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CONNECTING
MOUNTING TERMINAL LUGS AND STUD CONNECTORS

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1. SCOPE

1.1 This section contains methods for making bolted electrical connections when joining solderless type and solder type wire connectors to bus bars, bus bar details, battery posts, CEMF cell posts, stud connectors and ironwork. Also included are punchings secured under screw heads and connections made to studs.

1.2 Intercell connecting battery strings is covered in Section 17E.

1.3 Joining bus bars by clamping and bolting is covered in Section 8B.

2. GENERAL

2.1 The quality of solderless electrical connections depend a great deal on workmanship. Electrical resistance must be kept as low as practical. To attain this result, each of the following practices shall be observed:

- (1) Contact surfaces shall be clean so that direct metal to metal contact is made.
- (2) Contact surfaces shall be flat to insure maximum cross-sectional area in contact.
- (3) Apply a protective material to inhibit future corrosion.
- (4) Pressure or clamping devices shall be tight to hold metals in contact.

2.2 Connections to bus bars, studs, etc., are made up the same for both ac and dc circuits, that is, as far as cleaning and the use of protective materials are concerned.

3. PREPARATION OF CONTACT SURFACES TO WHICH LUGS FASTEN

3.1 General

3.11 Prepare all current carrying contact surfaces of bus bars, ironwork, details, etc., before making connections.

3.2 Plated Bus Bars

3.21 A metallic coating or plating is sometimes used on bus bars and lugs to reduce the electrical resistance of the connecting joints. These contact surfaces shall be cleaned with a cloth to remove grease and other foreign matter but should not be sanded or the surface otherwise scratched. Apply NO-OX-ID "A" immediately.

3.3 Copper Bars, Brass Bars and Ironwork

3.31 Clean copper, brass or iron current carrying contact surfaces with fine abrasive paper. First use a coarse abrasive paper when cleaning painted iron work. Apply a thin coating of NO-OX-ID "A" immediately after cleaning.

3.4 Aluminum Bus Bars

3.41 Clean aluminum contact surfaces with R-3163 abrasive paper to remove dirt, hard grease, etc., and to break down the hard oxide. Attach the abrasive paper to the R-3162 paper holder and secure by operating the clamping device and handle. When using the holder and paper, make sure it is parallel with the surface to be cleaned in order to avoid gouging. Apply a coat of NO-OX-ID "A" and use an R-2628 wire brush to break up soft oxide which forms immediately after abrasion. Aluminum connections should be made within 5 minutes, if possible, without removing the NO-OX-ID "A".

3.42 Do not use motor driven aids in cleaning aluminum contact surfaces.

3.5 Lead Battery Posts

3.51 Battery posts should be coated with NO-OX-ID "A" by the manufacturer. Do not remove any more of this compound than is necessary to get rid of surface dirt. Excess compound will squeeze out of connection under pressure.

3.52 Any contact surfaces on battery posts not factory coated shall be wire brushed with an R-2628 brush or its equivalent. Under no circumstances shall a power operated wire brush or sander be used. The cleaned surfaces shall immediately be covered with a thin film of R-3266 NO-OX-ID "A" compound. Apply the compound without heating. Use a finger or a stiff brush; a clean paint brush with the bristles cut short will suffice.

3.6 CEMF Cell Posts - Dry and Alkaline Type

3.61 Contact surfaces on cell posts shall be clean and a thin coating of R-3126 silicone compound shall be applied.

3.611 If oxidation or corrosion is evident remove with an R-2628 wire brush or with R-3163 abrasive paper. If high spots exist remove with an R-1482 flat file.

3.7 Nickel Cadmium Cell Posts

3.71 Steel posts on nickel cadmium cells are equipped with lugs for external connections. No cleaning is required unless there is evidence of oxidation or corrosion. These lugs are factory connected and no additional protective material is required.

