Improving Nonrevenue Flight Safety

Guidance material and proposed regulations target the risks in nonroutine operations.

BY MARK LACAGNINA

A spate of recent accidents and serious incidents has raised awareness of the increased risk involved in nonrevenue flight operations and has spurred action to address those risks. Nonrevenue flights, also called nonroutine or nonstandard flights, include functional check flights, ferry and positioning flights, and training flights.

In the past decade, about 25 percent of turbine aircraft accidents occurred during nonrevenue flights, according to the U.S. Federal Aviation Administration (FAA). A similar figure emerged from studies performed by a Flight Safety Foundation task force that examined approach and landing accident data in the late 1990s. The safety specialists found that although non-passenger-carrying flights represented only about 5 percent of the flights conducted by commercial operators, they accounted for 25 percent of the 287 fatal approach and landing accidents that occurred from 1980 to 1996.

In February, a symposium organized by the Foundation to examine functional check flight

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The pilots were unable to restart the engines on this regional jet after stalling the airplane at its maximum altitude during a positioning flight in October 2004.

safety drew 275 safety specialists from 41 countries (*ASW*, 3/11, p. 14). The consensus was that safety can be improved if operators adopt best practices in personnel selection and training, and in organizing their check flight efforts; if regulators consider sensible, well-defined regulations developed in conjunction with the industry; and if manufacturers provide more information to operators on training and procedures, said Jim Burin, the Foundation's director of technical programs.

Action is being taken on all fronts. Many operators are gleaning best practices from a variety of guidance material published by civil aviation authorities. The European Aviation Safety Agency (EASA) currently is poring over public comments on proposals to establish minimum qualifications for pilots and flight test engineers, as well as operational requirements, and hopes to complete the rule making next year. Airbus has introduced a Technical Flight Familiarization Course that is offered monthly at its training centers, and Boeing has posted generic flight test profiles for several models on its customer website.

Helpful Handbook

Among the leading sources of operational information on functional check flights is the *CAA Check Flight Handbook*, originally issued by the U.K. Civil Aviation Authority's Aircraft Certification Department in 2008. Issue 2.2 of the 90-page document was current at press time.

U.K. operators must coordinate required check flights with the CAA. Among other things, the CAA determines whether the pilot-in-command (PIC) is eligible to conduct the proposed check flight. This requires a briefing and, possibly, a flight with a CAA test pilot.

Although much of the content of the *CAA Check Flight Handbook* is specific to functional check flights conducted by operators of U.K.-registered aircraft according to "schedules" created or approved by the CAA, any operator likely will find the basic guidance useful.

Preparation is the key to risk management, the handbook says. "The nonroutine nature and requirements of a check flight require careful review and forethought, particularly when the check is to be carried out by pilots more familiar with routine line operations rather than by qualified test pilots. … It is important to decide at the briefing stage who is going to do what."

Only the minimum required flight crew, plus a flight test engineer or observer to record the test results, should be aboard the aircraft, the handbook says. "Should any member of the crew be unhappy with any of the checks being performed or planned, they must say so, and the matter must be resolved before continuing."

While the handbook provides detailed general guidelines for checking and recording handling, performance and systems characteristics — and for recovering from inadvertent stalls and overspeeds — the schedules provide type-specific information and forms for recording test results. For example, the schedule for the Boeing 737-500 includes a table of trim, stick-shaker-activation and stall speeds at various airplane weights and configurations. It stresses that airspeed should not be reduced beyond 4 kt below the expected stick-shaker-activation speed and that recovery should be initiated immediately if the stick shaker activates or pre-stall buffeting is encountered.

The handbook, as well as schedules for most aircraft with maximum takeoff weights above 5,700 kg/12,500 lb, are available on the CAA website <caa.co.uk>. Generic schedules for smaller aircraft also are available.

Maintenance Coordination

A serious incident involving a 737 in 2009 (Table 1, p. 24) prompted the U.K. CAA to follow up with an "airworthiness communication" — AIRCOM 2009-03, "Ensuring Satisfactory Coordination Between Operators and Maintenance Organizations for Maintenance Check Flights."

