CIVIL AVIATION AUTHORITY
OF NEW ZEALAND

Advisory Circular
AC121-1

Revision 2

1 November 2022

Extended Diversion Time Operations and Polar Area Operations

General

Civil Aviation Authority (CAA) Advisory Circulars (ACs) contain guidance and information about standards, practices, and procedures that the Director has found to be an **acceptable means of compliance** with the associated rules and legislation.

Consideration will be given to other methods of compliance that may be presented to the Director. When new standards, practices, or procedures are found to be acceptable, they will be added to the appropriate AC.

Purpose

This AC describes an acceptable means of compliance with Civil Aviation Rule Part 121, which, if included in a certificate holder's exposition, would support an application for Extended Diversion Time Operations (EDTO) and/or polar area operations authorisation. It explains means acceptable to the Director for a New Zealand-registered twin turbine engine Part 121 aeroplane to be eligible to operate over a route, or a designated polar area, that contains a point further than 60 minutes' flying time from an adequate aerodrome at an approved one-engine inoperative cruise speed.

This Revision also includes provisions for the authorisation of Part 121 turbine engine aeroplane with more than two engines to operate over a route beyond 180 minutes from an adequate aerodrome. Specific criteria are included for deviations up to 180 minutes, up to 240 minutes, and greater than 240 minutes from an adequate aerodrome.

Related Rules

This AC relates specifically to the rules regarding EDTO (Subpart G, rule 121.407, *Maintenance elements for EDTO*, and Subpart N, *EDTO Authorisation and Operations*, and rule 121.165, *Route distance limitations*, and those relating to the conduct of polar area operations: rule 121.171, *Requirements for Air Operations in a Polar Area*, rule 121.173, *Application for Air Operations in a Polar Area*, and rule 121.175, *Authorisation for Air Operations in a Polar Area*.

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Change Notice

Revision 2 makes minor updates to the Application (General) section in line with the recent forms refresh.

Version History

History Log

Revision No.	Effective Date	Summary of Changes
0	04 May 2000	Initial issue of the AC
1	5 April 2022	Updated this AC to support the revised rules governing aeroplane diversions greater than 60 minutes' flight time from an adequate aerodrome. The revised standard: • encompasses the operations of all turbine powered multi engine Part 121 aeroplanes, and • replaces the previous ETOPS rules, which applied only to extended range operations in twin turbine engine aeroplanes.
2	1 November 2022	Makes minor updates to the Application (General) section in line with the recent forms refresh.

Table of Contents

Definitions & Abbreviations:

AEC	Aeroplane/engine combination
AEO	All engines operative
AFM	Aeroplane flight manual
AMM	Aircraft Maintenance manual
APU	Auxiliary power unit
ATA	Air Transport Association
BITE	Built In Test Equipment
CASS	Continuing analysis and surveillance
CBT	Computer-based training
CDL	Configuration deviation list
CFR	Critical fuel required
CMP	Configuration, maintenance and procedures
CMR	Certification maintenance requirements
CP	Critical point
DA	Decision altitude
DH	Decision height
ECM	Engine condition monitoring
EDTO	Extended diversion time operations
EEP	EDTO entry point
EFOM	EDTO flight operations manual
EGT	Exhaust gas temperature
EMPM	EDTO maintenance procedures manual
ETA	Estimated time of arrival
ETOPS	Extended range operations by aeroplanes with twin turbine engines
ETP	Equal time points
EXC	Excess fuel
EXP	Exit point
FIS	Fault Isolation Manual
FL	Flight level
FMS	Flight management system
FOB	Fuel on board
FOI	Flight operations inspector
FOM	Flight operations manual
HF	High frequency

IAS	Indicated airspeed
ICA	Instruction for Continuing Airworthiness
IFSD	In-flight shut down
IPC	Illustrated parts catalogue
IPD	Illustrated parts data
ISA	International standard atmosphere
L/D	Lift over drag ratio
LOFT	Line-oriented flight training
LRC	Long-range cruise
MCAI	Mandatory continuing airworthiness information
MCT	Maximum continuous thrust
MDA	Minimum descent altitude
MDH	Minimum descent height
MEL	Minimum equipment list
MIN	Minute(s)
MMEL	Master minimum equipment list
MNPS	Minimum navigation performance specification
MPD	Maintenance planning document
MPM	Maintenance procedures manual
MRBR	Maintenance review board report
MRC	Maximum range cruise
MSN	Manufacturer serial number (i.e. serial number of the concerned aeroplane)
NOTAM	Notice to airmen
OEI	One-engine-inoperative
PBN	Performance-based navigation
P/Ns	Part numbers
RFFS	Rescue and firefighting service
RNP	Required navigation performance
RVR	Runway visual range
RVSM	Reduced vertical separation minimum
RWY	Runway
TAS	True air speed
TLS	Time-limited system
VMO/MMO	Maximum permissible operating speed or Mach number

Definitions

For the purposes of this AC the following definitions apply.

(a) ***Director*** means the Director of the Civil Aviation Authority of New Zealand.

(b) ***Extended Diversion Time Operation (EDTO)*** means any operation by an aeroplane with two or more turbine engines where the diversion time to an en route alternate aerodrome is greater than the threshold time.

(c) ***EDTO alternate:*** refer to the definition in Part 1.

(d) ***EDTO configuration, maintenance and procedures (CMP) document*** means the document approved by the State of Design and which contains the particular aeroplane configuration minimum requirements, including any special inspection, hardware life limits, master minimum equipment list (MMEL) constraints and maintenance practices found necessary to establish the suitability of an aeroplane/engine combination (AEC) for extended diversion time operation.

(e) ***EDTO critical fuel*** means the fuel quantity necessary to fly to an en route alternate aerodrome considering, at the most critical point on the route, the one most limiting system failure.

(f) ***EDTO significant system*** means an aeroplane system whose failure or degradation could adversely affect the safety particular to an EDTO flight, or whose continued functioning is specifically important to the safe flight and landing of an aeroplane during an EDTO diversion.

(g) ***Maximum diversion time*** means the maximum allowable range, expressed in time, from a point on a route to an en route alternate aerodrome.

(h) ***Threshold Time*** means:

(i) 60 minutes for an aeroplane with two turbine powered engines, and

(ii) 180 minutes for an aeroplane with more than two turbine powered engines.

Introduction

The EDTO concept is to prevent a diversion occurring and to protect the safety of the aeroplane should a diversion occur.

Extended Diversion Time Operations (EDTO)

(a) Rule 121.165 (a) states that an air operator must not operate a piston engine aeroplane on an air operation on a route that requires the aeroplane to be more than 60 minutes' flight time from an adequate aerodrome. The flight time of 60 minutes is based on the performance of the aeroplane while operating at the one engine-inoperative cruise speed in still air and in IAS conditions. Therefore, EDTO does not apply to piston engine aeroplanes.

(b) Rules 121.165(b) and (c) place similar requirements on aeroplanes powered by turbine engines. However, for these aeroplanes, the operator may be eligible to apply for EDTO authorisation if both the operator and the aeroplane can meet certain requirements. This AC discusses these requirements and should be read in conjunction with Part 121, Subparts C, G and N.

General

The Director grants authorisation by issuing an Operations Specification to the operator which has been endorsed with EDTO. The Operations Specification may also contain any appropriate limitations or conditions which must be met by the operator when exercising the authorisation.

Unless rule 121.951(b) applies, the EDTO authorisation subsequently granted by the Director will not be greater than 15 minutes less than the maximum duration of the aeroplane's most time limited system.

For a twin turbine engine aeroplane to be eligible for EDTO, the specified airframe/engine combination must have been certified for EDTO capability by the State of Design. Turbine engine aeroplanes with more than two engines are not required to be certified for EDTO operation.

Four levels of operational authorisation are used for two-engine aeroplanes:

(a) EDTO with a maximum diversion time from 60 minutes up to 75 minutes where the Director considers that the proposed airframe/engine combination, although not approved by the State of Design to operate more than 60 minutes' flight time (calculated at a one engine inoperative cruise speed in still air and ISA conditions) from an adequate aerodrome, is suitable for the intended EDTO operation.

(b) EDTO with a maximum diversion time from 60 minutes up to 180 minutes to an EDTO en route alternate aerodrome based on the approved one-engine-inoperative cruise speed under IAS conditions in still air.

(c) EDTO with a maximum diversion time from 180 minutes up to 240 minutes to an EDTO en route alternate aerodrome based on the one-engine-inoperative or all engines operative cruise speed and corrected for forecast wind and temperature.

(d) EDTO with a maximum diversion time greater than 240 minutes to an EDTO en route alternate aerodrome based on the one-engine-inoperative or all engines operative cruise speed and corrected for forecast wind and temperature.

In the case of aeroplanes with more than two engines, an EDTO authorisation is required for any flight that will be greater than 180 minutes from an EDTO en route alternate aerodrome calculated at the one-engine inoperative cruise speed under IAS conditions in still air.

Application for EDTO Authorisation

General

A holder of an Air Operator Certificate (AOC) applying for authorisation to conduct EDTO must apply in accordance with rule 121.953. Information must be provided to the Director at least 90 days in advance of the planned commencement of EDTO operations.

CAA is progressively updating certification forms to make them clearer and easier to complete. Part 119 AOC holders now have separate forms for application (issue), renewal and amendment respectively. More information can be found on the CAA website here:

How to apply for, renew, or amend an air operator certificate | aviation.govt.nz

For "in-service" EDTO authorisation, the application and required details should be provided at least 90 days in advance. For "accelerated" EDTO authorisation, the application and details should be provided at least 180 days in advance.

All necessary documentation, including a revised Part 121 rule matrix, must accompany the application.

Rule 121.953 lists the information that an operator must present to the Director for consideration when making an application for EDTO authorisation.

The application should also include the means used to satisfy the considerations outlined in this section. (Any reliability assessment obtained, either through analysis or service experience, will be used as guidance in support of operational judgements regarding the suitability of the intended operation.)

The documentation also needs to address the following elements for the Director to determine the applicable authorisation process (i.e. "in-service" or "accelerated" EDTO authorisation) and assess the operator's readiness for EDTO:

(a) the targeted date of start of EDTO

(b) the contemplated maximum diversion time authority required

(c) the concerned aeroplane model(s) and fleet(s) (MSNs), and

(d) the intended EDTO route(s) or operational area(s) and alternate aerodromes.

Rules 121.957 and 121.961 include additional requirements when seeking authorisation for EDTO in excess of 180 minutes in twin turbine engine powered aeroplanes, and rule 121.965 details the requirements for aeroplanes with more than two turbine engines.

From 1 November 2018, a New Zealand applicant for EDTO authorisation operating aeroplanes with more than two turbine engines must, in addition to meeting the basic requirements of rule 121.953(b), show that the aeroplane also has additional radio communication equipment which complies with the requirements of rule 121.965(b)(2).

In-Service and Accelerated Authorisation

"Accelerated" EDTO authorisation is where an operator has less than one year of direct experience with EDTO and/or the candidate aeroplane. Accelerated EDTO authorisation requires the operator to build a programme of process validation to address the lack of direct experience. This process validation may involve transfer of experience and use of proven processes, simulated EDTO flights, assistance from an operator with EDTO experience, assistance from the manufacturer, etc.

The main objective of this programme is the transfer of EDTO experience into the operator's organisation and operations. The required amount of process validation is directly linked to the operator's background and EDTO objectives.

