BOMBARDIER
Toronto (de Havilland)
PROPRIETARY INFORMATION

PPS 9.07

PRODUCTION PROCESS STANDARD

Soldering of Electrical Terminals

Issue 19
- This standard supersedes PPS 9.07, Issue 18.
- Vertical lines in the left hand margin indicate technical changes over the previous issue.
- This PPS is effective as of the distribution date.
- Validation of issue status is the responsibility of the user. Signed original on file.

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1 Scope

1.1 This Production Process Standard (PPS) specifies the procedure and requirements for soldering of wires to electrical terminals.

1.1.1 This PPS complements the engineering drawings that specify its use as an authorized instruction. The procedure specified in this PPS must 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.

1.1.3 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 9.14 - Handling Procedures for Static Sensitive Electronic Devices.

3.2.2 PPS 9.24 - Wire and Cable Stripping.

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

3.2.4 PPS 13.13 - Personal Protective Respiratory Equipment.

3.2.5 PPS 13.26 - General Subcontractor Provisions.

3.2.6 PPS 31.17 - Manual Solvent Usage.

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 Solder (rosin flux cored) to IPC J-STD-006, for soft soldering, as specified in Table 1.

4.1.3 Liquid soldering flux to IPC J-STD-004, as specified in Table 1.

4.1.4 Teflon sleeving, Commercial Plastics TFT200.

4.1.5 Continuous run jumper, bus wire to QQW343S22S1T.

4.1.6 Heat shrinkable tubing, bulk length, M23053/8-0XX-C (clear semi-rigid cross-linked polyvinylidine fluoride - Kynar). Refer to PPS 10.16 for the identification code breakdown.

Table 1 - Solder and Flux Selection

Wire to be Soldered	**Solder** (IPC J-STD-006)	**Flux** (IPC J-STD-004)
tin plated wire or silver plated wire	Sn60Pb40 (60% Tin/40% Lead)	Rosin base liquid flux
	Sn63Pb37 (63% Tin/37% Lead)	
	Sn63Pb37 “No clean” flux core solder	“No clean” liquid flux
nickel plated wire	Sn96.3Ag3.7 (96.3%Tin/3.7% Silver)	Rosin base liquid flux

4.2 Equipment

4.2.1 Soldering equipment capable of heating the solder joint to the required temperature without damaging the wire, terminal or wire insulation. See below for examples of approved soldering equipment used with tin/lead solder.

- Pace Resistance Soldering System: Pulse Heat Power Source (Model PR-10) with Pulse Heat Resistance Tweezer (Model TW-20-02)
- Pace Soldering System (Model SX-301): PPS-51 Power Source with Zero-Power Switching, SX-25 NO CLOG Dual Path Solder Extractor, deluxe soldering iron, hot cubby unit with wet/dry wipe facilities, cleaning brushes and tip kit
- Soldering irons, copper or iron clad tipped. Refer to Table 2 for a listing of the recommended sizes.
- Solder pots for dip tinning, thermostatically controlled to maintain solder at 400°F - 425°F (204°C - 218°C). Skim the surface of the molten solder in the solder melting pot using a metal spoon as often as necessary to keep it free of oxide and other contaminants.

4.2.2 Solder wick (e.g., Solder-Wick Fine Braid).

4.2.3 Solder smoke absorber/remover/fume extractor (e.g., 110V HAKKO Solder Smoke Absorber Remover Fume Extractor).

Table 2 - Selection of Soldering Irons

Wire Gauge (AWG)	Soldering Iron
26 - 20	35 watt
18 - 14	50 watt
12 - 10	60 watt, hatchet
8 - 6	150 - 300 watt

Notes 1. If a relatively small gauge wire is being soldered onto a larger terminal a more powerful soldering iron may be needed.

5 Procedure

5.1 General

5.1.1 Maintain strict cleanliness when soldering.

5.1.2 Apply solder sparingly. A properly soldered joint with just sufficient solder coverage is stronger and more efficient than a solder joint that has had excessive solder applied.

5.1.3 Adjust heat application so that a minimum amount of time is required to solder the joint. If insufficient heat is applied it will take longer for the solder to flow properly and may lead to burning the wire lead insulation.

