

METRIC

MIL-PRF-85045/28A

9 June 2014

SUPERSEDING

MIL-PRF-85045/28

27 July 2007

PERFORMANCE SPECIFICATION SHEET

CABLE, FIBER OPTIC, NINETEEN TUBE, BLOWN OPTICAL FIBER, STANDARD AND ENHANCED PERFORMANCE, CABLE CONFIGURATION TYPE 5 (TUBE), APPLICATION B (SHIPBOARD), CABLE CLASS SM AND MM, (METRIC)

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

The requirements for acquiring the product described herein shall consist of this specification and MIL-PRF-85045.

CLASSIFICATION:

Fiber optic cable configuration type (Tube): 5.

Fiber cable class: MM (graded-index, glass core and glass cladding, multimode).
SM (dispersion-unshifted, glass core and glass cladding, single-mode).

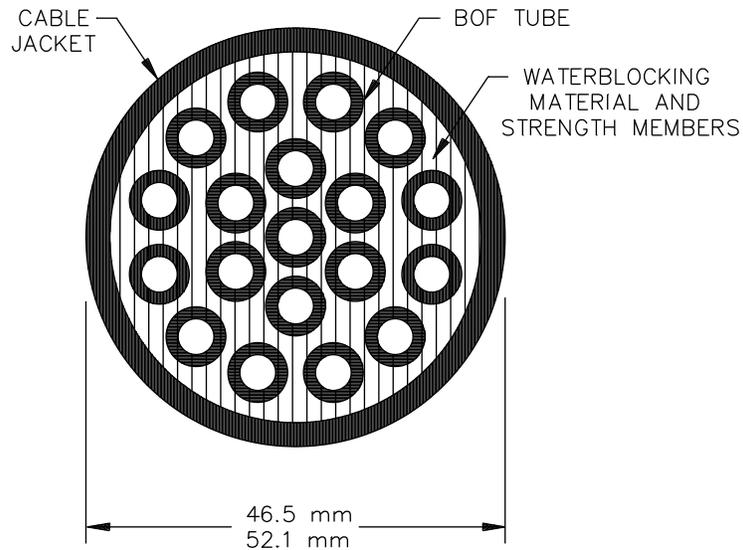


FIGURE 1. Nineteen tube cable.

AMSC N/A

FSC 6015

Part or Identifying Number (PIN):

M85045/28-01S (Standard performance).
M85045/28-01E (Enhanced performance).

DESIGN AND CONSTRUCTION:

FINISHED CABLE:

Dimensions and configuration: See figure 1. Nineteen tubes shall be helically laid in two layers around a central tube. The minimum outer jacket thickness shall be not less than 2.00 mm.

Concentricity: ≥ 0.80 .

Jacket material: The overall jacket shall be composed of a low halogen, low smoke, low toxicity polymer material.

Cable Jacket Color: Shall be Black or Blue.

Mass per unit length: $\leq 2,000$ kg/km.

Short term minimum bend diameter: 1.0 m. (The short term minimum bend diameter is to be used in all environmental and mechanical tests which specify a cable minimum bend diameter).

Long term minimum bend diameter: 1.27 m.

Blown optical fiber (BOF) tube:

Dimensions and configuration: See figure 2.

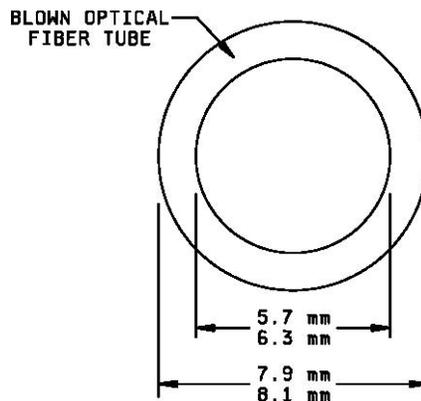


FIGURE 2. Blown optical fiber tube.

Short term minimum bend diameter: 127 mm.

Long term minimum bend diameter: 127 mm.

Tensile loading: ≥ 89 N.

Tube material: The tube shall be composed of a low halogen, low smoke, low toxicity polymer material.

