



DEFENSE LOGISTICS AGENCY
LAND AND MARITIME
P.O. BOX 3990
COLUMBUS, OHIO 43218-3990

February 22, 2023

MEMORANDUM FOR MILITARY/INDUSTRY DISTRIBUTION

SUBJECT: Initial Draft of MIL-PRF-29504/18 Amendment 4, MIL-PRF-29504/20 Amendment 5, MIL-PRF-29504/21 Amendment 1 and MIL-PRF-29504/26 Amendment 1;
Project Number(s) 66060-2023-008, -009, -010, -011.

The proposed initial drafts are being amended to add language to the slash sheets Part or Identifying number (PIN) which describes the meaning of the optional character, Crimp Sleeve, in the PIN. By making this change and designating that option as a 'C' to address inconsistency within DLA's cataloging of this item.

Also, to include a link to all referenced documents contained within the document. This will help all users of the document to have quick access to referenced documents.
As well as adding a DISTRIBUTION STATEMENT to the document.

The initial drafts for the subject documents, dated 24 February 2023, are now available for viewing and downloading from the DLA Land and Maritime-VA Web site:

<https://landandmaritimeapps.dla.mil/programs/milspec/initialdrafts.aspx>

Concurrence or comments are required at this Center within 30 days from the date of this letter. Late comments will be held for the next coordination of the document. Any further coordination concerning these documents will be circulated only to firms and organizations that furnish comments or reply that they have an interest. Comments from military departments must be identified as either "Essential" or "Suggested". Essential comments must be justified with supporting data. Military review activities should forward comments to their custodians of this office, as applicable, in sufficient time to allow for consolidating the department reply

The point of contact for this document is Mr. Ken Beymer, DLA Land and Maritime, VAT, Post Office Box 3990, Columbus, OH 43218-3990. Mr. Beymer can also be reached at 614-692-0557/850-0557, or by facsimile 614-692-6939/850-6939, or by e-mail to:
ken.beymer@dla.mil

/ SIGNATURE ON FILE /

MICHAEL A. RADECKI
Chief
Electronic Components Branch

NOTE: This draft dated 24 February 2023, prepared by DLA-CC has not been Approved and is subject to modification.
DO NOT USE FOR ACQUISITION PURPOSES.

INCH-POUND
MIL-PRF-29504/26
W/AMENDMENT 1
DRAFT
SUPERSEDING
MIL-PRF-29504/26
17 April 2020

PERFORMANCE SPECIFICATION SHEET

TERMINI, FIBER OPTIC, LENS, KEYED, CONNECTOR, REMOVABLE, ENVIRONMENT RESISTING,
PIN TERMINUS, REAR INSERT/REAR RELEASE, 1.58 MM LENS HOLDER (1MM lens),
(FOR [MIL-PRF-64266](#) CONNECTORS)

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-29504](#).

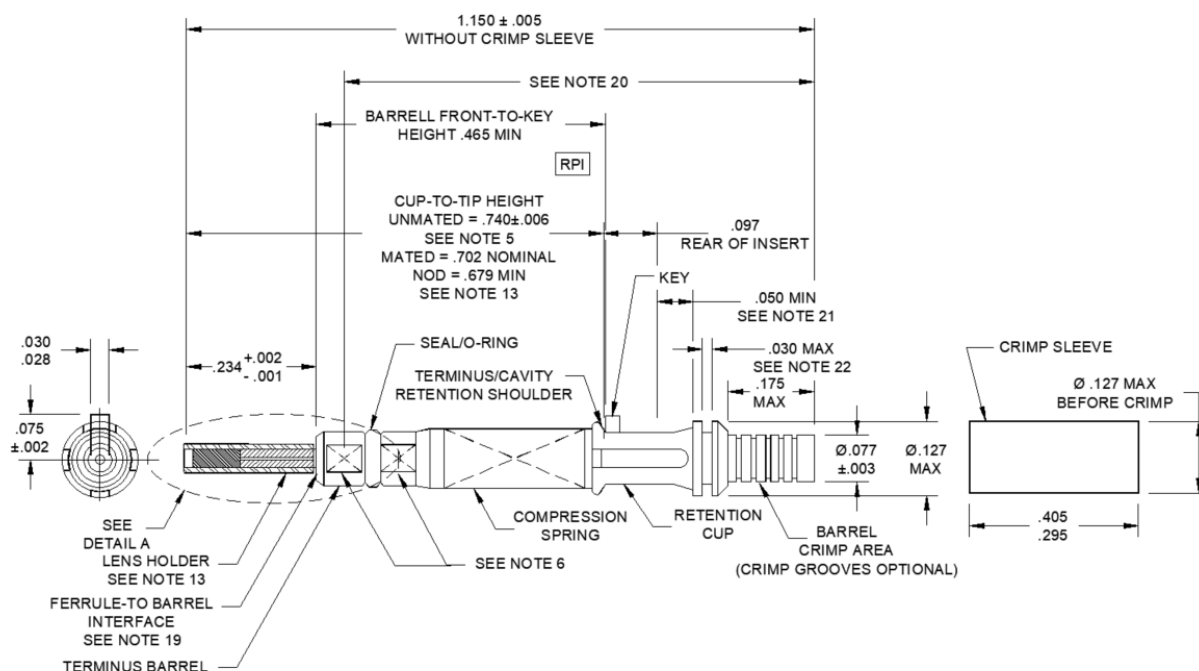
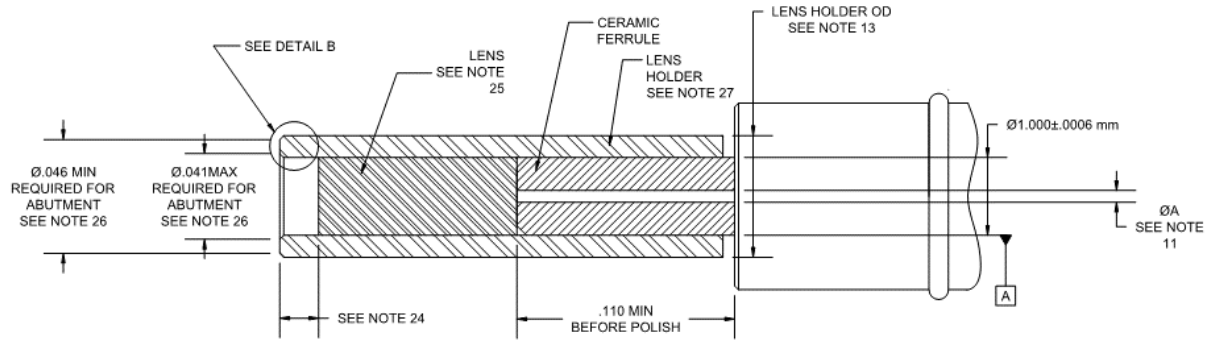


FIGURE 1. Lens keyed terminus.



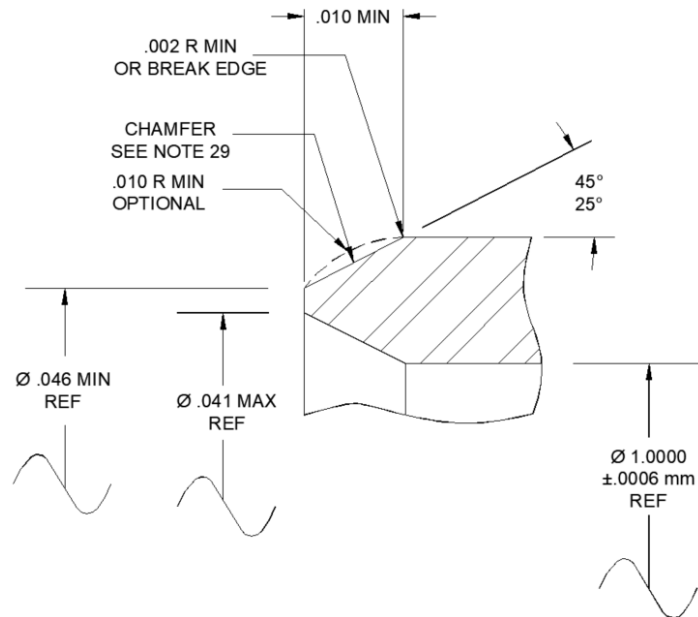
MIL-PRF-29504/26
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Inches	mm	Inches	mm	Inches	mm	Inches	mm	Inches	mm
.0006	.015	.028	.71	.077	1.96	.295	7.49	1.0000	25.40
.001	.03	.030	.76	.097	2.46	.405	10.3	1.150	29.2
.002	.05	.041	1.04	.110	2.79	.485	12.3		
.003	.08	.046	1.17	.127	3.23	.679	17.3		
.005	.13	.060	1.52	.175	4.45	.702	17.8		
.006	.15	.075	1.91	.234	5.94	.740	18.8		



DETAIL A

TERMINUS FRONT END INCLUDING LENS HOLDER



DETAIL B

CHAMFER SURFACE

FIGURE 1. Lens keyed terminus – Continued.

