BOMBARDIER
Toronto (de Havilland)
PROPRIETARY INFORMATION

PPS 6.20

PRODUCTION PROCESS STANDARD

Installation of Rynglok Swaged Fittings

Issue 9
- This standard supersedes PPS 6.20, Issue 8.
- Vertical lines in the left hand margin indicate technical changes over the previous issue.
- Direct PPS related questions to PPS.Group@aero.bombardier.com or (416) 375-4365.
- 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 installation of Rynglok swaged fittings.

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.

1.1.4 Refer to PPS 6.03 for the procedure and requirements for installation of fluid lines.

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 PPS 6.03 - Installation of Fluid Lines.

3.2 PPS 6.05 - Closure of Fluid System Lines.

3.3 PPS 6.10 - Cleaning of Fluid System Components.

3.4 PPS 6.12 - Pressure Testing Hydraulic Components & High Pressure Fuel Lines.

3.5 PPS 13.26 - General Subcontractor Provisions.

3.6 PPS 13.39 - Bombardier Toronto Engineering Process Manual.

3.7 PPS 31.07 - Cleaning & Stripping of Painted Surfaces.

3.8 PPS 31.17 - Manual Solvent Cleaning.

3.9 PPS 34.08 - Application of Epoxy-Polyamide Primer (F19 and F45).

4 Materials, Equipment and Facilities

4.1 Materials

4.1.1 Rynglok fittings (see Figure 1 for a part number breakdown).

4.1.2 Non-chlorine based permanent felt tip marker (e.g., Deutsch DLT5301-000-01).

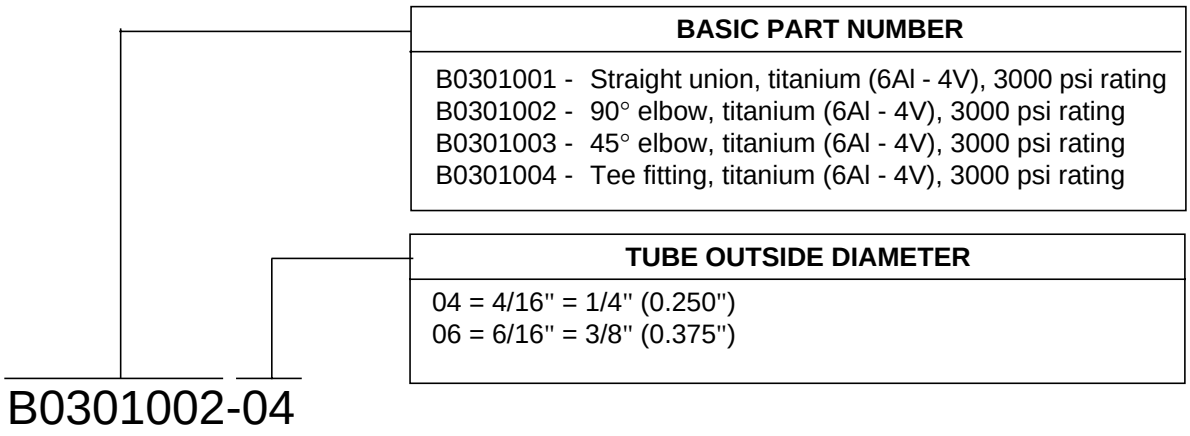

Figure 1 - Breakdown of Rynglok Fitting Part Number

4.2 Equipment

4.2.1 Chipless tube cutter (e.g., Deutsch tools as listed in Table 1).

4.2.2 Abrasive pads (e.g., 3M Scotch Brite, red).

4.2.3 Chipless deburring tool (e.g., Deutsch tools as listed in Table 2).

4.2.4 Swaging tools (e.g., Aeroquip tools as listed in Table 3).

4.2.5 Rynglok swage gauges (e.g., Aeroquip gauges as listed in Table 4).

4.2.6 Hand driven power supply capable of applying 8,000 psig (e.g., Aeroquip P-142). Alternatively, use of an air driven hydraulic power supply is acceptable provided it is capable of applying 8,000 psig.

