BOMBARDIER
Toronto (de Havilland)
PROPRIETARY INFORMATION

PPS 1.20

PRODUCTION PROCESS STANDARD

Set-Up & Operation of the APS Model 705 Automatic Drill Riveter

Issue 2
- This standard supersedes PPS 1.20, Issue 1.
- 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 Production Process Standard (PPS) specifies the procedure and requirements for set-up and operation of the APS Model 705 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. 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 1.33 - Countersinking for Flush Head Fasteners.

3.2 PPS 2.01 - Installation of Solid Rivets.

3.3 PPS 2.38 - Fluid Tight Installation of Solid Rivets.

3.4 PPS 13.13 - Personal Protective Respiratory Equipment.

3.5 PPS 13.26 - General Subcontractor Provisions.

3.6 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 Spray Dot Black Coating, Gro Lac.

4.1.3 Transeal Blue Paint, Gro Lac.

4.1.4 Non-Permanent Marker (e.g., Faber Castell 6000, Sanford's Vis-a-Vis, etc.).

4.1.5 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 APS Model 705 automatic drill riveter and associated hardware (i.e., hole locating laser, upper and lower anvils, pressure foot bushings, drills and drill/countersinks, panel positioner assembly, etc.). It is acceptable to use an alternative drill riveter and associated equipment in place of the APS Model 705 automatic drill riveter provided that it is set up and operated according to the manufacturers instructions and the installed rivets meet all the requirements specified herein.

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

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

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

5 Procedure

5.1 General

5.1.1 The APS Model 705 automatic drill riveter is designed to meet the requirements of automatic drilling, countersinking and riveting of aircraft structures and sub-assemblies. It is capable of exerting up to 16,000 pounds of riveting force between the upper and lower anvils. When used in automatic mode the machine will drill the hole, then insert and upset a rivet in one complete cycle. In addition to the full automatic cycle, it can also be used to drill only. Complete controls are provided so that all conventional styles of rivets, up to and including 3/16" diameter (1 inch length), can be utilized. A safety light curtain has been provided on the front of the machine to inhibit the machine cycle if the safety zone is violated.

5.1.2 All major power functions of the machine are hydraulic, electric and air actuated through an electrical/electronic control system. The hydraulic system is made up of commercially available components to allow for ease of replacement and repair. Electrical controls and hydraulic operating valves, gauges, etc. are mounted on separate panels installed at the side and rear of the machine.

5.1.3 The Automatic Riveter can drill, countersink, insert, and squeeze a rivet in a work piece in approximately 5 seconds for average material. The length of time necessary for the complete cycle varies with the thickness and alloy of the material being riveted.

5.1.4 The machine performs these functions automatically after being properly adjusted for feed, speed, countersink depth, and upset distance. The diameter of the formed head is determined by selecting the proper rivet length. The longer the rivet selected, the larger the diameter the formed head will become. The machine, therefore, has no control over the diameter of the formed head, but does determine, after adjustment, the height of the formed head.

5.1.5 The stroke control regulates the working space between the pressure foot bushing and the lower anvil tooling parts of the machine. It can be adjusted to allow for larger working space, in which to move the material in and out of the machine throat, or be reduced to 0.125". The distance between the pressure foot bushing and lower anvil tooling, therefore, can be adjusted to suit the size and shape of the material being worked.

5.1.6 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 or fasteners.

Step 4. Ensure that un-riveted holes and installed rivets or fasteners in the test piece assembly (if installed) 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 1). 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.

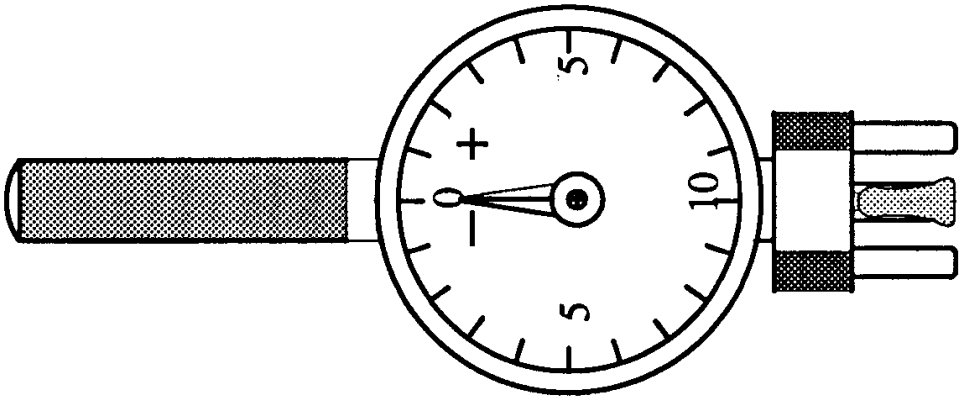

Figure 1 - Flushness Gauge

5.2 Machine Component Descriptions

5.2.1 C - FRAME - The basic structure of the machine is the C - Frame, which is an end-gaped, box section, stress-relieved C - shaped weldment. All of the component parts of the machine are mounted on the frame, except where noted.

