



## Notification of a Proposal to issue a Certification Memorandum

### Engine Time Limited Dispatch (TLD) and Master Minimum Equipment List (MMEL)

**EASA Proposed CM No.: Proposed CM-MMEL-001 Issue 01 issued 21 January 2015**

**Regulatory requirement(s): CS-MMEL, CS-E 1030**

In accordance with the EASA Certification Memorandum procedural guideline, the European Aviation Safety Agency proposes to issue an EASA Certification Memorandum (CM) on the subject identified below. All interested persons may send their comments, referencing the EASA Proposed CM Number above, to the e-mail address specified in the "Remarks" section, prior to the indicated closing date for consultation.

EASA Certification Memoranda clarify the European Aviation Safety Agency's general course of action on specific certification items. They are intended to provide guidance on a particular subject and, as non-binding material, may provide complementary information and guidance for compliance demonstration with current standards. Certification Memoranda are provided for information purposes only and must not be misconstrued as formally adopted Acceptable Means of Compliance (AMC) or as Guidance Material (GM). Certification Memoranda are not intended to introduce new certification requirements or to modify existing certification requirements and do not constitute any legal obligation.

EASA Certification Memoranda are living documents into which either additional criteria or additional issues can be incorporated as soon as a need is identified by EASA.





Issue	Issue date	Change description
01	21.01.2015	First issue.

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## 1. Introduction

### 1.1. Purpose and scope

The purpose of this Certification Memorandum is to provide specific guidance for the handling of Engine faults in the Master Minimum Equipment List (MMEL) and clarify the use of Time Limited Dispatch (TLD) analysis in the development process of the MMEL.

This Certification Memorandum describes the capabilities and limitations of the TLD analysis when intended to be used to support the justification of MMEL.

### 1.2. References

It is intended that the following reference materials be used in conjunction with this Certification Memorandum:

Reference	Title	Code	Issue	Date
[1]	Certification Specifications For Engines	CS-E	Amdt 3	23-12-2010
[2]	SAE ARP5107 Guidelines for Time-Limited-Dispatch (TLD) Analysis for Electronic Engine Control Systems	---	REV B	01-08-2006
[3]	CS-MMEL	CS-MMEL	Initial Issue	31-01-2014

### 1.3. Abbreviations

AMC	Acceptable Means of Compliance
CMR	Certification Maintenance Requirement
CS	Certification Specification
EEC	Electronic Engine Control
EECS	Electronic Engine Control System
ETOPS	Extended Range Operation with Two-Engine Aeroplanes
FHA	Functional Hazard Assessment
ICA	Instructions for Continued Airworthiness
IFSD	In-Flight Shut Down(s)
JAA	Joint Airworthiness Authorities (of Europe)
JAR	Joint Airworthiness Requirement
LOTC	Loss of Thrust Control
LT	Long Time Fault/Fault State/Repair Interval



LOPC	Loss of Power Control
MEL	Minimum Equipment List
MMEL	Master Minimum Equipment List
SSA	System Safety Assessment
ST	Short Time Fault/Fault State/Repair Interval
TC	Type Certificate
TLD	Time Limited Dispatch

## 2. Background

### 2.1. Identification of the need

Currently, dispatch with Engine faults may be assessed on one side by the Engine manufacturer during Engine certification, known as Time Limited Dispatch (TLD), and on the other side by the aircraft manufacturer at MMEL and ICA level. The relationship between these two activities needs to be clarified.

### 2.2. Evolutions of the engine certification specifications

The JAR-E 510 (e)(2) Engine Failure Analysis used to require for the purposes of the Failure Analysis: *“Justification for the inclusion in the Master Minimum Equipment List of any Engine-associated item permitted to be carried in an unserviceable state for specific periods”*.

The above JAR-E paragraph was introduced in JAR-E Change 7 dated 24/01/86 and was deleted with the incorporation of NPA E-38 at change 12 dated 05/2003. A new section CS-E 1030 was then introduced in CS-E Initial Issue. At that time the content of the paragraph was:

*“If time limited dispatch is requested, any dispatchable configuration of the Engine, including its control system, must comply with the applicable specifications of CS-E. The length of time allowed prior to rectification of a Fault resulting in degraded operation must be justified as part of the system safety assessment of CS-E 50 (d) or the safety analysis of CS-E 510 and documented as part of the MMEL of the aircraft in which the Engine is installed.”*

The CS-E 1030 was re-written and expanded, including AMC, at CS-E Amendment 1 dated 12/2007. The first sub-paragraph CS-E 1030 (a) states: *“If approval is sought for dispatch with Faults present in an Electronic Engine Control System (EECS), a time limited dispatch (TLD) analysis of the EECS must be carried out to determine the dispatch and maintenance intervals.”* But this CS-E change also clearly restricts the TLD approval to EECS degraded conditions with respect to redundancy only. Other systems than the EECS, and EECS faults not related to a loss of redundancy, cannot be included into the TLD approval.