4.3 Facilities

4.3.1 This PPS has been categorized as a “Controlled Special Process” according to PPS 13.39 and as such only facilities specifically approved according to PPS 13.39 are authorized to perform installation of Rynglok 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 (de Havilland) 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 installation of Rynglok 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 Rynglok fittings are used as production fittings when specified on engineering drawings or to repair damaged fluid lines when authorized by Liaison Engineering.

5.1.2 In order to seat correctly, Rynglok fittings require a minimum 1.25" straight section of tubing (measured from the cut end).

5.1.3 Titanium tubing and fittings are sensitive to contact with chlorinated solvents which are often used in standard permanent felt tip markers and therefore, only non-chlorine based permanent felt tip markers may be used (see Equipment section, paragraph 4.1.2).

5.1.4 Ensure that aluminum tubing is in the specified final heat treat temper before swaging the fitting.

5.1.5 Tubing may be bent before or after the swaging operation provided that tube bends are not less than 1" from tube ends for sizes -04 through to -20.

5.2 Preparation of Tubing

5.2.1 Cut tubes to length with the ends square to within ±1° of the tube center line using the chipless tube cutter specified in Table 1 as follows:

Step 1. Loosen the drive screw using a suitable hex wrench and locate the cutter head on the tube in the desired cutting position (see Figure 2).

Step 2. Tighten the drive screw until the cutter wheel lightly contacts the tube, then tighten a further 1/4 turn.

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

Step 4. Tighten the drive screw until the cutting wheel bites into the centre of the cut mark.

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

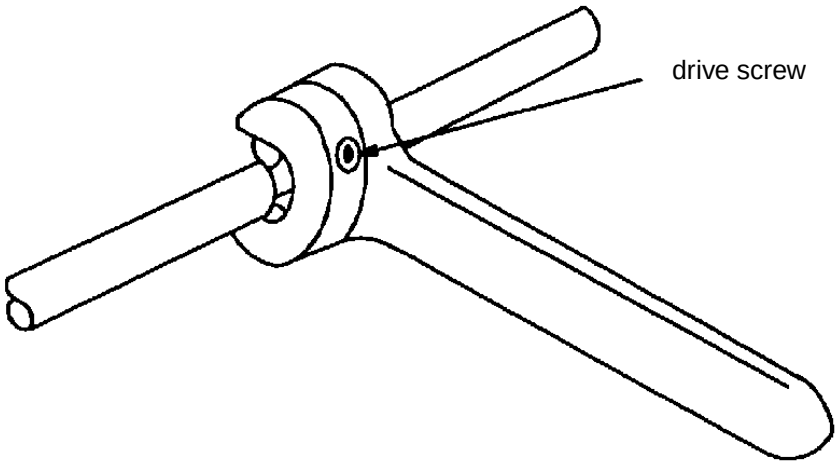

Figure 2 - Using the Chipless Tube Cutter

Table 1 - Chipless Tube Cutter Selection

TUBE OUTSIDE DIAMETER	CHIPLESS TUBE CUTTER (DEUTSCH P/N)
-04 (1/4" or 0.250")	RTCTO-01-04
-06 (3/8" or 0.375")	RTCTO-01-06
Note 1. It is acceptable to use alternate chipless cutting tools provided the tube interior is not contaminated with chips	

5.2.2 After cutting the tubing to length, remove the sharp outer edge left by the tube cutter by polishing the outer edge with an abrasive pad. Remove all scratches, gouges, etc., by polishing in a circumferential direction only. **Do not** chamfer tube ends. Tube ends that have nicks, dents, scratches, gouges, etc., that cannot be removed by polishing are not acceptable.

5.2.3 After removal of the sharp outer edge, deburr cut tube ends using a chipless deburring tool as follows (see Figure 3):

Step 1. Assemble the stem assembly specified in Table 2 into the tool body.

Step 2. Depress the tool plunger to extend the plug.

Step 3. Insert the tool into the tube until the cutters **lightly** contact the tube end.

Step 4. Rotate the cutter to remove any burrs **without** chamfering the tube end.

Step 5. Without depressing the plunger, withdraw the tool to the first bulge of the plug and wipe off the chips. Do not depress the plunger before withdrawing the tool or else metal chips will enter the tube.

