REV	SHT	NAVSEA DRAWING NO.	ESWBS
–	1	7379173	499

APPLICATION	
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REVISIONS			
REV	DESCRIPTION	DATE	APPROVED

1. SCOPE. This NAVSEA Drawing covers fiber optic, multifiber cable for pierside umbilical cable applications only. Smoke, flame, toxicity and other requirements specified for inboard cable are not appropriate with this cable type. Requirements for prolonged immersion or exposure to seawater and an estimated 20 year useful life indicative of outboard cables are not appropriate to this type cable. Frequent handling and various type outboard exposures are expected to limit this cable to a 2 to 5 year useful life. The cable dimensions are compatible with connector and termini that are procured separately under NAVSEA DRAWING 7379171 (FIBER OPTIC CONNECTORS, HERMAPHRODITIC, MULTIPLE REMOVABLE TERMINI) and NAVSEA DRAWING 7379172 (REMOVABLE TERMINI FOR MULTIPLE TERMINI FIBER OPTIC CONNECTORS), respectively.

2. CLASSIFICATION.

2.1 Type. The fiber optic, pierside, multifiber cable specified in this NAVSEA Drawing shall be referred to by the type designation PSC-Y. Designator "Y" is the type(s) of optical fiber in the breakout cables. Y = S for single mode, dispersion-unshifted optical fiber; Y = M for multimode, 62.5/125 micron, graded-index optical fiber; Y = H# for fiber-hybrid multifiber cable containing both single mode and multimode breakout cables with "#" = the number of single mode breakout cables in the multifiber cable.

Example: PSC-H4 is a pierside, multifiber cable with 12 breakout cables, a fiber-hybrid cable construction with 4 single mode breakout cables.

Note: The U.S. Government preferred system of measurement is the metric SI system. However, since this item was originally designed using inch-pound units of measurement, in the event of conflict between the metric and inch-pound units, the inch-pound units shall take precedence.

REV STATUS OF SHEETS																					
REV	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
SHEET	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	
REV																					
SHEET	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	

DISTRIBUTION STATEMENT A: APPROVAL FOR PUBLIC RELEASE; DISTRIBUTION IS UNLIMITED

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES TOLERANCES ARE: FRACTIONS DECIMALS ñ .XXñ ANGLES .XXXñ P DO NOT SCALE DRAWING	CAGE CODE CONTRACT NO.		DEPARTMENT OF THE NAVY NAVAL SEA SYSTEMS COMMAND WASHINGTON, D.C. 20362-5101
	APPROVED	G.Brown 9-30-99	CABLE, FIBER OPTIC , PIERSIDE USE ONLY 12 BREAKOUT CABLE COUNT, MULTIPLE CLASSES
	APPROVED	CDR M. ZIEGLER 9-30-99	
	APPROVED	D. INMAN 9-30-99	
	ENGINEER	E.Bluebond 9-9-99	
MATERIAL:	ACCEPTED FOR NAVSEA	H. LEWIS 9-30-99 SIGNATURE DOES NOT DENOTE APPROVAL	SIZE A | CAGE 53711 | ESWBS 499 | DRAWING NO. 7379173 | REV –
FINISHES:	APPROVED BY NAVSEA	(SIGN ONLY IF ENGINEERING HAS BEEN "PROVED" BY MANUFACTURE AND TEST)	SCALE: NONE | UCI | WT GRP | SHEET 1 OF 20

3. SALIENT CHARACTISTICS.

3.1 Performance requirements. The pierside cable shall meet the performance requirements specified in Table 1 and the salient characteristics in 1 through 14. When specified, new sources of supply for the pierside cable shall be inspected to Table 1. One cable sample, with a minimum length of 500 meters, shall be subjected to applicable Group I tests. After tests applicable to 500-meter cable lengths have been completed (including applicable Group III tests requiring 500 meter lengths), the cable shall be cut to lengths indicated in Table 1 for the remaining Group II, III and IV tests. When not specified, optical measurements shall be made at the 1300 nm wavelength window. A minimum of 8 fibers shall be monitored during testing. Each fiber shall be monitored individually with no fiber concatenation allowed. Both single mode and multimode fibers shall be monitored for hybrid multifiber cables.

Table 1. Cable Test Procedures and Performance Requirements

Test Procedure	**Performance Requirement**	**Cable Samples & Sample Lengths**
Group I Tests: Visual/Dimensional/Optical	When specified, to be performed prior to each shipment.	
• Size (EIA/TIA-455-13)	Dimensions per Salient Characteristics	1 cable @ 500 meters
• Workmanship (EIA/TIA-455-13)	1/	1 cable @ 500 meters
• Identification Markings (EIA/TIA-455-13)	Legible manufacturer name or logo, color code/numbering	1 cable @ 500 meters
* Attenuation Rate (EIA/TIA-455-46 or EIA/TIA-455-61 or EIA/TIA-455-78)	MM: 3.5 dB/km @ 850 nm MM: 1.75 dB/km @ 1300 nm SM: 1.0 dB/km @ 1310 nm SM: 1.0 dB/km @ 1550 nm	1 cable @ 500 meters
Group II Tests: Mechanical	Tensile Strength. Installation: 2669N (600 lb) Long term: 667 N (150 lb)	
* Tensile Loading & Elongation (EIA-455-33) See Appendix A, Test 1	1/, elongation ≤ 2 %	1 cable @ 150 meters 12/
* Operation Tensile Loading (EIA-455-33) See Appendix A, Test 2	1/ 2/	1 cable @ 150 meters 12/
* Kink See Appendix A, Test 3	1/ 3/ each breakout cable: 18 mm; multifiber cable: min bend diameter	2 cables @ 10 meters
* Corner Bend (EIA-455-88) See Appendix A, Test 4	1/ 2/	2 cables @ 5 meters
* Low Temperature Flexibility (EIA/TIA-455-37) See Appendix A, Test 5	1/ 3/	2 cables @ 10 meters

Table 1. Cable Test Procedures and Performance Requirements (Continued)

