INCH-POUND

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SUPERSEDING
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PERFORMANCE SPECIFICATION

CONNECTORS, FIBER OPTIC, CIRCULAR, PLUG AND RECEPTACLE STYLE, MULTIPLE REMOVABLE TERMINI, GENERAL SPECIFICATION FOR

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

1. SCOPE

1.1 Scope. This specification covers the performance requirements for circular, plug and receptacle style, multiple removable termini, fiber optic connectors that are for Department of Defense applications and that are compatible with multiple transmission element cables. Fiber optic connectors specified herein cover a family of general purpose, interconnection hardware providing a variety of compatible optical coupling arrangements. Connector parts specified within this specification include connector shells, connector inserts, connector insert retention nuts, connector backshells, and connector dust caps.

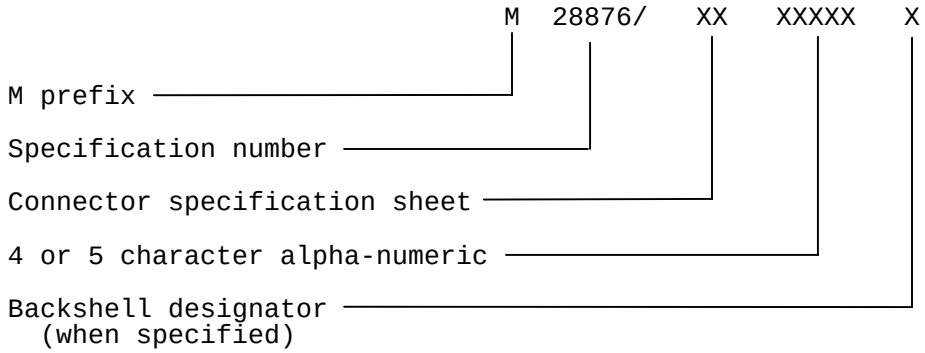
1.2 Classification. Plug and receptacle styles, as specified (see 3.1), include straight, wall (panel) mounted, jamnut mounted, right angle and other connector configurations as required for cable system applications.

1.2.1 Termini classification. Termini are classified as described in MIL-PRF-29504.

Note: Termini are not supplied with connectors procured to this specification. When termini other than those qualified to MIL-PRF-29504 are used, the requirements stated herein may not be met.

Comments, suggestions or questions on this document should be addressed to Department of the Navy, Naval Sea Systems Command (SEA 05Q), 2531 Jefferson Davis Highway, Arlington, VA 22242-5160 or emailed to (fill in email address). Since contact information can change, you may want to verify the currency of this address information using the ASSIST Online database at www.dodssp.daps.mil.

1.3 Part or Identifying Number (PIN). PINs to be used for connectors acquired to this specification are created as follows:



Example: M28876/01-A1P1M

2. APPLICABLE DOCUMENTS

2.1 General: The documents listed in this section are specified in sections 3 and 4 of this specification. This section does not include documents cited in other sections of this specification or recommended for additional information or as examples. While every effort has been made to ensure the completeness of this list, document users are cautioned that they must meet all specified requirements of documents cited in sections 3 and 4 of this specification, whether or not they are listed.

2.2 Government documents.

2.2.1 Specifications, standards, and handbooks. The following specifications, standards, and handbooks form a part of this document to the extent specified herein. Unless otherwise specified, the issues of these documents are those cited in the solicitation or contract (see 6.2).

DEPARTMENT OF DEFENSE SPECIFICATIONS

MIL-S-901	-	Shock Tests, HI (High-Impact) Shipboard Machinery, Equipment And Systems, Requirements For.
MIL-PRF-29504	-	Termini, Fiber Optic Connector, Removable, General Specification For.

DEPARTMENT OF DEFENSE STANDARDS

MIL-STD-1373	-	Screw-Thread, Modified, 60° Stub, Double
MIL-STD-2042	-	Fiber Optic Cable Topology Installation Standard Methods For Naval Ships

DEPARTMENT OF DEFENSE HANDBOOKS

MIL-HDBK-454	-	General Guidelines for Electronic Equipment.

(Copies of these documents are available online at http://assist.daps.dla.mil/quicksearch/ or www.dodssp.daps.mil or from the Standardization Document Order Desk, 700 Robbins Avenue, Building 4D, Philadelphia, PA 19111-5094.)

2.2.2 Other Government documents, drawings, and publications. The following other Government documents, drawings, and publications form a part of this document to the extent specified herein. Unless otherwise specified, the issues of these documents are those cited in the solicitation or contract.

NAVAL ENGINEERING STANDARD (NES)

713 - Determination of the Toxicity Index of the Products of Combustion From Small Specimens of Materials.

(Application for copies should be addressed to Commander, Naval Surface Warfare Center, Dahlgren Division, Code B35, 17320 Dahlgren Road, Dahlgren VA, 22448-5100.)

2.3 Non-Government publications. The following documents form a part of this document to the extent specified herein. Unless otherwise specified, the issues of these documents are those cited in the solicitation or contract.

ASTM INTERNATIONAL

ASTM-D-1149 - Rubber Deterioration-Surface Ozone Cracking in a Chamber.

(Application for copies can be obtained online at http://www.astm.org/ or by contacting ASTM International, P.O. Box C700, 100 Barr Harbor Drive, West Conshohocken, PA, 19428-2959).

INSTITUTE OF ELECTRICAL AND ELECTRONIC ENGINEERS (IEEE)

IEEE-299 - Measuring the Effectiveness of Electromagnetic Shielding Enclosures. (DoD adopted)

(Application for copies can be obtained online at http://www.ieee.org/ or by contacting the Institute of Electrical and Electronic Engineers (IEEE), 445 Hoes Lane, Piscataway, NJ 08854-1331).

TELECOMMUNICATIONS INDUSTRY ASSOCIATION/ELECTRONIC INDUSTRIES ALLIANCE (TIA/EIA)

EIA-359 - EIA Standard Colors for Color Identification and Coding. (DoD adopted)
EIA-364-81 - Combustion Characteristics of Connector Housings, Connector Assemblies and Sockets.
TIA/EIA-455 - Standard Test Procedure for Fiber Optic Fibers, Cables, Transducers, Sensors, Connecting and Terminating Devices, and Other Fiber Optic Components. (DoD adopted)
TIA/EIA-455-1 - Cable Flexing for Fiber Optic Interconnecting Devices.
TIA/EIA-455-2 - Impact Test Measurements for Fiber Optic Devices. (DoD adopted)
EIA/TIA-455-3 - Procedure to Measure Temperature Cycling Effects on Optical Fibers, Optical Cable, and Other Passive Fiber Optic Devices. (DoD adopted).
TIA/EIA-455-4 - Fiber Optic Component Temperature Life Test. (DoD adopted).
TIA/EIA-455-5 - Humidity Test Procedure for Fiber Optic Components. (DoD adopted).

TIA-455-6	-	Cable Retention Test Procedure for Fiber Optic Cable Interconnecting Devices. (DoD adopted)
TIA/EIA-455-11	-	Vibration Test Procedure for Fiber Optic Components and Cables.
EIA/TIA-455-12	-	Fluid Immersion Test for Fiber Optic Components.
TIA-455-13	-	Visual and Mechanical Inspection of Fiber Optic Components, Devices, and Assemblies. (DoD adopted)
TIA/EIA-455-16	-	Salt Spray (Corrosion) Test for Fiber Optic components. (DoD adopted).
TIA/EIA-455-20	-	Measurement of Change in Optical Transmittance. (DoD adopted)
TIA-455-21	-	Mating Durability of Fiber Optic Interconnecting Devices. (DoD adopted)
TIA-455-26	-	Crush Resistance of Fiber Optic Cable Interconnecting Devices. (DoD adopted).
TIA/EIA-455-32	-	Fiber Optic Circuit Discontinuities. (DoD adopted)
TIA/EIA-455-34	-	Interconnection Device Insertion Loss Test. (DoD adopted)
TIA/EIA-455-35	-	Fiber Optic Component Dust (Fine Sand) Test. (DoD adopted).
TIA-455-36	-	Twist Test for Fiber Optic Connecting Devices.
EIA/TIA-455-42	-	Optical Crosstalk in Fiber Optic Components. (DoD adopted)
TIA/EIA-455-56	-	Test Method for Evaluating Fungus Resistance of Optical Fiber and Optical Cable. (DoD adopted).
TIA/EIA-455-71	-	Procedure to Measure Temperature-Shock Effects on Fiber Optic Components.
EIA/TIA-455-98	-	Fiber Optic Cable External Freezing Test.
TIA/EIA-455-107	-	Determination of Component Reflectance or Link/System Return Loss Using a Loss Test Set. (DoD adopted)
TIA-455-189	-	Ozone Exposure Test for Fiber Optic Components

(Application for copies can be obtained online at http://www.eia.org or by contacting the Telecommunications Industry Association/Electronic Industries Alliance, 2500 Wilson Boulevard, Suite 300, Arlington, VA 22201-3834).

2.4 Order of precedence. In the event of a conflict between the text of this document and the references cited herein (except for related specification sheets), the text of this document takes precedence. Nothing in this document, however, supersedes applicable laws and regulations unless a specific exemption has been obtained.

3. REQUIREMENTS

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

3.2 Qualification. Fiber optic connectors and accessories furnished under this specification shall be products that are authorized by the qualifying activity for listing on the applicable qualified products list before contract award (see 4.4 and 6.3). The provisions of 4.4.4 for retention of qualification are included in this requirement.

3.3 Materials. Materials shall be as specified herein and in the applicable specification sheet. In all cases, materials selected for use shall meet all qualification requirements as specified, and be of a type and quality to assure physical, chemical, and optical compatibility with the requirements of this specification. All materials used shall be nontoxic (see 3.3.5), nonnutrient to fungus (see 3.14.13) and manufactured to good workmanship quality (see 3.10.4). Materials chosen shall be the lightest practicable material suitable for the intended use. Materials shall not interfere with or degrade the terminus cleaning operation and shall provide 20 year service.

3.3.1 Connector parts: Connector shells shall be aluminum. Connector inserts shall be either aluminum or a polymer material. Backshells, insert retention nuts, and dust covers shall be either aluminum, corrosion resistant (CRES) steel, or a polymer material.

3.3.2 Finish. The resultant finish on all connector parts shall meet the requirements herein and be:

a. Aluminum components: The finish used for external parts shall minimize reflections, shall be electrolytically compatible with cadmium plate, and shall meet the requirements herein. The finish used for internal parts shall be corrosion resistant.

b. CRES components: Unless otherwise specified (see 3.1), all exposed corrosion resistant steel parts shall be passivated and shall be treated to minimize reflections. CRES threads shall be treated in a manner to minimize galling and cold welding with mating parts. CRES parts which may be mated to non-CRES parts shall be treated to minimize scratching or damage to mating components during mating operations.

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

3.3.4 Nonmetallic materials. Nonmetallic materials used in connector parts shall not be degraded by the use of solvents or cleaning agents, nor be degraded at the specified environmental conditions.

3.3.5 Toxic and hazardous products and formulations. Materials used in the connectors, backshells, insert retention nuts, and dust covers shall not give off toxic or explosive fumes when exposed to flame. Materials used shall have no adverse effect on the health of personnel when used for its intended purpose.

3.3.6 Metals: Metals shall be corrosion resistant, or treated to be corrosion resistant. Unless otherwise specified (see 3.1), metals shall be nonmagnetic.

3.3.7 Dissimilar metals. The use of dissimilar metals in intimate contact should be avoided. When dissimilar metals are used in intimate contact with each other, protection against electrolysis and corrosion shall be provided.

3.3.8 Sealing compounds. Sealing compounds shall not flow at the maximum specified storage temperature or exhibit cracking at the minimum specified storage temperature.

3.3.9 Lubricants. Lubricants used in the construction of the connectors shall satisfy the following criteria:

a. Lubricants shall be permanent and shall not require replacement during the lifetime of the connector.

b. Lubricants shall not migrate to the optical interfaces resulting in the degradation of optical performance.

c. Lubricants shall be useful over the environmental conditions specified herein.

d. Lubricants shall not be affected by cleaning solvents.

3.4 Design and construction. Connector parts shall conform to figures A-1 through A-8, and as specified (see 3.1).

3.4.1 General. Connectors shall be designed to be compatible with optical fibers and cables as specified (see 3.1).

3.4.2 Seals. Seals shall provide environmental isolation for the optical contact junctions and connector interior parts. Grommets, O-rings, interfacial seals, boots, gaskets, or other sealing devices, as needed by the connector design, shall accomplish their intended purpose and meet all test requirements as specified herein.

3.4.2.1 Optical junction sealing. Optical junctions shall be sealed against moisture and contamination as specified herein.

3.4.2.2 Cable sealing. Connectors shall seal the terminating cables as specified herein.

3.4.3 Interchangeability and interoperability. Connector parts shall be interchangeable and interoperable as specified in 3.4.3.1 and 3.4.3.2.

3.4.3.1 Interchangeability. All connector parts having the same military Part or Identifying Number (PIN) shall be physically and functionally interchangeable without need for modification of such items or of the mating equipment.

3.4.3.2 Interoperability. All connectors of the same PIN shall be interoperable. Upon qualification of the first manufacturer, all subsequent manufacturers shall provide proof of interoperability with each qualified manufacturer as specified in 4.7. The connectors shall meet the requirements of 3.11.1, 3.12.3 and 3.12.4 for each specified interoperability condition (see 4.7).

3.5 Connectors parts.

3.5.1 Shells. The connector shells shall retain the connector insert.

3.5.1.1 Plugs: Plugs shall be of the inline (straight), 45°, and 90° type as specified (see 3.1).

3.5.1.2 Receptacles. Receptacles shall be of the wall (panel) mount, jamnut, or inline (straight) types as specified (see 3.1).

3.5.1.3 Engagement of connectors. Counterpart connectors of any arrangement and accessories shall be capable of being fully engaged and disengaged without the use of tools.

3.5.1.4 Coupling mechanism. Coupling rings of the connectors shall be knurled, and designed so that plug and receptacle optical termini shall approach or recede from each other as the coupling mechanism is respectively tightened by clockwise rotation or loosened in the counterclockwise direction as viewed from the rear of the plug connector. The coupling mechanism shall be captive on the plug to mate with the receptacle shell. Coupling ring and coupling screw threads shall be in accordance with MIL-STD-1373 and as shown on figures A-4 and A-5, and as specified (see 3.1). If the coupling threads must be lubricated to meet the requirements contained herein, the lubricant shall meet all of the requirements specified herein (see 3.3.9).

3.5.1.5 Plug and receptacle shell polarization (keying). Polarization keying shall be incorporated in the shells of plugs and receptacles to assure correct alignment of the inserts before mating is permitted. The polarization shall be accomplished by integral keys (see figure A-3) in the shells. The keying shall be designed to prevent physical contact of the mating optical termini, or of the termini with the insert surface of the counterpart connector until the keyways are properly aligned for engagement and coupling mechanisms are engaged.

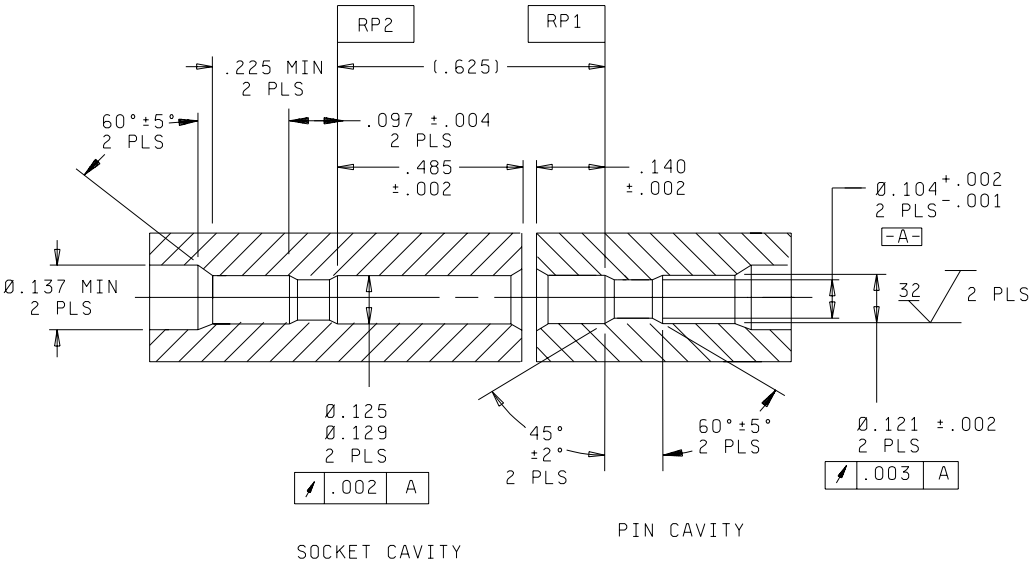
3.5.2 Termini. Removable, environment resisting fiber optic termini shall be used with these connectors for interconnecting fiber optic cables. The termini are not supplied with connectors acquired to this specification. Termini, for use with the connectors specified herein, shall be in accordance with MIL-PRF-29504 (see 3.1).

3.5.3 Inserts. Inserts shall be keyed and secured to prevent rotation within the connector shell. Inserts shall be of a one piece or two piece construction and shall be such that they will not crack, chip, or break in normal service or assembly. Inserts glued or bonded together shall not be used. The insert dimensions shall be as specified (see 3.1). The insert hole configuration shall conform to the dimensions shown on figure 1.

3.5.3.1 Number of termini, arrangement, and spacing. The insert pattern, that is, the number of termini, their arrangement and spacing shall be as specified in Appendix B. Every terminus position shall accept either optical or dummy termini.

3.5.3.2 Terminus insertion and removal methods. Optical terminus insertion shall be accomplished by inserting the terminus, using a terminus insertion tool, into the rear of the connector insert. A means for locking the terminus in place shall be provided. Optical terminus removal shall be accomplished by inserting the terminus removal tool into the front of the connector and by forcing the terminus out the rear of the connector. The individual termini shall be positively retained in the connector when installed with the terminus insertion tool and shall be capable of being removed without terminus or insert damage when using the terminus removal tool. Requirements for these tools shall be as specified (see 3.1).

