

EO 05-1-3/9

ROYAL CANADIAN AIR FORCE



ELECTRICAL WIRING

REVISION NOTICE

LATEST REVISED PAGES SUPERSEDE
THE SAME PAGES OF PREVIOUS DATE

Insert revised pages into basic publication.
Destroy superseded pages.

ISSUED ON AUTHORITY OF THE CHIEF OF THE DEFENCE STAFF

29 NOV 60

Revised 10 May 67

LIST OF RCAF REVISIONS

DATE	PAGE NO	DATE	PAGE NO
19 Jun 61	32		
19 Dec 61	43		
19 Dec 61	44		
19 Dec 61	45		
20 Apr 64	9		
20 Apr 64	43		
14 Dec 64	43		
10 May 67	31		

TABLE OF CONTENTS

TITLE	PAGE
SOLDERING ELECTRICAL COMPONENTS	1
IDENTIFICATION	4
INSTALLATION	4
ANSTAT DEAD END MAST ASSEMBLY INSTRUCTIONS	19
SIMMONDS PACITOR TANK UNIT ASSEMBLY	23
STOWAGE OF ELECTRICAL WIRING AND PLUGS	23
CLAMPING PROCEDURE	28
SEALING OF ELECTRICAL CONNECTORS (POTTING)	33
BONDING	36
GROUNDING WIRES AND SHIELDING	40

LIST OF ILLUSTRATIONS

FIGURE	TITLE	PAGE
1	Thermocouple Lead Connections	2
2	Use of Wire Strippers	5
3 (Sheet 1 of 2)	Copper Terminals and Tooling	7
3 (Sheet 2 of 2)	Copper Terminals and Tooling	8
4 (Sheet 1 of 2)	AN650 Electrical Terminal	10
4 (Sheet 2 of 2)	AN650 Electrical Terminal	11
5	Plastic Tubing Wall Thickness	12
6	Hand Tool Staking	13
7	Typical Drip Loops	14
8	Clamp Installation	15
9	Connector Assembly Using Washer and Nut	16
10	Terminal Strip Installation	17
11	Anstat Dead End Mast M-200	19
12	Dead End Mast Components	21
13	Dead End Mast Assembly	21
14	Simmons Pacitor Tank Unit Assembly	22
15 (Sheet 1 of 3)	Stowage Methods	24
15 (Sheet 2 of 3)	Stowage Methods	25
15 (Sheet 3 of 3)	Stowage Methods	25
16	Wrapping of Plugs	25
17	Plug Tying	25

LIST OF ILLUSTRATIONS (Cont'd)

FIGURE	TITLE	PAGE
18	Lacing Wire Bundles	26
19	Branch Ties	26
20	Unused Connector Insulation	27
21	Connector Installation	29
22	VP Rubber Plug Installation	30
23	Clip Mountings	31
24	Primary Insulation Damage Repair	32
25	Wire Splicing	34
26	Sealing of Connectors	35
27	Cannon Bonding Ring Installation	38
28	Taping Shielded Wires	38
29	Shielded Wire Soldering	40
30	Shielded Wire Soldering	40
31	Multiple Shielding Grounds	41
32	Plessy Plug Assembly	42
33 (Sheet 1 of 3)	Table of Material Specifications	43
33 (Sheet 2 of 3)	Table of Material Specifications	44
33 (Sheet 3 of 3)	Table of Material Specifications	45
34	Current Carrying Capacities of Wires and Cables	46

ELECTRICAL WIRING

SOLDERING ELECTRICAL COMPONENTS

GENERAL

1 For general instructions regarding soldering of electrical components, refer to EO 05-1-3/20:-

NOTE

Use only resin core solder (Item 12) for assembly of electrical parts.

CLEANING PRIOR TO SOLDERING

2 For cleaning of metals prior to soldering, refer to EO 05-1-3/20.

SOLDERING PROCEDURE

3 For soldering, proceed as follows:

- (a) Ensure sufficient solder for the job.
- (b) Before soldering the first wire to the contact, be certain that the assembly nut and coupling nut are slipped over the wires (or harness).
- (c) Strip wire as specified in paragraph 13, following.
- (d) Place the identification sleeves over the wire. Most aircraft wire is tinned when made, but re-tin to hold the strands solidly together.
- (e) Examine all surfaces to be soldered to ensure that they are clean. Lay the wire end flat in molten solder and touch wire solder to tip of wire just enough to allow flux to escape.
- (f) Choose the most convenient contact with which to start. Heat the solder in the terminal pot until it is molten, then push wire into cavity.
- (g) Under-heated solder appears granular, dirty and grey. Over-heating gives solder an iridescent appearance with rainbow colours which cool to a dark grey. Neither will be satisfactory. With the right amount of heat, solder appears bright, and on cooling retains a bright colour.

CAUTION

Do not use solder to cover cracks or flaws, to fill in dents or to close holes, Do not solder joints wider than .010". Do not use a torch to solder covered cables where there is a danger of burning the insulation.

(h) Ensure that iron is not held close to the insert too long or it will deform and buckle the melamine or phenolic insert, thereby ruining it for further use. Keep wire steady while solder sets, otherwise the solder may crystallize, resulting in a poor joint indicated by a

crack or granulization. Resolder such joints and wipe off excess rosin with a non-corrosive solvent, such as clean alcohol.

(j) Follow this procedure carefully with the remainder of the contacts according to the pattern chosen. Check the quality of the work.

(k) When joints have cooled, slip the insulating sleeving over the joints to prevent shorting and corrosion.

SOLDERING HARNESS SLEEVE TO FLEXIBLE CONDUIT

4 Proceed as follows:

- (a) Tin sleeve in solder pot.
- (b) Solder an adequate area of conduit braid at the desired point of attachment.

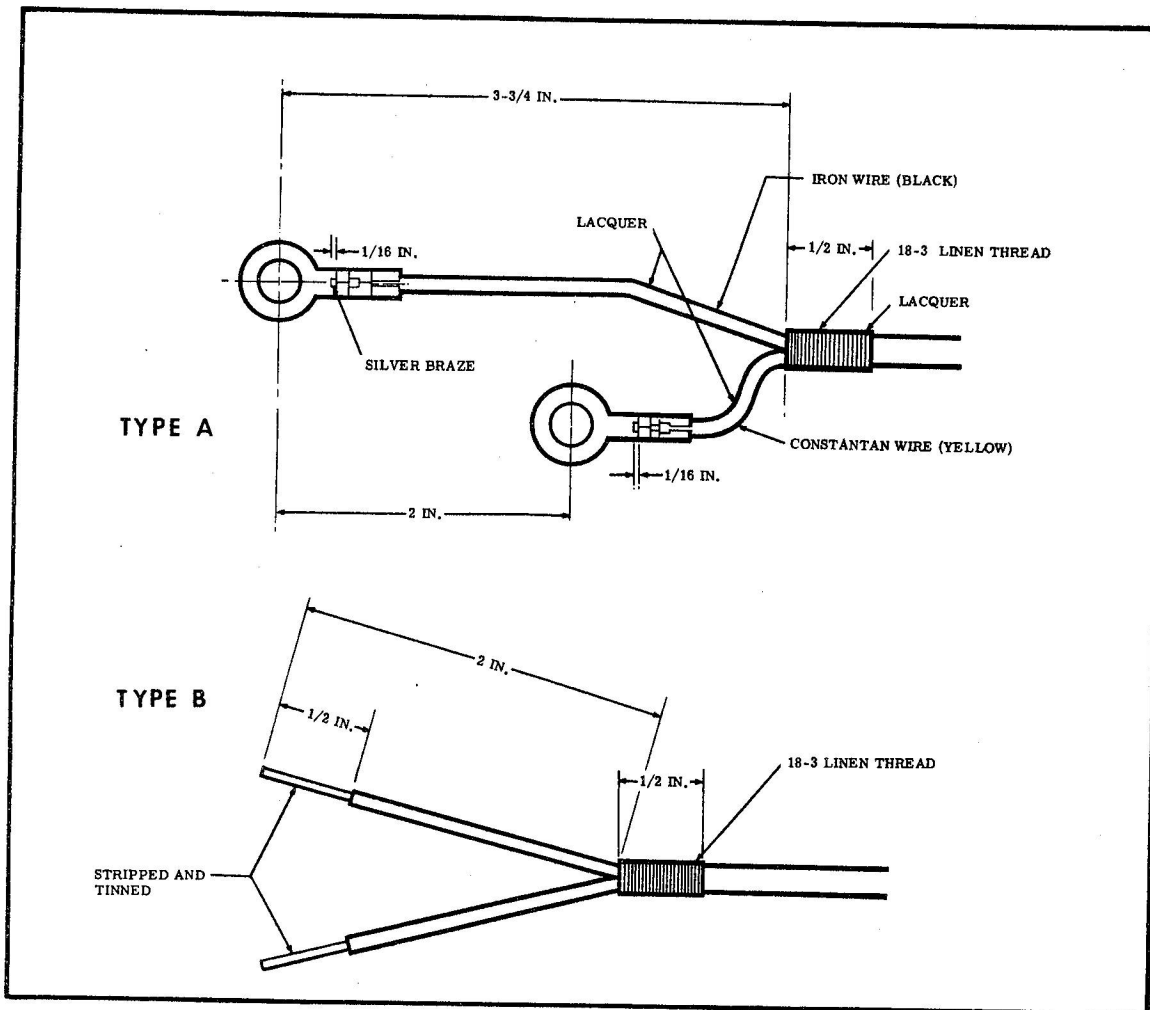


Figure 1 Thermocouple Lead Connections

- (c) Sweat solder the mating parts together, using additional solder as required.
- (d) Avoid excessive use of solder.

SOLDERING TERMINALS

5 Proceed as follows:

- (a) Strip sufficient insulation from wire so that bare wire will completely fill the tubular portion of the terminal. Follow procedures specified in paragraph 13 following.
- (b) Select transparent plastic tubing to give a snug fit. Wall sizes must be as specified in paragraph 16 following.
- (c) Cut tubing to cover tubular portion of the terminal or connector plus 3/8" to extend over the wire insulation.
- (d) Slip tubing over wire and insert wire into terminal.
- (e) Attach terminal by soldering, using rosin core solder. (Refer to EO 05-1-3/20).
- (f) Complete the installation by working tubing (Item 8) over the terminal, insulating the tubular portion of the terminal, and to cover joint between cable insulation and copper wire.

EYELETS

6 Parts which have eyelet type terminals (Item 13) for attachment of wiring are to be soldered as follows:-

- (a) Insert wire through eyelet and wrap wire one and one-half to two and one-half turns around eyelet.
- (b) Solder, refer to EO 05-1-3/20.
- (c) Install plastic tubing over soldered joints to give a snug fit as required in paragraph 5 (e), preceding.
- (d) Wrap wires passing through wire clamp with plastic tape (Item 39). The wrap should be thick enough to permit a snug fit to be obtained when screwing down the retaining clamp so that no strain from a wire pull is transmitted to the soldered joint.

THERMOCOUPLE LEAD CONNECTIONS

7 Fabricate the type of thermocouple lead connection specified in accordance with Figure 9-1. Observe the following points:

- (a) The solder and brazing requirements do not change with change in type of wire.
- (b) No mechanically applied terminals are to be used on thermocouple wires.
- (c) Use rosin core solder refer to EO 05-1-3/20, where metal surface conditions require the use of paste (Item 24,) it may be used but all flux must be removed due to its corrosive nature.
- (d) Terminals which require silver soldering must be cleaned to the bare metal before soldering.

- (e) Thermocouple wire insulation is to be coloured as follows:
- (1) Iron Black
 - (2) Constantan Yellow
 - (3) Chromel White
 - (4) Alumel Green
 - (5) Copper Red
- (f) Wrap insulated ends back 1/2" with linen thread (Item 14). Apply one coat of varnish (Item 26) or clear lacquer (Item 27) before assembly.
- (g) Insulate thermocouple connections individually with plastic tubing (Item 8) where necessary to prevent abrasion of insulation of adjacent wire. Tie tubing, if not snug, with prewaxed cotton cord.
- (h) Do not bend or coil thermocouple leads to less than a four inch diameter unless otherwise specified on the Engineering Drawing.

IDENTIFICATION

GENERAL

8 All electrical cables must be identified with the code letters and numbers assigned on the drawings. The characters must be of sufficient size to be legible and of a permanent nature to provide positive cable identification.

ELECTRICAL WIRING

9 For open wiring, each cable must be identified at not more than 15" intervals through its entire length. Electrical cables totally enclosed in rigid and non-transparent conduit, or which have such materials on the surface which do not retain a machine-stamped identification, must be identified at not more than three inches from each terminating point, Identification of furnished equipment wiring shall not be altered to conform to these instructions.

METHODS OF MARKING

10 Where required to identify wires or cables which have materials on the surface that do not retain a machine-stamped identification, clear plastic tubing, indelibly colour-branded, should be used. Slip the colour-branded piece of tubing over the insulated cable. Skin the insulation from cable end and apply connector. Push clear plastic tubing over the connector, completing the assembly.

11 For electrical cables routed near or through high temperature areas, identify with numbered metallic sleeves (Item 30) or stamped silicone glass sleeving (Item 31).

INSTALLATION

GENERAL

12 To make a proper termination on electrical wires use the utmost care in the preparation of the wire end, selection of terminal, insertion of wire end into the terminal

barrel and use of proper tooling. Neglect of proper precautions in any of the foregoing may result in an unsatisfactory joint.

STRIPPING INSULATION

13 In stripping insulation from wire, use only approved strippers, taking care to prevent nicks, cuts or other damage to the wire. When using wire strippers, observe the following:

- (a) Use only approved strippers as shown in Figure-2.
- (b) Select the correct size cutting hole for the gauge wire to be stripped.
- (c) Place the wire in the strippers so that the amount of wire from which the insulation is to be removed extends beyond the cutter.
- (d) Squeeze the handles of the strippers slowly. Close strippers completely.
- (e) Check the stripped insulation for strands of wire and any other indications of damaged

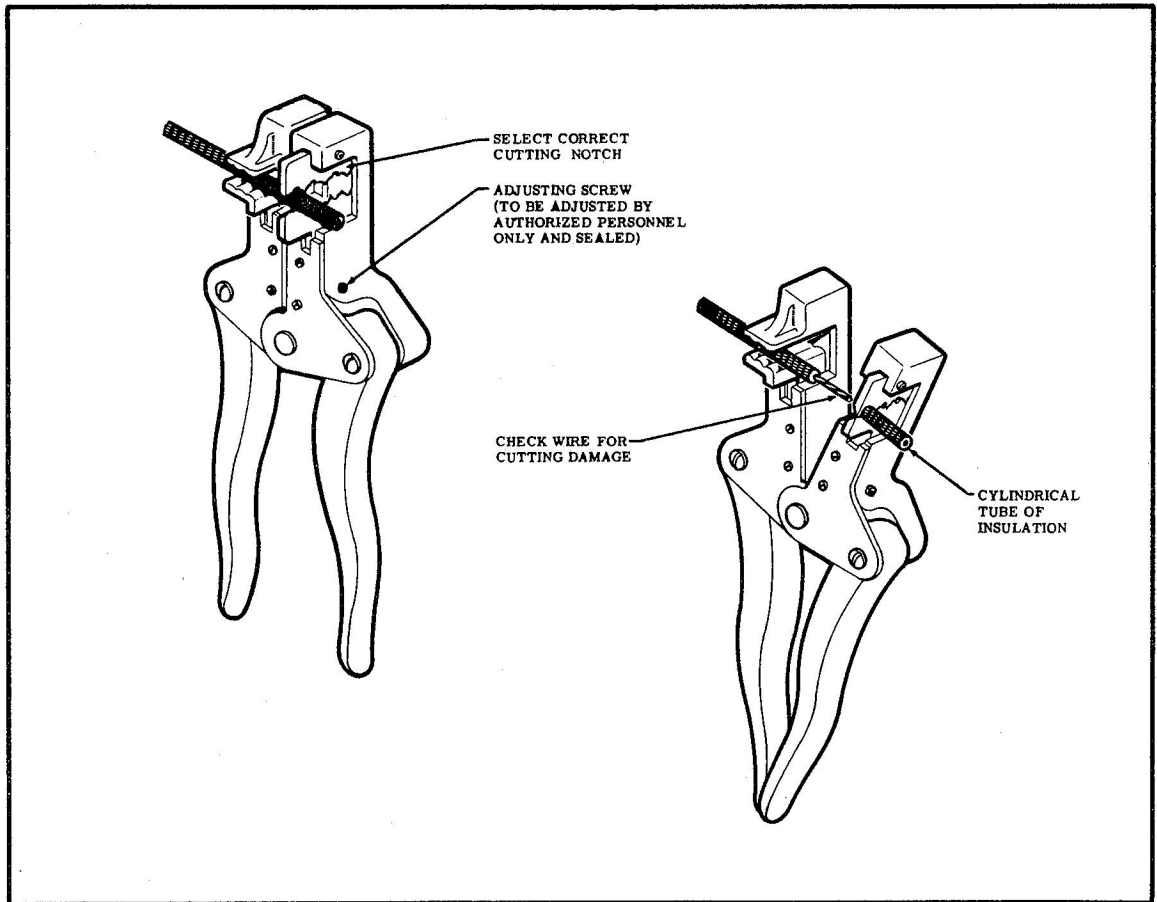


Figure 2 Use of Wire Strippers

wire strands. If such indications are found, the strippers must be adjusted.

