



National Aeronautics and
Space Administration

INCH-POUNDS

MSFC-SPEC-708
REVISION A
EFFECTIVE DATE: August 1, 2007

George C. Marshall Space Flight Center
Marshall Space Flight Center, Alabama 35812

EI42

SPECIFICATION FOR IDENTIFICATION MARKERS FOR SPACE SYSTEMS ELECTRICAL HARNESSES

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MSFC - Form 454 (Rev. October 1992)

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| Multiprogram/Project Common-Use Document EI42 | | |
| Title: Specification for Identification Markers for Space System Electrical Harnesses | Document No.: MSFC-SPEC-708 | Revision: A |
| | Effective Date: August 1, 2007 | Page Page 2 of 13 |

DOCUMENT HISTORY LOG

| Status (Baseline/ Revision/ Canceled) | Document Revision | Effective Date | Description |
|--|----------------------|-------------------|--|
| Baseline | - | 07/1/1981 | Initial release |
| Revision | A | 08/01/07 | Revised document throughout so that all requirements state "shall" to satisfy CAITS action #04-DA01-0387 |
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| Multiprogram/Project Common-Use Document EI42 | | |
|---|--------------------------------|-------------------|
| Title: Specification for Identification Markers for Space System Electrical Harnesses | Document No.: MSFC-SPEC-708 | Revision: A |
| | Effective Date: August 1, 2007 | Page Page 3 of 13 |

1. SCOPE

1.1 General – This specification covers the requirements for identification markers for use on space systems electrical cable harnesses.

1.2 Applicability – The identification markers are intended for use on electrical cable harnesses utilized in space systems both inside crew compartments and exposed to the outside space environment over the temperature range of -55°C to +200°C. The identification markers may also be used at temperatures down to -173°C if they are not subjected to flexing.

1.3 Types – The identification markers shall be furnished in two types as defined below:

Type I – Tie-on markers for use on .25-inch and larger diameter cables and cable harnesses.

Type II – Heat shrinkable markers for use on .45-inch and smaller diameter cables and cable harnesses.

1.4 Classes – Type I markers shall be furnished in two classes and Type II markers shall be furnished in six classes as defined below:

Type I:

| <u>Class</u> | <u>Cable Diameter Range (Inch)</u> |
|--------------|------------------------------------|
| 1 | .25 - .50 |
| 2 | .50 and larger |

Type II:

| <u>Class</u> | <u>Cable Diameter Range (Inch)</u> |
|--------------|------------------------------------|
| 1 | .035 - .080 3/32 |
| 2 | .075 - .110 1/8 |
| 3 | .100 - .150 3/16 |
| 4 | .135 - .215 1/4 |
| 5 | .200 - .300 3/8 |
| 6 | .260 - .450 1/2 |

2. APPLICABLE DOCUMENTS

2.1 The following documents form a part of this specification to the extent specified herein. Unless otherwise indicated, the issue in effect on date of invitation for bids or request for proposals shall apply.

| | | |
|--|---------------------------------------|--------------------------|
| Multiprogram/Project Common-Use Document | | |
| EI42 | | |
| Title: Specification for Identification Markers for Space System Electrical Harnesses | Document No.: MSFC-SPEC-708 | Revision: A |
| | Effective Date: August 1, 2007 | Page Page 4 of 13 |

SPECIFICATIONS

FEDERAL

TT-I-735 Isopropyl Alcohol

DEPARTMENT OF DEFENSE (DOD)

MIL-I-23053 Insulation Sleeving, Heat Shrinkable
MIL-L-23699 Lubricating Oil, Aircraft Engine, Synthetic Base
MIL-M-81531 Marking of Electrical Insulation Materials
MIL-H-83282 Hydraulic Fluid, Fire Resistant Synthetic Hydrocarbon Base, Aircraft
MIL-T-43435B Tape, Lacing, Teflon, Type III

STANDARDS

DOD

MIL-STD-104 Limits For Electrical Insulation Color
MIL-STD-202 Test Methods for Electronic and Electrical Compound Parts

PUBLICATIONS

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION (NASA)

NHB 8060.1 Flammability, Odor, and Offgassing and Test Procedures for Materials in Environments that Support Combustion

LYNDON B. JOHNSON SPACE CENTER (JSC)

SP-R-022 Vacuum Stability Requirements of Polymeric Material for Spacecraft Application

3. REQUIREMENTS

3.1 Material – Identification markers shall be manufactured from modified polyvinylidene fluoride. Identification markers shall be free from pin holes, cracks, or inclusions.

