

AC NO: 150/5345-26A

DATE: 4 May 1971



# ADVISORY CIRCULAR

## DEPARTMENT OF TRANSPORTATION FEDERAL AVIATION ADMINISTRATION

**SUBJECT:** SPECIFICATION FOR L-823 PLUG AND RECEPTACLE, CABLE CONNECTORS

1. PURPOSE. This circular describes the subject specification requirements for plug and receptacle, cable connectors.
2. CANCELLATION. This advisory circular cancels and replaces Federal Aviation Administration AC 150/5345-26, Specification for L-823 Plug and Receptacle, Cable Connectors, dated 5 October 1964. The deletion of the four figures from the last issue of the referenced specification together with the deletion of six figures from prior issues now makes only figures 1, 6, 11, 14, and 15 currently effective. The retention of the figure numbers, not in sequence, is to preserve the continuity of prior approval actions for currently used plugs and receptacles.
3. EXPLANATION OF CHANGES. The substantive changes made in this advisory circular consist of adding figures 14e, 14f, 15c, 15d, 15e, 15f, 15g, and 15h and the text material for this equipment.
4. SCOPE OF SPECIFICATION. The specification requirements presented are for a plug and receptacle to be used with underground supply cable and transformer primary leads, and with transformer secondary and fixture leads, as applicable. Where shapes other than those described (such as "T" or other cable terminals) are used, the shape may be altered but the dimensions relating to mating and interchangeability shall be as described in the applicable figure.
5. APPLICABLE SPECIFICATIONS AND STANDARD. The following specifications and standard, of the issue in effect on the date of application for qualification (see paragraph 10), apply to this circular. This circular shall govern in case of conflict.

a. American Society for Testing and Materials (ASTM) Specifications.

- (1) B 33 - Tinned Soft or Annealed Copper Wire for Electrical Purposes.
- (2) B 189 - Lead-Coated and Lead-Alloy-Coated Soft Copper Wire for Electrical Purposes.
- (3) D 676 - Method of Test for Indentation of Rubber by Means of a Durometer (Tentative).

b. Insulated Power Cable Engineers Association (IPCEA) Standard.

S-19-81 - General Specifications for Wire and Cable with Rubber, Rubber-Like and Thermoplastic Insulations.

6. SOURCE OF APPLICABLE SPECIFICATIONS AND STANDARD.

- a. Obtain copies of ASTM specifications from the American Society for Testing and Materials, 1916 Race Street, Philadelphia, Pennsylvania 19103, at published prices.
- b. Obtain copies of IPCEA standard publication from the Insulated Power Cable Engineers Association, 283 Valley Road, Montclair, New Jersey.

7. PERFORMANCE REQUIREMENTS.

- a. Determine that the voltage rating and current carrying capacity of each connector is not less than the values shown on the figures describing the connector.
- b. Determine that the voltage drop across the contacts of a connected plug and receptacle do not exceed the values tabulated below for the indicated ampere rating.

<u>Ampere Rating</u>	<u>Maximum Voltage Drop Across Contact</u>
20	6.0 Millivolts
25	7.5 Millivolts

c. Bonding Strength.

- (1) Determine that the bond between the cable and the molded-on plug or receptacle shown on figure 1 withstands a pull of at least 75 percent of the test force required in determining the mechanical strength of completed cord as set forth in

IPCEA Standard Publication S-19-81, under the table entitled "Strength of Completed Cord." Test cord conductors not covered by this table in accordance with requirements set forth in paragraph 7c(2).

- (2) Design the bond between the cable and the molded-on plug or receptacle shown on figures 6 and 11 of this specification to withstand a pull of at least 30,000 psi. This is based on 75 percent of an average tensile strength of 40,000 psi for all wire sizes. The wires are in accordance with ASTM Specification B 33 and B 189.
- d. Determine that each connected plug and receptacle does not show any evidence of separation when subjected to a static pull load of ten pounds, and that no damage occurs to the mating components when the connected plug and receptacle are separated by a static pull load greater than ten pounds.
- e. Design the connector for static service within a temperature range from a minimum of -45°F. to a maximum of +120°F. at sea level.
- f. Provide a watertight seal between rubber and metal parts of the plug and receptacle.

