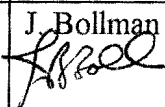


REVISIONS

| SYMBOL | DESCRIPTION | DATE | APPROVAL |
|---------------|--|-------------------|---|
| - A | Original Release Change Tables II,III,IV and V, and format change | 9/1/96 4/12/96 | J. Bollman  |

SHEET REVISION STATUS

| | | | | | | | | | | | | | | | | | | | | |
|-----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|
| SH | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 |
| REV | A | A | A | A | A | A | A | A | A | A | A | A | A | | | | | | | |
| SH | 21 | 22 | 23 | 24 | 25 | 26 | 27 | 28 | 29 | 30 | 31 | 32 | 33 | 34 | 35 | 36 | 37 | 38 | 39 | 40 |
| REV | | | | | | | | | | | | | | | | | | | | |

| | | |
|---|------------------------|--|
| ORIGINATOR: G. R. Cluff | DATE 8/30/95 | FSC: 5905 |
| APPROVED: S. Archer-Davies | 8/30/95 | PROCUREMENT SPECIFICATION FOR HERMETICALLY SEALED RESISTOR NETWORKS, BASE SPECIFICATION |
| CODE 311 APPROVAL: Michael J. Sampson | 8/31/95 | |
| ADDITIONAL APPROVAL: Jim Lohr | 8/31/95 | S-311-P-799 |

**NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
GODDARD SPACE FLIGHT CENTER
GREENBELT, MARYLAND 20771
CAGE CODE: 25306**

1.0 SCOPE

- 1.1 Scope. This specification details the procurement requirements for fixed, metal film, low TC, precision resistor networks. Two quality assurance levels are provided, level K and level H.

This specification and the individual device slash sheet, provide the complete device procurement requirements.

- 1.2 Goddard part number. The part number for the device shall be defined as follows.

| <u>Goddard designator</u> | <u>Slash sheet number</u> |
|---------------------------|---|
| 311P799- | 01X where "X" represents "K" or "H" quality assurance level (see para. 4.6 and 4.8) |

- 1.2.1 Specification Slash Sheet. The specification slash sheet defines the individual device mechanical configuration and electrical performance characteristics.

2. APPLICABLE DOCUMENTS

- 2.1 Documents. The following documents, of the issue in effect on the date of invitation for bids or request for proposal, form a part of this specification to the extent specified herein.

SPECIFICATIONS

| | |
|---------------|---|
| MIL-I-45208 | Inspection System Requirements. |
| MIL-R-83401 | Resistor Networks, Fixed, Film, General Specification For |
| MIL-PRF-38534 | Hybrid Microcircuits, General Specification For |

STANDARDS

| | |
|---------------|--|
| MIL-STD-883 | Test Methods and Procedures for Microelectronics |
| MIL-STD-45662 | Calibration System Requirements |

OTHER PUBLICATIONS

| | |
|------------|--|
| ASTM E 595 | Total Mass Loss and Collected Volatile Condensable Materials from Outgassing in a Vacuum Environment, Standard Test Method for |
|------------|--|

- 2.2 Order of precedence. In the event of any conflict between the text of this specification and the references cited herein, the text of this specification shall take precedence. However, nothing in this text shall supersede applicable laws and regulations unless a specific exemption has been obtained.

- 2.3 Copies of documents. Copies of federal and military documents can be obtained from the Standardization Document Order Desk, 700 Robbins Avenue, Building #4-Section D, Philadelphia, PA 19111-5094. Copies of ASTM publications are available from the American Society for Testing and Materials, 1916 Race Street, Philadelphia, PA 19103.

3. REQUIREMENTS

- 3.1 Item requirements. The individual item shall meet the requirements of MIL-STD-883, MIL-PRF-38534, MIL-R-83401, and the individual item slash sheet, to the extent specified herein.

- 3.2 Qualification. Resistors furnished to this specification shall be product which has been granted qualification approval by NASA/GSFC. Qualification approval shall be based on the following criteria.

- 3.2.1 Design and source approval. Prior to qualification, the manufacturer's facility shall be subjected to survey at the option of GSFC, by the Office of Flight Assurance, GSFC. Compliance with MIL-I-45208 is required. In addition, the history and detailed engineering of the specific resistor design will be reviewed, as will the documented manufacturing and quality control procedures.