5.2.2 UPPER HEAD EXTENSION - The upper head extension is a stress-relieved weldment that houses and/or supports major assemblies of the machine, including, the upper head transfer assembly, the upper head transfer actuator, the drill feed control assembly, upper buck assembly and the rivet feeding components. The upper head extension is bolted to the vertical face of the C-Frame upper leg. This assembly embodies the mechanism for drilling and countersinking the hole, inserting the rivet in the hole, and bucking the rivet head while upset pressure is applied from the underside by the hydraulic lower ram.

5.2.3 UPPER HEAD ASSEMBLY - The major components of the upper head assembly are as follows:

5.2.3.1 PRESSURE FOOT BUSHING - The pressure foot bushing is a hardened steel clamping piece that is connected to the pressure foot assembly. The underside of the pressure foot bushing is the surface against which the work piece is clamped. There are many styles and configurations available depending upon the specific requirements of the application.

5.2.3.2 PRESSURE FOOT BRACKET - The pressure foot bracket assembly is mounted to the underside of the upper head extension. The bracket provides for clearance of the drill spindle and the upper buck tooling during transfer. The part is clamped against the pressure foot bushing by the lower ram clamp table. The bushing gives rigid clamping during the drill and countersink operation.

5.2.3.3 DRILL SPINDLE - The drill rotation and vertical stroke are both electrically powered. The rotation is controlled by one electric motor and the stroke is controlled by a separate electric motor. Positional feedback is provided by motor encoder/resolver feedback.

5.2.3.4 DRILL COUNTERSINK DEPTH CONTROL - The drill spindle is adjusted electrically via the Allen Bradley Panelview 1000 operator interface. The adjustment range is either numeric input (range 0.0000" - 4.7500") or jogging plus or minus via F keys.

5.2.3.5 BUCK ASSEMBLY - The bucking assembly is a pneumatically actuated mechanical toggle mechanism controlled by a double solenoid valve. The stroke is fixed and the tooling pushaway is adjustable by means of a set screw located in the upper end of the tooling. The upper anvil assembly is held in the tool holder on the buck housing by a spring loaded locking pin.

5.2.3.6 UPPER HEAD TRANSFER ACTUATOR - The upper head transfer actuator is electrically driven and is connected to the transfer plate. Mounted to the end of the actuator is an encoder for positional feed back. The positions are maintained by a servo control module located in the PLC rack. The cylinder transfers from the drill position to the sealant position and buck position. All positions are software controlled and confirmed by proximity switches. Positional stops are provided in the front and rear as safety stops, if the transfer takes off unsolicited or does not stop at the commanded positions.

5.2.3.7 TRANSFER MECHANISM - The drill spindle assembly, inline sealant assembly and buck toggle assembly are attached to the transfer slide. This horseshoe has two linear guides and the transfer plate has four THK linear bearings attached to its surface which ride along the guides. The upset thrust is taken by the linear bearings.

5.2.3.8 SEALANT APPLICATION - This machine has been equipped with an inline sealant applicator attached to the transfer plate and also a side sealant applicator attached to the pressure foot bracket. Clean tips and hardware everyday to prevent fouling.

- The inline sealant applicator uses a spring-loaded, fastener specific, tip. The applicator is used to apply sealant to the countersunk hole or top of a universal head fastener drilled hole in evenly spaced dots. The sealant applicator consists of the sealant applicator holder which in turn houses the sealant cartridge. The amount of sealant displaced is controlled by the adjustable tip and the operator-adjustable setting on the Panelview screen.
- The side sealant applicator uses an EFD unit with a separate sealant applicator holder and sealant cartridge. The amount of sealant dispensed is controlled by the EFD unit. The sealant is applied after a hole is drilled from the left hand side of the pressure foot with an arm that has a tip. The transfer does not move to the inline sealant position.

5.2.4 UPPER ANVIL ASSEMBLY - The anvil holder is secured to the buck toggle assembly. During the drilling portion of the auto cycle, a rivet is injected into the rivet fingers, and is held erect under spring tension. When the buck cylinder is moved down, the upper anvil lowers, spreading the jaws of the fingers and inserting the rivet into the drilled hole. The upper anvil now bucks the rivet to be upset from below. The upper anvil assembly is situated on the transfer plate, just aft of the drill spindle, inline sealant and pressure foot assembly. The upper anvil consists of the following:

- RIVET FINGERS - A pair of rivet fingers (left-and-right-hand) are held to the bottom end (i.e., closest to the work line) of the anvil. They are maintained by a pair of retainers which, in turn, are held by a garter spring. The fingers function to hold a rivet beneath the upper anvil tooling which drives the rivet out of the fingers and into the pre-drilled hole in the work piece.
- THE UPPER ANVIL - A part of the assembly that functions to push a rivet from the rivet fingers into the pre-drilled hole in the work piece. When the anvil has inserted the rivet into the work piece, it remains in the extended position to buck the rivet when the rivet is upset from the underside.

