

INCH-POUND

MIL-PRF-24758A(SH)

24 September 2004

SUPERSEDING

MIL-C-24758(SH)

05 August 1991

PERFORMANCE SPECIFICATION

CONDUIT SYSTEMS, FLEXIBLE, WEATHERPROOF

This specification is approved for use by the Department of the Navy and is available for use by all Departments and Agencies of the Department of Defense.

1. SCOPE

1.1 Scope. This specification covers the performance requirements for weatherproof flexible conduit systems (see 6.3.12) for use primarily in exposed areas (see 6.3.10) on U.S. Navy ships, to shield against electromagnetic (EM) radiation from own-ship transmitters and emissions external to the ship, electromagnetic pulse (EMP) (see 6.3.8) events, and to minimize corrosion (see 6.3.6) while being field repairable to reduce maintenance.

1.2 Classification. Classification on conduit sizes is as follows:

Nominal ID (inches/metric)	Minimum ID (inches/metric)	Maximum OD (inches/metric)
.25 in (6 mm)	.245 in (6.223 mm)	.58 in (14.732 mm)
.50 in (13 mm)	.495 in (12.573 mm)	.85 in (21.59 mm)
.75 in (19 mm)	.745 in (18.923 mm)	1.10 in (27.94 mm)
1.00 in (25 mm)	.995 in (25.273 mm)	1.41 in (35.814 mm)
1.25 in (32 mm)	1.245 in (31.623 mm)	1.66 in (42.164 mm)
1.50 in (38 mm)	1.495 in (37.973 mm)	1.91 in (48.514 mm)
2.00 in (50 mm)	1.995 in (50.673 mm)	2.44 in (61.976 mm)
2.50 in (63 mm)	2.495 in (63.373 mm)	2.94 in (74.676 mm)

Beneficial comments, recommendations, additions, deletions, clarifications, etc. and any data that may improve this document should be sent to: Commander, Naval Sea Systems Command, ATTN: SEA 05Q, 1333 Isaac Hull Avenue, SE, Stop 5160, Washington Navy Yard DC 20376-5160 or emailed to commandstandards@navsea.navy.mil, with the subject line "Document Comment". Since contact information can change, you may want to verify the currency of this address information using the ASSIST Online database at www.dodssp.daps.mil.

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1.3 Part or identifying number (PIN). PINs to be used for conduits acquired to this specification are created as follows:

M **24758** = **X**
Prefix for Military Specification Size (see code
Specification number below)

Nominal ID (in/mm)	PIN Code
.25 in (6 mm)	A
.50 in (13 mm)	B
.75 in (19 mm)	C
1.00 in (25 mm)	D
1.25 in (32 mm)	E
1.50 in (38 mm)	F
2.00 in (50 mm)	G
2.50 in (63 mm)	H

2. APPLICABLE DOCUMENTS

2.1 General. The documents listed in this section are specified in sections 3, 4, or 5 of this specification. This section does not include documents cited in other sections 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 meet all specified requirements cited in sections 3, 4, or 5 of this specification, whether or not they are listed.

2.2 Government documents.

2.2.1 Specifications, standards, and handbooks. The following specifications, standards, and handbooks form a part of this document to the extent specified herein. Unless otherwise specified, the issues of these documents are those cited in the solicitation or contract.

DEPARTMENT OF DEFENSE SPECIFICATIONS

MIL-S-901 - Shock Tests, H.I. (High Impact) Shipboard Machinery, Equipment, and Systems, Requirements For

DEPARTMENT OF DEFENSE STANDARDS

MIL-STD-167-1 - Mechanical Vibrations of Shipboard Equipment (Type I - Environmental and Type II - Internally Excited)

(Copies of these documents are available online at <http://assist.daps.dla.mil/quicksearch/> or www.dodssp.daps.mil or from the Standardization Document Order Desk, 700 Robbins Avenue, Bldg. 4D, Philadelphia, PA 19111-5094.)

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 these documents are those cited in the solicitation or contract.

