

INCH-POUND

MIL-PRF-32471

10 September 2013

## PERFORMANCE SPECIFICATION

## POTTED ARAMID FIBER STRENGTH MEMBER FOR NAVY LIFELINES

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

## 1. SCOPE

1.1 Scope. This specification covers requirements for Navy lifeline strength members, comprising jacketed aramid fiber rope, and potted end fittings with threaded connections, used topside onboard U.S. Navy ships. The term “strength member” is equivalent to the term “terminated cable assembly” used herein and both terms apply to items covered by this specification.

## 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 must meet all specified requirements of documents 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.

## FEDERAL STANDARDS

FED-STD-H28 - Screw-Thread Standards for Federal Services

## 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.dla.mil/quicksearch/> or <https://assist.dla.mil/>.)

Comments, suggestions, or questions on this document should be addressed to: Commander, Naval Sea Systems Command, ATTN: SEA 05S, 1333 Isaac Hull Avenue, SE, Stop 5160, Washington Navy Yard DC 20376-5160 or emailed to [CommandStandards@navy.mil](mailto:CommandStandards@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 <https://assist.dla.mil>.

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2.2.2 Other Government documents, drawings, and publications. The following other Government documents, drawings, and publications 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.

## CODE OF FEDERAL REGULATIONS

- 47 CFR 15, Section 205 - Telecommunications; Radio Frequency Devices, Restricted Bands of Operation
- 47 CFR 15, Section 225 - Telecommunications; Radio Frequency Devices, Operation within the Band 13.110-14.010 MHz

(Copies of these documents are available from the Superintendent of Documents, U.S. Government Printing Office, Washington DC 20401 or online at [www.gpoaccess.gov/index.html](http://www.gpoaccess.gov/index.html).)

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

- ASTM B117 - Standard Practice for Operating Salt Spray (Fog) Apparatus
- ASTM B211 - Standard Specification for Aluminum and Aluminum-Alloy Rolled or Cold Finished Bar, Rod, and Wire
- ASTM B221 - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes
- ASTM B241/B241M - Standard Specification for Aluminum and Aluminum-Alloy Seamless Pipe and Seamless Extruded Tube
- ASTM B308/B308M - Standard Specification for Aluminum-Alloy 6061-T6 Standard Structural Profiles
- ASTM D1623 - Standard Test Method for Tensile and Tensile Adhesion Properties of Rigid Cellular Plastics
- ASTM D2240 - Standard Test Method for Rubber Property – Durometer Hardness
- ASTM D5963 - Standard Test Method for Rubber Property – Abrasion Resistance (Rotary Drum Abrader)
- ASTM G154 - Standard Practice for Operating Fluorescent Light Apparatus for UV Exposure of Nonmetallic Materials

(Copies of these documents are available from ASTM International, 100 Barr Harbor Dr., P.O. Box C700, West Conshohocken, PA 19428-2959 or online at [www.astm.org](http://www.astm.org).)

## SAE INTERNATIONAL

- SAE-AMS-QQ-A-200/8 - Aluminum Alloy 6061, Bar, Rod, Shapes, Tube, and Wire, Extruded UNS A96061
- SAE-AMS-QQ-A-225 - Aluminum and Aluminum Alloy, Bar, Rod, Wire, or Special Shapes; Rolled, Drawn, or Cold Finished, General Specification for

(Copies of these documents are available from SAE World Headquarters, 400 Commonwealth Drive, Warrendale, PA 15096-0001 or online at [www.sae.org](http://www.sae.org).)

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2.4 Order of precedence. Unless otherwise noted herein or in the contract, 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. When specified (see 6.2), a sample terminated cable assembly shall be subjected to first article inspection in accordance with 4.2.

3.2 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. The assembly shall consist of a cable assembly, end fittings, potting, and a radio-frequency identification (RFID) tag.

#### 3.4 Assembly.

3.4.1 Terminated cable assembly. The lifeline cable assembly shall be connected to the termination fitting through the use of potted synthetic bonding material.

3.4.2 Termination fitting. The potted cable termination fitting is an 11-degree cone. The angle refers to the walls of the resin cone used in the potting. The potted cable termination fittings dimensions shall be in accordance with [figure 1](#). The termination sleeve is threaded with a 1.375-12UNF-2A thread in accordance with FED-STD-H28 as shown on [figure 2](#).

