BOMBARDIER
Toronto (de Havilland)
PROPRIETARY INFORMATION

PPS 9.08

PRODUCTION PROCESS STANDARD

Swaging Ferrules to Flexible Conduit

Issue 5
- This standard supersedes PPS 9.08, Issue 4.
- Vertical lines in the left hand margin indicate 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.

Prepared By:	(Michael Wright)	January 11, 2012
	Production Process Standards (PPS)	
Approved By:	(L.K. John)	January 12, 2012
	Materials Technology	
	(B. DeVreede)	January 12, 2012
	Quality	

Table of Contents

Sections **Page**

Figures

Tables

1 Scope

1.1 This Production Process Standard (PPS) specifies the procedure and requirements for swaging ferrules to flexible, aluminum, electrical conduit.

1.1.1 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.

1.1.2 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 (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 13.26 - General Subcontractor Provisions.

3.2 PPS 15.01 - Part Marking.

3.3 PPS 31.17 - Solvent Usage.

4 Materials and Equipment

4.1 Materials

4.1.1 Conduit, coupling nuts and ferrules, as specified on the engineering drawing.

4.2 Equipment

4.2.1 Ferrule assembling machine (e.g., Amphenol model 97-199b) with matching mandrels and collets.

4.2.2 Saw vise adaptor.

5 Procedure

5.1 Preparation of Parts

5.1.1 Prepare parts for swaging as follows:

Step 1. Place the conduit into the applicable bore of the saw vise and measure off the length required.

Step 2. Cut the conduit using a fine-toothed hack saw (32 or more teeth per inch).

Step 3. Trim off the excess frayed-wire ends with a pair of side cutters. Remove burrs from the conduit ends using a fine-cut file.

Step 4. Ensure that the ferrule and coupling nut that are to be installed are free of contamination (i.e., grease, dirt, etc.). Solvent clean if necessary according to PPS 31.17.

Step 5. Assemble the coupling nut and ferrule to the conduit, ensuring that the conduit end is bottoming in the ferrule (see Figure 1).

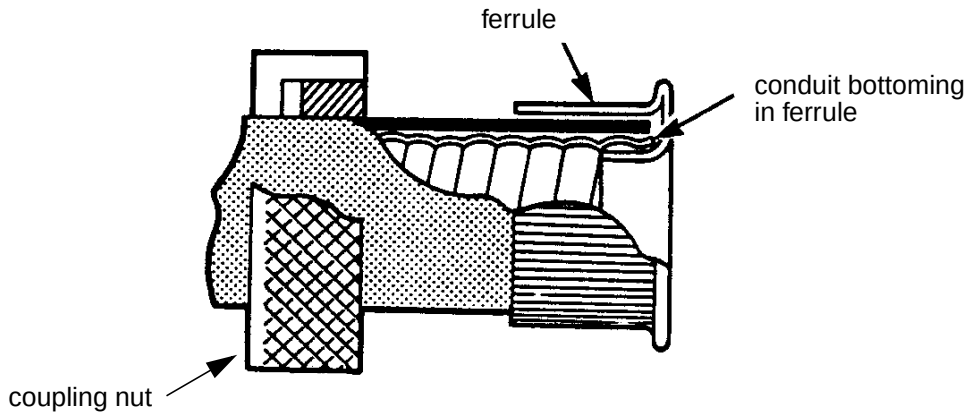

Figure 1 - Coupling-Nut and Ferrule Assembled on Conduit

5.2 Swaging

5.2.1 Perform swaging as follows:

Step 1. Fully open the beading rollers and retract the mandrel shaft.

Step 2. Place the correct size mandrel in the mandrel shaft and drop the lower half of the collet in place (see Table 1). The flange of the mandrel must be of the same diameter as the lip of the ferrule (see Figure 2). The smaller inside diameter of the collet must equal the outside diameter of the ferrule and the larger inside diameter of the collet must be equal to the diameter of the lip of the ferrule (see Figure 2).

Step 3. Advance the mandrel shaft until the mandrel lightly butts against the lower collet. Ensure that the mandrel is correctly seated in the mandrel shaft and then lock the mandrel shaft set-screw with an Allen key (see Figure 3).

Step 4. Retract the mandrel shaft to slip on the conduit and ferrule. Place the upper half of the collet on the mandrel shaft as shown in Figure 4.

Step 5. Advance the mandrel and grip the ferrule firmly between the mandrel and the collet.

Step 6. Adjust the beading rollers to exert a slight pressure against the ferrule.

