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Superseding AS13441

Test Methods for Electrical Connectors

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NOTICE

This document has been taken directly from U.S. Military Specification MIL-STD-1344A, Notices 1-5, and contains only minor editorial and format changes required to bring it into conformance with the publishing requirements of SAE technical standards. The initial release of this document is intended to replace MIL-STD-1344A, Notices 1-5. Any part numbers established by the original specification remain unchanged.

The original Military Specification was adopted as an SAE standard under the provisions of the SAE Technical Standards Board (TSB) Rules and Regulations (TSB 001) pertaining to accelerated adoption of government specifications and standards. TSB rules provide for (a) the publication of portions of unrevised government specifications and standards without consensus voting at the SAE Committee level, and (b) the use of the existing government specification or standard format.

Any material relating to qualified product lists has not been adopted by SAE. This material was part of the original military specification and is reprinted here for historic reference only.

1. SCOPE:

1.1 Scope:

This standard establishes uniform test methods for testing electrical connectors.

1.2 Numbering system:

The test methods are designated by numbers assigned in accordance with the following system:

1.2.1 Class of tests: The tests are divided into three classes: environmental, mechanical, and electrical. Within each class, the test methods are numbered as shown below:

1001 - 1999 - Environmental tests

2001 - 2999 - Mechanical tests

3001 - 3999 - Electrical tests

1.2.2 Revision of test methods: Revisions are identified by a decimal point and a number added to the basic method number. For example, if the maintenance aging test is initially 2002, the first revision will be numbered 2002.1; 2002.2 will indicate the second revision issued. Subsequent revisions will be numbered consecutively.

1.3 Method of reference:

When applicable, test methods herein shall be referenced in the individual specification by specifying this standard, the method number, and the details required in the summary paragraph of the applicable method. To avoid the necessity for changing specifications that refer to this standard, the decimal number shall not be used when referencing test methods. For example, use 2002 not 2002.1.

2. REFERENCED DOCUMENTS:

2.1 Issues of documents:

The issues of the following documents in effect on the date of invitation for bids form a part of this standard to the extent specified herein.

SPECIFICATIONS

FEDERAL

P-D-680	- Dry Cleaning Solvent.
TT-I-735	- Isopropyl Alcohol.
TT-T-291	- Thinner-Paint, Volatile Spirits Petroleum Spirits.

MILITARY

MIL-T-713	- Twine, Impregnated, Lacing and Tying.
MIL-G-3056	- Gasoline, Automotive, Combat.
MIL-H-5606	- Hydraulic Fluid, Petroleum Base; Aircraft, Missile, and Ordnance.
MIL-T-5624	- Turbine Fuel, Aviation, Grades JP-4 and JP-5.
MIL-L-7808	- Lubricating Oil, Aircraft, Turbine Engine, Synthetic Base.
MIL-A-8243	- Anti-icing and Deicing - Defrosting Fluid.
MIL-I-17214	- Indicator, Permeability; Low-Mu (Go-No Go).
MIL-L-23699	- Lubricating Oil, Aircraft Turbine Engines, Synthetic Base.
MIL-C-25769	- Cleaning Compound, Aircraft Surface, Alkaline Waterbase.
MIL-C-45662	- Calibration System Requirements.

2.1 (Continued):

STANDARD

MILITARY

- MIL-STD-202 - Test Methods for Electronic and Electrical Component Parts.
- MIL-STD-810 - Environmental Test Methods.
- MS3190 - Contact Wire Barrel, Crimp Type.

(Copies of specifications, standards, drawings, and publications required by contractors in connection with specific procurement functions should be obtained from the procuring activity or as directed by the contracting officer).

2.2 Other publications:

The following documents form a part of this standard to the extent specified herein. Unless otherwise indicated, the issue in effect on date of invitation for bids or request for proposal shall apply.

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

- ASTM D 1141-52(1971) Substitute Ocean Water, Specification for.
- ASTM D 1149-64(1970) Accelerated Ozone Test for Cracking of Vulcanized Rubber, Test for.

(Application for copies should be addressed to the American Society for Testing and Materials, 1916 Race Street, Philadelphia, PA 19120).

IEEE STANDARDS SALES, INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS

- IEEE Standards No. 287 - Precision Coaxial Connections (1968)

(Application for copies should be addressed to IEEE Standards Sales, Institute of Electrical and Electronics Engineers, 345 East 47th Street, New York, NY 10017).

(Technical society and technical association specifications and standards are generally available for reference from libraries. They are also distributed among technical groups and using Federal agencies).

3. DEFINITION:

- 3.1 The terms used in this standard are generally accepted by the electrical and electronics industries and commonly used in electrical connector engineering practice.

4. GENERAL REQUIREMENTS:

4.1 Test requirements:

The requirements that must be met by the electrical connectors subjected to the test methods described herein are specified in the individual specifications, as applicable, and the tests shall be applied as specified therein. Whenever this standard conflicts with the individual specification, the latter shall govern.

4.2 Standard test conditions:

Unless otherwise specified, all measurements shall be made within the following ambient conditions:

- a. Temperature: 15° to 35°C.
- b. Atmospheric pressure: 550 to 800 millimeters of mercury (mmHg).
- c. Relative humidity (RH): 20 to 80 percent.

4.3 Temperature variation:

Where a maximum or minimum temperature is specified herein, the specified temperature must be attained and a tolerance of 5°C is allowed. For example, a temperature cycle may be described as -55° to +125°C. The temperature and tolerances would be as follows: low temperature -55°⁺⁰₋₅ °C; high temperature +125°⁺⁵₋₀ °C. The equipment used to perform these temperature tests shall be capable of maintaining the sample area within 3°C variation at the specified test temperatures. The temperature control of this equipment shall be ±2°C or better for a single point.

4.4 Reference conditions:

Reference conditions as a base for calculations shall be 20°C for temperature, 760 millimeters of mercury of air pressure, and not applicable for relative humidity.

4.5 Test equipment:

Calibration requirements shall be in accordance with MIL-C-45662.

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4.6 Equipment test methods:

Table I is a cross reference of equivalent test methods to MIL-STD-202, and MIL-STD-810.

TABLE I. Cross reference equivalent test methods.

MIL-STD-1344 Method	MIL-STD-202 Method	MIL-STD-810 Method
1001	101	
1002, type II	103 (type I) 106 (type II)	507 (1)
1003	107	
1004 1005 1006 1007 1008 1009 1010	102 and 107	
1011	301	
1012 1013 1015 1016 1017 2001 2002 2003 2004 2005	213 (I, II, III, IV) (V and VI) 201, 204, 214	
2006 2007 2008 2009 2010 2011	212	
2012 2013 2014 2015 2016 2017 2018 2019 3001	105 and 301	
3002 3003 3004 3005 3006 3007 3008		

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5. NUMERICAL INDEX OF TEST METHODS:

Method Number	Title
	<u>Environmetal tests (1000 class)</u>
1001.1	Salt spray (corrosion)
1002.2	Humidity
1003.1	Temperature cycling
1004.1	Altitude immersion
1005.1	Temperature life
1006.1	Hydrostatic pressure
1007.1	Ozone exposure
1008	Air leakage
1009	Firewall
1010	
1011	Altitude-low temperature
1012	Flammability
1013	
1014	
1015	Simulated life
1016	Fluid immersion
1017	Porosity
	<u>Mechanical tests (2000 class)</u>
2001.1	Contact axial concentricity
2002.1	Maintenance aging
2003.1	Crimp tensile strength
2004.1	Shock (specified pulse)
2005.1	Vibration
2006.1	Probe damage (contacts)
2007.1	Contact retention
2008.1	Crush
2009.1	Cable pull-out
2010.1	Insert retention
2011.1	Acceleration
2012.1	Contact insertion and removal force
2013.1	Mating and unmating forces
2014	Contact engagement and separation force
2015	Impact
2016	Durability
2017	Cable seal flexing
2018	Gage location and retention
2019	Solder wicking
	<u>Electrical tests (3000 class)</u>
3001.1	Dielectric withstanding voltage
3002.1	Low signal level contact resistance
3003.1	Insulation resistance
3004.1	Contact resistance
3005	Standing Wave Ratio (SWR)
3006	Magnetic permeability
3007	Shell to shell conductivity
3008	Shielding effectiveness for multicontact connectors

CLASS 1000
ENVIRONMENTAL TESTS

**METHOD 1001.1
SALT SPRAY (CORROSION)**

1. PURPOSE:

The purpose of this test is to determine the effects of a controlled salt laden atmosphere on electrical connector components, finishes, mechanisms and permit electrical readings to be taken after exposure.

2. TEST EQUIPMENT:

2.1 Chamber:

The chamber and all accessories shall be made of material which will not affect the corrosiveness of the fog, such as glass, hard rubber, or plastic. Wood or plywood should not be used because they are resiniferous. Materials should not be used if they contain formaldehyde or phenol in their composition. In addition, all parts which come in contact with test sample shall be of materials that will not cause electrolytic corrosion. The chamber and accessories shall be constructed and arranged so that there is free circulation of the spray to the same degree for all samples, no return of the liquid that has come in contact with the test samples to the salt-solution reservoir, and no direct impinging of the spray or condensation dripping on the samples. The chamber shall be properly vented to prevent pressure build-up and allow uniform distribution of salt spray. The discharge end of the vent shall be protected from strong drafts which can cause strong air currents in the chamber.

2.2 Atomizers:

The atomizer or atomizers used shall be of such design and construction as to produce a finely divided, wet, dense fog. Atomizing nozzle shall be made of material which does not react with the salt solution.

2.3 Air supply:

The compressed air entering the atomizers shall be free from all impurities such as oil and dirt. Means shall be provided to humidify and warm the compressed air as required to meet the operating conditions. The air pressure shall be suitable to produce a finely divided dense fog with the atomizer or atomizers used. To insure against clogging the atomizers by salt deposition, the air should have a relative humidity of 95 to 98 percent at the point of release from the nozzle. A satisfactory method is to pass the air in very fine bubbles through a tower containing heated water. The temperature of the water should be 95°F (35°C) and often higher. The permissible temperature increases with increasing volume of air and with decreasing heat insulation of the chamber, and temperature of its surroundings should not exceed a value above which an excess of moisture is introduced into the chamber (for example, 110°F (43.3°C) at an air pressure of 12 pounds per square inch), or a value which makes it impossible to meet the requirement for operating temperature.