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NOTES:

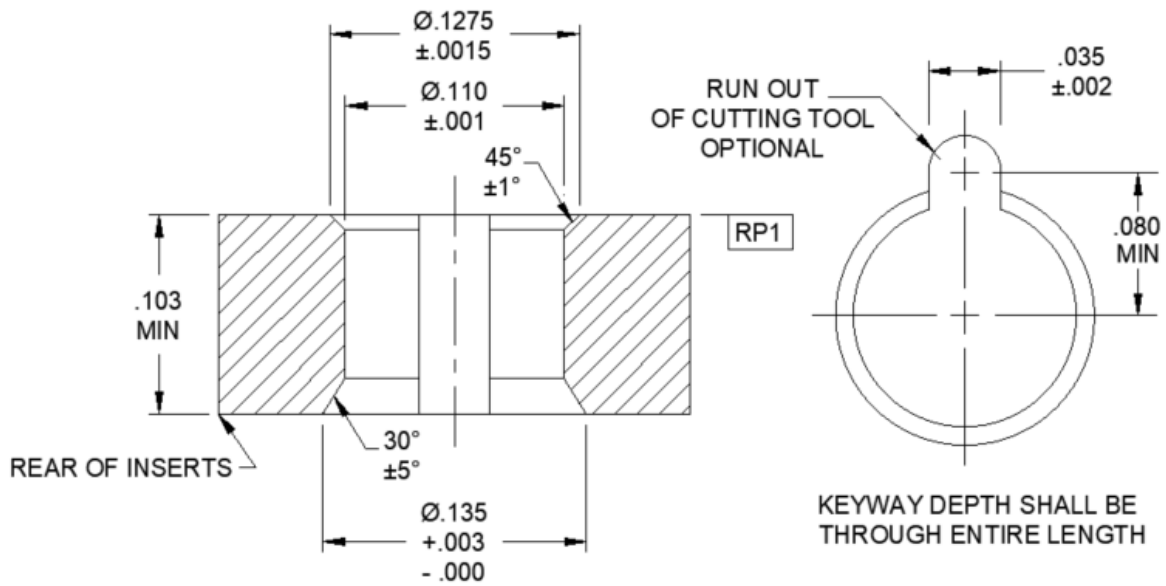
1. Dimensions are in inches except for diameter "A" (see [table II](#)), circular run out, lens holder surface roughness (see note 13), lens holder outside diameter and ferrule outside diameter which are dimensioned in metric units only.
2. Metric equivalents are given for general information only.
3. All diameters are to be concentric within .002 inch (0.05 mm), except as noted.
4. Dimensions apply to plated/finished part.
5. Dimension .740 inch (18.80 mm) is to be measured when installed in connector equivalent gauge fixture and when subjected to minimal compressive force. See [figure 2](#).
6. The TICC marking shall be at the front end of the terminus barrel. The TICC marking may be represented directly as alphabetical characters per 3.7.2 of MIL-PRF-29504. An alternative location of the marking shall be allowed only in the case of insufficient surface area and only if approved by the qualifying activity.
7. The individual bag or container shall have the [MIL-PRF-29504](#) Part Identifying Number (PIN) marking on container or on a tag inside the container.
8. All terminus metal parts are to be corrosion resistant.
9. Crimp sleeve is to be metal.
10. Crimp grooves are permissible on the crimp diameter.
11. See [table II](#) for ferrule hole diameter. Ferrule hole circular run out (concentricity) in [table II](#) is relative to datum A.
12. The non-optical disconnect (NOD) dimension is the maximum distance the terminus can be compressed. The terminus design shall include features to restrict the compression of the terminus such that the NOD dimension is met.
13. Lens holder outer diameter: .06246 to .06250 inches (1.5865 to 1.5875 mm). Lens holder outside diameter shall have a surface roughness of 0.2 micrometers maximum.
14. Terminus end face shall exert a load of $3.25 \pm .25$ pounds at normal pushback when the terminus has been deflected to a dimension of .702 inches spring working height. Verification of compliance shall be by means of installing the terminus into the fixture A shown in [figure 2](#) and deflecting the terminus to a dimension of $.702 \pm .002$ inches. The resultant load at this height or deflection must be within $3.25 \pm .25$ pounds. The deflection to dimension .702 inches is the distance measured from the clip-to-tip (from dimension RP1 to ferrule end face, see [figure 1](#)). The tolerance of $\pm .002$ on dimension 0.702 is specified only for use to measure the spring force for verification of compliance. Spring shall not take a set at the working height.
15. Withdraw force of the terminus from the ASR alignment sleeve is dependent upon both alignment sleeve (see [MIL-PRF-64266/9](#)) and the lens holder.
16. For split alignment sleeves, terminus engagement force shall be as specified in MIL-PRF-64266/9. No separation force is specified. No solid alignment sleeves shall be used with lens termini to this specification sheet.
17. Manufacturer's symbol or trademark location is in front of the first TICC band (see figure 1 of [MIL-PRF-29504](#)). An alternate location of the marking shall be allowed only in the case of insufficient surface area and only if approved by the qualifying activity. The manufacturer shall list the symbol or trademark in accordance with [SAE AIR 1351](#).
18. Barrel is the metallic portion of the terminus that accepts the ferrule at one end and the fiber optic cable (barrel crimp area) at the other end. The barrel can be comprised of multiple pieces.
19. If using epoxy to bond ferrule, no epoxy meniscus is permitted at ferrule-to-barrel interface.
20. One of the standardized strip dimensions of this terminus is based on a buffer insertion of the optical fiber to the back of the ferrule. Also, the intent is to allow insertion of a 20 gauge dispensing tip (syringe needle) to make contact with the ferrule (no neck down or dead zone/expansion zone at ferrule interface) and to have fiber supported with buffer up to entry into the ferrule. Compliance is conformance to the standardized strip length (see "Design and construction: Dimensions and configuration" in this specification sheet - the termination procedures cited contain the reference for the standardized cable strip lengths).
21. This dimension is the resultant length when the retention clip is in the most forward position in an insert equivalent fixture. See [figure 3](#). This dimension is measured from the rear surface of insert equivalent fixture B to the point shown at the rear of the retention clip. The rear (crimp area) of the terminus shall be pressed into the insert equivalent fixture B using hand (finger) pressure to place the retention clip in the most forward position prior to obtaining the measurement.
22. The specified .030 maximum gap between the back of the retention clip and the front (leftmost surface) of the rear shoulder is the resultant exposed length (or gap) when the retention clip is in the most forward position in an unmated condition.
23. The dimension shown is effective prior to the application of the TICC marking.
24. The distance between the front of the lens and the front end of the lens holder is half the distance of the lens separation distance (see [table III](#)).

FIGURE 1. [Lens keyed terminus](#) – Continued.

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25. Lens for the terminus (typical for each terminus). General depiction of a lens is shown rather than intent to use that particular lens configuration.
26. Standardized method used to compress lens terminus spring against a metal abutment, provide alignment and control the air gap is to have ferrule-to-ferrule abutment.
27. Design and installation to affix the lens holder to the ferrule. Means to affix the lens holder to the ferrule shall be mechanical (such as snap on groove, bayonet, screw-on, press-fit) or bonded (such as internally with epoxy or UV adhesive, externally with epoxy).
28. Detail A shows the location and distance of the beginning of the lens to the front end face of the ferrule. From this dimension and the counterpart dimension for the other lens terminus, the air gap in relation to the two mated lens termini can be determined.
29. Ferrule surface shown to have either a chamfer within 25° to 45° angle X .010 minimum, or a .010 R minimum or a combination of both.
30. Installation. For smaller OD (outside diameter) cable jackets (less than 1.7 mm), the OD of the cable is to be built up using tubing or larger diameter cable jacket (not packaged with the termini). This also provides additional strain relief.

FIGURE 1. Lens keyed terminus – Continued.

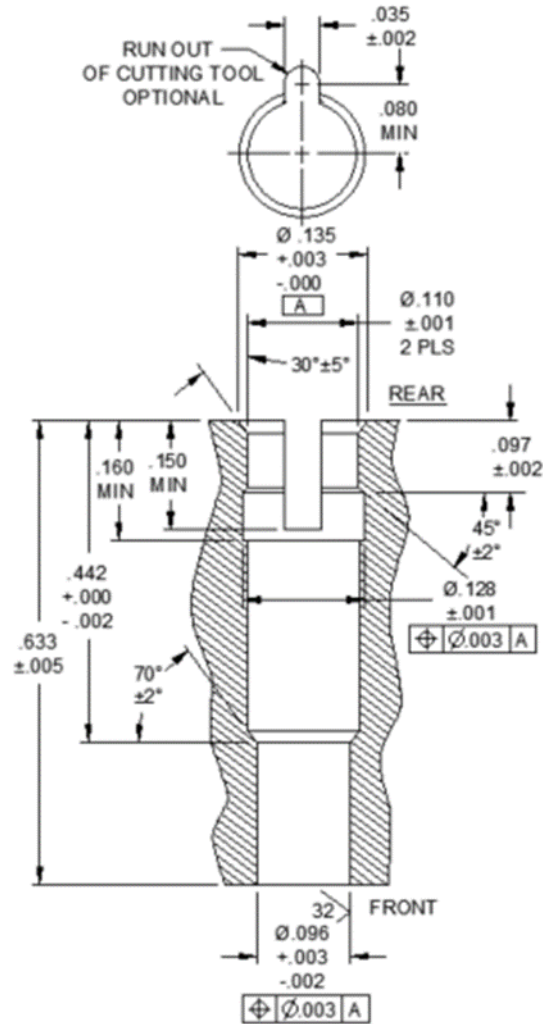


Inches	mm	Inches	mm	Inches	mm	Inches	mm	Inches	mm
.001	0.03	.002	0.05	.080	2.03	.110	2.79	.135	3.34
.0015	0.038	.035	0.89	.103	.1275	3.24	2.79		

NOTES:

1. Dimensions are in inches.
2. Metric equivalents are given for general information only.
3. All diameters are to be concentric within .002 inch (0.05 mm).
4. Dimensions apply to plated/finished part.
5. Tolerance on all angles is ± 1 degrees, unless otherwise noted.

FIGURE 2. Insert equivalent fixture for terminus spring working height measurement (see note 14 of figure 1).



Inches	mm
.001	0.03
.002	0.05
.003	0.08
.005	0.13
.035	0.89
.080	2.03
.096	2.44
.097	2.46
.128	3.25
.135	3.43
.150	3.81
.160	4.06
.442	11.2
.633	16.1

NOTES:

1. Dimensions are in inches.
2. Metric equivalents are given for general information only.
3. All diameters are to be concentric within .002 inch (0.05 mm).
4. Dimensions apply to plated/finished part.
5. Tolerance on all angles is ±1degrees, unless otherwise noted.

