BOMBARDIER
Toronto Site
PROPRIETARY INFORMATION

PPS 6.22

PRODUCTION PROCESS STANDARD

ASSEMBLY AND INSTALLATION OF DEUTSCHLITE AXIAL SWAGE FITTINGS

Issue 13 - This standard supersedes PPS 6.22, Issue 12.
- Vertical lines in the left hand margin indicate technical changes over the previous issue.
- Direct PPS 6.22 related questions to michael.wright@aero.bombardier.com.
- This PPS is effective as of the distribution date.

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1 Scope

1.1 This Production Process Standard (PPS) specifies the procedure and requirements for assembly and installation of Deutschlite axial swaged fittings.

1.2 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.

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

1.2.2 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 Site), all materials must be approved and assigned Material Safety Data Sheet (MSDS) numbers by the Bombardier (Toronto Site) 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 Site) 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 Site) Specifications

3.2.1 PPS 6.03 - Installation of Fluid Lines and Fittings.

3.2.2 PPS 6.10 - Cleaning of Fluid System Components.

3.2.3 PPS 6.12 - Pressure Testing Hydraulic Components, Fuel and Bleed Air Lines.

3.2.4 PPS 13.26 - General Subcontractor Provisions.

3.2.5 PPS 13.39 - Bombardier Toronto Engineering Process Manual.

3.2.6 PPS 27.05 - Manual Edge Finishing.

3.2.7 PPS 31.17 - Solvent Usage.

4 Materials, Equipment and Facilities

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 Deutschlite axial swage fittings as specified by the engineering drawing.

4.1.3 Abrasive pads (e.g., Scotch-Brite pads, Type A Fine, maroon colour).

4.2 Equipment

4.2.1 Manual or hydraulic pump, maximum pressure 10,000 psig.

4.2.2 Deutschlite tool kit as specified in Table 1 (see Figure 1), certified according to section 5.2.

4.2.3 Non-chlorine/non-graphite marking pen (e.g., Deutsch DLT5301-000-01) suitable for use on aluminum and titanium tubing.

Table 1 - Selection of Tool Kit

Aluminum Tube Sizes	Tool Kit Part Number
1/4", 5/16" & 3/8"	DAT03AEKT4003
1/4", 5/16", 3/8" & 1/2"	DAT03AEKT4004
5/16" & 1/2"	DAT03AEKT4005
3/4" & 1"	DAT03AEKT4007
1" & 1 1/4"	DAT03AEKT4006
1/2" & 1 3/4"	DAT06AEKT001

Titanium Tube Sizes	Tool Kit Part Number
1/4" & 3/8"	DAT02AEKT4002
1/4", 3/8" & 1/2"	DAT02AEKT4005
1/4", 3/8", 1/2", 5/8" & 3/4"	DAT02AEKT4000
1/4", 3/8", 1/2", 5/8", 3/4" & 1"	DAT02AEKT4001
1/4", 3/8", 1/2", 5/8", 3/4", 1", 1 1/4" & 1 1/2"	DAT02AEKT4007
1/2"	DAT02AEKT4012
1/2", 5/8" & 3/4"	DAT02AEKT4010
1" & 1 1/4"	DAT02AEKT4011