2.4 Salt solution:

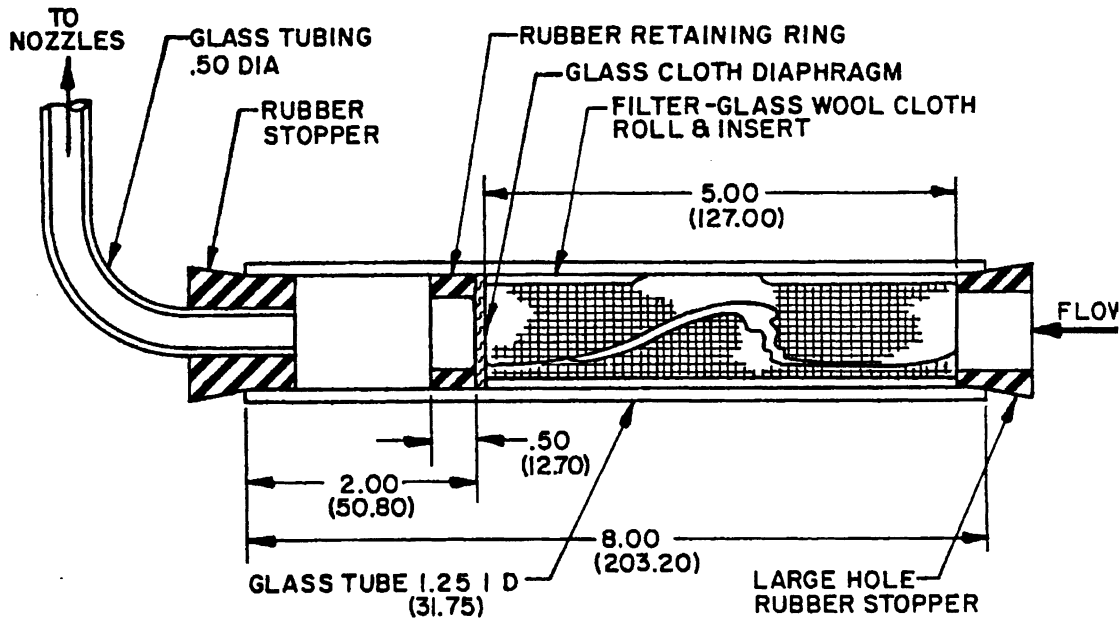
The salt-solution concentration shall be 5 percent. The salt used shall be sodium chloride containing on the dry basis not more than 0.1 percent of sodium iodide, and not more than 0.5 percent of total impurities. The 5-percent solution shall be prepared by dissolving 5 ± 1 parts by weight of salt in 95 parts by weight of distilled or other water. Distilled or other water used in the preparation of solutions shall contain not more than 50 parts per million of total solids. The solution shall be kept free from solids by filtration using a noncorrosive filter similar to that shown on figure 1, and located in the salt solution reservoir in a manner such as that illustrated on figure 2. The solution shall be adjusted to and maintained at a specific gravity in accordance with figure 3. The pH shall be maintained between 6.5 and 7.2, when measured at a temperature between 93° and 97°F (33.9° and 36.1°C). Before adjusting the pH, gently boil a sample of the solution (e.g. 10 milliliters in a pyrex breaker) for 30 to 60 seconds to remove the CO₂ absorption, then cool to the specified temperature prior to measuring the sample solution pH. Only diluted chemically pure grade hydrochloric acid or sodium hydroxide shall be used to adjust the pH. The pH measurement shall be made electrometrically using a glass electrode with a saturated potassium-chloride bridge or by a colorimetric method such as bromothymol blue, provided the results are equivalent to those obtained with the electrometric method.

3. TEST SAMPLE:

3.1 Procedure:

3.1.1 Sample:

- 3.1.1.1 Connector: A test sample shall consist of a connector assembly complete with wires, contacts, sealing plugs and accessories. The sample shall be suspended in a horizontal position. The mounting shall be compatible with the requirements for locating samples in the chamber as outlined in the test procedure. Unless otherwise specified, the connector assembly shall be normally mated.
- 3.1.1.2 Preparation: Unless otherwise specified, samples shall be given a minimum of handling, particularly on the significant surfaces, and shall be prepared for test immediately before exposure. Unless otherwise specified, samples having an organic coating shall not be cleaned with solvent. A suitable coating of wax or similar substance impervious to moisture shall be applied to protect those portions of samples which come in contact with the support and unless otherwise specified, to the cut edges and surfaces not required to be coated on coated samples.
- 3.1.1.3 Contacts: When tested separately, connector contacts shall be mated or unmated and suspended in a horizontal position. Contacts shall be subjected to low signal level contact resistance and contact resistance in accordance with methods 3002 and 3004.



NOTE: Metric equivalents are in parentheses.

FIGURE 1. Salt solution filter.

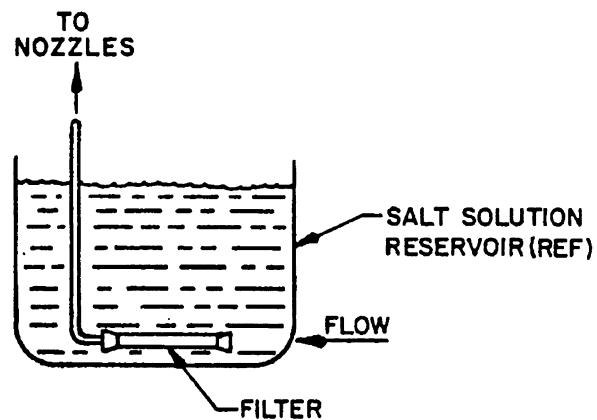


FIGURE 2. Location of salt solution filter.

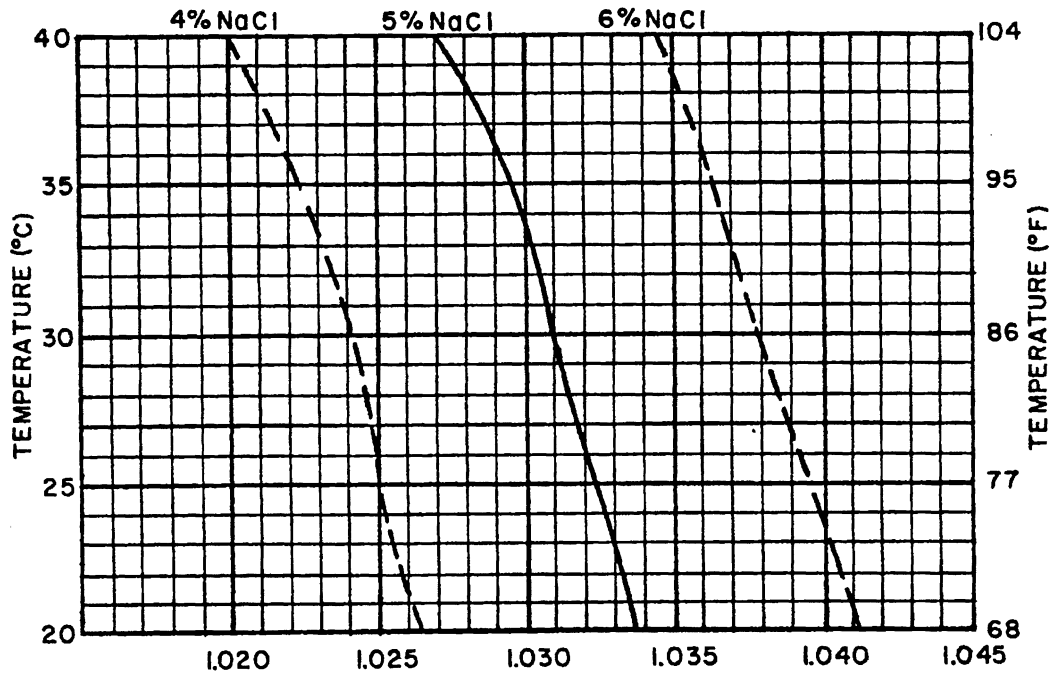


FIGURE 3. Variations of specific gravity of salt (NaCl) solution with temperature.

4. TEST PROCEDURE:

4.1 Location of samples:

Samples shall be suspended from the top using glass or plastic hooks, waxed twine, or string or nylon thread. If plastic hooks are used, they shall be fabricated of material, such as lucite, that is nonreactive to the salt solution. The use of metal hooks is not permitted.

4.2 Procedure:

The test procedures shall be as follows:

- 4.2.1 Temperature: The test shall be conducted with a temperature in the exposure zone maintained at 95^{+2}_{-3} °F ($35^{+1.1}_{-1.7}$ °C). Satisfactory methods for controlling the temperature accurately are by housing the apparatus in a properly controlled constant-temperature room, thoroughly insulating the apparatus and preheating the air to the proper temperature prior to atomization, and jacketing the apparatus and controlling the temperature of the water or of the air used. The use of immersion heaters for the purpose of maintaining the temperature within the chamber is prohibited.

4.2.2 Atomization: The conditions maintained in all parts of the exposure zone shall be such that a suitable receptacle placed at any point in the exposure zone will collect from 0.5 to 3.0 milliliters of solution per hour for each 80 square centimeters of horizontal collecting area (10 centimeters diameter) based on an average run of at least 16 hours. The 5-percent solution collected shall have a sodium-chloride content of from 4 to 6 percent (specific gravity) in accordance with figure 3 when measured at a temperature between 93° and 97°F (33.9° and 36.1°C). At least two clean fog-collecting receptacles shall be used, one placed near any nozzle and one placed as far as possible from all nozzles. Receptacles shall be fastened so that they are not shielded by samples and so that no drops of solution from samples or other sources will be collected. The specific gravity and quantity of the solution collected shall be checked following each salt-spray test. Suitable atomization has been obtained in boxes having a volume of less than 12 cubic feet with the following conditions:

- a. Nozzle pressure of from 12 to 18 pounds per square inch.
- b. Orifices of from 0.02 to 0.03 inch in diameter.
- c. Atomization of approximately 3 quarts of the salt solution per 10 cubic feet of box volume per 24 hours.

When using large-size boxes having a volume considerably in excess of 12 cubic feet, the conditions in 4.2.2 a, b, and c may have to be modified in order to meet the requirements for operating conditions.

4.2.3 Length of test: The length of the salt-spray test shall be indicated in one of the following test conditions, as specified:

<u>Test condition</u>	<u>Length of test</u>
A- - - - -	96 hours
B- - - - -	48 hours
C- - - - -	500 hours
D- - - - -	1000 hours

Unless otherwise specified, the test shall be run continuously for the time indicated or until definite indication of failure is observed, with no interruption except for adjustment of the apparatus and inspection of the specimen.

4.2.4 Post cleaning: Immediately after exposure, the test samples shall be dipped in running tap water not warmer than 100°F (37.8°C) for 5 minutes, maximum and dried for 12 hours, maximum in a circulating air oven at a temperature of 38° ±3°C, after which the sample shall be examined at room temperature. If closer examination of a plated surface is required, the corrosion products may also be removed using any method that will not affect the plating.

4.2.5 Measurements: At the completion of the exposure period, measurements shall be made as specified. To aid in examination, samples shall be prepared in the following manner, unless otherwise specified. Salt deposits shall be removed by a gentle wash or dip in running water not warmer than 100°F (37.8°C) and a light brushing, if necessary, using a soft-hair brush or plastic-bristle brush.

4.2.6 Examination: Examination of the connector shall include the following:

- a. Exposure of base metals, pitting and porosity of finishes.
- b. Cracking and delamination of components and/or finishes.
- c. Abnormal nicks, cracks or scratches on finished surfaces that indicate the removal of the normal protective coating.

5. DOCUMENTATION:

Data sheets shall contain:

- a. Title of test, date and name of operator.
- b. Sample description - including fixture, if applicable.
- c. Test equipment used and date of latest calibration.
- d. Identification of test method.
- e. Values and observations:
 - (1) Visual examination (see 4.2.6).

