BOMBARDIER
Toronto (de Havilland)
PROPRIETARY INFORMATION

PPS 3.08

PRODUCTION PROCESS STANDARD

Fabrication of Steel Cable Assemblies using Nicopress Sleeves

Issue 9
- This standard supersedes PPS 3.08, Issue 8.
- 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.

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1 Scope

1.1 This PPS (Production Process Standard) specifies the procedure and requirements for fabrication of loop terminals and T-splices on steel cable assemblies using Nicopress sleeves.

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.

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 3.05 - Proof Loading of Cable and Chain Assemblies.

3.2 PPS 13.26 - General Subcontractor Provisions.

3.3 PPS 15.01 - Part Marking.

3.4 PPS 31.17 - Solvent Usage.

4 Materials and Equipment

4.1 Materials

4.1.1 Nicopress sleeves as specified in Table 1 and Table 2.

4.1.2 Steel cables and thimbles as specified on the engineering drawing. If the engineering drawing specifies the use of MIL-W-1511 or MIL-W-83420 Type I or II Composition A carbon steel cables, the cables must have a protective treatment coating of either zinc or tin over zinc (tin over zinc is preferred, if available).

4.1.3 Grease to MIL-PRF-81322 (e.g., Shell Aviation Ltd. Aeroshell Grease 22).

4.2 Equipment

4.2.1 Nicopress tools and dies according to Table 1 and Table 2.

4.2.2 Nicopress GO gauge, compression checking gauge.

4.2.3 Die holder (e.g., SD 8045-1).

4.2.4 Soldering flux (e.g., Stay Clean soldering flux).

4.2.5 Sodium bicarbonate (baking soda).

5 Procedure

5.1 General

5.1.1 Nicopress sleeve applications at each cable connection consist of a swaged Nicopress sleeve to permanently secure the cables and either a serving sleeve or soft solder to prevent the cable end from unravelling.

5.2 Preparation of Parts

5.2.1 Measure off the required length of cable and mark with masking tape at the point where it is to be cut. Determine the length of the cable required for a Nicopress splice or joint by experiment. When determining the required length, take into account the permanent stretch or permanent increase in length after proof loading. Cut the cable cleanly and squarely using an abrasive wheel or in the case of the smaller size cables, use hand operated cutters.

5.2.2 If serving sleeves are required for a particular application, as specified in Table 1, prepare the sleeves as follows:

- For cable sizes 1/16" and 3/32", use an additional Nicopress sleeve as a serving sleeve.
- For cable sizes 1/8", 5/32" and 5/16", cut the appropriate Nicopress sleeve into 2 pieces of approximately equal length and use each of those pieces as a sleeve.
- For cable sizes 3/16" and 1/4", cut the appropriate Nicopress sleeve into 3 pieces of approximately equal length and use each of those pieces as a serving sleeve.

5.2.3 For Nicopress sleeves to be crimped using a Nicopress die set, soft solder the end of the cable as follows:

Step 1. Using a portable propane torch, melt a sufficient quantity of soft solder into a suitable soldering pot.

Step 2. Solvent clean the portion of the cable to be soldered according to PPS 31.17 and then dip the cable into soldering flux to a depth equal to approximately 1 1/2 times the cable diameter. Take care to ensure that flux does not come into contact with any other area of the cable.

Step 3. Dip the fluxed cable end into the molten solder to a depth equal to that which flux was applied. Hold the cable in the solder only long enough to ensure that complete soldering of the cable end, including filling of the cables interstices, has occurred.

Step 4. Immediately dip the soldered cable end into a fresh solution of 25% sodium bicarbonate in water. Allow the cable end to remain in the sodium bicarbonate solution until all chemical reaction has stopped.