Test Procedure	Performance Requirement	Cable Samples & Sample Lengths
* Cyclic Flexing (EIA/TIA-455-104) See Appendix A, Test 6 4/	1/ 2/	2 cables @ 5 meters
• Crush (TIA/EIA-455-41, Load ≥ 1250 N for 7 cycles) 5/	1/ 2/	2 cables @ 5 meters
• Impact (TIA/EIA-455-25) See Appendix A, Test 7	1/ 3/	2 cables @ 5 meters
• Strength Member Pullout (EIA-455-6) See Appendix A, Test 13	1/ 2/	2 cables @ 5 meters
Group III Tests: Environmental	Operating Temperature:-28 to 65°C Storage Temperature: -40 to 70°C	
• Temp. Humidity Cycling (TIA/EIA-455-5) See Appendix A, Test 8	1/ 6/	1 cable @ 500 meters 12/
• Temperature Cycling (EIA/TIA-455-3) See Appendix A, Test 9	1/ 6/ ; Δ cable O.D. ≤ ± 10 %	1 cable @ 500 meters 12/
Group IV Tests: Materials		
* Fluid Immersion 7/ (EIA/TIA-455-12)	1/ ; Cable O.D. ≤ ± 50 % of initial values; Jacket Tensile Strength and Elongation ≥ 50 % of initial values.	10 cables @ 1 meters and 50 jackets 8/
* Cable Scraping Abrasion See Appendix A, Test 10	No exposure of any layers below cable jacket	2 cables @ 2 meters
* Jacket Self-Adhesion/Blocking (TIA/EIA-455-84) See Appendix A, Test 11	No evidence of adhesion between cable surfaces, metal spool, or areas more severe than “mild” condition.	1 cable @ 3 meters
* Cable Element Removability See Appendix A, Test 12	Core components shall be easily removed w/o damage to cable or optical fibers. 1/	2 cables @ 0.5 meters
* Cable Jacket Tear Strength FED-STD-228, Method 3111	Tear strength ≥ 60 kN/m (4111 lb/ft) of jacket thickness	3 cables @ 1 meter
* Cable Jacket Tensile Strength and Elongation 9/	Tensile strength ≥ 2414 N/cm^2 (3500 psi), Elongation ≤ 400%	5 jackets 8/
• Fungus Resistance (TIA/EIA-455-56)	10/	1 cable @ 0.1 meters
* Weathering (ASTM-G-23) 11/	1/ ; Jacket Tensile Strength and Elongation ≥ 75 % of initial values.	1 cable @ 2 meters and 5 jackets 8/

Notes for Table 1:

1/ No visual evidence of surface damage (cracking, splitting or other defects to permit jacket penetration), softening, gumminess, degradation, deterioration, distortion, separation, corrosion, etc. when examined under 10X magnification.
2/ Change in optical transmittance ≤ 0.5 dB for MM, or ≤ 0.2 dB for SM, both during and after test. 13/
3/ Change in optical transmittance ≤ 0.5 dB for MM, or ≤ 0.2 dB for SM, after test. 13/
4/ Condition cables at test temperature at least 2 hours prior to test. Conduct 2000 cycles at 25 ± 2°C. Optical transmittance measurements every 400 cycles.
5/ The compressive load requirement, held for 3 minutes and released, shall be as follows: 400 N/cm of cable diameter at high and low operating temperature, 2000 N/cm of cable diameter at 25 ± 2°C. Compressive loading rate shall not be less than 2000 N/min.
6/ Change in optical transmittance ≤ 0.5 dB/km for MM, or ≤ 0.3 dB/km for SM, both during and after test. 13/
7/ A 24 hour immersion at 25 ± 5°C shall be performed in the following fluids or the commercial equivalent: fuel oil (MIL-F-16884), turbine fuel (JP-5, JP-8 MIL-T-5624), isopropyl alcohol (TT-I-735), hydraulic fluid (MIL-H-17672 and MIL-H-5606), lubricating oil (MIL-L-17331, MIL-L-23699), Chevron Int'l Coolanol 25R (MIL-C-47220 Type IV), sea water (3% NaCl).
8/ Jacket material samples shall be prepared from flat extruded specimens of multifiber cable jacket material per FED-STD-228, Method 3021, die size III (ASTM-D-412 die size Type C). The thickness of the specimen shall be measured using any micrometer. Test 3 jacket samples per fluid/test , except test 5 samples when 1 or more does not meet tensile strength requirement per FED-STD-228, Method 3021.
9/ Test in accordance with FED-STD-228, Methods 3021 and 3031 with 2.5 cm bench marks, 2.5 cm jaw separation and a travel rate of 25 cm/minute.
10/ Materials shall show no, sparse or very restricted microbial growth and reproduction. Little or no chemical, physical or structural change shall be detectable.
11/ ASTM-G-26 Method I using Type B or similar apparatus for a test duration of 720 hours. Setup conditions per 1200.3 of UL-1581.
12/ The 500 meter length shall be used and testing performed in sequence for the first two tests in Group III. Cut the 500 meter length into lengths specified for the first two tests in Group Upon completion of the first two tests in Group II, cut specified sample lengths for the remainder of the tests.
13/ Optical transmittance launch conditions: For SM fiber use 30 mm diameter mandrel and for MM fiber use 70/70 restricted. Perform per EIA/TIA-455-20.

3.2 Cable configuration. The fiber optic pierside, multifiber cables shall be constructed for an outside plant environment using a nine around three configuration (two planetary layers of single fiber breakout cables, three breakout cables in the first planetary layer, nine in the second). Each layer shall be helically laid. These layers of breakout cables shall be enclosed within an outer cable jacket. An optional layer of yarn strength member may surround the outer planetary layer of breakout cables under outer cable jacket. The outer cable jacket shall consist of a dual layer with a yarn strength member between the two jacket layers. The minimum bend diameters, short term and long term, of the cable shall be 10 times and 20 times the cable diameter, respectively.