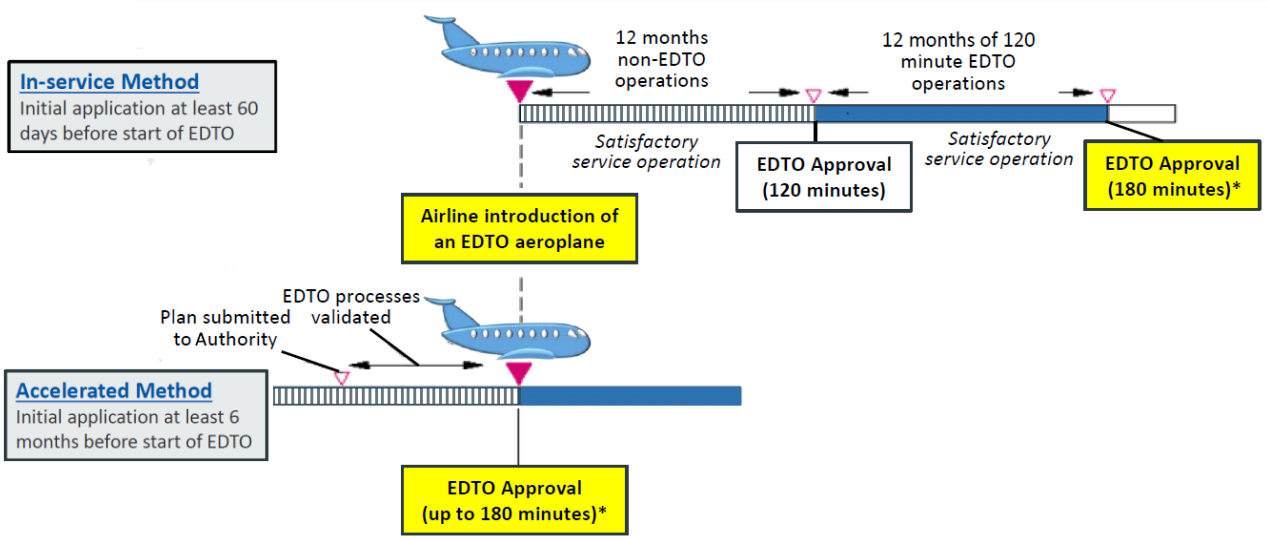
"In-service" EDTO authorisation is either:

(a) when the operator has accumulated more than one year of direct in-service experience with the aeroplane without EDTO. In this case, the operator may apply for a diversion time of 120-minute maximum, or

(b) when the operator has accumulated more than one year of EDTO experience at up to 120-minute maximum diversion time with the aeroplane. In that case, the operator may apply for a diversion time of 180-minute maximum.

The required amount of prior in-service experience listed above may be reduced (or increased) at the discretion of the Director.

Figure One: In-service experience requirements



Criteria for operations beyond 180 minutes

An operator seeking authorisation under rule 121.959 to conduct EDTO in twin engine aeroplanes, beyond 180 minutes and up to 240 minutes must hold a current 180 minutes EDTO authorisation issued under rule 121.955 and meet the requirements of rule 121.957(b).

An operator seeking authorisation to operate twin engine EDTO greater than 240 minutes must meet the additional requirements specified in rule 121.961. In addition, the operator must have engaged in twin engine EDTO of 180 minutes or more for at least 24 months.

The amount of service experience required may be increased or decreased after a review of the operator's experience which considers all factors, including the EDTO routes currently operated, and those proposed. In addition, the operator's capability to conduct operations and implement effective EDTO programmes will be examined.

The record of the operator in conducting its 180-minute programme will be considered when granting EDTO authorisation beyond 180 minutes. In the same way, operators seeking EDTO authorisation greater than 240 minutes will be assessed on their "up to 240 minutes" performance.

Assessment and Authorisation

Validation of Operator EDTO Maintenance and Operations Capability

The Director may grant EDTO authorisation, provided that granting it is not contrary to the interests of aviation safety, and the applicant can substantiate their ability and competence to safely conduct and support EDTO operations. A comprehensive assessment will be made to gauge the operator's ability to satisfactorily conduct EDTO.

The operator is required to demonstrate that it has the competence and capability to safely conduct, and adequately support, the intended operation. The type design approval of an aeroplane does not reflect a continuing airworthiness or operational authorisation to conduct EDTO: it is merely one requirement. The aeroplane engine combination and the general scope of the operation will be reviewed by a flight operations inspector (FOI) and an Airworthiness Inspector (AWI) to determine if there are any factors that could affect the safe conduct of operations before an operations specification is issued.

For operations with transport category aeroplanes with twin turbine engines, approval for EDTO requires:

(a) the Director to validate or accept the EDTO certification (also called EDTO type design and reliability approval) of the aeroplane granted by the State of Design of the aeroplane manufacturer. The aeroplane type design should meet the requirements for EDTO design features and criteria specified in the regulations

(b) conformity of the "candidate" aeroplane(s) (MSN), including auxiliary power unit (APU) and engines, to the EDTO configuration requirements listed in the EDTO configuration, maintenance and procedures (CMP document and its supplements)

(c) a system to maintain and dispatch an EDTO aeroplane in accordance with an approved maintenance and reliability programme that includes the EDTO requirements specified in Appendix A of this AC

(d) a system to authorise, dispatch, and monitor en route (flight following) an EDTO operation in accordance with an approved exposition

(e) a system to document, control, and provide guidance and operational limitations to flight crew

(f) trained and authorised staff capable of operating and ensuring airworthiness of an EDTO-certified aeroplane

(g) demonstration that the maintenance checks, servicing and programmes called for are in place and are properly conducted

(h) demonstration that dispatch authorisation and control are properly conducted for EDTO flights

(i) demonstration that the operational limitations, flight preparation and in-flight procedures called for are properly conducted, and

(j) assessment of the operator based on its application package: routes, desired diversion time, fleet, area of operations, planned date for the start of EDTO flights, experience records, operating manuals, training, etc as specified in Appendix B of this AC.

Table One - Twin turbine engine aeroplane

Flight Operations Assessment	**Airworthiness Assessment**
• Area of Operations • Aeroplane performance data • Routes, Alternates, Speed, Time, distance • Flight Planning, Weather, Communications • Flight following • Dispatch Planning • In-flight considerations • MEL, APU in-flight Start (Interface with Maint.) • Crew Training • Operations staff training • Aircraft configuration authorisation	• EDTO Certified aeroplane • EDTO Significant Systems • CMP Configuration, configuration control • EDTO Maintenance Programme • Task cards, Parts control • Oil consumption, ECM • EDTO Reliability Programme • Communications for >180min • Problem resolution • Technical staff training
Demonstrated Processes Operations/Maintenance Procedures Validation Flight	

For operations with transport category aeroplanes with more than two turbine engines, EDTO authorisation requires:

(a) a review of the time capabilities of the relevant EDTO time-limited systems (TLSs). (On most aeroplanes with more than two engines, the only relevant TLS is the cargo fire protection system.)

(b) trained and authorised staff capable of operating an EDTO aeroplane

(c) assessment of the operator based on its application package: routes, desired diversion time, fleet, area of operations, planned date for the start of EDTO flights, experience records, manuals, training, etc, and

(d) means of communication.

Table Two - Aeroplane with more than two turbine engines

Flight Operations Assessment	Airworthiness Assessment
• Area of Operations • Aeroplane performance data • Routes, Alternates, Speed, Time, distance • Flight Planning, Weather, Communications • Dispatch Planning • MEL, (Interface with Maint.) • Crew Training	• Technical staff Training • Communications equipment
Demonstrated Processes Operations Procedures Validation Flight	No demonstration of processes, procedures or validation flight required

Type Design Approval

Twin-engine aeroplanes require EDTO certification, but aeroplanes with more than two engines do not require EDTO certification. The aim for EDTO certification of an aeroplane, as for EDTO authorisation of an operator, is to prevent the diversion occurring and to protect the safety of the aeroplane should the diversion occur. Accordingly, the main intent of aeroplane EDTO certification requirements is to introduce:

(a) reliability objectives, to minimise the occurrence of failures that could lead to a diversion, and

(b) design features to retain a high level of systems performance.

The EDTO certification of an aeroplane is an assessment of compliance of the aeroplane with all the design provisions and reliability objectives of the applicable EDTO certification criteria (e.g., EASA CS25.1535 or FAA 14CFR 25.1535). The Type Certificate holder is required to continually evaluate the in-service reliability and systems performance to ensure the fleet continues to meet EDTO certification criteria.

Evidence of Type Design Approval

Rule 121.165(b) requires an applicant for EDTO authorisation to show that the design features of the airframe/engine combination are suitable for the intended operations.

Evidence that the type design of the aeroplane is certified for extended range operation is normally reflected by a statement in the AFM and Type Certificate Data Sheet (TCDS) or Supplemental Type Certificate (STC), which contains, either directly or by reference to other documents, the following information:

(a) Time limiting systems

(b) Revision to the performance section

(c) Flight crew procedures required for the specific extended range operation, and

(d) A description or reference to a document containing the approved aeroplane CMP. The CMP describes the standards of equipment configuration and maintenance required to operate the aeroplane on EDTO sectors.

The Director does not evaluate airframe/engine combination design features for the suitability of EDTO. However, type design approvals for extended range operations for an aeroplane with a New Zealand type acceptance certificate or a type certificate issued by the National Airworthiness Authority (NAA) of the country of type design are acceptable to the Director.

Time Limited Systems

Time capability of the most limiting system, typically the cargo fire suppression system, is published in the EDTO limitations section of the AFM. In addition, the time capability of the most time limited system other than the cargo fire suppression is also published.

Note: *On a cargo aeroplane with a Class E main deck cargo compartment, the most time limited system may be the oxygen system.*

Two-engine aeroplanes

For an EDTO flight operating up to and including 180 minutes, the time required to fly the distance to the planned EDTO alternate or alternates, at the approved one engine inoperative (OEI) cruise speed in still air and standard day temperature, must not exceed the time specified in the relevant manufacturer's documentation for the airplane's most time limited system minus 15 minutes, unless authorised under rule 121.951(b) (see below).

For an EDTO flight operating beyond 180 minutes, the time required to fly the distance to the planned EDTO alternate or alternates, adjusted on the day in the forecast conditions (such as prevailing winds, temperature and applicable diversion speed), a diversion to an en route alternate aerodrome must not exceed the capability of:

(a) the most limiting EDTO significant system, other than fire suppression systems, minus 15 minutes at the approved OEI cruise speed, and

(b) the cargo fire suppression system minus 15 minutes, at the all engine operative (AEO) cruise speed.

Aeroplanes with more than two engines

Operations of flights up to and including 180 minutes do not require EDTO authorisation.

Unless otherwise authorised under rule 121.951(b) (see below), for an EDTO flight operating beyond 180 minutes, the time required to fly the distance to the planned EDTO alternate or alternates, adjusted on the day in the forecast conditions (such as prevailing winds, temperature and applicable diversion speed), a diversion to an en route alternate aerodrome must not exceed the capability of:

(a) the most limiting EDTO significant system, other than fire suppression systems, minus 15 minutes at the approved OEI cruise speed, and

(b) the cargo fire suppression system minus 15 minutes, at the all engine operative (AEO) cruise speed.

unless otherwise authorised under rule 121.951(b).

Authorisation beyond the time limits of the most time-limited system

Rule 121.951(b) allows the Director to authorise operations beyond the time limits of the most time-limited system of an aeroplane as specified in the AFM. To satisfy the Director that the

operation will be safe, the operator must provide a safety risk assessment which addresses the:

Capabilities of the operator as shown by evidence of the operator's quantifiable in-service experience, compliance record, aeroplane capability and overall operational reliability that:

(a) are sufficient to support operations beyond the time limits of an EDTO significant time-limited system

(b) demonstrate the ability of the operator to monitor and respond to changes in a timely manner, and

(c) demonstrate that the operator's established processes, necessary for successful and reliable extended diversion time operations, can be successfully applied to such operations.

Overall reliability of the aeroplane as shown by:

(a) quantifiable standards of reliability, taking into account the number of engines, aircraft EDTO significant systems and any other factors that may affect operations beyond the time limits of a particular EDTO significant time-limited system, and

(b) relevant data from the aeroplane manufacturer and data from the operator's reliability programme used as a basis to determine overall reliability of the aeroplane and its EDTO significant systems.

Reliability of each time-limited system as shown by quantifiable standards of design, testing and monitoring that ensure the reliability of each EDTO significant time-limited system.

