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The application research for decision support of MEL assistant release based on flight operation control demand

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ABSTRACT

Minimum equipment list is the release manual for the flight dispatchers of the airline operation control department, and is the basis about the realization of MEL fault clearance in the flight dispatch. In practice the route repair personnel of maintenance engineering department conduct a deferred defect, complete technology release, and then the flight dispatchers achieve dispatch release. This paper firstly combined the release sequence of airline actual flight, the difference and connection of the maintenance release and dispatch release was analysed, the definition of MEL release was introduced. The classification of MEL release of the flight dispatcher was discussed, it had focus on the restrictive conditions analysis of the MEL auxiliary release and the corresponding countermeasures and advices. Finally, several noticeable issue of MEL release was paid attention. This article provides the theoretical support and reference release for the implementation of MEL release about airline flight dispatchers.

KEYWORDS

Minimum equipment list; Flight dispatcher; Maintenance release; MEL fault release.

INTRODUCTION

In the premise of civil aircraft safety and reliable flight, the reduction of operational costs and efficient operation is the target of every airline. Once if the plane has any fault or failure project it becomes grounded, this will cause a great waste of resources and increase the operational costs. When any system or equipment of the plane fails, the airlines can both ensure flight safety, and assure the flight normal operation and in order to reduce unnecessary economic loss, therefore, the purpose of minimum equipment list is to allow when certain equipment items can't be at work, under the premise of keeping the aircraft safety, the airlines can ensure that the plane can fly for a short time by using appropriate limiting conditions, and utilize limited resources more economically and effectively, under the equivalent safety level thus improve operation reliability and daily utilization rate of the plane, it achieves the limited flying and not-grounded flying.

MAINTENANCE RELEASE AND DISPATCH RELEASE

Introduction of MEL

Minimum Equipment List is the equipment list complied by the operator on the basis of the master minimum equipment list MMEL, comprehensively considering the actual configuration, operation procedures, maintenance technology, aviation materials supply, and operation conditions. The minimum equipment list is approved by the user airworthiness bureau, it allows the aircraft to continue running under prescribed conditions and the listed not-working equipment[1]. MEL manual is important foundation of the plane releasing.

Deferred defect

The deferred defect is defined as the fault or defect which is found in flight or after maintenance inspection can't be troubleshooted before take-off because of shortage of tools and equipment, equipment or lack of parking time.

When the failure appears during the flight or in the short stop, firstly route maintenance man conducts a troubleshooting, confirms the fault components, identifies the fault information clearly, then finds the MEL manual according to the fault information, quickly makes a decision whether release the aircraft or not. The maintenance release has three possibilities: First of all, it is found in MEL, maintenance man conducts a deferred defect and MEL release. Secondly, it is not found in MEL, it doesn't affect the airworthiness, maintenance man conducts a fault control or non-MEL release, has a defect retained according to the AMM or SRM and other related technology manual. Thirdly,it is not found in MEL,it affects the airworthiness, we must removal fault, it can not be retained, it can't be released. MEL is the release standard of aircraft operation, also it can be used as the basis of fault reservation. The reserved fault is based on MEL,the repair period shall comply with MEL regulations[2].

TABLE 1 : Comparison of maintenance fault release and dispatch release

Release classification	Maintenance release	Dispatch release
Department	Maintenance Control Center(MCC)	Flight Operation Center(FOC)
Relevant license	Maintenance personnel license of CAAC aircraft release authorized by airline	Dispatcher personnel license of CAAC dispatch release authorized by airline
Signature release	Sign and release in the flight book	Sign and release in the dispatch release list with captain
Release connotation	Maintenance release	Comprehensive release:weather, information, crew, MEL release
Release relationship	When the aircraft fault is not maintenanced timely,route maintenance man deals with retained defect,flight dispatchers conducts MEL fault clearance, and look for failure constraints in the minimum equipment list;	

Dispatch release

Flight dispatch release is that flight dispatch personnel has a comprehensive analysis and makes a final decision to release considering the aircraft information, meteorological information and intelligence information,crew information. Flight dispatcher mainly makes a analysis about plan weather criteria of the alternate airport, determines the alternate airport,calculates the total fuel consumption for takeoff, and signs and releases in the dispatch release sheet,sends FPL message to flight service center, explains release content to the pilot before departure. Flight dispatcher will provide the flight data file to flight crew, and monitors flight operation in the whole implementation process.