6. SUMMARY:

The following details shall be specified in the individual specification:

- a. Mating of connector assembly, if other than normal (see 3.1.1.1).
- b. Cleaning and coating of samples if other than herein (see 3.1.1.2).
- c. Contact mounting when tested separately (see 3.1.1.3).
- d. Special mounting and details, if applicable (see 4.1.1).
- e. Test condition letter. Test run conditions if other than herein. (See 4.2.3).
- f. Measurements after exposure (see 4.2.5).

METHOD 1002.2
HUMIDITY

1. PURPOSE:

1.1 Purpose:

The purpose of this test is to permit evaluation of the properties of materials used in connectors as they are influenced or deteriorated by the effects of high humidity and heat condition. This is an accelerated environmental test, accomplished by the continuous exposure of the specimen to high relative humidity at various temperatures. Measurements made under high humidity conditions may reflect the peculiar conditions under which the readings were made, and should be compared only to initial readings when careful analysis indicates that such a comparison is valid and applicable.

1.2 Steady state test (type I):

This test imposes a vapor on the material under test that constitutes the force behind the moisture migration and penetration. Hygroscopic materials are sensitive to moisture and deteriorate rapidly under humidity conditions. Absorption of moisture may result in swelling that would destroy functioning utility, and cause loss of physical strength and changes in other important mechanical properties. Degradation of electrical properties may also occur. This test, while not necessarily intended as a simulated tropical test, is useful in determining moisture absorption of insulating materials.

1.3 Humidity-temperature cycling tests (types II and III):

These tests obtain their added effectiveness in employment of temperature cycling that provides a breathing action, inducing corrosion processes, and the introduction of moisture into partially sealed connectors. This condition imposes a vapor pressure on the connector which constitutes the major force behind the moisture migration and penetration.

1.4 Polarizing voltage and electrical loading:

When specified, a polarizing potential of 100 volts dc shall be applied between alternate contacts connected together electrically and the remaining contacts and shell connected together electrically. The polarity of the voltage applied to the shell shall be negative.

2. TEST EQUIPMENT:

2.1 Test chamber:

The test chamber and accessories shall be constructed and arranged in such a manner as to avoid condensate dripping on the test sample. The chamber shall be trap-vented to the atmosphere to prevent the buildup of total pressure. Relative humidity shall be determined from the dry bulb-wet bulb thermometer comparison method or an equivalent method approved by the procuring activity. When readout charts are used, they shall be capable of being read with a resolution within 0.6°C (1°F). When the wet bulb control method is used, the wet bulb and tank shall be cleaned and a new wick installed at least every 30 days. The air velocity flowing across the wet bulb shall be not less than 900 feet per minute (ft/min). Circulation of conditioning air shall be at a rate (in cubic feet per minute) of five times the chamber volume; e.g. chamber volume 5 cubic feet, air flow must be 25 cubic feet per minute, minimum. However, provisions shall be made for controlling the flow of air throughout the internal test chamber area so that the velocity of air shall not exceed 150 ft/minute. Steam, or distilled, demineralized, or deionized water shall be used to obtain the specified humidity. No rust or corrosion contaminants shall be imposed on the test sample by the test facility.

3. TEST SAMPLE:

3.1 Sample:

A test sample shall consist of a plug, a receptacle, or a mated plug and receptacle as specified.

3.2 Sample preparation:

The samples shall be wired using the contacts, wire type, size, and sealing plugs (if applicable), specified.

4. TEST PROCEDURE:

4.1 Procedure:

The test procedures shall be as follows:

a. Type I, steady state.

- (1) Conditioning. The specimens shall be conditioned in a dry oven at a temperature of $50^{\circ} \pm 5^{\circ}\text{C}$ for 24 hours. At the end of this period, measurements shall be made as specified.
- (2) Mounting. The connector shall be mounted in the test chamber so that the wires descend vertically into the connector or one connector half. There shall be no drip loops in the wires.
- (3) Exposure. The specimens shall be placed in a chamber and subjected to a relative humidity of 90 to 95 percent and a temperature of $40^{\circ} \pm 2^{\circ}\text{C}$ for the period of time indicated in one of the following test conditions, as specified:

<u>Test condition</u>	<u>Length of test</u>
A- - - - -	240 hours
B- - - - -	96 hours
C- - - - -	504 hours
D- - - - -	1,344 hours

When specified, a direct-current potential of 100 volts, or as specified, shall be applied to the specimens during the exposure period. The length of time for the application of voltage and the points of application shall be as specified.

b. Type II, temperature cycling (see figure 1).

- (1) Conditioning. The specimens shall be conditioned in a dry oven at a temperature of $50^{\circ} \pm 5^{\circ}\text{C}$ for 24 hours. At the end of this period, measurements shall be made as specified.
- (2) Mounting. Specimens shall be mounted by their normal mounting means, in their normal mounting position, but shall be positioned so that they do not contact each other, and so that each specimen receives essentially the same degree of humidity.
- (3) Initial measurements. Prior to step 1 of the first cycle, the specified initial measurements shall be made at room ambient conditions, or as specified.
- (4) Number of cycles. Specimens shall be subjected to 10 continuous cycles, each as shown on figure 2.
- (5) Subcycle. During step 7, at least 1 hour but not more than 4 hours after step 7 begins, the specimens shall be either removed from the humidity chamber, or the temperature of the chamber shall be reduced, for performance of step 7a. After step 7a, the specimens shall be returned to 25°C at 90 to 98 percent relative humidity (RH) and kept there until the next cycle begins. This subcycle shall be performed during any five of the first nine cycles.

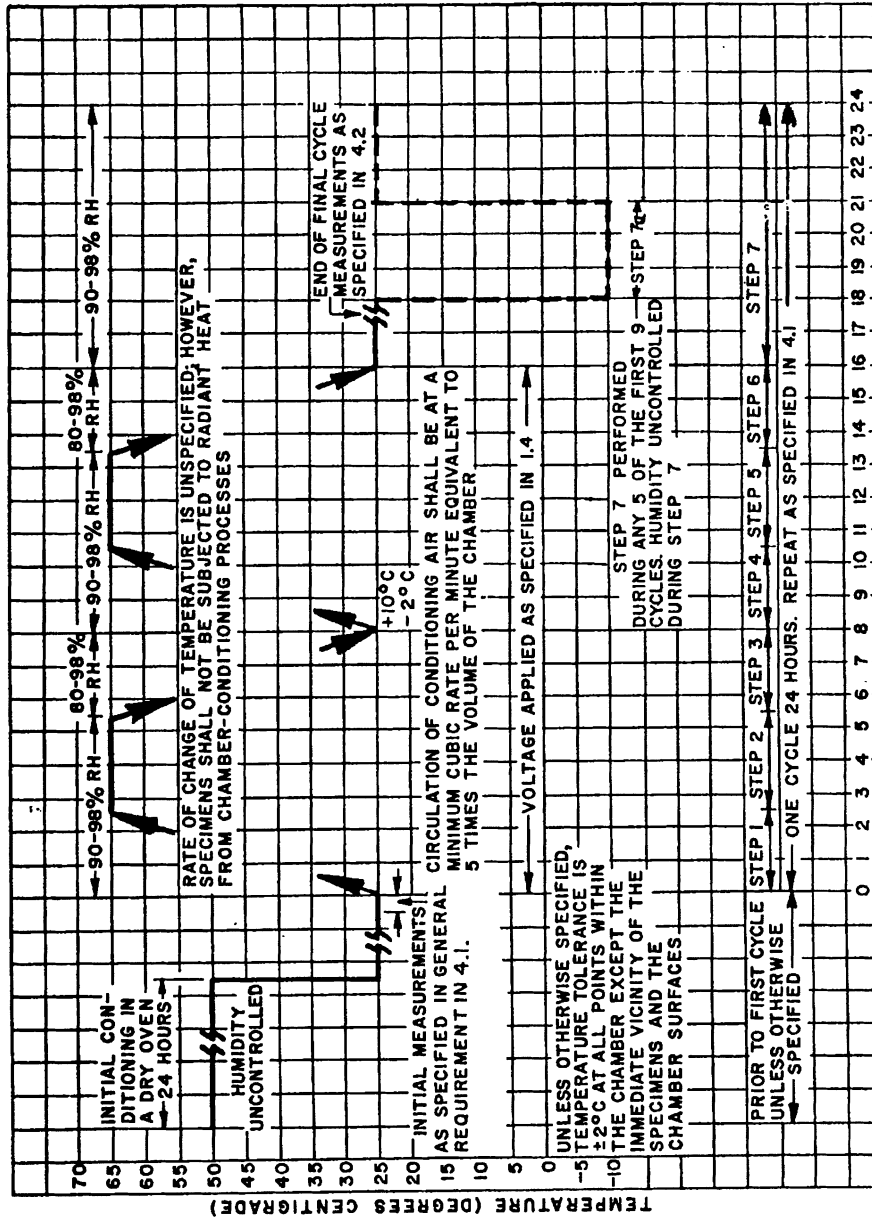


FIGURE 1. Graphical representation of moisture-resistance type II humidity test.

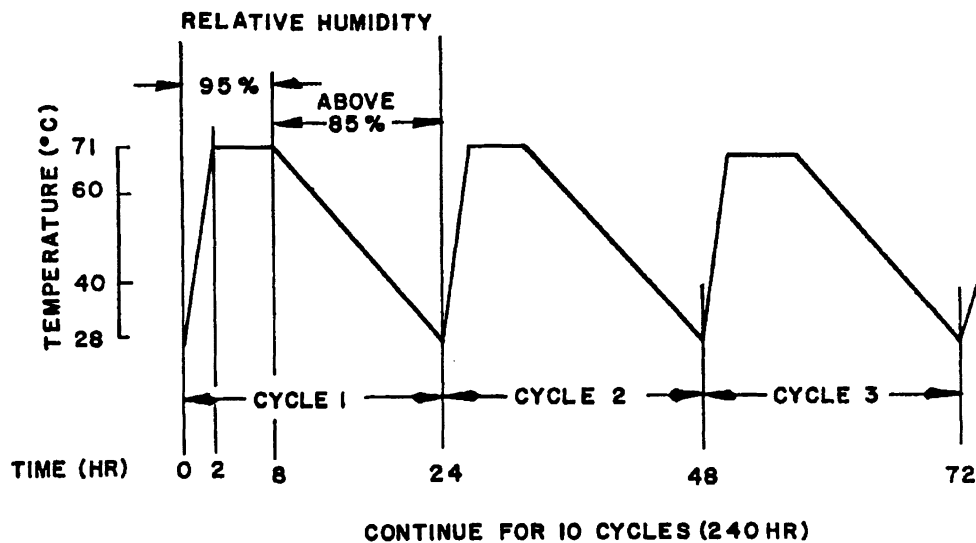


FIGURE 2. Humidity cycle, type III.

