BOMBARDIER
Toronto (de Havilland)
PROPRIETARY INFORMATION

PPS 1.43

PRODUCTION PROCESS STANDARD

Set-Up & Operation of Drivmatic Drill Riveters

Issue 11
- This standard supersedes PPS 1.43, Issue 10.
- 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	

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1 Scope

1.1 This Production Process Standard (PPS) specifies the procedure and requirements for set-up and operation of Gemcor Drivmatic drill riveters.

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 1.09 - Drilling and Reaming.

3.2 PPS 1.33 - Countersinking for Flush Head Fasteners.

3.3 PPS 2.01 - Installation of Solid Rivets.

3.4 PPS 2.38 - Fluid Tight Installation of Solid Rivets.

3.5 PPS 13.13 - Personal Protective Respiratory Equipment.

3.6 PPS 13.26 - General Subcontractor Provisions.

3.7 PPS 31.17 - Solvent Usage.

4 Materials and Equipment

4.1 Materials

4.1.1 Stencil ink - Crown #7080 Black Aerosol Can.

4.1.2 Drill riveter lubricant (e.g., as specified in Figure 8).

4.1.3 Spray dot black coating, Gro Lac.

4.1.4 Transeal blue paint, Gro Lac.

4.1.5 Non-permanent marker (e.g., Faber Castell 6000, Sanford's Vis-a-Vis, etc.).

4.1.6 DHMS S3.06 Type I, Class C-80 sealant. If the engineering drawing specifies PR1431G Type II or III sealants, use PR1431G Type II or III until depletion and then use DHMS S3.06 Type I, Class C-80 sealant (see EO 7336).

4.2 Equipment

4.2.1 Automatic drill riveters (e.g., Model G200BCHX-72-CE3941, G200BCHX-72-CE3994 and G200BCHX-36-CE4922 Gemcor Drivmatic Riveters). Refer to Figure 1 and Figure 2 for the general description of Gemcor Drivmatic drill riveters.