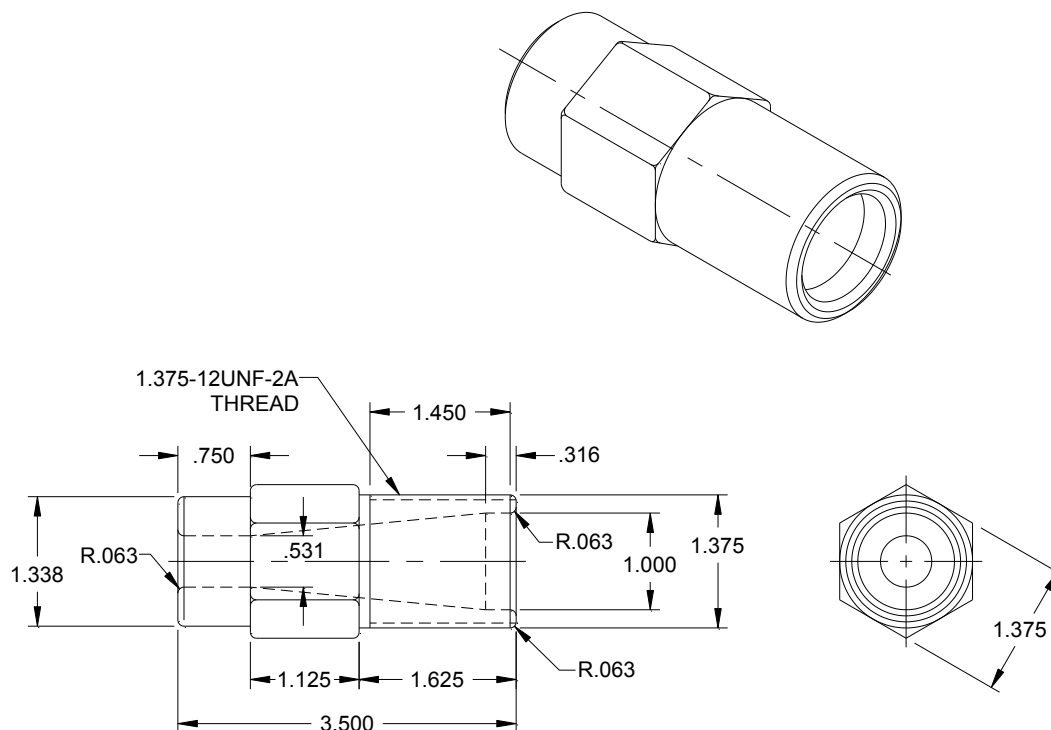


FIGURE 1. Drawing of 11-degree termination fitting.

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The procedure to make a potted termination on a rope begins with stripping a length of jacket off of the end of the rope equal to the length of the cone in the termination fitting. Strip 1.25 inches from each end of the rope. In addition to the jacket being stripped, split an additional 0.5 inch of jacket, but leave on the rope before potting. This allows the jacket to adhere to the potting resin and prevents the jacket from working its way down the rope over time.