Relevant information from the aeroplane manufacturer as shown by technical data and characteristics of the aeroplane and worldwide fleet operational data provided by the manufacturer and used as a basis to determine overall reliability of the aeroplane and its EDTO significant systems.

Specific mitigation measures as shown by the safety risk management mitigation strategies, which have manufacturer concurrence, ensure an equivalent level of safety is maintained and are based on:

(a) technical expertise (e.g. data, evidence) proving the operator's eligibility for an approval of operations beyond the time limit of the relevant EDTO significant system, and

(b) an assessment of relevant hazards, their probability and the severity of the consequences that may adversely impact the safety of the operation of an aeroplane operated beyond the limit of a particular EDTO significant time-limited system.

Applications for authorisation to operate aeroplanes beyond the most time-limited systems will normally only be considered for aeroplanes with a certified EDTO capability of 120 or 180 minutes' maximum diversion time.

Authorisation to operate and aircraft beyond the time limits of the most time-limited system will typically be limited to specific routes or on an exceptional basis and not normally exceed:

- 115 per cent of the certified maximum diversion time capability of the aeroplane for EDTO, and
- the capability of the most limiting EDTO significant system other than the fire suppression systems minus 15 minutes.

Aeroplane Configuration

An assessment will be carried out to ensure that the aeroplane(s) meets the configuration described in the aeroplane CMP and that the operator has policies and procedures in place to ensure the continuing configuration status is maintained to the CMP standard.

Modifications of Type Design

Additional modifications or maintenance actions generated by an operator or manufacturer of the aeroplane must be thoroughly evaluated to ensure such changes do not adversely affect reliability or conflict with requirements for EDTO certification.

Operator's Continuing Airworthiness

Continuing airworthiness is accomplished by the operator in accordance with the operator's EDTO maintenance programme. Information for EDTO continuing airworthiness requirements may be found in the:

- CMP and its supplements
- AMM
- MRBR/MPD
- MMEL
- IPC

The term "operator's EDTO maintenance programme" means the maintenance related elements (maintenance tasks, organisation manuals, procedures, etc.) that must be implemented by the operator to support their EDTO operations. In this context, the aeroplane's maintenance programme for EDTO is one element of the operator's maintenance programme. The elements required for an operator's EDTO maintenance programme are detailed in Appendix A.

The operator is required to monitor and report on the effectiveness of the EDTO continuing airworthiness through the use of a Reliability Programme.

Note: *There are no additional EDTO continuing airworthiness maintenance procedures or maintenance programme requirements for aeroplanes with more than two engines.*

Operator's Aeroplane Reliability

The Director will assess the applicant's ability to achieve and maintain a level of aeroplane reliability. This will include a review of EDTO significant system reliability, and of the operator's reliability programme. The assessment of the operator's reliability data will include determining that the operator can maintain a similar level of reliability that the aeroplane manufacturer achieved at EDTO certification of the aeroplane. The operator must be able to demonstrate capability to maintain the certification requirement. This may be done by comparing world fleet data with the operator's reliability data.

Adequacy of Technical Training

The Director will assess the operator's EDTO training programme for technical staff and where appropriate, contracted staff or organisations.

Adequacy of Operational Staff Training

The Director will assess the operator's EDTO training and procedures for operational staff that flight plan, dispatch, and flight-follow EDTO flights.

Adequacy of Flight Crew Training

The Director will review operator in-service experience.

The purpose of the review will be to verify the adequacy of information provided in training programmes and associated manuals. The operator should provide information for, and participate in, these reviews.

The Director may use the information resulting from these reviews to require the operator to amend flight crew training programmes, manuals and checklists as necessary.

Demonstration Flight

Following the Director's acceptance/approval of an operator's exposition and maintenance programmes in regard to EDTO, and before formal authorisation to conduct EDTO is granted, the applicant may be required to demonstrate the capability to conduct EDTO to the required standards.

A demonstration flight, in the aeroplane or an approved flight simulator (as determined by the Director on a case by case basis) will incorporate a demonstration of the following emergency procedures:

(a) Total loss of thrust of one engine

(b) Total loss of normal generated electrical power, and

(c) Any other condition considered to be equivalent in airworthiness, crew workload, or performance risk.

Continuing Surveillance

The Director will ensure, via on-going surveillance that the operator's reliability remains appropriate to safely conduct an EDTO operation, that the operator's Dispatch Planning and Training programmes continue to meet EDTO requirements. The operator must provide the Director with a quarterly EDTO report. If an acceptable level of reliability is not maintained, the Director will re-consider the basis for the EDTO authorisation and may impose conditions or withdraw the authorisation.

EDTO Quarterly Report

After EDTO authorisation is obtained, the operator must set up a quarterly reporting programme covering all the information required under rule 121.417 and provide reports to the Director.

The report provides the Director with evidence that the operator's EDTO procedures and processes are effective in precluding diversions and, if a diversion has occurred, ensuring diversions are protected by an acceptable level of system performance.

Continued Validity of EDTO Certification

EDTO certification of an aeroplane engine combination (AEC) is not granted permanently. It is subject to continued surveillance by the State of Design of the in-service reliability of the worldwide fleet of the model/type. This reliability surveillance may result in changes to the

EDTO standards for the airframe or engines (i.e. service bulletins issued by the aeroplane manufacturer, maintenance or procedures mandated to restore the reliability).

The certified EDTO capability of an aeroplane may therefore be reduced, suspended or even revoked if no solution exists to a major problem. EDTO operations of an aeroplane should not be performed beyond the revised EDTO capability.

Continued Validity of EDTO Authorisation

Operator EDTO authorisation is not granted permanently. It is subject to continued surveillance by the Director of the in-service reliability of the operator's EDTO fleet. The operator's procedures and training for EDTO are required to be maintained once EDTO authorisation is issued. The Director may therefore reduce, suspend or even revoke authorisation if there is evidence an operator does not continue to maintain and operate their EDTO fleet in accordance with the rules.

Appendix A – Operator's EDTO Maintenance Programme Requirements

General

Rule 121.407 requires the system of maintenance (the maintenance programme) to contain the standards, guidance and directions necessary to support the intended operations.

Note: *The maintenance programme requirements of 121.407 only apply to twin engine turbine aeroplanes. Aeroplanes with more than two turbine engines do not need to meet the requirements of rule 121.407.*

Maintenance personnel involved, including maintenance sub-contractors' personnel, should be made aware of the special nature of EDTO operation and have the qualifications, authorisation, knowledge, skill and ability to accomplish the requirements of the programme.

Maintenance Programme

The EDTO Maintenance Programme must identify the manufacturer's or operator's Instructions for Continuing Airworthiness (ICA) for EDTO and be approved by the Director as part of the EDTO operational authorisation. The programme should contain and/or detail procedures for the following elements:

Significant System List

Rule 121.407(a)(9) requires the operator to have an EDTO significant system list. A system is identified as "EDTO Significant" when it has a unique influence on EDTO, i.e. it specifically participates in the EDTO philosophy: "Preclude and Protect the diversion". Accordingly, an EDTO Significant System is either a system:

- whose functional failure may cause a diversion, or
- which is specifically more important to ensure a safe EDTO diversion and landing for the contemplated maximum diversion time.

Manufacturers usually provide guidance on EDTO significant systems for operator use. In most cases, the list from the operator is identical to that of the manufacturer. It is not expected that items from the list of the manufacturer would be removed. The list from the operator is approved by the Director and included in the EDTO Maintenance Procedures Manual (MPM).

Operators must also consider any additional systems that they may need to list over and above those provided by the manufacturer. These are significant systems that are unique to the type of operation, i.e. cargo only aeroplane oxygen system. The list of EDTO Significant Systems is an input to the following elements of the EDTO maintenance programme:

- Determining elements on which performing similar actions should be avoided
- Identifying the elements of the training programme which must be brought to the attention of staff undergoing EDTO training
- Developing reliability monitoring, tracking and reporting of EDTO relevant occurrences, and
- Developing a verification programme.

Specific Maintenance Tasks

Rule 121.407(a)(3) requires a schedule of maintenance activities that are required to be performed. The aeroplane must be maintained in accordance with the aeroplane's maintenance programme for EDTO as long as it is operated on EDTO flights. The maintenance programme needs to include EDTO specific maintenance tasks such as:

- Scheduled and unscheduled tasks
- EDTO service checks, and
- EDTO departure checks.

It is not mandatory to comply with the aeroplane's maintenance programme for EDTO while the aeroplane is not operated on EDTO: an operator may elect to include a statement in the maintenance programme that EDTO tasks are not mandatory when the aircraft is operated on non-EDTO flights. However, compliance with the aeroplane's maintenance programme for EDTO becomes mandatory as soon as the EDTO operations are resumed.

The maintenance tasks related to EDTO are typically tasks impacting EDTO Significant System(s). Tasks or sub-tasks not impacting any EDTO Significant System(s) should not be considered as EDTO-related tasks, including those tasks supporting the overall verification process. The operator should select, from the list of EDTO-related tasks, those tasks which must be accomplished by EDTO qualified staff.

The selected EDTO-related tasks should be identified on the routine work/task cards, parcelled together and identified as an EDTO package. It is not mandatory for operators to identify EDTO-related tasks in their maintenance programme. If the operator chooses to NOT identify the EDTO-related tasks, then ALL tasks should be accomplished by EDTO-qualified maintenance personnel.

The selection process for identification of these selected EDTO-related tasks should be developed by the operator and should be described in the operator's EDTO MPM.

Qualified Maintenance Staff

"EDTO qualified staff" are defined as people who have received EDTO training. The purpose of EDTO training is to promote EDTO awareness by ensuring only EDTO qualified maintenance personnel accomplish selected EDTO related tasks. Criteria to be met for being authorised as EDTO qualified staff, as well as the continued currency of such qualification, should be detailed in the EDTO MPM (EMPM). Selected EDTO-related maintenance tasks should only be accomplished by EDTO-qualified staff.

Parts Control

Rule 121.407(a)(10) requires the operator to have a parts control programme. The required EDTO configuration of the aeroplane is defined by the applicable EDTO CMP document. The aeroplane must be configured, maintained and operated in accordance with the EDTO CMP document as long as it is operated on EDTO flights.

Accordingly, a parts control programme must be put in place before the start of EDTO operations. The EDTO parts control programme should ensure that:

- Parts approved *(required)* for EDTO are obtained and used, and

- Parts not approved for EDTO are not used.

The EDTO parts control programme is therefore the means to maintain the EDTO Type Design configuration, defined in the CMP document and relying on the EDTO Parts List and Illustrated Parts Catalogue (IPC).

The EDTO parts control programme should include details of the assessment and provisioning of EDTO parts, considering the type and area of EDTO operation (Main Base, Outstations, Flight Kit). The programme should ensure that the correct parts are available and that borrowed or purchased parts are cleared for use prior to installation on an aeroplane undergoing EDTO operations.

Where non-EDTO approved parts are stored with approved EDTO parts, the operator must ensure that the parts are identified as non-EDTO approved or approved for EDTO. i.e. Integrated Drive Generators (IDGs) for the same aeroplane type with different dash numbers; one in compliance with the CMP, the other not approved for EDTO.

Pre-Departure Service Check

Rule 121.407(a)(2) requires the operator to complete a pre-departure service check immediately before the aeroplane is dispatched on an EDTO flight. The purpose of the EDTO service check is to verify the condition of the EDTO significant systems of the aeroplane prior to an EDTO flight. The EDTO service check would typically include:

- Reviewing applicable maintenance log(s)
- Standard Pre-flight items. Walk around, wheels, brakes, tyres, cargo liners etc.
- Items required for oceanic flight. Survival equipment, comms, navigation equipment etc.
- Verifying the condition of EDTO significant systems e.g. Fuel X-Feed valve
- Verifying Engine, APU, IDG oil levels. Calculating and recording consumption rates, and
- Checks for IDG, Engine and APU filter △P status.

Any MEL items that are EDTO critical must be detailed to flight crew.

The EDTO Service Check should be certified by EDTO qualified maintenance staff in the aircraft tech log or equivalent.

