

INCH-POUND

  
MIL-PRF-29504/20  
w/ AMENDMENT 3  
18 December 2013  
SUPERSEDING  
MIL-PRF-29504/20  
w/AMENDMENT 2  
2 August 2013

PERFORMANCE SPECIFICATION SHEET

TERMINI, FIBER OPTIC, KEYED, CONNECTOR, REMOVABLE, ENVIRONMENT RESISTING,  
GENDERLESS TERMINUS, REAR INSERT/REAR RELEASE, 1.25 MM CERAMIC FERRULE,  
(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.

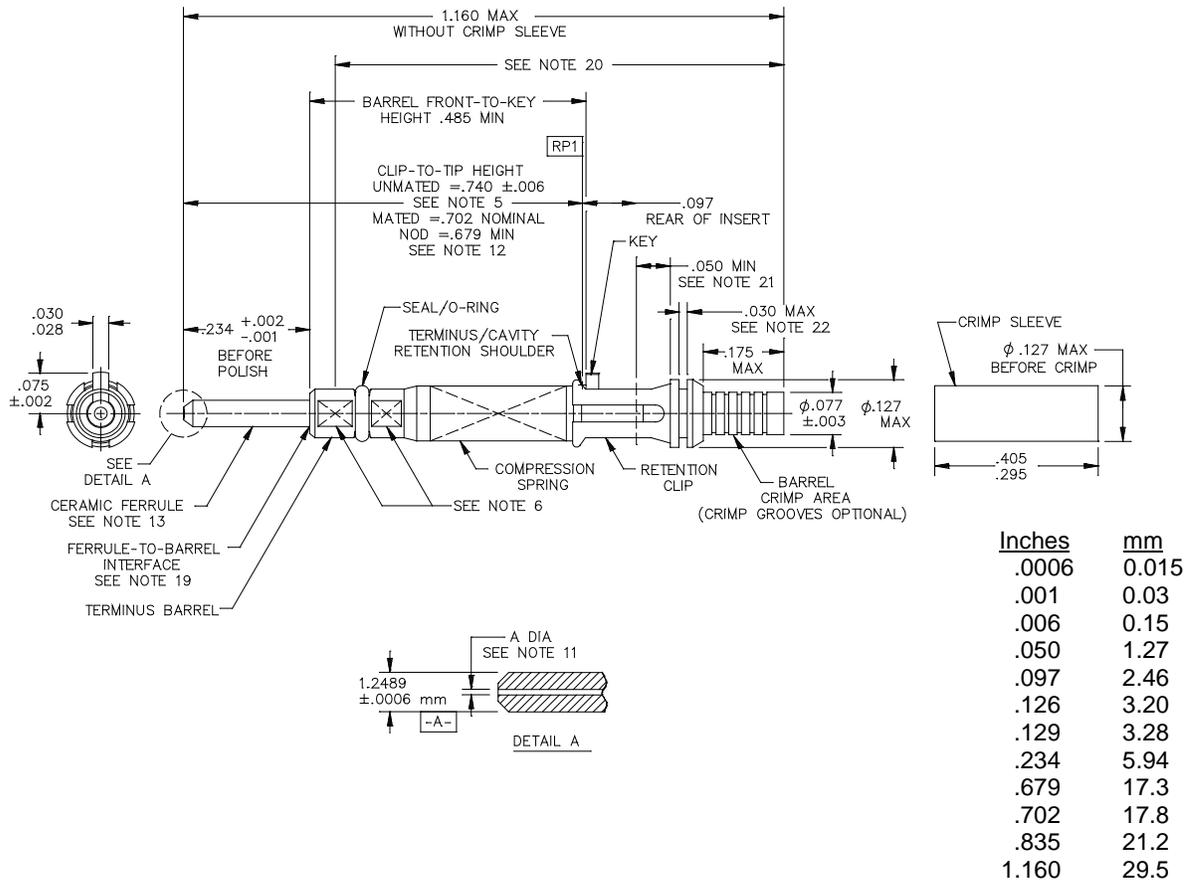


FIGURE 1. Keyed terminus.