4. CLAMPED LUGS

4.1 These wire connecting devices are secured to bus bars, bus bar details, etc., by clamping around the bar rather than fastened into or through the bar. Specifically covered are the T & B Cat. ATL type lug and the KS-15562 lug, both of which are described and listed in Section 7D when connections are made to the wire ends.

4.2 The contact surfaces of the lugs are ground and finished, and normally do not require cleaning, however, should there exist signs of oxidation or corrosion remove with fine abrasive paper and coat with NO-OX-ID "A".

4.3 The bus bar, bus bar detail, etc., to which these devices are to be fastened, shall have the contact surfaces cleaned and protected as outlined in Paragraph 3.

4.31 When wire connects to only one half of the lug, clean only the corresponding side of the bus bar.

4.4 After necessary preparation of bus bar and lug is complete, assemble the lug over the bar with the bolts and nuts provided. Assemble bolts in the direction

in which it will be easiest to remove them if future changes are necessary. The lug halves are convex to insure full contact when they are drawn down against the bar.

4.5 With properly fitted wrenches, tighten bolts and nuts gradually going from one to another until all are tight or until contact surfaces, adjacent to bolt heads and nuts, are drawn down firmly against bar. Avoid overtightening as the centers will bow out reducing the contact area and the ears will bend.

4.6 Verify the tightness of each nut and bolt and install the locknuts or palnuts.

4.61 Apply the palnut with the smooth side first - open side out. Run up to the regular nut finger tight and take up one quarter of a turn with a wrench.

4.62 On the T & B Cat. ATL type lug, lock washers may be provided and used in place of palnuts.

5. BOLTED LUGS

NOTE: On the KS-5537 list 300 series connector, the screws used to fasten the connector to the bar are the same screws used to clamp the wire, therefore, both of these connections are covered in Section 7D. The screws, washers and nuts provided, are part of the connector and are acceptable for use on either copper or aluminum finish.

5.1 Lugs may be fastened with machine screws or bolts. These in turn are threaded into tapped holes (except aluminum bars) or extended through clearance holes and secured with nuts. If there is a choice between one hole or two hole lugs, the two hole lug is preferred.

