BOMBARDIER
Toronto (de Havilland)
PROPRIETARY INFORMATION

PPS 4.24

PRODUCTION PROCESS STANDARD

Leak Testing Learjet Model 45 Integral Fuel Tanks

Issue 5
- This standard supersedes PPS 4.24, Issue 4.
- Vertical lines in the left hand margin indicate technical changes over the previous issue.
- Direct PPS 4.24 related questions to michael.wright@aero.bombardier.com.
- 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 leak testing Learjet Model 45 integral fuel tanks by filling the tanks with leak test fluid.

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 ASTM D1744 - Test Method for Water in Liquid Petroleum Products.

3.2 ASTM D2276 - Standard Test Method for Particulate Contaminant in Aviation Fuel by Line Sampling.

3.3 PPS 4.23 - Pressure Testing Learjet Model 45 Aircraft Wing Fuel System.

3.4 PPS 13.13 - Personal Protective Respiratory Equipment.

3.5 PPS 13.26 - General Subcontractor Provisions.

3.6 PPS 21.03 - Priming, Sealing and Repair of Integral Fuel Tanks.

3.7 PPS 31.17 - Solvent Usage.

4 Materials and Equipment

4.1 Materials

4.1.1 Leak test fluid to MIL-PRF-38299.

4.1.2 Leak detector solution (e.g., Turco Leak Detector, Sigma-Aldrich Leak-Tec, MIL-L-25567, etc.). When using Turco Leak Detector solution, mix 5 oz. with water to make up 1 imp. gallon of solution. Use Leak-Tec leak detector solution as received (i.e., do not thin with water).

4.1.3 Protective wrap - Kraft paper or equivalent.

4.2 Equipment

4.2.1 Coveralls, lint-free cotton or 65/35 polyester/cotton blend. Use of 100% cotton coveralls which are not qualified as lint-free is **not** acceptable.

4.2.2 Containers for collecting leak test fluid, minimum 50 litre capacity (e.g., **conductive** black plastic crates). These containers must be conductive so they can be electrically grounded.

4.2.3 Wing stands, metal, 4555700002-001-211C.

4.2.4 Fuel tank blanking kit, tool #4557000001-001-216.

4.2.5 Replacement (dummy) access covers, 4557200039-003-141.

4.2.6 Vent line hose, clear plastic, 1 1/2" inner diameter minimum.

4.2.7 DSC 378-3 lint free wiping cloths.

4.2.8 Tack cloths (e.g., DSC 375-1).

4.2.9 Protective gloves, neoprene (e.g., DSC 422-5).

4.2.10 Explosion proof lights.

4.2.11 Class B fire extinguisher.

4.2.12 Absorbent cloth.

5 Procedure

5.1 General

5.1.1 Leak testing of structurally complete integral fuel tanks is performed after all parts and assemblies that penetrate the fuel tanks have been installed and tested according to PPS 4.23. The test procedure consists of filling the fuel tank with leak test fluid and isolating the tank for at least 4 hours while checking for leaks.

5.1.2 Do not perform the leak test until all sealant is fully cured as specified in PPS 21.03.

5.1.3 Unless otherwise specified, always leak test the port and starboard fuel tanks simultaneously to keep the wing properly balanced.

5.1.4 Do not use materials that may leave a residue, such as putty, to plug holes or other openings.

5.1.5 Before leak testing, ensure that all fuel system components have been installed as specified by the engineering drawing and tested according to PPS 4.23.

5.1.6 All personnel working within the fuel tank must wear clean coveralls (see Equipment section, para. 4.2.1).

5.1.7 The leak test fluid pump system is equipped with two 1 micron filters which will help prevent contamination of the fuel tank by removing contaminants from re-used leak test fluid. Therefore, do not bypass the meters and filters during the fill cycle.