#### 8. DETAIL REQUIREMENTS.

- a. Determine that each connector conforms to the requirements shown on the applicable figure.
- b. Housing.
  - (1) Mold the connector housing from synthetic elastomeric materials serving both as insulation and sheath to fully enclose the pins and sockets of the connectors. Use synthetic elastomeric material suitable for direct burial in the earth, submergence in water, direct sunlight exposure, and capable of withstanding limited chemical, oil, or gasoline attack. Where applicable, use material capable of bonding during vulcanizing to cable sheaths made of polychloroprene or other selected synthetic elastomers to provide a watertight bond. Vulcanize all connectors to the cable sheath to provide a watertight bond, except those shown on figures 14 and 15.

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- (2) Use a compound containing not more than twenty-five pounds of carbon black per one-hundred pounds of elastomer, and the total weight of the compound with ingredients (elastomers excluded) are not to exceed one and one-half times the weights of the elastomer used.

c. Pins and Sockets.

- (1) Design the plug so that the pins will be held perpendicular to the face of the block. Fasten the pins so that:
- (a) The space between the ends of the pins will be not less than 1/8-inch when the pins are pinched together with a force of six pounds applied 1/2-inch out from the face of the plug.
  - (b) The space between the ends of the pins will be not greater than 9/16-inch when the pins are pulled apart with a force of six pounds applied 1/2-inch out from the face of the plug.
  - (c) The above requirements apply to plugs equipped with two pins. The force is applied to the pins only, plug not being held, except to prevent it from turning.
- (2) Design the sockets to conform to the dimensional and construction requirements as indicated on the applicable figure of this specification. Slot and spring-load the sockets for connectors shown in figures 1b, 1c, 6b, 11, 14b, 14d, 14f, 15c, and 15g, to insure positive electrical contact, as required under paragraph 7b.
- (3) Design figures 14 and 15 connectors to have provisions for pins or sockets to be crimped to the cable conductor at the job site. The metal of the pins and sockets for connectors shall exhibit no damage after crimping. Figures 14 and 15 pins or sockets shall be made of materials that contain at least 98 percent copper and have a minimum electrical conductivity of 85 percent at 68°F. (International Annealed Copper Standard, IACS). Sockets shall be fully annealed and supplied with a copper beryllium sleeve type spring which assures adequate contact pressure and protects the socket slots from filling with insulating compound during assembly and subsequent use. Make the pin from material at least "half hard"; fully anneal the crimping section but leave the contact portion of the pin "stock hard." Confine the hardness

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transition to the locking section of the pin. Plate both the pin and socket with any suitable electrical treatment such as electro-tinplating. Provide the pin for figure 14 with a visual indication that verifies proper assembly position.

- d. Insulating Compound. Furnish with each part of the figure 14 connector, an adequate amount of silicone insulating compound, to insure the filling of all internal voids when the connector is assembled.
- e. Figure 15 Connector Assemblies.
  - (1) Plug Connector Assemblies. Design the figure 15 plug assemblies to have two parts, an insert assembly and a housing. Design the insert assembly to consist of two metal contact pins of different outside diameter molded into material as specified in paragraph 8b(1) with the pins held perpendicular to the face of each end of the molded insert assembly and fastened so that they conform to paragraphs 8c(1)(a), 8c(1)(b), and 8c(1)(c). Design the mating contact pins on one end to conform to figures 15a or 15e. Design the contact pins on the cable connection end to have openings to fit No. 10 - No. 12 AWG size stranded wire as shown in figures 15a and 15e. Mold the housing of material as specified in paragraph 8b(1) and as shown in figures 15b or 15f. Design one end of the housing to have an opening to receive and lock the insert assembly and design the other end to have two cable entrance openings for two single conductor No. 10 - No. 12 AWG size stranded cable as shown in figure 15b, or to have a single opening for a two conductor No. 10 - No. 12 AWG size stranded cable as shown in figure 15f.
  - (2) Receptacle Connector Assemblies.
    - (a) Design the figure 15 receptacle assemblies in two parts, an insert assembly and a housing. Design the insert assembly consisting of two metal contact sockets of different inside diameter molded into material as specified in paragraph 8b(1) with the sockets held perpendicular to the face of each end of the molded insert assembly and fastened so that they conform to paragraphs 8c(1)(a), 8c(1)(b), and 8c(1)(c).

