Flight Performance and Functional Evaluation Report of the Pilatus PC-12
December 10, 2007

CONTENTS

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PREFACE

During the week of December 10-14, 2007, a smokejumper flight performance test and functional evaluation was conducted of the Pilatus PC-12 aircraft in Boise, ID. The evaluation results are documented in this report.

FLIGHT PERFORMANCE EVALUATION AND RESULTS

INTRODUCTION

The flight performance evaluation procedure is intended to show whether an airplane meets the performance criteria that the Smokejumper Aircraft Screening and Evaluation Board (SASEB) has defined as necessary for smokejumper operations.

The flight performance evaluation segment of the Smokejumper Aircraft Evaluation Process for the Pilatus PC-12, serial number N190PE, was performed on December 10 and 11, 2007, in designated aircraft maneuvering airspace south of Boise, ID. The evaluation consisted of two operational flights, each preceded by ground working sessions to establish procedures, weight and balance and airspeeds to be used, or target airspeeds expected for approach to stall maneuvers. Preflight working sessions included:

Bureau of Land Management (BLM), Aviation Management Directorate (AMD), and Forest Service (FS) representatives, attended as member of the evaluation group:

John Kovalicky – USFS-Evaluation Director
Joe Bates–BLM-Safety Officer
Jim Olson–BLM-Assistant Evaluation Director
John Stright–BLM-Project Air Officer
Gordon Harris–Contract-Co-Flight Performance Test Conductors
Scott Curtis–USFS-Co-Flight Performance Test Conductors
Ben Hinkle–BLM-Co-Flight Performance Test Conductors
Peter Duncan–Pilatus–Demonstration Pilot
Ron Barrett–USFS–Incoming Chairperson for SASEB
Joe Bussard–AMD–Flight Test Assistant

Ref. GLH-12/17/07

The performance evaluation considered the following areas:

1. All power off, approach to stall
2. Slow flight and jump pattern maneuvers
3. Power on, climbing approach to stall maneuver (simulating cargo run climb out)
4. Rapid descent evaluation
5. Steep turns
6. Stick-pusher activation evaluation

Weight and Balance: The aircraft weight was calculated by the pilot-in-command for gross weight (9,921pounds), which included four pilots on board, 150 pounds of ballast in the aft baggage compartment and the balance of weight made up of fuel.

Airspeed Determinations: Maneuvering airspeeds were determined from the Pilatus PC-12 Pilot's Information Manual. 1.3 Vs in drop configuration was calculated as 100 knots indicated airspeed (KIAS), based on the book value stall speed, with 15 degrees flap setting, 0 angle of bank at 76 KIAS. All expected "first indication of a stall" (stick shaker activation) indicated airspeeds were calculated from the appropriate charts for each power-off approach to stall maneuver. These included all configurations outlined in the SASEB evaluation process guide and are documented in the flight performance worksheet attached.

Onboard Duties/Briefing: All persons onboard were briefed to maintain visual alertness outside the cockpit to detect any conflicting aircraft traffic. A standard passenger briefing was completed along with the agreement that anyone on board should question any situation or maneuver that may indicate an unsafe or dangerous situation. If that happened, we would break off from that maneuver and discuss its merits, potential changes, or even termination of the flight. The following specific duties were defined:

Scott Curtis–Occupy left cockpit seat and perform take-off, landing and enroute flying duties while maintaining radio communications during maneuvers. During flight evaluation maneuvers, assist in describing the upcoming maneuver and document results.

Peter Duncan–Occupy right cockpit seat, acting pilot-in-command, and perform all flight evaluation maneuvers.

Gordon Harris–Occupy cabin seat during takeoff and landing, and describe and observe all flight evaluation maneuvers from behind and between the cockpit seats, documenting the flight maneuver results.

Ben Hinkel–Occupy cabin seat during takeoff and landing, mount camera on cockpit bulkhead after takeoff and ensure its proper operation, observe the outcome of all flight maneuvers, and maintain visual lookout outside aircraft.

The second flight included the Pilatus company structural/maintenance engineer who open and closed the inflight door. He used an appropriate harness and tether and personal protective gear for inflight operations with the door off.

A second evaluation flight was performed the following day with the same delegation of duties. The second flight was performed to reconfirm some questionable results from the first flight during steep turns, to verify approach to stall stick shaker activation speeds with the door open rather than closed as on the first flight, to evaluate the buffer between the actual stick-pusher speed compared to the stick-shaker warning activation speed and to evaluate the rate of descent using the ground idle setting of the fuel control as opposed to the flight idle setting.

Ref. GLH-12/17/07

A load analysis was performed to assure that the center of gravity (CG) was within the certified envelope for all combinations of fuel, crew, and smokejumper loads.

