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PERFORMANCE SPECIFICATION

HARNESS AND CABLE ASSEMBLIES

This specification is approved for use by the U.S. Army Tank-automotive and Armaments Command, Department of the Army, and is available for use by all Departments and Agencies of the Department of Defense.

1. SCOPE

1.1 Scope. This specification covers the general requirements for electrical harness and cable assemblies.

2. APPLICABLE DOCUMENTS

2.1 General. The documents listed in this section are specified in sections 3 and 4 of this specification. This section does not include documents cited in other section of this specification or recommended for additional information or as examples. While every effort has been made to ensure the completeness of this list, document users are cautioned that they must meet all specified requirements documents cited in sections 3 and 4 of this specification, whether or not they are listed.

Beneficial comments (recommendations, additions, deletions) and any pertinent data which may be of use in improving this document should be addressed to: U.S. Army Tank-automotive and Armaments Command, ATTN: AMSTA-TR-E/BLUE, Warren, MI 48397-5000, by using the Standardization Document Improvement Proposal (DD Form 1426) appearing at the end of this document, or by letter.

AMSC N/A FSC 5995

2.2 Government documents.

2.2.1 Specification, standards, and handbooks. The following specification, standards, and handbooks form a part of this specification to the extent specified herein. Unless otherwise specified, the issues of these documents are those listed in the issue of the Department of Defense Index of Specifications and Standards (DoDISS) and supplement thereto, cited in the solicitation (see 6.2).

STANDARDS

DEPARTMENT OF DEFENSE

MIL-STD-202	- Electronic and Electrical Component Parts, Test Methods For.
MIL-STD-810	- Environmental Test Methods and Engineering Guidelines.

(Unless otherwise indicated, copies of the above specifications, standards, and handbooks are available from the Standardization Document Order Desk, 700 Robbins Avenue, Building 4D, Philadelphia, PA 9111-5094.)

2.3 Non-Government publications. The following documents form a part of this document to the extent specified herein. Unless otherwise specified, the issues of the documents which are DoD adopted are those listed in the issue of the DoDISS cited in the solicitation. Unless otherwise specified, the issues of documents not listed in the DoDISS are the issues of the documents cited in the solicitation (see 6.2).

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

ANSI/ASQC Z1.4	- Sampling Procedures and Tables for Inspection by Attributes (DoD Adopted).

(Application for copies should be addressed to the American National Standards Institute, 11 West 42nd Street, New York, NY 10036.)

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A123	- Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel (DoD Adopted).

(Application for copies should be addressed to the American Society for Testing and Materials, 100 Barr Harbor Drive, West Conshohocken, PA 19428-2959.)

GLOBAL ENGINEERING

GM 9540P - Accelerated Corrosion Test.

(Application for copies should be addressed to Global Engineering, 15 Invernessway, Englewood, CO 80112.)

2.4 Order of precedence. In the event of a conflict between the text of this document and the references cited herein, the text of this document takes precedence. Nothing in this document, however, supersedes applicable laws and regulations unless a specific exemption has been obtained.

3. REQUIREMENTS

3.1 First article. Unless otherwise specified (see 6.2), the contractor shall furnish harness and cable assemblies which shall be subjected to first article inspection (see 4.2).

3.2 Materials. Materials used shall be in accordance with the accepted commercial materials specifications for harnesses. The materials shall be capable of meeting all the operational and environmental requirements specified herein. Materials shall be free from defects which adversely affect performance or serviceability of the finished product. Exposed functional parts shall be fabricated from suitable corrosion resistant materials. The corrosion resistance shall equal to or exceed that provided by hot dip galvanized 1020 steel, with coating thickness in accordance with ASTM A123 (or minimum coating thickness of 19 micrometers (0.75 mil) on pre-galvanized sheet 0.16 millimeters (mm) 0.063 inches (in.) or less), with zinc phosphate pre-treatment. A proposed alternate design shall be compared to a galvanized sample (as described above) using the Accelerated Corrosion Test GM 9540P Method B 120 cycles, or until prior failure of one of the items with defects such as extensive corrosion at scribe or significant penetration of base material (see 4.6.1 and 6.4).

3.2.1 Recycled, recovered, or environmentally preferable materials. Recycled, recovered, or environmentally preferable materials should be used to the maximum extent possible provided that the material meets or exceeds the operational and maintenance requirements, and promotes economically advantageous life cycle costs.

3.3 Design and construction. The harness and cable assemblies shall conform to the manufacturer's design and construction except for weight, length and harness assembly configuration which shall be in accordance with the applicable harness and cable assembly drawings. The installation details of figure 1 through 5 shall guide fabrication where it is not detailed on the drawing (see 4.6.1).

3.3.1 Weight. The weight of the harness and cable assemblies shall not exceed the weight specified on the applicable drawing (see 4.6.2 and 6.2).

3.3.2 Length. The length of the harness and cable assemblies shall be as shown on the applicable drawing. Length measurements shall be as indicated in figure 1 (dimensions W, X, Y and Z) (see 4.6.2).

3.3.3 Tolerances.

3.3.3.1 Connector and adapter angular tolerances. The angular tolerance between the connector keyway and centerline of 45 degree (°) or 90° adapters shall be as specified in table I. Angular tolerance between the connector keyway and the centerline of the 90° boots shall be ± 10° (see 4.6.2 and 6.2).

TABLE I. Angular tolerance.

