DE HAVILLAND AIRCRAFT OF CANADA LIMITED

BOMBARDIER

Toronto Site

PPS 9.04 - ASSEMBLY AND INSTALLATION OF ELECTRICAL AND ELECTRONIC WIRE ASSEMBLIES

Issue 50
- This standard supersedes PPS 9.04, Issue 49.
- Vertical lines in the left hand margin indicate technical changes over the previous issue.
- Direct PPS related questions to christie.chung@dehavilland.com or (416) 375-7641.
- This PPS is effective as of the distribution date.

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Prepared By:	(Christie Chung)	August 7, 2020
	De Havilland Canada PPS Group	
Approved By:	(Stephen Mabee)	August 14, 2020
	De Havilland Canada M&P Engineering	
	(Kenneth Quon)	August 18, 2020
	Bombardier Inc. M&P Engineering	

Issue 50 - Summary of Changes (over the previous issue)

The following summaries are not detailed and are intended only to assist in alerting PPS users to changes which may affect them; refer to the applicable sections of this PPS for detailed procedure and requirements.

- Specified this is a jointly owned PPS by both De Havilland Aircraft of Canada Limited and Bombardier Inc.
- Deleted use of the following fiberglass lacing tape: A-A-52083-C-2; A-A-52083-C-3; A-A-52083-D-2; or MIL-T-43435 Type IV, Finish F. These were allowed to be used to depletion for more than 3 years. Hence for current production, fiberglass lacing tape to A-A-52083-F-3 shall be used.
- Allowed use of Guideline tape to achieve the maximum allowable gap between a clamp and the wire bundle. However, specified that it is preferred not to wrap the wire bundle in Guideline (filler) tape or woven metal braid to achieve this maximum gap. See paragraph 5.4.2.
- Specified if using non-conductive clamps or if the wire bundle is not covered with an overbraid shield, all heavy feeder cables (i.e., 12 to 2/0 AWG cables) shall be wrapped with Guideline tape at all primary and secondary support locations. See paragraph 5.4.2.2.

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1 SCOPE

1.1 This Production Process Standard (PPS) specifies the procedure and requirements for assembly and installation of electrical and electronic wire assemblies, including those installed within overbraid shields.

1.1.1 This PPS complements the engineering drawings that specify its use as an authorized instruction. The procedure specified in this PPS shall be followed to ensure compliance with all applicable specifications. In general, if this PPS conflicts with the engineering drawing, follow the engineering drawing. The requirements specified in this PPS are necessary to fulfil the engineering design and reliability objectives.

1.1.2 Refer to PPS 13.26 for the subcontractor provisions applicable to this PPS.

1.2 This PPS is co-owned by De Havilland Aircraft of Canada Limited (DHC) and Bombardier Inc. (BA) due to its applicability for both the DHC DASH 8 and BA Lear 45 programs.

2 HAZARDOUS MATERIALS

2.1 Before receipt at DHC or BA, all materials shall be approved and assigned Material Safety Data Sheet (MSDS) numbers by the DHC/BA Environment, Health and Safety Department. Refer to the manufacturer's MSDS for specific safety data on any of the materials specified in this PPS. If the MSDS is not available, contact DHC/BA Environment, Health and Safety Department.

3 REFERENCES

3.1 DS 41 - Terminal Board Hardware.

3.2 PPS 9.03 - Fitting Connectors to Coaxial Cables.

3.3 PPS 9.06 - Electrical Bonding and Grounding of Aircraft Structures.

3.4 PPS 9.08 - Swaging Ferrules to Flexible Conduit.

3.5 PPS 9.09 - Splicing Electrical Wires.

3.6 PPS 9.12 - Soldering of Electrical and Electronic Components to Printed Circuit Boards.

3.7 PPS 9.22 - Assembly of Connectors.

3.8 PPS 9.30 - Fabrication of Learjet 45 Electrical Wire Harness.

3.9 PPS 9.31 - Preparation of Metal Overbraid Shield Break-Outs.

3.10 PPS 9.32 - Assembly and Installation of Aircraft Thermocouple Leads.

3.11 PPS 9.39 - Installation & Termination of Braided Shields for EMI & HIRF Protection of Wire Harnesses on DASH 8 Series 400 Aircraft.

3.12 PPS 9.41 - Termination of Individual Wire Shields at Glenair 550-003 & 557-581 Backshells.

3.13 PPS 9.48 - Abrasion Protection of Wire Assemblies.

3.14 PPS 9.49 - Installation of Open Conduit.

3.15 PPS 9.51 - Assembly of Terminal Lugs to Terminal Boards, Strain Relief Clamps and Components.

3.16 PPS 9.52 - Stowage of Electrical Wires and Connectors.

3.17 PPS 9.53 - Installation of HTAT Heat Shrinkable Tubing.

3.18 PPS 9.54 - Installation of Fyrejacket Sleeving.

3.19 PPS 10.16 - Installation of Heat Shrinkable Tubing, Tape and Identification Sleeves.

3.20 PPS 13.26 - General Subcontractor Provisions.

3.21 PPS 13.34 - Installation of Plastic Cable Ties.

3.22 PPS 14.01 - Torquing - Method and Identification.

3.23 PPS 15.01 - Part Marking.

3.24 PPS 15.02 - Identification Coding of Electrical and Electronic Wires and Cables.

3.25 PPS 25.30 - Bonding using DHMS A6.09 Epoxy Adhesive.

3.26 PPS 25.62 - Bonding using Fast-Weld #10 Epoxy Adhesive.

3.27 PPS 25.63 - Bonding using DHMS A6.11 Type I Class 2 Adhesive.

3.28 PPS 31.17 - Solvent Usage.

4 MATERIALS AND EQUIPMENT

4.1 Materials

4.1.1 Guideline tape, fire resistant filler - Freudenberg-NOK Inc. #52672 Guideline tape or insulation tape to A-A-59163 (e.g., Freudenberg-NOK Inc. #50215).

4.1.2 Tie Mounts as specified on the engineering drawing. See Figure 1 for examples of some of the plastic tie mounts which may be specified.

4.1.3 Fiberglass lacing tape, silicone resin impregnated, size 3 (0.077" to 0.094" wide and 0.013 to 0.019" thick) to A-A-52083-F-3.

4.1.4 MIL-T-43435 Type I, Finish B, Size 2, braided nylon lacing tape.

4.1.5 DSC 91-2 pressure sensitive glass cloth tape.

4.1.6 Woven metal braid, 20 mm, Glenair P/N 688-113C-20.

4.1.7 DSC 502-5 or Brady B-637 critical marker tape, fire resistant, red or pink. It is acceptable to use alternative red or pink critical marker tape (e.g, red masking tape) only if the critical marker tape will be removed after installation and checking of the harness on the aircraft.

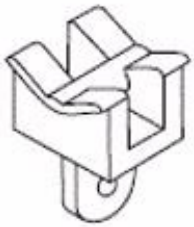
4.1.8 Panduit CR4H spacers.

4.1.9 Abrasive paper, aluminum oxide, 120 to 180 grit size.

4.1.10 High performance wire & cable pulling lubricant, American Polywater Corporation "Polywater J". Polywater J is a clean, slow drying, water based gel lubricant.

B0816026 / MS3340 / LHM Sxxx
Riveted transverse bulkhead type single harness tie mount

B0816027
Riveted transverse bulkhead heavy duty type single harness tie mount

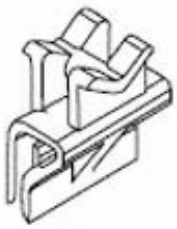


B0816005
Riveted longitudinal bulkhead type single harness tie mount

MS3339 / MTPxxx
Riveted type multiple harness tie mount

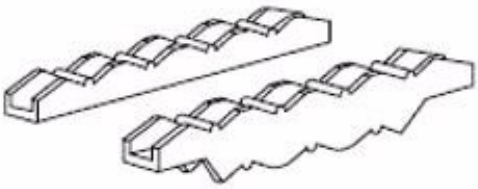
TMxxx / TM1xxx
Riveted cradle type single harness tie mount

