Civil Aviation Department
The Government of the
Hong Kong Special Administrative Region

CAD 513

EXTENDED DIVERSION TIME OPERATIONS (EDTO)

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FOREWORD

The development of the modern turbofan engine has made it possible to extend the range of multi-engined aeroplanes to allow some of them to fly great distances.

The problems that must be taken into account when planning flights over such distances include the availability of suitable aerodromes where a landing can be made in the event of an emergency.

Because of the additional problems associated with the loss of a power unit or certain major systems, it is necessary, as a first step to set a limit on the distance a multi-engined aeroplane may be from an adequate aerodrome without special requirements being imposed. Any operation that is planned to involve flight by a multi-engined public transport aeroplane where the diversion time to an en-route alternate aerodrome is greater than the threshold time will be considered as Extended Diversion Time Operations (EDTO).

CAD 513 indicates the criteria by which EDTO will be assessed. For the convenience of users, all matters relevant to EDTO are included, and consequently there is some repetition of criteria already applicable to other types of operations.

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SECTION I - EDTO GENERAL

Guidance for operations by turbine engine aeroplanes beyond 60 minutes to an en-route alternate aerodrome including EDTO

1. DEFINITIONS

1.1 Alternate aerodrome

An aerodrome to which an aircraft may proceed when it becomes either impossible or inadvisable to proceed to or to land at the aerodrome of intended landing where the necessary services and facilities are available, where aircraft performance requirements can be met and which is expected to be operational if required. Alternate aerodromes include the following:-

1.1.1 Take-off alternate

An alternate aerodrome at which an aircraft would be able to land should this become necessary shortly after take-off and it is not possible to use the aerodrome of departure.

1.1.2 En-route alternate

An alternate aerodrome at which an aircraft would be able to land in the event that a diversion becomes necessary while en route.

1.1.3 Destination alternate

An alternate aerodrome at which an aircraft would be able to land should it become either impossible or inadvisable to land at the aerodrome of intended landing.

Note.— The aerodrome from which a flight departs may also be an en-route or a destination alternate aerodrome for that flight.

1.2 Extended diversion time operation (EDTO)

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 established by CAD.

1.3 EDTO critical fuel

The fuel quantity necessary to fly to an en-route alternate aerodrome considering, at the most critical point on the route, the most limiting system failure, EDTO significant system. An aeroplane system whose failure or degradation could adversely affect the safety of an EDTO flight, or whose continued functioning is important to the safe flight and landing of an aeroplane during an EDTO diversion.

1.4 Isolated aerodrome

A destination aerodrome for which there is no destination alternate aerodrome suitable for a given aeroplane type.

1.5 Maximum diversion time

Maximum allowable range, expressed in time, from a point on a route to an en-route alternate aerodrome.

1.6 Point of no return

The last possible geographic point at which an aeroplane can proceed to the destination aerodrome as well as to an available en-route alternate aerodrome for a given flight.

1.7 Threshold time

The range, expressed in time, established by CAD to an en-route alternate aerodrome, whereby any time beyond requires an EDTO Approval from CAD.

2. INTRODUCTION

2.1 Extended Range Twin Operations (ETOPS) enable properly certificated twin-engined aeroplanes operated by appropriately qualified flight crew to fly further than a threshold time of 60 minutes at One Engine Inoperative (OEI) cruise speed. In accordance with International Civil Aviation Organization (ICAO) Annex 6 Part I, such requirement is renamed as Extended Diversion Time Operations (EDTO) and is expanded to include the operation of aeroplanes with three and four engines.

2.2 For all twin-turbine engined aeroplanes which are flying for the purpose of public transport, with maximum authorized take-off weight exceeds 5,700 kg and certificated to carry more than 19 passengers, and requires to fly more than a threshold time of 60 minutes (calculated at OEI cruise speed in still air and International Standard Atmosphere (ISA) conditions) from an en-route alternate aerodrome; or

all aeroplanes with three or more turbine engines which are flying for the purpose of public transport and require to fly more than a threshold time of 180 minutes flight time (calculated at an All Engines Operative (AEO) cruise speed in still air and ISA conditions) from an en-route alternate aerodrome;

the corresponding operations must be so approved in accordance with the requirements stipulated in this document.

2.3 ETOPS is considered as equivalent to EDTO for twin-turbine engined aeroplanes. Operators with ETOPS Approval DO NOT require to apply for EDTO Approval for the same aeroplane airframe/engine combinations and on the same routes and to the same maximum diversion time as was authorised for ETOPS. The previous edition of CAD 513, which details the corresponding provisions for ETOPS, is considered as an acceptable mean of compliance to the requirements for EDTO for twin-engined aeroplanes. Therefore they are maintained and adopted in this document as Section II Sub-Section B.

2.4 Readers should note the following:

(a) When the diversion time exceeds the threshold time, the operation is considered to be an EDTO.

(b) For the purpose of EDTO, the take-off and/or destination aerodromes may be considered en-route alternate aerodromes.

2.5 The purpose of this document is to provide guidance on the general provisions relating to operations by aeroplanes mentioned in paragraph 2.2 of Section I beyond 60 minutes flying time to an en-route alternate aerodrome and EDTO. The guidance will form the basis for establishing a threshold time and approving the maximum diversion time for a given operator with a specific aeroplane type. This document also provides guidance on the means of achieving the required level of safety envisaged.

2.6 Similar to the threshold time, the maximum diversion time is the range (expressed in time) from a point on a route to an en-route alternate aerodrome up to which CAD will grant approval. When approving the operator's maximum diversion time, CAD will need to consider not only the capable range of the aircraft, taking into consideration any limitation of the aeroplanes type certificate, but also the operator's previous experience on similar aircraft types and routes.