SUMMARY OF FINDINGS

1. Objective: An adequate airspeed margin exists between stall warning and anticipated smokejumper drop airspeed in a variety of power-off approach to stall maneuvers
   Conclusion: An adequate airspeed margin does exist.
2. Objective: No adverse control characteristics are encountered in a variety of maximum available power-on approach to stall maneuvers similar to those that could be used to clear terrain in the mountains.
   Conclusion: No adverse control characteristics were encountered.
3. Objective: Stall break is not inadvertently encountered in a variety of approach to stall maneuvers.
   Conclusion: Stall break was not inadvertently encountered in the objective mentioned above.
4. Objective: Stall warning is not encountered in normal or worst-case drop pattern maneuvers at prescribed airspeeds and banks.
   Conclusion: Stall warning was not encountered.
5. Objective: The aircraft can descend steeply for cargo dropping, stop descent, and establish a climb without significant altitude loss.
   Conclusion: The PC-12 did descend steeply, stop descent, and establish climb without significant altitude loss.
6. Objective: All emergency procedures can be successfully accomplished by a single pilot in aircraft intended for single-pilot smokejumping operations.
   Conclusion: All emergency procedures can successfully be accomplished by a single pilot.
7. Objective: Prompt engine power response is achieved after throttle movement.
   Conclusion: Prompt engine power was achieved after throttle movement.
8. Objective: Trim response is adequate through all power, airspeed, and configuration changes.
   Conclusion: Trim response was adequate.

TEST RESULTS

InFlight Evaluation (two flights 12/10/07 and 12/11/07)

Airspeed Determinations Worksheet:

Vs, Clean, 0 degrees flaps – 90 knots

Vs1, 15 degrees flaps, straight ahead – 76 knots – drop configuration

1.3 Vs1, drop configuration – 99 knots (roundup to 100 knots for standard speed)

1.3 Vs1 + 5 knots for drop pattern – 105 knots

1.3 Vs1 or +5 -10 knots for cargo delivery 100 to110 knots

1.25 Vs1 + 5 knots–100 knots (this value was not used during flight performance testing because it is the same value as 1.3 Vs for this aircraft)

1) All power-off, approach to stall, stick-shaker activation indicated airspeeds were within + or - 2 knots of those anticipated from the calculated book values, with most airspeeds meeting book value. These were well within parameters and met all requirements from the SASEB flight performance guidelines.

2) Slow flight and jump pattern maneuvers were accomplished with no adverse attributes at the prescribed bank angles and airspeeds.

3) Power-on, climbing approach to stall maneuver (simulating cargo run climb out) produced stick shaker activation at 65 KIAS, well below any airspeed that should be anticipated for this maneuver operationally, providing a very good safety margin.

4) Rapid descent evaluation did not produce a rate of descent as high as may be ideal with the fuel control lever in flight idle, but was adequate, with good recovery. Rates of descent varied from 800 fpm with 0 degrees flaps, 1350 fpm with drop configuration (15 degrees flap) to, 1500 fpm with the landing gear down and flaps fully extended. A subsequent test was performed the following day during flight 2 with the fuel control lever at ground idle, 15 degrees flaps and landing gear up. The rate of descent was, 1600 fpm.

5) Steep turns were performed during the evaluation (30 and 45-degree bank angles, left and right). The airspeed determined during the first flight was 1.3 Vs KIAS (100 knots) minus 5 knots (95 knots) at drop configuration. During the 45-degree banked turns, stick shaker activation was encountered twice. This is not an acceptable result according to the evaluation guidelines. After returning to the airport, review indicated the wrong airspeed had been used. The speed used had been drop speed, minus 5 knots, while it should have been pattern speed (105 knots) minus 5 knots. During the second flight the newly determined airspeed (100 knots) was used with no inadvertent approach to stall stick shaker warning, with an acceptable outcome.

6) Stick-Pusher activation evaluation: The "pilot's information manual" indicates that there is a built-in buffer of 6 knots between the first stick-shaker activation warning and the activation of the stick-pusher to prevent an actual stall. It further indicated that there is an additional 2 knots below that speed where an actual stall is encountered. Before the second flight we decided that we should verify the 6 knot buffer between stick-shaker and stick-pusher, but not try to determine the actual stall speed. The test was performed at the appropriate altitude using jump configuration (15 degrees flaps, door open) straight ahead (0 degree bank angle). The maneuver was accomplished twice with an 8 to 10 knot buffer from the first indication of the stick shaker to the activation of the stick pusher, a higher safety margin than anticipated.