Step 7. Rotate the crimping wheel to gradually increase the roller pressure. Each completed revolution of the crimping wheel will increase the depth of impression made on the ferrule (see Figure 5). Do not attempt to swage too rapidly as this may result in a cracked ferrule.

Step 8. Retract the beading rollers and mandrel shaft to remove the completed assembly.

Table 1 - Collet, Mandrel, Conduit and Ferrule Sizes

COLLET	MANDREL	CONDUIT	FERRULE
1/4"	1/4"	1/4"	AN3050-4
3/8"	3/8"	3/8"	AN3050-6

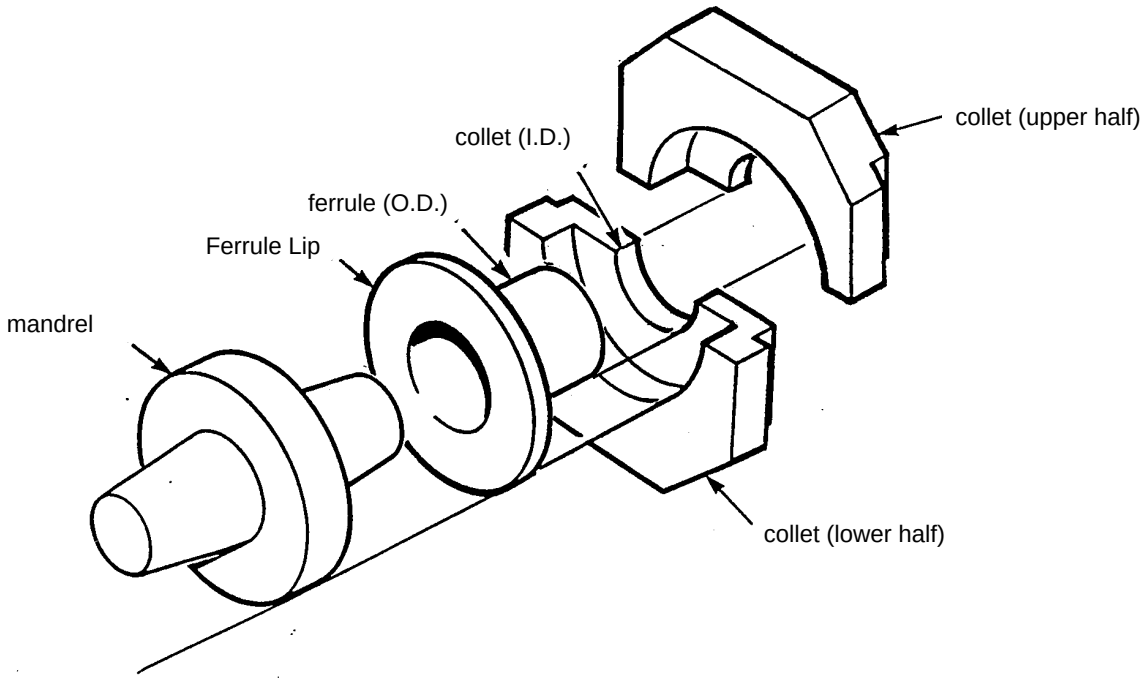

Figure 2 - Mandrel, Ferrule and Collet

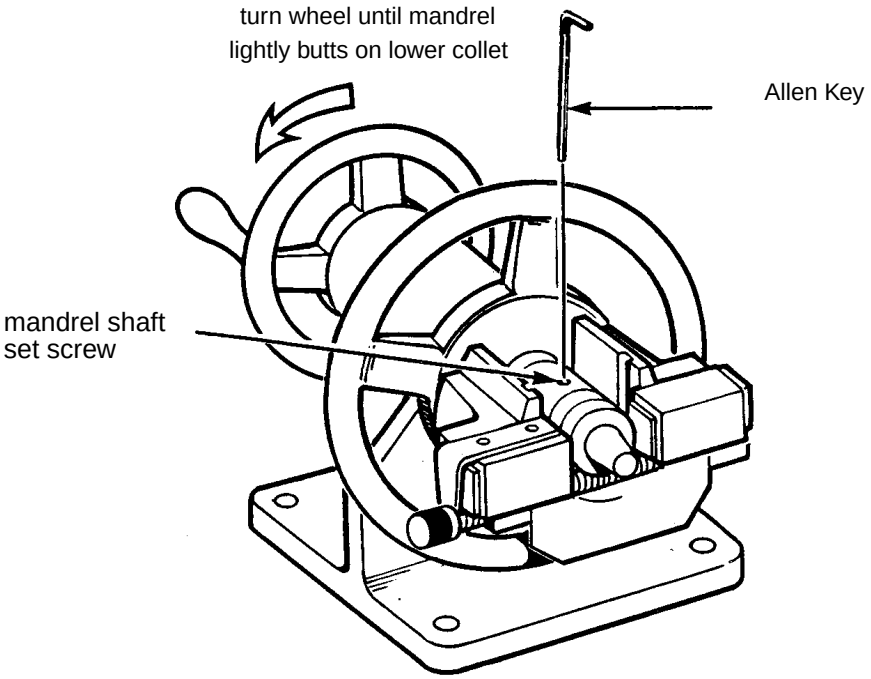

Figure 3 - Locking Mandrel in Place

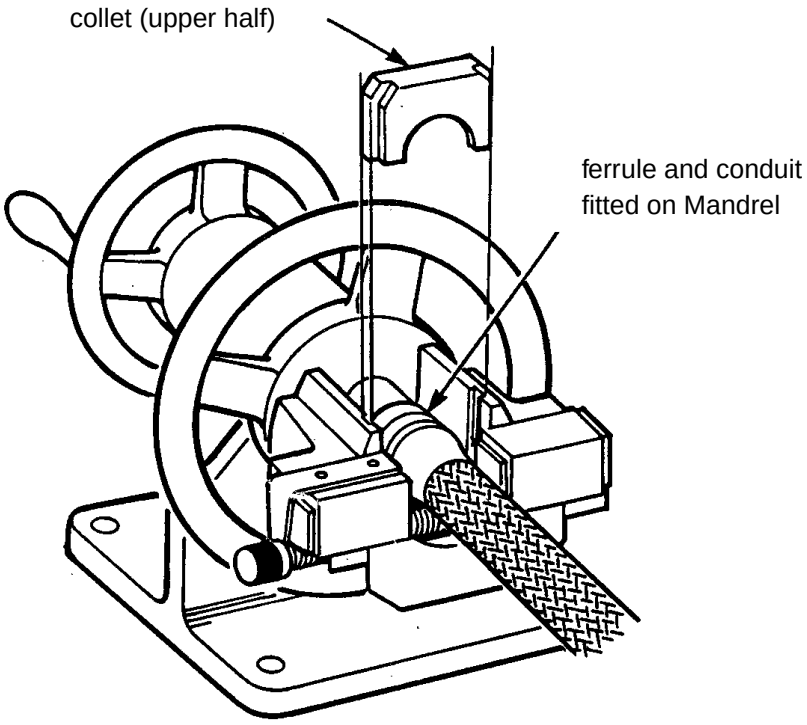

Figure 4 - Installation of Conduit and Ferrule, and Collet Upper-Half