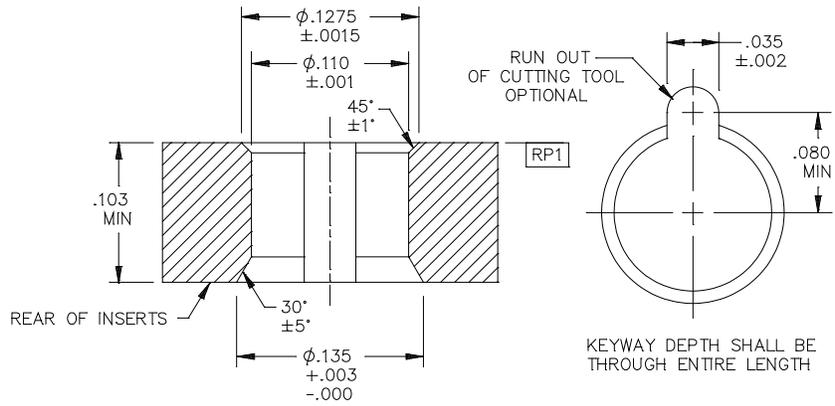
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NOTES:

1. Dimensions are in inches except for diameter "A", circular run out, ferrule surface roughness (see note 13), 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 of the terminus. The TICC marking may be represented directly as an alpha-numeric or by the associated color bands. 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 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. Ferrule 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 any position along the full length of travel.
15. Withdraw force is dependent upon both alignment sleeve (see [MIL-PRF-64266/9](#)) and ferrule.
16. Alignment sleeve shall meet a withdraw force between 1.0 N to 2.5 N when tested for breakaway frictional force in alignment sleeves in accordance with [TIA/EIA-455-158](#) using a gauge pin meeting the outside diameter (dimension CK), surface roughness and cylindricity requirements specified in figure 2.2.2 of [TIA-604-10](#).
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.

FIGURE 1. Keyed terminus - Continued.

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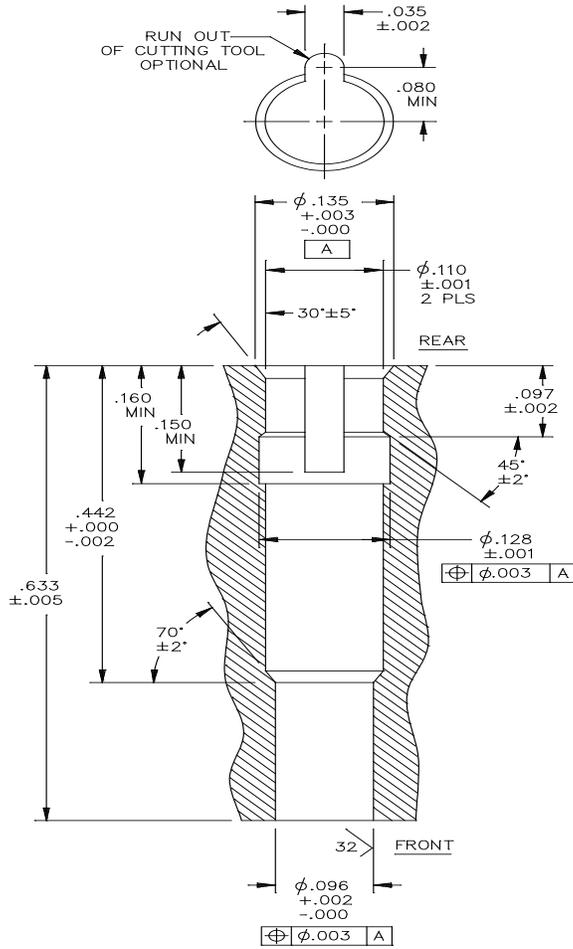
<u>Inches</u>	<u>mm</u>	<u>Inches</u>	<u>mm</u>	<u>Inches</u>	<u>mm</u>	<u>Inches</u>	<u>mm</u>
.001	0.03	.005	0.13	.110	2.79	.130	3.30
.002	0.05	.097	2.46	.125	3.18		

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  $\pm 1$ degrees, unless otherwise noted.

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

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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  $\pm 1$  degrees, unless otherwise noted.

Inches	mm
.001	0.03
.002	0.05
.005	0.13
.097	2.46
.110	2.79
.125	3.18
.130	3.30

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.

