MEL – A RISK MANAGEMENT TOOL

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Regular readers of this column will recognize the following accident from a previous Safety Sense article published in the Oct/Nov issue 2012 in which we analyzed the aspect of poor checklist discipline. In the following article we look at the role of the Minimum Equipment List (MEL) in this accident.

On 20 August 2008 Spanair's flight JKK5022, a McDonnell Douglas MD-82 aircraft, accelerates down runway 36L at Madrid-Barajas airport in day VMC. It struggles to get airborne and impacts terrain to the east of the runway. The impact and subsequent fire destroy the aircraft in a ball of fire and black smoke. 154 of the 172 occupants are killed with the remainder are seriously injured.

The aircraft commander is pilot flying and the crew unintentionally attempts to take off without the flaps/slats set for take-off. Four seconds after becoming airborne over the runway, the stick shaker activates and both pitch and roll control are lost as the aircraft stalls. The crew does not recognize the incorrect configuration of the aircraft and 14 seconds later the aircraft impacts terrain at a position some 60 meters from the runway centerline. It breaks up and an intense fire ensues.

During the investigation carried out by the Spanish Accident Investigation Board (CIAIAC) investigators are puzzled by the fact that the take-off warning system (TOWS) had not activated during the take off roll to warn the crew of the incorrect aircraft configuration.

Prior to the accident the aircraft had taxied out for departure but had returned due to a fault of the Ram Air Temperature (RAT) probe heating. The heating of the RAT probe is controlled by a ground sensing relay and normally only operates when the aircraft is airborne. On the accident aircraft it had been heating on the ground during taxiing.

OVERLOOK
Inadvertently, the crew attempted to take off without the flaps/slats set for takeoff.

The faulty RAT probe heating was not repaired. Investigators found that the aircraft was released to service according to the Minimum Equipment List entry for RAT probe heating inoperative. No troubleshooting was performed to establish whether the RAT probe was in itself defective, or whether the ground sensing relay controlling the RAT probe heating was defective. This is a critical point as the ground sensing relay also controls the TOWS.

During the investigation it proved impossible to establish reliably what caused the TOWS to malfunction. However, it was found that there had been many previous instances in the worldwide MD-80 fleet where inoperative TOWS had been linked to faults with RAT probe heating. This association was attributed to the ground sensing relay which controls both the RAT probe heating (which is only active when airborne) and the TOWS (which is only active on ground).

The MEL did not contain maintenance and operating procedures requiring the verification of the proper operation of the TOWS as part of releasing the aircraft to service with an inoperative RAT probe heater.

The accident investigators recommend in their final report on this accident that EASA issue an interpretation regarding the need to identify the source of a malfunction prior to using an MEL. The CIAIAC also recommend that the MMEL for the MD-80 family should be modified to include maintenance (M) and operating (O) procedures for dispatch with RAT probe heating inoperative to check that the TOWS is operative.

Purpose of the Minimum Equipment List

The MEL, in this context, serves two purposes. The first purpose is to identify those components or equipment which may be inoperative without rendering the aircraft un-airworthy.

Certifying Staff decide upon the airworthiness of an aircraft. Operations personnel, including pilots, are not qualified to make decisions on airworthiness, unless they are based on a Minimum Equipment List.

A Minimum Equipment List (MEL) is a precise listing of instruments, equipment and procedures that allows an individual aircraft to be operated under specific conditions with inoperative components or equipment. As such it is an important decision-making tool to determine the airworthiness of an aircraft.

The airworthiness of an aircraft is based on the assumption that all components and navigation and communication equipment are operative and serviceable for the intended flight. The aircraft manufacturer and operators risk assess the need for the installation of redundant systems. Were more than the required components or systems are installed an aircraft remains airworthy even when some of the supernumerary components are unserviceable.

