BOMBARDIER Toronto (de Havilland) **Proprietary Information**	**PPS 9.22** **Production Process Standard (PPS)**

Assembly of Connectors

Issue 29

- This PPS supersedes PPS 9.22, Issue 28.
- This PPS is effective as of the distribution date.
- Validation of issue status is the responsibility of the user.
- Vertical lines in the left hand margin indicate technical changes over the previous issue.
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Issue 29 - 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.

- Added para. 5.13.9.2 and Table 11 to specify maximimum allowable coupling force and free rotating force for MS3459 connectors.

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1 Scope

1.1 This Production Process Standard (PPS) specifies the procedure and requirements for the assembly of connectors, including rectangular, circular, solder contact and crimp contact types.

1.1.1 This PPS complements the engineering drawings that specify its use as an authorized instruction. The procedures specified in this standard must be followed to ensure compliance with all applicable specifications. In general, if this standard conflicts with the engineering drawing, comply with the engineering drawing. The requirements specified in this standard 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.

1.1.3 Procedure or requirements specified in a Bombardier BAPS, MPS, LES or P. Spec. **do not** supersede the procedure or requirements specified in this PPS.

2 Hazardous Materials

2.1 Before receipt at Bombardier Toronto (de Havilland), all materials must be approved and assigned Material Safety Data Sheet (MSDS) numbers by the Bombardier Toronto (de Havilland) 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 the Bombardier Toronto (de Havilland) Environment, Health and Safety Department.

3 References

3.1 General

3.1.1 Unless a specific issue is indicated, the issue of the reference documents specified in this section in effect at the time of manufacture shall form a part of this specification to the extent indicated herein.

3.2 Bombardier Toronto (de Havilland) Process Specifications

3.2.1 PPS 9.04 - Assembly and Installation of Electrical and Electronic Wires and Cables.

3.2.2 PPS 9.07 - Soldering of Electrical Terminals.

3.2.3 PPS 9.17 - Encapsulation of Electrical Wire Harnesses and Cable Assemblies.

3.2.4 PPS 9.30 - Installation and Termination of Learjet 45 Electrical Wire Harness Overbraid.

3.2.5 PPS 9.34 - Terminating Electrical Shields.

3.2.6 PPS 9.36 - Manual Crimping of Size 12 - 22 Electrical Contacts.

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

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

3.2.9 PPS 13.26 - General Subcontractor Provisions.

3.2.10 PPS 13.28 - Storage Life of Adhesives, Sealants, Paints and Composite Products.

3.2.11 PPS 14.01 - Torquing, Method and Identification.

3.2.12 PPS 19.01 - Safetying Devices.

3.2.13 PPS 19.02 - Securing of Threaded Fasteners and Retention of Bearings & Bushings using Anaerobic Sealants.

4 Materials and Equipment

4.1 Materials

4.1.1 Unless otherwise specified in this section, use only the materials specified; use of superseding or alternative materials is not allowed.

4.1.2 Petroleum jelly (e.g., Witco Chemical Co. petroleum jelly).

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

4.1.4 Release agent, silicone, Dow Corning #7.

4.1.5 Sealing plugs as specified in Table 5.

4.1.6 Teflon strips, to MIL-P-22241, Type 3, 0.002" thick.

4.1.7 Tamper proof sealant, white:

- Dykem Cross Check tamper proof torque mark, p/n 83319 (white)
- Organic Products Co. F-900 or F-925 Torque Seal
- 3M EC-1252 tamper proof sealant

4.1.7.1 Refer to PPS 13.28 for the storage life of tamper proof sealant. The tamper proof sealants specified herein are resistant to splashes of hydraulic fluid (e.g., Skydrol) but are not resistant to immersion. After application, allow tamper proof sealant to cure undisturbed according to the manufacturer's recommendations. Apply tamper proof sealant sparingly, do not apply more than needed, especially in overhead applications.

4.1.8 Substitute backshell clamp screws (e.g., MS35275-XXX). When substituting backshell clamp screws, the screw type must be the same as that of the screw supplied with the backshell. The length of backshell clamp screws must ensure minimum protrusion as specified in section 5.9.

4.2 Equipment

4.2.1 Front release crimp type contact insertion tools as specified in Table 2.

4.2.2 Rear release crimp type contact insertion tools as specified in Table 4.

4.2.3 Front release crimp type contact extraction tools as specified in Table 6 and Table 7.

4.2.4 Rear release crimp type contact extraction tools as specified in Table 8 and Table 9.

4.2.5 Soft jaw pliers (e.g., Daniels BT-SJ-468 or Glenair TG69).

4.2.6 Connector plug extraction tool, Deutsch #057-0289-00 A.

4.2.7 Pin inserter/extractor aid, Bombardier tool NPN-1024, for use with rear release insertion/extraction tools (e.g., M81969/14).

5 Procedure

5.1 General

5.1.1 Refer to Table 1 for a listing of standard front release and rear release connector types.

5.1.2 Before assembly of wires to connectors slide the following items, as applicable, over the wire bundle:

- part numbering sleeves
- identification sleeves
- heat shrinkable tubing and boots
- Atite seals
- Thermofit feed through seals

5.1.3 Terminate the shield of shielded electrical cables at connectors according to PPS 9.34.

5.1.4 Slide the required connector parts onto the wire bundle in the correct sequence of assembly.

5.1.5 Crimp contacts onto wires according to PPS 9.36. If filler wire has been used when crimping contacts (i.e., when a smaller AWG wire has been crimped into a larger AWG contact), ensure that a suitable length of M23053/5 heat shrinkable tubing has been shrunk onto the lead wire to “build-up” the wire outside diameter in the area of the rubber seal of the connector so that a hermetic seal is ensured.

5.1.6 Unless otherwise specified, do not remove “O” rings, if any, from connectors.

5.1.7 In all cases, take care to ensure proper thread alignment when assembling threaded components (i.e., avoid cross threading), as misalignment may irreparably damage one or both components. Use the following procedure to avoid cross threading or misalignment of threads:

Step 1. Orient the components to be threaded together, so that they are centred properly on one another.

Step 2. Instead of immediately screwing the components in the direction necessary to engage the threads (i.e., clockwise), lightly place the thread components together and rotate slowly and gently counterclockwise, with minimal engagement pressure, until you hear or feel a slight “click” indicating that the starting threads on both components are lined up.

Step 3. Start to thread the components together by turning clockwise slowly and gently, with minimal engagement pressure, being careful to be aware of any unusual resistance. If any unusual resistance is encountered, back off and repeat from Step 2.

Step 4. Run threaded components together by hand before final torquing or tightening, as required.

Table 1 - Connector Types

Front Release Type Connectors	Rear Release Type Connectors
MS3120 - MS3128 MS24264 - MS24266 Cannon CE903 & CE904 Series Cannon KPTM Series	MS3450 - MS3459 MS3470 - MS3477 MS27473 SERIES M83723-XX MIL-C-81703 (SERIES 3) MIL-T-81714 MIL-C-83733 D38999 Cannon DPX CE 9438 SERIES Cannon D*MAM SERIES CannoN D*MA SERIES Deutsch DMC-MD

5.2 Routing of Wires Terminating at Connectors

5.2.1 Approximately 3'' from the rear of the connector backshell or strain relief, if any, comb the wires of the wire bundle out parallel to each other so that each wire will run directly to its termination cavity (e.g.,as shown in Figure 1) with minimal crossing of the wires over each other (see Figure 2).

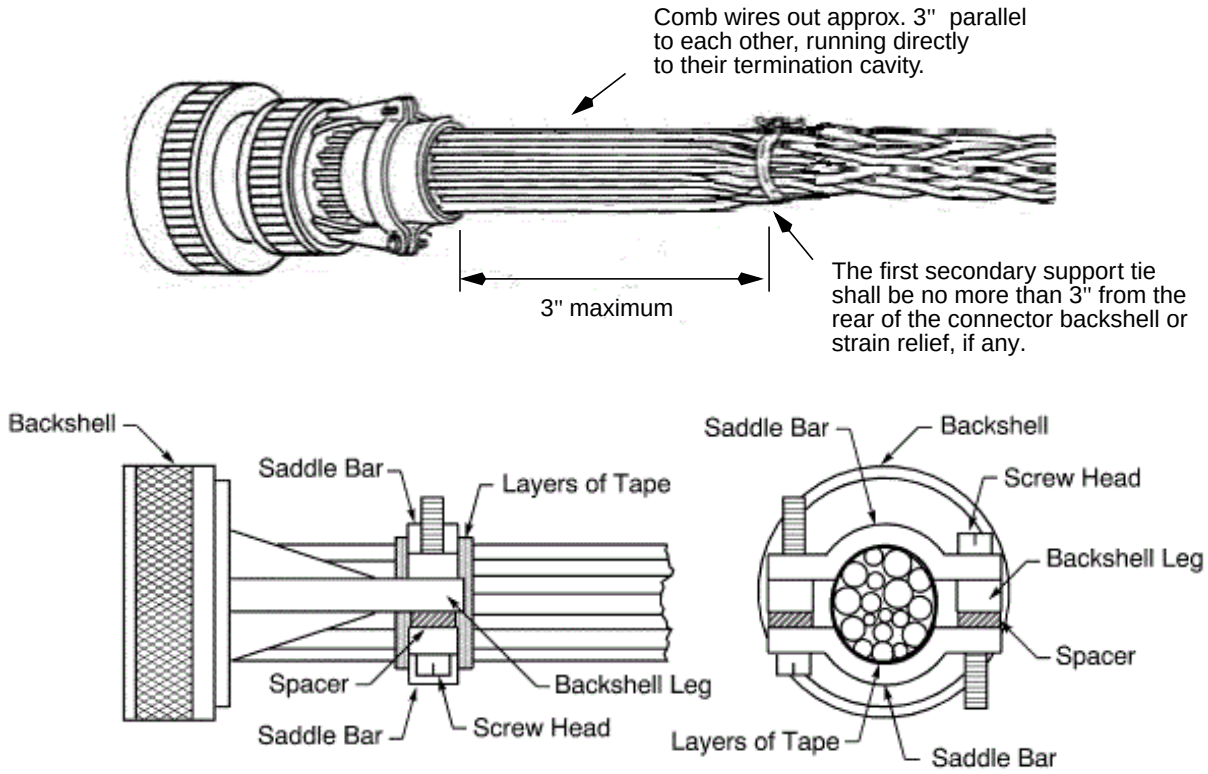
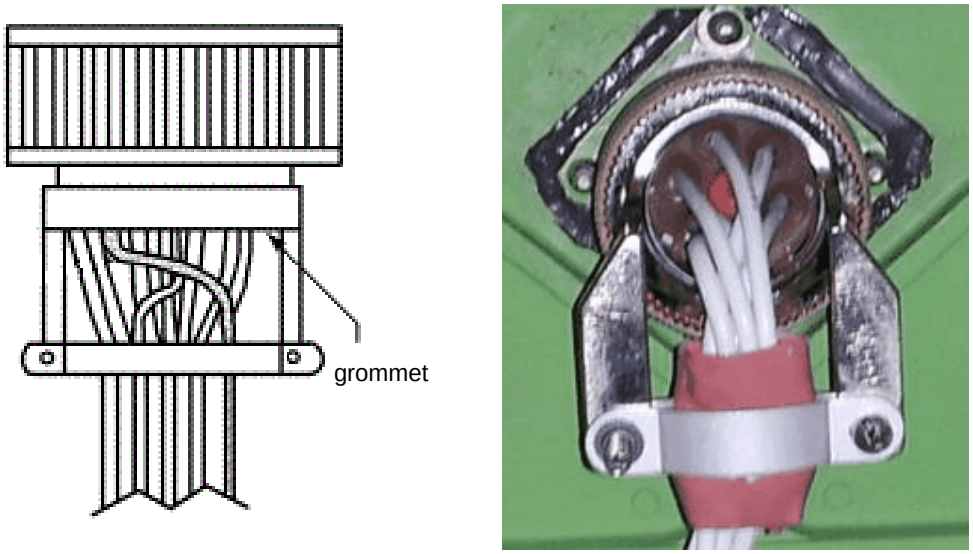