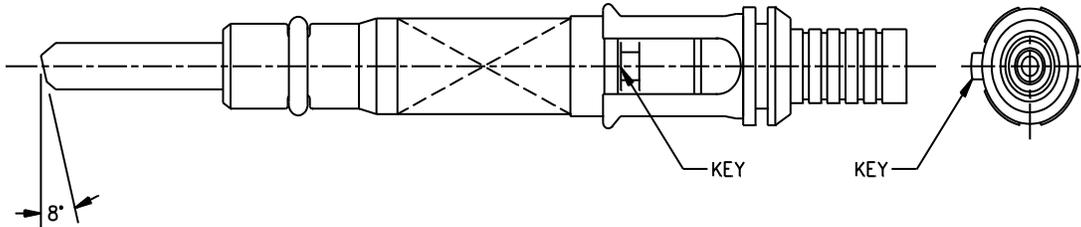
Temperature range designation	Operating temperature		Non-operating temperature		Storage temperature	
	°F	°C	°F	°C	°F	°C
1	-18 to +150	-28 to +65	-40 to +168	-40 to +70	-40 to +168	-40 to +70
2	-67 to +329	-55 to +165	-40 to +185	-40 to +85	-40 to +185	-40 to +85

Design and construction:

Dimensions and configuration: See figures 1, 2, 3, 4 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 4103 of [MIL-STD-1678-4](#).

Ferrule end face geometry shall be either domed or flat before polishing and shall be domed after polishing. End face geometry shall be on an 8 +/- 0.2 degree angle and in accordance with [figure 4](#) after polishing. The apex offset shall be 35 microns or less before polishing (as supplied by the terminus vendor) and 50 microns or less after all polishing procedures have been completed by the user/installer. The radius of curvature shall be between 5 to 12 mm after polishing.

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NOTE:

1. Standardized angle placed on the ferrule end face relative to the key applied only when an APC polish is applied during termination. Termination is the process of placing the terminus onto the end of a fiber optic cable. Terminus can be either PC polished or APC polished during termination. No angle is placed on the ferrule surface relative to the key as part of the finished terminus.

FIGURE 4. Orientation of end face angle relative to key for an APC polish.

Weight: 0.0022 lb (1.0 gram) maximum.

Adhesives: Use [MIL-PRF-24792](#) or as approved by the qualifying activity.

Material:

Ferrule: Ferrule materials shall have performance similar to that of zirconia. Termini shall meet all of the requirements of this specification when mated to qualified termini 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.

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  $.0945 \pm .001$  inch (2.400 mm  $\pm .025$  mm) across and .285 inch (7.2 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](#).

Optical performance:

Insertion loss: The initial insertion loss of a mated terminus pair shall be not greater than 0.50 dB. The maximum insertion loss of a mated terminus pair at any time during testing shall be not greater than the values specified in table II of [MIL-PRF-64266](#).

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Material performance:

Salt spray: Test samples (termini on single fiber cable) shall be tested in accordance with [TIA-455-16](#), test condition C. Terminus ferrule may be covered up to half way from the end face to the shoulder with plastic protective (dust) covers. No corrosive effects shall be seen on the external connector parts that would be detrimental to the operation of the connector. No optical degradation shall occur as a result of 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 salt spray test.

Fluid immersion: 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 that will be placed in both the connector plug and in the connector receptacle shall be immersed in each fluid. Terminus ferrule may be covered up to half way from the end face to the shoulder with plastic protective (dust) covers. Previous tests must first show that plastic protective covers are not susceptible to the test fluids. Examination of the termini tested shall reveal no swelling or softening of material, no loss of sealing capability or identification marking, and no discoloration or other effects detrimental to the intended use of these connectors, such as corrosion, distortion, blistering, or delamination of plating as a result of fluid immersion. No optical degradation shall occur as a result of 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.

Environmental/mechanical: Termini shall be tested to and meet the requirement as specified in MIL-PRF-64266 for the table IV group 3 mechanical and environmental tests performed 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-64266](#).

Fiber pull out force: Applicable

Cable pull out force: Applicable.

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

To qualify or re-qualify termini to this specification sheet, all requirements of [MIL-PRF-64266](#) shall be met using the qualifying terminus in a connector qualified to [MIL-PRF-64266](#).

Qualification connector: The qualification connector for this terminus shall be a qualified [MIL-PRF-64266](#) connector.

Test specimens:

Test samples constructed and fiber sizes used shall be as specified in Requirement 4103 of [MIL-STD-1678-4](#). As specified, separate test samples shall be constructed for interoperability, temperature range 1, and temperature range 2 using the fiber sizes listed for each configuration constructed.

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Qualification:

Qualification shall consist of performing testing specified for both temperature ranges 1 and 2 as listed in [table IV](#).

