BOMBARDIER Toronto (de Havilland) **Proprietary Information**	**PPS 9.55** **Production Process Standard (PPS)**

Qualification of Crimp Tools

Issue 1 - This is a new PPS.

- This PPS is effective as of the distribution date.
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Approved by:		Prepared by:
Bruce Campbell Materials Technology Nov 9, 2017	Davor Filipovic Quality Nov 9, 2017	Michael Wright Core Methods – PPS November 7, 2017

Issue 1 - Summary of Changes

The following summaries are not detailed and are intended only to assist in alerting PPS users to changes which may affect them; refer to the applicable section(s) of this PPS for detailed procedure and requirements.

- This is a new PPS raised to specify the procedure and requirements for qualification of crimp tools used for crimp termination of copper and/or aluminum wire at electrical terminal lugs, splices and/or contacts.
- This PPS is based in part upon information specified separately in PPS 9.01, PPS 9.09, PPS 9.19, PPS 9.20, PPS 9.35 and PPS 9.36, however changes and additions have also been made, summarized as follows.
  - Added authorization for qualification of crimp tools according to BAPS 145-029 or BAPS 145-260.

Issue 1 - Summary of Changes (over the previous issue) continued

- Added new sub-section 3.1 and para. 3.1.1, to ensure correct usage of reference specifications.
- Created new sub-sections 3.2, 3.3 and 3.4 to identify document references.
- Added new para. 4.1.1, to prevent inappropriate material substitution.
- Added requirements to use calibrated tensile testing machines and scale force indicators.
- Added requirement that tensile testing must be performed at a BAERD GEN-018 approved facility.
- Added clarification of the maximum acceptable interval between crimping tool qualifications.
- Added clarification that for the purposes of this PPS there is no difference between initial qualification of crimp tools and re-qualification of crimp tools.
- Clarified instructions regarding make-up of test samples and which test samples are required for tool qualification.
- For test samples comprising of terminal lugs crimped to copper wire according to PPS 9.01 or splices crimped to copper wire according to PPS 9.09, the tensile strength requirements for tin and silver coated copper wire have been so identified, and tensile strength requirements for nickel coated copper wire have been added.
- For test samples comprising of M39029 contacts crimped to copper wire according to PPS 9.19, PPS 9.20 and PPS 9.36, replaced minimum tensile strength requirements based upon contact wire barrel size with minimum tensile strength requirements based on wire size.

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1 Scope

1.1 This Production Process Standard (PPS) specifies the procedure and requirements for qualification of crimp tools used for crimp termination of copper and/or aluminum wire at electrical terminal lugs, splices or contacts.

1.1.1 As an alternative to the procedure and requirements specified herein, it is acceptable to perform qualification of crimp tools according to BAPS 145-029 or BAPS 145-260.

- Perform qualification of crimp tools according to the procedure and requirements of either BAPS 145-029, BAPS 145-260 or this PPS in their entirety; a piecemeal approach utilizing certain sections or portions of BAPS 145-029, BAPS 145-260 and this PPS is **not** acceptable.
- Subcontractor facilities which have been approved by Bombardier to perform qualification of crimp tools according to BAPS 145-029 or BAPS 145-260 are considered approved to perform qualification of crimp tools according to this PPS without further approval needed.
- PPS Process Standard Deviations (PSD's) issued against this PPS are **not** applicable to BAPS 145-029 or BAPS 145-260. Likewise, requests for deviation (RFD's) allowed against BAPS 145-029 or BAPS 145-260 are not applicable to this PPS.
- When processing parts according to BAPS 145-029 or BAPS 145-260, as an alternative to processing parts according to PPS 9.55, deviations allowed by an approved RFD against BAPS 145-029 or BAPS 145-260 may be used respectively unless a specific limitation regarding program applicability is specified by the RFD comments/restrictions.

1.1.2 This PPS complements the engineering drawings that specify its use as an authorized instruction. Except as noted in para. 1.1.1, the procedure specified in this PPS must be followed to ensure compliance with all applicable specifications. In general, if this PPS, BAPS 145-029 or BAPS 145-260 (as applicable) conflicts with the engineering drawing, follow the engineering drawing. The requirements specified in this PPS (or approved alternative BAPS) 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.

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 9.01 – Crimping Electrical Terminal Lugs to Copper Wire.