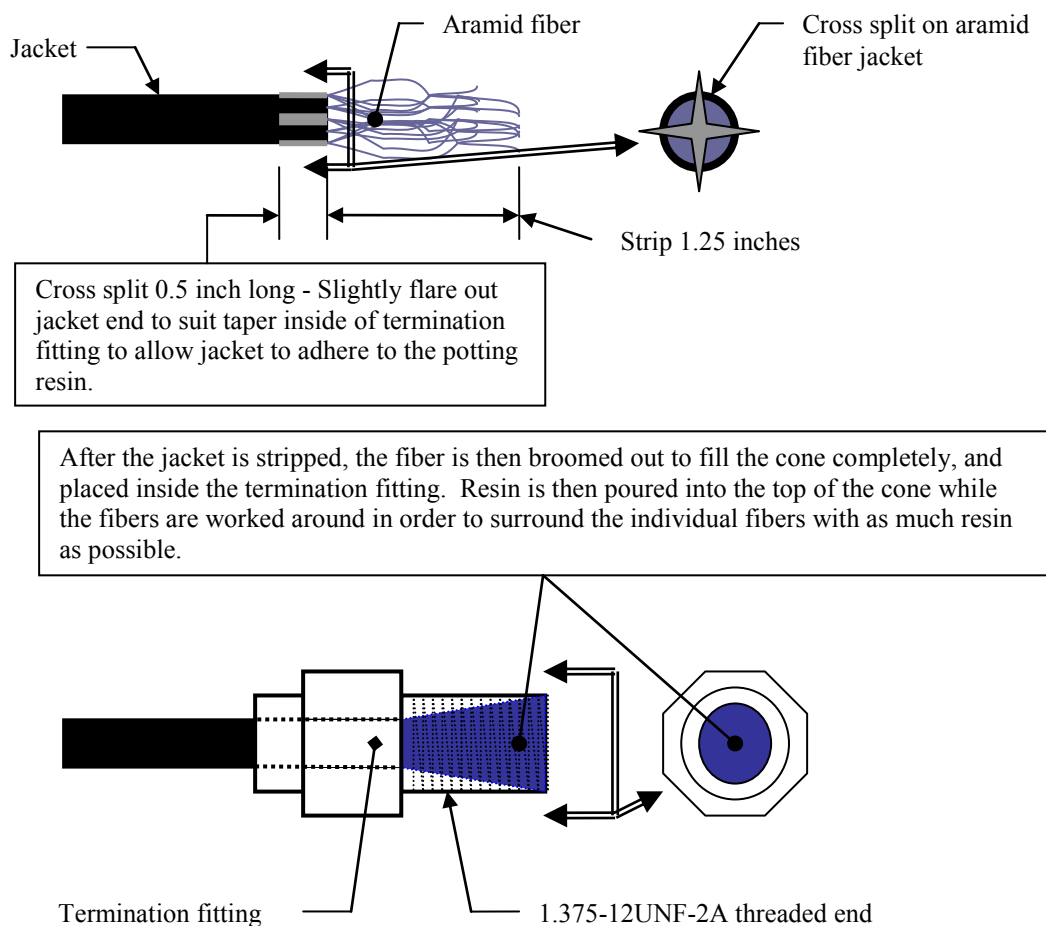


FIGURE 2. Procedure for potted assembly and termination fitting installation on lifelines (typical at each end).

3.4.3 Lifeline cable assembly. The lifeline cable assembly shall be a jacketed aramid fiber rope. The cable assembly shall be 0.5 inch outside diameter, +0.010 inch, -0.020 inch. The extruded fiber assembly jacket shall be  $0.0625 \pm 0.005$  inch thick.

3.4.4 Preparation for potting. The procedure to make a potted termination on a rope shall begin with stripping a length of jacket off of the end of the rope equal to the length of the cone in the termination fitting. In [figure 2](#), 1.25 inches were stripped from each end of the rope. In addition to jacket being stripped, an additional 0.5 inch of jacket shall be split, but left on the rope before potting. This allows the jacket to adhere to the potting resin and prevent the jacket from working its way down the rope over time.

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### 3.5 Materials.

3.5.1 Termination fittings. End fittings shall be 6061T6, black anodized aluminum in accordance with SAE-AMS-QQ-A-200/8, SAE-AMS-QQ-A-225, ASTM B211, ASTM B221, ASTM B241/B241M, or ASTM B308/B308M.

3.5.2 Jacket. The extruded jacket shall be a polyurethane elastomer selected for abrasion resistance and ultraviolet (UV) exposure.

3.6 Potting material. The potting material resins shall be selected for use with aramid fiber rope.

### 3.7 Physical characteristics.

3.7.1 Ability to detach for inspection. The potted termination fitting shall have the ability to release the potted end to allow for easy inspection of the cable termination for external voids, deformation, and cracks.

3.7.2 Appearance. Terminated cable assemblies shall be clean and free of defects that affect appearance, such as burrs, slivers, sharp edges, rough tool or grind marks, pitting, staining, blistering, flaking, peeling, or discoloration of the exposed surfaces. The jacket shall be thoroughly bonded to the substrate and free from blisters and air bubbles. Terminated cable assemblies shall be free of film, foreign matter embedded in the finish, a coated surface that has sags, runs, fractured, buckled, bent, punctured, or malformed parts. The potting shall have no cracks when examined after assembly testing in accordance with 4.6.7.2. The potting surface shall have no more than four voids; and any voids shall be less than 1/8 inch long by 1/8 inch wide and shall be less than 1/16 inch deep. The cable jacket surface of the cable shall have a shore hardness Type A range of 85 to 90 and shall have a uniform, matte black color.

