

CEN131A563, ABORTED TAKE-OFF, MSN 1253

1 SUMMARY

On 12th September, the pilot of PC-12/47E, MSN 1253, aborted the take-off shortly after lift-off, due to a perceived stagnation in rise of speed after lift-off, see Appendix A. The pilot also reported several stickshaker / stickpusher activations.

The NTSB assigned case no. CEN131A563 to the event.

The analysis is based on CVFDR and ACMS data received from the operator. It shows that power was reduced to idle shortly after lift-off. Shaker activations occurred only afterwards. No pusher activations were recorded.

The ACMS files show an engine exceedance about 20 minutes prior to the take-off event. For this reason, the engine start and the pre-flight stickpusher test were also analysed.

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3 INVESTIGATION

3.1 GENERAL

For the analysis of the event flight, CVFDR and ACMS data was available and was used in the following analyses as appropriate.

3.1.1 ACMS data

Significant changes in the status of the aircraft are logged as events. An engine start (e.g. starter engagement) is such an event. An exceedance event is logged when certain limits are exceeded. In the case analyzed, the ITT exceeded 870°C at 20:18:45.

3.1.2 CVFDR signal sources

The CVFDR records a large number of parameters, some of which are self-explanatory and others not. For the analysis of this case, signals indicating the position of the Power Control Lever (PCL) and the Condition Lever (CL) were used in addition to engine and aircraft parameters.

The “PCL idle” signal is generated by a microswitch that is activated when the PCL is close to the idle stop. Its main function is to provide the stickpusher computer with the “engine at idle” signal.

The condition lever (CL) located to the right of the power control lever (PCL) has three distinct positions. Please refer to the AFM for a detailed explanation.

When the condition lever is moved aft from the “ground idle” position towards the cut-off/feather position, it first activates the two propeller feather micro-switches. The status of these switches is recorded in the FDR but will not be used in this analysis. When the condition lever is pulled further aft, the “boost pump/ ignition” microswitch is activated. This signal is recorded as “condition lever cut-off” signal and will be used for the analysis. However, it is important to understand that the condition lever must be pulled further aft into the detent position to shut-off the fuel to the engine. Therefore, presence of the “CL cut-off” signal cannot be used as indication for fuel cut-off. Instead, the fuel flow signal must be consulted.

3.2 ENGINE START EVENT

The CVFDR data shows that the aircraft had been powered from 19:28:44 to 19:33:41, apparently to recharge the batteries with ground power. It was then powered up again at 20:15:24 and the start sequence was initiated at 20:16:16.