Conclusion: The overall outcome of the flight performance evaluation, using SASEB approved guidelines, was positive. The aircraft has exceptional climb performance at gross weight, with high speed cruise capability, yet can operate on short fields, is "pilot friendly" in the cockpit and is well laid out for single pilot operations. The aircraft did not display any adverse flight characteristics. All evaluated flight maneuvers and the prescribed margins for maneuvering speeds versus stall warning indications were well within the prescribed parameters of an acceptable smokejumper and para cargo platform. The flight performance evaluation was successful from the evaluators' perspective.

Ref. GLH-12/17/07

FUNCTIONAL EVALUATION

The smokejumper aircraft functional evaluation determines whether the aircraft is operationally suitable for dropping smokejumpers and cargo and identifies accessories and procedures needed to allow safe smokejumping from the aircraft.

The main conclusions of the Pilatus PC-12 functional evaluation group are summarized below.

Detailed documentation follows the summary.

SUMMARY OF FINDINGS

1. Objective: identify the suitability of the aircraft for smokejumping and cargo dropping, using standard smokejumper parachute equipment.
   Conclusion: The PC-12 can be safely used to drop the BLM Ram Air system. Dropping the FS-14 system is inconclusive at this point. Initial indications are that cargo can be dropped safely. A future evaluation of the FS-14 canopy should also include additional cargo drops to verify that there are no deployment issues similar to the FS-14.
2. Objective: Identify practical smokejumper load configurations compatible with cabin size, weight, and balance considerations, and various potential fuel loads. Conclusion: A six-person load is the maximum for this aircraft.
3. Objective: Evaluate existing accessories and identify new accessories needed to configure the aircraft for optimum efficiency and safety during smokejumping missions.
   Conclusion: The following accessories are recommended for smokejumping operations from the PC-12:
   A. Overhead cable. This cable will be used for emergency exit and the cargo dropper tether attachment point. BLM jumpers would hook up to the overhead cable. Note: The evaluation aircraft was not equipped with an overhead cable. The suitability of an overhead cable for an emergency exit attachment point and BLM primary attachment point would need to be tested and evaluated.
   B. Vertical anchor cable. This cable was used as the primary smokejumper cable and for cargo dropping. The Cessna Caravan static cable used in the evaluation is adequate as a vertical anchor cable.
   C. Jump-Step: The evaluation aircraft did not have a jump step. Sitting exits were used for the BLM jumps. FS jumper did not exit the aircraft, but will most likely require a step exit for this aircraft. A fold-out step incorporated into the floor platform may be an ideal design for this aircraft.
   D. Platform. This accessory will be required to level the aircraft floor with the jump door.
   E. Handrails. Handrails will be installed on the right side and over the top of the jump door.
   F. Door edge guard. This accessory is needed to prevent damage to static lines. The supplied guard was acceptable, but future guards should wrap around the upper corner and possibly extend forward to the front of the jump door.
4. Objective: Identify the best, safest, and most efficient smokejumping procedures for spotting, smokejumper exit, and cargo dropping and the best emergency exit procedures.

Conclusion: Configured with an overhead static-line anchor cable, vertical primary cable, and a jump step, all PC-12 procedures would correspond to established procedures used in other smokejumper aircraft with similar accessories.

WORK SESSIONS AND FUNCTIONAL EVALUATION TEST RESULTS

Work Session A-Initial Briefing

The PC-12 evaluation briefing began at 0800, December 10, 2008, in the ready room at the Boise Smokejumper Base.

Bureau of Land Management (BLM), Aviation Management Directorate (AMD), and Forest Service (FS) representatives attended as members of the evaluation group:

John Kovalicky–USFS Evaluation Director
Joe Bates-BLM Safety Officer
Jim Olson-BLM Assistant Evaluation Director
John Stright–BLM Project Air Officer
Gordon Harris-Contract Co-Flight Performance Test Conductors
Scott Curtis-USFS Co-Flight Performance Test Conductors
Ben Hinkle–BLM Co-Flight Performance Test Conductors
Ron Barrett–USFS Incoming Chairperson for SASEB and Smokejumper pilot
Joe Bussard–AMD Flight Test Assistant
Mel Tenneson-BLM Functional Evaluation Director

This evaluation group was supplemented by various BLM and FS smokejumper foremen and supervisors, including Jim Raudenbush, Marty Adell, Todd Jinkins, Ken Wabaunsee, Dale Longanecker and Tim Quigley. Ian Grobb and Chuck Harding of MTDC took photographs and video of various phases of the evaluation.

Pilatus representatives present during the evaluation were Gerry Arnold, Pilatus engineer; Leonard Luke, Pilatus sales manager; and Peter Duncan, Pilatus factory chief pilot.