Figure 1 - Proper Routing of Wires



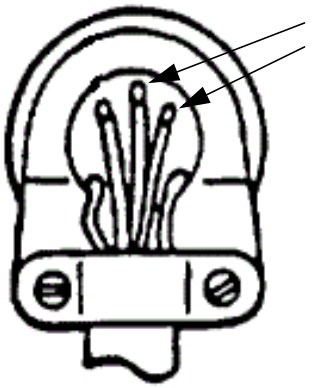
crossed wires
Unacceptable

crossed wires/improper entry angle
Unacceptable

Figure 2 - Unacceptable Routing of Wires

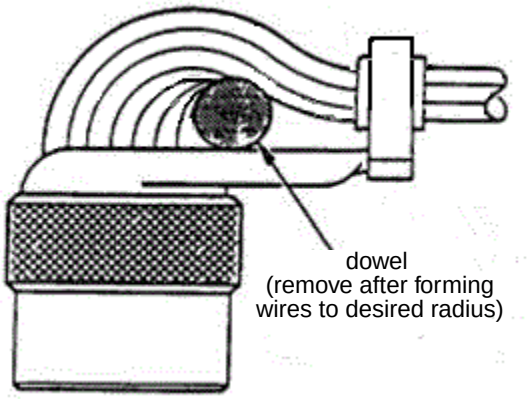
5.2.2 For all wires, including those terminating at connector backshells with 45° and 90° strain relief, it is imperative that the wires enter perpendicular (i.e., 90° ± 2°) to the connector grommet.

Any distortion of the grommet caused by strain on the wire is unacceptable (e.g., as shown in the adjacent figure). The installed contact (pin or socket) must not be visible from the grommet side of the connector.



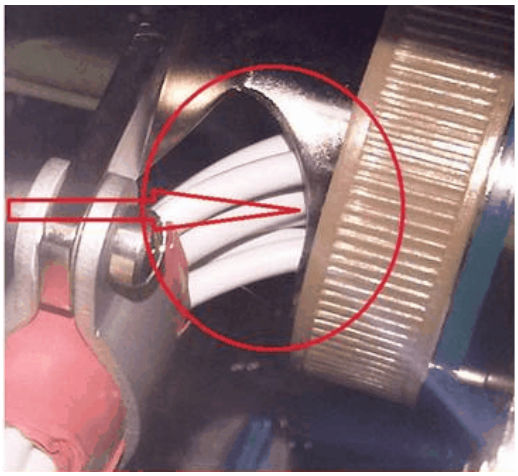
Strain on wires causes grommet distortion
Unacceptable

5.2.2.1 For heavier gauge wire (e.g., 8, 6, 4, etc.), to ensure wires enter perpendicular (i.e., 90° ± 2°) to the connector grommet without strain (especially at connector backshells equipped with a 45° or 90° strain relief) it may be necessary to pre-bend the wires before installation of contacts (e.g., using a suitable diameter dowel as shown in the adjacent figure).



dowel
(remove after forming wires to desired radius)

5.2.2.2 When terminating wires at connector backshells, ensure **clearance** between the wire insulation and any edge of the connector backshell or surrounding structure/ equipment (e.g., see adjacent figure). There must be **no contact** of the wire insulation with the edge of the connector backshell or surrounding structure/equipment.



Wire insulation comes into contact with the edge of the backshell
Unacceptable

5.3 Assembly of Solder Contact Connectors

5.3.1 Assemble solder contact connectors as follows:

Step 1. Slide the required connector components onto the wire bundle in the correct sequence of assembly.

Step 2. Solder wires to contacts according to PPS 9.07.

Step 3. Push previously installed insulating sleeves or rubber insulating grommets over the wires forward to bottom against the rear face of the connector insulator.

Step 4. Ensure that all wires are pre-shaped into the wire bundle at the cable clamp or first cable tie to prevent lateral strain on the contacts (see Figure 3).

Step 5. Tie insulating sleeves in place using a plastic cable tie according to PPS 9.04 (see Figure 3). Locate the plastic cable tie inside the backshell where it will not interfere with the cable clamp.

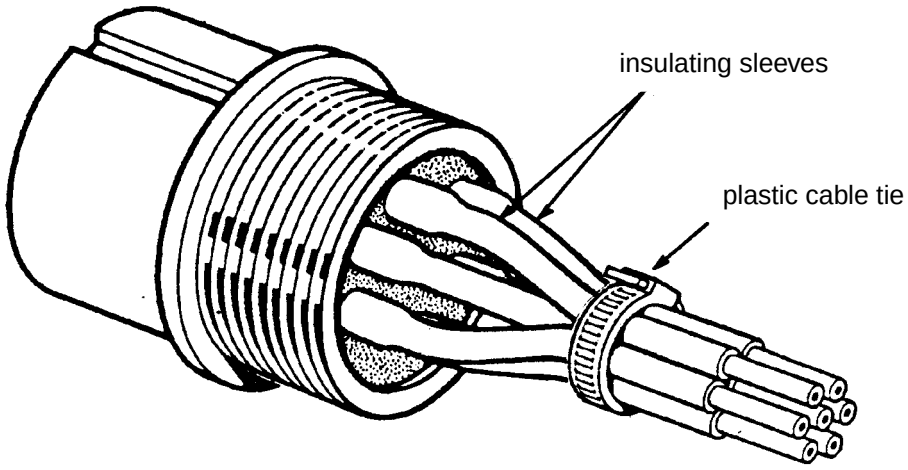


Figure 3 - Tying Insulating Sleeves

5.4 Insertion of Front Release Crimp Type Contacts (see Figure 4)

5.4.1 Insert front release crimp type contacts as follows:

Step 1. Slide the required connector components onto the wire bundle in the correct sequence of assembly.

Step 2. Starting at the centre cavity at the rear of the connector, insert the wired contact into the cavity, by hand, until the contact shoulder is approximately 1/8" from the rear face of the insulator.

Step 3. Insert contacts using the insertion tool specified in Table 2. For Cannon front release connectors, insert contacts using the Cannon insertion tool specified in Table 2.

Step 4. Place the tool tip onto the contact so that the wire runs along the groove in the tool and the tool tip butts against the contact barrel or against the back of the insulation support.

Step 5. Using firm, even pressure, push the contact straight into the insulator until the contact snaps into position. Do not rotate or withdraw the tool during insertion. If the pin or socket has not gone fully home, push out the front of the connector (according to the procedure specified in section 5.11) and re-install the contact according to this section. Under no circumstances shall the insertion tool be re-inserted into the contact cavity to complete a partial installation.

Step 6. Withdraw the insertion tool by pulling straight back out of the cavity and pull back gently on the wire of the inserted contact to verify proper contact seating. It is also acceptable to verify proper contact seating by push testing using a retention tester as specified in Table 3.

Step 7. Insert the rest of the contacts by working outwards from the centre in a circular pattern (see Figure 5).

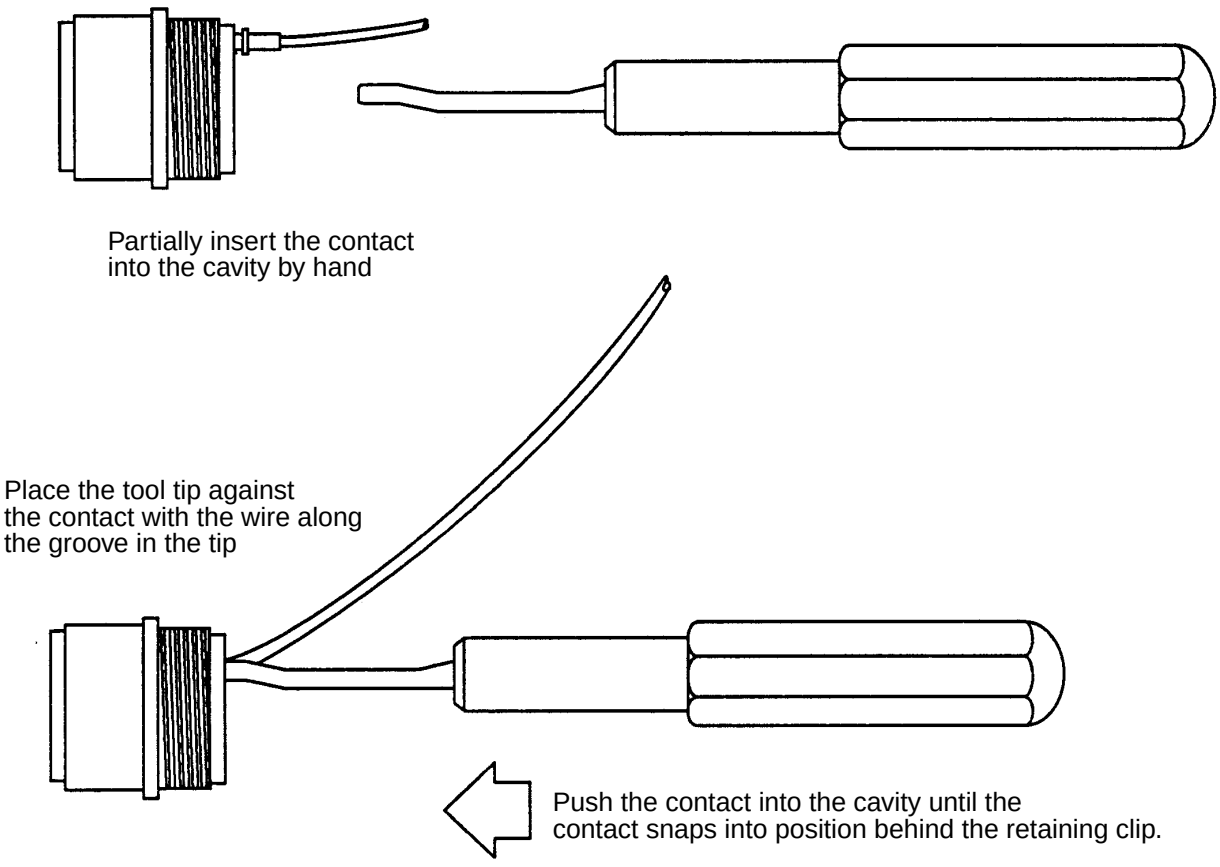


Figure 4 - Installation of Front Release Contacts (typ.)