4.1 (Continued):

- (6) Step 7a. At least 1 hour but not more than 4 hours after the beginning of step 7, the specimens shall be either removed from the humidity chamber, or the temperature of the chamber shall be reduced. Specimens shall then be conditioned at $-10^{\circ} \pm 2^{\circ}\text{C}$ with humidity not controlled, for 3 hours as indicated on figure 1. When a separate cold chamber is not used, care shall be taken to assure that the specimens are held at $-10^{\circ} \pm 2^{\circ}\text{C}$ for the full 3-hour period.

c. Type III, temperature cycling (see figure 2).

- (1) Conditioning. The specimens shall be conditioned in a dry oven at a temperature of $50^{\circ} \pm 5^{\circ}\text{C}$ for 24 hours. At the end of this period, measurements shall be made as specified.
- (2) Mounting. Specimens shall be mounted by their normal mounting means, in their normal mounting position, but shall be positioned so that they do not contact each other, and so that each specimen receives essentially the same degree of humidity.
- (3) Initial measurements. Prior to step 1 of the first cycle, the specified initial measurements shall be made at room ambient conditions, or as specified.
- (4) Number of cycles. Specimens shall be subjected to 10 continuous cycles, each as shown on figure 1.
- (5) Subcycle. The subcycle shall be performed in accordance with 4.1(b)(5).
- (6) Step 7a. This step shall be performed in accordance with 4.1(b)(6).

4.1 (Continued):

(7) Test.

- (a) Place the test item in the test chamber in accordance with 4.1(c)(1). Prior to starting the test, the internal chamber temperature shall be at standard test with uncontrolled humidity.
- (b) Gradually raise internal chamber temperature to 71°C (160°F) and the relative humidity to 95^{+5}_{-0} percent over a period of 2 hours.
- (c) Maintain condition of (7)(b) (see figure 2) for not less than 6 hours.
- (d) Maintain 85 percent, or greater, relative humidity and reduce internal chamber temperature in 16 hours to $28^{\circ} \pm 10^{\circ}\text{C}$ (82°F).
- (e) Repeat steps (7)(b), (7)(c), and (7)(d) for 10 cycles (not less than 240 hours). Figure 2 is an outline of the humidity cycle for this procedure.

4.2 Final measurements:

4.2.1 At high humidity: Particular precautions to be followed in making measurements under high humidity conditions shall be specified.

4.2.1.1 Type I: Upon completion of the exposure period and while the specimens are still in the chamber, the specified measurements shall be performed.

4.2.1.2 Type II: Upon completion of step 6 of the final cycle, the specified measurements shall be made.

4.2.1.3 Type III: Upon completion of step 7 of the final cycle, the chamber program cam shall be stopped to maintain the low temperature, high humidity condition. The specified measurements shall be made.

4.2.2 After high humidity (all types): Upon removal from the humidity chamber, final measurements shall be made within 1 to 2 hours if required by the connector specification. Specimens shall not be subjected to any means of artificial drying.

5. DOCUMENTATION:

Data sheets shall contain:

- a. Title of test, date, and name of operator.
- b. Sample description - Include fixture, if applicable.
- c. Test equipment used and date of latest calibration.
- d. Identification of test method.
- e. Values and observations - Initial and final ambient conditions.

6. SUMMARY:

The following details shall be specified in the individual connector specifications:

- a. If polarization voltage is required (see 1.4).
- b. Type samples to be tested and whether mated (see 3.1).
- c. Wire type, size, and sealing plugs (if applicable) (see 3.2).
- d. Type I - Test condition letter (see 4.1 a(3)).
- e. Type I - Direct-current potential, if applicable. Length of application time and points of application (see 4.1 a(3)).
- f. Type II - Initial measurements and conditions if other than room ambient (see 4.1 b(1) and (3)).
- g. Type III - Initial measurements and conditions, if other than 4.1 c(1) and (3).
- h. Final measurements and precautions under high humidity conditions (see 4.2).

METHOD 1003.1
TEMPERATURE CYCLING

1. PURPOSE:

The purpose of this test is to determine the resistance of a given electrical connector to exposure at extremes of high and low temperatures, and the shock of alternate exposure to these extremes, simulating the worst probable conditions of storage, transportation and application.

2. TEST EQUIPMENT:

2.1 Test chambers:

Separate chambers shall be used for the extreme temperature conditions of steps 1 and 3. The air temperature of the two chambers shall be held at each of the extreme temperatures by means of circulation and sufficient hot- or cold-chamber thermal capacity so that the ambient temperature shall reach the specified temperature within 2 minutes after the specimens have been transferred to the appropriate chamber.

3. TEST SAMPLE:

3.1 Sample and fixture:

A test sample shall consist of a plug, a receptacle, or a mated plug and receptacle as specified. Unless otherwise specified, the test sample shall be assembled with contact, wires, and sealing plugs, before, during, and after the test. The wire shall be of sufficient continuous length to interconnect the test connector and test equipment, as may be specified. Connectors not normally equipped with an integral coupling device shall be maintained in the simulated mated condition by a suitable fixture. The fixture shall be made as lightweight as possible in order to reduce "heat sink" effects that would reduce the severity of thermal shock. (See 4.2 for sample mass determination before wiring the sample.)

4. TEST PROCEDURE:

4.1 Initial and final measurements:

Specified measurements shall be made prior to the first cycle and upon completion of the final cycle, except that failures shall be based on measurements made after the specimen has returned to thermal stability at room ambient temperature following the final cycle.

4.2 Sample mass determination:

Before cycling, the combined mass of the assembly (mated, if applicable) to be tested shall be determined. This mass shall include contacts, sealing rings, connector accessories attached to the connector, and any wire within the envelope boundaries of the connector. The mass of any fixture used to hold the connectors in the mated condition shall also be determined. The mass of the specimen is the total mass of the mated assembly and any fixture attached to the connector.

4.3 Number of cycles:

Specimens shall be placed in such a position with respect to the airstream that there is substantially no obstruction to the flow of air across and around the specimen. When special mounting is required, it shall be specified. The specimen shall then be subjected to the specified test condition of table I. The first five cycles shall be run continuously. After five cycles, the test may be interrupted after the completion of any full cycle, and the specimens allowed to return to room ambient temperature before testing is resumed. One cycle consists of steps 1 through 4 of the applicable test condition. Specimens shall not be subjected to forced circulating air while being transferred from one chamber to another. Direct heat conduction to the specimen should be minimized.

TABLE I. Temperature cycling.

Step	Test condition	Number of cycles
	A	5
	A-1	25
	A-2	50
	A-3	100
	Temperature	Time
	<u>°C</u>	<u>Minutes</u>
1	-55^{+0}_{-3}	(See table II)
2	25 ± 10	5 max
3	85^{+3}_{-0}	(See table II)
4	25 ± 10	5 max

4.4 Exposure time:

The duration of test and the length of exposure at temperature extremes are standardized for a given mass of the test item (see table II). This approach will allow the connector to reach thermal stability at the temperature of the test chamber while keeping the testing time to a minimum.

TABLE II. Exposure time at temperature extremes.

Mass of specimen	Minimum time (for steps 1 and 3)
1 ounce (28 grams) and below - - - - -	<u>Hours</u> 1/2; or 1/4 (when specified)
Above 1 ounce (28 grams) to .3 pound (136 grams) incl - - - - -	1/2
Above .3 pound (136 grams) to 3 pounds (1.36 kilograms) incl - - - - -	1
Above 3 pounds (1.36 kilograms) to 30 pounds (13.6 kilograms) incl - -	2
Above 30 pounds (13.6 kilograms) to 300 pounds (136 kilograms) incl -	4
Above 300 pounds (136 kilograms) - - - - -	8

5. DOCUMENTATION:

Data sheets shall contain:

- a. Title of test, date, and name of operator.
- b. Sample description - Include fixture, if applicable.
- c. Test equipment used and date of latest calibration.
- d. Test condition letter.
- e. Values and observations.
 - (1) Initial and final measurements (see 4.1).
 - (2) Assembly mass (see 4.2).

6. SUMMARY:

The following details shall be specified in the individual connector specification:

- a. Mated or unmated state of the test connectors, assembly of test sample if other than 3.1, and test equipment interconnect (if applicable) (see 3.1).
- b. Initial and final measurements (see 4.1).
- c. Test condition letter (see 4.3).
- d. Special mounting, if applicable (see 4.3).

**METHOD 1004.1
ALTITUDE IMMERSION**

1. PURPOSE:

The purpose of this test is to demonstrate the ability of the connector-to-wire and interface-area seals of a mated connector assembly to perform satisfactorily during and subsequent to simulated rapid descents from high altitude with attendant moisture condensation.

2. TEST EQUIPMENT:

2.1 Altitude chamber:

The altitude immersion test chamber shall consist of a suitable sealed chamber with necessary vacuum pump equipment to maintain a reduced pressure of 1 inch of mercury or lower, if required. The chamber shall have provisions for electrical connections.

2.2 Test container:

The test container for positioning the connector assembly shall have the following minimum dimensions: 2 inches wide, 9 inches long, and 3 inches deep. A salt solution shall be placed in the container to a depth that will completely cover the connector at all times during the altitude immersion test. The salt solution shall be prepared by dissolving 5 ± 1 parts by weight of noniodized commercial table salt in 95 parts by weight of distilled water. No material shall be added to, and no contaminant shall be present in the container or solution which tend to prevent wetting of the test sample by the solution.

3. TEST SAMPLE:

3.1 Sample:

The test sample shall consist of a fully assembled, mated electrical connector with the specified number of contacts, proper wire type size, and end preparation, sealing plugs, and other hardware as specified. Care shall be taken to ascertain that the wires are free of pin holes that would permit leakage of the solution into the connector or breathing with the chamber pressure changes. It shall be verified that wires provided for connection to shells are actually electrically connected to preceding shells.

3.2 Sample preparation:

The test samples shall be placed in the container in the chamber in such a manner that the connector assembly will be entirely immersed in the salt solution. The uppermost point of the connector shall be 1 inch maximum below the surface of the solution. Unless otherwise specified, termination of the wires of the test sample shall be unsealed and within the sealed chamber as specified. The wires shall be arranged so as to prevent any voltage breakdown or low insulation resistance which might incorrectly indicate connector failure.

4. TEST PROCEDURE:

Unless otherwise specified, the test sample and test equipment shall be established and maintained at standard test conditions.

4.1 Altitude immersion cycling:

The chamber shall be sealed. The chamber pressure shall be reduced from room ambient to 1 inch (75,000 feet) $+0.0 -0.2$ inch of mercury within 5 minutes, and shall be maintained at this level for 30 minutes, minimum. The chamber pressure shall be increased to room ambient within 1 minute, and shall be maintained at room ambient pressure for 30 minutes, minimum. The foregoing shall constitute one cycle. Two additional cycles shall be performed (three cycles total). The connector shall remain fully immersed in the salt solution during the three cycles and for the subsequent measurements specified herein.

4.2 Insulation resistance test:

After the third cycle and while still in the salt solution, the insulation resistance test shall be performed in accordance with test method 3003.

4.3 Dielectric withstanding voltage test:

After the insulation resistance test and while the connector is still in the salt solution, a dielectric withstanding voltage test shall be performed in accordance with test method 3001.

