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Disagreements About Deicing, Post-deicing Inspection Contribute to Serious Incident

Citing inadequate procedures for contracting airport ground services, the Italian Air Safety Board said that the flight crew of a Fokker 70 did not recognize that the wings were cold-soaked, suspect formation of clear ice or inspect the upper-wing surface before takeoff.

FSF Editorial Staff

Ingestion of clear ice — which had not been removed from upper-wing surfaces during deicing by an airline contractor — led to failure of the right engine and high fan vibration in the left engine during takeoff of a Fokker F-28 Mk 70 (Fokker 70), prompting the flight crew to conduct an emergency landing at the departure airport.

No injuries or fatalities occurred to the four crewmembers or 30 passengers during the serious incident involving KLM Cityhopper Flight 1636 at Caselle Airport, Turin, Italy, on Feb. 16, 2002, at 0650 local time, said the final report of the Agenzia Nazionale per la Sicurezza del Volo (Italian Air Safety Board, [ANSV]). Aircraft damage comprised pits/scratches on fuselage skin, windows and the right wing; bent leading-edge tips on five fan blades in the left engine; and damage to the right engine, including fractured fan blades, damaged leading-edge tips of fan blades, a cracked accessory gearbox, a cracked hydraulic-pump housing and various detached/loosened components of the engine, cowling and cowling doors.

The aircraft, typically used to conduct several scheduled flights per day between Turin and Amsterdam, Netherlands, had been parked for about 9.5 hours after its last flight of the day preceding the incident flight. The quantity of fuel remaining from the previous day was adequate for flight to Amsterdam, and the aircraft was not refueled in Turin.

"Based upon the amount of fuel in the wing tanks, en route temperatures during flight, the weather conditions upon arrival at Turin and during the night, the captain's observations during the preflight inspection the following day, the Rolls-Royce technical report, and the description of the pieces of ice collected from the runway, it is concluded that a thick layer of (clear) ice formed on both wings of the aircraft while it was on the ground in Turin," the report said.

During preflight inspection with a flashlight in darkness and rain, the captain from ground level saw ridges of ice under the leading edges of the wings, slushy water and ice in small areas on top of the wing, and slush on the trailing edge of the left wing.

"During the preflight inspection, the captain decided that the aircraft needed to be deiced," the report said. "He did not specifically ask [Società Azionaria Gestione Aeroporto di Torino (SAGAT) Handling] for an anti-ice treatment, as he did not consider that icing conditions existed at that time. No fan-ice check was performed."

The deicing-truck operator completed spraying the aircraft with 413 liters (109 gallons) of Kilfrost ABC 3, Type II, 50-percent deicing fluid by 0610. The fluid temperature was 65 degrees Celsius (C, 149 degrees Fahrenheit [F]), and the report said that investigators could not determine whether the fluid-temperature combination was appropriate for cold-soaked wings in the overnight light rain, snow, wind and air temperatures from 2 degrees to 0 degrees C, (36 degrees to 32 degrees F).

"According to the deicing[-truck] operator, he deiced the upper side of the wings as normally required, and on request of the captain he deiced the underside of the wings and the horizontal

stabilizer," the report said. "The captain did not specify any specific type or mixture of deicing fluid to be used. The deicing truck operator stated that he requested the pilot 'to control the result' of the deicing, to which, he also stated, the pilot answered, 'OK good.'… On the basis of his recent deicing experience, the captain decided that he should go outside the aircraft to check the wings. It was not normal procedure for … crew to perform a post-deicing inspection when an inspecting company[1] is mentioned in company publications. … He did a visual check of the undersurface of both wings and noticed that the ridges of ice beneath the wings had now disappeared. He did not touch either of the wings."

Among several pieces of engine debris from the incident aircraft, pieces of clear ice were found on the right side of the runway centerline at the location of the aircraft rotation.

"The pieces of ice were described as appearing like glass, clear and compact and of different areas but with similar thickness of about 1.0 centimeter [0.4 inch]," the report said. "The largest pieces found were approximately 10 centimeters [four inches] by 10 centimeters, of irregular shape and also 1.0 centimeter thick."

During the three months preceding the month of the incident, the airline's flight crews had applied the procedure for "economical tanking" (i.e., fueling at Amsterdam without refueling at Turin for the return flight) for 16 day-return flights and for 66 night-stop flights. This procedure was used for the incident flight.

The report cited the following procedure from the aircraft operations manual: "When the [outside air temperature] during ground stop at the next station is expected to be 10 degrees C or less, no economical tanking should be performed."

