Section I: Design Requirements for Watertight Reusable Cables with Soldered Connectors.

Section II: Design Requirements for Watertight Reusable Cables with Crimped Connectors.

Section III: Design Requirements for Throwaway Cables with Soldered Connectors.

Section IV: Design Requirements for Throwaway Cables with Crimped Connectors.

Section V: Design Requirement for Non-watertight Reusable Cables.

Section VI: Design Requirements for Coax Cables.

VOL. V APPENDIX A
DESIGN REQUIREMENTS FOR CABLES:

Section I: Watertight Reusable Cables with soldered connectors

SRB watertight reusable cables are designed per 10SPC-0166 (Cable Assemblies, Watertight, Reusable, Specification For) for 20 mission capability under conditions encountered from an ocean depth of approximately 125 feet to an altitude of 210,000 feet above sea level. Cables are designed to operate in seawater at 60 psig up to 72 hours, in a temperature range of -48^{O}C (-54^{O}F) to 93^{O}C (200^{O}F), and under worst case SRB vibration requirements as specified in 10SPC-0165 (Connectors, Electrical, Circular Miniature, Underwater, Specification For) and SE-019-049-2H (Vibration, Acoustic and Shock, Design and Test Criteria, for Components on the Solid Rocket Booster). (Open, Short or Loss of Connector)

Cables utilize single conductor wire per MSFC-SPEC-40M39513 (Wire, Electrical, Nickel/Tin plated, TFE Insulated) or MIL-W-22759 and multiconductor cable per MSFC-SPEC-40M39526 or MIL-C-27500 (Cable, Electrical, Nickel/Tin plated Shield, TFE Jacketed). Single conductor wire and multiconductor cable is rated at 600 Volt RMS at a temperature range of -65^{O}C to 260^{O}C. Wire is designed to meet an Insulation Resistance test voltage of 500 VDC for not more than 60 seconds resulting in resistance value of 1000 meg ohm/1000 ft. of wire. Wire is also subjected to dry dielectric test of 2 KV for 60 seconds and for single conductor wire only, a pulse dielectric test of 6.5 KV (single conductor only) for not more than 75 microseconds. (Open or Short)

Connectors are underwater, miniature circular, threaded coupling types that utilize nonremovable solder contacts per 10SPC-0165 (MSFC-SPEC- 16A02980). Connectors are rated to operate up to 200^{O}C. Connector insert arrangements are per MIL-C-38999 (Connectors, Electrical, Circular, Miniature, High Density, Quick Disconnect, Environment Resistant, Removable Crimp and Solder Contacts, General Specification For). Connector exterior shells are corrosion resistant stainless steel per QQ-S-763 class 316 for saltwater exposure. Connector coupling nuts are aluminum bronze 630 per QQ-C-465. Coupling nuts are hex type with lockwire holes to help secure against high vibration environments. (Open, Short or Loss of Connector)

Soldering conforms to NHB5300.4 (3A-1) (Requirements for Soldering Electrical Connections). (Open or Short)

Receptacle connectors have an internal O-ring seal installed to insure water- tight integrity. O-rings are per MS9068 or AS3582 (alt.) (Packing, Preformed - AMS5304, O- ring). (Open or Short)

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The rear of the connector is potted with an epoxy resin compound (Stycast 2651) conforming to MSFC-SPEC-222 (Resin compounds, Electrical and Environ- mental Insulation Epoxy, Specification For) for enhancing watertightness. The connector is then molded per MSFC-PROC-186 (Procedure for Potting and Molding Cable Assemblies using Elastomeric Compounds). (Open or Short)

Cable assemblies are overall shielded and jacketed and a failure in the assembly will not propagate to another cable. (Short)

The watertight cable jacket is a translucent, nonreverting, abrasion resistant tubular polyurethane per MIS-13988 (Plastic, Ether Polyurethane, for Extrusion and Molding). (Short)

MSFC-SPEC-522A (Design Criteria for Controlling Stress Corrosion Cracking) is used to control stress corrosion. (Open, Short or Loss of Connector)

Cable routing is in accordance with specification 10PLN-0067 (Electromagnetic Effects Control Plan, Solid Rocket Booster). Cables are installed per 10SPC- 0220 (Installation of Cable Assemblies). (Open, Short or Loss of Connector)

Multimission Qualification testing for LaBarge Cables has been completed by MSFC and cables are certified for 20 mission (reference Certificate of Quali- fication A-E&I-2150-1 dated 06/24/88). (Open, Short or Loss of Connector)

