BOMBARDIER
Toronto (de Havilland)
PROPRIETARY INFORMATION

PPS 1.32

PRODUCTION PROCESS STANDARD

Set-Up and Operation of Spacematic Drillmotors Model 1600 & 6000

Issue 5
- This standard supersedes PPS 1.32, 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.

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

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1 Scope

1.1 This Production Process Standard (PPS) specifies the procedure and requirements for the set-up, adjustment and operation of Spacematic drillmotors Models 1600 and 6000 for drilling and drill countersinking.

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 Turboprops (de Havilland), all materials must be approved and assigned Material Safety Data Sheet (MSDS) numbers by the Bombardier Turboprops (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 Turboprops (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 13.26 - General Subcontractor Provisions.

4 Materials and Equipment

4.1 Materials

4.1.1 Liquid freon coolant, trichlorotrifluoroethane (e.g., Dupont T-B1).

4.2 Equipment

4.2.1 TS.514 drills and drill countersinks, as required.

4.2.2 Drill jig templates and fixtures, as required.

4.2.3 Spacematic drillmotors, footplates and collet assemblies, as required. Refer to Figure 1 for a general description of the Spacematic drillmotor and Figure 2 for a part number breakdown. Refer to Figure 3 for a general description of the variable spacing template foot and Figure 4 for a breakdown of the foot attachment part number designation.

