FUNCTIONAL FLIGHT CHECKS

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Surprises After Maintenance

The first sign of trouble that the pilot detected was an abnormal sense of tiredness. The Pilatus PC-12 aircraft was in a climb to FL240 after he and his co-pilot had picked it up at the manufacturer's facilities in central Switzerland where it had undergone a scheduled annual inspection. The crew noted that the cabin altitude was at 15,000 feet and climbing and that the differential pressure was abnormally low. The pilot stopped the climb, immediately ordered the oxygen masks to be donned and diverted to Geneva, Switzerland.

Maintenance engineers performed various ground checks to determine the cause of the fault in the pressurization system. Several components were replaced. Further ground tests were completed satisfactorily and the aircraft was returned to service.

The same crew picked up the aircraft again. When passing 5,000 feet in the climb the crew noted that pressurization was not taking place and returned to the airport immediately. Further investigation by maintenance personnel found that the bleed air line from the engine to the pressurization system was not properly connected. After this condition was rectified the aircraft was released to service and returned to Spain without further incident.

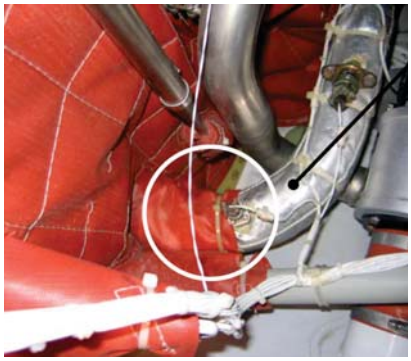
FAILURE
Ground checks failed to detect that the bleed air line on a PC-12 was not connected properly. PC-12 cabin air supply hose (right).

As a matter of policy, the PC-12 AMM does not contain any post-maintenance functional check flight requirement. Aircraft components and systems as well as maintenance activities are designed in such a way that satisfactory completion of the tasks can be determined using ground based tests only. These checks rely heavily on Built-in-Test (BIT) capabilities of the components and systems. Most aircraft manufacturer's maintenance instructions do not require functional post-maintenance check flights anymore. However, in this particular case such a check flight would have detected the fault in the pressurization system.

Functional Check Flights

All pilots know that after maintenance some functional problems may occur. It is therefore important to be particularly alert. Such "test flights" need to be given particular attention. Experience shows that the first flight after (heavy) maintenance bears a higher risk of some malfunction. There are numerous stories of inverted flight control cables.

In one recent instance the crew of an A320 almost lost control just after take-off due to inverted aileron deflection, after the wiring of the commander's side-stick had been inverted and was not detected by the maintenance engineers, the flight crew doing the pre-flight checks on ground or the



computers. Only the co-pilot's side-stick was correctly wired and he successfully took control after lift-off.

"Functional check flights" encompass various types of check flights: post-maintenance check flights to verify proper performance of maintenance, customer acceptance flights, end-of-lease flights prior to handover of an aircraft etc.

Special attention is required from flight crews during the first flight after maintenance even if the certificate of release to service certifies that all aircraft systems are fully and normally operative.

Today there are no EASA regulations which specify the training requirements for flight crews who perform functional check flights. Some NAAs have published guidance material on this subject and EASA has recently identified a need for regulatory requirements for check flights.

In the proposed regulation –which comes into force in 2012 - a distinction is made between four types of "flight

testing". Three categories involve experimental, engineering and production test flying, i.e. what is conventionally understood to be performed by "test pilots".

However, in the current version of the future regulation, functional check flying will fall in the fourth category, for which no specific crew training requirements are defined. Operators are left to determine which pilots are capable of performing the check flights. And, in the absence of clear guidelines and instructions from the manufacturer, they are also left to define the check programs themselves.

Manufacturers cannot be required to define check programs to be performed in flight if there is no control over the flying skills that can be presumed to be available in the crew that performs the flights. Testing systems, particularly emergency and protection systems, require the aircraft to be operated at or near the limits of its envelope. Such flights involve more risk, which needs to be identified and controlled.

Functional Check Flights Improperly Executed

An Airbus A320 crashed near Perpignan, France, in 2008 while performing low-speed checks at low altitude). The leasing contract required a check flight at the time of re-delivery from the lessee. A few days prior to the accident flight, the aircraft was washed without the required protectors being installed on the angle-of-attack sensors. Water entered the sensors and eventually froze, seizing two of the three sensors almost simultaneously and in the same position. The check plan was developed by an airline based on a manual used by Airbus for customer acceptance flights, which are performed by flight test pilots.

The investigation by the French BEA found that the crew adapted the check program in an improvised manner, according to the constraints of the flight plan and ATC. Specifically, the "crew decided, without preparation, and in particular without a call-out of the theoretical minimum speeds, to undertake the check of the low speed protections at an altitude of 4,000 feet" according to the BEA report.

The crew waited for the triggering of the stall protection devices, which did not trigger properly due to the frozen angle of attack (AOA) sensors, and allowed the speed to decrease to below stall speed. Several triggers and indications would have been available to identify the dangerous condition, but there was neither the time nor the mental preparedness to properly identify the indications and take appropriate action. The crew lost control of the aircraft and all occupants perished when the aircraft impacted the sea.

Functional check flights are an unregulated area in operations. They may be specifically required by manufacturer's maintenance programs following certain types of maintenance to ensure that "everything was put back together" properly, or they are performed by owners/operators on a voluntary basis to make sure aircraft are ready for service in order to reduce the probability of operational irregularities.

Given the very specific risks of functional check flights, utmost care must be taken to prepare for such flights. In a commercial operational environment, functional check flights are normally the domain of a technical pilot who is generally a pilot of higher seniority or education. Airlines may even designate dedicated check flight managers.

Proper Planning and Preparation

Functional check flights are not regulated yet. EASA is considering the introduction of relevant rules. The industry advocates the development of industry standards. Today it is up to each organization to develop its own set of procedures and standards to reduce the risks involved in functional check flights.

Such company actions might include the creation of a check flight cell, Internal Safety Investigations, the creation of a check flight manual, the specification of training and currency requirements and of crew requirements, specific training courses for functional check crews, the authorization of each individual flight by both maintenance and flight operations managers.

Given the evident risks, no professional should perform functional check flights without proper preparation. We have all heard of the 7-Ps: Proper Prior Planning Prevents Painfully Poor Performance. For Functional Check Flights the 7-Ps are even more applicable.

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DEADLY
A poorly executed flight check on an Airbus A320 in 2008 had fatal results. Angle of attack sensor (right).