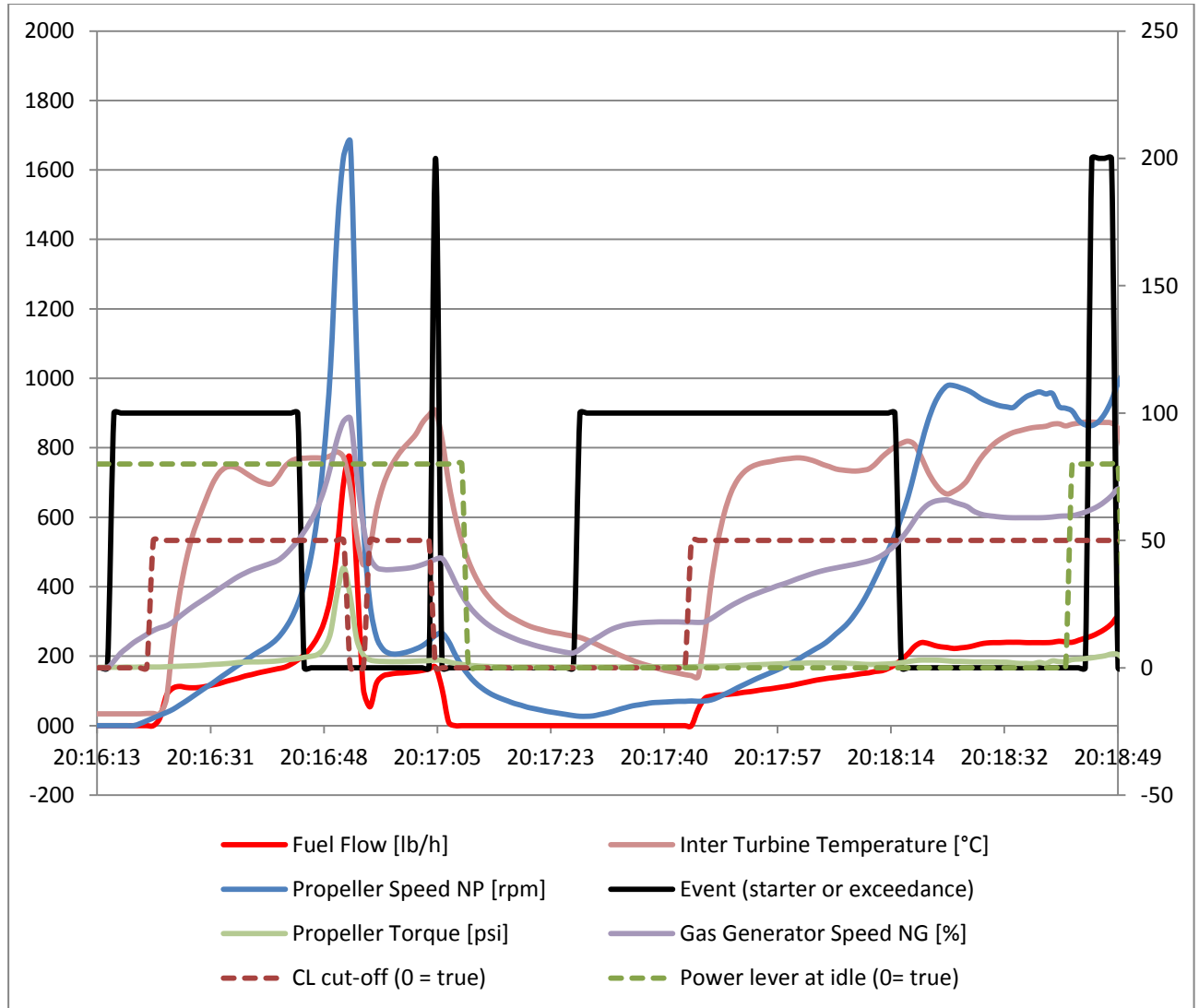


Figure 1 Engine start event

3.2.1 Analysis

At 20:16:16 the starter is engaged. Ng rises and at 20:16:22 with an Ng of 15%, the condition lever is put out of cut-off as indicated by the change of status (brown dashed line). ITT starts to rise indicating that the engine had ignited. At 20:16:45, the start cycle is finished at an Ng of 50% (see black line dropping to 0). During the entire event, the PCL is not at the idle stop as indicated by the green dashed line. How far forward from idle it was cannot be seen on the data but Ng, FF, Np and torque now rise in one go to nearly full power. The peak in torque and Np is registered at around 20:16:52. At the same time, the CL was pulled back far enough to activate the propeller feather switch (as indicated by the sharp drop in propeller speed) and the cut-off signal but not enough to shut the fuel off (see red FF line). After three seconds, the cut-off signal changes state again indicating that the CL had moved slightly forward. The propeller remains in feather as indicated by the low propeller speed. Only at 20:17:05, the CL was brought fully back as indicated by the fuel flow which now goes to zero. However, ITT had briefly exceeded the 870° and an exceedance was

logged (see black line). The power-lever was brought back to idle 5 seconds later, at 20:17:10. At 20:17:27, the engine is restarted and iaw the AFM, the ITT was allowed to drop to approx. 140°C before the CL was brought out of cut-off. At the end of the start cycle, ITT is at approx. 800°C before dropping to 670°C. Now it is however rising again and exceeds 870°C for 6 seconds after 20:18:43. An exceedance is logged once more.