Work Session B-Preflight Static-Line Trail Evaluation

On September 25, Mel Tenneson, John Kovalicky, and Jim Olson inspected the PC-12 in Denver, CO. The aircraft was checked for any possible protrusions, antennas, beacons, stabilizers, or other control surface areas that could interfere with static lines and deployment bags. The door edge was relatively sharp. A Teflon door edge protector was suggested to prevent the static lines from becoming worn. A boot could not be made for this aircraft because the door has to be able to open and close. The aircraft is pressurized and the tolerances are very tight. Pilatus removed an antenna on the bottom of the aircraft that might have interfered with static line/d-bag retrieval during the evaluation. Pilatus said it would build some kind of mesh coverings for two vents that protruded from the fuselage that might interfere with static lines/d-bags.

On December 10 in Boise, ID, the following inspection was performed for the preflight static line evaluation. Pilatus had installed a strip of Teflon aft of the jump door that: began about 8 inches below the top of the door, ran vertical to the bottom of the door, and continued forward 8 inches along the bottom sill of the door. The Teflon was about 3/16 inch thick and 3 inches wide. The strip protruded outside of the door edge about 3/16 of an inch. It would be better if this strip extended to the top of the door, but the strip was adequate for the evaluation. The Teflon at the bottom of the door could catch on a jumpsuit or harness, so the Teflon there was smoothed by filing it down an eighth of an inch.

The vertical static line cable used during the evaluation was originally built for the Cessna Caravan. The base plate was modified to fit the floor track in the PC-12. The cable assembly fit well and was positioned correctly to give the proper angle for the static lines. Pilatus engineers also built a platform to bring the jumpers and/or cargo level with the bottom of the door edge. The platform was about 7.5 inches in height.

The antenna that had been on the bottom of the aircraft was removed by Pilatus.

Pilatus had made a nice mesh covering for the vents so they should not snag the static line.

The FS-14 deployment bags, drogue d-bags, and cargo d-bags were hooked up and stretched out along the tail of the aircraft. The longest d-bag fully stretched, came to with in 8 inches of the rudder hinge line. The bags were moved high and low and under the fuselage to check for any possible hangups. On the aft edge of the strake a potential hang up spot was noted. The strake has about a 1/16 inch gap where a d-bag could get wedged between the strake and the aircraft. This spot was noted and taped with 100-mph tape. The hinges near the aft edge of the jump door had a few edges that might catch a static line. They were taped as well. The handle for the jump door could hang up a static line, if there was static line dump inside the aircraft. Pilatus said on the other jump door and any other jump doors they would make, this would not be an issue, because the handle would be recessed. This handle was taped in flight to prevent any possible entanglement. Other than the above mentioned areas the fuselage is really clean and should not pose any problems with static lines hanging up.

<u>Flight 1-Static Line Trail, Cargo, and Torso Dummy Drops</u>

The door opened easily in flight; the door handle was taped after it was opened. The spotter was tethered aft of the vertical cable where he had plenty of room to reach cargo and maneuver near the door.

All static line trail passes were performed at 300 feet AGL for optimal camera footage from the ground.

During the first, pass we deployed two ram-air drogue d-bags from the vertical cable. The aft end of the d-bag extended about 23 inches outside the jump door. No issues were observed.

During the second pass, one FS-14 d-bag was thrown out; the d-bag was horizontal with the door and appeared to stay parallel with the fuselage. When retrieving the d-bag, it contacted the fuselage.

During the third pass, two FS-14 d-bags were thrown out, with the results described above.

During the fourth pass, one cargo d-bag was thrown out. It behaved similarly to the FS-14 d-bag.

During the fifth pass, two cargo d-bags were thrown out. They behaved similarly to the two FS-14 D-bags.

The evaluation director and the functional evaluation director consulted over the radio and decided it was safe to proceed with dummy and cargo drops.

During the sixth pass, the ram-air dummy was dropped from 500 feet AGL. The roller track was used to launch the dummy. The dummy exited the aircraft well away from the fuselage, with no problems.

During the seventh pass, the FS-14 dummy was dropped from 500 feet AGL. This dummy also exited the aircraft well with no problems.

During the eighth pass, 5 gallons of water was dropped under a 20 foot canopy, from 300 feet AGL. No problems were encountered.

During the ninth pass, a 70 pound fire pack was dropped under a 20 foot cargo chute from 300 feet AGL. The roller track was still in from the dummy drops. As the fire pack was pushed out the door, the wind caught it, and the fire pack hit the aft edge of the door on the way out, causing it to spin. There wasn’t any problem with deployment, but the slipstream is more pronounced than on most of our other aircraft. The fire pack can be placed only an inch or two out of the door before it gets blown back to the doors aft edge. This could be compounded by the roller track. A fire pack should be kicked without the roller track in order to see if it prevents it from being blown to the doors aft edge.

