

W-S-610E
July 5, 1990
SUPERSEDING
W-S-610D(YD)
June 11, 1984

FEDERAL SPECIFICATION

SPLICE CONNECTORS

This specification is approved by the Commissioner, Federal Supply Service, General Services Administration for user of all Federal agencies.

1. SCOPE AND CLASSIFICATION

1.1 Scope. This document covers splice connectors, referred to herein as connectors, for providing pressure contact between current carrying conductors of an electrical wiring system.

1.2 Classification

1.2.1 Type, classes, kinds, and styles. The connectors covered by this document shall be of the following types, classes, kinds, and styles as specified (see 6.2).

Type I - Twist-on
Type II - Crimp on compression
Type III - Threaded on bearing

Class 1 - Insulated
Class 2 - Uninsulated

Kind AL - Aluminum to aluminum
Kind CU - Copper to Copper
Kind AL-CU - Aluminum to Copper

Beneficial comments (recommendations, additions, deletions) and any pertinent data which may be of use in improving this document should be addressed to: Commanding Officer (Code 156), Naval Construction Battalion Center, Port Hueneme, CA 93043-5000, by using the self-addressed Standardization Document Improvement Proposal (DD Form 1426) appearing at the end of this document or by letter.

FSC 5940

DISTRIBUTION STATEMENT A. Approved for public release; distribution is unlimited.

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Style A - Butt connectors
Style B - Combined "T" and straight connection
Style D - T connection
Style E - Parallel connection
Style F - Tap connection
Style G - Pigtail connection

1.2.2 Part number designation. Splice connectors covered by this document shall be identified by a part or identifying number (see 6.9).

2. APPLICABLE DOCUMENTS

* 2.1 Government documents.

* 2.1.1 Specifications and standards. The following specifications and standards form a part of this document to the extent specified herein. Unless otherwise specified, the issues of these documents are those listed in the issue of the Department of Defense Index of Specifications and Standards (DODISS) and supplement thereto, cited in the solicitation (see 6.2).

Federal Standards

FED-STD-123 - Marking for Shipment (Civil Agencies)

Military Specifications

MIL-P-116 - Preservation, Methods of
MIL-E-17555 - Electronic and Electrical Equipment, Accessories, and
Provisioned Items (Repair Parts), Packaging of

Military Standards

MIL-STD-105 - Sampling Procedures and Tables for Inspection by Attributes.
MIL-STD-129 - Marking for Shipment and Storage.
MIL-STD-147 - Palletized Unit Loads.

(Unless otherwise indicated, copies of Federal and military specifications and standards are available from Military Specifications and Standards, Building 4D, 700 Robbins Avenue, Philadelphia, PA 19111-5094.

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

Department of Defense (DoD)

Department of Defense Index of Specifications and Standards (DODISS)

(Copies of DODISS are available on a yearly subscription basis either from the Government Printing Office for hard copy or microfiche copies are available from the Director, Navy Publications and Printing Office, 700 Robbins Avenue, Philadelphia, PA 19111-5093.)

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

Underwriters Laboratories, Inc. (UL)

- UL 486A - Standard for Wire Connectors and Soldering Lugs for Use With Copper Conductors.
- UL 486B - Standard for Wire Connectors for Use With Aluminum Conductors.
- UL 486C - Standard for Splicing Wire Connectors.

(Application for copies should be addressed to the Underwriters Laboratories Inc., 333 Pfingsten Road, Northbrook, IL 60062.)

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

* 2.3 Order of precedence. In the event of a conflict between the text of this document and the references cited herein, the text of this document takes precedence. Nothing in this document, however, supersedes applicable laws and regulations unless a specific exemption has been obtained.

3. REQUIREMENTS

3.1 Description. The connectors shall provide contact between current carrying parts of an electrical wiring system. Unless otherwise specified herein, the connectors shall conform to the requirements for pressure type wire connectors of UL Standard 486A, 486B, and 486C as applicable.

3.1.1 Types. The types of connectors shall be as follows:

3.1.1.1 Type I. Type I connectors shall be class 1, kind CU, style G twist-on type connectors in which the pressure to provide contact between the current carrying conductors is applied by twist-on spring or equivalent device. Typical conductor capacities of type I connectors are provided in table I.

TABLE I. Size of Type I Connectors (reference).

	Typical Conductor Capacities - AWG #	
	Minimum	Maximum
COMMON SIZES	2 - #18	2 - #12, 3 - #14
	2 - #14	4 - #12, 2 - #10
	2 - #12	4 - #10, 2 - #8
	2 - #10	3 - #8, 2 - #6

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3.1.1.2 Type II. Type II connectors shall be crimp or compression type connectors in which the pressure to provide contact between the current carrying conductors is applied by crimp(s), or other means of deformation of the connector and conductors' junction interface and shall be class 1 or class 2.