3.5.4 Assembly methods. Connector assembly shall be accomplished in accordance with MIL-STD-2042.



Notes:
1. Mating cavities to be aligned Ø.010 Ⓢ and insert faces abutted when connectors are mated.
2. The following dimensions should be used as a reference:

M29504/1 and /12 pin termini protrude .342 from R.P.1
M29504/14 ceramic tip pin termini protrude .378 from R.P.1
M29504/2 and /13 socket termini with alignment sleeve protrude .428 from R.P.2
M29504/15 ceramic tip socket termini with alignment sleeve protrude .423 from R.P.2

Inches	mm	Inches	Mm
.001	0.03	.137	3.48
.002	0.05	.140	3.56
.003	0.08	.225	5.72
.004	0.10	.342	8.69
.010	0.25	.378	9.60
.097	2.46	.423	10.74
.104	2.64	.428	10.87
.121	3.07	.485	12.32
.125	3.18	.625	15.88
.129	3.28		

FIGURE 1. Termini cavity dimensions.

3.6 Backshells and insert retention nuts.

3.6.1 Backshells. Backshells shall conform to the requirements as specified (see 3.1). The backshells shall be provided with cable strain relief as specified (see 3.1). The backshells shall be free of any sharp edges or other configurations that could cause damage to optical fibers extending through them.

3.6.2 Insert retention nuts. Insert retention nuts shall conform to the requirements as specified (see 3.1). The insert retention nuts shall be provided without cable strain relief as specified (see 3.1). The insert retention nuts shall be free of any sharp edges or other configurations that could cause damage to optical fibers extending through them.

3.7 Protective caps or covers. All optical connectors (plugs and receptacles) shall be provided with throwaway caps or covers. The cap or cover shall be free of mold release, lubricants, or any other contaminants.

3.8 Dust covers. Dust covers shall conform to the requirements as specified (see 3.1). The dust covers shall be free of any sharp edges or any other configurations that could cause damage to the optical termini.

3.9 Tools. Tools used to terminate connectors onto cables shall be as specified (see 3.1).

3.10 Visual and mechanical.

3.10.1 Size. When examined in accordance with 4.6.2.1, the dimensions and dimensional tolerances for the connector parts shall be as specified (see 3.1).

3.10.2 Weight. When tested in accordance with 4.6.2.2, the weight of the connector parts shall be as specified (see 3.1).

3.10.3 Identification marking (see 4.6.2.3). Identification marking shall be as specified in 3.10.3.1 and 3.10.3.2. Markings shall be legible and permanent. Markings shall be legible to the extent that none are missing, in whole or in part, faded, blurred, smeared or shifted (dislodged) and shall be readily readable. Contrast between characters and surface shall be good. Markings shall be permanent to the extent of withstanding cleaning procedures and of withstanding environmental and mechanical performance tests conducted.

3.10.3.1 Connectors, backshells, and dust covers. Connectors, backshells, and dust covers shall be identified with markings that are permanent, clearly visible and legible. Identification marking shall include the PIN and either the manufacturer's CAGE code, name or logo. Connectors shall also be marked with a yellow band in accordance with EIA-359, or the phrase "FIBER OPTICS" as specified (see 3.1).

3.10.3.2 Inserts. Marking shall correspond between mating inserts and shall be as specified in Appendix B. Raised or depressed characters shall not be used on mating faces. Terminus locations shall be designated by identifiable characters on the front and rear faces of the insert or the insert assembly. Character position and arrangement shall assure appropriate terminus cavity identification.

3.10.3.3 JAN and J marking. The United States Government has adopted and is exercising legitimate control over the certification marks "JAN" and "J", respectively, to indicate that items so marked or identified are manufactured to, and meet all the requirements of specifications. Accordingly, items acquired to, and meeting all of the criteria specified herein and in applicable specifications shall bear the certification mark "JAN" except that items too small to bear the certification mark "JAN" shall bear the letter "J". The "JAN" or "J" shall be placed immediately before the part number except that if such location would place a hardship on the manufacturer in connection with such marking, the "JAN" or "J" may be located on the first line above or below the part number. Items furnished under contracts or orders which either permit or require deviation from the conditions or requirements specified herein or in applicable specifications shall not bear "JAN" or "J". In the event an item fails to meet the requirements of this specification and the applicable specification sheets, the manufacturer shall remove completely the military part number and the "JAN" or the "J" from the sample tested and also from all items represented by the sample. The "JAN" or "J" certification mark shall not be used on products acquired to contractor drawings or specifications. The United States Government has obtained Certificate of Registration Number 504,860 for the certification mark "JAN" and Registration Number 1,586,261 for the certification mark "J".

3.10.4 Workmanship. All details of workmanship shall be as specified herein when examined in accordance with 4.6.4. Connector parts shall be dimensionally uniform and free of manufacturing flaws that would degrade performance, inhibit proper connection to interfacing elements, and otherwise yield an inferior product. The following shall be a minimal level of visual examination to be performed and is not intended to restrict other pertinent workmanship examinations:

a. Loose termini, inserts, or other connector parts which adversely effect the environmental sealing, or degrade optical termini alignment shall not be permitted.

b. Peeling or chipping of plating or finish, galling of mating parts indicating excessive wear, nicks, burrs, or other substandard connector surface blemishes shall not be permitted.

3.10.5 Screw threads. When tested in accordance with 4.6.2.5, slight out-of-roundness beyond the tolerances specified is acceptable if the threads can be checked without forcing the thread gauges. Screw threads may be relieved provided the relief does not interfere with proper performance of the screw threads.

3.10.6 Maintainability. The connectors shall require no preventive maintenance.

3.11 Optical performance. The optical performance requirements of 3.11.1 through 3.11.5 shall be used to monitor effects of the inspection requirements specified in 3.12 and 3.13 as required by 4.4 and 4.5.3.

3.11.1 Insertion loss. The initial insertion loss and the insertion loss verified at any time during testing for a mated pair of connectors shall be not greater than the values specified in table I for each of the mated measurements. The insertion loss shall be measured for 10 mates and demates except for shell size 23 which shall be measured for 5 mates and demates (see 4.6.3.1).

TABLE I. Insertion loss.

Fiber Type (MIL-PRF-49291)	Terminus (MIL-PRF-29504)	Fiber style	Initial Insertion loss (dB)	Insertion loss verification (dB)
/3	/1 or /12	50/125	2.0	2.0
/3	/2 or /13	50/125	2.0	2.0
/4	/1 or /12	100/140	1.5	1.5
/4	/2 or /13	100/140	1.5	1.5
/6	/14	62.5/125	0.75	1.25
/6	/15	62.5/125	0.75	1.25
/7	/14	SM	0.75	1.25
/7	/15	SM	0.75	1.25

3.11.2 Discontinuities. When measured in accordance with 4.6.3.2, no discontinuity shall occur. For multimode 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. 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).

3.11.3 Crosstalk. When connectors with 3 or more channels are tested in accordance with 4.6.3.3, the signal power levels, or sum of levels of the passive channel or channels, shall be below the signal level of the active channel by at least 60 dB.

3.11.4 Change in optical transmittance. When tested in accordance with 4.6.3.4, the change in optical transmittance shall be less than 0.5 dB.

3.11.5 Return loss. When measured in accordance with 4.6.3.5, the return loss of a standard polish multimode or single mode optical terminus shall be not less than 30 dB. The return loss of an enhanced polish single mode optical terminus shall be not less than 40 dB.

3.12 Functional requirements.

3.12.1 Insert retention radial strength. When tested in accordance with 4.6.4.1, connector inserts shall withstand the clockwise and counterclockwise radial torque specified in table II for a minimum period of one minute. No rotational displacement shall be observed between the inserts and their shell body during or after the test exposure.

TABLE II. Insert retention radial strength.

Connector shell size	Maximum radial torque (inch pounds (N-m))
11	15 (1.7)
13	20 (2.3)
15	25 (2.8)
23	30 (3.4)

3.12.2 Insert retention axial strength. When tested in accordance with 4.6.4.2, connector inserts shall withstand an applied minimum pressure of 100 pounds per square inch (0.69 Mpa) in both the forward direction and the backward direction for a minimum period of 1 minute without cracking, breaking, or being dislocated from their normal positions in the connector shell. No axial displacement detrimental to performance shall be observed between the inserts and their shell body during or after the test exposure.

3.12.3 Terminus insertion and removal forces. Connectors shall be tested in accordance with 4.6.4.3. The terminus insertion force and the force required to remove unlocked termini shall not exceed 22.0 pounds (98 N).

3.12.4 Terminus retention force. When tested in accordance with 4.6.4.4 and subjected to axial loads of 22.0 pounds (98 N) termini shall be retained in their inserts and axial displacements of the termini shall not exceed 0.015 inch (0.38 mm).

3.12.5 Maintenance aging. Connectors with removable termini shall be tested in accordance with 4.6.4.5. Connectors shall show no visible evidence of wear or deformation which may degrade their ability to perform as specified. The terminus insertion and removal forces requirement of 22.0 pounds (98 N) (see 3.12.3) shall be met.

3.12.6 Connector coupling engagement and disengagement torque. When tested in accordance with 4.6.4.6, the maximum coupling ring and coupling screw engagement and disengagement torques shall be as specified in table III.

TABLE III. Connector coupling engagement and disengagement torques.

Connector shell size	Connector coupling engagement and disengagement torque (inch-pounds (N-m))
11	15 (1.7)
13	15 (1.7)
15	25 (2.8)
23	50 (5.7)

3.12.7 Backshell and insert retention nut attachment. When tested in accordance with 4.6.4.7, the minimum backshell or insert retention nut disengagement torque shall be as specified in table III. No evidence of excessive thread binding, seal pinching, or any contamination buildup shall be observed.

3.13 Mechanical requirements

3.13.1 Cable pull out force (connectors with backshells only). When tested in accordance with 4.6.5.1, the minimum cable to connector pullout strength shall be 162 pounds (720.3 N). There shall be no evidence of cable jacket damage, cable strain relief failure, cable to backshell seal damage, distortion or bending of metallic connector parts, or cable disengagement from the cable strain relief. The connector shall meet the requirements of 3.11.4 during and after the test.

3.13.2 External bending moment (connectors with backshells only). When tested in accordance with 4.6.5.2, connectors and backshells shall exhibit no visible evidence of damage that may degrade their ability to perform as specified (see 3.1).

3.13.3 Cable seal flexing. When tested in accordance with 4.6.5.3, connector strain relief mechanisms shall prevent loss of environmental sealing or other damage which may impair the connector operation.

3.13.4 Twist. When tested in accordance with 4.6.5.4, connector seals shall not be rendered inoperable nor shall any other connector damage occur. The change in optical transmittance attributable to the connector shall be less than 0.5 dB during and after the test.

3.13.5 Mating durability. When tested in accordance with 4.6.5.5, mating connectors shall show no evidence of mechanical defects detrimental to connector operation. The connector shall meet the requirements of 3.11.4 during and after the test.

3.13.6 Impact. When tested in accordance with 4.6.5.6, connectors shall not be visibly damaged or otherwise rendered unfit for operational use. The requirements of 3.11.4 shall be met after the test.

3.13.7 Crush. When tested in accordance with 4.6.5.7, connectors shall show no evidence of inability to mate or unmate, broken parts, loss of optical continuity, or damage to shells, backshells, or dust covers. The requirements of 3.11.4 shall be met during and after the test.

3.14 Environmental requirements.

3.14.1 Temperature ranges. The connectors shall meet all requirements specified (see 3.1), during the specified operating environments and after the specified storage environments. The operating temperature range and storage temperature range shall be as shown in table IV, as specified (see 3.1).

TABLE IV. Temperature ranges.

Operating extremes (°C)	Storage extremes (°C)	Non-operating extremes (°C)
-28 to +65	-40 to +70	-40 to +70

3.14.2 Thermal shock. When tested in accordance with 4.6.6.1, connectors shall show no evidence of mechanical damage, loosening of component parts, separation of bonded surfaces, or other damage detrimental to the operation of the connector. The connector shall meet the requirements of 3.11.4 after the test.

3.14.3 Temperature/humidity cycling. When tested in accordance with 4.6.6.2, connector parts shall not swell or otherwise degrade such that connector performance is impaired. The requirements of 3.11.4 shall be met during and after the test.

3.14.4 Temperature cycling. When tested in accordance with 4.6.6.3, a post test visual examination of the test connectors shall reveal no evidence of connector part dimensional change, no leakage of waterproofing compounds or other apparent loss of sealing capability, no surface or identification marking impairment, no coupling-thread binding or other evidence of mating or unmating incapability, and no other damage detrimental to the operation of the connector. The requirements of 3.11.4 shall be met during and after the test.

3.14.5 Life aging. When tested in accordance with 4.6.6.4, connectors subjected to these specified accelerated aging exposures shall not exhibit visual evidence of dimensional change, opening of seals, cracking or crazing of components or finishes, identification marking impairment, fusion or seizure of mating parts, leakage of waterproofing compounds or other effects detrimental to connector operation. The connector shall meet the requirements of 3.11.4 after the test. Connectors with dielectric inserts shall meet the insert retention radial strength (see 3.12.1) and insert retention axial strength (see 3.12.2) requirements after aging.

3.14.6 Freezing water. When tested in accordance with 4.6.6.5, connectors shall not be physically damaged. The connectors shall meet the optical requirements specified in 3.11.4 during and after the test.

3.14.7 Sand and dust. When tested in accordance with 4.6.6.6, the connectors shall show no evidence of physical damage which will adversely affect the operation of the connector. The change in optical transmittance requirements of 3.11.4 shall be met during and after the test, and coupling torques requirements of 3.12.6 shall be met after the test.

3.14.8 Terminus cleaning. After cleaning the terminus in accordance with 4.6.6.7, the marking requirements of 3.10.3 and the change in optical transmittance of 3.11.4 shall be met after the test.

3.14.9 Electromagnetic effects. When tested in accordance with 4.6.6.8 the propagated radio frequency (RF) attenuation of the connector shall be not less than 60 dB for frequencies not greater than 10 GHz.

3.14.10 Fluid immersion. When tested in accordance with 4.6.6.9, visual examination of the test connector 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.

3.14.11 Salt spray (corrosion). When tested in accordance with 4.6.6.10, no visible evidence of salt penetration into the connector sealed area shall be observed. No corrosive effects shall be seen on the external connector parts that would be detrimental to the operation of the connector.

3.14.12 Flammability. When tested in accordance with 4.6.6.11, the mated cable-connector assembly shall meet the optical requirements of 3.11.4. The unmated connector assembly shall not exceed a combined flame and afterglow extinguishing time of 30 seconds after removal of the applied flame. There shall be no dripping that will cause the flammable material to ignite and there shall be no violent burning or explosive type fire.

3.14.13 Fungus resistance. When tested in accordance with 4.6.6.12, polymeric connector materials shall show sparse or very restricted microbial growth and reproduction with minor or inhibited substrate utilization. There shall be little or no chemical, physical or structural change detectable.

3.14.14 Ozone exposure. When tested in accordance with 4.6.6.13, seals shall show no evidence of excessive swelling or embrittlement which may degrade environmental isolation.

3.14.15 Vibration. When tested in accordance with 4.6.6.14, connectors shall not exhibit visual evidence of loosening of parts for frequencies less than 75 Hz, relative motion between parts or other damage which can produce physical distortion or wear and may result in fatigue of the mechanical parts or failure of the connector operation. The requirements of 3.11.2 shall be met during the test and 3.11.4 shall be met after the test.

3.14.16 Shock. When tested in accordance with 4.6.6.15, connectors shall not be damaged and there shall be no loosening of parts. The requirements of 3.11.2 shall be met during the test and 3.11.4 shall be met after the test.

3.14.17 Water pressure. When tested in accordance with 4.6.6.16, visual inspection of the test connector shall reveal no penetration of water into the sealed region of the mated connector. The requirements of 3.11.4 shall be met after the test.

4. VERIFICATION

4.1 Verification program. Requirements for the verification program shall be as identified in the qualification instructions (see 6.3.3).

4.1.1 Assembly plants. Assembly plants must be listed on, or approved for listing on, the applicable qualified products list. The assembly plant shall use only piece parts supplied by the qualified connector manufacturer. No testing other than visual examination is required of certified piece parts obtained from the qualified connector manufacturer, except when there is cause for rejection. All assemblies produced at the assembly plant shall be subjected to examination of the product to assure that the assembly process conforms with that established at the qualified manufacturing plant. Quality control requirements, shall be the same as required for the qualified connector manufacturer.

4.2 Test equipment and inspection facilities. Requirements for test equipment and inspection facilities shall be as identified in the qualification instructions (see 6.3.4).

4.3 Inspections.

4.3.1 Classification of inspections. The inspections specified herein are classified as follows:

a. Qualification inspection (see 4.4).

b. Conformance inspection (see 4.5).

4.3.2 Inspection conditions. Unless otherwise specified, all inspections shall be performed in accordance with the test conditions specified in TIA/EIA-455 or as specified herein.

4.4 Qualification inspection. Qualification inspection shall be performed at a laboratory acceptable to the Government (see 6.3) on sample units produced with equipment and procedures normally used in production. This inspection shall consist of performing the inspections and optical tests specified in table V, in the sequence shown therein, on the qualification test samples specified in 4.4.1.

4.4.1 Test samples. Fiber optic connector parts complying with the specified requirements (see 3.1) shall be submitted for qualification. The parts submitted for qualification shall be selected from units produced on typical manufacturing lines. The manufacturer shall provide a counterpart connector for each connector subjected to qualifying tests requiring mating assemblies. The counterpart connectors provided for this purpose shall be new, previously qualified connectors or new connectors submitted for qualification testing. For those tests specifying the use of mated connectors, optical and mechanical test assessments shall be made using the assigned counterpart connector for those test measurements as required.

4.4.1.1 Sample size. Six mating pairs shall be submitted for qualification testing. These connectors shall consist of MIL-PRF-28876/2 wall (panel) mounted receptacles with straight backshells and MIL-PRF-28876/7 plugs with straight backshells or MIL-PRF-28876/1 wall (panel) mounted receptacles with MIL-PRF-28876/27 backshells and MIL-PRF-28876/6 plugs with MIL-PRF-28876/27 backshells as specified (see 3.1).

4.4.1.2 Sample preparation. Unless otherwise specified, connectors shall be fully assembled into cable-connector assemblies using the types of cable specified in the applicable connector specification sheet (see 3.1). Connector termini shall be optically finished with termini properly seated within their inserts. For mated connectors, full sealing capability shall be provided as specified. Connectors shall be provided with backshell, and attached to an appropriate length of the specified cable type.

4.4.1.2.1 Termini. The minimum number of active termini required for testing for each shell size shall be as follows: A minimum of two termini shall be active in connectors of shell size 11. A minimum of four termini shall be active in connectors of shell sizes 13 and 15. A minimum of eight termini shall be active in connectors of shell size 23. For shell sizes 15 and 23, the active termini shall be placed at different locations in each of the six samples.