4.2.4 Mistmatic coolant assemblies and equipment, as required.

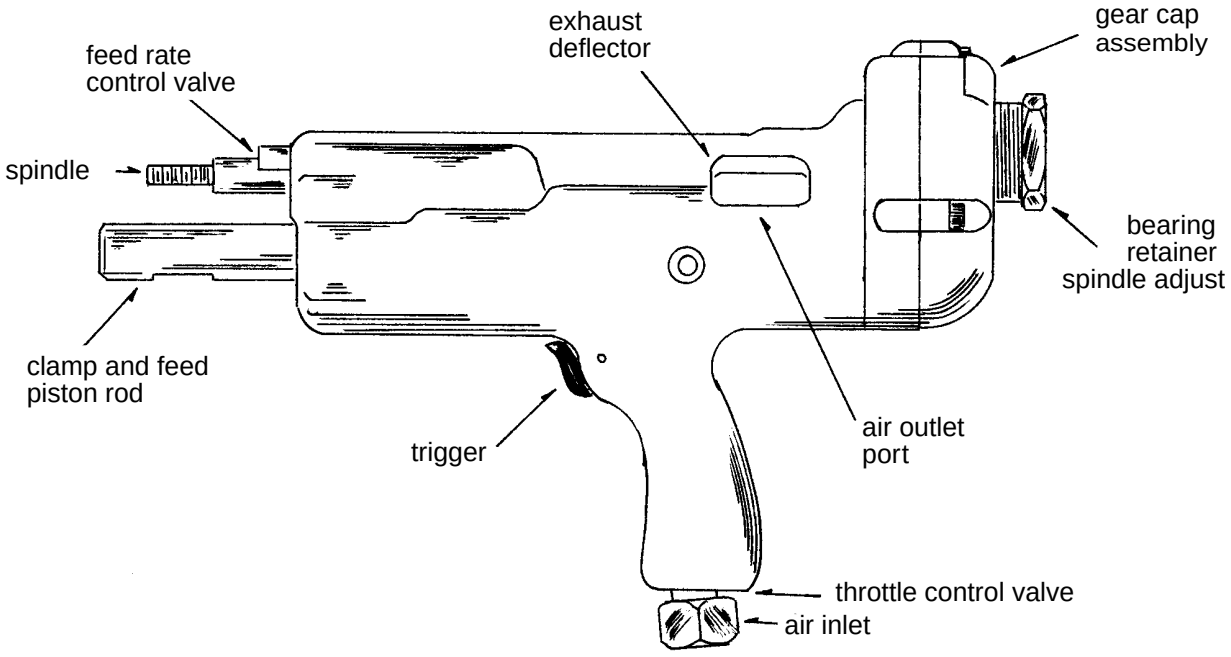

Figure 1 - Spacematic Drillmotor

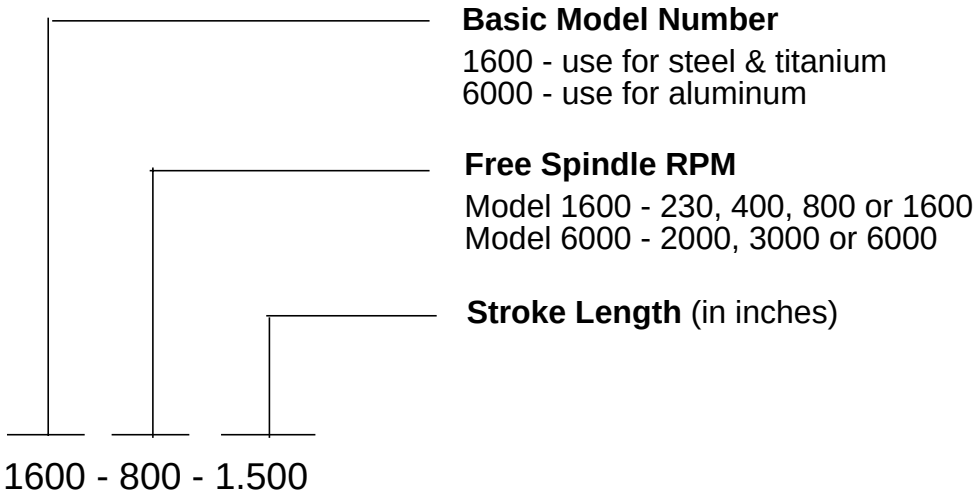

Figure 2 - Breakdown of Drillmotor Part Numbers

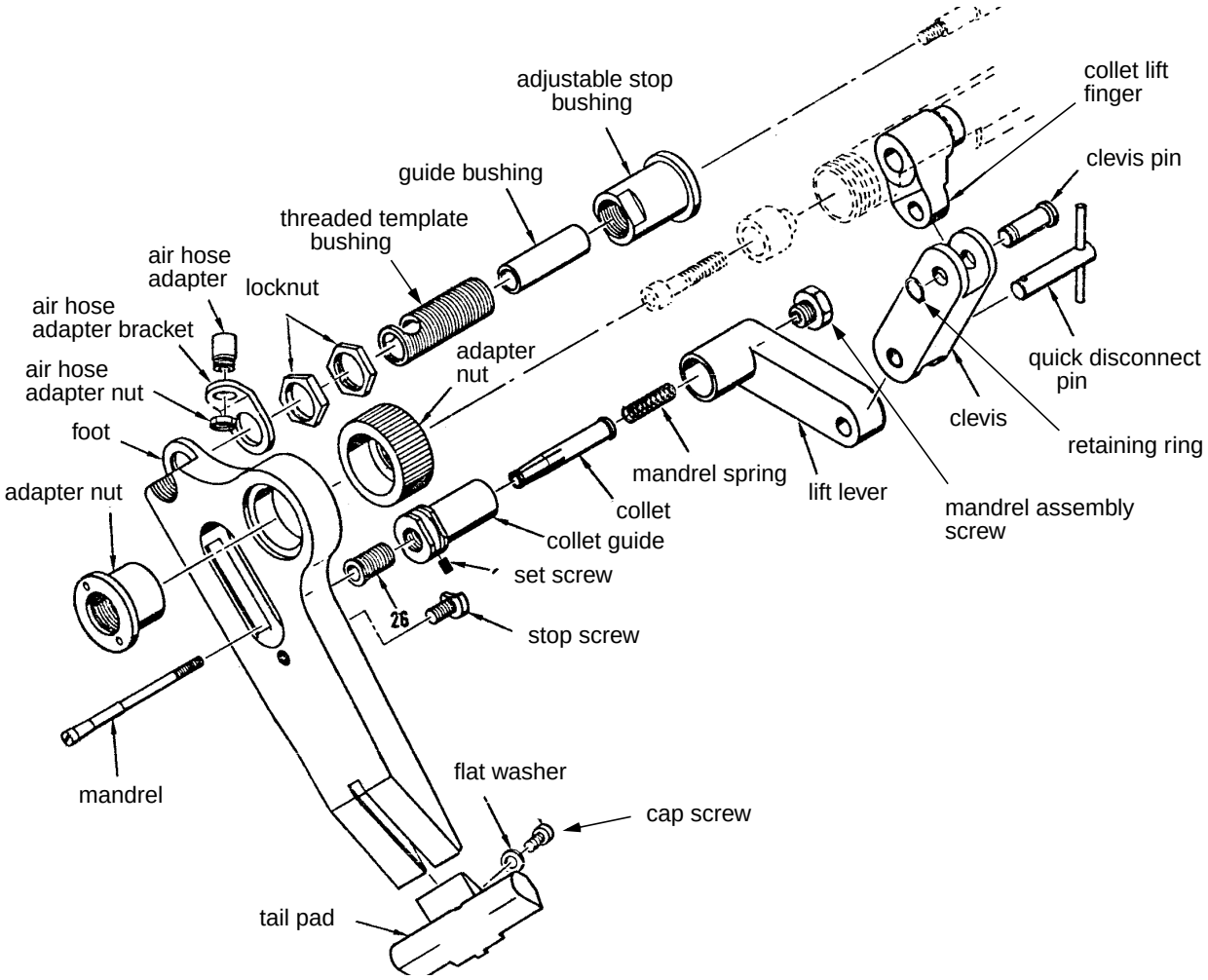

Figure 3 - Variable Spacing Template Foot

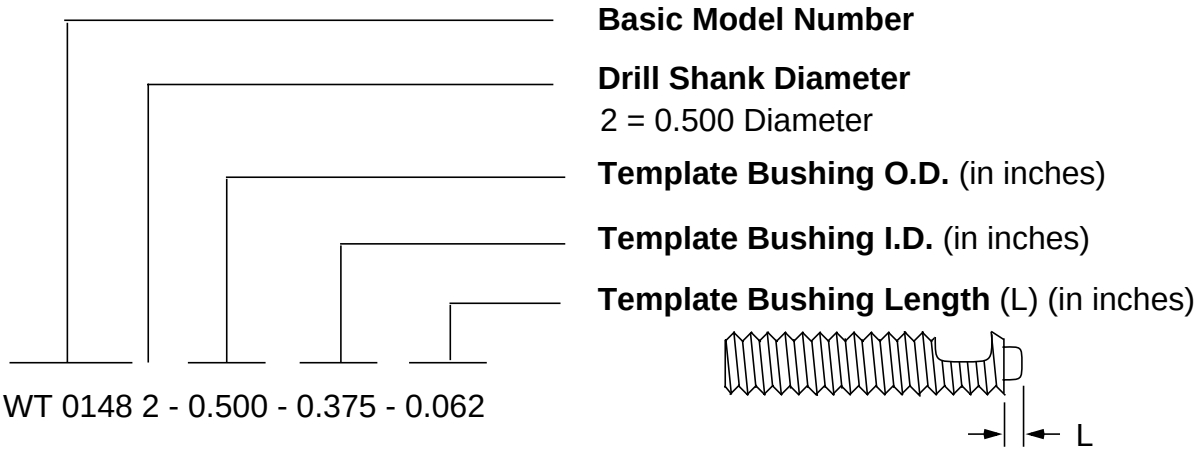

Figure 4 - Variable Spacing Template Foot Attachment Part Number Breakdown

5 Procedure

5.1 General

5.1.1 The 1600 and 6000 spacematic drillmotors are air operated, hydraulically controlled, portable tools that automatically drill and drill countersink holes with a high degree of accuracy.

5.1.2 Refer to TS 514 for a listing of drills and drill countersinks available for use with the Spacematic drillmotors. Drills and drill countersinks for use with Spacematic drillmotors are supplied in 2 types, as follows. Always use the correct type of drill for the material being drilled; when drilling through a combination of dissimilar alloys, use the type of drill for the harder alloy.

Type A - used for aluminum and aluminum alloys

Type S - used for steel and titanium alloys

5.2 Set-up of Drillmotors

5.2.1 Installation of the Variable Spacing Template Foot Attachment

5.2.1.1 Install the variable spacing template foot attachment as follows.

Step 1. Select the applicable collet, mandrel, collet guide and collet bushing from Table I, for the size to be used and thickness of the material to be drilled.

Step 2. Remove the screw and bushing from the draw rod within the position rod and insert the collet lift finger into the slot in the piston rod.

Step 3. Supply air pressure to the tool and press the trigger to draw the piston rod back into the tool housing and disconnect the air pressure while still pressing the trigger, so that the position rod remains in the retracted position.

Step 4. Replace the screw and bushing in the draw rod to secure the lift finger in place.