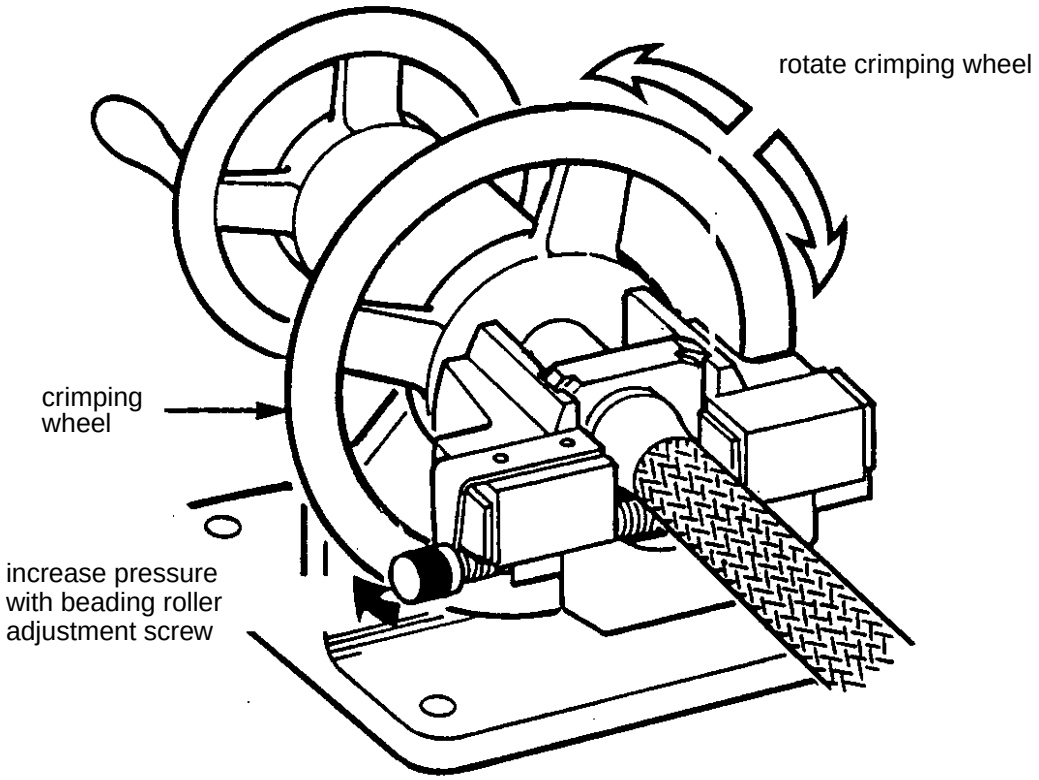

Figure 5 - Swaging of Ferrule

5.3 Part Marking

5.3.1 Part mark completed assemblies according to PPS 15.01.

6 Requirements

6.1 The ferrule shall have well defined swage indentations and an even metal flow around the conduit (see Figure 6 for an acceptable swaged joint).

6.2 Ensure that the swage provides a tight fitting ferrule to conduit joint. Cracked ferrules are not acceptable.

6.3 Ensure that it is not possible to separate the ferrule from the conduit when holding the coupling nut firmly against the ferrule and hand pulling the conduit with a straight pull.

6.4 If specified by Bombardier Quality, prepare test samples, approximately 18" in length, during a production run. Submit test samples to the Bombardier Toronto (de Havilland) Materials