WIRE TERMINALS

14 All wires not terminated at soldered terminals, connectors must be staked to approved copper terminals, see Figure 3. Strip sufficient insulation from the wire so that on sizes # 22 to # 10 inclusive, the bare wire will extend through, but not over 1/32" beyond, the tubular portion of the terminal, or so that on sizes # 8 to # 0000 inclusive, the bare wire will extend through, but not over 1/16" beyond, the tubular portion of the terminal. On closed or blocked terminals, the end of the bare wire must be inserted up to the stop and must be visible in the inspection hole. The conductor strands must not protrude past the end of the terminal barrel far enough to interfere with the installation of the proper size washer.

BENDING

15 When bent lugs are necessary, pre-formed terminals (Item 10) should be used. If pre-formed lugs are not available, copper terminals (Item 7), see Figure 4 for wire size # 22 to # 10 inclusive may be bent a maximum of 90° once, if done carefully. Larger sizes may be bent a maximum of 30°. Flag terminals (Item 11) may be bent when required, so that the barrel tends to close and no stress is applied on the brazed joint. Inspection of terminal installation is to be accomplished without bending the wire at the terminal.

NOTE

Flag terminals are to be used only when specified.

PLASTIC TUBING

16 To install plastic tubing (Item 8) proceed as follows:-

- (a) Select transparent plastic tubing to give a snug fit. Wall thickness for wire sizes must be as per Figure 5.
- (b) Cut tubing to cover tubular portion of the terminal or connector plus 3/8" extending over the wire insulation.
- (c) Slip tubing over wire and insert wire into terminal.
- (d) Stake terminals using approved tooling only. Centre indentation on tubular portion of terminal or connector. Terminals may be staked on either top or bottom as required by the tooling used. All indentations are to be inspected for cracking out. For staking procedures, see Figure 6.
- (e) Insulation grip must be snug on insulation. Tooling must be checked frequently to insure proper indentation.
- (f) Complete the installation by working the plastic tubing over the terminal, insulating the tubular portion of the terminal and covering the joint between cable insulation and copper wire.

WIRES NOT ENCLOSED IN CONDUIT

17 Observe the following instructions during installation:-

(a) Locate attachments at each frame on runs along the length of the fuselage or at each rib on runs through wings. Use a distance of not less than 6" and not more than 24" between points of attachment. Points of attachment may be less than 6" only in distribution and junction boxes and where required by paragraph 50 to 57 inclusive, following.

(b) Except for drip loop requirements, leave only enough slack in wiring to permit ease of maintenance such as the removal of plugs or terminals, to prevent mechanical strain on wiring, wiring junctions and wiring supports, and to permit free movement of shock-mounted equipment.

AN Wire Size	For Stud Size	AN659	T & B Part No.	Burndy Hand Tool	Power Tooling T & B 21070	T & B Hand Tool	RCAF Ref. No.
22, 20 & 18	4		A88G	Y14MV	ABC	WW-T-110	1C/2593
	6	-1	A85G				
	8		A86G				
	10	-2	A87G				
	1/4		A71G				
	5/16		A72G				
	3/8	-25	A73G				
16, 14	6	-3	B85G	Y14MV	ABC	WW-T-110	1C/2593
	8	-26	B86G				
	10	-4	B87G				
	1/4		B71G				
	5/16		B72G				
	3/8	-27	B73G				
12, 10	6			Y14MV	ABC	WW-T-111	1C/2593
	8		C77				
	10	-5	C25-C26				
	1/4		C71				
	5/16	-6	C72				
	3/8	-28	C73				

Figure 3 (Sheet 1 of 2) Copper Terminals and Tooling

AN Wire Size	For Stud Size	AN659	Burndy Part No.		Burndy Hand Tool	T & B Hand Tool	RCAF Ref. No.
			Straight	90°			
8	10	-7	YAV8C-L	-R	MY28	W-T-115	1C/2592
	1/4		YAV8C-L1	-R1			
	5/16	-8	YAV8C-L2	-R2			
	3/8	-29	YAV8C-L3	-R3			
6	10	-30	YAV6C-L1	-R1	MY28	W-T-115	1C/2592
	1/4	-9	YAV6C-L	-R			
	5/16	-31	YAV6C-L4	-R4			
	3/8	-10	YAV6C-L2	-R2			
4	10		YAV4C-L3	-R3	MY28	W-T-115	1C/2592
	1/4	-11	YAV4C-L	-R			
	5/16	-32	YAV4C-L4	-R4			
	3/8	-12	YAV4C-L2	-R2			
2	10		YAV2C-L3		MY28	W-T-115	1C/2592
	1/4	-13	YAV2C-L1	-R1			
	5/16		YAV2C-L2	-R2			
	3/8	-14	YAV2C-L	-R			
0	10		YAV25-L5		MY28	W-T-127	1T/1113
	1/4	-17	YAV25-L1	-R1			
	5/16		YAV25-L2	-R2			
	3/8	-18	YAV25-L	-R			
00	1/4		YAV26-L1	-R1	MY28	W-T-127	1T/1113
	5/16	-19	YAV26-L2	-R2			
	3/8	-20	YAV26-L	-R			

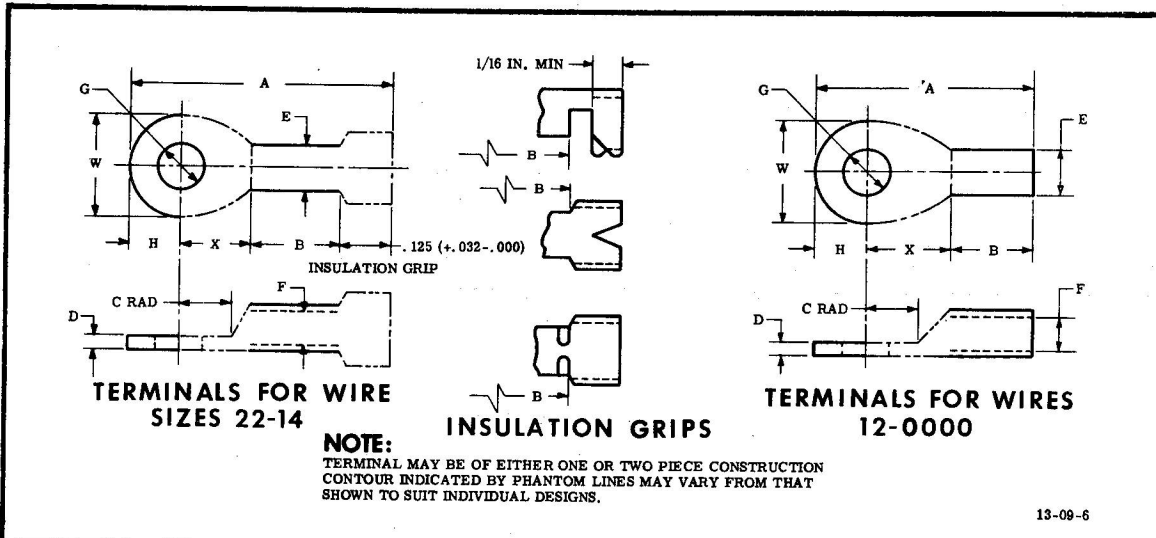
Figure 3 (Sheet 2 of 2) Copper Terminals and Tooling

- (c) Provide low points or drip loops as shown in Figure 7 before wiring reaches connectors, boxes or equipment. Downward attachment of terminals as shown is acceptable where proper drip loops are installed in the wiring and/or conduit just prior to reaching the junction box.
- (d) Wires and cables shall be supported and separated from lines containing flammable liquids, gases, and oxygen, and from their associated equipment. The distance between their supports shall be no greater than the separation from these lines and equipment except that the separation from oxygen lines and equipment shall be as required by specification MIL-L-5585. Wires and cables shall not be attached to lines and equipment containing flammable liquids and gases, unless they require electrical connections or if the clearance between them is less than 2 inches. When the clearance is less than 2 inches, the separation shall be maintained by attaching a cable clamp to a fitting on the equipment or a clamp on the line, and then no less than 1/2 inch separation shall be achieved.
- (e) Install and route wiring to allow easy accessibility for replacement and repair. Route wiring in front of interior insulation and sound-proofing, not behind, unless some means of replacing the wiring is provided.
- (f) Radio wiring must be routed in separate bundles from electrical system wiring except at equipment terminals and at disconnect junctions. Route these radio wire bundles at least three inches away from other wiring.
- (g) Install and attach wires to prevent damage to insulation from vibration or other movement of the wire with respect to adjacent structure and parts. This is particularly important in wires of #2 gauge or larger. Unfused power leads of #2 gauge and larger must not be clipped with other wiring but must be routed in separate, snug-fitting clips.
- (h) Fasten wiring securely, by means of a clip (Item 1 or 2) on each end of wire runs, to reduce strain on connections unless the run terminates in a cable clamp (Item 3) or equivalent. Strain must not be taken by terminals or terminal pots but is to be taken by cable clamps, supports or other approved means.
- (j) Co-axial and twin-conductor radio frequency cables are subject to minimum bend radii as specified in relevant Engineering Orders. When not specified, the minimum bend radius must be ten times the outside diameter of the cable.
- (k) Separate wiring from all heated equipment. Route wires away from water drainage areas where water may collect.
- (m) Install wiring in orderly fashion with individual cables in the bundle generally parallel, to facilitate maintenance and servicing. Avoid crossovers, snarls, tangles or kinks.
- (n) Do not parallel the input and output leads of radio noise filters.
- (p) Use positive locking clips in locations where failure of the clip to remain closed would permit wiring to fall into moving equipment, such as control cables, pushrods, etc.
- (q) Group wiring and bundles per wiring diagram.
- (r) When necessary to enclose wiring in plastic tubing, transparent tubing must be used exclusively unless otherwise specified.

WIRES IN RIGID CONDUIT

18 Observe the following instructions during installation:-

- (a) Drill rigid conduit for drain holes only as required. Do not drill holes in magneto, fire detector or ignition conduit. Holes must have burrs removed. Holes are not to be drilled



Dash#	Cable Size	Stud Size	A Max.	B Min.	C Min.	D		E Max. Dia.	F Min. Dia.	G Dia.		H	W	X Min.
						Min.	Max.			Min.	Max.			
38	22-20-18	4	.893	.250	.187	.029	.043	.155	.055	.116	.122	.115±.020	.225±.031	.218
1		6	.906		.218					.142	.152	.125±.015	.250±.031	.281
2		10	.969		.250					.193	.203	.156±.015	.312±.031	.312
25		3/8	1.312		.343					.385	.410	.320±.015	.656±.031	.437
39	16-14	4	.969	.250	.113	.029	.043	.170	.080	.116	.122	.115±.020	.225±.031	.218
3		6	.969		.218					.142	.152	.156±.015	.312±.031	.281
26		6	.969		.113					.142	.152	.113±.015	.225±.031	.218
4		10	.969		.250					.193	.203	.156±.015	.312±.031	.312
27		3/8	1.312	.343	.385	.410	.320±.015	.656±.031	.437					
5	12-10	10	.969	.250	.250	.037	.083	.230	.125	.193	.203	.187±.015	.375±.031	.312
6		5/16	1.125		.312					.320	.343	.265±.015	.531±.031	.406
28		3/8	1.281		.343					.385	.410	.281±.015	.567±.031	.437
7	8	10	1.125	.360	.250	.050	.083	.325	.175	.193	.203	.203±.015	.406±.031	.343
8		5/16	1.437		.312					.320	.343	.281±.015	.562±.031	.406
29		3/8	1.437		.343					.385	.410	.302±.026	.567±.031	.437
30	6	10	1.312	.422	.250	.050	.083	.385	.222	.193	.203	.234±.030	.468±.062	.375
9		1/4	1.375		.281					.260	.285	.250±.030	.500±.062	.375
31		5/16	1.468		.312					.320	.343	.320±.030	.625±.062	.437
10		3/8	1.468		.343					.385	.410	.312±.030	.625±.062	.437

Figure 4 (Sheet 1 of 2) AN659 Electrical Terminal

Dash#	Cable Size	Stud Size	A Max.	B Min.	C Min.	D		E Max. Dia.	F Min. Dia.	G Dia.		H	W	X Min.			
						Min.	Max.			Min.	Max.						
11	4	1/4	1.406	.437	.281	.070	.106	.450	.280	.260	.285	.250±.030	.500±.062	.375			
32		5/16	1.500		.312					.320	.343				.312±.030	.625±.062	.437
12		3/8	1.500		.343					.385	.410						
13	2	1/4	1.656	.562	.281	.070	.114	.585	.355	.260	.285	.312±.030	.625±.062	.375			
14		3/8	1.781		.343					.385	.410				.328±.030	.656±.062	.437
33		1/2	1.906		.468					.510	.535						
15	1	1/4	1.671	.593	.281	.078	.130	.598	.390	.260	.285	.343±.040	.687±.080	.437			
16		3/8	1.781		.343					.385	.410				.343±.040	.687±.080	.500
34		1/2	1.937		.468					.510	.535						
17	0	1/4	1.969	.656	.281	.088	.130	.665	.440	.260	.285	.375±.040	.750±.125	.437			
18		3/8	1.969		.343					.385	.410				.395±.020	.790±.040	.500
35		1/2	2.093		.468					.510	.535						
19	00	5/16	2.093	.781	.312	.097	.130	.755	.500	.320	.343	.390±.020	.839±.093	.468			
20		3/8	2.093		.343					.385	.410				.390±.020	.839±.093	.500
36		1/2	2.156		.468					.510	.535						
21	000	3/8	2.344	.781	.343	.097	.145	.820	.557	.385	.410	.468±.040	.937±.125	.500			
22		1/2	2.344		.468					.510	.535				.468±.035	.952±.082	.625
23	0000	3/8	2.406	.843	.343	.108	.145	.928	.622	.385	.410	.500±.040	1.000±.125	.500			
24		1/2	2.406		.468					.510	.535				.500±.040	1.000±.125	.625
37		7/8	2.906		.781					.890	.937						

NOTE

Where split barrel construction is used, the split shall be permanently sealed and shall not open as the result of crimping.

Material: Soft Copper, or Copper Tubing, or Gilding Metal, 95% Copper, 5% Zinc.

Optional Barrel Material: Commercial Bronze, 90% Copper, 10% Zinc.

Finish: Tinned Plate

Example of Part No.: AN659-4 - Terminal, Cable size 16-14, Stud size No.10.

Dimensions in inches.

Figure 4 (Sheet 2 of 2) AN659 Electrical Terminal

with wires in conduit. Rigid conduit must be installed with hole at lowest point with respect to aircraft ground attitude to permit drainage.

(b) When pulling wire and wire bundles through conduit, use only a double thickness of regular tying or lacing cord (Item 4) for every ten wires being pulled. Do not use metal wire. Talc (Item 5) may be used on bundles and the lugs may be staggered to facilitate installation. Keep bundles straight when installing.

(c) Pull a felt plug or cloth through all conduit immediately prior to wire pull.

(d) Remove all tape or temporary ties immediately prior to wire pull.

(e) Check wire for damage as it is being pulled.

(f) Do not lay wire on floors at any time.

(g) All partially installed wire which is not to be immediately pulled into conduit must be coiled and covered with a paper bag or wrapping until installation is to be completed.

(h) Wire must not be pulled tight over rolled edge of conduit.

(j) Install rigid conduits with rolled ends, unless otherwise specified.

(k) Install bundles so that a wire may be replaced without removing the entire bundle.

(m) Do not tie or fasten wires together in conduit or insulating tubing.

(n) Radius or smooth out sharp edges on conduit interiors or at flexjoints, as applicable, to facilitate installation and removal of wire.

(p) Sharp inside edges of telescoping bell joints are to be broken as follows, to prevent abrasion of wires:-

(1) Chamfer at 45° to approximately 20% to 30% of the wall thickness removing all sharp inside edges.

(2) The edges may be radiused with a sharp tool to approximately a 1/64 to 1/32" radius.

(q) Wires of # 2 gauge and larger must not be run with other wires smaller than # 2 gauge in the same conduit.