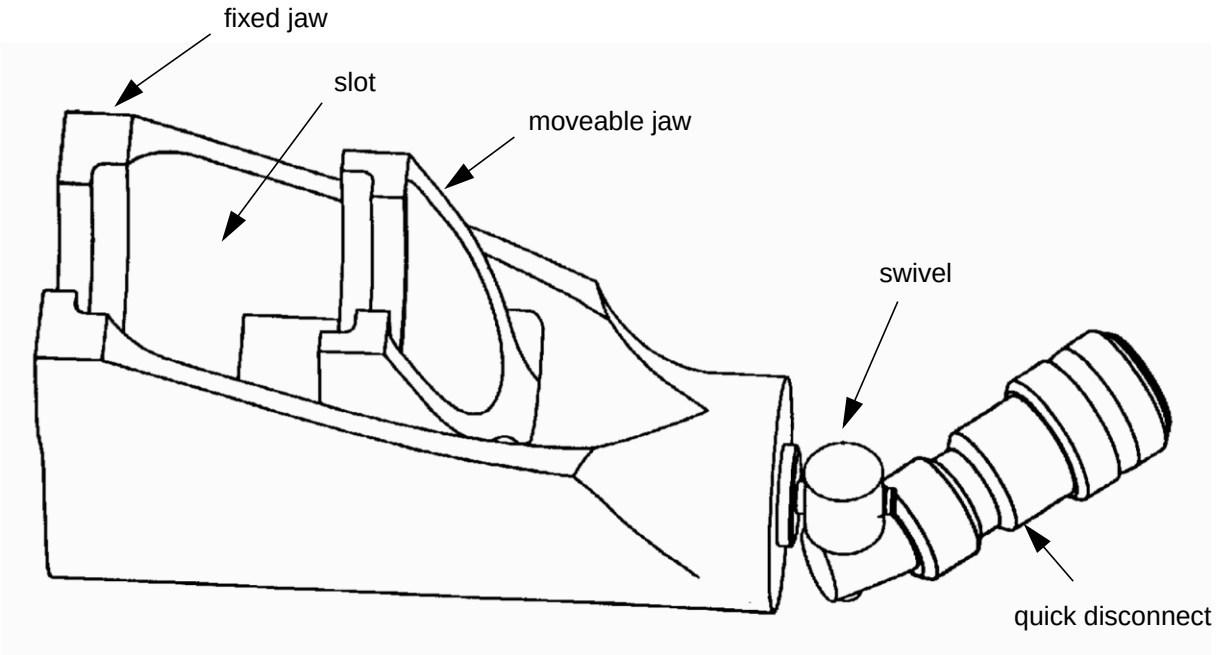


Figure 1 - Deutsch Axial Swage Tool

4.3 Facilities

4.3.1 This PPS has been categorized as a “Controlled Critical Process” according to PPS 13.39 and as such only facilities specifically approved according to PPS 13.39 are authorized to perform assembly and installation of Deutschlite axial swaged fittings according to this PPS.

4.3.2 Bombardier subcontractors must direct requests for approval to Bombardier Aerospace Supplier Quality Management. Bombardier Aerospace facilities must direct requests for approval to the appropriate internal Quality Manager.

4.3.3 Facility approval shall be based on a facility report, a facility survey and completion of a qualification test program, if required. The facility report must detail the materials and equipment to be used, the process sequence to be followed and the laboratory facilities used to show compliance with the requirements of this PPS. Any deviation from the procedure or requirements of this PPS must be detailed in the facility report. Based upon the facility report, Bombardier (Toronto Site) Materials Technology may identify additional qualification and/or process control test requirements. During the facility survey, the facility requesting qualification must be prepared to demonstrate their capability. Once approved, no changes to subcontractor facilities may be made without prior written approval from Bombardier Aerospace Supplier Quality Management.

4.3.3.1 Unless otherwise specified by Bombardier Aerospace Supplier Quality Management, for approval of subcontractor facilities to perform assembly and installation of Deutschlite axial swaged fittings according to this PPS, completion of a test program and submission of suitable test samples representative of production parts is required. Test samples must meet the requirements specified in section 6.

5 Procedure

5.1 General

5.1.1 Install fluid lines and fittings according to PPS 6.03.

5.1.2 Select the proper tool kit according to Table 1for the size of fitting to be swaged. Each tool kit contains the appropriate Deutsch axial swage tool, tube marking template and check gauge for each tube size. Also included are tube cutters, deburring tools with stem assemblies, a hex key and a marking pen.

5.2 Tooling Certification and Calibration

5.2.1 Before use on production parts, all new or repaired swaging tooling and machines must be certified for each tube material, tube diameter and tube wall thickness combination for which the tooling will be used in production. Also, all tooling must be recertified at least every 3 months during periods when production parts are being processed or more

frequently if there is cause for doubt. Maintain records of certification and re-certification tests and results.

5.2.2 For a particular tube material, tube diameter and tube wall thickness combination, certify and re-certify tooling as follows. If the test assembly does not meet the visual, pressure test or metallographic requirements, stop production using the tooling involved until the fault has been rectified and then re-test at least three more swaged assemblies identical to the failed assembly as follows.

Step 1. Prepare a suitable test assembly according to the procedure specified herein.

