

INCH-POUND

MIL-DTL-28840B

26 April 2007

SUPERSEDING

MIL-C-28840/A(EC)

26 May 1981

MILITARY SPECIFICATION

CONNECTORS, ELECTRICAL, CIRCULAR, THREADED, HIGH DENSITY,
HIGH SHOCK, SHIPBOARD, CLASS D, 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 circular electrical connectors with removable crimp front release contacts. These connectors are for use with jacketed cable in shipboard applications.

1.1.1 Temperature. These connectors are rated for specified operation within a temperature range of -55° C (-67° F) to 200° C (392° F). The upper temperature is the maximum internal hot-spot temperature resulting from any combination of electrical load and ambient conditions.

1.1.1.1 Insulation resistance. Insulation resistance limits vary with temperature (see [figure 1](#)).

1.1.1.2 Service life. Service life varies with temperature (see [figure 2](#) and [table I](#)).

1.2 Classification.

1.2.1 Military Part or Identifying Number (PIN). The connector PIN for qualified connectors procured in accordance with this specification is the letter "M", the basic number of the applicable specification sheet and the applicable alphanumeric characters formulated as in the following examples:

		M28840/XX	X	X	X	X	X	X
Basic PIN (see 1.2.1)	_____	_____	_____	_____	_____	_____	_____	_____
Class code (see 1.2.1.1)	_____	_____	_____	_____	_____	_____	_____	_____
Shell size (see 1.2.1.2)	_____	_____	_____	_____	_____	_____	_____	_____
Insert arrangement designator (see 1.2.1.3)	_____	_____	_____	_____	_____	_____	_____	_____
Backshell size designator (see 1.2.1.4)	_____	_____	_____	_____	_____	_____	_____	_____
Contact style (see 1.2.1.5)	_____	_____	_____	_____	_____	_____	_____	_____
Key position (see 1.2.1.6)	_____	_____	_____	_____	_____	_____	_____	_____

Comments, suggestions, or questions on this document should be addressed to Defense Supply Center Columbus, ATTN: VAI, P.O. Box 3990, Columbus OH 43218-3990 or emailed to circularconnector@dsccl.dla.mil. Since contact information can change, you may want to verify the currency of this address information using the ASSIST Online database at <http://assist.daps.dla.mil>.

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TABLE I. Connector classes – physical characteristics.

Class code	Class	Feature	Hot spot temperature (°C)	Service life	Insert material	Shell and coupling rings		Fluid resistance
						Material	Finish	
A	D	High impact shock	125 200 <u>1</u> /	20 yrs. 1000 hrs.	Fluorosilicone	Wrought aluminum	Cadmium olive drab over nickel	Complete
B	DS	High impact shock				Corrosion resistant steel 316	Cadmium	
C	DJ	High impact shock with backshell connector assembly				Wrought aluminum	Cadmium olive drab over nickel	
E	DJS					Corrosion resistant steel 316	Cadmium	

^{1/} Hot spot test requirement for inserts and seals is 200°C.

1.2.1.1 Class code. The class of the connector is as specified in [table I.](#)

1.2.1.2 Shell sizes. The shell size is as specified in [table II.](#)

TABLE II. Shell sizes.

Designator	A	B	C	D	E	F	G	H	J
Sizes	11	13	15	17	19	23	25	29	33

1.2.1.3 Insert arrangement. The insert arrangement designator is a single digit indicating the insert pattern in accordance with the applicable insert arrangement in accordance with MIL-STD-1698.

1.2.1.4 Backshell size designator. The backshell size designator is identified by the appropriate letter A, B, C, or D in accordance with applicable specification sheets.

1.2.1.5 Contact styles. The following designators identify the various contact styles.

a. Connectors ordered with standard contacts in accordance with MIL-STD-1698.

P - Pin contacts	-20-22 (see SAE-AS39029/83-450)
S - Socket contacts	-20-22 (see SAE-AS39029/84-452)
D - Pin contacts	-20-28 (see SAE-AS39029/83-451)
E - Socket contacts	-20-28 (see SAE-AS39029/84-453)
F - Pin contacts	-20-20 (see SAE-AS39029/83-508)
G - Socket contacts	-20-20 (see SAE-AS39029/84-509)

The P, S, D, E, F, and G designators are used to indicate that the connectors will be used with full complements of the applicable standard contacts in accordance with MIL-STD-1698. The connectors that accommodate crimp removable contacts (P, S, D, E, F, or G) may be ordered without standard contacts by adding an appropriate note on the purchase order. The connector PIN and the marking requirements remain unchanged.

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b. Connectors used with other than standard contacts in accordance with MIL-STD-1698.

- A - Less pin contacts
- B - Less socket contacts

The A or B designators are used to indicate that the connectors will be used with other than standard contacts in accordance with MIL-STD-1698 (example: Shielded, coaxial, thermocouple, fiber optic contacts). The A or B designators are part of the connector PIN and are marked on the connector. The connector will be supplied without contacts. The contacts that will be used with the connectors should be ordered separately (see 3.4.1.1.1 and 6.2).

NOTE: When A and B designators are used, the requirements stated herein may not be met.

1.2.1.6 Key position. The key or keyway position is identified by the appropriate number 1, 2, 3, 4, 5 or 6 as specified on figure 3.

1.2.2 Coupling. Connectors have a threaded coupling as specified on figures 8 and 9.

1.2.3 Receptacle mounting. Receptacle mounting is designed as either flange or jam nut.

1.3 Wire range accommodations. The wire ranges as specified in table III are accommodated by the contacts as indicated.

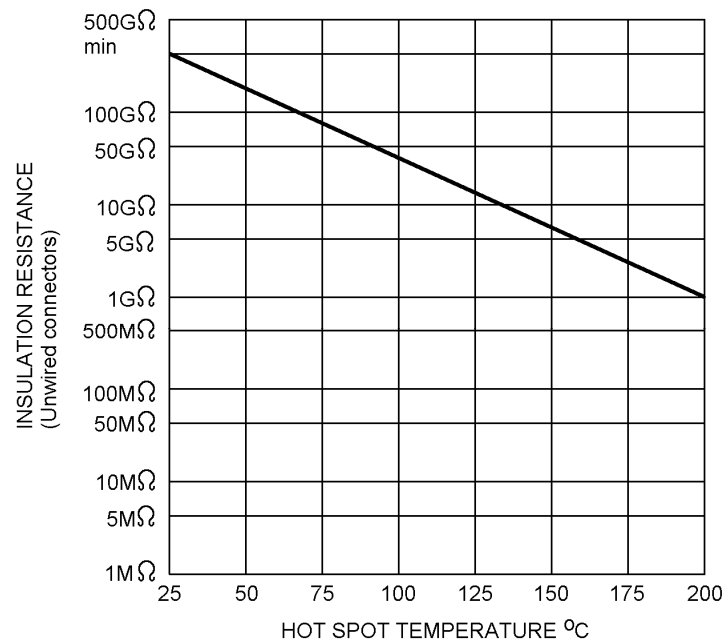


FIGURE 1. Minimum insulation resistance vs. hot spot temperature.

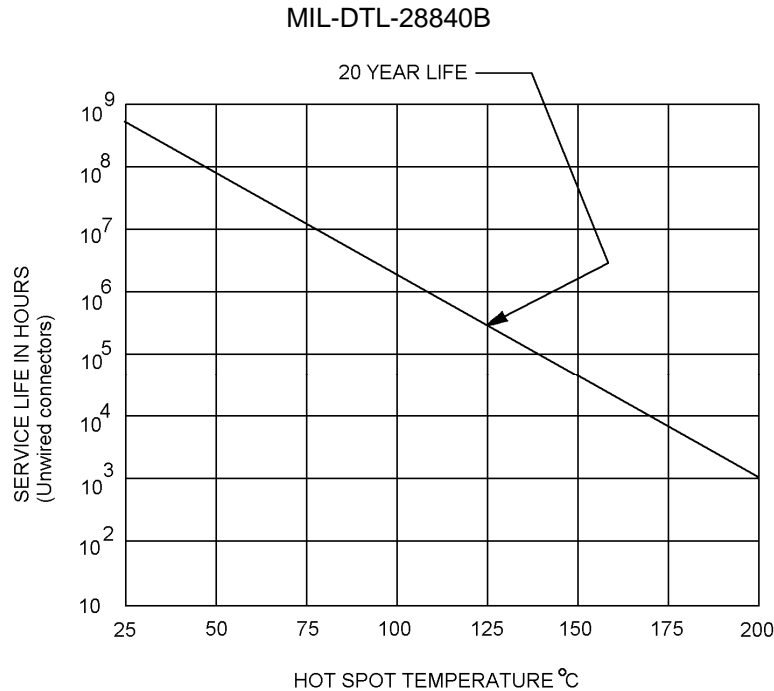


FIGURE 2. Service life vs. hot spot temperature.

TABLE III. Wire range accommodations. 1/ 2/

Contact size	Wire size	Outside diameter of finished wire (inch) 3/	
		Minimum	Maximum
20-20	24	.040 (1.02)	.070 (1.78)
	22		
	20		
20-22	26		
	24		
	22		
20-28 4/	32		
	30		
	28		

1/ Dimensions are inches.

2/ Metric equivalents are given for information only.

3/ To obtain sealing, wires must be built up to finished wire diameter (see 6.1.1).

4/ In accordance with MIL-DTL-24643 and MIL-DTL-16878.

2. APPLICABLE DOCUMENTS

2.1 General. The documents listed in this section are specified in sections 3, 4, or 5 of this specification. This section does not include documents cited in other sections of this specification or recommended for addition 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 documents cited in sections 3, 4, or 5 of this specification, whether or not they are listed.

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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.

DEPARTMENT OF DEFENSE SPECIFICATIONS

- | | | |
|------------------|---|--|
| MIL-S-901 | - | Shock Tests II, I (High-Impact): Shipboard Machinery, Equipment and Systems, Requirements for |
| MIL-DTL-22520 | - | Crimping Tools, Wire Termination, General Specification for |
| MIL-DTL-28840/10 | - | Connectors, Electrical, Circular, Screw Threads, High Density, High Shock, Shipboard Crimp Contacts Receptacle, Wall Mounting, Classes D And DS |
| MIL-DTL-28840/12 | - | Connectors, Electrical, Screw Threads, High Density, High Shock, Shipboard, Crimp Contacts Receptacle, Box Mounting, Classes D And DS |
| MIL-DTL-28840/14 | - | Connectors, Electrical, Circular, Screw Threads, High Shock, High Density, Shipboard, Crimp Contacts, Receptacle, Jam Nut Mounting, Classes D And DS |
| MIL-DTL-28840/16 | - | Connector, Electrical, Circular, Screw Threads, High Density, High Shock, Shipboard, Crimp Contacts Plug, Classes D And DS |
| MIL-DTL-28840/20 | - | Connector, Electrical, Circular, Screw Threads, High Density, High Shock, Shipboard, Crimp Contacts Receptacle, Wall Mounting, Assembly, Straight Classes DJ & DJS |
| MIL-DTL-28840/26 | - | Connector, Electrical, Circular, Screw Threads, High Density, High Shock, Shipboard, Crimp Contacts, Plug Assembly, Straight Classes DJ And DJS |
| MIL-I-81969/33 | - | Installing and Removal Tools, Connector, Electrical Contact, Type I, Class 1, Composition A |
| MIL-I-81969/34 | - | Installing and Removal Tools, Connector, Electrical Contact, Type II, Class 1, Composition A. |

FEDERAL STANDARD

- | | | |
|-------------|---|---|
| FED-STD-H28 | - | Screw-Thread Standards for Federal Services |
|-------------|---|---|

DEPARTMENT OF DEFENSE STANDARDS

- | | | |
|---------------|---|---|
| MIL-STD-167-1 | - | Mechanical Vibrations of Shipboard Equipment (Type –I Environmental and Type II - Internally Excited) |
| MIL-STD-202 | - | Test Methods for Electronic and Electric Component Parts |
| MIL-STD-790 | - | Established Reliability and High Reliability Qualified Products List (QPL) Systems for Electrical, Electronic, and Fiber Optic Parts Specifications |
| MIL-STD-810 | - | Environmental Engineering Considerations And Laboratory Tests |
| MIL-STD-889 | - | Dissimilar Metals |
| MIL-STD-1285 | - | Marking of Electrical and Electronic Parts |
| MIL-STD-1373 | - | Screw Thread, Modified, 60 Degree Stub, Double |

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- | | | |
|--------------|---|--|
| MIL-STD-1698 | - | Inert Arrangements for MIL-DTL-28840 High Density High Shock Circular connectors |
| MS3186 | - | Connector, Mounting To Connectors, Mounting Nuts, Plain Hexagon |
| MS27488 | - | Plug, End Seal, Electrical Connector |

(See supplement 1 for list of specifications sheets.)

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

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.

NCSL INTERNATIONAL

- | | | |
|-------------|---|--|
| NCSL Z540-1 | - | Calibration Laboratories and Measuring and Test Equipment – General Requirements |
|-------------|---|--|

(Copies of these documents are available online at <http://www.ncsli.org> or from NCSL International, 2995 Wilderness Place, Suite 107 Boulder, Colorado 80301-5404.)

AEROSPACE INDUSTRIES ASSOCIATION (AIA)

- | | | |
|-----------|---|----------------------|
| NASM20995 | - | Wire, Safety or Lock |
|-----------|---|----------------------|

(Copies of these documents are available online at <http://www.aia-aerospace.com> or from the Aerospace Industries Association, 1000 Wilson Boulevard, Suite 1700, Arlington, VA 22209-3901).

ASTM INTERNATIONAL

- | | | |
|-----------------|---|---|
| ASTM-A342/A342M | - | Standard Test Methods For Permeability Of Feebly Magnetic Materials |
| ASTM A276 | - | Standard Specification for Stainless Steel Bars and Shapes |
| ASTM A473 | - | Standard Specification for Stainless Steel Forgings |
| ASTM A580/A580M | - | Standard Specification for Stainless Steel Wire |

(Copies of these documents are available at <http://www.astm.org> or from ASTM International, 100 Barr Harbor Drive, PO Box C700, West Conshohocken, Pennsylvania 19428-2959.)

ELECTRONIC INDUSTRIES ALLIANCE (EIA)

- | | | |
|------------|---|---|
| EIA-364 | - | Electrical Connector/Socket Test Procedures Including Environment Classifications |
| EIA-364-09 | - | Durability Test Procedure for Electrical Connectors and Contacts |
| EIA-364-20 | - | Withstanding Voltage Test Procedure for Electrical Connectors, Sockets and Coaxial Contacts |
| EIA-364-21 | - | Insulation Resistance Test Procedure for Electrical Connectors, Sockets, and Coaxial Contacts |

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EIA-364-26	-	Salt Spray Test Procedure for Electrical Connectors, Contacts and Sockets
EIA-364-28	-	Vibration Test Procedure for Electrical Connectors and Sockets
EIA-364-31	-	Humidity Test Procedure for Electrical Connectors and Sockets
EIA-364-35	-	Insert Retention Test Procedure for Electrical Connectors
EIA-364-42	-	Impact Test Procedure for Electrical Connectors
EIA-557	-	Statistical Process Control Systems

(Copies of these documents are available online at <http://www.eia.org> or from the Electronic Industries Alliance, Technology Strategy & Standards Department, 2500 Wilson Boulevard, Arlington, VA 22201.)