4.2.2 Hole locating laser (e.g., Spectra Physics Model 155).

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

4.2.4 Upper and lower anvils as specified in Table 1.

4.2.5 Drills and drill/countersinks as specified in Table 2.

4.2.6 Pressure foot bushings (e.g., TS.321.25.00).

4.2.7 Automatic riveting machine templates (e.g., TS.321.52.00).

4.2.8 Shop head gauges (e.g., TS.759.14.11).

4.2.9 Offset sleeve (e.g., TS.321.26.15 MK 1, MK 2, MK 3 and MK 4).

4.2.10 Panel positioner assembly (e.g., TS.321.04.21).

4.2.11 Contour header boards (e.g., TS.321.04.22).

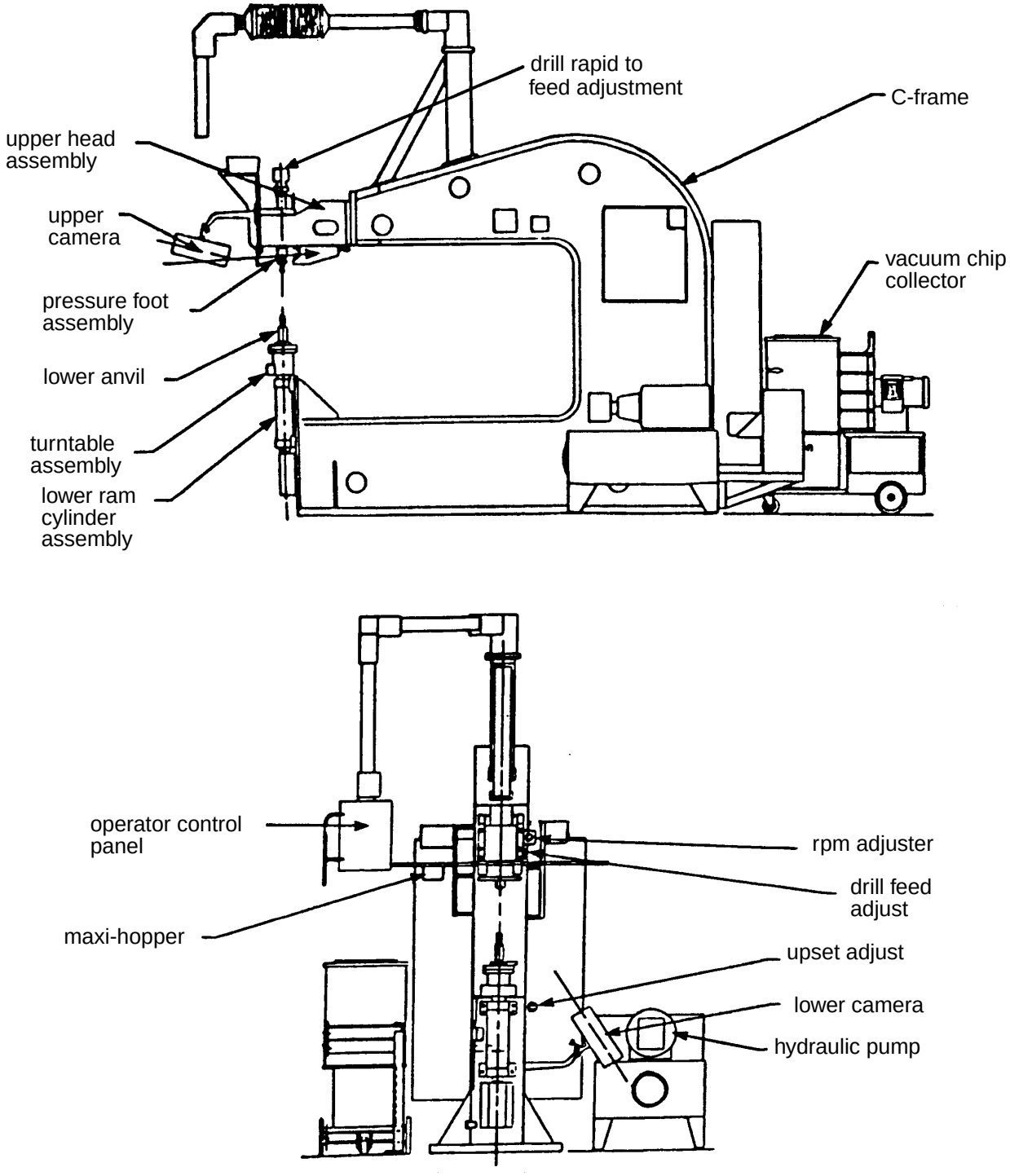


Figure 1 - General Description of Model CE3994 and CE4922 Gemcor Drivmatic Drill Riveters

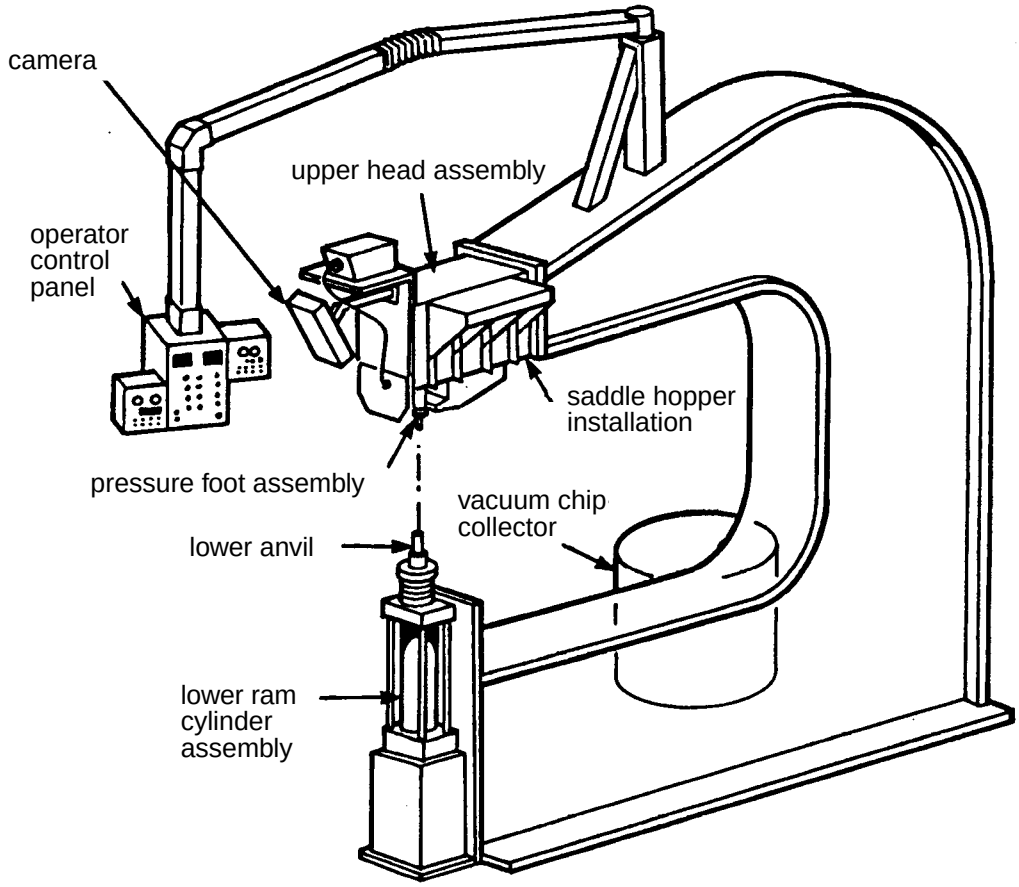


Figure 2 - Model CE3941 Gemcor Drivmatic Drill/Riveter

5 Procedure

5.1 General

5.1.1 The Gemcor Drivmatic automatic drill riveter drills, countersinks, feeds and upsets solid rivets in a continuous automatic operation.

5.1.2 It is possible to use drill riveters in automatic, drill only, rivet only or numerical control (NC) modes. When used in automatic mode the machine will drill the hole, then insert and upset a rivet in one complete cycle. The drill only mode is used to drill holes in the workpiece. The rivet only mode is used to upset rivets manually inserted into a pre-drilled workpiece. When used in the NC mode, the machine will drill the rivet holes, then insert and upset the rivets in the appropriate locations according to an NC program.

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

5.1.4 The CE3941 and CE3994 riveters are equipped with a panel positioner assembly, upper and lower camera, a splinter and a monitor to enable viewing of the operation at the surface of the workpiece. The cameras enable upper camera viewing only, lower camera viewing only or simultaneous upper and lower camera viewing on a vertically split screen.

5.1.5 The CE3994 and CE4922 riveters have series of maxi-hoppers, whereas CE3941 riveter has 8 saddle hoppers.

5.1.6 The panel positioner assembly (applicable for models CE3941 and CE3994) allows 3 axes of movement for positioning work pieces between the upper and lower anvils. The assembly consists of 4 carriages, 4 header assemblies and a set of transverse rails (see Figure 3). The rails extend across the front of the Drivmatic riveter for a distance of approximately 30 feet on either side of the spindle centre line. A header assembly attached to each carriage for positioning either flat or curved workpieces, travels along the rails and brings the workpiece into position for the desired operation.