TLD has therefore been recognised as being a separate approval to that of MMEL, that is part of the Engine TC and therefore fully managed at Engine level, but limited to EECS degraded conditions with respect to redundancy only. MMEL has been recognised as an aircraft activity and references have been removed from CS-E.

As a consequence of the above regulations history, there is a need identified today to clarify the certification workflow and the requirements for MMEL coverage of Engine faults to ensure certification specifications on the Engine and MMEL side are both complied with.



## 2.3. TLD “MEL maintenance approach” vs. “Inspection/Repair maintenance approach”

The general philosophy of the MMEL is that as soon as a failure/fault is known to the flight crew, an MMEL is normally required to allow the aircraft dispatch.

In the case of the Engine faults and according to Ref. [1] AMC 1030, this corresponds to a “MEL maintenance approach” (as per Ref. [1] AMC E 1030 (2) Definitions).

In another approach called “Inspection/Repair Maintenance Approach”, no fault indication is displayed in the cockpit and thus periodic check of the fault messages from the EECS by maintenance is required (as per Ref. [1] AMC E 1030 (2) Definitions).

As the subject of this Certification Memorandum is to address the interactions between MMEL & TLD, it will focus on cases where the TLD “MEL maintenance approach” is used. Considerations will nevertheless be given to Engine faults managed by “Inspection/Repair maintenance approach”, if hypothesis are taken on their timely rectification to support the repair interval of the other faults evident to the flight crew.

## 3. EASA Certification Policy

### 3.1. MMEL approach for EEC loss of redundancy faults

If MMEL approval is sought for loss of redundancy faults in an Electronic Engine Control System (EECS), a time limited dispatch (TLD) analysis of the EECS should be carried out as per Ref. [1] CS-E 1030 to determine dispatch intervals and demonstrate that the prescribed fleet-wide average LOTC/LOPC rates and Hazardous Engine Effects rates are not compromised.

### 3.2. MMEL approach for Engine system faults other than EECS loss of redundancy faults

In the case when the Engine manufacturer request a TLD approval, Engine system faults other than EECS loss of redundancy cannot be included in the TLD analysis as per Ref. [1] AMC E 1030 Fig.2. However the Engine manufacturer may have chosen to put these “other than EECS loss of redundancy faults” into a dispatch category other than “no dispatch”. In this case they should be included in a separate section of the TLD analysis report which clearly indicates that these faults are not included in the TLD approval. The report should record their impact (if any) on Engine protection against Engine Hazardous Effects, performance, operability, Engine indications and Instructions for Continued Airworthiness. The report should also include the Engine manufacturer justification for the dispatch category of the fault.

If MMEL approval is sought for Engine faults other than EECS loss of redundancy faults, an Engine type design approval for time limited dispatch (TLD) is not mandatory. If proposed to be covered by the MMEL, these faults should be evaluated against Ref. [3] CS MMEL criteria as for any other candidate item.

### 3.3. Evaluation of aircraft level consequences for MMEL evaluation

When Engine related MMEL items are involved in aircraft level failure conditions classified as hazardous or catastrophic at as per CS 25.1309 (e.g. dual IFSD), the corresponding requirements for qualitative and quantitative analysis Ref. [3] CS MMEL.145 are applicable and the MMEL specific risk should be contained as per the associated guidance material.

Such combination of failures should normally be identified as part of the FHA/SSA associated to the thrust control functions and the corresponding fault trees or diagrams may be used to conduct the MMEL analysis.

Note1 : the computational model used to comply with Ref. [1] CS-E 1030 requirements as described in Ref. [2] ARP are usually based on Time Weighted Average or Markov Model(s) and may not necessarily involve



fault tree analysis. Their utilisation for CS MMEL aircraft level requirements showing of compliance should be based on careful engineering judgement.