"Prior to any maintenance check flight, a full pre-brief must be conducted between engineering and operations, during which the flight crew must be made aware of the specific reasons for the check flight," the AIRCOM says. "In particular, specific note must be made of any maintenance tasks that have a direct effect on the control of the aircraft's attitude or the propulsive efficiency of the aircraft."

Red Flags

In the United States, nonrevenue flight risks were highlighted by fatal accidents involving a Douglas DC-8 in 1996 and a Bombardier CRJ200 in 2004 (Table 1). Based on its investigation of the DC-8 accident, the U.S. National Transportation Safety Board (NTSB) called on the FAA to introduce operating limitations and training requirements for nonroutine flights in Federal Aviation Regulations Part 121, which governs air carrier operations.

Because many nonroutine flights are conducted under the general operating and flight rules of Part 91, however, the FAA elected instead to amend the guidance for operations and airworthiness inspectors in FAA Order 8900.1, the *Flight Standards Information Management System* — an action accepted by NTSB. Among the new requirements is that company maintenance manuals must specify maintenance tasks requiring flight checks, as well as procedures for conducting the checks.

The FAA also published an "information for operators" bulletin — InFO 08032, *Non-Routine Flight Operations* — in May 2008. Among other things,

Nonrevenue Flight Accidents and Serious Incidents

Date	Location	Aircraft Type	Aircraft Damage	Injuries
Dec. 22, 1996	Narrows, Virginia, U.S.	Douglas DC-8-63F	destroyed	6 fatal
Following major modifications and an extensive maintenance check, the Airborne Express freighter was undergoing a functional check flight at night with three flight crewmembers and three maintenance technicians aboard. The U.S. National Transportation Safety Board (NTSB) said that airframe icing and/or control misrigging might have triggered a premature stall during a check of the stick shaker at 13,500 ft, just above a cloud deck. The crew applied full power, but the pilot flying held aft control pressure, prolonging the stall as the airplane descended rapidly and struck a mountain. The pilots previously had experienced DC-8 stalls only in a simulator that did not replicate the pronounced stall break characteristic of the airplane. (NTSB report AAR-97/05; *Accident Prevention,* 9/97)				
Oct. 14, 2004	Jefferson City, Missouri, U.S.	Bombardier CRJ200	destroyed	2 fatal
The captain told a controller that they had "decided to have a little fun" and climb to the airplane's maximum altitude, Flight Level (FL) 410, during a night positioning flight for Pinnacle Airlines. The CRJ was in a very low energy state when it reached that altitude, and the first officer kept increasing angle-of-attack in an attempt to keep it there. Both engines flamed out when the airplane finally stalled. The pilots regained control at FL 340 but were unable to relight either engine due to procedural nonadherence and possibly because of engine core lock. The CRJ crashed in a residential area 2.5 mi (4.0 km) from the emergency airport that the crew was trying to reach. NTSB said that the accident was caused in part by the pilots' "unprofessional behavior, deviation from standard operating procedures and poor airmanship." (NTSB report AAR-07/01; *ASW*, 7/06, p. 44)				
Nov. 27, 2008	Perpignan, France	Airbus A320-232	destroyed	7 fatal
The A320, leased by XL Airways, was undergoing functional checks required before its return to Air New Zealand. The French Bureau d'Enquêtes et d'Analyses (BEA) said that the flight crew was unaware that rinse water had accumulated and frozen inside the angle-of-attack sensors. The airplane stalled during low-speed checks conducted at a lower-than-authorized altitude and descended into the Mediterranean Sea. BEA said that among the factors contributing to the accident was the flight crew's lack of training and experience in performing functional check flights. (BEA report D-LA081127; *ASW*, 11/10, p. 22)				
Jan. 12, 2009	Norwich, Norfolk, England	Boeing 737-700	none	4 none
Observers from the aircraft owner and the airline due to take delivery from easyJet of the 737 were aboard for an end-of-lease functional check flight. The U.K. Air Accidents Investigation Branch (AAIB) said that the elevator balance tab had been readjusted improperly, and when the flight crew isolated hydraulic power from the flight controls for a manual reversion check, the aircraft pitched nose-down and descended out of control from 15,000 ft to 5,600 ft, reaching 429 kt and 20,000 fpm. The AAIB found that the crew did not use the aircraft maintenance manual test procedure, which requires that rudder boost be maintained during a manual reversion check. (AAIB Bulletin 9/2010)				
Nov. 11, 2009	Kent, England	Dassault Falcon 2000	substantial	6 none
Although not trained to conduct functional check flights, the flight crew was asked to perform "high-speed taxi tests" following maintenance to correct a tendency of the Falcon to pull left when the wheel brakes were applied. A flight attendant and three maintenance personnel were aboard the NetJets Europe airplane when the crew performed eight accelerate-stop tests within about 15 minutes, causing the brake assemblies to overheat severely and ignite hydraulic fluid released under high pressure from melted seals on the left main landing gear. (AAIB Bulletin 12/2010; *ASW*, 2/11, p. 57)				

