the internal solder which is used to mount the terminals onto the fuse body shall be +260°C as a minimum.

3.3.5 Case Materials
The case materials shall be capable of withstanding the maximum operating temperature and maintaining moisture resistance as well as electrical insulation properties. The case material shall not affect fuse performance. Details shall be in accordance with the detail specifications.

3.3.6 Outgassing
Unless otherwise specified, organic materials used for fuses shall satisfy the following requirements when tested in accordance with ASTM E 595.
   a) Total Mass Loss (TML): 1.0% or less
   b) Collected Volatile Condensable Material (CVCM): 0.1% or less

3.4 Design and Construction
Design and construction of the fuses shall be in accordance with the detail specifications.

3.5 Externals, Dimensions, Weight and Marking
When tested in accordance with paragraph 4.6.2, fuses shall satisfy the following requirements.

3.5.1 Externals and Marking
Fuses shall be free from loose terminals, cracked, or displaced parts, sharp edges, burrs, and other defects that will affect life, serviceability, or appearance. The following items shall be marked on the fuse surface in such a manner to ensure legibility. As a rule, the marking shall remain legible at the completion of any test.
   a) Part number
   b) Lot identification code:
      Code shall be given in accordance with the qualified manufacturers requirements.
   c) Serial number
   d) Qualified manufacturer name or its abbreviation (if there is enough marking space left)

3.5.2 Dimensions and Weight
The dimensions and weight of the fuses shall satisfy the requirements of each detail specification.

3.6 Workmanship
Fuses shall be manufactured based on good design practices and in accordance with the quality assurance program defined in paragraph 3.2.1.

3.6.1 X-Ray Inspection
When fuses are tested in accordance with paragraph 4.6.3.1, there shall be no loose or foreign material, solder dispersion, excessive solder on leads, insufficient connection of
lead terminal, voids over $\phi 0.51\text{mm}$ in molded material, voids in lead terminal exit, insufficient clearance between substrate and molded body, extraordinary gap of relative position between elements and body, cracks or fractures on substrate or arc suppression glass, or breakage of elements. The acceptance and rejection criteria shall be as follows.

a) Voids less than $\phi 0.51\text{mm}$ in molded material can be accepted unless it is located next to the arc suppression glass.

b) There shall be no voids in lead terminal exit exceeding 50% of the length between case bottom and substrate.

c) Scribe lines on the substrate side surface can be accepted.

d) There shall be no voids extending the entire length between terminals.

e) There shall be no pinholes over $\phi 0.25\text{mm}$ on arc suppression glass.

f) There shall be no foreign material over $\phi 0.38\text{mm}$ between terminals or on the substrate boundary edge.

g) There shall be no cracks in substrate.

h) There shall be no cracks in molded case.

i) There shall be no voids over $\phi 0.38\text{mm}$ in solder fillet at the tip of terminals.

j) If the total amount of solder voids generated under the terminals exceeds 50% of the solderable area, the fuse shall be rejected.
3.6.2 DPA

When fuses are tested in accordance with paragraph 4.6.3.2, the materials, design and construction and workmanship shall be as specified in the quality assurance program.

3.7 Rating

The following requirements shall be specified in the detail specifications.

a) Operating temperature range
   The operating temperature is the case temperature that ensures the operation of fuses. Unless otherwise specified, the operating temperature shall be -55°C to +125°C.

b) Rated voltage

c) Rated current
   If the case temperature exceeds +25°C, loads shall be reduced according to the derating curve specified in the detail specification.

d) Nominal resistance

e) Rated breaking capacity

3.8 Electrical Performance

Fuses shall satisfy the following electrical requirements.

3.8.1 Burn-In

When tested in accordance with paragraph 4.6.4.1, the fuses shall not open circuit. Their voltage drops shall not change by more than the value specified in the detail specification compared to the value before the thermal shock test [I]. There shall be no mechanical damage as a result of this testing.
### 3.8.2 Resistance
When tested in accordance with paragraph 4.6.4.2, fuses shall satisfy the electrical resistance specified in the detail specifications.

### 3.8.3 Current-Carrying Capacity
When tested in accordance with paragraph 4.6.4.3, fuses shall show no evidence of mechanical damage and shall carry the current as specified in detail specification without electrical failure. Unless otherwise specified, the temperature of the case or terminal shall not rise more than 85°C above room ambient temperature.

### 3.8.4 Dielectric Withstanding Voltage
When tested in accordance with paragraph 4.6.4.4, there shall be no evidence of arcing, flashover or insulation breakdown or opening of fuse element. The resistance after test shall be within the tolerance specified in the detail specification. Leak current during the test shall be 1mA or less.

### 3.8.5 Overload Interrupt
When tested in accordance with paragraph 4.6.4.5, fuses shall open the circuit within the time limits specified in the detail specification without causing the case or body to char or fracture. The circuit shall remain open without the circuit closing again during the one-minute period after interrupt. There shall be no mechanical failure.

### 3.8.6 Short Circuit Interrupt
When tested in accordance with paragraph 4.6.4.6, fuses shall remain intact and shall open the circuit. The fuse shall remain in the energized circuit for 30 seconds minimum without any indication of the circuit closing again. There shall be no breakage of case, separation of terminal and body, breaking of terminal or shunt between terminals. The insulation resistance between terminals after test shall be 1.0MΩ or more.

### 3.8.7 Insulation Resistance
When tested in accordance with paragraph 4.6.4.7, the insulation resistance between terminals shall be 10MΩ or more. However, for the fuses having a rated voltage of 5A or higher, the following requirements shall be satisfied.

- a) 250% loads: 100kΩ as a minimum
- b) Other loads: 1MΩ as a minimum

### 3.8.8 Resistance – Temperature Coefficient
When tested in accordance with paragraph 4.6.4.8, the resistance – temperature coefficient shall be as specified in the detail specification regarding +25°C as a standard.

### 3.9 Mechanical Performance
Fuses shall satisfy the following mechanical requirements.
3.9.1 Terminal Strength

3.9.1.1 Pull and Bending Strength (For Lead Terminal Type)
When tested in accordance with paragraph 4.6.5.1.1, there shall be no damage or loosening of terminals. The change in resistance before and after the test shall not exceed the value specified in the detail specification.

3.9.1.2 Adhesion (For Surface Mount Type)
When tested in accordance with paragraph 4.6.5.1.2, there shall be no damage or loosening of terminals.