(r) Where wire bundles break out at pull points or terminal strips, the wire bundles must not have break-offs less than 1/2" from rolled edges of conduit and shall

AN Wire Size	Plastic Tubing Wall Thickness
20	.016
18	.016
16	.018
14	.018
12	.020
10	.020
8	.020
6	.020
4	.025
2	.025
1	.025
0	.030
00	.030

Figure 5 Plastic Tubing Wall Thickness

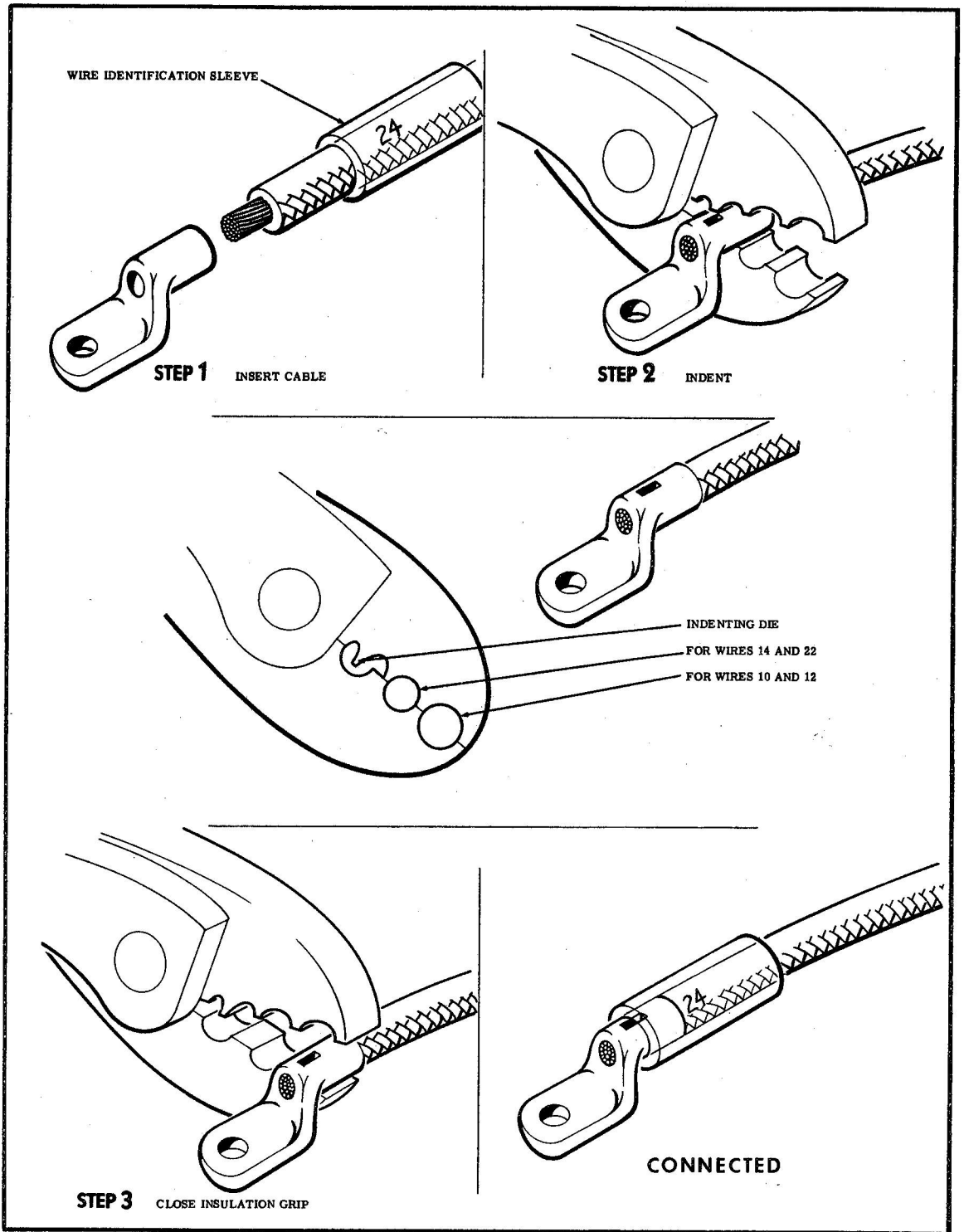


Figure 6 Hand Tool Staking

be properly clipped. Where it is impossible to clip the wiring, install tubing by slitting and wrapping around the wire bundle. Locate so that the tubing extends at least 1/2" into the conduit and tie with # 8 or # 12 electrical waxed cord.

NOTE

The use of plastic tubing in such cases is not to be considered as a protection against chafing but merely to keep wires together and in a straight run.

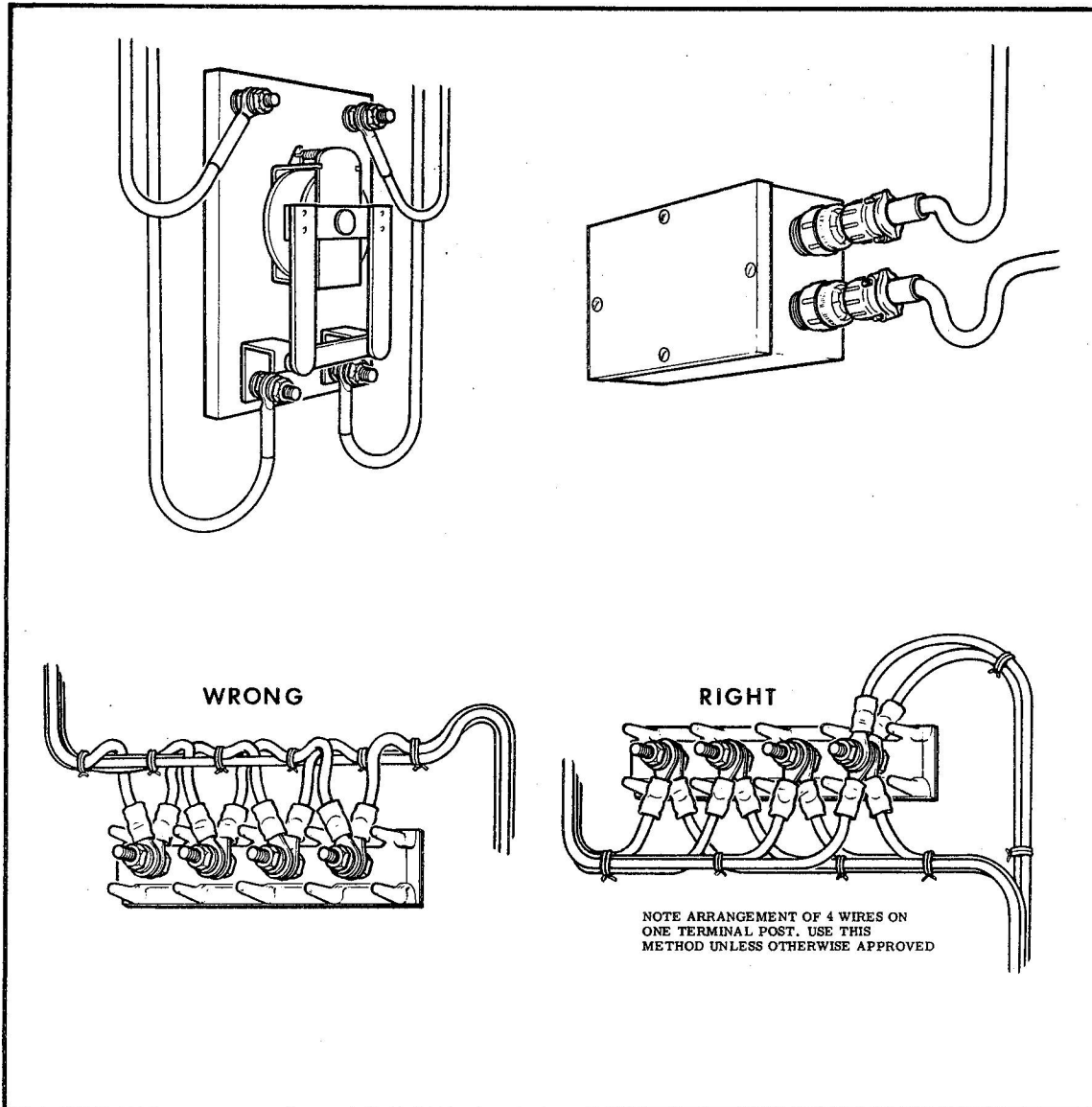


Figure 7 Typical Drip Loops

chafing but merely to keep wires together and in a straight run.

- (s) Where conduit opens upwards, permitting small hardware and metal chips to enter, wrap with tubing or sheet and tie at each end with # 8 or # 12 electrical waxed cord.
- (t) Do not fasten rigid conduit to inflammable fluid lines.
- (u) Install wire bundle so that the required slack remains. Support firmly to prevent the bundle weight from causing movement and elimination of the slack,
- (v) Install clamps over telescoping bell joints. The clamp may be installed up to the edge of the female end, but a 1/16" section of the sawcut must be visible at the other edge of the clamp to facilitate inspection, see Figure 8.

FLEXIBLE CONDUIT

19 Observe the following instructions during installation of flexible conduit:-

- (a) Do not drill flexible conduit unless done on original installation. Holes must have all burrs removed. Holes are not to be drilled with wires in conduit. Flexible conduit must be installed with the hole at lowest point to permit drainage.
- (b) Proper clipping of flex conduit must be maintained to prevent abrasion of adjacent parts.
- (c) Install without leaving a residual twist.
- (d) Leave only enough slack in flex conduit to permit ease of maintenance, to prevent mechanical strain on couplings and clips, and to permit free movement of vibration-mounted equipment.
- (e) Minimum bend radii for flex conduits #101, 138 and 152 are five times the inside dia. except for 1/4" #101 flex conduit for which the minimum bend radius is seven times the inside dia.

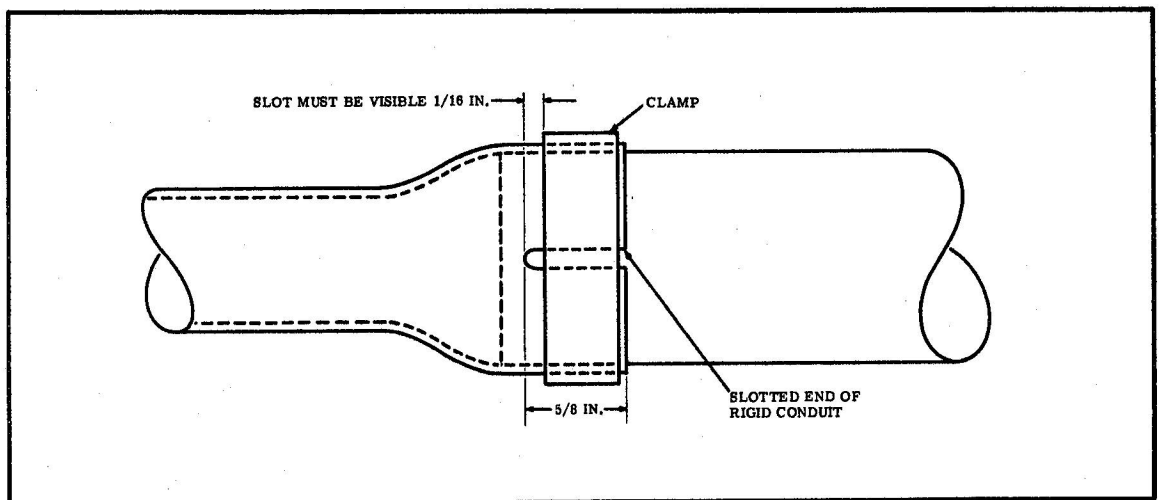


Figure 8 Clamp Installation

- (f) Ensure that all flexible conduit nuts are finger tight except on flexible conduit forward of firewall, on ignition flexible conduit where nuts must be finger tight plus 1/16 turn, or where thread interference introduces friction preventing normal tightening of the nut. Use a suitable tool to turn the nut without damage. Avoid excessive tightening.
- (g) Do not attach flexible conduit to inflammable fluid lines.

FERRULES ON FLEXIBLE CONDUIT

20 Observe the following instructions when installing ferrules on flexible conduit:-

- (a) Cut the conduit one inch longer than required.
- (b) Tin the ends of the conduit for approximately one inch and cut the tinned ends so as to secure the exact length. Trim the cut with diagonals to remove all ragged edges, loose wires, etc. Tin the collars of the ferrule (Item 16) for approximately one-half of their length.

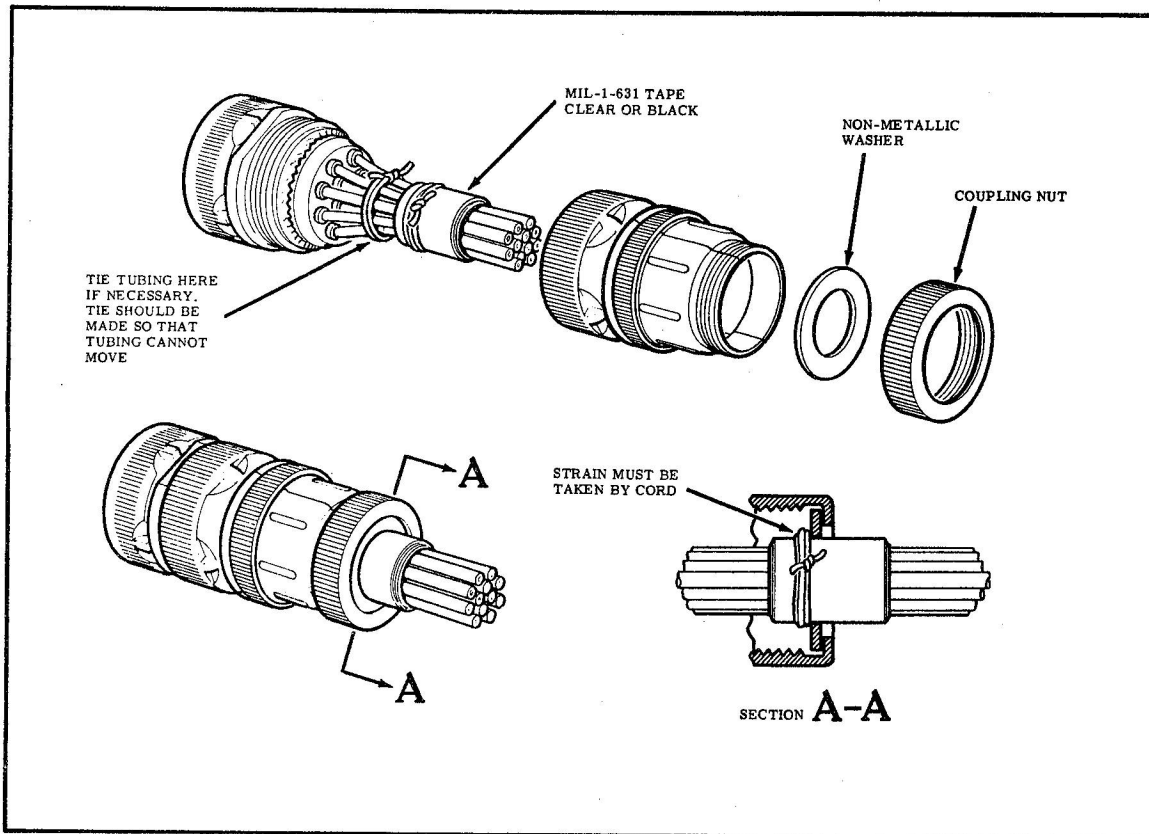


Figure 9 Connector Assembly using Washer and Nut

- (c) Roll or swage one ferrule on the conduit.
- (d) Slip the nuts on the conduit.
- (e) Roll or swage on the remaining ferrule.
- (f) Solder and wipe the ferrules and conduit until there are no blow holes between the ferrules and conduit and a smooth exterior is obtained.
- (g) Inspect the finished assembly for cracking (small cracks not into the radius of the ferrule are permissible), loose solder inside the conduit, improper mating of the parts and damaged plating. Damaged plating may be corrected by tinning the ferrule completely.

MISCELLANEOUS

- 21 Install wires in connector plugs, receptacles, pins and sockets as follows:-
- (a) Where provision is made for mechanical staking of wires, they should be so attached, except for thermocouple leads which must be soldered.
 - (b) Where solder type connectors are used, solder as instructed in EO 05-1-3/20. Connector and wire must be brought to correct temperature to prevent cold solder joints.
 - (c) Stake connector pins and sockets on pressurized panel only with approved tooling.
 - (d) Insulate and protect each connection and wire end with clean plastic tubing long enough to cover the staked or soldered end. The tubing must not extend more than 3/8" beyond the identification number except where necessary for clamping or tying.
 - (e) Tie plastic tubing securely or serve the wire bundle with cord as shown in Figure 9 to avoid slippage or insulation. Use method of tie given in paragraph 39 to 41 inclusive, following.

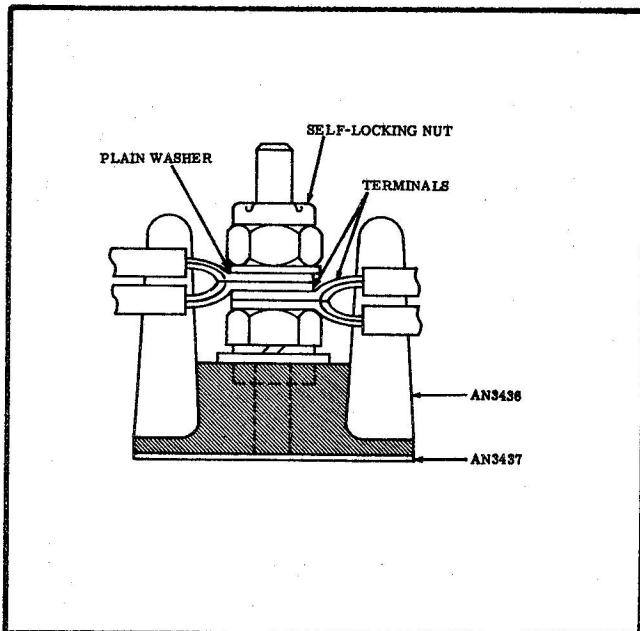


Figure 10 Terminal Strip Installation

TERMINAL STRIPS

- 22 For the installation of terminal strips observe the following:-
- (a) Attach terminals to connector panels (terminal strips) as called for on the wiring diagram. The order in which parts are installed must be shown in Figure 10.
 - (b) Attach not more than four terminals, or four terminals and a bus-bar, to any one terminal post unless otherwise directed on the wiring diagram.
 - (c) Elastic stop nuts may be substituted for top nut and lock washer only.
 - (d) Use only cadmium plated steel nuts, washers and lock washers to attach the terminals. If the engineering drawing calls for unplated or cadmium plated brass nuts and washers, cadmium plated steel may be

substituted. This substitution is not reversible. Unless brass parts are called for, only cadmium plated steel may be used.