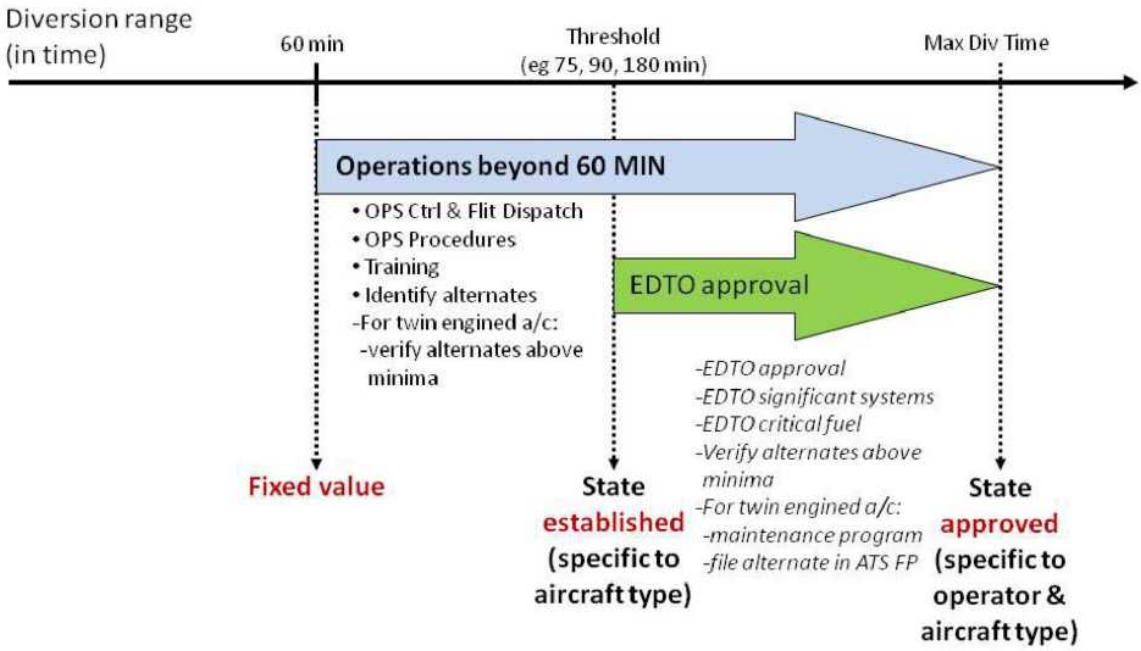
2.7 EDTO applicants must apply in writing to the Director-General of Civil Aviation (DGCA) and provide the details as required by this document.

3. OPERATIONS BY AEROPLANES WITH TURBINE ENGINES BEYOND 60 MINUTES TO AN EN-ROUTE ALTERNATE AERODROME

3.1 General

3.1.1 All provisions for operating by aeroplanes with turbine engines beyond 60 minutes to an en-route alternate aerodrome also apply to EDTO (see Figure 1).

Figure 1: Generic EDTO graphical representation.



3.1.2 Operators conducting operations beyond 60 minutes from a point on a route to an en-route alternative aerodrome shall ensure that:

(a) for all aeroplanes:

(i) en-route alternate aerodromes are identified;

(ii) the most up-to-date information is provided to the flight crew on identified en-route alternate aerodromes, including operational status and meteorological conditions;

(b) for aeroplanes with two turbine engines, the most up-to-date information provided to the flight crew indicates that conditions at identified en-route alternate aerodromes will be at or above the operator's established aerodrome operating minima for the operation at the estimated time of use.

3.1.3 In addition to the requirements in paragraph 3.1.2 of Section I, all operators shall ensure that the following are taken into account and provide the overall level of safety intended by the operator's Safety Management System (SMS):

(a) operational control and flight dispatch procedures;

(b) operating procedures; and

(c) training programmes.

3.1.4 In applying the requirements as stated in paragraph 3.1.3 of Section I, it should be understood that:

(a) operational control refers to the exercise by the operator of responsibility for the initiation, continuation, termination or diversion of a flight;

(b) flight dispatch procedures refer to the method of control and supervision of flight operations. This does not imply a specific requirement for licensed flight dispatchers or a full flight following system;

(c) operating procedures refer to the specification of organization and methods established to exercise operational control and flight dispatch procedures in the appropriate manual(s) and should cover at least a description of responsibilities concerning the initiation, continuation, termination or diversion of each flight as well as the method of control and supervision of flight operations; and

(d) training programme refers to the training for pilots and flight operations officers/flight dispatchers in operations covered by this and following sections.

3.1.5 Aeroplanes with turbine engines operating beyond 60 minutes to an en-route alternate aerodrome are not required to have specific additional approval by CAD except if they engage in EDTO.

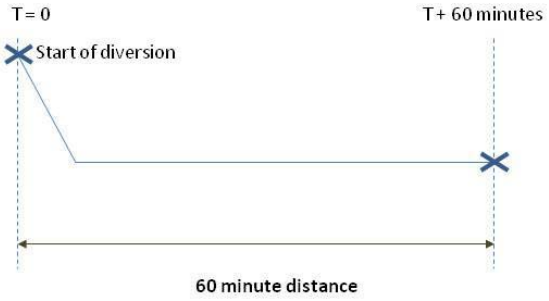
3.2 Conditions to be used when converting diversion times to distances

3.2.1 For the purpose of this guidance, an "approved OEI speed" or "approved AEO speed" is any speed within the certified flight envelope of the aeroplane.

3.3 Determination of the 60 min distance - aeroplanes with two turbine engines

3.3.1 For determining whether a point on the route is beyond 60 minutes to an en-route alternate, the operator should select an approved OEI speed. The distance is calculated from the point of the diversion followed by cruise for 60 minutes, in ISA and still air conditions as shown in the Figure 2 below. For the purposes of computing distances, credit for drift down may be taken.

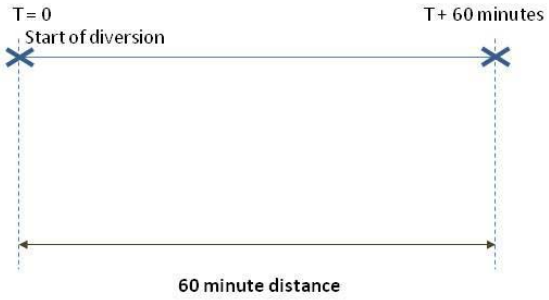
Figure 2: 60 min distance - Aeroplanes with two turbine engines



3.4 Determination of the 60 min distance - aeroplanes with more than two turbine engines

3.4.1 For determining whether a point on the route is beyond 60 minutes to an en-route alternate, the operator should select an approved AEO speed. The distance is calculated from the point of the diversion followed by cruise for 60 minutes, in ISA and still air conditions as shown in the Figure 3 below.

Figure 3: 60 min distance - Aeroplanes with more than two turbine engines



3.5 Training

Operators should ensure that the training programmes should include, but not limited to, route qualification, flight preparation, concept of EDTO and criteria for diversions.