3.9.1.3 Board Bending (For Surface Mount Type)
When tested in accordance with paragraph 4.6.5.1.3, there shall be no damage or loosening of terminals. The change in resistance before and after the test shall not exceed the value specified in the detail specification.

3.9.2 Solderability
When tested in accordance with paragraph 4.6.5.2, a minimum of 95% of the terminal surface shall be evenly covered with new solder. The existence of small pinholes or rough areas shall be acceptable, provided that they are not concentrated in one spot. The total area of the pinholes or rough areas shall be less than 5% of the solder area.

3.9.3 Resistance to Soldering Heat
When tested in accordance with paragraph 4.6.5.3, there shall be no external damage to the fuse. The change in resistance before and after the test shall not exceed the value specified in the detail specification.

3.10 Environmental Performance
Fuses shall satisfy the following environmental performance.

3.10.1 Vibration

3.10.1.1 High Frequency Vibration
When tested in accordance with paragraph 4.6.6.1.1, there shall be no electrical or mechanical damage to the fuse. The change in resistance before and after the test shall not exceed the value specified in the detail specification.

3.10.1.2 Random Vibration
When tested in accordance with paragraph 4.6.6.1.2, there shall be no electrical or mechanical damage to the fuse. The change in resistance before and after the test shall not exceed the value specified in the detail specification.
3.10.2 Shock
When tested in accordance with paragraph 4.6.6.2, there shall be no electrical or mechanical damage to the fuse. The change in resistance before and after the test shall not exceed the value specified in the detail specification.

3.10.3 Thermal Shock

3.10.3.1 Thermal Shock [I]
When tested in accordance with paragraph 4.6.6.3.1, the fuses shall show no mechanical or electrical damage and there shall be no loosening of the terminals.

3.10.3.2 Thermal Shock [II]
When tested in accordance with paragraph 4.6.6.3.2, the fuses shall show no mechanical or electrical damage and there shall be no loosening of the terminals. The change in resistance before and after the test shall not exceed the value specified in the detail specification.

3.10.4 Salt Splay (Corrosion)
When tested in accordance with paragraph 4.6.6.4, there shall be no evidence of corrosion which interferes with the electrical or mechanical performance of the fuse, or corrosion which has passed through the plating and attacked the base metal. Also, the fuses shall show no electrical or mechanical damage such as strains or cracks. The change in resistance before and after the test shall not exceed the value specified in the detail specification.

3.10.5 Moisture Resistance
When tested in accordance with paragraph 4.6.6.5, there shall be no cracking, peeling, loosening of terminals or evidence of electrolytic corrosion. The change in resistance before and after the test shall not exceed the value specified in the detail specification.

3.10.6 Low Temperature Operation
When tested in accordance with paragraph 4.6.6.6, the fuses shall not open circuit. The change in resistance before and after the test shall not exceed the value specified in the detail specification.

3.10.7 Thermal Vacuum
When tested in accordance with paragraph 4.6.6.7, the fuses shall not open circuit during the application of 90% of rated current. There shall be no evidence of arcing or mechanical damage after completion of the test. The fuses subjected to 400 percent overload interrupt test shall “blow” within the time period specified in the detail specification. For the fuses not submitted to the overload interrupt test, the change in resistance before and after the test shall not exceed the value specified in the detail specification.
3.10.8 Resistance to Solvents
   This test shall apply to the fuses which have screen-printed markings. When tested in accordance with paragraph 4.6.6.8, the fuses shall show no mechanical damage and its marking shall be clearly visible.

3.11 Durability
   Fuses shall have the following life performance.

3.11.1 Steady-State Life
   When tested in accordance with paragraph 4.6.7.1, the fuses shall not open circuit. The change in resistance before and after test shall not exceed the value specified in the detail specification.

4. QUALITY ASSURANCE PROVISIONS

4.1 General Requirements
   The manufacturer shall be responsible for implementing the quality assurance program as specified in paragraph 3.2 and operating the TRB.

4.2 Classification of Test and Inspection
   The tests and inspections shall be classified into the following three categories in accordance with paragraph 4.3 of JAXA-QTS-2000.
   a) In-process inspection
   b) Qualification test
   c) Quality conformance inspection

4.3 In-Process Inspection
   The manufacturer shall perform the in-process inspections as specified below to detect any failure which could seriously affect the reliability and quality of the products, assure the workmanship and characterize properties which cannot be measured using the finished products. The manufacturing flowchart in the quality assurance program plan shall define the inspection process.
   a) Resistance (non-destructive, 100% or sampling inspection)
   b) Pre-cap internal visual inspection (non-destructive, 100% inspection)
   c) Pre-arcing time-current characteristics (destructive, sampling inspection)
   d) External visual inspection (non-destructive, 100% inspection)

4.4 Qualification Test

4.4.1 Sample
   Samples shall be manufactured using the process and control as specified in the quality assurance programs. The samples shall be of the maximum and minimum rated current for which qualification is desired per each characteristic and rated voltage.
4.4.2 Manufacturing Records
The manufacturer, which intends to acquire certification status, shall archive material certification, receiving inspection data or test data of materials used, work records related to sample preparation, and in-process inspection data. These records shall be readily available upon request.

4.4.3 Test Items and Sample Size
The samples selected as specified in paragraph 4.4.1 shall be submitted to the tests specified in Table 4. Sample size for each test item shall be as specified in Table 4. Upon completion of Groups I and II tests, Group III through IX tests shall be performed using samples allocated to the appropriate group tests. Each test shall be conducted in the order listed in each group.

4.4.4 Criteria for Pass/Fail
A failure of any test in the qualification tests shall constitute failure of the qualification tests.