5.1.4 Avoid any form of forced cooling of the solder joint as forced cooling will result in pits or fractured solder joints.

5.1.5 Flux will aid the flow of the solder and help prevent dewetting or non-wetting of the solder joint through its cleaning action. However, the flux is activated at a temperature just below that at which the solder will flow so it is important to wait until the solder flows freely before soldering the joint. Failure to allow the solder to flow freely before soldering the joint will result in cold solder joints, dewetting, non-wetting or rosin or flux joints. Take care to ensure that type of liquid flux used is compatible with the solder used (i.e., if using “No clean” solder then use “No clean” Type LRL liquid flux or if using rosin flux cored solder then use rosin based liquid flux).

5.1.6 Handling of the solder joint or hook-up before cooling will result in unacceptable disturbed solder joints.

5.1.7 Perform soldering of lead wires to terminals mounted on printed circuit boards and subsequent verification of the solder joints at static-free work stations. Refer to PPS 9.14 for details of static-free work stations and standard handling procedures.

5.1.8 Unless otherwise specified by Methods documentation, for wires or harnesses that terminate at soldered electrical terminals it is recommended that soldering be performed after harness lay-out in order to avoid the danger of damaging the solder joint.

5.1.9 Always handle harnesses, assembles, etc. including soldered connections with care to avoid damage such as fractured soldered joints.

5.2 Stripping of Wire Ends

5.2.1 Strip the wire insulation from wire ends according to PPS 9.24.

5.3 Pre-Solder Cleaning

5.3.1 Before hook up of wires, remove any scale or dirt on terminals using a fine abrasive. After abrasive cleaning, solvent clean terminals with a bristle brush and the solvent specified in PPS 31.17. After solvent cleaning, dry the terminal by wiping with a tissue. When solvent washing in the area of DIP switches, relays, etc., take care to avoid contact of the solvent with the components.

5.3.2 Before tinning, solvent clean wire leads with a bristle brush and the solvent specified in PPS 31.17 to remove any oil, or grease (e.g., finger oils). Do not disturb the lay of the wire strands when solvent cleaning. After solvent cleaning, dry the wire lead by wiping with a tissue.

5.3.3 Do not touch cleaned terminals or wires with bare fingers. Wear clean cotton gloves to avoid contamination.

5.4 Tinning

5.4.1 Tin the soldering iron tip by heating the iron to maximum temperature and then contacting the tip with solder before wiping the iron with a single motion on a water dampened sponge.

5.4.2 Tin all stripped wire leads before soldering.

5.4.2.1 Tin stripped wire leads using a soldering iron as follows.

Step 1. Place the wire in a clamp and brush liquid flux along the stripped length to within approximately 1/16" of the wire insulation. Alternatively, it is acceptable to dip the wire end in a pot of liquid flux, but only to within approximately 1/16" of the wire insulation.

Step 2. Place the solder and the soldering iron approximately halfway along the length of the stripped length and wipe towards the insulation to within approximately 1/8" before reversing direction and wiping off the end of the wire.

5.4.2.2 Dip tin wire ends as follows.

Step 1. Brush liquid flux onto the stripped end of the wire to within approximately 1/16" of the insulation. Alternatively, it is acceptable to dip the wire end in a pot of liquid flux, but only to within approximately 1/16" of the wire insulation.

Step 2. Dip the fluxed end of the wire into the solder pot to within approximately 1/8" of the insulation.

5.5 General Requirements for Mechanical Hook Up of Terminals

5.5.1 Allow wires to curve smoothly to their place of attachment with no sharp bends.

5.5.2 Position the larger leads below the smaller leads if soldering various sizes of wire leads to the same terminal.

5.5.3 Use smooth jawed, round nosed pliers to form the wire around the terminal to the proper turn position. Ensure to locate the end of the insulation 1/32" - 3/32" away from the terminal.

5.5.4 Ensure that the connection is mechanically secure to prevent movement during the soldering operation.

5.6 Mechanical Hook Up of Bifurcated Terminal Assembles

5.6.1 Wrap the wire lead approximately 270° around the fork (see Figure 1). If soldering two or more wire leads to one bifurcated terminal, wrap the wires alternately on each fork.