Note: No determination has been made why the ITT exceeded 870° for 6 seconds and peaked at 874°C.

3.2.2 Interpretation

The pilot mentions in the second report (Appendix B), that the power lever may have been pushed forward inadvertently by the passenger which then caused the engine to accelerate to nearly full power. FDR data confirms that the PCL was not at the idle detent during the first engine start but it also shows that the PCL was not at idle since the aircraft was powered up, see Fig. 2 below. The data also shows that initially the pilot had not fully retarded the condition lever when attempting to shut-down the engine. Although the propeller went into feather, fuel flow was still present. Since the Ng had already dropped to 40%, the engine wasn't accelerating and ITT rose rapidly. Only in the second attempt, the condition lever was brought back into the cut-off detent and fuel was shut-off.

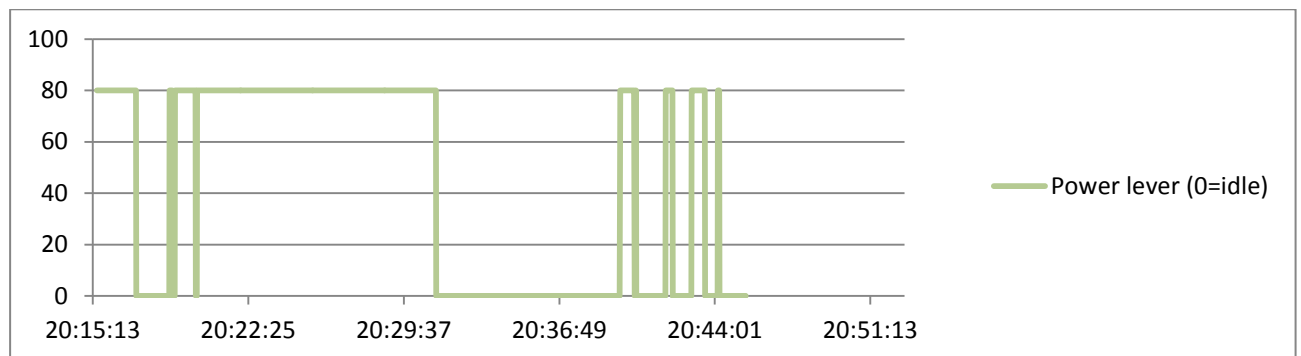


Figure 2 PCL position

3.3 TAKE-OFF EVENT

At 20:39:37, the power lever is brought forward as shown by the PCL at idle signal. Ground speed was zero at the beginning of the take-off run but the recorded airspeed indicates a headwind component of approx. 15 knots. The flaps were set to 15°.