4.4.5 Disposition after Inspections
Samples subjected to the qualification test shall not be delivered. The products in the same inspection lot that have passed the qualification test may be delivered upon passing the Group A inspection of the quality conformance inspection.
<table>
<thead>
<tr>
<th>Group</th>
<th>Order</th>
<th>Item</th>
<th>Requirement paragraph</th>
<th>Test method paragraph</th>
<th>Pass/fail criteria</th>
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<td>No. of samples</td>
<td>No. of allowable defects</td>
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<td>Thermal shock [I]</td>
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<td>3</td>
<td>Burn-in</td>
<td>3.8.1</td>
<td>4.6.4.1</td>
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<tr>
<td></td>
<td>4</td>
<td>Resistance</td>
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<td>4.6.4.2</td>
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<tr>
<td></td>
<td>5</td>
<td>Current-carrying capacity</td>
<td>3.8.3</td>
<td>4.6.4.3</td>
<td>0</td>
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<td></td>
<td>6</td>
<td>Dielectric withstanding voltage</td>
<td>3.8.4</td>
<td>4.6.4.4</td>
<td>0</td>
</tr>
<tr>
<td>II</td>
<td>1</td>
<td>X-ray inspection</td>
<td>3.6.1</td>
<td>4.6.3.1</td>
<td>All</td>
</tr>
<tr>
<td></td>
<td>2</td>
<td>DPA</td>
<td>3.6.2</td>
<td>4.6.3.2</td>
<td>3</td>
</tr>
<tr>
<td>III</td>
<td>1</td>
<td>Resistance–temperature coefficient</td>
<td>3.8.8</td>
<td>4.6.4.8</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td>2</td>
<td>Resistance to solvents</td>
<td>3.10.8</td>
<td>4.6.6.8</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td>3</td>
<td>Terminal strength</td>
<td>3.9.1</td>
<td>4.6.5.1</td>
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</tr>
<tr>
<td></td>
<td>4</td>
<td>Overload interrupt (-55°C to +125°C)</td>
<td>3.8.5</td>
<td>4.6.4.5</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td>5</td>
<td>Insulation resistance</td>
<td>3.8.7</td>
<td>4.6.4.7</td>
<td>0</td>
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<tr>
<td></td>
<td>6</td>
<td>Solderability (2)</td>
<td>3.9.2</td>
<td>4.6.5.2</td>
<td>0</td>
</tr>
<tr>
<td>IV</td>
<td>1</td>
<td>Low temperature operation</td>
<td>3.10.6</td>
<td>4.6.6.6</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td>2</td>
<td>Steady-state life</td>
<td>3.11.1</td>
<td>4.6.7.1</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td>3</td>
<td>Overload interrupt (+25°C)</td>
<td>3.8.5</td>
<td>4.6.4.5</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td>4</td>
<td>Insulation resistance</td>
<td>3.8.7</td>
<td>4.6.4.7</td>
<td>0</td>
</tr>
<tr>
<td>V</td>
<td>1</td>
<td>Thermal vacuum</td>
<td>3.10.7</td>
<td>4.6.6.7</td>
<td>8</td>
</tr>
<tr>
<td>VI</td>
<td>1</td>
<td>Short circuit interrupt</td>
<td>3.8.6</td>
<td>4.6.4.6</td>
<td>4</td>
</tr>
<tr>
<td>VII</td>
<td>1</td>
<td>Salt spray (corrosion)</td>
<td>3.10.4</td>
<td>4.6.6.4</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td>2</td>
<td>Overload interrupt (+25°C) (600%)</td>
<td>3.8.5</td>
<td>4.6.4.5</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td>3</td>
<td>Insulation resistance</td>
<td>3.8.7</td>
<td>4.6.4.7</td>
<td>0</td>
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<tr>
<td>VIII</td>
<td>1</td>
<td>Moisture resistance</td>
<td>3.10.5</td>
<td>4.6.6.5</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td>2</td>
<td>Resistance to soldering heat</td>
<td>3.9.3</td>
<td>4.6.5.3</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td>3</td>
<td>High frequency vibration</td>
<td>3.10.1.1</td>
<td>4.6.6.1.1</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td>4</td>
<td>Random vibration</td>
<td>3.10.1.2</td>
<td>4.6.6.1.2</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td>5</td>
<td>Shock</td>
<td>3.10.2</td>
<td>4.6.6.2</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td>6</td>
<td>Current-carrying capacity</td>
<td>3.8.3</td>
<td>4.6.4.3</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td>7</td>
<td>Overload interrupt (+25°C)</td>
<td>3.8.5</td>
<td>4.6.4.5</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td>8</td>
<td>Insulation resistance</td>
<td>3.8.7</td>
<td>4.6.4.7</td>
<td>0</td>
</tr>
<tr>
<td>IX</td>
<td>1</td>
<td>Thermal shock [II]</td>
<td>3.10.3.2</td>
<td>4.6.6.3.2</td>
<td>18</td>
</tr>
<tr>
<td></td>
<td>2</td>
<td>Overload interrupt (+25°C)</td>
<td>3.8.5</td>
<td>4.6.4.5</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td>3</td>
<td>Insulation resistance</td>
<td>3.8.7</td>
<td>4.6.4.7</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td>-</td>
<td>1 Materials</td>
<td>3.3</td>
<td></td>
<td>(3)</td>
</tr>
</tbody>
</table>

Notes:  
(1) The inspection can be conducted prior to the tests of Group I inspection.  
(2) For surface mount fuses, 18 additional samples which have passed the tests of orders 1 through 4 of Group I inspection shall be added as test samples for Solderability, to the test samples subjected for the tests of orders 1 through 5 of Group III inspection.  
(3) Documents shall be submitted to prove that the samples satisfy the design specification.
4.5 Quality Conformance Inspection

4.5.1 Quality Conformance Inspection (Group A)
Group A inspections shall be performed at the time of production for all products.

4.5.1.1 Sample
Selection of test samples for Group A inspections lots shall be defined as a part of the manufacturing conditions in the quality assurance program.

4.5.1.2 Inspection Items and Sample Size
Inspection items and samples size in Group A inspection shall be as specified in Table 5. Tests of each group shall be performed in the order listed in Table 5.