Shell size	Angular tolerance (°)
08	±15°
09	±15°
10	±15°
11	±15°
12	±10°
13	±10°
14	±10°
15	±10°
16	±7.5°
17	±7.5°
18	±7.5°
19	±7.5°
20	±7.5°
21	±5°
22	+5°
23	±5°
24	±5°
25	±5°
28	±5°
32	±5°
36	±5°
40	±5°

3.3.3.2 Dimensional tolerance. The dimensional tolerances on length dimensions shall be as follows (see 4.6.2):

Length Centimeters (cm) [in.]	Tolerances cm [in.]
(0 to 30) [0 to 11.9]	(-0, + 1.27) [-0, + 0.5]
(30.5 to 182.6) [12 to 71.9]	(-0, + 2.54) [-0, + 1.0]
(182.6 and up) [72 and up]	(-0, + 5) [-0, + 2.0]

3.3.4 Radio frequency interference (RFI) shielding. The RFI shielding shall eliminate radio frequency interference (see 4.6.1 and 4.6.2).

3.3.4.1 Electromagnetic radiation (EMR). The harness and cable assemblies shall have EMR antenna characteristics. Changes made to the identification or the design of connectors, RF, or audio shields from those specified on the applicable harness or cable drawing and associated hardness assurance must be approved by the acquisitioning activity responsible for nuclear hardening and EMR protection (see 4.6.2).

3.3.4.2 Harness terminations. The harness terminations shall be as shown in figures 3 and 5 or as specified on the applicable harness or cable assembly drawing. Terminating adapters, boots and jacketing shall be fully covered and watertight with no cracks, splits or abrasions. In cases where a boot is not specified on the drawing, a piece of heat shrinkable tubing shall be substituted. The length of this tubing shall be not less than 15.24 cm (6 in.). Harness terminations shall be designed to permit exposure of 5.1 cm (2 in.) of wire at connectors and transitions (see 4.6.2).

3.3.4.2.1 Cable terminating adapters. The adapters shall have anti-rotation features to prevent rotation of the adapter body with respect to the connector (such features shall not preclude component removal to accomplish cable repair). The adapter diameter shall not exceed the mating connector (see 4.6.2).

3.3.4.3 Harness jacketing. All harness branches shall be covered with the jacketing specified on the harness drawing. When optional jacketing material is specified, each individual harness branch shall be completely covered with one option only. The jacketing shall extend into the boot or transition as specified in figures 2, 3 and 5, depending on the application. The jacketing shall be a flexible convoluted tubing. The convolution may be helical or annular. Bonding of jacket points to their mating parts shall provide a watertight joint (see 4.6.1 and 4.6.2).

3.3.4.3.1 Heat shrinkable tubing. The heat shrinkable tubing shall be uniformly shrunk to minimum diameters, determined by the bundle size, with no evidence of cracks, splits, or abrasions. Multiple sections of tubing may be used on long harness branches, provided each individual length

is not less than 91.44 cm (36 in.) long and an overlap of not less than 5 cm (2 in.) is maintained. All joints including overlaps, shall be sealed watertight using adhesive specified on the applicable harness or cable assembly drawing or commercial equivalent (see 4.6.1 and 4.6.2).

3.3.4.4 Harness transitions. The harness transitions shall be positioned only after the harness jacketing has been installed over the individual branches (see figures 2 and 4). All transitions shall be watertight and free of cracks, splits, or abrasions. The transition shall withstand a horizontal load of not less than 90.7 kilograms (kg) (200 pounds (lbs)) without damage. The transition shall provide for internal accessibility to permit cable repair. Transition reassembly shall be performed without the aid of adhesives. When optional material is specified, only one option shall be used on any individual harness assembly. The existence of a heat shrinkable transition and a heat sealable tape transition on the same assembly is unacceptable (see 4.6.2 and 4.6.3).

3.3.4.4.1 Heat shrinkable transition. All heat shrinkable transition entries shall be sealed with the adhesive specified on the applicable harness or cable assembly drawing or commercial equivalent (see 4.6.2).

3.3.4.4.2 Heat sealable tape transition. The heat sealable tape transitions shall be constructed of not less than two layers of tape at all locations (see 4.6.2).

3.3.5 Pull strength. The harness and cable assemblies shall meet the requirements of 3.4.1 and 3.4.2 after being subjected to a force of 445 Newton (N) (100 lbs) applied along the cable axis between the cable terminations for 30 seconds (sec) (see 4.6.4).

3.3.6 Bend radius. The natural bend radius of harness and cable assemblies under 91.44 cm (3 feet (ft)) in length shall not stress the internal wires when a 2.26 kg(5 lbs) load is applied to the free end of the assembly (see 4.6.5).

3.3.7 Connector assembly.

3.3.7.1 Crimping.

3.3.7.1.1 Connector contacts. The crimp type connector contacts shall be crimped in accordance with the manufacturer's standard crimping procedures. The acceptable crimp tensile strength shall be not less than 249.8 (kg) (550 lbs) axial load when measured as specified in 4.6.6.

3.3.7.2 Unused contact locations. All unused connector contact locations shall be filled with contacts and all unused grommet feed through holes shall be plugged (see 4.6.2).

3.3.7.3 Connector threads. The connector threads shall be coated with a viscous coating conforming to a chemical composition formulated for use as a threadlocker on threaded fasteners, that will not harden upon cure (see 4.6.2).

