MILITARY SPECIFICATION

HARNESS ASSEMBLIES, CABLE, PRESSURE-PROOF, FIBER OPTIC GENERAL SPECIFICATION FOR

This specification is approved for use within 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 requirements for fabrication and test of fiber optic pressure-proof cable harness assemblies intended for use with fiber optic cable utilizing one or more single-fiber transmission elements.

2. APPLICABLE DOCUMENTS

2.1 Government documents.

2.1.1 Specifications and standards. The following specifications and standards form a part of this specification to the extent specified herein. Unless otherwise specified, the issues of these documents shall be those listed in the issue of the Department of Defense Index of Specifications and Standards (DODISS) and supplement thereto, cited in the solicitation.

SPECIFICATIONS

MILITARY

MIL-S-901	-	Shock Tests, HI (High-Impact); Shipboard Machinery, Equipment and Systems, Requirements for.
MIL-M-24041	-	Molding and Potting Compound, Chemically Cured, Polyurethane.
MIL-P-24628	-	Penetrators, Hull, Connectorized, Connectors, Pressure-Proof, Fiber Optic, Submarine General Specification for.
MIL-C-55442	-	Cable Assemblies and Cord Assemblies, Packaging of.
DOD-C-85045	-	Cable, Fiber Optics, General Specification for (METRIC).
MIL-H-24626/1	-	Harness, Assemblies, Cable, Pressure-Proof, Fiber Optic.

STANDARDS

MILITARY

MIL-STD-167-1	-	Mechanical Vibrations of Shipboard Equipment (Type I - Environment and Type II - Internally Excited).
MIL-STD-810	-	Environmental Test Methods and Engineering Guidelines.
MIL-STD-1344	-	Test Methods for Electrical Connectors.

Beneficial comments (recommendations, additions, deletions) and any pertinent data which may be of use in improving this document should be addressed to: Naval Sea Systems Command (SEA 55Z3), Department of the Navy, Washington, DC 20362-5101 by using the self-addressed Standardization Document Improvement Proposal (DD Form 1426) appearing at the end of this document or by letter.

2.1.2 Other Government publications. The following other Government publication forms a part of this specification to the extent specified herein. Unless otherwise specified, the issue shall be that in effect on the date of the solicitation.

NAVAL SEA SYSTEMS COMMAND

NAVSHIPS 0962-LP-022-2010 - Submarine Outboard Cables Molding and Inspection Procedures for Fabricating Connector Plugs, TM.

(Copies of specifications, standards, and other Government documents required by contractors in connection with specific acquisition functions should be obtained from the contracting activity or as directed by the contracting activity.)

2.2 Other publications. The following documents form a part of this specification to the extent specified herein. Unless otherwise specified, the issues of the documents which are DOD adopted shall be those listed in the issue of the DODISS specified in the solicitation. Unless otherwise specified, the issues of documents not listed in the DODISS shall be the issue of the non-Government documents which is current on the date of the solicitation.

ELECTRONIC INDUSTRIES ASSOCIATION (EIA)

EIA-455-34 - Interconnection Device Insertion Loss Test. (DOD Adopted)
EIA-455-51 - Pulse Distortion Measurement of Multimode Glass Optical Fiber Information Transmission Capacity. (DOD Adopted)

(Application for copies should be addressed to the Electronic Industries Association (EIA), 2001 Eye Street, NW, Washington, DC 20026.)

2.3 Order of precedence. In the event of a conflict between the text of this specification and the references cited herein (except for associated detail specifications, specification sheets, or MS standards), the text of this specification shall take precedence. Nothing in this specification, however, shall supersede applicable laws and regulations unless a specific exemption has been obtained.

3. REQUIREMENTS

3.1 Specification sheets. The individual item requirements shall be as specified herein and in accordance with the applicable specification sheet. In the event of any conflict between the requirements of this specification and the specification sheet, the latter shall govern.

3.2 First article. When specified (see 6.2.1), a sample shall be subjected to first article inspection (see 4.4 and 6.3).

3.3 Materials. The cable harness shall be constructed with material as specified herein and in the specification sheets. All materials used shall be ozone resistant, nontoxic, nonnutrient to fungus, and manufactured to good workmanship quality. Materials which are not specifically described herein shall be approved by the contracting agency.

3.3.1 Connectors. The fiber optic plug and receptacle connector material shall be in accordance with MIL-P-24628.

3.3.2 Plug cable boot. The plug cable boot shall be a polyurethane compound complying with category A, type I or II of MIL-M-24041. The color of the compound shall be amber or clear. The compound shall be molded or bonded to cable and metal parts, and cured as specified in NAVSHIPS 0962-LP-022-2010.

3.3.3 O-ring lubrication. The O-rings shall be lubricated at assembly with a light film of lubricant.

3.3.4 Fiber optic cable. The fiber optic cables connected to pressure-proof penetrators shall be watertight in accordance with DOD-C-85045.

resistance appropriate for use with

3.3.5 Recovered materials. Unless otherwise specified herein, all material incorporated in the products covered by this specification shall be new and shall be fabricated using materials produced from recovered materials to the maximum extent practicable without jeopardizing the intended use. The term "recovered materials" means materials which have been collected or recovered from solid waste and reprocessed to become a source of raw materials, as opposed to virgin raw materials. None of the above shall be interpreted to mean that the use of used or rebuilt products is allowed under this specification unless otherwise specified.

3.4 Construction and physical dimensions. Unless otherwise specified (see 3.1), the construction and physical dimensions of cable harness assemblies shall be as specified herein. Tolerances shall be as specified in table I. The color and mass shall be specified in the specification sheets.