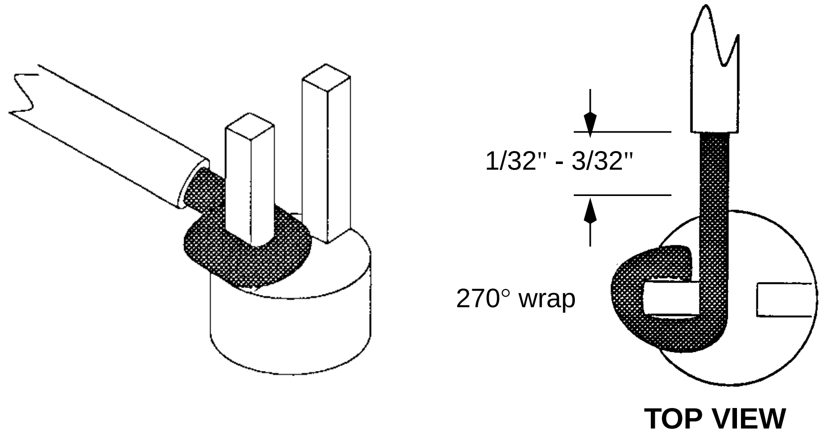

Figure 1 - Mechanical Hook-Up of Bifurcated Terminals

5.7 Mechanical Hook Up of Hook Terminal Assemblies.

5.7.1 Wrap the wire lead approximately 270° around the hook as shown in Figure 2

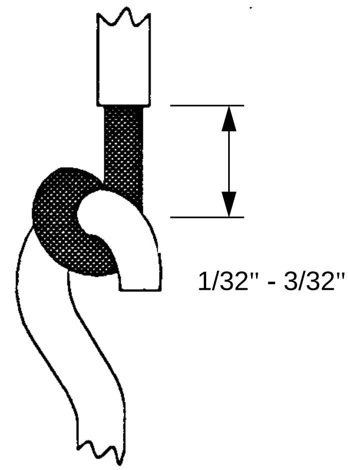

Figure 2 - Mechanical Hook-Up of Hook Terminals

5.8 Mechanical Hook Up of Pierced or Eyelet Terminal Assemblies

5.8.1 Wrap the wire end approximately 270° through the eyelet (see Figure 3).

5.8.2 If connecting two wires to a single pierced or eyelet terminal and the slot or hole in the terminal is not large enough to admit both wires, hook up the wires as follows:

Step 1. Strip one of the wires back an additional 1/2" (approximately).

Step 2. Wrap the other wire around the stripped back portion.

Step 3. Maintain an insulation gap of 1/32" - 3/32" for both wires

Step 4. Wrap the protruding wire end approximately 270° through the eyelet.

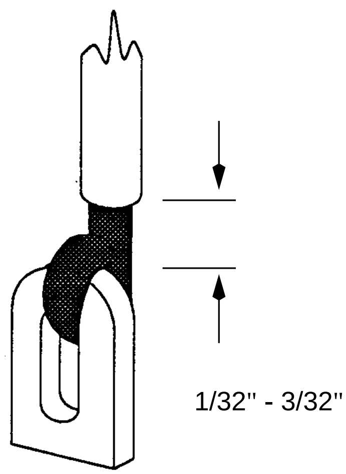

Figure 3 - Mechanical Hook-Up of Eyelet Terminals

5.9 Mechanical Hook Up of Pin Terminal Assemblies.

5.9.1 When soldering small gauge wire to pin terminals, wrap the wire lead once or twice (360° - 720°) around the pin to ensure a mechanically sound connection (see Figure 4).

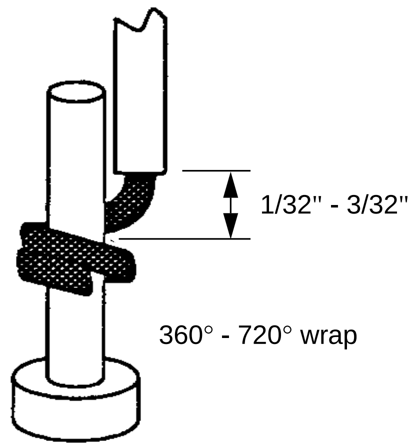

Figure 4 - Mechanical Hook-Up of Pin Terminals

5.10 Mechanical Hook Up of Turret Terminal Assemblies.

5.10.1 Wrap wire ends approximately 270° around the post without extending below the terminal base or flange (see Figure 5)

5.10.2 Hook up the wire lead at the base/lower post junction or similarly at the top shoulder/upper post junction.

5.10.3 All wire leads on a single terminal shall wrap in the same direction with the larger leads connected below the smaller leads.