ASTM INTERNATIONAL

B117 - Standard Practice for Operating Salt Spray (Fog) Apparatus (DoD adopted)

(Copies of this document are available online at www.astm.org or from ASTM International, 100 Barr Harbor Drive, West Conshohocken, PA 19428-2959.)

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INTERNATIONAL ELECTROTECHNICAL COMMISSION (IEC)

60068-2-5	-	Environmental Testing - Part 2: Tests. Test Sa: Simulated Solar Radiation at Ground Level
60096-1-am2	-	Radio Frequency Cables. Part 1: General Requirements and Measuring Methods - Amendment No. 2
60423	-	Conduits for Electrical Purposes - Outside Diameters of Conduits for Electrical Installations and Threads for Conduits and Fittings
60529	-	Degrees of Protection Provided by Enclosures (IP Code)
60614-1	-	Conduits for Electrical Installations – Specification - Part 1: General Requirements
60614-2-5	-	Specifications for Conduits for Electrical Installations - Part 2: Particular Specifications for Conduits - Section 5: Flexible Conduits
60695-2-4/1	-	Fire Hazard Testing - Part 2: Test Methods - Section 4/Sheet 1: 1 kW Nominal Pre-Mixed Test Flame and Guidance
60754-2	-	Test on Gases Evolved During Combustion of Electric Cables - Part 2: Determination of Degree of Acidity of Gases Evolved During the Combustion of Materials Taken from Electric Cables by Measuring pH and Conductivity
61035-1	-	Specification for Conduit Fittings for Electrical Installations - Part 1: General Requirements
61035-2-3	-	Specification for Conduit Fittings for Electrical Installations - Part 2: Particular Specifications - Section 3: Fittings for Flexible Conduits of Metal, Insulating or Composite Materials and for Pliable Conduits of Metal or Composite Materials

(Copies of these documents are available online at www.iec.ch or from IEC Central Office, 3 rue de Varembe, P.O. Box 131, CH – 1211 Geneva 20, Switzerland.)

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 Measurement units. English units shall be used to the maximum extent possible followed by the metric equivalent.

3.2 First article. When specified (see 6.2), a sample shall be subjected to first article inspection in accordance with 4.2.

3.3 Materials. Materials shall be used which will enable the assemblies to meet the performance requirements of this specification. The external finish of fittings and constituent parts shall be dull and non-reflective. The external finish on the conduit shall be paintable or ship gray in color. Materials used for end fittings shall be interchangeable with like components and mate to existing hardware currently employed aboard U.S. Navy ships.

3.3.1 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.

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3.4 Environmental conditions. Flexible conduits (see 6.3.12), conduit fittings, and constituent parts supplied under this specification shall meet the following environmental conditions (see 6.3.9).

3.4.1 Temperature range. -40°F to +257 °F (-40 °C to +125 °C).

3.4.2 Relative humidity. 10 to 100%.

3.4.3 Solar radiation. 1120±47 watts per meter squared (W/m²).

3.4.4 Shipboard environmental conditions. In addition, the equipment supplied shall be able to withstand salt fog, greenwater loading (see 6.3.13), stack gas and external influences (see 6.3.11), normal wear and tear evolutions such as line and hose handling evolutions, fresh/saltwater washdowns, shipboard shock, and jet blast effects. Equipment applications require satisfactory performance under weapon effects including shock (see 6.3.16) and EMP effects.

3.5 Flexible conduit and fitting size.

3.5.1 Flexible conduit size. Flexible conduit size shall be specified (see 6.2) by nominal ID in accordance with Table I to accommodate Naval shipboard external use applications. For conduits normally provided with a protective coating, the test for measuring the outside diameter will be conducted after the application of the protective coating. Dimensions and tolerances shall be interpreted as specified in Table I.

TABLE I. Conduit sizes.