4.4 Connector examination:

After the altitude immersion test, the test sample shall be removed from the chamber and washed in distilled or tap water. The test sample shall then be patted or wiped with suitable towels and dried by being exposed to room ambient conditions for 20 to 24 hours, or by placing in a circulating air oven at $48.9^{\circ} \pm 2.8^{\circ}\text{C}$ ($120^{\circ} \pm 5^{\circ}\text{F}$) for 2 - 3 hours. The following shall be observed and recorded:

- a. Evidence of foreign deposits on the interface or contacts.
- b. Deterioration of moisture seals.
- c. Evidence of dielectric breakdown across interface of connector.

5. DOCUMENTATION:

Data sheets shall contain:

- a. Title of test, date, and name of operator.
- b. Sample description - Include fixture, if applicable.
- c. Test equipment used and date of latest calibration.
- d. Test procedure.
- e. Values and observations:
 - (1) Record chamber pressure, temperature and duration of each cycle.
 - (2) Record: Insulation resistance values. Identity of each contact pair in test sample.
Dielectric withstanding test results. Identity of each contact pair in test sample.
Connector visual examination.

6. SUMMARY:

The following details shall be specified in the individual connector specification:

- a. Wire type and size (see 3.1).
- b. Number of contacts and sealing plugs (see 3.1).
- c. Connector accessories - Support hardware to be installed on connector specimen during test (see 3.1).
- d. Connector specimen preparation (see 3.2).
- e. Insulation resistance minimum allowable limit (see 4.2).
- f. Dielectric withstanding voltage, maximum leakage current and test voltage application time if other than 5 seconds (see 4.3).

METHOD 1005.1
TEMPERATURE LIFE

1. PURPOSE:

The purpose of this test is to determine the effects on the electrical and mechanical characteristics of electrical connectors resulting from exposure of the connector(s) to an elevated ambient temperature for a specified length of time.

2. TEST EQUIPMENT:

A suitable chamber and equipment shall be used that will maintain, monitor and record the test temperature to the tolerance and for the duration specified. The chamber temperature measurements shall be made in a manner that will indicate the connector exposure temperature rather than the chamber source temperature. The chamber size or capacity shall be such that the connectors under test shall be capable of dissipating the internally generated (I^2R) connector heat.

3. TEST SAMPLE:

3.1 Sample:

The test sample shall consist of a fully assembled, mated electrical connector with the specified number of contacts. Proper wire type, size, end preparation, sealing plugs, and other hardware shall be as specified.

3.2 Sample preparation:

Unless otherwise specified, the connectors, wires, and fixtures shall be normally positioned in the chamber so that there will be no restriction of the air flow. All contacts of the same wire size shall be wired in series.

4. TEST PROCEDURE:

The connector test potentials, duty cycle load and other operating conditions during exposure shall be specified.

4.1 Connector temperature:

The connector samples shall be exposed to one of the temperatures specified in table I. The connector internal temperature shall not exceed that specified in table I when test is performed under electrical load conditions. The continuous dc current to produce the specified internal temperature shall be regulated and recorded. The current shall not exceed the rated current of the contact.

TABLE I. Connector temperatures.

Test condition	Connector exposure temperature and tolerance		Connector internal temperature (maximum)	
	°C	°F	°C	°F
1	55 ±2	131 ±3.6	65	149
2	70 ±2	158 ±3.6	84	183
3	85 ±2	185 ±3.6	102	216
4	105 ±2	221 ±3.6	125	257
5	125 ±2	257 ±3.6	150	302
6	175 ±5	347 ±9	206	402
7	200 ±5	392 ±9	238	460
8	350 tol. as specified	662 tol. as specified	400	752
9	500 tol. as specified	932 tol. as specified	575	1067

4.2 Length of test:

The connector samples shall be subjected to the specified temperature for one of the durations of table II.

TABLE II. Length of test.

Test time condition	Hours
A	96
B	250
C	500
D	1000
E	1500
F	2000
G	3000
H	5000

4.3 Examination:

At the conclusion of the test, the connector(s) shall be examined for any of the following:

- a. Dimensional changes in excess of specified limits.
- b. Hardening or softening of dielectric materials in excess of specified limits.
- c. Opening of seals.
- d. Cracking or crazing or delamination of components or finishes.
- e. Fusing or seizure of mating connectors or components.
- f. Leakage of potting materials, as specified.

The above conditions shall be judged on their effect on the continued successful operation of the connector and the ability of the connector to meet the test requirements of the individual applicable specification.

5. DOCUMENTATION:

Data sheets shall contain:

- a. Title of test, date, and name of operator.
- b. Sample description - Include fixture, if applicable.
- c. Test equipment used, and date of latest calibration.
- d. Test procedure.
- e. Values and observations:
 - (1) Visual examination.
 - (2) Monitoring measurements as required by the individual specification.
 - (3) Current required to maintain specified internal temperature.

6. SUMMARY:

The following details shall be specified in the individual connector specification.

- a. Sample preparation (include internal temperature monitoring device type and location) (see 2.).
- b. Test sample description (see 3.1).
- c. Special fixtures and mounting, if other than that simulating normal operation (see 3.2).
- d. Load conditions (electrical) (see 4.).
- e. Test condition for chamber and connector temperature and length of test (see 4.1 and 4.2).
- f. Observations or measurements to be made before, during and after testing (see 4.3).

METHOD 1006.1
HYDROSTATIC PRESSURE

1. PURPOSE:

The purpose of this test is to determine the adequacy of receptacles and plugs (mated, unmated, or provided with protective covers) and wired-mated harnesses subjected to static and dynamic hydrostatic pressures that are encountered in the undersea environment.

2. TEST EQUIPMENT:

2.1 Test container:

The test equipment shall consist of a hydrostatic pressure test vessel (following the ASME pressure vessel code as a guide). The pressure vessel shall be designed to suit the hydrostatic pressure range of the connector or receptacle to be tested. The vessel shall be equipped with a suitable pump to permit pressurization of the vessel to its required pressure condition in accordance with 4.2 and table I. The pressure gage attached to the vessel shall be accurate within plus or minus 1 percent. The vessel shall include a cover designed for mounting and sealing test flanges to the cover, see figure 1.

2.2 Test liquid:

Unless otherwise specified, the test medium shall be tap water. When a union connector is tested (see figure 2), a dielectric oil shall be located above the water in the pressure vessel to completely immerse the bulkhead connector in oil and the union connector in the water. Plain tap water may be used for production testing when authorized by the individual specification.

3. TEST SAMPLE:

3.1 Sample:

A test sample may consist of any the following:

- a. An unmated receptacle.
- b. A mated bulkhead connector, or a mated union connector, see figure 2.
- c. A protective cover.

3.2 Sample preparation:

Three types of hydrostatic pressure tests shall be conducted: An unmated receptacle, a mated connector, and a protective cover test. Samples shall be tested under the specified electrical power with all contacts in connector, or ends of cables or wires connected. Instrumentation may be connected to the test sample via the pressure vessel for electrical performance monitoring.

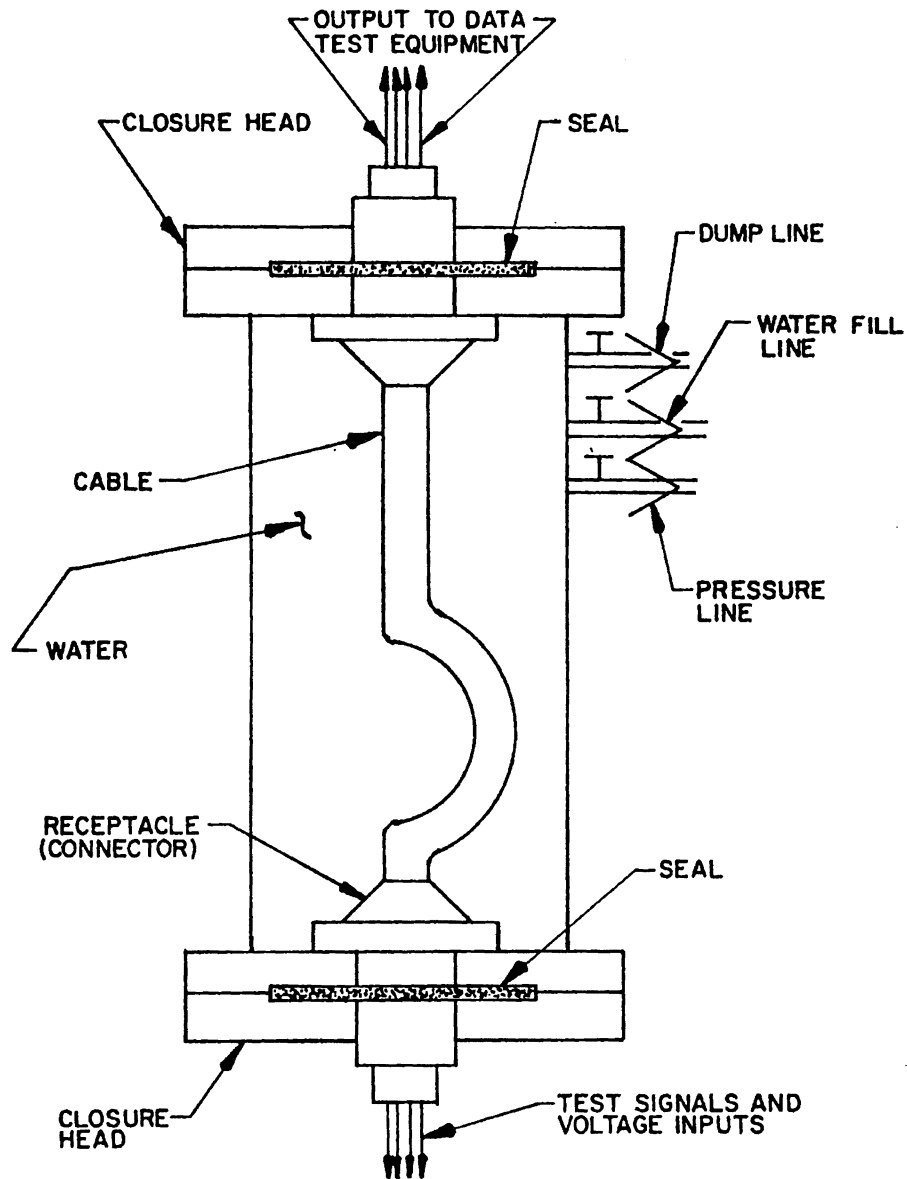


FIGURE 1. Hydrostatic test vessel.