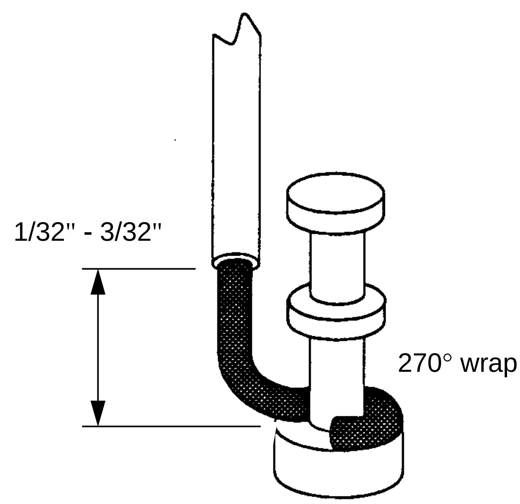

Figure 5 - Mechanical Hook-Up of Turret Terminals

5.11 Mechanical Hook Up of Continuous Run Jumper Wires

5.11.1 For bifurcated, turret and pierced or eyelet terminals to be connected in a continuous series (e.g., eyelet terminals on rotary switches) it is acceptable to connect the terminals as shown in Figure 6 by means of a continuous run jumper of bus wire to QQW343S22S1T in place of a series of single jumpers provided that the wiring diagram or schematic does not explicitly specify the type of jumper wire to be used. Insulate the bus wire between terminals using either heat shrinkable sleeving according to PPS 10.16 or Teflon sleeving (see Materials section, para. 4.1.4). Continuous run jumpering of feed through, hook or pin type terminals is not permitted.