- (b) Design the mating contact sockets on one side to conform to figures 15c or 15g. Design the contact sockets on the cable connection end to have openings to fit No. 10 - No. 12 AWG size stranded wire as shown in figures 15c or 15g. Mold the housing of material as specified in paragraph 8b(1) and as shown in figures 15d or 15h. Design one end of the housing to have an opening to receive and lock the insert assembly and design the other end to have two cable entrance openings for two single conductor No. 10 - No. 12 AWG size stranded cable as shown in figure 15d or to have a single cable entrance opening for a two-conductor No. 10 - No. 12 AWG size stranded cable as shown in figure 15h.
- (3) Provide a watertight seal to prevent moisture entrance into the housing when the figure 15 plug and receptacle assemblies are assembled.
- f. Wire Connection. Except for figures 14 and 15 connectors, mechanically and electrically bond a suitable conductor to a pin or socket and then mold the connector into the housing. Seal each socket at the end connected to the conductor in order to provide a barrier against entrance of moisture to conductor.
- g. Marking.
  - (1) Mark each plug and each receptacle with the manufacturer's name. Mark each plug and each receptacle also with the specification number and the appropriate identification number in accordance with the specification figures, i.e., L-823, figure 1a.
  - (2) Do not mold a connector to a cable having a higher voltage rating than the specification requirements for the connector.
- h. Caps.
  - (1) Design caps, other than the series short circuiting type, where required, to protect plugs and receptacle prior to final connection. Size and shape are optional.
  - (2) When a series short circuiting plug type cap is required for a receptacle, internally connect jumpers to the proper pins. Make the mating dimensions the same as the corresponding plug. Mark the series short circuiting cap with an "S" and mold of a red material.

i. Instructions. Furnish installation instructions with each figure 14 and 15 connector.

j. Figure 14 Disposable Accessories.

- (1) Equip each figure 14 receptacle with a disposable sleeve made of high density (linear) polyethylene fitted into the receptacle's water seal to catch surplus silicone compound upon assembly. Equip each figure 14 socket with a disposable pin, made of high density (linear) polyethylene, fitted tightly into the pin end of the socket to prevent entry of silicone compound on assembly and to provide a visual indication of proper socket position after assembly. The pin design should be such that proper internal dispersion of silicone compound in the assembly is assured.
- (2) Cap each housing with a disposable shipping cap on the cable entrance end. Provide a small pin hole in each cap to allow air venting to the pothead chamber. Make the pinhole small enough to prevent the escape of the silicone compound.

## 9. TESTING.

a. Approval Testing.

- (1) Subject all completed plugs and connectors molded of materials compounded in accordance with paragraph 8b(2) to the electrical and physical tests described below and the requirements specified under paragraph 7 and paragraphs 8a, 8b(3), 8c, and 8g. For all tests, assemble figures 14 and 15 connectors, when appropriate, in accordance with the manufacturer's instructions to individual lengths of cable, each at least 24-inches long.
- (2) Furnish six pairs of mated connectors, for each type of connector to be approved, selected at random from a production quantity, for a direct current insulation test for voltage to ground. Where the assemblies to be tested are rated at 600, 3000, or 5000 volts, use test voltages 4700 volts DC for rated 600 volt assemblies, and 15,000 volts DC for rated 3,000 and 5000 volts, respectively.
- (3) Make the tests as follows:
  - (a) Provide the manufacturer 6 test insert plugs manufactured of nylon or equal material with suitable dielectric strength. Use the test plugs made to the minimum dimensions of the corresponding standard plug intended for use with the receptacle being tested.