CLICK BOND CB3019
Adhesive bonded cradle type single harness tie mount



B0816028
Stringer mounting bracket

B0816006 / TA1xxx
Riveted miniature type single harness tie mount



B0816018
Single and double sided harness support bracket

FIGURE 1 - PLASTIC TIE MOUNTS

4.2 Equipment

4.2.1 Electrical wire twisting machine (e.g., BA/DHC SD8703).

4.2.2 Clamp installation aid (e.g., DH #82440001-001-96, as shown in Figure 2).

4.2.3 Abrasive pads (e.g., 3M Canada Ltd. Scotch-Brite pad, Type A fine or medium).

4.2.4 Wire bundle rework poke tool (e.g., BA/DHC SD20063).

4.2.5 Wiping cloths (e.g., DSC 378-2).

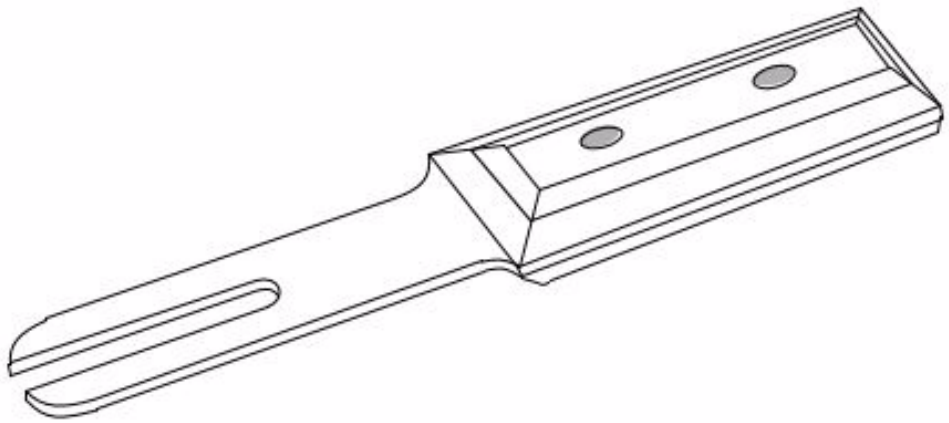


FIGURE 2 - DH #82440001-001-96 CLAMP INSTALLATION AID

5 PROCEDURE

5.1 General

5.1.1 Unless otherwise noted herein, for the purposes of this standard, the term wire assembly includes wire bundles, cables, harnesses, etc., including those installed within overbraid shields.

5.1.2 If possible, do not route wire assemblies behind insulating blankets (i.e., do not route between blanket and structure).

5.1.3 Install wire assemblies so that they are not under any tension.

5.1.4 Refer to PPS 9.03 for the procedure and requirements for fitting of connectors to co-axial cables.

5.1.5 Refer to PPS 9.06 for the procedure and requirements for electrical bonding and grounding of aircraft components and structures. Unless otherwise specified on the engineering drawing or wiring list, do not connect more than four ground wires to any one ground stud. Do not connect ground return electric wiring directly to magnesium parts.

5.1.6 Refer to PPS 9.12 for the procedure and requirements for assembly and installation of printed circuit board wiring.

5.1.7 Refer to PPS 9.22 for the procedure and requirements for the assembly of wires to connectors and installation of connectors (including torquing requirements).

5.1.8 Refer to PPS 9.30 for the procedure and requirements for the installation and termination of braided shield on Learjet 45 electrical wire harnesses.

5.1.9 Refer to PPS 9.31 for the procedure and requirements for the preparation of metal overbraid shield breakouts.

5.1.10 Refer to PPS 9.32 for the procedure and requirements for the assembly of thermocouple leads.

5.1.11 Refer to PPS 9.39 for the procedure and requirements for installation and termination of braided shields on DASH 8, Series 400 electrical wire harnesses.

5.1.12 Refer to PPS 9.41 for the procedure and requirements for termination of individual wire shields at Glenair 550-003 and 557-581 backshells.

5.1.13 Refer to PPS 9.48 for the procedure and requirements for abrasion protection of wire assemblies.

5.1.14 Refer to PPS 9.49 for the procedure and requirements for installation of open conduit.

5.1.15 Refer to PPS 9.51 for the procedure and requirements for assembly of terminal lugs to terminal boards, strain relief clamps and components.

5.1.16 Refer to PPS 9.52 for the procedure and requirements for stowage of electrical wires and connectors.

5.1.17 Refer to PPS 9.53 for the procedure and requirements for installation of HTAT heat shrinkable tubing.

5.1.18 Refer to PPS 9.54 for the procedure and requirements for installation of Fyrejacket sleeving.

5.1.19 Refer to PPS 13.34 for the procedure and requirements for installation of plastic cable ties.

5.1.20 MS 25082 nuts are used for the retention of switches, circuit breakers and other similarly mounted electrical hardware. Tighten MS 25082 nuts according to PPS 14.01 using torque limiting screw drivers pre-set at 25 inch pounds.

5.1.21 Install relays so that the gasket between the relay and the socket is compressed, but does not extend beyond the edge of the relay (see Figure 3).

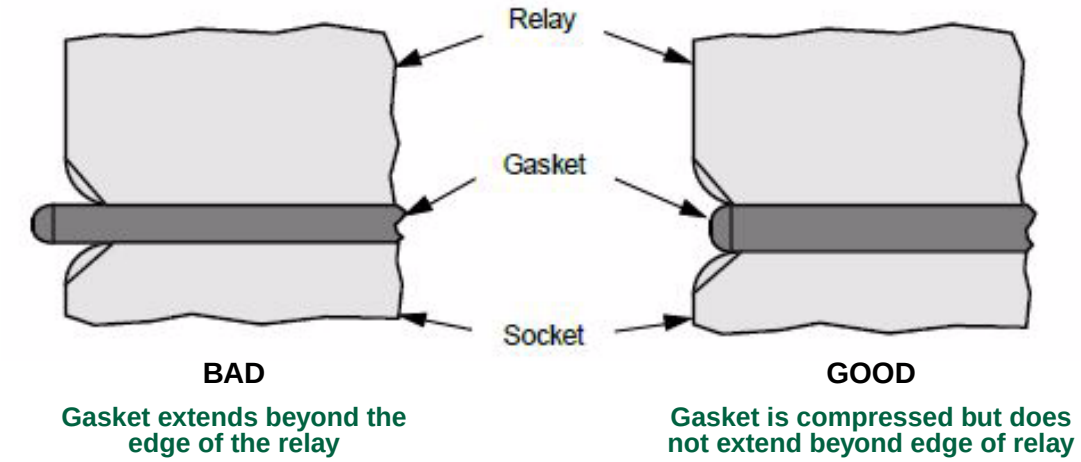


FIGURE 3 - COMPRESSED GASKET BETWEEN RELAY AND SOCKET

5.1.22 Install control panel switches so that the thread protrudes a minimum of 1/8" (see Figure 4). Install all the switches on any particular control panel so that the thread protrusion height of all the switches is approximately the same.

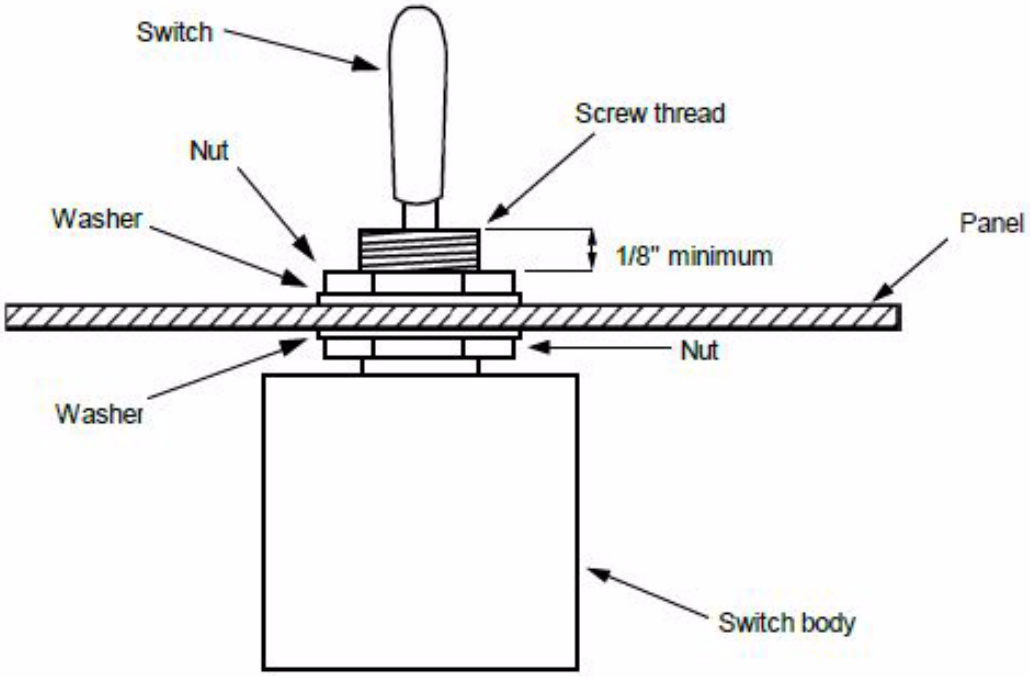


FIGURE 4 - INSTALLATION OF CONTROL PANEL SWITCHES

5.1.23 Before installation, solvent clean bus bars according PPS 31.17. Secure terminal lugs to bus bars using the hardware specified on the engineering drawing and DS 41.