3.3 Breakout cables. The individual single fiber breakout cable shall consist of a buffered fiber surrounded with a concentric layer of yarn strength members and jacket. Optical fiber shall conform to TIA/EIA-492AAAA for multimode and TIA/EIA-492CAAA for single mode. The optical fiber buffer shall be built up to 900 ± 50 microns (micrometers), have concentricity ≥ 0.65, and be readily removable by mechanical means. The breakout cable jacket shall have an outside diameter of 2.0 ± 0.2 mm. A layer of aramid yarn shall be equally spaced around the optical fiber buffer and breakout cable jacket. The minimum bend diameters, short term and long term, of the breakout cable shall be 18 mm and 36 mm, respectively.

3.4 Hybrid cable approval by similarity. Manufacturers who are approved under this NAVSEA Drawing for a multifiber cable with both multimode optical fiber and single mode optical fiber (fiber-hybrid construction) are approved under this NAVSEA Drawing for the multimode only and/or single mode only multifiber cable type.

3.5 Cable outer jacket material and diameter. Outer jacket material shall be a water resistant polyurethane. The outer jacket minimum wall thickness for each of the two layers of the multifiber cable with polyurethane outer jacket material shall be ≥ 1.2 mm (0.045 inches). The concentricity of the multifiber cable outermost jacket shall be ≥ 0.65. The outer jacket shall be dry and free from any film, coating or treatment and be black in color. The envelop for the outside diameter of the multifiber cable shall be confined to a maximum of 16.20 mm (0.639 in) and a minimum of 14.00 mm (0.551 in). The tolerance on the outer diameter for a specific cable part number shall not exceed ± 0.5 mm (0.020 in) and this tolerance shall fall within the specified envelope.

3.6 Breakout cable color coding. Unless otherwise specified, breakout cables within multifiber cables shall be color coded for identification in accordance with EIA/TIA-598. The color coding of the breakout cables within fiber-hybrid type multifiber cables shall start with multimode and end with single mode.

3.7 Breakout cable alternative cable identification. When specified, breakout cables within multifiber cables, containing only multimode optical fibers or only single mode optical fibers shall be uniquely marked with a number between 1 and 12. The form of the marking shall be the printed spelling of the number, followed by a dash, followed by the Arabic numeral. The marking shall be applied and repeated every 0.10 ± 0.01 m (4.0 ± 0.4 inches) along the breakout cable jacket. Breakout cable jackets within fiber-hybrid cables shall contain the same markings as just described with multimode jackets color-coded slate and single mode jackets being yellow. The numbering of the breakout cables within hybrid type multifiber cables for each cable count shall start with one for multimode and end with the largest number for single mode.

3.8 Waterblocking materials. When used, water blocking material shall be clean, non-tacky, and non-irritating to the touch when not exposed to moisture. The material shall be free-stripping from the cable and components by hand and shall not require the use of chemicals or other mechanical means of removal. The material shall not interfere with any termination technique used with finished cable or components.

3.9 Identification markings. The multifiber cable shall be identified by a marking applied to the outer jacket surface of the multifiber cable. The identification marking shall consist of the following, at intervals of 0.25 to 0.33 meters (10 to 13 inches), as measured from the beginning of one complete marking to the beginning of the succeeding complete marking: Cable Type, manufacturer's name, CAGE Code or logo; the words "Fiber Optic Cable" and Date Code (i.e. 4-digit week/year) or date of manufacture.

3.10 Workmanship. The minimum level of visual examination shall be as follows but is not intended to restrict other pertinent examinations deemed necessary:

3.10.1 Outer jacket shall be free of cuts, burnt areas, abrasions, holes, roughened areas, bulges, thin spots, and discontinuities.

3.10.2 Inner layers shall be free of cuts, holes, bulges thin spots, and discontinuities.

3.10.3 Waterblocking materials, when used, shall be uniformly distributed throughout the cable body.

3.11 Optical transmittance instrumentation stability. Optical transmittance instrumentation should be subjected to the following stability tests before certification testing is performed. The first test should consist of measuring the transmitted power through each channel once every minute for a 4 hour period. The second test should consist of measuring the transmitted power through each channel once every 30 minutes for a 96 hour period. The data for each channel should be analyzed to determine average transmittance, minimum and maximum transmittance, the standard deviation of the transmittance, and the minimum and maximum percent deviation of transmittance.

3.12 Cable length. Unless otherwise specified, the cable length shall be 152.4 m +5/-0 % (500 ft +5/-0 %).

3.13 Accessories. Each cable length shall be provided on a 3 flanged reel meeting the requirements specified in appendix B. When specified as an option in the procurement, the hand cranked spooling device in Appendix C shall be provided.

4. REGULATORY REQUIREMENTS.

4.1 Recovered materials. Products provided are encouraged to be manufactured with recovered materials to the maximum extent practicable, in accordance with paragraph 23.403 of the Federal Acquisition Regulation (FAR).

5. QUALITY ASSURANCE PROVISIONS.

5.1 Market acceptability. Multifiber cable procured to this NAVSEA Drawing shall have demonstrated commercial market acceptability. Suppliers will demonstrate market acceptability by showing

that they have sold more than 2000 meters of tight buffered, multiple fiber cable to commercial customers and have been selling the product for greater than 2 years.

5.2 Product conformance. The products provided shall meet the salient characteristics of this NAVSEA Drawing, conform to the producer's own drawings, specifications, standards, and quality assurance practices, and be the same product offered for sale in the commercial marketplace. The Government reserves the right to require proof of such conformance.

6. PACKAGING.

6.1 Preservation, packaging, packing and marking shall be as specified in the contract or order (See Ordering data).

7. NOTES.

7.1 Ordering data. Purchasers should specify the following:

7.1.1 When specified, Group I test results performed prior to shipping shall be supplied.

7.1.2 Group I through IV testing should be required when purchasing multifiber cable not previously provided under this NAVSEA Drawing.