FIGURE 3. Insert equivalent fixture for terminus retention clip exposed length measurement (see note 21 of figure 1).

REQUIREMENTS:

Temperature ranges: Temperature range designations shall be in accordance with [table I](#).

TABLE I. Temperature range designation.

Temperature range designation	Operating temperature	Operating temperature	Non-operating temperature	Non-operating temperature	Storage temperature	Storage temperature
	°F	°C	°F	°C	°F	°C
1	-18 to +150	-28 to +65	-40 to +168	-40 to +70	-40 to +168	-40 to +70
2	-67 to +329	-55 to +165	-40 to +185	-40 to +85	-40 to +185	-40 to +85

Design and construction:

Dimensions and configuration: See figures 1, 2, 3 and [table II](#). For both temperature ranges 1 and 2, termini shall meet the requirements of this specification when terminated using the procedures specified in Requirement 4106 of [MIL-STD-1678-4](#).

TABLE II. TICC numbers and dimensions for lens keyed termini.

Fiber Type	Fiber size (um)	Ferrule hole Diameter "A" (um) <u>2/</u> , <u>3/</u>	Wavelength nominal (nm) <u>4/</u> , <u>5/</u>	Wavelength range (nm) <u>4/</u> , <u>5/</u>	Temperature Range 1 <u>6/</u>	Temperature Range 2 <u>6/</u>
					TICC PC polished	TICC PC polished
SM <u>1/</u>	9/125	125.3	1310	1270-1355	CA	
	9/125	125.3	1550 <u>7/</u>	1530-1570		CD
	9/125	125.3	S Band	1460-1530		CE
	9/125	125.3	L Band	1565-1625		CF
	9/125	125.5	1310	1270-1355	CB	
	9/125	125.5	1550	1530-1570		CG
MM	50/125	126.0	850	750-950		CH
	62.5/125	126.0	850	750-950		
	50/125	126.0	1300	1270-1355	CC	
	62.5/125	126.0	1300	1270-1355		
	50/125/155	156.0	850	750-950		CJ
	62.5/125/155	156.0	850	750-950		

1/ Return loss shall be ≥ 30 dB for SM (single mode).

2/ Tolerance on the ferrule hole diameter (diameter "A") shall be +1/-0 um (microns or micrometers).

3/ Circular run-out on SM ferrule hole diameters shall be ≤ 0.5 um. Circular run-out on MM ferrule hole diameters shall be ≤ 1.0 um.

4/ Wavelength coating on the lens to cover the wavelength range for DWM applications.

5/ Recommend that current wavelength coverage (limits) of the lens coatings be extended by +/- 10 nm for potential future expansion of current wavelength ranges.

6/ Unless otherwise specified, TICC shall be marked on the terminus as letters (digits) and not color bands. Note that the leftmost digit does not represent yellow for fiber optic component per 3.7.3 of MIL-PRF-29504.

7/ This wavelength range cover the C Band (1530 to 1565 nm).

Size. For ferrule inside diameter and ferrule outside diameter inspection, ferrule manufacturer certification of compliance may be used in lieu of in-house inspection by the manufacturer at the terminus production facility.

Weight: 0.0022 lb (1.0 gram) maximum.

Mating termini: Same.

Crimp sleeve: The crimp sleeve shall accept single fiber cable with a maximum outer diameter of .094 inch (2.4 mm). The terminus shall meet all requirements when the crimp sleeve is assembled to the terminus using a hex crimp die with flats measuring .0945 +.002/-.001 inch (2.400 mm +.050/-.025 mm) across and .260 inch (6.6 mm) maximum long or as approved by the qualifying activity. Crimp sleeve is to be supplied with terminus unless specified in PIN.

Circular runout: The circular runout of the ferrule bore to the ferrule outer diameter shall be not greater than the value specified for applicable hole size in [table II](#). For ferrule circular run-out (concentricity) inspection, ferrule manufacturer certification of compliance may be used in lieu of in-house inspection by the manufacturer at the terminus production facility.

Frequency of terminus end face cleaning. Unless otherwise specified, terminus may be cleaned before or after each test if the connector is de-mated. Cleaning shall not be performed during the ten successive mates for the insertion loss test. Unless otherwise specified, cleaning may be performed during mating durability before each optical transmittance measurement. Terminus end face cleaning shall be performed for the post optical transmittance measurement after the salt spray test. The optical transmittance measurement is performed after the general cleaning and inspection for corrosion. No degradation in performance shall occur as a result of cleaning.

Material:

Ferrule: Ferrule material shall be zirconia ceramic.

Lens holder: Lens holder material shall be zirconia ceramic or made of metal. Termini shall meet all of the requirements of this specification when mated to qualified termini utilizing a qualified [MIL-PRF-64266/9](#) alignment sleeve retainer (ASR) for a lens terminus application in a qualified [MIL-PRF-64266](#) connector.

Sealing compounds: Sealing compounds which may flow at the maximum specified operating temperature or exhibit cracking at the minimum specified operating temperature shall not be used.

Adhesives: Adhesives: Use adhesive specified in Requirement 4103 of [MIL-STD-1678-4](#) for each temperature range.

Optical Interface Specifications

Key optical characteristics for the interface are defined in [table III](#) for lens termini compatible with the specified GRIN lens requirements. Requirements specified in [table III](#) are pertinent for measuring a fiber-lens assembly. All beam measurements are specified at the lens face opposite the optical fiber.

TABLE III. Optical interface parameters – lens termini compatible with GRIN lenses.

Parameter	Requirements <u>3/</u>	Requirements <u>3/</u>	Requirements <u>3/</u>	Requirements <u>3/</u>
Wavelength (nm)	850	1300	1310	1550
Lens diameter (Nominal)	1.0 mm	1.0 mm	1.0 mm	1.0 mm
Lens separation distance +/- 0.5 mm	1.0 mm	1.0 mm	1.0 mm	1.0 mm
Clear aperture	0.7 mm	0.7 mm	0.7 mm	0.7 mm
Beam Waist (Diameter) – SM (Nominal)	NA	NA	190 microns	190 microns
Beam Waist Location (Nominal +/- 100 microns) <u>4/</u>	NA	NA	Lens Vertex	Lens Vertex
Rayleigh range SM (minimum)	NA	NA	21 mm	21 mm
Beam Diameter MM (62.5/125) Max <u>1/</u>	625 microns	625 microns	NA	NA
Lens Pitch (Nominal) <u>2/</u>	.25	.25	.25	.25
Index Gradient Constant , (A) ^{.5} +/- .002 <u>2/</u>	0.601	0.597	0.597	0.596
Working distance (Nominal) <u>5/</u>	1.0 mm	1.0 mm	1.0 mm	1.0 mm

1/ Beam waist at front surface of lens.

2/ GRIN only.

3/ NA = Not Applicable.

4/ Varies by technology or design (generally at or near the lens front surface vertex).

5/ See definition for working distance at the end of this specification sheet.

Specifications for termination.

1. Lens termini shall be constructed to meet the requirements for temperature range 2 and be provided unterminated.
2. Termination shall be performed per Requirement 4106 of [MIL-STD-1678-4](#) except for strip length, polishing, and the noted exceptions for lens termini.

Qualification:

Qualification shall consist of performing testing specified for inspections for un-terminated termini, inspections for the terminus as part of a single fiber cable, and inspections of termini in a multiple termini connector as listed in [table IV](#).

TABLE IV. Qualification inspections.

Temperature range: test performed <u>1/</u> , <u>2/</u>	Temperature range 1 <u>3/</u>	Temperature range 1 <u>3/</u>	Temperature range 2 <u>3/</u>	Temperature range 2 <u>3/</u>
	SM	MM	SM	MM
Tests for un-terminated termini				
Group 1 <u>4/</u>				
Size <u>5/</u>	X	X	X	X
Weight <u>5/</u>	X		X	
Identification markings <u>5/</u>	X		X	
Workmanship <u>5/</u>	X		X	
Circular runout <u>5/</u>	X	X	X	X
Beam interface parameters <u>18/</u>	X	X	X	X
Group 2 <u>5/</u> , <u>6/</u> , <u>7/</u>				
Terminus insertion & removal forces	X		X	
Terminus retention <u>5/</u>	X		X	
Maintenance aging	X		X	
Terminus cleaning	X		X	
Lens scratches and defects	X	X	X	X
Lens abrasion resistance	X	X	X	X
Group 3 (polymeric materials)				
Ozone	X		X	
Fungus resistance	X		X	
Group 4				
Modified SO ₂ /salt spray			X	
Tests for termini as part of a single fiber cable				
Group 1 <u>14/</u> , <u>19/</u>				
Attenuation	X	X	X	X
Polarization dependent loss	X		X	
Bandwidth		X		X
Group 2 (16 termini mated pair – each pull out test) <u>6/</u>				
Insertion loss (16 cable PO & 16 Fiber PO mated pair)	X		X	
Fiber pull out force <u>8/</u>	X			
Cable pull out force <u>8/</u>	X		X	
Twist <u>17/</u>	X		X	
Group 3 (16 termini mated pair from cable pull out force)				
Salt spray <u>20/</u>			X	
Fluid immersion <u>20/</u>			X	
Terminus cleaning	X		X	
Radiation <u>15/</u>	X	X	X	X

See footnotes at end of table.

TABLE IV. Qualification inspections - Continued.