Step 6. Completely withdraw the tool.

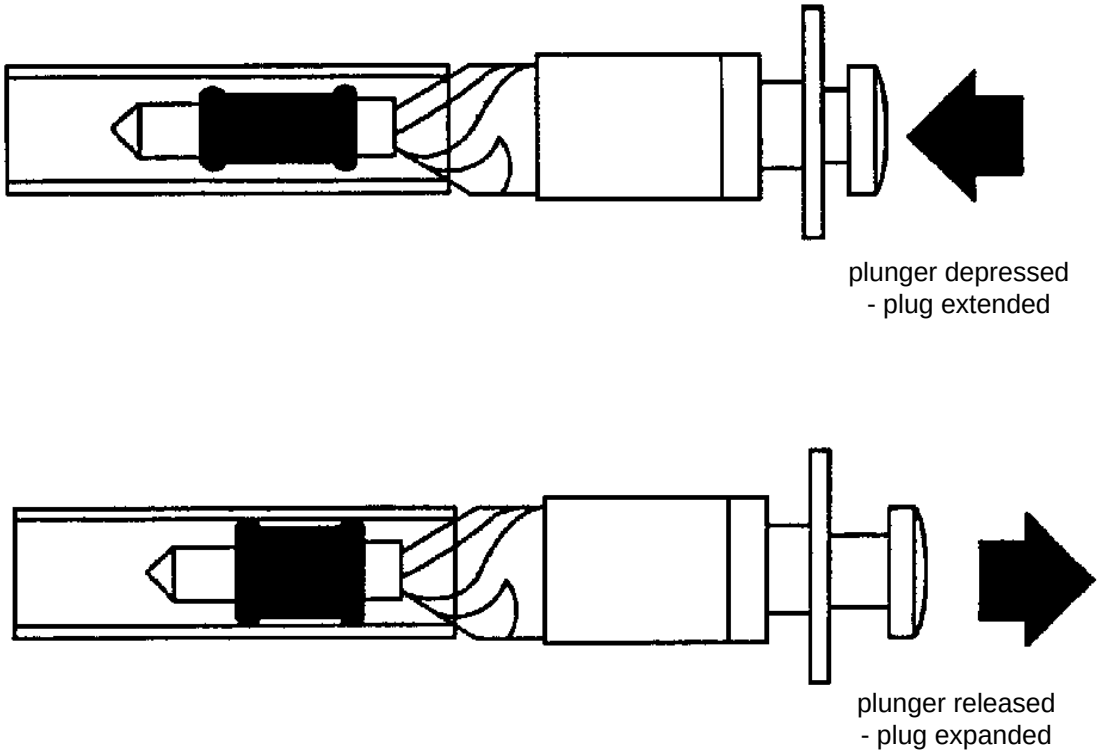

Figure 3 - Using the Deburring Tool

5.2.4 Strip any primer for a minimum distance of 2" from the tube end according to PPS 31.07. Do not mechanically remove the primer.

5.2.5 Ensure that the tube surface is free of dirt, grease, etc., for at least 4" from the tube end. If necessary, solvent wash the tube according to PPS 31.17. 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, 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.

5.2.6 Using the slots in the insertion marking tool and a permanent felt tip marker (see Equipment section, paragraph 4.1.2), apply swage check and positioning marks on the tube end (see Figure 4).