Multimission Qualification testing for Teledyne Cables was completed by MSFC and cables were certified for 7 missions only (reference Certificate of Qualification A-E&I-2136-1 dated 06/30/88). (Open, Short or Loss of Connector)

Section II: Watertight Reusable Cables with crimped connectors

SRB watertight reusable cables are designed per 10SPC-0166 (Cable Assemblies, Watertight, Reusable, Specification For) for 20 mission capability under conditions encountered from an ocean depth of approximately 125 feet to an altitude of 210,000 feet above sea level. Cables are designed to operate in seawater at 60 psig up to 72 hours, in a temperature range of -48C (-54F) to 93C (200F), and under worst case SRB vibration requirements as specified in 10SPC-0165 (Connectors, Electrical, Circular Miniature, Underwater, Specification For) and SE-019-049-2H (Vibration, Acoustic and Shock, Design and Test Criteria, for Components on the Solid Rocket Booster). (Open, Short or Loss of Connector)

Cables utilize single conductor wire per MSFC-SPEC-40M39513 or MIL-W-22759 (Wire, Electrical, Nickel/Tin plated, TFE Insulated) and multiconductor cable per MSFC-SPEC-40M39526 or MIL-C-27500 (Cable, Electrical, Nickel/Tin plated Shield, TFE Jacketed). Single conductor wire and multiconductor cable is rated at 600 Volt RMS at a temperature range of -65C to 260C. Wire is designed to meet an Insulation Resistance test voltage of 500 VDC for not more than 60 seconds resulting in resistance value of 1000 meg ohm/1000 ft. of wire. Wire also subjected to dry dielectric test of 2 KV for 60 seconds and for single conductor wire only, a pulse dielectric test of 6.5 KV (single conductor only) for not more than 75 microseconds. (Open or Short)

Connectors are underwater, miniature circular, threaded coupling types that utilize crimp removable contacts per 10SPC-0165. Connectors are rated to operate up to 200C. Connector insert arrangements are per MIL-C-38999 (Connectors, Electrical, Circular, Miniature, High Density, Quick Disconnect, Environment Resistant, Removable Crimp and Solder Contacts, General Specification For). Connector exterior shells are corrosion resistant stainless steel per QQ-S-763 class 316 for saltwater exposure. Connector coupling nuts are aluminum bronze 630 per QQ-C-465. Coupling nuts are hex type with lockwire holes to help secure against high vibration environments. (Open, Short or Loss of Connector)

Crimping of electrical contacts conforms to NHB 5300.4 (3H) (Crimping of Electrical Connections, Requirements for). (Open)

Pin Retention Test Conforms to 10STD-0013 (Standard for Electrical Contacts, Retention Criteria). (Open)

Crimp tools conform to MIL-T-22520 (Crimping Tools, Terminal, Hand). (Open)

Receptacle connectors have an internal O-ring seal installed to insure water- tight integrity. O-rings are per MS9068 or AS3582 (alt.) (Packing, Preformed - AMS5304, O- ring). (Open or Short)

DCN 042

The rear of the connector is potted with an epoxy resin compound (Stycast 2651) conforming to MSFC-SPEC-222 (Resin compounds, Electrical and Environ- mental Insulation Epoxy, Specification For) for enhancing watertightness. The connector is then molded per MSFC-PROC-186 (Procedure for Potting and Molding Cable Assemblies using Elastomeric Compounds). (Open or Short)

Cable assemblies are overall shielded and jacketed and a failure in the assembly will not propagate to another cable. (Short)

The watertight cable jacket is a translucent, nonreverting, abrasion resistant tubular polyurethane per MIS-13988 (Plastic, Ether Polyurethane, for Extrusion and Molding). (Short)

MSFC-SPEC-522A (Design Criteria for Controlling Stress Corrosion Cracking) is used to control stress corrosion. (Open, Short or Loss of Connector)

Cable routing is in accordance with specification 10PLN-0067 (Electromagnetic Effects Control Plan, Solid Rocket Booster). Cables are installed per 10SPC- 0220 (Installation of Cable Assemblies). (Open, Short or Loss of Connector)

Multimission Qualification testing for LaBarge Cables has been completed by MSFC and cables are certified for 20 mission (reference Certificate of Quali- fication A-E&I-2150-1 dated 06/24/88). (Open, Short or Loss of Connector)

Multimission Qualification testing for Teledyne Cables was completed by MSFC and cables were certified for 7 missions only (reference Certificate of Qualification A-E&I-2136-1 dated 06/30/88). (Open, Short or Loss of Connector)