Tube marking: Each tube shall be uniquely marked with a number between 1 and 19. The form of the marking shall be the printed spelling of the number, followed by a dash, followed by the printed arabic numeral. The marking shall be applied and repeated every 0.10 m (4 inches) along the tube. Tube number 1 shall be located at the center of the cable. Tubes in the innermost ring shall be consecutively numbered from 2 through 7. Tubes in the outermost ring shall be consecutively numbered from 8 through 19.

PERFORMANCE REQUIREMENTS:

Optical properties:

Attenuation rate: Not applicable.

Change in optical transmittance: Not applicable.

Crosstalk: Not applicable.

Mechanical properties:

Tensile loading and elongation: Applicable, tensile loading $\geq 3,300$ N. Change in optical transmittance is not applicable. A ball bearing with a minimum outer diameter of 4.0 mm shall pass through each tube after the test.

Operating tensile loading: Applicable, except change in optical transmittance is not applicable. A ball bearing with a minimum outer diameter of 4.0 mm shall pass through each tube during and after the test.

Dynamic bend: Not applicable.

Low temperature flexibility: The following procedure shall be used. A 4.0 m test specimen shall be placed in a straight configuration and conditioned at the exposure temperature for 4 hours.

a) For standard performance cable, the exposure temperature shall be the minimum operating temperature

b) For enhanced performance cable, the exposure temperature shall be -40°C .

The test specimen shall be removed from the conditioning chamber and formed into a single loop around a mandrel with a diameter equal to the cable short term minimum bend diameter. The time between the removal of the cable from the chamber to the completion of the loop shall be a maximum of 50 seconds. The specimen shall be secured to maintain its bent shape and allowed to return to room temperature. A ball bearing with a minimum outer diameter of 4.0 mm shall pass through each tube after the test.

Cyclic flexing: 100 cycles at $+25^{\circ}\text{C} \pm 2^{\circ}\text{C}$ and 20 cycles at $-28^{\circ}\text{C} \pm 2^{\circ}\text{C}$. Change in optical transmittance is not applicable. A ball bearing with a minimum outer diameter of 4.0 mm shall pass through each tube after every 25 cycles for the 100-cycle exposure and after the 20-cycle exposure. The cycling may be halted to perform the ball bearing test.

Crush: Applicable, except that the load shall be 2,650 N and the change in optical transmittance and crosstalk are not applicable. A ball bearing with a minimum outer diameter of 4.0 mm shall pass through each tube after the load is removed.

Cable twist bending: Not applicable.

Radial compression: Applicable, except the change in optical transmittance is not applicable. A ball bearing with a minimum outer diameter of 4.0 mm shall pass through each tube during and after the test.

Impact: Applicable, except that the drop hammer mass shall be 6 kg. 50 cycles shall be conducted at $+25^{\circ}\text{C} \pm 2^{\circ}\text{C}$ and 20 cycles shall be conducted at $-40^{\circ}\text{C} \pm 2^{\circ}\text{C}$. The change in optical transmittance is not applicable. A ball bearing with a minimum outer diameter of 4.0 mm shall pass through each tube after the test.

Corner bend: Applicable, except the change in optical transmittance is not applicable. A ball bearing with a minimum outer diameter of 4.0 mm shall pass through each tube during and after the test.

Hosing: Low pressure applicable, except the cable leakage shall be not greater than 430 ml. Tube ends shall be capped with end caps during this test.

Cable jacket tear strength: Applicable, except the cable jacket tear strength shall be not less than 35.0 newtons per centimeter (N/cm) for standard performance cable.

Tube tensile strength and elongation: Tube specimens shall be tested in accordance with FED-STD-228, method 3021 and 3031, with 2.5 cm (.98 inch) benchmarks, 6.35 cm (2.5 inch) jaw separation, and a rate of travel of 25 cm/min (9.8 inch/min). The tensile strength of the tube shall be not less than 900 N/cm^2 . The percent elongation-at-break shall be not less than 125 percent.

Cable scraping resistance: 750 cycles.

Cable to cable abrasion: 500 cycles.

Cable shrinkage: Applicable, except that the total shrinkage shall be not greater than 35.0 mm.

