BOMBARDIER
Toronto Site
PROPRIETARY INFORMATION

PPS 30.02

PRODUCTION PROCESS STANDARD

SUB-ZERO TREATMENT OF STEEL PARTS

Issue 7
- This standard supersedes PPS 30.02, Issue 6.
- Vertical lines in the left hand margin indicate technical changes over the previous issue.
- Direct PPS related questions to christie.chung@aero.bombardier.com or (416) 375-7641.
- This PPS is effective as of the distribution date.

Prepared By:	(Christie Chung)	January 9, 2017
	PPS Group	
Approved By:	(*K. Quon*, for Bruce Campbell)	January 10, 2017
	Materials Technology	
	(Stephen Pitt)	January 11, 2017
	Quality	

TABLE OF CONTENTS

Sections **Page**

1 SCOPE

1.1 This Production Process Standard (PPS) specifies the procedure and requirements for sub-zero treatment of steel alloy parts.

1.1.1 This PPS complements the engineering drawings that specify its use as an authorized instruction. The procedure specified in this PPS shall 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. Similarly, the procedure and requirements specified in this PPS are not applicable when use of a BAPS, MPS, LES or P. Spec. is specified.

2 HAZARDOUS MATERIALS

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

3 REFERENCES

3.1 BAERD GEN-007 - Quality Control of Heat Treating Equipment and Hot Forming Equipment.

3.2 BAERD GEN-018 - Engineering Requirements for Laboratories.

3.3 PPS 13.26 - General Subcontractor Provisions.

3.4 PPS 13.39 - Bombardier Toronto Engineering Process Manual.

3.5 PPS 30.04 - Steel Heat Treatment - Carbon and Low Alloy Steels.

3.6 PPS 30.06 - Heat Treatment of Precipitation Hardenable (PH) Stainless Steels.

3.7 PPS 30.08 - Heat Treatment of Martensitic Stainless Steels.

3.8 PPS 31.04 - Degreasing Processes.

4 MATERIALS, EQUIPMENT AND FACILITIES

4.1 Materials

4.1.1 Methyl alcohol (methanol) or liquid nitrogen.

4.1.2 Dry ice pellets.

4.2 Equipment

4.2.1 Sub-zero treatment tank or bath capable of maintaining the methanol/dry ice bath or liquid nitrogen bath at -90°F (-68°C) or colder for the soak time required.

4.2.2 Low temperature thermometer capable of reading bath temperature.

4.2.3 Instrumentation and equipment shall be qualified according to BAERD GEN-007.

4.2.4 Gloves, neoprene (e.g., DSC 422-5).

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 sub-zero treatment of steel alloy parts according to this PPS.

4.3.2 Bombardier subcontractors shall direct requests for approval to Bombardier Supplier Quality Management. Bombardier facilities shall 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 shall 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 shall be detailed in the facility report. Based upon the facility report, Bombardier Toronto Engineering may identify additional qualification and/or process control test requirements. During the facility survey, the facility requesting qualification shall 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 For approval of subcontractor facilities to perform sub-zero treatment of steel alloy parts according to this PPS, completion of a test program and submission of suitable test samples representative of production parts is required. Test samples shall meet the requirements specified in PPS 30.04, PPS 30.06 or PPS 30.08, as applicable.

4.3.3.2 All testing and evaluation specified herein shall only be performed by Bombardier Toronto Materials Laboratory or by laboratories accredited according to BAERD GEN-018.

5 PROCEDURE

5.1 General

5.1.1 Sub-zero treatment of steel alloy parts as specified herein, basically consists of immersing the parts into a refrigerant bath operating at -90°F (-68°C) or colder in order to facilitate complete austenite transformation. Sub-zero treatment of steel alloy parts shall be performed after hardening (other than tempering). Sub-zero treatment of steel alloy parts may be performed either before or after tempering, as specified.

5.2 Preparation of Parts

5.2.1 Degrease parts which have been oil quenched according to PPS 31.04 to remove all traces of oil before sub-zero treatment.

5.2.2 In order to reduce thermal shock and to prevent warpage or cracking of parts, immerse parts in cold running water for approximately 10 minutes immediately before placement in the refrigerant bath.

5.3 Sub-Zero Treatment

5.3.1 Perform sub-zero treatment of steel alloy parts as follows.

Step 1. Immerse the parts in the refrigerated alcohol bath.

Step 2. Lower the temperature of the refrigerant bath to the operating temperature range of -90°F (-68°C) or colder by carefully pouring dry ice pellets into the refrigerated alcohol at a rate just sufficient to prevent the alcohol from boiling over the sides of the tank. Thirty pounds of dry ice pellets will maintain the refrigerant bath within the operating temperature range for 2 to 3 hours while sixty pounds of dry ice pellets will maintain the refrigerant bath within the operating temperature range for 8 to 12 hours. Check the temperature of the alcohol bath using a suitable low-temperature thermometer.

Step 3. Once the temperature of the bath has been lowered to the operating temperature, allow parts to soak for the time specified in PPS 30.04, PPS 30.06 or PPS 30.08, as applicable for the particular type of steel alloy being treated. If a sub-zero soak time for the particular alloy being treated is not specified in the applicable heat treatment PPS, refer to Liaison Engineering for the soak time.

5.3.2 As an alternative to use of an alcohol bath and dry ice pellets, it is acceptable to sub-zero quench the parts in a liquid nitrogen bath (or in the evaporated vapour of such a bath), provided that the operating temperature of -90°F (-68°C) or colder in the bath (or operating zone) is achieved and maintained.

5.3.3 Prepare a sub-zero treatment record sheet for each batch of parts subjected to sub-zero treatment according to this PPS including the following information:

- Part number
- Material
- Lot number
- Heat treat condition
- Required soak time
- Start date, time and bath temperature
- Finish date, time and bath temperature

6 REQUIREMENTS

6.1 All parts to be sub-zero treated shall be immersed at -90°F (-68°C) or colder for the soaking time specified in PPS 30.04, PPS 30.06 or PPS 30.08, as applicable for the particular type of steel alloy being treated. The operating temperature of the sub-zero treatment bath (or operating zone) at the start and finish of the sub-zero treatment shall be -90°F (-68°C) or colder.

7 SAFETY PRECAUTIONS

7.1 Safety precautions applicable to the materials and procedures specified herein shall be defined by the subcontractor performing the work for Bombardier Toronto.

8 PERSONNEL REQUIREMENTS

8.1 This PPS has been categorized as a Critical Process according to PPS 13.39. Refer to PPS 13.39 for personnel requirements.

9 CALIBRATION AND MAINTENANCE OF EQUIPMENT

9.1 When using a methanol/dry ice bath for sub-zero treatment, replace the methanol in the refrigerant bath as required to prevent an excessive build-up of water in the bath.

9.2 Calibration and maintenance of sub-zero treatment equipment and instrumentation shall conform to BAERD GEN-007.