3.3.8 Fill factor. The fill factor of harness and cable assemblies shall be not more than 70% (see 4.6.2 and 6.3.2).

3.3.9 Spare wires. The harness and cable branches shall contain not less than 10% or at least two spare wires without wire markings (see 4.6.2).

3.3.10 Elastomers. All age sensitive elastomers in harness and cable assemblies shall be installed in the assembly within 8 quarters after the cure date (see 4.6.1 and 4.6.2).

3.4 Performance.

3.4.1 Direct current (dc) resistance. Unless otherwise specified on the harness or cable assembly drawing, the dc resistance measured from the connector contact at one end of a wire conductor to the corresponding contact at the other end (as indicated by the harness and cable assembly wiring diagrams) shall not be greater than the following listed values:

22 AWG 1/ - 0.85 ohm	8 AWG - 0.03 ohm
20 AWG - 0.5 ohm	4 AWG - 0.015 ohm
16 AWG - 0.2 ohm	0 AWG - 0.005 ohm
12 AWG - 0.1 ohm	

1/ American Wire Gauge (AWG) number.

When RFI shields are terminated at the connector shells, the dc resistance between any two connector shells of the assembly shall not exceed 0.5 ohm (see 4.6.7).

3.4.2 Insulation resistance. Unless otherwise specified on the harness or cable assembly drawing, the insulation resistance shall be not less than 100 megohms when measured at 500 ±50 volts (V) dc applied for at least one second between connector pins and the assembly connector and between isolated circuits (see 4.6.8).

3.4.3 Environmental. Assemblies shall meet the environmental requirements specified in 3.4.3.1 through 3.4.3.4. Assemblies exceeding 91.44 cm (3 ft) in length, after being exposed to environmental conditions specified in 3.4.3.1 through 3.4.3.4, shall have a bend radius of not less than 7.6 cm (3 in.) (see 4.6.9).

3.4.3.1 Humidity. The harness and cable assemblies shall meet the specified performance requirements of 3.4.1 and 3.4.2, during and after exposure to a relative humidity of 94 +4% at 35 +1 (95 +2 degrees Fahrenheit (°F)) (see 4.6.9.1).

3.4.3.2 Low temperature.

3.4.3.2.1 Storage. The harness and cable assemblies shall meet the specified performance requirements of 3.4.1 and 3.4.2, after exposure to ambient temperature down to -51°C (-60°F) (see 4.6.9.2).

3.4.3.2.2 Operating. The harness and cable assemblies shall meet the specified performance requirements of 3.4.1 and 3.4.2, during and after exposure to temperature down to -51°C (-60°F) (see 4.6.9.2).

3.4.3.3 High temperature.

3.4.3.3.1 Storage. The harness and cable assemblies shall meet the specified performance requirements of 3.4.1 and 3.4.2, after exposure to ambient temperature up to 71°C (160°F) (see 4.6.9.3).

3.4.3.3.2 Operating. The harness and cable assemblies shall meet the specified performance requirements of 3.4.1 and 3.4.2, during and after exposure to temperature up to 60°C (140°F) (see 4.6.9.3).

3.4.3.3.3 Extreme. When specified on the applicable harness or cable drawing, the assembly shall meet the performance requirements of 3.4.1 and 3.4.2 during and after exposure to the extreme high temperature of 149°C (300°F) (see 4.6.9.3).

3.4.3.4 Submergence. The harness and cable assemblies shall meet the specified performance requirements of 3.4.1 and 3.4.2, before, during and after submergence. The assembly shall be subjected to a differential pressure of 20.7 +3.5 kilopascals (kPa) (3 +0.5 pounds per square inch (psi)) (see 4.6.9.4).

3.5 Identification marking.

3.5.1 Harness and cable marking. Unless otherwise specified on the applicable harness or cable drawing the harness and cable assemblies identification shall be marked on the outer surface of the jacket. In the case of assemblies greater than 1.6 cm (0.625 in.) marking shall be located 180° opposed. Marking shall remain legible after exposure to all environments (see 4.6.2).

3.5.2 Marking identification: Marking identification information shall be as specified on the applicable drawing. As minimum, each assembly shall be identified by the following (see 4.6.2):

a. Harness or cable assembly part number.
b. Harness or cable reference designation (short sign).
c. Serial number.
d. Month and year of manufacture.
e. Manufacturers code identification (FSCM).
f. Termination reference designations (Placed near the termination but separate from the harness and cable assembly identification).

3.5.2.1 Wire marking. Marking of wire conductors shall be as specified on the applicable drawing. The marking shall be visible when the wire is installed in the electrical connector (see 4.6.2).

3.5.2.2 Exposed surface colors. Unless otherwise specified on the applicable harness or cable assembly drawing, all exposed metallic fittings shall be olive drab in color and exposed sheeting material shall be black (see 4.6.2).

3.5.3 Age control. The harness and cable assemblies that contain any synthetic, age sensitive elastomers shall have the assembly date and the earliest cure date (in quarter and year) indelibly affixed to the assembly (see 4.6.2).

3.6 Workmanship. Workmanship shall be in accordance with 3.6.1 and 3.6.2 (see 4.6.2).

3.6.1 Insulation stripping. The removal of insulation from electrical wire conductors, 12 A.W.G. and smaller, and from outer jackets of shielded cables shall be performed so that there is no evidence of physical damage to the individual wire or braided strands.