Only those sources approved in the design and source approval phase shall be eligible for qualification or award of contract under this specification. Source approval and design approval do not constitute part qualification or an equivalent thereof.

- 3.2.2 Part qualification. Resistor product granted qualification shall be that which has passed the qualification inspection requirement of this specification. This requirement may be satisfied by passing the qualification inspection specified in Section 4.

- 3.3 Markings. The resistor networks shall be permanently and legibly marked in accordance with MIL-PRF-38534. The markings shall include the following instructions:

- a. Manufacturer's identification or symbol.
- b. GSFC part number (see para. 1.2)
- c. Manufacturer's lot number.
- d. Manufacturer's date code (year and week of final seal).
- e. Serial number
- f. Pin identifier.

- 3.4 Design, construction, and physical dimensions. Resistor networks shall be of

the design, construction, and physical dimensions specified herein. Each network shall consist of film type, resistance elements in a hermetically sealed package with external terminations.

- 3.4.1 Physical dimensions. The resistor networks shall be as defined by the package outline detailed in the individual slash sheet.
- 3.4.2 Schematic. The resistance elements shall be as defined by the individual slash sheet.
- 3.4.3 Materials. All materials shall meet the requirements of MIL-PRF-38534 and MIL-R-83401.
- 3.4.4 Thermal Vacuum Outgassing. Externally exposed materials must meet outgassing requirements of 1.0% total mass loss (TML) maximum and 0.1% collected volatile condensable materials (CVCM) maximum when tested in accordance with ASTM E 595. Materials listed in NASA Reference Publication 1124 that meet these requirements do not require further testing.
- 3.4.5 Lead material. The lead material shall meet the requirements of MIL-PRF-38534.
- 3.4.6 Lead finish. The lead finish shall be gold plate and shall meet the requirements of MIL-PRF-38534.
- 3.4.7 Package. All devices supplied under this specification shall be hermetically sealed in a combination ceramic and metal package. All organic or polymeric materials used inside the package, shall have been tested and passed the requirements of MIL-STD-883, method 5011, unless previously approved by GSFC.

Unless otherwise specified, the package shall be capable of meeting the inspection requirements of MIL-PRF-38534.

Particle getter material shall not be used inside the package for level K devices.

3.5 Electrical

- 3.5.1 Power rating. The resistance element and total power rating are as specified in the individual device slash sheet and are based on continuous full load operation at an ambient temperature of 125°C linearly derated to 0 at +175°C, or as specified in the individual slash sheet.
- 3.5.2 Voltage rating. Each resistance element shall have a D.C. continuous

working voltage or an approximate sine wave root-mean-square (RMS) continuous working voltage corresponding to the wattage (power) rating as determined by the following formula:

$$V = \sqrt{PR}$$

Where:

V = Continuous rated DC or RMS working voltage in volts.

P = Rated wattage in watts.

R = Nominal resistance in ohms.

In no case shall the continuous working voltage for each resistance element exceed the DC or AC RMS value specified in the individual slash sheet.

- 3.5.3 Electrical performance characteristics. The electrical performance characteristics for the resistor network are as specified in Table II and the individual device slash sheet.
- 3.6 Data packet. The following data shall be shipped with each lot of devices:
- a. Certificate of conformance. A certificate of conformance in accordance with MI-PRF-38534 shall be provided with each lot of networks delivered to this specification.
 - b. Test data (variables, attribute, burn-in circuit, deltas, and X-ray) shall be provided.
- 3.7 Notification of change. Notification of change to GSFC shall be required in accordance with MIL-PRF-38534.
- 3.8 Verification and review. GSFC retains the option to review the manufacturer's facility and applicable documentation. Documentation shall be made available at the option of the reviewer. Pre-ship inspection is the option of GSFC and requires one week advance notice from the vendor for scheduling.
- 3.9 Workmanship. Resistors shall be processed in such a manner to be uniform in quality when inspected to the requirements of this drawing. Resistors shall also be free of any defects affecting life, serviceability or performance.
4. QUALITY ASSURANCE PROVISIONS
- 4.1 Sampling and inspection. Sampling and inspection procedures shall be in accordance with MIL-PRF-38534 to the extent specified herein. Two levels of quality assurance, level K and H, are provided.