3.1.1.3 Type III. Type III connectors shall be slip-on type connectors in which the pressure to provide contact between the current carrying conductors is applied by a set screw, split bolt, or insulation piercing device and shall be class 1 or class 2.

3.1.2 Classes. The classes of connectors shall be as follows:

3.1.2.1 Class 1. Class 1 connectors shall be insulated connectors which when applied to conductors, will provide a fully insulated joint. An insulated connector shall be rated for either 300 volts or 600 volts (1,000 volts in signs and fixtures), as specified (see 6.2).

3.1.2.2 Class 2. Class 2 connectors shall be uninsulated connectors.

3.1.3 Kinds. Connector kinds shall be suitable for joining the connector material combinations as follows:

3.1.3.1 Kind AL. Kind AL connectors shall be suitable for use in connecting aluminum to aluminum conductors.

3.1.3.2 Kind CU. Kind CU connectors shall be suitable for use in connecting copper or copper clad conductors to copper or copper clad conductors.

3.1.3.3. Kind AL-CU. Kind AL-CU connectors shall be suitable for use in connecting aluminum conducts to copper or copper clad aluminum conductors for dry locations only.

3.1.3.4 Oxide inhibitor. When specified, an oxide inhibitor shall be provided with kind AL and kind AL-CU connectors to inhibit corrosion of aluminum conductor surfaces (see 6.2 and 6.6).

3.1.4 Styles. Styles shall be as described herein and as shown in figure 1.

3.1.4.1 Style A. Style A connectors shall be suitable for use in providing a butt connection between conductors.

3.1.4.2 Style C. Style C connectors shall be suitable for use in providing a combined "T" connection and a straight (butt) connection between conductors.

3.1.4.3 Style D. Style D connectors shall be suitable for use in providing a "T" connection to a straight through conductor.

* 3.1.4.4 Style E. Style E connectors shall be suitable for making a connection between parallel conductors.

3.1.4.4.1 Type II, Style E. Type II, Style E connectors shall be of the compression type only.

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3.1.4.5 Style F. Style F connectors shall be suitable for use in providing a parallel or Y-type connection to a straight through conductor.

3.1.4.6 Style G. Style G connectors shall be suitable for use in providing a pigtailed type connection between ends of conductors.

3.1.5 Aluminum conductor connections. Aluminum conductor connections shall have the following conductor size and use limitations:

Style A, C, D, E, F - AWG #12 and larger aluminum

Style G

Types II and III - AWG #12 through AWG #6

Type I - Not applicable

3.1.6 Copper conductor connections. Copper conductor connections shall have conductor size and use limitations in accordance with UL 486A and UL 486C unless otherwise specified herein.

3.2 First article. When specified (see 6.2), the contractor shall furnish one connector of each classification included in the contract for first article inspection and approval (see 4.2.1 and 6.7).

3.3 Standard commercial product. The connectors shall, as a minimum, be in accordance with the requirements of this document. Additional or better features which are not specifically prohibited by this document but which are a part of the manufacturer's standard commercial product, shall be included in the connector being furnished. A standard commercial product is a product which has been sold or is being currently offered for sale on the commercial market through advertisements or manufacturer's catalogs, or brochures and represents the latest production model.

* 3.4 Design and construction. The design and construction of the connectors shall be such as to prevent conditions which may be hazardous to personnel or deleterious to electrical circuitry and equipment.

3.4.1 Style G twist-on design. Style G twist-on connectors shall contain a tapered coil insert secured inside a closed end insulator. The coil shall be so designed that increasing pressure is exerted upon joining conductor surfaces as the insulator cap is tightened. The coil diameter and cap shall be designed so that the coil is free to expand or contract during or after wire insertion and during operation at rated loads. The coil shall be of a hard drawn, square cross section, spring steel wire with a corrosion resistant finish. The insulator cap shall be of a flame-retardant material with a temperature rating of 105 degrees Celsius (deg. C) minimum. Type I connectors shall be restricted to use with copper (Kind CU).

* 3.5 Materials. Materials used shall be free from defects which would adversely affect the performance of the individual connector or the performance and/or maintainability of the electrical system in which it is installed. Materials not specified herein shall be of the same quality used for the intended purpose in commercial practice. Unless otherwise specified herein, all equipment, material, and articles incorporated in the work

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covered by this document are to be new and fabricated using materials produced from recovered materials to the maximum extent possible without jeopardizing the intended use. The term "recovered materials" means materials which have been raw materials, as opposed to virgin raw materials. Unless otherwise specified, none of the above shall be interpreted to mean that the use of used or rebuilt products are allowed under this document.