3.6 Flight dispatch and operational requirements

3.6.1 In applying the general flight dispatch requirements, particular attention should be paid to the conditions which might prevail any time that the operation is beyond 60 minutes to an en-route alternate aerodrome, e.g. systems degradation, reduced flight altitude, etc. For compliance with ICAO requirements at least the following aspects should be considered:

(a) identify en-route alternate aerodromes;

(b) ensure that prior to departure the flight crew is provided with the most up-to-date information on the identified en-route alternate aerodromes, including operational status and meteorological conditions and, in flight, make available means for the flight crew to obtain the most up-to-date weather information;

(c) methods to enable two-way communications between the aeroplane and the operator's operational control centre;

(d) ensure that the operator has a means to monitor conditions along the planned route including the identified alternate aerodromes and ensure that procedures are in place so that the flight crew are advised of any situation that may affect the safety of flight;

(e) ensure that the intended route does not exceed the established aeroplane threshold time unless the operator is approved for EDTO operations;

(f) pre-flight system serviceability including the status of items in the minimum equipment list;

(g) communication and navigation facilities and capabilities;

(h) fuel requirements; and

(i) availability of relevant performance information for the identified en-route alternate aerodrome(s).

3.6.2 In addition, operations conducted by aeroplanes with two turbine engines require that prior to departure and in flight, the meteorological conditions at identified en-route alternate aerodromes will be at or above the aerodrome operating minima required for the operation during the estimated time of use.

3.7 En-route alternate aerodromes

3.7.1 Aerodrome(s) to which an aircraft may proceed in the event that a diversion becomes necessary while en route, where the necessary services and facilities are available, where aircraft performance requirements can be met, and which are expected to be operational if required, need to be identified any time that the operation is beyond 60 minutes to an en-route alternate aerodrome.

4. EDTO REQUIREMENTS

4.1 Basic concept

This section addresses provision that apply in addition to operations by aeroplanes with two or more turbine engines where the diversion time to an en-route alternate aerodrome is greater than the threshold time established by CAD (i.e. EDTO).

4.2 The maximum diversion time is the range (expressed in time) from a point on a route to an en-route alternate aerodrome up to which CAD will grant approval. When approving the operator's maximum diversion time for an operator of a particular aeroplane type engaged in EDTO, CAD will need to consider not only the capable range of the aircraft, taking into consideration any limitation of the aeroplanes type certificate, but also the operator's previous experience on similar aircraft types and routes. The following factors will also be considered in conjunction with other requirements stipulated in this document:

(a) for all aeroplanes: the most limiting EDTO significant system time limitation, if any, indicated in the aeroplane flight manual (directly or by reference) and relevant to that particular operation is not exceeded; and

(b) for aeroplanes with two turbine engines: the aeroplane is EDTO certified.

4.3 Notwithstanding the provisions in paragraph 4.2(a) of Section I, the CAD may, based on the results of a specific safety risk assessment conducted by the operator which demonstrates how an equivalent level of safety will be maintained, approve operations beyond the time limits of the most time-limited system. The specific safety risk assessment shall include at least the:

(a) capabilities of the operator;

(b) overall reliability of the aeroplane;

(c) reliability of each time-limited system;

(d) relevant information from the aeroplane manufacturer; and

(e) specific mitigation measures.

4.4 For aeroplanes engaged in EDTO, the additional fuel required by CAD360 Part I Chapter 4 shall include the fuel necessary to comply with the EDTO critical fuel scenario.

4.5 A flight shall not proceed beyond the threshold time in accordance with paragraph 2.2 of Section I unless the identified en-route alternate aerodromes have been re-evaluated for availability and the most up-to-date information indicates that, during the estimated time of use, conditions at those aerodromes will be at or above the operator's established aerodrome operating minima for the operation (i.e. suitable aerodromes). If any conditions are identified that would preclude a safe approach and landing at that aerodrome during the estimate time of use, an alternative course of action shall be determined.

4.6 EDTO significant systems

4.6.1 EDTO significant systems may be the aeroplane propulsion system and any other aeroplane systems whose failure or malfunctioning could adversely affect safety unique to an EDTO flight, or whose functioning is important to continued safe flight and landing during an aeroplane EDTO diversion.

4.6.2 Many of the aeroplane systems which are essential for non-EDTO may need to be reconsidered to ensure that the redundancy level and/or reliability will be adequate to support the conduct of safe EDTO.

4.6.3 The maximum diversion time should not exceed the value of the EDTO significant system limitation(s), if any, for EDTO identified in the Aeroplane's Flight Manual directly or by reference, reduced with an operational safety margin, commonly 15 minutes, specified by the CAD.

4.6.4 The specific safety risk assessment to approve operations beyond the time limits of an EDTO significant time-limited system should be based on the safety risk management guidance contained in the *Safety Management Manual* (Doc 9859). Hazards should be identified and safety risks assessed according to predicted probability and the severity of the consequences based on the worst foreseeable situation. When addressing the following components of the specific safety risk assessment it should be understood that:

(a) capabilities of the operator refer to the operator's quantifiable in-service experience, compliance record, aeroplane capability, and overall operational reliability that:

(b) is sufficient to support operations beyond the time limits of an EDTO significant time-limited system;

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

(d) there is an expectation that the operator's established processes, necessary for successful and reliable EDTO, can be successfully applied to such operations;

(e) overall reliability of the aeroplane refers:

(i) to 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

(ii) relevant data from the aeroplane manufacturer and data from the operator reliability program used as a basis to determine overall reliability of the aeroplane and its EDTO significant systems;

(iii) reliability of each time limited system refers to quantifiable standards of design, testing and monitoring that ensure the reliability of each particular EDTO significant time limited system;

(iv) relevant information from the aeroplane manufacturer refers to 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; and

(v) specific mitigation measures refer to the safety risk management mitigation strategies that ensure an equivalent level of safety is maintained. These specific mitigations shall be based on:

- technical expertise (e.g. data, evidence, concurrence by the manufacturer) proving the operator’s eligibility for an approval of operations beyond the time limit of the relevant EDTO significant system; and
- an assessment of relevant hazards, their probability and 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.

4.7 Threshold time

4.7.1 It should be understood that the threshold time established is not an operating limit. It is a flight time to an en-route alternate aerodrome, which is established by the CAD as being the EDTO threshold beyond which particular consideration should be given to the aeroplane capability as well as the operator's relevant operational experience, before granting an EDTO approval.

4.8 Maximum diversion time

4.8.1 It should be understood that the maximum diversion time approved should take into consideration the most limiting EDTO significant system time limitation, if any, indicated in the Aeroplane's Flight Manual (directly or by reference) for a particular aeroplane type and the operator's operational and EDTO experience, if any, with the aeroplane type, or if relevant with another aeroplane type or model.

