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Progress Note A-032/2008

Accident involving McDonnell Douglas DC-9-82 (MD-82) aircraft, registration EC-HFP, operated by Spanair, at Madrid-Barajas Airport on 20 August 2008

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MINISTERIO DE FOMENTO

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Important note

This document presents the direction that has been followed up to date on the investigation of the accident occurred on 20 August 2008 to aircraft McDonnell Douglas DC-9-82 (MD-82), registered EC-HFP, summarizing the main proceedings carried out by the Civil Aviation Accident and Incident Investigation Commission (CIAIAC) during the investigation, especially in the last year.

In the note there is not any new factual information with relation to that included in the preliminary report on October 2008 and in the interim report on August 2009.

The final report of the investigation is currently underway. It's not foreseen to release other reports previous to the said final one.

The CIAIAC has the aim of preparing a draft final report on December 2010. This draft will be submitted to the different parties and authorities involved in the investigation, for their comments, according to the international standard and recommended practices and observing the consultation periods given on this regard. A subsequent process of consolidating those received comments must be foreseen before the publication of the final report.

This progress note must be read together with the interim report approved by the CIAIAC board on 4 August 2009. That report states more comprehensively the circumstances surrounding the flight, the most important details of the investigation up to that moment and seven (7) safety recommendations.

In accordance with the provisions of Law 21/2003 and pursuant to Annex 13 of the International Civil Aviation Convention, the investigation is of exclusively a technical nature, and its objective is not the assignment of blame or liability. The investigation is carried out without having necessarily used legal evidence procedures and with no other basic aim than preventing future accidents.

Consequently, any use of this information for purposes other than that of preventing future accidents may lead to erroneous conclusions or interpretations.

This progress note has been originally issued in Spanish. This English translation is provided for information purposes only.

Table of Contents

Data Sumary

LOCATION

Date and time	**Wednesday, 20 August 2008; 14:24 local time[1]**
Site	**Madrid-Barajas Airport. Madrid (Spain)**

AIRCRAFT

Registration	**EC-HFP**
Type and model	**McDonnell Douglas DC-9-82 (MD-82)**
Operator	**Spanair**

Engines

Type and model	**Pratt & Whitney JT8D-219**
Number	**2**

CREW

	Pilot in command	Copilot
Age	**39**	**31**
License	**Airline Transport ATPL (A)**	**Commercial Pilot CPL (A)**
Total flying hours	**8476 horas[2]**	**1276 horas[2]**
Flying hours on the type	**5776 horas**	**1054 horas**

INJURIES

	Fatal	Serious	Minor/None
Crew	**6**		
Passengers	**148**	**18**	
Third persons			

DAMAGE

Aircraft	**Destroyed**
Third parties	**45 Ha area of ground burned**

FLIGHT DATA

Type of operation	**Commercial air transport - Scheduled - Domestic passenger**
Phase of flight	**Takeoff - Initial climb**

PROGRESS NOTE

Date of approval	**11 August 2010**

1. All times in this report are local unless otherwise indicated. To obtain UTC, subtract two hours from local time.
2. As of 31 July 2008

Summary of the flight

On 20 August 2008, the McDonnell Douglas DC-9-82 (MD-82) aircraft, registration EC-HFP, operated by Spanair, arrived from Barcelona at Madrid-Barajas Airport at 10:13 to conclude what was the first flight programmed for that day. The aircraft was then scheduled to continue on to Las Palmas with the same crew that had flown the previous leg. The estimated departure time was 13:00.

Once the aircraft was on the runway threshold ready for takeoff, the crew communicated to ATC they had a problem and they had to return to parking. The crew had noted an abnormally high temperature of the RAT (Ram Air Temperature) probe and returned to the parking to attempt to solve the problem. After maintenance work performed by the airline's own maintenance technicians, it was proposed and accepted that the airplane be dispatched once more.

At 14:08, the aircraft was again cleared for engine start-up. At 14:23, with the airplane at the threshold of runway 36L, it was again cleared for takeoff once more. The airplane started the takeoff run, and became airborne briefly, before descending and impacting the terrain.

The aircraft was destroyed as a result of the impact with the ground and the subsequent fire. Onboard the airplane were 172 people, of whom a total of 148 passengers and all 6 crew perished. Eighteen passengers, including three minors, were seriously injured.

The investigation has determined that the takeoff was attempted while in an inappropriate and unapproved configuration, since the flaps and slats were fully retracted. The system outfitted on the airplane to warn of an inadequate takeoff configuration (TOWS) also failed to activate.