Clear ice below a snow/slush layer is difficult to detect, and the undetected ice layer may separate from the wing during the takeoff roll or rotation, possibly causing substantial loss of lift and/or severe engine damage. Although the pilot-in-command has the final responsibility for ensuring removal of frost/ice/snow/slush from wing leading edges and upper surfaces before takeoff, how this was to be accomplished became a focus of the investigation, the report said.

"At stations where no ground engineer [maintenance technician] is available, the deicing/anti-icing handling agent is responsible for the correct and complete deicing/anti-icing treatment of the aircraft," the report said. "At stations where a ground engineer is available, the ground engineer is responsible for the release of the aircraft free of frost, ice, snow or slush. [The ground engineer] is also responsible for the correct and complete deicing/anti-icing treatment of the aircraft.

"After completion of the deicing treatment, the aircraft should be thoroughly checked. These checks should be carried out by the deicing/anti-icing handling agent. … In some cases, the presence of (clear) ice on the upper-wing surface can only be determined by touch. To release the aircraft for the flight, the ground engineer or captain has to be assured that this check has been properly carried out."

According to the airline's regional operations manual, SAGAT Handling would conduct deicing/anti-icing operations and Alitalia would conduct post-deicing inspections, the report said.

"[The airline's aircraft operations manual] said, 'As the Fokker 70 wing is critical for ice buildup, a tactile check is required in certain circumstances,'" the report said. "'These checks may be performed by the flight crew, but normally are performed by a licensed ground engineer, not necessarily Fokker 70/100-licensed. … The tactile check must be done by touching the indicated area by bare (or surgical-glove-protected) fingers to check for ice/frost/snow/slush contamination. For this check, a platform with a minimum height of 1.0 meter [3.3 feet] is needed to reach the area.'"

In contrast with the airline's written procedures for flight crews (in English), the SAGAT Handling written procedures for deicing-truck operators (in Italian) said that airline ground personnel, the aircraft captain or an authorized post-deicing inspection company was responsible for the final check that ice/frost/snow/slush contamination had been removed and for releasing the aircraft for departure.

"The ground-handling contract between SAGAT Handling and [KLM Cityhopper], with regard to the [deicing]/anti-icing procedures, did not conform to the standard IATA [International Air Transport Association] handling-agreement specifications," the report said.

During the investigation, the airline and the two companies listed in airline manuals provided the following contradictory information, the report said:

- "KLM Cityhopper stated that there was a verbal agreement with Alitalia regarding the post-deicing inspection. KLM Cityhopper claimed [that] the agreement was that SAGAT Handling would inform Alitalia when deicing would take place, and that Alitalia would send a ground engineer to inspect the aircraft after deicing was completed;

- "SAGAT Handling stated that there were neither verbal nor written instructions from KLM Cityhopper about this agreement; [and,]

- "[The Alitalia representative said that] Alitalia was not the handling company performing inspection after [deicing]/anti-icing and that there wasn't any related contract with KLM Cityhopper, neither at the time of the audit (January 2001) [at Turin for a group of European airlines][2] nor at the time of the serious incident (February 2002); in 2001 and 2002, Alitalia personnel … in Turin did not have any certification on the Fokker 70; [and] Alitalia personnel were not trained to perform deicing inspection on the Fokker 70."

Communication about rectifying the deicing-audit findings occurred during 2001 between the KLM Cityhopper and SAGAT Handling. Nevertheless, Alitalia was listed as the inspecting company in airline manuals when the incident occurred.

Analysis of organizational contributing factors indicated that the aircraft captain and the deicing-truck operator had different expectations.

"According to the deicing operator, his request to 'control the result' directed to the captain, would have in essence related to the post-deicing inspection," the report said. "The reply from the captain — 'OK good' — may have been interpreted as confirmation of this. The captain, on the other hand, could not recall any … conversation with the operator other than the request to spray the underside of the wings and the tail. The fact that the captain could not recall any part of this conversation with the deicing[-truck] operator could indicate that [the captain] did not comprehend the meaning of the request to 'control the result.' There is no certainty about the actual or intended meaning of the conversation between the captain and the deicing operator; however, it can be concluded that there was a misunderstanding between them regarding the final inspection of the aircraft.

"The captain stated that, according to the regional operations manual, Alitalia ground staff would perform the post-deicing inspection. The captain, however, did not call for any Alitalia operator before deicing, nor did he request any verbal or written report from Alitalia ground staff after the treatment confirming the airworthiness of the aircraft. There were no procedures or instructions from the [airline] company to this effect and as such, the captain could have assumed that Alitalia would have been summoned by SAGAT [Handling]."