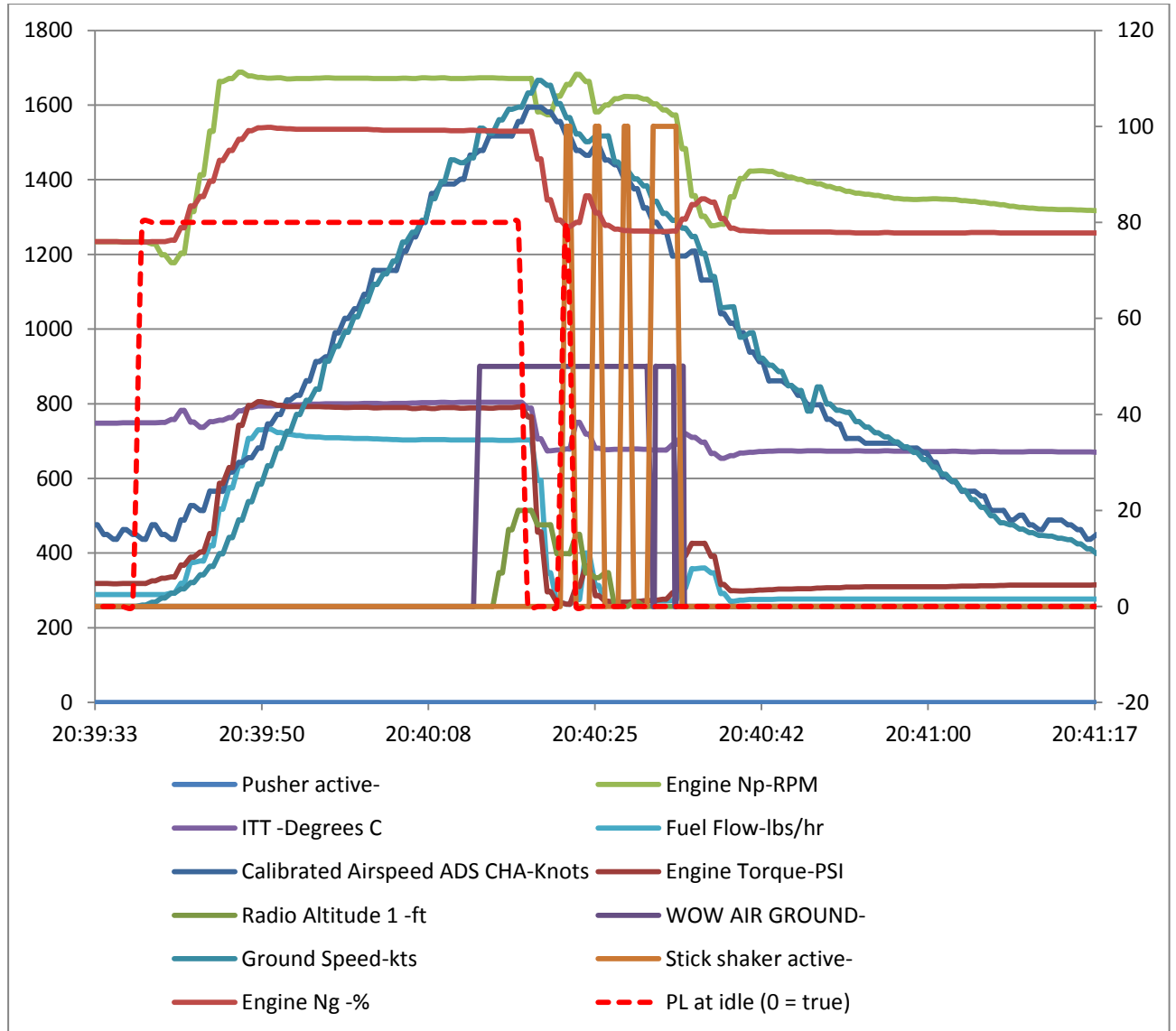


Figure 3 Take-off event

3.3.1 Analysis

The power lever is brought out of idle at 20:39:37. The engine reaches full power of approx. 42 psi 12 seconds after power application, airspeed has reached 31 KCAS. Lift-off as indicated by the WOW air-ground signal occurs at 20:40:13 at an airspeed of 95 KCAS. At 20:40:18, at 104 KCAS and 20 ft radar altitude, the power lever is pulled back to idle, power starts to drop and is 3 seconds later at idle. Airspeed has dropped to 98 knots and the stickshaker activates for 1 second. Data shows now a brief power application to 8 psi before it goes back to idle and remains there. The shaker activates three more times, the last time while the aircraft is already on the ground. No stickpusher activation is recorded. After the aircraft has finally settled on the runway, a 3 second power increase up to 13 psi torque can be seen which is considered to be reverse power application. After that, the engine stabilizes at approx. 4 psi torque and a fuel flow of approx. 280 pph corresponding to flight idle.