5.1.24 For manually twisted B0801150 wire assemblies refer to Table I for the required number of twists per foot. Manually twisted B0801150 twisted pair or triplet wire assemblies of 20 or 22 gauge may be replaced with BMS 13-48 pre-twisted wires as specified in Table II. Identify BMS 13-48 pre-twisted wires according to PPS 15.02.

TABLE I - REQUIRED NUMBER OF TWISTS PER FOOT FOR B0801150 MANUALLY TWISTED WIRE ASSEMBLIES

NUMBER OF B0801150 WIRES	TWISTED PER FOOT REQUIRED		
	22, 20 & 18 (AWG)	16 & 14 (AWG)	12 & 10 (AWG)
2	10 ± 2	7 ± 1	6 ± 1
3	9 ± 2	6 ± 1	5 ± 1
4	8 ± 2	5 ± 1	4 ± 1
5	7 ± 2	4 ± 1	3 ± 1
6	6 ± 2	3 ± 1	2 ± 1

TABLE II - REPLACEMENT OF B0801150 MANUALLY TWISTED WIRE ASSEMBLIES

SPECIFIED TWISTED WIRE ASSEMBLY		REPLACEMENT PRE-TWISTED WIRE BMS 13-48, TYPE 8, CLASS 1
B0801150 WIRE GAUGE	NUMBER OF WIRES	
20 AWG	2	2-20
	3	3-20
22 AWG	2	2-22
	3	3-22

5.1.25 To assist in rework of wire bundles, it is acceptable to use a wire bundle rework poke tool (e.g., SD20063) to create a gap in the wire bundle for the insertion of replacement wires and/or additional wiring. Exercise caution when using a rework poke tool to ensure that it does not damage wires within the harness being reworked, particularly where the harness is tightly secure/bundled; clamps shall be loosened and cable ties removed, as required, to loosen the bundle enough to ensure that the tool can be used without causing damage.

5.1.26 Remove all unused hardware (e.g., unused grounding screws) on **fully** installed electrical equipment.

5.1.27 Maintain the minimum bend radii shown in Table III during handling and storage of wire assemblies both before and during installation.

TABLE III - MINIMUM BEND RADIUS FOR WIRE ASSEMBLIES

TYPE OF CONDUCTOR	MINIMUM BEND RADIUS
Individual Wires (Note 1)	10 x O.D. of wire
Supported Wires	3 x O.D. of wire
Wire Harnesses	6 x O.D. of harness
Co-Axial Cables	6 x O.D. of cable
Note 1. Minimum bend radius is not applicable to filler wire loops (ref. PPS 9.09).	

5.1.28 Form drip loops in wire assemblies to prevent moisture from entering connectors or equipment when a non-moisture proof junction occurs at a low point in the wire run (see Figure 5). Note that an environmentally sealed connector is **not** considered a non-moisture proof junction and therefore, while it is acceptable to form drip loops at wire assembly terminations at environmentally sealed connectors, it is not necessary. Position drip loops so that moisture dripping from the loop will not fall on other equipment.

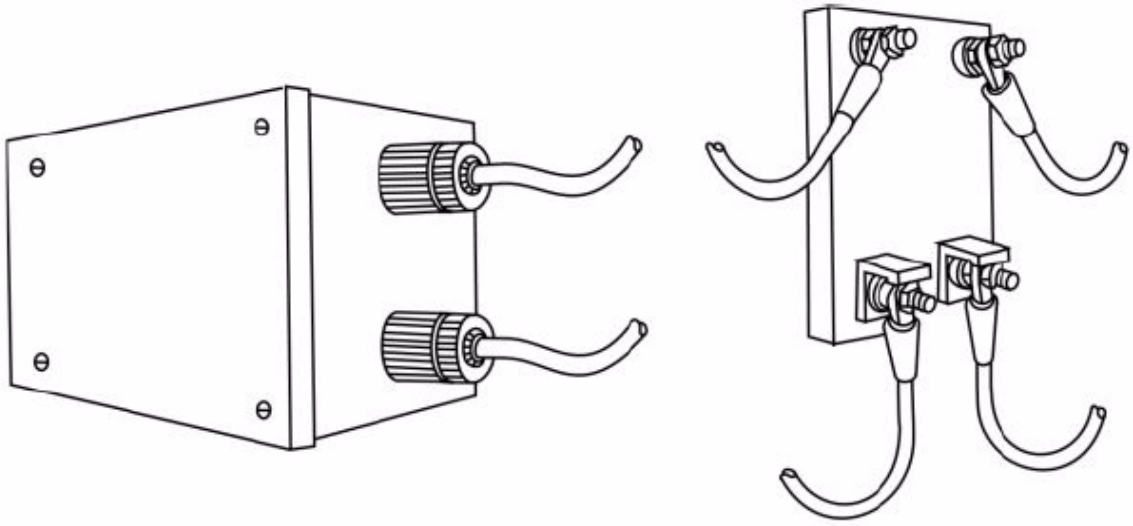


FIGURE 5 - FORMING OF DRIP LOOPS AT EQUIPMENT AND CONNECTORS

5.2 Preparation of Wire Harness

5.2.1 Before oversleeving the wire loom with convoluted tubing, overbraid shields, or conduit induce a slight twist into the loom so that the harness will maintain its shape at bends after encapsulation and remove any tie wraps from wire bundles.

5.2.2 Lay out the pull wires specified on the engineering drawing with the wire loom, but do not twist the pull wires in with the wire loom. Unless otherwise specified on the engineering drawing, pull wires are 16 gauge Teflon wires that are white with a red tracer.

5.2.3 Where indicated on the form board, apply critical markers (ref. paragraph 4.1.7) to the wire harness. To ease installing and checking of proper final harness installation, allow critical markers to remain in place until after the harness has been installed in the aircraft and checked. Removal of critical markers after installation and checking of the harness on the aircraft is optional **only** if DSC 502-5 or Brady B-637 critical marker tape was used; if any other alternative critical marker tape has been used (e.g., red masking tape) it **shall** be removed.

5.2.4 Always handle harnesses, assemblies, etc. including soldering connections with care to avoid damage such as fractured soldered joints (e.g., do not pull on or bend wires such that they place a strain on the solder joint).

5.2.5 To facilitate assembly, it is recommended that when preparing the first end of a bundle for connector termination, the wire bundle be first sorted by W-code and then second ends; use twist ties to separate the wire bundle for second end routing.

5.2.6 If necessary to facilitate routing of wire harnesses or individual wires, it is acceptable to apply Polywater J wire and cable pulling lubricant to harnesses or wires. After installation of the harness or wire, remove excess Polywater J residue from the harness or wire by wiping with a clean, moistened (damp) wiper (ref. paragraph 4.2.5).

5.3 Installation of Heat-Shrinkable Tubing, Boots and Sleeves

5.3.1 Install heat shrinkable tubing, boots and sleeves according to PPS 10.16.

5.3.2 Install heat shrinkable part-marking sleeves according to PPS 15.01.

5.3.3 Install heat shrinkable identification coding sleeves according to PPS 15.02.

5.4 Primary Support of Wire Assemblies

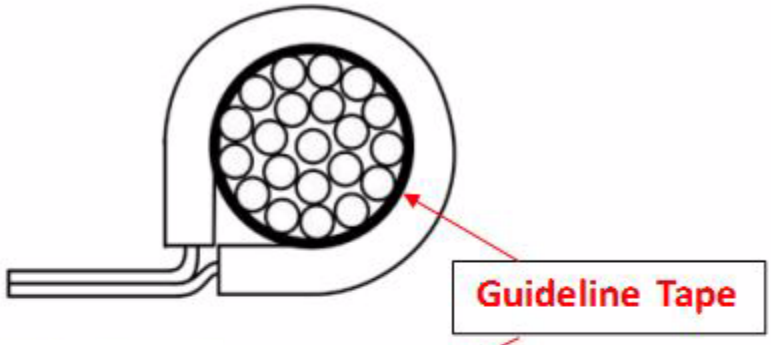
5.4.1 Provide primary support to wire assemblies using the clamps or cable ties specified on the engineering drawing. If using conductive metal clamps (e.g., 742F clamps) to provide primary support to wire assemblies with overbraid shields, prepare the clamp mounting area for electrical bonding and grounding according PPS 9.06.