5.2.5 PUSH AWAY - Push away is required for proper fastener installation of flush and universal head rivets. It is the amount of distance measured between the work piece and upper pressure foot bushing during fastener insertion into the drilled hole. Too much push away may deform the part being riveted. Not enough push away may create gaps under the fastener heads.

5.2.6 LOWER RAM ASSEMBLY - The lower ram assembly is bolted onto the C-frame and embodies the mechanisms for:

- Automatically inflating the turntable to clamp the work piece between the lower anvil pressure sleeve and the lower surface of the pressure foot bushing.
- Raising the lower ram to upset the shank of the rivet while the lower anvil pressure sleeve maintains clamp pressure under air tension.
- LDT (Linear Digital Transducer or Electric Stroke Feedback Device) preset stroke device.

5.2.7 LOWER CYLINDER ASSEMBLY - The lower cylinder assembly is mounted onto the C-frame. The lower cylinder assembly is responsible for the pneumatic clamping of the work piece and the hydraulic upsetting (heading) of the rivet.

5.2.8 TURNTABLE ASSEMBLY - The turntable assembly is mounted on top of the lower hydraulic cylinder assembly. The turntable permits 360 degree rotation of the lower anvil assembly. The rotation is manually driven.

5.2.9 UPSET CYLINDER - The upset cylinder is mounted on the centerline at the lower end of the C-frame on an x-y table. Extension of the hydraulic cylinder piston forces the piston rod and clamp table to rise until the lower anvil pressure sleeve contacts the underside of the work piece. The clamp cylinder built into the turntable will remain in this pressurized position until the cycle is complete or reset is activated, thus maintaining the lower ram assembly in the clamped position. The differential motion of the lower ram assembly relative to the C-frame initiates actuation of the clamp limit switch; this initiates the continuation of the cycle. After insertion of a rivet into the drilled hole, the hydraulic upset cylinder is energized, the inner anvil contacts the underside of the rivet while maintaining clamp pressure and then the inner anvil compresses the rivet to the selected dimension. Upon completion, the upset cylinder retracts and the clamp cylinder returns to a start position or preset stroke dimension. When installing two-part fasteners, the upset cycle is replaced by a pin insertion, swaging or nut-running action.

5.2.10 MACHINE CONTROL FOOT SWITCH/PENDANT - The foot switch consists of two pedals. The right pedal is the OPERATE pedal and the left pedal is the RESET pedal. The operate pedal initiates a pre-selected cycle or function on the operator interface panel. The reset pedal aborts a cycle that has started, clears temporary errors/faults and brings the lower ram to deep drop. The pendant is also outfitted with an operate and reset push button for combined single station operation of the riveter, overhead positioner, and e-stop functions.

5.3 Cycle Descriptions

5.3.1 There are four modes of operation, which can be used in various combinations:

- Drill
- Sealant (inline or side applicator)
- Rivet cycle
- Pin cycle

5.3.2 From the main screen the different modes may be selected by going to the mode screen (press F11). Each cycle starts with the lower ram moving up and clamping the part against the pressure foot bushing.

5.3.3 The following is the drill cycle:

Step 1. The system transfers to the Drill position.

Step 2. The drill moves down at the rapid feed rate and reaches the preset approach point.

Step 3. The drill changes to the slow feed rate until the preset countersink depth is reached for an elapsed amount of time (drill dwell 0.00-3.00 sec.).

Step 4. The drill cycle is completed and the drill spindle returns to the retracted position.

Step 5. If no other mode of operation is chosen, the lower ram retracts to the work level position.

5.3.4 The following is the inline sealant cycle:

Step 1. The system transfers to the Inline Sealant position.

Step 2. The sealant tip extends down for a specified amount of time (sealant dwells) and inserts sealant for a specified amount of time (timer preset).

Step 3. The sealant tip returns to the retracted position.

Step 4. If no other mode of operation is chosen, the lower ram retracts to the work level position.

5.3.5 If using the side sealant mode, the system does not transfer to Inline Sealant position; the arm moves in from the side, dispenses sealant controlled by EFD unit then retracts back. Then, if no other mode of operation is chosen, the lower ram retracts to the work level position.

5.3.6 The following is the rivet cycle:

Step 1. The system transfers to the Buck position.

Step 2. The upper anvil assembly extends downward, inserting the rivet into the hole.

Step 3. The lower ram moves upwards until upset is complete.

Step 4. The lower ram retracts to the work level position.

Step 5. The upper anvil assembly retracts.

Step 6. The transfer returns home (drill position).

Step 7. A previously oriented rivet is injected into the fingers and the machine is ready for another cycle.

5.3.7 The following is the pin cycle:

Step 1. The system transfers to the Buck position.

Step 2. The clamp table goes to HIGH pressure which is adjusted in set-up.

Step 3. The upper anvil assembly extends downward, inserting the pin into the hole and stays down for a specified amount of time. The insert pin dwell timer in the plc times out.

Step 4. The lower ram retracts to the work level position.

Step 5. The clamp table pressure is reduced to the original preset pressure.