3.8 Marking. Terminated cable assemblies shall be provided with passive RFID bonded to the end of the pot on one side of the terminated cable assembly. The RFID tag marking shall be retrievable by an RFID active reader in accordance with 47 CFR 15, Sections 205 and 225. The RFID tag shall be marked with the following information:

- a. Vendor name.
- b. Vendor Contractor and Government Entity (CAGE) Code.
- c. Month/date lifeline assembly was pull tested.
- d. Government contract number that ordered the lifeline assembly.
- e. Length of terminated cable assembly.
- f. Type of potted resin used in terminated cable assembly.
- g. Synthetic fiber type.

### 3.9 Performance characteristics.

3.9.1 Environmental conditions. Terminated cable assemblies shall maintain strength at temperatures between -20 °F (-29 °C) and +140 °F (+60 °C).

3.9.2 Minimum acceptance strength. Terminated cable assemblies shall be capable of withstanding a tension of 12,500 pounds without breaking, deforming the assembly, or cracking the jacket.

3.9.3 UV deterioration resistance. The lifeline cable assembly jacket material shall be capable of maintaining 90 percent of its axial strength when exposed to 20 iterations of UV Exposure Cycle 6 in accordance with ASTM G154.

3.9.4 Resistance to salt fog and humidity. Each terminated cable assembly shall be capable of withstanding an 11,000-pound tension for 10 minutes after being exposed to a test chamber salt fog for 240 hours in accordance with ASTM B117.

3.9.5 Vibration resistance. Each terminated cable assembly shall be capable of withstanding an 11,000-pound pull test for 10 minutes without breaking or deforming the assembly or cracking the jacket after being subjected to an endurance vibration test for a minimum of 2 hours in accordance with 4.6.4.

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3.9.6 Abrasion resistance. Each cable assembly jacket shall be capable of withstanding abrasion created by shipboard lines and hoses typically passed over the lifelines in port as defined by an abrasion resistance index of 90 or greater in accordance with ASTM D5963.

## 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).

TABLE I. Examinations and inspections.

<b>Test requirement</b>	<b>Requirement paragraph</b>	<b>Verification paragraph</b>	<b>First article</b>	<b>Conformance</b>
Examination	3.1 through 3.5	4.4	X	X
Strength tests	3.1, 3.9.1, and 3.9.2	4.6.1	X	
UV deterioration tests	3.1 and 3.9.3	4.6.2	X	
Salt fog and humidity test	3.1 and 3.9.4	4.6.3	X	
Vibration test	3.1 and 3.9.5	4.6.4	X	
Abrasion resistance test	3.1 and 3.9.6	4.6.5	X	
Jacket hardness test	3.1 and 3.7.2	4.6.6	X	

4.2 First article inspection. When specified (see 6.2), first article inspection and approval shall be accomplished in accordance with the requirements listed. This inspection shall include the examination of 4.4 and the tests of 4.6.1 through 4.6.7.

4.3 Conformance inspection. Conformance inspection shall include the examination of 4.4 and the tests of 4.6.

4.4 Examination. Each terminated cable assembly shall be examined for compliance with the requirements specified in 3.3 through 3.9.6. Terminated cable assemblies shall be subjected to a thorough inspection to ascertain that the material, fittings, joining of parts or assemblies, finish, color, and markings are in accordance with this specification. Terminated cable assemblies shall be inspected to ensure that the jacket is thoroughly bonded to the substrate and free from blisters and air bubbles. The RFID data shall be verified to be complete and in accordance with 3.8.

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4.5 Inspection.

4.5.1 Methods of inspection. Tests identified in 4.6.1 through 4.6.7 can be accomplished on separate test articles and may occur simultaneously. Unless otherwise specified (see 6.2), completed terminated cable assemblies that are to be tested shall be 6 feet  $\pm$ 1 inch in length. Tests identified in 4.6.1 through 4.6.5 shall be conducted by a certified, independent test facility.