- (e) Do not use lock washers between terminals. Nuts and/or washers, may be used if necessary. Limit the stack height to prevent terminals from slipping over the top of barrier posts.
- (f) Base insulating strips (Item 19) are to be cemented to the base of terminal strips (Item 20) unless the suffix C is used, which indicates that the insulating strip is not required.
- (g) A bus-bar, when used, may replace the bottom terminal and permits deletion of the bottom washer.
- (h) Plain nuts and lock washers may be used as an alternative to self-locking nuts in attaching terminals to the terminal posts.
- (j) Terminal strips which have spare connector studs must be provided with self-locking nuts and washers. The self-locking nuts must be tightened down on these spare connector studs.
- (k) Tighten self-locking nuts so that the terminal bolt ends extend through the nuts.
- (m) Torque # 8-32 terminal posts (anchor nut only) of terminal strips (Item 20) to 10 to 13 inch-pounds.

INSULATION OF CONNECTOR PANEL ATTACHING SCREWS AND NUTS

23 Attaching screws and nuts must be insulated so that terminals, bus bars and other electrical hardware cannot contact them and cause a short-circuit. Insulate as follows:

- (a) Use insulating strips (Item 21). Both post size and number of posts must be specified in ordering.
- (b) On connector panel assemblies where insulating strips are not available, wood dough filler or plastic wood (Item 23) may be used. The attaching screw and nut must be sufficiently below the surface to permit at least a 1/16" covering of filler. Pack the attaching screw cavity with filler, taking care to eliminate air pockets. Smooth with a spatula and allow to dry. No hump is permitted.

24 When attaching terminals to bus bars or equipment where current passage through terminals and hardware is required, install the larger terminal first.

RIVET INSTALLATION

25 Rivets are to be installed in junction boxes and structural members containing wiring with the rivet head inside. If this is not practicable make the upset head comparable to the manufactured rivet head.

26 Wherever Cherry rivets are used in proximity to wire bundles, particularly within junction boxes, the burr remaining after the rivet shank has been cut off must be removed.

SCREW INSTALLATION

27 For installation of screws observe the following:

- (a) Mount equipment with screwhead inside box or structure. Use brazier or flush head screws. Refer to EO 05-1-3/6.
- (b) Where design requires that either the nut or nutplate be mounted inside the box or structure, the capped type nut or nutplate is to be used. Refer to EO 05-1-3/6. Use lock-washers (Item 32) with cap or cap nutplates.
- (c) If screws are used for assembly or mounting of equipment, they must not be a hazard to electrical wiring or be a possible cause for a short-circuit.

ANSTAT DEAD END MAST ASSEMBLY INSTRUCTIONS

GENERAL

28 The purpose of this antenna mast assembly, see Figure 11, is to terminate the polyethylene insulated wire in a connector assembly which may also be used as a take-up device for adjusting the wire to the proper amount of tension. It is important that the instructions be followed very closely so that the metallic sections of the assembly will be insulated from the outside electrical effects and will give the equivalent insulating properties of the insulated polyethylene antenna wire.

ASSEMBLY OF ANTENNA MAST

29 To assemble antenna mast, proceed as follows, see Figure 11:-

- (a) Cut antenna wire (1) to the approximate length desired, allowing a few extra inches for later cutting to correct length.
- (b) Remove 3/4" of polyethylene insulation from end of wire
- (c) Insert wire seal (4) into mast (3).

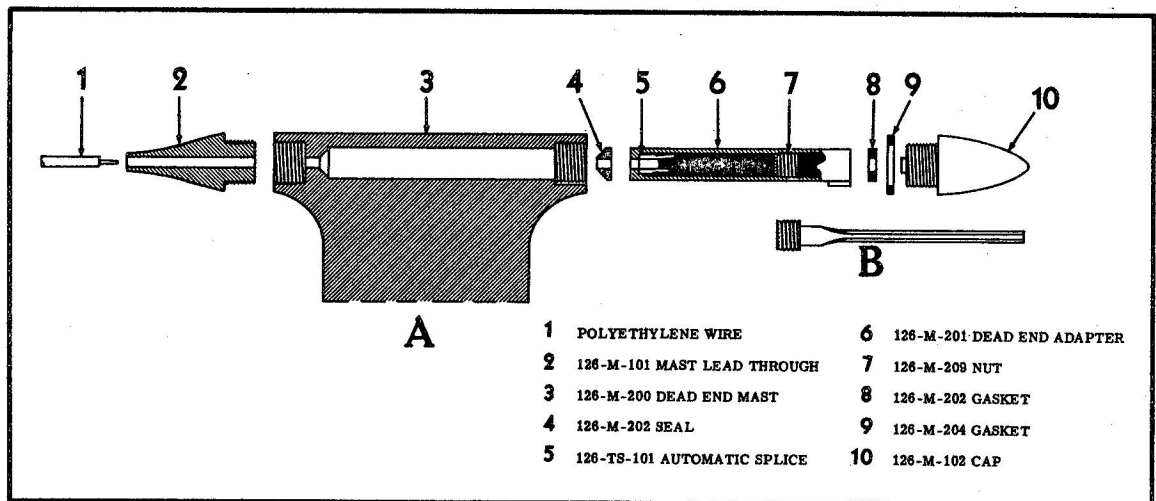


Figure 11 Anstat Dead End Mast M-200



Do not wipe compound (Item 28) out of mast openings.

- (d) Insert dead end adapter (6) into mast (3) so that the keyway is fitted properly and the dead end adapter fits snugly against wire seal (4).
- (e) Insert wire (1) through rubber lead-through sleeve (2) and push wire through the opening in the mast (3) until the wire engages the jaws within the connector (5).
- (f) Give a slight tug on the wire to make certain that it has been properly gripped.
- (g) Screw rubber lead-through sleeve (2) tightly into the mast (3).
- (h) When the antenna mast which supports the antenna at its opposite end has been installed, the slack in the antenna wire may be taken up by placing a screwdriver within the dead end adapter (6) and engaging the slot (7) in the screw. By turning the screw counter-clockwise, the antenna wire may be taken up a distance of approximately one inch. When the proper amount of tension is attained, place rubber seal (8) and (9) onto cap (10) and screw into the rear section of the mast as tightly as possible using only the hand. The mast is now assembled and will provide the necessary electrical insulation.

REMOVAL OF ANTENNA WIRE

- 30 To remove the antenna wire proceed as follows:- See Figure 11.
- (a) Cut polyethylene wire (1) about 6" from mast (3).
 - (b) Remove cap (10) and rubber seals (8) and (9).
 - (c) Remove rubber lead-through sleeve (2).
 - (d) Push wire (1) through the mast (3) so that dead end adapter (6) and rubber seal (4) are ejected.
 - (e) Insert screwdriver in slot (7) and turn screw clockwise as far as it will go.
 - (f) Crush the insulation on the remaining polyethylene wire with pliers and remove by twisting and pulling.
 - (g) Slide wire release tool over the bare wire until it engages jaws (5) within the connector. If necessary, tap on tool to release, jaws.
 - (h) Holding release tool firmly against jaws, pull out antenna wire.
 - (j) Coat the threads in each end of the mast with compound (Item 28). The mast assembly is ready for re-use.

ANTENNA FITTINGS

- 31 For best results observe the following points:-
- (a) Pliers or sharp knife must not be used to remove insulation from polyethylene wire. The conductor within the antenna wire is copperweld and, if nickled by sharp tools, becomes mechanically weak and may fall under vibration. Use a vee-shaped soldering iron tip to melt insulation from wire.

- (b) Place a small amount of compound (Item 28) in each cap. Do not wipe off, as this helps to prevent air pockets inside the threads of the cap when the unit is assembled.
- (c) Do not use pliers or other hand tools to assemble Anstat antenna fittings. Hand tightening, using a clean cloth to grip the parts, is sufficient.

CONNECTING WIRE INTO FITTING

32 To connect wire into fitting proceed as follows:- See Figure 12.

- (a) Remove 3/4" of insulation from end of polyethylene wire. (Refer to Paragraph 31, preceding).
- (b) Slide one cap (1) over wire (2).
- (c) Slide silicone rubber seal (3) over insulated wire (2).
- (d) Hold the fitting firmly in one hand and push bare wire section into connector as far as it will go.

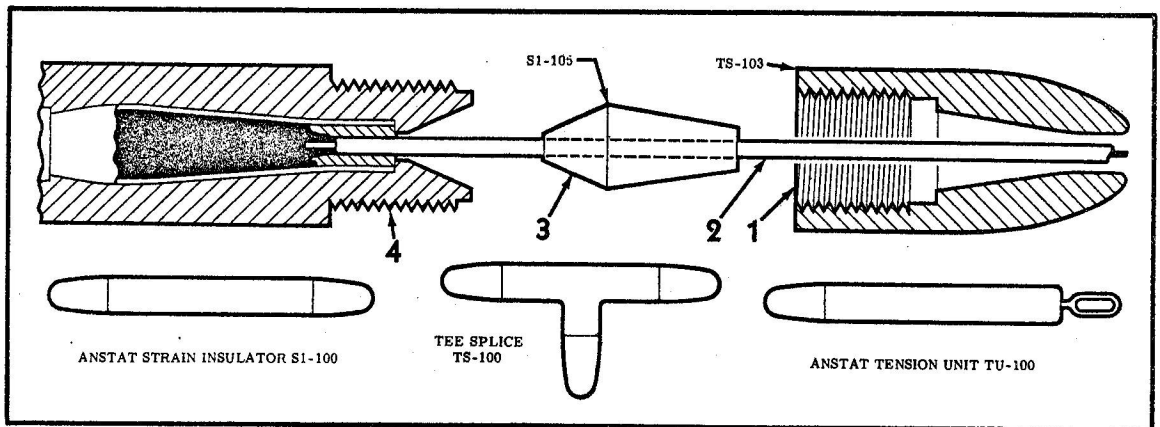


Figure 12 Dead End Mast Components

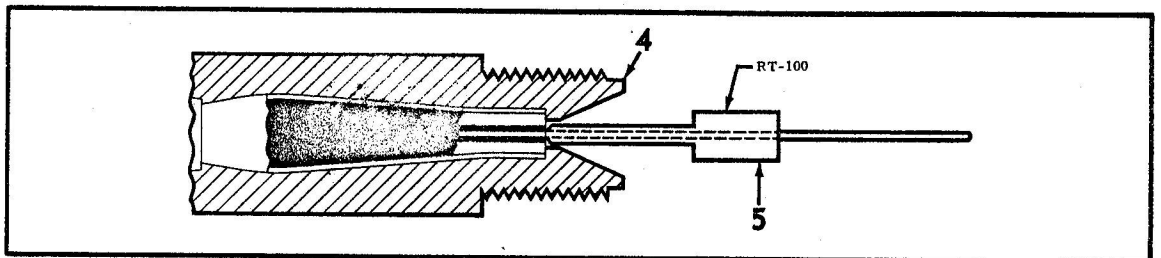


Figure 13 Dead End Mast Assembly

- (e) Give a slight pull on wire to be sure it is gripped firmly.
- (f) Push silicone rubber seal (3) into entrance of fitting until tapered section of seal is seated.
- (g) Screw end cap (1) onto the threads (4) hand tight.
- (h) Wipe off excess silicone compound (Item 28) with clean dry cloth.
- (j) Connection is now ready for use.

REMOVAL OF WIRE FROM FITTING

- 33 To remove wire from fitting proceed as follows:- See Figures 12 and 13.
- (a) Cut antenna 6" in front of cap (1) with pliers.
 - (b) Unscrew cap (1) and remove rubber seal (3).
 - (c) Using a pair of pliers, crush the insulation on the 6" section of wire up to entrance of the connector.
 - (d) Hold the unit in one hand and slide the insulation from the conductor. A slight twisting action will make the insulation slide from the wire easier.

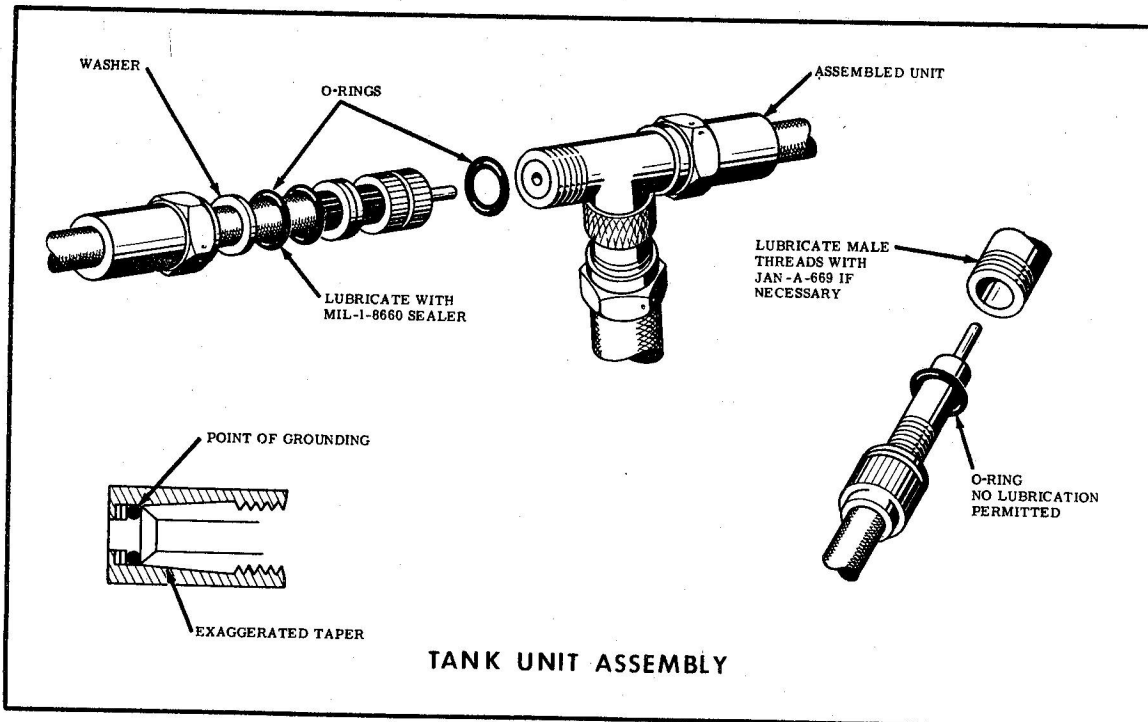


Figure 14 Simmonds Pacitor Tank Unit Assembly

- (e) Place the release tool (5) over the wire as shown and slide down inside the connector until it touches the jaws. It may be necessary to use a non-metallic hammer to tap on the end of the release tool to open the jaws from around the wire.
- (f) When the jaws are released, hold the release tool firmly against the jaws and pull the bare wire out of the connector.
- (g) The unit is now ready for re-use after replacing the wire seal (3) with a new one and placing a small amount of compound (Item 28) in the cap (1).

SIMMONDS PACITOR TANK UNIT ASSEMBLY

PROCEDURE

34 To assemble Simmonds Pacitor tank unit coupling nut to tank units, proceed as follows, see Figure 14:-

- (a) Lubricate male threads only with compound (Item 29), if necessary to prevent seizing.
- (b) Place the coupling nut and O-ring over the end of the coaxial cable.

NOTE

Do not lubricate the O-ring, as friction between the seal and cable holds the cable in place and waterproofs the connection.

- (c) Insert the bayonet-type end into the tank unit to the full depth of the central prong.
- (d) Complete the assembly by tightening the coupling nut finger tight.

STOWAGE OF ELECTRICAL WIRING AND PLUGS

GENERAL

35 Stowage of electrical wiring and plugs is carried out to ensure adequate protection from short-circuits, structural damage and fire.

GENERAL INSTRUCTIONS

36 Observe the following instructions:

- (a) All wires must be prevented from creeping by tying to a supporting cable run or structural member. Adequate support must be ensured, i. e. , a plug may not be tied to a cable run of less than 1/2 the diameter of the plug itself, unless specified.
- (b) Whenever possible, stowed plugs must be visible for ready inspection.
- (c) Wires with stripped ends must have the protruding strands cut flush with the end of the insulation, except when otherwise specified.
- (d) Wires ending in terminal lugs or other special purpose terminations must be stowed to preserve these ends. Use transparent tubing to show these ends intact whenever possible.
- (e) Wire numbers, either stamped or typed on tape, must be clearly visible when stowed.