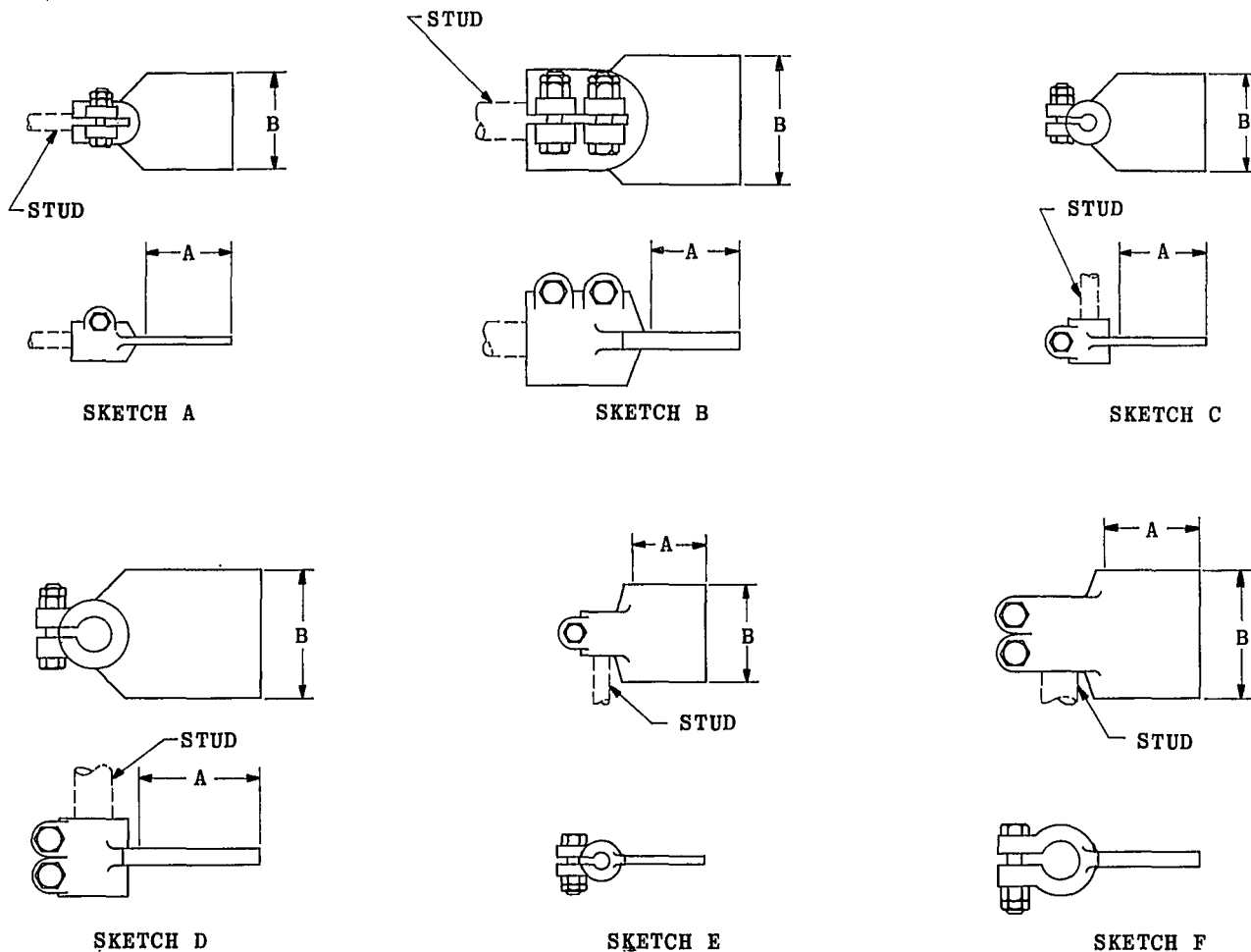
5.2 Ferrous bolts, screws, nuts, washers, bus bar supports and clips used in fastening aluminum to aluminum, copper to copper, or combinations of metals shall be zinc or cadmium-plated plus a chromate treatment. Zinc or cadmium finished parts are standard; however, copper finished parts may be used when furnished.

5.3 Some apparatus is equipped with bolts, screws, washers and nuts, e.g., batteries, CEMF cells and inductors. These fasteners shall be used for securing lugs unless specific instructions dictate otherwise.

5.4 All types of lugs to be connected to Alkaline type (wet type) CEMF cell posts, lead-acid battery cell posts, or to directly connected details used to facilitate multiple connections to cell posts, shall be cleaned of any sealing material which may have covered the contact surface of the lug. This sealing material was applied under other wire connecting sections in the 7 series.

5.41 Except for plated lugs, the compound may be removed by scraping with the R-2761 Wireman's Skinning Knife.

5.5 Regardless of where terminated, all untreated lugs such as plain bronze and copper shall be cleaned. The majority of solderless bronze lugs do not require cleaning as they are factory treated to retard oxidation; however, they will have to be cleaned if oxidation or corrosion is evident.



LIST NO.	SKETCH	STUD SIZE	DIMENSION "A" MIN. INCHES	DIMENSION "B" INCHES	AMPS CAPACITY MAX.
1	A	3/8 - 16	2	3	400
2	A	1/2 - 13	2	3	
3	B	7/8 - 12	2	3	
4	B	1-1/8 - 12	2	4	1000
5	B	1-1/4 - 12	2	4	1500
6	B	1 - 12	2	3	400
7	B	1-1/4 - 12	2	3	800
8	B	3/4 - 12	2	3	400
9	B	3/4 - 12	3	3	400
11	C	3/8 - 16	2	3	400
12	C	1/2 - 13	2	3	
13	D	7/8 - 12	2	3	
14	D	1-1/8 - 12	2	4	1000
15	D	1-1/4 - 12	2	4	1500
16	D	1 - 12	2	3	400
17	D	1-1/4 - 12	2	3	800
18	D	3/4 - 12	2	3	400
19	D	1-1/8 - 12	2	3	800
20	D	1-1/4 - 12	2	3	400
21	E	3/8 - 16	2	3	
22	E	1/2 - 13	2	3	
23	F	7/8 - 12	2	3	800
24	F	1-1/8 - 12	2	4	1000
25	F	1-1/4 - 12	2	4	1500
26	F	1 - 12	2	3	400
27	F	1-1/4 - 12	2	3	600
28	F	3/4 - 12	2	3	400