3.6 Interchangeability. All units of the same classification furnished with similar options under a specific contract shall be identical to the extent necessary to insure interchangeability of component parts, assemblies, accessories, and spare parts.

3.7 Connector size. Connector sizes shall be of adequate size and kind to accommodate the junction wire kinds and sizes specified (see 6.2 and table I). Solid wire sizes shall be limited to AWG #8 and smaller. Minimum conductor size shall be AWG #22.

3.8 Codes and standards. The connectors shall conform to the requirements of UL 486A, UL 486B, and UL 486C as applicable..

3.8.1 Compliance. Prior to approval of the first shipment, the contractor shall submit to the contracting officer, or his authorized representative, satisfactory evidence that the splice connectors proposed to be furnished under this document meet the above codes and standards.

3.8.2 Acceptable evidence. Acceptable evidence of meeting these requirements shall be the UL certification symbol or label, listed in the listing files, or a certified test report from a recognized independent testing laboratory indicating the connectors have been tested and conform to the applicable UL standard. Such evidence must be acceptable to the contracting officer.

4. QUALITY ASSURANCE PROVISIONS

4.1 Responsibility for inspection. Unless otherwise specified in the contract or purchase order, the contractor is responsible for the performance of all inspection requirements (examinations and tests) as specified herein. Except as otherwise specified in the contract or purchase order, the contractor may use his own or any other facilities suitable for the performance of inspection requirements specified herein, unless disapproved by the Government. The Government reserves the right to perform any of the inspections set forth in the document where such inspections are deemed necessary to assure supplies and services conform to prescribed requirements.

* 4.1.1 Responsibility for compliance. All items must meet all requirements of sections 3 and 5. The inspections set forth in this document shall become a part of the contractor's overall inspection system or quality program. The part of the contractor's overall inspection system or quality program. The absence of any inspection requirements in the document shall not relieve the contractor of the responsibility of ensuring that all products or supplies submitted to the Government for acceptance comply with all requirements of the contract. Sampling inspection, as part of manufacturing operations, is

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an acceptable practice to ascertain conformance to the requirements; however, this does not authorize submission of known defective material, either indicated or actual, nor does it commit the Government to accept defective material.

4.1.2 Component and material inspection. Components and materials shall be inspected in accordance with all the requirements specified herein and in applicable reference documents.

4.1.3 Standards compliance. The contractor shall provide to the contracting officer or his authorized representative evidence of compliance with the applicable standards cited in 3.8.

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

- a. First article inspection (see 4.2.1).
- b. Quality conformance inspection (see 4.2.2).

4.2.1 First article inspection. When a first article is required (see 3.2 and 6.2), the inspection shall be performed on one connector of each classification included in the contract. This inspection shall include the examination of 4.4, the tests of 4.5, and, when specified, the first article pack inspection of 4.6 (see 6.2). The contracting officer will provide specific guidance on whether the first article must be a first article sample or may be a first production item or a standard production item from the supplier's current inventory provided the item meets the requirements of the specification and is representative of the design,

4.2.2 Quality conformance inspection. The quality conformance inspection shall include the examination of 4.4 and the packaging inspection of 4.6. This inspection shall be performed on the samples selected in accordance with 4.3.

* 4.3 Sampling. When specified (see 6.2), sampling and inspection procedures shall be in accordance with MIL-STD-105. All connectors of the same classification and from the same manufacturing facility, offered for delivery at one time, shall be considered a lot for the purpose of inspection. The standard sample for first article inspection shall be one percent of a lot with the minimum sample being not less than ten units. For each defective unit, two additional units shall be inspected until the Acceptable Quality Limit (AQL) (see 6.10) has been exceeded. If an inspection lot is rejected, the contractor may rework it to correct the defects or screen out the defective units and submit for a complete reinspection. Resubmitted lots shall be reinspected using tightened inspection requirements. If the rejected lot was screened, reinspection shall be limited to the defect causing rejection. If the lot was reprocessed, reinspection shall be performed for all defects. Rejected lots shall be separate from new lots and shall be clearly identified as reinspected lots. The contracting officer may waive sampling requirements in lieu of the certification of 3.8.

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* 4.4 Examination. Each connector selected shall be examined for compliance with the requirements specified in section 3 of this document. Any redesign or modification of the contractor's standard product to comply with specified requirements, or any necessary redesign or modification following failure to meet specified requirements shall receive particular attention for adequacy and suitability. This element of inspection shall encompass all visual examinations and dimensional measurements. Noncompliance with any specified requirements or presence of one or more defects preventing or lessening maximum efficiency shall constitute cause for rejection.