Nominal ID (inches/metric)	Minimum ID (inches/metric)	Maximum OD (inches/metric)
.25 in (6 mm)	.245 in (6.223 mm)	.58 in (14.732 mm)
.50 in (13 mm)	.495 in (12.573 mm)	.85 in (21.59 mm)
.75 in (19 mm)	.745 in (18.923 mm)	1.10 in (27.94 mm)
1.00 in (25 mm)	.995 in (25.273 mm)	1.41 in (35.814 mm)
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1.50 in (38 mm)	1.495 in (37.973 mm)	1.91 in (48.514 mm)
2.00 in (50 mm)	1.995 in (50.673 mm)	2.44 in (61.976 mm)
2.50 in (63 mm)	2.495 in (63.373 mm)	2.94 in (74.676 mm)

3.5.2 Conduit fittings size. Conduit fittings shall be specified (see 6.2) by nominal ID of flexible conduit in which they are to be installed. Conduit entries in conduit fittings shall be suitable for flexible conduits that will accommodate those conduit sizes listed in Table I. Means shall be provided within the conduit system for securing the conduit to the conduit fitting and internally will provide for protection for the conductors or cables.

3.5.3 Interchangeability. The threads of conduit fittings and constituent parts shall be compatible with standard shipboard interfaces.

3.6 Conduit system. Conduits, conduit fittings, and constituent parts shall provide for installation, removal, inspection, and reinstallation of assemblies between fixed threaded fittings. The conduit system shall have at least one swivel fitting (see 6.3.17) attached, or other means of securing the conduit to the fitting without causing or requiring the conduit to rotate during the fabrication. The conduit system shall provide protection for the conductors and cables contained therein.

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3.7 Conduit/conduit fitting integrity. Conduits when bent or compressed, exposed to vibrations (see 6.3.19), or when exposed to extreme specified temperatures, shall maintain the following properties.

3.7.1 Compression. Conduits, when bent or banded, shall not compress by more than 10% of the conduit initial inside diameter (ID) when subjected to a compression force of 168.60 pounds (lbs) (750 newtons (N)).

3.7.2 Impact. The conduit system shall maintain performance requirements for electrical, electromagnetic, and weatherproofing properties when subjected to 14.75 ft/lbs (20 joules) of blunt impact energy with a fall height of 12 inches plus or minus .25 inches (304mm plus or minus 6 mm).

3.7.3 Vibration. The conduit system shall remain intact and the end fittings are to remain torqued to the manufacturer's specification when tested in accordance with paragraph 4.7.3.

3.7.4 Tensile strength. A complete conduit system with two terminating fittings shall show no damage nor have fittings become loosened when subjected to a tensile force of 224.80 lbs (1000 N).

3.7.5 Flexing. A conduit system with a terminating fitting, assembled according to the manufacturer's instructions, shall have no visible structural damage after two hundred flexings of 120 degrees, at the rate of 20 flexings per minute (min) at each of the temperature limits: -40 °F (-40 °C) to +257 °F (+125 °C). (see 3.4.1) 120° is understood to mean 60° each side of the longitudinal axis.

3.7.6 Resistance to heat. The conduit shall demonstrate resistance to heat at 257 °F (125 °C) and not be depressed under load for the relevant conduit. Conduit fittings and constituent parts shall demonstrate resistance to heat at 257 °F (125 °C) and not dimple under load.

3.7.7 Resistance to flame-propagation. Conduits shall demonstrate resistance to flame-propagation.

3.7.8 Acid gas emission. Conduit systems shall be halogen free (see 6.3.14). The level of acid gas evolved by conduits calculated as hydrochloric shall be not greater than .0001764 ounce (oz) (5 milligrams (mg)) of hydrochloric acid per gram of sample.

3.7.9 Shock. Conduit systems shall maintain performance requirements for electrical/electromagnetic properties and watertight integrity when subjected to nine hammer blows from a medium weight shock machine.

3.8 Weatherproofing. The conduit system shall be inherently weatherproof from end fitting to end fitting. The conduit system, with the ends of both terminating fittings plugged, shall allow no ingress of water when subjected to a water jet of 26.42 gallon (100 liters)/min \pm 5%, from a .49-inch (12.5-mm) diameter nozzle at a distance of 8.20 to 9.84 feet (2.5 to 3 meters) for 3 minutes.

3.9 External corrosion. Conduit systems shall be constructed of materials that provide external corrosion protection. Conduit systems shall show no evidence of corrosion when subjected to a cyclic sulfur dioxide/salt fog (SO₂/NaCl) test.