7.1.3 Cable length and reel requirement if standard cable length of 130.9 m (500ft) is not specified.

7.1.4 Number of single mode breakout cables in the multifiber cable.

7.1.5 Breakout cable marking if the specified alternative is used in lieu of the standard color code.

7.1.6 When this NAVSEA Drawing is used for procurement, the product conformance clause must appear in the solicitation.

7.1.7 Option hand cranked spooling device is to be specified when part of the procurement.

7.1.8 Preservation, packaging, packing and marking requirements. See appendix B.

7.2 Definitions (per ANSI/ICEA S-87-640).

- Hybrid cables. Cables which contain more than one size and/or type of optical fiber.
- Composite cables. Cables which contain both optical fibers and metallic conductors intended for communications use.

7.3 Test methods and standards.

- ASTM standards are available from the American Society of Testing and Materials, 1916 Race Street, Philadelphia, PA 19103.

- EIA standards are available from the Electronics Industries Association, Engineering Department, 2001 Eye Street, NW, Washington, DC 20006.

- Federal Government publications are available from the Standardization Documents Order Desk, 700 Robbins Avenue, Philadelphia, PA 19120-5094.

- ICEA standards are available from Insulated Cable Engineers Association, Inc., P.O. Box 440, South Yarmouth, MA 02664.

- UL standards are available from Underwriters Laboratories, Inc., 333 Pfingsten Rd., Northbrook IL 60062.

APPENDIX A
TEST PROCEDURE AND TEST REQUIREMENTS

Test 1: Tensile Loading & Elongation

Procedure: Multifiber cable and breakout cable shall be tested in accordance with EIA-455-33. The breakout cable may be tested using the same mandrel size as is used to test the multifiber cable. A 45 Newton preload shall be placed on the cable. The load shall be increased to 2669 N (600 lb) and 267 N (60 lb) in 4 equal increments for the multifiber cable and the breakout cable, respectively. Attenuation measurements on all fibers shall be determined in unstressed and stressed conditions. The change in optical transmittance shall be measured during and after the test. Perform a post visual inspection of the multifiber cable and breakout cable jackets.

Requirements: No visual evidence of surface damage (cracking, splitting or other defects to permit jacket penetration), softening, gumminess, degradation, deterioration, distortion, separation, etc. when examined under 10X magnification or elongation greater than 2 percent. Change in optical transmittance during the test shall be $\leq$ 2.0 dB and after the test shall be $\leq$ 0.5 dB for multimode breakout cable, $\leq$ 0.2 dB for single mode breakout cable.

Test 2: Operating Tensile Load

Procedure: Multifiber cable shall be tested in accordance with EIA-455-33. A 45 Newton preload shall be placed on the cable. The load shall be increased to 667 N (150 lb) and held for 72 hours. Attenuation measurements on all fibers shall be determined in unstressed and stressed conditions. The change in optical transmittance shall be measured during and after the test. Perform a post visual inspection of the multifiber cable and breakout cable jackets.

Requirements: No visual evidence of surface damage (cracking, splitting or other defects to permit jacket penetration), softening, gumminess, degradation, deterioration, distortion, separation, etc. when examined under 10X magnification or elongation greater than 2 percent. Change in optical transmittance during and after the test shall be $\leq$ 0.5 dB for multimode breakout cable, $\leq$ 0.2 dB for single mode breakout cable.

Test 3: Breakout Cable Kink Test

Procedure: Strip back five feet on each end of the multifiber cable to expose the breakout cables. Perform a pre-kink test visual inspection (using 10X magnification and feel). Perform a pre-test optical transmittance measurement on each breakout cable. Each breakout cable shall be tested in a free form loop using the procedure in IEC 794-I-E10. Three equidistant test specimens (lengths or exposed sections of the breakout cable) shall be tested from each breakout cable on each end of the multifiber cable. The free standing loop diameter shall be measured in a direction parallel to that in which the forces are applied at the bottom of the free standing loop. Test on each specimen shall be terminated when either a kink is formed or when the minimum bend diameter is reached. The free form loop diameter at which the first noticeable detrimental effect occurs is to be recorded along with the detrimental effect. Perform the post test optical transmittance measurement.

APPENDIX A
TEST PROCEDURE AND TEST REQUIREMENTS
(Continued)

Requirements: A post test visual inspection shall reveal no kinking, cracking, splitting, tearing, collapsing, deformation or other detrimental effects of the breakout cable jacket for free form loop diameter at or above the minimum short term bend diameter of the breakout cable (10 times the breakout cable jacket outer diameter). Change in optical transmittance after the test shall be $\leq$ 0.5 dB for multimode breakout cable, $\leq$ 0.2 dB for single mode breakout cable.

Test 4: Corner Bend

Procedure: Multifiber cable and breakout cable shall be tested in accordance with EIA-455-88. The radius of the corner shall be 5 times the cable outer radius, rounded to the next highest centimeter for the multifiber cable and shall be 1.3 cm for the breakout cable. The test force applied gradually and held for 1 minute after the full load is applied.

Requirements: No visual evidence of surface damage (cracking, splitting or other defects to permit jacket penetration), softening, gumminess, degradation, deterioration, distortion, separation, etc. when examined under 10X magnification or elongation greater than 2 percent. Change in optical transmittance during and after the test shall be $\leq$ 0.5 dB for multimode breakout cable, $\leq$ 0.2 dB for single mode breakout cable.

Test 5: Low Temperature Flexibility

Procedure: Multifiber cable shall be tested in accordance with Procedure II of EIA/TIA-455-37. The mandrel diameter shall be equal to the multifiber cable short term minimum bend diameter rounded up to the nearest centimeter and 3 mandrel turns shall be used. Condition the multifiber cable at -28 $\pm$ 2 °C for at least two hours prior to performing the test. The change in optical transmittance shall be measured after the test. Perform a post visual inspection of the multifiber cable.

Requirements: No visual evidence of surface damage (cracking, splitting or other defects to permit jacket penetration), softening, gumminess, degradation, deterioration, distortion, separation, etc. when examined under 10X magnification. . Change in optical transmittance after the test shall be $\leq$ 0.5 dB for multimode breakout cable, $\leq$ 0.2 dB for single mode breakout cable.