Cable element removability: Finished cable jacket, waterblocking materials, and strength members shall be easily and cleanly removable by mechanical means without damage to the cable or BOF tubes. No evidence of surface scratches, punctures, kinking, crushing, or defects to BOF tubes shall be visible after cable elements have been removed. The cable waterblock or filler materials, if applicable, 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. Filler material which leaves residue that is removable only by vigorous wiping or through the use of solvents shall not be acceptable.

Pressure withstand: One end of three tubes shall be capped and a static pressure of 1.4 MPa (200 psi) applied internal to the tube for 10 minutes. After the test, tubes shall show no evidence of splitting, cracking, or rupture. Perform as part of Group 1 on three tubes in each of the three 0.3 km samples.

Environmental properties:

Temperature range:

Operating: -28°C to $+65^{\circ}\text{C}$.
Nonoperating: -40°C to $+70^{\circ}\text{C}$.
Storage: -40°C to $+70^{\circ}\text{C}$.

Temperature cycling: Change in optical transmittance is not applicable. A ball bearing with a minimum outer diameter of 4.0 mm shall pass through each tube at the high temperature plateau, the low temperature plateau, and after the test.

Thermal shock: Not applicable.

Temperature humidity cycling: Change in optical transmittance is not applicable. A ball bearing with a minimum outer diameter of 4.0 mm shall pass through each tube at the high temperature plateau, the low temperature plateau, and after the test.

Storage temperature: Applicable, except the change in optical transmittance is not applicable. A ball bearing with a minimum outer diameter of 4.0 mm shall pass through each tube after the test.

Life aging: Applicable, except the change in optical transmittance is not applicable and a minimum test sample length of 150 m may be used.

- a) For standard performance product, the test shall be conducted as specified in the basic specification.
- b) For enhanced performance product, the test shall be conducted as specified in the basic specification except that the jacket material shall be tested at +175°C for 4 hours.

A minimum of 3.5 m of the sample shall be maintained at the long term minimum bend diameter throughout the test. A ball bearing with a minimum outer diameter of 4.0 mm shall pass through each tube after the test.

Weathering: Not applicable.

Fluid immersion:

- a) Standard performance product: Exposure to automobile gasoline and tap water are not required and the test temperature for lubricating oil exposure shall be 73°C to 77°C. The tensile strength retention of the cable jacket material after exposure to hydraulic fluid shall be not less than 30 percent.
- b) Enhanced performance product: Exposure to automobile gasoline and tap water are not required and the following test temperatures shall be used for the fluids indicated: Fuel oil (98°C to 100°C), turbine fuel (48°C to 50°C), and lubricating oil (98°C to 100°C).

Flame extinguishing and smoke generation: Applicable. Tube ends shall be plugged with a non-flammable sealant to simulate end caps.

Shock: Applicable.

Chemical properties:

Halogen content: < 0.2 percent.

Cross-link verification: This test is applicable for cables with cross-linked jackets only. The test shall be conducted in accordance with ICEA standard T-28-562 and run at 200°C. The test shall be sequenced after the fluid immersion test in the qualification test sequence and in the group C conformance test sequence. The hot creep shall not exceed 100 percent and the hot creep set shall not exceed 10 percent.

Qualification and conformance inspection: See table I.

TABLE I. Qualification and Conformance inspection.