5.2 Preparation of Containers

5.2.1 Containers (see equipment section, para. 4.2.2) will be used to collect excess leak test fluid. As the leak test fluid can be re-used many times, it is essential that care be taken to avoid contaminating the fluid. Therefore, immediately before use, thoroughly solvent clean the interior of all containers to be used to collect excess or residual leak test fluid according to PPS 31.17. If necessary, remove debris using a tack cloth before solvent cleaning. Electrically ground all containers before use.

5.3 Particulate and Water Content Testing of Leak Test Fluid

5.3.1 At least once weekly, ensure that the leak test fluid in the tank is acceptable for leak testing by submitting a 5 litre sample of the leak test fluid in the storage tank for particulate contamination testing according to ASTM D2276 and water content testing according to ASTM D1744.

5.3.2 Obtain samples of leak test fluid for particulate and water content testing as follows:

Step 1. Place the ends of the leak test fluid lines from the pump in a clean, empty container.

Step 2. Set the pump valves as specified in Table 1 for filling.

Step 3. Ensure that pump valve #13 and valve #14 are closed.

Step 4. Connect an air supply line to the pump.

Step 5. Open pump valve #13 and valve #14 to pump out enough leak test fluid to half fill the container to purge contaminants from the hose before taking the samples.

Step 6. Fill the sample containers with leak test fluid.

Step 7. Submit the samples to the Materials Laboratory for testing. The maximum acceptable level of particulate contamination is 1.00 mg/l and the maximum acceptable level of water is 0.03%. If the sample fails either particulate contamination or water content testing, determine and correct the cause of failure before testing another sample. A satisfactory sample must be obtained before the leak test fluid in the tank may be used.

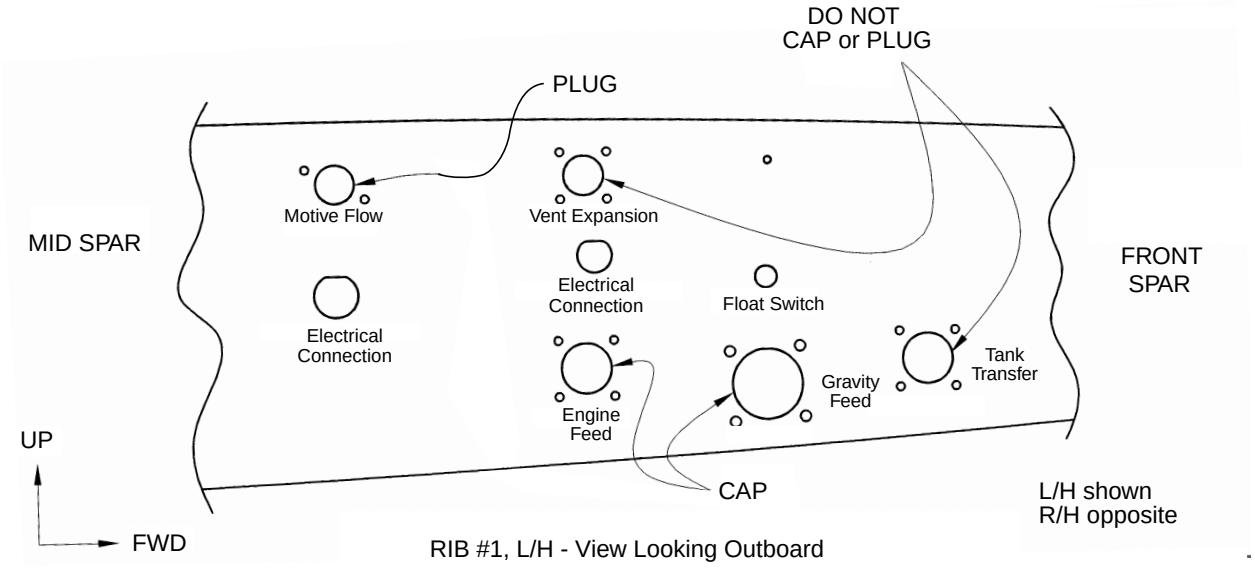
5.4 Preparation of Wing for Leak Testing

5.4.1 Prepare the wing for filling with leak test fluid as follows:

Step 1. Place two wing stands in the test area, oriented so that the wing will be supported along rib #3 on each side of the wing.