Step 2. Visually check the test assembly for conformance to the requirements specified in section 6.

Step 3. Proof pressure test the test assembly to the pressure specified by the engineering drawing according to PPS 6.12. If the engineering drawing does not specify a proof pressure refer to Liaison Engineering.

Step 4. Section the test assembly longitudinally and metallographically examine it at 10X magnification for cracks, folds, wrinkles or any other irregularities that may be detrimental to the performance of the joint. Metallographic examination must be performed by a Bombardier Aerospace approved laboratory.

5.2.3 Maintain tooling on a regular basis. Calibrate swaging machine gauges which indicate swaging pressure or swaging torque at least every 3 months during periods when production parts are being processed.

5.3 Tube Preparation

5.3.1 Cut the tube to length using a chipless tube cutter. Ensure that the tube face is cut square within ±1°. For in-situ installation of fittings, use of the tube cutter specified in Table 2 as follows is recommended:

Step 1. Loosen the drive screw using a screwdriver or hex key and locate the cutter head on the tube in the desired cutting location. In repair situations, ensure that the minimum straight length of tubing specified in Table 3 is available before any bends.

Step 2. Tighten the drive screw until the cutter wheel contacts the tube, then tighten 1/8 of a turn. Avoid over-torquing the drive screw since deformation may occur.

Step 3. Rotate the tool handle back and forth around the tube until there is no longer any resistance.

Step 4. Tighten the drive screw until the cutting wheel bites into the centre of the cut a further 1/8 of a turn.

Step 5. Repeat Step 3 and Step 4 until the cut is complete.

Table 2 - Chipless Tube Cutter Selection

Tube Size	Chipless Tube Cutter
3/16" to 3/8"	D12530-001
1/2" to 3/4"	D12531-001
7/8" to 1 1/2"	D12532-001

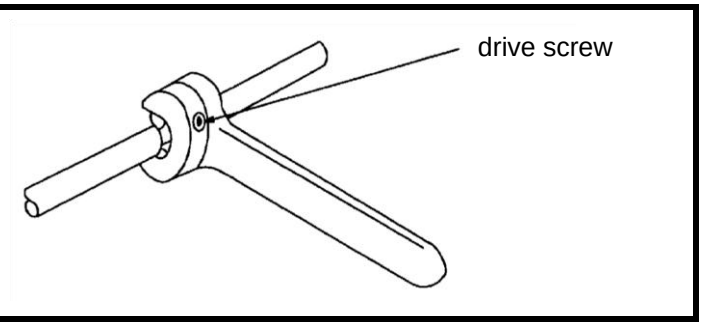


Table 3 - Minimum Straight Tubing Length before Bends

Tube Size	Aluminum		Titanium	
	Unions	All Others	Unions	All Others
1/4"	0.663"	0.813"	0.635"	0.785"
5/16"	0.793"	0.943"	---	---
3/8"	0.942"	1.092"	0.730"	0.880"
1/2"	1.040"	1.190"	0.880"	1.030"
5/8"	1.135"	1.285"	1.080"	1.230"
3/4"	1.290"	1.440"	1.255"	1.405"
1"	1.660"	1.810"	1.620"	1.770"
1 1/4"	1.935"	2.085"	1.945"	2.095"

5.3.2 Except for in-situ installations of fittings, after cutting the tube to length, deburr the tube ends according to PPS 27.05. For in-situ installations, deburr tube ends as follows:

Step 1. Insert the deburring tool stem assembly specified in Table 4 into the deburring tool handle and finger-tighten while depressing the plunger.

Step 2. Release the plunger and check to see if the rubber plug has expanded.

Step 3. Depress the plunger and insert the tool into the tube end so that the deburring blades are in contact with the inner tube surface. Release the plunger.

Step 4. While rotating the knurled tool handle, apply light pressure on the tool towards the tube end and continue rotating until the tube end is deburred.

Step 5. Without depressing the plunger, withdraw the tool until the first ridge of the rubber plug is exposed and wipe the ridge clean.

Step 6. Check the tube end for satisfactory deburring. If further deburring is required, slide the deburring tool back into the tube end and return to Step 4. If no further deburring is required, wipe the outer tube surface around the deburred area clean.

Step 7. Without depressing the plunger, remove the tool from the tube end.