After completing the drop the spotter had a little bit of a problem getting the door closed. The pilot said he had forgotten that the door was still open and was accelerating when the spotter was trying to close the door. The pilot said he would let the spotter close the door before increasing speed during subsequent tests.

Flight 2-Cargo and Torso Dummy Drops

The roller track was also used for these tests.

During the first pass, a 70 pound fire pack was dropped under a 24 foot triangle chute. Once again the fire pack got pushed toward the aft edge of the door, but not so much as during the first flight. The box cleared the fuselage fine. No problems from the spotter perspective.

During the second pass, two 5- gal cubies were dropped, one under a Sadik chute, the other under a 20 foot cargo chute with 1 second between them. No problems were observed from the aircraft.

During the third pass, a ram-air dummy was dropped from 500 feet AGL, dummy weight was 284 lbs. The dummy went out real smooth on the roller track and cleared the aircraft well. No problems from the spotter perspective.

During the fourth pass, a FS-14 dummy was dropped also from 500 feet AGL. This dummy also exited well, same as above.

Exhaust fumes were noticed in the aircraft, more fumes than the spotter was used to in other aircraft.

The spotter closed the door without incident. The door was easier to close at a slower speed.

Work Session C-Review of Flights 1 and 2

Static-line Trail. High-speed film of the static-line trails taken from the vertical static line cable location were normal and indicated no reason for concern regarding safe parachute deployments.

Torso Dummy Drops. Review of high-speed film footage showed that during one of the FS-14 dummy drops, the d-bag traveled inboard and under the strake on the aft bottom of the fuselage, just ahead of the rudder. The apex of the deploying FS-14's would travel upward in an arc immediately after leaving the d-bag. Because the d-bag sometimes ended up under the fuselage, the canopy might contact the aircraft in some situations. The plane was inspected for snag points. A rudder cable inspection port was identified as a possible problem. It was not clear whether the canopy's apex would arc high enough to contact the inspection port.

Originally there was concern whether the flaps of the airplane were to close to the door to safely drop cargo. After review of high-speed film this is not an issue.

<u>Cargo Drops.</u> High-speed film of cargo chute deployment showed normal cargo deployments.

After reviewing the film, it was decided by the evaluation director that the BLM system posed no problems and that live jumps on that system were a "go". We also decided to drop four more FS-14 dummies to gather more information about the path of the FS-14 apex upon leaving deployment bag.

<u>Flight 3–FS-14 Dummy Drops</u>

Three different video cameras were positioned on the ground for multiple camera angles of the deployments.

From the spotter's perspective, there were no problems kicking the four FS-14 dummies out of the PC-12 aircraft. Static lines were hooked to the vertical cable and the roller track was used. This mission was without incident, just like the ones before.

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<u>Flight 4-Live BLM System Jumps</u>

Boise Smokejumper Lead Spotter Mel Tenneson filed the following account:

> Four ram-air jumpers were dropped on this flight. Space in the aircraft was tight, but this was due to the executive seating, the lavatory and the forward bulkhead on the starboard side.
>
> I was tethered in forward of the jump door.
>
> I tried to plug in my spotters' headset forward of the door; but I was only able to listen from this station and not transmit to the pilot. I had to go back and plug in where I had before, aft of the vertical cable, and route the cord forward of the seat and on the floor, so I could spot forward of the jump door.
>
> Spotter visibility on jump runs is a factor; the low wing causes the spotter to loose sight of the exit point on final. When the exit point comes back into view after passing under the wing the spotter has very little time to make corrections. The spotter can compensate by picking a point 300 yards before the exit point and use this as an intermediate line up point to insure the plane is on line for the exit point.
>
> One jumper at a time came back and sat in the spotters' seat as I briefed them. I was able to observe the jumpers hooking up their static line from my position in front of the door. The jumpers hooked to the vertical cable because there wasn't a horizontal cable in the aircraft at this time. It

might be worth looking at a short horizontal cable on the floor for cargo and FS round jumpers. This would give the spotter more room to get to the aft cargo compartment of the aircraft. The overhead horizontal cable would provide an emergency cable for the FS jumpers with the floor cable serving as the primary cable.

Jumpers were able to get in the door fine after practicing in the mockup. The best method for the jumper seemed to be grabbing the forward edge of the door with the jumper's right hand. The jumper places the left hand on the vertical cable, right foot on the box, and kicks their left foot towards the door, with one long step.

The jumpers centered themselves in the door, but seemed to get pushed to the aft edge of the door on final due to the prop blast. I had enough room to stick out my head in the upper corner of the door, while the jumper was seated prior to exit. I gave them a couple of seconds after I said "get ready" for them to try and get centered in the door before the slap. The first jumper exited at 100 knots, the second at 96 knots, the third at 93, and the fourth at 91. From my perspective, it looked like all jumpers got pushed back to the aft edge of the door before exiting. From my perspective, jumper number 3 was centered in the door the best upon exiting the aircraft.