5.4.2 The maximum allowable gap between a clamp and the wire bundle (before wrapping the wire bundle) is 1/16". Except as specified in paragraph 5.4.2.2 for heavy feeder cables, it is preferred not to wrap the wire bundle in Guideline (filler) tape or woven metal braid to achieve this maximum gap. If the size of clamp specified by the engineering drawing is too tight (i.e., pinches the wire bundle) or too loose (i.e., gap larger than 1/16"), use a larger or smaller clamp as necessary to provide the proper fit. See Figure 6.

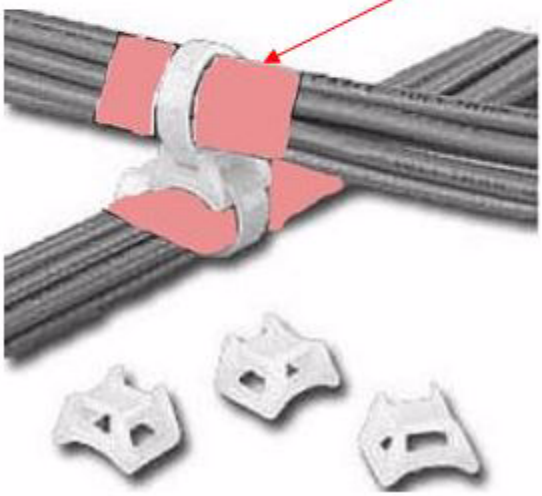
5.4.2.1 If using conductive metal clamps on a wire assembly which is covered with an overbraided shield, make the assembly both mechanically and electrically secure by wrapping the overbraid shield with woven metal braid (ref. paragraph 4.1.6) so that there is no gap between the clamp and the overbraid shield. The clamp must fit snugly on the harness without crushing the shield.

5.4.2.2 If using non-conductive clamps or if the wire bundle is not covered with an overbraid shield, wrap the wire bundle with Guideline (filler) tape (ref. paragraph 4.1.1) as necessary to prevent axial slippage of the clamp along the wire bundle. For all heavy feeder cables (i.e., 12 to 2/0 AWG cables), always wrap with Guideline tape at all primary and secondary support locations prior to installing the clamp (see below).