SAE INTERNATIONAL

SAE-AMS-QQ-P-416	-	Plating, Cadmium (Electrodeposited)
SAE-AMS2700	-	Passivation of corrosion resistant steel
SAE-AIR 4789	-	Aerospace Information Report on Evaluating Corrosion Testing of Electrical Connectors and Accessories For The Purpose Of Qualifications.
SAE-AS39029	-	Contacts, Electrical Connector, General Specification For
SAE-AS39029/83	-	Contacts, Electrical Connector, Pin, Crimp Removable (For MIL-DTL-28840 Connectors)
SAE-AS39029/84	-	Contact, Electrical Connector, Socket, Crimp Removable (For MIL-DTL-28840 Connectors)

(Copies of these documents are available at <http://www.sae.org> or from SAE International, 400 Commonwealth Drive, Warrendale, PA 15096-001.)

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 sheets. In the event of conflict between the requirements of this specification and the specification sheet, the latter shall govern.

3.2 Qualification. The 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 4.3 and 6.3).

3.2.1 Quality.

3.2.1.1 Statistical process control (SPC). The contractor shall implement and use SPC techniques in the manufacturing process for parts covered by this specification. The SPC program shall be developed and maintained in accordance with EIA-557. The SPC program shall be documented and maintained as part of the overall reliability assurance program as specified in MIL-STD-790.

3.3 Materials. Materials shall be suitable for the purpose intended and where required herein shall be as specifically described.

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3.3.1 Dissimilar metals. When dissimilar metals are used in intimate contact with each other, protection against galvanic corrosion shall be provided. The use of dissimilar metals in contact, which tend toward active galvanic corrosion (particularly brass, copper, or steel used in contact with aluminum or aluminum alloy) is not acceptable. However, metal plating of dissimilar base metals to provide similar or suitable abutting surfaces is permitted. The use of dissimilar metals separated by a suitable insulating material is also permitted. Dissimilar metals and compatible couples are specified in MIL-STD-889.

3.3.2 Nonmagnetic materials. All parts shall be made of materials considered to be nonmagnetic (see 3.6).

3.3.3 Contact materials. Contacts shall be made of suitable conductive copper-based alloy in accordance with SAE-AS39029.

3.3.4 Dielectric materials.

3.3.4.1 Inserts. Inserts shall be solid dielectric and shall have the hardness, electrical, and mechanical characteristics suitable for the purpose intended.

3.3.4.1.1 Resilient materials. Resilient materials shall be silicone or fluorosilicone and have the Shore A Durometer specified as follows:

Pin Insert pace	70 ± 5
Socket insert	70 ± 5
Gaskets	40 ± 5
Grommets	50 ± 5
O-Rings	60 ± 5
Wire separator	70 ± 5

3.3.4.1.2 Connectors. The mating faces of inserts shall be resilient material with a shore A Durometer as specified in 3.3.4.1.1 with a total (pin and socket insert face) minimum thickness of 0.090 inch.

3.3.5 Shells and coupling rings. Shells and coupling rings shall consist of the following materials as specified herein (see 1.2.1.1):

- a. Heat-treated wrought aluminum alloy meeting the performance requirements of this specification.
- b. Non-magnetic corrosion-resisting steal in accordance with ASTM A276, ASTM A473, or ASTM A580/A580M, type 316.

3.3.5.1 Finish. The resultant finish on all connectors shall be electrically conductive.

- a. The finish of connectors and external screws with wrought aluminum shells and coupling rings shall be cadmium plate in accordance with SAE-AMS-QQ-P-416, type II, class 3 over nickel. The resultant finish on cadmium plated connectors shall be olive drab (light to dark).
- b. The finish of connectors with corrosion-resisting steel shells and coupling rings shall be cadmium plate in accordance with SAE-AMS-QQ-P-416, type II, class 3, color - black.
- c. Spring fingers — Shell spring fingers shall be suitably protected to prevent corrosion.
- d. External screws may be stainless steel in lieu of the finish specified.

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3.3.6 Fungus-resistant. Materials used in the construction of these connectors shall be fungus inert (see [4.2.1](#)).

3.3.7 Recycled, recovered, or environmentally preferable materials. Recycled, recovered, or environmentally preferable materials should be used to the maximum extent possible, provided that the material meets or exceeds the operational and maintenance requirements, and promotes economically advantageous life cycle costs.

3.4 Design and construction. Connectors and accessories shall be designed and constructed to withstand normal handling incident to installation and maintenance in service. The connectors and accessories shall conform to the following:

Connector, position key and keyway:	Figure 3
Plug interface dimensions:	Figure 4
Receptacle interface dimensions:	Figure 5
Connector back-end configuration:	Figure 6
Rear accessory design standard:	Figure 7
Connector mating threads, internal:	Figure 8
Connector mating threads, external:	Figure 9

3.4.1 Contacts. Contacts shall be in accordance with SAE-AS39029. Contacts shall be designed so that neither the pin or the socket contact shall be damaged during mating of counterpart connectors. A quantity of crimp contacts consisting of the normal complement, plus 5 percent, but not less than two, shall be included in the unit package. For other than direct shipments to the Government, Connectors may be ordered without contacts, thus allowing contacts to be purchased in bulk (see [6.2](#)).

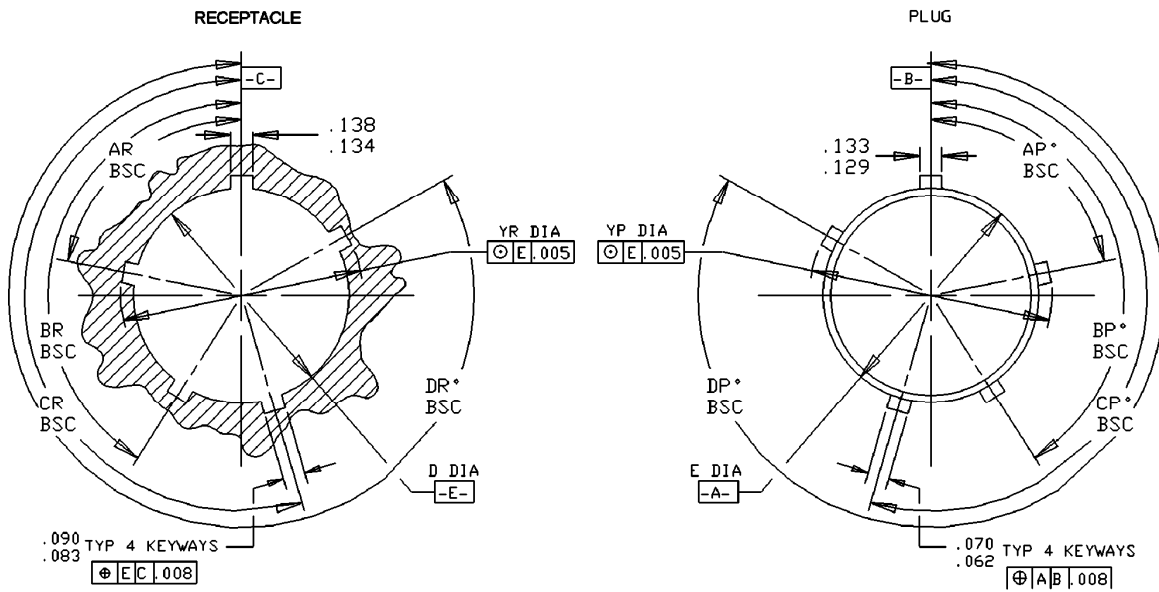
3.4.1.1 Contacts, retention device or sealing member. Contacts shall be designed to prevent damage to the contact retention device or sealing member during insertion and removal of the contact. Contacts shall be in accordance with SAE-AS39029/83, SAE-AS39029/84 and SAE-AS39029.

3.4.1.1.1 Indirect shipment. Environment resisting connectors may be ordered without contacts (see [1.2.1.5](#) and [6.2](#)).

3.4.1.2 Installing and removal tools. The individual contacts shall be positively retained in the connector when installed with the MIL-I-81969/33 contact installing tool. The individual contacts shall be capable of being removed from the connector when using the MIL-I-81969/34 contact removal tool.

3.4.2 Insert design and construction. The entire insert and wire sealing or wire support member of the insert assembly shall be of one integral part, designed to provide sealing and support around the wires. The entire insert shall be nonremovable from the shell and shall be keyed, bonded, and secured so as to prevent rotation or movement within the shell. The rigid dielectric shall be one molded piece or no more than two pieces bonded to form essentially one molded piece. Inserts shall be of voidless construction, eliminating all air paths between contacts.

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Inches	mm	Inches	mm	Inches	mm
.005	.13	.083	2.11	.133	3.38
.008	.20	.090	2.29	.134	3.40
.062	1.57	.129	3.28	.138	3.50
.070	1.78				

FIGURE 3. Connector, electrical, position key and keyways, mating.

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Designator (see note 3)	Key & keyway arrangement	AR° or AP° BSC	BR° or BP° BSC	CR° or CP° BSC	DR° or DP° BSC
A (11) B (13)	1	95	141	208	236
	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
C (15) D (17)	1	80	142	196	293
	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
E (19) F (23) G (25) H (29) J (33)	1	80	142	196	293
	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

FIGURE 3. Connector, electrical, position key and keyways, mating – Continued.

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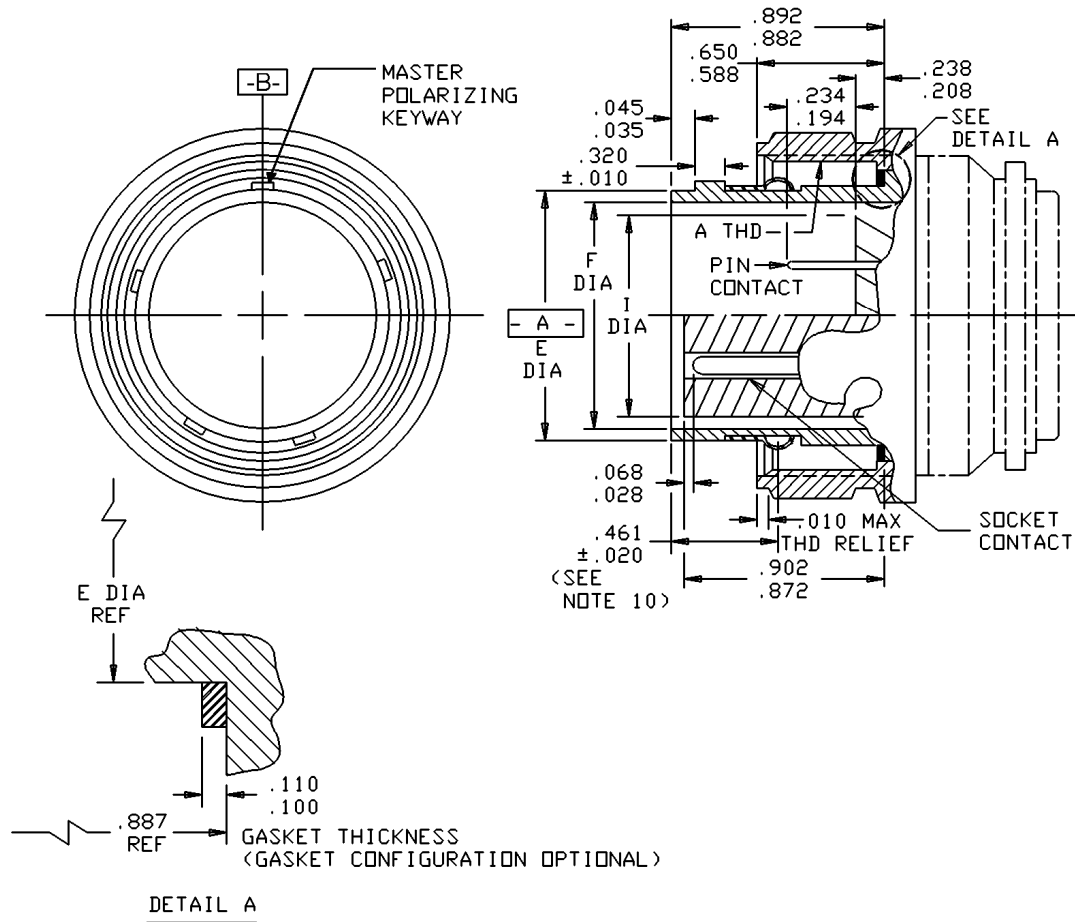
Designator (see note 3)	Key & keyway arrangement	YP dia	YR dia
A (11) B (13)	1	.559 (14.20) .551 (14.00)	.581 (14.76) .569 (14.45)
	2		
	3		
	4	.683 (17.35) .675 (17.14)	.705 (17.91) .693 (17.60)
	5		
	6		
C (15) D (17)	1	.855 (21.72) .847 (21.51)	.877 (22.28) .865 (21.97)
	2		
	3		
	4	.925 (23.50) .917 (23.29)	.947 (24.50) .935 (23.75)
	5		
	6		
E (19) F (23) G (25) H (29) J (33)	1	1.092 (27.74)	1.114 (28.30)
	2	1.084 (27.53)	1.102 (27.99)
	3	1.277 (32.44)	1.299 (32.99)
		1.269 (32.23)	1.287 (32.69)
	4	1.438 (36.52)	1.460 (37.08)
		1.430 (36.32)	1.448 (36.78)
	5	1.604 (40.74)	1.626 (41.30)
		1.596 (40.54)	1.614 (41.00)
	6	1.796 (45.62)	1.818 (46.18)
		1.788 (45.42)	1.806 (45.87)

NOTES:

1. Dimension are in inches.
2. Metric equivalents are given for information only.
3. Shell sizes are provided within parentheses for information and are not a part of the designator.
4. Dimensions apply after plating.
5. For datum A and E (see figures 4 and 5, respectively).

FIGURE 3. Connector, electrical, position key and keyways, mating – Continued.

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Inches	mm	Inches	mm
.010	0.26	.238	6.04
.020	0.52	.320	8.13
.028	0.71	.461	11.72
.035	0.89	.588	14.94
.045	1.14	.650	16.51
.068	1.73	.872	22.15
.100	2.54	.882	22.40
.110	2.79	.887	22.53
.194	4.93	.892	22.66
.208	5.28	.902	22.91
.234	5.94		

FIGURE 4. Connector, plug, electrical, interface dimensions.