Table 2 - Front Release Contact Insertion Tools

Wire Barrel Size	Insertion Tool	Cannon Insertion Tool
20	M81969/17-09	CIT20
16	M81969/17-04	CIT16
12	M81969/17-05	N/A

Note 1. Insert contacts into non-standard connectors using the insertion tool recommended by the connector manufacturer.

Note 2. For standard connectors use a M81696/17 insertion tool. For Cannon front release connectors use the Cannon insertion tool.

Table 3 - Contact Retention Testing Tools

Contact Size	Daniels Retention Tester	Retention Tester Calibrated Force
12	HT210-12	10 ± 3 LBS
16	HT210-16	10 ± 3 LBS
20	HT210-20	10 ± 3 LBS
22	HT210-22	10 ± 3 LBS
23	HT210-23	10 ± 3 LBS
26	HT210-26	2 ± 1 LBS

Use of Tool

Step 1. For socket contacts, fit the socket tester (pin) to the tool body and insert it into the mating end of the contact. For pin contacts, fit the pin tester to the tool body and place it over the contact at the mating end.

Step 2. Ensure that the tool is in a straight line with the contact and apply pressure toward the contact until the edge of the tool body aligns with indicator line. Proper retention is indicated if the contact remains in place.

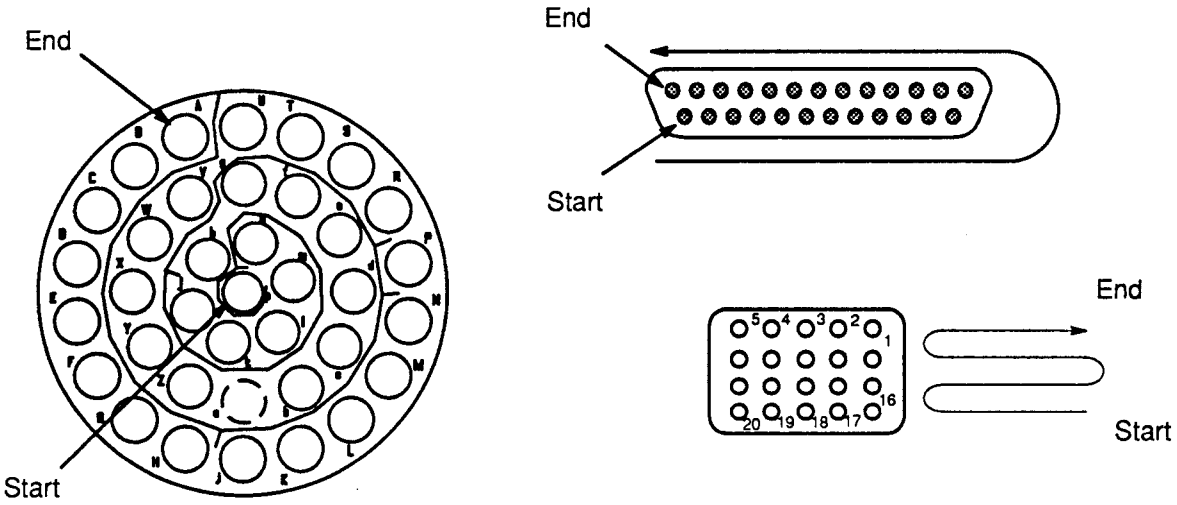


Figure 5 - Contact Insertion Sequence

5.5 Insertion of Crimp Type Contacts into Standard Rear Release Connectors
(see Figure 6)

5.5.1 Insert crimp contacts into standard rear release connectors as follows:

Step 1. Slide the required connector components onto the wire bundle in the correct sequence of assembly.

Step 2. Place the wire in the groove of the insertion tool (coloured end) and pull the wire back until the tip of the tool touches the contact shoulder. Except for Number 8 contacts and Number 20 contacts being inserted into DMA or D*MAM rectangular connectors, insert contacts using the plastic insertion tools supplied with the connector. Number 8 contacts do not require insertion tools as the wire itself provides sufficient support to push the contact into the connector. Number 20 contacts can be inserted into D*MA or D*MAM type rectangular connectors by hand due to the low insertion forces required. When inserting unwired contacts in circular connectors, place the contact in the insertion groove of the tool so that the tip of the tool seats against the contact shoulder. If an insertion tool did not come with the connector, insert the contact using the insertion tool specified in Table 4. It is recommended that an NPN-1024 inserter/extractor aid be used with the insertion tool; assemble the NPN-1024 inserter/extractor aid with the contact insertion tool as shown in Figure 7.

Step 3. Insert the contact straight into the insulator until the contact snaps into position. Use firm, even pressure when inserting the contact. For circular connectors start at the centre cavity; for rectangular connectors start at one end of the bottom row.

Step 4. Withdraw the insertion tool by pulling straight back out of the cavity.

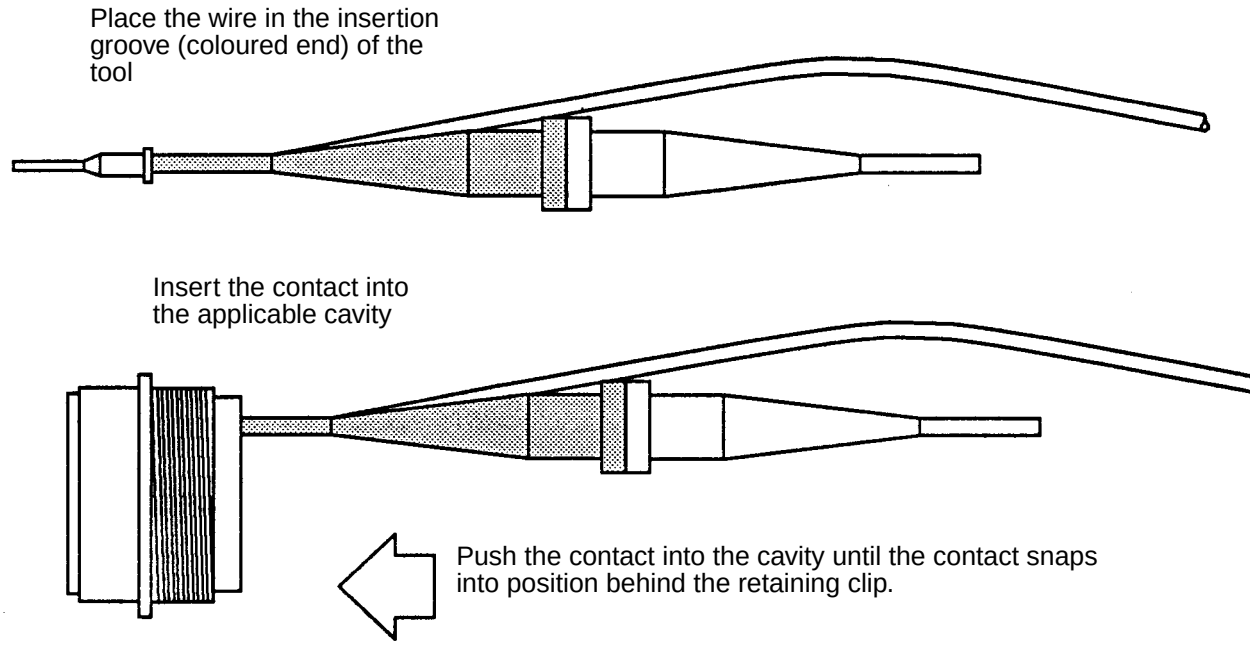


Figure 6 - Installation of Rear Release Type Contacts (typ.)

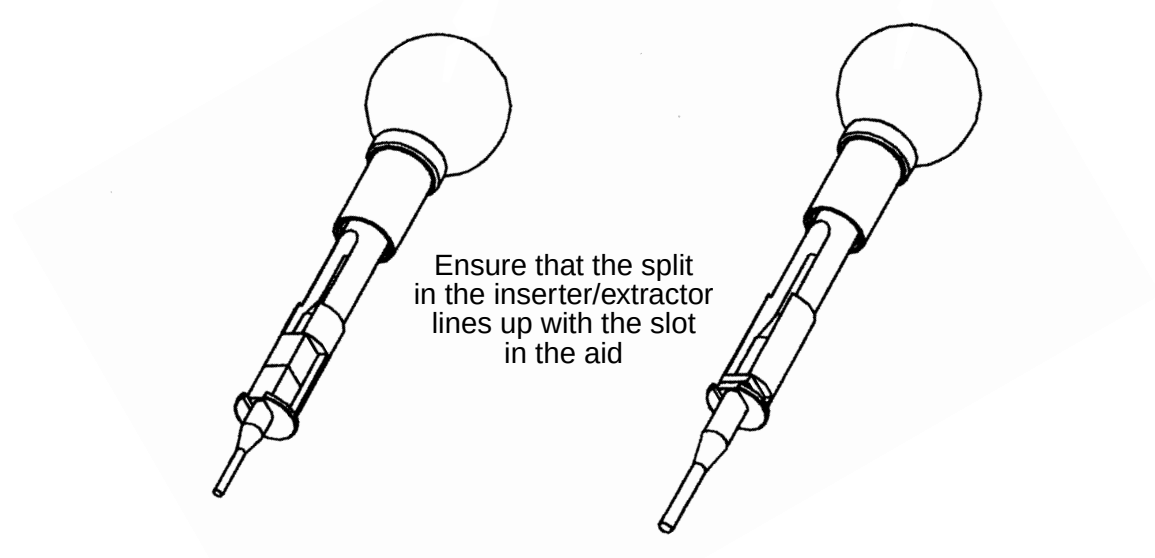


Figure 7 - NPN-1024 Inserter/Extractor Aid

Step 5. Pull back gently on the wire of the inserted contact to verify proper contact seating. It is also acceptable to verify proper contact seating by push testing using a retention tester as specified in Table 3.