4.4.2 Inspection routine. Connector parts shall be tested in accordance with the sequence of table V. Manufacturers desiring qualification for only backshells or dust covers shall, at a minimum, test connectors as specified in 4.4.1 in those tests indicated in table V. Group II, III and IV testing may be conducted simultaneously.

4.4.2.1 Qualification of modified designs. Qualification inspection of items which contain design changes from previously qualified items may be limited to a subset of the qualification inspections identified in 4.4.2. Qualification inspection reductions will be determined by the qualification activity based on the extensiveness of the design changes and the anticipated effects of those changes on the item performance.

4.4.3 Failures. One or more failures shall be cause for refusal to grant qualification approval.

4.4.4 Retention of qualification. To retain qualification, the manufacturer shall verify in coordination with the qualifying activity, the capability of manufacturing products which meet the performance requirements of this specification. Refer to the qualifying activity for the guidelines necessary to retain qualification with respect to this particular specification. The manufacturer shall immediately notify the qualifying activity at any time that the inspection data indicates failure of the qualified product to meet the performance requirements of this specification.

TABLE V. Qualification Inspection 1/.

Inspection Tests	Part applicability			Requirement paragraph	Test method
	Connector	Back-shell	Dust covers		
Group I (6 mated pairs)					
Interoperability 5/	x	x		3.4.3.2	4.7
Visual and mechanical				3.10	4.6.2
Size	x	x	x	3.10.1	4.6.2.1
Weight	x	x	x	3.10.2	4.6.2.2
Identification marking	x	x	x	3.10.3	4.6.2.3
Workmanship	x	x	x	3.10.4	4.6.2.4
Screw threads	x		x	3.10.5	4.6.2.5
Functional					
Insert retention radial strength	x			3.12.1	4.6.4.1
Insert retention axial strength	x			3.12.2	4.6.4.2
Terminus insertion and removal forces	x			3.12.3	4.6.4.3
Terminus retention force	x			3.12.4	4.6.4.4
Maintenance aging	x		x	3.12.5	4.6.4.5
Connector coupling engagement and disengagement torque	x			3.12.6	4.6.4.6
Backshell and insert retention nut attachment	x	x		3.12.7	4.6.4.7
Optical				3.11	
Insertion loss (initial)	x	x		3.11.1	4.6.3.1
Return loss	x	x		3.11.5	4.6.3.5
Crosstalk	x			3.11.3	4.6.3.3
Group II (2 mated pairs)					
Cable pull out force	x	x		3.13.1	4.6.5.1
External bending moment	x	x		3.13.2	4.6.5.2
Cable seal flexing	x	x		3.13.3	4.6.5.3
Twist	x	x	x	3.13.4	4.6.5.4
Mating durability	x			3.13.5	4.6.5.5
Return loss	x			3.11.5	4.6.3.5
Impact	x	x	x	3.13.6	4.6.5.6
Crush	x	x		3.13.7	4.6.5.7
Insertion loss	x			3.11.1	4.6.3.1
verification		x		3.14.15	4.6.6.14
Vibration	x				
Shock	x	x		3.14.16	4.6.6.15
Water pressure	x	x		3.14.17	4.6.6.16

TABLE V. Qualification Inspection - (Continued).

Inspection tests	Part applicability			Requirement paragraph	Test method
	Connector	Back-shell	Dust covers		
Group III (2 mated pairs)					
Thermal shock	x	x		3.14.2	4.6.6.1
Temperature/humidity cycling	x	x		3.14.3	4.6.6.2
Temperature cycling	x	x		3.14.4	4.6.6.3
Life aging	x	x		3.14.5	4.6.6.4
Insert retention radial strength 2/	x			3.12.1	4.6.4.1
Insert retention axial strength 2/	x			3.12.2	4.6.4.2
Freezing water	x	x			
Insertion loss	x			3.14.6	4.6.6.5
verification				3.11.1	4.6.3.1
Sand and dust	x	x	x	3.14.7	4.6.6.6
Connector coupling engagement and disengagement torque	x		x	3.12.6	4.6.4.6
Terminus cleaning	x			3.14.8	4.6.6.7
Identification marking	x	x	x	3.10.3	4.6.2.3
Group IV (2 mated pairs and parts)					
Electromagnetic effects (2 mated pairs) 4/	x	x	x	3.14.9	4.6.6.8
Fluid immersion (2 mated pairs)	x	x		3.14.10	4.6.6.9
Salt spray (2 mated pairs)	x	x	x	3.14.11	4.6.6.10
Flammability (1 mated pair)	x	x		3.14.12	4.6.6.11
Fungus resistance (parts 3/)	x	x	x	3.14.13	4.6.6.12
Ozone exposure (parts 3/)	x	x		3.14.14	4.6.6.13

1/ Group I mated pairs are to be used for groups II, III, and IV.

2/ Perform only for connector samples utilizing non-metallic inserts.

3/ Polymeric parts from 1 mated pair.

4/ Perform only for connector samples utilizing non-metallic inserts or non-metallic backshells.

5/ Separate samples are required for interoperability testing. Connector interoperability samples are to be fully populated with termini on single fiber cable and configured without backshells. Backshell interoperability samples are to be constructed with terminated cables that fully populate the connector of the shell size under test.

4.4.4.1 Additional shell sizes. Retention of qualification for all shell sizes may be granted after completion of testing for one shell size as determined by the qualifying activity.

4.4.5 Qualification of additional connectors and backshells. Qualification of wall (panel) mounted receptacles shall qualify straight (in-line) and jamnut mounted receptacles. Each shell size shall be qualified separately. Qualification of the straight backshell shall qualify the 45° and 90° backshells for that shell size.

4.4.5.1 Additional shell sizes. If a connector of one shell size is qualified, and connectors of a second shell size with similar design, construction, and materials meet the visual and mechanical, size, weight, identification marking, workmanship, screw thread, insert retention radial strength, insert retention axial strength, coupling engagement and disengagement torque, backshell and insert retention nut attachment, insertion loss, return loss, cable pull out, external bending moment, cable seal flexing, mating durability, impact, crush, vibration, shock, water pressure, thermal shock, temperature cycling and electromagnetic effects inspections herein, then the connectors of the second shell size are qualified.

4.4.5.2 Alternate insert materials. If a connector with an insert of one material is qualified, and connectors with an insert of a second material meet the interoperability, visual and mechanical, size, weight, identification marking, workmanship, insert retention radial strength, insert retention axial strength, terminus insertion and removal force, terminus retention force, maintenance aging, insertion loss, return loss, shock, temperature cycling, life aging, electromagnetic effects, flammability, fungus resistance, and ozone exposure inspections herein, then the connectors with the second insert material are qualified. Connector interoperability shall be performed using previously qualified plug/receptacle connector with a minimum of two termini from all qualified vendors.

4.4.5.3 Alternate shell/backshell materials. If a connector with a shell/backshell of one material is qualified, and connectors with shells/backshells of a second material meet the visual and mechanical, size, weight, identification marking, workmanship, screw thread, insert retention radial strength, insert retention axial strength, coupling engagement and disengagement torque, backshell and insert retention nut attachment, insertion loss, return loss, cable pull out, external bending moment, mating durability, impact, crush, shock, water pressure, thermal shock, temperature humidity cycling, temperature cycling, life aging, sand and dust, fluid immersion, salt spray, flammability, fungus resistance, and ozone exposure inspections herein, then the connectors with shells/backshells of the second material are qualified.

4.4.5.4 Alternate plating processes. If a connector with one plating is qualified, and connectors with a second plating meet the visual and mechanical, weight, identification marking, workmanship, external bending moment, mating durability, thermal shock, sand and dust, electromagnetic effects, fluid immersion, and salt spray inspections herein, then the connectors with the second plating are qualified.

4.4.5.5 Joint qualification of connectors and termini. Connectors may be qualified using previously qualified termini or using unqualified termini. Connectors may be qualified using either multimode termini or single mode termini. Connectors may be qualified using both multimode termini and single mode termini. In all cases, the failure of any inspection by any terminus shall be cause for refusal to grant qualification approval.

4.5 Conformance inspection. Conformance inspection shall consist of the inspections and optical tests specified for group A inspection (table VI), group B inspection (table VII), and group C inspection (table VIII). Requirements for alternate forms of conformance inspection shall be as identified in the qualification instructions (see 6.3.5).

4.5.1 Inspection of product for delivery. Inspection of product for delivery shall consist of group A inspection.

4.5.1.1 Inspection lot. The inspection lot shall consist of the number of units offered for inspection at one time, and all of the same design as covered by one specification sheet.

4.5.1.1.1 Sample unit. A sample unit shall be selected at random from the inspection lot. For conformance inspections, a sample unit shall consist of an individual unit of supply.

4.5.1.2 Group A inspection. Group A inspection shall consist of the inspection tests specified in table VI. All connector parts in the inspection sample shall be subjected to the inspection tests listed.

4.5.1.2.1 Sampling plan. Group A inspection shall be performed on 100 percent of delivered product.

4.5.1.2.2 Failures. One or more failures shall constitute group A inspection failure of the sample unit.

4.5.1.2.3 Disposition of sample units. Sample units that have failed any of the group A inspection tests shall not be shipped or submitted for group B testing.

TABLE VI. Group A inspection.

Inspection tests	Part applicability			Requirement paragraph	Test method
	Connector	Back-shell	Dust covers		
Visual and mechanical					
Size 1/	x	x	x	3.10.1	4.6.2.1
Weight 1/	x	x	x	3.10.2	4.6.2.2
Identification marking	x	x	x	3.10.3	4.6.2.3
Workmanship	x	x	x	3.10.4	4.6.2.4
Screw threads 1/	x		x	3.10.5	4.6.2.5
Functional					
Backshell and insert retention nut attachment	x	x		3.12.7	4.6.4.7

1/ In process inspections or controls may be used to verify conformance to these requirements.

4.5.2 Group B inspection. Group B inspection shall consist of the tests specified in table VII in the order shown. Group B inspection shall be performed on sample units selected from inspection lots which have passed group A inspection. The maximum time from the end of one group B inspection to the beginning of the following group B inspection shall be not greater than 24 months.

4.5.2.1 Sampling plan. Every 24 months, connector sample units which have passed group A inspection shall be selected to provide sample units for group B inspection.

4.5.2.2 Failures. If one or more sample units fail to pass group B inspection, the lot from which the samples were selected shall be rejected.

4.5.2.3 Disposition of sample units. Sample units which have been subjected to group B inspection may be delivered on the contract or purchase order.

4.5.2.4 Rejected lots. Requirements regarding the rework of rejected lots shall be as identified in the qualification instructions (see 6.4.1).

TABLE VII. Group B inspection.

Inspection tests	Part applicability			Requirement paragraph	Test method
	Connector	Back-shell	Dust covers		
Optical					
Insertion loss (initial)	x			3.11.1	4.6.3.1
Functional					
Connector coupling engagement and disengagement torque	x		x	3.12.6	4.6.4.6
Insert retention radial strength	x			3.12.1	4.6.4.1
Insert retention axial strength	x	x		3.12.2	4.6.4.2
Terminus retention force	x			3.12.4	4.6.4.4

4.5.3 Periodic inspection. Periodic inspection shall consist of group C. Except where the results of these inspections show noncompliance with the applicable requirements (see 4.5.3.1.5), delivery of products which have passed groups A and B inspections shall not be delayed pending the results of periodic inspection.

4.5.3.1 Group C inspection. Group C inspection shall consist of the inspections specified in table VIII, in the order shown. Group C inspection shall be made on sample units selected from inspection lots which have passed groups A and B inspections.

4.5.3.1.1 Sample unit preparation. Connectors shall be fully assembled into cable-connector assemblies using the types of cable specified in the applicable connector specification sheet (see 3.1). Connector termini shall be optically finished with termini properly seated within their inserts. For mated connectors, full sealing capability shall be provided as specified (see 3.1). Connectors shall be provided with backshell, and attached to an appropriate length of the specified cable type.

4.5.3.1.1.1 Termini. The minimum number of active termini required for testing for each shell size shall be as follows: A minimum of two termini shall be active in connectors of shell size 11. A minimum of four termini shall be active in connectors of shell sizes 13 and 15. A minimum of eight termini shall be active in connectors of shell size 23. For shell sizes 15 and 23, the active termini shall be placed at different locations in each of the four samples.

4.5.3.1.2 Sampling plan. Group C inspection shall be performed on four connectors of the same PIN with their mating connectors 60 months after initial qualification and within each 5 year period thereafter. All mating pairs shall be subjected to group I tests. Mated pairs from the group I tests shall be divided among the group II and III tests.

4.5.3.1.3 Failures. One or more specimen or sample unit failures shall constitute group C inspection failure.

4.5.3.1.4 Disposition of sample units. Sample units which have been subjected to group C inspection shall not be shipped.

4.5.3.1.5 Noncompliance. Requirements regarding failure of group C inspection shall be as identified in the conformance inspection instructions (see 6.4.2).

4.6 Methods of inspection.

4.6.1 Equivalent test methods. The use of equivalent test methods is allowed provided the preparing activity and the qualifying activity have approved the use of that equivalent test method by that manufacturer (see 6.3.5).

4.6.2 Visual and mechanical inspection. Connector parts shall be examined in accordance with TIA-455-13 to verify that materials, design, construction, physical dimensions, marking, and workmanship are in accordance with the applicable requirements (see 3.3, 3.4, and 3.5).

4.6.2.1 Size. Each of the dimensions specified (see 3.1) for the connector parts shall be measured using calibrated measuring devices with the precision and accuracy appropriate for the tolerances specified (see 3.1). Dimensions shall be in accordance with the applicable specification sheets (see 3.10.1).

4.6.2.2 Weight. The connector parts shall be weighed using calibrated scales, having the range, precision, and accuracy appropriate for the tolerances specified (see 3.1 and 3.10.2).

4.6.2.3 Identification marking. Identification marking on connectors, backshells, and dust covers shall be visually examined and measured for conformance with the requirements of 3.10.3. Inspection for legible markings shall be performed from a distance of at least 6 inches with normal room lighting and without the aid of magnification.

4.6.2.4 Workmanship inspection. The connectors, backshells, and dust covers shall be visually examined to verify that they meet the workmanship requirements of 3.10.4.

4.6.2.5 Screw threads. Screw threads shall be checked after protective coating by means of ring and plug gauges (see MIL-STD-1373 for guidance).

TABLE VIII. Group C inspection.

Inspection Tests	Part applicability			Requirement paragraph	Test method
	Connector	Backshell	Dust covers		
Group I (All mated pairs)					
Optical					
Insertion loss	x	x		3.11.1	4.6.3.1
Return loss (SM)	x	x		3.11.5	4.6.3.5
Functional					
Terminus insertion and removal forces	x			3.12.3	4.6.4.3
Group II (2 mated pairs)					
Cable pull out force	x	x		3.13.1	4.6.5.1
Cable seal flexing	x	x		3.13.3	4.6.5.3
Twist	x	x		3.13.4	4.6.5.4
Mating durability	x			3.13.5	4.6.5.5
Return loss	x			3.11.5	4.6.3.5
Insertion loss verification	x			3.11.1	4.6.3.1
Shock	x			3.14.16	4.6.6.15
Water pressure	x	x		3.14.17	4.6.6.16
Group III (2 mated pairs)					
Temperature/humidity cycling	x			3.14.3	4.6.6.2
Life aging	x			3.14.5	4.6.6.4
Insert retention radial strength 1/	x			3.12.1	4.6.4.1
Insert retention axial strength 1/	x			3.12.2	4.6.4.2
Identification marking	x	x	x	3.10.3	4.6.2.3

1/ Tests are only applicable for connectors with nonmetallic inserts.

4.6.3 Optical conformance test methods. Cladding power shall be removed. In those cases where the fiber coating does not adequately perform this function, cladding mode strippers shall be used between the source and the terminus, and between the terminus and the detector. Multiple fibers may not be concatenated during the measurement of change in optical transmittance or optical discontinuity. The center wavelength of test shall be 1300 $\pm$ 20 nm. For multimode fibers, the optical source used shall be noncoherent. Light launch conditions shall be as specified in table IX.

TABLE IX. Light launch conditions.

Fiber type	Launch conditions
Single mode	30 mm diameter mandrel
Multimode	Uniform overfill (initial Insertion loss only) and 70/70 restricted or equivalent

4.6.3.1 Insertion loss (see 3.11.1). The initial insertion loss of multimode connectors shall be measured in accordance with method A of TIA/EIA-455-34, using both 70/70 and overfill launch conditions. For subsequent insertion loss tests, 70/70 launch conditions or equivalent shall be used. The insertion loss of single mode connectors shall be measured in accordance with method B of TIA/EIA-455-34.

4.6.3.2 Discontinuities (see 3.11.2). The connector shall be tested in accordance with TIA/EIA-455-32 using test equipment having a time resolution sufficient to resolve discontinuities of duration not less than 50 µs. For tests of extended duration, discontinuity measurements may be made at discrete times during the test as approved by the qualifying activity.

4.6.3.3 Crosstalk (see 3.11.3). The crosstalk shall be measured in accordance with EIA/TIA-455-42.

4.6.3.4 Change in optical transmittance (see 3.11.4). The change in optical transmittance shall be measured in accordance with TIA/EIA-455-20 or by an equivalent method. The periodicity of the measurements shall be sufficient for the environmental test performed as approved by the qualifying activity. The use of a reference fiber to evaluate the change in optical transmittance due to exposure of the cable to the environmental tests is optional.

4.6.3.5 Return loss (see 3.11.5). The return loss shall be measured in accordance with TIA/EIA-455-107 or by an equivalent method (see 4.6.2).

4.6.4 Functional inspections.

4.6.4.1 Insert retention radial strength (see 3.12.1). Unmated connector samples shall be tested for radial strength as described herein. Counterpart test devices for plugs and receptacles shall be supplied by the connector manufacturer which are capable of applying radial torque forces between the insert and its shell body. Outermost termini positions or other means may be used for application of these torques, however, no damage shall occur to the insert as a result of the test exposure. A radial torque shall be applied up to the minimum specified (see 3.12.1) and held for 1 minute. The same torque shall then be applied in the opposite direction and held for one minute.

4.6.4.2 Insert retention axial strength (see 3.12.2). Unmated connector samples shall be tested as follows. An axial load shall be applied to either the front or rear face of the insert up to a minimum value of 100 pounds per square inch (0.69 Mpa) of insert face surface area. The load shall be held for a minimum of 1 minute and the axial displacement measured (see 3.12.2). The same pressure shall then be applied on the opposite face, held for 1 minute and the axial displacement measured. Termini positions within the insert may be either empty or filled during the test.