Flight crew must sign off acceptance of the aircraft serviceability status in the aircraft tech log.

Due to the improved reliability and the ability to access more systems data from the cockpit of the latest generation aeroplanes, a service check may take the following into consideration when considering the acceptability of cockpit checks instead of visual (physical) checks:

- The age and reliability of the A/C systems and engines
- The availability of a cockpit indicating system
- The accuracy of the indicating system, and
- The low level of oil consumption.

Although a cockpit check may be possible, the operator's EDTO service check should not rely solely on cockpit checks. Implementation of cockpit checks should only be used to increase the number of legs and/or flight hours between physical checks. For example:

- Main Base (Departure point) – Physical checks
- Transit (Intermediate point) – Cockpit based service check
- Destination (Terminating point) – Physical checks + Cockpit check for APU.

EDTO Service checks can be integrated into existing Line Checks. For example, EDTO Service Check items are combined with the appropriate:

- Pre-flight Checks
- Transit Checks
- Daily Checks
- Weekly Checks.

Reliability Programme

The objective of the reliability programme in respect of EDTO is to allow early identification and to prevent re-occurrence of EDTO related problems, involving EDTO significant systems.

Operators may already have an existing reliability programme in place: for example, where an aeroplane is maintained under MSG3 philosophy or where an operator is required to, or wishes to, use a Condition Monitoring Programme.

Where an existing reliability programme is already in place, the programme must be enhanced to monitor, identify and prevent re-occurrence of problems related to EDTO Significant Systems. The EDTO enhanced reliability programme should monitor EDTO Significant Systems and be event orientated, so that EDTO events can be reported as required under Part 12, *Accidents, Incidents and Statistics*, and the events can be investigated.

Where reliability monitoring detects issues with EDTO operation, the operator is expected to provide appropriate corrective actions to ensure the immediate mitigation of the EDTO operation, while the root cause is investigated, analysed and preventative actions are put in place. This may include, but is not limited to, such things as a reduction in EDTO diversion time, temporarily ceasing EDTO operations etc. For example, a deterioration of worldwide fleet IFSD rates above the Type Design target may mean the operator reduces its 180 min authorisation to 120 min. Appropriate actions should include the use of the operator's SMS and consultation with the OEM, CAA and State of Design as necessary.

Where the operation of the aeroplane is new to an operator, or where a reliability programme is not already in place, the operator must put a reliability programme for the aeroplane in place prior to EDTO authorisation being given. In such cases the Director will require evidence that the programme exists and is capable of operating and being effective and that the operator can achieve similar reliability levels as was shown at the initial EDTO certification of the aeroplane.

Reliability monitoring of EDTO events should include:

- IFSD

- Diversions or in-flight turn-backs
- Un-commanded engine power changes or surges
- Inability to control engines or to obtain desired thrust
- Failures related to EDTO Significant Systems, and
- Any other events detrimental to safety of EDTO operations.

Monitoring In-flight Shut Down (IFSD) Rates

The definition of an IFSD is when an engine ceases to function when the aeroplane is airborne and is shutdown, whether self-induced, flight crew initiated or caused by an external influence. When monitoring IFSD rates it is important that rates are monitored for a particular Airframe Engine combination. Examples of engine IFSD causes used to track IFSD rates are:

- Flameout
- Internal failure
- Flight crew-initiated shutdown
- Foreign object ingestion
- Icing
- Inability to obtain or control desired thrust or power, and/or
- Cycling of the start control, however briefly even if the engine operates normally for the rest of the flight.

Events that are not normally counted as IFSDs include:

- Engine failures before take-off decision speed or after touchdown
- Airborne cessation of the functioning of an engine when immediately followed by an automatic engine relight, and/ or
- Engine failing to achieve desired thrust or power but is not shutdown.

IFSD rates are typically measured as a 12-month rolling average:

$$\text{IFSD rate} = \frac{\text{Number of IFSD (EDTO and Non-EDTO) over past 12 months}}{\text{Total Engine Hours (EDTO and Non-EDTO) over past 12 months}}$$

Target rates for IFSDs vary depending on the level of EDTO authorisation required. Type design target rates are typically more stringent than operational requirements. Operators may use the following target rates as a guide in setting alert levels.

Operational IFSD rate	Type Design IFSD rate	EDTO Authorisation
< .05/1000	< .05/1000	Up to 120 min
< .03/1000	< .02/1000	Beyond 120 min, up to and including 180 min
< .02/1000	< .01/1000	Greater than 180 min

Further information on setting IFSD alert levels may be found in EASA AMC 20-6 or FAA 14 CFR 121.374(i).

The IFSD rate of the operator's fleet may be impacted significantly if the fleet is small in count (typically fewer than 15 aeroplanes). In this case, the IFSD rate computation will mainly be used as a trending mechanism. Exceedance of the target rate should therefore not be used as the only reason to suspend EDTO operation. Where the number of engine hours over a year is not sufficient to be statistically representative, the reliability of EDTO operation should be reviewed on an individual event basis and an event-orientated analysis of each in-service event performed. This analysis needs to identify the root cause of the event and define the related corrective and preventative actions.

Verification Programme

Rule 121.407(e)(3) requires EDTO operators to have procedures to verify aeroplane serviceability following maintenance on EDTO significant systems. The purpose of the verification programme is to ensure positive corrective action on IFSD or EDTO significant system failures. The verification procedures should be based on actions published by the manufacturer and by sound engineering judgement. The details and scope of the verification programme should be located in the operator’s EMPM.

Acceptable verification techniques would typically include:

- BITE Tests
- Functional Checks
- Operational Checks
- Other Ground Tests (FIM, AMM or specific airline procedures), and
- Verification flight (Required when the rectification of the defect cannot be verified on the ground).

Verification Flights

EDTO maintenance verification flights are required in addition to Operational Flight Checks required under rule 43.103(a)(4)(i). EDTO maintenance verification flights are focused on EDTO Significant System defects and subsequent maintenance actions. The concept is to protect the reliability of EDTO Significant Systems by confirming the defect rectification has been effective.

EDTO maintenance verification is typically accomplished through positive system verification on the ground. There are, however, cases where an EDTO significant system fault resolution may require in-flight verification through monitoring or exercising of the system by the flight crew. These cases are relatively infrequent but may occur if a fault is dependent upon specific en route conditions such as temperature or altitude.

Examples where a verification flight may be required include:

- APU change or APU Oil/fuel/control system failure (Requires high altitude cold soak start)
- Engine system failure; fuel, oil, ignition, control (Non-EDTO flight)
- Intermittent failure of an EDTO significant system (EDTO flight with verification prior to entering EDTO sector)

- Altitude related failure (EDTO flight with verification prior to entering EDTO sector), and/ or
- Extended periods of storage (Non-revenue flight or as recommended by the OEM).

EDTO operators must identify in their verification procedures what defects, rectification, maintenance actions require verification flights and the operational parameters for the flight, i.e. prior to EDTO entry point etc. Identification of items requiring verification flights should be made in consultation with the OEM.

The EDTO verification programme documentation must contain procedures to ensure maintenance staff and flight crew are aware of EDTO verification flight requirements and the required actions.

EDTO operators should establish flight operations procedures to address maintenance verification flights when required to include:

- Identification of verification flight requirement through the operational control and flight release process
- Instructions to flight crew to identify the affected system(s) and what should be monitored or exercised, and
- Recording and coordination procedures following success or failure of system verification.

An EDTO verification flight may be accomplished during an EDTO flight (e.g. prior to entering the EDTO sector) or a non-EDTO flight or on a dedicated non-revenue flight.

It is permissible to designate the period of time from airport departure to the EDTO entry point as a maintenance verification flight, in combination with a regularly scheduled EDTO revenue flight, provided the verification phase is documented as satisfactorily completed prior to reaching the EDTO entry point.

When this type of EDTO verification flight is conducted, written procedures must be in place to ensure that the flight crew is fully briefed prior to dispatch concerning the event and/or the maintenance performed that necessitated the verification flight. Maintenance personnel should convey to the flight crew the specific observations and/or actions required of them during the verification portion of the flight, as well as the method to be used to properly record the satisfactory completion of that verification flight.

Dual Maintenance Limitations

Rules 121.407(a)(5), 121.407(b), 121.407(d) and 121.407(e) require EDTO operators to have procedures to address dual maintenance limitations. The purpose of dual maintenance limitations is to ensure that simultaneous maintenance actions are not performed on the same or similar element of identical, but separate, EDTO Significant Systems during the same routine or non-routine visit. Examples of dual maintenance on the “same” EDTO Significant System are:

- Removal of both engine oil filters.
- Removal of both chip detectors.
- Replacement of left and right IDG.

Operators must have policies and procedures in place to ensure maintenance performed on the same element of identical but separate EDTO Significant Systems during the same routine or non-routine maintenance visit prevents duplication of a human error. Dual maintenance is commonly defined as any maintenance performed that could induce the same fault into redundant components of the same EDTO Significant System or function. Such maintenance error(s) could lead to dual system failure which could potentially cause aeroplane diversions in degraded configurations.

The "same" EDTO Significant System is typically one that is in the same ATA reference and would reduce the redundancy level designed into the twin-engine aeroplane to support EDTO.

"Simultaneous maintenance" on different engine driven components on both engines should also be considered as dual maintenance due to the possibility of affecting both propulsion system oil or fuel supplies. An example of this would be maintenance performed on the number one engine-driven electrical generator and the number two engine hydraulic pump. Each are in separate ATA references, but a similar human error could cause a dual engine failure.

The main concern is that such simultaneous maintenance actions, although on different equipment, may potentially affect both engines. An example of dual maintenance on "substantially similar" EDTO Significant Systems may include: Replacement of the Number One IDG and the Number Two Engine Driven Pump.

The list of EDTO Significant Systems should identify the systems that are identical and those that are similar. The "similar" category may be further split in two sub-categories: "substantially similar" and "redundant". Any maintenance actions on EDTO significant systems which are not falling in these categories are therefore not subject to dual maintenance limitations.

"Substantially similar" EDTO Significant Systems are engine-driven components mounted on both engines with similar attach procedures.

Examples of "substantially similar" EDTO Significant Systems are the electrical generator mounted on engine one and the engine-driven hydraulic pump mounted on engine two. Improper installation of these components could result in oil loss on both engines.

"Redundant" EDTO significant systems are systems providing the same redundant function.

Examples of "redundant" EDTO Significant Systems are the engine-driven electrical generator and the APU-driven electrical generator. Improper maintenance could lead to multiple loss of EDTO significant systems and/or loss of redundancy in the related EDTO significant function (e.g. dual loss of electrical power sources). Even though the tasks may not be exactly the same, the potential impact of a maintenance error on the level of redundancy should be considered to retain (or not) the related tasks as dual maintenance action. This could typically be the case of tasks involving complex removal/installation procedures where possibilities exist to induce a fault that could lead to the same consequence (i.e. loss of concerned system or function) in both systems.

The operator must define acceptable policies and procedures for a dual maintenance limitation programme to prevent loss of Significant System redundancy. The programme should be defined in the operator's EMPM. This programme should take into account the aeroplane design architecture and systems reliability, and the operator's experience.

There are different ways to comply with this dual maintenance limitation requirement. It may include, but is not limited to:

1) the execution of tasks performed on identical or similar EDTO Significant Systems being staggered

2) the task being performed by separate EDTO qualified technicians

3) the maintenance action on each of the elements in the EDTO Significant System being performed by the same technician under the direct supervision of a second EDTO-qualified individual, and

4) the operator verifying the corrective action to those EDTO Significant Systems as per applicable verification actions.

Servicing

The servicing of fluids and gases is not considered maintenance; however, this should be conducted properly as defined in the manufacturer procedures manual. One technician serving two separate, but similar systems is not considered dual maintenance, but the servicing instructions should be followed to ensure EDTO reliability standards are maintained. Operators should emphasise this in their EDTO training programme.