No issues with the drogue d-bag or ram-air deployment were observed.
It would be nice if the jump door could be removed from the inside of the aircraft. This might not be possible; but if there were a couple of pins in the hinges you could pull out, you could remove the door and bungee it inside, the spotter could spot aft of the jump door, making spotting easier and also making it easier to retrieve items from the aft cargo bay.

Work Session D-Review of Flight 3, FS Dummy Torso Drops and Flight 4, Live BLM System Jumps

Video of the FS-14 dummy drops, did not allow the location of the apex of the deploying FS-14 to be determined in relation to the rudder cable inspection port. Because this inspection port might to be a snag point, more information was needed. Specifically, can the apex of the FS-14 be high enough on the fuselage to reach the inspection port, and could the apex of the canopy move in toward the fuselage and contact the inspection port? The group decided to complete for more FS-14 dummy drops to try answering these questions.

Video was taken from a chase plane for a level side view of the deploying parachute. Video taken from the ground would try to show the underside of the plane to help determine whether the d-bag traveled under or came in contact with the aircraft.

Review of high-speed video of the BLM jumps revealed nothing unusual. The jumpers cleared the aircraft normally and the drogue deployment was normal and clean.

Comments from the jumpers indicated normal operations. All jumpers noted minor difficulties getting in the door, which they attributed mainly to a lack of door area handles. They also reported a fairly strong wind blast that made it somewhat difficult to center themselves in the door before to exiting.

Flight 5-Additional FS Dummy Torso Drops

Four torso dummies equipped with FS-14 parachutes were dropped on this flight. The Boise Smokejumper Bases Twin Otter was used as a chase plane and video platform for a level side view of the deploying parachutes. Additional ground video and still photography were taken.

All dummies were dropped safely with no problems encountered.

Work Session E-Review of Additional FS Dummy Torso Drops

High-speed video was obtained from the chase plane on three of the four drops. The first drop was missed. Review of the three drops showed the apex of the deploying canopies possibly touching the fuselage. The fourth drop showed the apex of the deploying canopy arcing up to about the bottom of the inspection hole on the rudder.

A photo taken from the ground captured what looked like the canopy touching the aircraft, and reaching the inspection port area. This was the first dummy drop of flight 5, and high speed air to air film was not captured.

Analysis of the evaluation group led to the conclusion that there may be a problem with canopy snagging on the inspection port. This potential snag point could not be covered, guarded, or otherwise modified on site to eliminate this risk. The evaluation team stopped the evaluation until this problem could be resolved.

Work Session F-Potential Load Configurations

For payload capabilities for a six person load, see the report – Pilatus PC-12 Compliance with SASEB Requirements 10/11/06.

The functional evaluators six person load is as follows- A six person load with cargo would fit inside the PC-12 aircraft. Three 42-inch- long Simula seats could be installed on the portside of the cabin and still leave room for a 37 inch fire pack with some room in front of the vertical cable. You could even stack a saw box on top of the fire pack if desired.

On the starboard side, you could put two 37 inch fire packs and still have plenty of room for the spotter to spot forward of the jump door.

Cubies would fit under the Simula seat. Saw (s), EMT kit, reserve, streamers, etc., would be stored in the aft cargo compartment.

The following load calculation for a six person load is based on information from the functional evaluation director as well as weights from the Pilatus PC-12 Compliance with SASEB Requirements 10/11/06 report.

1	Empty weight	5,534
1	Spotter audio panel at aft door	2
1	TCAS	20
1	Two FM radios	16
1	Pilot	180
1	Pilot's travel bag	25
1	Spotter	180
1	Spotter's bag	20
1	Map case	13
3	Simula seats 42 pounds each.	166
6	Smokejumpers 260 pounds each	1560
3	Fire packs w/chute 75 pounds each	225
3	5 gal cubbie w/chute 48 pounds each	144
1	Chainsaw w/chute	53
1	EMT kit w/chute	61
1	Fedco pump	5
1	Fusee bundle	5
40	Streamers	10
1	Spotter's kit	13
1	Ram-air reserve	15
1	Satellite phone w/chute	10
1	ICT3 kit	7
2	Great Basin crosscut saws	4
1	King radio	2
1	Set of climbers	17
1	Spotter helmet + misc.	9
1	Monitor kit	2
1	Field rigging kit	7
1	Set of cargo straps/rings	10
Total		8,315 pounds

All remaining allowable weight in fuel

Work Session G-Evaluation of Smokejumper Accessories Needs

Anchor Cable. An overhead cable similar to the Dornier 228 would serve as the primary and emergency cable for the BLM parachute system as well as an emergency cable for the FS in this aircraft. The FS has three options for their primary cable, a floor, vertical or overhead anchor system. The vertical anchor from the Caravan was used during the evaluation with a slight modification to the floor bracket. The vertical anchor took up a lot of space and hampered some access to the rear cargo compartment. The spotter is forward of the door in this aircraft and may have some difficulty monitoring the static lines in this configuration. Moving the vertical anchor's location may alleviate these concerns and should be explored. The overhead and floor anchor cables were not used and should be explored and evaluated further before a permanent design is engineered. The final floor platform design may be a consideration as well, especially in the case of a floor anchor cable. FS live jumps were not completed during the evaluation.