5.2.4 If a loop terminal is to include a thimble, cut off the tips of the thimble as shown in Figure 1.

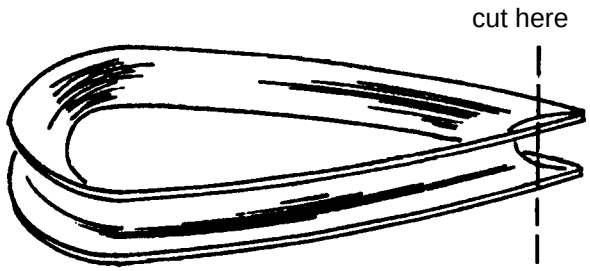

Figure 1 - Preparation of Thimble

5.3 Assembly Procedure (see Figure 2)

5.3.1 Assemble the cable and sleeve for crimping as follows:

Step 1. Select the applicable Nicopress sleeves from Table 1 or Table 2 for the particular cable size and tooling to be used.

Step 2. Insert the cable end through the sleeve and bend the free end of the cable back and insert it through the sleeve to form a loop or, where a T-splice is required, insert the second cable of the assembly into the sleeve. If a serving sleeve is required (see Table 1), ensure that the serving sleeve is placed onto the cable before the Nicopress sleeve.

Step 3. Arrange the assembly and sleeves in the correct position and, if a thimble is used in the terminal, push the sleeve firmly against the thimble to ensure that the cable is properly seated in the thimble. Ensure that the free end of the cable projects beyond the sleeve end for a distance equal to 2 1/2 times the nominal cable diameter.

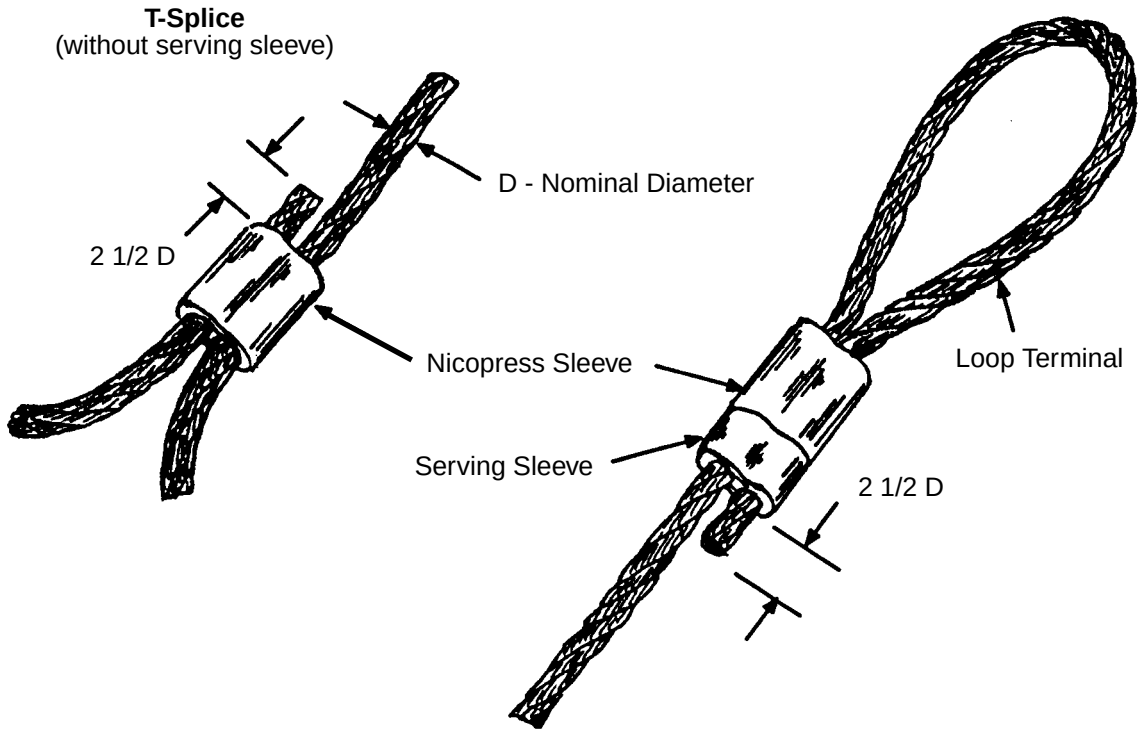

Figure 2 - Assembly Procedure

5.4 Crimping of Sleeves

5.4.1 Crimp sleeves using hand tools as follows:

Step 1. Select the appropriate hand tool from Table 1 for the particular cable size to be assembled.