The relationship between maintenance release and dispatch release

The specific definition of maintenance release is that according to the aircraft fault whether meet the airworthiness conditions, airline maintenance personnel finds the corresponding maintenance basis, sign and release the flight by the

qualified and approved personnel, the aircraft can continue to fly. Maintenance release is divided into routine release (non-fault release) and fault release (with fault release). Routine release is that non-MEL fault release, the aircraft is normal and has no failure. You can according to the task card to do and release. Once the aircraft has a fault, the maintenance must troubleshooting and determine the fault phenomenon, search MEL and determine whether release of not, released fault is dealt with deferred. Maintenance man completes M items according to MEL and AMM firstly, and then cooperates flight crew to complete O items, finally he can fill out the deferred defect sheet, fill in the flight book, sign and release the aircraft.

Maintenance release (fault clearance) mentioned in this articles specifically refers to fault reserved release of route maintenance personnel, which is corresponds to MEL release by the flight dispatchers. Maintenance release (technology release) is an important part of the dispatch release, dispatch release includes many factors, including weather conditions, the airport conditions, route conditions, control conditions, the aircraft systems and performance, and many other factors. Dispatch release is a comprehensive decision release (final release) process of flight dispatchers, the core ideas is: "man-aircraft-environment". “Person” is the crew members, including flight crew and cabin crew, especially the operation qualification and operation time of the flight crew; “Aircraft” is aircraft systems and aircraft performance, involving MEL fault clearance; “Environment” is the operating environment, including meteorological environment, navigation information. So maintenance release is related to the technology release of aircraft systems, retained defect caused by the aircraft failure corresponds to MEL release of flight dispatchers. Therefore, maintenance release about route maintenance member is the important part of dispatch release about flight dispatchers.

MEL AUXILIARY RELEASE APPLICATION RESEARCH

Types of MEL with fault release

According to different MEL fault conditions and constraints, the MEL release can be classified as follows:1. No releasing: the Installation quantity = release quantity, the device must work, system or equipment failure can not be released;2. Unlimited condition fault release: installation quantity is greater than the release quantity, system of equipment with failure can be released, there is no limited conditions (including post not-working sign);3. The limited conditions of fault release: installation quantity is greater than the release quantity, system of equipment with failure can be released, restricted conditions exists, constraints may be a single constraints or complex constraints.

TABLE 2 : Types of MEL release

MEL limited release	Release quantity limitation	Limited conditions
Equipment must be working (required equipment)	Installation quantity = release quantity	It must work, or else can't be released
	Normal quantity ≥ release quantity	It can fail, has no restricted conditions
Equipment have failure	Normal quantity ≥ release quantity; it can fail, has (O), (M) for additional conditions	Request other equipment to work normally or refers to MEL of other device
		Meteorological conditions constraints
		Flying time constraints
		Aircraft performance constraints
		Flight operation constraints

The analysis and application for MEL release constraints

No restrictions (unlimited release)

Device itself does not work, and can fail, it has nothing to do with other devices, this device doesn't not work or don't realize functions, it does not affect flight safety. Note and exception is that one or two can not work commonly, or stick a out of working sign. When the trouble which have unrestricted conditions and can release appears, flight dispatchers can generally ignore the influence of the device and release flight directly.

Equipment must be working (required equipment)

Equipment level of aircraft systems is classified as “key equipment (emergency equipment) - important equipment - secondary device”. The key device, emergency equipment must work generally, When installing quantity is equal to release quantity, it can be released. The equipment has failure or malfunction, it does not meet the airworthiness conditions, flight can't be released. In accordance with the requirements for aircraft airworthiness approval and airworthiness directives, the system and equipment which is not allowed to have failure must be able to work properly. When a fault of the key equipment or emergency equipment has occurred, flight dispatchers can never release the flight.

TABLE 3 : A320 aircraft required equipment list

MEL item number	MEL project name	MEL release conditions	The installation number
23-71-01A	Cockpit Voice Recorder	must work	1
24-24-01A	Emergency Generator	must work	1
24-38-01A	Battery channel	Both must work	2
27-40-01A	Stabilizer Mechanical Control	must work	1
27-92-03A	Side stick priority lights	All must work	3
28-23-01A	Crossfeed Valve	must work	1
29-10-01A	Engine Driven Pump	Both must work	2
29-10-05A	Yellow Brake Accumulator	must work	1
29-22-01A	Ram Air Turbine (RAT)	must work	1
34-10-01A	Air Data Reference 1	must work normally	1

Equipment limitation

Principal and subordinate equipment

Reference to any MEL project, some equipment is not available, refers to MEL23-05-08 release. "Inclusion" relationships: two master-slave equipments have same function and effect, major equipment contains subordinate equipment, They have inclusion relationship, correspond to the master-slave relationship. Restrictions: refers to other equipment MEL project number. The slave device can have constraints; the main equipment can refer to MEL restrictions of slave device, or is equivalent to unavailablity of the slave device.