Step 6. When filling cavities with unwired contacts, check the front face of the connector to visually verify proper contact insertion.

Step 7. Insert the remaining contacts by working outwards from the centre for circular connectors, or, in the case of rectangular connectors by completing one row at a time always starting at one end (see Figure 5).

Table 4 - Standard Rear Release Contact Insertion Tools

Wire Barrel Size	Insertion Tool
22D	M81969/14-01
22M	M81969/14-01
22	M81969/01-01
20	M81969/14-02
16	M81969/14-03
12	M81969/14-04

Note 1. Insert contacts into non-standard connectors using the insertion tool recommended by the connector manufacturer.

5.6 Insertion of Contacts into Deutsch DMC-MD Rear Release Connectors

5.6.1 Insert contacts into Deutsch DMC-MD rear release connectors as follows:

Step 1. Run all the wires of the wire loom through the tubes that will attach to the rear of the Deutsch DMC-MD backshell.

Step 2. Place the wire in the insertion groove of the insertion tool (coloured end) and pull the wire back until the tip of the insertion tool seats against the contact shoulder. Insert contacts using the plastic insertion tool supplied with the connector. If an insertion tool did not come with the connector, insert the contact using an M81969/14-01 insertion tool.

Step 3. Starting at the bottom row insert the contact straight into the insulator until the contact snaps into position. Use firm, even pressure when inserting the contact.

Step 4. Withdraw the insertion tool by pulling the insertion tool straight back out of the cavity.

Step 5. Pull back gently on the wire of the inserted contact to verify proper contact seating. It is also acceptable to verify proper contact seating by push testing using a retention tester as specified in Table 3.

Step 6. Insert the remaining contacts by completing one row at a time (see Figure 5).

5.7 Environmental Sealing

5.7.1 Unfilled connector cavities in rectangular connectors do not require any additional form of environmental sealing.

5.7.2 Unless otherwise specified on the engineering drawing or wiring list, it is not necessary to plug unused contact cavities of circular connectors by inserting unwired (i.e., un-crimped) contacts. If use of unwired contacts in unused connector cavities is specified by the engineering drawing, insert the unwired contacts using the same tools and procedure as those used for wired contacts and check the front face of the connector to visually verify proper contact insertion.

5.7.3 Wires entering the connector grommet must not deform the grommet such that gaps between the grommet cavity and the wire are formed.

5.7.4 Plug all circular connector (e.g., MS3450, MIL-DTL-38999, etc.) grommet holes that do not contain wired contacts by inserting the plastic sealing plug specified in Table 5 as shown in Figure 8.

Table 5 - Selection and Installation of Sealing Plugs

Connector Shell Style	Connector Cavity Size	Sealing Plug	
		Part Number	Colour
Rear release (with or without an unwired contact installed) and Front release (unwired contact not installed)	22	S8216-22	BLACK
	20	S8216-20	RED
	16	S8216-16	BLUE
	12	S8216-12	YELLOW
	8	S8216-8	RED
Front release (unwired contact installed)	20	MS3187-A20	RED
	16	MS3187-16	BLUE
	12	MS3187-12	YELLOW

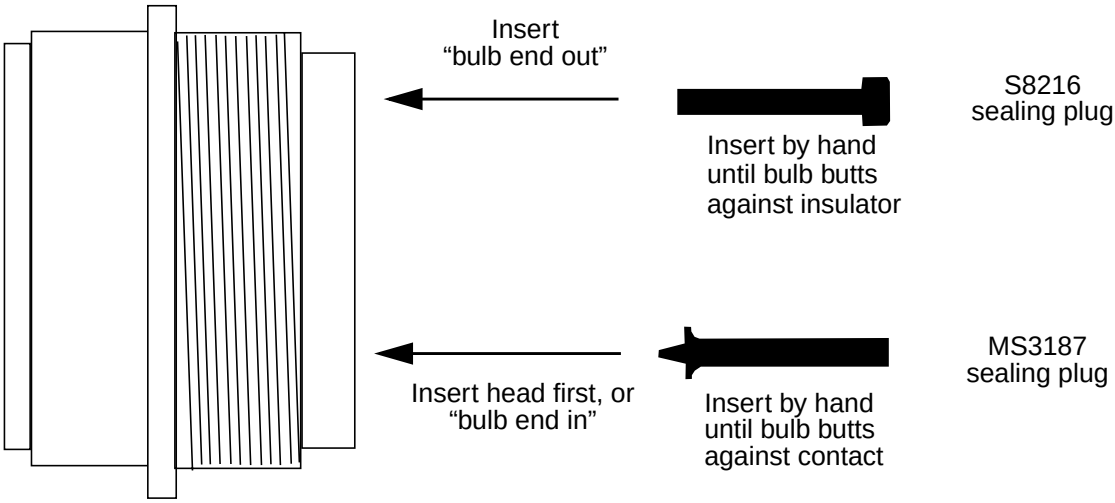


Figure 8 - Installation of S8216 and MS3187 Sealing Plugs

5.8 Assembly of Backshells on Circular Connectors

5.8.1 Torque circular connector backshells according to PPS 14.01 to the torque value specified therein.

5.9 Assembly of Deutsch DMC-MD Modular Connectors

5.9.1 Assemble Deutsch DMC-MD modular connectors as follows:

Step 1. If necessary, adjust the connector keyway to the position specified on the engineering drawing (see Figure 9).

Step 2. Insert the connector plug into the 2 way plug shell (see Figure 10). When properly oriented, the connector plug will snap into position within the plug shell. If necessary, remove the connector plug from the plug shell using an extraction tool (see Figure 11).

Step 3. Feed the wire loom of the connector plugs through the holes at the rear and front of the lower portion of the backshell.

Step 4. Assemble the upper portion of the backshell to the lower portion of the backshell, ensuring that the side latches extend from the front of the backshell.

Step 5. Tighten the 2 screws on the upper portion of the backshell with an Allen key, fastening it to the lower portion of the backshell.

Step 6. Assemble the backshell to the rear of the 2 way plug shell. When properly oriented, the shaft running through the lower portion of the backshell will line up with the screw running through the 2 way plug shell.

Step 7. Tighten both of the side latch screws using an Allen key, fastening the backshell to the 2 way plug shell.

Step 8. Once the backshell is in place, ensure that the screw running through the 2 way plug shell has engaged the shaft running through the backshell by rotating the shaft running through the backshell.

Step 9. Assemble the pipes to the rear of the backshell.

Step 10. Assemble electrical bonding and grounding hardware to the backshell according to PPS 9.30.