| Group | Qualification inspection | Requirement paragraph | Test paragraph | Cable length <u>1/</u> <u>2/</u> | Conformance inspection |
|-------|---|-----------------------|----------------|---|------------------------|
| I | Visual & mechanical inspection | 3.4,3.9,3.10 | 4.7.2 | 2 samples, 0.3 km each <u>3/</u> | A |
| | Pressure withstand | <u>5/</u> | <u>5/</u> | 2 specimen, 2m each <u>3/</u> | |
| II | Temperature cycling | 3.7.1 | <u>5/</u> | 2 samples, 0.3 km each <u>4/</u> (1 on reel, 1 off) | C |
| | Temperature humidity cycling | 3.7.3 | 4.7.6.3 | 2 samples, 0.3 km each <u>7/</u> | C |
| | Storage temperature | 3.7.4 | 4.7.6.4 | 2 samples, 0.3 km each <u>7/</u> | |
| | Low temperature flexibility (cold bend) | 3.6.3 | 4.7.5.3 | 2 specimens, 8 m each <u>8/</u> | B |
| | Cyclic flexing | 3.6.4 | 4.7.5.4 | 6 specimens, 5 m each <u>9/</u> (2 specimens at each temp) | |
| | Crush | 3.6.5 | 4.7.5.5 | 2 specimens, 5 m each <u>8/</u> | |
| | Cable twist-bend | 3.6.6 | 4.7.5.6 | 6 specimens, 5 m each <u>9/</u> , <u>24/</u> (3 specimens at each temp) | C |
| | Impact | 3.6.8 | 4.7.5.8 | 2 units, 5 m each <u>7/</u> | C |
| | Temperature life (Life aging) | <u>5/</u> | <u>5/</u> | 2 specimens, 150 m each <u>8/</u> | C |
| | Tensile loading and elongation | 3.6.1 | 4.7.5.1 | 2 specimens, 150 m each <u>11/</u> | C |
| | Operating tensile loading | 3.6.1.1 | 4.7.5.1.1 | 2 specimens, 150 m each <u>12/</u> | C |
| | Fungus resistance | 3.8.4 | 4.8.4 | 2 specimens, 0.5 m each <u>8/</u> | |
| | Cable element removability | 3.6.18 | 4.7.5.18 | 2 specimens, 0.5 m each <u>8/</u> | C |

See notes at end of table.

TABLE I. Qualification and Conformance inspection – Continued.

| Group | Qualification inspection | Requirement paragraph | Test paragraph | Cable length <u>1/</u> , <u>2/</u> | Conformance inspection |
|-------|---|-----------------------|----------------|---|------------------------|
| III | Fluid immersion | 3.7.9 | 4.7.6.9 | 1 unit, 2 m <u>12/</u> and 3 material samples <u>13/</u> for each specified fluid | C |
| | Paint susceptibility | 3.7.15 | 4.7.6.15 | 2 units, 2 m <u>14/</u> | |
| | Jacket self-adhesion or blocking | 3.7.11 | 4.7.6.11 | 1 specimen, 30 m / | |
| | Shock | 3.7.13 | 4.7.6.13 | 1 unit, 30 m <u>12/</u> | |
| | Tube tensile strength and elongation | 5/ | 5/ | 1 specimen, 1m | |
| | Hosing: Low pressure | 3.6.12.1 | 4.7.5.12.1 | 1 unit, 1.5 m <u>12/</u> | C |
| | Radial compression (for application B only) | 3.6.7 | 4.7.5.7 | 1 unit, 10 m <u>12/</u> | |
| | Corner bend | 3.6.9 | 4.7.5.9 | 2 specimens, 5 m <u>16/</u> | |
| | Cross-link verification | <u>5/</u> | <u>5/</u> | 2 specimens, 1 m <u>13/</u> | C |
| IV | Dripping | 3.6.13 | 4.7.5.13 | 1 unit, 30 cm <u>12/</u> | |
| | Cable jacket tear strength | 3.6.14 | 4.7.5.14 | 5 flat extruded jacket material strips <u>22/</u> | C |
| | Cable jacket material tensile strength & elongation | 3.6.15 | 4.7.5.15 | 5 specimens <u>17/</u> | |
| | Cable abrasion resistance | 3.6.16 | 4.7.5.16 | 4 specimens, 2 m <u>18/</u> | C |
| | Cable shrinkage | 3.6.17 | 4.7.5.17 | 3 specimens, 0.5 m <u>6/</u> | C |
| | Durability of identification | 3.6.19 | 4.7.5.19 | 3 specimens, 2 m each <u>16/</u> | |
| | Flame extinguishing and smoke generation | 3.7.12.2 | 4.7.6.12.2 | 1 unit, 50 m <u>12/</u> | C |
| | Water absorption | 3.7.14 | 4.7.6.14 | 2 specimens, extruded jacket material strips <u>19/</u> | |
| V | Acid gas generation | 3.8.1 | 4.8.1 | 1 specimens 1 m <u>21/</u> | C |
| | Halogen content | 3.8.2 | 4.8.2 | 1 specimen, 1m <u>21/</u> | |
| | Toxicity index | 3.8.3 | 4.8.3 | 1 specimen, 1 m <u>21/</u> | C |
| | Smoke Index | 3.8.5 | 4.8.6 | 1 specimen, 1 m <u>21/</u> | C |

See notes at end of table.