4.2 Responsibility for inspection. The manufacturer is responsible for the performance of all inspection requirements, as specified herein, using his own or any other suitable facility acceptable to Goddard Space Flight Center. Upon receipt of product, Goddard reserves the right to perform any of the inspections set forth in the specification where such inspections are deemed necessary to verify conformance to prescribed requirements.

4.2.1 Test equipment and inspection facilities. Test equipment and inspection facilities shall be of sufficient accuracy, quality, and quantity to permit performance of the required inspection. The manufacturer shall establish and maintain a calibration system for all instrumentation in accordance with the requirements of MIL-STD-45662.

4.2.2 Customer source inspection (CSI). GSFC, at their option, may perform customer source inspection at the following process steps:

- a. Internal precap visual inspection. The manufacturer shall make available all documentation associated with the requirements of this specification.
- b. Final inspection and data review prior to shipment. A GSFC representative may perform final inspection, review all process documentation and test data, and authorize shipment of the devices to GSFC. The manufacturer shall make available adequate records indicating process flow, inspection requirements, and all data taken on each device. Recorded test data shall be traceable to each serialized device.
- c. Audit. A GSFC representative may perform an audit during any portion of the screening and quality conformance tests.

The manufacturer shall notify GSFC Purchasing at least forty-eight (48) hours prior to the start of the above steps. If GSFC has elected to participate in a CSI, the testing and inspection shall not proceed without the presence of the GSFC representative, or without a documented authorization to proceed.

4.2.3 Authorization to ship devices. Devices shall be shipped to GSFC only with the authorization of a GSFC representative upon the successful completion of the provisions of 4.2.2.

4.3 Inspection system. The manufacturer shall have an inspection system that complies with MIL-I-45208.

- 4.4 Classification of inspection. Inspection requirements specified herein are classified as follows:
- a. Process control (see para. 4.5)
 - b. Screening (see para. 4.6)
 - c. Qualification inspection (see para. 4.7)
 - d. Quality conformance inspection (see para. 4.8)
 - e. Package evaluation (Group D inspections per Table V herein)
- 4.5 Process controls. Process controls shall be performed in accordance with MIL-PRF-38534, para. C.4.1
- 4.6 Screening. Screening tests consists of the tests and inspections specified in Table I for the quality level (K or H) as defined by the part number (see para. 1.2 herein) and shall be performed in the order shown on each device supplied to this drawing. Test procedures shall be in accordance with MIL-PRF-38534, para. 3.4.4 to the extent specified herein.
- 4.7 Qualification inspection. Qualification inspection shall be performed on the initial lot of devices and for any major change in the process as defined in MIL-PRF-38534, or as required by GSFC. Qualification inspections shall consist of the 100% screening specified in Table I, and the QCI inspection specified in para. 4.8 herein. Devices furnished to this screening and lot acceptance testing shall be considered qualified.
- 4.8 Quality conformance inspection (QCI) Quality conformance inspection shall be in accordance with MIL-PRF-38534, including groups A, B, C and D inspections. The following additional criteria shall apply. Samples for electrical tests shall be selected from the devices satisfactorily completing the 100% screening requirements of para. 4.6. The two quality levels, K and H are defined in Tables I and IV.
- 4.8.1 Group A inspection. Group A inspection shall be in accordance with Table II herein. Testing shall be in the order shown. Group A inspection shall be performed on each lot of devices delivered to the requirements of this drawing.
- 4.8.2 Group B inspection. Group B inspection shall be in accordance with Table III herein. Electrical rejects or test vehicles shall be used (if available) for all subgroups. Group B inspection shall be performed on each lot of devices delivered to the requirements of this drawing.

4.8.3 Group C inspection. Group C inspection shall be in accordance with Table IV herein. Samples selected shall have passed the screening tests and Group A inspections. Group C shall be performed only on the first inspection lot and as required to evaluate or qualify design changes.

4.8.4 Group D inspection. Group D inspection shall be in accordance with Table V herein. This inspection shall be performed on the first inspection lot submitted and at intervals not exceeding 26 weeks for additional inspection lots. Sealed empty packages that have been subjected to the handling and stress conditions of screening may be used for Group D testing.