Engine Condition Monitoring (ECM)

Rule 121.407(a)(6) requires that the operator has an engine condition monitoring (ECM) programme. The purpose of ECM is to detect deterioration of engines and to allow for corrective action to be taken before diversion capability is affected. EDTO operators must implement an ECM programme that detects deterioration at an early stage to allow for corrective action before safe operation is affected, and to ensure internal limit margins (e.g. rotor speeds, exhaust gas temperatures) are maintained to support single-engine diversion scenarios.

Engine margins preserved through this programme should also account for the effects of additional engine loading demands (e.g. anti-icing, electrical) which may be required during the single-engine flight phase associated with the diversion.

The operator's ECM programme should describe the parameters to be monitored, the method of data collection, and the corrective action process. The programme should reflect the type certificate holder's instructions and industry practice.

At a minimum, the programme should record parameters consistently during a benign part of flight, typically at cruise, and record them electronically or manually. The recorded parameters can be defined by the engine manufacturer but would typically include N1, N2, N3, FF, EGT, oil pressure and oil temperature.

Monitoring should be on a continual basis. The information should be collected and trended in a timeline to ensure parameters are maintained. If an electronic reporting and transmitting system is being used, a back-up method should be created to take the place of any automated system that has failed.

Operators may choose to use engine manufacturer support for this programme. These programmes offered by the manufacturer provide even further enhanced information and protection and are acceptable to meet this requirement. Information provided by the engine

manufacturer to the operator should be sent in a timely manner (interval to be agreed by the Authority) and include procedures to ensure that the information is continuous regardless of day or time.

Oil Consumption Programme

Rule 121.407(a)(7) requires EDTO operators to have a programme for oil consumption monitoring. The programme is required to allow operators to detect unexpected oil consumption that could be the result of an oil leak or unforeseen engine wear which can impact the EDTO dispatch capability of the aeroplane.

Regulations do not specify what the maximum oil consumption rate should be for EDTO (i.e. it can be the same as for non-EDTO operations) and what procedure should be applied to compute the consumption rate and detect unusual oil uplift. However, the oil consumption programme should reflect the type certificate holder's recommendations and be sensitive to oil consumption trends as well as unusual oil uplifts.

The dispatch procedures for EDTO segments are to take into account peak consumption and current running average consumption, including consumption on the immediately preceding segments. If oil analysis is meaningful to this make and model, it should be included in the programme. If the APU is required for EDTO operation, it should be included in the oil consumption programme.

The oil consumption monitoring programme for EDTO should define a baseline consumption rate (normal usage) and detect oil consumption based on the previous flight results. This oil consumption or loss must not exceed the manufacturer's maximum allowable usage rate and is defined in the aeroplane maintenance manual.

An evaluation must be made prior to the next EDTO flight to ensure the consumption supports the mission requirements. The programme should ensure there were no sudden increases in consumption/loss and, if there were, to initiate proper corrective action.

APU In-Flight Start Programme

Rule 121.407(a)(8) requires EDTO operators to have an APU in-flight start and run reliability programme if APU in-flight starting is required for EDTO. The purpose of the APU in-flight start monitoring programme is to demonstrate and/or confirm that the APU is able to start at altitude while in flight.

The aeroplane EDTO CMP document contains the configuration and maintenance items necessary to meet the reliability objectives for the APU (run reliability and in-flight start reliability). As the continued monitoring of the APU in-flight start capability is an operational requirement, it is usually not reflected in the EDTO CMP document or other aeroplane/engine maintenance document (e.g. MRBR or MPD). This allows the operator to adapt, as necessary, its programme for APU in-flight start monitoring to reflect its own utilisation of the APU.

Since the introduction of the initial ETOPS rules, it is usually a requirement for certification that the aeroplane manufacturer demonstrate the in-flight start reliability of the APU when the following two conditions are met:

1) the in-flight start of the APU and use of the APU electrical and/or bleed power source(s) is required in case of in-flight failure of another power source(s) within the EDTO sector, and

2) the continued operation of the APU is not required in the EDTO sector when the aeroplane is dispatched in fully operational electrical or bleed configuration (no MEL/MMEL).

This in-flight start capability demonstrated by the manufacturers must be maintained and monitored by the EDTO operator. The operator must develop a programme to monitor the APU cold soak in-flight start and run reliability.

Furthermore, tracking and reporting of APU run reliability (including failed in-flight starts) must be implemented when the APU is classified as an EDTO significant system.

The interval between the APU in-flight start tests is not prescribed by the regulations. It may be expected that operators would perform these initial in-flight starts on a routine basis (typically for the first six to 12 months of EDTO operations). The Director may still ask the operator to perform high-altitude/cold soak start of the APU on a regular basis even after the first months of operations.

The operator may adjust the sampling intervals according to system performance and fleet maturity. In particular, experience has shown that oversampling has the potential to actually degrade the APU in-flight start capability. Therefore, care should be taken in establishing appropriate sampling intervals.

In other words, it is expected that the initial programme may be alleviated, and the interval increased further following a review of relevant maintenance records by the Director when satisfactory in-service experience has been accumulated. Note that the interval should also consider the normal utilisation of the APU (e.g. on ground). An operator having a low utilisation of the APU may have to check it more frequently.

The typical interval to initially check the APU is once per month per aeroplane. As noted above, this interval may be increased, typically to once every three months per aeroplane. A highly experienced EDTO operator may increase this interval up to once or twice per year per aeroplane based on data showing successful in-flight starts with no issues noted.

The operator should propose an APU in-flight start/run programme that is acceptable to the Director, considering its own experience. The proposed programme should include periodic sampling of each aeroplane's APU in-flight start capabilities, i.e. the operator should ensure that each aeroplane's APU of the operator's EDTO fleet is periodically checked rather than repeatedly sampling the same APUs.

The APU in-flight start tests do not need to be performed systematically during EDTO flights. The start attempts should also not be performed systematically at the top of the aeroplanes and APU operating envelope. However, the duration of the cold soak (typically two-four hours into cruise) as well as the altitude (typically cruise altitude) of the test should be representative of normal EDTO operations.

In addition, the operator should consider performing a high-altitude cold soak start test after maintenance action(s) that may impact the start capability of the APU (APU change, replacement of electronic control box, fuel control unit, igniters, etc.).

The reliability objective for APU high-altitude relight should be defined in the operator's APU in-flight start programme. Usually a 95% success rate is expected to be demonstrated.

An APU in-flight start attempt should be classified as "successful" when the APU is started within three start attempts. This 95% criterion serves to monitor the APU in-flight start capability once the EDTO operation has begun. In other words, it is not required to demonstrate the 95% success rate prior to starting EDTO. Accordingly, this analysis/evaluation of in-flight start capability should be done only once a significant set of data has been collected for comparison against the 95% figure. Typically, the number of high-altitude starts required to demonstrate a 95% success rate should include a minimum of 20 attempts.

It is the EDTO fleet of the operator that must be monitored. The non-EDTO fleet, if any, may also be included in the programme but only if these APUs are also configured and maintained in accordance with the EDTO CMP requirements.

The APU in-flight start test is not a maintenance task. The primary role of the maintenance organisation is to:

1) launch the request of an APU in-flight start check which will be executed by flight operations, and

2) record the success or failure for appropriate further maintenance action(s).

Specific procedures to address the maintenance roles should include:

1) notification of the APU in-flight start requirement to flight crews through the maintenance release process and

2) documentation procedures for recording and tracking of success or failure of start attempts as well as reporting to the Director via the EDTO quarterly report.

EDTO Release Statement

It is the responsibility of the operator to ensure that the relevant time limitations of the aeroplane engaged in EDTO operations are not exceeded for any given EDTO flight. Therefore, the operator must implement procedures to control any aeroplane discrepancies that may impact the EDTO serviceability of the aeroplane. This requires the implementation of a system to continuously track and manage the aeroplane's EDTO status.

An EDTO maintenance release statement must be provided to the flight crew to confirm that:

1) the aeroplane condition has been checked and confirmed to comply with the applicable EDTO dispatch requirements set forth in the company policies and applicable MEL

2) the EDTO items of the applicable maintenance line check have been accomplished

3) the aeroplane configuration has been checked and confirmed to comply with the applicable configuration standards set forth in the EDTO CMP document (as applicable), and

4) the capability of relevant TLSes has been assessed.

The EDTO MPM (or equivalent) must define the content of the EDTO service check and the procedures associated with the EDTO maintenance release.

EDTO status: Downgrading and restoration

The EDTO status of the aeroplane must be indicated to the flight crew prior to each EDTO flight. For that purpose, an EDTO release statement should be issued and included in the aeroplane Technical Log. Operations Control must inform the flight crew via a pre-flight operational notice or equivalent, if other operational limits such as training, or carriage of crew affects EDTO capability for any specific aircraft/crew combination.

The EDTO status of the aeroplane depends on:

1) the certified EDTO capability of the aeroplane
2) the configuration of the aeroplane versus the applicable configuration requirements of the EDTO CMP document
3) the compliance of the aeroplane versus the applicable maintenance requirements of the EDTO CMP document
4) the capability of relevant TLS(s), and
5) any inoperative system (MEL).

An EDTO maintenance release statement must therefore be issued as part of the maintenance release of the aeroplane. The EDTO maintenance release statement, which is included in the aeroplane technical logbook, should also be provided to the operator's flight operations organisation for operations control and flight preparation purposes.

It should clearly indicate:

1) whether the concerned aeroplane is EDTO capable (yes or no), and
2) the related maximum diversion time capability.

Figure 1 is a typical example of an EDTO release statement for a two-engine aeroplane certified for EDTO operations up to 180 minutes.

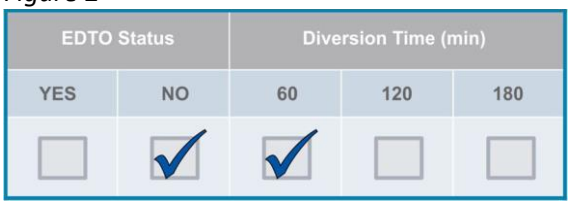
Figure 1

EDTO Status		Diversion Time (min)		
YES	NO	60	120	180
☑	☐	☐	☑	☐

As shown in *Figure 1*, the EDTO status of the concerned aeroplane is as follows:

1) the aeroplane is capable of EDTO, and
2) its maximum diversion time capability is currently 120 minutes.

Figure 2



As shown in *Figure 2*, the EDTO status of the concerned aeroplane is as follows:

1) the aeroplane is restricted to non-EDTO operations, and

2) accordingly, its maximum diversion time capability is 60 minutes.

For EDTO operations beyond 180 minutes, the operator must check that the diversion flight times (plus 15 minutes) along the planned flight track do not exceed the times specified in the AFM (or other relevant aeroplane manufacturer documentation) for the aeroplane's cargo fire suppression system, all engine operating (AEO) time capability, and for the aeroplane's most TLS time (other than cargo fire suppression), one engine inoperative (OEI) time capability.

Therefore, a dedicated process for the check and tracking of the time capability of the relevant TLS(s), should be implemented in order to ensure that this information is adequately transferred to the flight operations organisation (flight planning/dispatchers, flight following, and flight crews).

It may be done by including in the EDTO release statement the necessary check boxes for each of the possible values of time capability of the relevant TLS(s). The corresponding values should be updated as part of the aeroplane's maintenance release anytime there is a situation impacting the time capability of the concerned TLS(s), e.g. in case of:

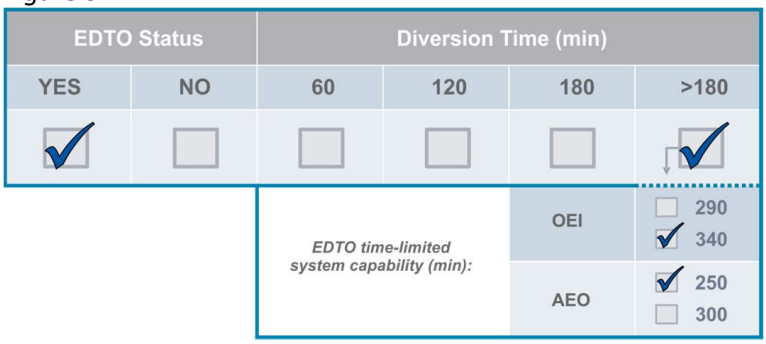
1) the system being inoperative

2) the system being replaced by another with a lesser/greater time capability, and

3) maintenance action impacting the time capability of the system.