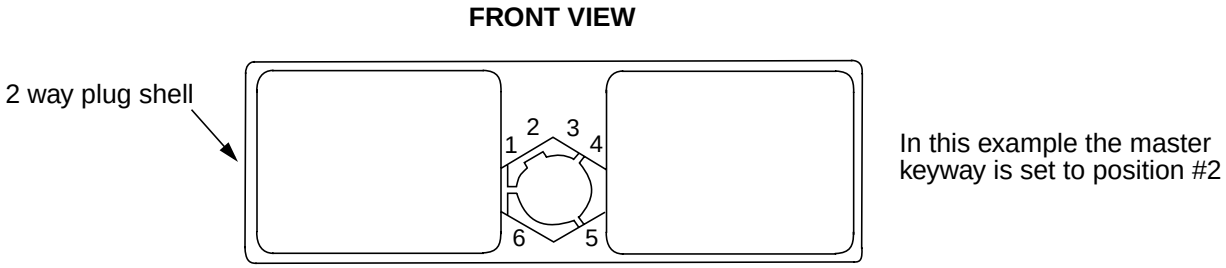


Figure 9 - Deutsch DMC-MD Keyway Code

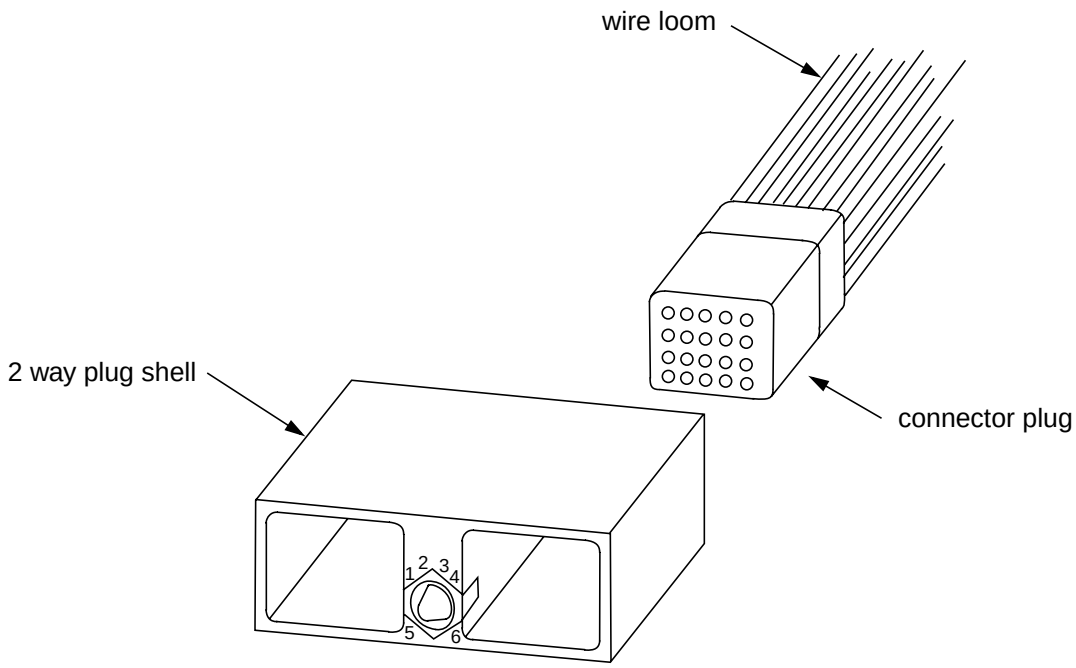


Figure 10 - Insertion of DMC-MD Connector Plug

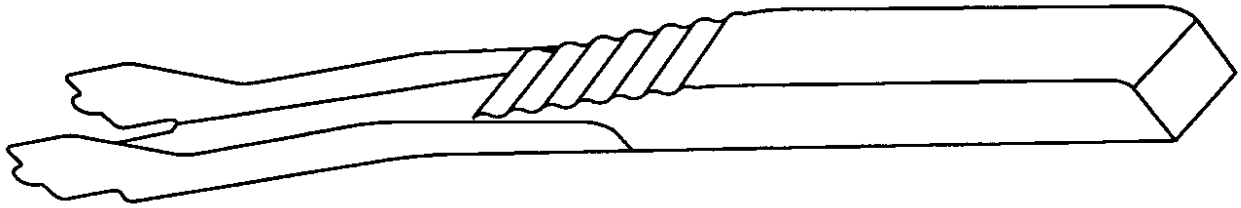
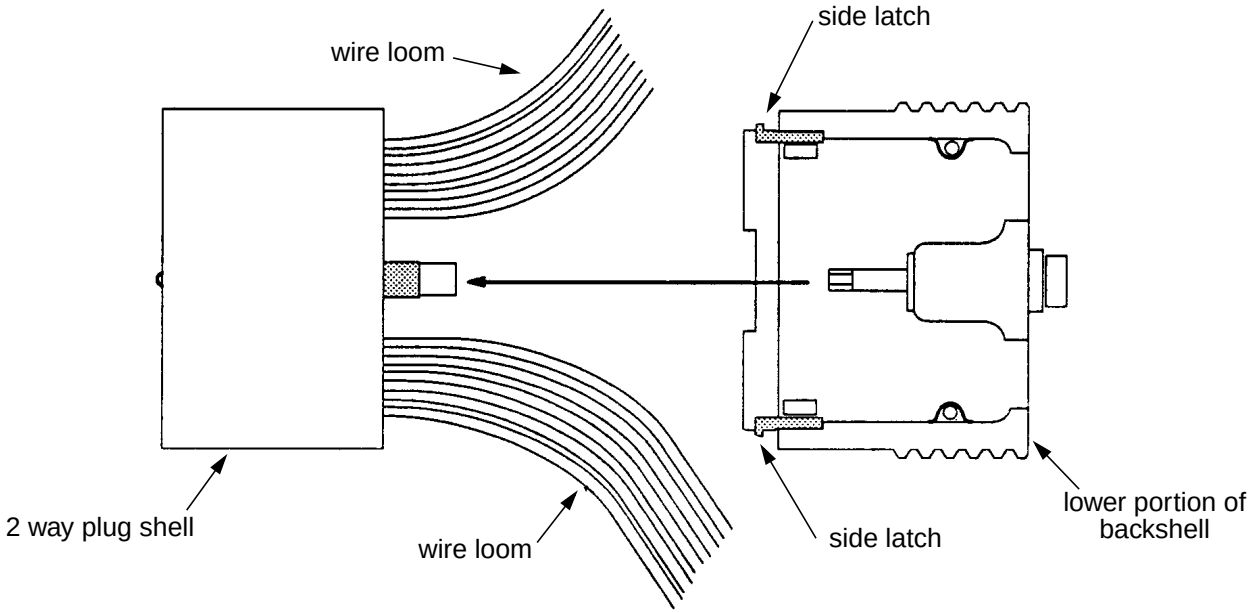


Figure 11 - Connector Plug Extraction Tool (ref. para. 4.2.6)



Note: Run the wire loom through the lower portion of the backshell and assemble the upper portion of the backshell to the lower portion of backshell before assembling the backshell to the 2 way plug shell.

Figure 12 - Assembly of Backshells to DMC-MD Connector 2 Way Plug Shells

5.9 Assembly of Securing Hardware

5.9.1 Assemble securing hardware as follows:

Step 1. Slide clamping glands and taper sleeves (if used) into place. Unless otherwise specified, butt the clamping glands and taper sleeves against the backshell or rear face of the connector.

Step 2. Before assembly, lubricate metal taper sleeves (if used) sparingly with release agent (ref. para. 4.1.4) at the mating face of the gland or insulator.

Step 3. Ensure wires terminating at the connector have been routed properly according to section 5.2.

Step 4. For protection of wires at the point of clamping, use 1 1/2 to 2 turns of the tape or strips specified by the engineering drawing. Except for connectors on the Lear 45 fuel tank harness, if the engineering drawing does not specify use of a particular type of tape or strips, protect wires at the point of clamping with 1 1/2 to 2 turns of Guideline tape (ref. para. 4.1.3). For connectors on the Lear 45 fuel tank harness, protect wires at the point of clamping using Teflon strips (ref. para. 4.1.6) if the engineering drawing does not specify use of a particular type of tape or strips. If the engineering drawing specifies the addition of a diode assembly in the connector, ensure that the diode is not covered with tape or strips; if the positioning of a diode is such that it would be covered with tape or strips, refer to Liaison Engineering.

Step 5. Tighten clamps enough to firmly hold the wires in place without crushing or straining them. If necessary, increase the amount of tape or strips protecting the wires at the point of clamping to ensure that the clamp will grip the wires firmly when tightened. Except when terminating terminal lugs at the strain relief clamp, gaps between the clamps and clamp support after tightening as shown in Figure 13 are acceptable even if this allows some lateral movement of the harness with the clamps on the clamp support; **do not** over-tighten to close such gaps. For Dash 8 Series 400 aircraft, terminate terminal lugs at strain relief clamps according to PPS 9.39; for Dash 8 Series 100, 200 and 300 aircraft, terminate terminal lugs at strain relief clamps according to PPS 9.04. The threaded end of clamp screws must protrude beyond the nut a minimum of the full round or chamfer; in the case of flat end screws, the threaded end must protrude a minimum of 1/32" or 1 1/2 threads, whichever is greater. If, when the connector is installed, the threaded end of a clamp screw could cause potential abrasion of an adjacent wire harness and adjustment of backshell clocking orientation (as specified in para. 5.13.8) will not completely eliminate the problem, swap the direction of the backshell clamp screws and/or substitute shorter clamp screws of the same type (provided the minimum screw protrusion limit will be met).

Step 6. Except for Souriau Pelican PEL1-ECF-3522 series connector kits, when assembling the securing hardware on rectangular connectors, fasten the wire loom to the securing hardware by means of a MS3447 tie-wrap. If necessary, wrap the wire loom with Guideline tape before fastening the tie-wrap. Select and install tie-wraps according to PPS 9.04.

Step 7. Terminate the overbraid shield, if used, as specified on the engineering drawing or wiring list.

Step 8. Remove or tighten unused hardware (i.e., unused grounding screws) on **fully** assembled and installed connectors.

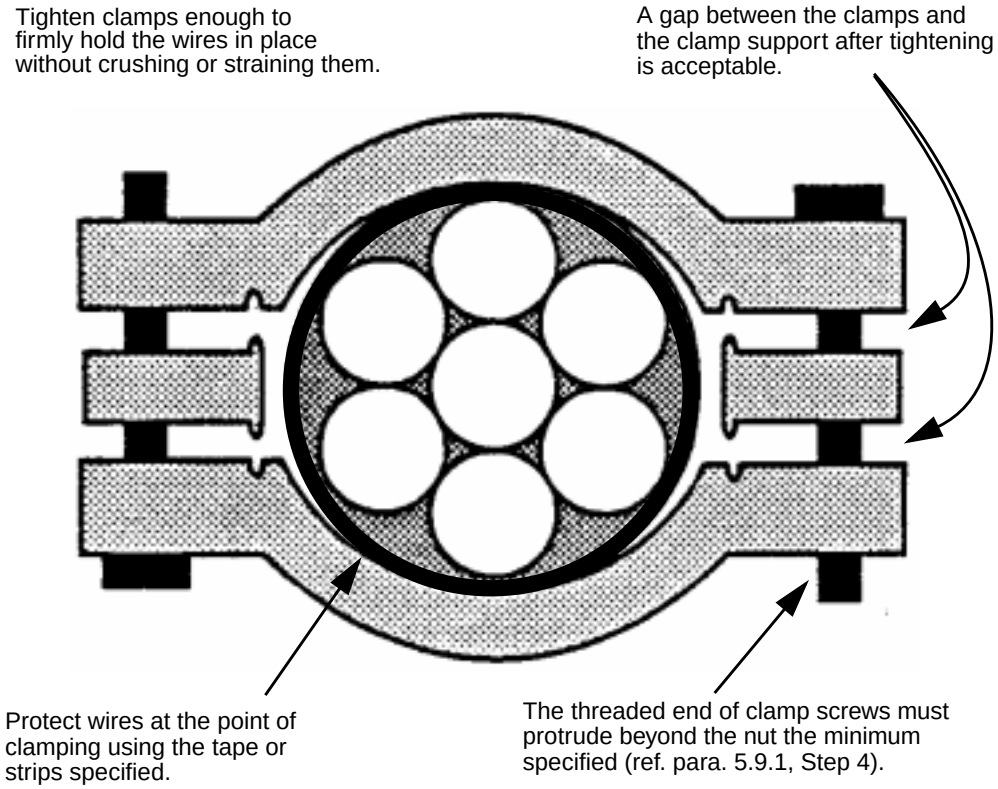


Figure 13 - Assembly of Securing Hardware

5.10 Placement of Connector Identification Sleeves or Cable Markers

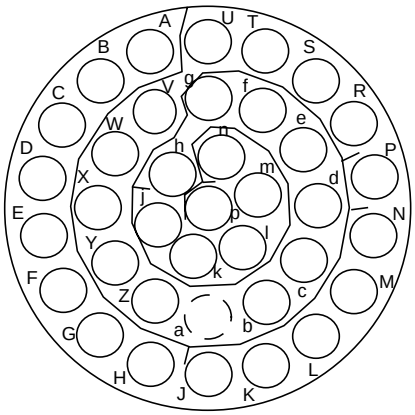
5.10.1 Position the connector identification sleeves or cable markers specified by the engineering drawing on the wire bundle with the forward edge of the sleeve or marker 1 1/2" - 2" from the rear of the connector **backshell** (do not include the strain relief, if any, in this measurement). For heat shrinkable connector identification sleeves, shrink the sleeve in place according to PPS 10.16. For cable markers, tie both ends with self-locking plastic cable ties according to PPS 9.04. For wire bundles within conduit or an overbraid shield, apply the connector identification sleeves or cable markers over the conduit or overbraid shield.