Table 1 - Hand Tool Installation of Nicopress Sleeves

CABLE DIAMETER	NICOPRESS SLEEVE	SERVING SLEEVE	NUMBER OF COMPRESSIONS		NICOPRESS TOOL NO.
			NICOPRESS SLEEVE	SERVING SLEEVE	
1/16"	28-1-C	28-1-C	1	1	51-C-887
3/32"	28-2-G	28-2-G	1	1	51-G-887
1/8"	28-3-M	Note 1	3	1	51-M-850
5/32"	28-4-P		3	1	51-P-850
3/16"	28-6-X	Note 2	4	1	51-X-850
7/32"	28-8-F2		4	1	51-F2-850
1/4"	28-10-F6		4	1	71-F6-950
5/16"	28-13-G9	Note 1	3	1	71-G9-950

Notes 1. Use half of the appropriate Nicopress sleeve.
2. Use one third of the appropriate Nicopress sleeve.

Step 2. Beginning with the sleeve which is nearest to the terminal or splice, locate the sleeve in the crimping die in the approximate location that the first compression (see Figure 3) is to be made. If there is only one compression to be made, locate the tool centrally on the sleeve. Orient the hand tool so that the major axis of the sleeve is at right angles to the axis of the crimping tool (see Figure 4).

Step 3. Compress the sleeve by closing the handles of the tool until the stops meet. Finish the sleeve compression in the sequence specified in Figure 3. Rotate the Nicopress sleeve 180° between compressions. Refer to Table 1 for the number of compressions for the different sleeve sizes.

Step 4. Locate serving sleeves so that the sleeve end is flush with the free end of the cable and compress the sleeve (see Figure 4).