<table>
<thead>
<tr>
<th>Group</th>
<th>Order</th>
<th>Test Item</th>
<th>Requirement paragraph</th>
<th>Test method paragraph</th>
<th>Pass/fail criteria</th>
</tr>
</thead>
<tbody>
<tr>
<td>A1</td>
<td>1</td>
<td>X-ray inspection</td>
<td>3.6.1</td>
<td>4.6.3.1</td>
<td>All</td>
</tr>
<tr>
<td>A2</td>
<td>1</td>
<td>Thermal shock [I]</td>
<td>3.10.3.1</td>
<td>4.6.6.3.1</td>
<td>All</td>
</tr>
<tr>
<td></td>
<td>2</td>
<td>Burn-in</td>
<td>3.8.1</td>
<td>4.6.4.1</td>
<td>All</td>
</tr>
<tr>
<td></td>
<td>3</td>
<td>Resistance</td>
<td>3.8.2</td>
<td>4.6.4.2</td>
<td>All</td>
</tr>
<tr>
<td>A3</td>
<td>1</td>
<td>Externals, dimensions and marking</td>
<td>3.5</td>
<td>4.6.2</td>
<td>AQL(1) 1.0%</td>
</tr>
<tr>
<td>A4</td>
<td>1</td>
<td>Current-carrying capacity</td>
<td>3.8.3</td>
<td>4.6.4.3</td>
<td>21(2)</td>
</tr>
<tr>
<td></td>
<td>2</td>
<td>Dielectric withstanding voltage</td>
<td>3.8.4</td>
<td>4.6.4.4</td>
<td>21(2)</td>
</tr>
<tr>
<td></td>
<td>3</td>
<td>Overload interrupt (+25°C)</td>
<td>3.8.5</td>
<td>4.6.4.5</td>
<td>21(2)</td>
</tr>
<tr>
<td></td>
<td>4</td>
<td>Insulation resistance</td>
<td>3.8.7</td>
<td>4.6.4.7</td>
<td>21(2)</td>
</tr>
<tr>
<td>A5</td>
<td>1</td>
<td>Terminal strength</td>
<td>3.9.1</td>
<td>4.6.5.1</td>
<td>4</td>
</tr>
<tr>
<td>A6</td>
<td>2</td>
<td>Solderability</td>
<td>3.9.2</td>
<td>4.6.5.2</td>
<td>4</td>
</tr>
<tr>
<td>A7</td>
<td>1</td>
<td>DPA</td>
<td>3.6.2</td>
<td>4.6.3.2</td>
<td>3</td>
</tr>
</tbody>
</table>

Notes: (1) The acceptance quality level (AQL) is based on a single sampling plans for normal inspection, specified in JIS Z 9015-1, Attachment Table 2-A.
(2) Samples shall be selected from the both ends of truncated distribution based on the voltage drop after burn-in test.

4.5.1.3 Criteria for Pass/Fail
A failure of any test specified in the Group A inspections shall constitute failure of the quality conformance inspections. If the failure mode of the defects is catastrophic such as an open- or short-circuiting where the function of the fuses might be lost, the fuses fail Group A of the quality conformance inspections.
4.5.1.4 Disposition after Inspections
Products from the lot rejected in the Group A quality conformance inspection shall not be shipped. If the lot has not passed Group A3 inspection of Table 5, all products of the lot shall be subjected to the failed inspection as specified in paragraph H.3.3 of JAXA-QTS-2000, and only the good products shall be shipped. The sample fuses subjected to the Group A4, A5, A6 and A7 inspections shall not be shipped.

4.5.2 Quality Conformance Inspection (Group B and Group C)
Group B and C inspections shall be performed in compliance with the following schedule.

a) The Group B inspection shall be performed on the first lot manufactured within the certification period.

b) When retention of certification is granted, the Group C inspection shall be performed prior to the restart of production when no products were manufactured within the previous certification period and no quality conformance inspection was performed.

4.5.2.1 Sample
Inspection lots for Group B and C inspections shall consist of samples that have passed Group A inspections. The Group B and C inspections shall be performed on the fuses with given rated current for each combination of characteristics and rated voltage.

4.5.2.2 Inspection Items and Sample Size
Inspection items and the sample size of Group B or C inspection shall be as specified in Tables 6 and 7. Each test group can be performed in any order, but the tests of each group shall be performed in the order listed in each table.

4.5.2.3 Criteria for Pass/Fail
A failure of any inspection specified in the Group B or C inspections shall constitute failure of the quality conformance inspection of each group.

4.5.2.4 Disposition after Inspections
The samples used for the Group B and C inspections shall not be delivered. If the samples fail in the Group B or C inspections, the manufacturer shall conduct a failure analysis on the defects and take corrective action. Delivery of the products shall be suspended until JAXA approves the corrective actions.
### Table 6. Quality Conformance Inspection (Group B)

<table>
<thead>
<tr>
<th>Group</th>
<th>Test Requirement</th>
<th>Test Requirement paragraph</th>
<th>Test method paragraph</th>
<th>Pass/fail criteria</th>
</tr>
</thead>
<tbody>
<tr>
<td>B1</td>
<td>Low temperature operation</td>
<td>3.10.6</td>
<td>4.6.6.6</td>
<td>12 0</td>
</tr>
<tr>
<td></td>
<td>Steady-state life</td>
<td>3.11.1</td>
<td>4.6.7.1</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Overload interrupt (+25°C)</td>
<td>3.8.5</td>
<td>4.6.4.5</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Insulation resistance</td>
<td>3.8.7</td>
<td>4.6.4.7</td>
<td></td>
</tr>
<tr>
<td>B2</td>
<td>Short circuit interrupt</td>
<td>3.8.6</td>
<td>4.6.4.6</td>
<td>4 0</td>
</tr>
<tr>
<td>B3</td>
<td>Resistance–temperature coefficient</td>
<td>3.8.8</td>
<td>4.6.4.8</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Terminal strength</td>
<td>3.9.1</td>
<td>4.6.5.1</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Overload interrupt (+25°C) (600%)</td>
<td>3.8.5</td>
<td>4.6.4.5</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Insulation resistance</td>
<td>3.8.7</td>
<td>4.6.4.7</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Resistance to solvents</td>
<td>3.10.8</td>
<td>4.6.6.8</td>
<td></td>
</tr>
<tr>
<td>B4</td>
<td>Resistance to soldering heat</td>
<td>3.9.3</td>
<td>4.6.5.3</td>
<td></td>
</tr>
<tr>
<td></td>
<td>High frequency vibration</td>
<td>3.10.1.1</td>
<td>4.6.6.1.1</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Random vibration</td>
<td>3.10.1.2</td>
<td>4.6.6.1.2</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Shock</td>
<td>3.10.2</td>
<td>4.6.6.2</td>
<td></td>
</tr>
<tr>
<td>B5</td>
<td>Salt spray (corrosion)</td>
<td>3.10.4</td>
<td>4.6.6.4</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Overload interrupt (+25°C) (600%)</td>
<td>3.8.5</td>
<td>4.6.4.5</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Insulation resistance</td>
<td>3.8.7</td>
<td>4.6.4.7</td>
<td></td>
</tr>
<tr>
<td>B6</td>
<td>Moisture resistance</td>
<td>3.10.5</td>
<td>4.6.6.5</td>
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</tr>
<tr>
<td></td>
<td>Current-carrying capacity</td>
<td>3.8.3</td>
<td>4.6.4.3</td>
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</tr>
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### Table 7. Quality Conformance Inspection (Group C)