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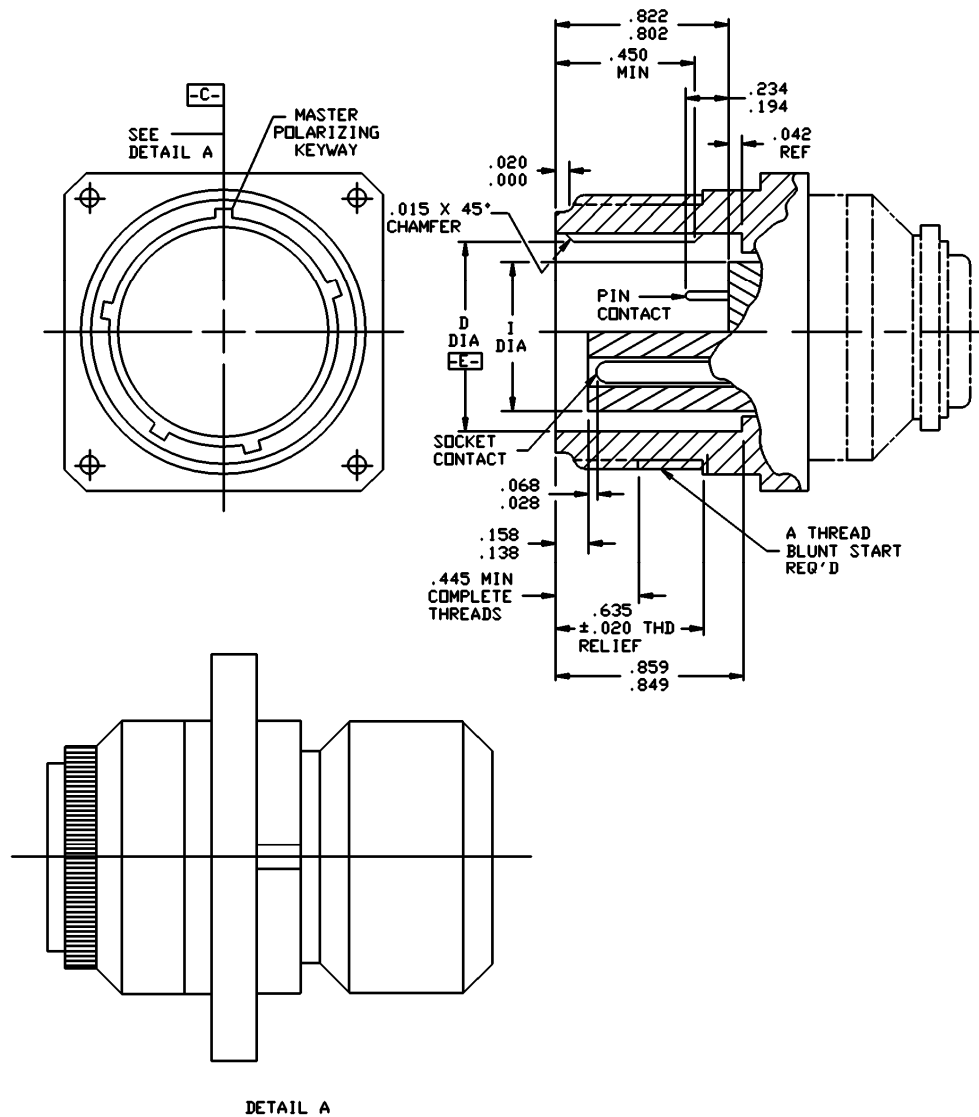
Designator (see note 3)	A thread class 2B	E dia	F dia	I dia
A (11)	.750-.1P-.2L-D.S.	.502 (12.75) .492 (12.50)	.381 (9.68) .371 (9.42)	.367 (9.32) .352 (8.94)
B (13)	.875-.1P-.2L-D.S.	.626 (15.90) .616 (15.65)	.503 (12.79) .493 (12.52)	.489 (12.42) .474 (12.04)
C (15)	1.062-.1P-.2L-D.S.	.798 (20.27) .788 (20.02)	.681 (17.30) .671 (17.04)	.667 (16.91) .652 (16.56)
D (17)	1.125-.1P-.2L-D.S.	.868 (22.05) .858 (21.79)	.758 (19.25) .748 (19.00)	.744 (18.90) .729 (18.52)
E (19)	1.312-.1P-.2L-D.S.	1.035 (26.29) 1.025 (26.01)	.902 (22.91) .892 (22.66)	.888 (22.56) .873 (22.17)
F (23)	1.500-.1P-.2L-D.S.	1.220 (30.99) 1.210 (30.73)	1.087 (27.61) 1.377 (27.36)	1.073 (27.25) 1.058 (26.87)
G (25)	1.625-.1P-.2L-D.S.	1.381 (35.08) 1.371 (34.82)	1.276 (32.41) 1.266 (32.16)	1.262 (32.05) 1.247 (31.67)
H (29)	1.812-.1P-.2L-D.S.	1.547 (39.29) 1.537 (39.04)	1.427 (36.25) 1.417 (35.99)	1.412 (35.86) 1.397 (35.48)
J (33)	2.000-.1P-.2L-D.S.	1.739 (44.17) 1.729 (43.92)	1.625 (41.28) 1.615 (41.02)	1.610 (40.89) 1.595 (40.51)

NOTES:

1. Dimensions are in inches.
2. Metric equivalents are given for information only.
3. Shell sizes are provided within parentheses for information only, and are not a part of the designator.
5. Dimensions apply after plating.
6. Mating key positions and dimensions as specified on [figure 3](#).
7. This design information establishes connector intermating criteria and interchangeability of accessory hardware.
8. Rear end connector design for attachment of non-rotatable accessory hardware as specified on [figure 6](#).
9. Dimension includes contact slack.
10. Distance from front of plug barrel to the point at which the gauge ring having the same nominal inside diameter as the receptacle shell first engages the spring member.

FIGURE 4. Connector, plug, electrical, interface dimensions - Continued.

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Inches	mm	Inches	mm	Inches	mm	Inches	mm
.015	0.38	.042	1.07	.194	4.93	.525	13.34
.020	0.52	.060	1.52	.234	5.94	.635	16.14
.028	0.71	.068	1.73	.445	11.31	.802	20.37
.030	0.76	.138	3.51	.450	11.43	.822	20.88
.040	1.03	.158	4.01	.515	13.08	.849	21.56
						.859	21.82

FIGURE 5. Connector, receptacle, electrical, interface dimensions.

MIL-DTL-28840B

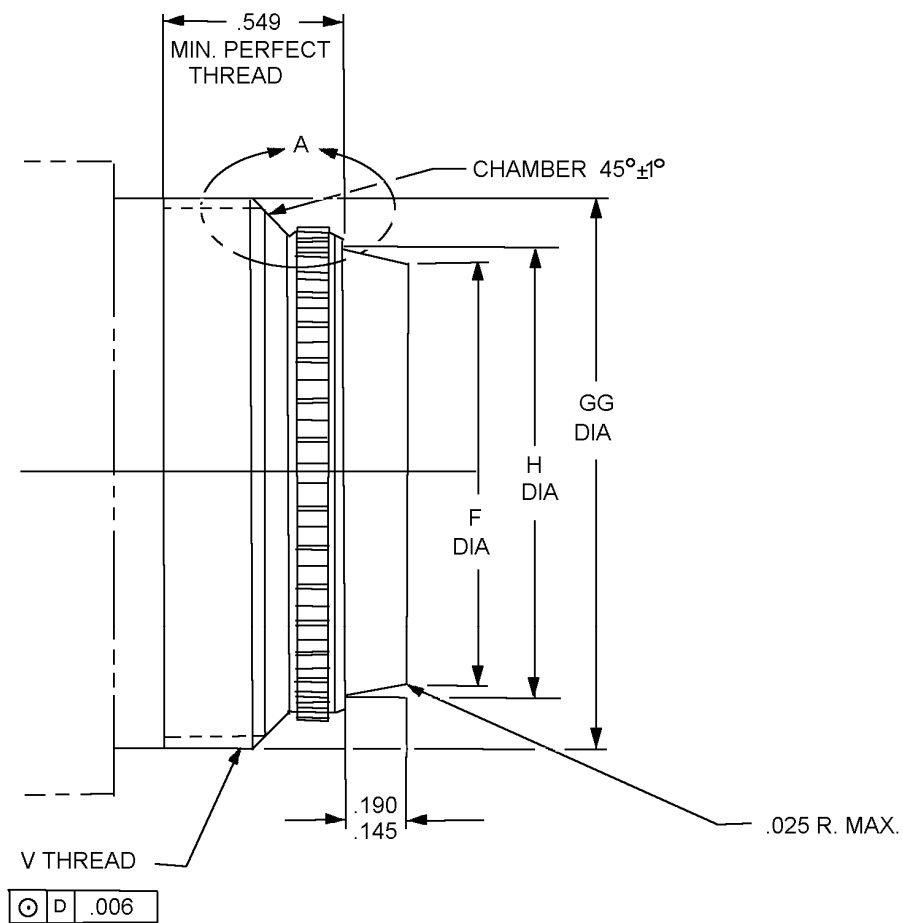
Designator (see note 3)	A-thread class 2A	D dia	I dia
A (11)	.750-.1P-.2L-D.S.	.513 (13.03) .504 (12.80)	.367 (9.32) .352 (8.94)
B (13)	.875-.1P-.2L-D.S.	.637 (16.18) .628 (15.95)	.489 (12.12) .474 (12.04)
C (15)	1.062-.1P-.2L-DS	.809 (20.55) .800 (20.32)	.667 (16.91) .652 (16.56)
D (17)	1.125-.1P-.21-D.S.	.579 (22.33) .870 (22.10)	.744 (18.90) .729 (18.52)
E (19)	1.312-.1P-.2L-D.S.	1.046 (26.57) 1.037 (26.34)	.883 (22.56) .873 (22.17)
F (23)	1.500-.1P-.2L-D.S.	1.231 (31.27) 1.222 (31.04)	1.073 (27.25) 1.058 (26.87)
G (25)	1.625-.1P-.2L-D.S.	1.392 (35.36) 1.383 (35.13)	1.262 (32.95) 1.247 (31.67)
H (29)	1.812-.1P-.2L-D.S.	1.558 (39.57) 1.549 (39.34)	1.412 (35.86) 1.397 (35.48)
J (33)	2.000-.1P-.2L-D.S.	1.750 (44.45) 1.741 (44.22)	1.610 (40.89) 1.595 (40.51)

NOTES:

1. Dimensions are in inches.
2. Metric equivalents are given for information only.
3. Shell sizes are provided within parentheses for information only and are not a part of the designator.
4. Dimensions apply after plating.
5. Mating keyway positions and dimensions as specified on [figure 3](#).
6. This design information establishes connector intermating criteria and interchangeability of accessory hardware.
7. Rear end connector design for attachment of non-rotatable accessory hardware as specified on [figure 6](#).
8. Dimensions include contact slack.

FIGURE 5. Connector, receptacle, electrical, interface dimensions - Continued.

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Inches	mm
.006	0.15
.145	3.68
.190	4.83
.549	13.94

FIGURE 6. Connector back-end configuration.

MIL-DTL-28840B

Designator (see note 3)	A BSC	C	F dia	H dia max grommet	V thread class 2A
A (11)	20°	.0515 (1.31) .0465 (1.18)	.388 (9.86) .358 (9.09)	.447 (11.35)	3/4 – 20 UNEF
B (13)	20°	.0615 (1.56) .0565 (1.44)	.523 (13.28) .493 (12.52)	.582 (14.78)	7/8 – 20 UNEF
C (15)	18°	.0660 (1.68) .0610 (1.55)	.680 (17.27) .650 (16.51)	.727 (18.47)	1 – 20 UNEF
D (17)	15°	.0630 (1.60) .0580 (1.47)	.765 (19.43) .735 (18.67)	.824 (20.93)	1 1/8 – 18 UNEF
E (19)	15°	.0720 (1.83) .0670 (1.70)	.897 (22.78) .867 (22.02)	.956 (24.28)	1 1/4 – 18 UNEF
F (23)	12°	.0680 (1.73) .0630 (1.60)	1.094 (27.79) 1.064 (27.02)	1.153 (29.29)	1 7/16 – 18 UNEF
G (25)	10°	.0645 (1.64) .0595 (1.51)	1.261 (32.03) 1.231 (31.27)	1.322 (33.58)	1 9/16 – 18 UNEF
H (29)	9°	.0680 (1.73) .0630 (1.60)	1.463 (37.16) 1.433 (36.40)	1.522 (38.66)	1 7/8 – 16 UN
J (33)	8°	.0680 (1.73) .0630 (1.60)	1.661 (42.19) 1.631 (41.43)	1.720 (43.69)	2 1/16 – 16 N

FIGURE 6 . Connector back-end configuration – Continued.

MIL-DTL-28840B

Designator (see note 3)	A BSC	EE dia	FF dia	GG dia max	HH dia
A (11)	20°	.549 (13.94) .543 (13.79)	.540 (13.72) .534 (13.56)	.755 (19.18)	.573 (14.55) .567 (14.40)
B (13)	20°	.664 (16.87) .658 (16.71)	.655 (16.64) .649 (16.48)	.880 (22.35)	.688 (17.48) .682 (17.32)
C (15)	18°	.799 (20.29) .793 (20.14)	.790 (20.07) .784 (19.91)	1.005 (25.53)	.823 (20.90) .817 (20.75)
D (17)	15°	.906 (23.01) .900 (22.86)	.897 (22.78) .891 (22.63)	1.130 (28.70)	.930 (23.62) .924 (23.47)
E (19)	15°	1.041 (26.44) 1.035 (26.29)	1.032 (26.21) 1.026 (26.06)	1.255 (31.88)	1.065 (27.05) 1.059 (26.90)
F (23)	12°	1.228 (31.19) 1.222 (31.04)	1.219 (30.96) 1.213 (30.81)	1.443 (36.65)	1.252 (31.80) 1.246 (31.65)
G (25)	10°	1.388 (35.26) 1.382 (35.10)	1.379 (35.03) 1.373 (34.87)	1.567 (39.80)	1.412 (35.86) 1.406 (35.71)
H (29)	9°	1.639 (41.63) 1.633 (41.48)	1.630 (41.40) 1.624 (41.25)	1.880 (47.75)	1.663 (42.24) 1.657 (42.09)
J (33)	8°	1.834 (46.58) 1.828 (46.43)	1.825 (46.36) 1.819 (46.20)	2.067 (52.50)	1.858 (47.19) 1.852 (47.04)

NOTES:

1. Dimensions are in inches.
2. Metrics are given for information only.
3. Shell sizes are provided within parentheses for information only and are not a part of the designator.
4. Dimensions apply after plating.

FIGURE 6 . Connector back-end configuration - Continued.

MIL-DTL-28840B

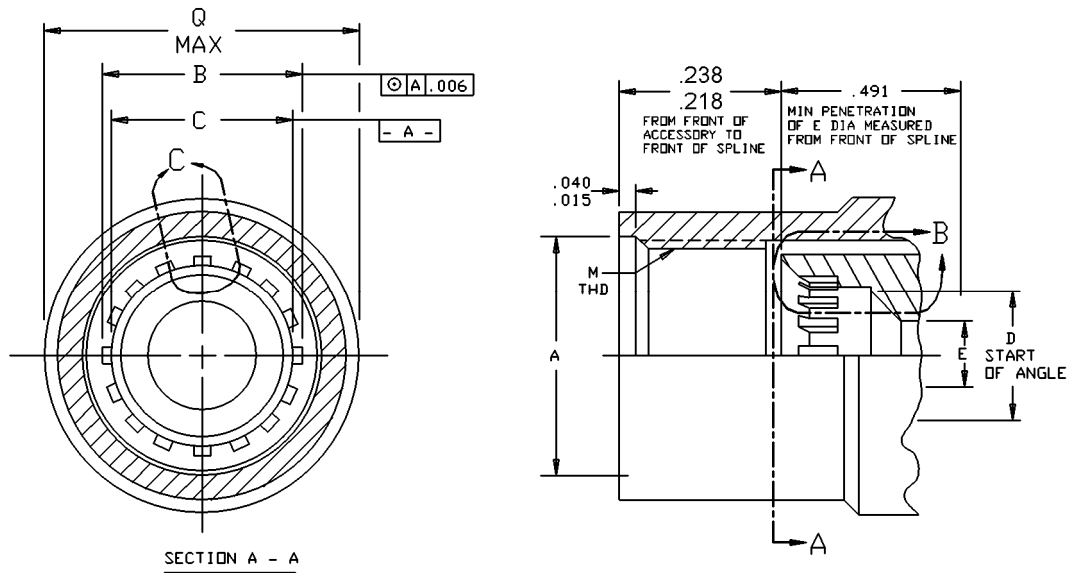


FIGURE 7. Connector, electrical, rear accessory design standard.