Step 5. Connect air pressure to the tool to return the piston rod to the extended position.

Step 6. Screw the adapter nut onto the piston rod.

Step 7. Thread the applicable drill or drill/countersink onto the spindle. Hold the spindle with a 5/16" open end wrench and tighten the drill with the appropriate drill wrench.

Step 8. Screw the template bushing into the template foot until the shoulder on the lower end of the bushing is just flush with the bottom of the foot. Turn the bushing locknut. Turn the bushing so that the cut out in the bushing is aligned with the opening in the foot (see Figure 5).

Step 9. Secure the template bushing and, if required, the air hose adapter with the bushing locknut. Thread the stop bushing locknut and stop bushing onto the threaded template bushing.

Step 10. Place the template foot against the end of the piston rod with the drill inserted through the threaded template bushing. Secure the template foot with the piston rod adapter nut.

Step 11. Install the collet guide in the slot in the template foot and secure it by turning the guide stop screw clockwise until it locks in place.

Step 12. Screw the collet bushing into the collet guide.

Step 13. Insert the collet down through the collet guide bushing.

Step 14. Insert the mandrel up through the collet and place the mandrel spring over the threads of the mandrel.

Step 15. Fit the mandrel lift lever over the collet guide and screw the mandrel into the nut in the lift lever.

Step 16. Position the mandrel lift lever between the ears on the clevis and secure it with the quick release pin.

Step 17. Loosen the tail pad locking screw and place a straight edge across the lower surface of the boss on the threaded template bushing. Adjust the tail pad so that the distance “T” (see Figure 5) is equal to the thickness of the applicable drill jig template. Tighten the tail pad locking screw.

Step 18. Adjust the drillmotor and foot assembly according to section 5.3.