Qualification by similarity.

a. Qualification of termini with different ferrule hole diameters and with single mode fiber sizes:

- (1) Qualification inspection shall be performed on termini with a ferrule hole diameter of 126 microns when termini with both 125 (or 125.5) and the 126 micron ferrule hole diameters are offered. Manufacturers who qualify under this specification sheet for the 126 micron ferrule hole diameter are qualified under this specification sheet for the 125 or 125.5 micron ferrule diameter.
- (2) Constraint for qualification by similarity case listed above. This qualification by similarity case is valid if the only difference between the qualified termini (single mode 126 micron) and the smaller size termini is a change in the terminus ferrule hole diameter and TICC markings.
- (3) Qualification inspection performed on the 5.8/125 micron fiber size. Qualification by similarity is then given for termini with the other single mode fiber sizes. For qualification with this fiber size, the terminus with the best fit ferrule hole diameter may be used. Qualification by similarity is given to other ferrule hole diameters for the single mode termini.

b. Qualification of termini for multimode fiber sizes:

- (1) Complete qualification inspection shall be performed on termini with optical fiber having a cladding diameter of 125 microns. Termini shall have a ferrule hole diameter of 126 +1, -0 microns. Manufacturers who qualify under this specification sheet for the terminus with the 126 +1, -0 micron ferrule hole diameter are qualified under this specification sheet for the other 125 cladding hole diameters for use with multimode fiber sizes.
- (2) Multiple fiber sizes, same ferrule hole diameter (temperature range 2 only). Manufacturers who qualify under this specification sheet for termini with the 50/125 micron fiber size are qualified under this specification sheet for the 62.5/125 micron fiber size. Qualification inspection shall be performed on termini with a ferrule hole diameter of 126 +1/-0 microns.
- (3) 100/140 fiber size (temperature range 2 only). Manufacturers who qualify under this specification sheet for the termini with the multimode, 50/125 or 62.5/125 micron fiber size and pass the size, circular run out, insertion loss, vibration, and shock inspections are qualified under this specification sheet for the 100/140 micron fiber size. Qualification inspection for the 100/140 micron fiber size shall be performed on termini with a ferrule hole diameter of 173 +3, -0 microns to cover the case for terminations of termini onto polyimide coated fiber. Manufacturers who qualify under this specification sheet for the terminus with the 173 +3/-0 micron ferrule hole diameter are qualified under this specification sheet for the other 100/140 hole diameters for use with multimode fiber sizes (both non-polyimide and polyimide).

Usage: Termini compliant with this specification sheet may be used in connectors other than [MIL-PRF-64266](#) at the discretion of the acquiring activity.

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Part or identifying number (PIN): See [table II](#) herein and 6.2 of [MIL-PRF-29504](#).

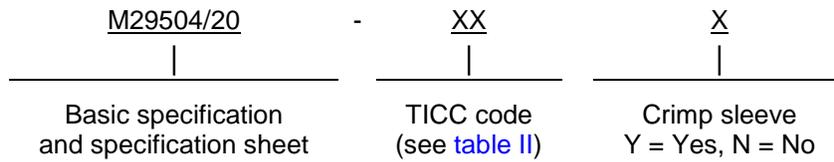


TABLE II. TICC numbers and dimensions for ferrules.

Fiber size (core/cladding) or (core/cladding /polyimide coat) (um)	Ferrule hole "A" diameter (um)	"A" Diameter tolerance (um)	Circular run-out (um)	TICC <sup>1/</sup>
Single mode < 9/125	125.0	+1/-0	0.75 <sup>2/</sup>	04
Single mode < 9/125	125.5			05
Single mode < 9/125	126.0			06
Single mode 9/125	125.0			01
Single mode 9/125	125.5			02
Single mode 9/125	126.0			03
50/125, 62.5/125				26
50/125, 62.5/125	127.0			27
100/140	142.0			42
100/140	145.0			45
62.5/125/155	156	+3/-0	3	56
62.5/125/155	157			57
100/140/172	173			73
100/140/172	175			75

Notes:

<sup>1/</sup> The two positions indicate the ferrule hole diameter (two digits of diameter for multimode sizes, consecutive values for single mode sizes).

<sup>2/</sup> Circular runout of 0.5 micron preferred as it becomes more standard in industry.

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Tools: See [table III](#).

TABLE III. Tools.

