BOMBARDIER
Toronto (de Havilland)
PROPRIETARY INFORMATION

PPS 1.41

PRODUCTION PROCESS STANDARD

Set-up and Operation of the Craco Automatic Drill Riveter

Issue 9
- This standard supersedes PPS 1.41, Issue 8.
- 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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	Quality	

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

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Tables

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1 Scope

1.1 This standard specifies the procedure and requirements for the set-up, adjustment and operation of the Craco automatic drill riveter.

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.

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.

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 1.33 - Countersinking for Flush Head Fasteners.

3.2 PPS 2.01 - Installation of Solid Rivets.

3.3 PPS 2.35 - Installation of BACB and Bombardier Type Titanium Lockbolts.

3.4 PPS 2.38 - Fluid Tight Installation of Solid Rivets.

3.5 PPS 13.26 - General Subcontractor Provisions.

3.6 PPS 15.04 - Use of Felt tip Markers for Marking Aircraft Parts and Assemblies.

4 Materials and Equipment

4.1 Materials

4.1.1 Slide and drill spindle lubricant - llithium base grease (e.g., Unitol).

4.1.2 Drill spindle lubricant - mineral oil (e.g., Nuto A22).

4.1.3 Air line lubricant - SAE 10 oil (e.g., Nuto H32).

4.2 Equipment

4.2.1 Automatic drill riveter (e.g., Craco model 3-0068) and associated equipment as listed below. Refer to Figure 1 and Figure 2 for a general description of the Craco automatic drill riveter. It is acceptable to use an alternative drill riveter and associated equipment in place of the Craco model 3-0068 and the equipment listed below provided that it is set up and operated according to the manufacturers instructions and the installed rivets or lockbolts meet all the requirements specified herein.

- Rivet hoppers (e.g., as specified in Table 1).
- Upper anvil equipment (e.g., as specified in Table 2).
- Lower anvils, anvil fingers, finger holders and anvil holders (e.g., as specified in Table 3)
- Drill/countersinks (e.g., as specified in Table 5).
- Drills (e.g., as specified in Table 4).
- Pressure foot bushings (e.g., as specified in Table 6).
- Hole locating laser (e.g., Spectra Physics model 155).
- Offset sleeve (e.g., TS.321.26.13 Mk 1 and Mk 2).
- Automatic collar feeder (e.g., Huck Model 435-06A3/08A3).