Primary Support



Secondary Support



5.4.3 Install clamps so that the mounting screw is located above the wire assembly (see Figure 7).

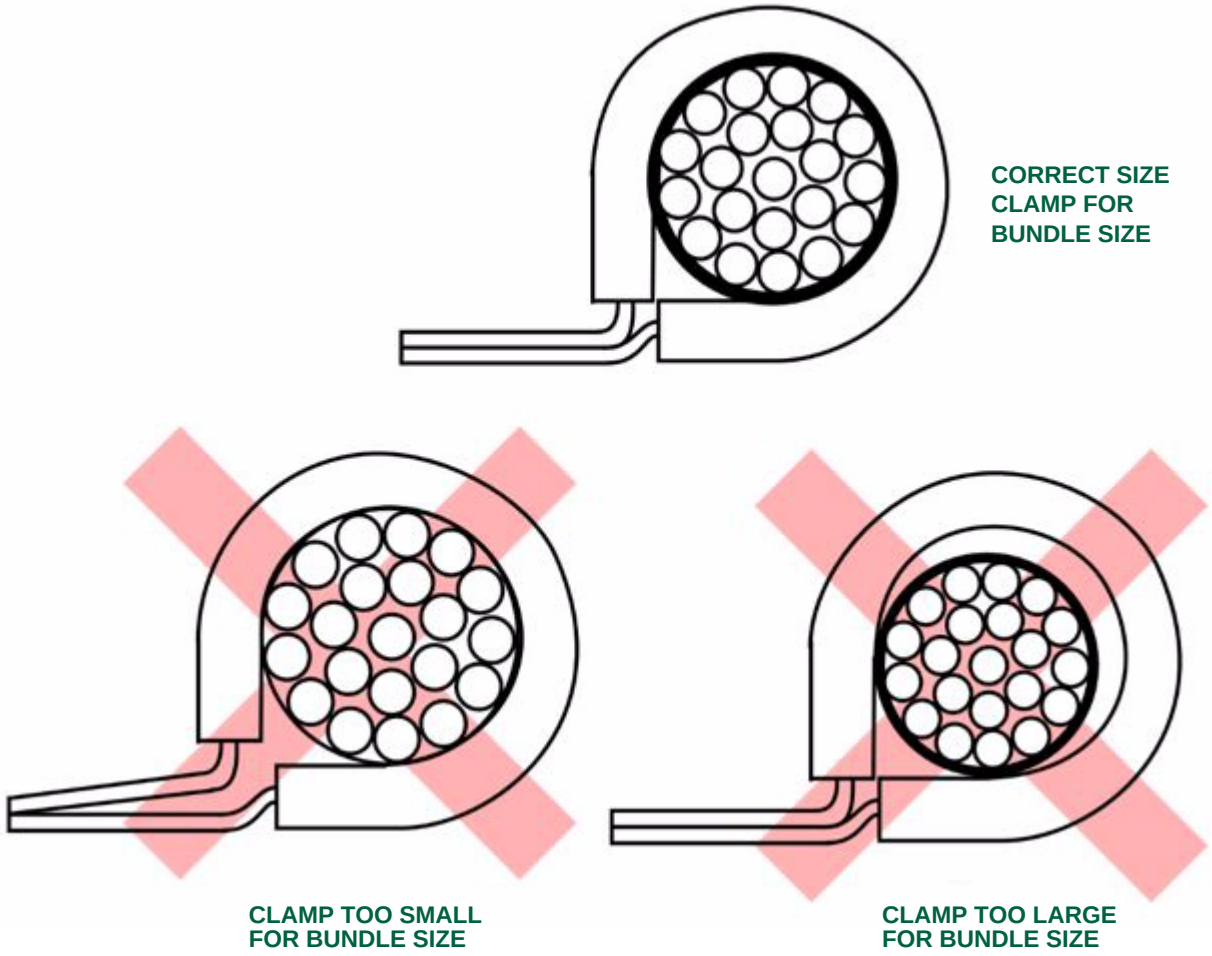


FIGURE 6 - CLAMP SELECTION

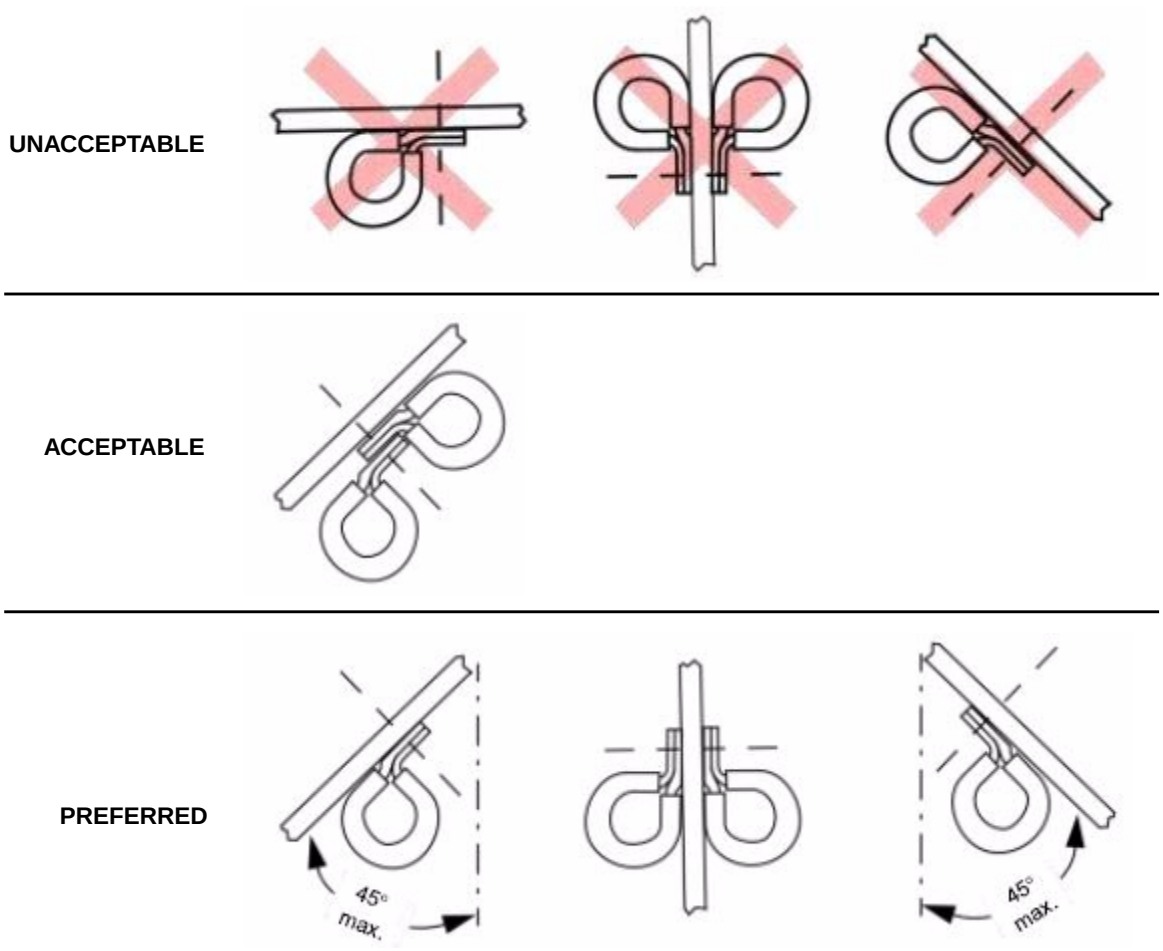


FIGURE 7 - POSITION OF CABLE CLAMPS

5.4.4 When installing 2 clamps on the mounting screw, do not interlace terminating ends (see Figure 8).

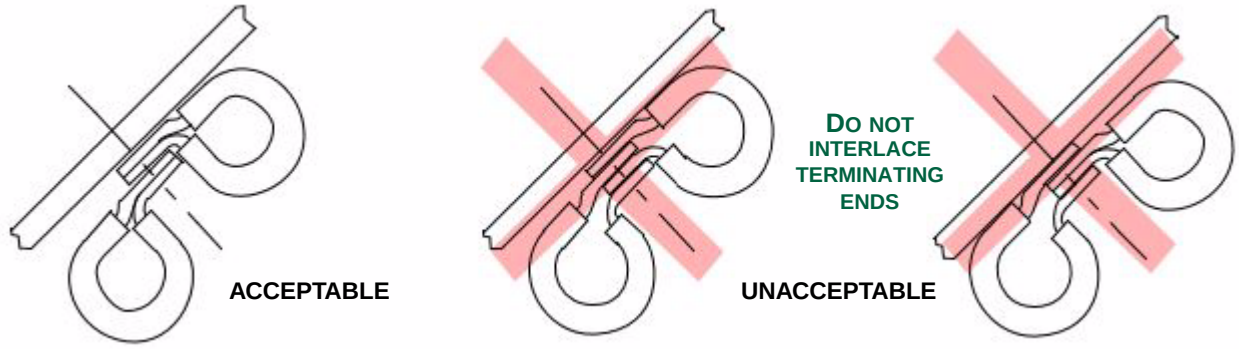


FIGURE 8 - TWO CLAMPS ON ONE MOUNTING SCREW

5.4.5 If the wire assembly is not round, pre-shape the metal clamps to fit the contour of the wire assembly. If the engineering drawing or wiring list specifies the use of one shaped clamp for securing two wire assemblies, fit the wire assemblies in the clamp so that neither assembly is deformed in the process. The clamp is shaped so that both assemblies will fit if positioned correctly. Unless otherwise specified by the engineering drawing or wiring list, it is **not** acceptable to bend clamps at the mounting screw; if bending of the clamp at the mounting screw appears to be necessary for proper routing of the harness and/or to avoid potential abrasion situations, refer to Liaison Engineering for disposition.

5.4.6 If the engineering drawing or wiring list specifies the use of plastic cable ties in tie mounts for primary support, install plastic cable ties according to PPS 13.34 so that the wire assembly will be secured within the cradle of the tie mount.

5.4.7 Install ties and clamps to seat snugly on the wire assembly without pinching the insulation of the wires.

5.4.8 If a clamp to be installed with foul on an already installed plastic cable tie, remove the plastic tie and do not replace.

5.4.9 Support wires which terminate at connectors using clamps to align the wires in the direction of the connector. Ensure that the clamps do not exert any tension on the wires entering the connector.

5.4.10 If necessary to aid in the installation of clamps, use a clamp installation aid (ref. paragraph 4.2.2) to hold the clamp closed on the mounting screw when running down the securing nut.

5.4.11 Unless otherwise specified on the engineering drawing or wiring list, do not clamp wires and cables together in bundles or harnesses exceeding 2" in diameter.

5.4.12 If adding a wire or a bundle of wires to a wire assembly which is already secured by cable ties or clamps, remove the installed ties or clamps, add the new wiring, then re-bundle and re-tie the new wire assembly.

5.5 Secondary Support of Wire Assemblies

5.5.1 Except as noted below, tie wire assemblies at approximately 4" - 6" intervals for secondary support.

- If necessary to keep the wire assembly together for installation in the aircraft it is acceptable to install additional ties.
- If the engineering drawing or wiring list specifies installation of the wire assembly in a conduit or overbraid shield, do not tie the wire assembly for secondary support.
- Secure wire assemblies with the first tie within 3" of the rear of the connector backshell or strain relief, if any, as shown in Figure 9.

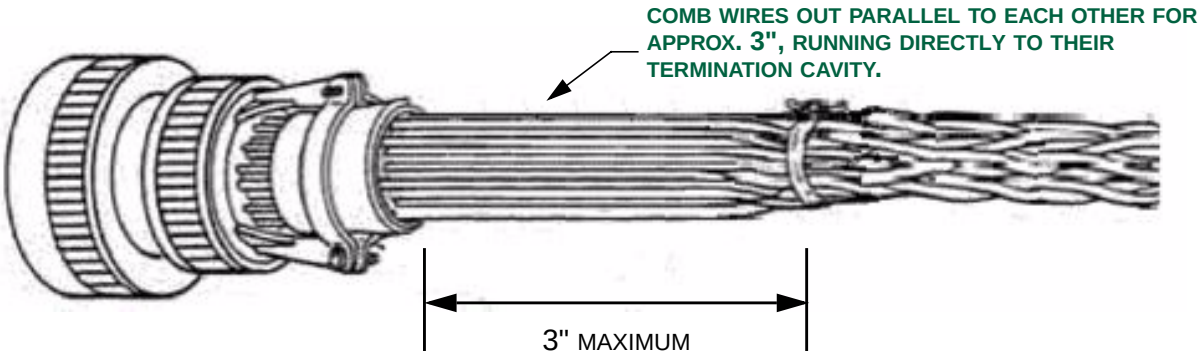


FIGURE 9 - PREPARATION AND SECURING OF WIRES BUNDLES AT TERMINATION

5.5.2 Tie wire assemblies according to section 5.6.

5.6 Tying of Wire Assemblies

5.6.1 Except as noted in paragraph 5.6.1.1 through paragraph 5.6.1.4, tie wire assemblies using self-locking plastic cable ties. Install plastic cable ties according to PPS 13.34.

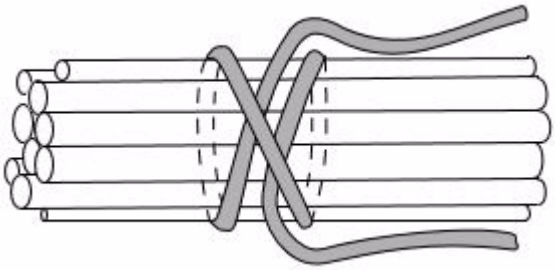
5.6.1.1 If the engineering drawing or wiring list specifies the use of high temperature resistant ties and in areas of high operating temperature, tie wire assemblies using fiberglass lacing tape (ref. paragraph 4.1.3). An area in which the operating temperature exceeds 200°F is an area of high operating temperature (e.g., nacelles forward of the firewall). If there is any doubt as to whether or not a high temperature resistant tie is required, consult Liaison Engineering. Tie fiberglass lacing tape as shown in Figure 10 and trim the tie ends to a length of approximately 1/2".

5.6.1.2 If it is not practical to install plastic cable ties (such as in confined areas in which the installation gun does not fit), tie wire assemblies using braided nylon lacing tape (ref. paragraph 4.1.4) or fiberglass lacing tape (ref. paragraph 4.1.3) as shown in Figure 10. Trim the ties ends to a length of approximately 1/2". **Do not** use braided nylon lacing tape or fiberglass lacing tape in fuel tank areas.