3.2.2 PPS 9.09 – Splicing Electrical Wires.

3.2.3 PPS 9.19 – Automatic Crimping of Size 16 - 22 Electrical Contacts.

3.2.4 PPS 9.20 – Crimping of Size 8 - 0 Electrical Contacts.

3.2.5 PPS 9.35 – Terminating and Splicing Aluminum Wire.

3.2.6 PPS 9.36 – Manual Crimping of Size 12 - 22 Contacts.

3.2.7 PPS 13.26 - General Subcontractor Provisions.

3.2.8 PPS 13.39 – Bombardier Toronto Engineering Process Manual.

3.3 Bombardier Aerospace Process Specifications (BAPS)

3.3.1 BAPS 145-029 - Qualification of Crimping Tools and their Crimped Electrical Contact Combinations for Mechanically Attached Terminals and Connectors

3.3.2 BAPS 145-260 - Qualification of Electrical Crimp Contacts

3.4 Bombardier Aerospace Engineering Requirements Documents (BAERD)

3.4.1 BAERD GEN-018 – Engineering Requirements for Laboratories

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 Wire used for each qualification test sample must be the same as wire used in Production with the terminal lugs, splices or contacts to be crimped using the crimp tool being qualified.

4.1.3 Terminal lugs, splices or contacts used for each qualification test sample must be the same as the terminal lugs, splices or contacts used in Production.

4.2 Equipment

4.2.1 Tensile testing machine, standard, calibrated.

4.2.2 Scale force indicator, calibrated

4.2.3 Dial gauge or micrometer, standard, calibrated.

4.3 Facilities

4.3.1 Qualification of crimping tools as specified herein is a requirement for facility approval for PPS's specifying the procedure and requirements for crimping of terminal lugs, splices or contacts which are categorized as "Controlled Special Processes" according to PPS 13.39 (i.e., PPS 9.01, PPS 9.09, PPS 9.19, PPS 9.20, PPS 9.35 and PPS 9.36).

4.3.2 Tensile testing as specified herein must be performed at a BAERD GEN-018 approved facility.

5 Procedure

5.1 General

5.1.1 For the purposes of this PPS, qualification (or "validation") of crimp tools is accomplished by successful use of the crimp tool in question to prepare test samples as specified herein for tensile testing as specified herein.

5.1.2 Unless otherwise specified by Bombardier Quality, each crimp tool to be used in production must be qualified as specified herein before use and at least once every 26 weeks thereafter. It is acceptable to perform qualification more often, e.g., every 13 weeks, if desired (i.e., the interval between each qualification of any given crimp tool used in Production must not exceed 26 weeks, but may be more frequent).

5.1.3 For the purposes of this PPS there is no difference between initial qualification of crimp tools and re-qualification of crimp tools.

5.1.4 For each crimp tool to be qualified, a test sample as specified in section 5.2 must be prepared for every wire size and termination (i.e., terminal lug, splice or contact) for which that tool will be used in production. For qualification of any given crimp tool, **all** test samples prepared must be tensile tested according to section 5.3 and found acceptable.

5.2 **Test Samples**

5.2.1 Use wire and terminal lugs, splices or contacts representative of the wire and terminal lug, splice or contact combinations used in production at that facility.

5.2.2 Prepare each test sample as follows:

Step 1. Strip the ends from the applicable wire according to PPS 9.24. The length of wire used must be suitable for the tensile testing machine to be used.

Step 2. Crimp the appropriate terminal lug, splice or contact on each end of the wire according to the procedure specified in PPS 9.01, PPS 9.09, PPS 9.19, PPS 9.20, PPS 9.35 and PPS 9.36, as applicable.

5.3 **Tensile Testing of Test Samples**

5.3.1 Place each of the prepared test samples in a standard tensile testing machine and apply force gradually and smoothly at a head travel speed of 1"± 1/4" per minute until either the wire pulls out of the crimped termination; the wire or crimped termination breaks; or the minimum load specified in Table 1, Table 2, Table 3 or Table 4, as applicable, is exceeded.

5.3.1.1 If the wire pulls out of a crimped termination before the minimum tensile strength requirement specified in Table 1, Table 2, Table 3 or Table 4, as applicable, is reached, insufficient crimping force has been applied at the crimp resulting in an under-crimped termination which is considered unacceptable. If the tensile testing results for any of the test samples indicates an under-crimped termination, the crimp tool shall be considered to have failed qualification testing.

5.3.1.2 If a wire or a crimped termination breaks at the crimp before the minimum tensile strength requirement specified in Table 1, Table 2, Table 3 or Table 4, as applicable, is reached, excessive crimping force has been applied at the crimp resulting in an over-crimped termination. If the tensile testing results for any of the test samples indicates an over-crimped termination, the crimp tool shall be considered to have failed qualification testing.

5.3.1.3 If the minimum load specified in Table 1, Table 2, Table 3 or Table 4, as applicable, is reached or exceeded without the wire pulling out of the crimp, or the wire or crimped termination breaking, the crimp is considered acceptable. Only if the tensile testing results for all of the applicable test samples for a particular crimp tool are acceptable, that crimp tool shall be considered to have passed qualification testing.