Test 6: Cyclic Flexing

Procedure: Multifiber cable shall be tested in accordance with EIA/TIA-455-104 at 30 cycles per minute over a sheave whose outer diameter is equal to the multifiber cable short term minimum bend diameter rounded up to the nearest centimeter. Condition the multifiber cable at the test temperature for at least two hours prior to performing the test. Perform the cyclic flex test for 2000 cycles at 25 °C. The change in optical transmittance shall be measured during (after every 400 cycles) and after the test. The measurements are to be obtained at the same position or orientation of the cycle. If necessary, the cycling may be halted only for the duration required to perform each measurement. The multifiber cable is not to be relaxed while the measurement is performed. Perform a post visual inspection of the multifiber cable.

APPENDIX A
TEST PROCEDURE AND TEST REQUIREMENTS
(Continued)

Requirements: No visual evidence of surface damage (cracking, splitting or other defects to permit jacket penetration), softening, gumminess, degradation, deterioration, distortion, separation, etc. when examined under 10X magnification. . Change in optical transmittance during and after the test shall be ≤ 0.5 dB for multimode breakout cable, ≤ 0.2 dB for single mode breakout cable.

Test 7: Impact

Procedure: Multifiber cable shall be tested in accordance with TIA/EIA-455-25. Condition the multifiber cable at each test temperature for at least two hours prior to performing the test. Perform the impact test for 50 cycles at -28±2 °C, for 100 cycles at 25±2 °C then for 50 cycles at -28±2 °C. The change in optical transmittance shall be measured after the test. Perform a visual inspection of the multifiber cable after completion of the cycles at each temperature.

Requirements: No visual evidence of surface damage (cracking, splitting or other defects to permit jacket penetration), softening, gumminess, degradation, deterioration, distortion, separation, etc. when examined under 10X magnification. Change in optical transmittance after the test shall be ≤ 0.5 dB for multimode breakout cable, ≤ 0.2 dB for single mode breakout cable.

Test 8: Temperature Humidity Cycling

Procedure: Multifiber cable shall be tested in accordance with TIA/EIA-455-5, Method B. The test shall be performed for 5 cycles. The subcycle shall be included in the test for two of the cycles. Change in optical transmittance shall be measured during and after the test. Perform a post test visual inspection of the multifiber cable.

Requirements: No visual evidence of surface damage (cracking, splitting or other defects to permit jacket penetration), softening, gumminess, degradation, deterioration, distortion, separation, etc. when examined under 10X magnification. Post test multifiber cable outer diameter shall remain within plus or minus 10 percent of the pretest multifiber cable outer diameter. Change in optical transmittance during and after the test shall be ≤ 0.5 dB for multimode breakout cable, ≤ 0.3 dB for single mode breakout cable.

Test 9: Temperature Cycling

Procedure: Multifiber cable shall be tested in accordance with EIA/TIA-455-3. The test shall be performed for 5 cycles using test condition C. Minimum temperature plateau shall be at -28±2 °C and the maximum at 65±2 °C. Change in optical transmittance shall be measured during and after the test. Perform a post test visual inspection of the multifiber cable.

APPENDIX A
TEST PROCEDURE AND TEST REQUIREMENTS
(Continued)

Requirements: No visual evidence of surface damage (cracking, splitting or other defects to permit jacket penetration), softening, gumminess, degradation, deterioration, distortion, separation, etc. when examined under 10X magnification. Post test multifiber cable outer diameter shall remain within plus or minus 10 percent of the pretest multifiber cable outer diameter. Change in optical transmittance during and after the test shall be $\leq$ 0.5 dB for multimode breakout cable, $\leq$ 0.3 dB for single mode breakout cable.

Test 10: Cable Scraping Abrasion

Procedure: The multifiber cable shall be clamped in a cable scraping abrasion tester. A mass of 0.45 kg (1 lb) shall be suspended from the bottom end of the cable via a 18 cm (7 in) cord that is tied to the cable. Two tests shall be performed on each multifiber cable length by moving the multifiber cable forward 20 cm (8 in) and rotated clockwise 90 degrees along the longitudinal axis between each test. Each test shall be discontinued when 750 cycles is attained for each of the two tests performed on each multifiber cable length. The cable scraping abrasion tester shall be configured as follows:

The cable scraping abrasion tester shall hold the multifiber cable length firmly clamped in a horizontal position with the outer longitudinal surface of the multifiber cable length fully exposed. The multifiber cable tester shall have two abrading surfaces 180 degrees apart on an eight inch rotating drum. The two abrading surfaces shall abrade the outer surface of the multifiber cable in such a position that the longitudinal axis of the abrading surfaces are at right angles to the multifiber cable contact surface. Each of the two abrading surfaces shall consist of high speed tool bits which have been ground of two adjacent longitudinal sides to produce a single, sharp 90 degree longitudinal edge, free of visible marks. A weight affixed to the multifiber cable below the drum level shall control the force exerted normal to the surface of the multifiber cable jacket. A motor driven reciprocating cam mechanism may be used to deliver an accurate number of abrading strokes in a direction parallel to the longitudinal axis of the multifiber cable length (Note: There are two stokes per cycle). The number of cycles shall be measured by a counter. The length of the stroke shall be 5 cm and the frequency shall be 30 cycles (60 strokes) per minute.

Requirements: The multifiber cable shall withstand 750 cycles of scraping abrasion without exposure of any layers below the outermost cable jacket.

Test 11: Jacket Self-Adhesion/Blocking

Procedure: Multifiber cable shall be tested in accordance with TIA/EIA-455-84. The cable shall be conditioned at 65$\pm$2 °C for a period of 48 hours prior to testing for blocking. After the high temperature exposure, the multifiber cable shall be visually examined.

Requirements: No visual evidence of localized adhesion between contacting cable surfaces, the storage spool or other areas that are of a more severe nature than a “mild” condition, when examined under 10X magnification.