TABLE I. Tolerances for cable harness assemblies. 1/2/3/4/5/

Class I			Class II		
6 inches through 24 inches (150-600)			Over 24 inches (600)		
1 Place	2 Place	3 Place	1 Place	2 Place	3 Place
±.1 inch (±2.54)	±.02 inch (±.051)	±.005 inch (±0.13)	±.1 inch (±2.54)	±.04 inch (±1.02)	±.010 inch (±0.26)

1/ Decimal dimensions.
2/ Angles ±.5°.
3/ Chamfer angles ±5° or as specified in the specification sheets.
4/ Millimeters are in parentheses.
5/ Class and harness length shall be specified in the specification sheets.

3.4.1 Penetrators. The fiber optic penetrators shall conform to MIL-P-24628.

3.4.2 Fiber optic cable. The fiber optic cables shall conform to DOD-C-85045.

3.4.3 Fiber optic cable harness. A pressure-proof cable harness shall consist of a penetrator terminated and sealed to one or both ends of a watertight fiber optic cable (see 3.4.1 and 3.4.2).

3.4.4 Cable boot. The cable molded boot seal configuration shall be molded in accordance with NAVSHIPS 0962-LP-022-2010 as specified (see 3.1).

3.5 Interchangeability. Fiber optic cable harness assemblies, having the same specification part number, shall be completely interchangeable with each other with respect to installation (physical) and performance (function) as specified herein.

3.6 Performance.

3.6.1 Insertion loss. Unless otherwise specified (see 3.1), 1.0 decibel (dB) is the maximum per channel insertion loss. The maximum insertion loss of the cable harness assembly shall be 2.0 dB (1.5 dB at the junction of the cable to penetration and 0.5 dB at the junction of the penetrator to penetrator or penetrator to connector) (see 4.7.2 and table II).

3.6.2 Discontinuity (optical). Unless otherwise specified (see 3.1), when tested in accordance with 4.7.3 and table II, the signal strength reduction shall be no more than 2 dB with a duration of 20 nanoseconds or more.

3.6.3 Analog modulation. Unless otherwise specified (see 3.1), when tested in accordance with 4.7.4 and table II, the peak-to-peak analog modulations bandpass, limited to between 4 Hz and 40 kHz, shall be not more than 5 percent of the steady-state signal level.

TABLE II. Optical performance requirements.

Environmental test	Insertion loss	Discontinuity (optical)	Analog modulation	Bandwidth	Crosstalk	Ambient optical pickup
Durability	A 1/					
Cable seal flexing	A					
Hydrostatic pressure	AD 2/					
Thermal shock	AD	D			A	A
Vibration	A	D	D		A	A
High impact shock	A	D			A	A
Accelerated aging	A					
Hydrostatic pressure (cyclic)	D			A	A	A

1/ A - Optical tests performed before and after the environmental test.
2/ D - Optical tests performed during the environmental test.

3.6.4 Optical fiber bandwidth. Unless otherwise specified (see 3.1), when tested in accordance with 4.7.5, the optical fiber bandwidth shall be equal to or greater than that specified.

3.6.5 Crosstalk. Unless otherwise specified (see 3.1), when tested in accordance with 4.7.6, the signal optical power level or sum of levels for devices with three or more passive channels shall be below the output signal level of the active channel by at least 60 dB.

3.6.6 Ambient optical pickup. Unless otherwise specified (see 3.1), when tested in accordance with 4.7.7, the optical power of the light from the optical ports (after accounting for cable and optical junction losses between the device and the detector) shall be less than -70 dBm.

3.6.7 Durability. Unless otherwise specified (see 3.1), when tested in accordance with 4.7.8, the mating plugs and receptacles shall show no evidence of excessive wear on engaging hardware, uneven wear or galling on guide hardware, metal chips or filings in the terminus areas, damaged inserts, or other mechanical defects detrimental to penetrator operation.

3.6.8 Cable seal flexing. Unless otherwise specified (see 3.1), when tested in accordance with 4.7.9, pressure-proof molded cable seals shall prevent loss of environmental sealing or other damage which may impair the penetrator operation.

3.6.9 Hydrostatic pressure . Unless otherwise specifed (see 3.1), when tested in accordance with 4.7.10, the cable harness assemblies shall reveal no permanent dimensional changes, cracking or crazing of jacket material, damage to cable sealing compounds, plug-to-receptacle seals, or cable-to-plug seals, or displacement or rupture of penetrator shells, inserts, termini, fibers or sealing compounds. There shall be no external evidence of water leakage around or through the fiber optic cable seal. There shall be no optical degradation observed.

3.6.10 Thermal shock. Unless otherwise specified (see 3.1), when tested in accordance with 4.7.11, cable harnesses subjected to the high and low temperature extremes shall reveal no evidence of penetrator part dimensional change, apparent loss of sealing capability, surface or identification marking impairment, coupling-thread binding or other evidence of mating or unmating incapability and no other damage detrimental to the operation of the connector. There shall be no optical degradation observed.

3.6.11 Vibration. Unless otherwise specified (see 3.1), when tested in accordance with 4.7.12, cable harness assemblies shall exhibit no visual evidence of loosening of parts, relative motion between penetrators and cable parts or other damage which can produce physical distortion and result in fatigue of the mechanical parts. There shall be no optical degradation observed.

3.6.12 High impact shock. Unless otherwise specified (see 3.1), when tested in accordance with 4.7.13, cable harness assemblies shall not be damaged and there shall be no loosening of parts. There shall be no optical degradation observed.