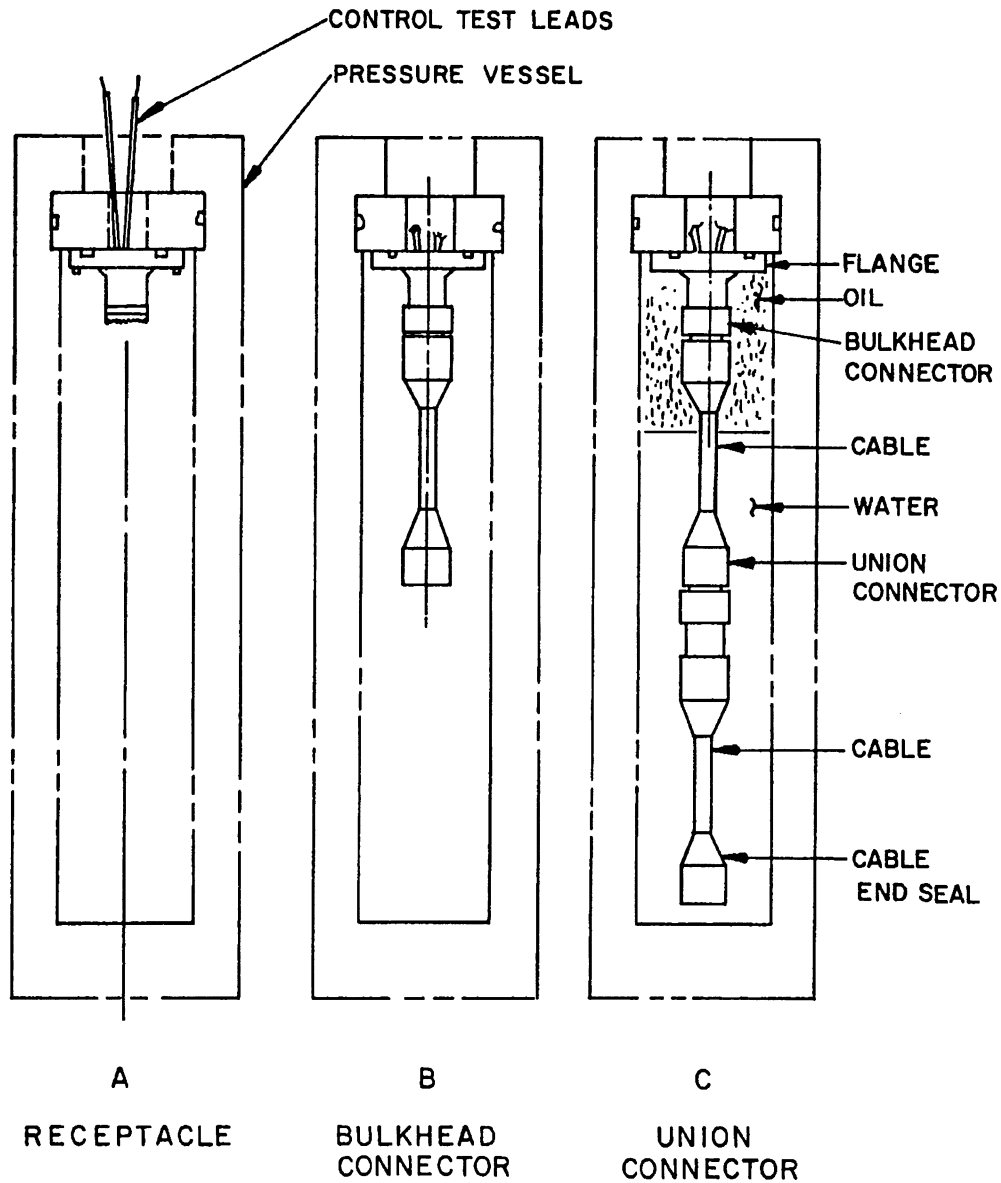


FIGURE 2. Typical connector tests.

- 3.2.1 Unmated receptacle: The unmated receptacle shall be mounted to the vessel cover flange using seal and fastening methods as specified. The face of the web section of the receptacle shall be exposed to pressure while this area is completely filled with water.
- 3.2.2 Mated connector: A bulkhead type connector or a union type connector shall be assembled using the wire or cable type, length, size and sealing methods as specified.
- 3.2.3 Protective cover: The test connector shall be installed in the vessel so that the pressure can be applied safely to the cover. The back end of the connector shall be suitably protected. Precaution should be taken to assure maximum safety when pressure is applied in various tests.

4. TEST PROCEDURE:

4.1 Hydrostatic pressure test (static):

The test sample shall be subjected to the specified test condition of table I. The test sample shall be subjected to the maximum pressure of each applicable increment for 5 minutes ± 30 seconds at standard ambient conditions, unless otherwise specified.

4.2 Hydrostatic pressure test (cycling):

When specified, the connector shall be subjected to a cyclic pressure test following the static pressure test. The specimen shall be subjected to the following cycling from 0 lb_f/in^2 to the maximum pressure of the test condition:

<u>Procedure</u>	<u>Number of cycles</u>	<u>Time at maximum pressure</u>
1	25	momentary
2	1,000	5 minutes ± 30 seconds
3	1	24 hours ± 30 minutes

4.3 Examination (control tests):

Control tests such as continuity and insulation resistance shall be as specified.

TABLE I. Hydrostatic pressure test increments (static).

Test condition				Pressure increments lb _f /in ² ±1 percent
A	B	C	D	
1	1	1	1	0-20
2	2	2	2	20-250
3	3	3	3	250-500
4	4	4	4	500-1,000
	5	5	5	1,000-1,500
	6	6	6	1,500-2,000
	7	7	7	2,000-2,500
		8	8	2,500-3,000
		9	9	3,000-3,500
		10	10	3,500-4,000
		11	11	4,000-5,000
		12	12	5,000-6,000
		13	13	6,000-7,000
		14	14	7,000-8,000
			15	8,000-9,000
			16	9,000-10,000
			17	10,000-11,000
			18	11,000-12,000
			19	12,000-13,000
			20	13,000-14,000
			21	14,000-15,000
			22	15,000-16,000

4.4 Failures:

Potential modes of failure resulting from this test include:

- Permanent dimensional changes.
- Cracking and crazing of insulation materials.
- Permanent damage to cable sealing compounds.
- Water absorption by insulation materials and leakage through these materials.
- Leakage of receptacle-to-bulkhead seals; plug-to-receptacle seals; and cable-to-plug seals.
- Displacement or rupture of connector shells, inserts, contacts, wire, or sealing compounds.
- Changes in electrical characteristics (adverse).

5. DOCUMENTATION:

Data sheets shall contain:

- a. Title of test, date, and name of operator.
- b. Sample description - Include fixture, if applicable.
- c. Test equipment used and date of latest calibration.
- d. Test method, condition, and procedure, as applicable.
- e. Values and observations:
 - (1) Initial and final ambient conditions.
 - (2) Circuit diagram, if used for control tests.
 - (3) Insulation resistance readings, if applicable.
 - (4) Observations of permanent or temporary dimensional changes; insulation, connector shell, contact, wire (or cable) seal, or insert damage.

6. SUMMARY:

The following details shall be specified in the individual specification:

- a. Test medium, if other than tap water (see 2.2).
- b. Electrical power to be applied (see 3.2).
- c. Mated or unmated condition of test connectors (see 3.2).
- d. Connector wire or cable type, length and size, and sealing methods (see 3.2).
- e. Receptacles seal mounting and fastening method (see 3.2.1).
- f. Special precautions, if applicable (see 3.2.3).
- g. Initial measurements and conditions, if other than room ambient (see 4.1).
- h. Test condition letter (see 4.1).
- i. Test procedure number (see 4.2).

METHOD 1007.1
OZONE EXPOSURE

1. PURPOSE:

The purpose of this test is to determine the ability of connectors to withstand the effects of controlled amounts of ozone.

2. TEST EQUIPMENT:

The test equipment shall be as follows and in accordance with ASTM D 1149-64(1970).

2.1 Test chamber:

- a. The test chamber shall be constructed of a material with minimal reaction to ozone.
- b. The volume of the chamber shall be at least 0.14 cubic meters (5 cubic feet).
- c. A means for generating and controlling an air-ozone stream shall be provided. The generating source shall be located outside the chamber. The source of the air can be either drawn directly from the laboratory or from a compressed air supply. In either case adequate filtration of foreign matter from the stream must be provided. The air-ozone stream shall be introduced into the chamber in such a manner that stratification of ozone is prevented.
- d. The air-ozone replacement rate or throughput rate must be of a magnitude such that no appreciable reduction in ozone concentration results from the introduction of test specimens. This minimum replacement rate will vary with the ozone concentration, temperature, number of test specimens introduced, and their reaction with ozone. In chambers possessing control of the replacement rate at the location of the test specimen, no minimum air-ozone rate need be defined. For many chambers operating under normal conditions (100 -150 ppm) and with the ozonated air control at the generator, an air-ozone replacement rate of a three-fourth change per minute is an acceptable minimum rate. For thorough and accurate work, especially under unusual conditions, the minimum or safe replacement rate should be determined.
- e. A means of providing adequate internal circulation shall be provided. The air-ozone velocity in the chamber shall be at least 61 centimeters (2 feet) per second. Where it is not possible to obtain such velocities, the installation of a 1,700 rpm electric motor and fan blade of approximately 15 centimeters (6 inches) diameter and 20 to 30 degrees pitch will produce such air velocities. The motor itself shall be used with an appropriate seal.
- f. A means of controlling the temperature of the chamber from ambient to $70^{\circ} \pm 5^{\circ}\text{C}$ ($158^{\circ} \pm 9^{\circ}\text{F}$) shall be provided. The temperature regulation shall be capable of maintaining the test temperatures.
- g. A glass window or glass front door shall be provided with the chamber for visual inspection.
- h. Chamber exhaust air, containing ozone, shall be vented out of the test area.

2.2 Ozone generator:

A mercury vapor lamp may be used as the source for generating ozone. The ozone concentration can be controlled by means of a variable transformer on the input to the mercury lamp.

2.3 Ozone measuring devices:

Ozone measuring devices shall be capable of measuring the concentration.

3. TEST SAMPLE:

3.1 Sample:

Each test sample shall consist of one mated and wired plug and receptacle.

3.2 Sample preparation:

All contacts shall be wired, connectors shall be mated, and suspended in the ozone chamber to allow exposure to ozone concentration.

4. TEST PROCEDURE:

Unless otherwise specified, each test sample and test equipment shall be stabilized at standard ambient conditions. Unless otherwise specified, each test sample shall then be subjected to an ozone concentration of 100 to 150 parts per million by volume for 2 hours.

WARNING: Since ozone is a toxic gas, care must be taken in using it to perform testing called out herein.

4.1 Failures:

Potential modes of failure resulting from this test are as follows:

- a. Loosening or breaking of parts.
- b. Degradation of elastomers.
- c. Insert bonding failure.
- d. Excessive swelling of resilient materials.
- e. Damage to interface seals.

5. DOCUMENTATION:

Data sheets shall contain:

- a. Title of test, date and name of operator.
- b. Sample description - Include fixture, if applicable.
- c. Test equipment used.
- d. Test procedure.
- e. Values and observations:
 - (1) Record ozone concentration.
 - (2) Visual and mechanical observation.

6. SUMMARY:

The following details shall be specified in the individual specification:

- a. The ozone concentration and time if other than herein (see 4.).
- b. Test conditions if other than standard ambient (see 4.).
- c. Wired, mated and unmated (see 3.2).