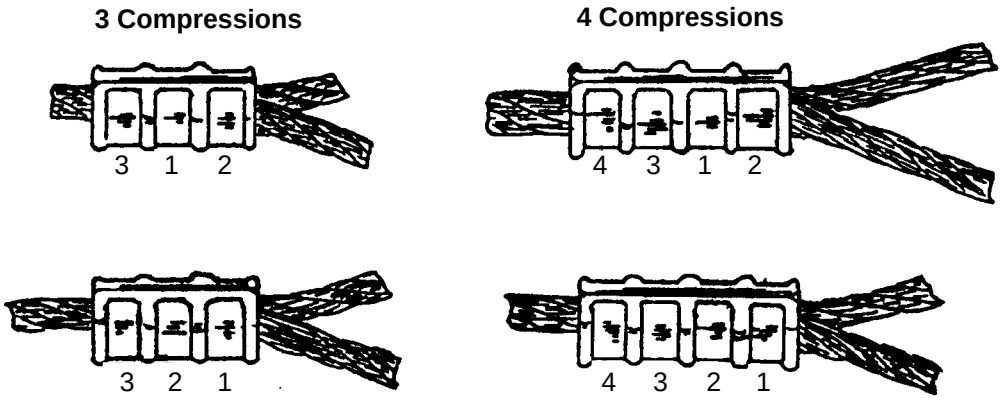

Figure 3 - Location and Sequence of Compressions

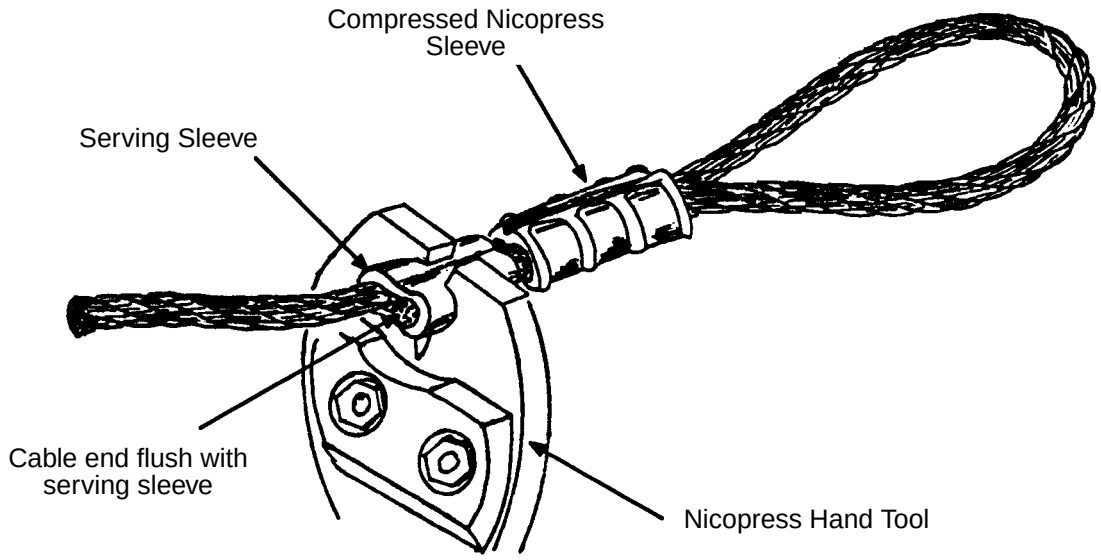

Figure 4 - Use of Nicopress

5.4.2 Crimp sleeves using Nicopress die sets as follows (see Figure 5):

Step 1. Select the applicable die set from Table 2 for the particular cable to be assembled.

Step 2. Insert the die set into Nicopress hydraulic tool No. 635 or an SD 8045-1 die holder. If using an SD 8045-1 die holder, set up the die holder in a power brake and adjust so that the die halves fully close during the compression operation.

Step 3. Locate the Nicopress sleeve centrally in the dies with the major axis of the sleeve aligned vertically between the die halves.

Step 4. Using either a Nicopress hydraulic tool or power brake, compress the sleeve by bringing the halves together, so that they are fully closed. Only one compression of the sleeve is required when using a Nicopress die set.