5.11.2 Hook up the jumper wire so that it curves smoothly with no sharp bends.

5.11.3 Hook up continuous run jumper wires so that the jumper wire wraps approximately as shown in Figure 6.

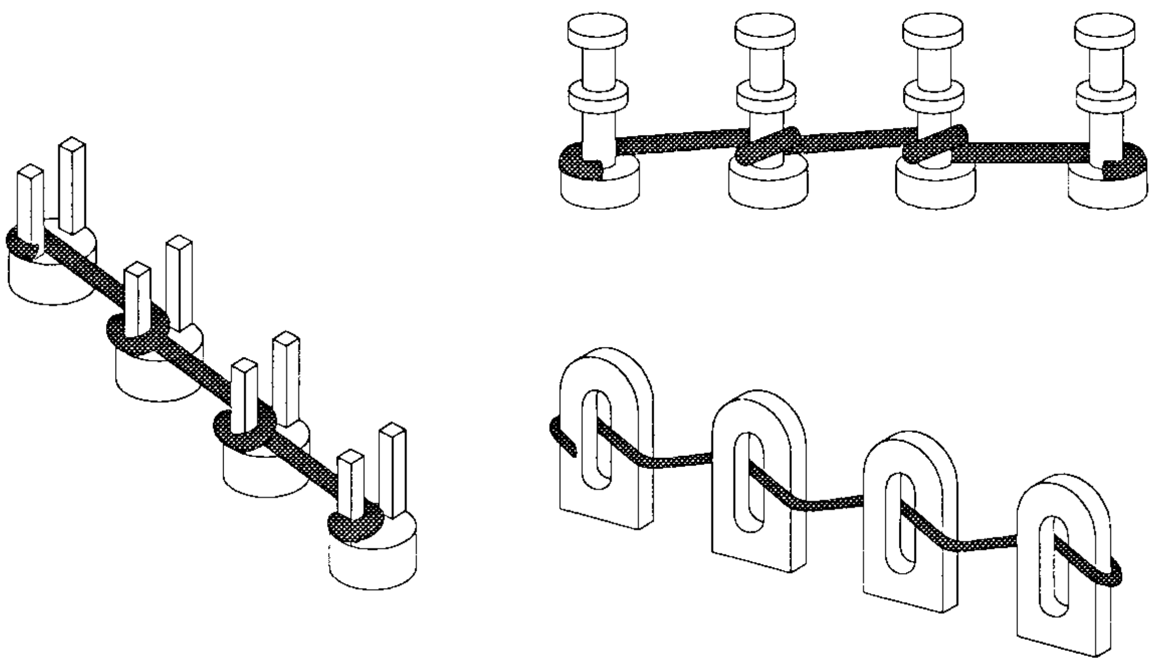

Figure 6 - Continuous Run Jumper

5.12 General Soldering Practices

5.12.1 Unless otherwise specified by the engineering drawing, oversleeve all exposed solder joints with M23053/8-0XX-C clear heat shrinkable tubing (e.g., joints which will not be covered by encapsulation sealing). Cut the heat shrinkable tubing to a length that will completely cover the solder joint and also the wire or cable insulation a length 3 - 5 times the wire or cable diameter when shrunk in place. Before assembling and soldering the joint, slide the heat shrinkable tubing along the wire, out of the way, until after the solder joint has been completed and cooled, and then shrink the heat shrinkable tubing over the joint according to PPS 10.16.

5.12.2 Unless otherwise specified by the engineering drawing, use the same type of solder and liquid flux for soldering as was used for tinning the lead wire (i.e., if rosin flux cored solder and rosin base liquid flux was used for tinning then use rosin flux cored solder and rosin base liquid flux for soldering; if “No-clean” flux cored solder and “No-clean” liquid flux were used for tinning then use “No-clean” flux cored solder and “No-clean” liquid flux for soldering).

5.12.3 Just before soldering, apply a small amount of liquid flux (two drops typically) to the terminal and the tinned wire lead junction. When soldering terminals on devices such as switches, connectors, relays, etc., orient (tilt or rotate) the device so that flux will not enter the device during the soldering process.

5.12.4 Wipe the soldering iron tip, with a single motion, on a water dampened sponge just before making each connection. This will remove the oxide film which forms on the tip of the soldering iron. Refer to Table 3 for the recommended type of soldering tip.

5.12.5 Place the soldering iron tip on the terminal near the terminal and lead wire junction so that the majority of the heat is applied to the larger mass of the terminal. Rest the soldering iron tip on the terminal without exerting any pressure. Place the soldering iron tip on the lowest portion of the terminal, if possible. It is often helpful to form a solder bridge right after placing the soldering iron tip on the joint to aid heat transfer. Ensure that there is no movement of the conductor when the tip is applied to the connection. Keep the soldering iron as far away from the wire insulation as possible.

5.12.6 The joint has reached the proper temperature to add solder when the solder of the solder bridge melts and flows into the joint.

5.12.7 Apply solder as soon as the solder of the solder bridge melts and flows into the joint. Apply solder to the part of the connection furthest away from the soldering iron tip. “Paint” the solder onto the joint lightly, using only enough solder to cover the joint, leaving the wire strands visible and creating a slightly concave fillet with a feather edge.

5.12.8 Use a soldering iron and tip that will allow completion of the connection within 5 seconds. Hold the heating time to a minimum to prevent damage to insulation or components and to avoid burning or carbonizing of flux. Use heat sinks to prevent damage to heat sensitive components, if necessary. Do not exceed 5 seconds of heat application, at one time, to any single connection.

5.12.9 Take care not to damage adjacent components, previously installed, when soldering. When soldering wires to miniature connectors, take care to prevent damage to insulation.

5.12.10 If soldering eyelet or pierced terminals, apply only sufficient solder to cover the wire and form a fillet between the terminal and the wire on both sides. It is not necessary to fill the eyelet with solder.

5.12.11 Remove the solder strand from the joint before removing the iron.

5.12.12 Do not handle or disturb the connection until the solder has completely cooled. If necessary, use supporting and locating clamps to hold wires in position while soldering and cooling.

5.12.13 Do not force cool the solder joint by blowing, fanning or any other means.

5.12.14 If soldering connections to closely spaced terminals, it is often easier to use Pulse Heat Resistance Tweezers.

5.12.15 If soldering unsecured terminal assemblies, use a holding fixture to avoid handling shock to the joint, if possible.