Section III: Throwaway Cables with soldered connectors

SRB Throwaway cables are designed per 10SPC-0213 (Cable Assemblies, Throwaway, Specification For) and are single mission cables (reference COQ A-E&I-2138). The cable assemblies are not designed for water submersion, but are designed to be resistant to moisture, condensation and moderate water exposure (not submersion). Cables are designed to operate in a temperature range of -48^{O}C (-54^{O}F) to 93^{O}C (200^{O}F) and under worst case SRB vibration requirements per SE- 019-049-2H (Vibration, Acoustic and Shock, Design and Test Criteria, for Components on the Solid Rocket Booster). (Open, Short or Loss of Connector).

Connectors are the threaded type per 10SPC-0165 (Connectors, Electrical, Circular Miniature, Underwater, Specification For). Connectors are potted and Heat Shrinkable Boots are installed over RFI Backshell per 10SPC-0213.

Connector contacts are nonremovable solder types. Connectors are rated to operate at 200 degrees Celsius. (Open, Short or Loss of Connector)

Cables utilize single conductor wire per MSFC-SPEC-40M39513 or MIL-W-22759 (Wire, Electrical, Nickel/Tin plated, TFE Insulated) and multiconductor cable per MSFC-SPEC-40M39526 or MIL-C-27500 (Cable, Electrical, Nickel/Tin plated Shield, TFE Jacketed). Single conductor wire and multiconductor cable is rated at 600 volts RMS at a temperature range of -65 degrees Celsius to 260 degrees Celsius. Wire is designed to meet an Insulation Resistance test voltage of 500 VDC for not more than 60 seconds resulting in resistance value of 1000 meg ohm/1000 ft. of wire. Wire also subjected to dry dielectric test of 2 KV for 60 seconds and for single conductor wire only, a pulse dielectric test of 6.5 KV (single conductor only) for not more than 75 microseconds. (Open or Short)

Exterior connector shells are either aluminum alloy plated with electroless nickel or corrosion resistant stainless steel. (All Watertight Connectors) (Loss of Connector)

Soldering conforms to NHB5300.4 (3A-1) (Requirements for Soldering Electrical Connections). (Open or Short)

Cable assemblies are jacketed and a failure in the assembly will not propagate to another cable. (Short)

MSFC-SPEC-522A (Design Criteria for Controlling Stress Corrosion Cracking) is used to control stress corrosion. (Open, Short or Loss of Connector)

Cable routing is in accordance with specification 10PLN-0067 (Electromagnetic Effects Control Plan, Solid Rocket Booster). Cables are installed per 10SPC- 0220 (Installation of Cable Assemblies). (Open, Short or Loss of Connector)

Single mission qualification testing for LaBarge cables was completed by MSFC and cables are certified for one mission only (reference Certificate of Qualification A-E&I-2145 dated 06/30/88). (Open, Short or Loss of Connector)

Single mission qualification testing for ASD cables was completed by MSFC and cables are certified for one mission only (reference Certificate of Qualification A-E&I-2137 dated 01/25/90). (Open, Short or Loss of Connector)

Single mission qualification testing for USA SRBE FL operations manufactured or modified cables was completed by MSFC and cables are certified for one mission only (Reference certificate of qualification A-E&I-2138 dated 08/12/92). (Open, Short, Loss of connector)

Section IV: Throwaway Cables with crimped connectors

SRB Throwaway cables are designed per 10SPC-0213 (Cable Assemblies, Throwaway, Specification For), and are single mission cables. The cable assemblies are not designed for water submersion, but are designed to be resistant to moisture, condensation and moderate water exposure (not submersion). Cables are designed to operate in a temperature range of -48^{O}C (-54^{O}F) to 93^{O}C (200^{O}F) and under worst case SRB vibration requirements per SE-019-049-2H (Vibration, Acoustic and Shock, Design and Test Criteria, for Components on the Solid Rocket Booster). (Open, Short or Loss of Connector)

Connectors may be either threaded or pull-away type per 10SPC-0165 (Connectors, Electrical, Circular Miniature, Underwater, Specification For) and MSFC- SPEC-40M39569 (Connectors, Electrical, Miniature Circular, Environment Resisting, Specification for) and are potted and molded per 10SPC-0213 (Cable Assemblies, Throwaway, Specification For) and MSFC-PROC-186 (Procedure for Potting and Molding Cable Assemblies Using Elastomeric Compounds). Connector contacts are crimp removable types. Connectors are rated to operate at 200^{O}C. (Open, Short or Loss of Connectors)