Table I - Collet Assembly Selection

HOLE SIZE	COLLET GRIP LENGTH				COLLET	MANDREL	COLLET BUSHING
	1" STROKE		1 1/2" STROKE				
	0.100" TEMPLATE BOSS	0.150" TEMPLATE BOSS	0.100" TEMPLATE BOSS	0.150" TEMPLATE BOSS			
0.1550" to 0.1610"	0.23" - 0.62"	0.18" - 0.57"	0.16" - 0.62"	0.11" - 0.57"	1050564	1053267	1055422
	0.48" - 0.87"	0.43" - 0.82"	0.41" - 0.87"	0.36" - 0.82"	1050576	1053279	
	0.73" - 1.12"	0.68" - 1.07"	0.66" - 1.12"	0.61" - 1.07"	1050588	1053280	
0.1605" to 0.1665"	0.23" - 0.62"	0.18" - 0.57"	0.16" - 0.62"	0.11" - 0.57"	1050655	1053267	1055434
	0.48" - 0.87"	0.43" - 0.82"	0.41" - 0.87"	0.36" - 0.82"	1050667	1053279	
	0.73" - 1.12"	0.68" - 1.07"	0.66" - 1.12"	0.61" - 1.07"	1050679	1053280	
0.1710" to 0.1770"	0.23" - 0.62"	0.18" - 0.57"	0.16" - 0.62"	0.11" - 0.57"	1050801	1053395	1055458
	0.48" - 0.87"	0.43" - 0.82"	0.41" - 0.87"	0.36" - 0.82"	1050813	1053401	
	0.73" - 1.12"	0.68" - 1.07"	0.66" - 1.12"	0.61" - 1.07"	1050825	1053413	
0.1815" to 0.1875"	0.23" - 0.62"	0.18" - 0.57"	0.16" - 0.62"	0.11" - 0.57"	1050904	1053486	1055483
	0.48" - 0.87"	0.43" - 0.82"	0.41" - 0.87"	0.36" - 0.82"	1050916	1053498	
	0.73" - 1.12"	0.68" - 1.07"	0.66" - 1.12"	0.61" - 1.07"	1050928	1053516	
0.1865" to 0.1925"	0.23" - 0.62"	0.18" - 0.57"	0.16" - 0.62"	0.11" - 0.57"	1051015	1053486	1055495
	0.48" - 0.87"	0.43" - 0.82"	0.41" - 0.87"	0.36" - 0.82"	1051027	1053498	
	0.73" - 1.12"	0.68" - 1.07"	0.66" - 1.12"	0.61" - 1.07"	1051039	1053516	
0.1970" to 0.2030"	0.23" - 0.62"	0.18" - 0.57"	0.16" - 0.62"	0.11" - 0.57"	1051246	1053644	1055525
	0.48" - 0.87"	0.43" - 0.82"	0.41" - 0.87"	0.36" - 0.82"	1051258	1053656	
	0.73" - 1.12"	0.68" - 1.07"	0.66" - 1.12"	0.61" - 1.07"	1051270	1053668	
0.2440" to 0.2500"	0.23" - 0.62"	0.18" - 0.57"	0.16" - 0.62"	0.11" - 0.57"	1051787	1053942	1055628
	0.48" - 0.87"	0.43" - 0.82"	0.41" - 0.87"	0.36" - 0.82"	1051799	1053954	
	0.73" - 1.12"	0.68" - 1.07"	0.66" - 1.12"	0.61" - 1.07"	1051805	1053966	
0.2490" to 0.2550"	0.23" - 0.62"	0.18" - 0.57"	0.16" - 0.62"	0.11" - 0.57"	1051920	1053942	1055640
	0.48" - 0.87"	0.43" - 0.82"	0.41" - 0.87"	0.36" - 0.82"	1051933	1053954	
	0.73" - 1.12"	0.68" - 1.07"	0.66" - 1.12"	0.61" - 1.07"	1051945	1053966	
0.2540" to 0.2600"	0.23" - 0.62"	0.18" - 0.57"	0.16" - 0.62"	0.11" - 0.57"	1052007	1053942	1055665
	0.48" - 0.87"	0.43" - 0.82"	0.41" - 0.87"	0.36" - 0.82"	1052019	1053954	
	0.73" - 1.12"	0.68" - 1.07"	0.66" - 1.12"	0.61" - 1.07"	1052020	1053966	

Note 1. Use collet guide #1027499 with the specified collet, mandrel and collet bushing assemblies.

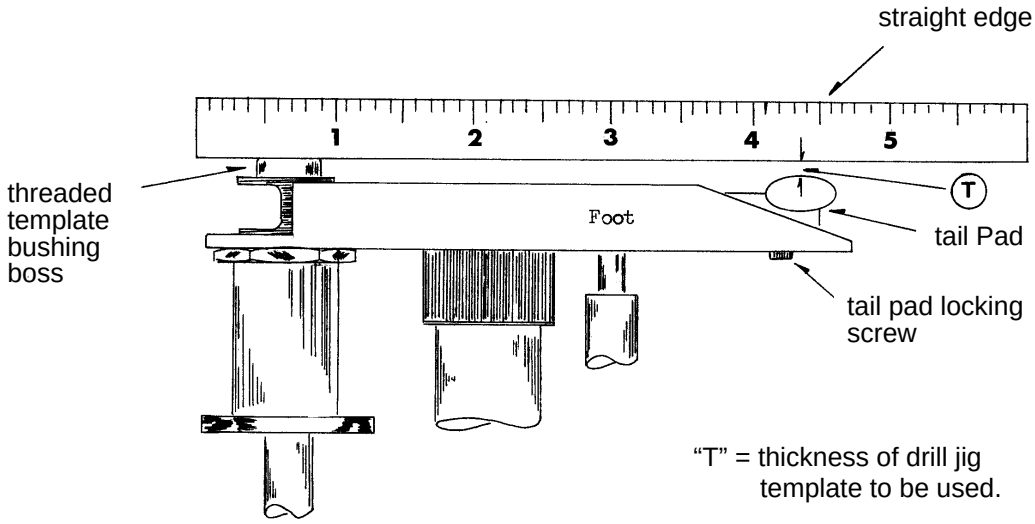

Figure 5 - Levelling Tail Pad on Foot Assembly

5.2.2 Installation of the Drill Jig Collet Foot Attachment

5.2.2.1 Install the drill jig collet foot attachment as follows (see Figure 6):

Step 1. Refer to Table II for the collet size and drill diameter range.