Table 3 - Soldering Iron Tips for Terminal Applications

Terminal Type	Recommended Soldering Iron Tip
bifurcated	pyramid or short taper chisel
hook	blunt or conical
pierced eyelet	narrow semi-chisel or pyramid
pin	pyramid or short taper chisel
solder cup	chisel or screw driver
turret	chisel or screw driver

5.13 Soldering of Cup Terminal and Co-Axial Cable Pin Assemblies

5.13.1 Solder cup terminals and coaxial cable pin assemblies as follows:

Step 1. Place a length of tinned wire lead in the cup, ensuring that the wire end bottoms in the cup, and trim level with the top of the cup. Use the length of this trimmed piece to determine the proper length, including insulation gap, for the wire lead.

Step 2. Trim and insert a length of solder into the cup. Insert enough solder so that the solder and wire lead will fill the cup.

Step 3. Place the resistance tweezers, or soldering iron, on the cup and heat the solder until it melts and then insert the wire end, ensuring the wire end bottoms in the cup.

Step 4. Before removing the heat, agitate the wire end in the cup to release any entrapped flux.

Step 5. Allow the joint to cool.

5.14 Post Soldering Cleaning

5.14.1 If the joint was soldered using rosin flux cored solder and rosin based liquid flux, solvent clean the solder joint after the solder has cooled using a stiff bristle brush and the solvent specified in PPS 31.17 to remove all traces of soldering flux. Take care when solvent cleaning in the area of DIP switches, relays, etc., to avoid contact of the solvent with the components. After solvent cleaning, dry the solder joint with a clean tissue.

5.14.2 If the joint was soldered using “No clean” flux cored solder (e.g., Kester #245 or IF 14 solder) and “No clean” liquid flux, post soldering cleaning is not required.

5.15 Removal of Solder

5.15.1 If solder connections require repair, remove the solder from the joint using the NO CLOG Dual Path Solder Extractor or a solder wick.

6 Requirements

6.1 Soldering and wiring shall be uniform in appearance and shall meet the requirements of the engineering drawing.

6.2 The hook up of wires to terminals shall be as specified in this PPS. Insufficient or excessive anchoring is not acceptable.

6.3 Acceptable solder joints (see Figure 7) shall have a shiny surface, show a wetting action on all surfaces of the solder joint, a slightly concave fillet and a feather edge.