Step 6. The upper anvil assembly retracts.

Step 7. The transfer returns home (drill position).

Step 8. A previously oriented pin is injected into the fingers and the machine is ready for another cycle.

5.3.8 The following is an example of a typical drill/rivet cycle:

Step 1. With the lower ram retracted and the work located under the pressure foot assembly, depress the OPERATE foot pedal or pendant OPERATE button. **Do not** operate the drill riveter without a part or test piece between the lower anvil and the pressure foot assembly.

Step 2. The lower ram assembly raises the lower anvil tooling until the lower pressure sleeve clamps the work to the pressure foot bushing. The rotating drill spindle descends to the approach point, goes into “slow feed” and starts the drill and countersink bit into the work. If the operate pedal or pendent button is released the drill will stop rotating and moving vertically.

Step 3. The depth of the countersink is controlled by positional feedback from the encoder or motor feedback device. When the final drill depth is reached, and the specified amount of drill dwell time has passed, the drill cycle is complete. The drill spindle returns to its retracted position after the drill and countersinking operation has been completed. The depth of the countersink is adjustable on the drill setup screen (F9 from the main screen) by selecting an absolute position from 0.0000" - 4.7500" (F9 from the drill setup screen) or by incrementing the depth by pressing the -0.0005" (F12 from the drill setup screen) or +0.0005" buttons (F11 from the drill setup screen).

Step 4. When the drill spindle descends and starts the drilling and countersinking operation, it also actuates the rivet feeding and injector blade which inserts a rivet into the upper anvil fingers. The blade has taken the rivet from the fastener feed system. The rivet is now in the upper anvil fingers, ready to be placed in the work for riveting.

Step 5. If inline sealant is included, after the drill has returned to the retracted position, the transfer actuator moves the drill spindle out of position and moves the sealant applicator in the operating position. The sealant applicator then moves down through the pressure foot bushing and the applicator nozzle is located in the hole. A switch acknowledges the applicator is in the down position and the slide will remain down for a preset amount of dwell time. Sealant dwell on the operator control dictates the amount of time the applicator is in the down position. After sealant is applied, the applicator retracts. The operation then continues.

If side sealant is included, after the drill has returned to the retracted position, the transfer actuator will move to the rivet position if the rivet or pin cycle are active, and the side sealant arm moves in and dispenses the sealant controlled by EFD unit. After it is done it retracts and the operation then continues.

Step 6. After the drill spindle has returned to its original position, and the rivet has been placed in the feed fingers, the transfer actuator moves the drill spindle out of position and moves the upper bucking cylinder into the fastening position. The bucking cylinder pushes the upper anvil with the rivet in the fingers through the pressure foot bushing.

Step 7. As the bucking cylinder moves downward, the upper anvil pushes the rivet from the rivet fingers and places it into the pre-drilled hole. The upper bucking cylinder then holds the upper anvil with the rivet in the down position. The fastener is now in position to be upset from underneath by the lower anvil tooling.

Step 8. When the upper bucking cylinder holds the rivet in position the buck down switch is triggered and after a programmed amount of dwell, it actuates the lower anvil to complete the upsetting of the rivet. This is driven by the hydraulic lower upset ram and is completed by a pre-selected linear distance. After the upsetting of the rivet, the lower upset ram retracts to work level, the upper anvil retracts, and the transfer actuator returns to drill position. The cycle is now complete.

5.4 Feed System Details

5.4.1 The APS Model 705 automatic drill riveter uses a 10 bowl feed system: 4 bowls for 1/8" diameter rivets, 4 bowls for 5/32" diameter rivets and 2 bowls for 3/16" diameter rivets. Each bowl consists of an individual, adjustable, vibratory bowl and a one-shot vertical escapement. Typically, the vibration setting should be #7 or #8. The machine has 3 self orienting injectors, one for 1/8" diameter rivets, one for 5/32" diameter rivets and one for 3/16" diameter rivets.

5.4.2 The feed system must be turned on via the Panelview Fastener Screen (F14 from the main screen). Pressing Bowl Feed (F11) will toggle the feed system on and off. When the system is on this provides for 120VAC power and air to the table. Upon powering up the feed system, the sequence is as follows:

Step 1. Clean the upper tooling of sealant to prevent fasteners from sticking in fingers or being inserted into the fingers crooked.

Step 2. Select the appropriate injector, ensuring the injector is clear of any fasteners left in by the previous operator.

Step 3. Choose the appropriate bowl. By selecting a new bowl the system will automatically purge three times. The “system” desires there to be 3 fasteners in process at all times to provide for cycle time requirements. These 3 fasteners are to be located in the following areas:

- 1 in the prechamber
- 1 oriented in the injector
- 1 in the upper anvil fingers

5.4.3 When there is no fastener in process and a bowl is selected the sequence is as follows:

Step 1. A fastener is escaped from the bowl, passes through the main distribution funnel and is blown to the prechamber at the head assembly.

Step 2. The fastener is released from the prechamber to the injector, the orienting process begins and the fastener is oriented in the injector

Step 3. The oriented fastener is injected into the fingers.