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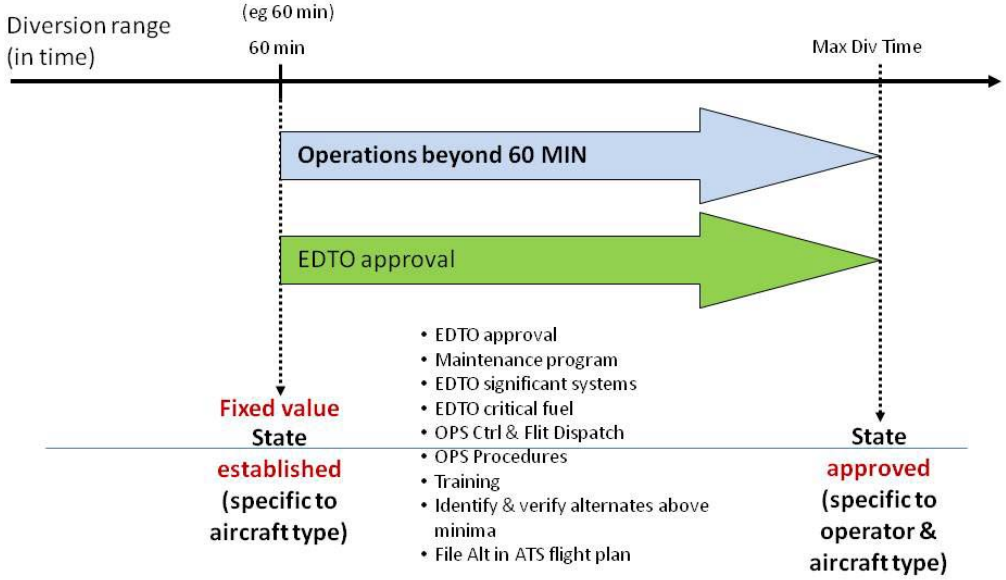
SECTION II - EDTO for Aeroplanes with Two Turbine Engines

Sub-Section A: Basic Principles

1. GENERAL

EDTO provisions for aeroplanes with two turbine engines do not differ from the previous ETOPS provisions. Therefore ETOPS carry the same meaning as EDTO for twin turbine-engined aeroplanes (see Figure 4).

Figure 4: Generic EDTO graphical representation for aeroplanes with two turbine engines.



2. OPERATIONAL AND DIVERSION PLANNING PRINCIPLES

When planning or conducting EDTO, an operator and pilot-in-command, should normally ensure that:

(a) the minimum equipment list, the communications and navigation facilities, fuel and oil supply, en-route alternate aerodromes or aeroplane performance, are appropriately considered;

(b) in the event of an aeroplane engine shutdown, the aircraft can proceed to and land at the nearest (in terms of the least flying time) en-route alternate aerodrome where a safe landing can be made; and

(c) in the event of a single or multiple failure of an EDTO significant systems or systems (excluding engine failure), the aircraft can proceed to and land at the nearest available en-route alternate aerodrome where a safe landing can be made unless it has been determined that no substantial degradation of safety results from any decision made to continue the planned flight.

3. EDTO CRITICAL FUEL

3.1 An aeroplane with two engines engaged in EDTO operations should carry enough fuel to fly to an en-route alternate aerodrome. This EDTO critical fuel corresponds to the additional fuel that may be required to comply with CAD 360 Part I Chapter 4.

3.2 The following should be considered, using the anticipated mass of the aeroplane, in determining the corresponding EDTO critical fuel:

(a) fuel sufficient to fly to an en-route alternate aerodrome, considering at the most critical point of the route, failure of one engine or simultaneous engine failure and depressurization or depressurization alone, whichever is more limiting;

(i) the speed selected for the AEO diversion (i.e. depressurization alone) may be different from the approved OEI speed used to determine the EDTO threshold and maximum diversion distance (see paragraph 9 of this Sub-Section).

(ii) the speed selected for the OEI diversions (i.e. engine failure alone and combined engine failure and depressurization) should be the approved OEI speed used to determine the EDTO threshold and maximum diversion distance (see paragraph 9 of this Sub-Section).

(b) fuel to account for icing;

(c) fuel to account for errors in wind forecasting;

(d) fuel to account for holding, an instrument approach and landing at the en-route alternate aerodrome;

(e) fuel to account for deterioration in cruise fuel burn performance; and

(f) fuel to account for APU use (if required).

3.3 The following factors may be considered in determining if a landing at a given aerodrome is the more appropriate course of action:

(a) aeroplane configuration, weight, systems status, and fuel remaining;

(b) wind and weather conditions en-route at the diversion altitude, minimum altitudes en- route and fuel consumption to the en-route alternate aerodrome;

(c) runways available, runway surface condition, weather, wind, and terrain, in proximity of the en-route alternate aerodrome; and

(d) instrument approaches and approach/runway lighting available, rescue and fire fighting services (RFFS) at the en-route alternate aerodrome;

(e) pilot's familiarity with that aerodrome and information about that aerodrome provided to the pilot by the operator; and

(f) facilities for passenger and crew disembarkation and accommodation.

4. THRESHOLD TIME

4.1 In establishing the appropriate threshold time and to maintain the required level of safety, the CAD will consider the following:

(a) the airworthiness certification of the aeroplane type specifically permits operations beyond the threshold time, taking into account the aeroplane system design and reliability aspects;

(b) the reliability of the propulsion system is such that the risk of double engine failure from independent causes is extremely remote;

(c) any necessary special maintenance requirements are fulfilled;

(d) specific flight dispatch requirements are met;

(e) necessary in-flight operational procedures are established; and

(f) the operator's previous experience on similar aircraft types and routes.

Considering the above factors in relation to the aircraft currently registered in Hong Kong, the threshold time set for twin turbine-engined aeroplanes is **60 minutes** unless otherwise stated.

4.2 For determining whether a point on a route is beyond the EDTO threshold to an en-route alternate aerodrome, the Operator should use the approved speed as described in paragraph 9 of this Sub-Section.

5. MAXIMUM DIVERSION TIME

5.1 In approving the maximum diversion time, the CAD will take into account of the following for the assessment of the overall level of safety:

(a) reliability of the propulsion system;

(b) airworthiness certification for EDTO of the aeroplane type; and

(c) EDTO maintenance programme.