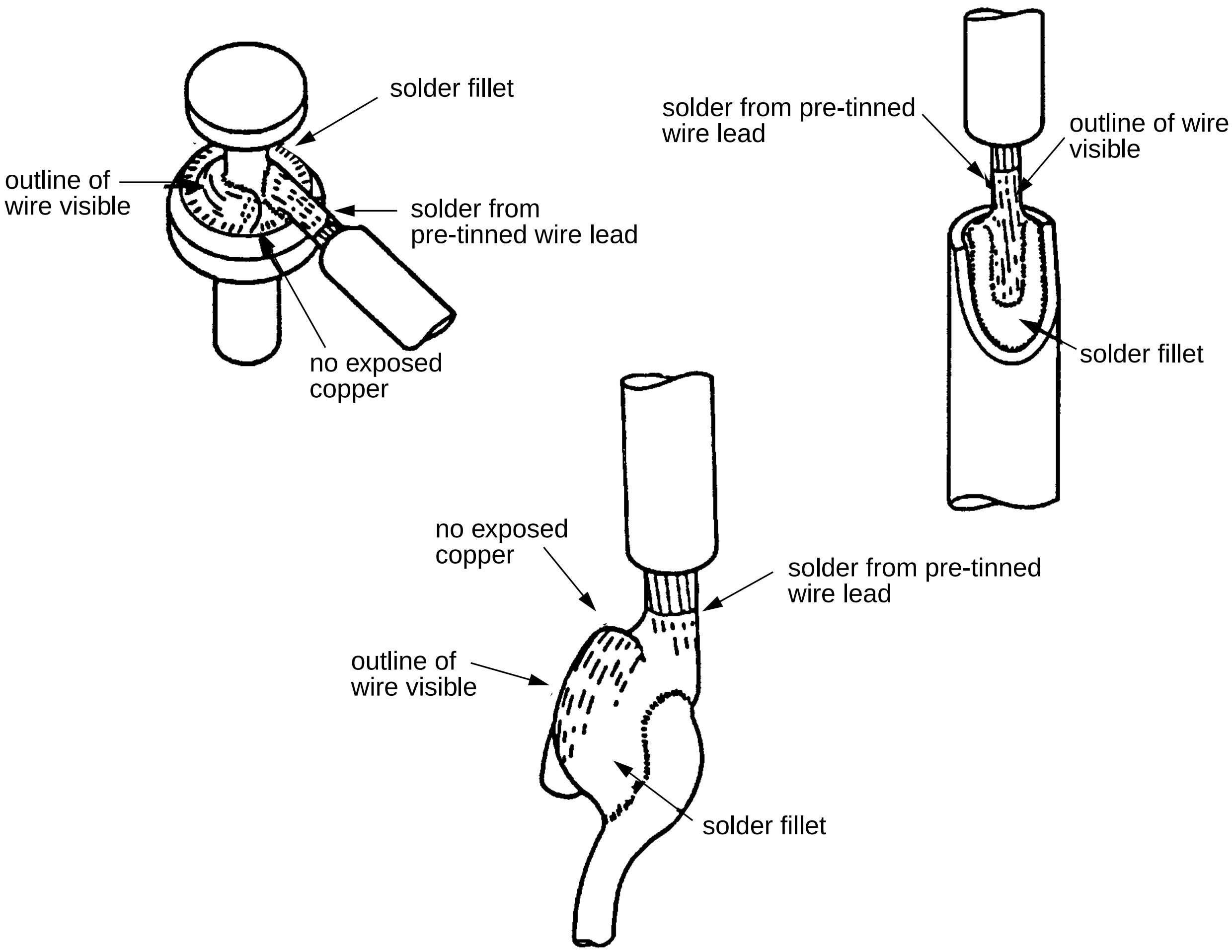

Figure 7 - Acceptable Solder Joints

6.4 Stranded wires shall be tinned as specified herein before soldering onto terminals or into solder cups and co-axial pins.

6.5 Clearance between the solder joint and the wire insulation shall be 1/32" - 3/32".

6.6 Refer to Table 4 for a listing of unacceptable defects. Use magnification aids in the range of 4X to 10X to check solder joints.

Table 4 - Solder Defects

DEFECT	DESCRIPTION	USUAL CAUSES	PREVENTIVE ACTION
cold solder	- the solder usually appears dull and crystalline - the solder may be shiny and smooth - solder appears stacked or piled up	- under heated solder - joint disturbed during cooling - improper solder flow - improper wetting action	- increase heat - increase dwell time - do not handle the joint or components during the cooling cycle
disturbed solder	- the solder has a dull, porous and crystalline appearing surface - under magnification the solder may reveal cracks or fractures	- handling shock during the cooling cycle - movement between the lead and the terminal during the soldering operation (i.e. springback)	- allow the solder to fully solidify before handling - ensure that the mechanical connection is tight before soldering - avoid exerting excessive pressure with the soldering iron tip during the soldering operation
rosin or flux joint	- the solder usually appears dull and crystalline - the solder may be shiny and smooth - solder appears stacked or piled up. - joint show evidence of rosin entrapped within the joint - condition results from an under heated solder joint; the flux has not been heated sufficiently to produce the cleaning action - due to poor flow and wetting action raw flux (under heated) is trapped within the joint and will seep out	- insufficient heat applied	- ensure joint elements are heated sufficiently to melt and flow the solder freely (flux will activate just before solder flow)