In addition, not all components or equipment are required for all flights, depending on the operating and environmental conditions. A flight in bright daylight does not require the use of certain lights for example. Conditions such as day and night, VMC and IMC, airspace classification, operation with or without passengers determine the need for systems required for an aircraft to be deemed airworthy.

MEL as the Link between Airworthiness and Operations

The MEL reflects the technical systems installed in the aircraft, the applicable regulation in the State of Registry and the operational environment.

The type certificate determines the basic rules according to which the aircraft was initially certified airworthy. Depending on the systems installed, any redundancy can be taken into account to maintain the airworthiness even after a component or system failure. The technical characteristics of each aircraft model are taken into account by the manufacturer when establishing the Master Minimum Equipment List (MMEL). The MMEL does not take into account the regulations of the State of Registry as well as the specific operating environment of the aircraft.

The applicable regulation of the State of Registry, the specific aircraft configuration including optional equipment and supplemental equipment installed in an individual aircraft and the specific operating environment has to be taken into account when tailoring the MEL. The importance of the MEL is recognized by aviation authorities who generally require their operators to update MELs latest 90 days after the manufacturer has revised the MMEL.

MEL as Risk Mitigation

The second purpose is to serve as guidance to crew and technical staff to conduct safety related activities prior to commencing the flight. The MEL is a risk management tool and forms an important part of the Safety Management System of an aircraft operator. To ensure that operators take the customization of the MEL seriously, most regulators require MEL revisions to be submitted for review before being approved to ensure operational considerations are considered in the MEL.

The devastating consequence of a lack of a comprehensive MEL as an effective barrier in the safety net in support of aircraft operation was highlighted by this MD-82 crash. Spanair's personnel were not required by procedures laid down in the MEL to properly identify the actual technical malfunction. In good faith they released the aircraft based on a symptom of a failure rather than on the technical failure itself.

SAFA

European SAFA inspectors review the MEL status of aircraft as part of their inspection program. While a MEL must be prepared and carried on all commercial flights, for private operations not all states require a MEL. A large part of the Business Aviation community today operates in regulatory environments either without a MEL or with the non-tailored MMEL. With the new EASA Part-NCC regulations a MEL will become mandatory for all operations with complex motor-powered aircraft.

Increasing Complexity – Reducing Clarity

As electronic aircraft systems become ever more complex and more inter-linked, understanding failures within such systems becomes ever more demanding. A single point of failure can have multiple consequences. Similarly, a single symptom can be caused by multiple failures. This increased level of complexity of aircraft systems makes it more demanding to identify the correct cause of a failure and to decide on the correct MEL item to apply.

In the case of flight JKK5022 the exact cause of the observed failure of the RAT probe heating was never established. The RAT probe heating could in itself have been defective, or it could have been a symptom for the failure of a different system such as the ground sensing relay controlling the status of the RAT probe heating. Unfortunately the particular MEL did not contain maintenance and operating procedures designed to identify the exact failure. As such it could well be that the ground sensing relay was in fact defective. This would also have caused the TOWS to be inoperative and would explain why this vital system did not activate when the crew applied take-off thrust.

EFIS Messages

For modern EFIS equipped aircraft some aircraft manufacturers have included separate sections in their MELs listing EICAS or ECAM messages and the dispatch requirements associated with each advisory and caution message. While this might ease the process of finding the applicable MEL entry, it does not remove the fundamental problem of identifying the exact technical failure.

Mindfulness – The Last Line of Defense

Expert technical writers will customize a MEL by taking into account the MMEL, the operational environment and safety management inputs in order to make it a valuable tool for decision-making.

As with all flight safety documentation in aviation, not every conceivable scenario which occurs in the real world can be covered in detail. That's why flight crews, maintenance technicians and other operations staff protect themselves and their passengers by remaining mindful and vigilant.

Mindfulness will remain the last line of defense when releasing aircraft to service with items inoperative.

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SAFETY
MEL will become mandatory for all complex motor powered aircraft in the new EASA Part NCC regulation.