3.4 MISCELLENEOUS ANALYSES

3.4.1 Stickpusher test

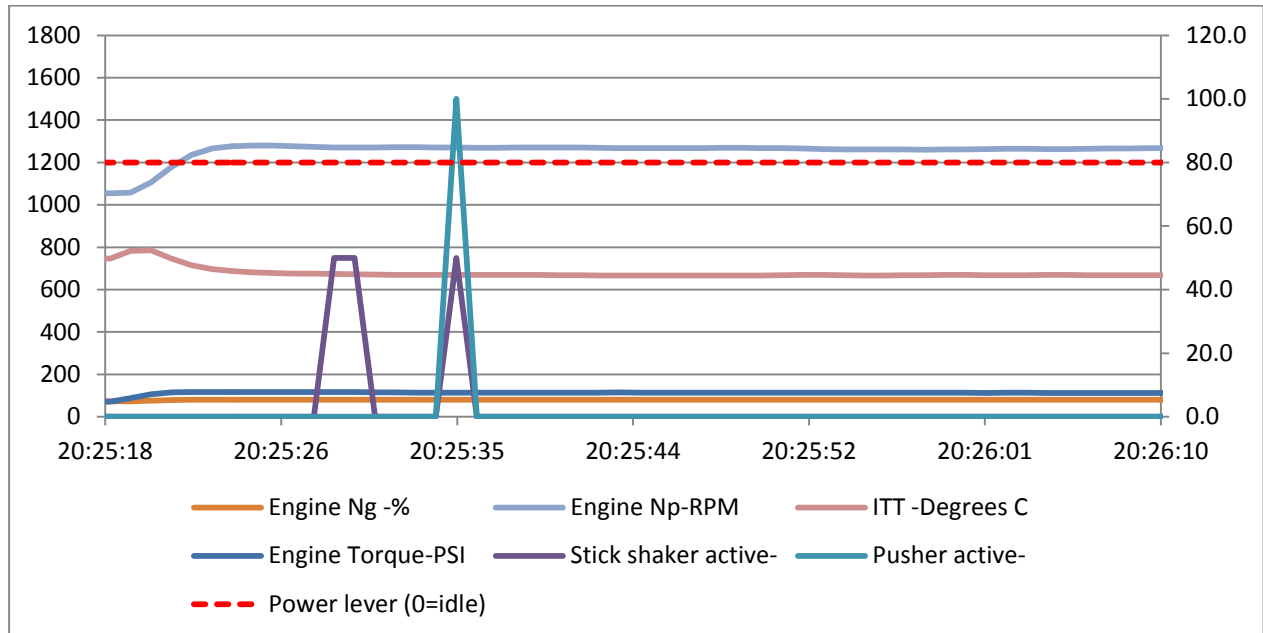


Figure 4 Shaker and Pusher activations

The above figure shows the time when the stickpusher check was done. At 20:25:18 power was increased to 7.8 psi (5 to 10 per AFM) and then the pusher test was started. From 20:25:28 to 20:25:31, the shaker activates and a few seconds later, the shaker and the pusher activate. No further pusher activities can be seen on the data.

It is noteworthy that the power lever was not in the idle position before the test nor was it brought back to idle after the initiation of the test as instructed in the AFM.

4 CONCLUSIONS

The ACMS and FDR data analysis did not identify any aircraft malfunctions or inconsistencies that would explain why the take-off was aborted shortly after lift-off. It shows that the power lever was retarded to idle prior to any shaker activities. The analysis of the engine start sequence is indicative of an operation outside the procedures given in the AFM.

5 REFERENCES

[1]FAA ASIAs report, 17th September

[2]AMM 12-B-76-10-01-00A-903A-A

[3]PWC Accident/incident notification 19th September 2013

6 APPENDICES

6.1 APPENDIX A, PILOT REPORT, EMAIL 21.9.2013

INCIDENT REPORT

ABORTED TAKEOFF

12 Sep 2013

Approximately 1540 local

AUS - Runway 17L. ATIS TEMP: 33C

Taxi for takeoff to Runway 17L was normal and unencumbered. Checklists were complete to LINE UP CHECK.