MIL-DTL-28840B

Designator (see note 3)	A dia	B dia	C dia
A (11)	.770 (19.56) .750 (19.05)	.583 (14.81) .579 (14.71)	.556 (14.12) .553 (14.05)
B (13)	.895 (22.73) .875 (22.22)	.698 (17.73) .694 (17.63)	.671 (17.04) .668 (16.97)
C (15)	1.020 (25.91) 1.000 (25.40)	.833 (21.16) .829 (21.06)	.806 (20.47) .803 (20.40)
D (17)	1.145 (29.08) 1.125 (28.58)	.940 (23.88) .936 (23.77)	.913 (23.19) .910 (23.11)
E (19)	1.270 (32.26) 1.250 (31.75)	1.075 (27.30) 1.071 (27.20)	1.048 (26.62) 1.045 (26.54)
F (23)	1.458 (37.03) 1.438 (36.52)	1.262 (32.05) 1.232 (31.29)	1.235 (31.37) 1.232 (31.29)
G (25)	1.582 (40.18) 1.562 (39.67)	1.422 (36.12) 1.418 (36.02)	1.395 (35.43) 1.392 (32.13)
H (29)	1.895 (48.23) 1.875 (47.62)	1.673 (43.49) 1.669 (42.39)	1.646 (41.81) 1.643 (41.73)
J (33)	2.082 (52.88) 2.062 (52.37)	1.868 (47.45) 1.864 (47.34)	1.841 (46.76) 1.838 (46.68)

Designator (see note 3)	D dia	J BSC	K
A (11)	.447 (11.35) .427 (10.84)	20°	.0445 (1.13) .0425 (1.08)
B (13)	.582 (14.78) .562 (14.27)	20	.0545 (1.38) .0525 (1.33)
C (15)	.727 (18.47) .707 (17.96)	18°	.0590 (1.50) .0570 (1.45)
D (17)	.824 (20.93) .804 (20.42)	15°	.0560 (1.42) .0540 (1.37)
E (19)	.956 (24.28) .936 (23.77)	15°	.0650 (1.65) .0630 (1.60)
F (23)	1.153 (29.29) 1.133 (28.78)	12°	.0610 (1.55) .0590 (1.50)
G (25)	1.285 (32.64) 1.265 (32.13)	10°	.0575 (1.46) .0555 (1.41)
H (29)	1.522 (38.66) 1.502 (38.15)	9°	.0610 (1.55) .0590 (1.50)
J (33)	1.720 (43.69) 1.700 (43.18)	8°	.0610 (1.55) .0590 (1.50)

FIGURE 7. Connector, electrical, rear accessory design standard - Continued.

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Designator (see note 3)	E dia	M thread class 2B	P dia
A (11)	.367 (9.32) .357 (9.07)	3/4 – 20 UNEF	.658 (16.71) .652 (16.56)
B (13)	.502 (12.75) .492 (12.50)	7/8 – 20 UNEF	.773 (19.63) .767 (28.98)
C (15)	.647 (16.43) .637 (16.18)	1 – 20 UNEF	.908 (23.06) .902 (22.91)
D (17)	.744 (18.90) .734 (18.64)	1 1/8 – 18 UNEF	1.015 (25.78) 1.009 (25.63)
E (19)	.876 (22.25) .866 (22.00)	1 1/4 – 18 UNEF	1.150 (29.21) 1.144 (29.06)
F (23)	1.073 (27.25) 1.063 (27.00)	1 7/16 – 18 UNEF	1.337 (33.96) 1.331 (33.81)
G (25)	1.205 (30.61) 1.195 (30.35)	1 9/16 – 18 UNEF	1.473 (37.41) 1.467 (37.26)
H (29)	1.442 (36.63) 1.432 (36.37)	1 7/8 – 16 UN	1.748 (44.40) 1.742 (44.25)
J (33)	1.640 (41.66) 1.630 (41.40)	1/16 – 16 N	1.943 (49.35) 1.937 (49.20)

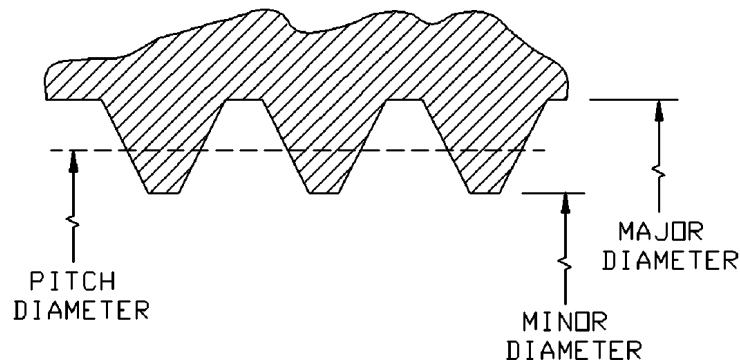
Designator (see note 3)	Q dia max	R dia max
A (11)	1.028 (26.11)	.588 (14.94)
B (13)	1.141 (28.98)	.703 (17.86)
C (15)	1.263 (32.08)	.838 (21.28)
D (17)	1.387 (35.23)	.945 (24.00)
E (19)	1.513 (38.43)	1.080 (27.43)
F (23)	1.703 (43.26)	1.267 (32.18)
G (25)	1.825 (46.36)	1.427 (36.24)
H (29)	2.143 (54.43)	1.678 (42.62)
J (33)	2.329 (59.16)	1.873 (47.57)

NOTES:

1. Dimensions are in inches.
2. Metric equivalents are given for information only.
3. Shell sizes are provided within parentheses for information only and are not a part of the designator.
4. Dimensions apply after plating.
5. The coupling nut shall be captive and free to rotate on accessory.

FIGURE 7. Connector, electrical, rear accessory design standard - Continued.

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INTERNAL THREADS

Class 2B thread, 0.1 pitch, Modified 60° stub internal
 Double thread series in accordance with MIL-STD-1373, Symbol DS-2B

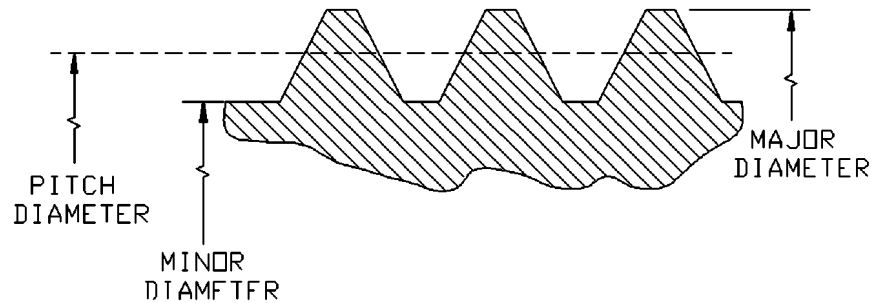
Designation			Internal thread-limits of size							
Thread size	Pitch	Lead	Minor diameter			Pitch diameter			Major diameter	
			Limits		Tolerance	Limits		Tolerance	Limits	
			min	max		min	max		min	max
.7500 (19.050)	.1	.2	.7042 (17.887)	.7142 (18.141)	.0100 (.254)	.7240 (18.390)	.7340 (18.644)	.0100 (.254)	.7540 (19.152)	.7700 (19.558)
.8750 (22.225)	.3	.2	.8292 (21.062)	.8392 (21.316)	.0100 (.254)	.8490 (21.565)	.8590 (21.819)	.0100 (.254)	.8790 (22.327)	.8950 (22.733)
1.0625 (26.988)	.1	.2	1.0025 (25.464)	1.0145 (25.768)	.0120 (.305)	1.0285 (26.124)	1.0405 (26.429)	.0120 (.305)	1.0665 (27.089)	1.0865 (27.597)
1.1250 (28.575)	.1	.2	1.0650 (27.051)	1.0770 (27.356)	.0120 (.305)	1.0910 (27.711)	1.1030 (28.016)	.0120 (.305)	1.1290 (28.677)	1.1490 (29.185)
1.3125 (33.338)	.1	.2	1.2525 (31.814)	1.2645 (32.118)	.0120 (.305)	1.2785 (32.474)	1.2905 (32.779)	.0120 (.305)	1.3165 (33.439)	1.3365 (33.947)
1.5000 (38.100)	.1	.2	1.4400 (36.576)	1.4520 (36.881)	.0120 (.305)	1.4660 (37.236)	1.4780 (37.541)	.0120 (.305)	1.5040 (38.202)	1.5240 (38.710)
1.6250 (41.275)	.1	.2	1.5650 (39.751)	1.5770 (40.056)	.0120 (.305)	1.5910 (40.411)	1.6030 (40.716)	.0120 (.305)	1.6290 (41.377)	1.6490 (41.885)
1.8125 (46.038)	.1	.2	1.1525 (29.274)	1.7645 (44.818)	.0120 (.305)	1.7785 (45.174)	1.7905 (45.479)	.0120 (.305)	1.8165 (46.139)	1.8365 (46.647)
2.0000 (50.800)	.1	.2	1.9400 (49.276)	1.9520 (49.581)	.0120 (.305)	1.9660 (49.936)	1.9780 (50.241)	.0120 (.305)	2.0040 (50.902)	2.0240 (51.410)

NOTES:

1. Formulas for these values are in accordance with MIL-STD-1373
2. For all other dimensions not shown refer to MIL-STD-1373.
3. Dimensions are in inches.
4. Metric equivalents are given for information only.

FIGURE 8. Connector mating threads internal.

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EXTERNAL THREADS

Class 2A thread, 0.1 pitch, Modified 60° stub external
Double thread series in accordance with MIL-STD-1373, Symbol DS-2A

Destination			Allowance	External thread-limits of size							
Thread size	Pitch	Lead		Major diameter		Pitch diameter		Minor diameter			
				limits		Tolerance	limits		Tolerance	limits	
				min	max		min	max		min	max
.7500 (19.050)	.1	.2	.0015 (0.0381)	.7485 (19.012)	.7405 (18.809)	.0080 (0.203)	.7225 (18.352)	.7145 (18.148)	.0080 (0.203)	.6925 (17.590)	.6785 (17.234)
.8750 (22.225)	.1	.2	.0015 (0.0381)	.8735 (22.187)	.8655 (21.984)	.0080 (0.203)	.8475 (21.527)	.8395 (21.323)	.0080 (0.203)	.8175 (20.765)	.8035 (20.409)
1.0625 (26.988)	.1	.2	.0020 (0.0508)	1.0605 (26.937)	1.0485 (26.632)	.0120 (0.305)	1.0265 (26.073)	1.0165 (25.819)	.0120 (0.305)	.9885 (25.362)	.9705 (24.651)
1.1250 (28.575)	.1	.2	.0020 (0.0508)	1.1230 (28.524)	1.1110 (28.219)	.0120 (0.305)	1.0890 (27.661)	1.0790 (27.407)	.0120 (0.305)	1.0510 (26.695)	1.0330 (26.238)
1.3125 (33.338)	.1	.2	.0020 (0.0508)	1.3105 (33.287)	1.2985 (32.982)	.0120 (0.305)	1.2765 (32.423)	1.2665 (32.169)	.0120 (0.305)	1.2385 (31.458)	1.2205 (31.001)
1.5000 (38.100)	.1	.2	.0020 (0.0508)	1.4980 38.049	1.4860 (37.744)	.0120 (0.305)	1.4640 (37.186)	1.4540 (36.932)	.0120 (0.305)	1.4260 (36.220)	1.4080 (35.763)
1.6250 (41.275)	.1	.2	.0020 (0.0508)	1.6230 41.224	1.6110 (40.919)	.0120 (0.305)	1.5890 (40.361)	1.5790 (40.107)	.0120 (0.305)	1.5510 (39.395)	1.5330 (38.938)
1.8125 (46.038)	.1	.2	.0020 (0.0508)	1.8105 (45.987)	1.7985 (45.682)	.0120 (0.305)	1.7765 (45.123)	1.7665 (44.869)	.0120 (0.305)	1.7385 (44.158)	1.7205 (43.701)
2.0000 (5.800)	.1	.2	.0020 (0.0508)	1.9980 (50.749)	1.9860 (50.444)	.0120 (0.305)	1.9640 (49.886)	1.9540 (49.632)	.0120 (0.305)	1.9260 (48.920)	1.9080 (48.463)

NOTES:

1. Formulas for these values are in accordance with MIL-STD-1373
2. For all other dimensions not shown refer to MIL-STD-1373.
3. Dimensions are in inches.
4. Metric equivalents are given for information only.

FIGURE 9. Connector mating threads external.

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3.4.2.1 Insert retention.3.4.2.1.1 Inserts. Inserts shall be non-removable.

3.4.2.2 Inserts and wire sealing grommets. The insert assembly shall be one integral part and permit the removal and reinsertion of individual contacts without damage to the sealing members or contact retention device.

3.4.2.3 Contact arrangement. Contacts shall be spaced in accordance with MIL-STD-1698.3.4.2.4 Contact spacing. Contacts shall be arranged in accordance with MIL-STD-1698

3.4.2.5 Contact alignment. Inserts for socket contacts shall provide an overall side play of the socket contacts of 0.0025 to 0.0075 inch from the required position to facilitate alignment of mating pin contacts.

3.4.2.6 Pin contact stability. When tested as specified in 4.6.22 the total displacement of reference point on the contact tip end shall not exceed .030 inch maximum with a one-half pound force applied.

3.4.2.7 Contact retention member. The contact retention member shall be a machined metallic clip.

3.4.3 Coupling screw threads. Coupling screw threads shall be .1P-.2L-DS Screw Thread, Modified, 60 Stub, Double Class 2A or 2B (see figures 8 and 9). Screw threads shall be checked after plating by means of ring or plug gages only, in accordance with FED-STD-H28. Slight out-of-roundness beyond the tolerance as specified on figures 8 and 9 is acceptable if the threads can be checked without forcing the thread gages. Screw threads may be relieved provided the relief does not interfere with proper performance of the screw threads.

3.4.4 Shell design. Connector shells shall be seamless and retain their inserts in a positive manner.

3.4.4.1 Lubrication. All internal coupling ring threads shall be coated with a lubricant during manufacture.

3.4.4.2 Spring fingers. Spring fingers shall be installed to make peripheral electrical contact with the mating shell, without interfering with proper engagement. The springs shall be retained about the plug periphery. Minimum engagement of the spring fingers shall be 0.040 inch prior to contact engagement.