1. INTRODUCTION

Since the publication of the interim report of 4 August 2009, the investigation into the accident has continued completing the outstanding issues indicated in that report. For that purpose, the Civil Aviation Accident and Incident Investigation Commission (CIAIAC) has continued to work in close collaboration with the National Transportation Safety Board (NTSB) of the United States, representing the State of design and manufacture of the aircraft, with the aircraft manufacturer, Boeing, with the engine manufacturer, Pratt & Whitney, and with the civil aviation authority of the United States, the Federal Aviation Administration (FAA). Spain's State Aviation Safety Agency (AESA), the European Aviation Safety Agency (EASA) and the operator of the aircraft, Spanair, and the airport and air navigation services provider, AENA, and the judicial authorities continue to participate in the investigation, providing essential information to CIAIAC. The working groups that comprise the investigation team have made progress in their task of gathering and evaluating information of use to the investigation. Their activities have focused mainly on the following areas:

- Continuing with the detailed tests and checks of the wreckage recovered from the accident.

- Ascertaining the owner's operational and maintenance structures.

- How the various organizations involved use and interpret the Minimum Equipment List (MEL).

- The preparation, review and management of checklists and their acceptance or approval.

- The human factors involved in the operation and maintenance and the working environment in the cockpit.

- The operator's internal audits, inspections by civil aviation authorities and the supervision of those by Europe's civil aviation authority.

- Survival aspects at the accident site.

- Coordination among airport services and with emergency services.

- The location of and access to the accident site.

The investigation final report will contain all circumstances, conclusions and/or possible safety recommendations related to the accident.

2. DETAILED TESTS AND CHECKS

The National Institute for Aerospace Technology (INTA) has completed its analysis of the components from the flaps/slat control lever. As was the case with the fixed track and the left stub on the throttle lever, the remaining components revealed signs consistent with a strong impact received by the entire assembly while the lever was in the UP/RET position, which corresponds to flaps and slats fully retracted.

An analysis was conducted of the incandescent bulbs installed in the center instrument panel, in particular, the lights associated with thrust reverser lock and deployment, in the indicators displaying the availability of additional automatic thrust in the event of an engine failure (READY/ART) and in the slats indicators. The results of these analyses for the reverse thrust indications and the panel displaying the availability of additional automatic thrust in the event of an engine failure offer no clear signs as to the functionality of these systems. The analysis of the lights installed in the slats panel, however, indicates that the lights were off at the time of impact, which would be consistent with the flaps/slats control lever being in the UP/RET position.

As for the investigation into the components of the ground sensing system, the disassembly of the R2-5 relay is still pending, as is the examination of its internal elements. These tests are under the control of the court handling the case. Regardless the result of the disassembly of the relay, the interim report released in August 2009 does contain a thorough study of the behavior of this type of relay and its consequences.

As regards the analysis of the electronic components that feature non-volatile memory elements, the information stored on the computers for the enhanced ground proximity warning system (EGPWS), the advanced flight management (AFMC), central air data (CADC), digital flight guidance (DFGC) and the optical inertial reference units (IRU) has been extracted. The results from the analysis of the data recovered from the ground proximity warning system computer are available and consistent with the data found on the flight data recorder (DFDR) and from the two air data computers, which indicate that both units were functioning normally on the previous flights and at the time of the accident.

The airplane's performance assuming various different scenarios has been studied with assistance from the manufacturer. The performance study is being expanded using analytical calculations to complement the results obtained by means of the manufacturer flight simulator, so that to reproduce aircraft maneuvers similar to those that took place on the accident flight and its behavior be analyzed, including the behavior of the plane when one throttle lever is moved back.

The investigation into the powerplant is continuing along the lines presented in the interim report, which is focusing on analyzing the operation of the engines during takeoff based on the data recorded on the digital flight data recorder (DFDR). This study has revealed that the response of the two engines during takeoff, and up to the moment of the initial impact with the ground, was consistent with the positions of the throttle levers in the cockpit.

From the initial inspections and the remaining processed information no evidences or anomalies have been noted on those components, although the disassembly and inspection of those components is pending.

3. MAINTENANCE ASPECTS AT THE OPERATOR

The investigation into the maintenance aspects has progressed along various lines.

Information has been obtained about the professional experience and training records of the various aviation maintenance technicians who responded to the high RAT temperature readings present on the accident aircraft in the days leading up to the accident and on the day of the accident itself.