5.11 Removal of Front Release Crimp Type Contacts

5.11.1 General

5.11.1.1 To correctly identify the particular contact to be removed refer to Figure 14 for a general description of the standard cavity identification system.

Contact cavities are identified in a spiral pattern



A projecting line from the spiral indicates the omission of a letter

A broken circle around the cavity indicates transition between upper and lower case and double letters

Figure 14 - Identification of Contact Cavities

5.11.1.2 Remove standard front release crimp type contacts using an M81969/19 extraction tool according to section 5.11.2. Remove front release crimp type contacts installed in Cannon type connectors using a CET extraction tool according to section 5.11.3

5.11.2 Use of M81969/19 Extraction Tool

5.11.2.1 Remove front release crimp contacts using the M81969/19 tool as follows:

Step 1. Slide the securing hardware back up the wire bundle.

Step 2. Remove the contact using the contact removal tool specified in Table 6.

Table 6 - Front Release Contact Removal Tools

Wire Barrel Size	Removal Tool
20	M81969/19-07
16	M81969/19-08
12	M81969/19-09

Note 1: Remove contacts from non-standard connectors using the removal tool recommended by the connector manufacturer.

Note 2: For Cannon front release contact removal tool refer to Table 7.

Step 3. Place the tool tip lightly over the contact at the front of the connector and push forward until the tool tip touches the insulator face.

Step 4. Carefully rotate the tool and push inward to properly seat the tool (see Figure 15).

Step 5. While maintaining an even pressure on the tool body, push the thumb assist collar or knob towards the connector to release the contact and push it partially out of the rear of the connector.

Step 6. Withdraw the extraction tool by pulling straight back out of the hole.

Step 7. Remove the released contact from the connector by pulling the contact wire at the rear of the connector. On unwired contacts, pull the contact from the rear of the connector with needle nose pliers.

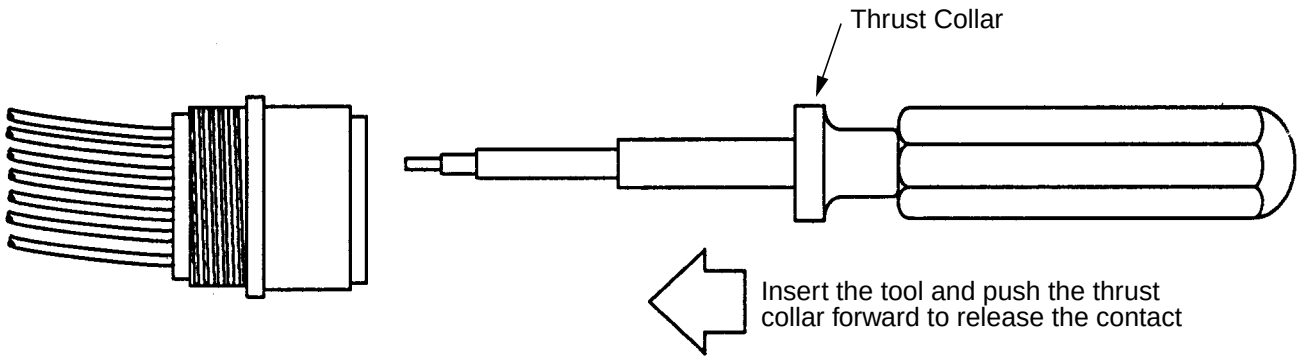


Figure 15 - Removal of Front Release Contacts using a M81969/19 Extraction Tool

5.11.3 Use of CET Extraction Tool

5.11.3.1 Remove front release crimp contacts using the CET tool as follows:

Step 1. Slide the securing hardware back up the wire bundle.

Step 2. Remove the contact using the contact removal tool specified in Table 7.

Step 3. Set the reversible tool tip for pin or socket contact extraction, as applicable (see Figure 16).

Step 4. Place the tool tip on the contact at the front of the connector.

Step 5. Apply firm pressure to release the contact and push the contact partially out of the connector.

Step 6. Withdraw the extraction tool by pulling straight back out of the hole.

Step 7. Remove the released contact from the connector by pulling the contact wire at the rear of the connector (or, for unwired contacts, by pulling the contact at the rear of the connector with needle nose pliers).

Table 7 - Cannon Front Release Contact Removal Tools

Wire Barrel Size	Removal Tool
20	CET20
16	CET16

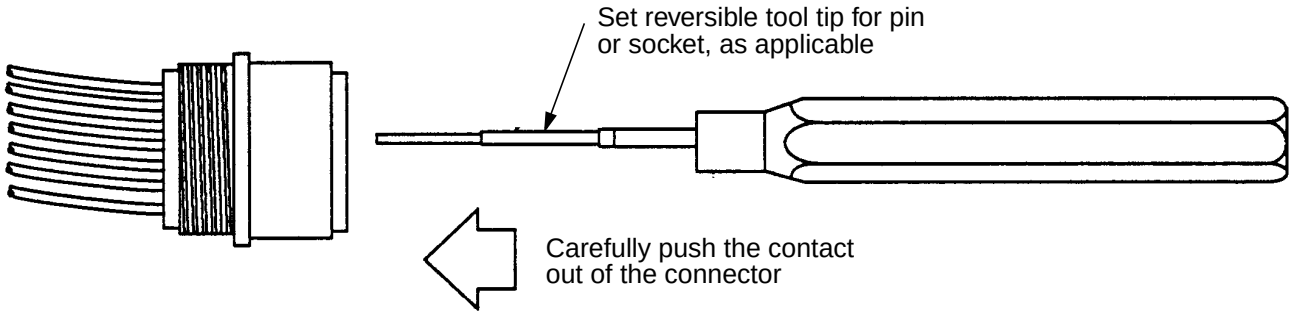


Figure 16 - Removal of Front Release Contacts using a CET Extraction Tool

5.12 Removal of Rear Release Crimp Type Contacts

5.12.1 Remove wired rear release crimp contacts as follows:

Step 1. Slide the securing hardware back up the wire bundle.

Step 2. Remove the contact using the contact removal tool specified in Table 8. It is recommended that an NPN-1024 inserter/extractor aid be used with the extraction tool; assemble the NPN-1024 inserter/extractor aid with the contact extraction tool as shown in Figure 7.

Table 8 - Rear Release Contact Removal Tools

Wire Barrel Size	Removal Tool
22D	M81969/14-01
22M	M81969/14-01
22	M81969/14-01
20	M81969/14-02
16	M81969/14-03
12	M81969/14-04

Note 1: Remove contacts from non-standard connectors using the removal tool recommended by the connector manufacturer.

Step 3. Place the wire of the contact in the groove of the tool (white end for M81969/14 type tools) and push the tool into the rear of the connector until it bottoms against the contact shoulder to release the contact retaining clip (see Figure 17).

Step 4. While maintaining a slight pressure on the tool, press the wire firmly against the serrated shoulder at the centre of the tool and pull back carefully on the wire and tool (see Figure 17).

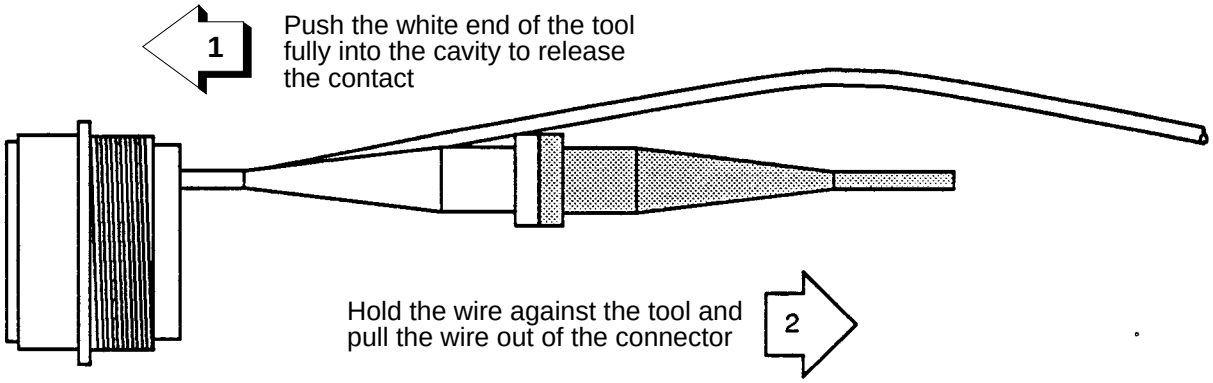


Figure 17 - Removal of Rear Release Contacts

5.12.2 Remove unwired rear release crimp contacts as follows:

Step 1. Slide the securing hardware back up the wire bundle.

Step 2. Remove the sealing plug.

Step 3. Remove the contact using the contact removal tool specified in Table 9.

Step 4. Carefully rotate while pushing the tool into the contact cavity until the tool tip bottoms against the contact shoulder to release the contact retaining clips (see Figure 18). Do not push the plunger in during insertion or removal of the tool.

Step 5. Pull the tool straight back out of the connector in a smooth even motion to extract the contact.

Step 6. Depress the plunger to eject the contact from the tool.

Table 9 - Unwired Rear Release Contact Removal Tools

Wire Barrel Size	Removal Tool
20	M81969/30-05
16	M81969/30-06
12	M81969/30-07

Note 1: Remove unwired contacts from non-standard connectors using the removal tool recommended by the connector manufacturer.