After I was cleared for takeoff power application, instrument check, and acceleration appeared to be normal. At rotation speed I smoothly and steadily rotated to establish a positive rate of climb to V_x (120 knots).

As the aircraft accelerated to 95 knots the airspeed stagnated and a positive rate of climb was not possible. Simultaneously, at 95 knots, the aural STALL WARNING activated accompanied by the STICK SHAKER. This was immediately followed by the STICK PUSHER violently pitching the nose down at the runway. I was able to override the STICK PUSHER to avoid a nose wheel impact on the runway.

When I leveled the aircraft at about 20 - 30 feet AGL, the unaccelerated airspeed was still in the 95 knot range and again the aural STALL WARNING and STICK SHAKER activated. This again was followed by an immediate and violent nose pitch down caused by the STICK PUSHER. I repeated a recovery to level flight and avoided runway contact.

The scenario repeated itself once again and the airspeed continued to appear to be stagnant. Again at about 95 knots the aural STALL WARNING and STICK SHAKER activated which was immediately followed by a STICK PUSHER violent downward pitch. Again I recovered from the unusual attitude and avoided runway contact.

After this recovery I was able to establish wings level and aborted the takeoff. I was able to settle the aircraft on the mains in a normal landing attitude. I did not perceive a hard landing.

Because I had flown over a considerable amount of runway distance, after safely touching down, I applied what I believe was normal to moderate braking. I would not classify the braking as heavy in nature.

I estimate the entire flying portion of the incident, from initial rotation to touchdown, took place in about 20 seconds.

I subsequently exited the runway and taxied to the Signature ramp where the aircraft was secured by chocks. The passengers deplaned and I escorted them into the terminal. Upon my return to the aircraft I observed that the right main tire had deflated.

There were no injuries to the passengers.

END REPORT

R.A. GALARZA, PIC

6.2 APPENDIX B, AMENDED PILOT REPORT, EMAIL PILBAL 24.9.2013

Subject: N617BG Start sequence

12 September 2013

START SEQUENCE

Checklists complete to ENGINE STARTING checklist.

1. Rotating Beacon ON
2. Cleared the prop area.
3. CAS window - no red, cyan or white indications.
4. Batteries 1 & 2 had good volts (>24 VDC)
5. Starter switch - pushed momentary
 - a. Moved left hand to near STARTER INTERRUPT switch (as I was taught)
 - b. Right hand was placed on the CONDITION LEVER
 - c. Oil pressure - check rising
 - d. NG - checked for 13%
6. At 13% the CONDITION LEVER was moved to GROUND IDLE detent.
7. The ITT started rising rapidly and I moved the CONDITION LEVER back to the CUT OFF detent and pushed the STARTER INTERRUPT switch as a precaution since I did not know what had caused the rapid ITT rise.
8. I was able to shut down the engine as the ITT rose above 850C but before the ITT rose to 1000C to avoid a hot start. According to the engine start limitations a hot start is defined in Section 4, page 4-13. It states "ITT 1000C limited to 5 seconds. 850C-870C limited to 20 seconds." It is my observation that this was not a hot start by definition.
9. After I evaluated the start anomaly I saw the PCL that I had previously placed in the idle position had been bumped so that it was off the IDLE DETENT. I surmised that my right seat passenger in adjusting his seat and seat belts must have inadvertently bumped the PCL while I was looking upward to the start panel to engage to start switch and before I placed my right hand on the condition lever.
10. After a cooling time I ran the ENGINE STARTING checklist procedure once again. This time I motored the engine until the ITT was below 150C before I introduced fuel via the CONDITION LEVER.
11. The second start was normal with the NG stable above 50%, engine instruments in the green range and generator volts and amps good on both generators.
12. By all accounts the engine was operating normally after this start.