3.6.2 Contact insertion in connectors. Damage to connector inserts or the contacts due to insertion or extraction is unacceptable. The insertion and extraction tools recommended by the manufacturer of connector and contacts shall be used in all cases. Alcohol or lubricants recommended by the connector manufacturer may be used as an aid to contact insertion. The connector assembly is to be thoroughly dried after lubricant application and there shall be no evidence of residue from lubricant remaining on the connector insert or contacts.

4. VERIFICATION

4.1 Classification of inspection.

a. First article inspection (see 4.2).
   1. Preproduction inspection (see 4.2.1).
   2. Initial production inspection (see 4.2.2).

b. Conformance inspections (see 4.3).
   1. Examination (see 4.3.2).
   2. Tests (see 4.3.3).

4.2 First article inspection. First article inspections shall be performed on preproduction or initial production samples as specified herein.

4.2.1 Preproduction inspection. When specified (see 6.2) the preproduction sample shall consist of two assemblies. Preproduction inspection shall consist of inspection as specified in table III.

TABLE III. Classification of inspections.

Title	Requirement	Inspection	First article	Conformance		Control
				Examination	Tests	
Materials and construction	3.2 thru 3.3	4.6.1	X			X
Defects (see 4.6.2 and table IV)	3.3.1 thru 3.3.4.4.2, 3.3.7.2 thru 3.3.10 and 3.5 thru 3.6.2	4.6.2	X	X		
Harness transitions	3.3.4.4	4.6.3	X		X	X
Pull strength	3.3.5	4.6.4	X		X	X
Bend radius	3.3.6	4.6.5	X		X	X
Crimp tensile strength	3.3.7.1.1	4.6.6	X		X	X
Direct current resistance	3.4.1	4.6.7	X		X	X
Insulation resistance	3.4.2	4.6.8	X		X	X
Environmental	3.4.3	4.6.9	X		X	X
Humidity	3.4.3.1	4.6.9.1	X		X	X
Low temperature	3.4.3.2	4.6.9.2	X		X	
Storage	3.4.3.2.1	4.6.9.2	X		X	

TABLE III. Classification of inspections - Continued.

Title	Requirement	Inspec-tion	First article	Conformance		Control
				Exami-nation	Tests	
Operating	3.4.3.2.2	4.6.9.2	X		X	
High temperature	3.4.3.3	4.6.9.3	X		X	
Storage	3.4.3.3.1	4.6.9.3	X		X	
Operating	3.4.3.3.2	4.6.9.3	X		X	
Extreme	3.4.3.3.3	4.6.9.3	X		X	
Submergence	3.4.3.4	4.6.9.4	X		X	X

4.2.2 Initial production inspection. Unless otherwise specified (see 6.2), the Government shall select two assemblies, from the first 10 assemblies produced under the production contract for initial production inspection. Initial production units shall be inspected as specified in table III.

4.2.3 First article inspection failure. Test item deficiencies during, or as a result of, the first article test, shall be cause for rejection of the items until evidence has been provided by the contractor that corrective action has been taken to eliminate the deficiency. Any deficiency found during, or as a result of the first article test, shall be evidence that all items already produced prior to completion of the first article test are similarly deficient unless contrary evidence satisfactory to the contracting officer is furnished by the contractor. Such deficiencies on all items shall be corrected by the contractor. The Government will not accept products until first article testing is completed to the satisfaction of the Government.

4.3 Conformance inspection.

4.3.1 Sampling.

4.3.1.1 Lot formation. An inspection lot shall consist of all the harness and cable assemblies of one type and part number, from an identifiable production period, from one manufacturer, submitted at one time for acceptance.

4.3.1.2 Sampling for examination. Samples for examination shall be selected in accordance with ANSI/ASQC Z1.4.

4.3.2 Examination. Each sample selected in accordance with 4.3.1.2 shall be examined and shall be free from any defects listed in table IV.

TABLE IV. Classification of defects.

Category	Defects	Method of examination
Critical	None	
Major:		
101	Incorrect dimensions affecting interchangeability (see 3.3, 3.3.3.1 and 3.3.3.2).	SIE 1/
102	Improper weight (see 3.3.1).	SIE
103	Improper length (see 3.3.2).	SIE
104	Improper RFI shielding (see 3.3.4 and 3.3.4.1).	Visual and SIE
105	Improper harness termination (see 3.3.4.2).	Visual
106	Improper cable terminating adapters (see 3.3.4.2.1).	Visual and SIE
107	Improper harness jacketing (see 3.3.4.3).	Visual and SIE
108	Improper heat shrinkable tubing application (see 3.3.4.3.1).	Visual and SIE
109	Improper harness transition (see 3.3.4.4)	Visual
110	Improper heat shrinkable transition (see 3.3.4.4.1)	Visual
111	Improper heat sealable tape transition (see 3.3.4.4.2)	Visual
112	Improper connector contacts (see 3.3.7.1.1).	Visual
113	Improper connector threads coating (see 3.3.7.3).	Visual
114	Fill factor more than 70% (see 3.3.8).	Visual and SIE
115	Improper spare wires (see 3.3.9).	Visual
116	Age sensitive elastomers not as specified (see 3.3.10).	Visual
Minor:		
201	Incorrect dimensions not affecting interchangeability, not within tolerance (see 3.3, 3.3.3.1, and 3.3.3.2).	Visual and SIE
202	Improper identification marking (see 3.5.1 through 3.5.3).	Visual
203	Improper workmanship affecting appearance (see 3.6).	Visual and SIE

1/ SIE = Standard Inspection Equipment.