Step 4. A second fastener is escaped from the bowl, passes through the main distribution funnel and is blown to the prechamber.

Step 5. The second fastener is released from the prechamber to the injector, the orienting process begins and the second fastener is oriented in the injector

Step 6. The third fastener is escaped from the bowl, passes through the main distribution funnel and is blown to the prechamber. There is now a fastener at the prechamber, a fastener oriented in the injector and a fastener in the tooling fingers, for a total of 3 fasteners.

Step 7. After inserting and upsetting/bucking, the transfer returns to drill position.

Step 8. The oriented fastener in the injector is injected into the fingers.

Step 9. The fastener in the prechamber is released to the injector, the orienting process begins and the fastener is oriented in the injector.

Step 10. Another fastener is escaped from the bowl, passes through the main distribution funnel and is blown to the prechamber. Again, there is a fastener at the prechamber, a fastener oriented in the injector and a fastener in the tooling fingers, for a total of 3 fasteners.

Step 11. Process then repeats from Step 7.

5.5 Start Procedure

5.5.1 The following is the cold start power up sequence:

Step 1. Turn on the main power bus located at the rear of the C-Frame for both the Riveter and the Overhead Positioner (remember that the riveter is interlocked electrically with the positioner and if the positioner is faulty or not powered up, the riveter will not run).

Step 2. Ensure that the door on the Main Electrical Enclosure is closed so that the safety door interlock is engaged.

Step 3. Ensure that all E-STOPS are reset by pulling the red knobs out. Keep in mind that there is a maintained E-STOP button on the operator console, one on the main electrical enclosure, one on the feed system, and one on the left hand side of the head. There is also an E-STOP push button on the operators pendant for a total of 5 E-STOPS. If any of these is depressed the machine will not come on.

Step 4. From the MAIN SCREEN, go to the DRIVE POWER UP (press F8). Then press MACHINE POWER (F1).

Step 5. Wait 30 seconds for Main Air to initialize.

Step 6. Press HYDRAULIC POWER (F9) which turns the hydraulic pump on.

Step 7. Home the Feed Axis, Transfer Axis and the Lower Ram Transducer.

5.5.2 At the start of each shift, go thought the following check list

- Check for error messages.
- Home the feed servo.
- Home the transfer servo.
- Home the lower ram. (i.e., calibrate the lower ram).
- Verify that all preset values are okay on Panelview. (e.g. upset value, approach, etc.). Never assume that the previous shift has left the pre-sets in operating condition.
- Clean and inspect all tooling. (remember that marked tooling will cause marked parts).
- Take a careful look at the turntable cables and ensure that they will not get caught.
- Adjust all lights/cameras/monitors as needed.
- Wipe off any accessory equipment. (e.g., Missing Rivet/Broken Drill Detectors).
- Clean rivet fingers using the solvent specified by PPS 31.17 and a brush. Wipe dry after solvent cleaning.
- Clean the sealant applicator and adjust pressure and time accordingly.
- Check at the chip vacuum canister and empty as necessary.
- Check air pressure is 90 PSI.
- Visually check the hydraulic oil level in the tank.
- Check the turntable and Buck Cylinder Lubricator for air tool oil.
- Visually check injectors for any stray fasteners and empty. Purge may be used.
- Remove any fasteners left in fingers.
- Adjust the upper and lower chip blowers. The upper chip blowers keep rogue rivets from being squashed under the pressure foot and possibly damaging the skins.
- Run test coupon to verify fastener quality and good machine cycle.
- Fill fastener feed system bowls with required rivets, being sure to empty track if the fasteners are of a different grip length.

5.6 Marking Rivet Location

5.6.1 Attach the applicable rivet marking template (see paragraph 4.2.3) 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.

5.6.2 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.

5.6.3 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.

5.6.4 When using Mylar templates, mark hole locations using a non-permanent marker (see Materials section, paragraph 4.1.4)

5.7 Assembly of Parts to be Riveted

5.7.1 Position mating parts without excessive gaps.

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

5.7.3 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.

5.8 Drill Speeds and Feed Rates

5.8.1 Refer to Table 1 as a general reference when establishing the optimum drill speed and feed rate.

Table 1 - Drill Speeds and Feed Rates

RIVET DIAMETER	SPINDLE SPEED (RPM)	DRILL FEED RATE (RPM
3/32"	7500	16
1/8"	6000	18
5/32"	6000	18
3/16"	5000	20
1/4"	4500	22

5.9 Riveter Messages/Faults

5.9.1 These are displayed on the Panelview 1000 ALARMS SCREEN. The messages have two states. The RED signifies a fault condition while the GREEN state signifies a good, no fault condition. It is very important that prompt attension be paid to fault messages.