The investigation has had access to all of the statements made to court officers and to police investigators by the operator's maintenance technicians and supervisors and by personnel from its Maintenance and Control Center Department (MCC).

A chronological analysis has been carried out between the high RAT temperature probe readings recorded on the digital flight data recorder (DFDR). In addition, the various actions taken by the maintenance technicians in response to the pilots complaints registered in the Technical Logbook on days 19 and 20 of August, 2008 have been analyzed. Of particular interest are the actions taken prior to the last takeoff, which are being analyzed alongside the transcription of the cockpit voice recorder (CVR).

Also has been analyzed are the operator's maintenance structure and organization, particularly in terms of the functions of the Maintenance and Control Center Department (MCC), the analysis of repetitive defects and the functions of the In-Line Maintenance and Engineering Department. Specifically, the procedures described in the company's manuals have been evaluated, as is the degree of compliance by maintenance personnel. Likewise, an assessment has been made of the suitability of having basic maintenance documentation available and accessible when conducting maintenance in a remote part of the platform or in an airport without operative base.

The investigation has inquired about the results of the internal quality audits conducted by Spanair of its aviation maintenance practices. The State Aviation Safety Agency (AESA) has been petitioned to provide the results of the inspections carried out on Spanair as these relate to its continued airworthiness management program and its maintenance of aircraft and parts, as well as to the tracking and analysis of those corrective actions that could have ensued from the findings of those inspections.

With respect to the Minimum Equipment List (MEL) and the Master Minimum Equipment List (MMEL), an in-depth investigation is being conducted of aspects such as the different interpretations suggested by the concept of an inoperative component as it relates to the high RAT probe temperature reading, the use of these lists by operators, the MMEL and MEL approval process in both the United States and the European Union and, specifically, the definition of operational and maintenance procedures associated with specific ATA[3] articles or chapters.

Based upon such actions the final report will contain the conclusions and/or possible safety recommendations related to the maintenance aspects.

3. The most of aviation manufacturers in the air transport industry have adopted ATA (Air Transport Association) Specification no.100 for classifying aircraft systems, components and equipment.

4. OPERATIONAL AND HUMAN FACTORS ASPECTS

In continuation of the work done and which is detailed in the interim report of August 2009, the Commission has proceeded with its in-depth investigation into the operator's checklist preparation and review process from the time a modification is identified until its implementation. Information has been gathered on the original and modified versions of the checklists that form part of the company's operational procedures. Reviews have also been conducted of the participation by the State Aviation Safety Agency (AESA) in this process through the inspections made by the Authority as part of the operator's renewal of its Air Operator Certificate (AOC), and of the regulations applicable in Spain and the European Union in this regard. A comparison was made to ascertain how this issue is addressed in States outside of Europe.

Existing literature on the design, execution and preparation of checklists was thoroughly reviewed, with an emphasis on the criteria used to write them and in the guidelines for their usage in order to understand how interruptions or distractions, operational pressures and the perception can affect to the progress and execution of the operating procedures. So as to determine how checklists are used in actual practice at the operator, flight crews were interviewed.

The investigation has also focused on the sterile cockpit concept and on relevant European regulations, which were compared with those in use in other countries, such as the United States. Particular attention was paid to the use of cellular telephones by the crew and the presence of third parties in the cockpit. Along these lines, and so as to establish how the operator conducts its day-to-day activities, the line checks carried out by the operator and by the national authority were requested and analyzed. Flight crews and managers from the various company´s departments were also interviewed for this same purpose.

The crew's actions prior to and during the flight were examined in order to understand any possible influence from external or internal factors on the events leading up to the accident. The human factors aspects and the crew resource management (CRM) have been studied. In an effort to better understand the environment present at the time and the company's operational safety culture, its organization was studied, in particular its Flight Safety Department and the mechanisms that were available to it to identify potential risks and steps to correct them, including monitoring of pilots adherence to procedures/professionalism.

The selection processes of the company to contract operations personnel have been analyzed. The company's training program for its cockpit crews has been studied, in particular as it pertains to the training received in identifying and recovering from stalls on takeoff. So as to analyze the benefits that could result from this type of training, and from possible modifications to the stall recovery procedure on takeoff, a flight simulation was conducted that yielded qualitative conclusions regarding the implications of this type of improvement. Along these lines, Boeing has modified its MD series aircraft Flight Crew

Operation Manual (FCOM) to suggest that if the onset of a stall is detected by the crew during takeoff, the position of the flaps/slats control lever should be checked, and appropriate actions taken to avert the stall.