4.3.3 Tests. Each harness and cable assembly shall be subjected to the conformance tests specified in table III.

4.4 Control tests. Unless otherwise specified (see 6.2), harness and cable assemblies for control tests shall be subjected to the tests specified in table III. The frequency of selected test samples shall be specified by the acquisitioning activity.

4.5 Inspection conditions. Unless otherwise specified (see 6.2), all inspections shall be conducted under the following conditions:

a. Air temperature: 22.8 ± 10°C (73 ± 18°F)
b. Barometric pressure: 96.5 (+6.8, -10) kilopascals (kPa) (28.5 (+2, -3) inches mercury) in Hg
c. Relative humidity: 50 ± 30%

4.6 Methods of inspection.

4.6.1 Materials and construction. Conformance to 3.2 and 3.3 shall be determined by inspection of contractor records providing proof or certification that design, construction, processing, and materials conform to requirements. Applicable records shall include drawings, specifications, design data, receiving inspection records, processing and quality control standards, vendor catalogs and certifications, industry standards, test reports, and rating data.

4.6.2 Defects. Conformance to 3.3.1 through 3.3.4.4.2, 3.3.7.2 through 3.3.10, and 3.5 through 3.6.2 shall be determined by examination for the defects listed in table IV. Examination shall be visual, tactile, or by measurement with standard inspection equipment.

4.6.3 Harness transitions. To determine conformance to 3.3.4.4, the harness and cable assemblies shall be tested in accordance with MIL-STD-202, method 211A, condition A. Each end of the harness or cable assembly shall be clamped in a suitable holding fixture (harness and cable assemblies terminations shall not be used for clamping in this test setup). Care shall be taken not to damage the harness or cable assembly with excessive clamping force. A force of 889.6 N (200 lbs) shall be applied along the assemblies horizontal axis for a period of 5 to 10 sec. A calibrated scale with an accuracy of ± 2% shall be used to measure the pull force. Following the measurement the assembly shall be inspected for damage to the transition and then subjected to the tests of 4.6.7 and 4.6.8.

4.6.4 Pull strength. To determine conformance to 3.3.5, the harness and cable assemblies terminations shall be tested in accordance with MIL-STD-202, method 211A, condition A. Terminations at each end of the assembly shall be clamped in a suitable holding fixture. Care shall be taken not to damage the termination with excessive clamping force. A force of 445 N (100 lbs) shall be applied along the assembly axis for a period of 30 seconds. Vertical orientation is preferred, however, horizontal orientation is allowed for long harness and cable assemblies. A calibrated scale with an accuracy ± 2% shall be used to measure pull force. Following the force measurement, the assembly shall be inspected for damage to connectors, terminals, wire and insulation and then subjected to the tests of 4.6.7 and 4.6.8.

4.6.5 Bend radius. To determine conformance to 3.3.6, one end of a harness or cable assembly shall be clamped in a suitable holding fixture. Care must be taken not to damage the assembly with excessive clamping force. A 2.26 (kg) (5 lbs) load shall be applied to the free end of the assembly. A calibrated scale, within an accuracy of ± 2% shall be used to measure the load force. The natural bend radius of the assembly shall not stress the internal wires. There shall be no evidence of damage to the assembly. Upon completion of this test the assembly shall be subjected to the tests of 4.6.7 and 4.6.8.

4.6.6 Crimp tensile strength. To determine conformance to 3.3.7.1.1, a sample shall consist of an identified contact and a 2.5 cm (2 in.) minimum conductor crimped together. An axial force shall be exerted at a speed of 2.5 ± 0.64 cm per minute (1 ±1/4 in. per minute) separating contact and conductor. Tensile strength shall be measured and sample shall be examined.

4.6.7 Direct current resistance. To determine conformance to 3.4.1, the harness and cable assemblies resistance shall be tested in accordance with MIL-STD-202, method 303.

4.6.8 Insulation resistance. To determine conformance to 3.4.2, the harness and cable assemblies shall be tested in accordance with MIL-STD-202, method 302, test condition B. Measurement may be taken prior to the 2 minutes electrification time if the insulation resistance meets the specified limit and is steady or increasing.

4.6.9 Environmental. To determine conformance to 3.4.3, the harness and cable assemblies shall be subjected to the environmental tests specified in 4.6.9.1 through 4.6.9.4. The minimum bend radius test for assemblies over 3 ft in length shall be performed in conjunction with the low temperature tests specified in 4.6.9.2.

4.6.9.1 Humidity. To determine conformance to 3.4.3.1, the harness or cable assembly shall be placed in a humidity chamber and subjected to the test specified in MIL-STD-810, method 507.3, procedure II. During and after the humidity exposure the assembly shall be subjected to the tests of 4.6.7 and 4.6.8.

4.6.9.2 Low temperature. To determine conformance to 3.4.3.2, the harness or cable assembly shall be subjected to low temperature tests of MIL-STD-810, method 502.3, procedure I. The temperature of -51°C (-60°F) shall be maintained for a period of 24 hours (hr). At the end of this time, with the temperature stabilized at -29°C (-20°F), bend the harness or cable assembly (at least 180°) around a 15.24 cm (6 in.) diameter mandrel. There shall be no evidence of cracks, splits or other damage to the jacketing or conduit. After the inspection and with the temperature stabilized at -29°C (-20°F), perform the tests of 4.6.7 and 4.6.8. After testing return the assembly to 22.8 ± 10°C (73 ± 18°F) and perform tests of 4.6.7 and 4.6.8.