3.6.13 Accelerated aging. Unless otherwise specified (see 3.1), when tested in accordance with 4.7.14, cable harnesses subjected to these specified aging exposures shall not exhibit visual evidence of dimensional change, opening or leaking of seals, cracking or crazing of components or finisnes, identification marking impairment, or other effects detrimental to their operation. There shall be no optical degradation observed.

3.6.14 Hydrostatic pressure (cyclic). Unless otherwise specified (see 3.1), tne cable harness shall be subjected to hydrostatic pressure cycling as specified in 4.7.15. There shall be no evidence of mechanical damage or water leakage. There shall be no optical degradation observed.

3.6.15 Bonding. Bonding of the cable harness assembly shall be as specified in 3.6.15.1 and 3.6.15.2.

3.6.15.1 Nondestructive. Failure of bonding as noted in 4.7.16.1 and on figure 1 shall be cause for rejection.

3.6.15.2 Destructive. When tested in accordance with 4.7.16.2, any evidence of voids, gaps, or unfilled areas between the polyurethane and exposed metal or cable shall be cause for rejection (see figure 2).

3.6.16 Cleaning. Cleaning of the cable harness assembly shall be as specified in 3.6.16.1 and 3.6.16.2.

3.6.16.1 Normal cleaning. Normal cleaning shall consist of removing salt contaminants first with warm distilled water as necessary. Excess water shall be blown dry with oil-free dry air. The air may be warmed at 25°C. In addition, the component may be washed with technical grade chemically pure methyl alcohol and parts scrubbed with a small bristle brush. Excess alcohol can be blown dry with dry, oil-free air. Normal cleaning may be used prior to control tests to remove surface contaminants from insulator and terminus surfaces (see 4.7.1).

3.6.16.2 Force cleaning. Air drying at temperatures elevated above 52°C and requiring more than three cycles is considered force cleaning, and shall not be permitted.

3.7 Marking. Manufacturer's markings shall appear on the exterior molded section of each molded plug assembly (straight or 90°). The markings shall consist of the military part number, date molded (month and year), and the manufacturer's symbol. Markings shall be a part of the mold, embossed, 0.125 inch (3.18 mm) minimum height lettering, legible, and located so as not to affect the function of tne mold. A removable yellow band (e.g., heat shrinkable tubing) shall be affixed to each of the connecting devices and to tne cable of the harness assembly.

3.8. Workmanship. The cable harness assemblies shall be dimensionally uniform and free of flaws that would degrade performance after installation, inhibit proper connection to interfacing elements or otherwise yield an inferior product. The following shall be a minimum level of visual inspection to be performed and is not intended to restrict other pertinent workmanship inspections deemed necessary by the contractor.

a. Cable harness assemblies shall conform to the dimensional and interchangeability requirements of this specification.

b. Loose termini, poor molding, poor fabrication, loose materials, defective bonding, damaged or improperly assembled termini, and physical defects in the seals shall not be permitted.

c. Peeling or chipping of plating or finish, galling of mated parts, nicks or burrs of metal parts, and postmolding warpage shall not be permitted.

4. QUALITY ASSURANCE PROVISIONS

4.1 Responsibility for inspection. Unless otherwise specified in the contract or purchase order, the contractor is responsible for the performance of all inspection requirements as specified herein. Except as otherwise specified in the contract or purchase order, the contractor may use his own or any other facilities suitable for the performance of the inspection requirements specified herein, unless disapproved by the Government. The Government reserves the right to perform any of the inspections set forth in the specification where such inspections are deemed necessary to assure supplies and services conform to prescribed requirements.

4.1.1 Responsibility for compliance. All items must meet all requirements of sections 3 and 5. The inspection set forth in this specification shall become a part of the contractor's overall inspection system or quality program. The absence of any inspection requirements in the specification shall not relieve the contractor of the responsibility of assuring that all products or supplies submitted to the Government for acceptance comply with all requirements of the contract. Sampling in quality conformance does not authorize submission of known defective material, either indicated or actual, nor does it commit the Government to acceptance of defective material.

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

a. First article inspection (see 4.4).

b. Materials inspection (see 4.5).

c. Quality conformance inspection (see 4.6).

4.3 Inspection conditions. Unless otherwise specifed (see 3.1), all inspections shall be made in accordance with the following conditions:

a. Temperature: +15°C to +35°C.

b. Relative humidity: 20 to 80 percent.

c. Barometric pressure: 550 to 800 millimeters of mercury.

4.4 First article inspection. First article inspection shall consist of the examinations and tests performed in the sequence specified in table III, on the test samples specified in 4.4.1.

TABLE III. First article inspection.

Inspection	Requirement paragraph	Test paragraph
Visual and mechanical inspection	3.1, 3.3, 3.4, 3,5, 3.7, and 3.8	4.7.1
Insertion loss	3.6.1	4.7.2
Optical fiber bandwidth	3.6.4	4.7.5
Crosstalk	3.6.5	4.7.6
Ambient optical pickup	3.6.6	4.7.7
Durability	3.6.7	4.7.8
Cable seal flexing 1/	3.6.8	4.7.9
Hydrostatic pressure	3.6.9	4.7.10
Discontinuity (optical)	3.6.2	4.7.3
Analog modulation	3.6.3	4.7.4
Thermal shock	3.6.10	4.7.11
Vibration	3.6.11	4.7.12
High impact shock	3.6.12	4.7.13
Accelerated aging	3.6.13	4.7.14
Hydrostatic pressure (cyclic)	3.6.14	4.7.15
Bonding (destructive)	3.6.15.2	4.7.16.2
Visual and mechanical inspection	3.1, 3.3, 3.4, 3.5, 3.7, and 3.8	4.7.1

1/ Mandrel size is 10 times diameter; number of cycles is 5.