Step 2. Ensure that initial set-up and any changing of colleting accessories for the drill jig collet foot are performed according to the manufacturer`s instructions.

Step 3. To remove or install drills, connect air pressure to the tool and press the trigger to retract the piston rod. With the piston rod fully retracted, disconnect the air pressure while still pressing the trigger so that the piston rod remains in the withdrawn position. Thread the applicable drill onto the spindle and tighten it with the applicable drill wrench while holding the spindle with a suitable open end wrench.

Step 4. Connect air pressure to the tool and allow the piston rod to return to the extended position.

Step 5. Adjust the drillmotor and collet foot according to section 5.3.

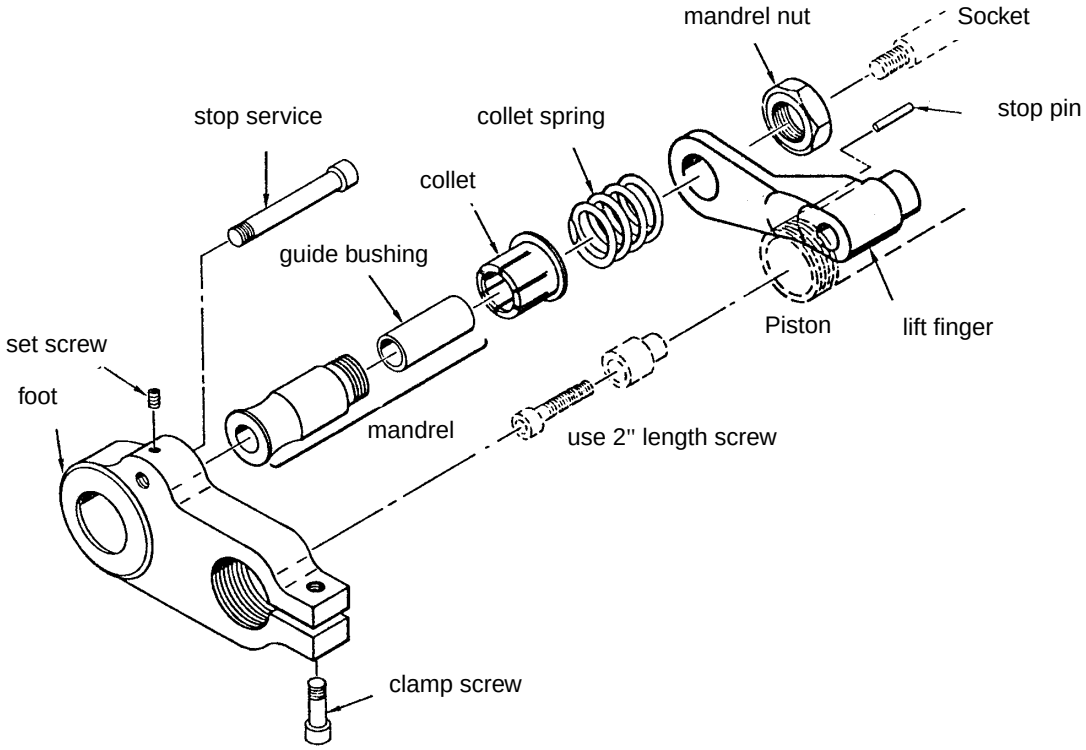

Figure 6 - Drill Jig Collet Foot Assembly

Table II - Collet Size and Drill Diameter Range

FOOT ASSEMBLY (NOTE 1)	COLLET	MANDREL AND BUSHING ASS'Y. NO.	COLLET DIAMETER	DRILL DIAMETER RANGE
1000420 (WT01360-2)	1015630	1014912	.789	0.3760 - 0.5000
1004050 (WT01360-5)	1015630	1209899 1215516 (Note 2)	.789	0.3760 - 0.5000

Note 1. Superseded foot assembly numbers shown in parenthesis.
Note 2. Mandrel (1209899) and bushing (1215516) supplied separately.

5.3 Adjustment of Drillmotors and Template Foot Assemblies

5.3.1 Spindle Speed Adjustment

5.3.1.1 Spacematic drillmotor spindle speed may be changed by replacing the reduction gears in the gear cap assembly with various gear sets developing free spindle speeds as shown in Figure 2. A further reduction of the spindle speed by up to 50 percent may be achieved by means of a throttle control valve located in the base of the tool handle.

5.3.1.2 Unless otherwise specified, the drillmotor spindle speed, as measured with a suitable tachometer, shall be according to PPS 1.09.

5.3.1.3 If it is necessary to change the reduction gear sets, the drillmotor shall be returned to the maintenance department to be set up according to the manufacturer`s instructions.

5.3.2 Rate of Feed Adjustment

5.3.2.1 The feed rate of the Spacematic drillmotors is adjustable by means of the control screw or nut on the constant feed control valve. Turning the control screw or nut counterclockwise increase the rate of feed and clockwise and clockwise decrease the rate of feed.