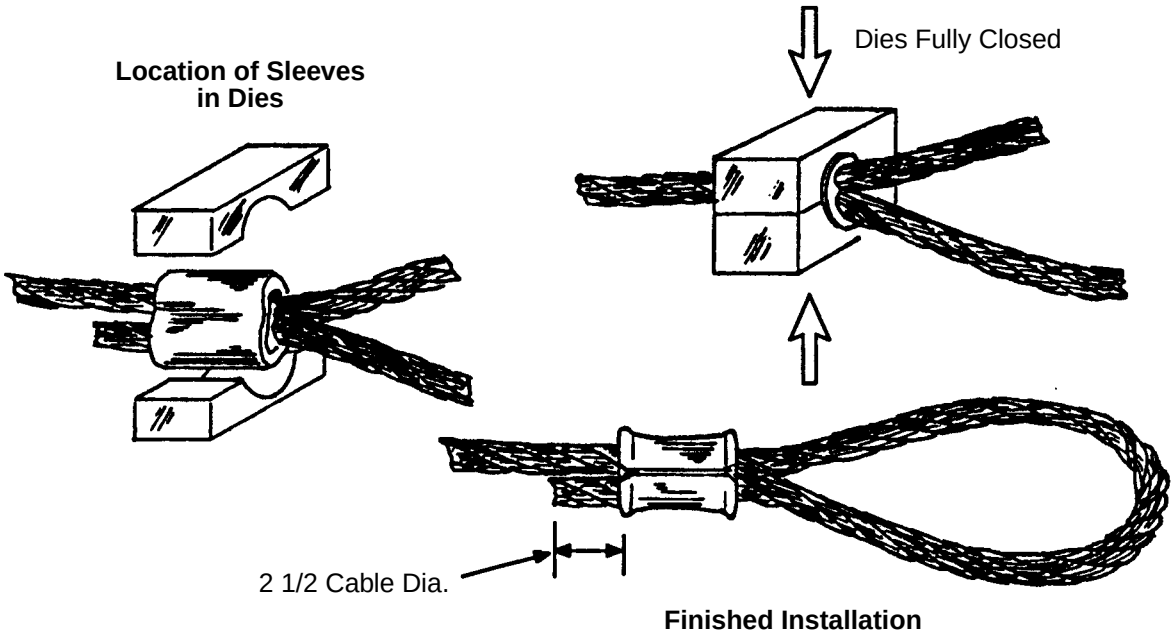

Figure 5 - Use of Nicopress Die Sets

Table 2 - Die Set Installation of Nicopress Sleeves

CABLE DIAMETER	NICOPRESS SLEEVES	SERVING SLEEVE	NICOPRESS DIE SET	TOOLING
5/16"	28-13-G9	None (Cable ends soldered according to para. 5.2.3)	G9	Nicopress No. 635 or SD8045-1
3/8"	28-23-H5		H5	
7/16"	28-24-J8		J8	
1/2"	28-25-K8		K8	
9/16"	28-27-M1		M1	

5.4.3 Occasionally check the maximum diameter of compressions using the appropriate Nicopress GO gauge (see Figure 6). Excessively large diameter compressions indicate wear of the swaging dies and requires replacement of the die set or adjustment of the hand tool according to para. 9.3, as applicable.

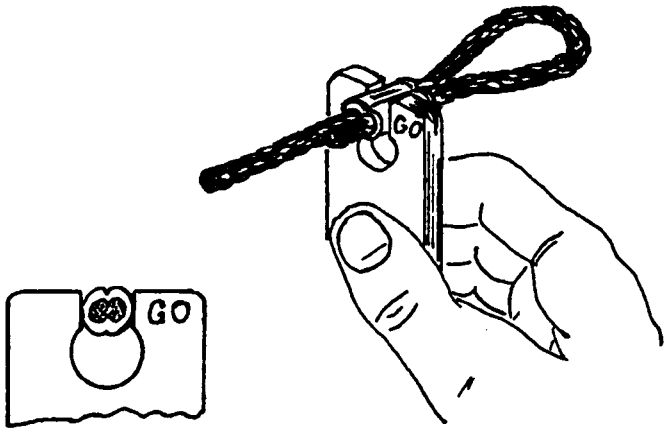

Figure 6 - Checking Compression Diameter

5.5 Protective Treatment, Part Marking and Proof Loading

5.5.1 Part mark completed cable assemblies according to PPS 15.01.

5.5.2 Protect all part marked cable assemblies as follows:

- Do not remove the manufacturer's lubricant on carbon steel or corrosion resistant steel cables.
- On non-jacketed carbon steel cables, apply a thin protective additional coating of grease (ref. para. 4.1.3) over the full length of the cable.

5.5.3 Proof load all fully completed cable assemblies according to PPS 3.05. Check the length of the cable assembly after it has been proof loaded to ensure that the drawing requirements are met within the tolerance specified in PPS 3.05.

5.6 Handling and Transport

5.7 For transport or storage, roll each cable assembly into a coil. Ensure that the minimum diameter of the coil is no tighter than the minimum acceptable coil diameter specified in Table 3. Should the protective coating on a cable become damaged during handling, touch it up immediately with the same type of coating.

5.8 For transportation purposes, enclose coiled cable assemblies in suitable containers, such as boxes or bags, so that they remain coiled and protected from abrasion and contamination.

Table 3 - Coil Diameter

CABLE DIAMETER	MINIMUM ACCEPTABLE COIL DIAMETER
3/32" or less	8"
1/8"	10"
5/32" to 5/16"	12"
3/8" and greater	15"

6 Requirements

6.1 Assemblies with cracked sleeves are not acceptable.

6.2 Ensure compression spacing is reasonably uniform.

6.3 Ensure that the trimmed cable end is flush with or recessed not more than 1/16" below the end of the serving sleeve. Soldered cable ends shall protrude approximately 2 cable diameters from the Nicopress sleeve.

6.4 The cable shall be free of kinks and the cable lay shall be uniform over the entire length with no looseness or looping of individual wires or strands.