Example 1: MEL 78-30-02A the failure of reverser inhibition relay switch, one or more can not work, as long as the corresponding thrust reverser is regarded as inoperation, refers to the MEL 78-30-01A1 thrust reverser.

TABLE 4 : Airbus A320 reference other devices limit table

MEL item number	MEL project name	MEL release conditions
22-81-03|A	Auto Flight Control Panel A) AP Engagement Pb	Provided the auto pilot is inoperative. Refer to 22-10-01 AP
22-81-04|C	FD Pb	Provided the flight director is inoperative. Refer to 22-10-02 FD
22-83-01	Flight Management Guidance Computer (FMGC)	Provided the flight management system is inoperative. Refer to 22-70-01 FMS

Equivalent Equipment: require the other equipment to be normal

"Intersection "relationship (overlapping relationship): The main equipment and auxiliary equipment has the function of intersection. Some important functions overlap, two intersecting equipment can replace some important functions each other. One is the main equipment and other is auxiliary equipment. Limit condition is: the main equipment fails, it requires auxiliary equipment to work normally.

Example 2: the failure of push switch display lamp/fault light, request ECAM parameter display is normal; MEL49-70-04 APU start avail light may be inoperative provided N indication is available on ECAM APU page.

The device limit is occurred, flight dispatchers need to confirm other device is working correctly with route maintenance personnel, or refers to the corresponding MEL limit of other equipment.

Meteorological conditions (airway, airport meteorological conditions)

The classification of meteorological conditions limit is as follows:1. The visual meteorological conditions (VMC);2. Route can't have predicted icing condition: anti-ice valve failure in the closed position; 3. The take-off or landing airport has no rain;4. Total temperature is less than or equal to 12 degrees. MEL21-52-01 air conditioning components (the heat exchanger work only in a refrigeration condition);5.landing airport crosswind limit;6.route have no rainfall: weather radar failure;

When the weather conditions encountered, flight dispatchers analyses weather status and trend of airports and airways by querying the airport meteorological message and air route meteorological chart, if you have meteorological questions to confirm with meteorological engineer route ice-free, no rain, to meet the visual meteorological conditions, good visibility conditions, and then achieves flight release.

TABLE 5 : A320 aircraft meteorological conditions limit table

MEL item number	MEL project name	MEL release conditions
30-11-01B	Wing Anti-ice Control Valve be inoperative in the closed	Provided the aircraft is not operated in icing conditions.
30-21-01A	Engine Anti-ice Valve be inoperative in the closed	Provided the aircraft is not operated in icing conditions.
30-42-01A	Window heat computer	Provided the aircraft is not operated in icing conditions.
34-40-05A1	Weather Radar System	In the planned route cumulonimbus clouds or other adverse weather is avoided
30-45-01B	Windshield Wiper	The aircraft is not operated in precipitation with in arrival and departure areas
21-52-01	Air Conditioning Pack	TAT is less than 12°C
32-51-01A1	Nose Wheel Steering Control System	The crosswind component is not higher than 20 kt.
34-05-08A	PFD Attitude Display	one maybe inoperative for day VMC flight only.

The performance limits (speed, height, weight limit)

Aircraft performance constraints are classified as follows:1.speed limit (flight speed limit): the flight speed is limited less than 300KT;2.height limit (flight height limit): the flying height is limited below FL250;3.weight limit (aircraft weight limit): performance reducing load and weight;4.take-off conditions limit: don't take off in the 1+F configuration, as long as maximum takeoff thrust is used in the takeoff; takeoff performance don't consider the application of super thrust.5.performance adjust according to the flight manual and accomplish corresponding performance impairment;

TABLE 6 : A320 aircraft performance limit table

MEL item number	MEL project name	MEL release conditions
35-20-02B	Cabin Attendant Oxygen Unit	Provided the operating altitude is limited to FL 250.
24-22-01A1	AC Main Generation	Flight altitude is limited to33500 ft
32-07-03A	Landing gear doors	Flight max velocity is limited 250kt/M0.60
30-11-01A1	Wing Anti-ice Control Valve be inoperative in the open position	Flight fuel increases, the maximum climbing weight reduces
34-10-02B	Air data reference 2	Takeoff is not performed in CONF 1 + F.
32-31-01A	Landing Gear Control and Interface Unit	Flexible takeoff thrust is not used
32-33-01A	Landing Gear Gravity Extension System	The aircraft is operated in accordance with the appropriate Flight Manual gear down appendix
30-21-01B1	Engine Anti-ice Control Valve be inoperative in the open position	Flight Manual performance penalties are applied