TABLE I. Qualification and Conformance inspection – Continued.

Notes:

- 1/ Tolerance on 0.5 km length is ± 5 percent provided results are normalized to 1 km.
- 2/ Tolerance on shorter lengths is ± 5 percent.
- 3/ The inspection shall only be conducted on a 2 m section of each sample.
- 4/ The same samples as used in the visual and mechanical inspection shall be used.
- 5/ As stated under the applicable tests in this specification sheet.
- 6/ Intentionally left blank.
- 7/ The same samples as used in the temperature cycling test shall be used.
- 8/ A specimen cut from each sample used in the temperature cycling test shall be used.
- 9/ Three specimens cut from each sample used in the temperature cycling test shall be used.
- 10/ A specimen cut from one of the samples used in the temperature cycling test shall be used.
- 11/ A specimen cut from each specimen used in the temperature life test shall be used.
- 12/ The same specimen as used in the tensile loading and elongation test shall be used.
- 13/ A specimen cut from the specimen used in the temperature cycling test shall be used.
- 14/ Three flat extruded jacket material strips as specified in 4.7.5.15 shall be used in this test.
- 15/ A specimen cut from the specimen used in the tensile loading and elongation test shall be used.
- 16/ Specimens cut from the specimen used in the temperature cycling test shall be used.
- 17/ Flat extruded jacket material as specified in 4.7.5.15 shall be used in this test.
- 18/ Specimen cut from the sample used in the temperature cycling test shall be used. Two specimens shall be used for scraping abrasion and two specimens shall be used in the cable to cable abrasion testing.
- 19/ Use 76 mm (3 inch) lengths of cable adjacent to one another to form a 76 mm (3 inch) strip. For a 2 mm (.08 inch) diameter cable, an approximate length of 3 m is needed.
- 20/ Intentionally left blank
- 21/ A specimen cut from one of the samples used in the temperature cycling test shall be used.
- 22/ Flat extruded jacket material strips (i.e., strips of flat extruded material with the same composition of the cable jacket and of sufficient dimensions in which dumbbells can be cut) prepared as specified in 4.7.5.14 cited method and obtain from flat extruded material that underwent the temperature cycling test shall be used.

Qualification by similarity:

Manufacturers who produce products for both MIL-PRF-85045/25 and this specification sheet, and are qualified under MIL-PRF-85045/25 and whose standard performance product passes all applicable tests specified in table I, are qualified under this specification sheet for standard performance product. This qualification by similarity is applicable if the same cable jacket materials are used in the previously qualified MIL-PRF-85045/25 cable and the standard performance cable under test.

TABLE II. Qualification by similarity to M85045/25.

| Group | Qualification inspection | M85045/28 Qualification inspection <u>1/</u> | M85045/28 Conformance inspection <u>2/</u> | |
|---|--|--|--|---|
| I | Visual & mechanical inspection | X | A | |
| III | Temperature cycling | X | C | |
| | Temperature humidity cycling | X | C | |
| | Storage temperature | X | | |
| | Low temperature flexibility (cold bend) | X | B | |
| | Cyclic flexing | X | | |
| | Crush | X | | |
| | Impact | X | C | |
| | Temperature life (Life aging) | X | C | |
| | Tensile loading and elongation | X | C | |
| | Operating tensile loading | X | C | |
| | Cable element removability | X | C | |
| | IV | Shock | X | |
| | | Hosing: Low pressure | X | C |
| Radial compression (for application B only) | | X | | |
| Corner bend | | X | | |
| Cross-link verification | | X | | |
| V | Dripping | X | | |
| | Cable abrasion resistance | X | C | |
| | Cable shrinkage | X | C | |
| | Flame extinguishing and smoke generation | X | C | |
| VI | Acid gas generation | X | C | |
| | Halogen content | X | | |
| | Toxicity index | X | C | |
| | Smoke Index | X | C | |

1/ Where manufacturers are qualified for MIL-PRF-85045/25 and pursuing qualification for MIL-PRF-85045/28.