- (b) Mate each receptacle under test with one of these test plugs and allow to soak for 24 hours in a tap water bath.
- (c) At the end of the soaking period, and with measurements made at room temperature (provided the latter does not exceed 80°F.), the minimum megohm resistance shall be 3000 with the receptacles still immersed.
- (d) The receptacles having passed this test will be used for testing not only the corresponding male plugs but also the assembled connectors to determine the characteristics of both.
- (e) Check each of the male plugs supplied with "go" and "no go" ring gauges to determine that the plugs are in accordance with the dimensions specified for the plugs being tested.
- (f) Measure the dielectric strength of an assembly of a plug and a receptacle in megohms, and the minimum megohms resistance shall be 3000 to ground at 60°F. and 1000 megohms to ground at 135°F. Immerse the assembly in a tap water bath for at least 24 hours prior to test. Immerse not more than two feet of cable (one foot on receptacle and one foot on plug) during the soaking and testing period along with the connector. Make a test with the water at 60°F. Before further testing, heat the water to 135°F. without removing the assembly and then hold this temperature for a minimum of one hour.
- (g) When the assembly has two or more conductors, make dielectric tests also between contacts. For these tests, 3000 volts shall be applied and a minimum of 1000 megohms resistance shall be observed at 60°F. while assemblies are mated.
- (h) If an assembly fails in any of the foregoing dielectric tests, a sample of its cable may be tested separately to determine whether the cable insulation resistance is satisfactory. If cable is found to cause failure, a new assembly shall be retested.
- (i) Additionally, test figure 14 connectors by connecting one figure 14 plug and one mating figure 14 receptacle together and then immersing in tap water at room temperature. While immersed, manually flex the two connectors for two minutes and then let them remain



immersed for a minimum of 24 hours with their cable leads flexed 180° from their longitudinal axis and tied in that position. Measure the connected assembly after 24 hours immersion to determine if it meets the required resistance of 7500 megohms to ground. Make the measurement one minute after a test voltage of 15KV, DC, has been applied, with the assembly immersed in water which has been maintained at a temperature of 90°F. for the last hour. Use a guard connection to eliminate the effect of leakage current.

(j) Additionally, test figure 15 assembled plug and receptacle connectors as follows:

- 1 Connect the following plug and receptacle connectors to a 2-foot length of the proper size and type of cable in accordance with manufacturer's instructions.
  - a Plug assembly composed of figures 15a and 15b.
  - b Receptacle assembly composed of figures 15c and 15d.
  - c Plug assembly composed of figures 15e and 15f.
  - d Receptacle assembly composed of figures 15g and 15h.
  - e Plug composed of figure 1a molded to proper size cable.
  - f Receptacle composed of figure 1b molded to proper size cable.
  - g Receptacle composed of figure 1c molded to proper size cable.
- 2 Mate the following combination of the above plug and receptacle assemblies with the assembled plug or receptacle as specified.
  - a Plug assembly 9jla mated with receptacle assembly 9jlb.
  - b Plug assembly 9jla mated with receptacle assembly 9jld.
  - c Plug assembly 9jla mated with receptacle assembly 9jlf.

- d Plug assembly 9jla mated with receptacle assembly 9jlg.
- e Plug assembly 9jlc mated with receptacle assembly 9jlb.
- f Plug assembly 9jlc mated with receptacle assembly 9jld.
- g Plug assembly 9jlc mated with receptacle assembly 9jlf.
- h Plug assembly 9jlc mated with receptacle assembly 9jlg.
- i Plug assembly 9jle mated with receptacle assembly 9jlb.
- j Plug assembly 9jle mated with receptacle assembly 9jld.

- 3 Immerse the above mated plug and receptacle assemblies in tap water at room temperature. While immersed, manually flex the connector assemblies for two minutes and then leave the assemblies immersed for a minimum of 24 hours with their cable leads bent 180° from their longitudinal axis and tied in that position. During the last 24-hour period, maintain the bath water at 90°F. After the above cycle and while still immersed, test the connected assembly to determine that a minimum resistance of 3,000 megohms to ground and 1,000 megohms between conductors is obtained. Make the measurements one minute after a test voltage of 4,700 volts DC has been applied. Use a guard connector to eliminate the effect of leakage circuits.

10. QUALIFICATION. To obtain approval of equipment covered by this specification, the manufacturer is to submit sample connectors to a disinterested testing laboratory, acceptable to the Federal Aviation Administration (FAA), Airports Service (AS), Washington, D.C. 20590 to be tested as described in paragraph 9 to obtain certification regarding the ability to manufacture connectors meeting the requirements of this specification. The manufacturer is required to furnish two copies of the testing laboratory's report to Airports Service for review and approval consideration. The cost of testing is to be borne by the manufacturer offering the material for qualification.