3.1.1 Color – Identification markers shall be opaque white in accordance with MIL-STD-104, Class II.

3.1.2 Size – Type I identification markers shall be furnished in the sizes specified in Figure 1 with a nominal thickness of .025 inch. Typical designations are shown. Actual designations

CHECK THE MASTER LIST VERIFY THAT THIS IS THE CORRECT VERSION BEFORE USE

| Multiprogram/Project Common-Use Document EI42 | | |
|---|--------------------------------|-------------------|
| Title: Specification for Identification Markers for Space System Electrical Harnesses | Document No.: MSFC-SPEC-708 | Revision: A |
| | Effective Date: August 1, 2007 | Page Page 5 of 13 |

shall be as specified in the ordering data when applicable. Type II identification markers shall be furnished in the sizes specified in Table I.

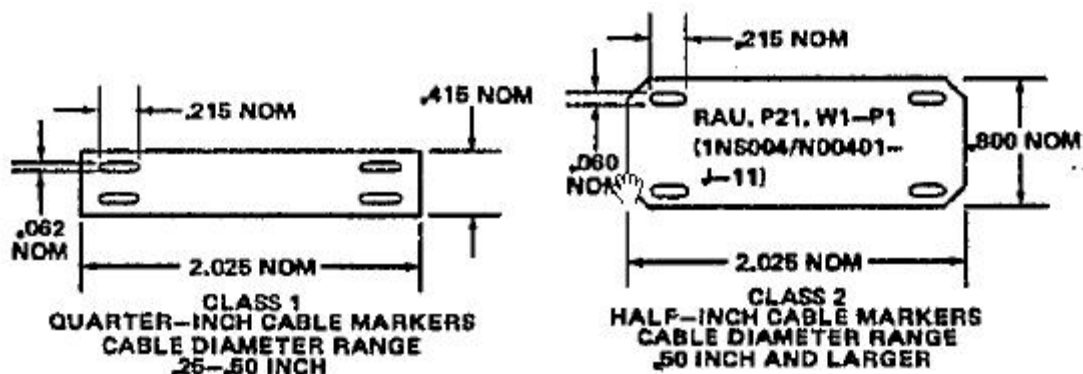


FIGURE 1. TYPE I IDENTIFICATION MARKERS

*15-character markable length max./2 lines *15-character markable length max./3 lines

*Based on 12 characters per inch

TABLE I.

| Class | Wire or Cable Diameter Range | | Markable Length* Characters | Installed Sleeve Length (Nom) | As-supplied Inside Diameter (Min) | Recovered Inside Diameter (Max) | Recovered Wall Thickness | |
|-------|------------------------------|------|-----------------------------|-------------------------------|-----------------------------------|---------------------------------|--------------------------|------|
| | Min | Max | | | | | Min | Max |
| 1 | .035 | .080 | 18 | 1.5 | .093 | .031 | .013 | .019 |
| 2 | .075 | .110 | 18 | 1.5 | .125 | .062 | .010 | .016 |
| 3 | .100 | .150 | 18 | 1.5 | .187 | .093 | .012 | .018 |
| 4 | .135 | .215 | 18 | 1.5 | .250 | .125 | .012 | .018 |
| 5 | .200 | .300 | 18 | 1.5 | .375 | .187 | .012 | .018 |
| 6 | .260 | .450 | 18 | 1.5 | .475 | .250 | .012 | .018 |

*Based on 12 characters per inch.

3.1.3 Properties - The properties of the identification markers shall comply to the Table II.

CHECK THE MASTER LIST VERIFY THAT THIS IS THE CORRECT VERSION BEFORE USE

| Multiprogram/Project Common-Use Document EI42 | | |
|---|--------------------------------|-------------------|
| Title: Specification for Identification Markers for Space System Electrical Harnesses | Document No.: MSFC-SPEC-708 | Revision: A |
| | Effective Date: August 1, 2007 | Page Page 6 of 13 |

TABLE II.