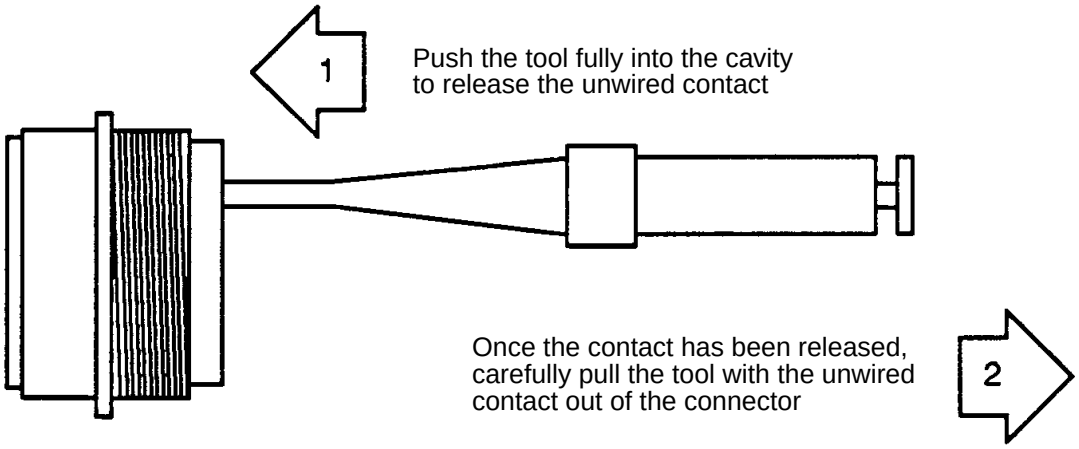


Figure 18 - Use of MS3448 Extraction Tool for Unwired Contacts

5.13 Installation of Connectors

5.13.1 Unless otherwise specified, ensure connector mounting plates used to secure connectors to the aircraft structure are oriented with the open portion (if any) of the mounting plate facing down (i.e., like an inverted “U”).

5.13.2 When installing single hole mounting receptacles (jam nut receptacles) on bulkheads, etc., torque the jam nut according to PPS 14.01 to the torque value specified on the engineering drawing. Refer to Table 10 for the torque values for MS3474 and MIL-C-38999/MIL-DTL-38999 jam nut receptacles.

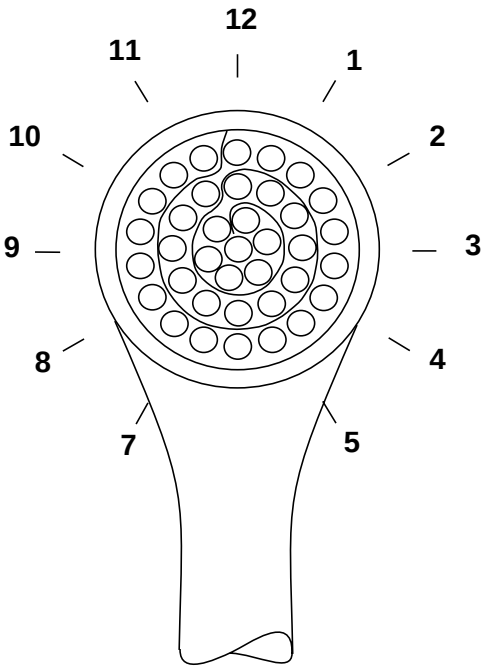
Table 10 - Torque Values for MS3474 and MIL-C-38999/MIL-DTL-38999 Jam Nuts

MS3474		MIL-C-38999/MIL-DTL-38999 Series I, III AND IV		MIL-C-38999/MIL-DTL-38999 Series II	
Shell Size	**Torque** (inch lbs)	**Shell Size**	**Torque** (inch lbs)	**Shell Size**	**Torque** (inch lbs)
8	25 - 30	9	30 - 36	8	46 - 50
10	30 - 35	11	40 - 46	10	55 - 60
12	40 - 45	13	55 - 60	12	70 - 75
14	55 - 60	15	70 - 75	14	80 - 85
16	65 - 70	17	80 - 85	16	90 - 95
18	80 - 85	19	90 - 95	18	100 - 110
20	90 - 95	21	100 - 110	20	110 - 120
22	105 - 110	23	110 - 120	22	120 - 130
24	115 - 120	25	120 - 130	24	140 - 150

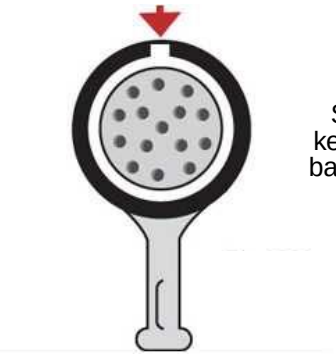
5.13.3 Wire lock jam nuts and coupling rings of threaded coupling connectors according to PPS 19.01.

5.13.4 Install flange mounted connectors with the master keyway located at the top when the connector axis is horizontal and forward when the connector axis is vertical.

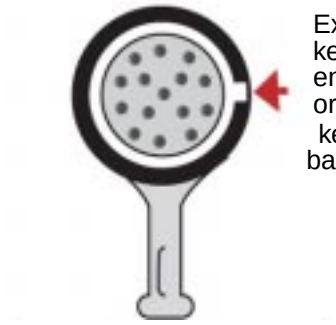
5.13.5 Unless otherwise specified on the engineering drawing or wire list, position the master keyway of connectors fitted with angle boots or backshells at the 12:00 position and the backshell at 6:00 (see Figure 19). Determine the clocking position by using the mating face of the connector as a reference.



Unless otherwise specified on the engineering drawing or wire list, position the master keyway of connectors fitted with angle boots or backshells at the 12:00 position and the backshell at 6:00.



STANDARD
keyway - 12:00
backshell - 6:00



Example: If 3:00 keyway specified by engineering drawing or wiring list
keyway - 3:00
backshell - 6:00

Figure 19 - Master Keyway Positioning

5.13.6 When installing connectors on pressure bulkheads, it is acceptable to use 4 **small** dabs of petroleum jelly (ref. para. 4.1.2) to hold the o-ring onto the connector, if necessary. Remove excess petroleum jelly.

5.13.7 If the engineering drawing specifies encapsulation of a connector, encapsulate according to PPS 9.17.

5.13.8 Unless otherwise specified, adjust the backshell clocking orientation as necessary to minimize possible abrasion of adjacent wire harnesses on the threaded ends of the backshell clamp screws.

5.13.9 Except as noted in para. 5.13.9.2, tighten connector coupling rings as follows.

- For connectors with ratchet type couplings, tighten the coupling until resistance increases sharply and the red band on the receptacle is obscured. Due to the nature of the ratchet mechanism, after full tightening the coupling ring may settle back slightly into the nearest locking groove; this condition is acceptable and is not indicative of loosening of the coupling ring.
- For connectors with bayonet type couplings with notched, ramped slots within the coupling ring (i.e., locking type), tighten the coupling ring until the pins drop into the notches to tension lock the ring in place (listen for an audible click just before the coupling ring locks into place). The coupling ring has holes at the notches and the pins will be visible in the holes when the coupling ring is properly tightened.
- For connectors with bayonet type couplings which engage on a plain thread (i.e., non-locking type), tighten the coupling ring by hand until finger tight and then final tighten with soft jawed pliers until the pliers slip.

5.13.9.1 For **all** types of coupling rings (i.e., ratchet type as well as locking and non-locking bayonet type coupling rings), after tightening the connector coupling ring apply a stripe mark of white tamper proof sealant onto the coupling ring overlapping onto the connector body. The mark must be a continuous stripe approximately 1/8" wide. For coupling rings which must be re-tightened, remove the original stripe mark before applying a new stripe mark. Inspection witnessing of tightening is **not** required unless otherwise specified on the engineering drawing.

5.13.9.2 For coupling of MS3459 connectors, tighten the coupling using a strap wrench fitted in a torque wrench according to PPS 14.01. Refer to Table 11 for the maximum torque which can be applied to tighten the coupling; if appropriate tightening of the coupling cannot be achieved using the maximum torque allowed by Table 11, the installation is not considered acceptable and appropriately authorized corrective action must be taken.

Table 11 - Maximum Allowable Coupling Force for MS3459 Connectors

MS3459 Shell Size	Maximum Coupling Torque (Note 1)	Maximum Free Rotating Torque (Note 2)
8S	12 inch-lbs	10 inch-lbs
10S	14 inch-lbs	
10SL		
12	16 inch-lbs	12 inch-lbs
12S		
14	20 inch-lbs	14 inch-lbs
14S		
16	24 inch-lbs	
16S		
18	30 inch-lbs	16 inch-lbs
20	40 inch-lbs	
22	46 inch-lbs	20 inch-lbs
24	55 inch-lbs	
28	66 inch-lbs	24 inch-lbs
32	78 inch-lbs	
36	93 inch-lbs	28 inch-lbs
40	106 inch-lbs	

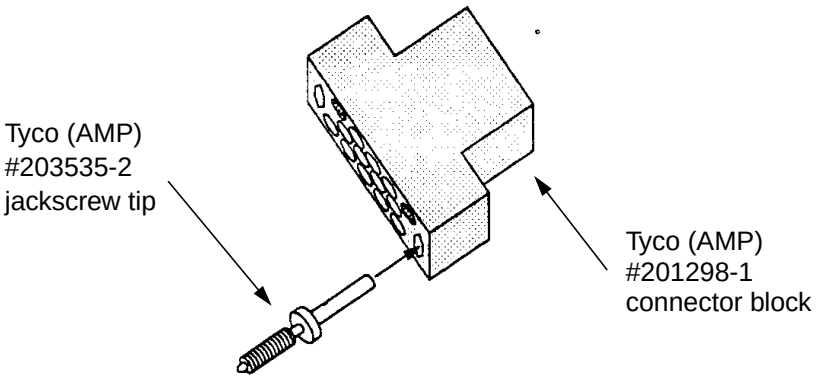
Note 1. Coupling torque is the force required to engage the coupling on the mating connector.

Note 2. Free rotating torque is the force required to turn the coupling in either direction when not engaging the mating connector. These values are provided for reference purposes only.