- (f) Each wire of a multiple wire conductor must be treated as a single wire.
- (g) Do not bend solid conductors for stowage purposes.
- (h) Do not stow wires inside AN connectors, clamps or terminal boxes.
- (j) Observe temperature conditions which regulate material being used.
- (k) Whenever glass tape (Item 33) is used to box and wrap AN connectors, coat the tape with silicone resin (Item 34).
- (m) Do not push stowed wires back into the bundle.
- (n) Use a maximum of three and a minimum of two wraps per spot tie.
- (p) The radius shown in Figure 15 (Sheet 1) must be $3/8$ " minimum for AN20 gauge wire, $1/2$ " minimum for AN18 and 16 gauge wire and $5/8$ " minimum for AN14 and 12 gauge wire. For co-axial cables, the bend radius shall not be less than 6 times the diameter of the co-axial cable.
- (q) For insulating conduit in low temperature areas, use a tying cord (Item 4) and tape (Item 35).
- (r) For insulating conduit in high temperature areas use tying cord and tape (Item 37).
- (s) In cases where more than one wire per bundle is stowed, the individual wires must be staggered.
- (t) An alternate method for stowage in the case of wires AN10 and larger sizes for the co-axial cables is shown in Figure 15 (Sheet 2).
- (u) For shielded wire, strip and push back the shielding from the end of insulating conduit as shown.

STRUCTURAL STOWAGE

37 The method used in attaching wires to structural members using clips is shown in Figure 15 (Sheet 3). The clip (Item 1 or 2) is placed over the first tie. The sizes of the loops are different and are staggered. The wires are individually insulated but bound as a unit

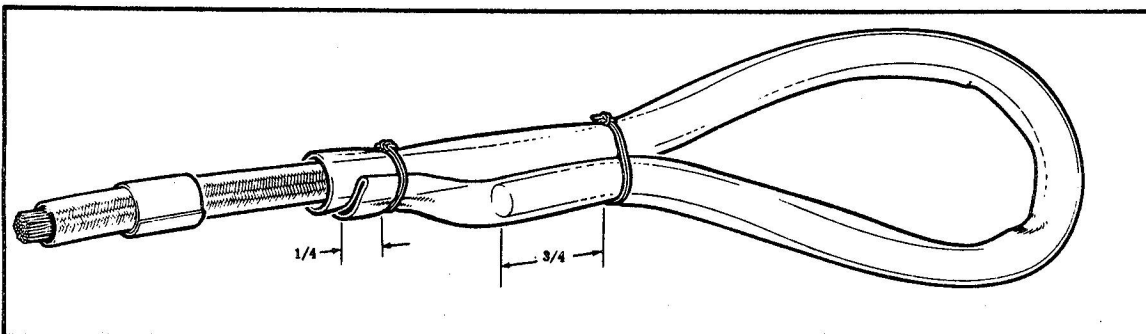


Figure 15 (Sheet 1 of 3) Stowage Methods

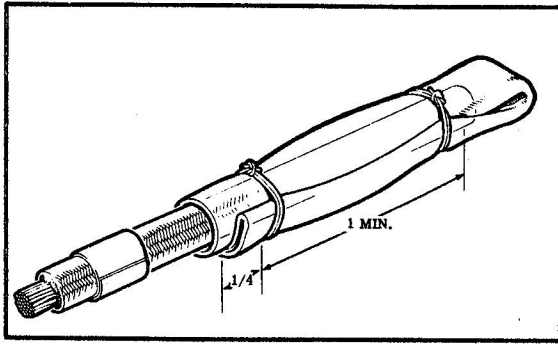


Figure 15 (Sheet 2 of 3) Stowage Methods

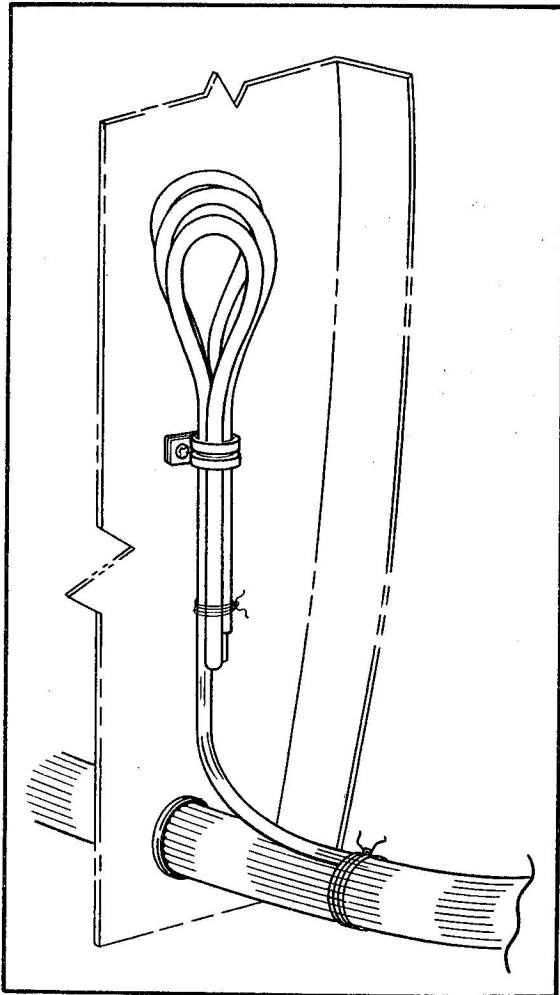


Figure 15 (Sheet 3 of 3) Stowage Methods

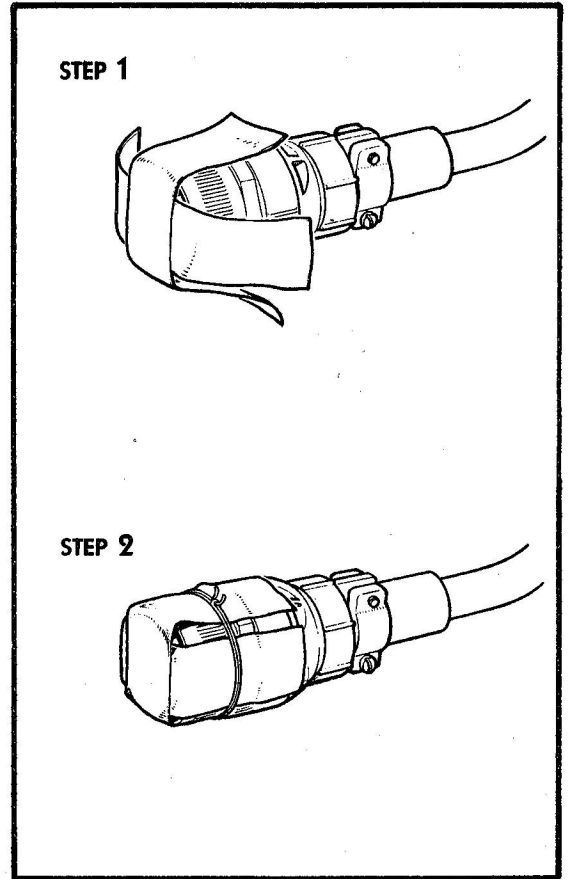


Figure 16 Wrapping of Plugs

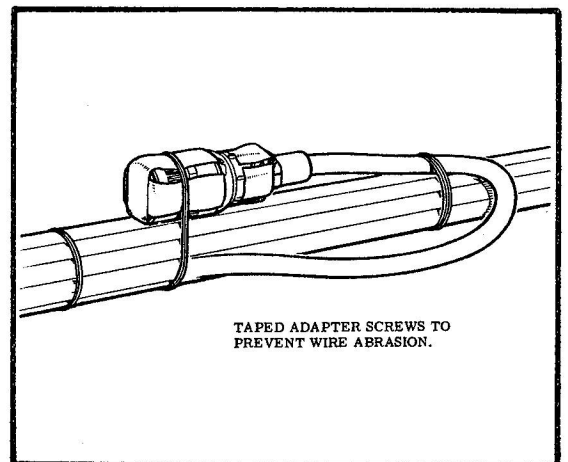


Figure 17 Plug Tying

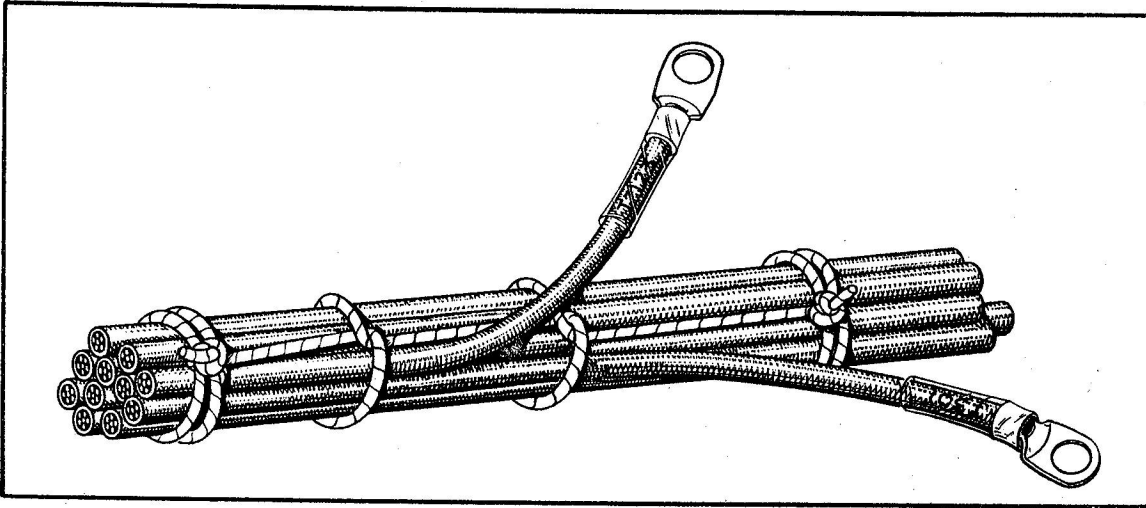


Figure 18 Lacing Wire Bundles

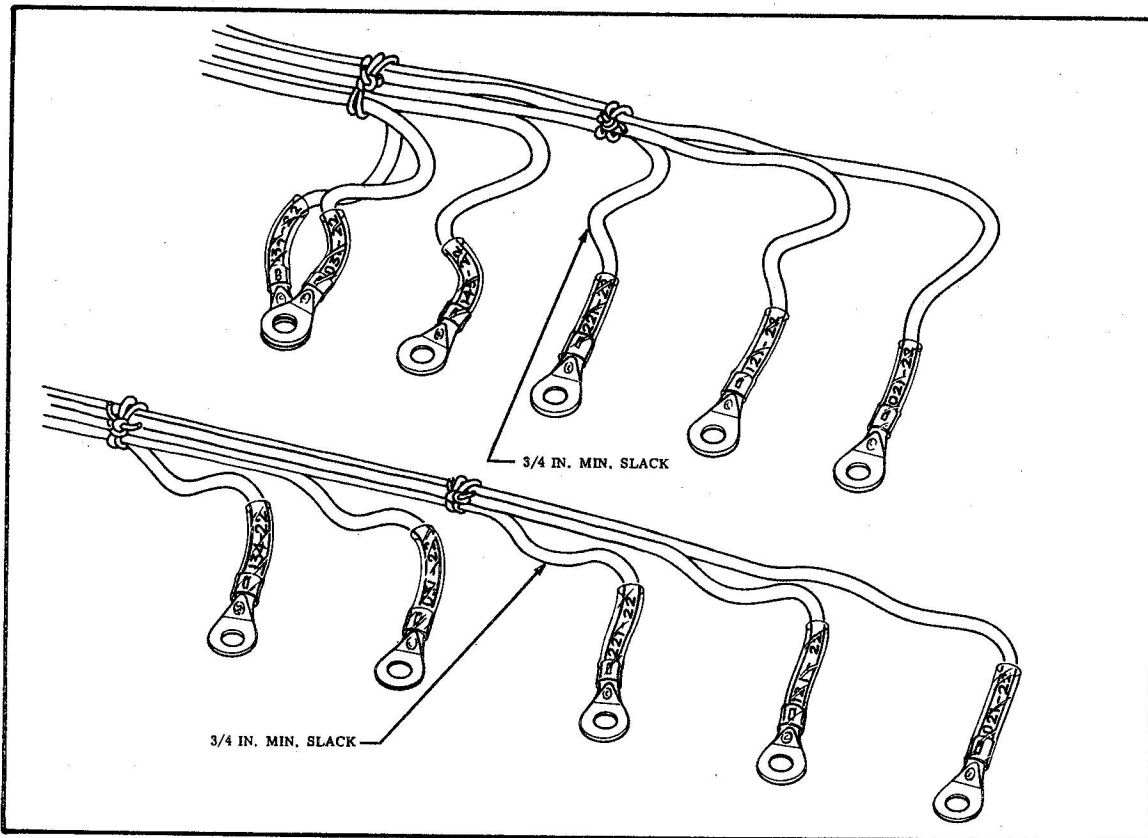


Figure 19 Branch Ties

AN CONNECTORS

38 For the stowage of AN connectors, proceed as follows:-

- (a) Box and wrap plugs as shown in Figure 16. Where dummy receptacles or dust covers are provided for stowage, they must be used and taping will not be necessary.
- (b) Tape and cord must comply with temperature limitations, (refer to paragraph 36, Sub-paragraphs (a) and (r)). Expose no part of the plug except as indicated.
- (c) Plugs must be either tied to cable runs or clamped to structure members as shown in Figure 17. Special care should be taken to ensure that fluid can not run down into the wire end of the plug. Use drip loops as required.

TYING WIRES

39 Make all wire ties with cord (Item 4) as follows:-

- (a) Tie a clove hitch around the wire or bundle of wires.
- (b) Tie an overhand knot over the clove hitch to produce a square knot.

LACING

40 Do not use lacing unless specified on the engineering drawing. When specified, proceed as follows, see Figure 18:-

- (a) Tie knot as above.

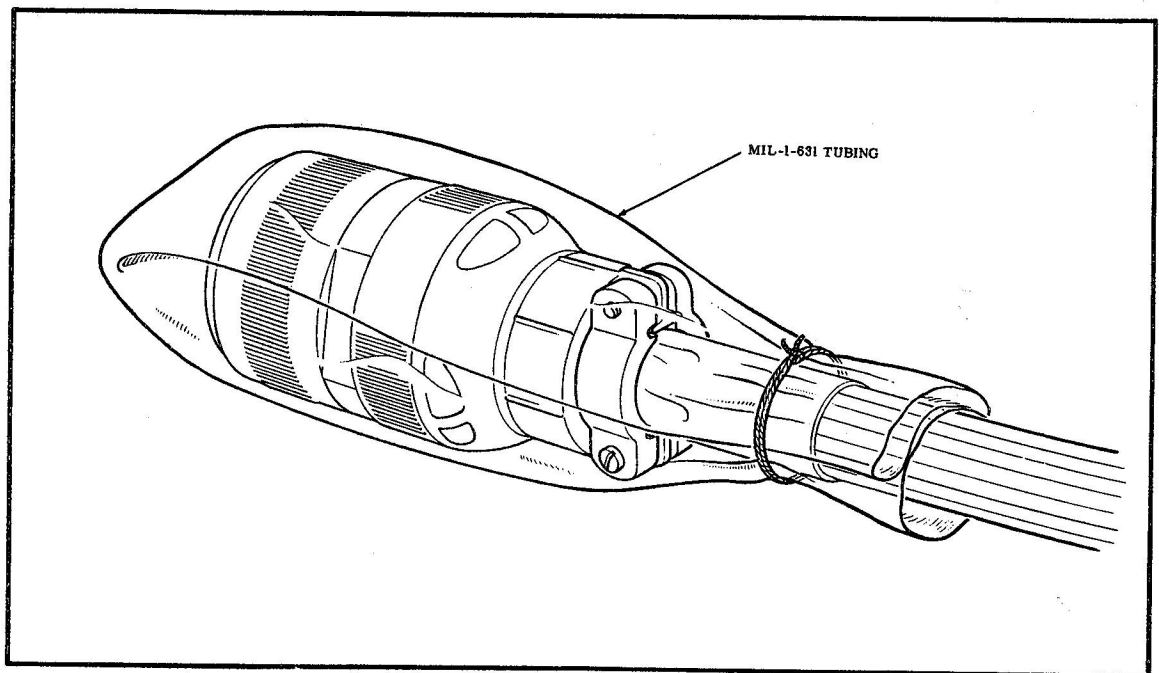


Figure 20 Unused Connector Insulation

- (b) Use an overhand knot for the running knot.
- (c) End lacing with knot as above.

BRANCH TIES

41 Make ties as shown in Figure 19. Ties from each branch from the main bundle are not necessary. Tie when wires or groups of wires leave the main bundle and where necessary for support. Allow a minimum of 3/4" of slack on each branch from tie to terminal shank. The 3/4" slack is essential to prevent strain on terminals.

EXCESS WIRE

42 Excess wire is not permitted except for the installation of alternate equipment, in special instances where specified and where thermocouple leads must be of a specified length and cannot be cut.

UNUSED WIRES

43 To stow unused wires, proceed as follows:-

- (a) Cover ends of wire not terminating in equipment and which are intended for future or alternate use, with plastic tubing (Item 8). The ends of individual wires must be insulated snugly and tied with waxed cord (Item 4).
- (b) Coil and tie to bundle with waxed cord.
- (c) Insulate connector plugs which are not used or stowed in mountings as shown in Figure 20. Plugs must be stowed with a drip loop adjacent to the plug to prevent entry of fluids, see Figure 7.