4.6.9.3 High temperature. To determine conformance to 3.4.3.3, the harness or cable assembly shall be subjected to the high temperature tests of MIL-STD-810, method 501.3, procedure I. The temperature of 71°C (+160°F) shall be maintained for a period of 48 hr. At the end of this time, return the temperature to 60°C (+140°F) and perform the tests of 4.6.7 and 4.6.8. After testing return the assembly to 22.8 ±10°C (73 ±18°F) and perform the tests of 4.6.7 and 4.6.8. When specified on the applicable harness or cable drawing, the assembly shall be subjected to the extreme high temperature of +149°C (+300°F) for a period of 48 hr and the tests of 4.6.7 and 4.6.8 performed. After testing return the assembly to 22.8 ±10°C (73 ±18°F) and repeat test 4.6.7 and 4.6.8.

4.6.9.4 Submergence. To determine conformance to 3.4.3.4, the harness or cable assembly shall be submerged in a container with the uppermost surface not less than 2.54 cm (1 in.) below the surface of the liquid and subjected to a differential pressure of 20.7 ± 3.5 kPa (3 ± 0.5 psi) (the internal pressure of the assembly is positive with respect to the external pressure) for a period of 5 minutes ± 30 sec. Bubbles coming from within the assembly shall be considered leakage. Bubbles resulting from entrapped air on the exterior surface shall not be considered a leak. Connector caps or any suitable device to prevent leakage through the pin opening is permissible. Before, during and after submergence the assembly shall be subjected to the tests of 4.6.7 and 4.6.8. A 5 minute drip dry period is permissible prior to performance of tests conducted after removal from the liquid container.

5. PACKAGING

5.1 Packaging. For acquisition purposes, the packaging requirements shall be as specified in the contract or order (see 6.2). When actual packaging of materiel is to be performed by DoD personnel, these personnel need to contact the responsible packaging activity to ascertain requisite packaging requirements. Packaging requirements are maintained by the Inventory Control Point's packaging activity within the Military Department or Defense Agency, or within the Military Department's System Command. Packaging data retrieval is available from the managing Military Department's or Defense Agency's automated packaging files, CD-ROM products, or by contacting the responsible packaging activity.

6. NOTES

(This section contains information of a general or explanatory nature which may be helpful, but is not mandatory.)

6.1 Intended use. The harness and cable assemblies are intended to provide electrical interconnection between operating components and test equipment of the M1 tank system. The harness or cable assembly will also provide environmental, mechanical, and RFI protection for individual electrical wiring. The connectors on each assembly are keyed to minimize the possibility of improper mating to equipment.

6.2 Acquisition requirements. Acquisition documents must specify the following:

a. Title, number, and date of this specification.
b. Issue of DoDISS to be cited in the solicitation, and if required, the specific issue of individual documents referenced (see 2.2.1 and 2.3).
c. Harness or cable assembly drawing number and date.
d. If first article samples are not required (see 3.1).
e. If preproduction inspection is required (see 4.2.1).
f. If initial production inspection is not required (see 4.2.2).
g. If inspection conditions should be other than as specified (see 4.3).
h. Sampling plan for control testing (see 4.4).
i. If control tests are not required (see 4.4)
j. Packaging requirements (see 5.1).

6.3 Definitions.

6.3.1 Harness and cable jacketing. Harness and cable jacketing is the exterior elastomeric harness cover which accounts for the assembly's water resistance capability. This elastomeric jacketing includes, but is not limited to, heat shrinkable tubing, heat sealable tape, boots and transitions.

6.3.2 Cable fill factor. The cable fill factor is the ratio of the number of conductor pairs in use to the total number of pairs in a cable. the maximum cable fill is the percentage of pairs in a cable which may be used safely and economically without serious interference with the availability and continuity of service.

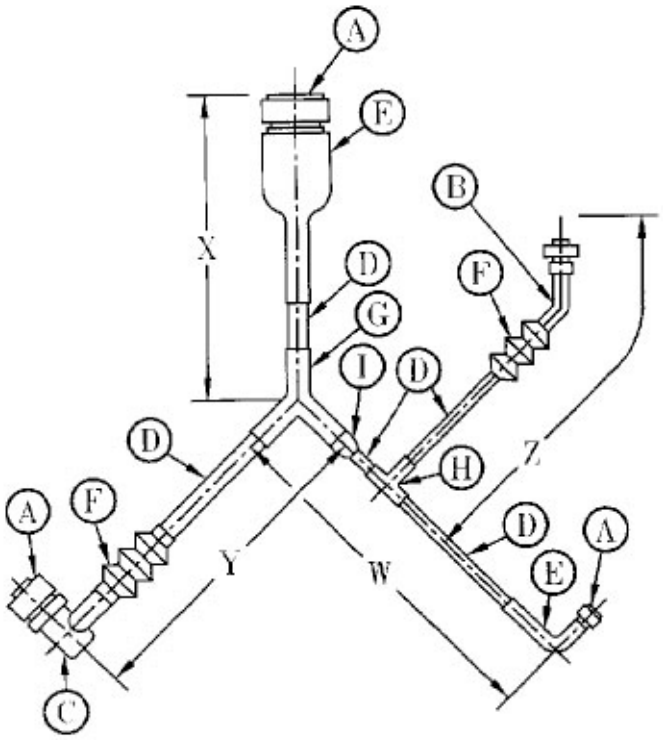
6.4 Disposition of test assemblies. The harness and cable assemblies that have been damaged undergoing tests will not be used and should be indelibly marked "DO NOT USE".