3.9.1 Corrosion and polluting substances. Conduit systems shall demonstrate a high degree of protection against corrosion, both outside and inside, when flexed to the minimum bend radius of 8 times the conduit's outside diameter (OD).

3.9.2 Solar radiation. The conduit system shall not degrade in electrical or mechanical performance due to exposure to 10 cycles of solar radiation. The conduit shall be resistant to solar radiation as defined in 3.4.3.

3.10 EM signal attenuation. EM signal attenuation over a frequency range of 100 KHz to 600 MHz for a conduit system shall not exceed a surface transfer impedance of 100 milliohms per meter.

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3.11 Marking. Conduits shall be marked with:

- a. Name of the manufacturer, responsible vendor, trademark, or other identifying symbol.
- b. Classification codes in accordance with applicable IEC 60614-1 Annex A.
- c. Any other mark or symbol required by IEC 60614-2-5 Annex A.
- d. "Halogen Free" shall appear on all conduits.

The markings on conduits and conduit fittings shall be legibly and permanently marked on the material, and located as described in 3.11.1 and 3.11.2 to insure readability when the fittings are installed.

3.11.1 Flexible conduit marking. The weatherproof jackets of flexible conduits shall be paintable or surface ship gray in color. If a conduit is marked with a type reference and/or a size, these markings are placed before the identification of the manufacturer or responsible vendor. Marking of classification codes shall be in accordance with Annex A of IEC 60614-2-5. Markings of conduits shall be at 11.81-inch (30-cm) intervals.

3.11.2 Conduit fittings marking. Each conduit fitting shall be marked with:

- a. Name of the manufacturer, responsible vendor, trademark, or other identifying symbol.
- b. Classification codes in accordance with IEC 61035-1 Annex A.

4. VERIFICATION

4.1 Classification of inspections. The inspection requirements specified herein are classified as follows:

- a. First article inspection (see 4.2).
- b. Conformance inspection (see 4.3).

4.2 First article inspection. First article inspection shall be performed as specified (see 3.2). This inspection shall include the examination of 4.4 and the tests listed in Table II. Any changes to the product design, materials, or production process shall automatically require re-testing and re-certification of product samples.

TABLE II. First article inspection.

Test	Requirement Paragraph	Verification Paragraph
Flexible conduit size	3.5.1	4.5.1
Conduit fittings size	3.5.2	4.5.2
Interchangeability	3.5.3	4.5.3
Conduit and joint/systems	3.6	4.6
Compression	3.7.1	4.7.1
Impact	3.7.2	4.7.2
Vibration	3.7.3	4.7.3
Tensile strength	3.7.4	4.7.4
Flexing	3.7.5	4.7.5
Resistance to heat	3.7.6	4.7.6

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TABLE II. First article inspection - Continued.

Resistance to flame-propagation	3.7.7	4.7.7
Acid gas emission	3.7.8	4.7.8
Shock	3.7.9	4.7.9
Weatherproofing	3.8	4.8
External corrosion	3.9	4.9
Corrosion and polluting materials	3.9.1	4.9.1
Solar radiation	3.9.2	4.9.2
EM signal attenuation	3.10	4.10
Marking	3.11	4.11
Flexible conduit markings	3.11.1	4.11
Conduit fittings markings	3.11.2	4.11

4.3 Conformance inspection. Conformance inspection shall include the examination of 4.4 and the tests listed in Table III.

4.3.1 Conditions for testing. Testing of the conduit and conduit fittings shall be as specified in IEC 60614-1 and IEC 61035-1 and the following if not specified:

- a. Unless otherwise specified, the tests shall be carried out at an ambient temperature of 68 ± 5 °F (20 ± 5 °C).
- b. Unless otherwise specified, each test shall be made on three new samples. Certain tests, such as the checking of dimensions, clearly does not affect a change in the property of the samples, and therefore these samples shall be considered as new samples and can be used for further tests.
- c. The atmosphere shall have a relative humidity of 45 to 75%.
- d. Environmental tests may be combined when cost effective and approved by the procuring activity.