Step 2. Position the wing on the wing stands with the wing supported along rib #3 on each side. Ensure that the stands clear access holes and drain plugs.

Step 3. Disconnect and cap or plug the engine feed line, gravity feed line and the motive flow line at the inboard face of rib #1 on the LH and RH sides as shown below. Do not disconnect the vent expansion or tank transfer lines.



RIB #1, L/H - View Looking Outboard

Step 4. Ensure that the tank transfer switch along the left hand rib is in the “closed” (i.e., up) position.

Step 5. Remove the lower access hole panel assemblies (second outboard from the centre).

Step 6. Remove the AMETEK fuel quantity probe located horizontally in the collector bay. Wrap (see Materials section, para. 4.1.3) the probe to protect it from contamination until it is re-installed after the leak test.

Step 7. Solvent clean the replacement access covers according to PPS 31.17 to remove any contaminants.

Step 8. Install the replacement access covers (complete with leak test fluid supply lines) in place of the removed lower access hole panel assemblies.

Step 9. Route and connect a clear plastic hose to each of the wing vent lines as shown in Figure 1 below.

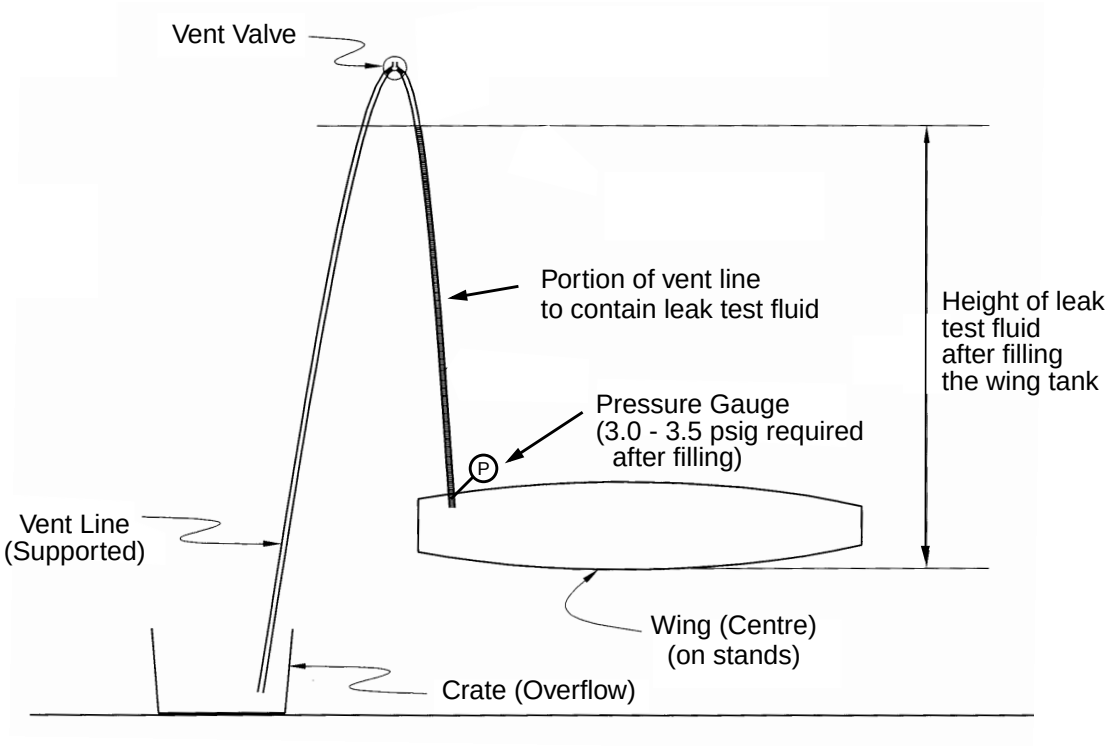


Figure 1 - Set-up of Vent Lines

Step 10. Connect the ground wire from the contact on the pump to the braid at the wing/fuse fitting to ground the wing.