6.5 Subject term (key word) listing.

Adapter boot
Boot
Boot, convoluted
Connector assembly

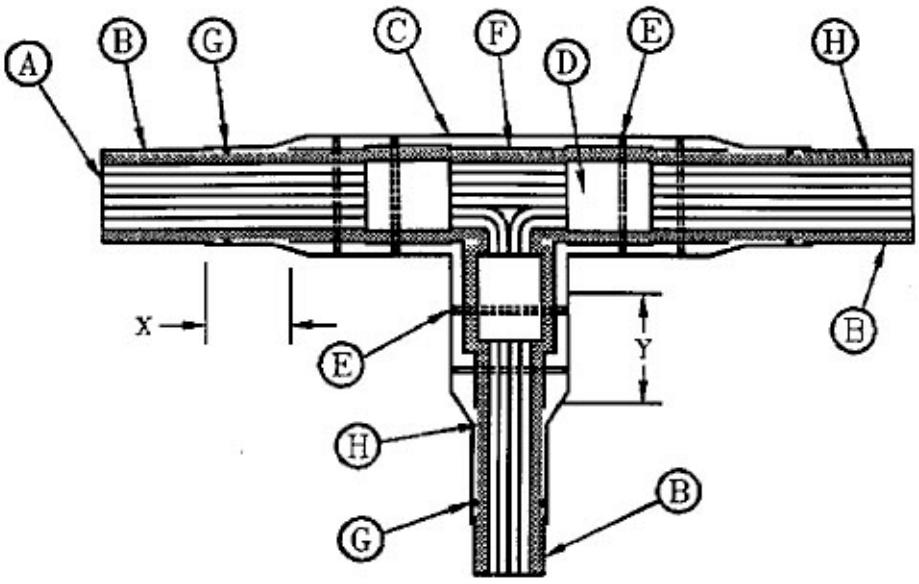
Heat shrinkable tubing
R.F.I. adapter
Transition

6.6 Change from previous issue. Marginal notations are not used in this revision to identify changes with respect to the previous issue due to the extent of the changes.



a. Connector assembly.
b. 45° R.F.I. adapter.
c. 90° R.F.I. adapter.
d. Heat shrinkable tubing.
e. Boot.
f. Boot, convoluted.
g. Transition, “Y”.
h. Transition, “T”.
i. Adapter boot.

FIGURE 1. Composite harness assembly.



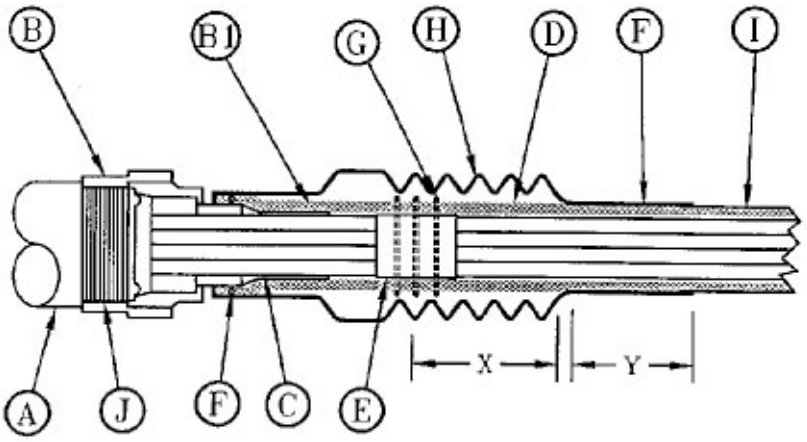
a. Wire bundle.
b. Heat shrinkable tubing/heat sealable tape.
c. Heat shrinkable tubing transition/heat sealable tape transition.
d. Heat shrinkable tubing extend for 1.9 cm (0.75 in.) either side of R.F.I. tubular braid ends.
e. Lacing:
   Tie 2 places each branch, equally spaced or different standard option.
f. R.F.I. shield tape:
   Wrap transition branches with minimum 50% overlapping turns.
g. Adhesive.
h. R.F.I. tubular braid.

Dimension “X” is minimum overlap dimension of transition and harness jacketing. “X” dimension must be greater than 2.54 cm (1.00 in.).

Dimension “Y” is minimum overlap dimension of R.F.I shield tape wrap and R.F.I. tubular braid. “Y” dimension must be greater than 5 cm (2.00 in.).

Harness jacketing may extend over R.F.I. tape wrap.

FIGURE 2. Harness transition (with RFI shielding).