<table>
<thead>
<tr>
<th>Group</th>
<th>Test Requirement</th>
<th>Test Requirement paragraph</th>
<th>Test method paragraph</th>
<th>Pass/fail criteria</th>
</tr>
</thead>
<tbody>
<tr>
<td>C1</td>
<td>Thermal vacuum</td>
<td>3.10.7</td>
<td>4.6.6.7</td>
<td>8 0</td>
</tr>
<tr>
<td>C2</td>
<td>Thermal shock [II]</td>
<td>3.10.3.2</td>
<td>4.6.6.3.2</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Overload interrupt (+25°C)</td>
<td>3.8.5</td>
<td>4.6.4.5</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Insulation resistance</td>
<td>3.8.7</td>
<td>4.6.4.7</td>
<td></td>
</tr>
</tbody>
</table>
4.6 Test Method

4.6.1 Test Conditions

Unless otherwise specified, all tests and inspections shall be performed on the following conditions and conditions specified in paragraph 4 of MIL-STD-202.

a) Test current tolerance shall be ±1.0% of specified current.

b) Current fluctuation during the test shall be within ±1.0% of specified current or tolerance.

4.6.1.1 Mounting Method

If the mounting method is specified in this specification, fuses shall be mounted on the test board in accordance with the following procedure. If the mounting of fuses are not required, the fuses shall be tested by using other suitable method without being mounted on the test board.

a) Test board

Fuse shall be soldered on the suitable printed wiring board as shown in figure 2. The test board shall be either an alumina substrate (alumina of 95% purity or higher) with a thickness of 0.635 ± 0.05mm or glass base woven epoxy resin copper-clad laminate board with a thickness of 1.6 ± 0.1mm. Either shall not inversely affect the tests or measurements.

b) Mounting procedure

Fuse shall be mounted on the test board by reflow soldering using tin-lead alloy solder with nominal tin content of 60% including inactivated flux. Soldering temperature and duration shall be as follows.

1) Temperature: +200 to 240°C

2) Duration: 30 to 60 seconds
4.6.2 Externals, Dimensions and Marking

Fuses shall be examined to verify that the materials, design, construction, physical dimensions, externals, marking and weight are in accordance with the requirements specified in the detail specification. External visual inspection shall be performed with a magnifier of 10X or greater and marking shall be visually inspected.

4.6.3 Workmanship

The following inspections shall be performed to confirm that the workmanship of fuses conforms to the requirement of paragraph 3.6.
4.6.3.1 X-Ray Inspection

Fuses shall be subjected to radiographic inspection in accordance with method 209 of MIL-STD-202. The following details shall apply.

a) The radiograph shall be of sufficient quality to render a clear, sharp image of the penetrater.

b) The source – object distance shall ensure a sharply defined image.

c) The radiograph shall be taken from two views (0 and 90°) which are perpendicular to the direction of the lead terminal exit.

d) The radiographic film shall be sensitive enough to clearly detect φ0.10mm of lead particle. A double emulsion film may be used at the manufacturer’s option. If radiographs are taken without films, the following conditions shall be satisfied.

1) Record shall be stored in a reproducible electronic medium which has equivalent or better resolution than the radiographic film.

2) Devices used to take radiographs shall be able to gain results of same quality as using radiographic film. The radiograph shall be inspected using a graphic display monitor which can display the radiograph in same or higher magnetization. However, the radiograph shall meet with the quality criteria specified above a), and it shall not be enlarged until its defective features become unclear.

e) A radiograph penetrater shall be included on each radiographic film.

f) The radiographs shall be inspected with a magnifier of 10X or greater.

4.6.3.2 DPA

The DPA shall be performed in accordance with the DPA manual specified in the quality assurance program plan. The DPA manual shall include the method specified in MIL-STD-1580 or method to confirm that the fuses satisfy the requirements of MIL-STD-1580.

4.6.4 Electrical Performance

4.6.4.1 Burn-In

Fuses shall be mounted with inserting their terminals into suitable sockets or jigs. Unless otherwise specified, the mounting clearance shall be 2.54mm to 25.4mm. The fuses shall be electrically connected to the direct constant current power supply, and rated current shall be applied to each fuse at room temperature for 168 hours. Forced air circulation shall not be used during the test. Caution shall be taken to prevent the fuses from being subjected to switching transient or surge current. After completion of the test, the voltage drop of each fuse shall be measured in accordance with paragraph 4.6.4.1.1, and the change amount of the voltage drop shall be calculated using the value measured prior to the thermal shock [I] test specified in paragraph 4.6.6.3.1. External visual inspection shall be performed with a magnifier of 10X or greater to check for mechanical damage.

4.6.4.1.1 Voltage Drop

The voltage drop shall be measured with a direct current voltmeter, which has input impedance of 11MΩ or greater, after rated direct current are applied until the fuse
The temperature stays constant. The measurement shall be performed at the ambient temperature of +25°C±3°C with placing the voltage probe as close to the fuse element as practicable. The accuracy of measurement shall be within ±1.0%.

4.6.4.2 Resistance
The resistance shall be measured using the direct constant current power supply which has a recovery voltage less or equal to the rated voltage of the fuse. The measurement current shall be small enough not to induce the fuse element to produce heat. The accuracy of measurement shall be within ±1.0%. Resistance shall be measured with a Wheatstone bridge, Kelvin bridge, or equivalent sensitive instrument or calculated from the voltage drop. Measurement shall be taken at the ambient temperature of +25°C±3°C and as close to the fuse element as practicable.

4.6.4.3 Current-Carrying Capacity
Fuses shall be tested with the conditions specified in Table 8. The test current shall be maintained for 30 minutes after the temperature of each fuse has stabilized. Stabilization shall be considered to have occurred when no individual fuse temperature rise reading of 4 consecutive readings taken at 5 minute intervals exceeds the average reading of these 4 readings by more than 2°C and no indication of increasing temperature rise is observed. This average temperature rise reading shall be deemed to be the temperature rise of the fuse. The temperature of the fuse case or terminals shall be measured by thermocouples (wire size 28 to 32 AWG). After completion of the test, the fuses shall be visually inspected with a magnifier of 10X or greater to check for mechanical damage.