5.3.2.2 Unless otherwise specified, the rate of feed of the drillmotor shall be according to PPS 1.09.

5.3.2.3 The feed rate in inches/revolution may be calculated as follows:

$$\text{Feed rate (in/rev.)} = \frac{\text{Tool Stroke x 60}}{\text{Time for Full Stroke (sec.) x RPM}}$$

5.3.3 Drill and Countersink Depth Adjustment

5.3.3.1 Raising or lowering of the stop bushing on the variable spacing template or the stop screw on the drill jig collet foot to contact the pop-off mechanism earlier or later during the tool stroke will control the drill and counterclockwise depth stroke of the drillmotor.

5.3.3.2 If control of the depth adjustment is required than that afforded by the adjustable stops, the spindle length may be adjusted by loosening the clamp screw in the gear cap and rotating the bearing retainer clockwise to increase or counterclockwise to decrease the spindle length (see Figure 7).

5.3.3.3 After making an adjustment to the stops or to the spindle length, secure the adjustment by tightening the stop bushing nut, set screw or clamp screw to applicable.

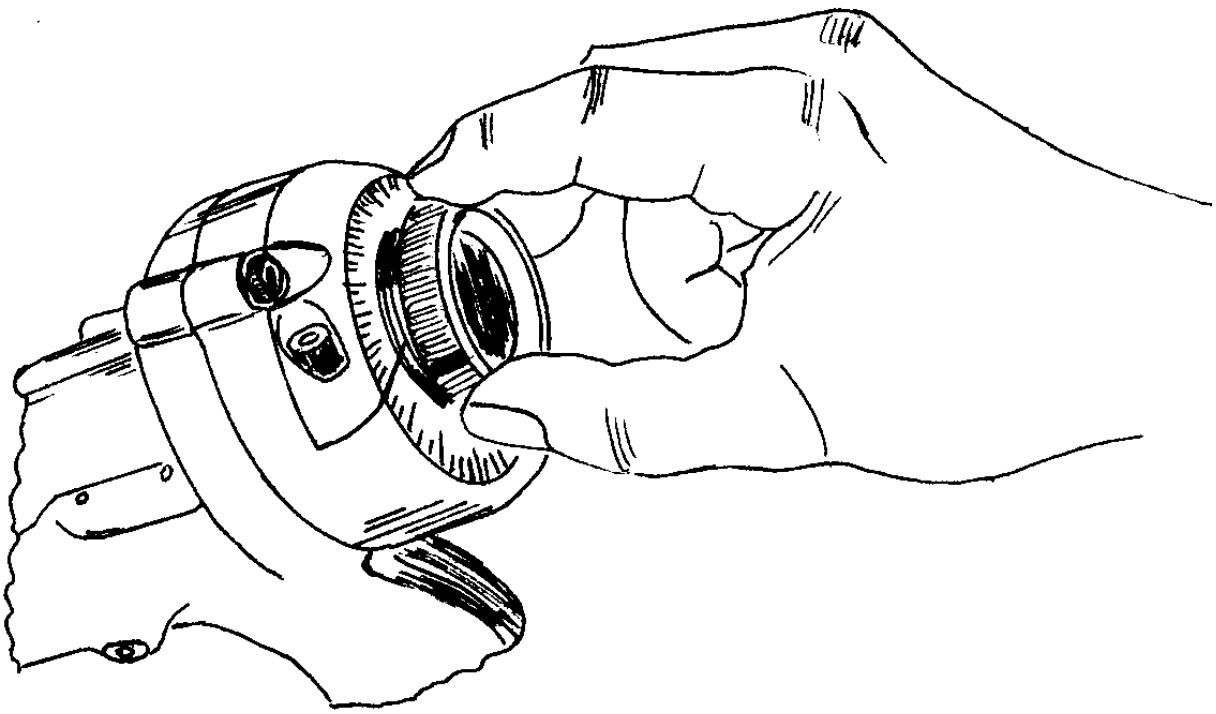

Figure 7 - Adjusting Spindle Length

5.4 Operation of Drillmotors

5.4.1 Operating Cycle (see Figure 8)

5.4.1.1 Before beginning work on production parts, drill test holes in test pieces of similar material and gauge as that being used in production. Adjust the Spacematic drillmotor according to section 5.3 to produce holes and countersinks within the specified tolerances. Check drilled holes with a suitable GO/NO GO gauge. Check countersinks with a countersink gauge according to PPS 1.33.

5.4.1.2 The drillmotor operates as follows. If the trigger is released at any time during the drilling operation, the tool will automatically retract and unclamp.

Step 1. With the collet inserted into the starting hole or jig template hole and the foot attachment held firmly against the template, the trigger is pressed to start the drillmotor and the clamping action as the mandrel is drawn up into the collet, expanding the collet and locking the drillmotor securely to the material being drilled or to the template being used.

Step 2. The clamp and feed piston rod retracts, thereby feeding the drill into the work.

Step 3. The stop bushing contacts the feed rate control mechanism causing the rate of feed to be reduced while the countersinking operation (if applicable) is performed. At the end of the pre-test length of travel the stop bushing or screw contacts the pop-off mechanism causing the feed piston to reverse and retract the drill.