The performance correction problem of MEL release is the most troublesome, flight dispatchers finds the failure limit of height, speed weight, they need to set up the flight height, flight velocity, recalculate the flight plan, increase total takeoff fuel of releasing. More performance correction problems is the performance degradation or performance or loss, in general, flight dispatchers will inform performance engineers to calculate the maximum take-off weight or maximum landing weight under actual ambient temperature and wind speed. According to the limited weight, flight dispatchers will calculate total fuel of flight plan.

Flight operation limitation

The classification of flight operation constraints is as follows:

(1) The flight time limit:1.the day or night flight; 2. a certain limited flight cycles, flight hours, flight segments, the flight calendar day ;

(2) Flight procedure restrictions:1.do not perform RVSM ETOPS, RNAV, RNP;2.the limits of approach procedure, landing capacity ; 3. the restrictions of plateau airport, special airport; 4. extended over-water operation; 5. The non-pressurization flight;

(3) Crew operation environment: the conditions of cockpit influenced on flight operation can be accepted by flight crew;1.crew ensure that they can establish voice communication with ground controller ;2. effect on the sight of side windshield can be accepted by the flight crew

The flight time limit appears, restricted certain flight cycles or flight time occurs, flight dispatcher need to communicate with MCC, ensure the repair period of fault reserved meet the corresponding repair interval of MEL, the maintenance period cannot be extended. The flight procedures limit occurs, flight dispatchers may replace the aircraft or to remind the pilot.

Intelligence limit

The classification of navigation information constraints is as follows:1.the rest navigation station of flying route can work;2. The departure and arrival airport runway is at least 45 meters wide;3. it have suitable landing airport on the flight route;

Flight dispatchers meet with intelligence limits, they need to query intelligent information, determine the intelligence of airport or route to satisfy constraints, at the same time they confirm with intelligence engineers.

THE NOTED PROLEM OF MEL RELEASE

MEL is minimum standards of aircraft release, the use of MEL should pay attention to the following questions:

1.For different MEL constraints classification, flight dispatchers should take different measures and methods to solve. The weather or intelligence limit conditions is encountered, flight dispatchers confirms that the weather and navigation information whether meet the airworthiness conditions typically with meteorological engineer and information engineer. The performance correction of MEL release is the most difficult, It is also the weaknesses of flight dispatchers, when he meets the aircraft performance limit, flight dispatchers must contact performance engineer in time, let performance engineers help to calculate the taking off or landing analysis of abnormal configuration.

2. The failed project is not involved in MEL, flight can not be released generally. Because the MMEL does not include any items which affect flight safety and is essential, for example, the wing, flap, rudder, engines and other key equipment, also it doesn't include any device which has the smaller impact on flight safety or no impact, such as passenger convenience service equipment, so project which can't be found the corresponding reference in MEL manual occurs, generally there are only two possibilities: one is don't release, the other is can release.

3. MEL is only applicable to fault release before departure. For failure retention before takeoff, flight dispatchers can release according to MEL.MEL is not applicable to the fault or defect occurred and found in the process of flight, once the aircraft begins to move by own momentum, flight crew shall deal with fault by the approved airplane flight manual AFM or quick reference handbook QRH, and the captain has the right to decide whether to continue to fly.

CONCLUSIONS

In the airline operation, MEL fault release is one of an important auxiliary release, the release quality directly has influence on the quality of the final dispatch, decides the smooth execution of the operation plan. While the MEL fault release is related to two aspects, including maintenance release and dispatch release, airlines need Maintenance Engineering Department (MCC) and Operation Control Center of OCC to cooperate, fault is encountered before flight, route maintenance personnel need to discharge, and conduct the fault reserve according to MEL, then MCC notifies flight dispatchers to achieve MEL release. For the O project limit, flight dispatchers assists flight crew to complete, For the M project limit, route maintenance is responsible for repairing, MCC notifies the flight dispatchers to complete maintenance, finally realizes the dispatch release. Flight dispatchers needs special attention to reference basis of MEL release in the daily release process, increases working experience of MEL release, improves the ability of MEL release.

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