Cables utilize single conductor wire per MSFC-SPEC-40M39513 or MIL-W-22759 (Wire, Electrical, Nickel/Tin plated, TFE Insulated) and multiconductor cable per MSFC-SPEC-40M39526 or MIL-C-27500 (Cable, Electrical, Nickel/Tin plated Shield, TFE Jacketed). Single conductor wire and multiconductor cable is rated at 600 volt RMS at a temperature range of -65^{O}C to 260^{O}C. Wire is designed to meet an Insulation Resistance test voltage of 500 VDC for not more than 60 seconds resulting in resistance value of 1000 meg ohm/1000 ft. of wire. Wire also subjected to dry dielectric test of 2 KV for 60 seconds and for single conductor wire only, a pulse dielectric test of 6.5 KV (single conductor only) for not more than 75 microseconds. (Open or Short)(BI-1467R2)

Exterior connector shells are either aluminum alloy plated with electroless nickel or corrosion resistant stainless steel. (Loss of Connector)

Crimping of electrical contacts conforms to NHB 5300.4 (3H) (Crimping of Electrical Connections, Requirements For). (Open)

Pin retention test conforms to 10STD-0013 (Standard for Electrical Contacts, Retention Criteria). (Open)

Crimp tools conform to MIL-T-22520 (Crimping Tools, Terminal, Hand). (Open)

Cable assemblies are jacketed and a failure in the assembly will not propagate to another cable. (Short)

MSFC-SPEC-522A (Design Criteria for Controlling Stress Corrosion Cracking) is used to control stress corrosion cracking. (Open, Short or Loss of Connector)

Cable routing is in accordance with specification 10PLN-0067 (Electromagnetic Effects Control Plan, Solid Rocket Booster). Cables are installed per 10SPC- 0220 (Installation of Cable Assemblies). (Open, Short or Loss of Connector)

Single mission qualification testing for LaBarge cables was completed by MSFC and cables are certified for one mission only (reference Certificate of Qualification A-E&I-2145 dated 06/30/88). (Open, Short or Loss of Connector)

Single mission qualification testing for ASD cables was completed by MSFC and cables are certified for one mission only (reference Certificate of Qualification A-E&I-2137 dated 01/25/90). (Open, Short or Loss of Connector)

Single Mission qualification testing for USA SRBE FL Operations manufactured or modified cables was completed by MSFC and cables are certified for one mission only (Reference Certificate of Qualification A-E&I-2138 dated 08/12/92). (Open, Short, Loss of Connector)

Cables X13W14, X13W15 & X13W16 are Data Bus cable per MB0150-051 (Cable, Electrical, Two Conductor, Shielded and Jacketed, Special Purpose). (Open, short of loss of connector)

Cables X16W1, X16W2, X17W1, X17W2, X18W1, and X18W2 are equiped with ordnance connectors (Bayonet) designed and keyed per MSFC-SPEC-40M38298 to interface with pyrotechnic devices only. (open, short or loss of connector)

Section V: Non-watertight Reusable Cables with crimped connectors

SRB nonwatertight reusable cables are designed per 10SPC-0212 (Cable Assemblies, Non Watertight, Reusable, Specification For). The cable assemblies are not designed for water submersion, but are designed to be resistant to moisture, condensation and moderate water exposure (not submersion). Cables are designed to operate in a temperature range of -48^{O}C (-54^{O}F) to 121^{O}C (250^{O}F) and under worst case SRB vibration requirements as specified in 10SPC-0165 (Connectors, Electrical, Circular Miniature, Underwater, Specification For) and SE-019-049-2H (Vibration, Acoustic and Shock, Design and Test Criteria, for Components on the Solid Rocket Booster).(open, short, or loss of connector)

Cables utilize single conductor wire per MSFC-SPEC-40M39513 or MIL-W-22759 (Wire, Electrical, Nickel/Tin plated, TFE Insulated) and multiconductor cable per MSFC-SPEC-40M39526 or MIL-C-27500 (Cable, Electrical, Nickel/Tin plated Shield, TFE Jacketed). Single conductor wire and multiconductor cable is rated at 600 Volt RMS at a temperature range of -65^{O}C to 260^{O}C. Wire is designed to meet an Insulation Resistance test voltage of 500 VDC for not more than 60 seconds resulting in resistance value of 1000 meg ohm/1000 ft. of wire. Wire also subjected to dry dielectric test of 2 KV for 60 seconds and for single conductor wire only, a pulse dielectric test of 6.5 KV (single conductor only) for not more than 75 microseconds. (open or short)