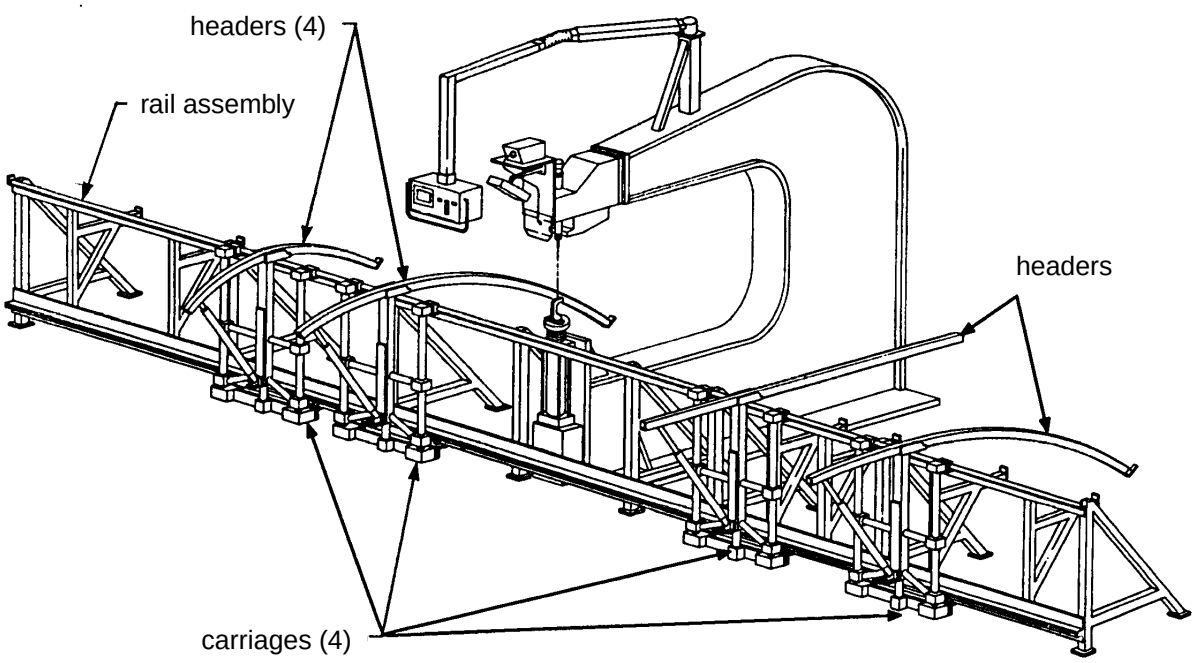


Figure 3 - Drivmatic Panel Position Assembly

5.2 Set-Up of the Drill Riveter

5.2.1 The maxi-hoppers (applicable for models CE3994 and CE4922 only) are colour coded to various rivet sizes, provide storage of rivets and inject them into the rivet fingers (see Figure 4). Refer to Table 1 for the colour coded maxi-hopper legend. Install maxi-hoppers as follows:

Step 1. Shut off the air supply to the maxi-hopper by pushing the appropriate button on the control panel.

Step 2. Slide the desired maxi-hopper along the slide gibs until it is slightly to the right of the C-frame centre.

Step 3. Rotate the hopper stop located on the lower left edge of the upper head assembly until it hangs downward.

Step 4. Slide the maxi-hopper to the left until the horizontal adjustment stud on the hopper is against the hopper stop.

Step 5. Secure the maxi-hopper in position using a toggle clamp.

Step 6. Engage the pneumatic cylinder control knob to hold the maxi-hopper in place.

Step 7. Connect the air supply line to the maxi hopper and switch on the hopper's air supply.

Table 1 - Maxi-Hopper Colour Legend

MAXI-HOPPER COLOUR	RIVET DASH NUMBER	RIVET SHANK DIA. (Inches)
White	3	3/32"
Green	4	1/8"
Yellow	5	5/32"
Red	6	3/16"
Blue	8	1/4"