TABLE III. Conformance inspection.

Test	Requirement Paragraph	Verification Paragraph
Flexible conduit size	3.5.1	4.5.1
Conduit fitting size	3.5.2	4.5.2
Tensile strength	3.7.4	4.7.4
Marking	3.11	4.11

4.4 Examination. Each conduit, end fitting, and adapter shall be examined for compliance with the requirements specified in 3.6 through 3.11.2. Any redesign or modification of the contractor's standard product to comply with specified requirements, or any necessary redesign or modification following failure to meet the specified requirements, shall receive particular attention for adequacy and suitability. This element of inspection shall encompass all visual examinations and dimensional measurements. Noncompliance with any specified requirement or presence of one or more defects preventing or lessening maximum efficiency shall constitute cause for rejection.

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4.5 Flexible conduit and fitting size. To determine conformance with the flexible conduit and fitting size requirement of 3.5, each representative sample of flexible conduit and end fitting shall be measured for minimum ID and maximum OD as specified in 4.5.1 and 4.5.2.

4.5.1 Flexible conduit size. To determine conformance with the flexible conduit minimum ID requirement of 3.5.1, each representative sample of conduit shall be gauge checked as specified in IEC 60614-2-5, and Table I. The appropriate ID gauge shall pass through the conduit under its own weight and without any initial speed. To determine conformance with the flexible conduit maximum OD requirement of 3.5.1, each representative sample of conduit shall be checked as specified in IEC 60423, and Table I. The appropriate OD gauge shall slide over the conduit without excessive force, and be tested after the protective cover has been applied.

4.5.2 Conduit fitting size. To determine conformance with the conduit fitting ID requirements of section 3.5.2, each representative sample of conduit fitting shall be checked by means of the appropriate ID gauge used in 4.5.1. As an alternative, conformance of the minimum ID shall be demonstrated by two measurements taken with an inside caliper at radial positions 90 ± 10 degrees from the midpoint of the fitting ID. Any measurement less than the minimum ID will constitute a failure of conformance to the requirement. Conduit fitting sizes will accommodate the conduits listed in Table I.

4.5.3 Interchangeability. To determine conformance with the interchangeability requirement of 3.5.4, each representative sample of conduit fitting, adapter, associated fitting, and constituent part shall provide for installation between fixed equipment or threaded fittings such as kickpipes and stuffing tubes.

4.6 Conduit and joint/systems. To determine conformance with the conduit and joint/system requirements of 3.6, each representative sample of conduit, end fitting, and constituent part shall be installed on a test fixture in accordance with the manufacturer's published instructions. End fittings shall be torqued to the manufacturer's published specifications to meet installation requirements. Upon completion of the installation, the conduit system shall be removed from the test fixture. The conduit system shall be reinstalled on the test fixture in accordance with the manufacturer's instructions and the end fittings torqued to the manufacturer's specifications. Upon completion of the installation, removal, and reinstallation of the conduit system, a visual inspection shall be performed to include verification of at least one swivel fitting, or other means of securing the conduit to the fitting without causing or requiring the conduit to rotate during the fabrication. Evidence of cracks or visible damage to the conduit or end fitting integrity constitutes failure of conformance to requirements. The test environment temperature shall be maintained at 68 ± 3 °F (20 ± 3 °C). This verification should be performed prior to shock testing, and may use the bedplate of the shock test platform.

4.7 Conduit/conduit fitting integrity tests.

4.7.1 Compression. To determine conformance with the conduit compression requirements of 3.7.1, each representative sample of conduit shall be tested as specified in IEC 60614-1. The exception is maximum compression, when measured under full load, shall not exceed 10% of the conduit ID.

4.7.2 Impact. To determine conformance with the conduit system impact requirements of 3.7.2, each representative sample of conduit fitting, adapter, and constituent part shall be tested as specified in IEC 61035-1. Any signs of disintegration or visible cracks in any of the representative samples shall be cause for rejection.