Table 2 - Riveter Messages/Faults

ALARM	POSSIBLE CAUSES
LOW HYDRAULIC PRESSURE	• Hydraulic power unit failure. • HPU overcurrent protection tripped. • Hydraulic pressure switch failure. • Improper pressure switch setting.
HYDRAULIC TEMP HIGH	• HPU thermocouple failure. • Cooling fan failure. • Improper thermostat setting.
LOW AIR PRESSURE	• Inadequate shop air supplied to machine. • Main air pressure switch failure. • Improper pressure switch setting. • Main air regulator not set properly.
OVERTRAVEL DETECTED	• Overtravel switch is not set properly. • Overtravel switch failure. • Upset potentiometer failure. • Clamp switch failure.
ANVIL NOT IN PLACE	• Lower anvil not properly located on turn table base. • Switch not set properly. • Anvil location switch failure.
MISSING RIVET	• Injector error. • Detector fiber optic cable dirty. • Detector amplifier not set properly.
APPROACH CONFLICT	• Drill approach point set at below countersink setting.
DROP FEED OBSTRUCTION	• Rivet stuck in drop feed station. • Rivet stuck in tube. • Drop feed station air not present.
LOWER RAM CAL REQUIRED	• The lower ram has lost its reference point • Lower ram sensor (lvt) error or failure.
BROKEN DRILL BIT	• Drill bit is broken or missing. • Detector fiber optic cable dirty. • Detector amplifier not set properly.

5.10 Operating Screens

5.10.1 INTRODUCTION SCREEN - Appears after initial power up and system check is complete. Pressing [F16] will bring up the Main Operations screen.

5.10.2 MAIN SCREEN - The riveter must be on the main screen to run a cycle. It displays all of the preset values of the variables and their respective actual value comparison. The upper left corner indicates that the main screen is being displayed. To the right is an indication of the action that the machine is currently set to perform. At the upper right side of the screen is the message box. This box cycles through fault messages and alarms as needed. Below the message box is an indicator showing which bowl is active on the fastener system. Below the active bowl indicator is another indicator to show where the fasteners are located as they are transmitted from the bowls to the collecting funnel, to the prechamber, to the injector, and to the fingers of the upper anvil.

Function Keys:
F1 - Powers up the hydraulic pump.
F6 - Brings up the Transfer Screen with required password.
F7 - Brings up the Stats Screen.
F8 - Brings up the Drive Power Up Screen.
F9 - Brings up the Drill Setup Screen.
F11 - Brings up the Mode Screen.
F12 - Brings up the Seal & Buck Screen.
F13 - Brings up the Alarm Screen.
F14 - Brings up the Fastener Screen.
F15 - Brings up the Lower Ram Screen.
F16 - Brings up the Introduction Screen.

5.10.3 SERVO DRIVE SCREEN - The servo drive screen is where the machine is powered up and the electric servos are energized. The display portion of the screen shows if the servos drives have been powered on, if the servo cards have been enabled, and if the axis have been homed.

Function Keys:
F1 - Turns the machine power on.
F3 - Resets the servo drives. This is the first button to be pressed when coming out of an E-STOP condition.
F4 - Resets the servo cards in the controller. This is the second button to be pressed when coming out of an E-STOP conditon.
F5 - Applies power to the drives. This is the third button to be pressed when coming out of an E-STOP condition.
F6 - Enables the drives and servo cards. This is the fourth button to be pressed when coming out of an E-STOP condition.
F7 - Homes the drill spindle in the upwards position.
F8 - Homes the transfer axis.
F9 - Turns the hydraulic power unit on.
F11 - Manually jogs the head in the positive direction (towards the front of the machine).
F12 - Manually jogs the head in the negative direction (towards the rear of the machine).
F13 - Manually jogs the drill spindle in the positive direction (up away from the work line).
F14 - Manually jogs the drill spindle in the negative direction (down towards the work line).
F15 - Brings up the Transfer Screen.
F16 - Brings up the Main Screen.

5.10.4 MODE SCREEN - The Mode Screen is used to select the operation that the machine will perform. At the upper portion of the screen is a banner indicating the operation that the machine is currently set to perform. Other accessories are also able to be enabled and disabled from this screen.

Function Keys:

F1 - Enable/disable the drill cycle of the machine.
F2 - Enable/disable the side sealant cycle of the machine.
F3 - Enable/disable the inline sealant cycle of the machine.
F4 - Enable/disable the rivet cycle (upset) of the machine.
F5 - Toggle the sequence of the lower ram between a Rivet sequence or a Pin sequence. A rivet sequence is a process where the lower ram extends to force the lower anvil to squeeze and deform the shank of the rivet protruding out of the bottom of the aircraft article. A pin sequence is a process where the pin is inserted into the drilled hole but no other action is taken with the lower ram.
F7 - Enable/disable the lower chip blower.
F8 - Enable/disable the upper chip blower.
F9 - Enable/disable the laser locator of the machine.
F10 - Enable/disable the chip vacuum of the machine.
F11 - Enable the chip blowers while [F11] is pressed. This is a manual over ride for the chip blower.
F15 - Bring up the Drill Setup Screen.
F16 - Bring up the Main Screen.

5.10.5 DRILL SETUP SCREEN - The Drill Setup Screen shows the parameters for the drill spindle of the machine. The display shows the presets that are set by the operator of the drill spindle and also shows actual updates while the machine is running or if the drill spindle is being tested.