- a. If the manufacturer has satisfactory laboratory facilities, the qualification tests may be performed at the factory. These factory tests must be witnessed by a representative of the FAA, Airports Service.
- b. In addition to the test performed by the above disinterested testing laboratory or by a manufacturer, the manufacturer is to:
  - (1) Furnish samples of connectors to Airports Service for physical inspection. Cost of submitting these samples shall be borne by the manufacturer.
  - (2) Furnish installation instructions for connectors shown in figures 14 and 15 to the Airports Service for review and approval.
  - (3) Furnish certification that the housing compound is in accordance with paragraph 8b(2).
- c. Upon approval of the test reports and the additional data required in paragraph 10a, which have shown satisfactory conformance to specification requirements, Airports Service will list the name of the qualified manufacturer and a description of their connector in Advisory Circular 150/5345-1B, Approved Airport Lighting Equipment.
- d. Additional inspection and tests, including tests for watertightness, mechanical strength, and interchangeability, will be made as deemed necessary by the FAA, Airports Service, to determine compliance with this specification.
- e. The furnishing of products which prove to be unequal to the approved sample(s) may be sufficient cause for removal of the product and the manufacturer's name from the list of approved equipment.
- f. Due to the inherent characteristics of the material involved and the critical demand placed on this equipment, the FAA, Airports Service, may require the requalification of plugs and receptacles manufactured in accordance with this specification whenever in its judgement it appears desirable.
- g. Manufacturer's are not to make a change of materials of manufacturing methods or revision of catalog numbers of approved equipment without prior approval of FAA, Airports Service, Washington, D.C. 20590.

- h. At any time after approval has been granted under the above conditions, make available, upon written request from FAA, Airports Service, a certified copy of factory test reports on the latest production run of equipment.
11. HOW TO GET THIS CIRCULAR. Obtain additional copies of this circular, AC 150/5345-26A, Specification for L-823 Plug and Receptacle, Cable Connectors, from the Department of Transportation, Distribution Unit, TAD-484.3, Washington, D. C. 20590.



CLYDE W. PACE, JR.  
Deputy Director, Airports Service

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Appendix 1

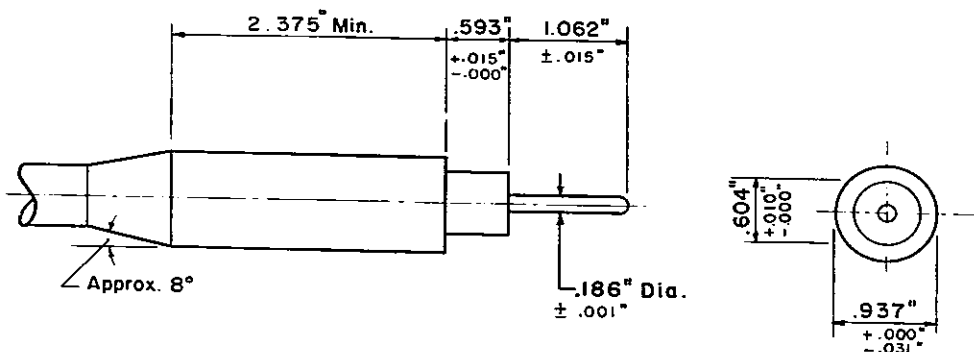


Contacts & Contact Position same  
as Receptacle above.

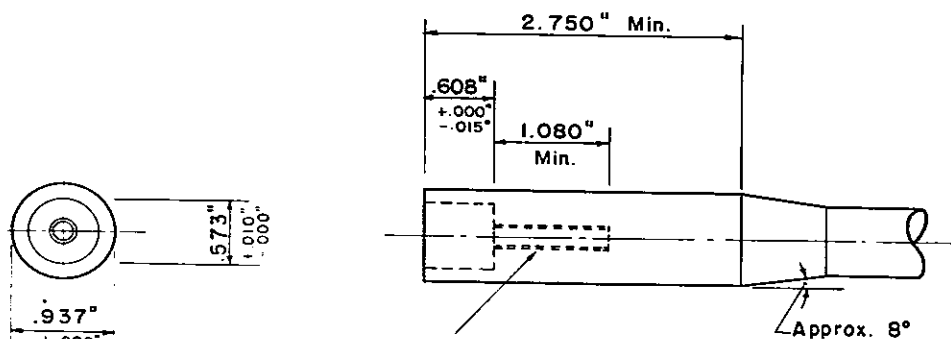


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(a) PLUG



Note: Metal socket shall be recessed not more than  $\frac{1}{8}$ " below inside face of receptacle and before splitting shall have an I.D. of .188"  $\pm$  .001.