4.7.3 Vibration. To determine conformance with the conduit system and vibration requirements of 3.7.3, each representative sample of conduit shall be tested as specified in MIL-STD-167-1, Type 1. Failure of the sample to remain intact and failure of the end fittings to remain torqued to the manufacturer's specification shall constitute cause for rejection.

4.7.4 Tensile strength. To determine conformance with the conduit system tensile strength requirements of 3.7.4, each representative sample of conduit system, torqued to manufacturer's specification, shall be tested as specified in IEC 60614-2-5 with a tensile force of 224.80 lbs (1000 N). After the test, the terminating fittings shall

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remain properly assembled to the conduit and there shall be no damage visible to normal or corrected vision without additional magnification.

4.7.5 Flexing. To determine conformance with the conduit flexibility requirements of 3.7.5, each representative sample of conduit system shall be tested as specified in IEC 60614-2-5. After the test, there shall be no structural damage visible to normal or corrected vision without additional magnification, and the stated classification level of protection for the conduits shall not be reduced.

4.7.6 Resistance to heat. To determine conformance with the conduit resistance to heat requirement of 3.7.6, each representative sample of conduit shall be tested as specified in IEC 60614-2-5, except the high temperature shall be 257 °F (125 °C). The samples are to be conditioned at the high temperature for 4 hours, then loaded with the specified weight, and returned to the heating cabinet for 24 hours. Verification shall be the vertical passing of the specified test gauge through the samples, once cooled to room temperature. To determine conformance with the fitting resistance to heat requirements of 3.7.6, each representative sample fitting, as appropriate, shall be tested as specified in IEC 61035-2-3 at a temperature of 257 °F (125 °C).

4.7.7 Resistance to flame-propagation. To determine conformance with the resistance to flame-propagation requirements of 3.7.7, each representative sample of conduit shall be tested as specified in IEC 60614-1. The test flame shall be as specified in IEC 60695-2-4/1. The time exposure of the sample to the test flame shall be 60 ± 5 seconds. Representative samples 26.57 ± 0.39 inches (675 ± 10 mm) in length are mounted vertically in a rectangular metal enclosure, which has one open side, in a draft free surrounding. Mounting is by means of two metal clamps equidistant from each end of the sample. A steel rod, of a diameter as specified, passed centrally through and extending to the bottom of the sample, is independently mounted at the enclosure top. A piece of white pine board approximately 0.39 inches (10 mm) thick covered with a single layer of tissue paper, as specified, is positioned below the sample. After the removal of the flame and after the burning of the sample has ceased, the surface of the sample is wiped clean by rubbing with a piece of cloth soaked with water. If the sample has no evidence of burning or charring within 1.96 inches (50 mm) of any part of the clamp, or ceases to propagate flame after 30 seconds of removal of test flame, and the tissue paper does not ignite, the sample shall be deemed to have passed the test.

4.7.8 Acid gas emission. To determine conformance with the level of acid gas emission requirement of 3.8.8, each representative sample of conduit shall be tested as specified in IEC 60754-2.

4.7.9 Shock. To determine conformance with the conduit system shock requirements of 3.7.9, each representative sample of conduit shall be tested as specified in MIL-S-901.

4.8 Weatherproofing. To determine conformance with the conduit system ingress of water requirement of 3.8, each representative sample of conduit system shall be tested as specified in IEC 60529 clause 14.2.6. The assembly with both end fittings plugged is deemed to have passed the test if no ingress of water is detected inside the test sample following the test.

4.9 External corrosion. Conformance to the external corrosion requirements of 3.9 shall be verified by a cyclic sulfur dioxide/salt fog (SO_2/NaCl) test. The test sample shall be a representative conduit system. The test chamber shall be per ASTM B117. The test conditions shall include a 30 ± 2 -min spray of 5% NaCl salt solution, then a 30 ± 2 -min exposure to SO_2 gas flow of $35 \text{ cm}^2/\text{min}/\text{m}^3$, followed by a 120 ± 4 -min rest period, to be repeated for four weeks. Upon completion of the test, the sample shall be examined for visual evidence of corrosion. Any corrosion, rust, staining, pitting, scaling, or other evidence of corrosion shall constitute failure to conform to the requirements of 3.9.