4.6.4.3 Terminus insertion and removal forces. Termini shall be inserted into an unmated connector using a terminus insertion tool and the force required to insert the terminus measured (see 3.12.3). A terminus removal tool shall then be engaged to unlock the terminus. The terminus shall be removed and the force required to remove the terminus measured.

4.6.4.4 Terminus retention force. Termini shall be inserted into an unmated connector and tested as follows. Termini shall be subjected to axial compressive loads applied to the front face of the terminus tending to push the terminus to the rear of the connector insert. (Care must be exercised in the design of the force application mechanism so that it does not physically touch the optical fiber endface.) A preload not greater than 3 lbs (13.3 N) may be used to seat the terminus for the initial position measurement. Axial loads shall be applied at a rate of 1.0 lb (4.4 N) per second up to the minimum load specified (see 3.12.4). The terminus position shall be measured while under the specified load. The specified load shall be maintained for a minimum of 5 seconds.

4.6.4.5 Maintenance aging (see 3.12.5). Unmated connectors shall be tested as follows. Termini shall be inserted and removed from the connector a minimum of ten times. The termini selected for insertion and removal shall be the same termini that are monitored for optical performance. The force required to insert each terminus into the connector and the force required to remove each terminus from the connector shall be measured during the first and final maintenance aging cycle.

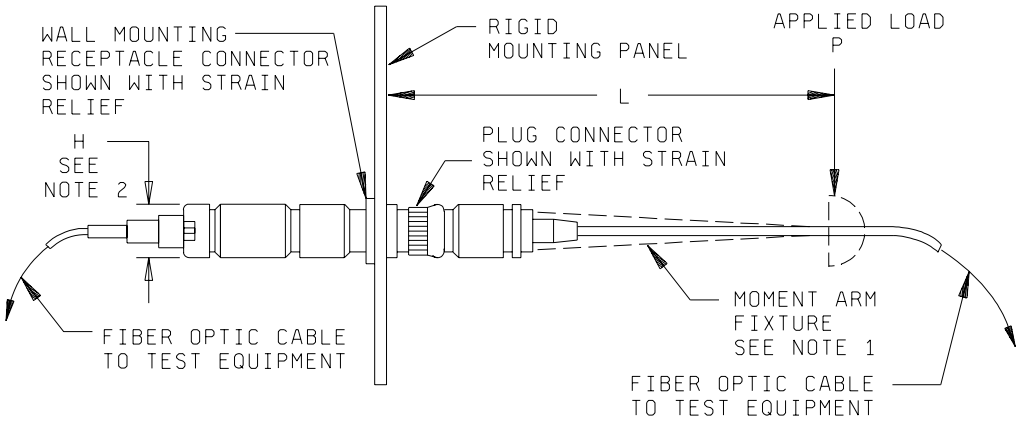
4.6.4.6 Connector coupling engagement and disengagement torque (see 3.12.6). Unmated connector samples (or connector and dust cover samples) shall be tested as follows. The two mating parts shall be brought to a position where mechanical mating begins and the torque gauge is at zero indication. The parts shall then be fully mated or coupled and the torque required for mating shall be recorded. The torque gauge shall then be reset to zero indication. The mated parts shall be fully unmated and the torque required for unmating shall be recorded.

4.6.4.7 Backshell and insert retention nut attachment (see 3.12.7). Connector backshells and insert retention nuts shall be manually mated and unmated five times to their counterpart connectors. The torque required to remove the backshell or insert retention nut shall be measured on the last unmating. The backshell or insert retention nut shall be visually examined in accordance with 4.6.2 after the test.

4.6.5 Mechanical test methods.

4.6.5.1 Cable pull out force (see 3.13.1). Mated connector samples shall be tested in accordance with TIA-455-6. The axial tensile load shall be applied up to the load specified and shall be maintained for 10 minutes. The change in optical transmittance shall be measured during and after the test (see 4.6.3.4). At the completion of the test, the connector shall be visually examined in accordance with 4.6.2.

4.6.5.2 External bending moment (see 3.13.2). Cable-connector assemblies shall be tested in accordance with the following procedure. The cabled receptacle shall be mounted as in normal service to a rigid wall (panel). Before mating the cabled plug to the receptacle, a bending moment test arm shall be secured to the rear of the plug shell. The fixture shall be of any convenient design for application of the load except it must not provide support for the connector shell in front of the engaged threads (see figure 2). After mating the plug and receptacle, a minimum bending moment load of 300 inch-pounds (33.9 N-m) as measured from the wall (panel) shall be applied. The load (P) shall be applied across the smallest exterior dimension (H) of the connector (see figure 2). The load shall be applied at a rate of approximately 10 inch-pounds (1.1 N-m) per second until the required load is applied. The load shall be held for 1 minute.



NOTES:
1. Moment arm fixture shall be of a convenient design.
2. Dimension "H" is the smallest exterior dimension of connector.

FIGURE 2. External bending moment test fixture and connector setup.

4.6.5.3 Cable seal flexing (see 3.13.3). Connector assemblies shall be tested in accordance with TIA/EIA-455-1. The connector assembly shall be exposed to 100 flexing cycles, the assembly rotated approximately 90° in the flexing fixture and then exposed to another 100 flexing cycles. The cycling rate is not to exceed 14 cycles per minute if the test is performed manually. The connector assemblies shall be visually examined in accordance with 4.6.2 after the test.

4.6.5.4 Twist (see 3.13.4). Mated cable-connector assemblies shall be tested in accordance with TIA-455-36. The connector-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 ±180° about the neutral axis. The cable assemblies shall be stretched with minimum tension of 11.0 pounds (48.9 N) to their maximum lengths and clamped at a distance of about 100 times the cable diameter from the connector to the table top. The connectors shall be visually examined in accordance with 4.6.2 after the test. The change in optical transmittance shall be measured during and after the test (see 4.6.3.4).

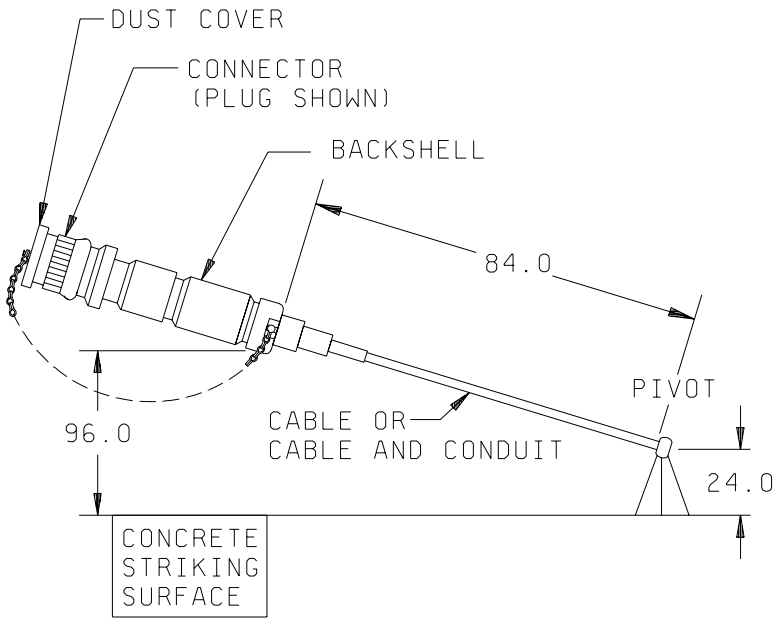
4.6.5.5 Mating durability (see 3.13.5). Connector plugs and receptacles shall be tested in accordance with TIA-455-21. Five hundred complete (plug and receptacle separating) cycles (mate and unmate) shall be accomplished by hand at a rate not to exceed 1 cycle per 15 seconds. The change in optical transmittance (see 4.6.3.4) shall be measured every 100 mating cycles during the test and after the test. Cleaning of the termini is permitted during and after completion of the test in order to meet the requirements of 3.11.4.

4.6.5.6 Impact (see 3.13.6). The unmated cable assemblies with backshell and dust cover shall be tested in accordance with method B of EIA/TIA-455-2 (see figure 3). Impacts shall be performed on the cable assembly with the plug connector. The dust cover shall be screwed onto the plug connector. The cable assembly shall be extended its full length from the test fixture. The plug shall be dropped 8 times (the eight highest drops specified for the moderate service class in EIA/TIA-455-2) and rotated after each fall so that the connector strikes the impact pad in eight different radial positions. The test assemblies shall be visually examined for damage in accordance with 4.6.2, then mated. The connector termini may be cleaned after exposure and prior to mating. The change in optical transmittance shall be measured after the test (see 4.6.3.4).

4.6.5.7 Crush (see 3.13.7). Connectors shall be tested in accordance with TIA/EIA-455-26, with the exception that the test sample shall be a connector. The test load shall be 1250 newtons, and the number of loading cycles shall be 7. The two load bearing surfaces may be faced with one inch thick rubber pads with a durometer between 60 and 75. Position the connector on the crush pads so that the plug, plug backshell and portion of receptacle in front of the wall (panel) mounting is on the crush pads. The change in optical transmittance shall be measured during and after the test (see 4.6.3.4). The connector shall be visually examined in accordance with 4.6.2 after the test.

4.6.6 Environmental test methods. Connectors with a composite body shall be unmated and re-mated after each environmental test. Change in optical transmittance measurements shall be performed prior to the connector being unmated and after the connector re-mating. Post exposure optical transmittance measurements may be taken up to 24 hours after completion of the environmental exposure.

4.6.6.1 Thermal shock (see 3.14.2). Mated connectors shall be tested in accordance with test schedule C of TIA/EIA-455-71 for five cycles. The temperature extremes shall be the specified non-operational temperature extremes. The change in optical transmittance shall be measured after the test (see 4.6.3.4). The connectors shall be visually examined in accordance with 4.6.2 after the test.



Inches	mm
24.0	610
84.0	2134
96.0	2438

NOTES:
1. Dimensions are in inches.
2. Metric equivalents are given for general information only.
3. Conduit or other means of stiffening the cable may be used to ensure that the impact occurs on the connector surface in the specified orientation.

FIGURE 3. Impact test fixture connector setup.

4.6.6.2 Temperature humidity cycling (see 3.14.3). Mated cable-connector assemblies shall be tested in accordance with method B of TIA/EIA-455-5. The subcycle shall be included in the testing. The change in optical transmittance shall be measured during and after the test (see 4.6.3.4).

4.6.6.3 Temperature cycling (see 3.14.4). Mated cable-connector assemblies shall be tested in accordance with EIA/TIA-455-3 using the test condition schedule and soak times in accordance with table X below. The change in optical transmittance shall be measured during and after the test (see 4.6.3.4). The connector assemblies shall be visually examined in accordance with 4.6.2 after the test.

TABLE X. Temperature cycling steps.

Step	Temperature (°C)	Duration (hours)
1. Maintain 2. Ramp to 3. Maintain 4. Ramp to 5. Maintain 6. Ramp to 7. Maintain 8. Ramp to 9. Maintain 10. Repeat steps 2 through 9 four additional times (a total of 5 cycles).	Room ambient Low operating temp +0, -5 Low operating temp +0, -5 25±3 25±3 High operating temp +5, -0 High operating temp +5, -0 25±3 25±3	4 (minimum) 2 2 (minimum) 2 2 (minimum) 1 2 (minimum) 1 2 (minimum)

4.6.6.4 Life aging. Mated connectors shall be tested in accordance with TIA/EIA-455-4 and as specified herein (see 3.14.5). The specimens shall be exposed to dry air at +110°C +5°C, –0°C for a period of 240 hours. The change in optical transmittance shall be monitored after the test in accordance with 4.6.3.4. The connectors shall be visually examined in accordance with 4.6.2 after the test. For connectors with dielectric inserts, the inserts shall be inspected for insert retention radial strength and insert retention axial strength after the test.

4.6.6.5 Freezing water immersion (see 3.14.6). Mated connector assemblies shall be tested in accordance with method A, procedure 1 of EIA/TIA-455-98. The size of the water vessel shall be such that, when the mated connectors are placed in the vessel, the mated connectors are within 150 mm of the sides and bottom of the vessel, and within 150 mm of the surface of the water. The change in optical transmittance shall be monitored during and after the test in accordance with 4.6.3.4. At the completion of the test, the connectors shall be visually examined in accordance with 4.6.2. For the exposure at -10°C, the water is considered completely frozen when the water temperature reading is less than –1°C.

4.6.6.6 Sand and dust (see 3.14.7). Mated cable connector assemblies shall be tested in accordance with EIA/TIA-455-35 except as noted herein. Each connector shall be oriented in the chamber such that the coupling mechanism is in line with the oncoming air flow. The connectors shall be affixed in such a manner that the orientation of the connector does not change throughout the duration of the test. The 16 hour holding period of step 5.5 is not required. Step 5.6 may proceed immediately after reaching temperature stabilization. The change in optical transmittance shall be measured before the dust test, during the 6 hour exposure period of step 5.4, before step 5.6, during the 6 hour exposure period of step 5.6, and after the test. The connector coupling engagement and disengagement torque (see 4.6.4.6) shall be measured after the test. The connector shall be visually examined in accordance with 4.6.2, after cleaning, at the conclusion of the test.

4.6.6.7 Terminus cleaning (see 3.14.8). The optical face of the terminus shall be cleaned according to the instructions supplied by the connector manufacturer. The terminus shall not be removed from its operational position within the connector to facilitate cleaning.

4.6.6.8 Electromagnetic effects. Electromagnetic effects testing of receptacles mated to plugs with backshells and of receptacles mated to dust covers shall be conducted as follows. The test specimens (including terminated cable) shall be tested to determine the propagation characteristics (attenuation or conduction) of the specimen assembly. The shielding effectiveness of a shielded enclosure shall be verified in accordance with the procedures specified in IEEE-299 at the discrete frequencies specified in Table XI with the test specimen mounted in position. The test specimen receptacle shall be mounted into the wall (panel) of the shielded enclosure such that the plug or dust cover mates from the inside of the shielded enclosure. The cable(s) from the plug and receptacle shall be extended parallel to the test specimen for a minimum of 2 m on each side of the enclosure wall (panel). The dynamic range of the test setup shall be measured as specified in IEEE-299 at each discrete frequency specified in table XI. The measured level of radio frequency (RF) propagation through the test specimen installed in the shielded enclosure shall be determined in accordance with the procedures specified in IEEE-299 at each discrete frequency specified in table XI.

TABLE XI. Electromagnetic effects test frequencies.

Field propagation	Test frequencies
Planewave	100 MHz 400 MHz 1 GHz
Microwave	10 GHz

4.6.6.8.1 Antenna placement. Antenna types and placement distances shall conform to table XII and table XIII respectively. Matched antennas shall be used for each measurement. Placement distances are specified for both antenna to test specimen cable and for antenna to setup wall (panel) of the shielded enclosure. The transmitting antenna shall be oriented in both the parallel and perpendicular directions for each frequency listed in table XI. Energy from the transmitting antenna shall be maximized by positioning the antenna parallel along the test specimen cable length and perpendicular along the test specimen cable circumference. The sensitivity of the receiving antenna shall be maximized by measuring both end view and side (length) view with a constant rotation between the horizontal and vertical antenna positions. For planewave measurements in the perpendicular direction, the transmit antenna shall be 1 meter above the test specimen cable.

TABLE XII. Antenna types.

Field propagation	Antenna type
Planewave	Log periodic or dipole
Microwave	Horn

TABLE XIII. Antenna placement distances.

Location	Placement
Receiving antenna to test specimen cable	5 cm
Transmitting antenna to test specimen cable	1 m
Transmitting antenna to shielded enclosure	2 m

Note: Extended dipole antenna distance measurements shall be made from the center of the antenna elements.

4.6.6.9 Fluid immersion (see 3.14.10). Connector assembly and separate polymeric samples shall be exposed to each of the fluids identified in EIA/TIA-455-12 in accordance with EIA/TIA-455-12, except that exposure to automobile gasoline is not required and the test temperature for lubricating oil exposure shall be 73°C to 77°C. Sample preconditioning shall be done under ambient conditions for a minimum of 4 hours. Each connector assembly and sample of each polymeric material shall be completely dried after each immersion. After testing, the connector assembly shall be visually examined for fluid penetration into the shell body and the connector junction region.

4.6.6.10 Salt spray (corrosion) (see 3.14.11). Mated cable-connector assemblies shall be tested in accordance with test condition I of EIA/TIA-455-16. The exposure time shall be 500 hours, and the exposure temperature 35°C. After test exposure, the assemblies shall be externally cleaned and examined under three-power magnification for salt penetration into the connector junction area and damage to external parts.

4.6.6.11 Flammability (see 3.14.12). Mated and unmated cable-connector assemblies shall be tested in accordance with EIA-364-81 and as specified herein. Mated assemblies 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 test sample has returned to room temperature (see 4.6.3.4). The sample shall then be demated, and the unmated connector assembly with backshell and dust cover exposed to a 1.50 inch (38.1 mm) flame height applied for 60 seconds to the backshell-cable interface region. For connectors with dielectric inserts, the connector samples shall be exposed to a third flame, with a 1.50 inch (38.1 mm) flame height. The connector samples shall be remated and the flame shall be applied for 60 seconds to the region of the mated pair interface.

4.6.6.12 Fungus resistance (see 3.14.13). Connector materials not listed as fungus inert in guideline 4 of MIL-HDBK-454 shall be tested in accordance with TIA/EIA-455-56 for a duration of 28 days.

4.6.6.13 Ozone exposure (see 3.14.14). Polymeric connector parts shall be tested to TIA-455-189 and exposed to an ozone concentration of 100 to 150 parts per million at a temperature of 70°C +5°C –0°C and an air velocity not less than 0.6 m/s for two hours. The ozone test apparatus and ozone measuring device shall be in accordance with ASTM-D-1149. If a polymeric part is expanded on the connector, then the part is to be tested at the same level of expansion.

4.6.6.14 Vibration (see 3.14.15). Mated cable-connector assemblies shall be tested in accordance with test condition II and test condition VII (test condition letter C) of TIA/EIA-455-11. The test duration for test condition VII shall be 30 minutes for each axis. The frequency range of test for test condition II shall be extended to a low frequency of 5 Hz. Optical discontinuities shall be measured during each test (see 4.6.3.2). For connectors of shell sizes 13, 15 and 23, a minimum of four termini shall be monitored for discontinuity. The change in optical transmittance shall be measured after the test (see 4.6.3.4). The connector shall be visually examined in accordance with 4.6.2 after the test. Retightening of the connector after each axis and test condition is permitted.