3.4.4.3 Finish. All surfaces shall have a finish thickness of 125 micro inches, unless otherwise specified herein.

3.4.4.4 Jam (panel) nut. The panel nut for M28840/14 connectors shall be as specified in the specification sheet. MS3186 may be used for procurement of spare panel nuts. Panel nuts in accordance with MIL-DTL-28840 connectors or parts do not require bayonet clearance slots.

3.4.5 Coupling connections. Threaded coupling rings shall be knurled, and designed so that the pin and socket contacts shall engage or disengage as the ring is respectively tightened or loosened. The coupling rings of connector plugs shall be captive to the shell.

3.4.5.1 Safety coupling rings. Coupling rings shall be designed for safety wiring. At least two holes shall be provided for shell sizes 15 and smaller, and at least three equally spread holes for connector sizes 17 and larger. These holes shall be of a diameter sufficient to accommodate 0.032 inch diameter wire.

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3.4.5.2 Shell polarization. Polarization of connectors shall be accomplished by matched integral key and keyway of counterpart connectors. The polarization of counterpart connectors shall take place before coupling rings are engaged.

3.4.3.2.1 Backshell polarization. The backshell splines key and keyway shall be polarized and mated prior to coupling.

3.4.5.3 Engagement seal. Connectors shall contain sealing means so that engaged connectors comply with the requirements specified herein. The design of the seal shall be such that in mated connectors all air paths between adjacent contacts and between contacts and shells are eliminated. There shall be interfacial mating of the engaged connector insert to provide dielectric under compression of 0.005 inch minimum. Connector plug shells shall be provided with a static peripheral seal to ensure shell to shell sealing.

3.4.5.4 Safety wire holes. Safety wire holes shall not pull out when tested as specified in 4.6.24.

3.4.6 Wire sealing. Connectors, except box mounting receptacles, shall be provided with a wire sealing grommet capable of sealing on wire sizes specified in [table III](#) when used with suitable rear accessory (backshell).

3.4.6.1 Grommet sealing plug. The grommets of connectors shall be designed to accept sealing plugs in accordance with MS27488 in lieu of wire where unwired contacts are employed. Sealing plugs for 15 percent of the number of contacts but not less than 1, shall be enclosed in the unit package. For indirect shipments, connectors may be ordered without grommet sealing plugs (see [6.2](#)).

3.4.7 Wire separator. Box mounting receptacles shall have a wire separator in lieu of a wire sealing grommet, which shall extend to at least the rear end of the connector shell. The wire separator is not required to be capable of sealing on wires.

3.5 Intermateability and interchangeability.

3.5.1 Intermateability. Plug and receptacle connectors having the same shell size, keying, and contact arrangement shall be intermateable.

3.5.2 Interchangeability. All connectors and accessories having the same military PIN shall be completely interchangeable with each other with respect to installation (physical) and performance (function) as specified herein.

3.6 Magnetic permeability. The relative magnetic permeability of aluminum and stainless steel connectors and accessories shall be less than 2.0 and 5.0, respectively, when tested as specified in [4.6.2](#).

3.7 Thermal shock. There shall be no evidence of damage detrimental to the operation of the connector after being subjected to the temperature extremes in [4.6.3](#).

3.8 Contact retention. The axial displacement of contacts shall not exceed 0.012 inch and contacts shall be retained in their inserts when subjected to an axial load of 20 pounds when tested as specified in [4.6.4](#).

3.9 Dielectric withstanding voltage. Connectors shall show no evidence of breakdown or flashover when subjected to the test voltage in [4.6.5.1](#). Corona shall not be considered as a breakdown.

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3.10 Vibration. Mated connectors shall not be damaged and there shall be no loosening of parts due to vibration. Counterpart connectors shall, be retained in full engagement, and there shall be no interruption of electrical continuity of one microsecond or longer when tested as specified in [4.6.6.1](#).

3.11 High impact shock. Mated connectors shall not be damaged and there shall be no loosening of parts, nor shall there be an interruption of electrical continuity one microsecond or longer during the exposure to mechanical shock when tested in [4.6.7](#).

3.12 Contact resistance. Contacts in the mated condition shall meet the ambient (25°C) contact resistance requirements in accordance with SAE-AS39029 (see [4.6.8](#)).

3.13 Durability. Counterpart connectors shall show no mechanical or electrical defects detrimental to the operation of the connector after 100 cycles of coupling and uncoupling in [4.6.9.1](#). The connectors shall be subjected to 50 cycles, before and after the corrosion test. No lubricant shall be applied prior, during or after the test except as specified in [3.4.4.1](#).

3.14 Salt spray (corrosion). When tested in [4.6.10](#), connectors shall show no exposure of basis material due to corrosion when evaluated as specified in SAE-AIR 4789.

3.15 Insulation resistance.

3.15.1 At ambient temperature. The insulation resistance at 25°C (77°F) shall be greater than 5,000 megohms when tested in [4.6.11.2](#).

3.15.2 At elevated temperature - (long time). The insulation resistance shall be 1000 megohms at 200°C as specified on [figure 1](#) when tested in [4.6.11.3](#).

3.16 Fluid immersion. When tested as specified in [4.6.12](#), the connectors shall meet the requirements for coupling torque (see [3.28](#)) and dielectric withstanding voltage (see [3.9](#)).

3.17 Insert retention. Inserts shall not be dislocated from their original positions or damaged when they are subjected to the specified pressures in [4.6.13](#).

3.18 Humidity. Mated connectors with any rear accessory hardware assembled shall maintain an insulation resistance of 100 megohms or greater at 25°C after being subjected to the humidity test in [4.6.14](#).

3.19 Water pressure.

3.19.1 Sealing connectors. Mated connectors assembled with backshells shall exhibit an insulation resistance of 1.00 megohms or greater after being subjected to the water pressure test. They shall show no evidence of entrance of water when subjected to the test in [4.6.15](#).

3.19.2 Backshells. Cable adapters shall show no evidence of entrance of water when subjected to the water pressure test in [4.6.15](#).

3.20 Cable pull-out. Cables shall not pull out when the loads are applied in [4.6.16](#) nor shall the slippage exceed .125 inch.

3.21 External bending moment. Connectors shall, exhibit no evidence of damage, as revealed by inspection with 3X magnification, when stressed using the applicable bending moment in [4.6.17](#).

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3.22 Shell conductivity. Mated connectors shall be electrically conductive from the plug accessory thread to the receptacle mounting flange or to the accessory thread on the cable connecting receptacle. The overall dc resistance shall not exceed 0.005 ohms when measured in 4.6.18.1. When tested with accessory on the dc resistance should not exceed 0.010 ohms when measured in 4.6.18.2.

3.23 Maintenance aging (contact installing and removal forces). The forces required to install and remove unlocked contacts shall not exceed 10 pounds maximum when tested in 4.6.19.

3.24 EMI shielding. When tested as specified in 4.6.21, the EMI shielding capabilities of mated connectors shall not be less than that specified in table IV at the specified frequencies.

TABLE IV. EMI Shielding Effectiveness.

Frequency (Megahertz)	Attenuation (Decibels)
100	60 min.
200	50 min.
400	45 min.
600	45 min.
800	35 min.
1000	40 min.

3.25 Impact. When connector plugs with straight strain relief clamps and protective covers are tested as specified in 4.6.20, there shall be no breaking or cracking of inserts, bending of pins or any other damage which prevents the connectors from being mated or renders them unfit to continue further testing. Any chipping of the inserts which affects its polarization or retention in the shell shall be considered a failure.

3.26 Marking. Each connector shall be legibly and permanently marked on the shell, or coupling ring in accordance with MIL-STD-1285. The military PIN shall be as shown in 1.2.1 (see 3.1.). The connector shall be marked with the connector PIN. The connector assembly PIN shall only be marked on the plastic bag containing the assembly.

3.26.1 Insert marking. Inserts shall be marked as specified in MIL-STD-1698 manufacturer's identification is permitted. Raised or depressed characters shall not be used on insert mating faces for any markings.

3.26.1.1 Contact designations. Contact identification on connector inserts shall be designated by identifiable letters or numbers of contrasting color. Positioning and arrangement of the characters shall be designated on the front face of the insert.

3.26.1.2 Connectors. Eighty percent of the characters on any face of the connectors shall remain identifiable after completion of the tests as specified in table VI.

3.26.1.3 Grommet and insulating spacers. Where space permits, wire openings on the rear face of grommets and wire separator shall be marked with legible characters corresponding to the insert contact designators. Contrasting colored characters shall be used.

3.26.1.4 Use of military PIN. Military PIN shall not be applied to a product, except for qualification test samples (see 6.3), until notification has been received from the activity responsible for qualification that the product has been approved for listing on the qualified products list (QPL).

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3.27 Workmanship. Poor molding fabrication, loose materials, defective bonding, damaged or improperly assembled contacts, peeling, or chipping of plating or finish, galling of mating parts, nicks and burrs of metal parts and post molding warpage will be considered adequate basis for rejection of items.

3.28 Coupling torque. When tested as specified in 4.6.23, the coupling torque for mating of the counterpart connectors and protective covers shall meet the requirement as specified in [table V](#).

TABLE V. Coupling torque.

Shell size	Maximum engagement and disengagement (lb-in)
A (11)	12
B (13)	16
C (15)	20
D (17)	24
E (19)	28
F (23)	36
G (25)	40
H (29)	47
J (33)	53

3.29 Change effectivity. Unless otherwise specified by the preparing activity and/or the qualifying activity, all changes from the previous revision shall become effective within 90 days from the date of publication of the latest revision. QPL listed Manufacturers who have concerns regarding possible changes to retention reporting requirements, should contact the Qualifying Activity for clarification.

3.30 Disposition of stock. Unless otherwise specified by the preparing activity and/or the qualifying activity, qualified manufacturers and their selling agents or distributors may ship from stock; connectors and accessories which were manufactured with the previous revision in for a period of 6 months from the date of the latest revision.

3.31 Pure tin. The use of pure tin, as an underplate or final finish, is prohibited both internally and externally. Tin content of connector components and solder shall not exceed 97 percent, by mass. Tin shall be alloyed with a minimum of 3 percent lead, by mass (see [6.9](#)).

4. VERIFICATION

4.1 Classification of inspection. The inspection of connectors shall be classified as follows:

- a. Qualification inspection (see [4.3](#)).
- b. Conformance inspection (see [4.4](#)).

4.1.1 Fungus resistance certification. Certification of method 508.4 of MIL-STD-810 is required (see [3.3.6](#)).

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4.1.2 Inspection conditions. Unless otherwise specified herein, all inspections shall be performed under any combination of conditions within the following ranges. Any specified condition shall not affect the other two ambient ranges.

Temperature: 15° to 35°C

Relative humidity: 30 to 80 percent

Barometric pressure: 650 to 800 mm of mercury

4.2 Test equipment and inspection facilities. Test and measuring equipment and inspection facilities of sufficient accuracy, quality and quantity to permit performance of the required inspection shall be established and maintained by the contractor. The establishment and maintenance of a calibration system to control the accuracy of the measuring and test equipment shall be in accordance with NCSL-Z540-1.

4.2.1 Established reliability assurance program. A reliability assurance program shall be established and maintained in accordance with MIL-STD-790. Evidence of such compliance shall be verified by the qualifying activity of this specification as a prerequisite for qualification and continued qualification.

4.2.1.1 Statistical process control (SPC). A SPC program shall be established and maintained in accordance with EIA-557. Evidence of such compliance shall be verified by the qualifying activity as a prerequisite for qualification and retention of qualification.

4.2.2 Assembly plants. Assembly plants must be listed on or approved for listing on the applicable qualified products list. The qualified connector manufacturer shall certify that the assembly plant is approved for the distribution of the manufacturer's parts. 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. Assemblies produced at the assembly plant shall be subjected to inspection to assure that the assembly process conforms with that established at the qualified manufacturing plant. Quality control requirements, including Government inspection surveillance, shall be the same as required for the qualified connector manufacturer.

4.3 Qualification inspection. Qualification inspection shall consist of the examinations and tests performed in the sequence specified in [table VI](#) on the qualification test samples specified in 4.3.2. After receipt of the letter of authorization from the agent responsible for qualification, the applicant shall submit three copies of his test reports (certified by the Government inspector indicating the extent to which the tests were witnessed), to the agent responsible for qualification.

4.3.1 Qualification of additional connectors. Qualification by similarity to qualified connectors or connectors submitted for qualification is permissible when materials, designs and manufacturing processes are identical. When materials, designs or manufacturing processes differ, sufficient testing to prove the adequacy of the affected characteristics will be required to obtain qualification by similarity. Full details of the similarity and differences, along with proposed tests, shall be submitted to the qualifying activity for approval prior to the commencing of testing. Provided receptacle wall mounting is qualified, the receptacle cable connecting, receptacle jam nut mounting and dummy receptacle wall mounting of the same shell size may be qualified by similarity. Box mount receptacle shell sizes will be tested to groups 1, 2, 3, and 4 in [table V](#), except for those tests requiring moisture or fluid sealing and rear accessory hardware. One sample in each shell size for which qualification is desired shall be tested in [table VI](#), group 5. Provided one backshell is qualified all backshells of the same size may be qualified by similarity.

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4.3.2 Qualification samples. Samples of each shell size for which qualification is desired shall be tested in the sequence specified in [table VI](#), as applicable. Specific details on preparation of samples shall be as follows: Each connector subjected to qualification testing shall be provided with a counterpart connector or those tests requiring mating assemblies. The counterpart connectors provided for this purpose shall be new, previously qualified connectors or new connectors submitted for qualification testing. Manufacturers not producing mating connectors shall submit data substantiating that tests were performed with approved counterpart connectors.

4.3.2.1 Wire-to-contact assembly. Unless otherwise specified herein, connectors shall be wired with approximately 3 feet of wire as applicable, selected from those specified in [table III](#). Where wired contacts are required, terminations shall be accomplished as follows.

4.3.2.1.2 Contacts. Contacts shall be crimped with tools in accordance with MIL-DTL-22520 as specified on the applicable contact specification sheet.

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TABLE VI. Qualification inspection.

Inspection	Requirement paragraph	Test paragraph
<u>Group 1</u>		
Visual and mechanical examination	3.1, 3.3, 3.4, 3.5, 3.26, 3.27	4.6.1
Magnetic permeability	3.6	4.6.2
Shell conductivity	3.22	4.6.18.1
Maintenance aging	3.23	4.6.19
Pin contact stability	3.4.2.6	4.6.22
Insulation resistance at ambient temperature	3.15.1	4.6.11.2
Dielectric withstanding voltage	3.9	4.6.5.1
Thermal shock	3.7	4.6.3
Humidity	3.18	4.6.14
Coupling torque	3.28	4.6.23
Durability	3.13	4.6.9.1
Salt spray (corrosion)	3.14	4.6.10.1
Coupling torque	3.28	4.6.23
Shell conductivity	3.22	4.6.18.1
Contact resistance	3.12	4.6.8
Contact retention	3.8	4.6.4
Insert retention	3.17	4.6.13
External bending moment	3.21	4.6.17
Visual and mechanical examination	3.1, 3.3, 3.6, 3.5, 3.26, 3.27	4.6.1
<u>Group 2</u>		
Visual and mechanical examination	3.1, 3.3, 3.4, 3.5, 3.26, 3.27	4.6.1
Insulation resistance at ambient temperature	3.15.1	4.6.11.2
Dielectric withstanding voltage	3.9	4.6.5.1
Insulation resistance at elevated temperature	3.15.2	4.6.11.3
Contact resistance	3.12	4.6.8
Dielectric withstanding voltage	3.9	4.6.5.1
Contact retention	3.8	4.6.4
Insert retention	3.17	4.6.13
Visual and mechanical examination	3.1, 3.3, 3.4, 3.5, 3.26, 3.27	4.6.1

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TABLE VI. Qualification inspection – Continued.