METHOD 1008
AIR LEAKAGE

1. PURPOSE:

The purpose of this test is to determine the integrity of the seal of the shell/insert/contact interfaces in an electrical connector. It may be conducted as one of the tests in a sequential test plan and after or during the exposure of the test sample to a specified low temperature. A pressure differential is established between the front and rear faces of a mounted receptacle. The degree of leakage through the seals of the test sample is measured by means of a detection device located on the low pressure side of the test sample.

2. TEST EQUIPMENT:

2.1 Hermetic seal test equipment:

Test equipment shall be as follows:

- a. Chamber capable of providing for:
 - (1) Mounting of the test sample by means of its flange on the chamber divider which separates low from high pressure.
 - (2) A gas tight seal at the flange mounting surface of the test sample.
 - (3) Surrounding the high pressure side of the connector with a tracer gas for hermetic testing.
- b. Pressure or vacuum pumps, or a pressure bottle with pressure control valve capable of achieving and maintaining the pressure differential specified.
- c. Gages shall be provided in order to read the pressure and/or vacuum of the pressure differential between the front and rear faces of the connector during test.
- d. A mass spectrometer detector shall be used to read the tracer gas leakage rate through the connector.
- e. The tracer gas shall be either helium, argon, or a mixture of 90 percent nitrogen and 10 percent helium.

2.2 Environmental seal test equipment:

Test equipment shall be as follows:

- a. The insulated pressurized chamber shall be operable to -60°C and shall be capable of withstanding an internal pressure of 30 pounds per square inch. The internal container for mounting the connector under test shall have piping to external fittings in accordance with figure 1.
- b. Air line pressure adapter.
- c. Air line pressure regulator and gage.
- d. Graduated cylinder. 25 milliliters.
- e. Thermometer. Readable to -60°C .
- f. Valves and plumbing. In accordance with figure 1. (An alternate environmental seal test equipment arrangement in accordance with figure 2 may be used in place of the arrangement of figure 1.)

3. TEST SAMPLE:

A test sample shall consist of a wired receptacle as specified. The wires shall not be brought out of the test chamber.

4. TEST PROCEDURE:

4.1 Test conditions:

Unless otherwise specified, all measurements shall be made within the ambient conditions per general requirements of this standard.

4.2 Mounting:

The test sample shall be mounted on the chamber divider which separates low from high pressure. A suitable opening must be provided in the divider such that, with the aid of greases and/or sealing gaskets, a leak-proof junction is achieved between the test sample connector flange and divider. The test sample, after mounting in the chamber, shall be conditioned for at least 1/2 hour at the desired temperature before conducting the test.

4.3 Applying pressure:

The pressure differential between the front and rear faces of the connector shall be maintained at the value specified. Depending on the type of equipment used, this may be achieved by evacuation of one side of the chamber while maintaining atmospheric pressure at the other side, or pressurizing one side of the chamber with atmospheric pressure at the other side, or a combination of pressurizing one side of the chamber and partially evacuating the other side.

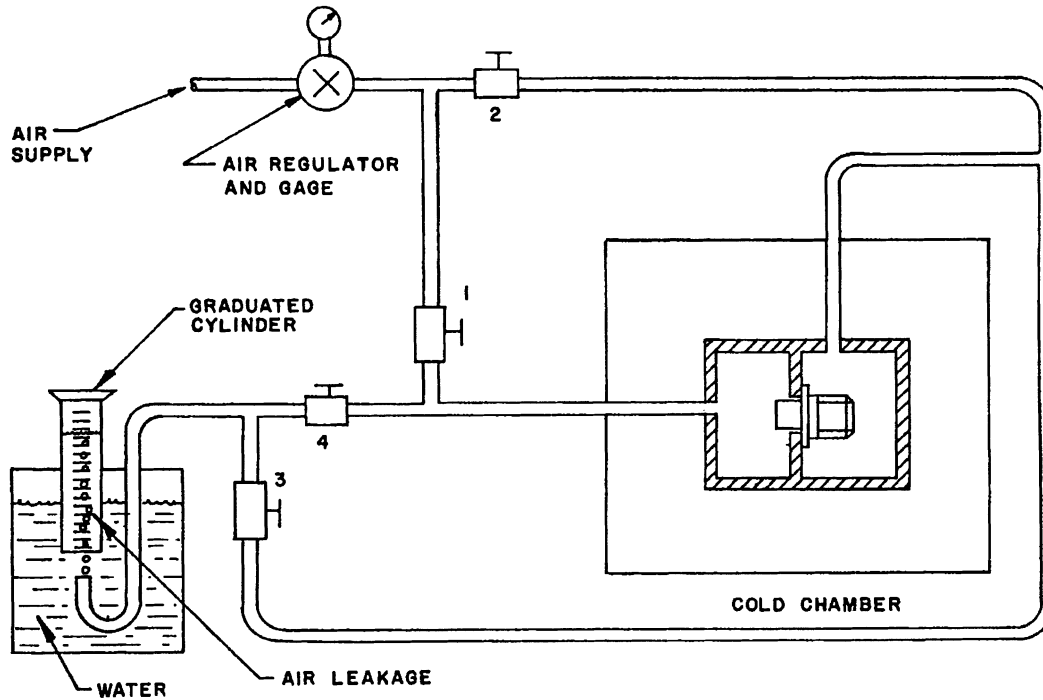


FIGURE 1. Environmental seal test equipment arrangement.

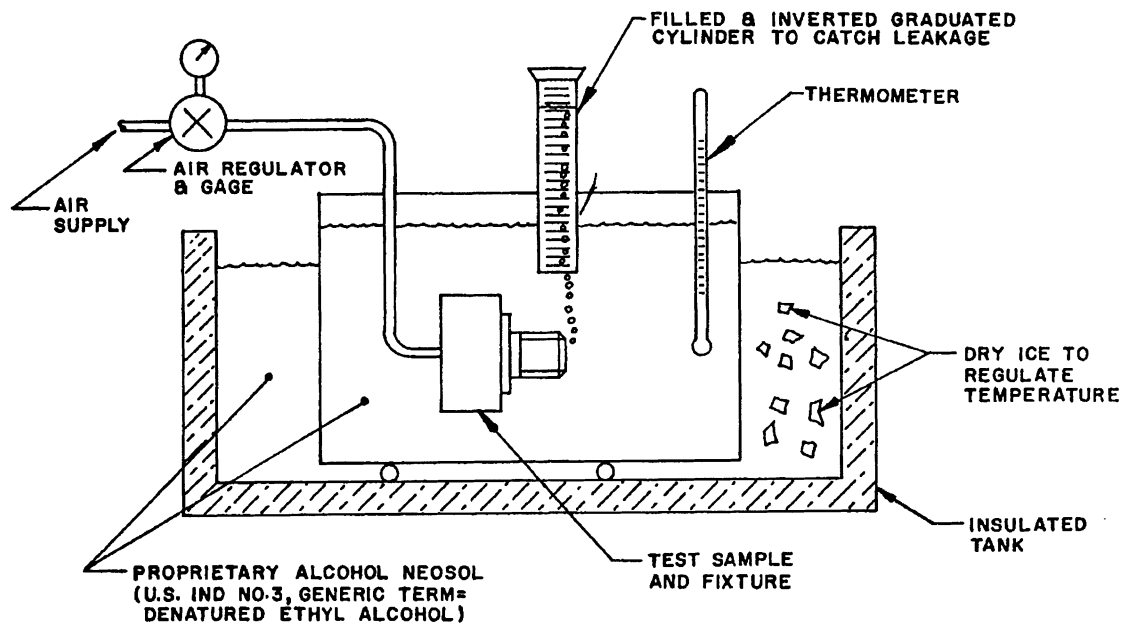


FIGURE 2. Alternate environmental seal test equipment arrangement.

4.4 Leak detection:

- 4.4.1 Leak detection for hermetic seal connectors: The leak detector shall be connected to the low pressure or vacuum side of the chamber. The tracer gas shall be introduced at the high pressure side of the chamber in such a manner that it surrounds the face of the connector test sample. The leakage rate (if leakage exists) shall be measured and compared to the maximum allowable leakage specified.
- 4.4.2 Leak detection for environmental seal connectors: The graduated cylinder shall be filled with liquid and then inverted over the air exit tube from the test sample. The leakage rate shall be measured and recorded.

4.5 Test sample orientation:

Unless otherwise specified, the test sample shall be tested with the flange and mating face in the high pressure side of the chamber, the rear face to extend into the low pressure side of the chamber. When specified, the connector shall be reversed and leakage checked in the opposite (or both) directions.

5. DOCUMENTATION:

Data sheets shall contain:

- a. Title of test, date, and name of operator.
- b. Sample description - Include fixture, if applicable.
- c. Test equipment used and date of latest calibration.
- d. Test procedure used.
- d. Values and observations:
 - (1) Initial and final ambient conditions.
 - (2) Leakage rate observed, comparison to connector specification requirements, whether samples passed or failed.

6. SUMMARY:

The following details shall be specified in the individual specification:

- a. Initial measurements and conditions, if other than room ambient (see 4.1).
- b. Full description of test sample (see 3.).
- c. Manner in which sample is to be prepared (see 3.).
- d. Pressure differential required (see 2.1 b).
- e. Test sample orientation and whether reverse testing is also required (see 4.5).
- f. Maximum allowable leakage rate, expressed as atmospheric cubic centimeters per second ($\text{atm cm}^3/\text{s}$) (see 4.4.1).

METHOD 1009
FIREWALL

1. PURPOSE:

The purpose of this test is to determine the ability of mated wired connector (plug and receptacle) to resist flame, passing through the connector for 20 minutes or other causes such as ignition of gases on the end of the connector protected by the firewall, or break in continuity for a limited period of time.

2. TEST EQUIPMENT:

Test equipment shall be as follows:

- a. Glass tape.
- b. Flame producing apparatus capable of producing a natural gas flame at a flow rate equivalent to an input of 33,000 to 37,000 Btu/h, and maintaining a flame at a temperature of 1,093°C +30° -00°.
- c. Power supply capable of producing a potential of 100-125 Vac at 60 Hz, capable of delivering 2 amperes.
- d. Ammeter certified to an accuracy of 1 percent having capabilities of measuring dc test currents specified in table I.
- e. Vibration apparatus capable of vibrating the mated connector continuously at 33 Hz with a total excursion of 1/4 inch.
- f. Power supply capable of producing dc test current as specified.

3. TEST SAMPLE:

3.1 Sample:

The test sample shall consist of a mated, torqued, high temperature wired connector.

3.2 Sample preparation:

The sample shall be prepared as follows:

- a. Thoroughly clean of oil, grease, dirt and foreign material using a non-combustible solvent.
- b. Wrap the plug wire bundle with glass tape or protect by suitable means to ensure that the wire bundle is capable of meeting the electrical requirements of this test.
- c. Physical and electrical degradation after 20 minutes exposure and 6 minutes electrical assessment.

4. TEST PROCEDURE:

4.1 Mounting:

Unless otherwise specified, the mated, torqued and wired connector shall be mounted on a fixture in accordance with figures 1, 2, and 3.

4.2 Gas flow:

The flame shall be natural gas at a flow rate equivalent to an input of 33,000 to 37,000 Btu/h during the entire test.