4.4.1 Sample size. Two complete fiber optic cable harnesses of each penetrator shell size for which first article inspection is desired shall be furnisned for first article testing in the sequence specified in table III (see 6.3).

4.4.1.1 Disposition of sample units. The sample units which have been subjected to the first article inspection shall not be delivered on the contract.

4.5 Materials inspection. The contractor snall provide a certificate of compliance, supported by verifying data, that materials specified (see 3.1 and 3.3) were used in fabricating the delivered cable harness assemblies (see 6.2.2).

4.6 Quality conformance inspection. Quality conformance inspection shall be conducted on 100 percent of all production parts (see table IV).

TABLE IV. Quality conformance inspection.

Inspection	Requirement paragraph	Test paragraph
Insertion loss	3.6.1	4.7.2
Cable seal flexing 1/	3.6.8	4.7.9
Bonding (nondestructive)	3.6.15.1	4.7.16.1
Visual and mechanical inspection	3.1, 3.3, 3.4, 3.5, 3.7, and 3.8	4.7.1

1/ Mandrel size is 10 times diameter; number of cycles is 5.

4.6.1 Inspection of products for delivery. Inspection of products for delivery shall consist of inspections specified in table IV, in the order shown.

4.6.2 Failures. If any assembly fails to pass any of the quality conformance inspection tests, that unit shall be considered to have failed.

4.6.3 Noncompliance. If any unit fails to pass the inspection, the contractor shall take corrective action on all materials or processes or both, as warranted, and on all units of product which are to be corrected and which were manufactured with essentially the same materials, processes, and which are considered subjected to the same failure. Acceptance of the product shall be discontinued until corrective action acceptable to the acquiring activity has been taken. In the event of failure after reinspection, information concerning the failure and corrective action taken shall be furnished to the cognizant inspection activity and the qualifying activity.

4.6.4 Inspection of packaging. The sampling and inspection of the preservation, packing, and container marking shall be in accordance with MIL-C-55442.

4.7 Methods of inspection. Unless otherwise specified (see 3.1), cladding mode stripping devices shall be used when making optical measurements. The mode stripper shall be installed in the test circuit between the source and the penetrator. In devices with one, two, or three optical channels, optical measurements shall be made simultaneously on each channel. Unless otherwise specified (see 3.1), in penetrators with four or more channels, optical measurements shall be made simultaneously on three randomly selected channels.

4.7.1 Visual and mechanical inspection (see 3.1, 3.3, 3.4, 3.5, 3.6.1, 3.6.16.1, 3.7, and 3.8). The cable harness assemblies shall be inspected to verify the materials, construction, interchangeability, marking, and workmanship are in accordance with the applicable requirements.

4.7.2 Insertion loss (see 3.6.1). The test for insertion loss shall be EIA-455-34 (FOTP-34), Interconnection Device Insertion Loss Test, method A, with the changes specified in table V.

4.7.3 Discontinuity (optical)(see 3.6.2). The test for discontinuity shall be as follows: The optical ports of the device under test shall be connected through short optical test cables to an appropriate optical signal source and detector. Unused ports shall be capped. The source shall produce a constant level, static signal easily detected by the detector. The output of the detector shall be monitored for discontinuities while the device under test is subjected to a physical test. The detector and monitoring equipment shall possess sensitivity and high frequency response to detect discontinuities in the optical signal. The monitoring equipment shall include transient capture capability, such as provided by an oscilloscope with an adjustable sweep trigger and oscilloscope camera.

TABLE V. Changes to EIA-455-34 for the insertion loss test.

Paragraph number	Delete	Substitute	Add
2.1.5	Entire paragraph	Not applicable	---
3.0	Entire paragraph	The test sample shall be one harness assembly and optical fibers/cables as specified below.	---
4.1	Interconnection device	Harness assembly	---
4.1.1	Entire paragraph	The test setup shall be configured as shown on figure 1. The test fiber/cable used in addition to the harness assembly shall be 4.0 to 10.0 meters long. The cable harness assembly shall be as specified . SME shall be installed to continuously monitor the source output.	---
4.1.2	Entire paragraph	Not applicable.	---
4.1.3	Sample	Test	---
4.1.3	Second sentence	The installation of one interconnection device of the same type as those on the cable harness assembly shall be accomplished in accordance with the manufacturer's specifications. The interconnection device components shall be mated in accordance with the manufacturer's specifications.	---
4.1.4	Entire paragraph	The light source shall be operated continuous wave or modulated and the initial power (P_0) shall be measured at the detector. The source monitor power (P_{M0}) shall also be measured.	---
4.1.5	Entire paragraph	The harness assembly shall be inserted into the test fiber/cable and the power (P_1) present at the detector shall be measured. The source monitor power (P_{M1}) shall also be measured.	---
4.1.6	Entire paragraph	Insertion loss shall be calculated as follows: Insertion loss (dB) = $10 \log \left[\frac{P_1}{P_0} \times \frac{P_{M0}}{P_{M1}} \right]$	4.1.7 If the interconnection device is rematable, steps 4.1.4, 4.1.5, and 4.1.6 shall be repeated until 10 loss values have been calculated. The mean and standard deviation of these calculations shall be reported.