FIG. 1 KS-15755 ROUND STUD TYPE CONNECTORS (PAR. 6.21)

5.51 Any nicks or high spots that would keep the lug from lying flat on the surface to which it is to be fastened, should first be dressed flat with an R-1482 file or equivalent. Clean contact surfaces of all untreated lugs and treated lugs that show signs of oxidation or corrosion by sanding flat with abrasive paper. As soon as practicable, apply a thin coating of R-3266 NO-OX-ID "A" Compound to the clean and cleaned contact surfaces except on those lugs to be connected to alkaline type (wet type) CEMF cell posts or dry type CEMF cell posts. In these latter two cases, these previously sealed lugs shall have their contact surfaces protected with a coating of R-3126 Silicone Compound.

5.6 Regardless of where terminated, all plated lugs such as lead-plated, tin-plated, silver-plated, etc., shall be cleaned as necessary to remove grease and other foreign matter.

5.61 Clean plated lugs by wiping with a dry cloth. Apply a thin coating of R-3266 NO-OX-ID "A" Compound to the contact surface of all plated lugs except those plated lugs to be connected to alkaline type (wet type) CEMF cell posts or dry type CEMF cell posts. In these latter two cases, these previously sealed lugs shall have their contact surfaces protected with a coating of R-3126 Silicone Compound.

5.7 Apply R-3266 NO-OX-ID "A" compound to the contact face of all clean and cleaned lugs except on lugs to be connected to alkaline type (wet) CEMF cells and dry CEMF cells, in which case the contact face shall be coated with R-3126 Silicone Compound.

5.8 Assemble bolts, screws, washers and nuts as provided and tighten securely with properly fitted wrenches.

6. CONNECTIONS TO STUDS

6.1 General

6.11 Lugs, bus bars, details, etc., are connected to threaded studs, either by fastening between the two nuts on the studs or by the use of a stud connector.

6.12 Shorting links are sometimes provided on inductors. Place the end of the link with the hole, on the back of the stud. Turn the link in an open position (approximately 180° from the short circuited position) and clamp with the contact nuts. After making connections as covered herein, tape in accordance with Section 8C.

6.2 Stud Connectors KS-15755

6.21 Besides clamping a bar or lug between two nuts or a stud, an alternate method is to use an intermediate device known as a stud connector. Figure 1 shows various shapes available and their corresponding list numbers.

6.22 Screw on the predrilled connector over the end of the threaded stud until it is fully engaged. Position the connector so the tang lies in the correct plane and securely tighten the clamping screws.

6.23 If lock washers are not provided install locknuts. Verify the tightness of the clamping bolts and nuts if the operation of installing the locknuts (or palnuts) does not follow directly. Place locknuts on finger tight and with a wrench make an additional one quarter turn.

6.24 Prepare contact surfaces for connections to lugs and bus bars by cleaning with fine abrasive paper and coating with NO-OX-ID "A".

6.3 Lugs and Bars

6.31 When fastening bus bars, details and lugs between nuts on a stud, it is necessary to clean both sides of the bar, detail or lug and the flat contact surfaces of both contact nuts. Remove the nuts and clean the flat side by sanding across fine abrasive paper held against a flat surface. Apply NO-OX-ID "A" to all contact surfaces except the threads. See Figure 2.