Step 4. At the end of the operating cycle the mandrel is released and the collet may be removed from the starting hole or jig template.

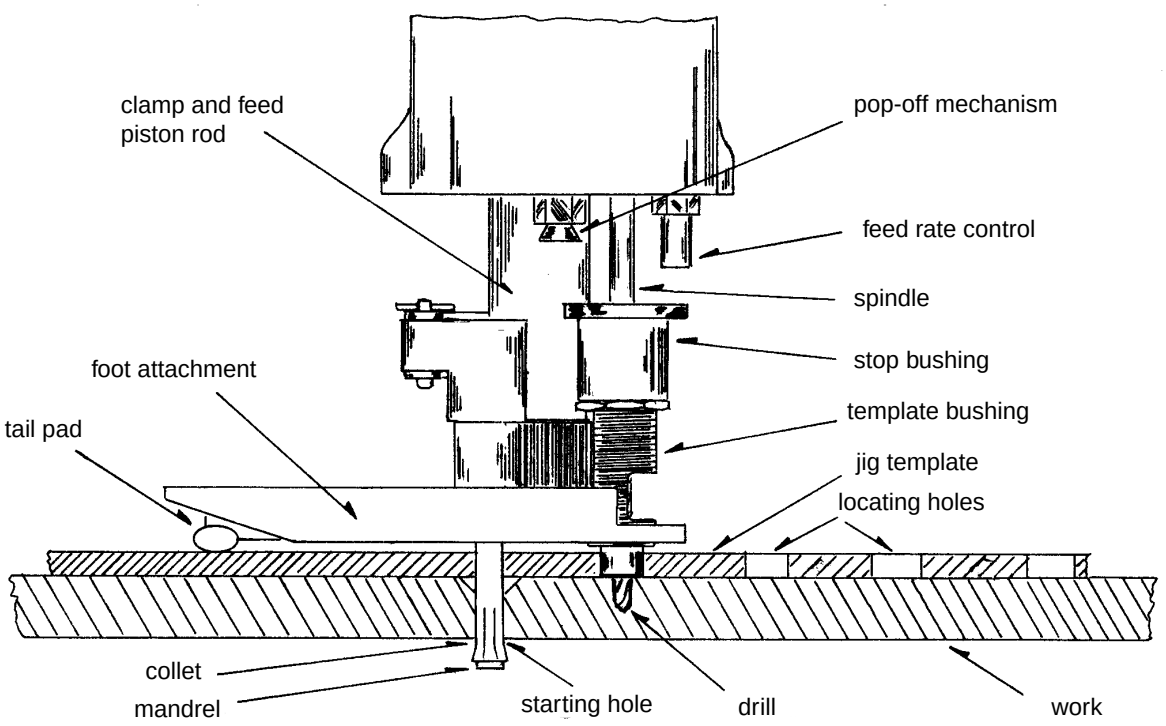

Figure 8 - Drillmotor Operation

5.4.2 Use of the Variable Spacing Template Foot

5.4.2.1 Use the variable spacing template foot as follows:

Step 1. Align the jig template on the work piece to be drilled and drill off the starting hole.

Step 2. Insert the collet into the starting hole and locate the boss on the threaded template bushing in the first hole in the template.

Step 3. Operate the drillmotor according to section 5.4.1.

Step 4. Relocate the threaded template boss in the next hole on the template or remove the collet from the starting hole and place it into a finished drilled hole, as required to reach the next hole to be drilled.

5.4.3 Use of the Drill Jig Collet Foot Attachment

5.4.3.1 Operation of the drill jig collet foot is similar to that for the variable spacing template foot except that the collet and drill utilize the same template hole and no starting hole is required.

5.4.3.2 The drill jig collet foot is used only for drilling applications.

5.4.4 Mistmatic Coolant System

5.4.4.1 The mistmatic coolant system consists of either a container assembly fitted to the air outlet port on the side of the drillmotor housing (see Figure 9) or a valve assembly fitted to the air outlet port and connected to a separate reservoir (see Figure 10) and delivery hoses leading to a nozzle fitted to the foot attachment. In operation the system delivers a fine spray of liquid freon coolant (ref. paragraph 4.1.1) to the cutting tool during the drilling operation.

5.4.4.2 Ensure that the container or reservoir assembly is filled with coolant before beginning the drilling operation.

5.4.4.3 Adjust the air pressure regulator on the reservoir or the needle valve adjust screw on the container assembly so that a fine mist of coolant is just barely discernible during operation of the drillmotor. Ensure that too much coolant is not delivered to the cutting tool as this will tend to leave a residue on the surface of the work.