Figure 3 is a typical example of an EDTO release statement for EDTO operations beyond 180 minutes.

Figure 3



In this example, the EDTO status of the concerned aeroplane is as follows:

1) the aeroplane is capable of EDTO beyond 180 minutes

2) its maximum OEI time capability is 340 minutes, and

3) its maximum AEO time capability is 250 minutes.

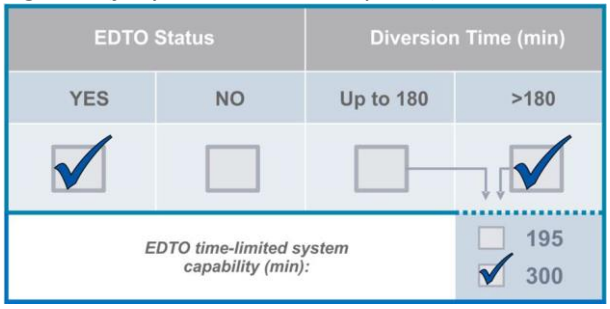
Aeroplane with more than two engines

For aeroplanes with more than two engines, both the basic type certification standards and maintenance programme provide the required level of safety for EDTO and are suitable for EDTO operations. Because of this, the EDTO Standards do not introduce additional maintenance requirements for aeroplanes with more than two engines. Nevertheless, it has also been concluded that a review of the time limitation of relevant TLS(s), if any, is necessary for aeroplanes with more than two engines engaged in EDTO.

Therefore, the EDTO status of aeroplanes with more than two engines is linked to the status of the relevant TLS. The impact of an unserviceable TLS (e.g. an inoperative cargo fire suppression bottle) should still be addressed to facilitate the management of this EDTO status.

Figure 4 provides an example of an EDTO release statement adapted to aeroplanes with more than two engines (assuming that the EDTO threshold has been set at 180 minutes).

Figure 4 (fully serviceable aeroplane)

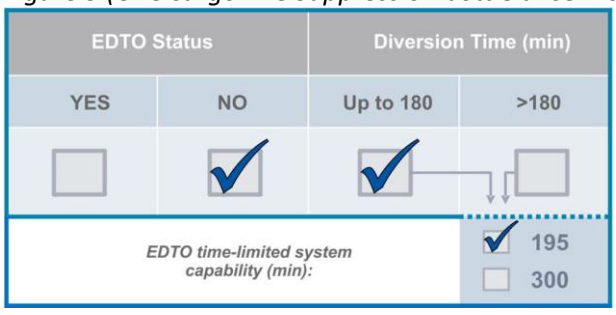


In *Figure 5* the EDTO status of the aeroplane is as follows:

1) The aeroplane is restricted to non-EDTO operations, and

2) Its maximum AEO time capability is 195 minutes.

Figure 5 (One cargo Fire Suppression bottle unserviceable)



Persons authorised to change EDTO status

The changing of the aeroplane EDTO status to “EDTO/non-EDTO" should be carried out by the EDTO authorised person responsible for the aeroplane and advised to the maintenance control centre (or other control system) prior to aeroplane release for service.

The changing of the aeroplane EDTO status to “EDTO/non-EDTO” away from main base by the flight crew when an EDTO authorised person is not available should only be permitted on receipt of authorisation from the maintenance control centre (or other control system). The

EDTO status change should be recorded in the aeroplane technical log by the flight crew prior to the aeroplane release for service.

Centralised Maintenance Control

Although there are no EDTO requirements directly related to Centralised Maintenance Control, the EDTO Operator should have an entity that manages the day-to-day EDTO operation and ensures EDTO dispatches follow programme requirements. Processes for Centralised Maintenance Control should be defined in the EDTO MPM.

The centralised maintenance control entity:

1) Manages the daily EDTO operation, and

2) Ensures an aeroplane is not dispatched on an EDTO flight without a confirmed resolution or MEL relief, in particular after the following occurrences:

   - IFSD
   - EDTO significant system failure
   - Discovery of adverse trends in system performance without corrective action being taken (Oil consumption, intermittent faults, etc.)
   - Requirements for verification flights, or
   - Coordination with flight crew where no qualified EDTO technical person is available.

Technical Training

EDTO operators must create an EDTO training programme to educate personnel on the special nature of EDTO and to assure that EDTO programme tasks are properly accomplished. The training course is an integral part of the operator's EDTO maintenance programme and is in addition to any specific aeroplane technical training required.

The training should ensure that all personnel who have assigned EDTO responsibilities are provided with the necessary training so that EDTO tasks are properly planned and accomplished. The training must be acceptable to the Director and should be described in the operator's EDTO MPM.

The training programme should include consideration of all maintenance providers and contain the process of qualification of individuals. The EDTO MPM should define how the training records are tracked and stored, and a notification process should be implemented to notify qualified personnel when training is required. The process of delegating any training should also be defined in the EDTO MPM.

The EDTO maintenance training should cover:

1) *initial training* to ensure that all maintenance personnel have the knowledge, skills and ability to perform an adequate EDTO technical procedure for the specific Aeroplane Engine combination, and

2) *recurrent training* to ensure that all maintenance personnel maintain and update, if necessary, their awareness of EDTO maintenance specificities.

The recurrent timeline should be defined in the programme, and a notification system should be in place to notify personnel and management of any required up-coming training.

The EDTO training programme should typically include:

1) introduction to EDTO regulations
2) overview of EDTO certification of twin-engine aeroplane
3) EDTO Significant Systems
4) EDTO authorisation (maximum diversion times, TLSs, operator's approved diversion time, EDTO routes, EDTO MEL)
5) CMP and EDTO maintenance programme
6) EDTO pre-departure service check (including the EDTO maintenance release)
7) EDTO reliability programme and procedures
8) Parts control programme
9) EDTO event reporting
10) Verification programme
11) Dual maintenance limitations
12) Engine condition monitoring
13) Oil consumption monitoring
14) APU in-flight start monitoring programme, and
15) Additional procedures for EDTO (as applicable).

The training format can be created as an instructor-led course or as a computer-based training course and should cover the general nature of EDTO. The programme should also reflect the specific operator EDTO maintenance programme requirements. As revisions to the EDTO MPM are developed, the training programme should be revised to include any changes to the EDTO maintenance programme.

The training course can be created by the operator or it can be contracted for development from an outside source. In either case, the programme is the responsibility of the operator and must be acceptable to the Director. The specific theoretical, practical, and/or process training should be defined in a syllabus.

The purpose of EDTO technical training is to ensure that all personnel who are assigned EDTO responsibilities (including technical dispatch, parts control or any other EDTO related function) are provided with the necessary training to ensure EDTO tasks are properly accomplished.

Appropriately authorised personnel will have completed the EDTO training programme, satisfactorily performed EDTO tasks under supervision, and been assessed as competent under the operator's authorisation procedures. Authorised personnel will have access to the scope of their authorisation.

Records of initial training, refresher training, and assessment results must be retained by the operator in accordance with Rule 121.859 (c), that is, for the full period in which they are employed and for a 12 month period after the person leaves.

Appendix B – Operator's EDTO Operating Requirements

Operations En Route Alternate Requirements

Selection

One of the distinguishing features of EDTO is the concept of an EDTO en route alternate aerodrome being available to which an aeroplane can divert after an engine failure or failure combinations which require a diversion.

Whereas most aeroplanes operate in an environment where there is usually a choice of diversion aerodromes available, an aeroplane operating over an extended range route may have only one en route alternate available within a range dictated by the endurance of a particular airframe system (e.g. cargo fire suppressant), or by the maximum diversion time authorised for the operator's aircraft engine combination.

It is, therefore, important that:

- only adequate aerodromes that meet the definition of "Adequate Aerodrome" and "EDTO alternate aerodrome" as defined in Part 1 are selected as possible EDTO en route alternates
- EDTO en route alternates are an aerodrome where after landing, the aeroplane can taxi clear of the active runway/s
- any aerodrome designated as an EDTO en route alternate has the capabilities, services and facilities to safely support that particular aeroplane
- the operator has an established recovery plan which, should it be required, can provide for the physiological needs of the passengers and crew for the duration of the stay at the diversion aerodrome until safe evacuation can be affected
- should the EDTO en route alternate aerodrome fall inside the latitudes defined as "polar areas", any additional requirements specified in rule 121.173 are complied with, and
- flight crew assigned to the flight meet any training and/or recency requirement in regard to the approach and landing at the selected EDTO en route alternate.

Additional Considerations

For an aerodrome to be suitable as an EDTO en route alternate as defined in Part 1, it must also comply with rule 121.71 requirements.

In addition, rule 121.969(b)(3) requires that the latest available meteorological weather forecast for an EDTO en route alternate must, at the time of dispatch, indicate that suitable conditions will exist for a landing to be completed at that aerodrome, in the event that a diversion to it becomes necessary.

Due to the natural variability of weather conditions with time, as well as the need to determine the suitability of a particular en route aerodrome prior to departure, the EDTO en route alternate weather minima for planning purposes are generally higher than the weather minima necessary to initiate an instrument approach (rule 121.977 refers).

This is necessary to ensure that the instrument approach can be conducted safely if the flight has to divert to the en route alternate aerodrome. The visual reference necessary to safely complete an approach and landing is determined by, among other things, the accuracy with which the aeroplane can be controlled along the approach path by reference to instrument aids. The weather minima for non-precision approaches are generally higher than for precision approaches.

Standard En Route Alternate Aerodrome Pre-departure Weather Minima

When an EDTO en route alternate meets the criteria specified in rules 121.977 or 121.979 but is forecast to deteriorate intermittently (INTER) or temporarily (TEMPO) below the landing minima, it may be nominated as a required EDTO en route alternate, provided the critical fuel reserves have been calculated to include 30 or 60 minutes holding (as necessary).

When a forecast provides for a probability (PROB) of less than 40% for a condition to occur, the condition need not be taken into account.

Determination of EDTO En Route Alternate during Flight

The suitability of an EDTO en route alternate aerodrome, for an aeroplane which encounters a situation in flight which may require a diversion whilst en route on an EDTO, is based on a determination that the aerodrome is still suitable for the circumstances. This includes checking that the current weather and field conditions at that aerodrome will permit an instrument approach to be initiated and a landing completed.

Once the flight is dispatched, the flight crew must remain informed of any significant changes at the EDTO alternate aerodromes and must be updated with the latest weather and aerodrome information (as per rule 121.973(a)).

Prior to the EDTO entry point (rules 121.973 (b) & (c)[1]

Prior to proceeding beyond the EDTO entry point, the pilot-in-command should review all the EDTO alternate aerodromes identified on the operational flight plan and ensure that:

- the forecast weather is equal to or exceeds the published operating minima for the expected runway and approach procedure during the applicable validity period, and
- any other changes in the condition of the aerodromes do not preclude their use.

For cases where the weather forecast or aerodrome conditions do not meet the required published operating minima for landing, the flight plan must be amended to include another EDTO alternate aerodrome (i.e. one which does meet the landing minima requirements) within the maximum authorized EDTO diversion time.

If this cannot be done, the EDTO area of operation is compromised and the flight must continue as non-EDTO.

***Note**: The in-flight EDTO alternate weather check prior to proceeding beyond the EDTO entry point is not the same as the flight preparation weather minima check. The in-flight check is based on published operating minima, whereas the flight preparation check is based on the more conservative EDTO dispatch planning minima*.

[1] Also as outlined in ICAO Doc 10085, Section 3.6.

Beyond the EDTO entry point (rule 121.973(e))

Once the flight has entered the EDTO area of operation, if the forecast for any of the designated EDTO alternate aerodromes is revised to below the landing limits or the EDTO alternate aerodrome becomes inadequate, the EDTO flight may continue at the pilot-in-command's discretion.