4.5.2 Materials and construction. Conformance shall be determined by examination for the defects listed in [table II](#). All terminated cable assemblies presented for delivery at one time shall be considered a lot. The sample size of acceptable major and minor defects is shown in [table III](#). The number of minor defects is shown in [table III](#). If an unacceptable amount of minor defects are found in any lot, the entire lot shall be rejected.

TABLE II. Classification of defects.

Category	Defect	Method of examination
<b>Major</b>		
101	Dimensions affecting interchangeability, out of tolerance	SIE <sup>1/</sup>
102	Failure to meet any test acceptance criteria	As specified (4.6)
<b>Minor</b>		
201	Dimensions not affecting interchangeability, out of tolerance	SIE
202	Nonconformance in design or construction	Visual and SIE
203	Weight not as specified	SIE
204	Improper finish, color or application	Visual
205	Improper marking or identification plates	Visual
206	Logistics support documentation inaccurate or incomplete	Visual
NOTE: <sup>1/</sup> SIE = Standard inspection equipment.		

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TABLE III. Conformance inspection/verification sampling.

<b>Lot size</b>	<b>Sampling size</b>
1 to 8	3
9 to 25	5
26 to 40	7
41 to 65	10
66 to 110	15
111 to 300	25
301 to 500	35
501 to 800	50

4.6 Tests.

4.6.1 Strength tests. The terminated cable assembly shall be cooled in an environmental chamber for 2 hours at -20 °F (-29 °C). The terminated cable assembly shall be removed from the chamber and immediately pulled to 12,500 pounds at room temperature and held for 10 minutes. A separate terminated cable assembly shall be heated in an environmental chamber for 2 hours at 140 °F (60 °C). The terminated cable assembly shall be removed from the chamber and immediately pulled to 12,500 pounds at room temperature and held for 10 minutes.

4.6.2 UV deterioration test. A test chamber shall be equipped with a UV 340 fluorescent light, means to control temperature, and cause condensation to form on the exposed surface of the test specimens. The test chamber shall also be equipped with a means to control and record the relative humidity of the test. Three lifeline jacket material samples shall be tested in accordance with Exposure Cycle 6 of ASTM G154. The three samples shall be tested simultaneously with three control specimens together in the same test chamber for 20 continuous iterations. The relative humidity of the test shall be recorded. The axial tensile strength shall be tested in accordance with ASTM D1623 and recorded for each sample following this test.

4.6.3 Salt fog test. Terminated cable assemblies shall be environmentally tested in accordance with ASTM B117 for 240 hours. Environmentally tested terminated cable assemblies shall be pull-tested to 11,000 pounds for 10 minutes. The assembly shall not break or deform and the jacket shall be free of cracks as a result of this test.

4.6.4 Vibration. Terminated cable assemblies shall be tested in accordance with the requirements of Type 1 equipment as defined in MIL-STD-167-1. Terminated cable assemblies fabricated for vibration testing shall be limited to 6 feet in length. A NAVSEA-approved drawing should show the arrangement of the lifeline assembly (including attachments and stanchions) to be tested, prior to any vibration testing covered under this paragraph to ensure the test setup is valid for the installed configuration. Exploratory vibration testing shall be conducted from 4 Hertz to 33 Hertz to determine the critical response prominences. A 2-hour (minimum) endurance test shall be conducted at the response prominence frequency or frequencies most seriously affecting the terminated cable assembly structural integrity. Vibration testing shall be performed at a certified, independent, vibration test facility. Following the vibration test, the terminated cable assembly shall be pull-tested to 11,000 pounds.

4.6.5 Abrasion resistance testing. The lifeline jacket shall be tested for abrasion resistance in accordance with ASTM D5963 to demonstrate that the jacket meets or exceeds the Abrasion Resistance Index specified in 3.9.6.



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4.6.6 Jacket hardness testing. The lifeline jacket hardness shall be measured in accordance with ASTM D2240 to demonstrate that the jacket meets or exceeds the hardness specified in 3.7.2.

4.6.7 Terminated cable assembly proof load testing. Terminated cable assemblies shall be loaded to 5,000 pounds for 10 minutes prior to bonding material inspection and shipment.

4.6.7.1 Pot removal. After proof loading, each composite pot shall be removed from its shell for inspection as specified by 3.4.4.

4.6.7.2 Potting cracks. Each composite pot shall be visually inspected for cracks to verify compliance with the requirements specified in 3.7.2.