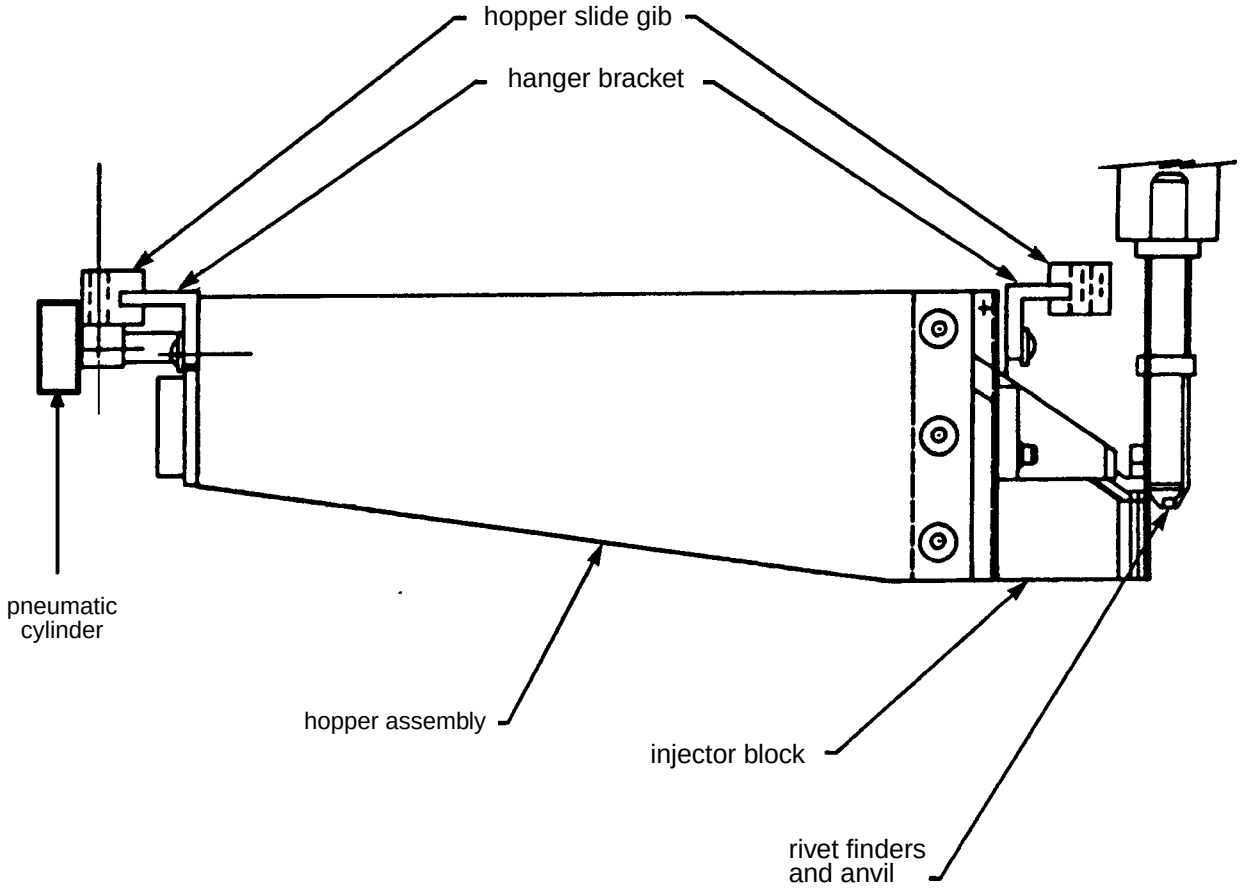


Figure 4 - Maxi-Hopper Installation

5.2.2 The saddle hoppers (applicable for model CE3941) are colour coded and there are 4 on each side of the machine. Each hopper also has the diameter and type of rivet marked on it. Each hopper has a separate, colour coded long track or injector assembly with colours matching those of the corresponding hoppers (see Figure 5). Set-up saddle hoppers as follows:

Step 1. Install the long track or injector assembly on the C-frame.

Step 2. Mount the slide support in the lower support slide tracks and locate the upper mounting bracket on the dowel pin. Secure the assembly with the wing nut.

Step 3. Rotate the index lever counter clockwise and slide the hopper assembly along the track rod until the hopper is aligned with the corresponding long track/injector assembly.

Step 4. Release the index lever and the hopper will lock into position.

Step 5. Interlock the slot connector with the connecting dog.

Step 6. Connect the air supply lines to the hopper and injector assemblies.