4.6.6.15 Shock (see 3.14.16). Mated cable-connector assemblies shall be tested in accordance with MIL-S-901, grade A, class I. Optical discontinuities shall be measured during the test (see 4.6.3.2). For connectors of shell sizes 13, 15 and 23, a minimum of four termini shall be monitored for discontinuity. The change in optical transmittance shall be measured after the test (see 4.6.3.4). The connector shall be visually examined in accordance with 4.6.2 after the test. Retightening of the connector after each blow is permitted. Standard shock fixture 4A for bulkhead mounting shall be used.

4.6.6.16 Water pressure (see 3.14.17). Mated cable-connector assemblies shall be tested for water pressure susceptibility as follows: The assemblies shall be immersed in fresh water to an equivalent depth of 32 feet (9.8 m) for a period of 48 hours. The water temperature shall be maintained between 10°C and 35°C during the exposure period. The connector assemblies shall be externally cleaned, unmated, the backshell removed, and visually examined for water penetration into the connector. The change in optical transmittance shall be measured after the test (see 4.6.3.4).

4.7 Interoperability (see 3.4.3). Connectors and backshells shall be tested as specified in 4.7.1 and 4.7.2.

4.7.1 Connector interoperability. Unless otherwise specified (see 3.1), qualified termini shall be inserted into and shall fully populate connector specimens as specified in table XIV. Insertion loss shall be measured in accordance with 4.6.3.1. The terminus insertion and removal forces shall be measured in accordance with 4.6.4.3. The terminus retention force shall be measured in accordance with 4.6.4.4.

TABLE XIV. Connector interoperability test configurations.

Configuration No.	Connector receptacle	Connector plug
1	Qualified	Candidate
2	Candidate	Qualified
3	Candidate	Candidate

4.7.2 Backshell interoperability. Unless otherwise specified (see 3.1), qualified termini shall be inserted into and shall fully populate qualified connector plugs and receptacles with backshells as specified in table XV. Insertion loss shall be measured in accordance with 4.6.3.1.

TABLE XV. Connector interoperability test configurations.

Configuration no.	Receptacle backshell	Plug backshell
1	Candidate	Candidate

5. PACKAGING

5.1 Packaging. For acquisition purposes, the packaging requirements shall be as specified in the contract or order (see 6.2). When packaging of material is to be performed by DoD or in-house contractor personnel, these personnel need to contact the responsible packaging activity to ascertain packaging requirements. Packaging requirements are maintained by the Inventory Control Point's packaging activities within the Military Service or Defense Agency, or within the military service's system commands. Packaging data retrieval is available from the managing Military Department's or Defense Agency's automated packaging files, CD-ROM products, or by contacting the responsible packaging activity.

6. NOTES

(This section contains information of a general or explanatory nature that may be helpful, but is not mandatory.)

6.1 Intended use. The fiber optic connectors covered by this specification are intended for use in military applications where their performance characteristics are required. The connectors covered by this specification are unique due to the fact that these items must be able to operate satisfactorily in systems under the following demanding conditions: 10 g's vibration, over 1000 g's of shock, temperature excursions from -40°C to +70°C and mechanically harsh conditions. In addition, these requirements are verified under a qualification system. Commercial connectors are not designed to withstand these environmental conditions.

6.2 Acquisition requirements. Acquisition documents should specify the following:

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

b. Issue of DODISS to be cited in the solicitation, and if required, the specific issue of individual documents referenced (see 2.2.1).

c. PIN.

d. Quantity of connectors required.

e. Packaging requirements (see 5.1).

f. Exception, if any, to the optional provisions of this specification including:

(1) Responsibility for inspection.

(2) Special preparation for delivery requirements, if applicable (see 5.1).

Note: Termini are not supplied with connectors procured to this specification.

6.3 Qualification. With respect to products requiring qualification, awards will be made only for products which are, at the time of award of contract, qualified for inclusion in Qualified Products List QPL No. 28876 whether or not such products have actually been so listed by that date. The attention of the contractors is called to these requirements, and manufacturers are urged to arrange to have the products that they propose to offer to the Federal Government tested for qualification in order that they may be eligible to be awarded contracts or orders for the products covered by this specification. The activity responsible for the Qualified Products List is Commander, Naval Sea Systems Command, (SEA 05Q), 2531 Jefferson Davis Highway, Arlington, VA 22242-5160; however, information pertaining to qualification of products may be obtained from Defense Supply Center Columbus (DSCC-VQP), P.O. Box 3990, Columbus, OH 43216-5000, or by email at vqp.chief.dla.mil.

6.3.1 Conformity to qualification sample. It is understood that connectors supplied under the contract shall be identical in every respect to the qualification sample tested and found satisfactory, except for changes previously approved by the Government. Any unapproved changes from the qualification sample shall constitute cause for rejection.

6.3.2 Provisions governing qualification SD-6. Copies of "Provisions Governing Qualification (Qualified Products List) SD-6" may be obtained upon application to Standardization Documents Order Desk, Building 4D, 700 Robbins Avenue, Philadelphia, PA 19111-5094.

6.3.3 Verification program. A verification program must be established and maintained in accordance with MIL-STD-790 or comparable standard. Evidence of such compliance will be verified by the qualifying activity of this specification as a prerequisite for qualification and continued qualification. The verification system procedures, planning and all other documentation and data that comprise the verification system must be available to the Government for review. The Government may perform any necessary inspections, verifications and evaluations to ascertain conformance to the requirements and adequacy of the implementing procedures.

6.3.4 Test equipment and inspection facilities. Provision for test and measuring equipment and inspection facilities of sufficient accuracy, quality, and quantity to permit performance of the required inspections must be the responsibility of the contractor. The establishment and maintenance of a calibration system to control the accuracy of the measuring and test equipment must be in accordance with NCSL-Z540-1 or comparable standard.

6.3.5 Alternate forms of conformance inspection and equivalent test methods. Requests for alternate forms of conformance inspection (see 4.5) must be submitted to the qualifying activity and to the preparing activity. Alternate forms of conformance inspection may be used upon written approval by the qualifying activity and by the preparing activity. The use of equivalent test methods is allowed (see 4.6.1). The manufacturer must have conducted both test methods and have submitted complete test data to the preparing activity and to the qualifying activity verifying the equivalency of each equivalent test method proposed.

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

6.3.7 Government witnessing of qualification tests. The qualification activity may require that a government witness be present during the following tests: size, screw threads, connector assembly (test sample) fabrication, initial insertion loss, terminus insertion and removal forces, cable pull out force, mating durability, temperature cycling, mechanical shock, salt spray and thermal shock.

6.3.8 Electromagnetic effects test documentation. Electromagnetic effects test documentation should include a detailed test plan and test report. The test plan should detail the specific test setups and procedures, the test facility, and the test profiles that will be used. The test report should detail the exact procedures followed, the equipment used for each test phase, calibration dates of all test equipment, test results in graphical and tabular format, photographs/sketches of the test setups, the test data sheets, and an indication of pass/fail. The test data sheets should include test sample identification, ambient temperature and humidity values, dates and times of the test initiation and completion, names and initials of the test personnel, and data tables. The data tables should include the frequency at which each measurement was conducted, the field propagation/orientation, enclosure shielding effectiveness, reference level of the transmitter, dynamic range of the measurement, measured level for the test, the propagated RF attenuation, the required RF attenuation, and an indication of pass/fail. The reference level should include the source output, receiver sensitivity, and antenna gain.

6.4 Conformance inspection.

6.4.1. Rejected lots. If a group B inspection lot is rejected, the contractor may rework it to correct the defects, or screen out the defective units (if applicable), and resubmit the lot for inspection.

6.4.2 Noncompliance. If a sample fails to pass group C inspections, the manufacturer should notify the qualifying activity of the failure and take corrective action on the materials or processes, or both, as warranted, and on all units of product which can be corrected and which were manufactured under essentially the same conditions, with essentially the same materials, processes, and so forth, and which are considered subject to the same failure. Acceptance of the product should be discontinued until corrective action, acceptable to the Government, has been taken. After the corrective action has been taken, group C inspection should be repeated on additional sample units (all inspection tests or the inspection test which the original sample failed, at the option of the Government). Groups A and B inspection may be reinstituted; however, final acceptance should be withheld until the group C reinspection has shown that the corrective action was successful. In the event of failure after reinspection, information concerning the failure and corrective action taken should be furnished to the cognizant inspection activity and the qualifying activity.

6.5 Definitions. Definitions and terms are in accordance with EIA-440 and as stated below.

6.5.1 Backshell. The backshell attaches to the rear of the connector shell, provides for environmental sealing of the connector, and provides for cable strain relief. The backshell also holds the connector insert in position within the connector shell, using an integral or separate insert retaining sleeve. The backshell includes the seal or sealing mechanism which seals to a plug or receptacle connector.

6.5.2 Connector. The connector is the entire cable termination assembly and is composed of the connector shell, connector insert, and backshell or insert retention nut.

6.5.3 Insert. The insert is the interior portion of the connector which holds and aligns the optical termini.

6.5.4 Insert retention nut. The insert retention nut attaches to the rear of the connector shell and holds the connector insert in position in the connector shell when the connector is used without a backshell. The insert retention nut may utilize an integral or a separate insert retaining sleeve.

6.5.6 Insertion loss. Insertion loss is the radiant power loss (dB) caused by absorption, scattering, diffusion, leaky waves, dispersion, microbends, macrobends, reflection, radiation, or other causes when a connector is inserted into the system.

6.5.7 Overfill launch. An overfill launch is a launch with a source spot size at least 100 percent the fiber spot size and source aperture at least 100 percent of the fiber numerical aperture.

6.5.8 Protective covering. A protective covering is a disposable protective cap or cover.

6.5.9 70/70 restricted launch. A 70/70 restricted launch is beam optics launch with a 70 percent spot size and source aperture equal to 70 percent of the fiber numerical aperture.

6.5.10 Shell. The shell is the front portion of the connector which holds the connector insert and contains the connector coupling mechanism. Shells are either of the plug or receptacle configuration.

6.5.11 Terminus. Terminus is the part of the connector that provides a means of positioning and holding the fiber within the connector.

6.6 Patent notice. The Government does not have royalty-free license under the following listed patents for the benefit of manufacturers of the item, either for the Government or for use in equipment to be delivered to the Government.

Patent no.	Patent expiration date
US 65,032	11/17/2004

6.7 Subject term (key word) listing.

Backshells	Military specification
Cable, fiber optic	Multiple termini
Circular	Optical performance requirements
Connectors	Plug
Covers, protective	Receptacle
Dust covers	Screw threads
Environmental resistant	Strain relief, cable
Epoxies	Style, plug and receptacle
Fiber optic	Termini
Inserts	Test plugs

6.8 Changes from previous issue. Marginal notations are not used in this revision to identify changes with respect to the previous issue due to the extensiveness of the changes.

APPENDIX A

CONNECTOR INTERFACE DIMENSIONS

A.1 SCOPE

A.1.1 Scope. This appendix lists the connector interface dimensions and is a mandatory part of the specification. The information contained herein is intended for compliance.

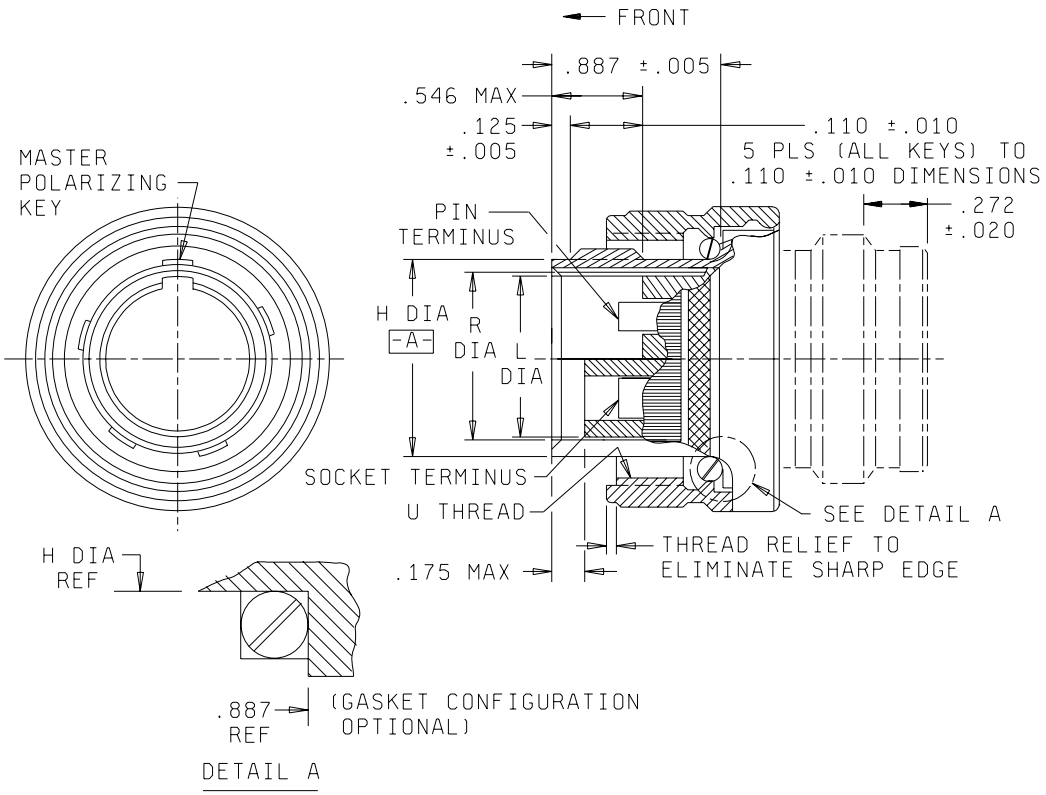
A.2 APPLICABLE DOCUMENTS

This section is not applicable to this appendix.

A.3 DRAWINGS

A.3.1 Interface dimension. The connector interface dimension drawings (figures A-1 through A-8) are listed as follows.

APPENDIX A



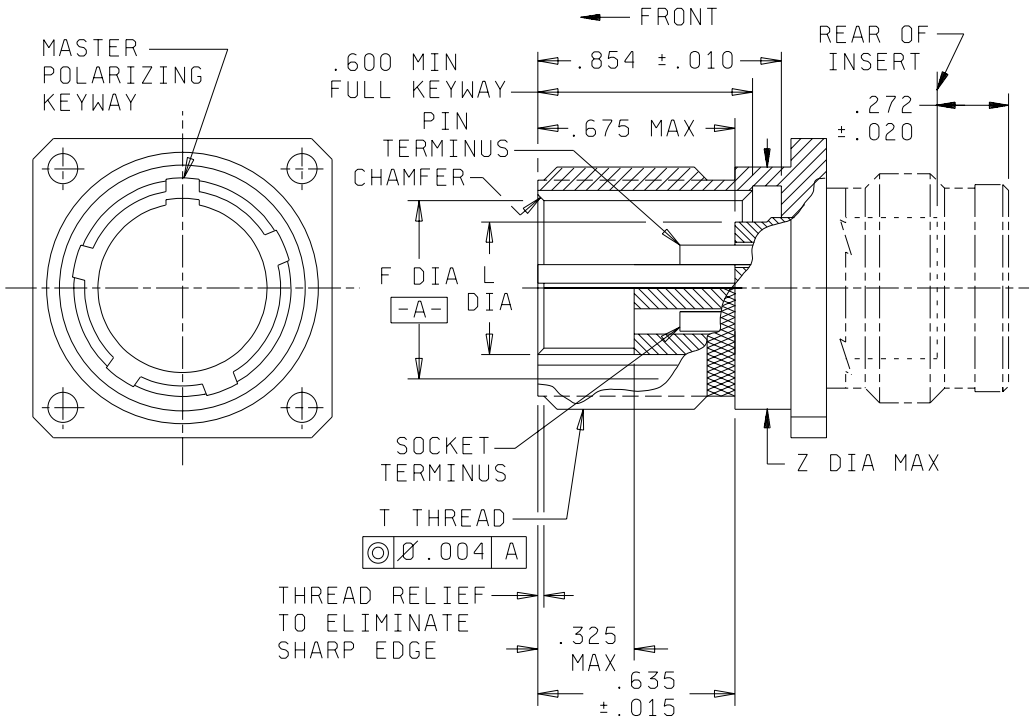
Shell size	U thread class 2B	H dia.	R Shell I.D.	L Insert dia.
11	.750-.1P-.2L-D.S.	.502 (12.75) .492 (12.50)	.383 (9.73) .373 (9.47)	.365 (9.27) .361 (9.17)
13	.875-.1P-.2L-D.S.	.626 (15.90) .616 (15.65)	.505 (12.83) .495 (12.57)	.488 (12.40) .483 (12.27)
15	1.062-.1P-.2L-D.S.	.798 (20.27) .788 (20.02)	.683 (17.35) .673 (17.09)	.666 (16.92) .661 (16.79)
23	1.500-.1P .2L-D.S.	1.220 (30.99) 1.210 (30.73)	1.089 (27.66) 1.079 (27.41)	1.073 (27.25) 1.063 (27.00)

FIGURE A-1. Interface dimensions, connector, plug, fiber optic.

Inches	mm
.005	0.13
.010	0.25
.020	0.51
.110	2.79
.125	3.18
.175	4.45
.272	6.91
.546	13.87
.887	22.53

NOTES:
1. Dimensions are in inches.
2. Metric equivalents are given for general information only.
3. Metric equivalents are in parentheses.
4. Dimensions apply to plated/finished part.
5. Mating key positions and dimensions are shown on figure A-3.
6. This design information establishes connector intermating criteria.
7. Rear end connector design for attachment of nonrotatable backshell is shown on figure A-6.
8. See MIL-PRF-28876/6 through MIL-PRF-28876/9 for appropriate plug outer configuration dimensions.
9. See figures A-7 and A-8 for backshell and insert retention nut mating dimensions.

FIGURE A-1. Interface dimensions, connector, plug, fiber optic - Continued.