4.5 Testing. Each connector selected shall be tested as required by UL 486A, UL 486B, or UL 486C.

4.6 Inspection of packaging. Except when commercial packaging is specified, the inspection of the packaging and marking shall be in accordance with the requirements of section 4 of MIL-E-17555. The inspection shall consist of the quality conformance inspection and, when specified (see 6.2), a preproduction pack shall be furnished for examination and test within the time frame required (see 6.2). The inspection of commercial packaging shall be as specified in the contract (see 6.2).

5. PACKAGING

5.1 Preservation and packing. Preservation and packing shall be commercial or in accordance with the requirements of MIL-P-116 and MIL-E-17555 with the level of preservation and level of packing as specified (see 6.2).

5.2 Palletization. When specified (see 6.2), material shall be pelletized in accordance with MIL-STD-147 when the following criteria are met:

- a. Load to consist of four or more unskidded containers; and,
- b. Load shall utilize a minimum of 80 percent of the pallet base.

5.3 Marking.

5.3.1 Military agencies. Shipments to military agencies shall be marked in accordance with MIL-STD-129.

5.3.2 Civil agencies. Shipments to civil agencies shall be marked in accordance with FED-STD-123.

6. NOTES

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

6.1 Intended use. The connectors are intended to provide a secure (electrical) contact between two or more current carrying conductor.

6.2 Ordering data. Purchasers should select the preferred options permitted herein and include the following information in acquisition documents:

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- a. Title, number, and date of this document.
- b. Type, class, kind, and style required (see 1.2.1).
- c. Issue of DODISS to be cited in the solicitation and, if required, the specific issue of individual documents referenced (see 2.1.2, 2.1.2, and 2.2).
- d. Voltage rating required (see 3.1.2.1).
- e. When an oxide inhibitor shall be provided (see 3.1.3.4).
- f. When a first article connectors are required for inspection and approval (see 3.2, and 4.2.1).
 - (1). Location for first article inspection.
 - (2). Notification requirements.
 - (3). Special instructions.
- g. Conductor wire kinds and sizes and combination (see 3.7, and table I).
- h. When a first article pack inspection is required (see 4.2.1 and 4.6).
- i. When sampling in accordance with MIL-STD-105 is required (see 4.3).
- j. Level of preservation, level of packing, and marking required (see 5.1).
- k. When palletization in accordance with MIL-STD-147 is required (see 5.2).

6.3 Bid samples. It is believed that this document adequately describes the characteristics necessary to secure the desired connectors and normally no samples will be necessary prior to award to determine compliance with this document. If, for any particular purpose, samples with bids are necessary, they should be specifically asked for in the invitation for bids and the particular purpose to be served by the bid samples should be definitively stated. The document is to apply in all other respects.

6.4 Types, class, style, style ranges. Federal specifications do not include all types, classes, styles, sizes, etc., of the commodities indicated by the titles of the specification of which are commercially available but are intended to cover the Federal Government requirements.

6.5 Connector sizing. Connector sizing guidance for style G connectors is shown in Table I. Due to the variance between available products, specific sizing for all types should be based upon the specified wire combination to the connected (see 6.2).

6.6 Oxide inhibitor application. Oxide inhibitor should be applied to aluminum or copper covered aluminum conductor connector junctions. The preferred method of application is with pre-filled connectors. The inhibitor's function is to inhibit the build-up of electronically restrictive oxide coatings and potential reliability problems over long term usage.

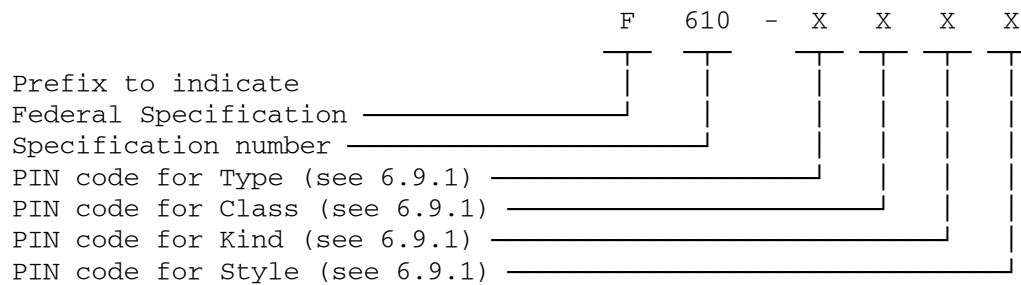
* 6.7 First article. When first article inspection is required, the contracting officer should provide specific guidance to offerers whether the item(s) should be a first article sample, a first production item, or a standard production item from the contractor's current inventory and the number of items to be inspected as specified in 4.3. The contracting officer should include specific instructions in acquisition document regarding arrangements for examinations, approval of the first article test results,