Table 1

the five-page bulletin reviews and expands upon regulations related to nonroutine flight operations. Of particular note is its extension of Part 91.3, which covers PIC responsibilities, and Part 91.103, which covers preflight duties, to mean that the PIC of a nonroutine flight must be familiar with anything done to the aircraft that might affect its operation and to cancel or discontinue the flight if he or she determines that safety would be compromised.

The bulletin notes that the preparation for a nonroutine flight operation might be more extensive than the actual flight. It also says that air carrier manuals should include policies and procedures for authorizing and conducting nonroutine flight operations, as well as requirements for flight crew qualification and training.

Noncompliance With SOPs

The "willful misconduct" found by NTSB in its investigation of the CRJ crash was among the factors that led to the publication of a "safety alert for operators" — SAFO 08024, *Review of Flight Data Recorder Data from Non-revenue Flights* — in December 2008.

Noting that noncompliance with standard operating procedures (SOPs) and/or aircraft performance limitations is a common factor in accidents during maintenance ferry flights and repositioning flights, the bulletin encourages air carriers to review flight data recorded during nonrevenue flights.

"If FDR [flight data recorder] analysis indicates a potential trend of SOP noncompliance during such flights, that information should be communicated to appropriate airline management personnel for action to mitigate associated risks," the SAFO says. "If FDR data indicates noncompliance on the part of an individual crew, it is recommended that the information be communicated to the chief pilot and, if applicable, to the professional standards group in the labor association, for the purposes of crew contact discussion, counseling and safety education."

Another useful FAA document is Advisory Circular 25-7A, *Flight Test Guide for Certification of Transport Category Airplanes*. The 459-page circular is intended primarily for personnel at companies seeking certification of transport category airplanes. The most useful information for those conducting nonrevenue flights might be the clarifications and explanations of Part 25 airworthiness standards, and the detailed technical guidance on how to demonstrate compliance with the standards.

'We Need to Do Something'

During the Foundation's symposium in February, Didier Nicolle, chairman of the EASA flight test group, pointed to the fatal A320 accident at Perpignan, France, and the 737 and the Falcon 2000 incidents (Table 1) in saying, "We need to do something."

That *something* is a package of proposed regulations that would affect "flight testing" operations. EASA has grouped these operations in four categories, loosely defined as "experimental flight test," "engineering flight test," "production flight test" and "less-demanding test flights" that do not fit the first three categories.

The notices of proposed amendment — NPA 2008-17 and NPA 2008-20 — would establish minimum qualifications for pilots and flight test engineers based on the types of aircraft involved in the tests, and require operators to have an approved flight test operations manual.

EASA has proposed that the manual include formal hazard assessment methods; crew qualification and training requirements, and their responsibilities during test flights; a policy for carrying personnel beyond the minimum crew requirements; specifications for flight test instruments and safety equipment; and weather minimums.

The agency said that best practices assembled by the EASA Flight Test Safety Committee, available at <flighttestsafety.org>, could be used by operators to develop a flight test operations manual.

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