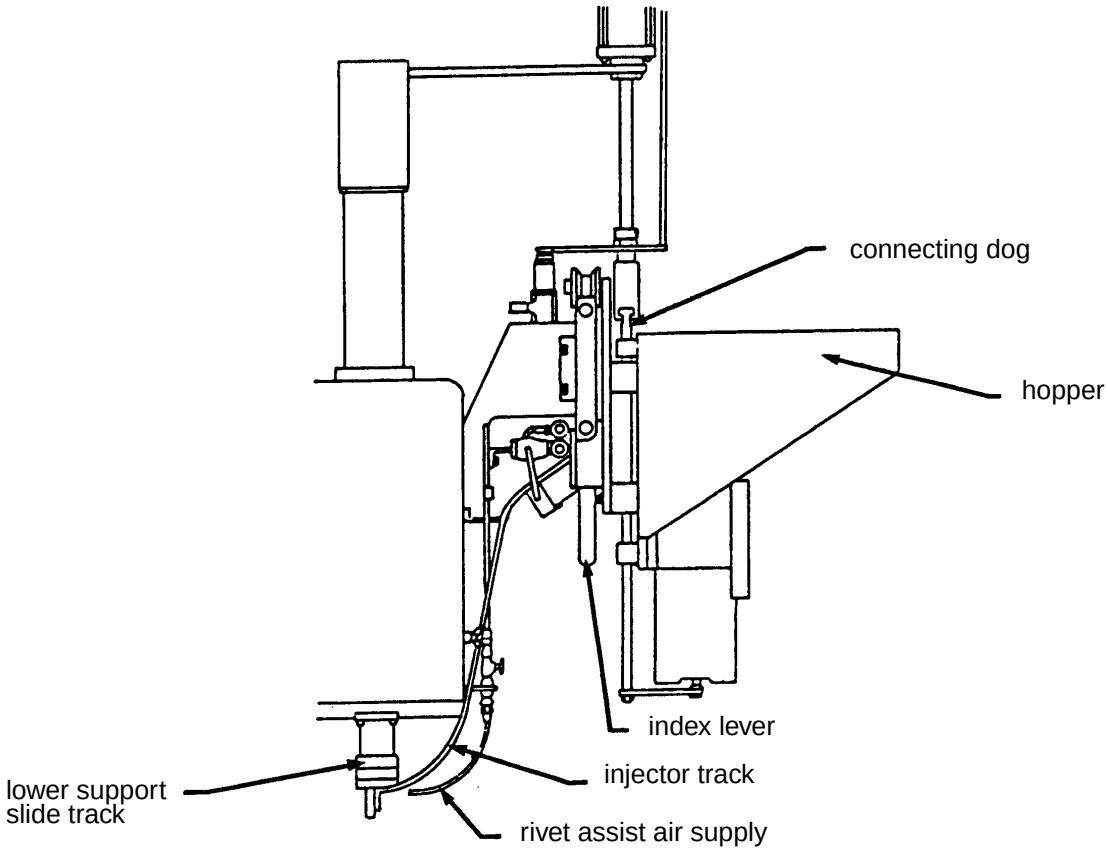


Figure 5 - Hopper - Long Track/Injector Assembly

5.2.3 Install the of upper anvil (see Figure 6) as follows:

Step 1. Select the appropriate upper anvil assembly and button from Table 2 for the diameter and style of rivet head to be installed.

Step 2. Install the button in the upper anvil assembly.

Step 3. Place the upper anvil shank in the upper ram assembly and exert upward pressure until the slot in the anvil shank seats securely within the ram holder.

Step 4. To remove, grasp the upper anvil and exert downward pressure. The anvil will pop out.

Table 2 - Upper Anvil Assemblies for Gemcor Drivmatic Drill Riveters

RIVET TYPE	UPPER ANVIL ASSEMBLY		UPPER ANVIL
	GEMCOR PART NUMBERS	TOOL STANDARD PART NUMBER	TOOL STANDARD PART NUMBER
B0205016	302B2225-#	TS.321.20.12 MK BB #	TS.321.21.09 MK BB #
B0205017	302B2224-#	TS.321.20.11 MK BA #	TS.321.21.09 MK BA #
B0205018	302B2251-#	TS.321.20.10 MK CE #	TS.321.21.09 MK CE #
BACR15BA	302B2224-#	TS.321.20.11 MK BA #	TS.321.21.09 MK BA #
BACR15BB	302B2225-#	TS.321.20.12 MK BB #	TS.321.21.09 MK BB #
BACR15CE	302B2251-#	TS.321.20.10 MK CE #	TS.321.21.09 MK CE #
BACR15FT	302B2225-#	TS.321.20.12 MK BB #	TS.321.21.09 MK BB #
MS20426	302B2224-#	TS.321.20.11 MK BA #	TS.321.21.09 MK BA #
MS20470	302B2225-#	TS.321.20.12 MK BB #	TS.321.21.09 MK BB #
NAS1097	302B2251-#	TS.321.20.10 MK CE #	TS.321.21.09 MK CE #

Note 1. In this table # represents the diameter dash number of the rivet in question (e.g., for a -4 diameter B0205017 rivet, the Gemcor part number for the upper anvil assembly is 302B2224-4)

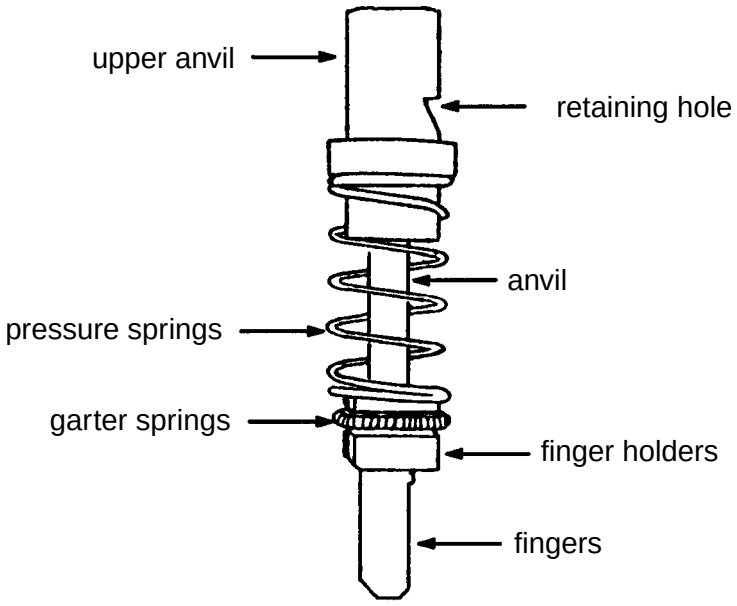


Figure 6 - Upper Anvil Assembly

5.2.4 Install the lower anvil as follows:

Step 1. Select the appropriate lower anvil from Table 3 for the diameter and type of rivet to be installed.

Table 3 - Lower Anvil Assemblies for Gemcor Drivmatic Drill Riveters

RIVET DIAMETER	LOWER ANVIL GEMCOR/TS PART NUMBER	BUTTON GEMCOR/TS PART NUMBER	OFFSET LOWER ANVIL GEMCOR/TS PART NUMBER	BUTTON GEMCOR/TS PART NUMBER
3/32"	301C149-5/ TS.321.26.11 MK 1	301B7016-5A/ TS.321.24.15 MK 1	301C2921/ TS.321.27.11	301A4756/ TS.321.24.14
1/8"				
5/32"				
3/16"	301C149-6/ TS.321.26.11 MK 2	301B7016-5/ TS.321.24.15 MK 2		
1/4"	301C149-8/ TS.321.26.11 MK 3	301B7016-11/ TS.321.24.15 MK 3	- - -	- - -

Notes:
1. See TS.321.26.12 and TS.321.26.14 for piloted lower anvil assemblies.
2. See TS.321.27.12, TS.321.27.14, TS.321.27.15 and TS.321.27.16 for special Bombardier Aerospace Toronto offset lower anvil assemblies.