Factors such as the EDTO certified capability of the aeroplane, the aeroplanes EDTO significant systems (e.g. limiting time limitation, if any, and relevant to that particular operation) for a particular aeroplane type and the operator's operational and EDTO experience with the aeroplane type, or if relevant, with another aeroplane type or model will also be considered.

5.2 For determining the maximum diversion distance to an en-route alternate, the operator should use the approved speed.

5.3 The operator's approved maximum diversion time should not exceed the EDTO certified capability of the aeroplane nor the most limiting EDTO significant system time limitation identified in the Aeroplane's Flight Manual reduced by an operational safety margin specified, commonly 15-minutes, by CAD.

6. EDTO SIGNIFICANT SYSTEMS

6.1 This section addresses particular provisions for aeroplanes with two turbine engines.

6.2 The reliability of the propulsion system for the aeroplane-engine combination being certified is such that the risk of double engine failures from independent causes is assessed and found acceptable to support the diversion time being approved.

6.3 Consideration of time limitations

6.3.1 For all operations beyond the EDTO threshold as determined by CAD, the operator should consider, at time of dispatch and as outlined below, the EDTO certified capability of the aeroplane and the most limiting EDTO significant system time limitation, if any, indicated in the Aeroplane's Flight Manual (directly or by reference) and relevant to that particular operations.

6.3.2 The operator should check that from any point on the route, the maximum diversion time does not exceed the most limiting EDTO significant system time limitation reduced with an operational safety margin, commonly 15 minutes, specified by CAD.

7. EN-ROUTE ALTERNATE AERODROMES

7.1 In addition to the en-route alternate aerodrome provisions described in paragraph 3.7 of Section I, the following apply:

(a) for route planning purposes, identified en-route alternate aerodromes need to be located at a distance within the maximum diversion time from the route and which could be used if necessary;

(b) in EDTO, before an aeroplane crosses its threshold time during flight, there should always be an en-route alternate aerodrome within the approved maximum diversion time whose conditions will be at or above the operator's established aerodrome operating minima for the operation during the estimated time of use.

If any conditions, such as weather below landing minima, are identified that would preclude a safe approach and landing at that aerodrome during the estimated time of use, an alternative course of action should be determined such as selecting another en-route alternate aerodrome within the operator's approved maximum diversion time.

7.2 During flight preparation and throughout the flight the most up-to-date information should be provided to the flight crew on the identified en-route alternate aerodromes, including operational status and meteorological conditions.

8. OPERATIONAL APPROVAL PROCEDURE

8.1 In approving an operator with a particular aeroplane type for EDTO, CAD will establish an appropriate threshold time and approve a maximum diversion time, ensure that:

(a) specific operational approval is granted (by CAD);

(b) the operator's past experience and compliance record is satisfactory and the operator establishes the processes necessary for successful and reliable EDTO and shows that such processes can be successfully applied throughout such operations;

(c) the operator's procedures are acceptable based on certified aeroplane capability and adequate to address continued safe operation in the event of degraded aeroplane systems;

(d) the operator's crew training programme is adequate for the proposed operation;

(e) documentation accompanying the authorization covers all relevant aspects; and

(f) it has been shown (e.g. during the EDTO certification of the aeroplane) that the flight can continue to a safe landing under the anticipated degraded operating conditions which would arise from:

(i) the most limiting EDTO significant system time limitation, if any, for EDTO identified in the Aeroplane's Flight Manual directly or by reference; or

(ii) total loss of engine generated electric power; or

(iii) total loss of thrust from one engine; or

(iv) any other condition which CAD considers to be equivalent in airworthiness and performance risk.

8.2 EDTO Approval will be evidenced by a Permission specifically related to each operation.

9. CONDITIONS TO BE USED WHEN CONVERTING DIVERSION TIMES TO DISTANCES FOR THE DETERMINATION OF THE GEOGRAPHICAL AREA BEYOND THRESHOLD AND WITHIN MAXIMUM DIVERSION DISTANCES

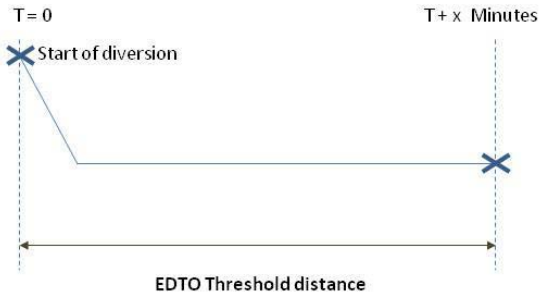
9.1 For the purpose of this guidance, an "approved OEI speed" is any OEI speed within the certified flight envelope of the aeroplane.

9.2 When applying for EDTO an operator should identify, and CAD will approve the OEI speed that will be used to calculate diversion distances considering ISA and still air conditions. The identified speed should be the same one used to determine fuel reserves for OEI diversions. This speed may be different from the speed used to determine the 60 minutes and EDTO thresholds.

10. DETERMINATION OF THE EDTO THRESHOLD

10.1 For determining whether a point of the route is beyond the EDTO threshold to an en-route alternate, the operator should use the approved speed. The distance is calculated from the point of the diversion followed by cruise for the threshold time as determined by CAD and is shown in Figure 5. For the purposes of computing distances, credit for drift down may be taken.

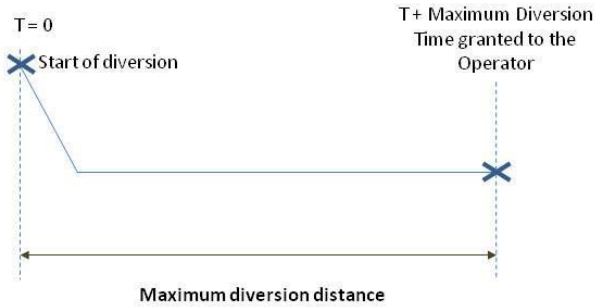
Figure 5: Threshold distance - Aeroplanes with two turbine engines



11. DETERMINATION OF THE MAXIMUM DIVERSION TIME DISTANCE

11.1 For determining the maximum diversion time distance to an en-route alternate, the operator should use the approved speed. The distance is calculated from the point of the diversion followed by cruise for the maximum diversion time as approved by CAD. For the purposes of computing distances, credit for drift down may be taken. See Figure 6 for illustration.

Figure 6: Maximum diversion distance - Aeroplanes with two turbine engines



12. AIRWORTHINESS CERTIFICATION REQUIREMENTS FOR EDTO BEYOND THE THRESHOLD TIME

12.1 During the airworthiness certification procedure for an aeroplane type intended for EDTO, special attention should be paid to ensure that the required level of safety will be maintained under conditions which may be encountered during such operations, e.g. flight for extended periods following failure of an engine and/or aeroplanes EDTO significant systems. Information or procedures specifically related to EDTO should be incorporated into the Aeroplane's Flight Manual, Maintenance Manual or other appropriate documents.