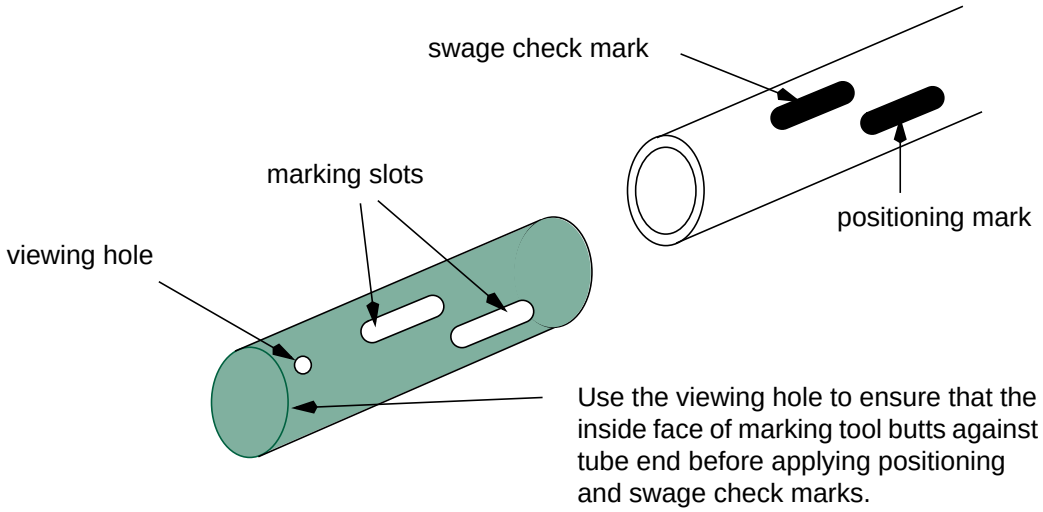

Figure 4 - Insertion Marking Tool

Table 2 - Chipless Deburring Tool Selection

TUBE OUTSIDE DIAMETER	TUBE WALL THICKNESS	STEM ASSEMBLY (DEUTSCH P/N)	TOOL BODY (DEUTSCH P/N)
-04 (1/4" or 0.250")	0.016" - 0.028"	D9851-13-04	D9851-14
	0.028" - 0.050"	D9851-13-03	
-06 (3/8" or 0.375")	0.016" - 0.035"	D9851-13-06	
	0.035" - 0.058"	D9851-13-07	
Note 1. It is acceptable to use alternate chipless deburring tools provided the tube end is **not** chamfered and the tube interior is not contaminated with chips.			

5.3 Preparation of Fitting

5.3.1 Store Rynglok fittings as received in their protective packages until required for installation.

5.3.2 Before installation, check that the inside of the fitting is free from scratches, dirt, etc., and that both silicone seals are present and undamaged.

5.3.3 Wipe contaminated fittings with a clean dry cloth or, if necessary, solvent wipe according to PPS 31.17. 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, 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.

5.4 Preparation of Swaging Tools and Air Driven Hydraulic Power Supply

5.4.1 Prepare swaging tools as follows:

Step 1. Refer to Table 3 for the swaging tool required.

Step 2. Visually examine the swaging tool for signs of damage. If there is a tool calibration/verification sticker on the tool, check the expiry date before use; do not use a tool if the calibration/verification date has expired.

Step 3. Connect the hydraulic pressure hose to the swage tool and to the hydraulic outlet on the hydraulic power supply.

Step 4. If using a hand driven power supply, pump to a hydraulic pressure of 8000 psig. If using an air driven hydraulic power supply, cycle the unit by pressing the ON actuating switch until the pulsing action of the pump automatically ceases.

Step 5. Verify that the hydraulic power supply gauge is reading 8,000 psig.

Step 6. Ensure that the swaging die slides freely.

Step 7. Release the hydraulic pressure by releasing the actuating switch.

Table 3 - Swaging Tool Selection

FITTING SIZE/TUBE OUTSIDE DIAMETER	SWAGING TOOL (AEROQUIP P/N)
-04 (1/4" or 0.250")	RTST8-01-04
-06 (3/8" or 0.375")	RTST8-01-06

5.5 Swaging Procedure

5.5.1 Swage Rynglok fittings as follows:

Step 1. Ensure that the swage head is free of chips, burrs and other contaminants and that the fitting is free of any foreign particles that have lodged inside the grooves on the outside of the fitting or inside the bore.

Step 2. Slide the fitting onto the tube until the tube contacts the stop shoulder. To prevent scratching or shaving of the tube surface, ensure the fitting slides freely without force or rotation. If the fitting does not slide freely, measure the tube and fitting to ensure roundness. If an out-of-roundness condition exists, replace the out-of-tolerance parts.

Step 3. Ensure proper position of the fitting on the tube as shown in Figure 5.