Temperature range: test performed <u>1/</u> , <u>2/</u>	Temperature range 1	Temperature range 1	Temperature range 2 <u>3/</u>	Temperature range 2 <u>3/</u>
	SM	MM	SM	MM
Tests for termini as an integral part of a multiple termini connector				
Group 1 (4 connector mated pair, <u>16/</u>)				
Interoperability <u>9/</u>	X	X	X	X
Optical tests				
Insertion loss	X	X	X	X
Return loss	X		X	
Bit error rate			X	X
Group 2 (2 connector mated pair, <u>16/</u>)				
Mating durability	X		X	
Terminus cleaning	X		X	
Return loss <u>10/</u>	X		X	
Group 3 <u>16/</u>				
Mechanical tests <u>11/</u>				
Vibration <u>12/</u>	X		X	X
Shock, MIL-DTL-901 <u>12/</u>	X	X	X	X
Environmental (2 connector mated pair) <u>11/</u>				
Thermal shock	X		X	X
Temperature humidity cycling	X			
Temperature cycling	X		X	
Altitude immersion			X	
Temperature life	X		X	
Flammability <u>11/</u>	X			
Insertion loss verification <u>13/</u>	X		X	X
Return loss <u>13/</u>	X		X	

Notes:

- 1/ Qualification consist of performing tests in this table for temperature range 1, for temperature range 2 or for both temperature range 1 (TR1) and temperature range 2 (TR2). There is no separate qualification for only one fiber size (SM or MM).
- 2/ "X" indicates test applies when performing a terminus qualification. There is no combined provision for performing a terminus qualification along with a [MIL-PRF-64266](#) connector qualification.
- 3/ Assumes same terminus material and physical configuration as used in the other temperature range.
- 4/ Sample size. Sample size, test sample configuration and test sample fabrication shall conform to [MIL-STD-1678-4](#) Requirement 4106.
 - a. Unterminated termini. One test sample is a terminus that has not been terminated (fabricated) onto the end of a fiber optic cable or optical fiber.
 - b. Termini as part of a single fiber cable. One termini mated pair = one pin terminus and one socket terminus (i.e., two pin termini for this configuration).
 - c. Termini as part of a multiple termini connector. One connector mated pair = A multiple fiber cable assembly with a mated MIL-PRF-64266 connector plug and connector receptacle fully populated with [MIL-PRF-29504](#) lens termini.
- 5/ These inspections are to be performed by the manufacturer at the production facility. Exception may be taken for weight, circular run out, terminus retention, terminus insertion and removal forces and maintenance aging.

- 6/ Test fixture for this test is to include fiber optic [MIL-PRF-64266](#) connectors; either plug or receptacle for retaining the termini during testing.
- 7/ Test performed using connector in which the ASR is not inserted.
- 8/ Each terminus is to be terminated on one end of a single fiber cable. Cable used is to have provisions compatible with termini strain relief, as applicable. Termini, selected from the group that underwent inspections for un-terminated termini, shall be used. A minimum sample size of 16 pin termini and 16 of the applicable counterpart socket termini (i.e., 32 pin termini for this configuration), selected from the group that underwent inspections for un-terminated termini, shall be used for each of these tests.
- Fiber pullout. Separate test samples of the termini must be prepared on single fiber cable without any strain relief. The change in optical transmittance shall be met after the test.
- Cable pullout. Separate test samples of the termini must be prepared on single fiber cable with strain relief (aramid yarn on cable affixed to terminus via the crimp sleeve). The change in optical transmittance shall be met after the test.
- 9/ Interoperability. This testing is done by DLA Land and Maritime-VTP which maintains/retains the interoperability standards. Please note that separate test samples are required for interoperability testing. These test samples will then be retained by DLA Land and Maritime as interoperability standards. Interoperability needs to be performed for one temperature range, not both when the constraints specified under note 3/ are met.
- 10/ Return loss after the mating durability. The relaxation given for PC polished termini to re-polish and redo the test is not allowed for the lens termini.
- 11/ Mechanical tests. Use the same test samples from Group 2 for Group 3 Mechanical test. Separate test samples are used for Group 3 Environmental tests. For Flammability, the test samples from the Group 2 and 3 Mechanical tests may be used in lieu of the test samples from the Group 3 Environmental tests.
- 12/ Shock and vibration. Two connector mated pair must be tested. At least four termini mated pair in each connector mated pair are to be monitored for optical signal discontinuity. Any other termini mated pair not monitored for optical signal discontinuity is to be monitored for change in optical transmittance.
- 13/ Per [MIL-PRF-64266](#), an insertion loss verification and a return loss test are required after the conclusion of the mechanical tests and after the environmental tests. If both the mechanical tests and the environmental tests are done on the same connector mated pair, then one insertion loss verification and one return loss test are performed after the conclusion of the mechanical and environmental tests. Each insertion loss verification shall be performed in both directions.
- 14/ Wavelength integrity For the optical beam characteristics inspections, perform at both 850 and 1300 for test samples with the multimode fiber size nm wavelength and at both 1310 and 1550 nm wavelength for test samples with the single mode fiber size.
- 15/ Separate test samples shall be prepared in accordance with [MIL-STD-1678-4](#) Requirement 4105. For each temperature range, wavelength and fiber size; three single mode and three multimode test samples shall be prepared.
- 16/ For single mode mated pair, 4 connector mated pair shall be used for Group 1. From these 4 connector mated pair, each 2 connector mated pair shall be tested as specified in note 11. For multimode connector mated pair, either the same scheme may be used or the same 2 connector mated pair may be used for Groups 1, 2 and 3.
- 17/ Test samples from the cable pullout test shall be used.
- 18/ Certifications are required for the lens to show beam interface parameters are met.
- 19/ Lens termini selected from the group that underwent inspections for un-terminated termini shall be used for each of these tests. These termini test samples shall be prepared as specified in note 8/ for the cable pullout test. Four termini mated pair shall be used for the test samples that undergo the Group 1 tests. For each temperature range, wavelength and fiber size, this test sample quantity applies.

TABLE IV. Qualification inspections (except interoperability) - Continued.

20/ Lens termini selected from the group that underwent inspections for un-terminated termini shall be used for each of these tests. These termini test samples shall be prepared as specified in note 8/ for the cable pullout test. Eight termini mated pair shall be used for the salt spray test. Sixteen termini mated pair shall be prepared for the fluid immersion test. Two termini mated pair shall be used as test samples for each of the eight categories of fluids. The eight termini mated pair from the salt spray test may be used as eight of the sixteen termini mated pair for the fluid immersion test. For each temperature range, wavelength and fiber size, these test sample quantities apply.

TABLE IV. Qualification inspections (except interoperability) - Continued.

Inspections for un-terminated termini:

Test sample configuration. Test fixture for this test shall include [MIL-PRF-64266](#) shell size 15 connectors, utilizing both plug and receptacle for retaining the termini during testing. For each temperature range, wavelength and fiber size, a minimum sample size shall be used to ensure sufficient quantity for termini inspections as part of a single fiber cable and for termini inspections as an integral part of a multiple fiber connector.

Identification markings. Applicable. The Termini Identification Color Coding (TICC) shall be marked on the barrel of the termini as stated in footnote 6/ of figure 1. Manufacturer's symbol or trademark shall be in accordance with footnote 17/ of figure 1.

Terminus retention. Terminus displacement measurement is not applicable. Test may be used as one operational means to verify acceptable shoulder construction.

Terminus engagement and separation force. Not Applicable.

Maintenance aging. Applicable. Terminus marking shall remain legible upon completion of testing.

Lens scratches and defects.

Method: Inspect per Requirement 1305 of [MIL-STD-1678-1](#). Standardized cleaning process with standardized cleaning equipment and consumable supplies (see [MIL-STD-1678-6](#)) may be used prior to this inspection.

Requirement: Lens shall meet the end face inspection criteria for scratches and defects specified in the contact zone. The contact zone pertains to visual inspection ferrule end face criteria specified in Requirement 1305 of [MIL-STD-1678-1](#).

Lens abrasion resistance.

Method: Abrade with each cleaning swab with a 1.25 mm (.05 inch) diameter cleaning surface (exposed tip), per item number 6201AE in [MIL-STD-1678-6](#) table 6201-I or equivalent. Abrade by performing the specified cleaning process.

Requirement: There shall be no visible damage, such as evidence of abrasion, scratching, crazing, layer separation or anti-reflective (AR) coating removal, to the coated surface. The change in optical transmittance shall be met once the abrading is completed.

Fungus resistance. Applicable.

Inspections for the terminus as part of a single fiber cable:

Test sample configuration. Each terminus is to be terminated on one end of a single fiber cable as specified in [MIL-STD-1678-4](#) Requirement 4106. Cable used is to have provisions compatible with termini strain relief, as applicable. Termini, selected from the group that passed inspections for un-terminated termini, shall be used. Termini shall be tested for each temperature range, wavelength and fiber size. Test sample quantities and configurations shall conform to the applicable notes in the qualification and conformance tables. Three additional lens termini pair (6 lens termini total) shall be prepared for the radiation test for each lens terminus wavelength being qualified. The connector that shall be used as part of a single fiber cable inspection shall be a qualified [MIL-PRF-64266](#) connector. If no connector is approved to date, then the connector used shall be specified by the qualifying activity.

Fiber pull out force. Applicable.

Cable pull out force. Applicable. The change in optical transmittance shall be measured during and after the test for a pin terminus.

Salt spray.

Method: Test samples (termini on single fiber cable) shall be tested to [TIA-455-16](#), test condition C. The criterion for insertion loss verification shall be used to determine if this optical requirement is met. Insertion loss verification, with termini inserted into a [MIL-PRF-64266](#) shell size 15 connector, shall be performed both prior to and after the salt spray test.

Requirement: Examination of the termini tested shall reveal no lens damage, no loss or deterioration of any lens surface coating, no swelling or softening of material, no loss of sealing capability or identification marking, no corrosion, distortion, blistering, or delamination of plating to the degree that it is detrimental to the intended use of these termini. The requirements for insertion loss verification shall be met prior to the test and after the test once salt is removed by cleaning.

Fluid immersion.

Method: Test samples (termini on single fiber cable) shall be tested in accordance with [TIA-455-12](#) using the test fluids in table 3409-AI of [MIL-STD-1678-3](#). Termini shall be immersed in each fluid from the end of the ferrule to half the length of the barrel. Two test samples shall be exposed to each fluid in one category per table 3409-AI of MIL-STD-1678-3. The lens is to be exposed to the fluid for this test. The criterion for insertion loss verification shall be used to determine if this optical requirement is met. Insertion loss verification, with termini inserted into a [MIL-PRF-64266](#) shell size 15 connector, shall be performed both prior to and after the fluid immersion test.