Tool	PIN
Insertion tool	See Requirement 4103 of <a href="#">MIL-STD-1678-4</a>
Removal tool	
Polishing tool	

TABLE IV. Qualification inspections (except interoperability).

Temperature range: test performed <u>1/</u> , <u>2/</u>	Temperature range 1		Temperature range 2 <u>3/</u>		
	SM	MM	SM	MM	MM 100/140
Tests for un-terminated termini					
Group 1 <u>4/</u>					
Size <u>5/</u>	X, C	X, C	X, C	X	X
Weight <sup>2/</sup>	X, C				
Identification markings <u>5/</u>	X, C		X		
Workmanship <u>5/</u>	X, C		X		
Circular runout <u>5/</u>	X, C	X, C	X, C	X	X
Group 2 (16 pair minimum) <u>6/</u>					
Terminus insertion & removal forces <u>7/</u>	X				
Terminus retention <u>5/</u> , <u>7/</u>	X				
Maintenance aging	X				
Terminus cleaning	X, C				
Group 3 (polymeric materials)					
Ozone	X, C				
Fungus resistance	X, C				
Group 4					
Modified SO <sub>2</sub> /salt spray			X, C		
Tests for termini as part of a single fiber cable					
Group 1					
None					
Group 2 (16 pair – minimum each test)					
Fiber pull out force <u>8/</u>	X, C				
Cable pull out force <u>8/</u>	X, C				
Group 3 (16 pair from cable pull out force)					
Salt spray			X, C		
Fluid immersion			X, C		

See notes at end of table.

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

Temperature range: test performed <u>1/</u> , <u>2/</u>	Temperature range 1		Temperature range 2 <u>3/</u>		
	SM	MM	SM	MM	MM 100/140
Tests for termini as an integral part of a multiple termini connector					
Group 1 (4 mated connectors, SM)					
Interoperability <u>9/</u>	X, C	X, C			
Optical tests					
Insertion loss	X	X	X	X	X
Return loss	X		X		
Group 2 (2 mated connectors, SM)					
Mating durability	X				
Terminus cleaning	X				
Return loss <u>10/</u>	X				
Group 3 (2 mated connectors, SM)					
Mechanical tests <u>11/</u>					
Twist	X		X		
Impact	X				
Vibration <u>12/</u>	X		X	X	X
Shock, <u>MIL-S-901</u> <u>12/</u>	X	X	X	X	X
Environmental					
Thermal shock	X		X	X	
Temperature humidity cycling	X				
Temperature cycling	X		X		
Altitude immersion	X		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 consists of performing tests in this table for both temperature range 1 (TR1) and temperature range 2 (TR2). There is no separate qualification for only one temperature range or one fiber size.
- 2/ "X" indicates test applies when performing a terminus qualification. "C" indicates test applies when performing a terminus qualification along with a [MIL-PRF-64266](#) connector qualification. The limitation of performing a joint terminus and connector qualification is that if a failure occurs, then both the terminus and the connector are considered to have failed.
- 3/ Assumes same terminus material and physical configuration as used for Temperature range 1.
- 4/ Sample size. One pair = one pin terminus and one socket terminus (i.e., two pin termini for this configuration). 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.
- 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, and terminus insertion and removal forces when approved by the qualifying activity.

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

- 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-TEB 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.
- 10/ Return loss after the mating durability. If failure occurs, ferrule end faces may be repolished and test redone.
- 11/ Mechanical tests. Option of using new test samples from Group 2 for Group 3 Mechanical test. Otherwise, continue with those for Group 2 to Group 3, Mechanical. Separate test samples are used for Group 3 Environmental tests.
- 12/ Shock and vibration. Two connector mated pair must be tested. At least four termini pair in the two connector mated pair are to be monitored for optical signal discontinuity (and for change in optical transmittance). Any other 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 near or 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 mated pair, then only one insertion loss verification and one return loss test are performed (after the conclusion of the mechanical and environmental tests).

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

MIL-S-901  
MIL-STD-1678-3  
MIL-STD-1678-4  
MIL-PRF-24792  
MIL-PRF-64266  
MIL-PRF-64266/9  
TIA-455-12  
TIA-455-16  
TIA/EIA-455-158  
TIA-604-10  
SAE-AIR1351

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Custodians:

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

Preparing activity:  
DLA - CC

(Project 6060-2014-005)

Review activities:

Navy - AS  
Air Force - 13, 19, 93, 99  
NASA - NA

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