Step 8. To disassemble stem from handle, depress the plunger and turn the handle counter-clockwise to release stem. Wipe stem clean.

5.3.3 Ensure that the tube surface is free of dirt, grease, scratches, cracks, seams, folds or any other imperfection detrimental to the performance of the swaged joint for at least 4" from the tube end. Remove any scratches less than 0.003" deep with a fine abrasive pad. Refer tubes with scratches deeper than 0.003" to Bombardier (Toronto Site) MRB or Bombardier (Toronto Site) delegated MRB for disposition. In addition, this area must also be free of paint, glue or any other substance not specified in this PPS.

5.3.4 After cutting the tube to length and deburring, apply tube marks to each tube end to be swaged as follows (see Figure 2):

Step 1. Position the tube marking template specified in Table 5 flush against the tube end to be swaged. Use the sight hole to ensure that the marking template fits flush against the tube end.

Step 2. Using the kit marking pen (see para. 4.2.3), make a mark in each template slot by running the pen along the sides of the slot. Ensure that the markings on the tube are clearly visible. If the marking template does not include a verification marking slot, it is not necessary to apply a verification mark.

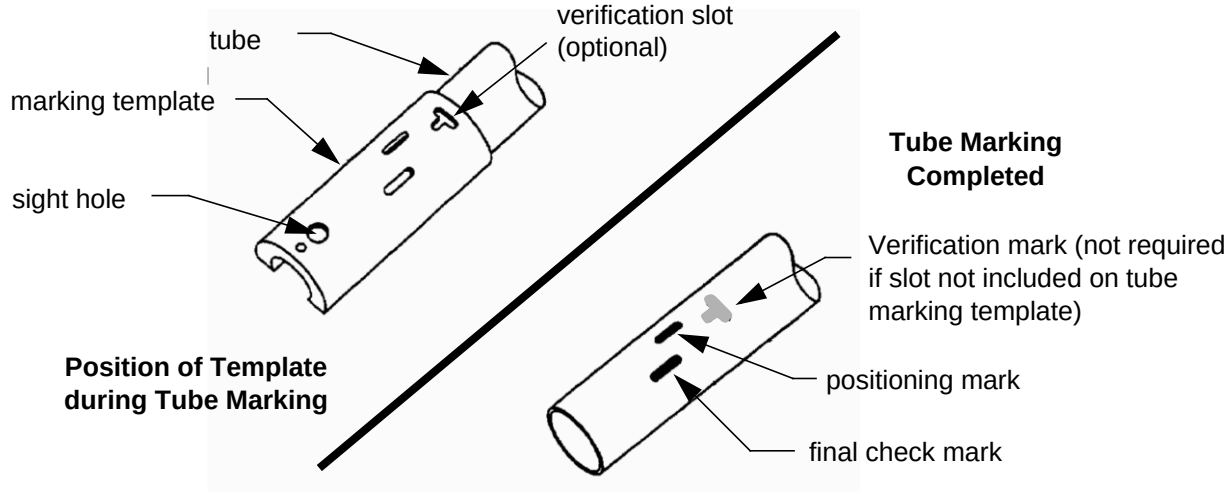


Figure 2 - Using the Tube Marking Template

Table 4 - Deburring Tools & Stem Assembly Part Numbers

Tube Size	Deburring Tool	Stem Assembly
1/4"	D9851-14	D9851-13-04
5/16"	D9851-14	D9851-13-05
3/8"	D9851-14	D9851-13-06
1/2"	D9850-14	D9850-13-08
5/8"	D9850-14	D9850-13-10
3/4"	D9850-14	D9850-13-12
1"	D9849-15	D9849-13-16
1 1/4"	D9849-15	D9849-13-20
1 1/2"	D9849-15	D9849-13-24

5.4 Tool Preparation

5.4.1 Prepare the axial swage tool specified in Table 5 for swaging and check to ensure that it is in good working condition as follows:

Step 1. Check the area between and around the jaws to ensure that there is no dirt or other debris lodged in the tool. Pay particularly close attention to the slot that guides the moveable jaw. Check the jaws to ensure that there are no nicks or dents. If there are nicks or dents the tool must be repaired and re-certified before use.

Step 2. Check for oil leaks.