4.6.7.3 Potting voids. Each composite pot shall be inspected for voids to verify compliance with 3.7.2.

## 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

6.1 Intended use. The terminated cable assemblies covered by this specification are intended for use topside aboard U.S. Navy Surface Ship lifeline systems.

6.2 Acquisition requirements. Acquisition documents should specify the following:

- a. Title, number, and date of this specification.
- b. When first article is required (see 3.1).
- c. Illustration, and associated data requirements for terminated cable assemblies, if required (see 3.4.1).
- d. When first article inspection is required (see 4.2).
- d. Assembly length (see 4.5.1).
- e. Packaging requirements (see 5.1).

6.3 Technical documentation. The requirement for technical documentation should be considered when this specification is applied on a contract. Technical documentation, including assembly drawings identifying parts being used with dimensions and tolerances required for dimensional examination and installation instructions of a lifeline strength member to Navy ships should be included in the contract for delivery with each order of assemblies. Drawing types should be in accordance with ASME Y14.24 and drawing practices should be in accordance with ASME Y14.100.

6.4 Test reporting. A report covering data on all testing performed should be submitted for Government review if required by the contract. The test reports should accompany any proposal and be in Microsoft Word format. The report should contain the test results for each test, required by this performance specification, forwarded as PDF files attached to the report, that were provided by the independent testing facility that actually performed the testing. The report should contain the solicitation number and a statement that identifies the purpose and applicability of this certification. It should clearly state the degrees of compliance achieved for all processes/tests required by this specification. The report should certify the completion of tests performed, and that specific qualifications have been obtained. The report should certify that the supporting documentation has been reviewed and approved by an authorized Government representative.

6.5 Drawing guidance. Drawings 804-5184155 and 804-5959308 may be referred to for information on the application of lifeline strength members specified herein on U.S. Navy Surface Ship lifeline systems.

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6.6 Suggested packaging requirements. Suggested packaging requirements are as follows:

a. Exposed thread protection. The exposed threads on the end fittings should be covered during shipping in a manner that will avoid damage to the threads.

b. Bend radius. The cable assembly bend radius should not be less than 4 inches in the package.

6.7 Definitions.

6.7.1 Aramid fiber. A manufactured fiber in which the fiber-forming substance is a long-chain synthetic polyamide in which at least 85 percent of the amide (-CO-NH-) linkages are attached directly between two aromatic rings.

6.7.2 End fitting. Mechanical device which is attached on each end to the termination fitting. The end fittings are not included in this specification.

6.7.3 Lifeline cable assembly. The aramid fiber rope core and synthetic jacket covering the core.

6.7.4 Ordered length. Measure the distance between staples on stanchions, inside to inside, then subtract 22 inches for fittings to obtain required length of rope. The purpose of this definition is to allow the ship lifeline system dimensions to be measured from staple to staple and allow room for the sister hooks and turnbuckles currently in the Navy inventory.

6.7.5 Potted cable termination. The bundle of fibers that are individually encapsulated by a resin matrix (adhesive) at the terminal end of the lifeline, contained by a "pot". Together the adhesive and fibers form a composite structure. This composite end holds 100 percent of the cable's load that is imparted to the fitting terminations.

6.7.6 Proof load. An axial tensile load, expressed in units of force, which the product must withstand without evidence of any damage or permanent set.

6.7.7 Sister hooks. End fittings that allow, via opposing hooks that rotate on the same axis, attachment to a permanent support structure. Two are required to install the lifeline strength member on the ship's lifeline system. The sister hooks are not included in this specification.

6.7.8 Terminated cable assembly. The lifeline cable assembly, termination fitting, and potted connection.

6.7.9 Turnbuckle. An end fitting that allows the lifeline length to be adjusted to tension the lifeline after connection to the ship's lifeline stanchions. The turnbuckle is not included in this specification.

6.8 Subject term (key word) listing.

Lifeline cable assembly

Lifeline system

Potted cable termination

Terminated cable assembly

Termination fitting

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Custodians:

Navy – SH  
Air Force – 99

Preparing Activity:

Navy – SH  
(Project 2040-2010-002)

Review Activities:

Navy – AS  
DLA – CC

Civil Agency:

GSA – FAS

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