12.2 Aeroplane manufacturers should supply data specifying the aeroplanes EDTO significant systems and where appropriate, any time-limiting factors associated with those systems.

13. MAINTAINING OPERATIONAL APPROVAL

13.1 In order to maintain the required level of safety on routes where these aeroplanes are permitted to operate beyond the established threshold time, it is necessary that:

(a) the airworthiness certification of the aeroplane type specifically permits operations beyond the threshold time, taking into account the aeroplane system design and reliability aspects;

(b) the reliability of the propulsion system is such that the risk of double engine failures from independent causes is extremely remote, assessed as provided in the *Airworthiness Manual* (Doc 9760) and found acceptable to support the diversion time being approved;

(c) any necessary special maintenance requirements are fulfilled;

(d) specific flight dispatch requirements are met;

(e) necessary in-flight operational procedures are established; and

(f) specific operational approval is granted by the CAD.

14. AIRWORTHINESS MODIFICATIONS AND MAINTENANCE PROGRAMME REQUIREMENTS

14.1 Each operator's maintenance programme should ensure that:

(a) the titles and numbers of all airworthiness modifications, additions and changes which were made to qualify aeroplane systems for EDTO are provided to CAD;

(b) any changes to maintenance and training procedures, practices or limitations established in the qualification for EDTO are submitted to CAD;

(c) a reliability monitoring and reporting programme is developed and implemented prior to approval and continued after approval;

(d) prompt implementation of required modifications and inspections which could affect propulsion system reliability is undertaken;

(e) procedures are established which prevent an aeroplane from being dispatched for an EDTO after engine shutdown or EDTO significant system failure on a previous flight until the cause of such failure has been positively identified and the necessary corrective action is completed. Confirmation that such corrective action has been effective may, in some cases, require the successful completion of a subsequent flight prior to dispatch on an EDTO; and

(f) a procedure is established to ensure that the airborne equipment will continue to be maintained at the level of performance and reliability required for EDTO.

(g) a procedure is established to minimize scheduled or unscheduled maintenance during the same maintenance visit on more than one parallel or similar EDTO significant system. Minimization can be accomplished by staggering of maintenance tasks, performing and/or supervising maintenance by a different technician, or verifying maintenance correction actions prior to the airplane entering an EDTO threshold.

15. EXAMPLES

15.1 On establishing the appropriate threshold and approved maximum diversion time for an operator with a particular aeroplane type, the CAD will consider, but not be limited to, the following: the airworthiness certification of the aeroplane, the operator's experience in conducting operations beyond the 60-minute threshold, flight deck crew experience in conducting such operations, the maturity of that operator's flight dispatch system, the communication capability with the operator's operational control centre (ACARS, SATCOM, HF, etc.), the robustness of both the operator's standard operating procedures and the familiarity of the crews with those procedures, the maturity of the operator's SMS, the crew training programme and the reliability of the propulsion system. The following examples are provided for readers' references:

(a) Example A: CAD has established the threshold time based on the capability of the operator and the aeroplane type for a twin turbine-engined aeroplane at 60 minutes and approved a maximum diversion time of 180 minutes. That operator will need to have specific approval to be further than 60 minutes to an en-route alternate aerodrome (calculated at in ISA conditions and still air at the OEI cruise speed), remain within 180 minutes to an en-route alternate airport.

If that operator with the particular aeroplane type plans a route within the threshold time established by CAD (in the above example this is 60 minutes) to an en-route alternate airport, that operator by definition would not be conducting an EDTO.

(b) Example B: CAD has established the threshold time based on the capability of the operator and the aeroplane type for a twin engine aeroplane at 90 minutes and approved a maximum diversion time of 180 minutes, that operator will need to have specific approval to be further than 90 minutes to an en-route alternate aerodrome (calculated in ISA conditions and still air at the OEI cruise speed), remain within 180 minutes to an en-route alternate airport.

(c) If that operator with the particular aeroplane type plans a route within the threshold time established by CAD (in the above example this is 90 minutes) to an en-route alternate airport, that operator would not require any additional approval from the CAD.

(d) CAD is approached by an operator who is in a process of expansion, having acquired twin engine aeroplane(s) capable of EDTO. The operator submits an application to amend its AOC to include this new aeroplane type on newly granted routes. These routes take the flight beyond 60 minutes to an en-route alternate, thus requiring the establishment of a threshold time and approval of a maximum diversion time. Taking into account:

(i) that the operator has not had previous experience with the routes and area of operation;

(ii) the new aeroplane type;

(iii) the inexperience of the company and its flight operations / operations control department at planning and dispatching such flights; and

(iv) the new operating procedures to be established.

CAD determines that the threshold time for this operator should be limited to 60 minutes and approves a maximum diversion time of 120 minutes.

As this operator gains experience with the operation and the procedures over time, the CAD may amend the initially established threshold time and approved maximum diversion time.

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Sub-Section B: Acceptable Mean of Compliance to the Requirements for EDTO with Two Engines

CHAPTER 1 GENERAL

1. PURPOSE

This sub-section states an acceptable mean (but not necessarily the only mean) by which approval may be given for Hong Kong registered twin-engined aeroplanes to operate over a route that contains a point further than 60 minutes flying time (in still air) at the normal one-engine-inoperative cruise speed from an adequate aerodrome.

2. APPLICABILITY

The detailed requirements of this sub-section will be applicable to all twin-engined aeroplanes (including those powered by turbo-props and reciprocating engines) which are flying for the purpose of public transport, and which meet both of the following criteria:

(a) the maximum authorised take-off weight exceeds 5700 kg; and

(b) the aeroplane is certificated to carry more than 19 passengers.

Although many of the requirements in this sub-section are currently incorporated into an operators approved programmes for other aeroplanes or route structures, the case of EDTO operations with twin-engined aeroplanes necessitates an evaluation of these operations, to ensure that the approved programmes provide a level of safety broadly consistent with that achieved for current EDTO operations with three and four-engined turbine powered aeroplanes. To be eligible for EDTO, the specified airframe/engine combination should be evaluated by considering the concepts in paragraph 5 of Chapter 1 and meet the type design considerations in Chapter 2, the prerequisite in-service experience requirements of Chapter 3, and the continuing airworthiness and operational considerations in Chapter 4.