Note: *Despite the above consideration, it is good practice for the flight crew to continue to monitor the status of the EDTO alternate aerodromes after the flight has entered the EDTO sector. This is typically done for the next primary alternate when approaching an EDTO Equal Time Point.*

It may be necessary to re-check for updated forecasts for aerodromes to confirm this. Once en route, the final decision to divert to a planned EDTO alternate, or any other suitable alternate, rests with the pilot-in-command (PIC).

Passenger Recovery Plan

Rule 121.953(b)(13) states that the operator must ensure that for any nominated EDTO en route alternate there are sufficient facilities to ensure the safety of a full complement of passengers and crew, and the operator has developed a recovery plan that will ensure the safety of the passengers and crew until they are transported to another place that can provide for their safety.

The operator's recovery programme should provide guidance as to what minimum level of services should be available at or in the vicinity of the EDTO en route alternate, which, if not available, would precipitate recovery plans being formulated.

An EDTO en route alternate should be able to provide sufficient accommodation for an aeroplane full of passengers and crew within a 100-mile radius and be capable of providing continuing needs such as medical care, food, water, toilet facilities, shelter and safety.

The recovery plan devised by the operator should be capable of recovering passengers and crew within 48 hours. The operator should devise a plan of substance that details how the operator intends to recover the passengers and crew in the event of a diversion to the particular EDTO en route alternate. The plan should have enough detail to demonstrate that the recovery operation can be readily effected, and that the basic needs of the passengers and crew members can be provided for in the interim.

The plan should address any issues unique to that particular environment. In some environments, provision of shade from direct sunlight and cooling may be a concern, while in others, such as polar areas, plans should provide for shelter from the elements, heating and clothing. After these basic requirements have been met, the plan should then address the extraction procedures.

In all cases, the particular EDTO en route alternate aerodrome environment should drive the requirements of the passenger recovery plan and prioritise the concerns that need to be addressed.

EDTO Flight Preparation and In-flight Considerations

Flight Release Limitation

The flight release limitation should specify the maximum diversion time from an EDTO en route alternate aerodrome for which an operator can conduct a particular EDTO. The

maximum diversion time must not be greater than the value stated in the Operations Specification issued to the operator by the Director.

Flight Planning

The effects of wind and temperature have to be accounted for in the calculation of equal time points and fuel calculations for depressurised operations, one engine inoperative operations and the depressurised with one engine inoperative case. For twin-engine aircraft these are commonly known as 2D, 1E, and 1D respectively.

The operator's programme should provide flight crews with information on adequate aerodromes appropriate to the route to be flown, which are forecast to be at, or greater than, the required EDTO en route alternate weather minima.

Aerodrome facility information and other appropriate planning data concerning these aerodromes should be provided to flight crews for use when executing a diversion. A system of communicating information to the flight crews must be established for provision of current meteorological, route, aerodrome and recovery information.

Weather Information System

An operator should substantiate that the weather information system which it uses can be relied upon to forecast terminal and en route weather with a reasonable degree of accuracy and reliability in the proposed area of operation.

Rule 121.153 specifies that a provider of meteorological information must hold a Part 174 certificate or "equivalent".

Communications

Rules 91.519 and 121.353 list the basic communication and navigation equipment requirements when conducting IFR operations.

For EDTO greater than 180 minutes, additional communication equipment requirements apply – see rules 121.957, 121.961 and 121.965.

An aeroplane must not be released on an EDTO unless the requirements of these rules are met. Communications facilities must be available to provide, under normal conditions of propagation at the appropriate one-engine-inoperative cruise altitude, reliable two-way voice communications between the aeroplane and the appropriate air traffic services unit over the planned route of flight, and the routes to any suitable alternate to be used in the event of a diversion. Where EDTO exceeds 180 minutes, an additional means of communication is required – see rules 121.957, 121.961 and/or 121.965 as appropriate.

Minimum Equipment List (MEL)

System redundancy levels appropriate to EDTOs are reflected in the Master Minimum Equipment List (MMEL).

An operator's MEL may be more restrictive than the MMEL considering the kind of EDTO proposed and equipment service problems unique to the operator. For aeroplanes already in operational service, the existing MEL should be re-evaluated and adjusted to reflect system redundancy level requirements for EDTO.

The MEL should reflect adequate levels of EDTO significant system redundancy to support the EDTO time requested. The systems listed below should be considered in relation to meeting this requirement.

Systems considered to have a significant influence on flight safety may include, but are not limited to:

(a) Air Conditioning

(b) Auto Flight

(c) Communications

(d) Electrical Power

(e) Equipment & Furnishings

(f) Fire Protection

(g) Flight Controls

(h) Fuel System

(i) Hydraulic Power

(j) Ice/Rain Protection

(k) Navigation Equipment

(l) Oxygen

(m) Pneumatic

(n) Electrical/Electronic Panels & Multipurpose Components

(o) Airborne Auxiliary Power

(p) Ignition System

(q) Engine Indicating System, and/ or

(r) Any other equipment specified by the aeroplane manufacturer as necessary for EDTO or ETOPS operations.

Note: *Engine and APU oil consumption must also be considered as necessary (refer rule 121.407).*

EDTO Significant Event during Flight

General

A number of events might prompt the flight crew to consider diverting on an EDTO flight. Some of these events are “technical” in nature and are addressed by non-normal procedures established by the aeroplane manufacturer which are common to all (EDTO and non-EDTO) operations.

Non-normal conditions and flight crew procedures which call for a technical diversion are provided by the aeroplane manufacturer in the quick reference handbook (QRH) or by other methods (e.g. electronic checklists). Procedures are validated during the EDTO certification of the aeroplane and are typically common to both EDTO and non-EDTO operations.

The majority of diversions that have occurred in actual EDTO service have been due to nontechnical causes. Passenger and crew medical emergencies, adverse en route weather conditions, or EDTO alternate aerodromes becoming unavailable may also result in a diversion or air turn back.

The nature of the emergency and possible consequences to the aeroplane, passengers and crew will dictate the best course of action for the specific situation. The flight crew must decide the best course of action based on all available information. Operator procedures documentation and training programmes should support this decision-making process.

Where an event occurs prior to the EDTO entry point, flight crew should use all available means of communication to ensure assistance from the flight dispatcher/flight following to update and/or revise, if applicable, the flight plan as a result of re-evaluating the aeroplane's system capability to ensure that the flight can safely continue into the EDTO area of operation.

Where an event occurs after crossing the EDTO entry point, the flight crew must ensure the safety of the flight is protected.

Note: *Further information and guidance regarding performance data may be found in ICAO Doc 10085 EDTO Manual, Section 3.6.3.*

Be prepared

Many of the potential scenarios that could lead to an EDTO en route diversion are events that rarely happen. However, like all the other events that could occur during flight, the flight crew should be prepared to handle these situations safely and effectively. A key element of being well prepared for an EDTO diversion is the pre-flight briefing, where possible areas of concern can be reviewed, and the potential plans of action communicated to all the flight crew without the added stress of required immediate action.

A review of the weather and terrain along possible EDTO diversion tracks should ensure that the crew has a common plan for handling possible contingencies. On long flights, with crew members transitioning from a duty station to crew rest and back, it is important that standard operating procedures be followed to minimize any possible confusion about the aeroplane's position relative to EDTO ETPs and the direction of turn required to proceed to the nearest designated en route alternate aerodrome on the operational flight release.

Note*: The EDTO alternate aerodromes determined during the EDTO flight preparation process provide one potential course of action in the event of an en route diversion. However, the flight crew is not bound by the dispatch assumptions and may select another diversion aerodrome if this is determined to be more suitable for the prevailing operational conditions.*

Diversion decision-making

It is not possible to cover every situation that might occur during a diversion, so operator guidance to flight crews may be general only. It is left up to the judgment of the flight crew to conduct the flight as safely as possible in light of prevailing operational conditions.

The specific guidance provided by EDTO operators to their flight crews may also include the details of terrain clearance or oxygen limited escape route policies and procedures which the operator has established. Terrain clearance and oxygen requirements are generally independent of EDTO and should be covered as needed in other applicable sections of the operator's operations manual.

EDTO alternate aerodromes listed in the flight release for a particular EDTO flight provide one diversion option to the pilot-in-command, as do the selected EDTO diversion planning speeds established by the operator. However, the EDTO alternates selected at dispatch may not be the only aerodromes available for the diversion. Furthermore, the EDTO one engine inoperative or all engine operative speeds used at the planning stage may not be the best choice for a particular circumstance. Operator policy should specify the authority of the pilot-in-command to deviate from these dispatch planning parameters in the event of an actual EDTO diversion.

Diversion strategies

Once the need for an EDTO diversion has been established and an en route alternate aerodrome selected, the flight crew will need to consider how to conduct the diversion based on the nature of the emergency and prevailing operational considerations. Non-technical diversions or technical diversions which do not have a significant impact on the performance of the aeroplane would normally be performed at a typical cruise flight condition or at a higher all-engine cruise speed to minimize the diversion time as permitted by the aeroplane's fuel state.

For an engine failure diversion, the consequences of speed selection on the aeroplane's performance (e.g. fuel, altitude) can be significant particularly for a two-engine aeroplane. As such, it is important for the flight crew to understand these consequences and to have appropriate guidance to choose the safest and most appropriate diversion strategy. Typically, there are three primary considerations to determine the best course of action from the standpoint of one engine inoperative speed selection which may be described as follows:

Time strategy

If minimum diversion time and getting the aeroplane on the ground as soon as possible are the most critical considerations, a high one engine inoperative speed strategy may be selected, as permitted by the aeroplane's fuel state, altitude capability and structural integrity. For two-engine aeroplanes, the time strategy is sometimes considered to be equivalent to the approved one engine inoperative speed, but a higher speed approaching VMO/MMO could be selected if conditions warrant. The flight crew is not bound by the speed assumptions used for EDTO flight preparation purposes.

Fuel strategy

If the fuel remaining to accomplish the diversion is the most critical consideration, one engine inoperative long-range cruise (LRC) speed or even maximum range cruise (MRC) speed could be selected to optimise fuel management during the diversion. EDTO critical fuel planning will generally preclude the possibility of a fuel-critical EDTO diversion; however, fuel may nevertheless be a primary consideration in managing the diversion.

Note: *Further information and guidance regarding fuel requirements may be found in ICAO Doc 10085 EDTO Manual, Section 3.5.3.*

Obstacle strategy

If the diversion track following engine failure will traverse high terrain, additional care should be taken in speed selection to ensure that en route terrain clearance margins are maintained. The speed associated with maximum lift over drag ratio (L/Dmax) will provide the best OEI altitude performance and should be selected until clear of any limiting terrain.

In the occurrence of any EDTO significant event in-flight prior to the EDTO entry point, all available means of communication should be used by the flight crew to ensure assistance from the flight dispatcher/flight following to update and/or revise, if applicable, the flight plan as a result of re-evaluating the aeroplane's system capability to ensure that the flight can safely continue into the EDTO area of operation.

Alternate Aerodromes

Rule 121.969 states that an aeroplane must not be dispatched on an EDTO unless the required take-off, destination and alternate aerodromes, including EDTO en route alternate aerodromes (to be used in the event of a diversion), are listed in the dispatch release. This is in addition to the requirements of rules 91.405 and 91.407 which also list requirements that must be included in an operational flight plan.

Since these EDTO en route alternates serve a different purpose than the destination alternate aerodrome, and would normally be used only in the event of a diversion, an aerodrome must not be listed as an EDTO en route alternate unless it meets the requirements of an EDTO en route alternate aerodrome as defined in Part 1 Definitions and further in rule 121.969(b).

During the flight, the flight crew are to be informed, by the operator, of any significant changes in conditions at the required EDTO en route alternates. Changes to EDTO en route alternate weather forecast conditions and qualifying conditions are discussed in detail in paragraph "Determination of EDTO En route Alternate during Flight" above.