4.7.4 Analog modulation (see 3.6.3). The test for analog modulation shall be as follows: The optical ports of the device under test shall be connected through short optical cables to an optical signal source and detector. Unused ports shall be capped. The source shall produce a constant level, static signal easily detected by the detector. The output of the detector shall be monitored for analog modulation while the device under test is subjected to a physical test. The detector and monitoring equipment shall possess sensitivity and frequency response to discern analog modulation at the acceptance level. The monitoring equipment shall include signal recording capability such as provided by a triggerable oscilloscope and an oscilloscope camera.

4.7.5 Optical fiber bandwidth (see 3.6.4). Cable harness assemblies shall be tested in accordance with EIA-455-51. All optical channels in the cable harness assembly shall be tested by this method. Method B shall be used. The bandwidth shall not be normalized.

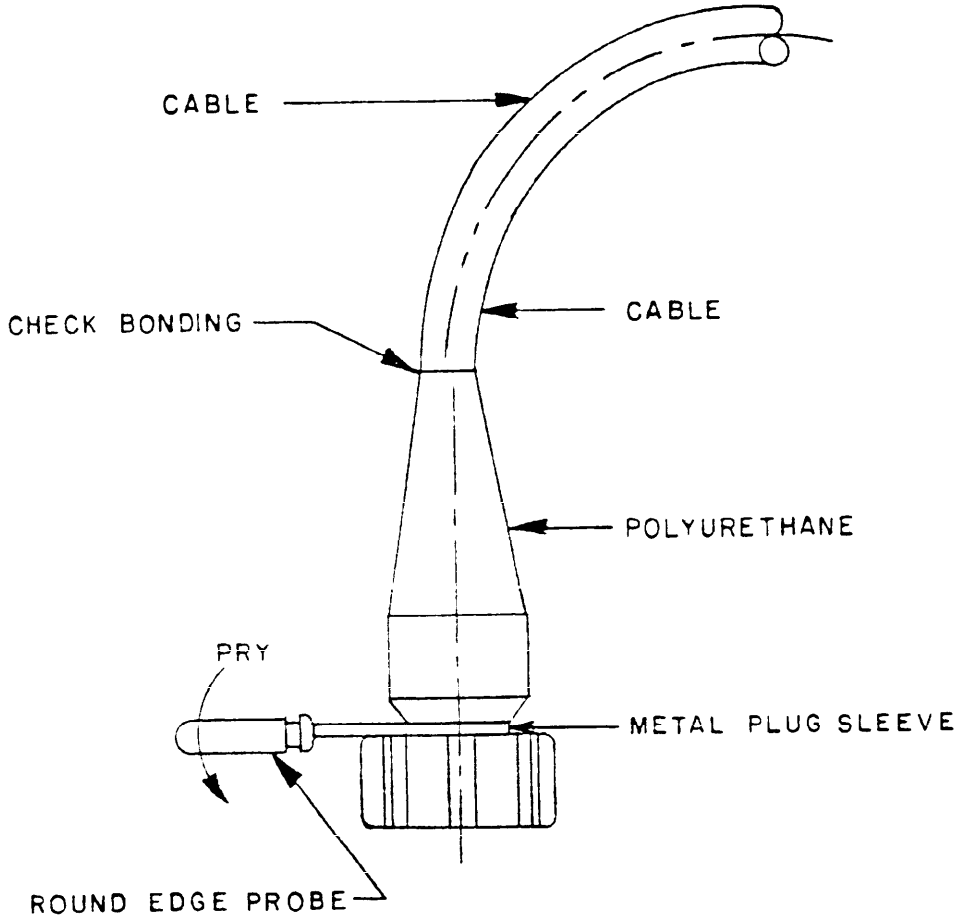
4.7.6 Crosstalk (see 3.6.5). The test for crosstalk is as follows: The ports of the circuit under test shall be connected to short test cables or opaquely capped as appropriate. The input port to one optical channel (active channel) is connected via its test cable to an optical signal source, the signal of which may be either continuous or amplitude modulated as appropriate. The output ports of the other channels (passive channels) are connected to test cables. The other input ports shall be opaquely capped. The output signal power from both the active and passive channels shall be measured. When there is more than one passive channel, the output of all passive channels shall be summed. This test shall be repeated making each remaining input port the active channel.

4.7.7 Ambient optical pickup (see 3.6.6). The test for ambient optical pickup is as follows: The optical ports of the device under test shall be either opaquely capped or connected to short optical test cables as appropriate. The far ends of these test cables shall be either capped or connected to power monitoring instruments as appropriate. Mode stripping shall not be employed. The device under test is, as far as practical, isotropically and homogeneously bathed in simulated sunlight as defined in method 505 of MIL-STD-810. The light shall be broad spectrum with infrared, visible, and ultraviolet components in accordance with method 505 of MIL-STD-810, and shall illuminate the device under test with an irradiance (power density) of 112 ±5 milliwatts per square centimeter. Light emanating from the output optical ports of the device under test shall be measured by optical power monitoring equipment having a broad spectral response compatible with the source.

4.7.8 Durability (see 3.6.7). The cable harness assemblies shall be completely mated and unmated 100 times at a rate of 25-50 cycles per hour with the plug coupling ring operated in a manner to simulate actual service.