APPENDIX A
TEST PROCEDURE AND TEST REQUIREMENTS
(Continued)

Test 12: Cable Element Removability

Procedure: All multifiber cable parts external to the cable core, such as multifiber cable jacket and yarn strength member, shall be removed from one end of the multifiber cable so as to expose the breakout cables and any optional water blocking and/or filler material for a distance of 0.9 meters (3 ft). Using fingers only (no hand tool); any filler, yarn and/or water blocking material shall be separated from the breakout cables for their fully exposed length. For breakout cables, approximately 40 cm (16 inch) of breakout cable jacket shall be removed exposing the yarn strength members, any optional water blocking and/or filler material and the any residual material on the buffered fiber shall be removed using fingers only. Approximately 20 cm (8 inch) of buffered fiber shall be removed exposing the optical fiber. Any residual buffer material on the optical fiber shall be removed using fingers only. Tools used for mechanical removal shall be typical commercially available.

Requirements: The cable components shall be easily and cleanly removable by mechanical means without damage to the buffered fiber. No surface scratches or defects to the buffered fiber shall be visible under 10X magnification after the buffered fiber material has been removed. Any optional waterblocking and/or filler material shall be flexible and easily removable from any part to which it is in contact through the use of fingers only. The presence of occasional particles or slivers of filler residue will be acceptable, provided that these can be removed by light brushing with the fingers or with a dry cloth. Material which leaves residue that is removable only by vigorous wiping or through the use of solvents shall not be acceptable.

Test 13: Strength Member Pullout

Procedure: The following tests shall be performed on a separate cable with a 500 ft length:

a. Cable preparation: A 152.4 m (500 ft) length of multifiber cable shall be spooled onto a reel. Multifiber cable outer jacket shall be removed from each end of the cable sample so that a sufficient length of the yard strength member is exposed and the breakout cables protrude at least 20.3 cm (8 inches). This exposed yarn strength member at each end of the multifiber cable shall be pulled taunt and secured in a test fixture that includes a yarn capture mechanism. Three inches of cable jacket on each breakout cable shall be removed to expose the buffered fiber. Reference marks shall be placed on the yarn strength member at a 5.1 cm (2 inch) distance from the fixed point on the test fixture. Each breakout cable shall be marked at a 12.7 cm (5 inch) distance from a fixed point on the test fixture. Each buffered fiber shall be marked at a 5.1 cm (2 inch) distance from a marked point at the end of the outer cable jacket or 17.8 cm (7 inch) distance from the fixed point on the test fixture. An optical measurement shall be performed to verify optical signal continuity for each buffered fiber.

APPENDIX A
TEST PROCEDURE AND TEST REQUIREMENTS
(Continued)

b. Spooling operation.
   (1) Optical continuity measurement. An optical measurement shall be performed to verify optical signal continuity for each buffered fiber.
   (2) Relative movement measurement prior to spooling operation. Prior to unspooling the cable from the reel, the distance of the yarn strength member, each breakout cable and buffered fiber from the fixed point shall be measured.
   (3) Unspooling operation verification. A spooling operation shall completely remove the 152.4 m (500 ft) length of multifiber cable from the reel. The multifiber cable shall be placed in a straight run with no applied tension. The distance of the yarn strength member, each breakout cable and buffered fiber from the fixed point shall be measured.

c. Full multifiber cable deployment.

(1) First full length applied tension. Apply a load on the test fixture(s) to remove any slack between the cable ends. Apply a load on the cable until a force ≥ 181.4 kg (400 pounds) is obtained. This force shall be applied for 10 minutes. This load shall be applied slowly and evenly. The distance of the yarn strength member, each breakout cable and buffered fiber from the fixed point shall be measured at the end of 10 minutes while the force is applied and after the force is released.

(2) Second full length applied tension. Apply a load on the test fixture(s) to remove any slack between the cable ends. Apply a load on the cable until a force ≥ 181.4 kg (400 pounds) is obtained. This force shall be applied for 10 minutes. This load shall be applied slowly and evenly. The distance of the yarn strength member, each breakout cable and buffered fiber from the fixed point shall be measured at the end of 10 minutes while the force is applied and after the force is released.

d. Partial multifiber cable deployment.
   (1) Partial deployment at 91.4 m (300 ft). Detach the test fixture from one end of the multifiber cable. Perform a spooling device operation to place 61.0 m (200 ft) of cable onto the reel. Affix the reel to a stationary platform. Apply a load on the outside end of the cable until a force ≥ 181.4 kg (400 pounds) is obtained. This force shall be applied for 10 minutes. This load shall be applied slowly and evenly. The distance of the yarn strength member, each breakout cable and buffered fiber from the fixed point shall be measured at the end of 10 minutes while the force is applied and after the force is released.

APPENDIX A
TEST PROCEDURE AND TEST REQUIREMENTS
(Continued)

(1) Partial deployment at 30.5 m (100 ft). Repeat the partial deployment test when 121.9 m (400 ft) of multifiber cable are spooled onto the reel. The load applied on the outside end of the cable shall be ≥ 181.4 kg (400 pounds).
(2) Optical continuity measurement. An optical measurement shall be performed to verify optical signal continuity for each breakout cable after the conclusion of this test.

Requirements: No visual evidence of yarn strength member damage during and after the test. Relative movement of the breakout cable relative to the yarn strength member shall not exceed 10 mm (0.39 in). No fiber breakage shall occur to be verified by uninterrupted optical signal continuity.