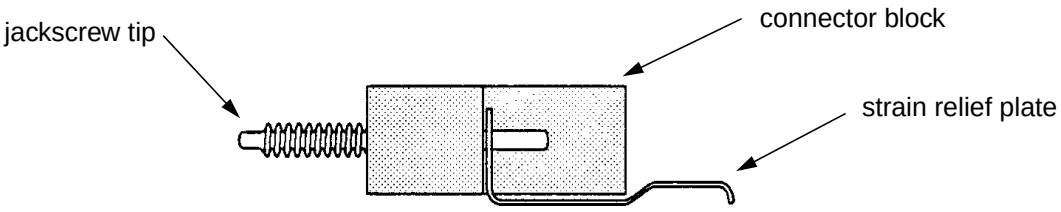
5.14 Assembly of Tyco (AMP) Ground Connectors (Kit Number 348523-1)

5.14.1 Assemble Tyco (AMP) ground connectors in the following sequence:

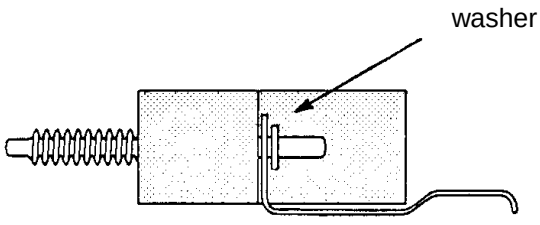
Step 1. Insert one of the Tyco (AMP) #203535-2 jackscrew tips through the Tyco (AMP) #201298-1 connector block as shown:



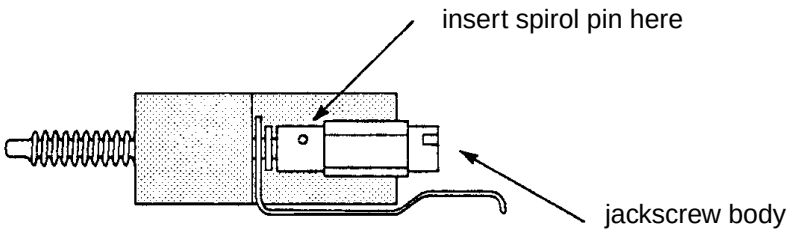
Step 2. Slip the Tyco (AMP) #200686-1 strain relief plate over the end of the protruding jackscrew tip as shown:



Step 3. Slip the washer over the end of the protruding jackscrew tip as shown:

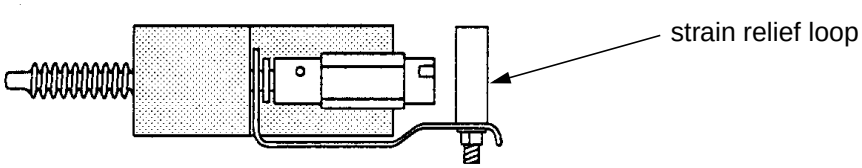


Step 4. Slip the jackscrew body over the end of the protruding jackscrew tip and secure with a spirol pin as shown:



Step 5. Repeat steps 1 through 4 for the other jackscrew.

Step 6. Assemble the strain relief loop to the strain relief plate as shown:



5.14.2 Crimp Tyco (AMP) #201328 contacts for the Tyco (AMP) ground connector using an Tyco (AMP) #601967-1 hand tool with a TH501 turret.

5.14.3 Insert contacts into the Tyco (AMP) ground connector using an Tyco (AMP) #200893-2 insertion tool.

5.14.4 If necessary, contacts can be removed from the Tyco (AMP) ground connector using an AMP #305183 extraction tool.

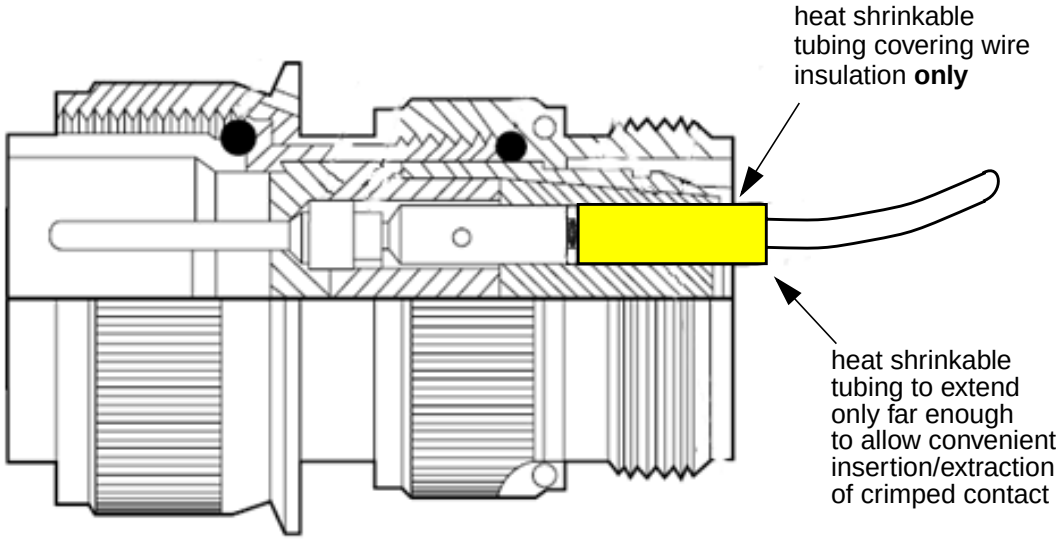
6 Requirements

6.1 The shield of shielded electrical cables must be terminated at connectors according to PPS 9.34.

6.2 Wires must be soldered to solder type contacts according to PPS 9.07.

6.3 Insulating sleeves must be tied in place using a plastic cable tie according to PPS 9.04 (see Figure 3).

6.4 Crimp type contacts must be crimped onto wires according to PPS 9.36. If filler wire has been used (i.e., when crimping a smaller AWG wire into a larger AWG contact), ensure that a suitable length of M23053/5 heat shrinkable tubing has been shrunk onto the lead wire to "build-up" the wire outside diameter of the lead wire in the area of the rubber seal of the connector so that a hermetic seal is ensured, as shown below. Ensure the heat shrinkable tubing does not extend past the end of the wire insulation; under no circumstances shall the heat shrinkable tube extend over **any** part of the crimped contact. It is not necessary or desirable for the heat shrinkable tubing to extend any considerable distance outside the rubber seal of the connector; the heat shrinkable tubing should extend only far enough to allow convenient insertion/extraction of the contact, as necessary.



6.5 Contacts must be inserted using the plastic insertion tool supplied with the connector. If an insertion tool was not included with the connector, the contact shall be inserted using the insertion tool specified in Table 2 or Table 4, as applicable.

6.6 Contacts must be firmly seated within the connector cavity.

6.7 Unfilled connector cavities in rectangular connectors do not require any additional form of environmental sealing.

6.8 If specified on the engineering drawing or wiring list, plug unused contact cavities of circular connectors with unwired contacts.

6.9 All circular connector grommet holes that do not contain wired contacts must be plugged by plastic sealing plugs as specified in Table 5.

6.10 Circular connector backshells must be assembled and tightened to the connector body using the tools specified in section 5.8.

6.11 If a heat shrinkable boot is going to seal the connector or it is necessary to prevent loosening of the back shell during handling, the back shell must be assembled onto the connector with Grade M anaerobic sealant according to PPS 19.02.

6.12 Wires must be protected at the point of clamping with 1 1/2 to 2 turns of the tape or strips specified by the engineering drawing. Except for connectors on the Lear 45 fuel tank harness, if the engineering drawing does not specify use of a particular type of tape or strips, wires must be protected at the point of clamping using Guideline tape. For connectors on the Lear 45 fuel tank harness, if the engineering drawing does not specify use of a particular type of tape or strips, wires must be protected at the point of clamping using Teflon strips. The clamp must grip the wires firmly in place without crushing or straining them. Except when terminating terminal lugs at the strain relief clamp, gaps between the clamps and clamp support after tightening as shown in Figure 13 are acceptable even if this allows some lateral movement of the harness with the clamps on the clamp support. Refer to PPS 9.04 (DASH 8 Series 100, 200 & 300 aircraft) or PPS 9.39 (Dash 8 Series 400 aircraft) for requirements for termination of terminal lugs at strain relief clamps. If the engineering drawing specifies the addition of a diode assembly in the connector, ensure that the diode is not covered with tape or strips; if the positioning of a diode is such that it would be covered with tape or strips, refer to Liaison Engineering.

6.13 Backshell clamp screws must protrude beyond the nut a minimum of the full round or chamfer; in the case of flat end screws, the threaded end must protrude a minimum of 1/32" or 1 1/2 threads, whichever is greater.

6.14 Securing hardware on rectangular connectors must be fastened to the wire loom by means of a MS3447 tie-wrap. The wire loom must be wrapped with Guideline tape in the area of the tie-wrap.

6.15 All unmated connectors must be protected with suitable dust caps or plastic bags to prevent contamination during transportation or storage.

6.16 All unused hardware on **fully** assembled and installed connectors (i.e., unused grounding screws) must be tightened or removed.

6.17 Wire harnesses must not be bent or coiled to a radius of less than 6 times the diameter of the harness.

6.18 Nuts, bolts and screws must be torqued according to PPS 14.01.

6.19 Circular connector cavities that have not been filled with wired contacts must be plugged according to section 5.7.

6.20 Unless otherwise specified, backshell clocking orientation may be adjusted to minimize possible abrasion of adjacent wire harnesses on the threaded ends of the backshell clamp screws. Backshell clamp screws must be oriented in direction to minimize possible abrasion of adjacent wire harnesses on the threaded ends of the backshell clamp screws.

6.21 Wires must be routed directly to termination cavities with minimal crossing of wires.

6.22 For all wires, including those terminating at connector backshells with 45° and 90° strain relief, it is imperative that the wires enter perpendicular (i.e., $90° \pm 2°$) to the connector grommet. Any distortion of the grommet caused by strain on the wire is unacceptable.

6.23 Ensure **clearance** between the insulation of wires terminating at a connector backshell and any edge of the connector backshell or surrounding structure/equipment.

7 Safety Precautions

7.1 The safety precautions specified herein are specific to Bombardier Toronto (de Havilland) to meet Canadian Federal and Provincial government environmental, health and safety regulations. It is 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 general shop safety precautions when performing the procedure specified herein.

7.3 Ensure sufficient ventilation when applying tamper proof sealant, especially in confined areas.

7.4 Avoid skin and eye contact with tamper proof sealant. Wear chemical resistant protective gloves when applying tamper proof sealant. If skin contact occurs, wash the affected area immediately and thoroughly with soap and water. If eye contact occurs, immediately flush eyes with large quantities of water at an eye-wash station; after initial flushing, remove any contact lenses and continue flushing for at least 15 minutes. Report any contact with tamper proof sealant to the Health Centre. Take care when applying tamper proof sealant in overhead applications to avoid applying excess sealant, as drips may result.

8 Personnel Requirements

8.1 Personnel responsible for the assembly of connectors must have a good working knowledge of the procedure and requirements as specified herein and shall have exhibited their competency to their supervisor.

9 Additional Points to Note

9.1 It is extremely important that all the provisions of this PPS be observed when assembling connectors, especially aircraft feeder cable connector terminations, as improper assembly could result in significant consequences to the aircraft in operation (e.g., fire may result if aircraft feeder cable connector terminations are improperly assembled, see following figure).