Fuel and Oil Supply

Rule 121.975 details the EDTO fuel requirements. Rule 121.75 also discusses the requirement for an operator to develop a "fuel policy". The data required to comply with rule 121.975 and 121.75 must be included in the operator's exposition (refer to rule 119.81(a)(1)(i)) which must contain sufficient data to support the critical fuel reserve and EDTO area of operations calculation.

An aeroplane should not be dispatched on an EDTO flight unless it carries sufficient fuel and oil to meet the requirements of rule 121.975(a), including additional contingency fuel reserves.

Fuel Requirements

Rule 121.975 details the EDTO fuel requirements. Rule 121.75 also discusses the requirement for an operator to develop a "fuel policy". The data required to comply with rule 121.975 and 121.75 must be included in the operator's exposition (refer to rule 119.81(a)(1)(i)) which must contain sufficient data to support the critical fuel reserve and EDTO area of operations calculation.

An aeroplane should not be dispatched on an EDTO flight unless it carries sufficient fuel to meet the requirements of rule 121.975(a), including additional contingency fuel reserves.

The EDTO critical fuel calculation is strictly a flight preparation consideration and does not apply once en route, as operational variances such as more adverse winds than forecast may result in actual fuel burns which differ from the assumptions used to produce the operational

flight plan. EDTO operators should develop a minimum en route fuel policy as the basis for the flight crew to determine if the fuel remaining on the aeroplane is sufficient to complete the mission. It is not necessary for the calculated critical fuel to be on board when passing the EDTO ETPs including the critical point provided these en route policy reserves are satisfied.

EDTO critical fuel calculation is intended to ensure that the planned fuel load is sufficient to support an en route diversion from the most critical EDTO ETP critical point (CP) in the event of an engine failure, a depressurisation, or both, with appropriate planning allowances. This does not preclude the importance of en route fuel progress monitoring, which is complementary to the flight preparation process.

EDTO operators should develop appropriate en route procedures for flight crews to track actual versus planned fuel burn on the operational flight plan (OFP) and appropriate contingency procedures in the event that the fuel state of the aeroplane becomes unacceptable to complete the intended mission.

The importance of adhering to these procedures should be addressed in the EDTO training programme.

Note: *Further information and guidance regarding EDTO fuel requirements may be found in ICAO Doc 10085 EDTO Manual, section 3.5.3.*

Aeroplane Performance Data

An aeroplane should not be released on an EDTO flight unless the operator's Exposition contains sufficient performance data to support all phases of any applicable EDTO operation. The following data must be based on approved information provided or referenced in the AFM or provided by the aeroplane manufacturer:

(a) EDTO area of operations (diversion distance)

(b) Detailed one-engine inoperative performance data, including fuel flow for standard and non-standard atmospheric conditions, and as a function of airspeed and power setting where appropriate, covering:

  (i) driftdown (includes net performance)

  (ii) cruise altitude coverage including 10,000 feet

  (iii) holding

  (iv) altitude capability (includes net performance), and

  (v) fuel requirements

(c) Detailed AEO performance data, including nominal fuel flow data, for standard and non-standard atmospheric conditions covering:

  (i) cruise performance (altitude coverage including 10 000 ft), and

  (ii) holding, and

(d) Details of any other conditions relevant to EDTO which can cause significant deterioration of performance, such as ice accumulation on the unprotected surfaces of the aeroplane, Ram Air Turbine (RAT) deployment, thrust reverser deployment, etc.

Note: *Further information and guidance regarding performance data may be found in ICAO Doc 10085 EDTO Manual, Section 3.7.*

Area of Operation

In determining an EDTO area of operation, for any given airframe/engine combination, operators are to nominate the performance data used (altitudes, airspeeds, thrust settings and fuel flow). The resulting aeroplane performance must ensure compliance with terrain and obstruction clearance requirements specified in Subpart D of Part 121. To comply with the en route requirements particular attention must be paid to rule 121.215, *En route critical engine inoperative*.

Dispatch Requirements

The dispatch requirements are specified in rules 121.969 (general requirements up to 180 minutes EDTO) and 121.971 (additional requirements for dispatch more than 180 minutes EDTO). While each differ, the requirement is that, despite what EDTO diversion time authorisation the type of aeroplane may hold, the EDTO limit at dispatch must be no more than that which the aeroplane is capable of.

For example, an aeroplane may hold a 240 minute authorisation and be about to be dispatched, but on this occasion not all fire bottles are available. The MEL may allow the aeroplane to depart, but the maximum fire suppression time available will have been reduced to 210 minutes. The EDTO planned would thus have to be reduced to 195 minutes (195 + 15 = 210 or refer to rule 121.969(a)(3)) to meet rule requirements.

Release Considerations

Rules 121.407(2) and 121.969 specify considerations that must be satisfied for an aeroplane to be released on an EDTO.

Under rule 121.969(a)(2), the dispatch release must include a list of all aerodromes that are required for the operation. Whilst not specified in the rules, it would also be expected that the operator would identify for the pilot-in-command the maximum diversion time that applies to each flight in the dispatch release documentation.

No aeroplane should be dispatched on EDTO unless the MEL supports the operation for the EDTO planned.

Flight Crew & Dispatch Training, Evaluation Programme

Rule 121.953(b)(8) states that one of the elements required by the Director when assessing an application for EDTO authorisation is the “EDTO specific” training package. This must be applicable to the EDTO and maximum diversion time proposed. Dispatch training will require a programme that addresses the preparation, planning, and flight following requirements: the topics listed below are required, but not to the same degree of type-specific operational detail that flight crew require.

Note*: An EDTO training and competency program that evaluates training and competency needs under an evidence-based training (EBT) programme approved by the Director, may not require all elements described below.*

Part 121 Subpart I identifies the general crew member training requirements. The operator’s flight crew training programme in respect of EDTO must address the elements of Subpart I (as appropriate) and provide training, evaluation, proficiency checks, and refresher training in the following areas:

(a) Introduction to EDTO rules and authorisations

(b) Routes and aerodromes intended to be used in the EDTO area of operations, including QFE/QNH and metre/feet conversions

(c) General route specific training on seasonal weather systems, and

(d) Performance (flight planning, including all contingencies, and flight performance progress monitoring), and

(e) Procedures:

(i) Relevant aeroplane systems limitations e.g. fuel temperature limitations

(ii) Diversion procedures and diversion decision making. Initial and recurrent training to prepare flight crews to evaluate probable propulsion and airframe systems failures should be conducted. The goal of this training is to establish crew competency in dealing with the most probable operating contingencies, and

(iii) Use of appropriate navigation and communication systems, including appropriate flight management devices, and the effect of solar flare activity.

The flight crew must be provided with detailed initial and annual recurrent training which emphasises abnormal and emergency procedures to be followed in the event of foreseeable failures in each area of operation, including:

(a) Procedures for single and multiple failures in flight that would precipitate go/no go and diversion decisions. If standby sources of electrical power significantly degrade cockpit instrumentation to the pilots, then approved training, which simulates an instrument approach with the standby generator as the sole power source, must be conducted during initial and recurrent training

(b) Operational restrictions associated with these failures including any applicable MEL consideration

(c) Procedures for air start of the propulsion systems, including the APU, if required

(d) Use of emergency equipment including anti-exposure suits (if EDTO will encompass operations in Polar Regions) and ditching equipment

(e) The operator's passenger recovery plan

(f) Procedures to be followed if there is a change in conditions at designated EDTO en route alternates, which would preclude a safe approach and landing

(g) Understanding and effective use of approved additional or modified equipment required for EDTO

(h) Training on the fuel management procedures to be followed during the en route portion of the flight. These procedures must provide for an independent cross-check of fuel quantity indicators. For example, fuel flows could be used to calculate fuel burned and compared with indicated fuel remaining, and

(i) Training on fuel freeze issues.

EDTO Check Programme

The objective of the EDTO check programme should be to ensure standardised flight crew practices and procedures and also emphasise the special nature of EDTO. Only those with a demonstrated understanding of the unique requirements of EDTO should be designated as Airline Flight Examiners for EDTO.

Appendix C - Polar Area Operations

Polar Area (North and South Pole) Operations

This section documents the requirement for the operator to develop plans in preparation for all polar flights in the north and south polar areas (defined in Part 1 as north of 78 degrees north latitude or south of 60 degrees south latitude), and identifies equipment and aeroplane configuration requirements that apply to all operations in these areas from 1 October 2011.

Polar Area Authorisation

Rule 121.173 lays out the requirements for authorisation to operate in a polar area. Operators are required to obtain authorisation from the Director to conduct these operations and also obtain authorisation to operate in the area of magnetic unreliability. Application should be made on CAA Form 24119/01 at least 90 days prior to the proposed commencement date of operation. The Director's authorisation is granted by issue of appropriate Operations Specifications.

Requirements for En Route Alternate Aerodromes

The flight must be able to make a safe landing and the aeroplane should be able to be manoeuvred off the runway at the selected diversion aerodrome.

For these operations, the passenger recovery plan should include special consideration for the possibility of extreme weather, limited passenger facilities and the need to initiate passenger recovery without delay.

Fuel Freeze Strategy and Monitoring

The operator may wish to develop a fuel freeze strategy and monitoring programme in lieu of using the standard minimum fuel freeze temperatures for specific types of fuel used. In such cases, the operator's fuel freeze analysis and monitoring programme for the aeroplane fuel load is subject to the Director's acceptance.

The operator should have procedures established that require coordination between maintenance, dispatch, and assigned flight crew to convey the determined fuel freeze temperature of the fuel load on board the aeroplane.

Communication Capability

Under rule 121.173 the operator must have an effective voice communications and/or data link capability for all portions of the flight route.

Company communications may be accomplished using High Frequency (HF) voice, HF data link, Satellite Communication (SATCOM) voice or SATCOM data link.

It is recognised that SATCOM may not be available for short periods during flights in the polar areas.

Communication capability with HF radios may be affected during periods of solar flare activity. The operator needs to consider, for each dispatched flight, the predicted solar flare activity and its effect on communication.

Training Requirements

The operator should reflect the following training requirements in its approved training programmes:

(a) QFE/QNH and metre/feet conversions (required for both flight crew and dispatch personnel training)

(b) Fuel freeze issues (for maintenance, dispatch and flight crew personnel)

(c) Seasonal weather systems and their impact on operations (for dispatch and flight crew personnel)

(d) Aeroplane system limitations e.g. fuel temperature limits (for dispatch and flight crew personnel)

(e) The provision of aeroplane systems capability to dispatch and flight crew to aid the PIC and Dispatcher in diversion decision making (for maintenance personnel)

(f) Crew training in the use of anti-exposure suits (for flight and cabin crew personnel)

(g) The effect of solar flare on the performance of navigation and communication equipment (for dispatch and flight crew personnel), and

(h) The operator's passenger recovery programme (for maintenance, dispatch, flight and cabin crew personnel).

Special Equipment for Polar Operations

Rule 121.173(7) requires a minimum of **two** cold-weather anti-exposure suits to be on board, so that outside coordination at a diversion aerodrome with extreme climatic conditions can be accomplished safely. A short-term MEL relief for this item may be granted, provided the operator has arranged ground support provisions for providing such protective clothing at alternate aerodromes. The Director may relieve the operator from this requirement if the season of the year makes it unnecessary.

Demonstration Flight before Authorisation

In order to receive authorisation to conduct these operations, the Director may, in accordance with the provisions of rule 121.57, require the operator to conduct a demonstration flight. The demonstration flight may be conducted in the aeroplane or an approved flight simulator, as determined by the Director on a case-by-case basis. As part of the demonstration flight, the operator may be required to exercise its recovery plan in the event of a diversion to one of its designated alternates, with emphasis on:

(a) Communications

(b) Coordination

(c) Facilities

(d) Accuracy of NOTAM and weather information, and

(e) Operability of ground equipment during the simulated diversion.

The details of the operator's recovery plan may be considered by the Director before the demonstration flight. The Director may give favourable consideration to a request by the operator to conduct the demonstration flight on a revenue flight if the operator's recovery plan has previously been evaluated as satisfactory.