Step 2. Align the flats of the lower anvil with the turntable assembly. Pull out the spring loaded retaining pin located on the turntable assembly and slide the lower anvil into the slide clamps. Release the retaining pin allowing it to locate in the lower anvil base.

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

Step 4. Hand tighten the locking screw.

5.2.5 Install drill bits as follows:

Step 1. Select the applicable drill or drill/countersink from Table 4 for the diameter and type of rivet to be installed. If necessary, it is acceptable to use drill/countersink drill bits to drill holes for protruding head rivets in assemblies having a total sheet thickness of at least 0.10" less than the length of the body of the drill portion of the tool.

Step 2. Insert the drill bit into the drill collet and securely tighten the drill collet nut.

Table 4 - Drills and Drill/Countersinks for Gemcor Drivmatic Drill Riveters

NOMINAL RIVET DIAMETER	DRILL OR DRILL/COUNTERSINK (NOTES 1, 2 & 3)		
	TS.321.51.13 DRILL	TS.321.51.15 TYPE 3 DRILL/COUNTERSINK	TS.321.51.16 TYPE 4 DRILL/COUNTERSINK
-3 (3/32")	MK 1 (0.098")	TS 321-098-XXX	TS 321-098-XXX
-4 (1/8")	MK 2 (0.128")	TS 321-128-XXX	TS 321-128-XXX
-5 (5/32")	MK 3 (0.159")	TS 321-159-XXX	TS 321-159-XXX
-6 (3/16")	MK 9 (0.190")	TS 321-191-XXX	TS 321-191-XXX
-8 (1/4")	MK 7 (0.253")	TS 321-253-XXX	TS 321-2464-XXX

Note 1. Drill/countersink cutters may be used to drill holes for protruding head rivets in thin gauge assemblies.
Note 2. XXX denotes length of drill portion of drill/countersink (in thousandths on an inch).
Note 3. It is acceptable to use equivalent drills or drill/countersinks provided that hole sizes are verified using gauges/equipment calibrated in inches.

5.2.6 Install the pressure foot bushing as follows:

Step 1. Select the appropriate pressure foot bushing from Table 5 according to the configuration of the work at hand.

Table 5 - Pressure Foot Bushings for Drivmatic Drill Riveters

TOOL STANDARD NUMBER	MAXIMUM RIVET DIAMETER	RIVET HEAD TYPE
TS.321.25.10	3/16"	universal & flush
TS.321.25.12	3/16"	flush
TS.321.25.13	1/8"	universal & flush
TS.321.25.14	3/16"	flush
TS.321.25.15	3/16"	universal & flush
TS.321.25.16	3/16"	flush
TS.321.25.17	1/8"	universal & flush
TS.321.25.18 MK 1	1/8"	flush
TS.321.25.18 MK 2	5/32"	flush
TS.321.25.18 MK 3	3/16"	flush

Step 2. Remove the quick change pressure foot retaining plate by loosening the two underside thumbscrews.

Step 3. Insert the appropriate pressure foot bushing, replace the retaining plate and tighten the thumbscrews.

5.3 Adjustment of the Drill Riveter

5.3.1 Drill Spindle Adjustment

5.3.1.1 Refer to Table 6 as a general reference when establishing the optimum drill speed and feed rate.

Table 6 - Gemcor Drivmatic Drill Speeds and Feed Rates

RIVET DIA.	DRILL OR DRILL/COUNTERSINK (NOTES 1 & 2)	SPINDLE SPEED (RPM)	DRILL FEED RATE (RPM
3/32"	TS.321.098.XXX	7500	16
1/8"	TS.321.098.XXX	6000	18
	TS.321.51.13 MK 2		
5/32"	TS.321.159.XXX	6000	18
	TS.321.161.XXX		
	TS.321.51.13 MK 3		
	TS.321.51.13 MK 4		
3/16"	TS.321.190.XXX	5000	20
	TS.321.191.XXX		
	TS.321.193XXX		
	TS.321.51.13 MK 5		
	TS.321.51.13 MK 6		
1/4"	TS.321.253.XXX	4500	22
	TS.321.257XXX		
	TS.321.51.13 MK 7		
	TS.321.51.13 MK 8		

Notes: 1. XXX - Denotes drill/countersink drill bit length (in thousandths of an inch).
2. - Denotes drill/countersink.

5.3.1.2 Adjust the drill and countersink depth by turning the drill stop adjusting screw located beneath the hydraulic motor on the drill spindle, clockwise to increase the depth and counter clockwise to decrease the depth. An adjustment of one graduation on the stop adjusting screw corresponds to a change of 0.001".

5.3.1.3 When drilling holes ensure that the drill depth is sufficient to feed the drill, at least to the beginning of the shank, through the workpiece assembly but not so deep as to come into contact with the lower anvil during the drill/countersink operation.

5.3.1.4 Refer to PPS 2.01 or PPS 2.38, as applicable, for countersink diameters.

5.3.1.5 When a drill/countersink is being used to drill holes for protruding head rivets take care that the countersink does not contact the work surface.

5.3.1.6 Adjust the fast approach distance of the drill spindle by turning the drill feed adjust knob mounted on the top of the C-frame. Turn the drill feed adjust knob clockwise to increase the fast approach distance and counter clockwise to decrease the fast approach distance.