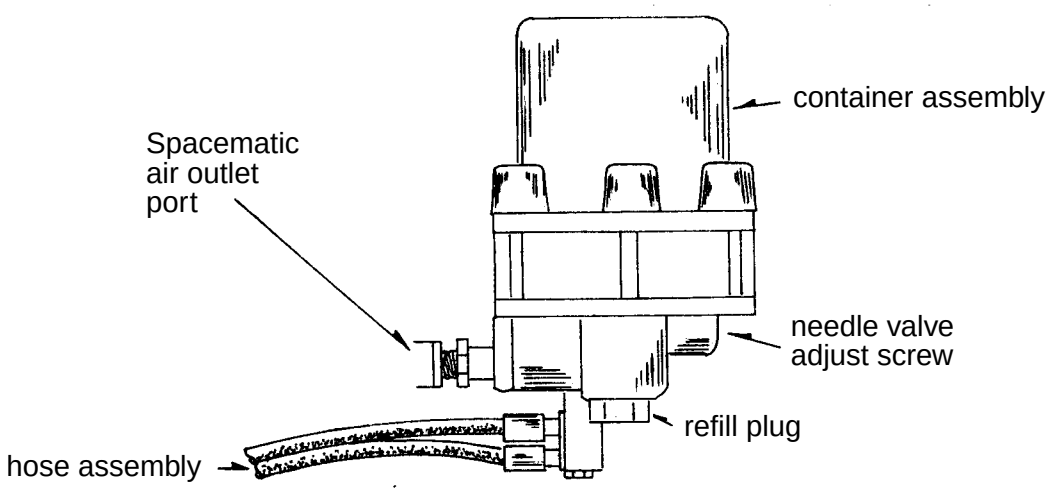

Figure 9 - Mistmatic Coolant System

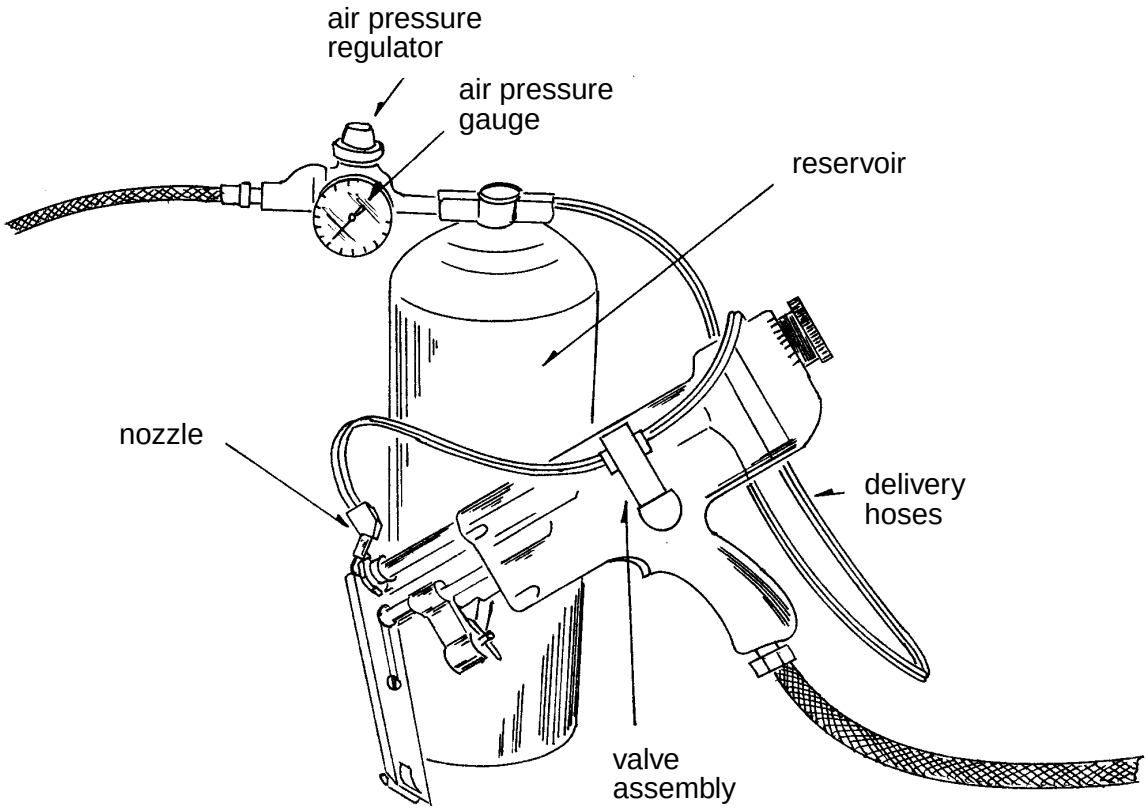

Figure 10 - Mistmatic Reservoir Coolant System

6 Requirements

6.1 Drilled holes shall meet the tolerance requirements for size, concentricity, angularity and finish according to the relevant engineering drawing, work order card or PPS, as applicable.

6.2 Countersunk holes shall meet the requirements of PPS 1.33.

7 Safety Precautions

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

7.2 Wear Bombardier approved safety glasses when operating drillmotors.

7.3 Ensure adequate ventilation when using a Spacematic drillmotor fitted with a mistmatic coolant system in a confined area.

7.4 Disconnect the shop air supply from drillmotors when changing drill bits, collets, mandrels and bushings.

8 Personnel Requirements

8.1 Personnel responsible for set-up, adjustment and operation of Spacematic drillmotors Models 1600 and 6000 for drilling and drill countersinking 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 of Equipment

9.1 When the fluid level indicating rod, on the side of the tool, reaches the ADD FLUID mark on the housing, refill with hydraulic fluid according to the manufacturer`s instructions.

9.2 If a drillmotor functions incorrectly, repair or adjust according to the manufacturer`s instructions.