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and disposition of the first articles. Invitations for bids should provide that the Government reserves the right to waive the requirement for samples for first article inspection to those bidders offering a product which has been previously acquired or tested by the Government, and that bidders offering such products, who wish to rely on such production or test, must furnish evidence with the bid that prior Government approval is presently appropriate for the pending contract.

* 6.8 Supersession data. This specification supersedes W-S-610D dated 11 June 1984.

* 6.9 Part or identifying number (PIN). The PIN to be used for splice connectors acquired to this document are created as follows:



* 6.9.1 Cataloging data. For cataloging data purposes. PIN code numbers are assigned as follows:

- a. PIN code for type.
 - 1 = Type I
 - 2 = Type II
 - 3 = Type III
- b. PIN code for class.
 - 1 = Class 1
 - 2 = Class 2
- c. PIN code for kind.
 - A = Kind AL
 - B = Kind CU
 - C = Kind AL-CU
- d. PIN code for style.
 - A = Style A
 - C = Style C
 - D = Style D
 - E = Style E
 - F = Style F
 - G = Style G

* 6.10 Sampling for quality inspection. Recommended inspection level is S-2 with an AQL of 0.02 percent defective (see 4.3).

* 6.11 Sampling for testing. Recommended inspection level is S-2 with an AQL of 0.02 percent defective (see 4.3).

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* 6.12 Sampling for packaging inspection. Recommended inspection level is S-2 and an AQL of 2.0 percent defective (see 4.6).

* 6.13 Changes from previous issue. The margins of this document are marked with an asterisk to indicate where changes (additions, modifications, corrections, or deletions) from the previous issue were made. This was done as a convenience only and the Government assumes no liability whatsoever for any inaccuracies in these notations. Bidders and contractors are cautioned to evaluate the requirements of this document based on the entire content to evaluate the requirements of this document based on the entire content irrespective of the marginal notations and relationship to the last previous issue.

MILITARY INTERESTS:

Custodians

Navy - YD

Air Force - 85

CIVIL AGENCY COORDINATING ACTIVITY:

GSA - FSS

PREPARING ACTIVITY:

Navy - YD

Review Activities

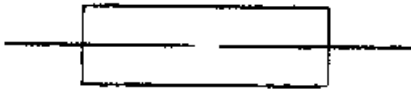
Air Force - 99

DLA - GS

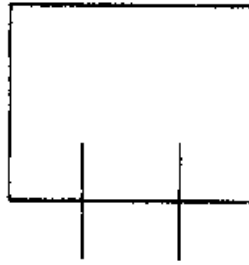
(Project 5940-1110)

Orders for this publication are to be placed with General Services Administration, acting as an agent for the Superintendent of Documents. See section 2 of this specification to obtain extra copies and other documents referenced herein.

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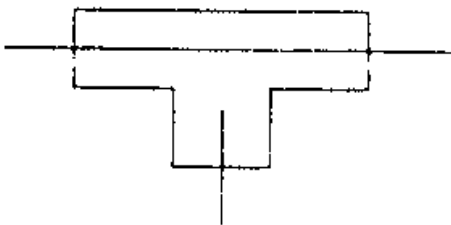
Style A
Butt



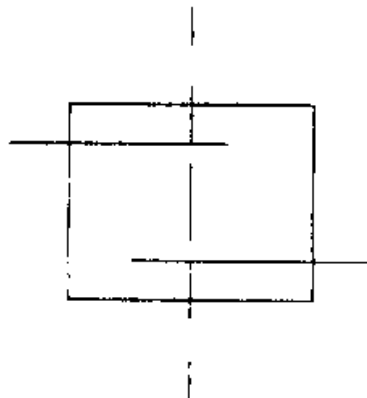
Style G
Pigtail



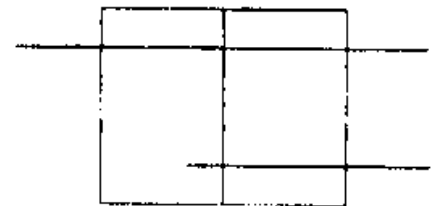
Style C
Combined T



Style D
Tee



Style E
Parallel



Style F
Tap

Figure 1. Connector Styles.