Requirement: Examination of the termini tested shall reveal no lens damage, no loss or deterioration of any lens surface coating, no swelling or softening of material, no loss of sealing capability or identification marking, and no corrosion, distortion, blistering, or delamination of plating as a result of immersion into each fluid. The requirements for insertion loss verification shall be met prior to the test and after the test once the last fluid is removed by cleaning. No degradation of any sealing shall occur that may cause leakage behind the lens and into the optical path.

Terminus cleaning.

Method: Applicable except cleaning shall include the contamination on the lens by each test fluid in table 3409-AI of [MIL-STD-1678-3](#). Use standardized cleaning process with standardized cleaning equipment and consumable supplies (see [MIL-STD-1678-6](#)).

Requirement: Lens shall not be damaged, and there shall be no loss or deterioration of any lens surface coating, separation of bonded surfaces or other damage detrimental to the operation of the termini. The change in optical transmittance shall be met once each test fluid is removed by cleaning.

Inspections of termini in a multiple termini connector:

Test sample configuration:

Number of test sample: For each temperature range, wavelength and fiber size, four test samples (connector mated pair) shall be used for group I inspections except for interoperability. Two of the four connector mated pair shall be used for group II inspections and the other two for group III inspections with one clarification. The same two connector mated pair used in the Group II mechanical (mating durability) inspection shall be used in the Group III mechanical inspections.

Test sample configuration: The connector mated pair for group II inspections and for group III inspections shall be comprised of a cable assembly with termini placed into a [MIL-PRF-64266](#) shell size 15 connectors with eight cavity inserts as specified in MIL-STD-1678-4 Requirement 4106. As specified, separate test samples shall be constructed for interoperability.

Cable assembly construction: These termini/connectors are located in the middle of each cable assembly. Termini, selected from the group that passed inspections for un-terminated termini, shall be used and inserted into a [MIL-PRF-64266](#) shell size 15 connector as part of the connector mated pair that comprises each test sample. Cable assembly length of the connector mated pair shall be 10 meters with the connector inserted 5 meters from the cable ends. Cable length may be longer (with added cable at the optical source end) if cut-backs are performed to verify insertion loss. Each connector shall be fully populated with termini.

Optical measurements: The eight lens termini mated pair in each connector mated pair shall be measured for optical transmittance after and when specified, during environmental and mechanical testing. Insertion loss shall be performed on all termini mated pair in each connector mated pair.

Backshell configuration: Connectors used in each connector mated pair, both the plug and receptacle, are to include backshells. Selection of the backshell shall be in accordance with [MIL-STD-1678-4](#) Requirement 4106 and is to include assurance of proper strain relief for each single fiber cable and not cause degradation in optical performance.

Interoperability. Applicable. Test performance and test sample configurations/fabrication shall conform to Requirement 4106 of MIL-STD-1678-4. Interoperability is applicable only for termini among vendors with the same TICC.

Optical source wavelength. Unless otherwise specified (see optical beam characteristics inspections), lens termini shall be tested at the nominal wavelength specified in tables II and III.

Launch conditions shall conform to MIL-STD-1678-2.

Optical performance:

Attenuation.

Method: Test in accordance with [MIL-STD-1678-2](#), Measurement 2101. First an attenuation measurement (DUT measurement) shall be obtained at the number of test increments over the wavelength range specified in [table V](#) to ensure sufficient coverage for a termini mated pair. Next perform a 1 meter cut back and an attenuation measurement (reference measurement) through only the 1 meter cut back of fiber optic cable at those same increments over the wavelength range. Calculate the spectral attenuation at each wavelength. Present results as a table of attenuation versus wavelength and a plot of attenuation versus wavelength. Repeat for each terminus mated pair. Use of a tunable optical source with a power meter to perform this measurement is acceptable.

Requirement: Maximum attenuation over the specific range of wavelengths and at specific wavelengths of operation shall not exceed the maximum values listed in [table V](#).

TABLE V. Attenuation performance.

Wavelength (nm)	Wavelength range (nm)	1 nm increments /range (nm)	Test increments of (nm) ^{1/}	Maximum Attenuation (dB)
1310	1270-1355	85	2	1.5
1550	1530-1570	40	1	1.5
S Band	1460-1530	70	2	1.5
L Band	1565-1625	60	2	1.5
850	750-950	200	4	1.0
1300	1270-1355	85	2	1.0

^{1/} Perform a measurement at the number of test increments indicated. For example, at the 1300 nm wavelength over the wavelength range of 1270 to 1355 nm, obtain a measurement at each 2 nm wavelength increments starting at 1270 nm (i.e., 1270, 1272, 1274, etc. in increments of 2 nm) until reach 1355 nm. Since the number of 2 nm increments in this wavelength range is an odd number, the measurements may end at 1344 nm.

Insertion loss. The initial insertion loss and the insertion loss verification shall be as specified in [table VI](#). The insertion loss limits specified are the maximum allowed values for each measurement (each mating with respect to the pre-cut back measurement). It is not intended to average the ten mating's or use other averaging schemes. Insertion loss shall be performed in accordance with MIL-STD-1678-2 Measurement 2101 except test in both directions both for the initial insertion loss and for the insertion loss verification.

TABLE VI. Optical insertion loss performance. ^{1/}

Fiber size (um)	Initial insertion loss (dB) ^{3/}	Insertion loss verification (dB) ^{2/, 3/}
Single mode 9/125	1.5	2.0
50/125	1.0	1.5
62.5/125	1.0	1.5
62.5/125/155	1.0	1.5

^{1/} Optical loss performance is based on use of specified fabrication procedure.

^{2/} Insertion loss verification is an insertion loss performed after a series of environmental tests or mechanical tests.

^{3/} Measure in both directions for lens termini mated pair due to potential deviation in each direction due to the maximum angle error from the mechanical axis and due to parts relative to adhesive expansion and contraction with temperature.

Return loss. Return loss shall be performed in accordance with [MIL-STD-1678-2](#) Measurement 2105. Return loss of a PC polished single mode lens terminus shall be not less than 30 dB.

Bit error rate (BER).

Method: Test in accordance [TIA-455-235](#) using the "Variable decision threshold method". Bit error sampling rates for 50 um core Multimode fiber connections shall include 1, 10, and 40 Gbits per second using a 850 nm VCSEL source. Single mode fiber connections shall include 1, 10, and 40 Gbits per second test setups using a 1310 nm laser source. In addition, the Single mode interconnection shall be test in a WDM condition using 10 different wavelengths from the C Band (1530-1565 nm) with a data rate of 10 Gbits per second.

Requirement: Test Bit pattern sequences at a minimum shall include PRBS 31, and K28.5. Mean bit error ratio shall be less than 10^{-12} .

Polarization-Dependent Loss (PDL).

Method: Test in accordance [TIA-455-198](#) "Measurement of Polarization Sensitivity of Single Mode Fiber Optic Components by Matrix Calculation Method" using the optical source specified for the fiber size/component being tested. First obtain the polarization- dependent loss (PDL) of the fiber optic cable. Next obtain the PDL for each termini mated pair in the connector. The results for these two measurements shall be compared.

Requirement: The PDL for each fiber-lens mated pair in the connector shall be the same as or not greater than two percent above the measurement mean PDL for a termini mated pair. The value for polarization mode dispersion obtained for each termini mated pair in the connector shall be ≤ 0.075 dB.

Bandwidth.

Method: Test in accordance with [TIA-455-175](#) using the optical source specified for the fiber size being tested. First obtain the bandwidth through only the fiber optic cable. Next obtain the bandwidth for each termini mated pair in the connector. The results for these two measurements shall be compared.

Requirement: The bandwidth for each termini mated pair in the connector shall be the same as or not greater than one percent below the bandwidth for only the fiber optic cable. The value for bandwidth obtained for each termini mated pair in the connector shall be ≥ 300 MHz@850nm for an overfilled launch and ≥ 300 MHz@850nm for the RML/EMB_c launch.

Environmental/mechanical: Termini shall be tested to and meet the requirement as specified under "Tests for termini as an integral part of a multiple termini connector". Change in optical transmittance and optical discontinuity requirements shall be as specified in [MIL-PRF-29504](#).

Interoperability. Applicable. Separate test samples shall be prepared for interoperability.

Mechanical. The following mechanical tests shall be performed in the sequence listed in [table IV](#).

Optical signal discontinuity.

Temperature range 1. Applicable.

Temperature range 2. Applicable except for single mode termini, a discontinuity is considered to be a reduction of optical transmittance of 0.5 dB or more for a duration of 50 microseconds or more (during vibration) or 100 milliseconds or more (during shock).

Mating durability. Applicable except that terminus engagement and separation force does not need to be performed after the test. The lens termini shall be cleaned after each 100 cycles. The change in optical transmittance shall be 0.5 dB or less over 500 cycles. A return loss after mating durability shall be performed. Return loss of 30 dB or greater shall be obtained after 500 cycles with no re-polishing or otherwise refurbishment of the lens.

Twist.

Method: Connector mated pair shall be tested in accordance with [TIA-455-36](#). The terminus-held fixture shall be rotated 360° at a rate of one cycle per 5 seconds for a total of 50 cycles. One cycle shall consist of a 360° twist $\pm 180^\circ$ about the neutral axis. The connector mated pair tested shall be placed in tension with minimum loading of 11.0 pounds (48.9 N) applied (such as clamped) at a distance of about 12 inches below the optical (connecting) interface. The connector mated pair shall be visually examined after the test including the key on the terminus. The change in optical transmittance shall be measured during and after the test.

Requirement: No terminus damage shall occur. The change in optical transmittance shall be less than 0.5 dB during and after the test.

Mechanical shock.