Step 11. Ensure that pump valve #13 and valve #14 are closed.

Step 12. Set the other pump valves (#1 through #12) as specified in Table 1 for filling the wing.

Step 13. Reset the pump meters to zero.

Table 1 - Valve Settings

VALVE NUMBER (see Figure 2)	VALVE POSITION FOR FILLING	VALVE POSITION FOR DRAINING
1	OPEN	CLOSED
2	CLOSED	OPEN
3	CLOSED	OPEN
4	CLOSED	OPEN
5	OPEN	CLOSED
6	OPEN	CLOSED
7	CLOSED	OPEN
8	OPEN	CLOSED
9	CLOSED	OPEN
10	CLOSED	OPEN
11	OPEN	CLOSED
12	CLOSED	OPEN

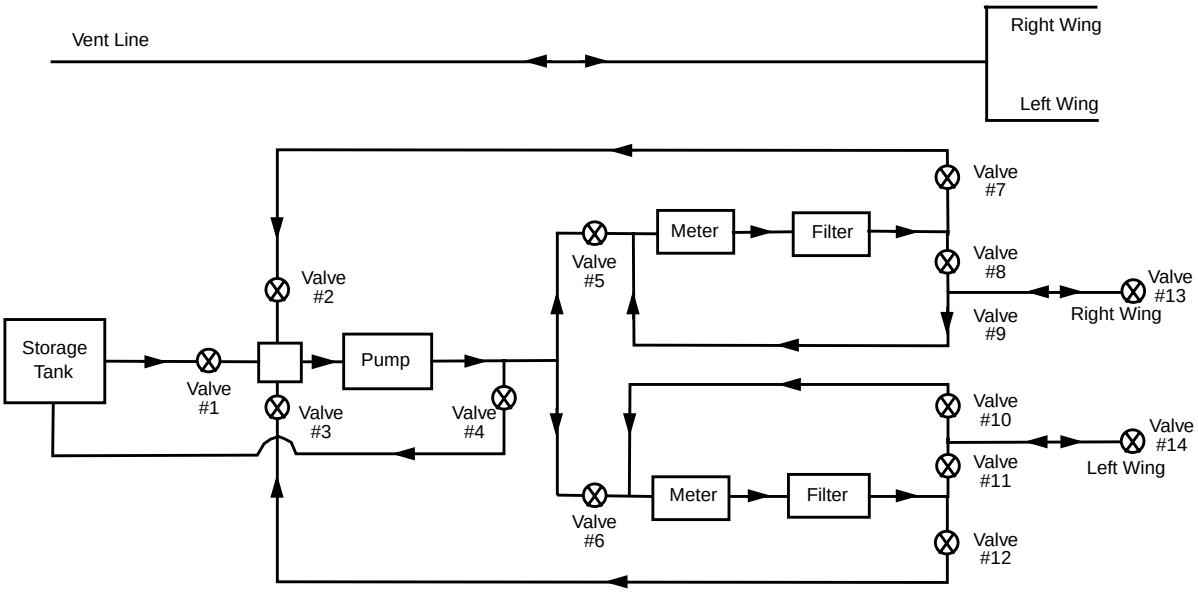


Figure 2 - Valve schematic

5.5 Filling of Wing Tanks

5.5.1 Fill the wing tanks with leak test fluid (ref. para. 4.1.1) as follows:

Step 1. Connect an air supply line to the leak test fluid pump.

Step 2. Open pump valves #13 and #14 to simultaneously fill both tanks (75 litres/minute maximum fill rate).