HANDLING TIES

44 Handling ties are used for convenience in handling or storing wire assemblies before installation and must be removed from all installed wiring.

WIRE BUNDLES TIES

45 Make ties around wire bundles (outside junction boxes) only where the clipping distance exceeds 24" or where necessary to prevent interference between wires and adjacent items. Minimum distance between ties is 6" or less, if required by the provisions of paragraph 17, preceding. This does not apply to branch ties.

46 Inside of junction boxes make ties around wire bundles only where necessary to prevent the interference of loose wires with operating relays or similar equipment. This does not apply to branch ties.

CLAMPING PROCEDURE

GENERAL

47 If regular grommets are not available, .020" plastic tape (Item 39) clear or black, may be used. Wrap the tape around the bundle to the desired diameter. Tighten the saddle while holding tension on the tape. There must be no gap between saddle and clamp. See Figure 21.

WASHER METHOD

48 Where the grommet and plastic tape method cannot be used due to space limitations, the washer method may be used. Build up a number of turns with cord (Item 4) over the plastic tape (Item 8) and tie so that the strain on the wiring will be against the cord rather than the connectors, as shown in Figure 22.

DISCONNECT PLUG ASSEMBLIES

49 On disconnect plug assemblies, make certain that all threads are properly engaged before tightening. Proceed as follows:-

- (a) Tighten the coupling nuts and the cable clamp (Item 3) finger tight. Cable clamp must be tightened before the saddle is clamped on the wire bundle to prevent twisting the wires.
- (b) Safety all connectors in engine nacelles and in areas not readily available for visual ground inspection.
- (c) Safety all disconnect plug assemblies which might become disconnected due to wire pull etc., if coupling nut backed off due to vibration.
- (d) Do not safety co-axial transmission connectors. Install to correct torque specified in the applicable Description and Maintenance Manual.
- (e) Tighten all vibration-proof connectors with a suitable tool.

PROTECTION OF PLUGS

50 Plugs installed so that the wires leave the plug in an upward direction require water-proofing and protection from dirt and metal particles. To obtain the required protection, secure a length of plastic tubing around the plug and extending along the wires to the point

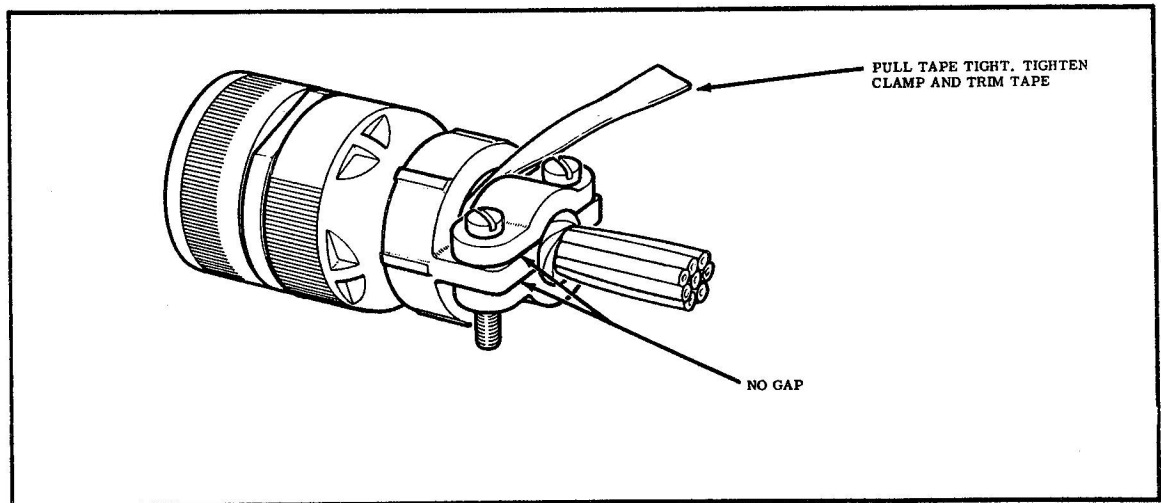


Figure 21 Connector Installation

where the wires have completed a turn downwards.

51 Where the nut is installed inside the junction box, or on the open wiring side of the bulkhead where conduit terminates in open wiring, safety hexagon locknuts used to attach bulkhead type conduit fittings as follows:-

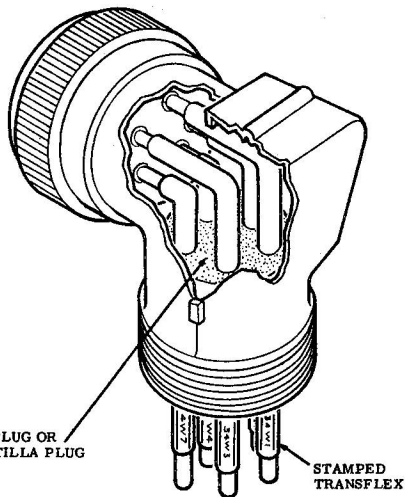
- (a) Tighten locknut on fitting.
- (b) Using a medium automatic punch adjusted to full setting, stake the nut against the last visible thread on the fitting with a light blow. Stake at one point only.

52 Ninety degree connectors used without conduit must point downward where possible, see Figure 22.)

53 Where rubber seals are employed with vibration-proof connectors and flexible conduit, the plastic tubing (Item 8) shall be added as shown in Figure 22. Adequate protection is afforded the identification numbers by the flexible conduit. The numbers must be installed close to, yet not be covered or hidden by the seal.

CLIP APPLICATIONS

54 Locate clips (Item 1 or 2) with point of attachment above the wire bundle, wherever practicable. Clip to clear slack from structure. Rigid and flex conduit should be clipped to ensure adequate support according to size, length and shape of conduit. Do not secure conduit to the aircraft structure at intervals greater than three feet. See Figure 23.



55 Choose clips to insure a snug fit of the wire bundle. Wires in non-loop clips or clips without protective covering must be installed with the wiring suitably protected from chafing.

56 Where secure attachment of the wire bundle is required, fasten in such manner as to prevent slippage of the wire bundle through the clip under flight conditions, but not sufficiently tight to damage the insulation or to prevent closing of the clip. Wrap clear or black plastic tape (Item 39) around the wire bundle if a clip of the proper size cannot be obtained. Where there are exposed terminals in regions subjected to explosive vapour accumulation, clip the leads to prevent side movement of the terminal ends of the cables.

57 Where an angle bracket (Item 40) is required for clipping open wiring, only angle brackets with two or more points of attachment may be used. Two hole attach angles are to be used with rigid conduit where vibration permits movement of conduit and subsequent contact with structures, cutouts, etc. Where conduit is routed so that it crosses over longerons, frames, etc. and is not attached at the

Figure 22 VP Rubber Plug Installation

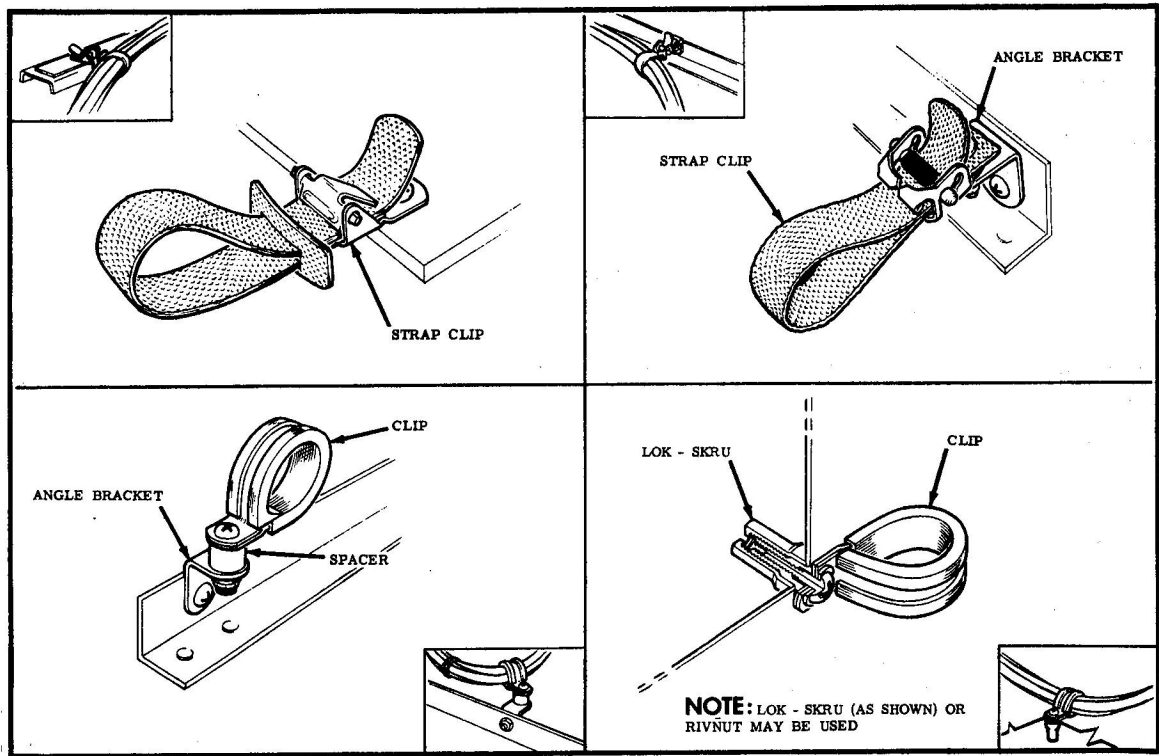


Figure 23 Clip Mountings

point of crossover, a minimum clearance of $1/16''$ is required. Washers may be used under conduit attach clips (Item 1) to obtain necessary clearance but should not exceed a total of $3/16''$ under clip.

WIRE PROTECTION

58 The use of plastic tape and tubing to protect wires mechanically from chafing or abrasion is prohibited. Where wiring would chafe on structure, protect the wiring by additional clips or clamps, re-routing or other installation changes. Plastic tape or tubing may only be used to protect wiring insulation from damage by fluids or when wires passing through holes where it is impossible to install off-angle clamps to maintain wiring away from the edges of holes and the use of phenolic blocks, plastic liners or rubber grommets is not sufficient protection, the use of plastic tape or insulating tape to give additional protection is permissible. Do not use friction tape or adhesive tape.

59 For additional protection at all locations noted below, wrap with fish paper and tie with plastic tape (Item 39) and cord (Item 4) or cord alone, as required:

- (a) Wires entering plastic grommets which are not fully closed.
- (b) Small wires at ground power receptacle clamp.
- (c) Wires entering plastic grommets and which run from leading edge centre wing to fuselage seal plug.

60 Wrap with plastic tape (Item 39) all wires in battery enclosure.

REPAIRING DAMAGED WIRES

61 Repair damage to primary insulation along $3/4$ " of wire or less, except for #22, 20 and 18 wire, by installing plastic tubing over or wrapping plastic sheet (.020" minimum wrap thickness) around the damaged portion and tying at each end, as shown in Figure 24.

SPLICING WIRES

62 Uninterrupted wiring is preferred for aircraft applications. Splices are not to be used for initial installation except for specific applications with approval of the engineering authority. Repair of damaged wires; except those listed below, may be carried out in accordance with this EO and EO 40-90-10 on engineering authority at unit level. Emergency repair by splicing may be carried out on the following types but shall be rectified as soon as proper tools and materials are available.

- (a) Thermocouple wires
- (b) High tension wires.
- (c) Shielded wires and cables.
- (d) Twisted or multiple wire and cables.
- (e) Wires with special insulation.
- (f) Wires larger than AN10.
- (g) Aluminum wires.
- (h) Antenna leads or connections.

63 To splice wires, proceed as follows:- See Figure 25.

- (a) Locate splices so that they will not be in clipping, tying or wrapping areas. Make splices away from clamp or other wire support locations. Do not locate where wire is subject to flexing.
- (b) Do not use more than two splices in one wire in any eight foot length. Do not allow splicing to change normal routing.
- (c) Stagger splices in wire bundles or tie as shown to prevent relative movement and excessive increase in bundle size.

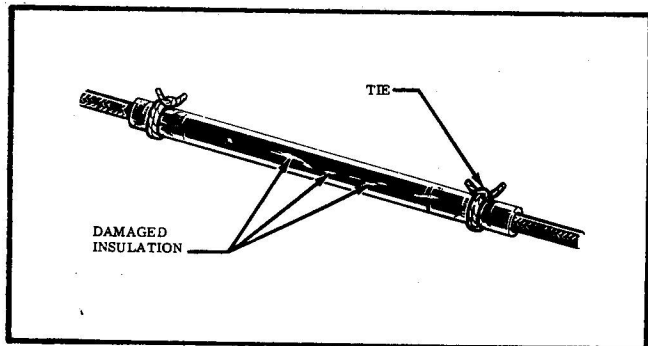


Figure 24 Primary Insulation
Damage Repair

(d) Splices may be made before wires are installed only if installation will be accomplished without pulling the wire through conduit or a small aperture.

(e) To make splices, select proper connector (Item 36) for the given wire size from Figure 3. Plastic tubing sizes are larger for splicing connectors than for terminals. Select tubing for the connector which affords a snug fit. Assemble as shown.

(f) Install plastic tubing (Item 8) over completed splices and tie securely with waxed cord as shown.

SEALING OF ELECTRICAL CONNECTORS (POTTING)

GENERAL

64 Sealing is carried out to protect electrical connections against attack by moisture, fuels, oils, fungus and salt air.

PREPARATION OF PARTS

65 The surfaces of the connectors to be protected with sealer must be free from oil, grease, dirt, etc. Refer to EO 05-1-3/20. Clean surfaces by wiping with a clean, lintless, cotton cloth dampened with naphtha (Item 45).

PREPARATION OF SEALANT

66 To prepare sealant proceed as follows:-

- (a) Slowly stir accelerator to a smooth, creamy paste.
- (b) Agitate the sealer (Item 43), for at least two minutes by hand stirring.
- (c) Weigh out the desired amount of sealer.
- (d) Weight out 12 parts of accelerator for each 100 parts of sealer used.
- (e) Add the required quantity of accelerator to the base material and thoroughly agitate until no accelerator streaks or traces of unmixed sealer are visible. This usually requires approximately five minutes. The sealer must assume a uniform pink or tan colour.
- (f) To ensure that material is adequately mixed, spread a thin film on white paper and examine closely for accelerator or sealer streaks.
- (g) The working life of the accelerated sealer is approximately 90 minutes at 75° F to 80° F. Longer working life may be obtained by cooling the sealer to 40° F to 60° F just prior to addition of accelerator.
- (h) The accelerated sealer may also be stored, for periods of from 24 to 36 hours, by cooling quickly immediately after acceleration and keeping at a temperature of -20° F.
- (j) After storing at low temperature, the accelerated sealer may be thawed out by blowing compressed air on the outside of the container. Do not raise the temperature of the sealer by heating or by blowing air into the container.

APPLICATION PROCEDURE

67 Apply the properly mixed, accelerated sealer to the connector shell with a spatula, putty knife or flow gun. A flow tip small enough to reach soldered wire connections at base of plug is recommended. Apply the accelerated sealer so that no large entrapped air bubbles remain which result in loss of strength and electrical properties. The sealing of the connectors must protect the electrical wiring connections completely, as shown in Figure 26.

CURING OF SEALER

68 Cure the accelerated sealer for at least 24 hours at 75° to 80° F before the connectors are installed in the electrical system. The curing time will be shortened if temperatures are higher and will be lengthened if temperatures are lower.