Method: Mated connector mated pair shall be tested in accordance with the applicable mechanical shock test listed below. Optical discontinuities shall be measured during the test. A minimum of four termini shall be monitored for discontinuity. The change in optical transmittance shall be monitored after the test. The termini shall be visually examined after the test to the extent feasible inside the connector. For testing, initially mate the connector mated pair and apply the specified torque value. Mark the position after the torque has been applied and check/record position after each impact. For a connector mated pair containing a coupling ring ratchet mechanism, do not tighten the coupling ring after each impact if the connector is being tested in addition to the terminus. Otherwise, retighten after each impact.

a. [MIL-DTL-901](#). Mated connector mated pair shall be tested in accordance with MIL-DTL-901, grade A, type B, class I. Standard shock fixture 4A for bulkhead mounting shall be used. Supplement test fixture with mounting shall be performed as specified in Measurement 3202 of [MIL-STD-1678-3](#).

b. Half-sine pulse (temperature range 2 only). Mated connector mated pair shall be tested in accordance with [TIA-455-14](#), test condition D. Three shocks in each direction shall be applied along the three mutually perpendicular axes of the test sample (18 shocks).

Requirement: Termini shall not be damaged and there shall be no loosening of parts. The requirement for optical discontinuity shall be met during the test and the requirement for the change in optical transmittance shall be met after the test.

Vibration.

Method: Mated connector mated pair shall be tested for sinusoidal vibration in accordance with the applicable vibration tests listed below. Optical discontinuities shall be measured during the test. For connectors of shell sizes 15 and greater, a minimum of four termini shall be monitored for discontinuity. The change in optical transmittance shall be monitored after the test. The termini shall be visually examined after the test to the extent feasible inside the connector. For testing, initially mate the connector mated pair and apply the specified torque value. Mark the position after the torque has been applied and check/record position after each axis. Retightening of the connector after each axis and test condition is permitted.

Temperature range 1:

Mated pair shall be tested in accordance with 5.2 of [MIL-STD-1678-3](#) Measurement 3201 (test condition B for multiple termini connectors).

Temperature range 2:

a. Sine vibration shall be performed in accordance with [MIL-STD-1678-3](#) Measurement 3201, test conditions C, 5.3.a (60 G at ambient temperature only). This cycle shall be performed 12 times in each of three mutually perpendicular directions at ambient temperature. This results in a total of 36 cycles being applied for approximately 12 hours. The sequence shall be repeated twice. (36 hours total at ambient temperature). Interruptions are permitted provided the requirements for rate of change and test duration are met. Completion of cycling within any separate band is permissible before proceeding to the next band.

b. Random vibration shall be performed in accordance with MIL-STD-1678-3 Measurement 3201, test conditions C, 5.3.b (41.7 G rms at a temperature of 125°C).

c. Random vibration shall be performed in accordance with MIL-STD-1678-3 Measurement 3201, test conditions C, 5.3.c (49.5 G rms at an ambient temperature).

Requirement: Termini shall not be damaged, and there shall be no loosening of parts, no backing off of the coupling mechanism, and no other damage which can produce physical distortion or wear and may result in fatigue of the mechanical parts. The requirement for optical discontinuity shall be met during the test and the requirement for the change in optical transmittance shall be met after the test.

Environmental. The following environmental tests shall be performed in the sequence listed: in table IV.

Thermal shock.

Method: The temperatures of -40°C +0°C, -5°C and 70°C +5°C, -0°C shall be used for the low and high soak temperatures, respectively for temperature range 1. The temperatures of -55°C +0°C, -5°C and 165°C +5°C, -0°C shall be used for the low and high soak temperatures, respectively for temperature range 2. Mated connector assemblies shall be tested in accordance with [TIA-455-71](#), schedule C-0 (5 cycles). The mated connector mated pair shall not be un-mated then re-mated after the test as part of the inspection. The change in optical transmittance shall be measured after the test for temperature range 1. The change in optical transmittance shall be measured during (towards the end of each soak temperature) and after the test for temperature range 2. The termini shall be visually examined after the test only if optical performance is not met.

Requirement: Termini shall not be damaged, and there shall be no loosening of parts, separation of bonded surfaces or other damage detrimental to the operation of the termini. The requirement for the change in optical transmittance shall be met during and after the test.

Temperature/humidity cycling.

Method: Mated connector mated pair shall be tested in accordance with method B of [TIA-455-5](#). The sub-cycle shall be included in the testing. The change in optical transmittance shall be measured during and after the test.

Requirement: Termini shall not be damaged, and there shall be no loosening of parts, separation of bonded surfaces or other damage detrimental to the operation of the termini. The requirement for the change in optical transmittance shall be met during and after the test.

Temperature cycling.

Method: Mated connector mated pair shall be tested in accordance with [TIA-455-3](#) using the setup procedure specified in Measurement 3301 of [MIL-STD-1678-3](#) with the temperature profile in Measurement 3301 table 3301-I for temperature range 1 and the temperature profile in Measurement 3301 table 3301-II for temperature range 2. The connector mated pair shall be visually examined after the test. Test fixtures, if used must be of minimum mass and approved by the qualifying activity. No other mass shall be added inside the chamber. The change in optical transmittance shall be measured during and after the test. At a minimum for the “during test” measurements, an optical transmittance measurement shall be performed towards the end of each soak period (maintain step) after every cycle for temperature range 1 and after every 5 cycles for temperature range 2. The connector mated pair shall be visually examined after the test.

Requirement: Termini shall not be damaged, and there shall be no loosening of parts, separation of bonded surfaces or other damage detrimental to the operation of the termini. The requirement for the change in optical transmittance shall be met during and after the test.

Altitude immersion (temperature range 2 only).

Method: Mated connector mated pair shall be tested in accordance with [TIA-455-15](#). The complete connector mated pair shall be located within the chamber, with the entire mated connector submerged in a distilled water tank within the chamber. Instrument end connections shall not be submerged and shall be either routed outside the chamber or to an optical interface port. The change in optical transmittance shall be measured during and after the test. During each test cycle, optical transmittance measurements shall be made at each ramp and during the plateau.

Requirement: Mated connector mated pair shall not be damaged and there shall be no evidence of moisture penetration into the connector interior. The requirement for the change in optical transmittance shall be met during and after the test.

Temperature life.

Method: Mated connector mated pair shall be tested in accordance with [TIA-455-4](#). For temperature range 1, the high exposure temperature shall be 110°C +5, -0°C for the duration of 240 hours. For temperature range 2, the high exposure temperature shall be 165°C +5, -0°C for the duration of 1,000 hours. The change in optical transmittance shall be measured after the test. The termini shall be visually examined after the test to the extent feasible inside the connector.

Requirement: Termini shall not be damaged, and there shall be no loosening of parts, separation of bonded surfaces or other damage detrimental to the operation of the termini. The requirement for the change in optical transmittance shall be met after the test. Performance of a cable/fiber retention test is not required as part of the final inspection for this test.

Flammability.

Method: Portion of the connector mated pair containing the termini mated pair shall be exposed to a 0.75 inch (19 mm) flame height applied for ten seconds to the region of the mated pair interface. The change in optical transmittance shall be measured during the test, and after the test once the connector mated pair has returned to room temperature.

Requirement: There shall be no dripping of the lens and other terminus material that will cause the flammable material to ignite and there shall be no violent burning or explosive type fire. The requirement for the change in optical transmittance shall be met during and after the test.

Insertion loss (verification): If the cut back method is used after the mechanical or environmental tests are concluded, then return loss may be performed prior to the insertion loss verification.

Radiation (Nuclear radiation resistance).

Method: Mated termini mated pair shall be tested for susceptibility to gamma radiation in accordance with [TIA/EIA-455-64](#) using the test conditions listed in [table VII](#). Optical characteristics shall be verified at the low operating temperature and at +25°C. The change in optical transmittance shall be measured during and after the test. If the change in optical transmittance at +25°C is greater than the change in optical transmittance at the low operating temperature, the fiber shall be tested at the high operating temperature. Light launch conditions shall be in accordance with [TIA-455-78](#). For single mode termini mated pair, test shall be performed at a wavelength of 1310 ± 25 nm using a laser diode with FWHM spectral width ≤ 10 nm. For multimode termini mated pair, test shall be performed at a wavelength of 1300 ± 25 nm using an LED with FWHM spectral width ≤ 160 nm.

Requirement: Termini mated pair shall meet the nuclear radiation resistance requirements as listed in [table VIII](#).

TABLE VII Steady state gamma radiation test conditions.

Test temperature (°C)	Dose rate (rad (Si)/sec)	Total dose (rad (Si)) ^{1/}
-28 ± 2	50 +0/-20	Classified
+25 ± 2		
+85 ± 2		

^{1/} Some nuclear radiation resistance characteristics of this lens are classified and shall be obtained from the qualifying activity. Application to receive these requirements must be made through the Department of the Navy, Naval Surface Warfare Center, Dahlgren Division, ATTN: Code B35, 17320 Dahlgren Road, Dahlgren, VA 22448-5100. Information concerning security clearance classification and "need to know" must be detailed in the request.

TABLE VIII Radiation test requirements.

Maximum induced attenuation (dB) <u>2/</u>	Attenuation at specific recovery time (dB) <u>2/</u>	Specified recovery time (sec)
≤ 5 <u>1/</u>	≤ 3 at -28°C (-18°F) ≤ 2 at 25°C (77°F) ≤ 2 at 85°C (185°F) <u>1/</u>	1,000

1/ The radiation induced loss for a given threat. The total dose associated with the threat is classified and not necessarily equal to the test total dose.

2/ Requirement for induced attenuation in lens (dB).

Qualification by similarity. Qualification inspection shall be performed on test samples configured in accordance with MIL-STD-1678-4 Requirement 4106.

a. Qualification of termini with different ferrule hole diameters.

(1) Manufacturers who qualify under this specification sheet for the lens terminus of a specific wavelength range and with the ferrule hole diameter specified in column three of [table IX](#) are qualified under this specification sheet for the other ferrule hole diameter(s) in column four on the same row of table IX.

