BOMBARDIER
Toronto (de Havilland)
PROPRIETARY INFORMATION

PPS 1.34

PRODUCTION PROCESS STANDARD

Magnetic Pulse Forming of Tubes - Expansion and Compression

Issue 7
- This standard supersedes PPS 1.34, Issue 6.
- 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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	Production Process Standards (PPS)	
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	Quality	

Signed original on file. Validation of paper prints is the responsibility of the user.

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1 Scope

1.1 This PPS (Production Process Standard) specifies the procedure and requirements for the magnetic pulse expansion and compression forming of non-critical parts.

1.1.1 Magnetic pulse form critical parts according to PPS 1.08.

1.1.2 This PPS complements the engineering drawings that specify its use as an authorized instruction and the procedure specified 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.

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

1.1.4 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 PPS 1.08 - Magnetic Pulse Forming of End Fittings to Control Rods.

3.2 PPS 13.26 - General Subcontractor Provisions.

3.3 PPS 13.39 - Bombardier Toronto Engineering Process Manual.

3.4 PPS 27.09 - Repair of Surface Defects in Aluminum Alloy Tubing.

3.5 PPS 31.02 - Cleaning Processes for Aluminum and Aluminum Alloys.

3.6 PPS 31.03 - Cleaning of Carbon and Low Alloy Steels.

3.7 PPS 31.05 - Surface Treatment of Corrosion Resistant Steels.

3.8 QI 4-12.2 - Personal Identification Stamp Use and Control - *Bombardier Aerospace internal quality procedure*.

4 Materials, Equipment & Facilities

4.1 Materials

4.1.1 Tubes and end fittings as specified on the engineering drawings.

4.2 Equipment

4.2.1 Magneform machines (e.g., Maxwell Model 16 - CE #3288 and Maxwell Model 16A - CE #7918).

4.2.2 Locating tools, insulators and field shapers (e.g., TS.291.01.00).

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 magnetic pulse expansion and compression forming of non-critical parts 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 magnetic pulse expansion and compression forming of non-critical parts 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 Preparation of Parts

5.1.1 Handle all parts to be magneformed with care.

5.1.2 Prepare tubes as follows:

Step 1. Heat treat the tube, if specified on the engineering drawing.

Step 2. Check the tubing for surface defects, and If necessary, repair according to PPS 27.09.

Step 3. If required, swage the tube ends.

Step 4. Face the tube to length, square to the longitudinal axis of the tube. When the length of the tube assembly is critical, take the linear expansion of the tube (which occurs during magneforming) into account when cutting and facing the tube to length. The actual linear expansion will be determined during testing and preparation of a Tube Master for the particular assembly.

Step 5. If the tube has a wall thickness of 0.049" or greater, chamfer the inside edge of the tube as shown in Figure 1.

Step 6. Clean the tube according to PPS 31.02, PPS 31.03 or PPS 31.05, as applicable. After cleaning, the tube must be clean and free from grease, oil or foreign matter.

5.1.3 Ensure end fittings are clean and free from grease, oil or foreign matter before magneforming. If necessary, clean according to PPS 31.02, PPS 31.03 or PPS 31.05, as applicable.

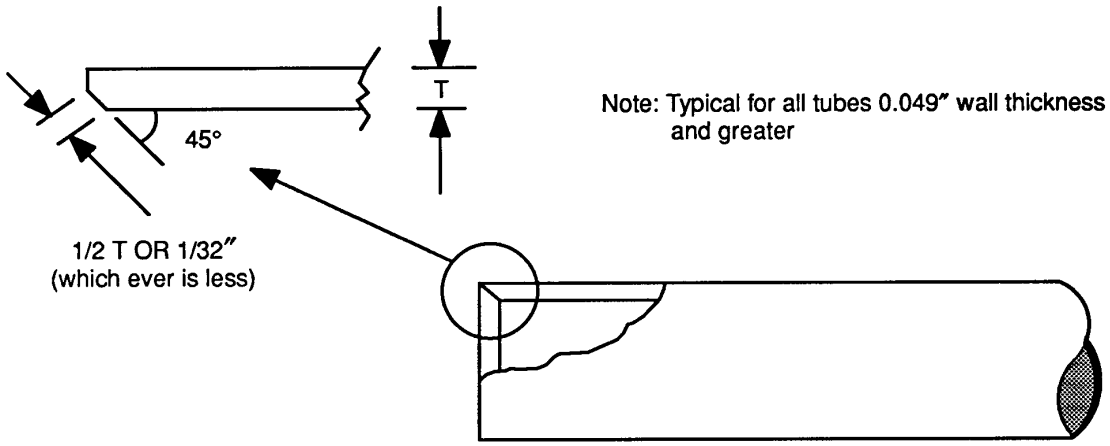

Figure 1 - Detail of Chamfer on Tube End

5.2 Magneforming

5.2.1 Magnetic pulse expansion and compression forming of tubes does not require an accompanying Magneform schedule. Refer to the production documentation (e.g., Process Sheet or Assembly Manual) or Magneform schedule, if available, for Magneforming machine settings. Verify the settings for the magneform machine when forming the first batch of parts.

6 Requirements

6.1 Examine the assemblies for cracks or other defects. If the engineering drawing specifies proof loading, examine the assembly using a 5 X magnifying glass. If the engineering drawing does not specify proof loading, examine the assembly by eye alone.

6.2 Formed assemblies with arcing marks are not acceptable.

6.3 Proof load the formed assemblies if specified by the engineering drawing.

6.4 Parts showing any evidence of rotation, separation or linear play of the end fitting within the tube, or any other signs of looseness are not acceptable.

7 Safety Precautions

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

7.2 Ensure that the safety cover on the machine remains closed while the magneforming operation is taking place.

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 Additional Information

9.1 For proof loaded parts, the work order accompanying each acceptable production batch must be stamped “TESTED” (e.g., according to QI 4-12.2).

9.2 It is recommended that the magneform machine be maintained according to a regular schedule.