Step 3. While filling, adjust the valves (#13 and #14 only) as necessary to ensure that the amount of leak test fluid in each tank is kept approximately the same. This will help to prevent the wing from becoming unstable.

Step 4. If a major leak big enough to prevent adequate filling of the tank and/or performance of the leak test is detected while filling, shut pump valves #13 and #14 and drain the wing of leak test fluid according to section 5.7. After repairing the leak, refill the wing tanks as specified in this section and proceed with the leak test.

Step 5. When both meters read approximately 950 litres, reduce the flow rate using pump valves #13 and #14.

Step 6. Continue filling each wing tank until leak test fluid fills the vent line hoses resulting in a pressure of 3.0 - 3.5 psig (see Figure 1).

Step 7. Close pump valves #13 and #14 to stop the flow of leak test fluid. Do not re-open these valves until it is time to drain leak test fluid from the wing tanks.

Step 8. Record the meter readings for each tank on the process sheet.

Step 9. Disconnect the air supply line from the pump.

5.6 Leak Test Procedure

5.6.1 Allow the leak test fluid to remain in the wing tanks for a minimum of 4 hours. Throughout the leak test, some leak test fluid must remain visible within the vent line hoses above the wing. If, before a minimum of 4 hours has passed, the leak test fluid is no longer visible within the vent line hoses, it will indicate a major leak. Once the origin of the leak is detected, drain the wing of leak test fluid, repair the leak and re-fill and re-test as specified herein.

5.6.2 Periodically check the wing surface for leaking test fluid and record the location of any leaks. Soak up spills of leaked test fluid on the floor using absorbent cloth. Dispose of used absorbent cloth according to Environment, Health and Safety procedures.

5.6.3 As the final step of the leak test procedure, perform a final check of the entire wing surface and record the location of any leaks. If there are no leaks, indicate proper verification.

5.7 Draining of Wing Tanks

Step 1. Set pump valves #1 through #12 as specified in Table 1 for draining the wing.

Step 2. Reset the pump meters to zero.

Step 3. Connect an air supply line to the leak test fluid pump.

Step 4. Open pump valves #13 and #14 to control flow and drain both wing tanks simultaneously.

Step 5. While draining, allow air into the wing tanks through the vent line hoses.

Step 6. If a wing tank is not draining properly, it is acceptable to bypass its meter and filter by re-setting the pump valves as follows:

- RH WING TANK: Open valve #8 and close valve #9
- LH WING TANK: Close valve #10 and open valve #11

Note: Bypassing the meter and filter is only acceptable when draining the wing; it is NOT acceptable during filling.

Step 7. Continue draining until the pump motor stops pumping.

Step 8. Position one clean container under each of the 4 drain plugs located in the bottom skin at the inboard end.

Step 9. Depress the drain plugs along the bottom of the wing to drain the remainder of the leak test fluid from the wing tanks. Continue draining until leak test fluid stops flowing from the plugs.

Step 10. Disconnect the replacement access covers (complete with leak test fluid supply lines).

Step 11. Using clean DSC 378-3 lint free wiping cloths, soak up the leak test fluid remaining in the wing tanks. Use blowers to ensure adequate ventilation and assist in evaporation of residual leak test fluid.

Step 12. Use the leak test fluid supply lines attached to the replacement access covers to pump out as much as possible of the leak test fluid from each of the containers.

Step 13. Disconnect the air supply line from the pump.

Step 14. Check the pump filters for excessive clogging and contaminates. Replace and/or clean clogged filters as necessary.

5.8 Repairing Leaks

5.8.1 If the origin of a leak is not obvious, apply leak detector solution (ref. para. 4.1.2) inside the fuel tank in the suspect area and blow compressed air at the leak **exit** point to determine the leak **origin** on the interior of the tank (i.e., determine the leak **path**). After determining the leak origin, remove leak detector solution using a clean DSC 378-3 lint free wiping cloth dampened with water and then wipe dry with another clean DSC 378-3 lint free cloth.