Inspection	Requirement paragraph	Test paragraph
<u>Group 3</u>		4.6.1
Visual and mechanical examination	3.1, 3.3, 3.4, 3.5, 3.26, 3.27	
Dielectric withstanding voltage	3.9	4.6.5.1
Fluid immersion	3.16	4.6.12
Insulation resistance at ambient temperature	3.15.1	4.6.11.2
Dielectric withstanding voltage	3.9	4.6.5.1
Contact retention	3.8	4.6.4
Insert retention	3.17	4.6.13
Visual and mechanical examination	3.1, 3.3, 3.4, 3.5, 3.26, 3.27	4.6.1
<u>Group 4</u>		4.6.1
Visual and mechanical examination	3.1, 3.3, 3.4, 3.5, 3.26, 3.27	
Dielectric withstanding voltage	3.9	4.6.5.1
Water pressure	3.19.1	4.6.15
Vibration	3.10	4.6.6.1
High impact shock	3.11	4.6.7
Dielectric withstanding voltage	3.9	4.6.5.1
Humidity	3.18	4.6.14
Salt Spray (corrosion)	3.14	4.6.10.2
Shell conductivity	3.22	4.6.18.2
Impact	3.25	4.6.20
Cable pull out	3.20	4.6.16
External bending moment	3.21	4.6.17
Visual and mechanical examination	3.1, 3.3, 3.4, 3.5, 3.6, 3.27	4.6.1

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TABLE VI. Qualification inspection – Continued.

<u>Inspection</u>	Requirement paragraph	Test paragraph
<u>Group 5 (Accessories only)</u>		
Visual and mechanical examination	3.1, 3.3, 3.4, 3.5, 3.26, 3.27	4.6.1
Magnetic permeability	3.6	4.6.2
Vibration	3.10	4.6.6.1
High impact shock	3.11	4.6.7
Humidity	3.18	4.6.14
Water pressure	3.19.2	4.6.15
Salt spray (corrosion)	3.14	4.6.10.2
Shell conductivity	3.22	4.6.18.1
Cable pull out	3.20	4.6.16
Safety wire holes	3.4.5.4	4.6.24
External bending moment	3.21	4.6.17
Visual and mechanical examination	3.1, 3.3, 3.4, 3.5, 3.26, 3.27	4.6.1
<u>Group 6</u>		
EMI shielding	3.24	4.6.21

4.3.2.2 Connectors. Qualification samples and qualification tests shall be as specified in the following. Successful completion of qualification tests as specified in [table VI](#) for:

- | | | | |
|--------|---|-----------|-----------------|
| a. DJ | - | qualifies | D |
| b. DJS | | " | DS |
| c. D | | " | DS (see note) |
| d. DJ | | " | DJS (see note) |

NOTE: To qualify DS or DJS a mated pair of PS (MIL-DTL-28840/10, /12, or /14 and /16) or of DJS (MIL-DTL-28840/20 and /26) as applicable shall be submitted to the qualifying activity for examination and qualification approval.

4.3.2.2.1 Group 1. Two mating connectors in each shell size with insert arrangements representing typical manufacturing, shall be subjected to the group 1 tests as specified in [table VI](#). One sample shall have the pin inserts in the plug and the socket inserts in the wall mounting receptacle. The other sample shall have the inserts reversed. One sample shall be terminated with wire approaching the minimum OD specified in [table III](#), and the other with maximum OD wire. The connectors shall be tested with a strain relief clamp M28840/1 assembled on the back threads or other appropriate backshell hardware for which qualification is desired. The receptacles shall be wall mounting.

4.3.2.2.2 Group 2. One mating connector with insert arrangement having the maximum contact density shall be subjected to the group 2 tests as specified in [table VI](#). The plug shall have socket inserts, and the wall mounting receptacle pin inserts, and shall be terminated with maximum OD hook up wire specified in [table III](#). Backshell hardware shall be the same as group 1, and the receptacles shall be wall mounting.

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4.3.2.2.3 Group 3. Eleven mated pairs of connectors of either class D, DS, DJ, or DJS of the largest shell size with insert representing typical manufacturing shall be subjected to group 3 test as specified in [table VI](#). All samples shall have the socket insert in the plug and the pin insert in the wall mounting receptacle and shall be terminated with maximum OD wire specified in [table III](#). Backshell hardware shall be the same as group I. One sample shall be subjected to each fluid test.

4.3.2.2.4 Group 4. Two complete connector assemblies, wall mounting receptacles and straight plugs, each with insert arrangements with the greatest number of contacts for which qualification is desired in each shell size shall be subjected to the tests as specified in [table VI](#), group 4. One sample shall have the pin insert in the plug and the socket insert in the receptacle. The other sample shall have the socket insert in the plug and the pin insert in the receptacle. One connector shall be assembled with a M28840/6 cable backshell and 10 feet of the applicable cable as specified in [table VII](#). The remaining, connector shall be assembled with 7 feet of the applicable conduit and 10 feet of the applicable cable as specified in [table VII](#).

4.3.2.2.5 Group 5 (accessories only). One accessory (backshell) of each shell size, for which qualification is desired shall be tested. Each sample shall be assembled to an appropriate connector plug. The backshell shall be assembled to 10 feet of the applicable cable as specified in [table VII](#) or to 7 feet of the applicable conduit and 10 feet of the applicable cable specified in [table VII](#) as applicable. The sample shall be mated with its counterpart wall mounting receptacles.

4.3.2.2.6 Group 6. Two straight plug and counterpart wall mounting receptacles, less inserts and contacts of each shell size with applicable conduit and conduit backshell as specified in [table VII](#) for which qualification is desired shall be tested.

TABLE VII. Test cables and accessory size.

Designator <u>1/</u>	M24643 Cable	M28840/6 Backshell	M28840/5 Adapter	M28840/4 Conduit <u>2/</u>	Tensile load (pounds)
A (11)	/52-02UN	-01WB	-01WB	-03BE	50
B (13)	/52-03UN	-03WB	-02WB	-03BE	50
C (15)	/45-01U0	-06WB	-05WB	-04BE	50
D (17)	/45-02U0	-08WB	-08WB	-05BE	50
E (19)	/45-03U0	-11WB	-11WB	-05BE	75
F (23)	/45-04U0	-13WB	-14WB	-06BE	75
G (25)	/45-05U0	-16WB	-18WB	-08BE	75
H (29)	/45-06U0	-20WB	-21WB	-10BE	100
J (33)	/31-09UN	-23 WB	-24WB	-16BE	100

1/ Shelf sizes are provided within parenthesis for information and are not a part of the designator.

2/ BC or BE type designators are acceptable.

4.3.3 Qualification rejection. There shall be no failures during any examination or tests of the connectors or accessories' submitted for qualification tests. After notification of any failure, the agent responsible for qualification testing (see [6.3](#)) shall receive details of corrective action from the manufacturer before initiating any further tests deemed necessary to assure compliance with connector requirements.

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4.4 Conformance inspection.

4.4.1 Inspection of product for delivery. Inspection of product for delivery shall consist of groups A and B inspection.

4.4.2 Inspection lot. An inspection lot shall consist of all connectors covered by the same specification sheets, produced under essentially the same conditions, and offered for inspection at one time. In-process controls unrelated to lot sizes of finished connectors may be used, provided an inspection method equivalent to the actual testing level is maintained.

4.4.3 Group A inspection. Connectors shall be subjected to the individual tests as specified in [table VIII](#) or group A inspection. The documentation and standard test procedure EIA-364 do not apply.

TABLE VIII. Group A inspection.

Inspection	Requirement paragraph	Test paragraph
Visual and mechanical examination <u>1/</u>	3.1, 3.3, 3.4, 3.5, 3.26, 3.27	4.6.1
Insulation resistance at ambient temperature <u>1/ 2/ 3/</u>	3.15.1	4.6.11.2
Dielectric withstanding voltage <u>1/ 3/</u>	3.9	4.6.5.2
Water pressure <u>1/ 3/</u>	3.19.1	4.6.15

1/ One hundred percent inspection.

2/ Test between two adjacent contacts and between two peripheral contacts and the shell.

3/ The contractor may use in-process controls for this requirement.

4.4.4 Group B inspection. Group B inspection shall consist of the applicable tests as specified in [table IX](#) and shall be made on sample units which have been subjected to and have passed group A inspection. The documentation and standard test procedure EIA-364 do not apply.

TABLE IX. Group B inspection.

Inspection	Requirement paragraph	Test paragraph
Visual and mechanical examination	3.1, 3.3, 3.4, 3.5, 3.26, 3.27	4.6.1
Contact resistance <u>2/</u>	3.12	4.6.8
Contact retention <u>1/</u>	3.8	4.6.4

1/ The contractor may use in-process controls for this requirement.

2/ Test 3 contacts in each sample connector.

4.4.4.1 Sampling plan. A sample size shall be randomly selected as specified in [table X](#). If one or more defects are found the lot shall be rescreened and defects removed. A new sample as specified in [table X](#) shall then be randomly selected. If one or more defects are found in the second sample the lot shall be rejected and shall not be supplied to this specification.

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4.4.4.2 Rejected lot B. If an inspection lot is rejected, the supplier may rework it to correct the defects, or screen out the defective units, and resubmit for reinspection. Resubmitted lots shall be inspected using a tightened inspection. Such lots shall be separate from new lots, and shall be clearly identified as reinspected lots.

TABLE X. Group B sampling plans.

Lot size	Sample size
1 to 13	100 percent
14 to 150	13 units
151 to 280	20 units
281 to 500	29 units
501 to 1,200	34 units
1,201 to 3,200	42 units

4.4.4.3 Disposition of sample units. Sample units which have passed the group B inspection may be delivered on the contract or purchase order.

4.5 Periodic inspection. Periodic inspection shall consist of group C. Except where the results of these inspections show noncompliance with the applicable requirements (see 4.5.1.5), delivery of products which have passed groups A and B inspections shall not be delayed pending the results of this periodic inspection.

4.5.1 Group C inspection. Group C inspection shall consist of the tests as specified in [table XI](#) in the order shown. Group C inspection shall be made on sample units selected from inspection lots which have passed the groups A and B inspection. Group C inspection reports shall be forwarded to the qualifying activity every 18 months as specified in the sampling plan.

4.5.1.1 Sampling plan. Every 18 months, mated connector sample units which have passed Groups A and B inspection shall be subjected to the tests as specified in [table XI](#). Samples shall be selected in sufficient quantity to provide two samples per applicable test group, of each class for which retention of qualification is desired. When a manufacturer is qualified in all shell sizes, the group C inspection shall be performed on three sizes, one each of small, medium, and large. They shall be selected such that after three consecutive group C inspections, all shell sizes shall have been inspected.

4.5.1.2 Connectors. Sample connectors shall consist of four mating plugs and receptacles in small, medium, and large shell size. Two mating connectors in small, medium, and large shell sizes shall be subjected to the tests as specified in [table XI](#), group 1, and the remaining mating connectors shall be subjected to group 2.

4.5.1.3 Failures. If one or more sample units fail to pass group C inspection, the sample shall be considered to have failed.

4.5.1.4 Disposition of sample units. Sample units which have been subjected to group C inspection shall not be delivered on the contract or purchase order.

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TABLE XI. Group C Inspection.

Inspection	Requirement paragraph	Test paragraph	Group	
			1	2
Maintenance aging (contact installing and removal)	3.23	4.6.19	X	
Contact retention	3.8	4.6.4	X	
Pin contact stability	3.4.2.6	4.6.22	X	
High impact shock	3.11	4.6.7		X
Humidity	3.18	4.6.14		X
Durability	3.13	4.6.9.1	X	
Salt spray (corrosion)	3.14	4.6.10.1	X	
Shell conductivity	3.22	4.6.18.1	X	
Contact resistance	3.12	4.6.8	X	
Visual and mechanical examination	3.1, 3.3, 3.4, 3.5, 3.26, 3.27	4.6.1	X	X

4.5.1.5 Noncompliance. If a sample fails to pass group C inspection, the manufacturer shall 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 with essentially the same materials and processes, and which are considered subject to the same failure. Acceptance of the product shall be discontinued until corrective action, acceptable to the Government has been taken. After the corrective action has been taken, group C inspection shall be repeated on additional sample units (all inspection, or the inspection which the original sample failed, at the option of the Government). Groups A and B inspections may be reinstituted; however, final acceptance shall 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 shall be furnished to the cognizant inspection activity and the qualifying activity.

4.6 Methods of examination and tests.

4.6.1 Visual and mechanical examination. The connectors, accessories, and piece parts shall be visually and mechanically examined to ensure conformance with this specification and the applicable military specification sheets and standard (see 3.1, 3.3, 3.4, 3.5, 3.26, and 3.27). In-process controls of component parts, unrelated to lot sizes of finished connectors, may be utilized in lieu of examination of these components in the finished connectors to assure conformance of these component parts.

4.6.1.1 Lubrication. No lubricant shall be applied to the connectors, prior to, during or after any of the tests, except as specified in 3.4.4.1.

4.6.2 Magnetic permeability. The relative permeability shall be checked with an indicator conforming to ASTM-A342/A342M. The connectors or accessories may be wired or unwired, but shall not be carrying current (see 3.6).

4.6.3 Thermal shock. Accessories or unmated connectors shall be tested in accordance with MIL-STD-202, method 107, condition A except that the temperature extremes shall be as specified in table XII. At the completion of the last cycle, the connectors shall be returned to room temperature for inspection (see 3.7).

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TABLE XII. Temperature extremes.

Extremes	Degrees °C	Degrees °F
Low	+0	+0
	-55	-67
	-3	-5
High	+3	+5
	+200	+392
	-0	-0

4.6.4 Contact retention. A minimum load of 20 pounds shall be applied to individual contacts. The connector shall have all contacts in place during the test. The load shall be applied at a rate of approximately 1 pound per second until the specified load has been reached. Twenty percent of the contacts in each connector shall be tested (see 3.8), except when testing in table VI, group 3, where only 10 percent shall be tested. Connectors shall be tested with the accessory removed prior to the test and loads shall be applied from the mating end of the contacts. The load shall be applied after the slack in the contact has been taken up and the displacement of the contacts shall be measured under load after the load has been applied for a minimum period of 5 seconds. Remove and reinsert the contacts using the tools specified in 3.4.1.2. The contacts shall be retained in the connector (see 3.8).