Shell size	T thread class 2A	F Shell I.D.	L Insert dia.	Z Dia.max
11	.750-.1P-.2L-D.S.	.515 (13.08) .506 (12.85)	.365 (9.27) .361 (9.17)	.750 19.05)
13	.875-.1P-.2L-D.S.	.639 (16.23) .630 (16.00)	.488 (12.40) .483 (12.27)	.875 (22.23)
15	1.062-.1P-.2L-D.S.	.809 (20.55) .800 (20.32)	.666 (16.92) .661 (16.79)	1.062 (26.97)
23	1.500-.1P .2L-D.S.	1.233 (31.32) 1.224 (31.09)	1.073 (27.25) 1.063 (27.00)	1.500 (38.10)

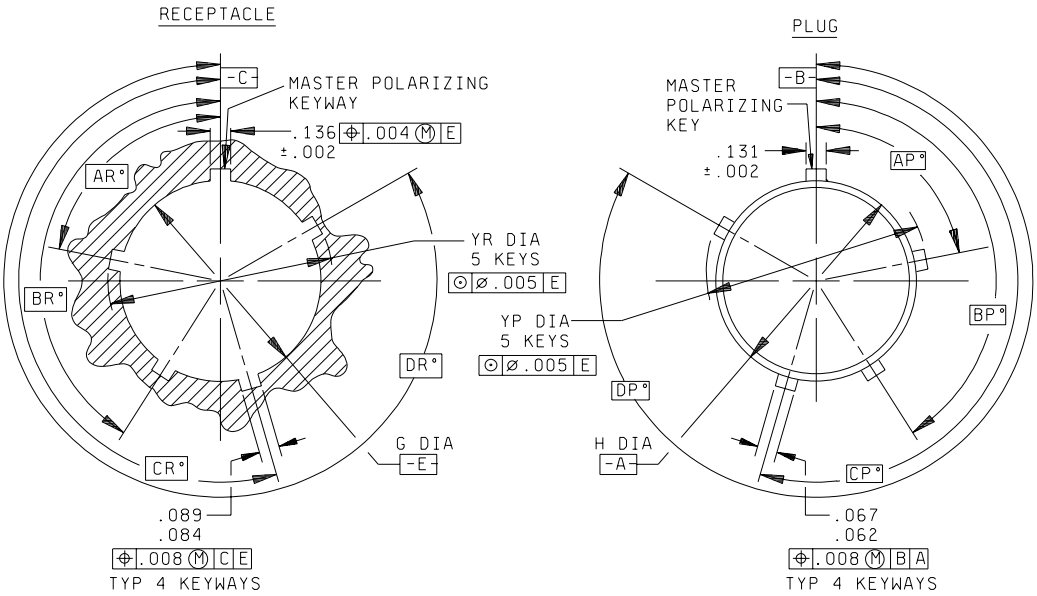
FIGURE A-2. Interface dimensions, connector, receptacle, fiber optic.

Inches	mm
.004	0.10
.010	0.25
.015	0.38
.020	0.51
.272	6.91
.325	8.26
.600	15.24
.635	16.13
.675	17.14
.854	21.69

NOTES:
1. Dimensions are in inches.
2. Metric equivalents are given for general information only.
3. Metric equivalents are in parentheses.
4. Dimensions apply to plated/finished part.
5. Mating key positions and dimensions are shown on figure A-3.
6. This design information establishes connector intermating criteria.
7. Rear end connector design for attachment of nonrotatable backshell is shown on figure A-6.
8. See MIL-PRF-28876/1 through MIL-PRF-28876/5 and MIL-PRF-28876/11 through MIL-PRF-28876/14 for appropriate receptacle outer configuration dimensions.
9. See figures A-7 and A-8 for backshell and insert retention nut mating dimensions.

FIGURE A-2. Interface dimensions, connector, receptacle, fiber optic - Continued.

APPENDIX A



Shell size	G dia.	H dia.
11	.515 (13.08) .505 (12.83)	.502 (12.75) .492 (12.50)
13	.639 (16.23) .629 (15.98)	.626 (15.90) .616 (15.65)
15	.809 (20.55) .800 (20.32)	.798 (20.27) .788 (20.02)
23	1.233 (31.32) 1.223 (31.06)	1.220 (30.99) 1.210 (30.73)

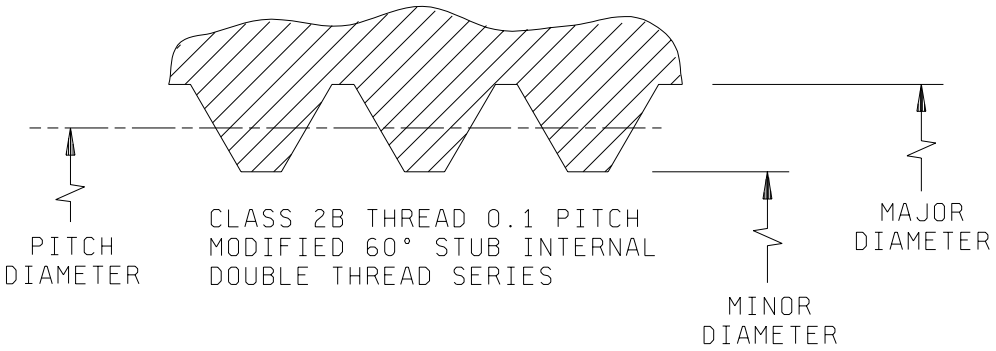
Inches	mm
.002	0.05
.004	0.10
.005	0.13
.008	0.20
.062	1.58
.067	1.70
.084	2.13
.089	2.26
.131	3.33
.136	3.45

FIGURE A-3. Connector, fiber optic, position of key and keyway mating.

Shell size	Key and keyway arrangement	AR° Or AP° BSC	BR° Or BP° BSC	CR° Or CP° BSC	DR° Or DP° BSC	YP diameter	YR diameter
11	1	95	141	208	236	.559 (14.20) .551 (14.00)	.581 (14.76) .569 (14.45)
	2	113	156	182	292		
	3	90	145	195	252		
	4	53	156	220	255		
	5	119	146	176	298		
	6	51	141	184	242		
13	1	95	141	208	236	.683 (17.35) .675 (17.14)	.705 (17.91) .693 (17.60)
	2	113	156	182	292		
	3	90	145	195	252		
	4	53	156	220	255		
	5	119	146	176	298		
	6	51	141	184	242		
15	1	80	142	196	293	.855 (21.72) .847 (21.51)	.877 (22.28) .865 (21.97)
	2	135	170	200	310		
	3	49	169	200	244		
	4	66	140	200	257		
	5	62	145	180	280		
	6	79	153	197	272		
23	1	80	142	196	293	1.276 (32.41) 1.267 (32.18)	1.301 (33.04) 1.288 (32.71)
	2	135	170	200	310		
	3	49	169	200	244		
	4	66	140	200	257		
	5	62	145	180	280		
	6	79	153	197	272		

NOTES:
1. Dimensions are in inches.
2. Metric equivalents are given for general information only.
3. Metric equivalents are in parentheses.
4. Dimensions apply to plated/finished part.

FIGURE A-3. Connector, fiber optic, position of key and keyway mating - Continued.



INTERNAL THREADS

Shell size	Designation		
	Thread size	Pitch	Lead
11	.7500	.1	.2
13	.8750	.1	.2
15	1.0625	.1	.2
23	1.5000	.1	.2

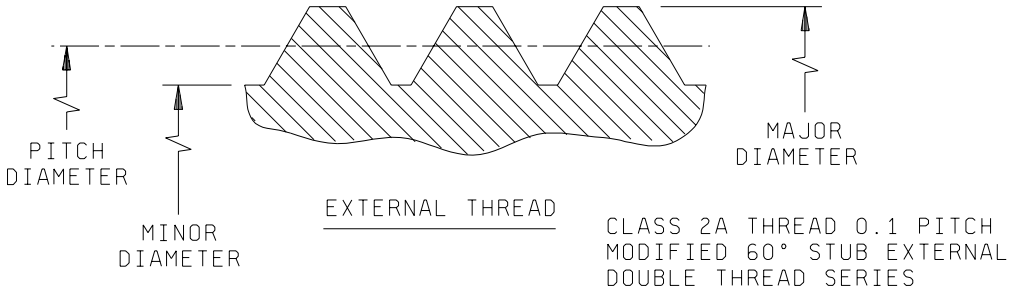
Inches	mm	Inches	mm
.100	2.54	.8950	22.733
.200	5.10	1.0025	25.464
.7042	17.887	1.0145	25.768
.7142	18.141	1.0285	26.124
.7240	18.390	1.0405	26.429
.7340	18.644	1.0625	26.988
.7500	19.050	1.0665	27.089
.7540	19.152	1.0865	27.597
.7700	19.588	1.4400	36.576
.8292	21.062	1.4520	36.881
.8392	21.316	1.4660	37.236
.8490	21.565	1.4780	37.541
.8590	21.819	1.5000	38.100
.8750	22.225	1.5040	38.202
.8790	22.327	1.5240	38.710

FIGURE A-4. Connector mating threads (internal).

Shell size	Internal thread limits of size					
	Minor diameter		Pitch diameter		Major diameter	
	Limits		Limits		Limits	
	Max	Min	Max	Min	Max	Min
11	.7142	.7042	.7340	.7240	.7700	.7540
13	.8392	.8292	.8590	.8490	.8950	.8790
15	1.0145	1.0025	1.0405	1.0285	1.0865	1.0665
23	1.4520	1.4400	1.4780	1.4660	1.5240	1.5040

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

FIGURE A-4. Connector mating threads (internal) - Continued.



Shell size	Designation		
	Thread size	Pitch	Lead
11	.7500	.1	.2
13	.8750	.1	.2
15	1.0625	.1	.2
23	1.5000	.1	.2

Inches	mm	Inches	mm
.100	2.54	.8750	22.225
.200	5.10	.9705	24.651
.6785	17.234	.9885	25.108
.6925	17.590	1.0165	25.819
.7145	18.148	1.0265	26.073
.7225	18.352	1.0485	26.632
.7405	18.809	1.0605	26.937
.7485	19.012	1.0625	26.988
.7500	19.050	1.4080	35.763
.8035	20.409	1.4260	36.220
.8175	20.764	1.4540	36.932
.8395	21.323	1.4640	37.186
.8475	21.526	1.4860	37.744
.8655	21.984	1.4980	38.049
.8735	22.187	1.5000	38.100

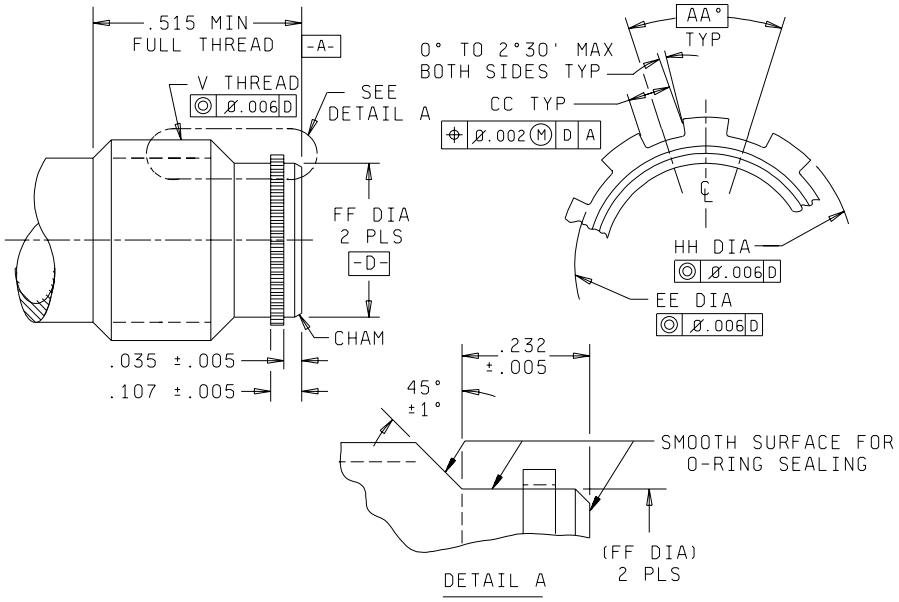
FIGURE A-5. Connector mating threads (external).

Shell size	External thread limits of size					
	Minor diameter Limits		Pitch diameter Limits		Major diameter Limits	
	Max	Min	Max	Min	Max	Min
11	.7485	.7405	.7225	.7145	.6925	.6785
13	.8735	.8655	.8475	.8395	.8175	.8035
15	1.0605	1.0485	1.0265	1.0165	.9885	.9705
23	1.4980	1.4860	1.4640	1.4540	1.4260	1.4080

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

FIGURE A-5. Connector mating threads (external) - Continued.

APPENDIX A



Inches	mm
.002	0.05
.004	0.10
.005	0.13
.006	0.15
.035	0.89
.107	2.71
.232	5.89
.515	13.08

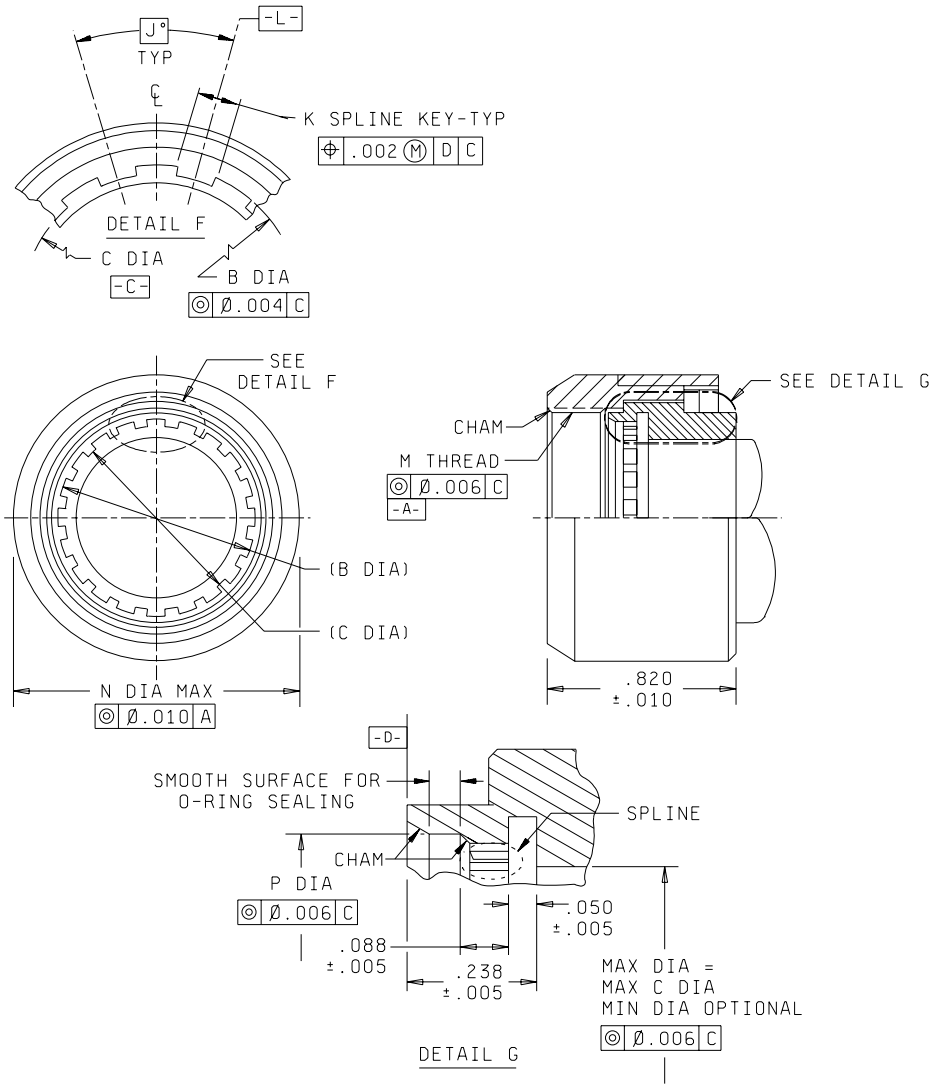
FIGURE A-6. Connector shell back-end configuration.

Shell size	AA BSC	CC	V thread class 2A	EE diameter	FF diameter	HH diameter
11	20°	.0534 (1.356) .0484 (1.229)	.750-20 UNEF	.547 (13.89) .541 (13.74)	.538 (13.67) .532 (13.51)	.571 (14.50) .565 (14.35)
13	20°	.0634 (1.610) .0584 (1.483)	.875-20 UNEF	.662 (16.81) .656 (16.66)	.653 (16.59) .647 (16.43)	.686 (17.42) .680 (17.27)
15	18°	.0679 (1.725) .0629 (1.598)	1.000-20 UNEF	.797 (20.24) .791 (20.09)	.788 (20.02) .782 (19.86)	.821 (20.85) .815 (20.70)
23	12°	.0664 (1.687) .0649 (1.648)	1.4375-18 UNEF	1.224 (31.09) 1.222 (31.04)	1.217 (30.91) 1.211 (30.76)	1.250 (31.75) 1.244 (31.60)

NOTES:
1. Dimensions are in inches.
2. Metric equivalents are given for general information only.
3. Metric equivalents are in parentheses.
4. Dimensions apply to plated/finished part.
5. This design information establishes interface criteria for backshell attachment in accordance with figure a-7.
6. When properly seated, the rear of the connector insert to be 0.272 ± 0.020 from rear of connector shell.
7. Minimum inside diameter of connector shell back end shall be .412 inch (10.46 mm) for shell size 11, .534 inch (13.56 mm) for shell size 13, .712 inch (18.08 mm) for shell size 15, and 1.118 inch (28.40 mm) for shell size 23. Minimum diameters apply to a depth of .300 inch (7.62mm).

FIGURE A-6. Connector shell back-end configuration - Continued.

APPENDIX A



Inches	mm
.002	0.05
.004	0.10
.005	0.13
.006	0.15
.010	0.25
.050	1.27
.088	2.24
.238	6.05
.820	20.83

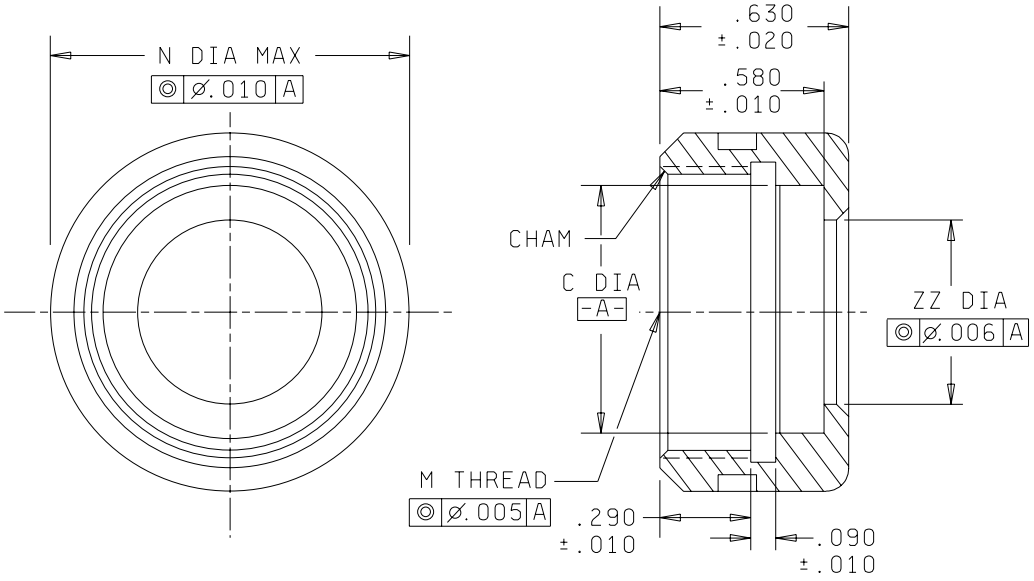
FIGURE A-7. Interface dimensions, connector, fiber optic backshell attachment.