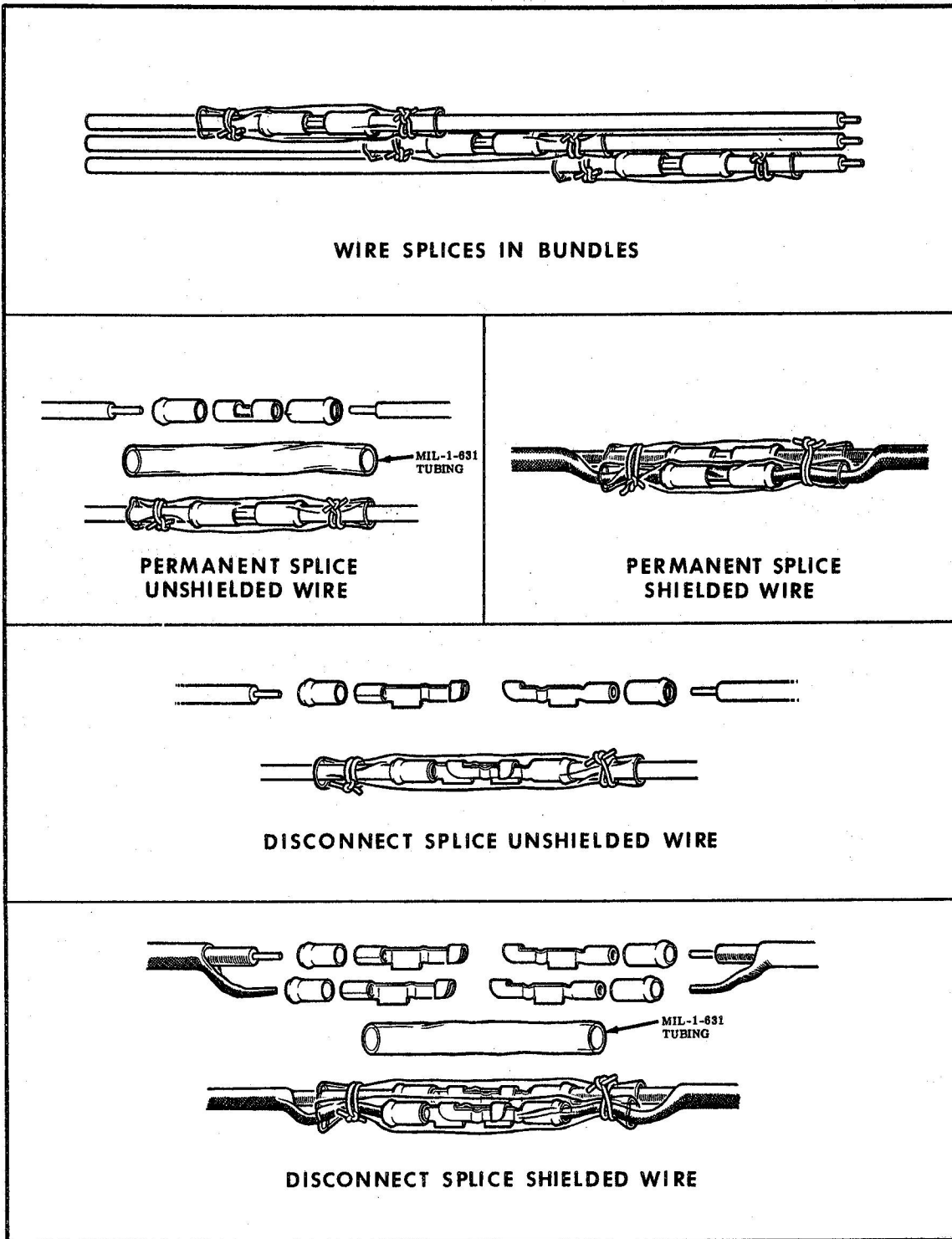


Figure 25 Wire Splicing

NOTE

Remove excess sealer from equipment before it cures, using toluene (Item 46) or methyl ethyl ketone (Item 47).

69 Where a finish, such as primer or lacquer, has been removed during stripping, refinish the area around the new sealant with the same finish as was used originally.

REMOVAL OF SEALANT

70 For the removal of sealant use the following procedure:-

- (a) Cut away as much of the sealant as possible around the repair area, using a sharp micarta scraper. Sealant remover tools may be used in a slow-hitting rivet gun or corner hammer to facilitate initial removal of the sealant. Do not use a tool made of metal. Take care not to scratch the surrounding metal surfaces.
- (b) Mask off the area surrounding the scraped sealant with fabric-backed masking tape (Item 49), and similarly mask any other areas where the ensuing application of stripper may splash or drip.
- (c) Apply stripper (Item 48) to the scraped sealant as heavily as possible without running or dripping. A micarta scraper pushed under the sealant will accelerate the action of the stripper. Wipe off immediately any stripper which falls accidentally on unmasked surrounding areas with a clean dry cloth, and mark its position for cleaning later, (see paragraph 71, following).
- (d) At 10 minute intervals, remove the stripper and any loosened sealant with a micarta scraper, and apply a fresh quantity of stripper. Do not allow the stripper to dry out on the sealer. Repeat this cycle of operations until all the sealant has been removed. If there is any finish, such as primer or lacquer, under the sealant, continue stripping to bare metal.
- (e) Remove all masking tape.
- (f) Roughen all surfaces of the original sealant adjacent to the stripped area over at least one inch of their length, using a micarta scraper or clean hardwood. Take care not to scratch the surrounding metal surfaces.

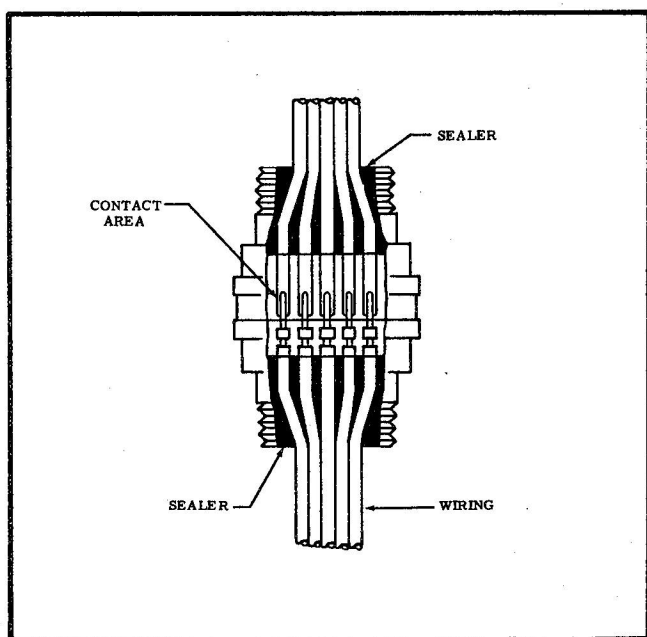


Figure 26 Sealing of Connectors

- (g) If there are structural or other repairs besides the sealant repairs to be made, incorporate at this point.

CAUTION

Rubber gloves must be worn at all times and a heavy pair is mandatory when using stripper. Keep stripper in an air-tight container and store in a cool dry place when not in use.

CLEANING PRIOR TO RESEALING

71 Proceed as follows:-

- (a) Remove all dirt and foreign matter which may have accumulated during stripping operations and other structural repairs.

- (b) Scrub the stripped area and surroundings with a clean cloth dampened with methylene chloride (Item 50). Apply the cloth to only a small area at a time and change the cloth frequently. Make sure that all wax residue from the stripper (Item 48) is removed completely, including any surfaces from which splashes or drips have been wiped.
- (c) Wipe down the areas in Sub-paragraph (b) thoroughly with a clean cloth dampened with butyl acetate (Item 51). Apply the cloth to only a small area at a time, and wipe off with a clean dry cloth before the butyl acetate dries. Change both cloths frequently.
- (d) Wipe the whole area under repair with a clean dry cloth.



Rubber gloves must be worn at all times.

BONDING

GENERAL

72 Bonding is used on aircraft to provide current paths, to eliminate danger of arcing or sparking, to eliminate radio static disturbances which originate from vibrating parts and to prevent insulated parts from absorbing energy emitted by the radio transmitter. Attaching parts must be firmly seated and secured to ensure permanent electrical contact. Finishes must frequently be removed, dissimilar metal contacts must be protected against corrosion and other considerations are necessary which directly affect the life and performance of the bond.

TYPES OF FINISH

73 Certain finishes are suitable for bonding contacts in that they satisfactorily conduct an electric current. However, non-conductive finishes and surface treatments, such as paint, stain, dye, graphite in lacquer base and anodized oxide and phosphate surface, treatments must be removed from the areas in which a bonding contact is to be made.

BONDING PROCEDURE

74 To bond, proceed as follows:-

- (a) Remove all paint coatings and non-conductive chemical treatments in the area only in which the bonding contact is to be made. Where the use of star-tooth washers is specified do not remove the paint coating or chemical treatment.
- (b) Remove all foreign matter, such as oil, grease, tarnish and dirt, from the contacting surfaces just before making the bonding connection.
- (c) Install all clamps, screws, rivets, bolts, washers, jumpers, etc. Ensure that they are firmly seated and secured to make good contact. When a star-tooth washer is used, exercise all possible care to prevent it from turning while the nut is tightened.
- (d) Touch up the assembled bonding connection or attachment and all areas outside the bonding area from which protective coating has been removed and where bare metal is exposed.

NOTE

Unless otherwise authorized, do not use bonding jumpers under structural fasteners because the soft bonding strip lug is crushed during application of normal torque to the fastening device. Creep of the lug material, either at rest or under repeated loads, causes the fastener to lose its initial tension and become loose.

DETAIL INSTRUCTIONS

75 Remove paint coatings, dyes or stains by means of ethyl acetate (Item 9) on a cloth or with a steel wire brush or sandpaper. Remove oil and dirt with a cloth dampened in cleaner (Item 25). Use the following precautions:-

(a) In using ethyl acetate or cleaner, exercise extreme care to see that none of the liquid reaches adjacent surfaces, seams or cracks. Use masking tape, if necessary, to protect areas from which finish is not to be removed.

(b) Use only brushes made of corrosion-resistant steel wire of .005 to .006" maximum diameter. Remove only a minimum of the metal surface, especially in the case of clad aluminum alloys. Avoid grinding a concave surface which will fail to make intimate contact when assembled.

(c) Use sandpaper (Item 38) and hand rub the surface. Do not use any mechanical method.

76 When using papers in electrical connections, select the washers with the finish specified for the particular materials involved. When a star-tooth washer is used to contact with magnesium alloy surfaces, dip the washer in wet zinc chromate primer before assembly. Install and tighten the attaching parts before the primer is dry.

77 The following finishes and surface conditions are satisfactory for bonding connections and need not be further stripped or removed:-

(a) Bare metal surfaces.

(b) Cadmium, chromium, copper, solder, tin or zinc plating.

(c) Dow # 1 (Chrome Pickle) Treatment on magnesium alloy.

(d) Dow # 7 (Dichromate) Treatment on magnesium alloy.

(e) Graphite (powder, flake or stock).

78 After installation, touch up the entire bonding connection or attachment and all areas outside the bonding area from which protective coating has been removed, by the following methods:-

(a) Aluminum alloys:- Touch up exposed areas with weak chromic acid solution, and finish the entire bonding connection and exposed areas with a brush or heavy spray coat of zinc chromate primer refer to EO 05-1-3/23.

(b) Magnesium alloys and unplated steel:- Touch up entire bonding connection and exposed areas with a brush or heavy spray coat of zinc or chromate primer refer to EO 05-1-3/23.

(c) Apply a final coat of lacquer or enamel where necessary to match adjoining areas.

79 Check each bonding connection or attachment to ensure that:-

(a) The correct cleaning procedure has been followed.

- (b) The correct sequence of attachable parts has been followed.
- (c) The connection is mechanically secure and firmly seated.
- (d) The protective organic finish has been applied correctly.

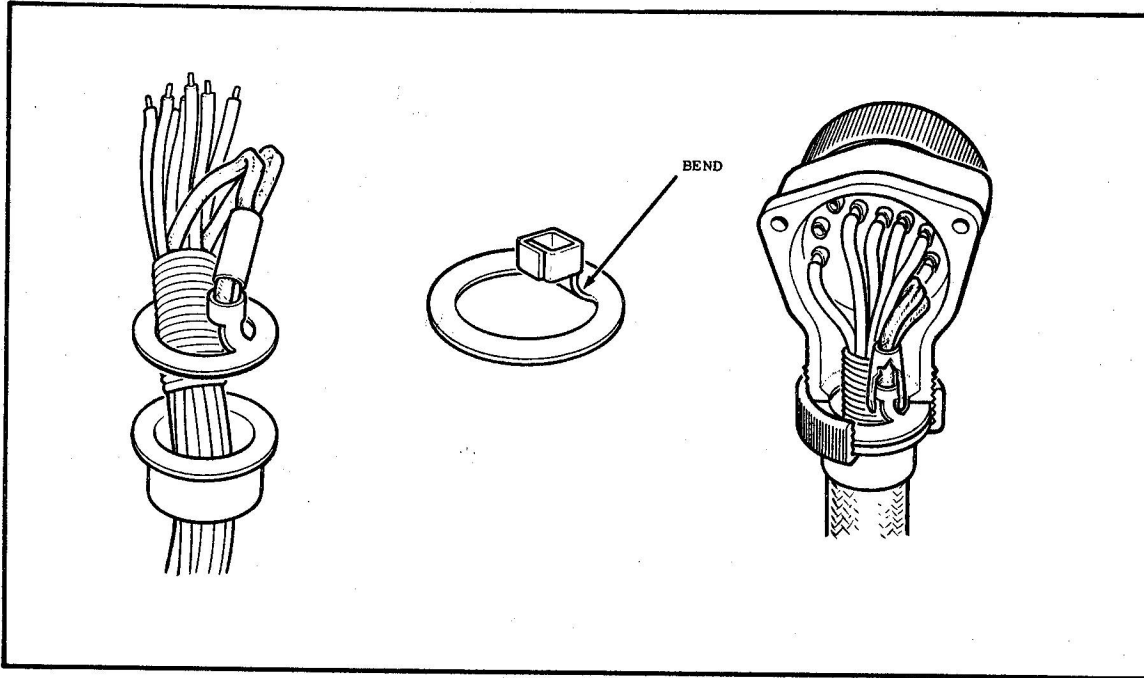


Figure 27 Cannon Bonding Ring Installation

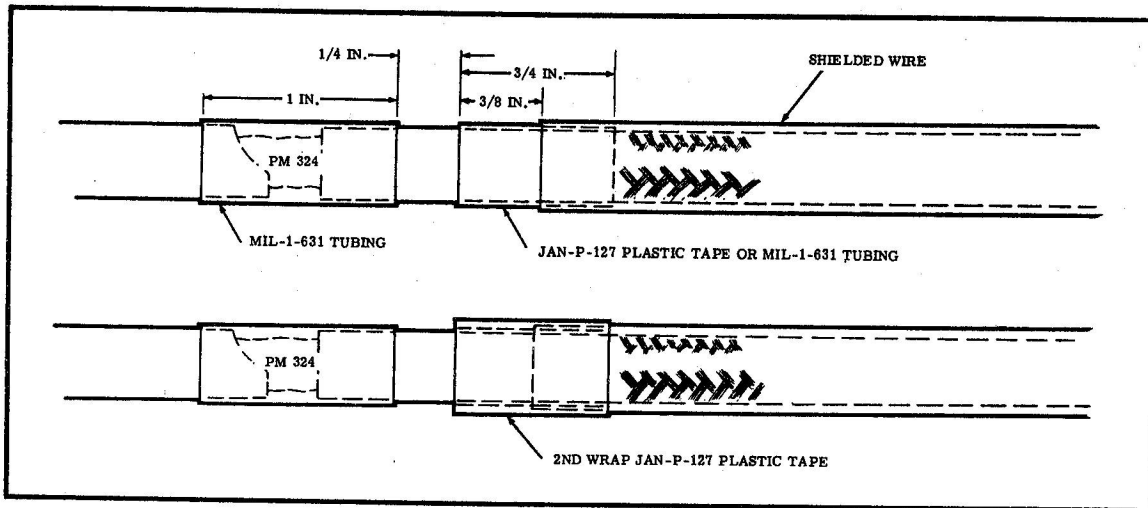


Figure 28 Taping Shielded Wires

GROUNDING CO-AXIAL CABLE

80 For grounding the outer conductor for RG59U co-axial cable when terminating in a plug or receptacle, use the following procedure:-

- (a) Strip the outer insulation from the cable, avoiding such damage as nicks, scratches and broken strands in the outer conductor.
- (b) Comb the outer conductor, divide it into three equal and parallel groups, and braid the groups into a single pigtail.
- (c) Tin the end of the braid (at least one inch distant from the cable) and splice to a length of single conductor copper wire (Item 44) at least one inch of which must be pliable after all soldering operations. Overwrap with 24 gauge copper or brass wire for a distance of $3/8$ ($\pm 1/8$ ") and sweat and braid the wire and overwrap together. The overwrapping operation may be omitted when the braided pigtail is inserted into another braid.
- (d) Install the proper diameter transparent plastic (Item 8) tubing for the full length of the grounding pigtail.
- (e) Solder into the pot of plug or receptacle, refer to EO 05-1-3/20.
- (f) Serve the wire bundle with linen thread (Item 14) and apply a medium coat of varnish (Item 26) or lacquer (Item 27). Start serving as close to the number bands as possible without covering the numbers.
- (g) Attach terminal of ground wires or shielding grounds to a suitable grounding screw.

CANNON BONDING RINGS

81 Use bonding rings only when specified on the engineering drawing.

- (a) Separate wire shielding from wire to form a pigtail as described in paragraph 80, preceding.
- (b) Install a short length of plastic tubing (Item 8) over the pigtail or pigtails to prevent any stray wires of the shielding braid from rupturing the insulation of other wires and causing a short-circuit.
- (c) Bend tongue of bonding ring into position for attaching pigtails as shown in Figure 27. Dotted portion indicates how legs of tongue are bent around pigtails before soldering. All excess lengths of tongue may be cut away.
- (d) Serve wires and shielding with linen thread (Item 14) and apply one coat of varnish (Item 26) or lacquer (Item 27).
- (e) Assemble as shown in Figure 27. Soft solder the tongue and pigtails.
- (f) Slip plastic tube (Item 8) over soldered joint and tighten flexible conduit nut to complete assembly. During assembly, do not allow the ring to turn in relationship to the plug. Cutaway of 90° Type K Connector is shown as finished assembly in Figure 27.

GROUNDING WIRES AND SHIELDING

GENERAL

82 Ground the shielding on shielded wires at each end unless otherwise specified on the engineering drawing. Where drawings specify grounding on one end of the shielding only, finish the other end by wrap or tape method.