5.3.1.7 Turn the drill feed adjust so that the drill goes into slow feed just before contact with the work piece.

5.3.1.8 Adjust the drill spindle speed by depressing the speed-setup button on the main control panel and turning the control knob for drill speed (mounted on the right of the upper head assembly) until the desired drill spindle speed is achieved. Depress the speed-setup button to lock the drill spindle speed.

5.3.1.9 Adjust the drill feed rate by depressing the feed-setup button on the main control panel and turning the feed rate micro-dial (located below the control knob for drill speed) until the desired feed rate is achieved. Depress the feed-setup button to lock the feed rate.

5.3.2 Rivet Upset Adjustment

5.3.2.1 Control the shop head height for the rivet by adjusting the hydraulic pressure delivered to the lower anvil.

5.3.2.2 Rotate the valve handle at the right side of the lower ram until it is horizontal. This prevents fluid from leaving the upper chamber of the lower ram.

5.3.2.3 Depress the OPERATE foot treadle and observe the pressure on the gauge to the right of the lower ram while adjusting the relief valve to obtain the desired upset pressure.

5.3.2.4 Release the OPERATE foot treadle and return the valve handle to the vertical position.

5.3.3 Clamp Pressure and Lower Ram Adjustment

5.3.3.1 Adjust the lower anvil pressure sleeve to provide sufficient pressure to the underside of the workpiece, to prevent burring or chip accumulation between the faying surfaces. It is not acceptable to have any markings on the workpiece surfaces made by the clamping tools. Adjust the clamp pressure by turning the clamp pressure adjusting knob located on the left side of the lower C-frame until the desired clamp pressure is indicated on the attached pressure regulator gauge.

5.3.3.2 Adjust the stroke distance for the lower ram inter-rivet retraction, such that the distance is not to be greater than necessary to enable movement of the workpiece while clearing the rivet shop heads and the underside obstructions.

5.3.3.3 Adjust the lower ram inter-rivet retraction stroke distance by repositioning the stroke limit switch located on the left side of the lower C-frame. Reposition the stroke limit switch by loosening the wing nut securing the limit switch to obtain optimum underside clearance. Re-tighten the wing nut to secure the limit switch.

5.4 Marking Rivet Location

5.4.1 Attach the applicable rivet marking template (see paragraph 4.2.7) to the work surface using Cleco or other suitable temporary fasteners. Ensure that there are no excessive gaps between the template and the work surface.

5.4.2 Coat the metal rivet marking templates with strippable Transeal Blue paint on the outer surface. Mylar templates do not require this coating. Apply Transeal Blue paint to the surface of the metal rivet marking templates in the detail paint shop.

5.4.3 When using metal rivet marking templates, mark all hole locations with Gro Lac Spray Dot Ink using Prevail spray guns. If the hole location markings are no longer legible, send the metal rivet marking template to the detail paint shop for removal of the build up of Spray Dot Ink and repainting with Transeal Blue coating.

5.4.4 When using Mylar templates, mark hole locations using a non-permanent marker (see paragraph 4.1.5).

5.5 Assembly of Parts to be Riveted

5.5.1 Position mating parts without excessive gaps.

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

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

5.6 Operation of the Drill Riveter

5.6.1 Adjust the drill riveter according to section 5.2 to produce holes, countersinks and install rivets within the tolerances specified in PPS 2.01 or PPS 2.38, as applicable. 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. Except when the machine is to be used only to drill holes (i.e., rivets or fasteners are not being installed at that time), in 3 of the 6 holes install the appropriate rivets.

Step 4. Ensure that un-riveted holes and installed rivets in the test piece assembly (if installed) meet the requirements of PPS 2.01 or PPS 2.38, as applicable. If the test piece assembly fails to meet the requirements, 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 7). 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.

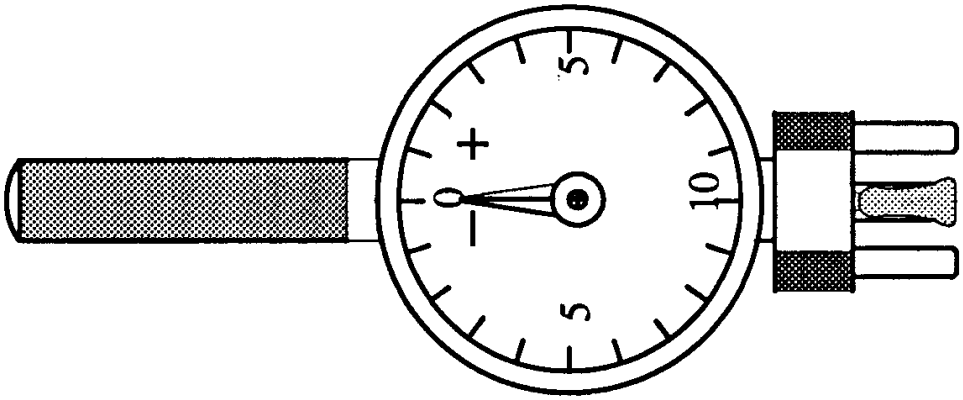


Figure 7 - Flushness Rivet Gauge

5.6.2 Set up the drill riveter for operation as follows:

Step 1. Open the shop air shut-off valve.

Step 2. Press the machine “ON” button on the control panel to start the hydraulic pump.

Step 3. Check that the hydraulic pump pressure is approximately 1000 psi.

Step 4. Set the clamp pressure, RPM and feed rate specified in Table 6 for the size and type of rivet to be installed.