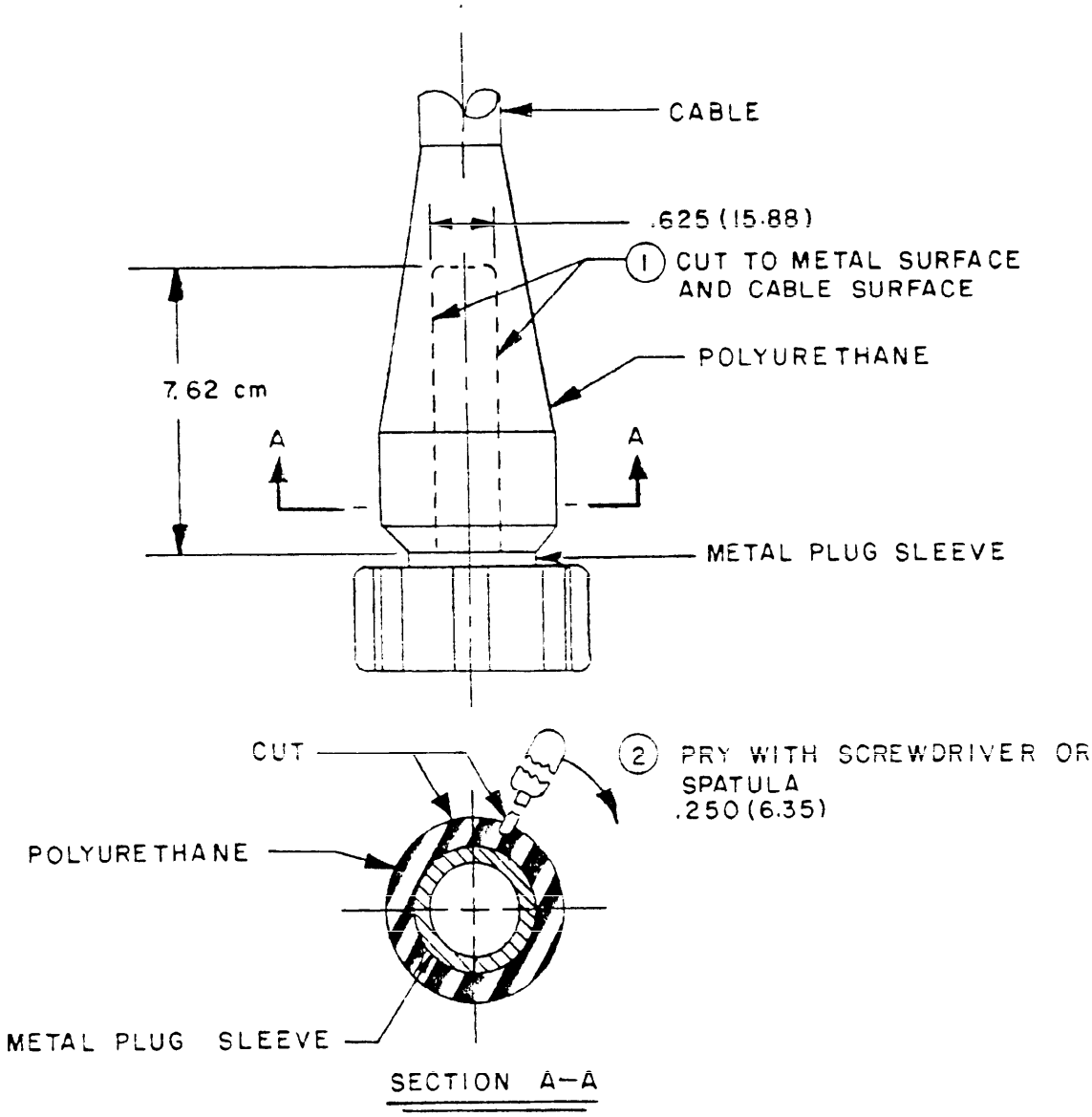
4.7.9 Cable seal flexing (see 3.6.8). The cable harness penetrator assemblies shall be tested in accordance with method 2017 of MIL-STD-1344, test procedure I. "X" distance shall be 50 millimeters.

4.7.10 Hydrostatic pressure. The cable harness assembly shall be installed in a pressure vessel with the penetrator facing into the chamber as shown on figure 3. The pressure vessel test medium shall be tap water. The cable harness assembly shall then be subjected to each step of the hydrostatic pressure test. The optical performance tests shall be conducted as specified in table II.



NOTES:
1. Use round edge probe (rigid plastic or metal) with no sharp edges or corners, do not use screwdriver.
2. If polyurethane materials peel back to reveal bare metal, the plug assembly shall be rejected. Repeat test at four different points along circumference.

FIGURE 1. Nondestructive bond test.



NOTES:
1. Dimensions are in inches.
2. Metric equivalents are given for general information only.
3. Metric equivalents are in parentheses.

FIGURE 2. Destructive bond test.

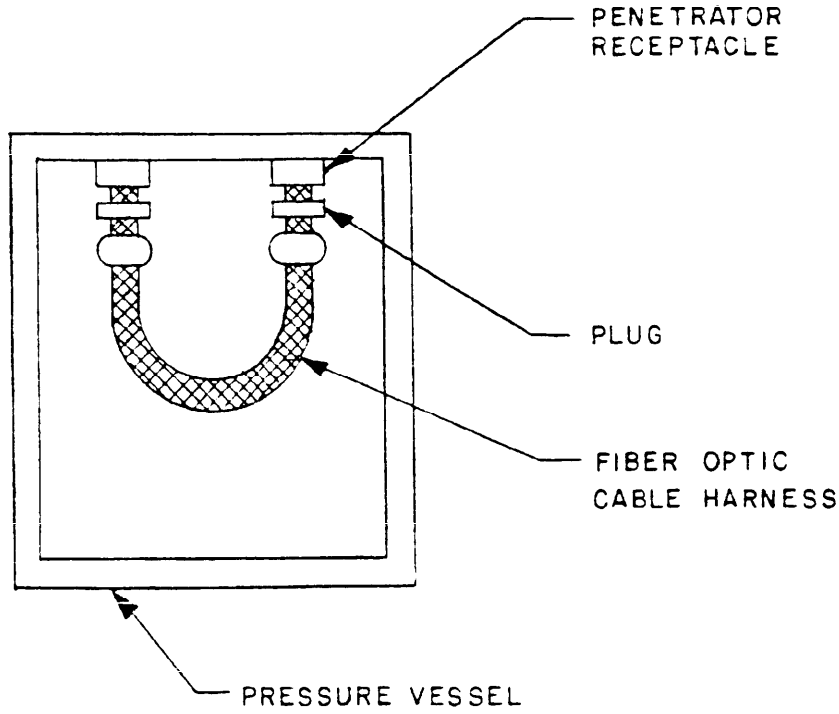


FIGURE 3. Hydrostatic pressure test setup.