4.6.5 Dielectric withstanding voltage.

4.6.5.1 Dielectric withstanding voltage (sea level). Mated or unmated connectors as applicable, shall be tested in accordance with test procedure EIA-364-20. A 1000 volt EMS shall be applied between each adjacent contact and between all peripheral contacts and the shell (see 3.9).

4.6.5.2 Dielectric withstanding voltage (group B inspection and after fluid immersion, see table VI, group 3). Unmated connectors or insert assemblies as applicable shall show no evidence of breakdown when a 1000 volt root mean square (rms) is applied between the two closest contacts and between the shell (or simulated shells) and the contact closest to the shell in accordance with test procedure EIA-364-20. The period of application of voltage shall be 1 second minimum and simulated contacts may be used (see 3.9)

4.6.6 Vibration (mounting). Complete mated connectors shall be mounted as follows and subjected to the applicable vibration test. Each receptacle shall be mounted on a suitable fixture, which in turn, shall be attached to a vibration table. A suitable sensor shall monitor the vibration of the receptacle at a point on or near the receptacle. A counterpart plug shall be engaged with the receptacle and held by normal coupling means without the use of safety wire. The wire bundles or cables shall be clamped to non-vibrating points at least 36 inches from the rear of the connectors. The clamping length shall be chosen to avoid resonance of the wire bundles or cables.

4.6.6.1 Vibration. Mated connectors shall be mounted as specified in 4.6.6 and tested in accordance with test procedure EIA-364-28, test condition III and also in accordance with MIL-STD-167-1, endurance test. All contracts shall be wired in series and a current of 100 ± 10 milliamperes shall flow through the series circuit during the test. A suitable instrument shall be employed to monitor current flow and indicate discontinuity of contact or interruption of current flow of one microsecond or longer (see 3.10).

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4.6.7 High impact shock. A complete mated connector shall be affixed with the M28840/6 backshell and six feet of cable, as specified in [table VII](#). Another complete mated connector shall be a fixed with the conduit backshell, conduit, and six feet of cable as specified in [table VII](#). Both connector assemblies shall then be tested in accordance with MIL-S-901, grade A. The mounting shall be in accordance with the standard mounting for electrical switchboard instruments and other panel mounted equipment, Fixture 6D-1 in accordance with MIL-S-901. All contacts shall be wired in a series circuit with 100 ± 10 milliamperes flowing through the series circuit during the high impact shock. A suitable device shall be used to monitor the current flow and to indicate any discontinuity of current flow which is one microsecond or longer. The mated connectors shall be held together only by the normal coupling device. Cable or wires shall be supported on a stationary frame not closer than 36 inches from the connector assembly (see 3.11).

4.6.8 Contact resistance. The contact resistance shall be measured in accordance with SAE-AS39029, contact resistance test (see [3.12](#)).

4.6.9 Durability.

4.6.9.1 Durability with coupling rings. The wired, assembled plugs and receptacles shall be mated and unmated 100 times at a maximum rate of 30 cycles per hour with coupling rings attached. The connectors shall be mated and unmated 50 cycles before salt spray and 50 cycles after salt spray (see [3.13](#)).

4.6.10 Salt spray (corrosion) (see 3.14). Connectors shall be tested in accordance with test procedure EIA-364-26, test condition C. The following details and exceptions shall apply:

- a. The connectors shall be tested for 452 hours mated followed by 48 hours unmated.
- b. The connectors shall not be mounted, but shall be suspended from the top of the chamber using waxed twine or string, glass rods or glass cord.
- c. Wire ends shall be protected to prevent salt migration. After salt spray exposure the remaining number of durability cycles as specified in [4.6.9.1](#) shall be completed.

4.6.10.1 Salt spray (corrosion). Same as above except on groups 4 and 5 samples the durability test does not need to be performed.

4.6.11 Insulation resistance. Unmated connectors shall be tested in accordance with test procedure EIA-364-21 (see [3.15](#)). The following details and exceptions shall apply:

- a. For lot acceptance testing, where it is undesirable to install actual contacts in connectors, simulated contacts and special techniques may be used in performing this test.
- b. The tolerance on the applied voltage shall be ± 10 percent.

4.6.11.1 Insulation resistance at ambient temperature. Insulation resistance shall be measured in [4.6.11.1](#) between at least two closest adjacent contacts, and between the shell and at least one contact closest to shell. Simulated contacts may be used (see [3.15.1](#)).

4.6.11.2 Insulation resistance at elevated temperature (long time). The insulation resistance shall be measured in [4.6.11.1](#). Elevated temperatures shall be 200°C. All measurements shall be made at the end of 1,000 hours while the connectors are at the elevated temperature (see [3.15.2](#)).

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4.6.12 Fluid immersion (see 3.16). Connector samples shall be subjected to the test specified in test procedure EIA-364-09 (one sample per fluid). Following the fluid immersion cycles, the connectors shall be tested for coupling torque as specified in 3.28 and dielectric withstanding voltage at sea as specified in 3.9 within 3 hours. Samples shall be subjected to the fluids specified in test procedure EIA-364-09 as specified in table XIII.

TABLE XIII. Fluids for fluid immersion test.

Sample number	Test fluid (test procedure EIA-364-09)
1	d
2	e
3	a
4	b
5	f
6	g
7	c
9	l
9	h
10	i

4.6.13 Insert retention. Inserts, less removable grommets or any insert supporting accessories, shall be subjected to axial loads in each direction; in accordance with test procedure EIA-364-35. The loading shall be accomplished by applying an equivalent load to the pressure specified. The pressure shall be increased gradually at a rate of approximately 10 pounds per square inch (psi) /second until the pressure as specified in table XIV is reached. The insert shall retain its normal position in the connector shell for at least 5 seconds at the maximum specified pressure (see 3.17).

TABLE XIV. Insert retention test pressure.

Designator ^{1/}	Test pressure (PSI gauge)
A (11)	100
B (13)	100
C (15)	100
D (17)	100
E (19)	100
F (23)	75
C (25)	60
H (29)	60
J (33)	45

^{1/} Shell sizes are provided within parenthesis for information and are not a part of the designator.

4.6.14 Humidity (see 3.18). Wired, mated connectors shall be subjected to the humidity test specified in test procedure EIA-364-31. The following details and exceptions shall apply:

- a. Test procedure - Type IV.
- b. The mated connectors shall be mounted in a vertical position.

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- c. Step 7a shall be performed during the last cycle.
- d. Three hours minimum after the start of step 7a, during the final cycle and while the connectors are still subjected to high humidity. The insulation resistance shall be measured when the chamber temperature reaches $20^{\circ} \pm 5^{\circ}\text{C}$ and condensation is observed on the connector.
- e. For qualification testing, insulation resistance readings shall be made on a minimum of 50 percent of the circuits.

4.6.15 Water pressure. The connectors shall be immersed in tap water to a depth of 6 feet for 48 hours as follows:

- a. Plugs with backshells shall be assembled to test cables.
- b. Receptacles shall be mounted by their normal mounting means, with mounting flange gaskets. One-half of the wall mounting receptacle shall be front mounted and the remaining half shall be back mounted. The terminal ends of the receptacles shall, be external to the tank.
- c. The connectors tested shall be mated, and Insulation resistance of the mated immersed connectors shall be measured at the end of the 48 hour period. Upon completion of the test, the connectors shall be removed from the tank, all external moisture removed from the connectors by shaking them at room temperature, and insulation resistance measured within one-half hour after removal from the water. The connectors shall be inspected for internal leakage of water at the connector interface and cable housing. Receptacles shall be inspected for leakage through or around the insert and for leakage of the panel seals (see [3.19](#)). Dummy connectors duplicating the connectors accessory interfacing features, see [figure 7](#), may be used in lieu of actual connectors in testing the accessories.

4.6.16 Cable pull-out (see [3.20](#)). The connector shall have the adapter installed and wired with the cable specified in [table VII](#). The tensile load specified in [table VII](#). The tensile load specified in [table VII](#) shall be applied in the direction tending to displace the cable towards the rear of the adapter. The load shall be applied for one hour and the amount of slippage between the cable and test plug shall be measured.

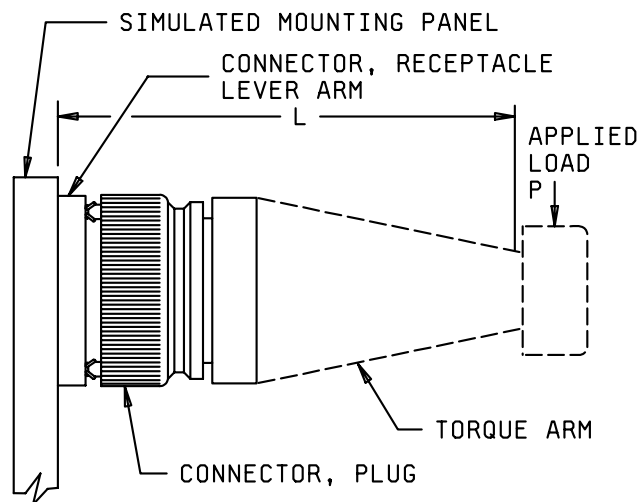
4.6.17 External bending moment (see [3.21](#)). The receptacle connector shall be mounted as in normal service to a rigid panel. Before mating the plug connector to the receptacle, and adapter or test torque arm shall be attached as shown on [figure 10](#). After mating the plug and receptacle connectors, the distance "L" from the point of load application "P" to the mounting panel shall be determined. The load shall be applied at point "P" and shall then be determined as the bending moment as specified in [table XV](#), divided by the level arm "L". This load shall be applied at a rate of approximately 10 pounds per second until the required load is achieved. The applied load shall be held for 1 minute, then the load shall be released.

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TABLE XV. External bending moment.

Designator 1/	Bending moment (inch/pounds)
A (11)	300
B (13)	300
C (15)	300
D (17)	370
E (19)	420
F (23)	520
C (25)	570
F (29)	630
J (33)	750

1/ Shell sizes are provided within parentheses for information only and are Not a part of the designator.

FIGURE 10. External bending moment test setup.4.6.18 Shell conductivity.

4.6.18.1 Shell conductivity (connectors only). The direct current resistance of the wired, mated, assembled connectors shall be measured from a point on the rear accessory thread of the plug to the mounting flange of the receptacle. The point of measurement on the square flange receptacle shall be adjacent to the mounting holes and adjacent to the "O" ring on the front or mounting side of the flange for the single hole mount receptacle. The direct current resistance shall not exceed the value as specified in 3.22 when measured by the volt meter-ammeter method. The applied potential shall be 1-1/2 volts direct current maximum. A resistance shall be inserted in the circuit to limit the current to $.100 \pm .010$ amperes. Probes with spherical ends of .05 inch minimum radius shall be used to make the voltage measurements on the connectors. The probes shall not puncture or otherwise damage the connector finish (see 3.22).

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4.6.18.2 Shell conductivity (accessories and connectors). Same as above except on Group samples. Measurement shall be taken from end of accessory as specified in [table VII](#) (see [figure 11](#)).

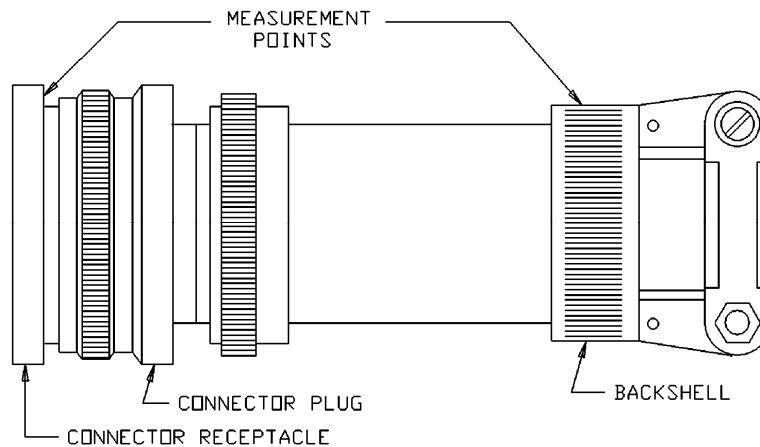


FIGURE 11. Shell conductivity test setup (accessories and connectors).

4.6.19 Maintenance aging (contact installing and removal force). With the grommet relaxed, 20 percent of the contacts in each connector shall be removed and reinserted using the applicable tools specified in [3.4.1.2](#). The forces required to insert and remove the unlocked contacts shall be measured. Counterpart connectors shall be mated and unmated ten times. The same contacts shall then be removed and reinserted nine more times. The contact insertion and removal forces shall be measured on the ninth cycle (see [3.23](#)).

4.6.20 Impact (see 3.25). Connector plugs with straight strain relief clamps and protective covers shall be tested as specified in test procedure EIA-364-42. The following conditions apply.

- a. Drop height shall be 6 feet (1.829 meters).
- b. Number of drops shall be ten.
- c. Plate shall be indexed at 36° intervals."

4.6.21 EMI shielding (see 3.24). The connectors under test shall be mounted to a shielded room wall as specified on [figure 12](#). Mounting should simulate normal mounting procedures and be detailed in the test report. Two identical 1.5 meter long test cables - one shielded and one unshielded - will be required. Shielding effectiveness of the shielded cable and connector will be obtained as follows:

- a. Connect the unshielded test cable to the connectors. The cable should be supported horizontally on a wooden table (or other nonconducting material) at a height of one meter or greater above the floor (or ground plane) and arranged in a semi-circle having a radius of approximately 0.45 meter.

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- b. Place the receiver antenna in front of the connectors, centered between the connectors, one meter distance from the plate containing the connector and 0.5 meter above the plane of the cable. The antennas used in these tests shall be linearly polarized. Circularly polarized antennas such as the conical log spiral antennas shall not be used.
- c. Connect the signal source to the test cable as specified on [figure 12](#). A 50-ohm matching termination should be used at the generator output. If the generator is not calibrated, the output should be monitored with a voltmeter or power meter.
- d. Connect the receiver, either a tuned EMI receiver or spectrum analyzer, to the receiver antenna. The test wires will be selected such that the wires are on opposite sides and at the outer perimeter of the connector. A 50-ohm load will be connected between the wire pairs at the other connector.
- e. With the receiver and signal generator set to 100 MHz, increase the signal generator output until a level at least 100 dB above the minimum discernible level of the receiver is obtained. Record both the generator output level and receiver level. Continue recording output and received levels as the generators are swept over the 100 MHz - 1,000 MHz frequency range maintaining at least 100 dB dynamic range. The received level may be photographically recorded if a spectrum analyzer is used, otherwise record at least three frequencies per octave.
- f. Replace the unshielded cable and connector with the shield connector and cable and repeat the measurements using the same signal generator levels as obtained in step e. Record the received levels. Shielding effectiveness is the difference in received levels obtained in steps e and f (see [3.24](#)).

4.6.22 Pin contact stability. The unmated connectors shall have 10 percent of their pin contacts subjected to this test. Gage pins conforming dimensionally on [figure 13](#) shall be used. The connector shall be held in a holding device. The forces as specified in [3.4.2.6](#) shall be applied to the exposed rod as specified on [figure 14](#). The rate of load application shall not exceed 1 inch (25.4mm) per minute. The total pin tip displacement shall be measured as shown on [figure 14](#). The unmated connector shall have all cavities loaded with contacts in which minimum OD wire (see [table III](#)) has been crimped. The unmated connectors shall have no backshells attached.