(b) RECEPTACLE

FIGURE 6. PLUG AND RECEPTACLE (SINGLE CONDUCTOR, 25 AMPERE, 5000 VOLTS TO GROUND)

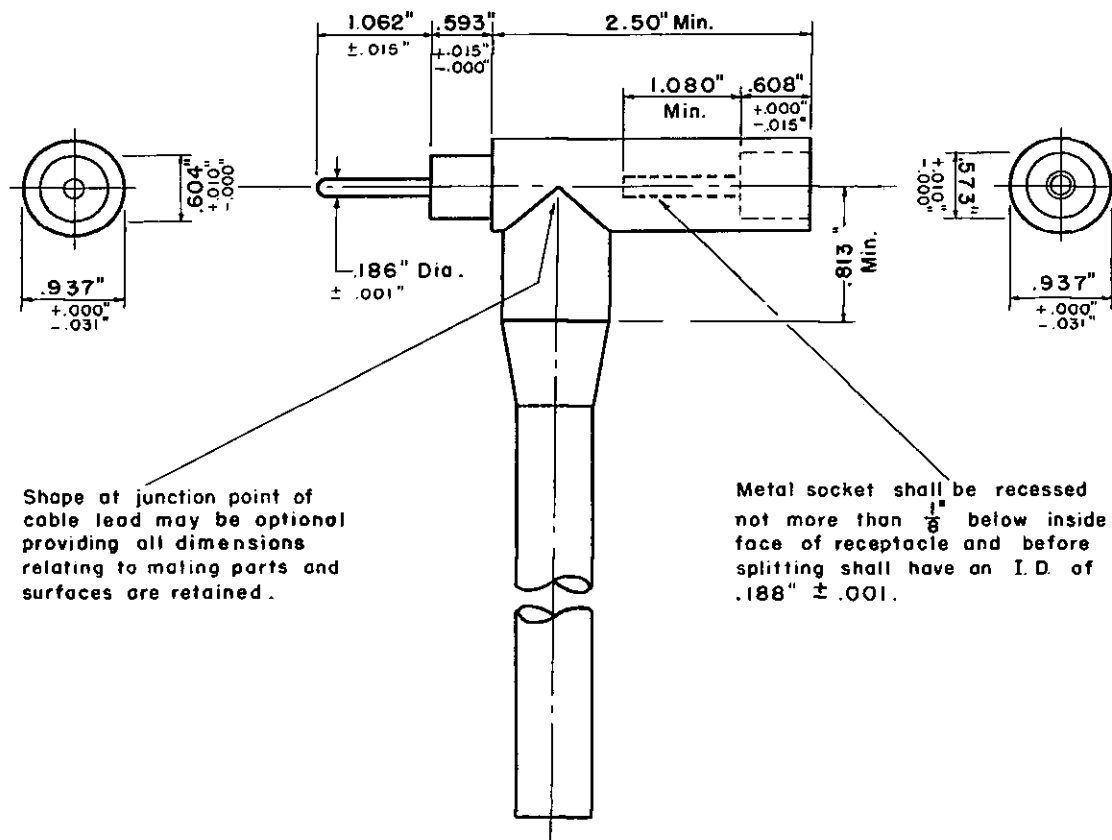
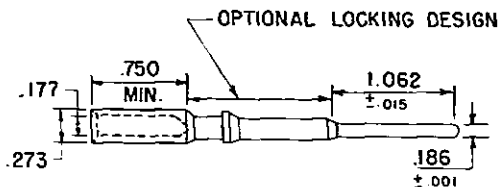
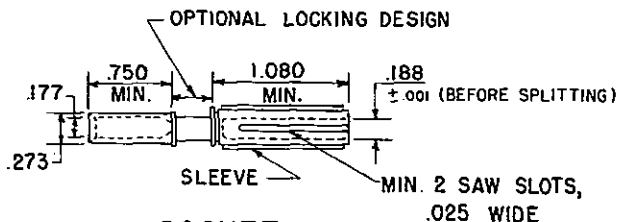


FIGURE 11. PLUG AND RECEPTACLE (SINGLE CONDUCTOR, 25 AMPERE, 5000 VOLTS TO GROUND.)