Note 2: It is recommended that this analysis is made prior to the definition of the associated cockpit alert to avoid re-design issues. Indeed if a particular fault classified as a ST or LT fault per TLD requires a more restrictive approach at MMEL level, an adequate cockpit alert (alert caution or advisory/status message) may be required to ensure proper fault identification at the end-user level.

### 3.4. Dispatch with EECS faults on more than one Engine on twin-engined aircraft

When dispatch with faults in more than one Engine EECS is foreseen, the cumulative effect on the dual Engine LOTC rate should be evaluated.

Dispatches of configurations with dual Engine LOTC rates (computed from TLD analysis) greater than  $10^{-09}$  failures per hour are allowed, but only for limited periods of time as per the guidance provided in Ref. [3] GM1 MMEL.145(d).

As MMEL is normally dealing with Engine faults categorised as ST, the above is primarily applicable to ST/LT and ST/ST (eng1/eng2) combination dispatch states. LT/LT combinations may however also be reviewed when LT faults have been associated to a flight deck effect.

Particular attention should be paid to ETOPS certified aircraft where the derivation of the probability of a dual-engine inflight failure takes into account flight duration and diversion time. If necessary MMEL ETOPS operational limitations should be introduced to mitigate the associated specific risk.

Combinations of faults that need to be prohibited at dispatch should be explicitly mentioned in the MMEL, whenever one or more of the concerned faults are included in the MMEL.

### 3.5. MMEL rectification intervals allocation

When TLD approval is granted, the repair limitations for ST or LT faults may be used to support the allocation of the appropriate rectification interval. If the repair intervals are taken from the TLD, MMEL Rectification interval A (non-extendable) should be used.

The MMEL rectification interval should not exceed the time for repair allocated to the corresponding item in the approved TLD.

The MMEL rectification interval may need to be set to a shorter period based on a qualitative evaluation of the flight deck effects, consequences on crew procedures, workload, etc. Consideration about the adequate aircraft alerting level are also applicable.

### 3.6. Certification workflow for TLD and MMEL

In the case when a MMEL approval is requested including faults present in the EECS, the following workflow is proposed to enable proper coordination of certification activities:

1. Application for TLD approval according to CS-E 1030 should be made by the Engine Type Certificate holder.
2. According to AMC 1030 paragraph (8), the fact that the Engine has been approved for TLD operations is recorded in the Engine TCDS (See CS-E 40(d)).
3. According to AMC 1030 paragraph (8), the approved TLD operating limitations (times allowed for rectification of ST and LT Faults) should be declared in the manuals specified in CS-E 20 (d) and CS-E 25 (a), whichever is appropriate, and provided to operators as required by Part 21.A.61. When the TLD operating limitations are published in the Engine Installation Manual/Engine Operating Manual, the aircraft Type Certificate Holder is responsible to issue them in the appropriate aircraft documentation available to the operators. The periodic inspection and repair requirement may also