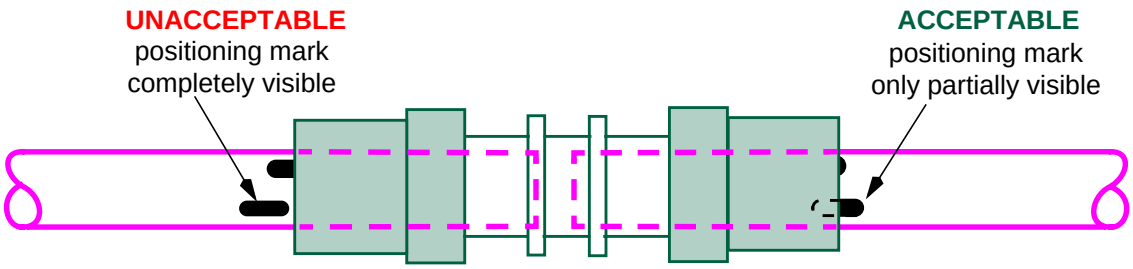

Figure 5 - Fitting Position on Tube End before Swaging

Step 4. Insert the swaging head onto the fitting, ensuring that the positioning mark is partially covered by the fitting (see Figure 6).

Step 5. With the swaging head held firmly against the fitting, apply a hydraulic pressure of 8000 psig using a hand pump or an air driven hydraulic power supply, if available.

Step 6. Release the hydraulic pressure.

Step 7. Remove the tool from the swaged fitting.

Step 8. Dimensionally check the swage using the Rynglok swage gauge specified in Table 4 (see Figure 7). If a swaged fitting is oversized, the fitting may be re-swaged **once**. Before re-swaging, check that no foreign matter exists between the die faces and ensure that the power unit hydraulic pressure is correct. Do not swage another fitting until the first swage has passed the dimensional check.

Step 9. Apply a rotation witness mark to the tube and the fitting using a permanent felt tip marker (see Equipment section, paragraph 4.1.2).