3. RELATED LEGISLATION AND REQUIREMENTS

3.1 Air Navigation (Hong Kong) Order (1995), Articles 6, 27, 29 and 32, and Schedule 5;

3.2 Air Navigation (Hong Kong) Order (1995), Regulation 4 & 14 of Schedule 15;

3.3 JAR.ACJ 25.901, 25.903, 25.1309;

3.4 CAD 360 Air Operator's Certificates Requirements Document;

3.5 CAD 418;

3.6 JAA Information Leaflet No 20

4. DEFINITIONS

4.1 Aerodrome

In general terms, an operator may make an appraisal that an aerodrome has long enough runways, and is sufficiently equipped to be considered **adequate** for his planned EDTO routes. The commander must satisfy himself on the day, using criteria provided by the operator, that he has sufficient **adequate** aerodromes which, taking into account the weather and any equipment unserviceablilities, are **suitable** for his intended operation. Definitions of **adequate** and **suitable** aerodromes are in Appendix B, paragraph B.2. The use of the word **suitable** in this context may be different from its use in paragraph (1)(c) of Article 27 of the Air Navigation Order.

4.2 Auxiliary Power Unit (APU)

A gas turbine engine intended for use as a power source for driving generators, hydraulic pumps, and other aeroplane accessories and equipment, and/or to provide compressed air for aeroplane pneumatic systems.

(a) An essential APU installation provides the bleed air and/or mechanical power necessary for the despatch of a transport category aeroplane for operations other than EDTO with twin-engined aeroplanes.

(b) An APU installation required for EDTO provides the bleed air and/or mechanical power necessary for the safe flight of a twin-engined transport category aeroplane approved for EDTO and is designed and maintained to provide a level of reliability necessary to perform its intended function.

4.3 Engine

The basic engine assembly plus its essential accessories as supplied by the engine manufacturer.

4.4 EDTO/ETOPS

For the purpose of this sub-section, EDTO/ETOPS are those operations by a twin-engined aeroplane over a route that contains a point further than 60 minutes flying time (threshold time) in still air at the normal OEI cruise speed from an **adequate** aerodrome.

4.5 EDTO/ETOPS Entry Point

The EDTO/ETOPS entry point is the point on the aeroplane's outbound route which is 60 minutes flying time at the agreed OEI cruise speed (in still air) from a SUITABLE aerodrome prior to entering the EDTO/ETOPS segment.

4.6 EDTO/ETOPS Exit Point

The EDTO/ETOPS exit point is the point on the aeroplane's routing at the end of the EDTO/ETOPS segment and is 60 minutes flying time at the agreed OEI cruise speed (in still air) of a SUITABLE aerodrome.

4.7 EDTO/ETOPS Segment

The EDTO/ETOPS segment is the route segment from the EDTO/ETOPS entry point to the EDTO/ETOPS exit point, wherein the aeroplane remains within the permitted Rule Time.

4.8 Extremely Improbable

So Extremely Remote that it does not have to be considered as possible to occur.

4.9 Normal OEI Cruise Speed (Rule Distance)

For the purpose of this sub-section, this cruise speed shall be the TAS specified in the EDTO/ETOPS Airworthiness Approval in the Aeroplane Flight Manual, and agreed with the Department and specified in the Company Operation Manual. If not otherwise specified, it shall be calculated from the single-engine, long range, cruise control data for the aeroplane, assuming that it:

(a) takes off at maximum authorised take-off weight; and

(b) climbs to and maintains the two-engined optimum initial cruise level for long range cruise, in ISA conditions, until two hours from take-off, and;

(c) at its then current weight, in ISA conditions, with one engine shutdown and the other at the power recommended for maximum continuous operation is flying level at a comfortably achievable maximum height and at the resultant stabilised speed.

4.10 Powerplant

A system consisting of an engine and all ancillary parts installed on the engine prior to installation on the aeroplane to provide and control power/thrust and for the extraction of energy.

4.11 Rule Time

The maximum one engine inoperative diversion time that any point on the EDTO/ETOPS route may be from a SUITABLE aerodrome for landing.

4.12 Rule Distance

The distance travelled in still air in the Rule Time, at the normal one-engine-inoperative cruise speed.

4.13 System

A system includes all elements of equipment necessary for the control and performance of a particular major function. It includes both the equipment specifically provided for the function in question, and other basic equipment, such as that required to supply power for the equipment operation.

(a) Airframe System
Any system on the aeroplane that is not a propulsion system.

(b) Propulsion System
The aeroplane powerplant installation, including each component that: is necessary for propulsion; affects the control of the propulsion units; or affects the safety of the propulsion units.

4.14 Threshold Distance

The distance travelled in still air in 60 minutes by an aeroplane at the normal one-engine-inoperative cruise speed.

4.15 Threshold Time

60 minutes.

4.16 Unacceptable Thrust-Loss

Total thrust loss, or loss of thrust to an extent that might affect continued safe flight.

5. CONCEPTS

Although it is self-evident that the overall safety of an EDTO cannot be better than that provided by the reliability of the propulsion systems, some of the factors related to EDTO are not necessarily obvious. For example, cargo compartment fire suppression/containment capability could be a significant factor, or operational practices may invalidate certain assumptions made during the aeroplane type design certification, or the probability of propulsion system failures. Although engine reliability is a critical factor, it is not the only factor which should be seriously considered in evaluating EDTO. Any decision relating to EDTO with twin-engined aeroplanes should also consider the probability of occurrence of any condition which would prevent the continued safe flight and landing, as well as the probability of occurrence of any condition which would reduce the capability of the aeroplane or the ability of the crew to cope with adverse operating conditions.

6. CONSIDERATIONS

6.1 A number of airframe and propulsion systems have an effect on the safety of EDTO; therefore, the type design certification of the aeroplane will be reviewed, to ensure that the design of these systems is acceptable for the safe conduct of the intended operation.

6.2 In order to maintain a level of safety consistent with the overall safety level achieved by current aeroplanes used in airline service, it is necessary for twin-engined aeroplanes used in EDTO to have an acceptably low risk of double propulsion system failure for all design and operations related causes. Additionally, in the event of a single propulsion system failure, the performance and reliability of the airframe systems, and of the remaining propulsion systems, should be sufficiently high to ensure a high probability of continued safe flight and landing at a suitable aerodrome.

6.3 Since the quality of maintenance programmes can have an appreciable effect on the reliability of the propulsion systems and the airframe systems required for EDTO, an assessment will be made of the manufacturers recommended and operators proposed maintenance programmes ability to maintain a satisfactory level of systems reliability for the particular airframe/engine combination.