Shell size	B Dia	C dia	J BSC	K	M thread class 2B	N Dia Max	P dia
11	.585 (14.86) .579 (14.71)	.559 (14.20) .553 (14.05)	20°	.0445 (1.130) .0395 (1.003)	.750-20 UNEF	.960 (24.38)	.617 (15.57) .605 (15.37)
13	.700 (17.78) .694 (17.63)	.674 (17.12) .668 (16.97)	20°	.0545 (1.384) .0495 (1.257)	.875-20 UNEF	1.085 (27.56)	.732 (18.59) .720 (18.29)
15	.835 (21.21) .829 (21.06)	.809 (20.55) .803 (20.40)	18°	.0590 (1.499) .0540 (1.372)	1.000-20 UNEF	1.255 (31.88)	.867 (22.02) .855 (21.72)
23	1.264 (32.11) 1.258 (31.95)	1.238 (31.45) 1.232 (31.29)	12°	.0575 (1.461) .0560 (1.422)	1.4375-18 UNEF	1.695 (43.05)	1.296 (32.92) 1.284 (32.61)

NOTES:
1. Dimensions are in inches.
2. Metric equivalents are given for general information only.
3. Metric equivalents are in parentheses.
4. Dimensions apply to plated/finished part.
5. The coupling nut shall be captive and free to rotate on backshell.
6. Backshell insert retention hardware not shown. The backshell shall prevent the connector insert from moving rearward during connector mating. See figure A-6 for proper rear position of connector insert.
7. K dimension is the width of the spline key.

FIGURE A-7. Interface dimensions, connector, fiber optic backshell attachment - Continued.

APPENDIX A



Inches	mm
.005	0.13
.006	0.15
.010	0.25
.020	0.51
.090	2.29
.290	7.37
.580	14.73
.630	16.00

FIGURE A-8. Interface dimensions, connector, fiber optic insert retention nut attachment.

Shell size	M thread class 2B	C dia.	N dia (max)	ZZ dia
11	.750-20 UNEF	.616 (15.65) .594 (15.09)	.960 (24.38)	.340 (8.64)
13	.875-20 UNEF	.731 (18.57) .709 (18.01)	1.085 (27.56)	.460 (11.68)
15	1.000-20 UNEF	.866 (22.00) .844 (21.44)	1.255 (31.88)	.645 (16.38)
23	1.4375-18 UNEF	1.306 (33.17) 1.284 (32.61)	1.695 (43.05)	1.065 (27.05)

NOTES:
1. Dimensions are in inches.
2. Metric equivalents are given for general information only.
3. Metric equivalents are in parentheses.
4. Dimensions apply to plated/finished part.
5. Insert retention nut hardware (insert retention sleeve) not shown. The insert retention nut shall prevent the connector insert from moving rearward during connector mating. See figure A-6 for proper rear position of connector insert.
6. Inner diameters to be 0.347 MIN, 0.457 MIN, 0.642 MIN, and 1.042 MIN for shell sizes 11, 13, 15, and 23 respectively.

FIGURE A-8. Interface dimensions, connector, fiber optic insert retention nut attachment - Continued.

APPENDIX B

CONNECTOR INSERT ARRANGEMENTS AND INTERFACE DIMENSIONS

B.1 SCOPE

B.1.1 Scope. This appendix lists the connector insert arrangements and interface dimensions and is a mandatory part of the specification. The information contained herein is intended for compliance.

B.2 APPLICABLE DOCUMENTS

B.2.1 Non-Government publications. The following document forms a part of this document to the extent specified herein. Unless otherwise specified, the issues of the documents which are DoD adopted are those listed in the issue of the DoDISS cited in the solicitation. Unless otherwise specified, the issues of documents not listed in the DoDISS are the issues of the documents cited in the solicitation (see 6.2).

AMERICAN SOCIETY OF MECHANICAL ENGINEERS (ASME)

ASME Y14.5M - Dimensioning and Tolerancing. (DoD adopted)

(Application for copies should be addressed to the American Society of Mechanical Engineers, 3 Park Avenue, New York, NY 10016).

(Non-Government standards and other publications are normally available from the organizations that prepare or distribute the documents. These documents also may be available in or through libraries or other informational services.)

B.3 REQUIREMENTS

B.3.1 Dimensions. Dimensions shall be in accordance with figures B-1 through B-6 herein, and the following dimensional data:

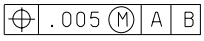
a. ▼ indicates the insert indexing feature position and vertical centerline of insert arrangement.

b. Dimensioning and tolerancing in accordance with ASME Y14.5M. (Dimensions are true position and are in inches.)

c. Metric equivalents are given in parentheses for general information only.

d. Dimensions, features and markings shown are for engaging face of pin insert and the engaging face of the socket insert.

e. The following tolerance applies to an insert installed in a shell:

The center of each hole in an insert for epoxy terminus connectors shall be located 

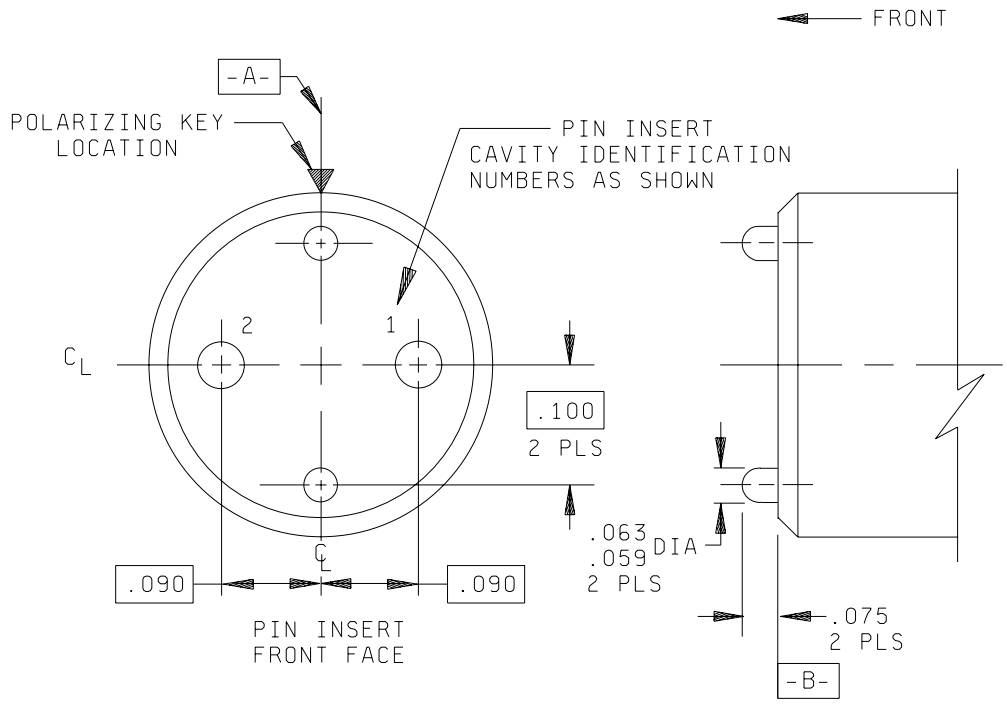
f. Unless otherwise indicated, dimensions are symmetrical about centerlines.

g. Each insert arrangement is shown in the "normal position" with indexing feature at top of vertical centerline of the engagement face.

h. Shell polarization shall be in accordance with figure A-3 of MIL-PRF-28876, appendix A.

i. Tolerance is ± .010 for three decimal places and ± .030 for two decimal places unless otherwise stated.

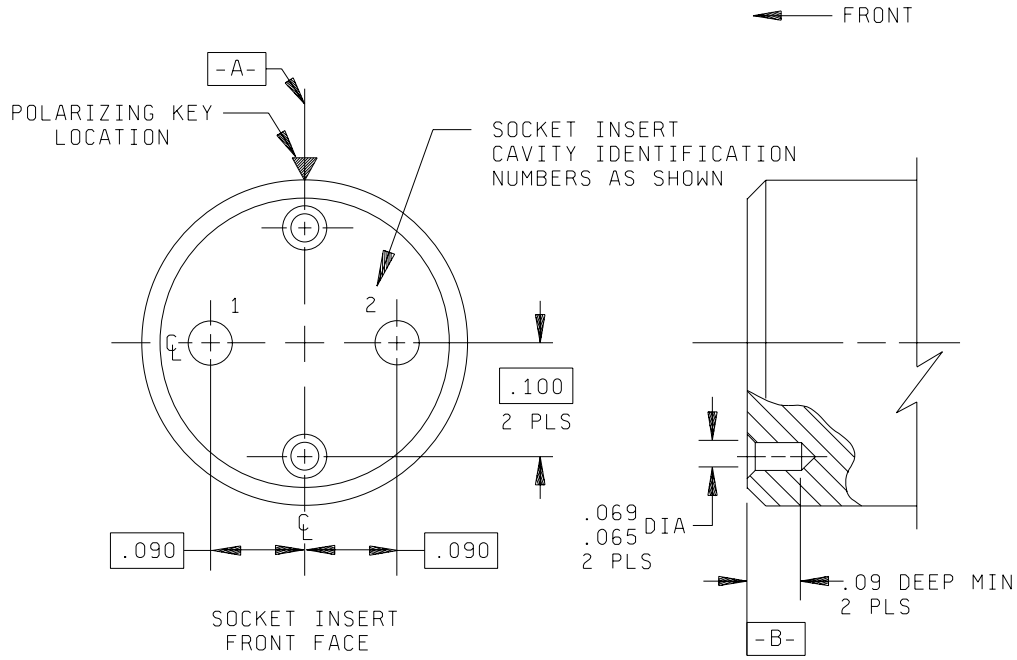
APPENDIX B



Inches	mm
.059	1.50
.063	1.60
.065	1.65
.069	1.75
.075	1.91
.090	2.29
.100	2.54

FIGURE B-1. Two-position termini arrangement for shell size 11.

APPENDIX B

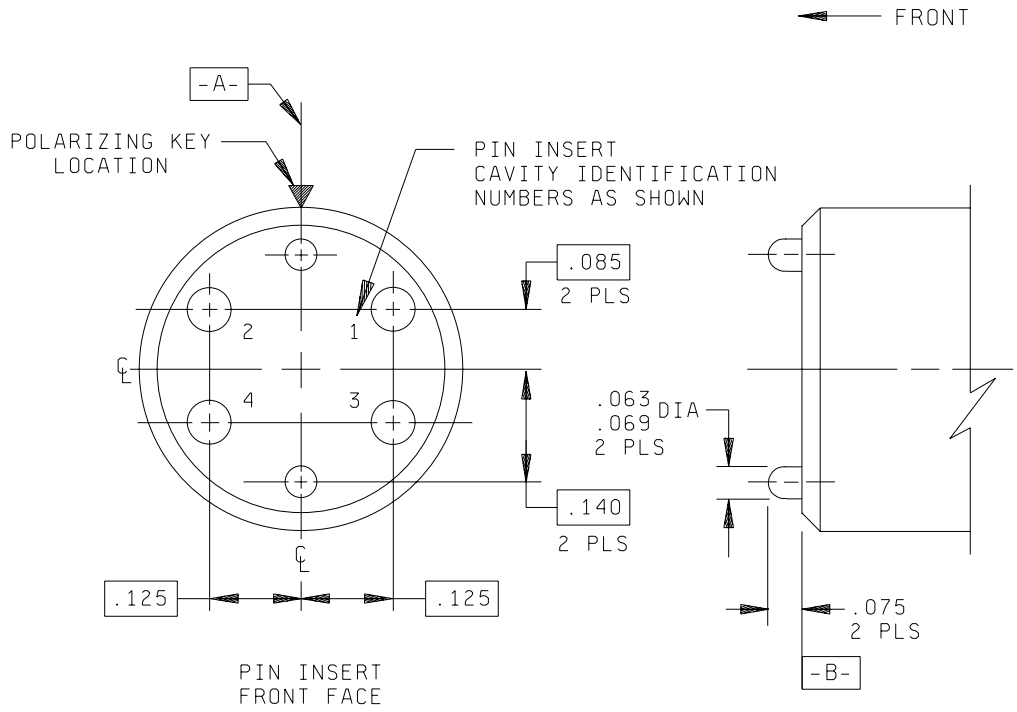


Shell size	Shell size designator	Arrangement number	Number of termini
11	A	1	2

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

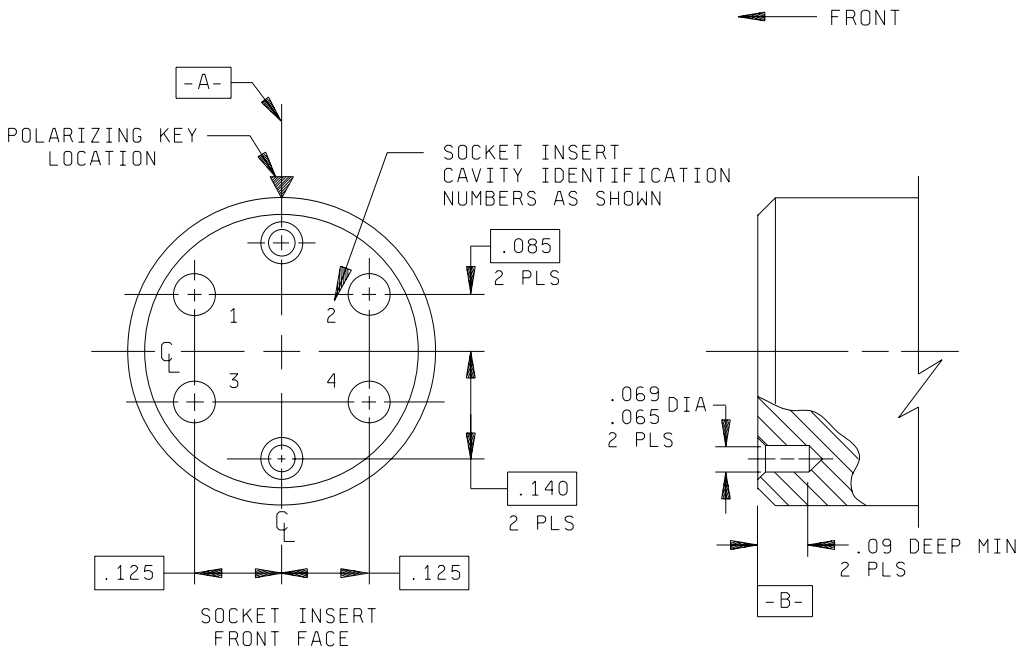
FIGURE B-1. Two-position termini arrangement for shell size 11 - Continued.

APPENDIX B



Inches	mm
.063	1.60
.065	1.65
.069	1.75
.075	1.90
.085	2.16
.090	2.29
.125	3.18
.140	3.56

FIGURE B-2. Four-position termini arrangement for shell size 13.

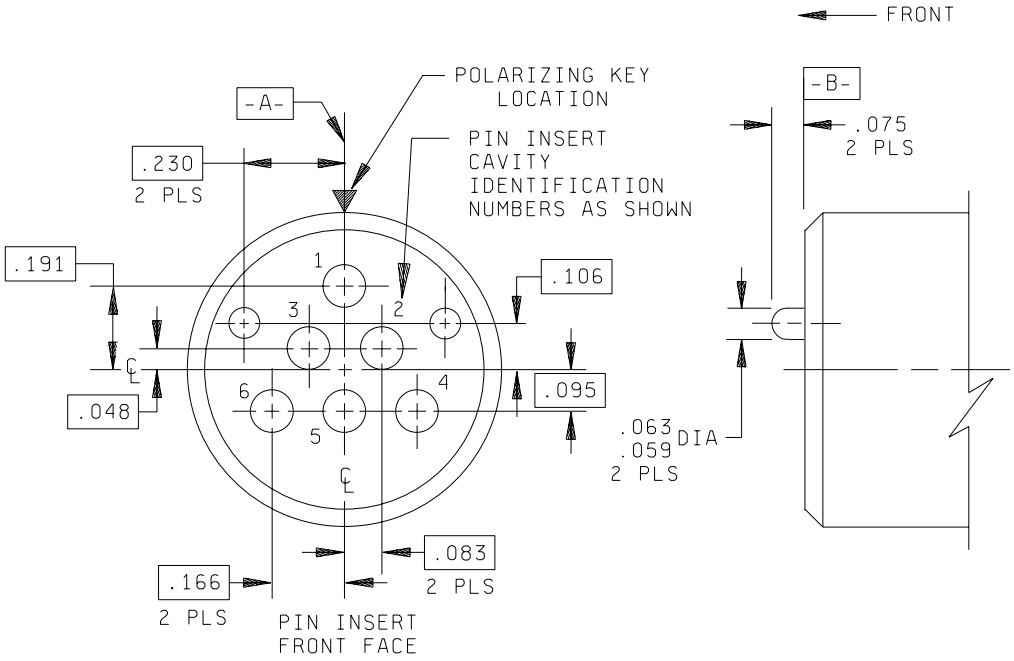


Shell size	Shell size designator	Arrangement number	Number of termini
13	B	1	4

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

FIGURE B-2. Four-position termini arrangement for shell size 13 - Continued.