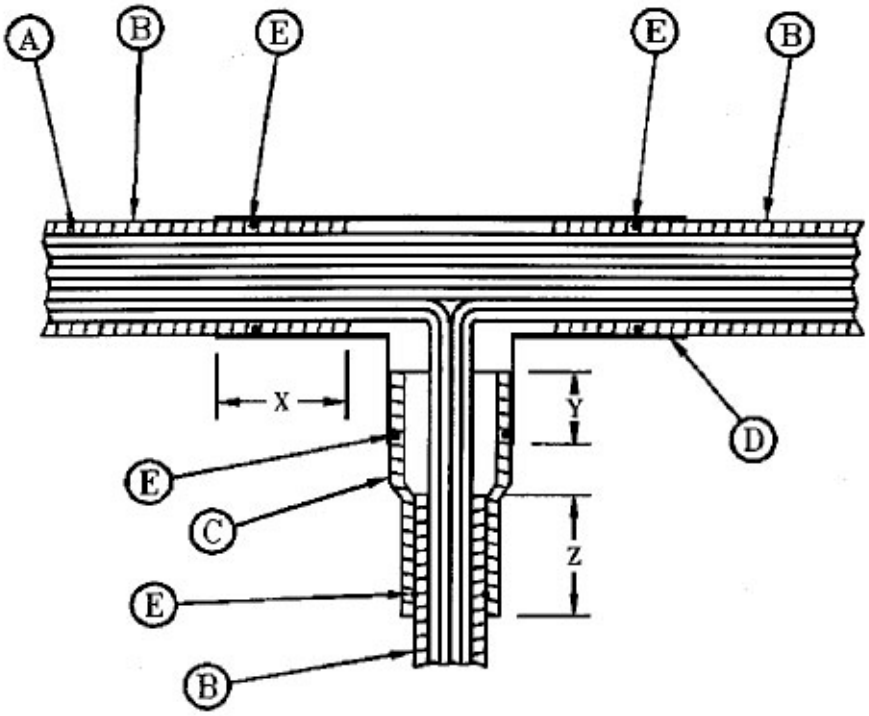
a. Connector assembly.
b. R.F.I. adapter.
   B1. R.F.I. adapter braid, attached
c. Wire bundle.
d. R.F.I. tubular braid.
e. Heat shrinkable tubing/heat sealable tape:
   Extend for 1.9 cm (.75 in.) either side of R.F.I.
   Tubular braid end.
f. Adhesive.
g. Lacing:
   Tie 3 places equally spaced or different standard option.
h. Heat shrinkable convoluted boot.
i. Heat shrinkable tubing/heat sealable tape.
j. R.F.I. adapter nut to be torqued as specified in table II.

"X" dimension is minimum R.F.I. tubular braid overlap dimension.
"X" dimension should be greater than 7.62 cm (3.00 in.).

"Y" dimension is minimum overlap dimension of boot and harness jacketing. "Y" dimension should be greater than 3.8 cm (1.50 in.).

NOTE: This design is not intended to limit construction to features other than as shown hereon by dimensions and notations.

FIGURE 3. Harness termination (with RFI shielding).



a. Wire bundle.
b. Heat shrinkable tubing/heat sealable tape.
c. Heat shrinkable adapter boot
   Use method of adapting shown figure 3.
   If no boot is specified or different standard option.
d. Heat shrinkable tubing transition/heat sealable tape transition.
e. Adhesive.

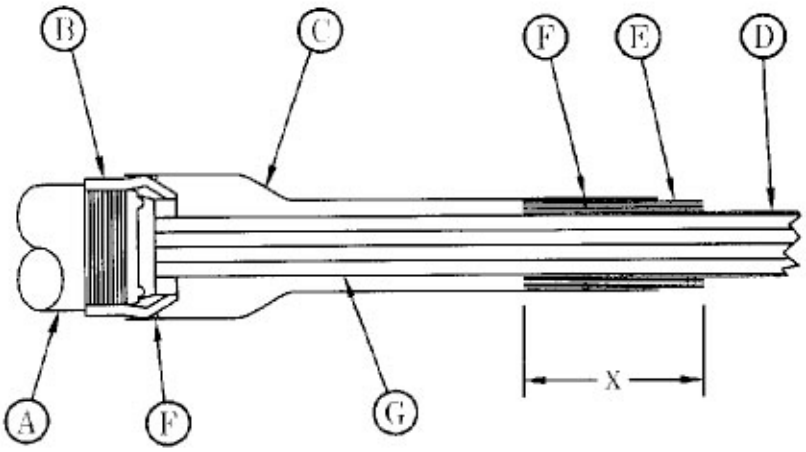
Dimension “X” is minimum overlap dimension must be greater than 2.54 cm (1.00 in.).

Dimension “Y” is minimum overlap dimension of boot and harness jacketing.

Dimension “Z” is minimum overlap dimension of boot and harness jacketing.

These dimensions must be a maximum length attainable, limited by the boot configuration.

FIGURE 4. Harness transition (without RFI shielding).



a. Connector assembly.
b. Backshell.
c. Heat shrinkable boot.
d. Heat shrinkable tubing/heat sealable tape.
e. Heat shrinkable tubing, if required.
To shim under harness jacketing to nominal recovered diameter of boot. Use the method specified on assembly drawing. Heat sealable tape may also be used.
f. Adhesive.
g. Wire bundle.

Dimension "X" is minimum overlap dimension of boot and harness jacketing. "X" dimension must be greater than 3.8 cm (1.50 in.).

NOTE: This design is not intended to limit construction to features other than as shown hereon by dimensions and notations.

FIGURE 5. Harness termination (without RFI shielding).

Custodian:
Army - AT

Preparing Activity:
Army - AT

Review Activity:
DLA - IS

(Project 5995-0130)