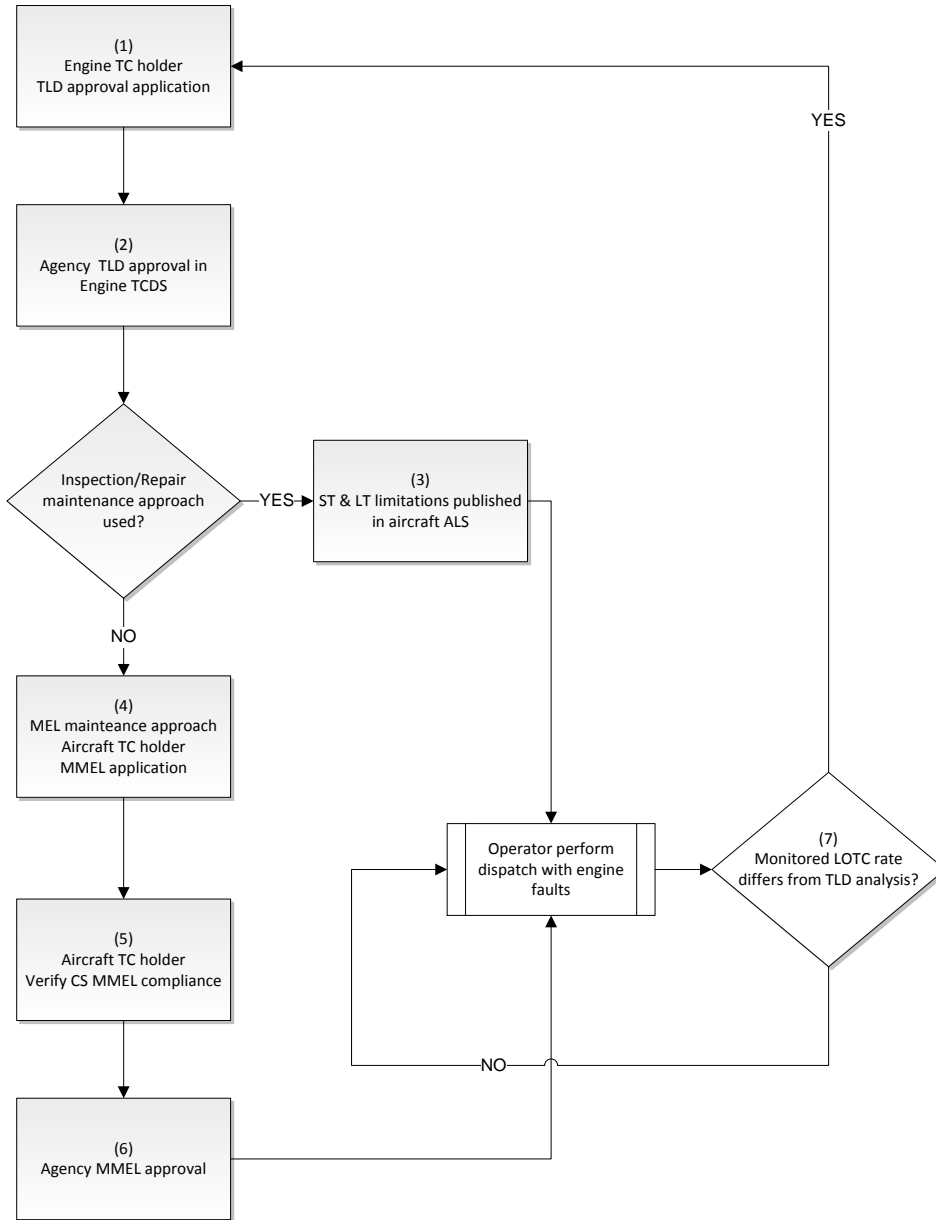


be identified as Certification Maintenance Requirements (CMRs) by the Certification Authorities and be listed in the CMR section of the MRB report and MPD (Ref. [2] Appendix D page 92).

4. If “MEL maintenance approach” is retained, the aircraft Type Certificate Holder should apply for MMEL inclusion of corresponding items
5. The aircraft Type Certificate Holder provides justifications for MMEL, taking into account the results of the TLD analysis but also the aircraft level aspects to comply with CS-MMEL.
6. The MMEL is approved as part of the OSD within the aircraft TC and issued to the operators
7. The actual LOTC rate is monitored by the Engine Type Certificate Holder in accordance with Ref. [1] AMC E 1030. A yearly review of this rate should be organized. This topic should be part of the Continuing Airworthiness activities. If the need for changes to the TLD is identified, an application for a major change should be sent to EASA.
8. Following the initial approval, all changes to the TLD operating limitations (change to the times allowed for rectification of Faults, addition or removal of Faults) must also be approved by EASA. If such a change result in a more restrictive operating limitation, operators will be informed by appropriate means.
9. The aircraft Type Certificate Holder is responsible for updating the MMEL in accordance with more restrictive changes to the TLD operating limitations.



**Certification Process Flowchart for TLD and MMEL**





### 3.7. Who this Certification Memorandum affects

Aircraft and Engine Type Certificate Holders when Time Limited Dispatch (TLD) and/or MMEL are applied to cover dispatch with Engine faults.

## 4. Remarks

1. This EASA Proposed Certification Memorandum will be closed for public consultation on the **4<sup>th</sup> of March 2015**. Comments received after the indicated closing date for consultation might not be taken into account.
2. Comments regarding this EASA Proposed Certification Memorandum should be referred to the Certification Policy and Safety Information Department, Certification Directorate, EASA. E-mail [CM@easa.europa.eu](mailto:CM@easa.europa.eu) or fax +49 (0)221 89990 4459.
3. For any question concerning the technical content of this EASA Proposed Certification Memorandum, please contact:

Name, First Name: Vandendorpe, Thierry

Function: Senior Expert Master Minimum Equipment List

Phone: +49 (0)221 89990 4186

E-mail: [thierry.vandendorpe@easa.europa.eu](mailto:thierry.vandendorpe@easa.europa.eu)