Floor Platform. A temporary plywood platform was used to bring the floor elevation up to the bottom of the door sill. An accessory will need to be designed that will replace this temporary platform for jumping and cargo operations. Pilatus engineers proposed a retractable egress platform that would work well for this aircraft. See BLM Proposed Initial Evaluation of the Pilatus PC-12 10-11-06.

The following requirements were identified for the floor platform:

1. Compatible with operation of the inflight door..
2. Nonskid surface.
3. Compatible with vertical cable and overhead cable.
4. Smooth contours.
5. Quick removal.

Jump Step. A jump step will be needed for this aircraft. The BLM uses a standard sitdown exit. The FS did not perform any live jumps from the PC-12, but a step exit is a more stable exit for the deployment of the FS-14. A fold-out step should be considered along with the retractable platform. If a fold-out step is not practical a fixed step would be the next best option. A step with standard size and weight limitations is recommended. Standup exits will not be an option in this aircraft because the door is not tall enough.

The evaluation group identified the following requirements for a jump step:

1. No interference with aircraft pressurization.
2. Compatible with opening the large cargo door.
3. Compatible with operation of inflight jump door.
4. See through metal mesh bottom.

Handrails. Handrails are recommended on the inside right and top of the door and would need to be specifically engineered for this aircraft.

In-flight Door. The Pilatus has a factory installed in-flight door. The door opens and closes easily in flight to 90 degrees. The door is not removable in flight and does hamper access to the rear cargo compartment. It also forces spotter to spot from forward of the door, similar to the Casa 212. One solution might be to equip the in-flight door with a quick release hinge and pins so the door could be opened, removed and stowed during jump operations, similar to the operation of the in-flight doors the Casa 212 and C23A. When the door is closed the airplane can be pressurized to fly at high altitudes. This is a desirable feature and would benefit smokejumper missions.

Door Edge Protector. The door edge protector Pilatus designed for this aircraft will be suitable with some modifications. The radius should be increased to 3/8 to 1/2 inch. The protector needs to extend to the uppermost corner of the trailing edge of the door and possibly a little beyond. If the protector was extended across the bottom sill, it might protect the door from damage that could affect the pressurization. The attachment screws need to be countersunk farther into a beveled hole.

Faring for Inspection Port on Vertical Stabilizer. This inspection port needs to be covered to prevent it from snagging parachute material.

Spotter Tether Point. A standard cargo ring in the seat track forward of the door can be used when spotting smokejumpers. The overhead cable can be used when dropping cargo.

Door Strap. A standard smokejumper aircraft door strap will need to be constructed for the PC-12. The door strap should release from the aft side of the door and be secured so it will not interfere with jumper and cargo operations.

Spotter Communications Panel. A spotter communications package should be located just forward, as high as possible, of the large cargo door on left side of the aircraft. A second headset jack should be installed close to the door for a second spotter or for the first jumper in the door.

Static-Line Monitoring Devices. Standard rubber band clusters will need to be installed to facilitate two jumper sticks on a vertical anchor cable. Configuration and installation of this device will be assigned to the field evaluation director.

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Spotting. Because the in-flight door opens at a 90 degree angle the spotter must spot from forward of the door. Visibility for streamer and jumper runs is a factor; the low wing causes you to lose your sight reference for some time on the final approach. Ideally if you can pick out a reference point about 300 yards before the spotters' exit point, you could line up on this and be close to your flight line when arriving at the exit point. If you do not do something like this, you do not have much time to make corrections by the time the exit point comes into view under the wing of the aircraft. FS spotters did not get an opportunity to spot FS-14 jumpers during this evaluation.

Exits. The only live jumps were made by four single-stick jumper using drogue deployed ram airs. Sit down exits standard to the BLM were used. The jumpers were blown to the aft edge of the door and experienced some minor difficulty exiting the aircraft, (their shoulders and pack trays hit the door). The jumpers felt these minor issues could be resolved with practice and the appropriate accessories. FS jumpers did not exit the airplane. A jump step for this aircraft is recommended for FS jumpers.