5.8.2 Repair any leaks by re-sealing at the leak origin according to PPS 21.03 or by replacing fasteners, as necessary. Ensure surfaces to be sealed are clean and dry. Take particular care when cleaning and drying close fitting assemblies as sealant will not properly cure if surfaces are improperly prepared.

5.8.3 After completing repairs, re-test the fuel tank for leaks as specified herein. Allow any applied sealant to fully cure according to PPS 21.03 before re-testing as specified herein.

5.9 Draining and Cleaning of Containers

5.9.1 After removing as much of the leak test fluid from the containers using the leak test fluid pump system as possible, drain and clean each of the containers as follows:

Step 1. Drain as much as possible of the remaining leak test fluid into the “Discard Fluid” drum. Dispose of Discarded Fluid according to Environment, Health and Safety procedures for hazardous waste.

Step 2. Soak up residual leak test fluid using clean wipers.

Step 3. Final wipe with a clean, damp wiper.

5.10 Post Leak Test Procedure

5.10.1 After the completion of all leak testing, leak repairs, re-testing, etc., proceed as follows:

Step 4. Disconnect the ground wire from the braid at the wing/fuse fitting.

Step 1. Disconnect the vent line hoses.

Step 2. Replace the AMETEK fuel quantity probe in the collector bay.

Step 3. Remove caps and plugs from the engine feed line, gravity feed line and the motive flow line at the inboard face of rib #1 on the LH and RH sides.

Step 4. Re-connect the engine feed line, gravity feed line and the motive flow line at the inboard face of rib #1 on the LH and RH sides.

Step 5. Re-install the lower access hole panel assemblies.

6 Requirements

6.1 After a minimum of 4 hours filled with leak test fluid, the integral fuel tank shall show no evidence of leakage over the entire surface of the wing. The leak test must be repeated after any repairs until this requirement is met.

6.2 Any leaks must be repaired by re-sealing according to PPS 21.03 or by replacing fasteners.

6.3 Leak test fluid must pass weekly particulate contamination and water content testing according to section 5.3 before use.

7 Safety Precautions

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

7.2 Smoking or any other kind of open flame is prohibited within 100 feet of the leak test area or leak test fluid storage tank. Ensure that adequate fire extinguishing equipment, and personnel familiar with its use are immediately available and standing by at all times.

7.3 Do not have open flames in areas where leak testing operations are carried out. Do not use infra-red or other heat lamps in any area where leak test fluid is used. Only vapour/explosion proof lamps, with good electrical connections and serviceable extension cords, may be used inside or in the vicinity of open fuel tanks.

7.4 Do not leave the wing unattended at any time when it is filled with leak test fluid.

7.5 Do not eat or drink in leak testing areas.

7.6 Wear personal protective respiratory equipment according to PPS 13.13 when wiping up pooled leak test fluid residue within the wing.

7.7 Wear protective coveralls, neoprene gloves and splash goggles when wiping up pooled leak test fluid residue within the wing.

7.8 Avoid skin contact with leak test fluid. If skin contact occurs, wash the affected area thoroughly with soap and water (15 minutes minimum).

7.9 Avoid eye contact with leak test fluid. If contact occurs, flush the eyes immediately with large quantities of water (15 minutes minimum) at an eye wash station and obtain medical attention immediately.

7.10 Dispose of used wipers in oily waste cans (red containers with self-closing lids).

7.11 Take particular care to ensure proper grounding of equipment any time leak test fluid is being used. Containers must be electrically grounded.

7.12 Ensure that leak test fluid storage tank vent outlets are not blocked at any time.

7.13 In the event of a large spill of leak test fluid, all operations in the area must cease until the spill is cleaned up and the area checked safe by fire personnel. Soak up spills of leak test fluid on the floor using absorbent cloth.

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

9.1 Drain any water from the leak test fluid storage tank on a weekly basis.

9.2 The open end of the return line to the storage tank must face downwards and terminate no more than 2" above the tank bottom.