Connectors are the threaded type per 10SPC-0165 and bayonet coupling type per MSFC-SPEC-40M39569 and MSFC-SPEC-40M-38277/40M-38298. Cables utilize crimp removable contacts. Connectors are rated to operate at 200^{O}C. (open, short or loss of connector)

Crimping of electrical contacts conforms to NHB 5300.4 (3H) (Crimping of Electrical Connections, Requirements For). (open)

Crimp tools conform to MIL-T-22520 (Crimping Tools, Terminal, Hand) (open).

Pin Retention Test conforms to 10STD-0013 (Standard for Electrical Contacts Retention Criteria) (open)

Cables are jacketed and a failure in the assembly will not propagate to another cable. Cable jacketing is per MIL-I-23053/5 (Insulation Sleeving, Electrical, Heat Shrinkable, Poly-olefin, Flexible, Cross-linked). (short)

MSFC-SPEC-522A (Design Criteria for Controlling Stress Corrosion Cracking) is used to control stress corrosion. (open, short or loss of connector)

Cable routing is in accordance with specification 10PLN-0067 (Electromagnetic Effects Control Plan, Solid Rocket Booster). Cables are installed per 10SPC- 0220 (Installation of Cable Assemblies). (open, short, or loss of connector)

Multimission qualification testing for LaBarge Cables has been completed by MSFC and cables are certified for 20 missions (reference Certificate of Quali- fication A-E&I-2144 dated 06/30/88). (open, short or loss of connector)

Multimission qualification testing for Teledyne cables has been completed by MSFC and cables are certified for 20 missions (reference Certificate of Qualification A-E&I-2135 dated 06/30/88). (open, short or loss of connector)

Multimission qualification testing for USA SRBE-FL Operations manufactured or modified cables has been completed by MSFC and cables are certified for 20 missions (reference certificate of qualification A-E&I-2139 dated 8-12- 92.(open,short or loss of connector).

Section VI: Coax (non-watertight) Cables

Coax cables (a nonwatertight cable assembly) are designed per 10SPC-0212 (Cable Assemblies, Non-Watertight, Reusable, Specification For). Cable meets SRB worst case vibration requirements per SE-019-049-2H (Vibration, Acoustic and Shock, Design and Test Criteria, for Components on the Solid Rocket Booster). The cables are designed for 7 mission capability and are environmentally sealed against moisture condensation and moderate water exposure. Cables are designed to operate in a temperature range of -48^{O}C (-54^{O}F) to 121^{O}C (250^{O}F). (Open, Short or Loss of Connector)

Coax connectors are per MIL-C-39012 (Connectors, Coaxial, Radio Frequency, General Specification For) type "N" series. The connector is an all crimp weatherproof, threaded coupling type. (Open or Loss of Connector)

Coax cable is RG 400/U type per MIL-C-17 (Cables, Radio-Frequency, Coaxial, Dual Coaxial, Twin Conductor, and Twin Lead, General Specification For). (Open or Short)

Crimping of electrical contacts conforms to NHB 5300.4 (3H) (Crimping of Electrical Connections, Requirements For). (Open)

Crimp tools conform to MIL-T-22520 (Crimping Tools, Terminal and Hand). (Open)

MSFC-SPEC-522A (Design Criteria for Controlling Stress Corrosion Cracking) is used to control stress corrosion. (Open, Short or Loss of Connector)

Cable routing is in accordance with specification 10PLN-0067 (Electromagnetic Effects Control Plan, Solid Rocket Booster). Cables are installed per 10SPC- 0220 (Installation of Cable Assemblies). (Open, Short or Loss of Connector)

Multimission qualification testing for LaBarge cables has been completed by MSFC and cables are certified for 20 missions (reference Certificate of Quali- fication A-E&I-2144-1 dated 06/30/88). (Open, Short or Loss of Connector)

Multimission qualification testing for Teledyne cables has been completed by MSFC and cables are certified for 7 missions (reference Certificate of Qualification A-E&I-2135-1 dated 06/30/88). (Open, Short or Loss of Connector)

Multimission qualification testing of USA SRBE Fl operations manufactured or modified cables was completed by MSFC. (Reference Certificate of Qualification A-E&I-2139 dated 8-12-92). (Open, Short, or Loss of Connector)