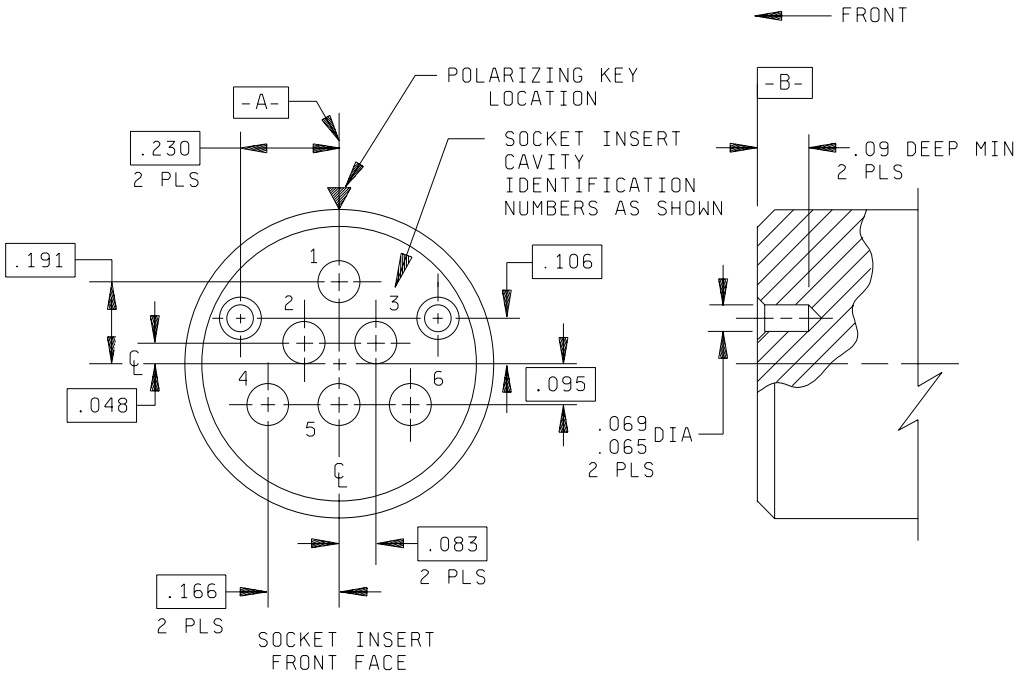
APPENDIX B



Inches	mm
.048	1.22
.059	1.50
.063	1.60
.065	1.65
.069	1.75
.075	1.90
.083	2.11
.090	2.29
.095	2.41
.106	2.69
.166	4.22
.191	4.85
.230	5.84

FIGURE B-3. Six-position termini arrangement for shell size 15.

APPENDIX B

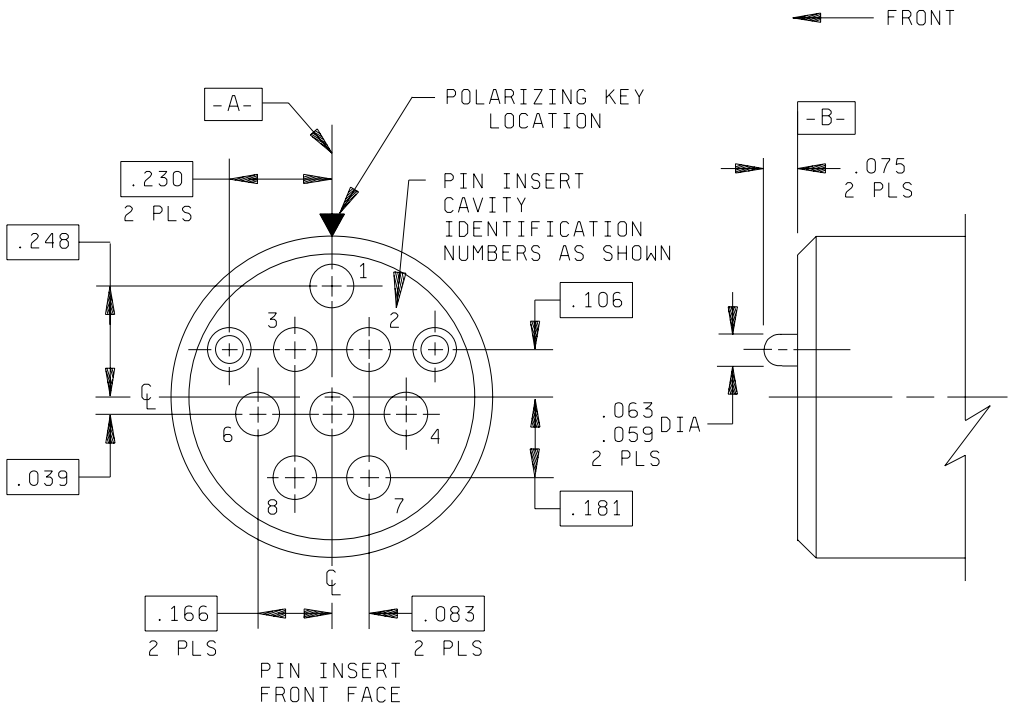


Shell size	Shell size designator	Arrangement number	Number of termini
15	C	2	6

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

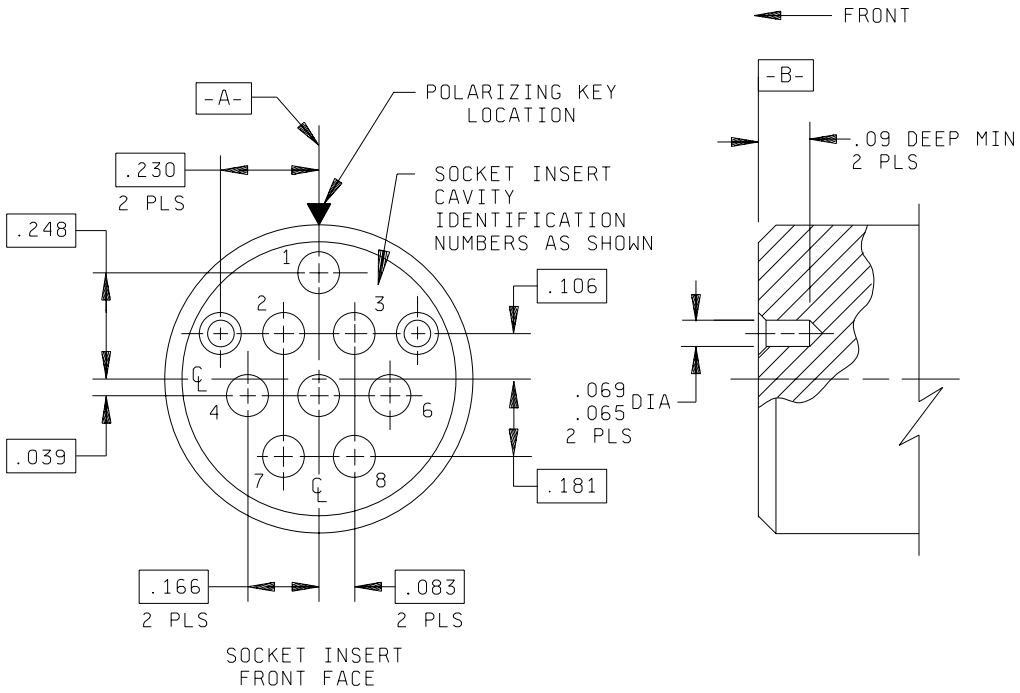
FIGURE B-3. Six-position termini arrangement for shell size 15 - Continued.

APPENDIX B



Inches	mm
.039	0.99
.059	1.50
.063	1.60
.065	1.65
.069	1.75
.075	1.90
.083	2.11
.090	2.29
.106	2.69
.166	4.22
.181	4.60
.230	5.84
.248	6.30

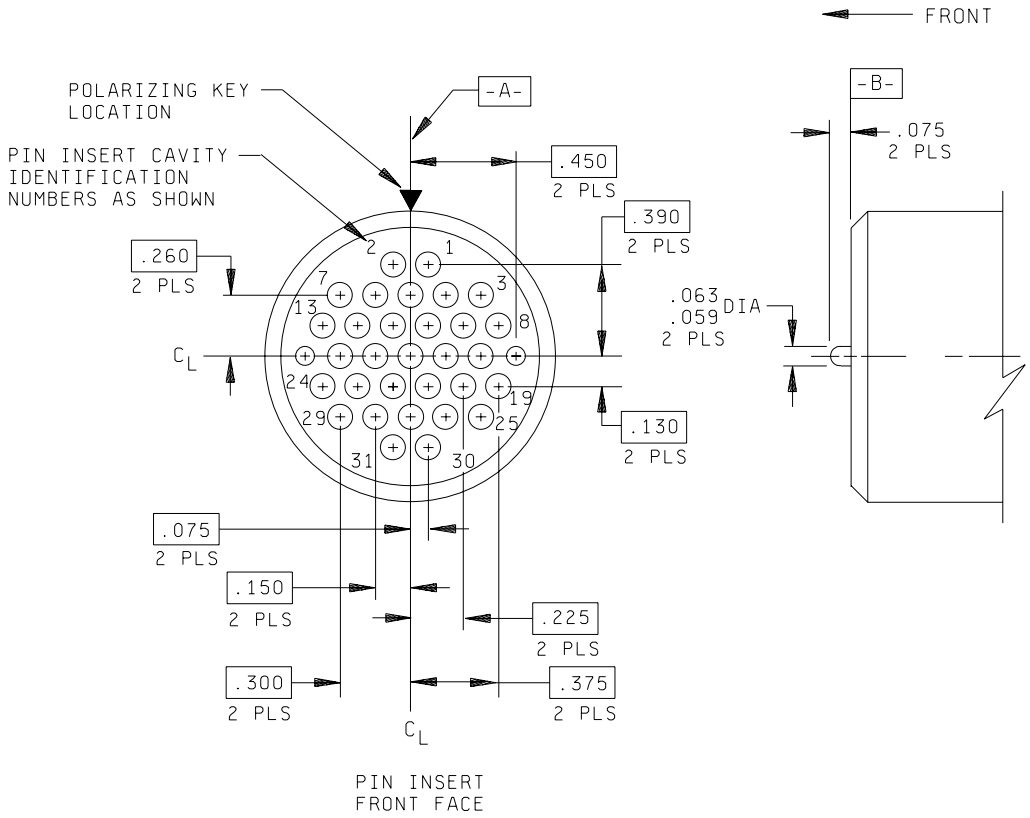
FIGURE B-4. Eight-position termini arrangement for shell size 15.



Shell size	Shell size designator	Arrangement number	Number of termini
15	C	1	8

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

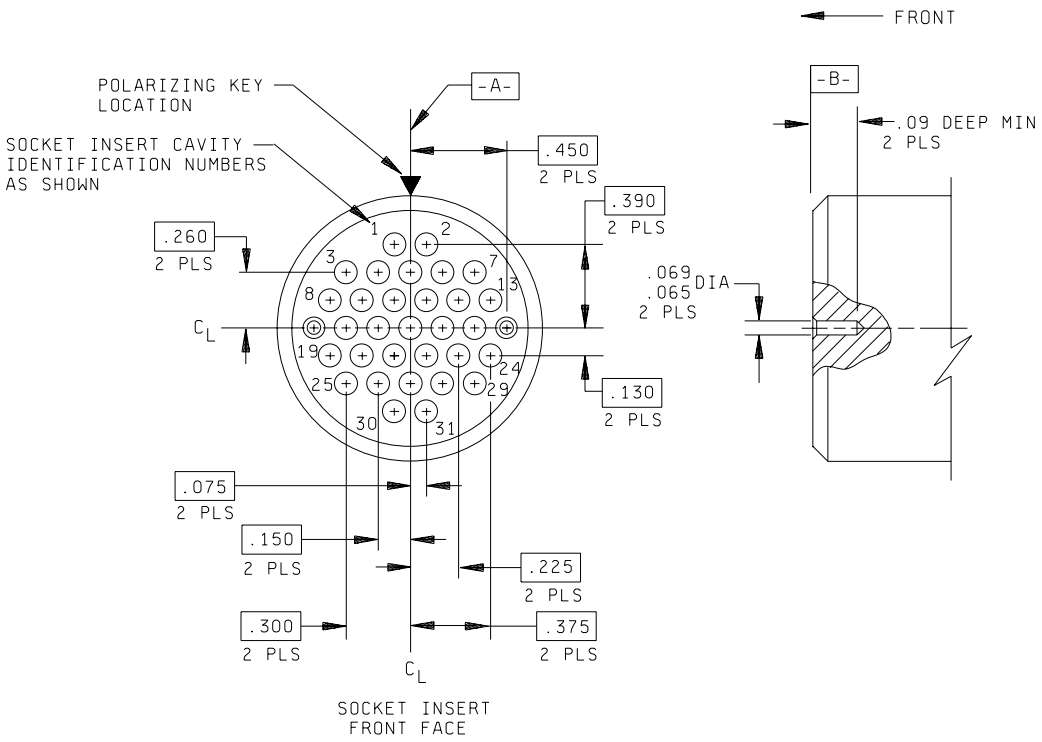
FIGURE B-4. Eight-position termini arrangement for shell size 15 - Continued.



Inches	mm
.059	1.50
.063	1.60
.065	1.65
.069	1.75
.075	1.90
.090	2.29
.130	3.30
.150	3.81
.225	5.72
.260	6.60
.300	7.62
.375	9.53
.390	9.91
.450	11.43

FIGURE B-5. Thirty one-position termini arrangement for shell size 23.

APPENDIX B

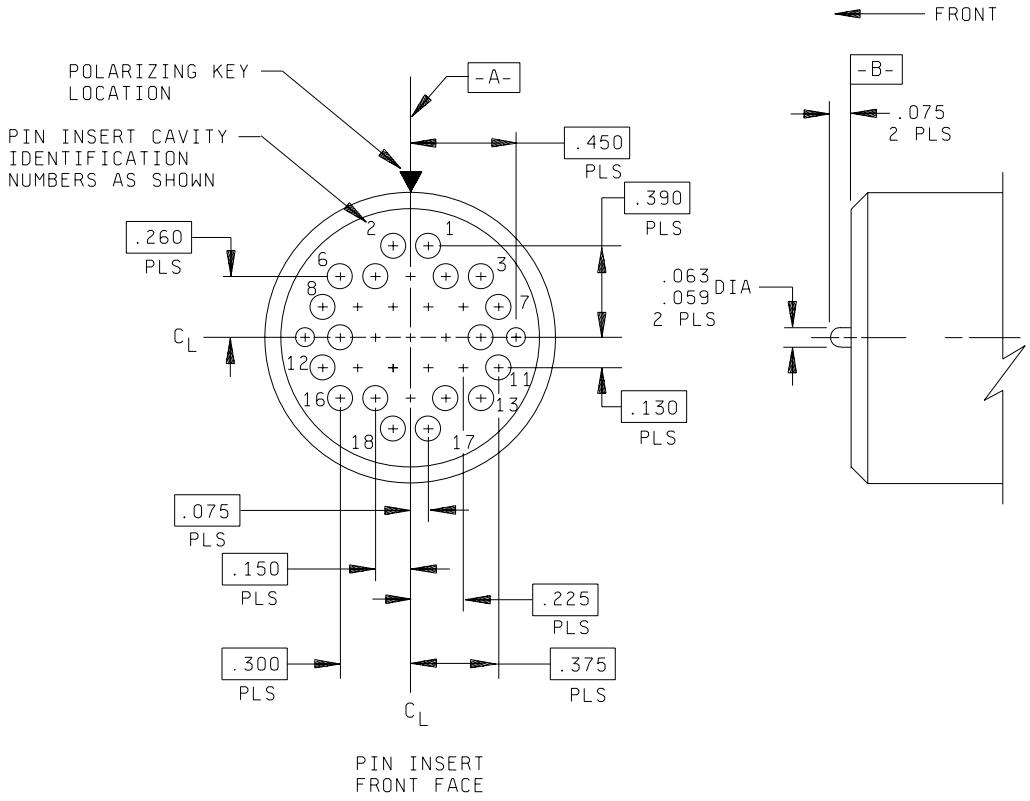


Shell size	Shell size designator	Arrangement number	Number of termini
23	F	1	31

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

FIGURE B-5. Thirty one-position termini arrangement for shell size 23 - Continued.

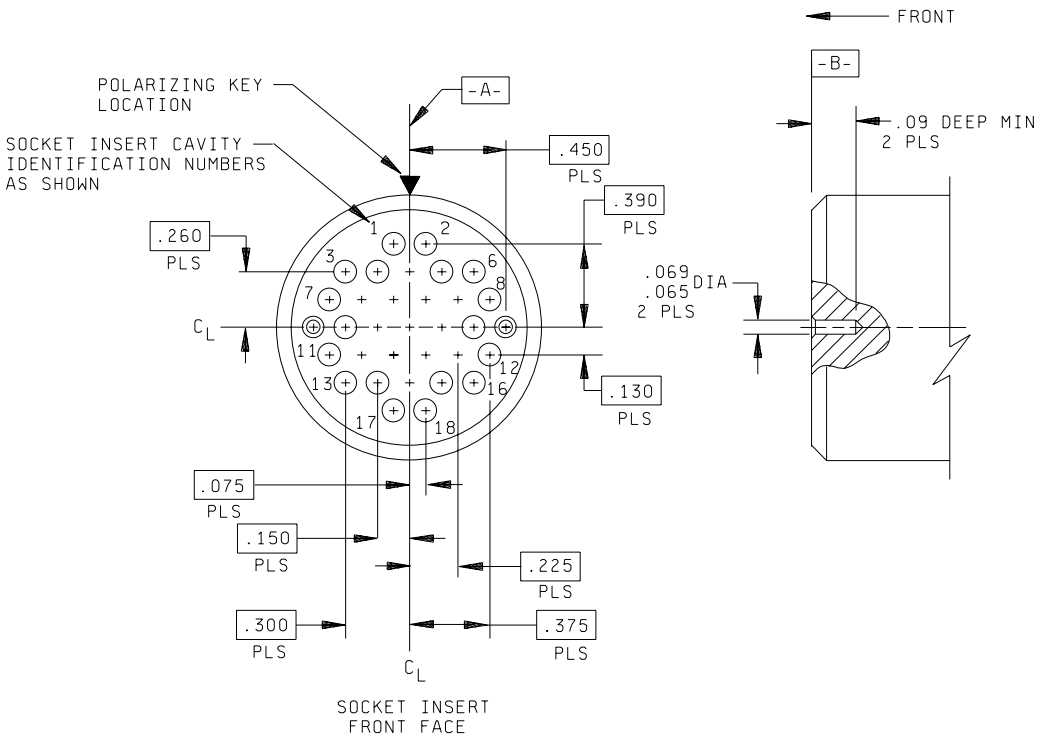
APPENDIX B



Inches	mm
.059	1.50
.063	1.60
.065	1.65
.069	1.75
.075	1.90
.090	2.29
.130	3.30
.150	3.81
.225	5.72
.260	6.60
.300	7.62
.375	9.53
.390	9.91
.450	11.43

FIGURE B-6. Eighteen-position termini arrangement for shell size 23.

APPENDIX B



Shell size	Shell size designator	Arrangement number	Number of termini
23	F	2	18

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

FIGURE B-6. Eighteen-position termini arrangement for shell size 23 – Continued.

Custodians:
Army - CR
Navy - SH
Air Force - 11

Review activities:
Navy - AS
Air Force - 13, 19, 93, 99
DIA - DI
DLA - CC
NASA - NA

Preparing activity:
Navy-SH

Agent:
DLA - CC

(Project 6060-0144)

NOTE: The activities listed above were interested in this document as of 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 www.dodssp.daps.mil.