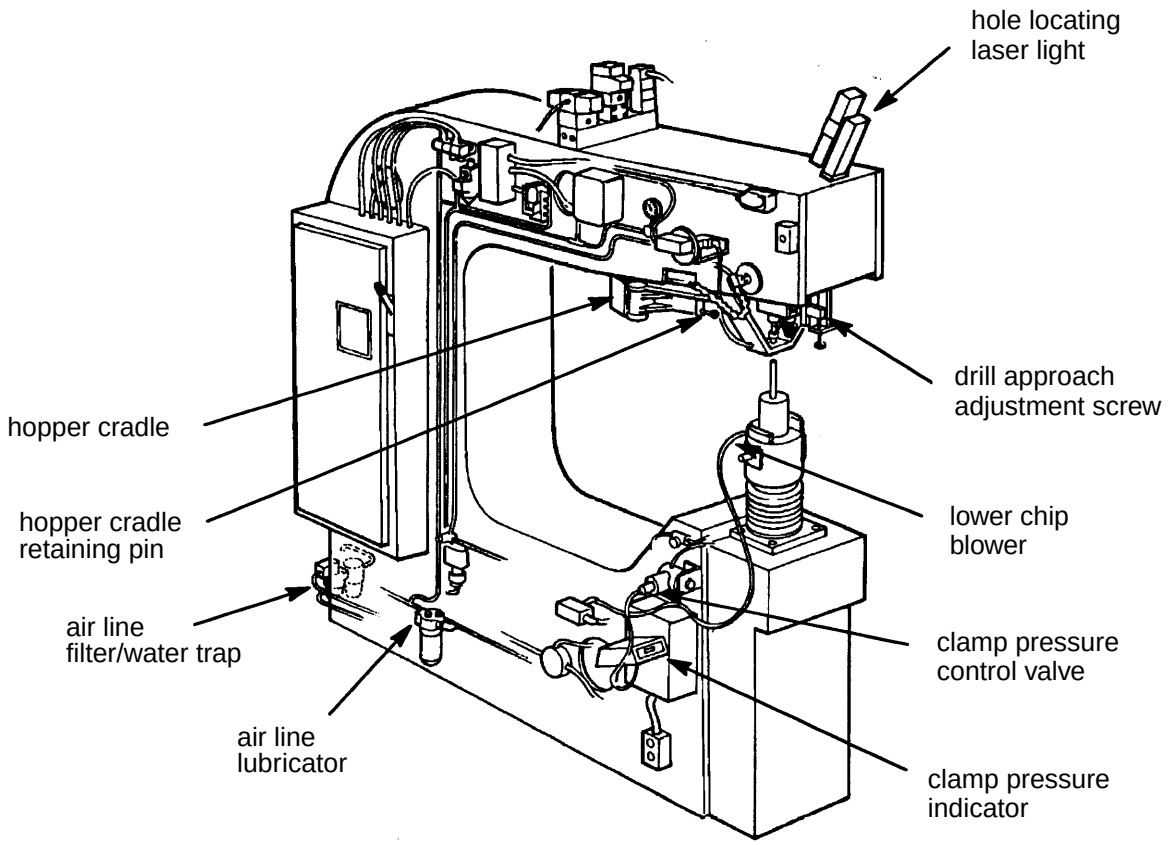

Figure 1 - Craco Automatic Drill Riveter - Left View

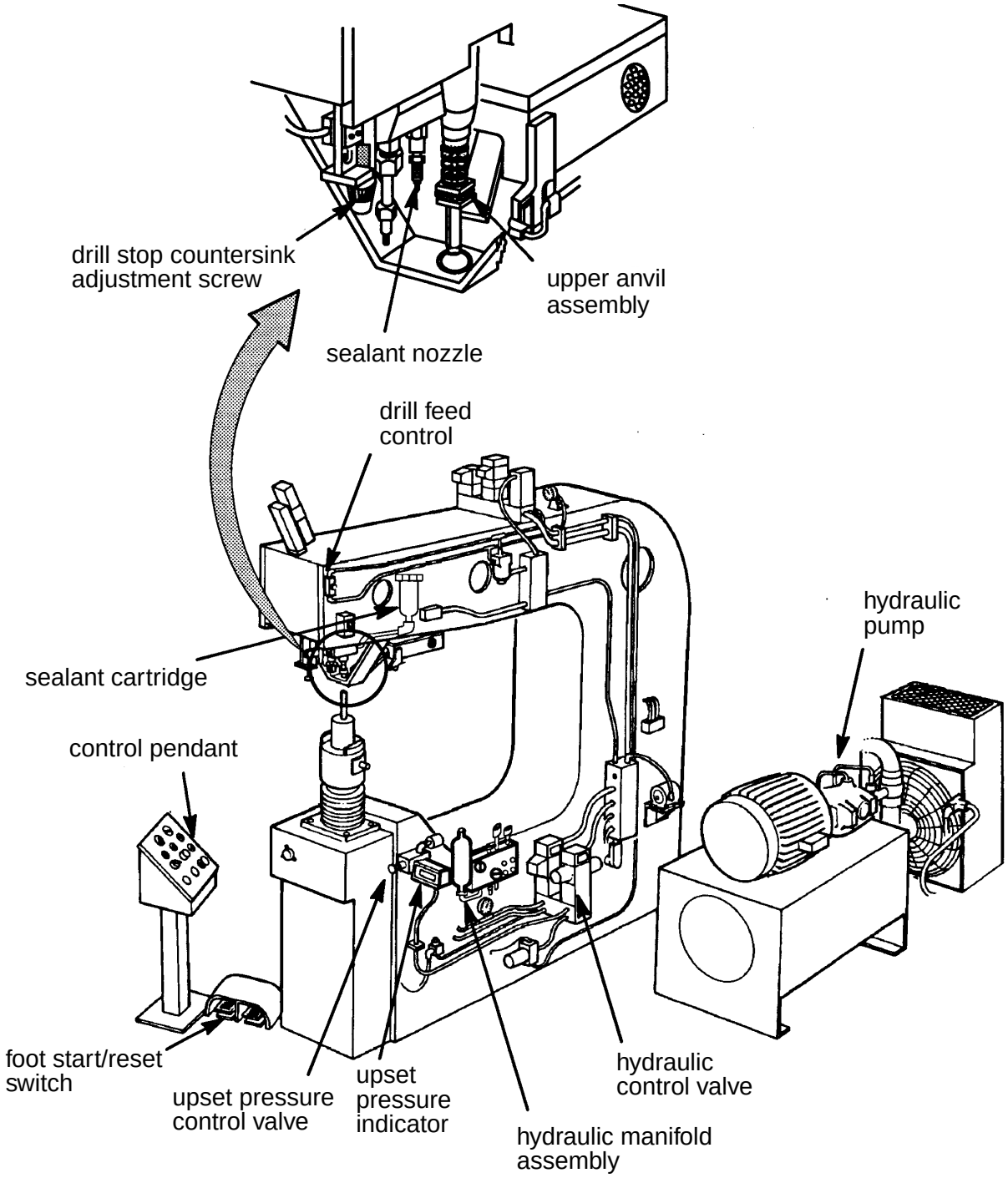

Figure 2 - Craco Automatic Drill Riveter - Right View

4.2.2 Hole location marking spray (e.g., Gro Lac spray dot black coating applied using Prevail spray guns).

4.2.3 Strippable coating (e.g., Gro Lac Transeal blue paint) for metal rivet templates.

4.2.4 Laser safety labels (e.g., TS.321.04.25).

4.2.5 Rivet marking templates (e.g., TS.321.52.00).

5 Procedure

5.1 General

5.1.1 The Craco automatic drill riveter is used for installing solid rivets or stump type titanium lockbolts and may be operated in the automatic, drill only or rivet only modes. The automatic mode is used to drill or drill/countersink, insert the fastener and then upset a rivet or swage a lockbolt collar in one complete cycle. The drill only mode is used to drill holes without inserting a fastener into the hole. The rivet only mode is used to upset rivets in a pre-drilled workpiece. In this mode the rivets must be inserted manually into pre-drilled holes.

5.1.2 If installing stump type titanium lockbolts, operate the drill riveter in the automatic mode with the automatic collar feeding device used as the lower anvil.

5.1.3 Do not operate the drill riveter at any time without a part or test piece between the lower anvil and the pressure foot bushing.

5.2 Set-Up of Drill Riveter

5.2.1 Install the hopper as follows:

Step 1. Select the appropriate hopper according to Table 1. For lockbolts, use the Gemcor mini-hopper.