<table>
<thead>
<tr>
<th>Test temperature (°C)</th>
<th>DC test current</th>
<th>Applicable test(1)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Qualification test</td>
</tr>
<tr>
<td>-55 to 0°C</td>
<td>110% of rated current</td>
<td>X</td>
</tr>
<tr>
<td>+25 to 10°C</td>
<td>100% of rated current</td>
<td>X</td>
</tr>
<tr>
<td>+125 to 0°C</td>
<td>80% of rated current</td>
<td>X</td>
</tr>
</tbody>
</table>

Note: (1) The tests identified with the symbol “x” shall be performed.

4.6.4.4 Dielectric Withstanding Voltage
Fuses shall be tested in accordance with Test Method 301 of MIL-STD-202. The fuses shall be mounted on the test jig which can apply test voltage between whole main surface and leads. The test voltage shall be applied between electrically connected terminal and test jig. The following conditions shall apply.

a) Test voltage: 500Vrms
b) Duration
   1) Qualification test: 60 seconds
   2) Group A inspection: 5 seconds
c) Leakage current: 1mA max.
d) Measurement after test:
   Resistance shall be measured in accordance with paragraph 4.6.4.2.
e) Inspection after test:
Fuses shall be inspected with a magnifier of 10X or greater to check for the evidence of arcing, flashover or insulation breakdown.

4.6.4.5 Overload Interrupt

Fuses shall be subjected to the 250%, 400% or 600% of rated direct current specified in the detail specification using the test circuit as shown in Figure 3. For qualification test group III, the sample fuses shall be apportioned and submitted to the tests at the case temperature of \(-55^{\circ}C\) and \(+125^{\circ}C\). Unless otherwise specified, other tests shall be performed at the case temperature of \(+25^{\circ}C\). The fuses shall be maintained at the test temperature for a minimum of 30 minutes, prior to the actual application of the test current. The low-impedance voltage source shall be adjusted to make the recovery voltage conforms to the rated voltage of the fuses. Pre-arcing time of each fuse shall be measured by applying the specified fusing current. The measurement accuracy of the pre-arcing time shall be within \(\pm5.0\%\).

If the pre-arcing time is too short to maintain the test conditions specified in paragraph 4.6.1 a) and/or b), the pre-arcing \(I^2t\) shall be determined from an oscillogram showing the current trace or by other equivalent means and calculate the virtual time. UL 248-1 may be used for guidance in determining pre-arcing \(I^2t\).

The fuses shall be left in the circuit for 1 minute after opening to see if there is any indication of the circuit reclosing. After completion of the test, the fuses shall be visually inspected with a magnifier of 10X or greater to check for mechanical damage.

Notes:
(1') The battery or impedance of the power supply shall be less than 10 % of the impedance of whole circuit.
(2') The switch shall be a high current switch without contact bounce.
(3') The current measurement circuit shall be an oscillogram or equivalent.
(4') The resistance value shall be same as the test fuse in order to evaluate the prospective current.

Figure 3. Overload Interrupt Test Circuit
4.6.4.6 Short Circuit Interrupt

Fuses shall be placed in a DC test circuit capable of supplying a minimum of the rated breaking capacity specified in the detail specification (see Figure 4). The rate of current rise for the test circuit shall be adjusted to at least $3.25 \times 10^6$ A/s. The recovery voltage of the test current shall be adjusted to conform to the rated voltage of the test fuses. The short-circuit current shall be measured with an oscillograph. After completion of the test, the insulation resistance between terminals shall be measured in accordance with paragraph 4.6.4.7. Also, the fuses shall be visually inspected with a magnifier of 10X or greater to check for the breakage of case, separation of terminal and body or breaking of terminals. The time constant of the test circuit shall be calibrated to obtain the required test conditions by inserting the connecting piece which can ignore the impedance into the circuit to replace the fuse.

![Figure 4. Short Circuit Interrupt Test Circuit](image)

Notes: (') The battery or impedance of the power supply shall be less than 10% of the impedance of whole circuit.

(2) The switch shall be a high current switch without contact bounce.

(3) Indicates removable rink for calibration.

4.6.4.7 Insulation Resistance

The resistance shall be measured by applying rated DC voltage between terminals of the interrupted fuse. The measurement shall be performed immediately after applying the voltage continuously for one minute.

4.6.4.8 Resistance – Temperature Coefficient

Fuses shall be tested in accordance with the Test Method 304 of MIL-STD-202. Measurement of resistance at each temperature shown in Table 9 shall be conducted in accordance with paragraph 4.6.4.2 after the fuses reach a condition of thermal equilibrium.
Table 9. Test Temperature for Resistance – Temperature Coefficient

<table>
<thead>
<tr>
<th>Order</th>
<th>Qualification test</th>
<th>Quality conformance inspection</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>+25</td>
<td>+25</td>
</tr>
<tr>
<td>2</td>
<td>0</td>
<td>-55</td>
</tr>
<tr>
<td>3</td>
<td>-25</td>
<td>+25</td>
</tr>
<tr>
<td>4</td>
<td>-55</td>
<td>+125</td>
</tr>
<tr>
<td>5</td>
<td>+25</td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>+50</td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>+85</td>
<td></td>
</tr>
<tr>
<td>8</td>
<td>+125</td>
<td></td>
</tr>
</tbody>
</table>

Unit: °C

4.6.5 Mechanical Performance

4.6.5.1 Terminal Strength

4.6.5.1.1 Pull and Bending Strength (for Lead Terminal Type)
Fuses shall be tested in accordance with the Test Method 211 of MIL-STD-202 with the following conditions.

a) Test conditions:
   Test condition A (22.3N) applying the force axially to each lead terminal individually, then Test condition C (4.5N) applying three bends to each lead terminal.

b) Method of holding:
   The fuse body shall be held by means other than rigid clamping to prevent stresses which may cause misalignment between fuse body and fuse element or cracks on the fuse body.

c) Measurements before and after test:
   The resistance shall be measured in accordance with paragraph 4.6.4.2.

d) Inspection after test:
   The terminals shall be inspected with a magnifier of 10X or greater for evidence of breaking or loosening.

4.6.5.1.2 Adhesion (for Surface Mount Type)
Fuses shall be tested in accordance with the paragraph 8.5.3 of JIS C 60068-2-21 with the following conditions.

a) Mounting method:
   The fuse shall be mounted as specified in paragraph 4.6.1.1. The test board shall be a glass base woven epoxy resin copper-clad laminate board.

b) Load: 10 ± 1N

c) Duration of application of the load: 10±1 seconds:

d) Inspection after test:
The terminals shall be inspected with a magnifier of 10X or greater for evidence of breaking or loosening.

