

SAFETY RECOMMENDATION

Reference: REC 01/09

Date: February, 25th, 2009

Background

On 20 August 2008 at 14:24, a McDonnell Douglas DC-9-82 (MD-82), registration EC-HFP, operated by Spanair, was involved in an accident immediately after takeoff at Madrid-Barajas Airport (Spain). The aircraft was destroyed as a consequence of the impact with the ground and the resultant fire. There were 154 fatalities, including the 6 crew members, and 18 seriously injured among the occupants of the airplane.

Prior to takeoff while on the runway threshold, the crew reported a problem with the RAT probe heater and returned to the stand to have it checked by company maintenance personnel. The pilots had noted an overheating of the RAT probe, while on the ground, with the DFDR recording temperatures as high as 104° C.

Once the aircraft returned to the stand, maintenance personnel verified the fault described in the ATLB, checked the Minimum Equipment List under the appropriate section for the Rat probe heating, and proceeded to open the circuit breaker that supplied electrical power to the heater of the probe. Once this was done, it was proposed and accepted that the airplane be dispatched. The information recorded on the DFDR during the subsequent taxi and takeoff run prior to the accident indicated a maximum probe temperature of 30° C.

Upon completion of this action, the aircraft was cleared for takeoff and, once airborne, reached a height of 40 feet above the ground before descending and impacting the terrain. Although the accident investigation has not yet been concluded, all available data show that flaps and slats were not set in takeoff configuration, resulting in the failure of the airplane to climb properly after takeoff. It also shows that the cockpit crew did not receive the automated takeoff configuration warning during the takeoff roll.

The day before, the crews had logged in the aircraft's ATLB two cases of the RAT probe overheating while on the ground. When company maintenance personnel checked for the problem, the fault was not present. They proceeded to conduct other checks on the system but did not detect any anomalies.

Discussion

The RAT temperature probe has a heating system that should be inhibited while the aircraft is on ground. The way the airplane detects that it is in ground or in flight is by means of a switch connected to the nose landing gear that provides a ground signal when the strut is compressed, and a flight signal when it is extended. This ground-flight signal is sent to a set of relays. Each of these relays provides a ground-flight signal to various systems that require it for proper operation. In accordance with the manufacturer's Wiring Diagram Manual (WDM), in the case of the RAT probe heater, its associated relay is R2-5 which, in addition to heating, also supplies information to the TOWS, the radio cooling fan and the AC cross tie. Although no determination has yet been reached as to why the TOWS did not sound and/or whether there was a fault with the R2-5 relay, the investigation has focused on the relationship between the R2-5 relay, the high temperature indication while the airplane was on the ground, and the failure of the TOWS to sound during the takeoff roll.

In page 1 of the chapter on anti-ice systems (30-30-00) of the airplane manufacturer's Aircraft Maintenance Manual (AMM), the section on "PITOT AND STATIC - TROUBLESHOOTING" lists the maintenance actions to take in order to detect the cause of a malfunction in the event of failures involving various heating devices, including temperature probe heating.

In the case of the RAT probe heater, it indicates the maintenance actions to be carried out so as to detect the cause of the fault only for cases in which the heater is not supplying heat to the probe when it should, but it does not specifically state what actions to take when the heater is supplying heat to the probe when it is not supposed to, that is, when the airplane is in ground.

The manufacturer acknowledges that there is no specifically named, dedicated section that addresses detecting the cause of temperature probe heating while on the ground. It does, however, note that there are multiple references in its AMM and in its WDM that show that RAT probe heating should be inhibited while the aircraft is on ground.

As for the Maintenance Manual, Boeing stated that there are several sections within AMM Chapter 30-30-00 that would be useful in detecting the cause of this fault. These sections contain a basic description of the RAT heating system along with electric circuit block diagrams that show the circuit and components, including the connection between the RAT and relay R2-5, and which identify the electrical wires and contact positions of relay R2-5.

Boeing also stated that applying similar reasoning to the contents of the section on "PITOT AND STATIC - TROUBLESHOOTING", intended to detect the cause of a fault in which the heater is not supplying heat to the probe when it should, would help to identify why heat is being supplied when the airplane is on the ground.

So as to gather practical information on the methods operators of this type of airplane use to detect the cause of this fault and its subsequent resolution, the investigation team consulted with various operators of MD airplanes and noted that, in general, there is no single set of

steps taken by maintenance personnel, even within the same operator, and that these steps, in many cases, depend on the maintenance personnel's own experience.

In light of this information, it may be concluded that there is no specifically named section, such as "High RAT Indications on the Ground", in the Maintenance Manual with the sole purpose of detecting the cause of a fault involving heating of the temperature probe while on the ground. It was noted that the information needed to detect said cause was contained in different paragraphs and block diagrams in a chapter in the Maintenance Manual (Chapter 30-30-00), and could be supplemented by the Wiring Diagram, which required additional work by maintenance personnel to interpret this information so as to locate the cause of the fault.

Therefore, the steps to be taken are not specifically named in the manufacturer's maintenance manuals, for this specific issue, and some reliance is placed on the maintenance personnel's ability to look for and interpret the information.

The instructions for the ongoing airworthiness of the aircraft, therefore, do not address with the same level of specificity, two possible anomalies that could occur involving RAT probe heating:

- No heat when required (while airborne).
- Improper heating, while on ground (as occurred in this case).

The following safety recommendation is therefore proposed.

Conclusions

It is recommended that the FAA and EASA require the manufacturer, Boeing, to include in its Aircraft Maintenance Manual (AMM) for the DC-9 and MD-80, the Troubleshooting Manual for the MD-90 and the Fault Isolation manual for the 717 series of airplanes, specifically identified instructions to detect the cause and to troubleshoot the fault involving the heating of the RAT temperature probe while on the ground.