4.9.1 Corrosion and polluting materials. To determine conformance with the conduit corrosion and polluting materials requirement of 3.9.1, each representative sample of conduit system shall be tested as specified in IEC 60614-1 with the flexible conduits flexed to their minimum bend radius.

4.9.2 Solar radiation. To determine conformance with the conduit solar radiation protection requirements of 3.9.2, each representative sample of conduit system shall be tested as specified in IEC 60068-2-5.

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4.10 EM signal attenuation test procedure for 100 KHz to 600 MHz. EM signal attenuation testing shall be the final test conducted and shall not immediately follow the tests of 4.7.8, 4.8, 4.9, or 4.9.1. The conduit system with terminated end fittings shall not exceed a surface transfer impedance of 100 milliohms per meter over the frequency range of 100 KHz to 600 MHz, as specified by IEC 60096-1-amendment 2, line injection method.

4.11 Marking. Each conduit jacket shall be inspected to determine that it is marked as specified in 3.11. Each end fitting and constituent parts shall be inspected to determine that it is marked as specified in 3.11.2. Marking according to 3.11 through 3.11.2 shall be checked by inspection, and by rubbing the marking by hand for 15 seconds with a piece of cloth soaked with water, and again for 15 seconds with a piece of cloth soaked with petroleum spirit. Any markings, which are missing in whole or in part, faded, smeared, blurred, or shifted (dislodged) to the extent they cannot be readily identified from a distance of 5.90 inches (15 cm) with normal lighting, shall be evidence of failure to conform to the requirements of 3.11 through 3.11.2.

5. PACKAGING

5.1 Packaging. For acquisition purposes, the packaging requirements shall be as specified in the contract or order (see 6.2). When packaging of materiel is to be performed by DoD or in-house contractor personnel, these personnel need to contact the responsible packaging activity to ascertain packaging requirements. Packaging requirements are maintained by the Inventory Control Point's packaging activities within the Military Service or Defense Agency, or within the military service's system commands. 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 that may be helpful, but is not mandatory.)

6.1 Intended use. The conduit, end fittings, and constituent parts covered by this specification are intended to shield electrical and electronic cables aboard U.S. Navy ships from the influence of external electromagnetic fields, that can be generated from own-ship transmitters or emissions external to the ship and/or EMP. The conduit systems are also intended to have low or no corrosion, provide easy maintenance, be field repairable and reusable, and reduce costs. Recommended material used for end fittings is stainless 316, or nickel-teflon plated aluminum. The primary EM frequencies of interest are those between 100 KHz and 600 MHz. Requirements for flexible conduit, end fittings, and constituent parts that provide magnetic shielding below 100 KHz, are addressed in Shipboard Electromagnetic Shielding Practices, S9407-AB-HBK-010. Material compatibility requirements are provided in Shipboard Bonding, Grounding, and Other Techniques for Electromagnetic Compatibility and Safety, MIL-STD-1310; and Dissimilar Metals, MIL-STD-889. This method of cable shielding applies to topside cables routed to connection boxes. The use of a brazed stuffing tube on the connection box facilitates weatherproofing of the end fitting by moving the conduit interface away from the connection box. This method also provides improved cable shield grounding as compared to the previous method of conduit termination to connection boxes.

6.2 Acquisition requirements. Acquisition documents should specify the following:

- a. Title, number, and date of the specification.
- b. When first article inspection is required (see 3.2).
- c. Quantity and size of conduit required (see 3.5.1).
- d. Quantity and size of fitting required (see 3.5.2).
- e. Packaging (see 5.1).

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6.3. Definitions. The definitions specified in ANSI/IEEE 100 and 6.3.1 through 6.3.19 apply.

6.3.1 Commercial and government entity (CAGE). A five-position code that identifies companies doing or wishing to do business with the U.S. Federal Government.

6.3.2 Conduit fitting. A device designed to join or terminate one or more portions of a conduit installation.

6.3.3 Conduit joint. An interface between two or more components of a conduit system, or between a conduit system and another piece of equipment.