(2) Constraint for qualification by similarity case listed above. This qualification by similarity case is valid if the only difference between the qualified termini and the other termini listed in the same row of table IX is a change in the terminus ferrule hole diameter and TICC markings.

b. Qualification of termini for change in design or material.

(1) Perform complete re-qualification.

TABLE IX. Termini Qualification by similarity.

Fiber Type <u>1/</u>	Ferrule Material	Qualified with Hole Diameter	Get Other Hole Diameter(s)	Temperature Range 1	Temperature Range 1	Temperature Range 2	Temperature Range 2
				Qualified with TICC	Get other TICC	Qualified with TICC	Get other TICC
SM	Ceramic	125.5	125.3	CC	CA	CG	CD
MM <u>2/</u>	Ceramic	126	156	---	---	CH	CJ

1/ SM = Single mode, MM = Multimode (50/125, 62.5/125 fiber sizes)

2/ Temperature range 1: Qualified with 62.5/125 micron fiber size, Temperature range 2: Qualified with 50/125 micron fiber size, see [MIL-STD-1678-4](#) Requirement 4106

Cleaning prior to packaging. Termini shall be cleaned prior to packaging/shipment internally (for ensuring proper adherence of epoxy to terminus barrel (body) and ferrule and externally (for minimizing contamination).

Tools: See [table X](#).

TABLE X. Tools.

Tool	PIN
Insertion tool	See Requirement 4106 of MIL-STD-1678-4
Removal tool	
Polishing tool	

Conformance tests (Group A, B and C).

- a. Group A. Group A shall consist of the inspections/tests specified for Group A in table XI.

Group A sampling plan. Group A shall be performed by random sampling for product supplied under this specification. This random sampling shall be performed to [MIL-STD-1678-1](#) Requirement 1304. Number of samples for random sampling inspected per lot size is specified in table 1304-1 of MIL-STD-1678-1 Requirement 1304. The required acceptance criterion is a zero nonconformance regardless of sample size.

Group A sampling plan for occurrence of a nonconformance. If any nonconformance is found, then 100 percent inspection shall be used until the qualifying activity is satisfied that the cause for the nonconformance has been corrected and will not reoccur. Also, until the nonconformance has been corrected, inspection with the requirement that data be provided (in lieu of inspection by attribute) may be specified by the qualifying activity.

TABLE XI. Conformance inspections (Groups A, B and C).

Test performed <u>1/</u> , <u>2/</u>	Groups A, B,C	Groups A, B,C	Number of Termini/ Number of mated pair <u>9/</u> , <u>13/</u>
	Temperature Range 1	Temperature Range 2 <u>3/</u>	
Tests for unterminated termini			
Group 1			
Size <u>5/</u>	A	A	---
Identification markings <u>5/</u>	A	A	---
Workmanship <u>5/</u>	A	A	---
Circular runout <u>5/</u>	B	B	---
Beam interface parameters <u>15/</u>	B	B	
Group 2 <u>5/</u> , <u>6/</u> , <u>7/</u>			
Terminus insertion & removal forces	B	B	16 termini <u>14/</u>
Terminus retention	B	B	16 termini
Maintenance aging	B	B	16 termini from terminus retention
Group 3 (polymeric materials)			
Ozone		C	
Tests for termini as part of a single fiber cable			
Group 2			
Insertion loss	C		16 termini - cable pullout, 16 termini - fiber pullout
Fiber pull out force <u>8/</u>	C		16 termini
Cable pull out force <u>8/</u>	C	C	16 termini
Twist	C	C	16 termini from cable pullout
Tests for termini as an integral part of a multiple termini connector			
Group 1 <u>4/</u> , <u>9/</u> , <u>12/</u>			
Optical tests			
Insertion loss <u>11/</u>	C	C	2 connector mated pair-#1,2
Return loss <u>11/</u>	C	C	2 connector mated pair-#1,2
Group 2 <u>4/</u> , <u>9/</u> , <u>12/</u>			
Mating durability	C	C	1 connector mated pair - # 1
Group 3 <u>4/</u> , <u>9/</u> , <u>12/</u>			
Mechanical tests <u>9/</u>			
Vibration <u>10/</u>	C	C	1 connector mated pair - # 1
Shock, MIL-DTL-901 <u>10/</u>	C	C	1 connector mated pair - # 1
Environmental <u>4/</u> , <u>9/</u> , <u>12/</u>			
Thermal shock		C	1 connector mated pair - # 2
Temperature humidity cycling	C		1 connector mated pair - # 2
Temperature cycling	C	C	1 connector mated pair - # 2

Notes:

- 1/ Conformance consist of performing tests in this table for temperature range 1, for temperature range 2, or for both temperature range 1 (TR1) and temperature range 2 (TR2). Conformance tests are those inspections specified for unterminated termini (groups A, B), termini as part of a single fiber cable (group C) and termini as an integral part of a multiple termini connector (group C).
- 2/ "A", "B" and "C" indicates test applies when performing a Group A, B or C Conformance test.
- 3/ Assumes same terminus material and physical configuration as used for Temperature range 1 (see note 9/).
- 4/ For Group C conformance testing, use a [MIL-PRF-64266](#) shell size 11 connectors with a 4 cavity insert. Connector is to be fully populated with PC polished termini. All insert cavity positions are to be active (monitored). Use of other connector configurations is not allowed (such as one MIL-PRF-64266 shell size 15 with an 8 cavity insert in lieu of two MIL-PRF-64266 shell size 13 connectors with 4 cavity inserts).
- 5/ These inspections are to be performed by the manufacturer at the production facility. Exception may be taken for weight, circular run out, terminus retention, terminus insertion and removal forces, and maintenance aging.
- 6/ Test fixture for this test is to include fiber optic; [MIL-PRF-64266](#) connectors; either plug or receptacle for retaining the termini during testing.
- 7/ Test performed using connector in which the ASR is not inserted.
- 8/ Each terminus is to be terminated on one end of a single fiber cable. Cable used is to have provisions compatible with termini strain relief, as applicable. Termini, selected from the group that underwent inspections for un-terminated termini, shall be used. A sample size of 8 pin termini and 8 of the applicable counterpart socket termini (i.e., 16 pin termini for this configuration), selected from the group that underwent inspections for un-terminated termini, shall be used for each of these tests. These test sample quantities apply for each temperature range, wavelength and fiber size.
Fiber pullout. Separate test samples of the termini must be prepared on single fiber cable without any strain relief. The change in optical transmittance shall be met after the test.
Cable pullout. Separate test samples of the termini must be prepared on single fiber cable with strain relief (aramid yarn on cable affixed to terminus via the crimp sleeve). The change in optical transmittance shall be met after the test.
- 9/ Number of connector mated pair for group C. Two connector mated pair shall be tested for each PIN undergoing group C testing. The group C tests must be performed for each row in [table VIII](#) for which termini are offered.
- 10/ Shock and vibration. One connector mated pair shall be tested (see note 4/). The four termini pair in the connector mated pair are to be measured for optical signal discontinuity and for change in optical transmittance. For temperature range 1 vibration, testing is limited to performing the 5.2.c random vibration in Measurement 3201 of MIL-STD-1678-3. For temperature range 2 vibration, testing is limited to performing the 5.3.c random vibration in Measurement 3201 of MIL-STD-1678-3.
- 11/ An insertion loss verification and a return loss test shall be performed at the start of Group C testing and on any termini mated pair used in Group B. The initial insertion loss and return loss shall be performed on any new mated pair used in Group C testing. The one exception is that return loss shall be performed only on termini with single mode fiber.
- 12/ Termini to be placed in each mated pair shall be selected based on [table XIII](#).
- 13/ For each test in group C, the column for "Number of mated pair" first specifies the total number of connector mated pair tested followed by the which connector mated pair are used for that test (each connector mated pair being assigned a number).
- 14/ When maintenance aging is performed, the first and last maintenance aging cycle can be used as the terminus insertion and removal force test. Otherwise, perform in the sequence listed (on the 16 termini prior to and used for the terminus retention test).
- 15/ Certification is required to show beam interface parameters are met.

TABLE XI. Conformance inspections (Groups A, B and C) – Continued.

- b. Group B. Group B shall consist of the inspections/tests specified for Group B in [table XI](#) on termini 24 months after initial qualification and within each 2 year period thereafter.

Group B test sample configurations.

(1) Unterminated termini. No test sample preparation is required for circular runout, terminus insertion and removal forces, terminus retention, and maintenance aging.

Group B sampling plan. A minimum of sixteen sample units shall be selected from a lot of the same PIN within 24 months after the date of notification of qualification and during every 24 month period thereafter. When a manufacturer is qualified for multiple TICC/PINs, then the group B inspection shall be performed every two year period on at least one TICC from each row in [table XII](#) where the manufacturer has qualified parts. The terminus selected from each row shall be such that after two, three or four consecutive group B inspections (as applicable) all qualified TICC/PINs from the same row in [table XII](#) have been inspected. If a manufacturer is qualified for only 1 TICC in a particular row, then that TICC shall be inspected during every two year period.

TABLE XII. Termini Group B sampling plan by TICC.

Temperature Range/ Nominal Wavelength/ Fiber Diameter	TICC <u>1/</u>	Fiber Type <u>2/</u>	Group B Period 1	Group B Period 2	Group B Period 3	Group B Period 4	Fabrication Remarks
1, 1310/1300 nm, 125 um	CA,CB,CC	SM, MM	CA	CC	CB	CA	<u>3/</u>
2, 1550/850 nm, 125/155 um	CD,CE,CF,CG	SM, MM	CD	CE	CG	CF	<u>4/</u> , <u>5/</u>
2, S Band & L Band, 125 um	CH,CJ	SM	CH	CJ	CH	CJ	<u>4/</u>

1/ If not qualified for all TICCs in a particular row alternating inspections shall be performed for the qualified TICCs. (Ex: If qualified for CA and CB, but not CC, perform alternating inspections of CA and CB, i.e., perform inspection on CA during Period 1 and during Period 3, perform inspection of CB during Period 2 and during Period 4).