4.3 Exposure:

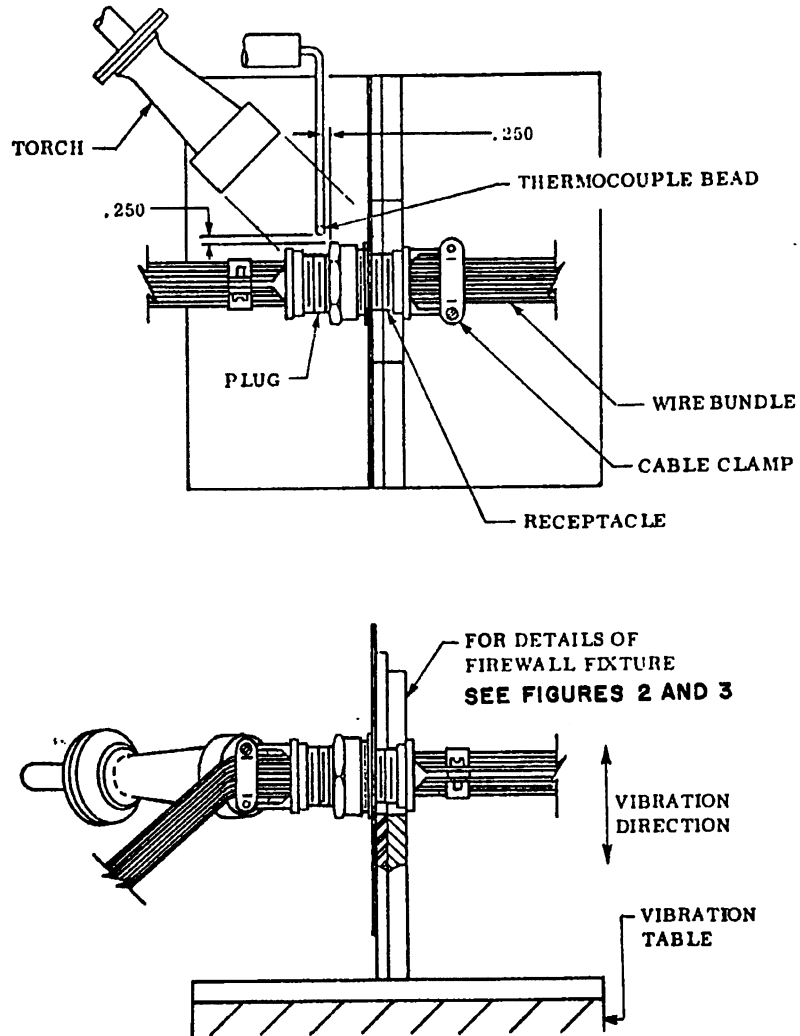
The connector assembly shall be exposed to a 1,093°C minimum flame (measured 0.250 inch from the assembly) for a period of 20 minutes. Simultaneously the assembly shall be vibrated continuously at 33 Hz with total excursion of 1/4 inch.

4.4 Test potential:

During the first 5 minutes of the test, unless otherwise specified, all contacts shall carry the dc current specified in table I without break in continuity. Electrical integrity shall be maintained through the first 6 minutes of test. During the sixth minute of the test, the potential specified in 2.c. shall be applied between adjacent contacts, and between contact and shell, and draw no more than 2 amperes.

TABLE I. Firewall test currents.

Contact size		DC test currents (amperes)
Mating end	Wire barrel end	
22	22	5.0
20	20	7.5
16	16	13
12	12	23
8	8	46
4	4	80
0	0	150



DIMENSIONS IN INCHES

FIGURE 1. Firewall test setup.

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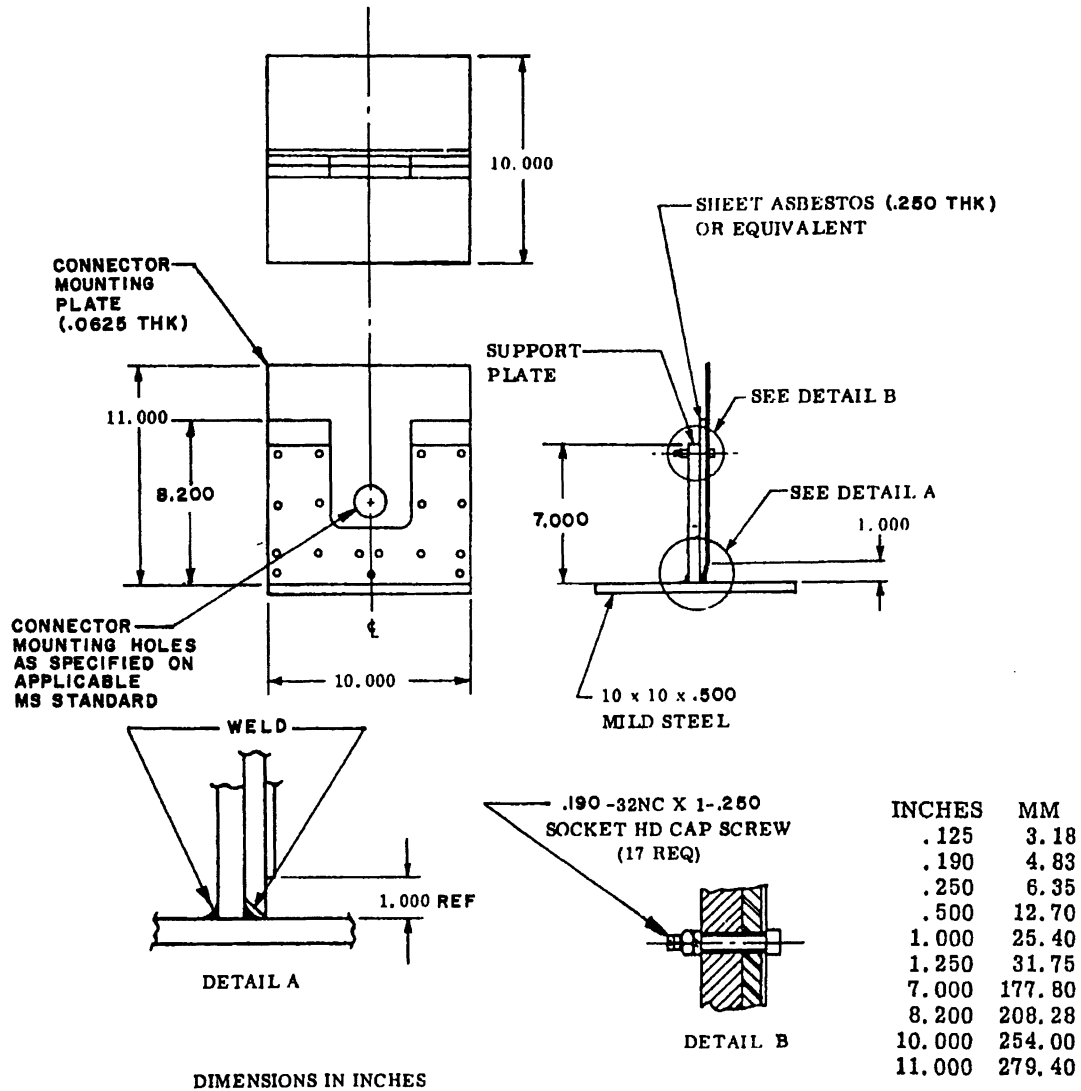
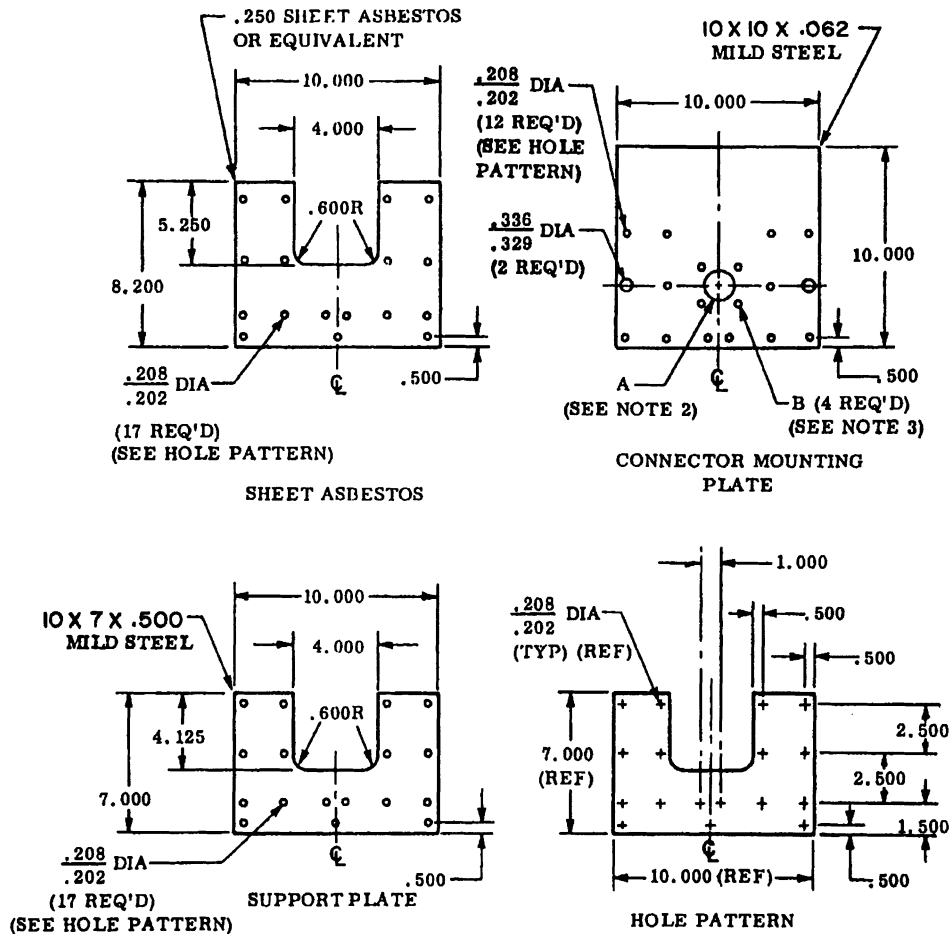


FIGURE 2. Firewall fixture assembly (typical).

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NOTES:

1. Dimensions are in inches. Unless otherwise specified, dimensions symmetrical about centerline.
2. A hole shall provide suitable clearance for the applicable connector.
3. B connector mounting holes shall be as specified on the applicable MS standard.

FIGURE 3. Firewall fixture details (typical).

5. DOCUMENTATION:

Data sheets shall contain:

- a. Title of test, date, and name of operator.
- b. Sample description - Include fixture, if applicable.
- c. Test equipment used and date of latest calibration.
- d. Values and observations.

6. SUMMARY:

The following details shall be specified in the individual specification:

- a. Special mounting, if applicable (see 4.1).
- b. Vibration frequency, if other than 33 Hz (see 4.3).
- c. Voltage and test currents, if other than herein (see table I and 4.4).
- d. Physical and electrical degradation acceptable after 20 minutes exposure and 6 minutes electrical assessment (see 4.4).