Table 1 - Hopper Selection

NOMINAL FASTENER DIAMETER	RIVET HOPPER TS.321.18.11
3/32"	MK 1
1/8"	MK 2
5/32"	MK 3
3/16"	MK 4
1/4"	MK 5

Step 2. Place the hopper in the hopper cradle, attach the electrical connector and the 3 colour coded air lines to the appropriate connectors on the back panel of the hopper.

Step 3. Fill the hopper approximately three-quarters full with the applicable fastener.

Step 4. Swing the hopper cradle into place and secure the retaining pin.

5.2.2 Install the upper anvil as follows:

Step 1. Select the appropriate upper anvil, anvil fingers, finger holder and anvil holder according to Table 2.

Step 2. Assemble the upper anvil as shown in Figure 3. Ensure that the locating pins of the anvil are aligned in the anvil holder and fingers so that the finger opening will face the rivet hopper. Ensure that the spring on the rivet injector of the hopper is between the rivet fingers.

Table 2 - Selection of Upper Anvil Equipment

NOMINAL DIAMETER	HEAD STYLE	UPPER ANVIL	ANVIL FINGER TS.321.14.11	FINGER HOLDER TS.321.15.10	ANVIL HOLDER TS.321.13.10
3/32"	Flush & Reduced Flush Head	TS.321.12.22 MK 6	MK 1	MK 1	MK 1
	Protruding Head	TS.321.12.22 MK 1			
1/8"	Flush & Reduced Flush Head	TS.321.12.22 MK 7	MK 2		
	Protruding Head	TS.321.12.22 MK 2			
5/32"	Flush & Reduced Flush Head	TS.321.12.22 MK 8	MK 3		
	Protruding Head	TS.321.12.22 MK 3			
3/16"	Flush & Reduced Flush Head	TS.321.12.22 MK 9	MK 4		
	Protruding Head	TS.321.12.23 MK 4			
1/4"	Flush & Reduced Flush Head	TS.321.12.22 MK 10	MK 5	MK 2	MK 2
	Protruding Head	TS.321.12.23 MK 5			