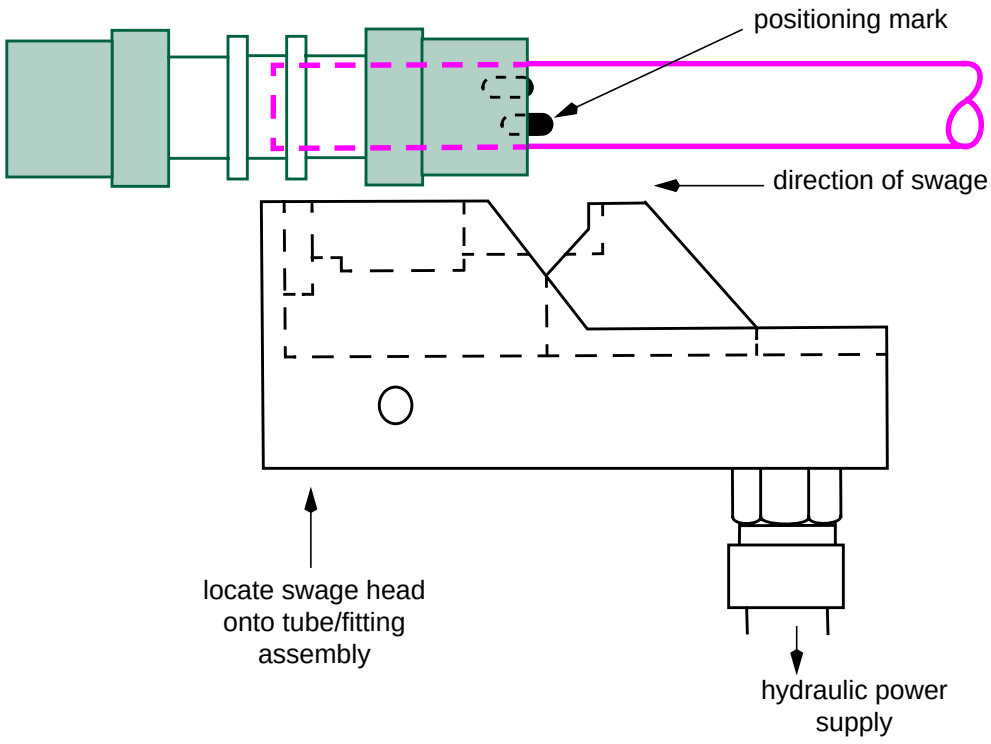

Figure 6 - Location of Swaging Head before Swaging

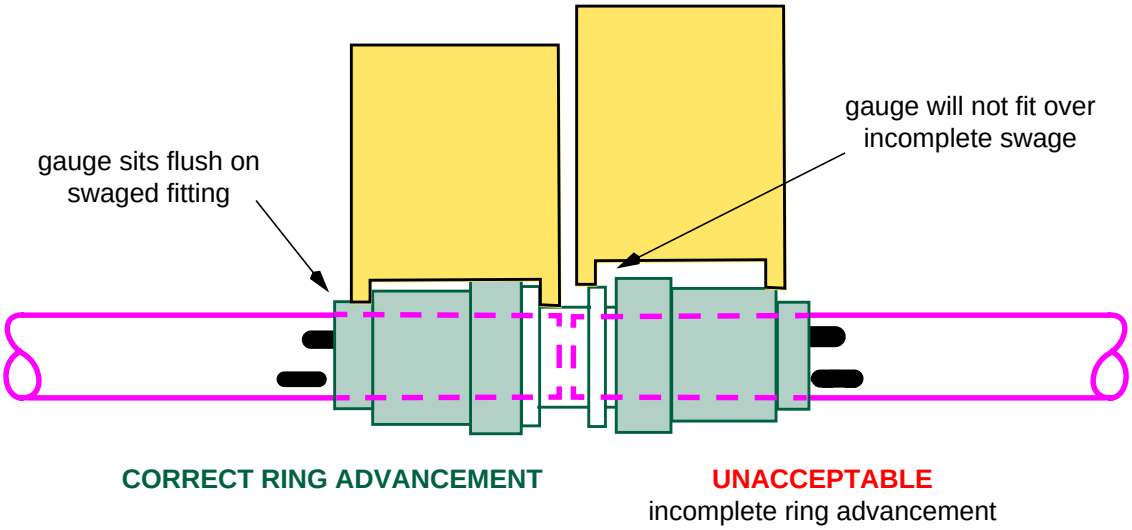

Figure 7 - Ring Advancement Gauge

Table 4 - Rynglok Swage Gauges

RYNGLOK FITTING SIZE	RYNGLOK SWAGE GAUGE (AEROQUIP P/N)
-04 (1/4" or 0.250")	RTSG0-51-04
-06 (3/8" or 0.375")	RTSG0-51-06

5.6 Post Swaging Procedure

5.6.1 Close all tube assemblies or Rynglok fittings according to PPS 6.05.

5.6.2 Touch-up exposed **tubing** with brush application of F19 primer according to PPS 34.08 (but do not apply chemical conversion coating before priming). **Do not** coat the Rynglok fitting.

5.7 Repair of Tubing Defects

5.7.1 Repair tubing defects 0.300" length or less using one Rynglok union. Cut out the defective section of tubing ensuring that the gap left does not exceed 0.300" (see Figure 8).

5.7.2 If the length of the defect exceeds 0.300", use two Rynglok unions to repair the line. Table 5 shows the minimum amount of tubing that needs to be removed for a two union repair. Replace the removed tubing with an equal or slightly shorter length of similar tubing, ensuring that the maximum gap as shown in Figure 8 is not exceeded.