4.7.11 Thermal shock (see 3.6.10). The cable harness assembly, including mated penetrator assemblies, shall be subjected to the thermal shock test as specified in method 1003 of MIL-STD-1344, test condition A according to the sequence of temperature conditions specified in table VI. The optical performance tests shall be conducted as specified in table II.

TABLE VI. Thermal shock test conditions.

Step	Temperature - °C
1	-46 +0, -5
2	+23 ±3
3	+71 +5, -0
4	+23 ±3

4.7.12 Vibration (see 3.6.11). The cable harness assembly shall be vibrated in accordance with MIL-STD-167-1, type I classification. The mating plug coupling nuts shall be held in place by the normal locking mechanism. Cables shall be supported on a stationary frame not closer than 12 inches (304.8 mm) from the penetrators, unless otherwise specified in the specification sheet (see 3.1). The optical performance tests shall be conducted as specifed in table II.

4.7.13 High impact shock (see 3.6.12). The cable harness assembly shall be tested in accordance with grade A, class 1, type A of MIL-S-901. The plug coupling rings shall be held in place by normal locking means, unless otherwise specified in the specification sheet (see 3.1). The cables shall be unsupported for a minimum distance of 12 inches (304.8 mm) from the plug or the penetrator. The optical performance tests shall be conducted as specified in table II.

4.7.14 Accelerated aging (see 3.6.13). The cable harness assembly shall be subjected to an accelerated aging test for a period of 1,000 hours. The temperature shall be +71°C +5°C, -0°C, with a relative humidity of 95 percent. The outboard cable harnesses shall be installed in the mating receptacles. The receptacle fiber optic cables shall exit the test chamber and be suitably sealed to the chamber wall at the exit point. The optical performance tests shall be conducted as specified in table II.

4.7.15 Hydrostatic pressure (cyclic) (see 3.6.14). The cable harness assembly shall be connected to mating penetrators. The penetrator shall be installed in a pressure vessel with the external section of the receptacle facing to the chamber as shown on figure 3. The pressure vessel test medium shall be tap water. The cable harness assembly shall be subjected to 2,000 cycles of 1,000 lbs/in^2 gauge hydrostatic pressure. The test cycle shall be 5 minutes at 0 lbs/in^2 gauge, 10 minutes to rise to the test pressure, 5 minutes hold at the maximum test pressure, and 10 minutes to drop to 0 pressure. The time duration of each pressure cycle shall be 30 minutes ±1 minute. Tap water temperature for the first 500 cycles shall be 0°C to 2°C. Temperature for the next 1,000 cycles shall be 4.5°C to 30°C; the last 500 cycles shall be conducted at a 30°C +3°C, -0°C tap water temperature. The optical performance tests shall be conducted as specified in table II.

4.7.16 Bonding. The tests for bonding shall be as follows.

4.7.16.1 Nondestructive (see 3.6.15.1). A nondestructive bond test shall be conducted on each fiber optic cable-to-penetrator boot seal. The polyurethane boot seal shall be tested as shown on figure 1 with a round edge probe at four different locations along the circumference.

4.7.16.2 Destructive (see 3.6.15.2). The destructive bonding test shall be conducted on the penetrator assembly in a fully cured condition as determined by checking durometer and shall be tested with a sharp knife, making two cuts .625 inch (15.9 mm) apart and 3 inches (76.2 mm) long as shown on figure 2. Cut to metal surface and cable surface. Place a screwdriver or spatula (minimum width of .250 inch (6.25 mm)) approximately midway between the polyurethane surface and the metal sleeve surface in one of the cuts as shown on figure 2. Pry back the polyurethane material in this manner until the polyurethane breaks or the bond releases. Repeat this probing process along the 3-inch (76.2 mm) cut. If necessary, use pliers to pull polyurethane compound as determined by durometer tests of both inside and outside surfaces.

5. PACKAGING

5.1 Packaging requirements. The requirements for packaging shall be in accordance with MIL-C-55442.

6. NOTES

6.1 Intended use. The fiber optic cable harness assemblies described in this specification are intended for outboard use on naval submarines.

6.2 Ordering data.

6.2.1 Acquisition requirements. Acquisition documents should specify the following:

a. Title, number, and date of this specification.

b. Title, number, and date of the applicable specification sheet and the complete part number from the applicable slash sheet.

c. If first article inspection is required (see 3.2).

d. Special wiring requirements.

e. Length of cable harness assembly required (see 3.1, 3.3, and 4.1).

6.2.2 Data requirements. When this specification is used in an acquisition which incorporates a DD Form 1423, Contract Data Requirements List (CDRL), the data requirements identified below shall be developed as specified by an approved Data Item Description (DD Form 1664) and delivered in accordance with the approved CDRL incorporated into the contract. When the provisions of FAR 52.227-7031 are invoked and the DD Form 1423 is not used, the data specified below shall be delivered by the contractor in accordance with the acquisition document or as cited in the following paragraphs.