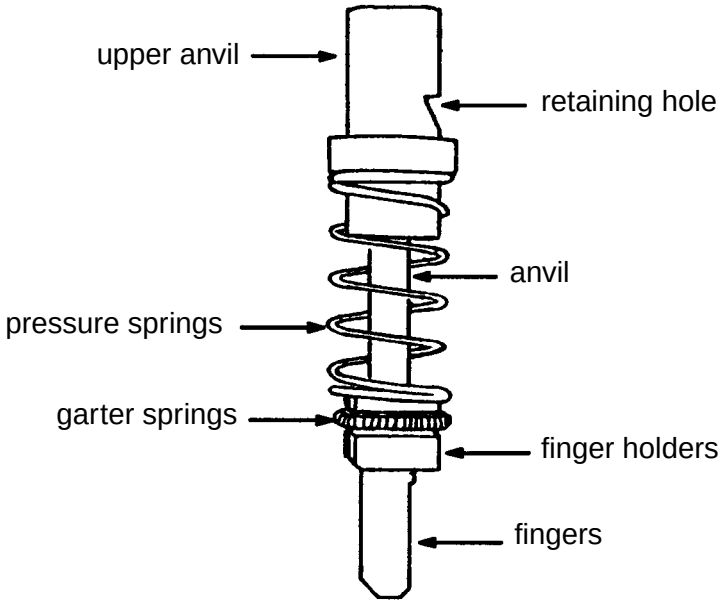

Figure 3 - Upper Anvil Assembly

5.2.3 Install the lower anvil (for installation of rivets only) as follows:

Step 1. Select the appropriate lower anvil according to Table 3. If required, use an offset sleeve (see Equipment section, paragraph 4.2.1) on the lower anvil assembly to provide an offset of 0.310".

Table 3 - Selection of Lower Anvil

FASTENER NOMINAL DIAMETER	**LOWER ANVIL TS.321.17.11**	**MODIFIED LOWER ANVIL TS.321.17.16**	**GEMCOR LOWER ANVIL** (Note 1) **TS.321.26.11**	**GEMCOR OFFSET LOWER ANVIL** (Note 1)
3/32"	MK 1	MK 1	MK 1	TS.321.27.11
1/8"	MK 2	MK 2		
5/32"	MK 3	MK 3		
3/16"	MK 4	MK 4	MK 2	
1/4"	MK 5	MK 5	MK 3	

Note 1. Gemcor lower anvils may be used on the Craco automatic drill riveter provided that a TS.321.17.17 adaptor is used.

Step 2. Align the flats of the anvil base with the turntable assembly and lower the anvil into place.

Step 3. Turn the anvil 90° so that the opening in the pressure sleeve faces the operator.

Step 4. Hand tighten the locking screw.

Step 5. Attach the chip blower air line to the lower anvil.

5.2.4 Install the automatic collar feeder (for installation of lockbolts only) as follows:

Step 1. Place the automatic collar feeder (see Figure 4) on the lower anvil post and align it with the upper anvil.

Step 2. Hand tighten the locking screw.

Step 3. Connect all lines from the automatic collar feeder to the hydraulic manifold assembly.