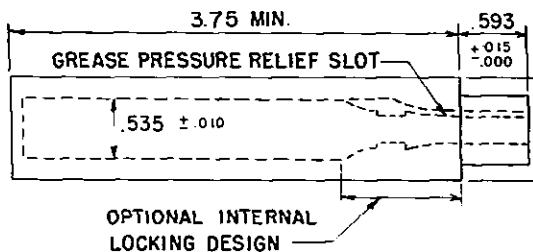
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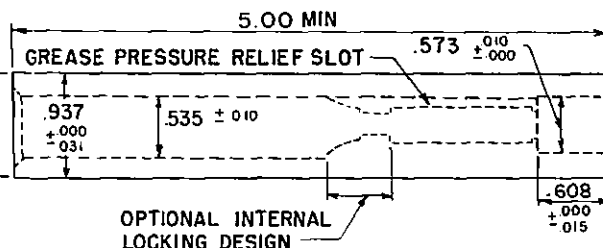
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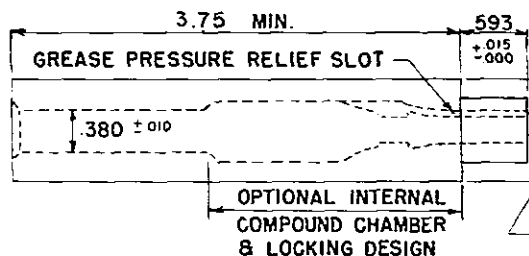
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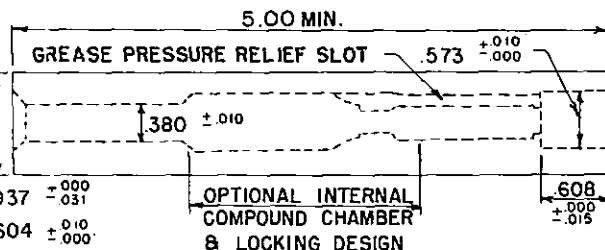
a) 5000 VOLT PLUG



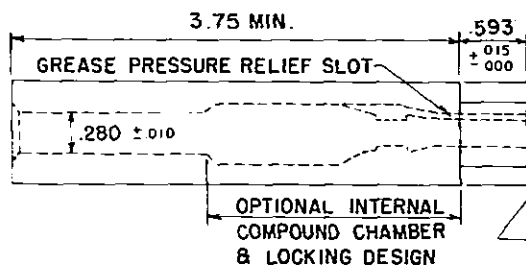
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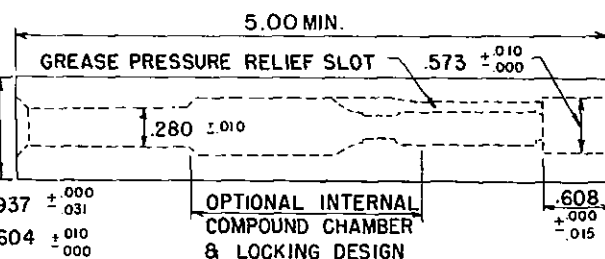
c) 3000 VOLT PLUG