WRAP METHOD

83 For wrap method (for two conductors and over) proceed as follows:-

- (a) Undo the shielding and fold back to give an overlap of 1/4 to 3/4".
- (b) Secure the end by serving with linen thread (Item 14) and apply one coat of varnish (Item 26) or lacquer (Item 27).

TAPE METHOD

84 For tape method proceed as follows:-

- (a) Install a one inch length of plastic tubing over soldered joint to give a snug fit. This procedure provides additional support for the soldered joint, see Figure 28.
- (b) Pull shielding back from soldered joint and apply 1-1/2 to 2 turns of 3/4" plastic tape (Item 39) or tubing (Item 8) beginning 1/4" from the end of the identification sleeve.
- (c) Pull shielding forward so that the shielding end lies at the centre of the tape without any residual tendency to move forward or aft.
- (d) Overwrap the shielding positioned on the tape or tubing with a second wrap of plastic tape consisting of 1-1/2 to 2 turns. In the case of multiple shielded wires, overwrap together all shielded wires with a second wrap of plastic tape (1-1/2 to 2 turns).

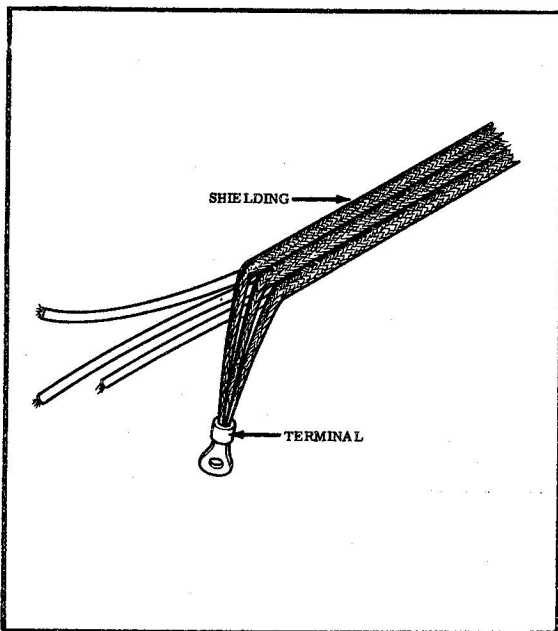


Figure 29 Shielded Wire Soldering

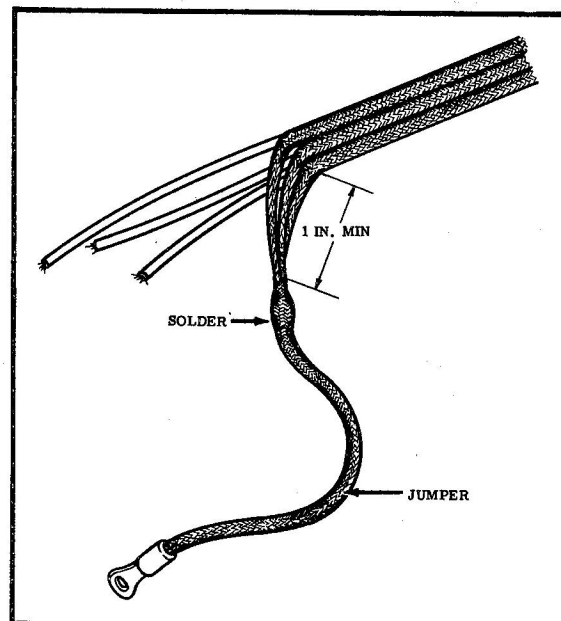


Figure 30 Shielded Wire Soldering

- (e) Ground wires or pigtails are to be as short as possible and are not to be over four inches in length.
- (f) Install plastic tubing over the pigtail or jumper to prevent short-circuits with other equipment when inside junction boxes or at terminal strips.

GROUNDING SHIELDED WIRES

85 Form pigtail as follows:-

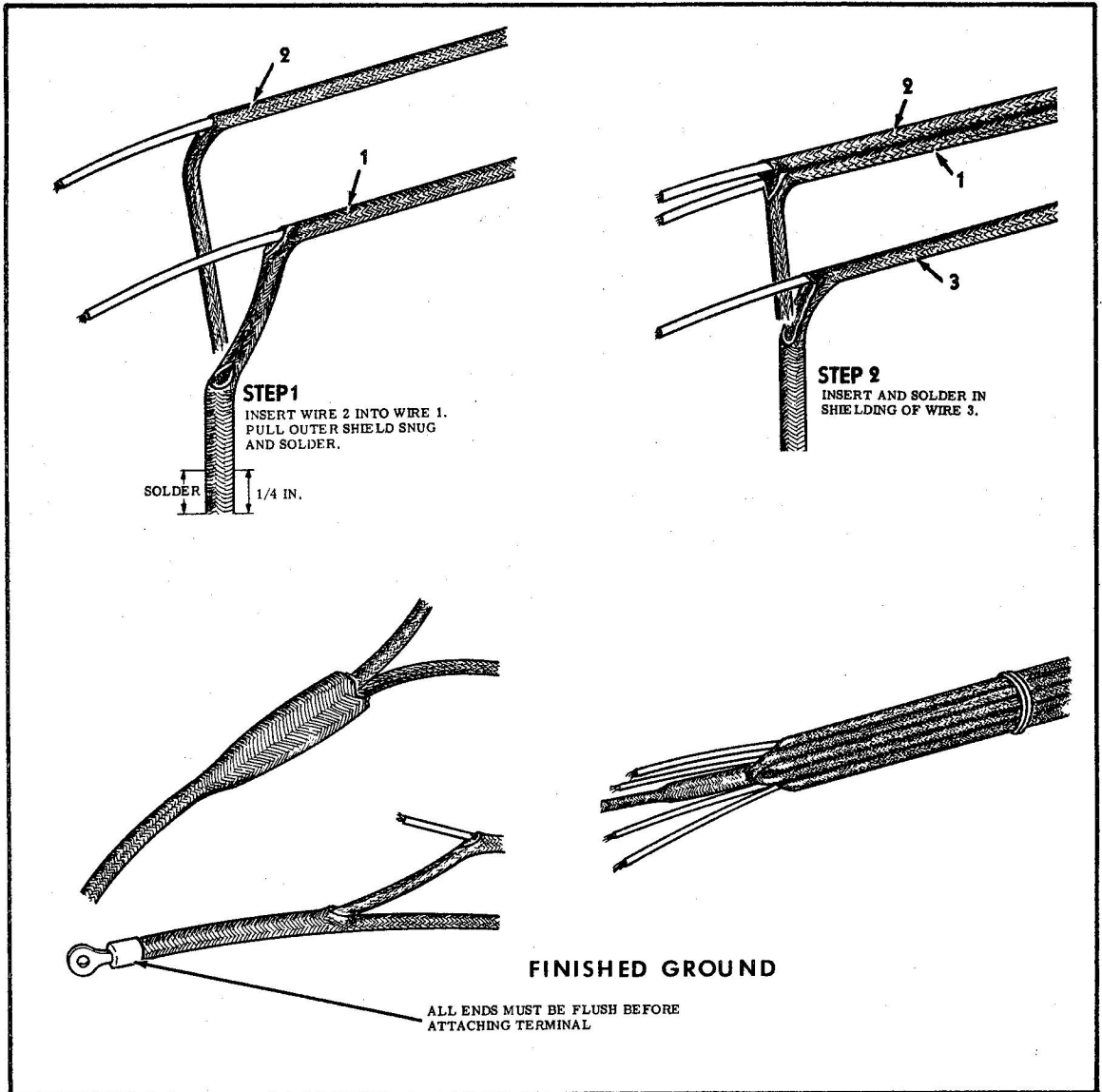


Figure 31 Multiple Shielding Grounds

- (a) Approximately three inches from the end of the wire, insert a scriber into the shielding without damaging the strands.
- (b) Work an open circular area into the shielding without damaging the strands.
- (c) Insert scriber between shielding and wire and pull wire through circular area previously formed. The shielding can be loosened or puffed by working the shielding and thus facilitating withdrawal of the wire.

86 Use one of the following methods when two or more shields are grounded to the same point.

- (a) Bring pigtailed individually into a terminal and attach by approved staking or soldering methods, see Figure 29.
- (b) Solder short pigtailed into a longer one, see Figure 30.
- (c) Loosen or puff up one pigtail and draw others through it as shown in Figure 31. Attach terminal by approved staking or soldering methods:
- (d) Loosen or puff up shielding inserting the second into the first and soldering as shown in Figure 31. If necessary, repeat the process, soldering as illustrated. If shielding is to be staked, omit the soldering operation.
- (e) Ground shielding at a soldering cup by forming a pigtail by one of the approved methods and solder into cup.

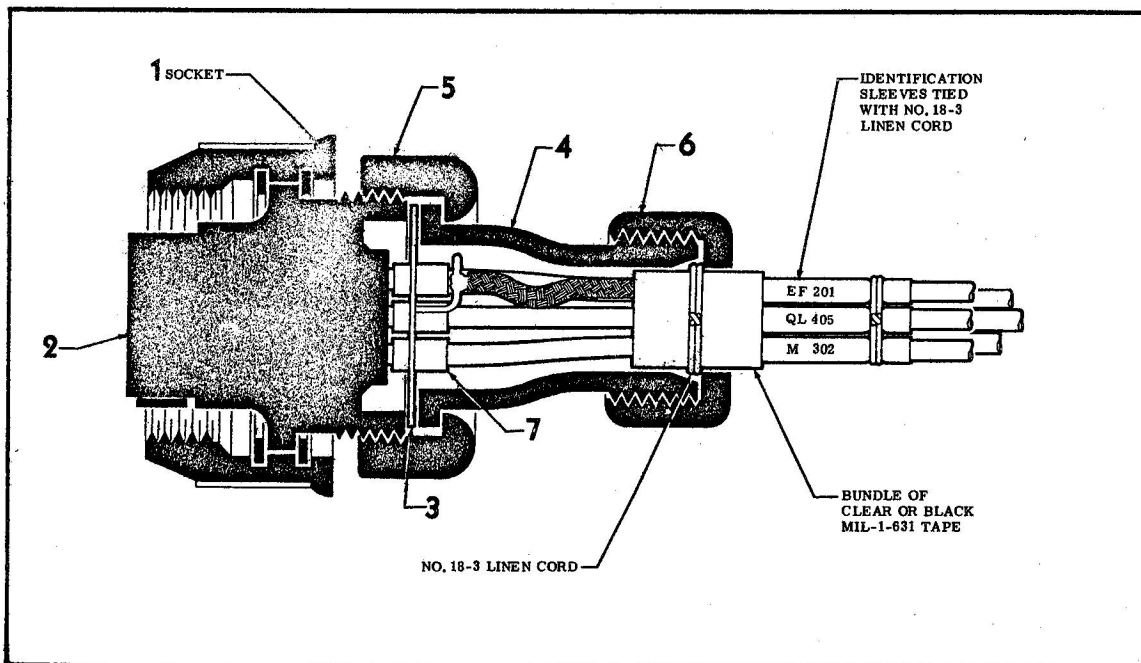


Figure 32 Plessey Plug Assembly

GROUNDING AND ASSEMBLY OF PLESSY PLUGS

87 Use the following method of grounding shielded wires when used in a British Plessy plug, see Figure 32.

- (a) Separate wire shielding from wire to form a pigtail, (refer to paragraph 80, preceding).
- (b) Install unstamped plastic tubing over each soldered connection. Plastic tubing to extend approximately 1/8" over wire insulation.

Item No.	Material	RCAF Ref. or Class	Specification	Manufacturer
1	Clamp MS21919(AN742)	28/	MIL-C-8603	
2	Clamp AS4580	28NS/		Howard Clayton Wright
3	Clamp, Cable AN3057	5935	MIL-C-8603	
4	Twine, Waxed, Linen, 6 Ply, Twisted, General Purpose or Twine Nylon, 4 Ply, Class 3 or Braid Nylon (or FOR POWER PLANT USE) Plastic Strip	4020-21-802-0469 4020-21-803-3703 8315-00-753-6555 9330-21-806-9548	MIL-T-713A Type N MIL-T-713A Type P MIL-T-713A 14-006-01	BF Goodrich
5	Talc	6810-21-570-4900	MAT-2-1	
7	Terminal, Copper, AN659	5940	MIL-T-5042	
8	Tubing, Plastic (transparent unless otherwise specified)	5970-	MIL-I-631	
9	Ethyl Acetate	6810-21-804-4853	C-31-302	
10	Terminal, Preformed	5940		
11	Terminal, Flag	5940		
12	Solder, Resin Core		QQ-S571 Comp Sn50	
13	Terminal, Eyelet	5940		
14	Thread, Linen #18	8310-21-744-6010	3-F-34 (BSI)	
15	Lacquer CGSB 1-12B Colour	8010-	MIL-L-7178	Canadian Ind. Ltd. P.O. Box 10, Montreal
16	Ferrule, AN3083	5975		

Figure 33 (Sheet 1 of 3) (Issue 3) Table of Material Specifications

Item No.	Material	RCAF Ref	Specification	Manufacturer
18	Nut, Cadmium Plate Steel	28/		
19	Strip, Insulating Base, AN3437	5F/		
20	Strip, Terminal, AN3436	5CC/		
21	Strip, Insulating, AN3434	5F/		
22	Solder, Silver			
23	Wood, Plastic	33A/458		Canadian Industries Ltd., P.O.Box 10 Montreal
24	Flux, Soldering, Paste			Canada Metal Co. 721 Eastern Ave., Toronto
25	Cleaner	33C/182	3-GP-8	
26	Varnish, Glyptal	33G/144	1-GP-20	Canadian General Electric, 212 King St. W. Toronto
27	Lacquer, Clear Cellulose Nitrate	33A/420	1-GP-31	
28	Compound, Insulating	33G/49	MIL-I-8660	Fibreglas Can. Ltd. 50 St. Clair Ave., Toronto
29	Compound, Anti-seize	34Z/164	3-GP-801	
30	Sleeve, Numbered, Metallic		AAF650	
31	Sleeving, Stamped, Silicone GLA33			
32	Lock-Washer, Split, AN935	28/		
33	Tape, Glass	33G/158	MIL-T-4053A	
34	Coating, Clear Silicone Resin	33A/487		
35	Tape	33G/137	JCNAAF-T-14	
36	Connector, Splice, AN753	5K/275 etc.	MIL-S-6852	
37	Cord, Tying, Varglass No.46			
38	Paper, Abrasive, Waterproof	29/1869, 1870		

Figure 33 (Sheet 2 of 3) (Issue 1) Table of Material Specifications

Revised 19 Dec 61

- (c) With bonding ring (3) positioned against plug body (2), wrap pigtailed to bonding ring and soft solder in place.
- (d) Wrap clear or black tape .020" thick around wire bundle, building up the bundle to the necessary thickness. Tie with prewaxed cotton cord over the tape so that the strain on the wiring will be against the cord rather than the connectors. Tape must extend beyond outlet nut (6) as shown.
- (e) Slip outlet (4) in position, then tighten union nut (5) and outlet nut (6).
- (f) Add identification tubing outside the plug assembly as shown. Tie identification tubing together at one end with linen thread, (Item 14).

MATERIAL SPECIFICATIONS

88 For the table showing the item numbers, specifications and manufacturers, see Figure 33.

Item No.	Material	RCAF Ref.	Specification	Manufacturer
39	Tape, Plastic	32E/212	MIL-T-631C	
40	Bracket, Angle, AN743			
41	Alcohol, Non-corrosive Solvent	34A/214	3-GP-525	
43	Compound, Sealing, EC-1120-PC	33G/163	MIL-S-8516A	Minnesota Mining and Mfg. Co., London, Ontario
44	Wire, Copper, 24 Gauge	5E/		
45	Naphtha, Aliphatic	33C/653	TT-N-95	
46	Toluene	22A/467	TT-T-548	
47	Methyl Ethyl Ketone	33C/520	TT-M-261	
48	Stripper	33C/584	LAR 388	B. W. Deane & Co. Ltd. 3620 Namur St., Montreal
49	Tape, Masking, Fabric Backed	32B/282	AN-T-12	Bauer & Black, Curity Ave., Toronto
50	Methylene Chloride	33C/583	MIL-M-6998	
51	Butyl Acetate			Commercial Product

Figure 33 (Sheet 3 of 3) (Issue 1) Table of Material Specifications

Wire or Cable Size		Continuous Duty Current - Amperes	
Aluminum	Copper	Single Wire in Free Air	Wires and Cables in Conduit or Bundles
	AN 22	--	5
	AN 20	11	7.5
	AN 18	16	10
	AN 16	22	13
	AN 14	32	17
	AN 12	41	23
	AN 10	55	33
	AN 8	73	46
	AN 6	101	60
	AN 4	135	80
	AN 2	181	100
	AN 1	211	125
	AN 0	245	150
	AN 00	283	175
	AN 000	328	200
	AN 0000	380	225
AN 8		60	36
AN 6		83	50
AN 4		108	66
AN 2		152	82
AN 1		174	105
AN 0		202	123
AN 00		235	145
AN 000		266	162
AN 0000		303	190

NOTE

The current carrying capacities tabled in this Figure are to be used as a guide only and in no way cover every application. The wires detailed are for general aircraft applications and do not include special types of wire such as high-temperature, flexible, coaxial, antenna etc..

Figure 34 Current Carrying Capacities of Wires and Cables