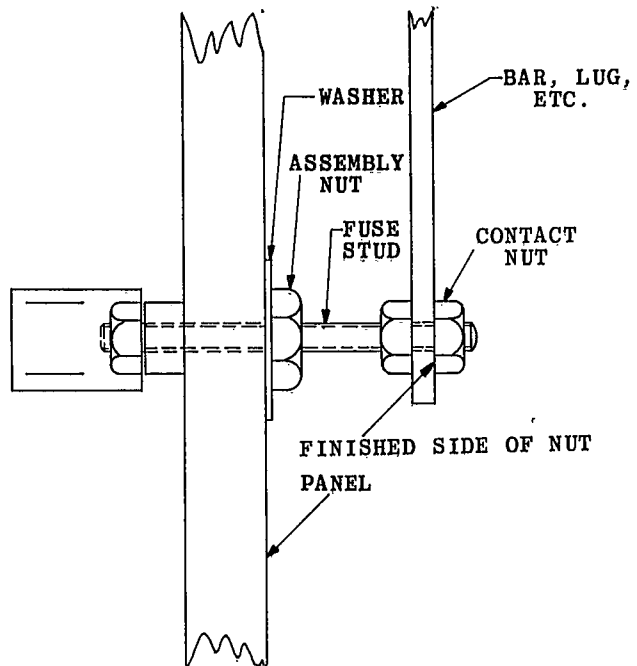


FIG. 2 TYPICAL ARRANGEMENT OF STUD ASSEMBLY (PAR, 6.31)

6.32 Verify the assembly nut for tightness against the panel. Place the lower contact nut and the connecting device on the stud keeping it as near the end of the stud as practicable when this is left as a decision of the installer. This may not be possible when bus bar arrangements dictate the position on the stud or when a "stud stiffener", e.g., (a sleeve placed tightly between the panel assembly nut and the back contact nut of the lug) has been used. Place alarm punching when required under outside contact nut.

6.33 With properly fitted wrenches, tighten nuts securely.

6.331 In order to prevent undue strain on the stud, place wrenches so their handles are near one another. The final tightening of the larger nuts can best be effected by properly fitting the R-1543 adjustable wrench and striking the handle with a short piece of lumber.

6.332 Once tight, do not attempt to rotate lug or detail as this will loosen the nuts.

7. PUNCHINGS

7.1 Small soldered terminal punchings shall be free of dirt or other foreign material.

7.2 Plated or tinned punchings should not be sanded or otherwise scraped. If cleaning is required wipe with a cloth. NO-OX-ID "A" is not required on punchings as they are used with #10 and smaller wire.

[7.3 Install punching and tighten screws or nuts until electrically and mechanically secure.

→ Arrowed lines indicate new or changed information.

[Vertical lines at side of paragraphs indicate requirements.

8. VERIFICATION FOR TIGHTNESS

NOTE: Toward the end of the installation period, shop and job assembled lug and stud connectors shall be verified for tightness.

8.1 On two hole bolted lugs and punchings check for tightness of bolts and nuts.

8.2 Check small single hole lugs, connectors and punchings between double nuts spaced from the assembly nut by pressing gently in a clockwise direction.

8.3 Check small single hole lugs, connectors and punchings under screw heads or nuts when back nut is tightened against a stop, by pressing firmly with the hand, in a clockwise direction.

8.4 Verify large single hole lugs on studs or under nuts or screw heads by grasping the wire close to the lug and applying pressure in a clockwise direction.

8.5 Determine KS-15755 stud connectors are secure by checking the clamping bolts and nuts for tightness when lock washers were provided instead of locknuts. Further, check by hand that the connector will not rotate on the stud.

8.6 Verify bus bar and detail connections to studs by checking for tightness.

Manager, Product Engineering

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- (1) To include T.I. 7E dated 2-17-67.
- (2) To include T.I. 7E dated 5-19-67.