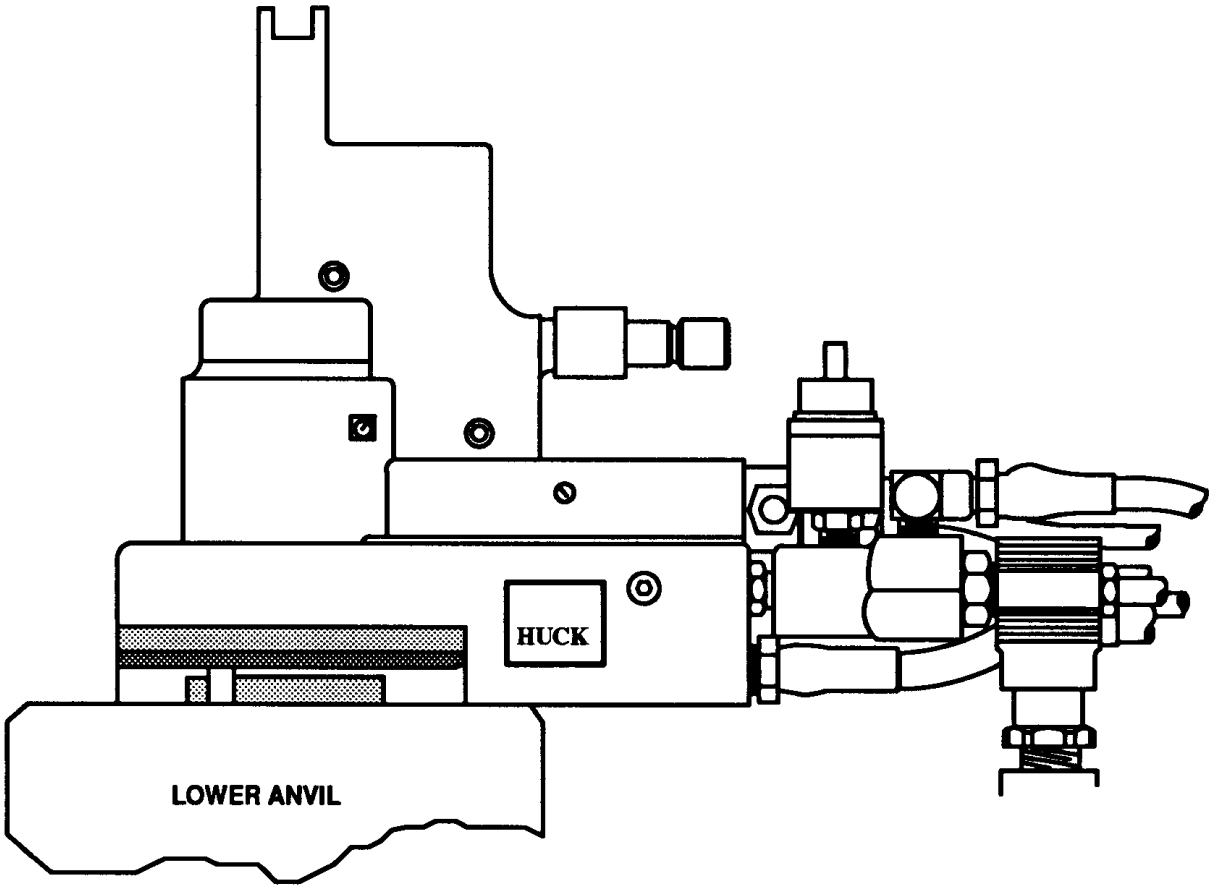

Figure 4 - Automatic Collar Feeder

5.2.5 Install drills and drill/countersinks as follows:

Step 1. Select the applicable drill or drill/countersink according to Table 4 or Table 5, as applicable. Drill/countersink bits may be used to drill holes for protruding head rivets in assemblies having a total sheet thickness at least 0.100" less than the length of the body of the drill portion of the tool.

Table 4 - Selection of Drills (Note 1)

NOMINAL FASTENER DIAMETER	DRILL TS.321.51.13	COLLET ADAPTOR ASSEMBLY TS.321.19.11
3/32"	MK 1	AF-2 (0.098 COLLET)
1/8"	MK 2	AF-6 (0.128 COLLET)
5/32"	MK 3	AF-8 (0.161 COLLET)
3/16"	MK 4	AF-10 (0.191 COLLET)
1/4"	MK 7	AF-14 (0.250 COLLET)

Note 1. Drill/countersink cutters according to Table 5 may be used to drill holes for protruding head rivets in thin gauge assemblies.

Table 5 - Selection of Drill/Countersinks

FASTENER NOMINAL DIAMETER	DRILL/COUNTERSINK		COLLET ADAPTOR ASSEMBLY (TS.321.19.11)
3/32"	TS.321.098.XXX Type 3	TS.321.098.XXX Type 4	AF-14 (.250 COLLET)
1/8"	TS.321.128.XXX Type 3	TS.321.128.XXX Type 4	
5/32"	TS.321.161.XXX Type 3	TS.321.161.XXX Type 4	
	TS.321.159.XXX Type 3	- - -	
3/16"	TS.321.191.XXX Type 3	TS.321.191.XXX Type 4	
	- - -	TS.321.1865.XXX Type 4	
1/4"	TS.321.257.XXX Type 3	- - -	
	- - -	TS.321.2464.XXX Type 4	

Note 1. XXX denotes length of the drill portion of the drill/countersink cutter (in thousands of an inch).
Note 2. Type 2 drill/countersink cutters have been superseded by Type 3 drill/countersink cutters, but may be used to depletion of current stock.
Note 3. For type 3 drill/countersink cutters refer to TS.321.51.15.
Note 4. For type 4 drill/countersink cutters refer to TS.321.51.16.

Step 2. Insert the drill bit into the drill collet or drill adapter and securely tighten the drill collet nut or set screw.

5.2.6 Install pressure foot bushings as follows:

Step 1. Select the appropriate pressure foot bushing according to Table 6.

Step 2. Set the bushing into place in the pressure foot bracket and tighten the two retaining screws.

Table 6 - Selection of Pressure Foot Bushings

NOMINAL FASTENER DIAMETER	PRESSURE FOOT BUSHING
3/32"	TS.321.16.22 MK 1 or TS.321.16.31 MK 1
1/8"	TS.321.16.22 MK 2, TS.321.16.31 MK 1 or TS.321.16.32
5/32"	TS.321.16.22 MK 3, TS.321.16.31 MK 2 or TS.321.16.32
3/16"	TS.321.16.22 MK 4
1/4"	TS.321.16.22 MK 5

5.2.7 Install the sealant applicator as follows:

Step 1. Select the applicable sealant from the freezer and insert it into the sealant dispensing cartridge, closing the cap firmly.