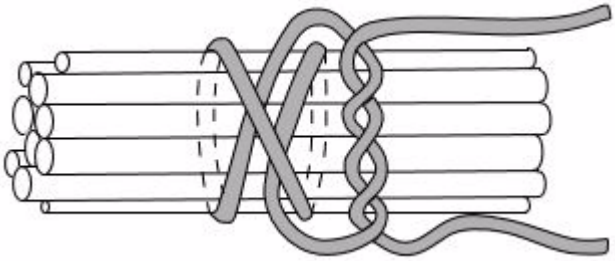
5.6.1.3 Linen cable thread, tied in a suitable knot, may be used for **temporary** ties only. Linen ties shall be removed after harness installation.

5.6.1.4 If the engineering drawing or wiring list specifies the use of pressure sensitive tape to secure a wire bundle or Fyrejacket sleeving, wrap the tape spirally around the wires with the ends secured with suitable ties to prevent unwinding.

Step 1. Form a clove hitch around the wire bundle as shown.



Step 2. Over the clove hitch, form the first portion of a square knot plus an extra turn as shown and pull tight.



Step 3. Complete the second portion of a square knot, again with an extra turn, as shown and pull tight.

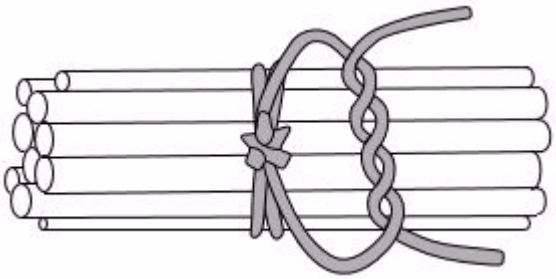


FIGURE 10 - FIBERGLASS AND BRAIDED NYLON LACING TAPE TIE

5.6.2 It is not necessary to install ties at all breakouts. Install ties only where additional support is necessary (see Figure 11).

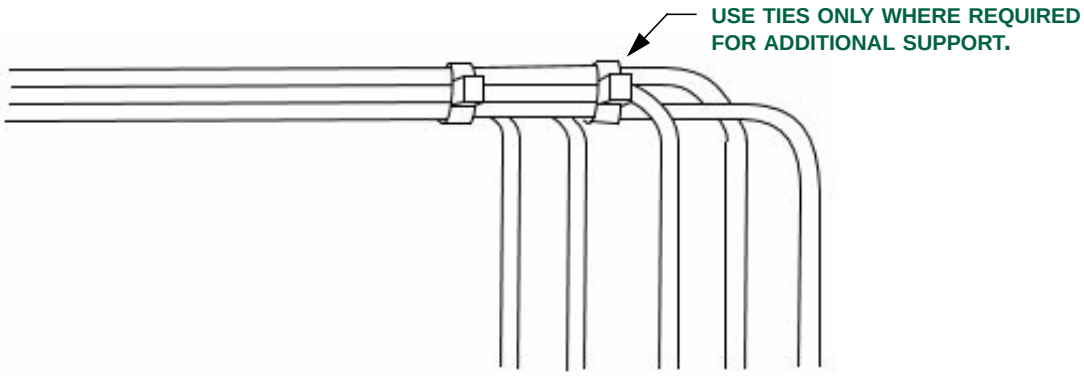


FIGURE 11 - USE OF TIES FOR ADDITIONAL SUPPORT

5.6.3 Except when using a single tie at breakout, install ties so that they are seated at 90° to the lay of the wires in the bundle (see Figure 12A). If using a single tie at breakout, it is acceptable to have the tie overlap as shown in Figure 12B.

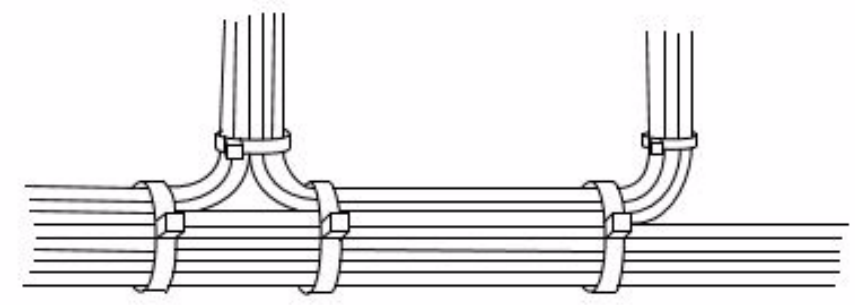


Figure 12A - Multiple Ties at Breakout

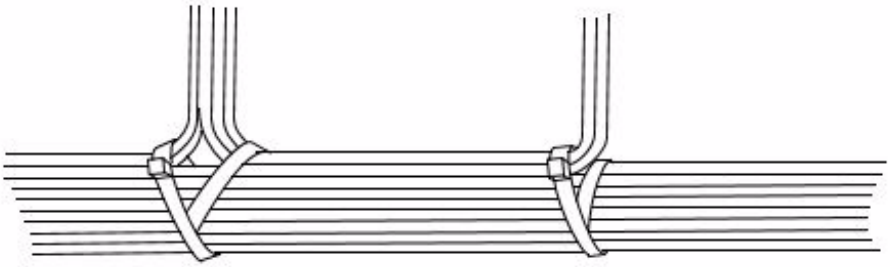


Figure 12B - Single Tie at Breakout

FIGURE 12 - USE OF TIES AT WIRE BUNDLE BREAKOUTS

5.6.4 When adding a wire or a bundle of wires to a wire assembly already secured by ties, remove the installed ties, add the new wiring and re-bundle and re-tie the new wire assembly.

5.6.5 Install ties to seat snugly on the wire assembly without pinching the insulation of the wires.

5.7 Installation of Wire Assemblies and Overbraid Shields Near Flammable Fluid Lines, High Temperature Lines, Hydraulic Lines, and Control Cables

5.7.1 Install additional secondary support ties if a wire broken at a clamp or tie could fall onto a control cable or a flammable fluid, high temperature, or hydraulic line.

5.7.2 Ensure that any cable ties or Spirap used on wire assemblies will not come into contact with control cables or flammable fluid, high temperature, or hydraulic lines.

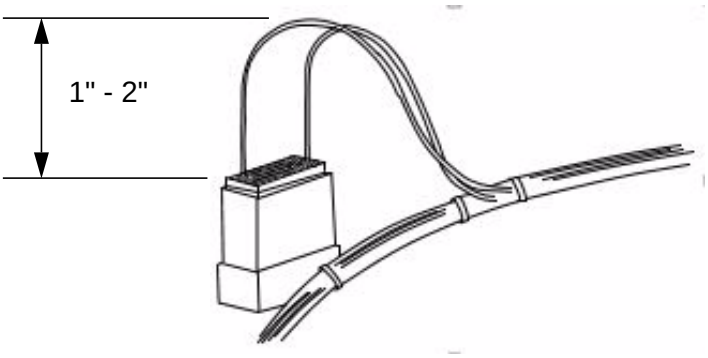
5.7.3 Except as noted in paragraph 5.7.3.1, maintain a minimum clearance of 2" between wire assemblies or overbraid shields and flammable fluid lines (i.e., fuel, oxygen, etc.), high temperature lines (lines where surface temperature can exceed 150°C), hydraulic lines and control cables.

5.7.3.1 If the engineering drawing or wiring list specifies a clearance of less than 2" between wire assemblies or overbraid shields and control cables or flammable fluid, high temperature, or hydraulic lines, install the mechanical guards or clamps specified on the engineering drawing or wiring list to ensure that the wires do not touch the lines or control cables.

5.8 Slack in Wire Assemblies

5.8.1 Unless otherwise specified by the engineering drawing or wiring list, provide extra wire to allow for the following conditions:

- To form drip loops, when required.
- To allow the free movement of shock and vibration mounted equipment.
- To allow 2 service replacements of end fittings. It is not necessary to provide sufficient excess bus wire (solid conductors) for any service replacements. If the engineering drawing or wiring list specifies termination of both ends of a wire lead at the same connector but does not specify the lead length, provide sufficient length to ensure that after two service replacements on each termination there would still be sufficient length to avoid violating the minimum bend radius specified in Table III.
- At terminal blocks, provide excess wire to allow for a service loop 1" - 2" in height above the terminal block. This allows for 2 service replacements while maintaining minimum bend radii as shown.