Paragraph number	Data requirement title	Applicable DID number	Option
4.5	Certificate of compliance	DI-E-2121	---

(Data item descriptions related to this specification, and identified in section 6 will be approved and listed as such in DOD 5000.12-L, AMSDL. Copies of data item descriptions required by the contractors in connection with specific acquisition functions should be obtained from the Naval Publications and Forms Center or as directed by the contracting officer.)

6.3 First article. When a first article inspection is required, the item(s) shall be a first article sample. The first article shall consist of two complete fiber cable harnesses of each connector shell size for which first article inspection is desired. The contracting officer should include specific instructions in acquisition documents regarding arrangements for examinations, approval of first article test results and disposition of first articles. Invitations for bids should provide that the Government reserves the right to waive the requirement for samples for first article inspection to those bidders offering a product which has been previously acquired or tested by the Government, and that bidders offering such products, who wish to rely on such production or test, must furnish evidence with the bid that prior Government approval is presently appropriate for the pending contract.

6.4 Definitions

a. Ambient optical pickup test. Ambient optical pickup, as used herein, refers to optical interference of the optical data signals in the device in question by ambient optical power incident upon its exterior. The purpose of this test is to confirm the ability of the device to exclude ambient optical power incident upon its exterior from its optical signal circuits.

b. Analog modulation test. Analog modulation, as used herein, refers to dynamic amplitude modulation of the optical signals transmitted by the optical device in question. The purpose of this test is to confirm that the device does not excessively modulate the optical signal when subjected to physical stress tests.

c. Connector plug. The plug is usually that portion of the connector set which is affixed to the cable.

d. Coupling ring. A device fitted to the plug assembly which engages and disengages the plug to the receptacle.

e. Crosstalk test. Crosstalk, as used herein, refers to unwanted, coupled optical energy from an optical circuit (the active channel) into another optical signal circuit or group of signal circuits (the passive channels). The purpose of this test is to ensure that the circuits of the device in question have adequate optical channel isolation.

f. Discontinuity test. Signal discontinuity, as used herein, refers to measuring the presence of relatively sharp, short duration interruptions or "drop-outs" of the optical signals transmitted by the optical device in question. The purpose of this test is to confirm that the device's signal discontinuities are not excessive when subjected to physical stresses.

g. In-line receptacle. A receptacle wired and molded to a cable.

h. Insertion loss test. Insertion loss, as used herein, is the total optical signal power loss in an optical circuit caused by insertion of the optical device in question into the optical circuit. The purpose of this test is to confirm the device does not excessively attenuate the optical signal.

i. Molded boot. The molded or vulcanized member of a harness forming the seal between the fiber optic cable and the fiber optic connector.

j. Molded insert assembly. A cylindrical epoxy housing used in the receptacles to seal, locate, and insulate the contacts and termini in the receptacle body. The insert assembly has a groove to house the O-ring gasket which seals the insert to the receptacle body.

k. Pressure-proof plug cap. A cover fitted to a plug whose primary function is to provide protection against full submergence sea water pressure.

l. Pressure-proof receptacle cap. A cover fitted to a receptacle whose primary function is to provide protection against full submergence sea water pressure.

m. Protective plug cap. A nonpressure-proof cover fitted to a plug whose primary function is to protect against mechanical damage and contamination by dirt or foreign objects.

n. Protective receptacle cap. A nonpressure-proof cover fitted to a receptacle whose primary function is to protect against mechanical damage and contamination by dirt or foreign objects.

o. Receptacle. The receptacle is normally the fixed member of the connector set.

p. Receptacle style. The general configuration of a receptacle which better suits it to one type of mounting to a housing than another. The various styles are: welded, flanged welded, in-line, mid-flanged bolted, end-flanged bolted, locknut and union.

q. Right angle plug. A degrees plug connector having the cable wired and molded at a right angle (90°) to the axis of the plug shell.

r. Straight plug. A plug connector having tne cable wired and molded on the same axis of the plug shell.

s. Termini. Devices used to terminate optical fibers that provide a means to locate the fiber with the connector.

6.5 Subcontracted material and parts. The preparation for delivery requirements of referenced documents listed in section 2 do not apply when material and parts are acquired by the contractor for incorporation into the equipment and lose their separate identity when the equipment is shipped.

6.6 Subject term (key word) listing.

Cable assembly
Cable boot
Fiber optic
Insertion loss
Pressure-proof
Optical cable

Custodian:
Navy - SH

Review activities:
Navy - AS, CG, EC, MC
DLA - ES

Preparing activity:
Navy - SH

Agent:
DLA - ES

(Project 6020-N004)

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1. DOCUMENT NUMBER	2. DOCUMENT TITLE
MIL-H-24626(NAVY)	

3a. NAME OF SUBMITTING ORGANIZATION	4. TYPE OF ORGANIZATION *(Mark one)*
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b. ADDRESS *(Street, City, State, ZIP Code)*	☐ USER
	☐ MANUFACTURER
	☐ OTHER *(Specify)*: _____

5. PROBLEM AREAS

a. Paragraph Number and Wording:

b. Recommended Wording:

c. Reason/Rationale for Recommendation:

6. REMARKS

7a. NAME OF SUBMITTER *(Last, First, MI)* – Optional	b. WORK TELEPHONE NUMBER *(Include Area Code)* – Optional
c. MAILING ADDRESS *(Street, City, State, ZIP Code)* – Optional	8. DATE OF SUBMISSION *(YYMMDD)*

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Procedures shall apply.