Fume Level with Open Door. Participants mentioned several times during the evaluation that the fume level inside the airplane was much higher or at least much more noticeable than on other smokejumper aircraft. Pilatus had the airplane fume level tested. The fume level fell with in acceptable limits. See ACS report, 11/3/06.

Recommendations

The inspection port on the vertical stabilizer needs to have a fairing of some kind built to cover it, eliminating the possibility that it might snag a parachute. It must be determined if canopy material is regularly contacting the airplane. It must be determined if the hinge line between the aircraft and the vertical stabilizer poses any kind of a hazard as far as snagging canopy material. If it is decided to finish the evaluation, an exterior camera or two will need to be mounted to the airplane to determine whether the canopy is contacting the aircraft and whether it is in danger of being snagged. It may be possible to anchor a camera pod inside the aircraft that could extend out of the aircraft once the door was open. Once the functional evaluation is completed, the SASEB committee could determine whether to proceed to a field evaluation.

8.0 VENTILATION

8.1 OBJECTIVE

To demonstrate that with the utility door open, the maximum Carbon Monoxide (CO) concentration specified by FAR 23 is not exceeded.

8.2 APPLICABLE AIRWORTHINESS STANDARDS

FAR 23.831(a) Amdt. 23-42

8.3 TEST PROCEDURES

For each of the test conditions listed below a handheld Carbon Monoxide detector was used to record the maximum values observed in the vicinity of the utility door and the forward, mid, and aft cabin.

With the aircraft trimmed for level flight [8.4(c)], CO measurements were recorded with half of the cabin gaspers open and then again with all gaspers closed during level flight. Gaspers fully closed was determined to be the critical configuration and all subsequent readings were taken in this configuration.

Following the initial series at level flight, measurements were recorded for each of the remaining test conditions [8.4(a), 8.4(b), 8.4(c)]. Each test condition was repeated with the ECS firewall shutoff valve in the shutoff (CLOSED) position. Note that operation of the ECS firewall shutoff valve opens a ram air scoop on the right fuselage underside which introduces ambient ventilation air through the distribution system [Ref AFM 02211 pg 7-81].

8.4 TEST CONDITIONS

TEST	WEIGHT	CG	GEAR	FLAPS	DOOR	V_{TRIM}	ALT	PWR
8.4(a)	OPT	OPT	UP	0°	OPEN	120 KIAS	10000	MCP
8.4(b)	OPT	OPT	UP	0°	OPEN	120 KIAS	10000	.75MCP
8.4(c)	OPT	OPT	UP	0°	OPEN	120 KIAS	8000	PLF
8.4(d)	OPT	OPT	UP	0°	OPEN	120 KIAS	7000	FIP

8.5 TEST RESULTS

Carbon Monoxide (CO) concentration was measured for each test condition identified in Subsection 8.4. The CO meter accuracy is the greater of 3% or 2 PPM (±2 PPM at readings below approximate 66 PPM). Tests results, corrected for instrument error are presented in Table 8.5-1.

In addition to the test conditions prescribed in Subsection 8.4, CO concentration was monitored throughout the flight test program. Although CO concentration levels were all within the maximum 50 PPM specified by FAR 23.831(a), the smell of exhaust gas was noted occasionally with the utility door open. This was most prevalent during a static engine run and for tests where FIP was selected.

	FLIGHT E550-F001 (17 OCT 06)							
	8.4(a) – CLIMB 37 PSI (MCP)		**8.4(b) - CRUISE**[1] 27.8 PSI (75%MCP)		**8.4(c) – CRUISE** PLF		**8.4(d) – GLIDE** FIP	
ECS SOV	OPEN	CLOSED	OPEN	CLOSED	OPEN	CLOSED	OPEN	CLOSED
GASPERS	CLOSED	CLOSED	CLOSED	CLOSED	½ OPEN	CLOSED	CLOSED	CLOSED
Forward	2 PPM	2 PPM	2 PPM	2 PPM	2 PPM	2 PPM	2 PPM	0 PPM
Center	2 PPM	2 PPM	2 PPM	2 PPM	2 PPM	2 PPM	7 PPM	7 PPM
Aft	2 PPM	2 PPM	2 PPM	2 PPM	2 PPM	2 PPM	13 PPM	10 PPM
Utility Door	2 PPM	2 PPM	2 PPM	2 PPM	8 PPM	2 PPM	13 PPM	26 PPM

Table 8.5-1
CO Concentration Test Results

8.6 CONCLUSION

The above test results have demonstrated compliance with FAR 23.831(a) with the Utility Door open. The cabin and cockpit areas were measured to be suitably ventilated and free of harmful concentrations of Carbon Monoxide. Also for those conditions when exhaust gases were noticed, in either the crew compartment or the cockpit area, precautionary information will be included in the AFM Supplement.