To deice an aircraft, however, the deicing-truck operator needs to be aware that clear ice is present and to use the required type and concentration of deicing fluid, fluid temperature and spraying technique, which includes varying cross-sectional area of spray and distance of the nozzle from the surface of the wing, the report said.

Analysis of organizational contributing factors within the airline showed that inappropriate division of responsibility for managing the deicing of all aircraft, ineffective quality assurance and inadequate communication of deicing concerns to the accountable manager (i.e., the airline representative designated for the organizational structure required by Joint Aviation Requirements–Operations 1 [JAR-OPS 1]) were involved.

"In spite of the … JAR-OPS 1 requirements, the responsibilities as described in the KLM Cityhopper basic operations manual prior to the serious incident showed that deicing-operation responsibilities were shared between the manager [of] ground operations [and] the manager [of] flight operations," the report said.

The airline's quality-assurance manager had alerted the manager of ground operations and the manager of flight operations about previous fluid-type discrepancies and the discrepancy about Alitalia performing post-deicing inspections at Turin, and he received a reply that these would be corrected.

"Although the quality-assurance manager noticed several times that [his alerts] did not have the [result] he expected, he took no further action, as he anticipated that the next audit would be sufficient to correct the situation," the report said. "The accountable manager, on the other hand, was aware of deicing problems but [said] that these were so vast in number that it was difficult to decide which one had more importance."

Among the report's findings relevant to contracting for deicing and conducting post-deicing inspections were the following:

- "The [airline] operating company's instructions, procedures and equipment were insufficient for ensuring the discovery and removal of clear ice;
- "According to company deicing [tables] and holdover tables, a minimum of Type II 75-percent fluid was required to be sprayed as a second-step anti-icing treatment for the conditions of rain on cold-soaked wings;
- "The deicing operation carried out before the flight did not remove the (clear) ice from the upper surface of the wings;
- "There was misunderstanding between the captain and the deicing operator regarding the final inspection of the aircraft;
- "There was no (1.0-meter-high) platform readily available at Turin and there were no surgical gloves available either at the handling agent or [aboard] the aircraft;
- "The (clear) ice on the upper surface of the wings was not discovered after the deicing treatment was performed;
- "Information concerning recognition, detection and removal of clear ice in the company … publications was considered insufficient and confusing for ensuring the discovery and removal of clear ice;
- "KLM Cityhopper did not have a contract for an inspecting company in Turin;
- "[The] quality system regarding the deicing process was ineffective. The feedback system did not ensure that necessary corrective actions were both identified and carried out in a timely manner; [and,]
- "The crew was not aware that there was no [deicing]/anti-icing inspecting company available in Turin for KLM Cityhopper."

The following recommendations about contracting for deicing and conducting post-deicing inspections were directed to the airline:

- "Clearly define postholder[3] responsibilities with respect to icing operations and assign an order of priority to these responsibilities;
- "Review and modify all ground-handling contracts to conform to industry-recognized agreement specifications;
- "Review the company's instructions, procedures, training and information reported in the relevant publications (basic operations manual, regional operations manual [and] aircraft operations manual) related to detection and removal of clear ice; [and,]
- "Specify and inform all crew of their responsibilities regarding the execution of the duties that are performed by ground-handling companies."

General recommendations included the following:

- "European [aviation authorities and] international aviation authorities [should] establish international safety standards and procedures for ground-handling companies; [and,]
- "[Ground-]handling companies [in Italy should] publish the operating [deicing]/anti-icing manual (normally published in Italian) also in English."♦

[This article, except where specifically noted, is based on the Italian Agenzia Nazionale per la Sicurezza del Volo Final Report no. I/2/04, *Serious Incident Occurred to Fokker 70, Registration Marks PH-KZH, Torino Caselle Airport, 16th of February 2002*. The 144-page report contains photographs, charts, tables and diagrams.]

Notes

1. The report said, "Although the … aircraft was one-step deiced/anti-iced with Type II/50-percent fluid, it was not the intention of the captain to anti-ice the aircraft. For the purposes of this report, therefore, the deicing/anti-icing of the aircraft will only be referred to as deicing."
2. In 1998, the Deicing/Anti-icing Quality Control Pool (DAQCP) was formed; by early 2004, the pool had 37 European airline members. On Jan. 22, 2001, KLM Cityhopper "on behalf of DAQCP … conducted a deicing audit on SAGAT [Handling] and Alitalia service for maintenance in Turin," the report said.
3. To comply with the organizational requirements of European Joint Aviation Requirements–Operations 1, nominated postholders are functional positions held by individuals — such as "manager flight operations (postholder)" — who report to the accountable manager within an airline (the title assigned to the corresponding individual within the airline may vary).

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