- To Allow shifting of wiring or attached equipment to perform aircraft maintenance, as necessary.

5.8.2 Install wire assemblies so that there will be a minimum clearance of 1/2" between wire bundles. If necessary, it is acceptable to use CR4H spacers (ref. paragraph 4.1.8) to maintain this clearance.

5.8.3 Ensure that slack in wire assemblies will not allow contact with either control cables or flammable fluid lines to occur.

5.8.4 Install wire assemblies so that the deflection between primary supports will be no greater than 1/2" as shown in Figure 13.

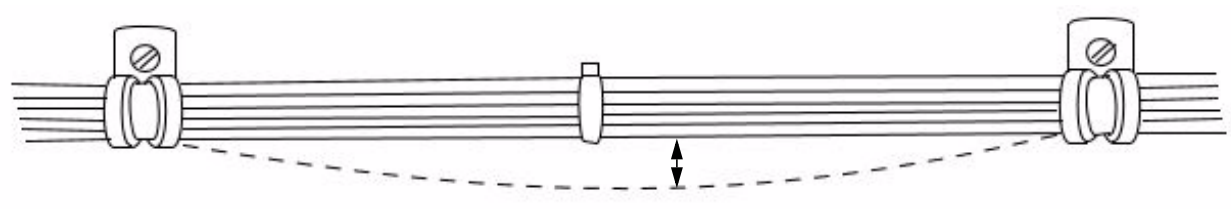


FIGURE 13 - MAXIMUM ALLOWABLE SLACK BETWEEN PRIMARY SUPPORTS

5.8.5 If a portion of a wire bundle is longer than the rest of the bundle terminating at a connector, trim and re-terminate the longer wires to produce a consistent length to the wire bundle. Do not double back the extra wires as bend radius requirements will not be met without creating an awkward assembly.

5.8.6 If excess slack exists in wire bundles double back the excess wire along the harness and secure it with ties as shown in Figure 14. Do not form a tighter bend radius than allowed in Table III. Ideally, in order to minimize weight and to produce a neater installation the amount of slack in wire assemblies should be just sufficient to meet the requirements specified in paragraph 5.8.1.

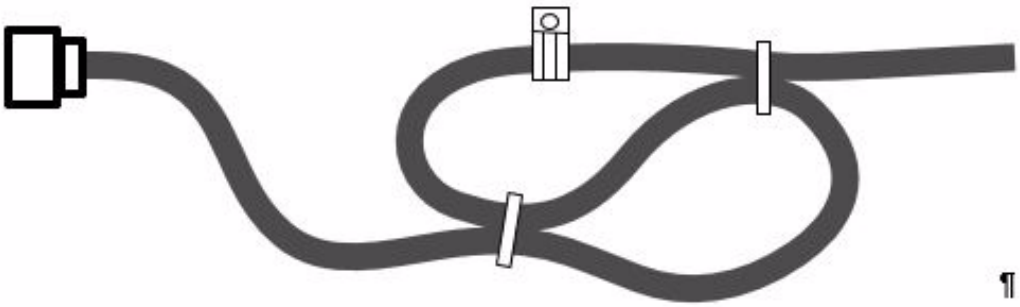


FIGURE 14 - DEALING WITH EXCESS SLACK IN WIRE BUNDLES

5.9 Assembly of Conduit

5.9.1 Before use, ensure that flared conduit tubing ends are free of burrs.

5.9.2 Prepare rigid metallic conduit as specified on the engineering drawing or wiring list. Make bends using a suitable tube bender. If a bend cracks, flattens or kinks, determine the source of the problem, replace the conduit and re-bend.

5.9.3 Ground metallic conduit according to PPS 9.06.

5.9.4 Support wires exiting a length of conduit using a cable clamp or other suitable means within 10" of the end of rigid conduit.

5.9.5 Seal the open ends of conduit that face upwards using DSC 91-2 glass cloth tape (ref. paragraph 4.1.5) to prevent the entry of foreign materials.

5.9.6 If specified on the engineering drawing or wiring list, drill 1/8" diameter drainage holes at low points in rigid metallic conduit as shown in Figure 15. Carefully remove all burrs on the drainage holes to prevent damage to wires passing through the conduit. Do not drill drainage holes in conduit for the magneto ground cable, ignition circuit or fire detector.

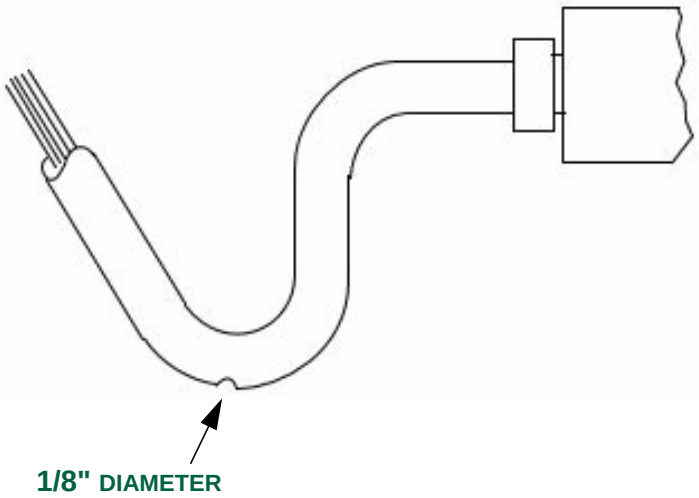


FIGURE 15 - DRAINAGE HOLE AT BOTTOM OF DRIP LOOP IN METALLIC CONDUIT

5.9.7 Do not install secondary support ties on wire assemblies installed in a conduit.

5.9.8 Do not install conduit over wire splices. If the engineering drawing specifies installing conduit over wires which have been spliced, contact Liaison Engineering.

5.9.9 Prepare flexible metallic conduit according to PPS 9.08. Refer to Table IV for the minimum bend radii for flexible metallic conduit.

TABLE IV - MINIMUM BEND RADIUS FOR FLEXIBLE METALLIC CONDUIT

NOMINAL INSIDE DIAMETER	MINIMUM INSIDE BEND RADIUS	NOMINAL INSIDE DIAMETER	MINIMUM INSIDE BEND RADIUS
1/4"	2 3/4"	1"	5 3/4"
3/8"	3 3/4"	1 1/4"	8"
1/2"	3 3/4"	1 1/2"	8 1/4"
5/8"	3 3/4"	1 3/4"	9"
3/4"	4 3/4"	2"	9 3/4"

5.10 Application of GelTek Sealant Strips or Tape

5.10.1 If the engineering drawing or wiring list specifies use of GelTek sealant strip, apply as follows:

Step 1. Begin by wrapping the GelTek strip around the cable just in front of one end of the connector. Start with a minimum of 2 tight wraps.

Step 2. Continue wrapping, using a 50% overlap. Maintain sufficient tension so that the strip will conform closely to contours, but with no more than 50% elongation of the strip. Also, take care to avoid trapping air under the strip.

Step 3. Finish wrapping with two turns, maintaining tension to ensure a good end-seal.

Step 4. Unless otherwise specified by the engineering drawing or wiring list, wrap the ends of the installation with Guideline tape or cable ties to ensure a long lasting fit.

Step 5. If specified by the engineering drawing or wiring list only, cover the overall installation with the tape or heat shrinkable sleeve specified.

5.11 Susceptibility Code, Waycode (W-Code) and EMC Code Routing

5.11.1 The design criteria for electric and electronic wiring is based on available EMI data to route wires to produce minimum electro-interference and susceptibility. The minimum design concept for adequate wiring isolation is based on classification according to the energy and power that each wire carries. For DASH 8 series 400 aircraft, unless otherwise specified on the engineering drawing or wiring list, do not route wires with different Waycodes (W-Codes) together. Refer to Table V for a description of W-Codes. If W-Codes are not identified, do not bundle wires with different EMC codes together unless otherwise specified on the engineering drawing or wiring list. Refer to Table VI for a description of EMC codes.

5.11.2 For DASH 8 Series 100, 200 and 300 aircraft, unless otherwise specified on the engineering drawing or wiring list, do not route wires with different susceptibility categories (i.e., last dash number in the code) together. See below for a description of the circuit susceptibility categories.