| Property | Requirement | Test Method |
|------------------------------|--|-------------|
| Dimensions | Paragraph 3.1.2 | 4.3 |
| Recovered Dimensions Type II | Paragraph 3.1.2 | 4.3 |
| Odor and Offgassing | Compliance with NHB 8060.1 | 4.4 |
| Thermal Vacuum Stability | Compliance with SP-R-0022 | 4.5 |
| Flamability | Compliance with NHB 8060.1 | 4.6 |
| Marking Adherence | MIL-M-81531, except number of rubs across marking shall be 100 (minimum) | 4.7 |
| Fluid Resistance | Paragraph 3.1.4 | 4.8 |
| High Temperature Resistance | Paragraph 3.1.5 | 4.9 |
| Thermal Shock | Paragraph 3.1.6 | 4.10 |
| Split Resistance | Paragraph 3.1.7 | 4.11 |

3.1.4 Fluid Resistance – After being subjected to the fluid immersions and marking adherence tests specified in paragraph 4.8, marking shall remain legible and the identification markers shall show no evidence of cracking or swelling.

3.1.5 High-temperature Resistance – After being subjected to the conditions specified in paragraph 4.9, marking shall remain legible and the identification marker specimens shall show no evidence of cracking.

| Multiprogram/Project Common-Use Document EI42 | | |
|---|--------------------------------|-------------------|
| Title: Specification for Identification Markers for Space System Electrical Harnesses | Document No.: MSFC-SPEC-708 | Revision: A |
| | Effective Date: August 1, 2007 | Page Page 7 of 13 |

3.1.6 Thermal Shock – After being subjected to the conditions specified in paragraph 4.10, marking shall remain legible and the identification marker specimens shall show no evidence of cracking.

3.1.7 Split Resistance – After marking and when examined in accordance with paragraph 4.11, the specimens shall show no evidence of splitting or cracking.

3.1.8 Workmanship – The identification markers shall show evidence of good workmanship and shall be free from manufacturing imperfections or defects which would adversely affect their serviceability. Small localized discolorations are permissible. Note it is allowable to trim square or sharp corners to create a radius.

4. VERIFICATION

4.1 Certification – The manufacturer shall have the responsibility for certifying that the identification markers furnished meet all requirements specified herein. A certificate of compliance shall be submitted to the procuring activity covering each type of identification marker manufactured at one time and under the same conditions.

4.2 Visual – Conformance to the workmanship requirements of paragraph 3.1.8 shall be determined by visual inspection.

4.3 Dimensional – Dimensions of Type I identification markers shall be determined with a micrometer having an accuracy of ± 10 percent of the measured value. Dimensions of Type II identification markers shall be determined in accordance with Table I. Specimens used to determine recovered dimensions shall be conditioned in a circulating air oven at a temperature of $200 \pm 5^\circ\text{C}$ for a minimum of three minutes. Dimensions shall conform to paragraph 3.1.2.

4.4 Odor and Offgassing – Odor tests shall be performed in accordance with Test No. 6 of NHB 8060.1. Offgassing tests shall be performed in accordance with Test No. 7 of NHB 8060.1. Requirements of paragraph 3.1.3 shall be met.

4.5 Thermal Vacuum Stability – Thermal vacuum stability tests shall be performed in accordance with SP-R-0022. Requirements of paragraph 3.1.3 shall be met.

4.6 Flammability – The flammability tests shall be performed in accordance with Test No. 1 of NHB 8060.1. Requirements of paragraph 3.1.3 shall be met.

4.7 Marking Adherence – Marking adherence tests shall be performed in accordance with the applicable portions of MIL-M-81531. Specimens shall comply with requirements of paragraph 3.1.3. Specimens for the marking adherence tests shall be marked using a special purpose IBM Selectric II typewriter or equivalent with a Courier 12 type element, using a Tech III ribbon with appropriate platen/deflector. The marked specimens shall be passed through a TMS-208

| Multiprogram/Project Common-Use Document EI42 | | |
|---|--------------------------------|-------------------|
| Title: Specification for Identification Markers for Space System Electrical Harnesses | Document No.: MSFC-SPEC-708 | Revision: A |
| | Effective Date: August 1, 2007 | Page Page 8 of 13 |

permatizer or equivalent. Marking equipment is available from Raychem Corporation, 300 Constitution Drive, Menlo Park, California 94025.

4.8 Fluid Resistance – Identification marker specimens marked in accordance with paragraph 4.7 shall be immersed in each of the fluids (separate specimens for each fluid) listed below for the period and at the temperature specified.