4.6.5.1.3 Board Bending (for Surface Mount Type)

After the completion of the Adhesion test as specified in paragraph 4.6.5.1.2, fuses shall be tested in accordance with the paragraph 8.5.1 of JIS C 60068-2-21 with the following conditions.

a) Measurement before test:
   The resistance shall be measured in accordance with paragraph 4.6.4.2.

b) Deflection: 1mm

c) Measurement during test:
   The resistance shall be measured with test board bent in accordance with paragraph 4.6.4.2.

d) Inspection after test:
   The terminals shall be inspected with a magnifier of 10X or greater for evidence of breaking or loosening.

4.6.5.2 Solderability

All terminals shall be tested in accordance with Test Method 208 of MIL-STD-202.

4.6.5.3 Resistance to Soldering Heat

a) Solder dip (for lead terminal type)

Fuses shall be tested in accordance with the Test condition B, Test Method 210 of MIL-STD-202 with the following conditions.

1) Immersion depth:
   Lead shall be immersed to a depth of within 1.27mm from the fuse body.

2) Cooling time: 5 minutes as a minimum

3) Measurements before and after test:
   The resistance shall be measured in accordance with paragraph 4.6.4.2.

4) Inspection after test:
   Fuses shall be visually inspected with a magnifier of 10X or greater for evidence of damage.

b) Reflow method (for surface mount type)

Fuses shall be tested in accordance with the Test condition K, Test Method 210 of MIL-STD-202 with the following conditions.

1) Measurement before test:
   The resistance shall be measured in accordance with paragraph 4.6.4.2.

2) Mounting board
   As specified in paragraph 4.6.1.1 a).

3) Measurements after test:
   The resistance shall be measured in accordance with paragraph 4.6.4.2.

4) Inspection after test:
   Fuses shall be visually inspected with a magnifier of 10X or greater for evidence of damage.
4.6.6 Environmental Performance

4.6.6.1 Vibration

4.6.6.1.1 High-Frequency Vibration

Fuses shall be tested in accordance with the Test Method 204 of MIL-STD-202 with the following conditions.

a) Mounting method:
   Fuses shall be firmly mounted directly on the shake table or using an appropriate fixing jig.

b) Test condition:
   1) Amplitude of vibration: Sinusoidal vibration having total amplitude of 10.2mm or 294m/s^2-p-p whichever is smaller.
   2) Frequency range: 5 to 3,000Hz
   3) Sweep rate: Approximately 0.5oct/min.
   4) Test duration: 12 hours in total (4 hours each for 3 mutually perpendicular directions).

c) Loads during test:
   Rated direct current shall be applied to half of the samples.

d) Measurements before and after test:
   The resistance shall be measured in accordance with paragraph 4.6.4.2.

e) Inspection after test:
   Fuses shall be inspected with a magnifier of 10X or greater to check for mechanical damage.

4.6.6.1.2 Random Vibration

Fuses shall be tested in accordance with the Test Method 214 of MIL-STD-202 with the following conditions.

a) Mounting method:
   Fuses shall be firmly mounted directly on the shake table or using an appropriate fixing jig.

b) Vibration direction: three mutually perpendicular directions.

c) Test condition: II-H

d) Test duration: 15 minutes each for three directions (45 minutes in total).

e) Loads during test:
   Rated direct current shall be applied to half of the samples.

f) Measurements before and after test:
   The resistance shall be measured in accordance with paragraph 4.6.4.2.

g) Inspection after test:
   Fuses shall be inspected with a magnifier of 10X or greater to check for mechanical damage.
4.6.6.2 Shock

Fuses shall be tested in accordance with the Test Method 213 of MIL-STD-202 with the following conditions.

a) Mounting method:
   Fuses shall be firmly mounted directly on the shake table or using an appropriate fixing jig.

b) Test condition: F (14.71km/s², 0.5ms, half sine wave)

c) Loads during test:
   Rated direct current shall be applied to half of the samples.

d) Measurements before and after test:
   The resistance shall be measured in accordance with paragraph 4.6.4.2.

e) Inspection after test:
   Fuses shall be inspected with a magnifier of 10X or greater to check for mechanical damage.

4.6.6.3 Thermal Shock

4.6.6.3.1 Thermal Shock [I]

Fuses shall be tested in accordance with the Test Method 107 of MIL-STD-202 with the following conditions.

a) Test condition: B (5 cycles in a row)

b) Measurement before test:
   The voltage drop shall be measured in accordance with paragraph 4.6.4.1.1.

c) Inspection after test:
   Fuses shall be inspected with a magnifier of 10X or greater to check for mechanical damage or loosening of terminals.

4.6.6.3.2 Thermal Shock [II]

Fuses shall be tested in accordance with the Test Method 107 of MIL-STD-202 with the following conditions.

a) Measurement before test:
   The resistance shall be measured in accordance with paragraph 4.6.4.2.

b) Test condition: As specified in Table 10.

c) Number of cycles: 1,000 cycles

d) Measurement and inspection:
   The following measurement and inspection shall be performed after the fuses are at room temperature for 30 minutes or more at the completion of each 50±10 cycles, 100±10 cycles, 250±20 cycles, 500±20 cycles and 1,000±10 cycles.
   1) Resistance measurement
      The resistance shall be measured in accordance with paragraph 4.6.4.2.
   2) External inspection
      Fuses shall be inspected with a magnifier of 10X or greater for evidence of mechanical damage or loosening of terminals.
Table 10. Test Conditions for Thermal Shock [II]

<table>
<thead>
<tr>
<th>Stage</th>
<th>Temperature (°C)</th>
<th>Holding time (minutes)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>-55°5</td>
<td>30</td>
</tr>
<tr>
<td>2</td>
<td>25°10</td>
<td>5 max.</td>
</tr>
<tr>
<td>3</td>
<td>125°5</td>
<td>30</td>
</tr>
<tr>
<td>4</td>
<td>25°10</td>
<td>5 max.</td>
</tr>
</tbody>
</table>

4.6.6.4 Salt Spray (Corrosion)
Fuses shall be tested in accordance with the Test Method 101 of MIL-STD-202 with the following conditions.
   a) Test condition: B
   b) Rated current shall be applied for 1 hour after drying.
   c) Measurements before and after test:
      The resistance shall be measured in accordance with paragraph 4.6.4.2.
   d) Inspection after test
      Fuses shall be inspected with a magnifier of 10X or greater to check for corrosion, strain, crack or other mechanical damages.