Function Keys:

F1 - Allows setting of the drill RPM of the spindle during a drill operation.
F2 - Allows setting of the drill feed rate of the spindle during a drill operation.
F3 - Allows setting of the drill dwell of the spindle when the spindle has reached its depth.
F4 – Sets the machine to perform a test of the drill cycle without clamping the part.
F5 – Sets the machine to transfer the head to the tool change position to allow the drill bit to be changed or the upper anvil to be changed. Pressing the RESET pedal or button will cancel the function and return the head to the drill position.
F6 – Brings up the SEAL and Buck Setup Screen.
F7 – Brings up the ALARM and MESSAGE Screen.
F8 – Brings up the MODE Screen.
F9 – Allows setting of the drill depth by entering a direct number of the distance the drill is to travel.
F10 - Allows setting of the drill approach point (the distance the drill spindle extends before entering the drill spindle feed rate.
F11 - Increases the drill depth by 0.0005".
F12 - Decreases the drill depth by 0.0005".
F14 - Brings up the Fastener Feed Screen.
F15 - Brings up the Lower Ram Screen.
F16 - Brings up the Main Screen.

5.10.6 SEALANT & BUCK SETUP SCREEN - The Sealant & Buck Setup Screen shows parameters of the sealant operation and allows testing of the buck and sealant operations.

Function Keys:

F1 - Enables the upper anvil to be tested for correct push away.
F3 - Allows the extended sealant dwell time of the inline sealant applicator to be set and adjusted.
F4 - Sets the machine to transfer to the sealant position and extend the sealant through the bushing for verification of the setup. Inline sealant has to be selected at the mode screen for this to function.
F5 - Sets the machine to transfer to the sealant change position to replace the sealant tip and tubing.
F6 - Brings up the Drill Setup Screen.
F7 - Brings up the Alarm & Message Screen.
F8 - Brings up the Mode Screen.
F11 - Allows for priming of the sealant. This operation pressurizes the sealant canister to force the sealant to the tip.
F14 - Brings up the Fastener Feed Screen.
F15 - Brings up the Lower Ram Screen.
F16 - Brings up the Main Screen.

5.10.7 LOWER RAM SCREEN - The Lower Ram Screen displays the preset parameters of the lower ram along with actual updates while the machine is on and operating. This screen provides for the operator to set up and adjust the parameters of the lower ram and calibrate the lower ram.

Function Keys:

F1 - Allows setting of the upset height during a rivet cycle.
F3 - Allows setting of the clamp pressure that the machine maintains during the rivet cycle.
F6 - Brings up the Seal & Buck Setup Screen.
F7 - Brings up the Alarm & Message Screen.
F8 - Brings up the Mode Screen.
F9 - Allows setting the work level of the lower ram. This is the distance the lower ram retracts to at the end of a cycle from the pressure foot bushing.
F10 - Sets the machine to calibrate the lower ram. With the stack thickness gauge clamped between the lower anvil and the pressure foot, the machine will record the ram position and calibrate itself to the tooling that is installed. The gauge is 1.0000” thick.
F11 - Allows the setting of the high clamp pressure for inserting interference fit fasteners. The high clamp is only enabled when the pin sequence for the lower ram has been enabled.
F14 - Brings up the Fastener Feed Screen.
F15 - Brings up the Drill Setup Screen.
F16 - Brings up the Main Screen.

5.10.8 FASTENER FEED SCREEN - The Fastener Feed Screen displays the current status of the fastener feed system. The active bowl that is selected is displayed in the upper right hand portion of the screen. Below is a list of bowls that may be chosen. To the left of the active bowl is an indicator showing where the fasteners are located as they are transmitted from the bowls to the collecting funnel, to the prechamber, to the injector, and to the fingers of the upper anvil. This screen also allows for manual operation of the fastener feed system.

Function Keys:

F1 - Manually escape a fastener from the active bowl provided that there is not already a fastener in the prechamber.
F2 - Manually inject a fastener into the upper anvil fingers if there is a fastener in the injector.
F3 - Activate the bowl selection list. To manually select and make a bowl active press the up or down arrow until the proper bowl is highlighted, then press the enter key.
F4 - Clears errors and registers as to where the fasteners is located in the system.
F5 - Vibrate the active bowl.
F6 - Brings up the Drill Setup Screen.
F7 - Brings up the Mode Screen.
F8 - Brings up the Seal & Buck Screen.
F9 - Manually blow a fastener through the rivet tube to the next station.
F10 - Purge the fastener from the injector and request another fastener at the injector.
F11 - Turn the feed system on and off.
F12 - Not used on this machine. On other machines this will reset the rivet detector.
F14 - Brings up the Alarm & Message Screen.
F15 - Brings up the Lower Ram Screen.
F16 - Brings up the Main Screen.

5.10.9 ALARM AND MESSAGE SCREEN - The Alarm and Message Screen displays all the indicators that cycle through the message box. The messages are displayed with green lettering and grey background if the item is in a working state. The messages will be displayed in red when the item needs to be brought to the operator's attention.