4.6.23 Coupling torque. For qualification testing, mating halves shall be coupled and the torque which must be applied to facilitate full coupling shall be measured and recorded (see [3.28](#)).

4.6.24 Safety wire holes. Safety wire holes shall not pull out when safety wire Ni-Cu alloy (MONEL) UNS NO4400) or Ni-Cr alloy (INCONEL) (UNS NO6600) that is .032 inch in diameter in accordance with NASM20995 is threaded through the hole and a pull of 30 ± 2 lbs is applied. Three pulls shall be made, parallel to the axis of the connector or connector accessory (see [3.4.5.4](#)).

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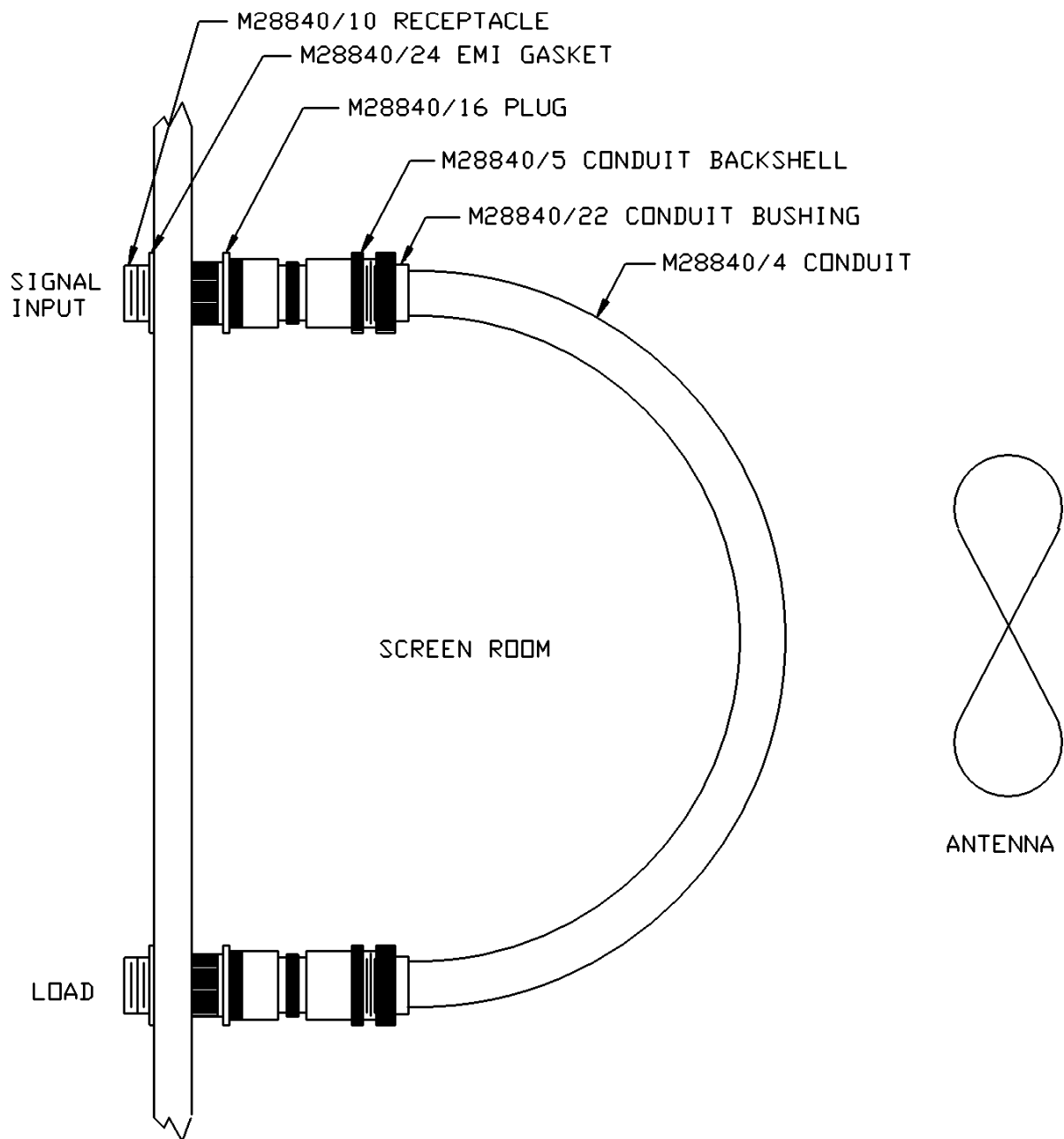
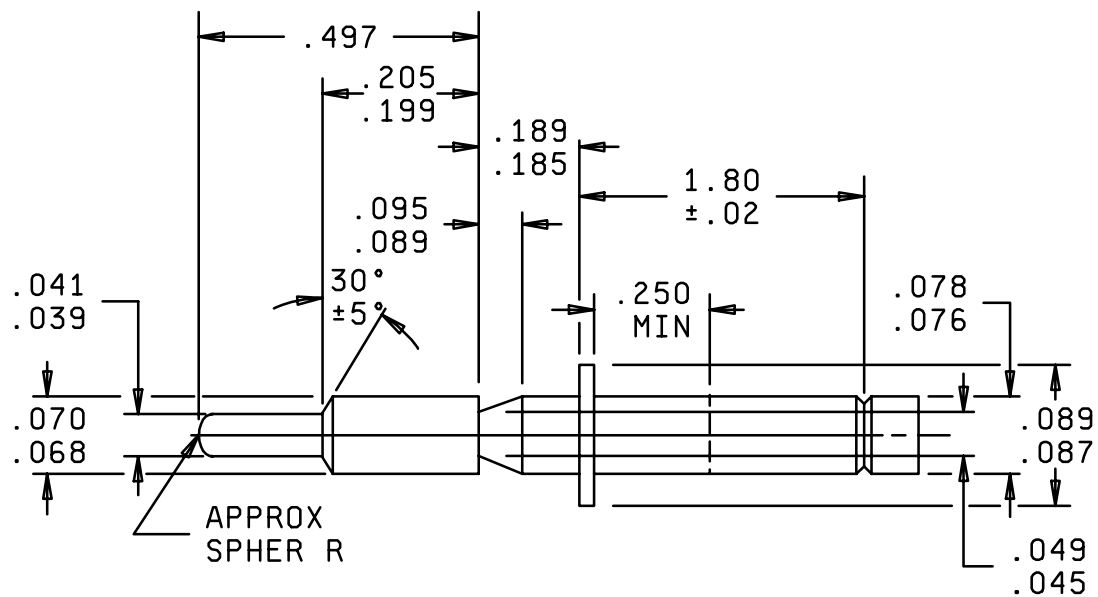


FIGURE 12. Electromagnetic interference test.

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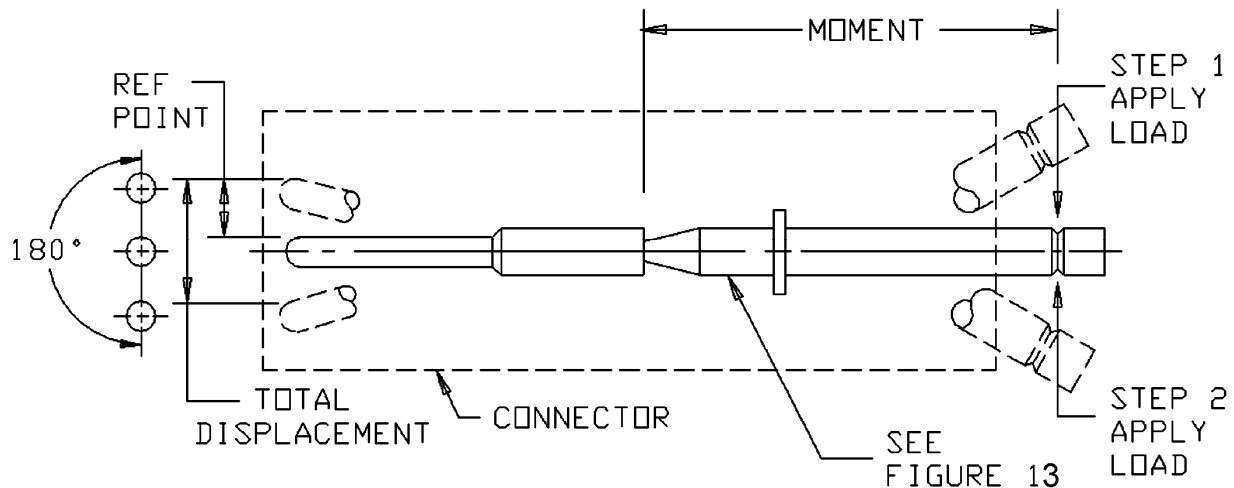
Inches	mm	Inches	mm
.020	0.51	.089	2.26
.039	0.99	.095	2.41
.041	1.04	.180	4.57
.045	1.14	.185	4.70
.049	1.24	.189	4.80
.068	1.73	.199	5.05
.070	1.78	.205	5.21
.076	1.93	.250	6.35
.078	1.98	.495	12.62
.087	2.21		

NOTES:

1. Material: Hardened tool steel.
2. Finish: 32 microinches polished.
3. Design of rear extension is optional, but must have a groove provided as indicated.
4. Dimensions are in inches.
5. Metric equivalents are given for information only.
6. All diameters concentric to each other within a .004 TIR.

FIGURE 13. Test gauge, pin, gauge location, and retention.

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Step 1 – Apply load to determine reference point.
 Step 2 – Apply load in apposite direction (180°) and measure total displacement.

FIGURE 14. Pin contact stability test.

5. PACKAGING

5.1 Packaging. For acquisition purposes, the packaging requirements shall be as specified in the contract or order (6.2). When packaging of materiel 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 System Command. 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 various classes and types of connectors are intended for application as follows:

- a. MIL-DTL-28840/10 - are receptacles intended for wall or bulkhead flange mounting and for use with conduit backshells, or cable clamps.
- b. MIL-DTL-28840/11 - are receptacles intended for use at the end of a cable where mounting provisions are not required.

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- c. MIL-DTL-28840/12 - are receptacles intended for mounting on shielding boxes and equipment eases. They have no fittings and are for use with open wiring. Individual wires should not exceed 12 inches in length. Box mount connectors will be used only in controlled atmosphere applications where environmental sealing is not required.
- d. MIL-DTL-28840/14 - are receptacles intended for wall or bulkhead jam nut mounting and for use with conduit or a cable clamp.
- e. MIL-DTL-28840/16 - are plugs intended for use at the end of a cable to be mated with a receptacle.
- f. MIL-DTL-28840/18 - are 90° plugs intended for use at the end of a cable where space does not permit the use of a straight plug.
- g. Connectors are intended for use with jacketed cable where the connectors will be subjected to high-impact shock conditions beyond the capabilities of the other class connectors. These connectors have crimp contacts which are removed from the front of the connector and a wire sealing range capable of sealing on Naval shipboard cable. These connectors also have a specified shell conductivity.
- h. These connectors are intended for use where the connector will be subject to heavy condensation and rapid changes in temperature or pressure, and where the connector is subject to high vibratory conditions. A type MIL-C-28840/12 receptacle does not provide moisture or vibration protection at its back end, and a type MIL-C-28840/10 or MIL-C-28840/11 should be used if such protection is desired.

6.1.1 Wire sizes to be used with contacts. Satisfactory performance of connectors will be obtained if wire sizes are governed in [table III](#). For wire diameters less than specified in [table III](#), shrink-fit sleeving should be over the wire. Where two or more wires are used in a wire barrel, moisture sealing is not obtainable.

6.2 Acquisition requirements. Acquisition documents should specify the following:

- a. Title, number and date of this specification.
- b. Title, number, and date of the applicable specification sheet and the complete PIN (see [3.1](#) and [1.2](#)).
- c. For indirect shipment, these connectors may be furnished without contacts or grommet sealing plugs (see [3.4.1](#) and [3.4.6.1](#)).
- d. Length and tolerance of conduit.
- e. Packaging requirements (see 5.1)

6.2.1 Accessory hardware. Accessory hardware, such as dust covers or mounting hardware is shown on separate drawings (see [3.1](#)).

6.2.2 Crimp contacts. Crimp contacts may be ordered in bulk in accordance with SAE-AS39029.

6.2.3 Connector PINs. PINs should be in accordance with the detail document covering the individual connector (see [3.1](#)).

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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. 28840 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 purchase orders for the products covered by this specification. Information pertaining to qualification of products may be obtained from the Defense Supply Center Columbus (DSCC-VQ), Document Control Unit, Columbus, OH 43218-3990 or e mail vq.chief@dla.mil .

6.3.1 Copies of "Provisions Governing Qualification SD-6". Copies of "Provisions Governing Qualification SD6" may be obtained upon application to Commanding Officer, Naval Publications and Forms Center, 5801 Tabor Avenue, Philadelphia, PA 19120.

6.4 Working voltage. The maximum recommended sea level working voltage is 200 volts rms.

6.5 Cable/connector interface. MIL-STD-1683 may be used as a guide for the selection of cables specified in MIL-DTL-24643.

6.6 Subject term (key word) listing.

Removable crimp front release contacts
Hot-spot temperature
Ambient conditions
Service life

6.7 Environmentally preferable material. Environmentally preferable materials should be used to the maximum extent possible to meet the requirements of this specification. [table XVI](#) lists the Environmental Protection Agency (EPA) top seventeen hazardous materials targeted for major usage reduction. Use of these materials should be minimized or eliminated unless needed to meet the requirements specified herein (see section 3).

TABLE XVI. EPA top seventeen hazardous materials.

Benzene	Dichloromethane	Tetrachloroethylene
Cadmium and Compounds	Lead and Compounds	Toluene
Carbon Tetrachloride	Mercury and Compounds	1,1,1 - Trichloroethane
Chloroform	Methyl Ethyl Ketone	Trichloroethylene
Chromium and Compounds	Methyl Isobutyl Ketone	Xylenes
Cyanide and Compounds	Nickel and Compounds	

6.8 Guidance on use of alternative parts with less hazardous or nonhazardous materials. This specification provides for a number of alternative plating materials via the PIN. Users should select the PIN with the least hazardous material that meets the form, fit and function requirements of their application.

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6.9 Military unique statement. This connector is military unique because it is high density, high shock, circular electrical connector, supplied under a MIL-STD-790 reliability assurance program, and specifically designed to be used in shipboard applications.

6.10 Tin whisker growth. The use of alloys with tin content greater than 97 percent, by mass, may exhibit tin whisker growth problems after manufacture. Tin whiskers may occur anytime from a day to years after manufacture and can develop under typical operating conditions, on products that use such materials. Conformal coatings applied over top of a whisker-prone surface will not prevent the formation of tin whiskers. Alloys of 3 percent lead, by mass, have shown to inhibit the growth of tin whiskers. For additional information on this matter, refer to ASTM-B545 (Standard Specification for Electrodeposited Coatings of Tin) (see 3.31).

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

CONCLUDING MATERIAL

Custodians:
Navy – EC
DLA – CC

Preparing activity:
DLA – CC

Reviewers:
Navy – OS, SH, YD

(Project 5935–2005–029)

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 <http://assist.daps.dla.mil>.