Step 2. Connect the air supply to the sealant cartridge assembly.

Step 3. Screw the quick push pull elbow tightly into the sealant holder.

Step 4. Connect one end of the plastic pneumatic tube to the quick push pull elbow and the other end to the plastic extension attachment through the Festo pneumatic coupling.

Step 5. Attach the applicable Semco sealant nozzle to the extension attachment.

Step 6. Select the “Sealant On” position on the control pendant to activate the applicator.

Step 7. The sealant applicator kit (i.e. nozzle, tube and fittings) shall only be used once.

Step 8. Allow the sealant to warm to room temperature before use.

5.3 Adjustment of the Drill Riveter

5.3.1 Adjust the drill and countersink depth by turning the *drill stop adjusting screw* clockwise to increase the depth and counterclockwise to decrease the depth. An adjustment of one graduation on the *drill stop adjusting screw* results in an increase or decrease in depth of 0.001". If using a drill/countersink to produce holes for installation of protruding head rivets, take care to ensure that the countersink does not contact the work surface. Countersink diameters shall be as specified in PPS 2.01, PPS 2.35 or PPS 2.38, as applicable. If countersinking is not specified on the engineering drawing, adjust the *drill stop adjusting screw* so that the drill bit protrudes through the workpiece by a length approximately equal to the drill diameter.

5.3.2 Adjust the fast approach of the drill spindle by turning the *drill approach adjustment wheel* clockwise to decrease the fast approach distance and counterclockwise to increase the fast approach distance.

5.3.3 Adjust the drill feed speed by turning the *drill feed control knob* so that the holes produced are free from burr.

5.3.4 For installation of rivets only, adjust the rivet upset pressure as follows:

Step 1. Set the selector switch on the control pendant to the set-up position.

Step 2. Adjust the rivet upset pressure by turning the upset pressure control valve located on the right side of the lower C-frame such that the formed shop head dimensions are as specified in the relevant rivet PPS's.

5.3.5 Adjust the clamp pressure as follows:

Step 1. Set the selector switch on the control pendant to the *set-up* position.

Step 2. Adjust the clamp pressure to hold the work piece firmly together without marking or damaging the work surface by turning the clamp pressure control valve located on the left side of the lower C-frame.

5.3.6 Adjust the clamp stroke height so that the lower anvil retracts to clear rivets or lockbolts and underside obstructions between cycles. The clamp stroke height is adjusted by turning the *stroke adjustment knob* clockwise to lower the ram and counterclockwise to raise the ram.

5.3.7 Adjust the height of the work table to give just enough clearance between the workpiece and the pressure foot bushing to allow easy positioning and accurate alignment of the workpiece with the locating light.

5.4 Marking Rivet Locations

5.4.1 Attach the applicable rivet marking template (see Equipment section, paragraph 4.2.5) to the work surface to be riveted using Clecos or other suitable temporary fasteners. Ensure that there are no excessive gaps between the template and the work surface.

5.4.2 Ensure metal rivet marking templates have been coated with strippable paint (see Equipment section, paragraph 4.2.3) on the outer surface. Mylar templates do not require this coating.

5.4.3 If using metal rivet marking templates, mark all hole locations with hole location marking spray (see equipment section, paragraph 4.2.2). If the hole location markings are no longer legible, remove the build up of Spray Dot Ink and re-coat with Transeal Blue coating.

5.4.4 When using Mylar templates, mark hole locations using a non-permanent marker according to PPS 15.04.

5.5 Assembly of Parts

5.5.1 Position mating parts without excessive gaps.

5.5.2 Tack rivet assemblies which are jig located according to PPS 2.01.

5.5.3 Clamp assemblies which are not jig located through the locating holes using Clecos or other suitable temporary fasteners. If possible, insert Clecos from the shop head side of the fastener to be installed, to prevent any obstruction of the pressure foot bushing during fastener installation.

5.6 Operation of the Drill Riveter

5.6.1 Prepare a test piece assembly as follows to ensure appropriate machine set-up and operation at the start of each production run. For fluid tight rivet installation only, a test piece assembly must also be prepared after a change in rivet size during a production run, before re-starting a production run after any work stoppage due to machine failure or if the machine has been shut down for more than 1 hour and at the end of each production run.

Step 1. Prepare test pieces using a 3" x 10" piece of material representative of the production parts to be fastened (i.e., of the same alloy and combined thickness). It is acceptable to use 7075-T6 QQA-250/13 sheet as a substitute for AMS 4252 7150-T7751 for test piece preparation.