APPENDIX B
CABLE REEL SPECIFICATION

1. Configuration and general requirements.
   a. Cable reel shall be a three flange reel consisting of two outside flanges and a divider (center) flange.
      (1) One area between an outside flange and the divider flange shall be for the storage of the major length of cable (outer length of cable or outside end of cable). This area is the main cable storage area.
      (2) The area between the other side of the divider flange and the other end flange, the "pocket", shall be for a minor length of cable (the starting length of cable or the inside end of the cable). This area is the starting cable storage area or pocket.
   b. Constant diameter of the barrel is required along the axial length of the barrel where cable interfaces with barrel.
   c. Cable pass-through shall be provided for the inside end of the cable and connector from the main storage area to the pocket.
      (1) The divider flange shall contain an opening (pass-through) to enable a cable assembly (cable with connectors on the ends) to be routed from the main storage area into the pocket.
      (2) Divider flange pass-through shall have a minimum circumferential length of 117 mm (4.63 inch) at the surface of the barrel.
   d. Pocket. The pocket shall accommodate a minimum cable length of 508 mm (20 ft) and the inside end connector.
   e. Attachment provisions.
      (1) Connector attachment (To accept high tensile strength (175 lb) 0.300 inch wide electrical tiedown straps). A tie down provision shall be incorporated into the reel to affix both inside end and outside end connector (terminated to the cable) to the reel. This tie down provision is to prevent the inside end connector from moving during outside end spooling operations and to prevent connector damage when the reel is rolled long the ground. This tie down provision shall consist of a minimum of 18 sets of holes equally spaced around the circumference of the three flanges. Each set shall consist of four holes, one located below the other in the radial direction, one hole being within 2.5 cm (1 in) of the next hole. The outer hole shall be within 2.5 cm (1 in) from the top of the flange.
      (2) Cable tie down provision (To accept high tensile strength (175 lb) 0.300 inch wide electrical tiedown straps). A tie down provision shall be incorporated into the reel to affix the cable to the reel so that the inside end of the cable is not removed from the reel during the outside end unwinding operation. One set of holes shall be located on each side of the divider flange pass-through. Each set shall consist of two holes, one located below the other in the radial direction. The bottom of the innermost hole shall be located at the surface of the barrel. The center of the outermost hole shall be located within 13 mm (0.5 in) above the center of the innermost hole.
2. Dimensions to ensure interchangeability with fiber optic cable (length & diameter) and cable reel:
   a. Reel barrel diameter: 304.80 mm (12 in) minimum, 336.55 mm (13.25 in) maximum.

APPENDIX B
CABLE REEL SPECIFICATION
(Continued)

b. Reel overall axial length of reel: 552.45 mm (21.75 in) minimum, 571.50 mm (22.5 in) maximum.
c. Reel flange diameter: 685.8 mm (27 in) minimum, 711.2 mm (28 in) maximum.
d. Pocket outside flange diameter: 533.4 mm (21 inches) maximum.
e. Reel traverse length of main storage area: 457.2 mm (18 in) minimum.
f. Reel center hole: To interface with a 2.54 cm x 2.54 cm (1 inch x 1 inch) standard square drive shaft on the spool device.
g. Cable outside diameter envelop: 14.00 mm (0.551 in) minimum, 16.20 mm (0.639 in) maximum.
h. Cable length: 152.4 m (500 ft).
i. Connector diameter: 50.80 mm (2.0 in) maximum.
j. Connector length without flexible strain relief: 190.5 mm (7.5 in) maximum.

3. Environmental requirements.
   a. Reel shall withstand an outdoor, seaport environment.
   b. Reel shall withstand a corrosive salt air environment with no appreciable corrosion. Reel metal and finish material used and method of application for the finish shall satisfy a 500 hour salt spray requirement performed in accordance with TIA/EIA-455-16 or other Navy recognized commercial standard. Certificate of Conformance shall be submitted to verify this requirement. Finish on reel shall have a non-reflective color.
   c. Reel shall withstand exposure to outdoor temperatures ranging from –40 C to + 65 C with no effect that may impact cable optical performance.

4. Mechanical requirements.
   a. Reel shall withstand a 0.9 m (3 ft) drop and be functional after straightening any bent metal back into place using standard hand tools.
   b. Reel may be re-enforced to comply with this requirement.
   c. Reel components shall be welded together. No threaded rods, threaded fittings, bolts, screws or nuts shall be used in the assembly.
   d. Reel shall contain no sharp edges or surfaces that may cause damage to fiber optic cable or injure personnel.

5. Marking requirements.
   a. Reel shall be permanently marked or stenciled with the manufacturer's name and part number using the manufacturer's commercial standard.
   b. Reel shall be permanently stenciled with the words "Fiber Optic Umbilical Assembly (Caution: 2 Man Lift)" on the two outside flanges.

6. Packaging.
   a. Reel shall be provided in a commercial cardboard box that can be reused to ship a completed cable assembly (nominal weight of 445N (100 lb)) and that can provide surface protection and minor impact protection of the reel during shipment.
   b. Packaging shall be coordinated with the cable supplier.

APPENDIX C
CABLE HAND CRANKED SPOOLING DEVICE SPECIFICATION

1. Configuration and general requirements.
   a. Spooling device shall be taken apart and reassembled without the use of hand tools for purposes of installing and removing the reel from the shaft.
   b. Spooling device shall contain a hand crank (handle) to spool the outside end of the cable onto the reel.
      (1) Hand crank shall be removable.
      (2) Hand crank shall contain a safety chain (chain, plastic covered wire rope, etc.).
      (3) Safety chain shall be affixed to the hand crank and spooling device.
      (4) Safety chain shall be attached in a manner that will not impede rotation of the hand crank during cable spooling onto reel.
      (5) Spooling device shall contain a storage position/place for the hand crank when the latter is removed from the shaft.
   c. Spooling device shall contain provisions to be both fixed and portable.
   d. Spooling device shall contain a locking mechanism to prevent reel rotation or the hand crank from turning when a spooling operation is not performed.
   e. Spooling device shall contain no sharp edges or surfaces that may cause damage to fiber optic cable or injure personnel.
   f. Spooling device shall have a shaft to interface with both the spooling device bushings and the reel.
      (1) Shaft shall have a square middle portion to interface with the reel and shall be rounded on the ends to fit into bushings.
      (2) The middle portion of the shaft shall be comprised of a 2.54 cm x 2.54 cm (1 inch x 1 inch) standard square drive shaft with a minimum length of 635 mm (25 inch).
      (3) The rounded ends of the shaft shall be a minimum of 203 mm (8 inch) in length on both sides and be used to fit into the bushings on the spooling device and to allow a two man lift of the cable to and from the spooling device.
   g. Spooling device shall contain half bushings for inserting and removing the shaft and reel.
      (1) Bushing housing shall be hinged.
      (2) Top half of bushing is to be retained in the top half of the bushing housing when the latter is opened.
      (3) Circular portion of the shaft is to be placed into the bottom half of the bushing.
      (4) Top half of the bushing shall fit over the circular portion of the shaft when the top half of the busing housing is closed.
   h. Spooling device shall accommodate a nominal reel and cable weight of 534 N (120 lb).
   i. Spooling device shall contain safety chains for any pins and a place to mount/secure the pins when not in use.
   j. Spooling device shall be available in two mounting orientations.
      (1) Floor (deck) use/mounting. Hole pattern is oriented for mounting parallel to floor. Feet are provided (may be in mounting holes, if removable).
      (2) Wall (bulkhead) mounting. Hole pattern oriented for mounting normal to floor.