d) 3000 VOLT RECEPTACLE



e) 5000 VOLT PLUG



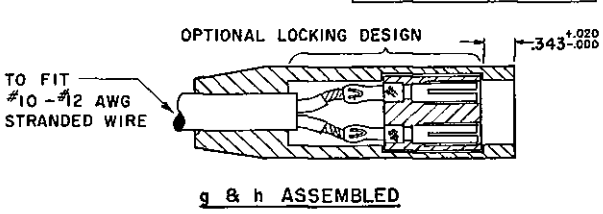
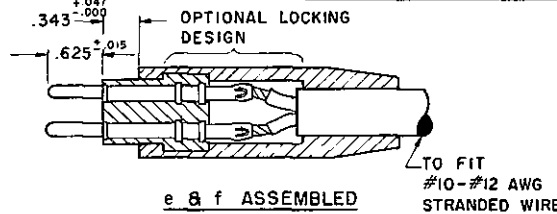
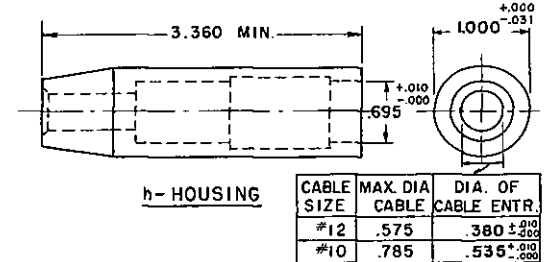
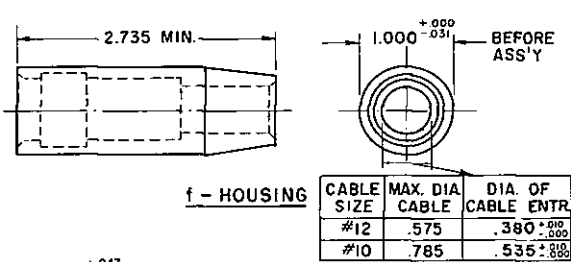
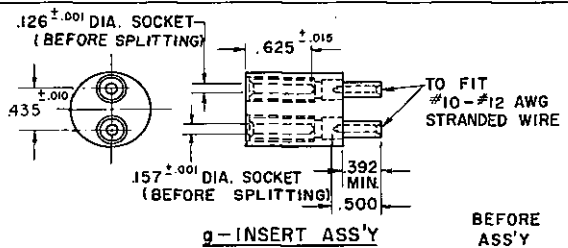
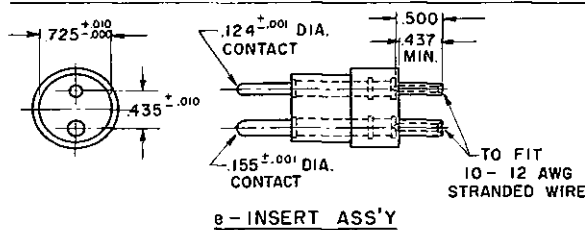
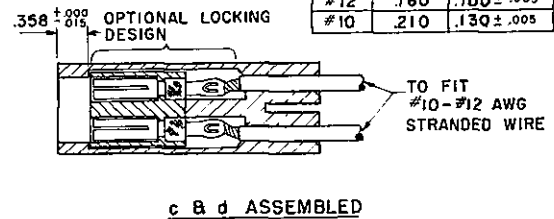
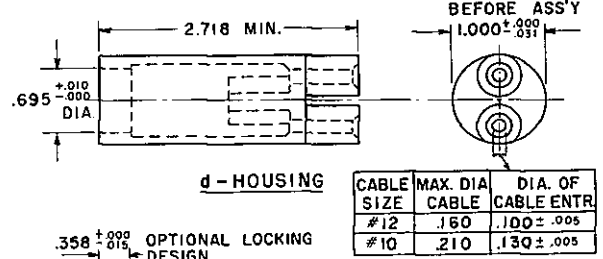
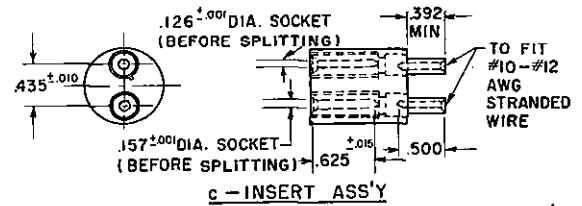
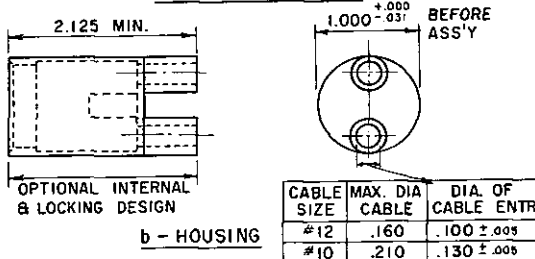
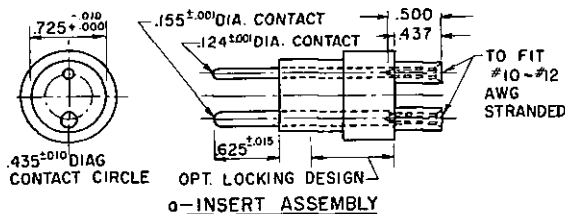
f) 5000 VOLT RECEPTACLE

FIGURE 14. PLUG AND RECEPTACLE KIT (SINGLE CONDUCTOR, 25 AMPERE).



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Appendix 1



**FIGURE 15. PLUG AND RECEPTACLE KIT (TWO SINGLE CONDUCTORS AND ONE TWO CONDUCTORS, 20 AMPERE, 600 VOLTS BETWEEN CONTACTS 1500 VOLTS TO GROUND).**

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