4.9 Disposition of Group B, Group C and Group D inspection sample units. Sample units which have been subjected to Group B, Group C or Group D inspection shall not be delivered as a part of the quantity on the purchase order. They shall be suitably marked (permanent marking) as Group B, Group C or Group D inspection sample units, identified as to the purchase order, and forwarded to GSFC with all test data.

4.10 Failures in Group B, Group C, and Group D inspection. If a sample fails to pass Group B, Group C or Group D inspection, action shall be taken immediately to determine whether an accumulation of design and/or process changes has adversely affected the devices from current production. Devices represented by the sample and all other devices fabricated with the same materials and processes, shall not be offered for acceptance or shipped to GSFC until the cause of the failure has been determined and the corrective action has been concurred with by GSFC. After corrective action has been taken and additional samples have passed the failed inspection, acceptance inspection may be reinstated.

4.11 Accept/reject criteria. Devices that do not meet the specified requirements for each test shall be rejected. Rejected parts shall not be delivered as a part of the quantity on the purchase order.

The failure of any single group to meet its required accept criteria shall be cause for rejection of the lot. GSFC reserves the right to designate additional inspection tests and to accept or reject the lot based on the results of these tests.

4.12 Failure analysis of failures. All catastrophic failures (open or shorted failure modes) occurring during acceptance inspection shall be subjected to a failure analysis to determine the cause of failure. Devices that exhibit significant shifts in electrical parameters shall be candidates for analysis. The analysis shall be accomplished in detail to the extent necessary so that corrective action can be

implemented in production, testing, or application to eliminate recurrences of the failure. A detailed report of each failure shall be submitted to GSFC for review and approval.

- 4.13 Inspection report. Qualification test data and the qualification test samples shall be submitted to the following activity:

NASA/GSFC
Greenbelt, MD 20771
Attn: QPLD Administrator
Code 311

5. PACKAGING

- 5.1 Packaging requirements. The requirements for packaging shall be in accordance with MIL-PRF-38534

6. NOTES

- 6.1 Intended use. Resistor networks conforming to this drawing are intended for use in space application.
- 6.2 Ordering data. Acquisition documents should specify the following:
- Number, title, and date of this specification.
 - Goddard part number
 - Quantity
- 6.3 NOTICE. When GSFC drawings, specifications, or other data are sent for any purpose other than in connection with a definitely related GSFC procurement operation, the United States Government thereby incurs no responsibility nor any obligation whatsoever. The fact that GSFC might have formulated, furnished or in any way supplied the said drawings, specifications, or other data is not to be regarded by implication or otherwise as in any manner licensing the holder or any person or corporation, or conveying any right or permission to manufacture, use or sell any patented invention that may in any way be related thereto.

Custodian:

Code 311.2
Goddard Space Flight Center
Greenbelt, MD 20771

Table I. 100% screening

| Test/Inspection | Processing Level (1) | | MIL-STD-883 (3) | |
|-----------------------------|----------------------|---|-----------------|--|
| | K | H | Method | Conditions |
| Nondestructive bond pull | X | - | 2023 | |
| Internal visual | X | X | 2017, 2032 | |
| Stabilization bake | X | X | 1008 | C, T _A =150°C, t = 24 hour |
| Temperature cycling | X | X | 1010 | C, 10 cycles |
| Constant acceleration | X | X | 2001 | A, Y1 axis only |
| PIND | X | X | 2020 | A |
| Serialize | X | - | | |
| Initial electrical tests | X | X | | DC resistance, see Table II, read and record |
| Burn-in | X | X | 1015 | T _A = 125°C, t = 240 hrs (4) |
| Final electrical test | X | X | | See Table II, read and record DCR, calculate delta DCR. delta DCR = ±0.7% |
| PDA calculation | X | X | 5004 | 2% or 1 device for K level 10% or 1 device for H level (DCR and delta DCR are used in PDA calculation) |
| Seal a. Fine b. Gross | X | X | 1014 | A, ≤ 5 x 10 ⁻⁸ atm. cc/sec C |
| Radiographic (2) | X | - | 2012 | 2 views 90° apart |
| External visual | X | X | 2009 | |

- (1) The screening level (K or H) is determined by the part number defined in para. 1.2 herein.
- (2) X-ray plates or films for each view shall be provided as variables data.
- (3) Methods and procedures are as defined in Table X of MIL-PRF-38534.
- (4) Adjust bias to each resistor so that the power dissipation reaches the maximum value specified in the individual slash sheet for 125°C. Bias conditions and test figures shall be included in the data package.