5.3.1.4 For each crimp tool, maintain a complete record of all tool qualification test results and qualification dates.

Table 1. Minimum Tensile Strength Requirements for Test Samples with Terminal Lugs or Splices Crimped to Copper Wire (ref. PPS 9.01 and PPS 9.09)

Wire Size	Minimum Tensile Strength	
	Tin or Silver Coated Copper Wire	Nickel Coated Copper Wire
26	7 lbs	5 lbs
24	10 lbs	7 lbs
22	15 lbs	11 lbs
20	19 lbs	13 lbs
18	38 lbs	27 lbs
16	50 lbs	35 lbs
14	70 lbs	49 lbs
12	110 lbs	77 lbs
10	150 lbs	105 lbs

Wire Size	Minimum Tensile Strength	
	Tin or Silver Coated Copper Wire	Nickel Coated Copper Wire
8	225 lbs	158 lbs
6	300 lbs	210 lbs
4	400 lbs	300 lbs
2	550 lbs	440 lbs
1	650 lbs	585 lbs
0	700 lbs	700 lbs
00	750 lbs	750 lbs
000	825 lbs	825 lbs
0000	875 lbs	875 lbs

Table 2. Minimum Tensile Strength Requirements for Test Samples with M39029 Contacts Crimped to Copper Wire (ref. PPS 9.19, PPS 9.20 and PPS 9.36)

Wire Size	Minimum Tensile Strength	
	Tin or Silver Coated Copper Wire	Nickel Coated Copper Wire
26	5 lbs	3 lbs
24	8 lbs	6 lbs
22	12 lbs	8 lbs
20	20 lbs	19 lbs
18	38 lbs	Note 1
16	50 lbs	37 lbs
14	70 lbs	60 lbs
12	110 lbs	100 lbs
10	150 lbs	135 lbs

Wire Size	Minimum Tensile Strength	
	Tin or Silver Coated Copper Wire	Nickel Coated Copper Wire
8	220 lbs	200 lbs
6	300 lbs	270 lbs
4	400 lbs	360 lbs
2	550 lbs	495 lbs
1	650 lbs	585 lbs
0	700 lbs	630 lbs
00	750 lbs	675 lbs
0000	875 lbs	785 lbs

Note 1. If preparing test samples using size 18 nickel coated copper wire, refer to Liaison Engineering for the minimum acceptable tensile strength.

Table 3. Minimum Tensile Strength Requirements for Test Samples with MS25435, MS25436, MS25437 or MS25438 Terminal Lugs Crimped to Aluminum Wire (ref. PPS 9.35)

Wire Size	Minimum Tensile Strength	Wire Size	Minimum Tensile Strength
8	130 lbs	1	700 lbs
6	200 lbs	0	900 lbs
4	300 lbs	00	1100 lbs
2	500 lbs		

Table 4. Minimum Tensile Strength Requirements for Test Samples with Copalum Terminal Lugs or Butt Splices Crimped to Aluminum Wire (ref. PPS 9.35)

Wire Size	Minimum Tensile Strength	Wire Size	Minimum Tensile Strength
8	130 lbs	2	500 lbs
6	200 lbs	0	550 lbs
4	300 lbs	00	650 lbs

6 Requirements

6.1 Crimp Tools that Fail Qualification Testing

6.1.1 For all crimp tools which fail qualification testing, the applicable tool must no longer be used for crimping production parts until the cause of the failure has been identified/corrected and qualification testing repeated as specified herein.

6.1.1.1 At Bombardier facilities, Quality must be informed of failure of the crimp tool qualification and an investigation of parts crimped by that tool since the last successful qualification must be begun.

6.1.1.2 At supplier/subcontractor facilities, Bombardier Supplier Quality Management (SQM) must be informed of the failure of the crimp tool qualification via a suitable disclosure letter so that an investigation of all parts crimped by that tool since the last successful qualification can be initiated.

6.2 **Crimp Tools that Pass Qualification Testing**

6.2.1 Identify tools which have passed qualification testing, for example using a suitable label or sticker, such as shown in Figure 1, which includes the qualification expiry date. After the qualification expiry date, crimp tools may no longer be used to crimp production parts until re-qualified.

Figure 1. **Example Crimp Tool Qualification Label**

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.

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.

8.2 Personnel responsible for crimping of terminal lugs, splices or contacts as specified herein must meet the personnel requirements specified in PPS 9.01, PPS 9.09, PPS 9.19, PPS 9.20, PPS 9.35 or PPS 9.36, as applicable.

8.3 Personnel performing tensile testing as specified herein must meet the personnel requirements specified in BAERD GEN-018.