Step 3. Connect the hydraulic hose connections to the tool and to the hydraulic pump.

Step 4. Actuate the pump and allow the tool to cycle twice. Ensure that the moveable jaw moves smoothly and retracts completely. Verify for the ability of the pump to move the pressure gauge needle into the 10,000 ± 250 psi range. For manual pumps, ensure that the pressure relief valve “snaps”. For electric and pneumatic pumps, ensure that the unit stops cycling.

Step 5. Check that the tool open and closed position meet the dimensions specified in Table 5.

Step 6. Check for any leakage from any of the tool components.

Table 5 - Swaging Tool Selection

Tube Material	Tube Size	Deutsch Axial Swage Tool	Length 'A' (Tool Open) (Note 1)	Length 'B' (Tool Closed) (Note 1)	Marking Template	Swage Gauge
Aluminum	1/4"	DAT03AETA4004	0.645"	0.407"	DAT06AEMG1004	DAT06AEIG1004
		DAT06AETA1004				
	5/16"	DAT03AETA4005	0.750"	0.483"	DAT06AEMG1005 (Note 2)	DAT06AEIG1005
		DAT06AETA1005				
	3/8"	DAT03AETA4006	0.945"	0.604"	DAT06AEMG1006	DAT06AEIG1006
		DAT06AETA1006				
	1/2"	DAT03AETA4008	1.145"	0.761"	DAT06AEMG1008	DAT06AEIG1008
		DAT06AETA1008				
	5/8"	DAT06AETA1010	1.170"	0.780"	DAT06AEMG1010	DAT06AEIG1010
	3/4"	DAT06AETA1012	1.315"	0.862"	DAT06AEMG1012	DAT06AEIG1012
	1"	DAT06AETA1016	1.620"	1.123"	DAT06AEMG1016	DAT06AEIG1016
	1 1/4"	DAT06AETA1020	1.960"	1.343"	DAT06AEMG1020	DAT06AEIG1020
	1 1/2"	DAT06AETA1024	2.310"	1.603"	DAT06AEMG1024	DAT06AEIG1024
Titanium	1/4"	DAT06AETA4004	0.630"	0.390"	DAT06AEMG4004	DAT06AEIG4004
	3/8"	DAT06AETA4006	0.685"	0.440"	DAT06AEMG4006	DAT06AEIG4006
	1/2"	DAT06AETA4008	0.850"	0.570"	DAT06AEMG4008	DAT06AEIG4008
	5/8"	DAT06AETA4010	1.030"	0.710"	DAT06AEMG4010	DAT06AEIG4010
	3/4"	DAT06AETA4012	1.190"	0.850"	DAT06AEMG4012	DAT06AEIG4012
	1"	DAT06AETA4016	1.575"	1.130"	DAT06AEMG4016	DAT06AEIG4016
	1 1/4"	DAT06AETA4020	1.880"	1.330"	DAT06AEMG4020	DAT06AEIG4020
	1 1/2"	DAT06AETA4024	2.245"	1.605"	DAT06AEMG4024	DAT06AEIG4024

Notes: 1. Length may vary by up to ±0.010" (see Figure 3).
2: Use DAT06AEMG1105 tube marking template for 5/16" DPLBU300D05, DPLB334D05 and DPLB336D05 fittings only.