2/ SM = single mode, MM = multimode.

3/ Temperature range 1: see MIL-STD-1678-4 Requirement 4101 Appendix A.

4/ Temperature range 2: see MIL-STD-1678-4 Requirement 4101 Appendix B.

5/ Qualified with polyimide coated optical fiber, see MIL-STD-1678-4 Requirement 4101 for cable type.

- c. Group C. Group C shall consist of the inspections/tests specified for Group C in [table XI](#) on termini 60 months after initial qualification and within each 5 year period thereafter.

Group C test sample configurations.

(1) Unterminated termini. Test samples for ozone shall consist of a minimum of 16 seals (O-rings or other configurations used) on a dowel or similar fixture. Diameter of dowel shall be the same as that of the terminus. Other, 16 termini shall be tested.

(2) Termini as part of a single fiber cable. Test samples shall be fabricated on termini of the same PIN as described in the applicable note in [table XIII](#) for single fiber cables.

(3) Termini as part of a multiple termini connector. Test samples shall be fabricated as specified in Requirement 4103 of MIL-STD-1678-4 with one exception. Termini of the same PIN shall be cabled and inserted into the insert cavities of [MIL-PRF-64266](#) shell size 11 connectors with a 4 cavity insert (i.e., four termini mated pair per connector mated pair) as specified in Requirement 4103 of [MIL-STD-1678-4](#). Two connector mated pair shall be used for each row as listed in [table XIII](#).

Group C sampling plan. Group C inspection shall be performed on termini of the same PIN from the highest production volume of each row in [table XIII](#). For tests on termini as an integral part of a multiple termini connector, the two connector mated pair shall be subjected to group 1 tests for each row in table XIII. For one mated pair in each row of table XIII, the connector mated pair undergoes the group 1 tests followed by the group 2 and group 3 mechanical tests. For the other mated pair in each row of table XIII, the other connector mated pair undergo group 1 tests followed by group 3 environmental tests. The terminus shall be selected such that the terminus is chosen with the ferrule hole diameter in each row of table XIII with the largest volume of product produced during the five year Group C period.

Table XIII. Termini Group C sampling plan by temperature range and TICC.

Temperature Range/Fiber Diameter/Wavelength	TICC <u>1/</u>	Fiber Type <u>2/</u>	Sampling Plan (base on production volume)	Termini as a part of a	Termini as a part of a	Fabrication Remarks
				Single Fiber Cable	Multiple Fiber Connector <u>4/</u>	
1 125 um 1310/1300 nm	CA, CB	SM	Select highest volume SM from 5 year period; CA or CB	<u>3/</u>	Mated Pair 1 Mated Pair 2	<u>5/</u>
1 125 um 1310/1300 nm	CC	MM	Select highest volume MM from 5 year period; CC	<u>3/</u>	Mated Pair 1 Mated Pair 2	<u>5/</u>
2 125 um 1550/850 nm	CD, CG	SM	Select highest volume SM from 5 year period; CD or CG	<u>3/</u>	Mated Pair 1 Mated Pair 2	<u>6/</u>
2 125/155 um 1550/850 nm	CE, CF	MM	Select highest volume MM from 5 year period; CE or CF	<u>3/</u>	Mated Pair 1 Mated Pair 2	<u>6/</u>
2 125 um S & L Bands	CH, CJ	SM	Select highest volume SM from 5 year period; CH or CJ	<u>3/</u>	Mated Pair 1 Mated Pair 2	<u>7/</u>

1/ Select highest volume from 5-year period for each row of termini being offered.

2/ SM = single mode, MM = multimode.

3/ The number of termini of the same PIN needed for Group C inspection of termini as part of a single fiber cable is as follows: Fiber pullout force = 16, Cable pullout force = 16.

4/ See table VI for tests to be performed for each mated pair.

5/ Temperature range 1: see MIL-STD-1678-4 Requirement 4101 Appendix A.

6/ Temperature range 2: see MIL-STD-1678-4 Requirement 4101 Appendix B.

7/ Qualified with polyimide coated optical fiber, see MIL-STD-1678-4 Requirement 4101 for cable type.

Part or identifying number (PIN): See [table II](#) herein and see 6.6 of MIL-PRF-29504.

<u>M29504/26</u>	-	<u>XX</u>	<u>X</u>
Basic specification and specification sheet		TICC code (see table II)	Crimp Sleeve (Optional) C = Crimp sleeve provided Blank = Crimp sleeve not provided

PIN Example: M29504/26-CAY

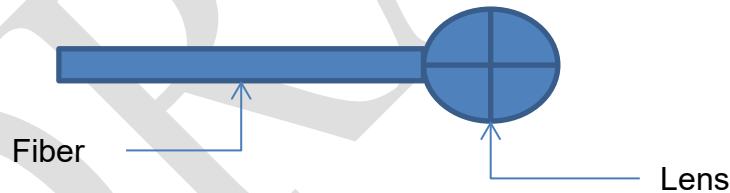
Cleaning prior to packaging. Termini shall be cleaned prior to packaging/shipment internally (for ensuring proper adherence of epoxy to terminus barrel (body) and ferrule and externally (for minimizing contamination).

Definitions.

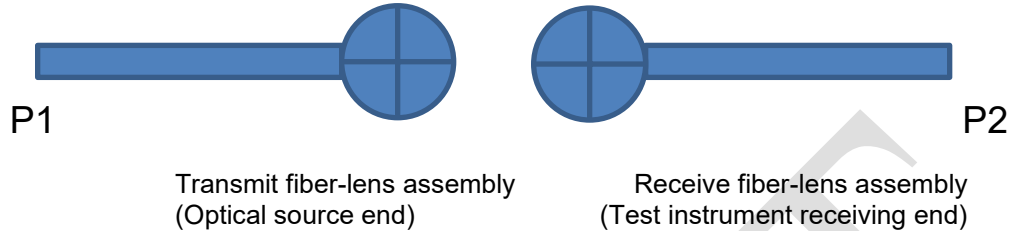
Barrel. The barrel is the part of the terminus that provides the means of holding the ferrule within the terminus on one end and may be used as the surface to affix the crimp sleeve (or provide other means of cable strain relief) on the other end. Also, the barrel may be referred to as the terminus body.

Ferrule. A mechanical fixture, generally a rigid tube, at one end of the terminus used to hold and secure the stripped end of an optical fiber attached to the terminus. The ferrule functions as a bushing and is one means to precisely position the optical fiber.

Fiber-lens assembly. The configuration that consists of light being transmitted through one end of an optical fiber and exiting a lens located at the other end of the optical fiber. Measurements are taken of fiber-lens assembly primarily to optimize lens positioning during the fabrication process.



Fiber-lens mated pair. The configuration composed of two fiber-lens assemblies. For the launch (transmit) end fiber-lens assembly, light being transmitted through one end of an optical fiber (end P1) and exiting a lens located at the other end of the optical fiber. For the detection (receive) end fiber-lens assembly, light is transmitted from the second lens located at one end of the optical fiber and exits at the other end of the optical fiber (end P2). Measurements are taken of fiber-lens mated pair for qualification testing to duplicate use in the application.



Lens holder. The piece of the lens terminus that houses the lens, is attached to the ferrule, and is placed into the alignment sleeve (i.e., alignment sleeve retainer or ASR).

Working distance. The working distance is the focal distance from the objective (launch lens) front surface to the focus point (in this case the receiving lens). However, in this application, the objective lens focus is virtual (negative – inside or close to the front surface the objective lens due to the high index glass) there is no real focus point in front of the objective. So, in this case, the closer the lenses are the better the performance. A distance of 1.0 mm was chosen because it was within the optical system Rayleigh range (the focus distance +/- range [really on the + part of the range]) and is an achievable distance to manufacture. Even if a manufacturer uses a different index glass (shifting the focal point) that distance should be sufficient (within the specified working distance). Different glass prescriptions will produce slight asymmetrical insertion loss results but should be within tolerance if they are close in value to each other.

Termini. A component used in a fiber optic, multiple termini, connection that is inserted into one of the insert cavities of a multiple termini connector, provides a means to break and rejoin an optical path, and is terminated onto the end of a simplex, fiber optic cable. The term “termini” is the plural form for the word terminus.

Terminus. Singular form for the word termini.

Terminus, pin. The male configuration of a terminus that consists of a metal barrel (body) and a metal or ceramic ferrule.

Terminus, socket. The female configuration of a terminus that consists of a metal barrel (body), a metal or ceramic ferrule and an alignment sleeve. The alignment sleeve attaches to the socket terminus ferrule. Fiber alignment occurs when the pin terminus slides into the alignment sleeve of the socket terminus.

MIL-PRF-29504/26
W/AMENDMENT 1

Referenced documents. In addition to MIL-PRF-29504, this specification sheet references the following documents:

MIL-DTL-901
MIL-STD-1678-1
MIL-STD-1678-2
MIL-STD-1678-3
MIL-STD-1678-4
MIL-STD-1678-6
MIL-PRF-64266
MIL-PRF-64266/9
TIA-455-15
TIA-455-3
TIA-455-4
TIA-455-5
TIA-455-12
TIA-455-14
TIA-455-16
TIA-455-36
TIA-455-64
TIA-455-71
TIA-455-78
TIA-455-175
TIA-455-198
TIA-455-235
SAE-AIR1351

Custodians:
Army - CR
Navy - SH
Air Force - 85
DLA - CC

Preparing activity:
DLA - CC

(Project 6060-2023-011)

Review activities:
Navy - AS
Air Force - 13, 19, 93
NASA - NA

NOTE: The activities listed above were interested in this document on the date of this document. Since organizations and responsibilities can change, you should verify the currency of the information above using the ASSIST Online database at <https://assist.dla.mil>.