Step 2. Drill 6 holes in the test piece.

Step 3. In 3 of the holes, install the appropriate rivets or lockbolts.

Step 4. Ensure that un-riveted holes and installed rivets or lockbolts in the test piece assembly meet the requirements of the applicable fastener PPS. If the test piece assembly fails to meet the requirements of the fastener PPS, determine/correct the cause of the failure and prepare another test piece assembly before commencing production. Check countersink diameters with a countersinking gauge set-up and adjusted according to PPS 1.33. Measure flush head fastener protrusion using a flushness rivet gauge (see Figure 5). If the test piece assembly prepared after completion of the production run fails to meet the requirements of the fastener PPS, refer the corresponding production parts to Bombardier Toronto (de Havilland) MRB or Bombardier Toronto (de Havilland) delegated MRB for disposition.

5.6.2 Operate the drill riveter as follows:

Step 1. Check that the *mode selector* and *hopper motor* switches on the control pendant are in the OFF position.

Step 2. Open the shop air *shut off valve*.

Step 3. Press the green *start* button on the control pendant to start the hydraulic pump and energize the main air solenoid.

Step 4. Check that the hydraulic pump pressure is approximately 1000 psi.

Step 5. Set the clamp pressure, upset pressure, RPM and feed rate as required.

Step 6. Turn the mode selector switch to auto.

Step 7. Turn the hole locating laser and hopper motor switches to the on position.

Step 8. Set the locating light so that the light dot is directly in line with the vertical axis of the drill spindle at the plane of work.

Step 9. Rivet the workpiece starting at the centre of the skin and working outward toward the edges of the skin, so that the tendency of the skin to stretch does not result in warping or oil-canning. Position the workpiece on the work table in such a way that the locating laser beam is centered on the locating dot. Depress the foot start switch to cycle the machine. If the foot start switch is released at any time during the cycle, the cycle may be continued by depressing the foot start switch or the drill riveter may be reset to the start of the cycle by depressing the *reset* switch. When the cycle has been interrupted, remove the fastener from the fingers, as a new fastener will be injected when the cycle is re-started.

Step 10. Repeat Step 9 until all holes are drilled and riveted.

5.6.3 When operating the drill riveter, ensure that holes and countersinks are prepared and fasteners installed within the tolerances specified in PPS 2.01, PPS 2.35 or PPS 2.38, as applicable. Check countersink diameters with a countersink gauge, set-up and adjusted according to PPS 1.33. The height and diameter of shop formed rivet heads must meet the requirements of PPS 2.01 or PPS 2.38, as applicable. Flush head fastener protrusion may be measured using a flushness rivet gauge (see Figure 5) to the values specified in the applicable fastener PPS's.

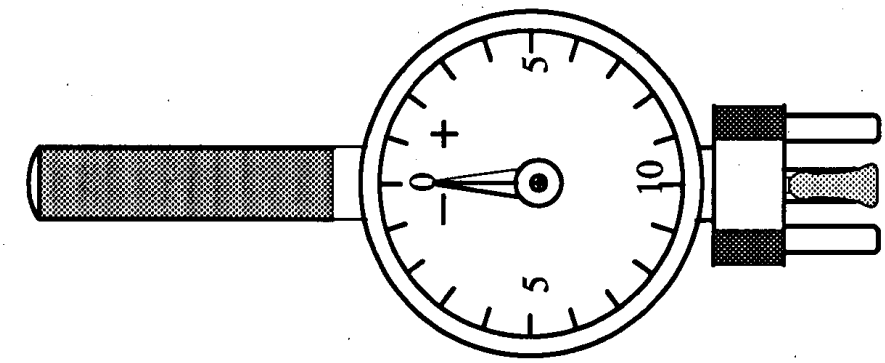

Figure 5 - Flushness Rivet Gauge

5.6.4 During each production run, check every 20th (approximately) swaged collar (lockbolts) using the applicable pin position & swage gauge according to PPS 2.35 or shop formed head (solid rivets) according to PPS 2.01 or PPS 2.38,as applicable.

6 Requirements

6.1 Ensure that lockbolts installed in production parts meet the visual and dimensional requirements specified in PPS 2.35. Refer production parts with installed lockbolts which do not meet the requirements to Bombardier Toronto (de Havilland) MRB or Bombardier Toronto (de Havilland) delegated MRB for disposition.

6.2 Ensure that solid rivets in production parts meet the visual and dimensional requirements specified in PPS 2.01 or PPS 2.38, as applicable. Refer production parts with installed solid rivets which do not meet the requirements to Bombardier Toronto (de Havilland) MRB or Bombardier Toronto (de Havilland) delegated MRB for disposition.