5.6.3 To ensure the reliability of the machine settings, during each production run, make random checks of the shop head dimensions (approximately every 20th rivet) using a shop head gauge (see paragraph 4.2.8).

5.6.4 For automatic mode, operate the drill riveter as follows:

Step 1. Press the “inject” button on the control panel to inject a rivet into the upper anvil rivet fingers.

Step 2. Turn on the hole locating laser (see paragraph 4.2.2).

Step 3. Set the locating light so that the light dot is directly in line with the vertical axis of the drill spindle.

Step 4. Turn on the chip vacuum by pressing the chip vacuum button on the main control panel. During the auto drill-rivet cycle chip blowers are activated automatically.

Step 5. Position the work piece on the table so that the locating laser beam is centred on the locating dot. Start at the centre of the skin and working outwards in all directions to the edges of the skin so that the tendency of the skin to stretch does not result in warping or oil-canning.

Step 6. Depress the foot start switch to cycle the machine. If necessary the cycle can be stopped by releasing the foot start switch. The cycle may be continued by depressing the foot start switch. The cycle can be reset by depressing the reset switch before depressing the foot start switch.

5.6.5 For NC mode, operate the drill riveter as follows:

Step 1. Set-up the assembly to be riveted on the appropriate NC tooling.

Step 2. Orient the assembly on the machine as specified by the set-up sheet with the start off rivet hole location in the correct position.

Step 3. Begin the program and observe the process, halting the program and correcting any problems (e.g., misfed rivet) if necessary.

5.7 Post-Riveting Procedure

5.7.1 After the drilling and riveting operations, remove all excess stencil ink over-spray from the work piece by solvent wiping according to PPS 31.17.

6 Requirements

6.1 Visually and dimensionally check production parts according to PPS 2.01 or PPS 2.38, as applicable. Production parts failing to meet the requirements specified are not acceptable.

7 Safety Precautions

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

7.2 Wear approved safety glasses and hearing protection at all times while operating the Gemcor automatic drill riveter.

7.3 Wear protective respiratory equipment according to PPS 13.13 while spraying stencil ink.

7.4 Turn off the drill riveter while installing or changing drill bits or anvils.

7.5 Keep hands clear of the clamp area while drill riveter is turned on.

7.6 Post appropriate labels, containing laser safety information according to TS.321.04.25, on the drill riveter.

7.7 Repairs are not permitted to the optical or electronic parts of the hole locating laser at Bombardier Toronto (de Havilland). 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 Do not rework or alter anvils or templates without proper authorization.

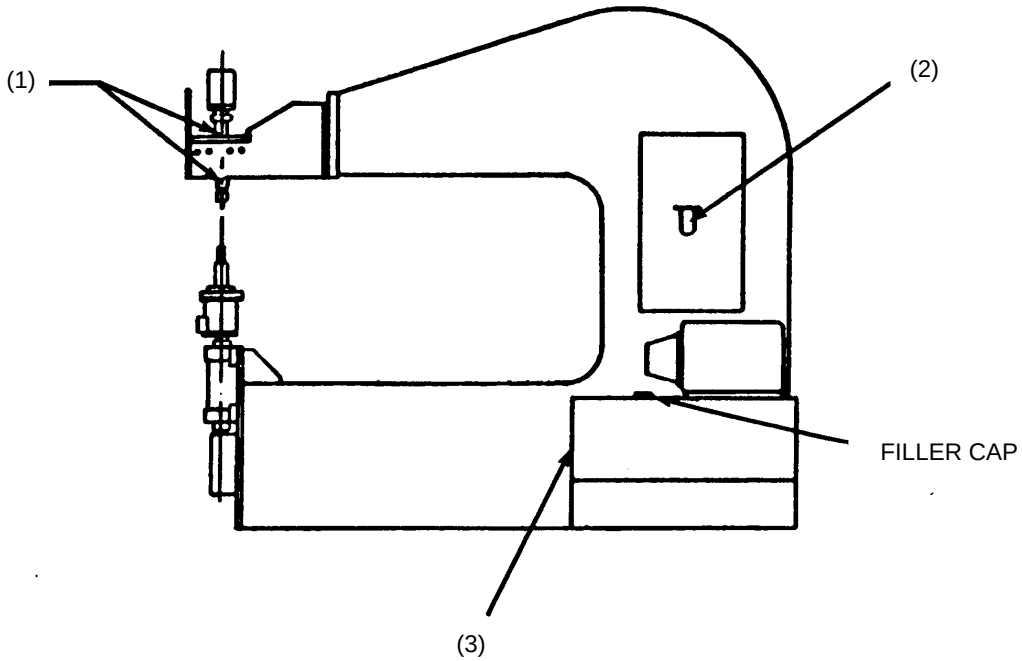
9.2 Do not use drill riveter tools exhibiting signs of wear or damage.

9.3 It is recommended that at the beginning of each 8 hour shift, the slide, drill and slide spindle be lubricated according to Figure 8.

9.4 When the oil level indicated on the sight glass of the hydraulic pump reaches the LOW mark, the pump needs to be refilled with hydraulic fluid according to manufacturer's instructions.

9.5 It is recommended that general machine maintenance be carried out according to the manufacturer's instructions on a regularly scheduled basis.

9.6 It is recommended that the chip collector be checked at the beginning of each 8 hour shift and emptied as necessary.



NUMBER	LUBRICANT	AMOUNT
1	MOBILUX EP1	3 shots
2	MOBIL D.T.E. 24	maintain level
3	MOBIL D.T.E. 24	maintain level

Figure 8 - Lubrication Points