Based upon such actions the final report will contain the conclusions and/or possible safety recommendations related to operation and human factors aspects.

5. SURVIVAL ASPECTS AND ONSITE ACTIONS AT AIRPORT

The following initiatives have been pursued as regards survival aspects and the actions taken at the airport during the emergency.

The human and material resources available to the Firefighting and Rescue Service at Barajas Airport have been analyzed, along with their operational protocols.

The accessibility to the accident site was evaluated, especially in terms of the presence of and circumvention of obstacles in the roads within the airport complex.

The contents of the Aviation Emergency Plan (PEA) prepared by the airport was evaluated, as was the response of the Airport Management Center and the ATC Tower in its application of said plan. In particular, the investigation has reviewed the system used for precisely locating the wreckage of an accident aircraft anywhere within the airport grounds, as well as the communications of the services involved in transmitting any related information.

The airport's ability to continue its operations immediately after the accident has been assessed.

An analysis was conducted of how access to meeting points by emergency personnel is controlled of their response times, and of the internal and external communications and the coordination and oversight of the actions at the accident site.

Based upon these such actions the final report will contain the conclusions and/or possible safety recommendations related to mentioned survival aspects.

6. RESPONSE TO THE SAFETY RECOMMENDATIONS

From the start of the investigation to the present, a total of eight (8) safety recommendations have been issued, addressed to the FAA, the civil aviation authority of the United States, the International Civil Aviation Organization (ICAO) and the European Aviation Safety Agency (EASA).

REC 01/09: 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.

REC 07/09: It is recommended that the FAA of the United Stated establish mandatory airworthiness instructions to modify the procedures contained in the aircraft flight manuals for the Boeing DC-9, MD-80, MD-90 and B-717 series so as to include a functional check of the TOWS prior to each flight.

REC 08/09: It is recommended that the European Aviation Safety Agency and the FAA of the United States require Boeing to evaluate the operating conditions, in-service life, reliability and failure modes of relays in position R2-5 of the ground sensing system in DC-9, MD-80, MD-90 and B-717 series airplanes, and that it specify a maintenance program for this component based on the results of said evaluation.

REC 09/09: It is recommended to the European Aviation Safety Agency and to the FAA of the United States that the design of Takeoff Warning Systems be reviewed in transport airplanes whose certification standards did not require the installation of such systems or which, if they did require it, did not apply to them the guidelines and interpretation provided by AMC 25.703 in the case of the EASA, or circular AC 25.703 in the case of the FAA. The goal of this review should be to require that the TOWS comply with the applicable requirements for critical systems classified as essential in CS 25.1309 and FAR 25.1309.

REC 10/09: It is recommended that the European Aviation Safety Agency and the FAA of the United States revise regulations CS-25 and FAR 25, respectively, on the certification of large transport airplanes to add a requirement that ensures that Takeoff Warning Systems (TOWS) are not disabled by a single failure or that they provide the crew with a clear and unequivocal warning when the system fails.

REC 11/09: It is recommended that the European Aviation Safety Agency revise the accompanying guidelines and the clarifying material for the CS-25 certification regulations for large transport airplanes so as to consider the human errors associated with faults in takeoff configurations when analytically justifying the safety of the TOWS, and to analyze whether the assumptions used when evaluating these systems during their certification are consistent with existing operational experience and with the lessons learned from accidents and incidents.

REC 12/09: It is recommended that the International Civil Aviation Organization (ICAO), the FAA of the United States and European Aviation Safety Agency jointly promote the holding of an international conference, to be attended by every civil aviation representative organization, such as authorities, industry, academic and research institutions, professional associations and the like, for the purpose of drafting directives on good industry practices in the area of aviation operations as they apply to checklist design, personnel training and improved procedures and cockpit work methods so as to ensure that crews properly configure aircraft for takeoffs and landings.

REC 13/09: It is recommended that the European Aviation Safety Agency compile the results of studies and works done, as well as of any instructions and directives issued by civil aviation authorities to date, concerning the principles and guidelines relative to the

- design of checklists and

- working methods in the cockpit

so as to allow European operators and manufacturers and national authorities to have clear references on the state of the art in the design and application of checklists.

The first safety recommendation was issued in February 2009. The other ones were included in the interim report published in August 2009.

The FAA and ICAO have replied to all of the safety recommendations addressed to them to date. The EASA has responded to two (2) of them. Their reply to five (5) more is pending.

The replies received from the addressee are being assessed by the CIAIAC.