Table 4 - Solder Defects

DEFECT	DESCRIPTION	USUAL CAUSES	PREVENTIVE ACTION
insufficient solder	- the terminal or lead shows exposed base metal in the area of the solder joint - the absence of a solder fillet between the terminal and the conductor	- improper solder flow - improper wetting action - improper application of heat - improper application of flux - improper application of solder - insufficient solder applied to the joint	- improve method of applying heat, flux or solder
excessive solder	- contour of conductor is completely obscured - solder overflow beyond the confines of the area being soldered	- insufficient heat, allowing the solder to solidify too rapidly - improper solder flow - improper wetting action - excessive solder applied to the joint	- improve method of applying heat, flux or solder
non-wetting	- non-wetting is distinguished from the surrounding areas of solder coated material by exhibiting its original bare un-coated base metal - condition produced when molten solder contacts the metal surface and recedes with none of the solder adhering to it	- improper flux application - improper solder application - improper heat application	- improve method of applying flux, heat and solder - ensure that solder joint elements and tools are clean before soldering - increase amount of flux applied to joint

Table 4 - Solder Defects

DEFECT	DESCRIPTION	USUAL CAUSES	PREVENTIVE ACTION
dewetting	- the solder appears dull and depleted in contrast to the shiny and more thickly coated surrounding areas - condition produced when molten solder contacts the metal surface and recedes, leaving only a thin film of solder on it	- improper flux application - improper solder application - improper heat application	- reduce dwell time during heat application - ensure that solder joint elements and tools are clean before soldering - increase amount of flux applied to the joint
wicking	- solder extending under the lead insulation - some wicking is normal but should not distort or damage the insulation - wicking of solder under the insulation of a length more than 1/4" is not acceptable	- wicking is the result of capillary action drawing the solder up between the strands of the lead - excessive heat, dwell time or solder	- apply only enough solder to bind the wire strands when tinning stranded connectors and only enough to wet the connection and form a light fillet when soldering terminal connections
fractured solder joint	- the solder has cracked or broken between the joint elements	- mechanical stresses during the cooling cycle - thermal stresses during the cooling cycle - stresses due to design application	- allow the solder to fully solidify before handling - allow the solder to solidify without forced cooling such as blowing or fanning
over heated solder	- the solder has a chalky, dull or crystalline appearance - solder shows evidence of coarse grain porosity or pitting	- excessive heat - excessive dwell time	- reduce heat - reduce dwell time
pits	- small holes occurring as imperfections in the surface of the solder which penetrate entirely through the solder to the base metal	- contaminants or dross on the soldering iron tip - flux and oxide contaminants on the solder surface - too rapid cooling	- ensure that the soldering iron tip has been properly tinned - ensure that the surfaces to be soldered are clean and all surface oxides have been removed - do not force cool the solder joint

Table 4 - Solder Defects

DEFECT	DESCRIPTION	USUAL CAUSES	PREVENTIVE ACTION
pin holes	- small holes occurring as imperfections in the surface of the solder which penetrate entirely through the solder to the base metal	- contaminates and oxides on the surface to be soldered - failure of flux to clean surface - dirty or improperly tinned soldering iron tip	- ensure that the surfaces to be soldered are clean and all surface oxides have been removed - increase flux application or use a more active flux - ensure that the soldering iron tip has been properly tinned and is kept clean
solder projections	- solder projections (i.e. icicles, spikes, bridges, etc.) are undesirable protrusions from a solidified solder joint	- insufficient heat causing the solder to “follow tip” when removed from the connection - insufficient dwell time resulting in solder elements which are not hot enough to flow the solder properly - excessive solder applied	- ensure that the soldering iron and tip are big enough for the job - ensure that the soldering iron tip is properly tinned and cleaned - ensure that the surfaces to be soldered are hot enough to melt and flow the solder properly before applying the solder - apply only enough solder to wet and bond the connection

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 Take care to ensure that personnel are not accidentally burned by the hot iron or solder.

7.4 Never leave hot irons unattended when powered; power down hot irons (turn off) and place on the bench in holders when not in use.

7.5 Do not eat or drink in soldering areas. Always wash your hands after soldering, especially before eating.

7.6 Take care to avoid inhaling the fumes generated when soldering. If possible, soldering shall be performed in an area equipped with a solder smoke absorber/remover/fume extractor (ref. para. 4.2.3**, see** Figure 8**); if a solder smoke absorber/remover/fume extractor is not available or impractical, wear a NIOSH approved air-purifying respirator equipped with an organic vapor cartridge/P100 filter according to** PPS 13.13**.**

Figure 8 - Solder Smoke Absorber/Remover/Fume Extractor

8 Personnel Requirements

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