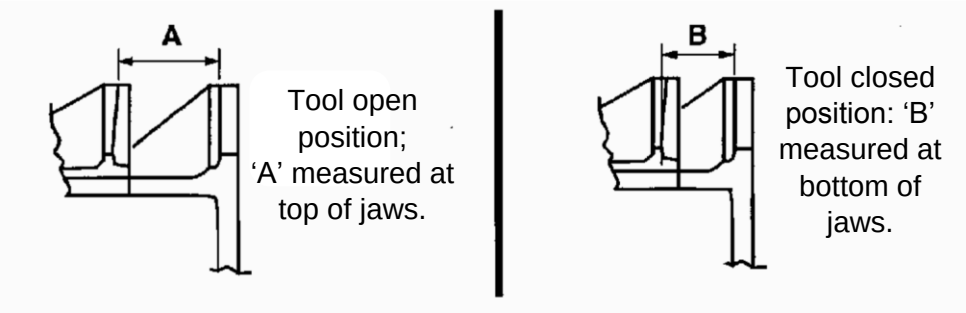


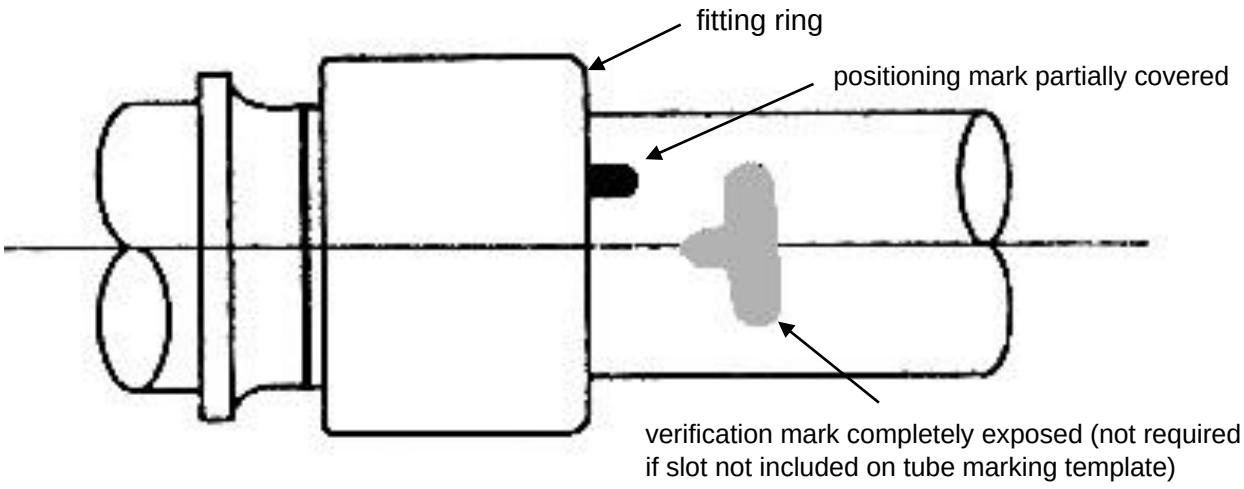
Figure 3 - Tool Open and Tool Closed Positions

5.5 **Swaging Procedure**

5.5.1 Swage fittings onto tubes as follows:

Step 1. Ensure that performance of the Deutsch axial tool will not be restricted by any structure adjacent to the fitting being swaged.

Step 2. For fittings with a tube stop, slide the fitting onto the tube until it stops. For fittings without a stop, position the end of the fitting at the approximate centre of the positioning mark as shown below (ensure that the verification mark, if any, is completely exposed).



Step 3. Position the Deutsch axial tool onto the fitting so that the fitting groove is bottomed against the tool and the fitting ring is nested within the tool jaws. The longitudinal axes of the tool and the fitting must be parallel. The fitting location is critical to the integrity of the swaged joint. Do not force the tool into position.

Step 4. Hold the tool in place and actuate the pump until the pressure gauge needle is in the 10,000 ± 250 psi range and the pressure relief valve has functioned. As the pump pressure increases, the tool jaw advances the fitting ring until it is flush or almost flush with the fitting flange.

Step 5. Release the pressure. The forks will retract, allowing the tool to be easily removed from the joint.

Step 6. Check all around the swaged fitting flange/fitting ring as shown in Figure 4 using the swage gauge specified in Table 5. If the gauge does not fit freely, reswage the fitting according to section 5.5 at about 90° from its original swaging position and re-check. A gap between the fitting flange and the ring leading edge is acceptable and will not affect joint integrity provided that the requirements of this PPS are met.