Function Keys:

F1 - Apply power to the hydraulic unit.
F6 - Brings up the Seal & Buck Screen.
F7 - Brings up the Servo Drive Screen.
F8 - Brings up the Mode Screen.
F14 - Brings up the Fastener Feed Screen.
F15 - Brings up the Lower Ram Screen.
F16 - Brings up the Main Screen.

5.10.10 STATISICS SCREEN - The Statistics Screen displays cycle count information to the operator. Each type of cycle is counted as it is completed. The cycle types that are counted and displayed are Drill Cycles, Inline Sealant Cycles, Rivet Upset Cycles, Side Sealant Cycles, and Pin Insert Cycles. Also displayed and accumulated are Machine On Time (Power On) and Cycle Time. All of this information is stored in two sets of accumulators. The first set of accumulators are non-resetable by the operator and count until they roll over. The second set of accumulators are resetable by the operator and can be used for shift information.

Function Keys:
F1 - Reset the SHIFT accumulators back to zero.
F16 - Brings up the Main Screen.

5.10.11 TRANSFER SETUP SCREEN - The Transfer setup screen displays the current position of the head and the preset position of the Drill, Sealant, and Buck. This screen allows the head to be manually transferred to one of the preset positions and for the preset positions to be adjusted. **This screen is for maintenance and is being provided for reference only.**

Function Keys:
F3 - Sets the machine to transfer to drill position.
F4 - Sets the machine to transfer to sealant position.
F5 - Sets the machine to transfer to buck position.
F7 - Manually jog the head in the forward direction (towards the front of the machine).
F8 - Manually jog the head in the reverse direction (towards the rear of the machine).
F11 - Allows the drill position preset to be adjusted(0.0000-15.0000).
F12 - Allows the sealant position preset to be adjusted(0.0000-15.000).
F13 - Allows the buck position preset to be adjusted(0.0000-15.0000).
F15 - Brings up the Servo Drive Screen.
F16 - Brings up the Main Screen.

6 Requirements

6.1 Visually and dimensionally check production parts according to the appropriate fastener PPS (e.g., PPS 2.01, PPS 2.38, etc.). Production parts failing to meet the requirements specified are not acceptable.

6.1.1 An acceptable test piece assembly, demonstrating appropriate machine set-up and operation, must have been prepared at the start of each production run. For fluid tight rivet installation only, an acceptable test piece assembly must also have been prepared after a change in fastener size during a production run, before re-starting a production run after any work stoppage due to machine failure or where the machine has been shut down for more than 1 hour and at the end of each production run.

7 Safety Precautions

7.1 The machine should only be operated by individuals trained and familiar with the equipment.

7.2 Wear safety glasses and hearing protection at all times when operating the machine.

7.3 Never place hands in the machine operating area when it is energized. This machine is equipped with a infrared light curtain to inhibit the machine cycle if the safety zone is violated.

7.4 Always use appropriate tools.

7.5 Always disconnect the compressed air and electrical power before working in the operating area or on mobile parts.

7.6 Be certain no one else is near the moving parts of the machine before initiating a cycle.

7.7 Never operate the machine with the electrical cabinet door open or with any other access doors open.

7.8 When hand feeding rivets, be sure hands are clear before starting a cycle.

7.9 Chip blowers must never be positioned in such a way as to direct air flow toward the operator.

7.10 Never look into or direct the spot locating laser into the eyes.

7.11 All adjustments on the machine should be made while at idle, then tested. Never make adjustments of any kind while machine is in cycle.

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

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

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

7.15 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.

7.16 The machine is fitted with four emergency stop latching push-buttons. One on the operator console, one on the main electrical encloure, one on the feed system, and one on the left hand side of the head. There is also an emergency stop momentary push button on the operator pendent. They are all connected to the main electrical circuit and cause the machine to stop entirely when pressed.

7.17 The machine is operated by a Foot Pedal; left pedal: RESET, right pedal: OPERATE. A safety feature of the "OPERATE" foot pedal switch is that pressure must be maintained to continue the operation. Release of the "OPERATE" foot pedal switch STOPS the machine. The operator depresses the switch again to continue cycle or depresses "RESET" to abort the cycle and return to the "START" position.

8 Personnel Requirements

8.1 The procedure specified herein has been classified as a critical operation and, therefore, certification and/or qualification of personnel is required. Certified and/or qualified personnel must have a good working knowledge of the following, as applicable:

- engineering drawing notes on fastener locations
- requirements for the installation of solid rivets
- procedure and requirements for the set-up and operation of the APS Model 705 automatic drill riveter
- how to prepare test assemblies
- how to operate the machine using the drill, sealant (inline or side applicator), rivet cycle and pin cycle modes
- how to process production parts
- how to assemble and position parts for riveting
- how to set-up marking templates
- how to use inspection gauges
- safety precautions

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 general machine maintenance be carried out according to the manufacturer’s instructions on a regularly scheduled basis.