APPENDIX C
CABLE HAND CRANKED SPOOLING DEVICE SPECIFICATION
(Continued)

2. Dimensions to ensure interchangeability for mounting hole location.
   a. Mounting hole pattern shall conform to figure 1.

3. Dimensions to ensure interchangeability with fiber optic cable reel:
   a. Reel barrel diameter: 304.80 mm (12 in) minimum, 336.55 mm (13.25 in) maximum.
   b. Reel overall axial length of reel: 552.45 mm (21.75 in) minimum, 571.50 mm (22.5 in) maximum.
   c. Reel flange diameter: 685.8 mm (27 in) minimum, 711.2 mm (28 in) maximum.
   d. Reel traverse length of main storage area: 457.2 mm (18 in) minimum.
   e. Reel center hole: To interface with a 2.54 cm x 2.54 cm (1 inch x 1 inch) standard square drive shaft on the spool device.

4. Environmental requirements.
   a. Spooling device shall withstand an outdoor, seaport environment.
   b. Spooling device shall withstand a corrosive salt air environment with no appreciable corrosion. Spooling device metal and finish material used and method of application for the finish shall satisfy a 500 hour salt spray requirement performed in accordance with TIA/EIA-455-16 or other Navy recognized commercial standard. Certificate of Conformance shall be submitted to verify this requirement. Finish on spooling device shall have a non-reflective color.
   c. Spooling device shall withstand exposure to outdoor temperatures ranging from –40 C to + 65 C with no effect that may impact cable optical performance.

5. Mechanical requirements.
   a. Spooling device shall withstand a 0.9 m (3 ft) drop and be functional after straightening any bent metal back into place using standard hand tools.
   b. Spooling device may be re-enforced to comply with this requirement.
   c. Spooling device components shall be welded together. No threaded rods, threaded fittings, bolts, screws or nuts shall be used in the assembly except for reel removal and assembly.

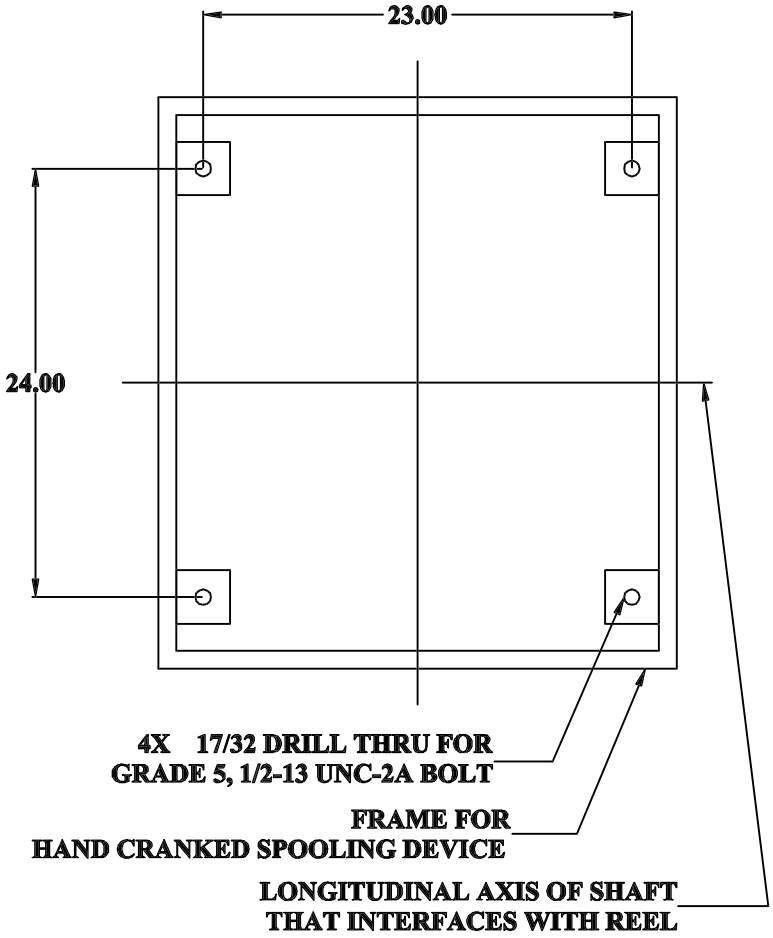
6. Usage.
   a. Both ends are to be disconnected prior to spooling cable to or from the reel.
   b. Inside end cable is to be wrapped onto the reel by hand prior to spooling outside end onto the reel.

7. Marking requirements.
   a. Spooling device shall be permanently marked or stenciled with the manufacturer's name and part number.

REV	SHT	DRAWING NO.	NAVSEA	ESWBS
–	20	7379173	DRAWING NO.	499

7-20-98

APPENDIX C



NOTES:
1. DIMENSIONS ARE IN INCHES.
2. TOLERANCE IS ±0.01 INCH FOR 2 PLACE DECIMALS.

FIGURE 1
INTERCHANGEABILITY DIMENSIONS FOR MOUNTING HOLE PATTERN

SIZE	CAGE	ESWBS	DRAWING NO.	REV
A	53711	499	7379173	–
SCALE: NONE	UCI	WT GRP	SHEET 20	