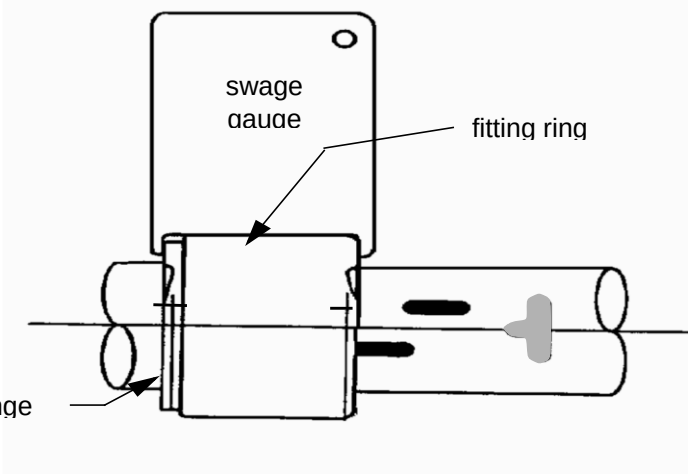


Figure 4 - Use of Swage Gauges

5.6 Repairs of Defects in Line Sections

5.6.1 If authorized by Liaison Engineering, repair defects in line sections as follows:

Step 1. Using a rotary type tube cutter, cut a section from the line to remove the defect. Plan cuts to ensure that there is adequate room in which to operate the swage tool.

Step 2. If the resulting gap between tube ends will be greater than 0.300", cut out a section of the damaged tube long enough to accommodate the installation of two unions and deburr a splice tube to replace the cut-out section.

Step 3. Prepare tube ends for swaging according to section 5.3.

Step 4. Swage the union fitting according to section 5.5 to connect the cut tube ends.

5.7 **Post Swaging Procedure**

5.7.1 Where the tubing was masked off before the application of coatings specified by the engineering drawing, touch up bare areas of the tube after swaging of the fitting according to the appropriate coating PPS.

5.7.2 Where coatings, as specified by the engineering drawing, were removed according to paragraph 5.3.3 before swaging of the fitting, re-apply such coatings to the bare areas of the tube according to the appropriate coating PPS after swaging of the fitting.

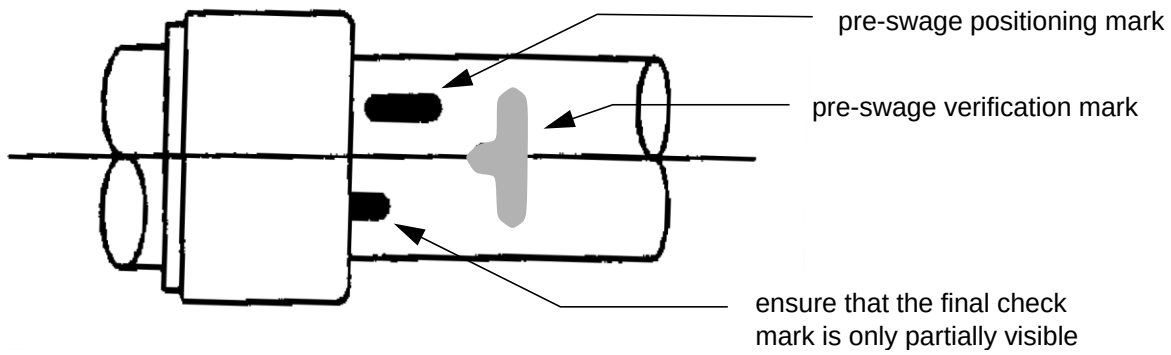


Figure 5 - Verification of Final Swaged Fitting

6 **Requirements**

6.1 For installed fittings, the tube final check mark must be partially visible as shown in Figure 5. Replace the fitting if the mark is either completely hidden or completely visible.

6.2 Ensure that any deformation of the fitting flange or fitting ring does not exceed 0.030".

7 **Safety Precautions**

7.1 **The safety precautions specified herein are specific to Bombardier (Toronto Site) 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 **Tooling is subject to extremely high pressure during swaging. Improper use may result in injury and/or tool damage.**

8 Personnel Requirements

8.1 This PPS has been categorized as a "Controlled Special Process" by PPS 13.39. Refer to PPS 13.39 for personnel requirements.

9 Special Points to Note

9.1 Replace protective caps over all connectors and remove all dirt and debris before storing tools.

9.2 Take care to ensure that hydraulic fluid lines and hydraulic system components used with MIL-H-5606 hydraulic fluid do not come into contact with solvent blends containing isopropyl alcohol (IPA), also known as isopropanol and 2-propanol. Hydraulic fluid lines and hydraulic system components used with MIL-H-5606 hydraulic fluid which have been contaminated with solvent blends containing isopropyl alcohol must be cleaned according to PPS 6.10.