6.3.4 Constituent parts. Any device used to join together two fittings, which differ in diameter, thread size, or thread type. Such constituent parts include end fittings, panel fittings, threaded pipe fittings, tapered pipe fittings, kick pipes, and stuffing tubes.

6.3.5 Conduit system. The physical makeup of a section of conduit with an end fitting attached to each end, one of which being a swivel fitting.

6.3.6 Corrosion. A specific type of deterioration resulting in damage or impairment of metals or metallic parts as the result of attack by moisture, air, acid, alkali, chemicals, or electrochemical action.

6.3.7 Design activity code. The design activity CAGE code is part of the item identification number and where the manufacturer is not the design activity, both the manufacturer and the subcontractor CAGE codes are required on the item except for military specification or approved standard parts. If the CAGE code and the part number are applied on one line, a dash or virgule separates the number from the code.

6.3.8 Electromagnetic pulse (EMP). A transient, high-intensity electromagnetic field, EMP is commonly associated with nuclear explosions in or near the Earth's atmosphere. However, EMP can arise from other sources, such as lightning.

6.3.9 Environmental conditions. Flexible conduits, conduit fittings, and constituent parts supplied under this specification perform in a shipboard exposed (see 6.3.10) environment, and have an initial shielding effectiveness minimum of 56 decibels (dB), with service performance minimum of 40 dB after an expected service life of at least 12 years. This requires a performance degradation of no more than 1.3 dB/yr.

6.3.10 Exposed areas. Installations that are not protected from the external environment.

6.3.11 External influences. Examples of external influences are the presence of water, low and high temperatures, corrosive or polluting substances, and solar radiation.

6.3.12 Flexible conduit. A conduit which can be bent by hand with a reasonable small force, but without any other assistance, which is intended to flex frequently throughout its service life without significant loss of its characteristics, and if suspended at its ends may be approximated by a catenary curve.

6.3.13 Greenwater loading. A mechanical loading due to wave slap. (The requirement is 6.09 pounds per square inch (PSI) (42 kilopascal) for surface craft.)

6.3.14 Halogen free conduit. A conduit that on combustion produces a low level of acid gas emission. (The level of acid gas evolved by conduits calculated as hydrochloric is not greater than .0001764 oz (5 mg) of hydrochloric acid per gram of sample, reference IEC 60614-1 clause 11.2.1.)

6.3.15 Identifying number. The identifying number is as specified in the acquisition document. The identifying number may be a part number as defined in DoD 4120.3-M and in ASME Y14.100, Appendix B,C,D, and E, a type number, a type designation, or a number identifying a definitive acquisition document, which specifies the requirements for the part and the applicable CAGE codes of the manufacture and design activity. All parts may

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be marked with a logo, in lieu of the CAGE code, if the product specification or contract so determines they are too small to be marked with a CAGE code.

6.3.16 Shock. The relative infrequent, non-repetitive slams, or transient vibrations encountered in handling, transportation, and service conditions.

6.3.17 Swivel. A link, pivot, or other fastening, so designed that it permits free turning of attached parts. A conduit system has at least one swivel fitting attached.

6.3.18 System. A system is a composite of equipment, skills, and techniques capable of performing or supporting an operational role or both. A complete system includes all equipment, related facilities, material, software, services, and personnel required for its operation and support to the degree that the system could be considered a self-sufficient unit in its intended operational environment. A combination of two or more sets, which may be physically separated when in operation, and such other assemblies, subassemblies, and parts necessary to perform an operational function or functions. (Examples: electronic system, fire control system, computer, and gun mount.)

6.3.19 Vibration. The relative frequent, repetitive linear motion of a system, about an equilibrium position. Naval vessels are subject to environmental vibrations, caused by sea conditions, rotating machinery, or propulsion systems.

6.4 Subject term (key word) listing.

Electromagnetic interference (EMI)

Electromagnetic pulse (EMP)

Fitting

6.5 Changes 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.

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NOTE: The activities listed above were interested in this document as of the date of this document. Since organizations and responsibilities can change, you should verify the currency of the information above using the ASSIST Online database at www.dodssp.daps.mil.