4.6.6.5 Moisture Resistance
Fuses shall be tested in accordance with the Test Method 106 of MIL-STD-202 with the following conditions.
   a) Mounting method:
      Fuses shall be mounted on the noncorrosive metallic panel, which is inclined at a 15 degree angle to the vertical direction, with the terminals down.
   b) Polarization voltage: 100V<sub>DC</sub>
   c) Load condition: unloaded
   d) Steps 7a and 7b shall not be applied
   e) Measurements before and after test:
      The resistance shall be measured in accordance with paragraph 4.6.4.2.
   f) Inspection after test:
      Fuses shall be inspected with a magnifier of 10X or greater for evidence of crack, peeling, loosening of terminals or other electrical corrosion.

4.6.6.6 Low temperature Operation
Fuses shall be mounted by their terminals in suitable sockets or soldered to test boards in accordance with paragraph 4.6.1.1, and then placed in a low temperature chamber. The chamber temperature shall be lowered gradually to -55°3°C within a period of 1 hour. After stabilizing at the low temperature for a period of 1 hour, rated DC current shall be applied to the fuses for a period of 4+<sup>1</sup> hours while at the low temperature. The chamber shall then be gradually raised to room temperature within a 4 hour period and maintained at room temperature for a period of 8 hours minimum. After this time, the DC current shall be removed from the fuses and the fuse removed.
from the chamber. The resistance of the fuses shall be measured before and after the test in accordance with paragraph 4.6.4.2.

4.6.6.7 Thermal Vacuum
The resistance of each fuse shall be measured before test in accordance with paragraph 4.6.4.2. Fuses shall be mounted in suitable mount sockets or soldered to test boards in accordance with paragraph 4.6.1.1. The fuses shall then be placed in a vacuum chamber and the chamber is evacuated to a pressure of 6.67x10⁻³ Pa or less. The temperature of the fuse mount shall be controlled such that the temperature of the fuses, measured with a thermocouple mounted on the fuse body, is maintained at +125±3°C for a period of 48±4 hours, while 90% of the +25°C rated current is flowing through each fuse. At the end of the 48 hour exposure and while the fuses are at the test temperature and pressure, half of the samples shall be given an overload current at 400 percent of their rated current using the procedure specified in paragraph 4.6.4.5. The resistance of the fuses shall be measured in accordance with paragraph 4.6.4.7. The fuses shall then be removed from the chamber and the remaining fuses (not blown) measured for resistance in accordance with paragraph 4.6.4.2. After completion of the test, the fuses shall be visually inspected with a magnifier of 10X or greater for evidence of arcing or mechanical damage.

4.6.6.8 Resistance to Solvents
Fuses shall be tested in accordance with Method 215 of MIL-STD-202.

4.6.7 Durability Performance

4.6.7.1 Steady-State Life
Fuses shall be mounted by their terminals in suitable sockets or soldered to test boards in accordance with paragraph 4.6.1.1, and then placed in a chamber at +125±3°C ambient. The fuses shall be electrically connected to a DC source and applied 64 percent of the +25°C rated current for 2,000±8 hours. The power supply shall be adjusted to make the recovery voltage conforms to the rated DC voltage of the fuses. The electrical circuit shall provide a suitable indicator, which shall be monitored daily during the length of the life test, to identify failure (blowing) of any fuse. The time of failure shall be recorded to the nearest ±12 hours and the blown fuse replaced with a short circuit for the remainder of the test. The resistance of the fuses shall be measured before and after test in accordance with paragraph 4.6.4.2.

4.7 Long-Term Storage

4.7.1 Handling of Products Stored for a Long-Term at the Manufacturer’s Site
When fuses have been stored at the manufacturer’s site for 24 months or longer after the Group A inspections of the quality conformance inspection, the manufacturer shall perform 100% inspection for the following test items prior to delivery. Only the fuses which have passed the inspections can be shipped as products.
a) Resistance (see paragraph 3.8.2)
b) External and marking (see paragraph 3.5.1)

If a fuse fails to the sample inspection performed as specified in Tables 5 and 6 for A4 tests (current-carrying capacity, dielectric withstanding voltage, overload interrupt, insulation resistance) and A6 test (solderability) of Group A inspection or B4-1 test (resistance to soldering heat) of Group B inspection, the products in the same lot shall not be delivered. Date of re-inspection shall be marked on the package or storage box.

4.7.2 Storage by Purchasers
Instructions for storage by purchasers shall be as specified in the detail specification.

4.8 Change to Tests and Inspections
Any change in the in-process inspection and quality conformance inspection specified in this specification shall be made in accordance with paragraphs 4.4 and 6.1 of JAXA-QTS-2000.

5. PREPARATION FOR DELIVERY
Preparation for delivery shall be as follows and as specified in Section 5 of JAXA-QTS-2000.

5.1 Packaging
The fuses shall be appropriately packaged as high reliability parts for delivery from the manufacturer to the purchaser.
a) Unit packaging
   Fuses shall be properly packaged with an appropriate unit of 5, 10 or 20 pieces.
b) Whole packaging
   Individually packaged fuses shall be placed in a container with cushioning materials to protect the products. Additional requirements for packaging shall be specified in procurement documents, if required.

5.2 Marking on Package
Each shipping package shall have the following markings.
a) Part name
b) Part number
c) Applicable specification number
d) Lot identification code
e) Purchaser’s name
f) Manufacturer’s name
g) Quantity of packages
h) Date of inspection
i) Inspection result
6. NOTES

6.1 Notes for Manufacturer

6.1.1 Preparation and Registration of Application Data Sheet
The manufacturer shall prepare the Application Data Sheet in accordance with Appendix G of JAXA-QTS-2000 and register it with JAXA.

6.2 Notes for Purchasers
Refer to the Application Data Sheet for the detailed data of the products and notes.

6.2.1 Items to be Specified for Procurement
To purchase fuses manufactured in compliance with this specification, the purchaser shall provide the following information.

a) Part number
b) This specification number
c) Detail specification number
d) Indication of test data or source inspection results to be submitted for delivery
e) Others
For item e), requirements other than those defined in this specification may be specified for special applications. However, if the requirements conflict with the existing requirements in this specification, the purchaser shall not request that the manufacturer indicate that the fuses comply with this specification.