Category “1” - Power Wiring
Category “2” - Secondary Power
Category “3” - Control Wiring
Category “4” - Sensitive Wiring
Category “5” - Susceptible Wiring

TABLE V - DASH 8 SERIES 400 AIRCRAFT WAYCODES (W-CODES)

W-CODE	DESCRIPTION	EMC CODE	W-CODE	DESCRIPTION	EMC CODE
W1A	AC Generator No. 1 Power	1	W2	Audio No. 1	6
W1B	AC Generator No. 1 Control & Monitoring	4, 2, 1	W3	Audio No. 2	6
W1C	AC Generator No. 2 Power	1	W4	Flux Valve No. 1	6
W1D	AC Generator No. 2 Control & Monitoring	4, 2, 1	W5	Flux Valve No. 2	6
W1E	External AC Power	1	W6	Co-axial Cables	3, 7
W1F	External AC Control & Monitoring	4	W7	General (single systems - low power)	4, 2
W1G	TRU No. 1	2	W8	General No. 1 (low power)	4, 2
W1H	TRU No. 2	2	W9	General No. 2 (low power)	4, 2
W1J	DC Generator No. 1 Power	2	W10	AC Distribution No. 1	1
W1K	DC Generator No. 1 Control & Monitoring	4, 2	W11	AC Distribution No. 2	1
W1L	DC Generator No. 2 Power	2	W12	Sensitive Circuits No. 1 (Critical Volts/Amps/Freqs)	6
W1M	DC Generator No. 2 Control & Monitoring	4, 2	W13	Sensitive Circuits No. 2 (Critical Volts/Amps/Freqs)	6
W1N	Main Battery Power	2	W14	Windshield No. 1	1
W1P	Main Battery Control & Monitoring	4	W15	Windshield No. 2	1
W1R	Aux Battery Power	2	W16	Databus No. 1	5
W1S	Aux Battery Control & Monitoring	4	W17	Databus No. 2	5
W1T	Standby Battery Power	2	W18	DC Distribution No. 1	2
W1U	Standby Battery Control & Monitoring	4	W19	DC Distribution No. 2	2
W1V	External DC Power	2	W20	Propeller De-Ice No. 1	1
W1W	External DC Control & Monitoring	4	W21	Propeller De-Ice No. 2	1
W1X	APU Power	2	W22	Sensitive Fuel #1	6
W1Y	APU Control & Monitoring	4	W23	Sensitive Fuel #2	6

TABLE VI - DASH 8 SERIES 400 EMC CODES

EMC CODE	DESIGNATION	DESCRIPTION
1	AC Power	• 115 VAC, 400Hz, 3 phase and single phase • 115 VAC, 2 phase, variable frequency
2	DC Power	• 28 VDC Primary Power • DC Power Bus / Distribution
3	RF Sources	• Transmitter Power • Modulation signal for RF carrier
4	Discretes	• Circuits that operate at 28 VDC (less than 3 Amps) or secondary AC power (less than 1 Amp): switching circuits, hydraulic valves, low power lights, AC or DC power control circuitry, etc.
5	Digital	• Digital circuits, signal levels of 0V to 5V, digital data bus, clocks, digital discretes, digital circuitry secondary power
6	Analog	• Low level sensitive circuits, noise floor millivolts, high source and load impedance • Single phase AC signals, noise floor millivolts, high source and load impedance • Audio signals, frequencies between 50 Hz and15 KHz, moderate source and load impedance • Analog circuitry power reference or DC secondary power (filtered)
7	Communications	• Analog video, frequencies greater than 100 KHz • Low level RF signals, RF receivers

6 REQUIREMENTS

6.1 Wire assemblies shall not be bent or coiled to a radius of less than 6 times the diameter of the harness.

6.2 All completed wire assemblies shall be tested for continuity and short circuits. Testing to be performed when specified by the build documentation (i.e., work order, assembly manual, etc.).

6.3 Identification sleeves shall be installed according to PPS 15.01.

6.4 Identification coding of wires, cables and assemblies shall be carried out according to PPS 15.02.

6.5 Between assembly and installation, connectors shall be protected with suitable dust caps or plastic bags to prevent contamination.

6.6 All unused hardware (e.g., unused grounding screws) on fully installed electrical equipment shall be removed.

6.7 All installed wire assemblies shall be supported to prevent chafing at clamping points or against adjacent structures, and to prevent mechanical strain on the wires and connections.

6.8 Except as noted, self-locking plastic cable ties or braided nylon lacing tape shall be used to tie wires, cables and harnesses between primary supports. If the engineering drawing or wiring list specifies the use of high temperature resistant ties, or in areas of high (above 200°F) operating temperature (e.g., nacelles forward of the firewall), wires shall be tied using fiberglass lacing tape. Wires, cables and harnesses that are installed in conduit shall not be tied together. Braided nylon lacing tape or fiberglass lacing tape **shall not** be used in fuel tank areas.

6.9 When a non-moisture proof junction occurs at a low point n the wire run, drip loops in the wire assembly must prevent moisture from entering connectors or equipment (see Figure 5).

6.10 Unless otherwise specified by the engineering drawing or wiring list, ensure that a minimum clearance of 2" has been maintained between all wire assemblies and control cables, flammable fluid lines (i.e., fuel, oxygen, etc.), hydraulic lines, or high temperature lines. If the engineering drawing or wiring list specifies a clearance of less than 2", clamps or mechanical guards must ensure that the wires do not contact control cables, flammable fluid lines, hydraulic lines, or high temperature lines.

6.11 Control panel switches shall be installed such that a minimum 1/8" thread protrusion is obtained. All the switches on any particular control panel shall be installed such that a consistent thread protrusion height is maintained (i.e., the amount of thread protrusion for all the switches on a particular control panel shall be approximately the same).

6.12 Installed cable ties and clamps must not pinch the wire insulation.

6.13 There shall be no axial slippage of installed cable ties along the wire bundle or the wire bundle at clamps.

6.14 The gap between a primary support clamp and the wire bundle (before wrapping the wire bundle in Guideline (filler) tape or woven metal braid) shall not be greater than 1/16".

6.15 There shall be no wire splices inside a conduit.

6.16 A slight twist shall be induced in the wire loom before it is oversleeved with convoluted tubing, overbraid shields, or conduit.

6.17 Pull wires shall be included with the wire loom as specified on the engineering drawing. Pull wires shall not be twisted in with the wire loom.

6.18 There shall be a minimum clearance of 1/2" between wire bundles; if necessary, maintained by the use of CR4H spacers (ref. paragraph 4.1.9).

7 DHC/BA SAFETY PRECAUTIONS

7.1 The safety precautions specified herein are specific to DHC/BA to meet Canadian Federal and Provincial government environmental, health and safety regulations. It is strongly recommended that other facilities consider these safety precautions; however, suppliers, subcontractors and partners are responsible for ensuring that their own environmental, health and safety precautions satisfy the appropriate local government regulations.

7.2 Observe standard plant safety precautions when performing the procedure specified herein.

7.3 Refer to PPS 31.17 for the safety precautions for handling and using solvents.

7.4 Wear suitable protective gloves (e.g., DSC 422-8 nitrile or DSC 422-5 neoprene) when applying Polywater J wire and cable pulling lubricant. If skin contact occurs, wash thoroughly with soap and water. If eye contact occurs, immediately flush eyes in a direct stream of water for a minimum of 15 minutes.

8 PERSONNEL REQUIREMENTS

8.1 Personnel shall have a good working knowledge of the applicable procedure and requirements as specified herein and shall have exhibited their competency to their supervisor.

9 ADDITIONAL INFORMATION

9.1 Refer to the following figure for a general description of diodes:

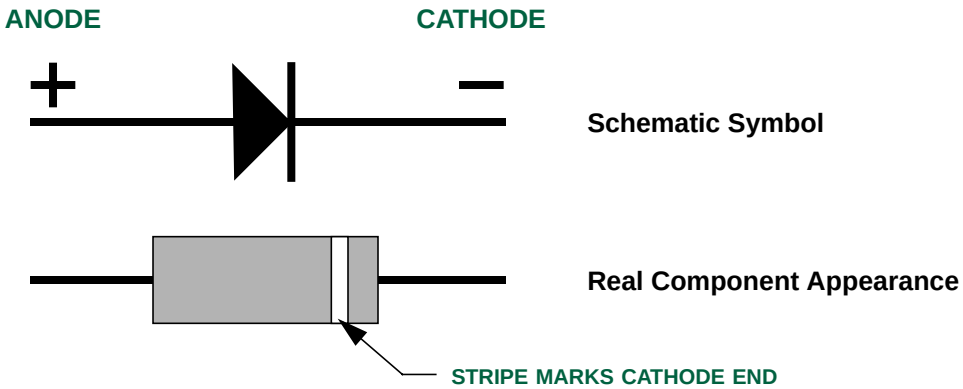


FIGURE 16 - DIODE