- (1) In TT-I-735, Isopropyl Alcohol for 20 hours minimum at 20 to 25°C.
- (2) In MIL-L-23699, Lubrication Oil, for 7 hours minimum at $175 \pm 2^\circ\text{C}$.
- (3) In MIL-H-83282, Hydraulic Fluid, for 20 hours minimum at 48 to 50°C.

Following immersion, the specimens shall be visually examined and subjected to the marking durability test specified in paragraph 4.7. The specimen shall conform to the requirements of 3.1.4.

4.9 High-temperature Resistance – High-temperature resistance tests shall be performed by conditioning identification marker specimens in a circulating air oven at $200 \pm 5^\circ$ for a minimum of 168 hours. Following high-temperature exposure, the specimens shall be removed from the oven and allowed to cool to room temperature. Follow high-temperature exposure, the specimens shall be examined for marking legibility with normal vision and for cracks under 2X magnification. The specimens shall conform to the requirements of paragraph 3.1.5.

4.10 Thermal Shock – Thermal shock tests shall be performed on identification marker specimens in accordance with method 107 of MIL-STD-202, except that low-temperature conditioning shall be performed at -118°C maximum and high-temperature conditioning shall be performed at 200°C minimum. The specimens shall be subjected to a minimum of 5 cycles. Following thermal shock exposure, the specimens shall be visually examined with the unaided eye for marking legibility and under 2X magnification for cracking. The specimens shall conform to the requirements of paragraph 3.1.6.

4.11 Split Resistance – After being marked in accordance with paragraph 4.7, identification marker specimens shall be examined under 2X magnification for cracks or splits. The specimens shall conform to the requirements of paragraph 3.1.7.

5. PACKAGING

5.1 Packaging – The identification markers shall be delivered installed on bandoliers which are compatible with the marking system (See paragraph 4.7.). The identification markers installed on the bandoliers shall be packaged in heat-sealed polyethylene bags and in non-returnable containers which shall protect them from physical, chemical, and environmental damage during

| Multiprogram/Project Common-Use Document EI42 | | |
|--|---------------------------------------|--------------------------|
| Title: Specification for Identification Markers for Space System Electrical Harnesses | Document No.: MSFC-SPEC-708 | Revision: A |
| | Effective Date: August 1, 2007 | Page Page 9 of 13 |

handling, shipment, and storage. Only one type and class of identification marker shall be packaged in the same heat-sealed polyethylene bag.

5.2 Marking – Each bandolier and external package shall be marked with this specification title and number, type, class, and date of manufacture of the identification markers as applicable. Additional marking at the manufacturer’s discretion is permissible.

6. NOTES

6.1 Intended Use – Identification markers described herein are intended for use on space systems electrical cable harness assemblies both inside crew compartments and exposed to the outside space environment over the temperature range of -55°C to +200°C. The identification markers may also be used at temperature down to -173°C provided they are not subjected to flexing at temperatures below -55°C.

6.2 Ordering Data – Procurement documents should specify the following:

- (1) Title, number, and date of this specification.
- (2) Marker Type (See paragraph 1.3.).
- (3) Marker Class (See paragraph 1.4.).
- (4) Marker printed information, if applicable.

6.3 Suggested Source – Based on part testing, usage, and performance of identification markers on other programs, it is suggested that the following manufacturer be considered as a possible source of supply for the identification markers specified herein:

Raychem Corporation
300 Constitution Drive
Menlo Park, California 94025

6.4 Changes – Suggestions for changes or improvements to this document should be directed to the preparing activity listed below.

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|--|---------------------------------------|---------------------------|
| Multiprogram/Project Common-Use Document | | |
| EI42 | | |
| Title: Specification for Identification Markers for Space System Electrical Harnesses | Document No.: MSFC-SPEC-708 | Revision: A |
| | Effective Date: August 1, 2007 | Page Page 10 of 13 |

Preparing Activity

NASA
George C. Marshall Space Flight Center
EI42
Marshall Space Flight Center, AL 35812

| | | |
|--|---------------------------------------|---------------------------|
| Multiprogram/Project Common-Use Document EI42 | | |
| Title: Specification for Identification Markers for Space System Electrical Harnesses | Document No.: MSFC-SPEC-708 | Revision: A |
| | Effective Date: August 1, 2007 | Page Page 11 of 13 |

APPENDIX A

PROCEDURE FOR

INSTALLATION OF IDENTIFICATION MARKERS

A1. SCOPE

A1.1 Appendix A has been prepared as a separate entity to MSFC-SPEC-708 to assist the users of this specification in the installation of the two types of identification markers. Type I is the tie-on type and consists of two sizes (Class 1 and Class 2). Type II is the shrink-on type and consists of six sizes (Classes 1 through 6).