7 Safety Precautions

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

8 Personnel Requirements

8.1 Personnel responsible for fabrication of steel cable assemblies using nicopress sleeves must have a good working knowledge of the procedure and requirements as specified herein and must have exhibited their competency to their supervisor.

9 Maintenance

9.1 Keep all tools clean and frequently oil all moving parts.

9.2 Ensure hand tool handles are easily movable. Jamming may be corrected by loosening of the particular jaw or handle bolt which is causing the binding (see Figure 7).

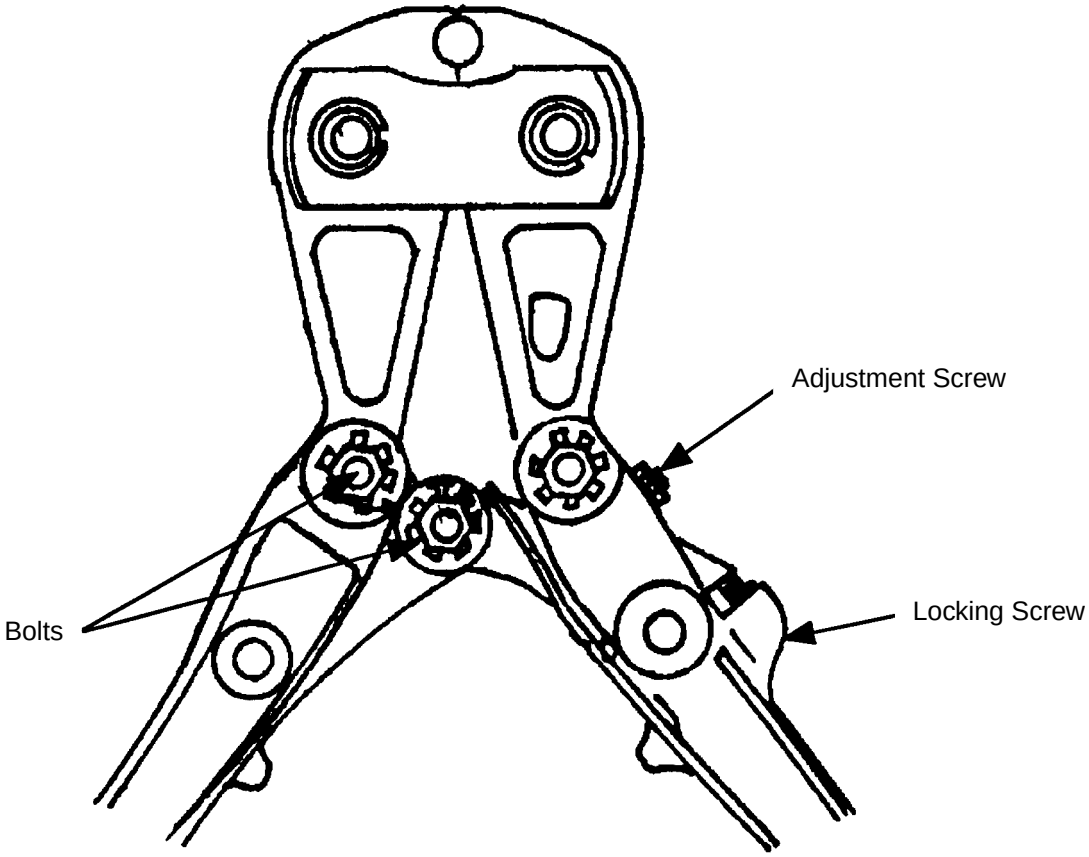

Figure 7 - Adjustment of Hand Tools

9.3 Hand tools may be adjusted, as required, as follows.

Step 1. Open the tool handles fully and loosen the locking screw with an Allen wrench and turn the adjustment screw clockwise (a fraction of a turn at a time) until the proper setting is obtained before re-tightening the locking screw (see Figure 7).

Step 2. Compress a sleeve onto a test loop and check the compressions with the applicable Nicopress GO gauge.

Step 3. Re-adjust as specified in the preceding steps until the proper crimp diameter is achieved.