7 Safety Precautions

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

7.2 Wear Bombardier Toronto (de Havilland) approved safety glasses and hearing protectors at all times when operating the automatic drill riveter.

7.3 Turn off the drill riveter when installing or changing drill bits or anvils.

7.4 Keep hands clear of the clamp area when drill riveter is turned on.

7.5 Ensure that appropriate labels (see Equipment section, paragraph 4.2.4), containing laser safety information, are posted on the drill riveter. It is imperative that optical or electronic repair of the hole locating laser be performed only by qualified personnel. Do not remove the optical filter from the laser.

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.

9 Maintenance of Equipment

9.1 Rework or alteration of anvils and templates must only be performed by qualified personnel.

9.2 Repair drill riveter tools exhibiting signs or wear or damage, before use.

9.3 At the start of each 8 hour shift during which the drill riveter will be used, lubricate as follows:

- Lubricate the slide and drill spindle on the drill riveter according to Figure 6.
- Check and re-fill the air line lubricator (see Figure 6), if necessary, with SAE 10 oil (see equipment section, paragraph 4.1.3).
- Check the oil level as indicated on the sight glass of the hydraulic pump. When the oil level reaches the LOW mark, refill the pump with hydraulic fluid according to the manufacturer's instructions.

9.4 Carry out general machine maintenance according to the manufacturer's instructions on a regularly scheduled basis.

9.5 Drain the air line filter/water trap at the beginning of each 8 hour shift during which the drill riveter will be used and at 2 hour intervals thereafter.

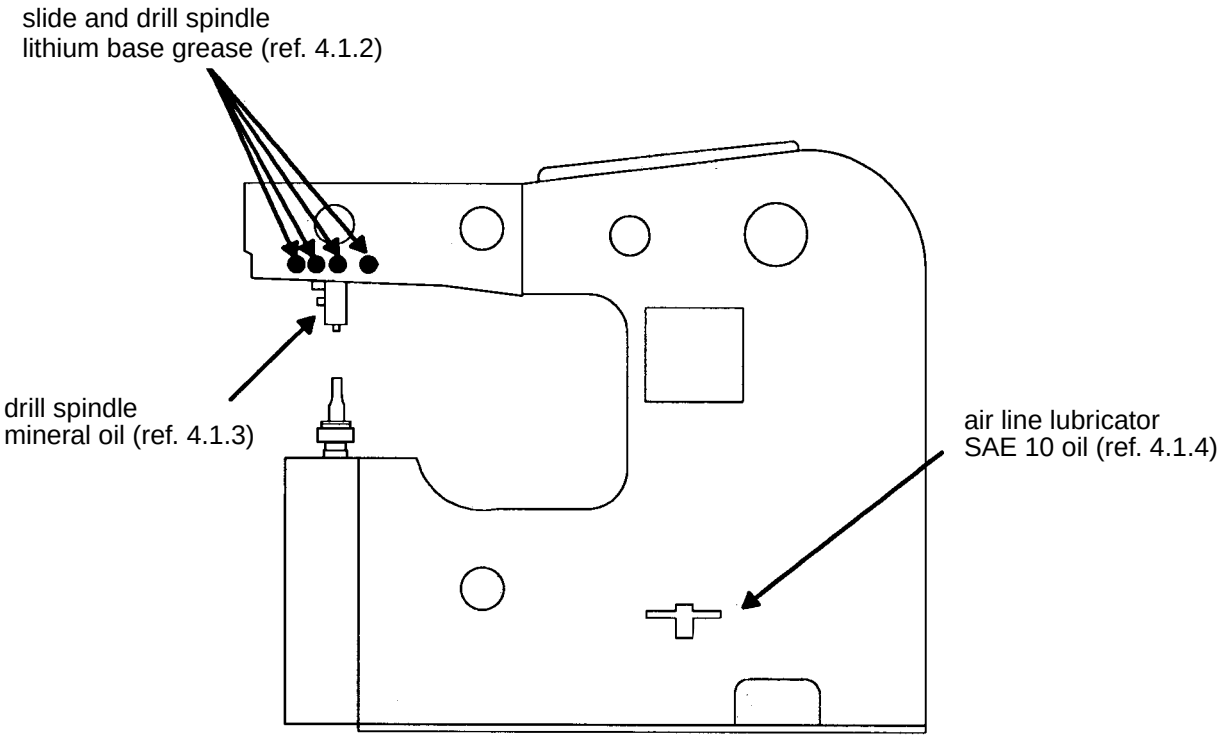

Figure 6 - Lubrication Points