A2. Identification Marker Location. – Identification markers shall be placed as closed to the appropriate connector as practical. In no case shall a connector identification marker be installed more than six inches from the appropriate connector. Circuit class identification markers shall be installed at five-foot intervals along the cable and within six inches of each branch of the cable.

A3. Identification Marker Location Preparation – The harness area shall be cleaned with isopropyl alcohol, wiping clean with either a lint-free cloth or sponge. The lint-free cloth method shall be used in all cases where Type II markers are to be applied. The cleaned area shall be dried with clean, moisture-free air before applying the marker.

A4. Type I or tie-on type identification markers consist of two sizes, Class 1 and Class 2, and are installed as follows.

A4.1 Select the Class 1 or Class 2 as required.

A4.2 Type the applicable nomenclature on the identification marker using IBM typewriter model number 715 with IBM ribbon number 1136108 or an approved equivalent. Typing is best achieved while markers are on bandolier.

A4.3 Permatize the typed markers using Raychem permatizer TMS-208 or an approved equivalent. After permatizing, remove marker from bandolier.

A4.4 After cleaning marker location surfaces as specified in A3 above, select a suitable lacing tape that fulfills the requirements of Table II and MIL-T-43435B as referenced in this specification. To assist in locating and making the first tie-knot, the identification marker may be secured temporarily with any convenient device provided it does not damage or contaminate the harness assembly. Tie-knot shall be permanent and secure to prevent slippage.

CHECK THE MASTER LIST VERIFY THAT THIS IS THE CORRECT VERSION BEFORE USE

| Multiprogram/Project Common-Use Document | | |
|--|---------------------------------------|---------------------------|
| EI42 | | |
| Title: Specification for Identification Markers for Space System Electrical Harnesses | Document No.: MSFC-SPEC-708 | Revision: A |
| | Effective Date: August 1, 2007 | Page Page 12 of 13 |

A4.5 Secure the other end of this marker by repeating the tie operation as in paragraph A4.4 above. Care should be taken to ensure that the identification marker is lying flat and does not twist. (See Figure A-1.)

A4.6 Trim excess lacing tape and remove temporary holding device.

A5. Type II Identification Marker Installation – Type II or shrink-on tubing type markers consist of six (6) sizes or classes. Identification markers shall be installed before attachment of connectors. They are installed as follows.

A5.1 Select the appropriate size shrinkable tubing, material as specified herein, whose expanded and recovered sizes are appropriate to the cable or harness size being covered. (See Table I.)

A5.2 Type the applicable nomenclature on the identification marker as noted in A4.2 above.

A5.3 Permatize as in A4.3 above.

A5.4 After determining marker location and cleaning as noted in A2 and A3 above, slide the selected marker over the cable or harness to the desired location. The marker may be temporarily held in place by mechanical means or by exposing the marker to a brief application of heat. The suggested heat source is a portable hand-held hot air gun or some other convenient regulated heat source.

A5.5 Once the marker is secured in place, the temporary holding device is removed in order to complete the shrinking operation. If the heat is applied properly, the shrinkable marker shall rapidly shrink to a predetermined inside diameter and provide the desired grip-tight mechanical bond. (See Figure A-2.)

A6. Identification Marker Installation Workmanship – The installation workmanship requirements are specified in paragraph 3.1.8 of basic specification.

| Multiprogram/Project Common-Use Document EI42 | | |
|---|--------------------------------|--------------------|
| Title: Specification for Identification Markers for Space System Electrical Harnesses | Document No.: MSFC-SPEC-708 | Revision: A |
| | Effective Date: August 1, 2007 | Page Page 13 of 13 |



Figure A-1 Type I: Tie-on Identification Marker

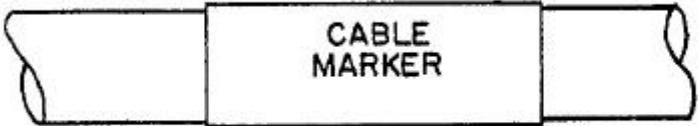


Figure A-2 Type II: Shrink-on Identification Marker