Table II. Final Electrical and Group A inspection requirements.

| Subgroup | Test | MIL-R-83401 Method | MIN | MAX | Unit | Quantity/ acc. no |
|---|---------------------------------------|---------------------|-----|-----|---------|-------------------|
| FINAL ELECTRICAL TEST PARAMETERS | | | | | | |
| 1 | Dielectric Withstanding Voltage (DWV) | para. 4.6.12 (2) | | (1) | (1) | 100% |
| 2 | Insulation Resistance | para. 4.6.13 (2) | | (1) | (1) | 100% |
| 3 | DC Resistance (1) | para. 4.6.5 | - | (1) | ±% | 100% |
| GROUP A INSPECTION PARAMETERS | | | | | | |
| 4 | Temperature Coefficient of Resistance | para. 4.6.8 | - | (1) | ±ppm/°C | 5(0) |
| | Short Time Overload | para. 4.6.10 | - | (1) | (1) | |

- (1) The test limits as defined in the individual network slash sheet.
 (2) Measured with leads connected together - to - package case.

Table III. Group B Inspection

| Subgroup | Test (1) | MIL-STD-883 method | Condition | Quantity/ acc. no. |
|----------|---------------------------------------|--------------------|---|--------------------|
| 1 | Physical Dimensions | 2016 | | 2(0) |
| | Solderability | 2003 | | |
| | Resistance to Solvents | 2015 | | |
| | Internal Visual and (2) Mechanical | 2014 | | |
| | Wire Bond Strength | 2011 | | |
| 2 | Internal Water Vapor Content | 1018 | T _A =+100°C, 3000 ppm max. | 5(0) |

- (1) Test requirements are as defined in MIL-PRF-38534, para. C.6.3.2 for Group B, Option 1, inspection.
 (2) See para. C.6.3.2e of MIL-PRF-38534 for test requirements and sample selection.

Table IV. Group C Inspection

| Sub-group | Test (1) | MIL-STD-883 method | Condition | Quantity/acc no. |
|-----------|---------------------------------------|--------------------|---|------------------|
| 1 | External Visual | 2009 | | 5(0) |
| | Temperature Cycling | 1010 | C, 20 Cycles | |
| | Constant acceleration | 2010 | A1, Y1 axis | |
| | Shock | 2002 | B | |
| | Vibration | 2007 | A | |
| | PIND (2) | 2020 | A | |
| | Seal a. Fine b. Gross | 1014 | A, $\leq 5 \times 10^{-8}$ atm cc/sec C | |
| | Radiographic | 2012 | Y axis | |
| | Visual Examination | 2009 | | |
| | End Point Electrical Test | | DC resistance, see Table I, read and record, calculate deltas. delta DCR = $\pm 0.7\%$ | |
| 2 | Steady-state Life | 1005 | 2000 hrs at $T_A = +125^\circ\text{C}$ | 5(0) |
| | Interim and End Point Electrical Test | | DC resistance, see Table I, read and record, calculate deltas. readouts at 250, 500, 750, 1000, 1500, and 2000 hours. delta DCR = $\pm 0.7\%$ | |

- (1) Test requirements are as defined in MIL-PRF-38534, para. C.6.3.3, for Group C, Option 1 inspection.
- (2) PIND may be performed any time after Vibration.
- (3) The processing level (K or H) is determined by the part number specified in para. 1.2 herein.

Table V. Group D Inspection (package related tests)

| Test (1) | MIL-STD-883 method | Condition | Quantity/ acc no. |
|-----------------------------|--------------------|---|-------------------|
| Thermal Shock | 1011 | C | 5(0) |
| Stabilization Bake | 1008 | T _A = +150°C, t = 24 hr | |
| Seal a. Fine b. Gross | 1014 | A, ≤ 5 x 10 ⁻⁸ atm cc/sec C | |
| Lead Integrity | 2004 | B2 | |

(1) Test requirements are as defined in MIL-PRF-38534, para. C.6.4.4, for Group D inspection.