Laboratory or other Bombardier approved laboratory to determine, by destructive tests, the pull-off load at the swage joint. The minimum acceptable failing load at the swage point is 50 pounds.

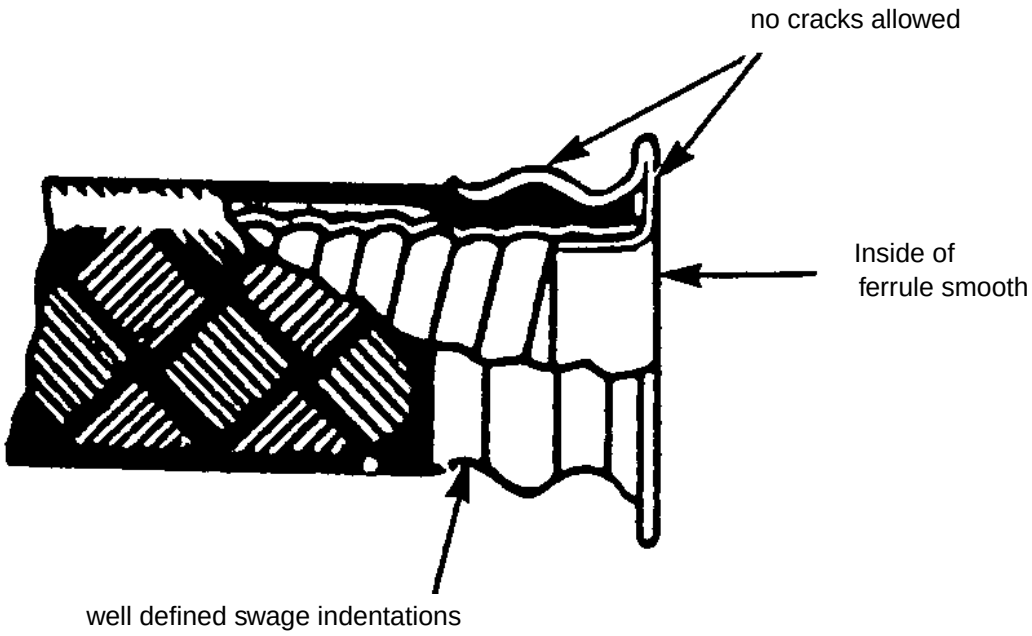

Figure 6 - Swaged Ferrule

7 Safety Precautions

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

8 Personnel Requirements

8.1 Personnel responsible for swaging ferrules to flexible, aluminum, electrical conduit must have a good working knowledge of the procedure and requirements as specified herein and must have exhibited their familiarity to their supervisor.

9 Additional Information

9.1 Ensure that assembled swaged ferrules are not be subjected to pulling or coiling into tight turns (especially near the swage joint), or similar maltreatment.