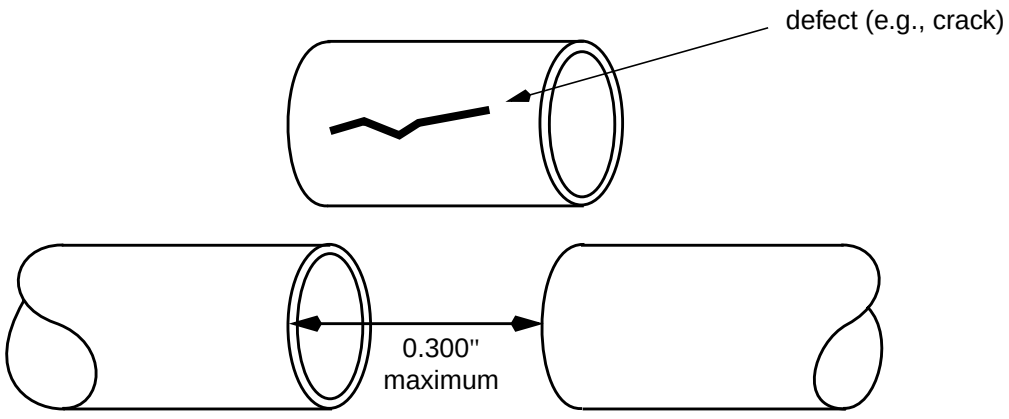

Figure 8 - Maximum Tube Cut-Out for Single Union Repair

Table 5 - Minimum Tubing Cut-Out Length for a Two-Union Repair

TUBE OUTSIDE DIAMETER	MINIMUM CUT-OUT LENGTH
-04 (1/4" or 0.250")	2.38"
-06 (3/8" or 0.375")	2.64"

6 Requirements

6.1 Visually examine each swaged fitting to determine the following:

- Ensure the swaged fitting and adjacent tube area show no evidence of cracks, dents, folds or gouges.
- Ensure that the swage check mark, applied during assembly, is partially visible (see Figure 9). Swaged joints are not acceptable if the swage check mark is completely exposed or completed covered.
- Fittings must be tight on the tube.
- Ensure fittings have not been damaged during swaging or handling.

6.2 Dimensionally check swaged joints using the Rynglok swage gauge specified in Table 4 (see Figure 7).

6.3 Fittings must be square to the tube to within 1°.

6.4 Tube assemblies having a swaged fitting that has passed visual and dimensional examination shall be pressure tested according to PPS 6.12. Assemblies installed and swaged in situ on the aircraft shall be pressure tested by isolating the applicable section of line or, if this is not possible, they shall be pressure tested during the aircraft functional test procedures.

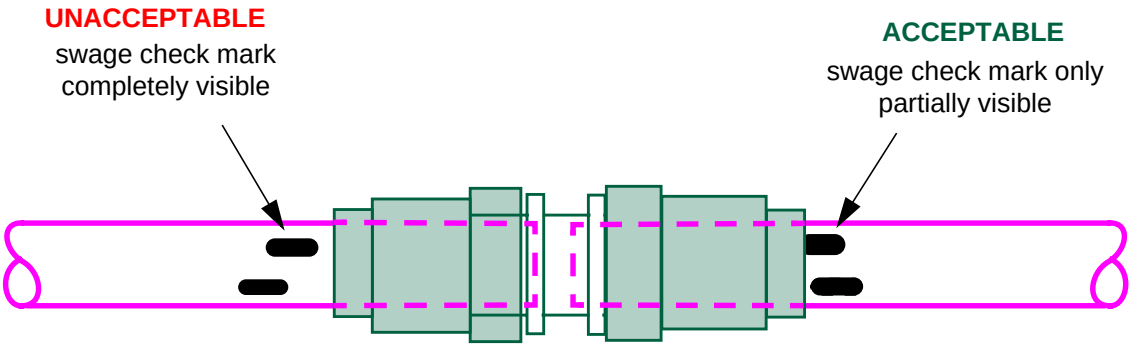

Figure 9 - Visual Examination of Swaged Rynglok Fittings

7 Safety Precautions

7.1 Observe general shop safety precautions when performing the procedure specified herein.

7.2 Tooling is subject to extremely high pressure during swaging. Improper use may result in injury and/or tool damage. Keep hands clear of the die block assembly during swaging operations.

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 Maintenance of Equipment

9.1 Keep the hydraulic power unit, swaging tool and all accessories free from chips, dirt and other foreign matter. Repair or replace worn or damaged parts immediately. Use of a calibration/verification sticker to establish a regular scheduled maintenance check for swage tools is recommended.

9.2 At Bombardier Toronto (de Havilland), authorization and written instructions from Tool Design are required for any modification to the tools specified herein.