2/ Where manufacturers are qualified for MIL-PRF-85045/25 and MIL-PRF-85045/28 and are performing conformance testing for M85045/28.

Qualification by similarity for change to outer cable jacket:

Manufacturers who produce products for MIL-PRF-85045/28 using one particular overall cable jacket compound and are qualified under MIL-PRF-85045/28 for that compound and pass all tests identified in Table III for cables with a modified overall cable jacket compound or modified cable jacket color are also qualified under MIL-PRF-85045/28 for cables with the modified overall cable jacket.

TABLE III. Qualification by similarity for change in outer cable jacket or color.

| Group | Qualification inspection | Modified overall cable jacket compound | Modified cable jacket color <u>1/</u> |
|-------|---|--|---------------------------------------|
| I | Visual and mechanical inspection | X | X |
| III | Low temperature flexibility (cold bend) | X | X |
| | Cyclic flexing | <u>3/</u> | |
| | Temperature life (life aging) | <u>3/</u> | |
| | Fungus resistance | <u>4/</u> | <u>4/</u> |
| IV | Fluid immersion | X | |
| | Paint susceptibility | X | |
| | Jacket self-adhesion or blocking | X | |
| | Hosing: low pressure | <u>2/</u> | <u>2/</u> |
| | Cross-link verification | X | X |
| V | Dripping | X | |
| | Cable jacket tear strength | <u>3/</u> | |
| | Cable jacket material tensile strength & elongation | X | X |
| | Cable abrasion resistance | X | |
| | Cable shrinkage | <u>2/</u> | <u>2/</u> |
| | Durability of identification | X | X |
| | Flame extinguishing and smoke generation | X | X |
| VI | Water absorption | X | X |
| | Acid gas generation | X | X |
| | Halogen content | X <u>5/</u> | X <u>5/</u> |
| | Toxicity index | X | X |
| | Smoke Index | X | X |

1/ Perform if only colorants have changed.

2/ Perform if process conditions change.

3/ Perform if results of cable jacket material tensile strength and elongation for the modified cable jacket are not the same as the qualified cable jacket.

4/ Perform unless fungus inert in accordance with MIL-HDBK-454.

5/ If information on formulation of colorants provided, test may be waived.

Manufacturers who produce products for MIL-PRF-85045/28 using one particular tube and are qualified under MIL-PRF-85045/28 for that tube and pass all tests identified in table IV for cables with a modified tube are also qualified under MIL-PRF-85045/28 for cables with the modified tube.

TABLE IV. Qualification by similarity for change in tube.

| Group | Qualification inspection | Change to tube |
|--|---|----------------|
| I | Visual and mechanical inspection | X |
| III | Temperature Cycling | X |
| | Temperature humidity cycling | X |
| | Storage temperature | X |
| | Low temperature flexibility (cold bend) | X |
| | Cyclic flexing | X |
| | Impact | X |
| | Temperature Life (Life aging) | X |
| | Fungus resistance | X <u>1/</u> |
| IV | Radial compression (for application B only) | X |
| V | Dripping | X |
| | Cable shrinkage | X |
| | Flame extinguishing and smoke generation | X |
| VI | Acid gas generation | X |
| | Halogen content | X |
| | Toxicity index | X |
| | Smoke index | X |
| NOTES: | | |
| <u>1/</u> Perform unless fungus inert in accordance with MIL-HDBK-454. | | |

Referenced documents: In addition to MIL-PRF-85045, this document references the following:

MIL-PRF-85045/25
FED-STD-228

MIL-HDBK-454
ICEA T-28-562

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CONCLUDING MATERIAL

Custodians:
Navy - SH
Air Force – 85
DLA – CC

Preparing activity:
DLA – CC

Review activity:
AF – 99

(Project 6015-2012-007)

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