6.4 Flight crew workload and procedures in the event of system failures or malfunctions will be reviewed in the context of EDTO. The normal certification assessment of the demands on the flight crew will be critically examined to ensure that the procedures can be accomplished by an average flight crew. In some cases, crew emergency and abnormal drills contained in the Aeroplane Flight Manual (AFM) and in the Operations Manual for an EDTO approved aeroplane may differ from those for a non-EDTO approved aeroplane. Where both drills are retained, they must be clearly identified and annotated as to the circumstances when they are to be used.

6.5 Following a determination that the airframe systems and propulsion systems are suitably designed for EDTO, an in-depth review of the applicant’s training programmes, operations, and maintenance programmes will be made to determine his ability to maintain an acceptable level of systems reliability in order to conduct these operations safely with the particular airframe/engine combination.

6.6 System redundancy levels appropriate to EDTO will need to be reassessed and, where appropriate, reflected as revisions to minimum flight despatch configuration of the aeroplane (see paragraph 4 of Chapter 4).

7. APPROVAL BASIS

7.1 General

For safe operations of twin-engined aeroplanes in EDTO, it should be shown that the aeroplane is sufficiently reliable. This requires the systems relevant to EDTO, including the propulsion system, to meet certification safety objectives in the conditions of the intended operations.

7.2 Type Design Approval

Evidence that the type design of the aeroplane is eligible for EDTO is reflected by a statement in the approved AFM and Type Certificate Data Sheet.

7.3 In-service Experience Approval

In addition to the Type Design approval, it should be shown that the propulsion systems for that particular airframe/engine combination (world fleet) have achieved a sufficiently high level of reliability in-service so that safe EDTO may be conducted. The achievement of this level of reliability is determined in accordance with Appendix A (see Chapter 3). It is also necessary for each operator desiring approval for EDTO to show that sufficient maintenance and operations familiarity with that particular airframe/engine combination has been obtained (see Chapter 4).

7.4 Continuing Airworthiness and Operations Approval

Since the type design approval does not reflect a continuing airworthiness or operational approval to conduct EDTO, each operator should demonstrate the ability to maintain the aeroplane so as to achieve the required reliability, and to train its personnel to achieve competence in EDTO. The continuing airworthiness and operational approval to conduct EDTO is made through the machinery of a permission (see Chapter 4).

CHAPTER 2 TYPE DESIGN APPROVAL CONSIDERATIONS

1. GENERAL

If a new twin-engined type design aeroplane is to be used in EDTO, a determination should be made that the design features are suitable for the intended operation. In the event that an existing aeroplanes operation is expanded to include EDTO, a re-evaluation of some design features may be necessary because of the greater exposure of the aeroplane in operations associated with EDTO. In this case, modifications to some systems may be necessary to achieve the desired reliability. In either case, the essential systems and the propulsion systems for the particular airframe/engine combinations should be shown to be designed to a level of reliability suitable for the intended maximum range operation of the aeroplane.

2. CRITERIA

The evaluation of failures and failure combinations should be based on engineering judgment and acceptable safety assessment methods. The analysis should consider effects of operations with a single engine, including allowance for damage that could result from failure of the first engine. Unless it can be shown that equivalent safety levels are provided or the effects of failure are minor, failure and reliability analysis should be used as guidance in verifying that the proper level of fail-safe design has been provided. The following criteria are applicable to the extension of range of aeroplanes with two engines:

2.1 Aeroplane systems should be shown to comply with JAR 25.1309 and the ACJs to 25.1309.

2.2 The propulsion systems should be shown to comply with JAR 25.901, ACJ 25.901, JAR 25.903 and ACJ 25.903.

2.3 Engineering and operational judgment applied in accordance with the assessment conditions outlined in Appendix A should be used to show that the propulsion system reliability has reached a level acceptable to the Department for EDTO, due account being taken of the still-air intended flight duration and mean diversion time to a suitable alternate. This determination of the propulsion system reliability is derived from a worldwide fleet data base containing all in-flight engine shutdown occurrences, all significant engine reliability problems, and available data on cases of significant loss of thrust. This determination also includes the appropriate accounting for the rectification of the identified engine design problems, as well as occurrences where in-flight starting capability may be a significant factor.

2.4 The safety impact of an uncontained engine failure should be reassessed in accordance with JAR 25.903 having due regard to both the Rule Time and system status allowed under the minimum flight despatch configurations of the aeroplane.

2.5 The APU installation, if required for EDTO, should meet the applicable JAR-APU provisions, and the requirements of JAR 25.1309.

2.6 For extended duration single-engine operations (considering the resulting degradation on the performance of the aeroplane type), any increase in workload and the adverse effects of malfunctions of remaining systems and equipment on flight crew procedure should be minimised, and should be within the capabilities of an average flight crew.

2.7 For extended duration single-engine operation, remaining power (electrical, hydraulic, pneumatic) should continue to be available at levels necessary to permit continued safe flight and landing and to provide those services required for the overall safety of the passengers and crew.

2.8 In meeting the requirements of the AN(HK) O Schedule 5 Scale L1 or L2 (as applicable), unless it can be shown that normal cabin pressure can be maintained on single-engine operation at the altitude required for continued flight to a suitable aerodrome, oxygen should be available to sustain the passengers and crew for the maximum diversion time.

2.9 A sufficient number of reliable, independent electrical power sources should be available to meet the requirements of JAR 25.1309; this is likely to require at least three power sources. As a minimum, each electrical source should be non-time limited and be capable of powering the items specified in paragraphs 3.4 and 3.7 of Chapter 2. If one or more of the required electrical power sources are powered by (i) an APU, (ii) a hydraulic system, or (iii) a ram air turbine, the following criteria apply respectively:

(a) The APU, when installed, should meet the requirements of JAR-25, Sub-part J, together with any additional criteria arising from paragraph 2.5 above. It should be shown that there is a very high probability that, after the failure of any one or two generated sources of power, the APU can be started without delay at any altitude up to and including the aeroplanes certificated altitude. If this condition cannot be met, the APU will have to be kept running throughout the EDTO segment unless the Department agrees otherwise. Other requirements may be specified by the Department after review of the applicant’s data;

(b) The hydraulic power source should be driven by two or more independent energy sources, and at least one should continue to be available in the event of failure of either engine and/or both main generators; e.g. bleed-air driven pump and RAT;

(c) Ram air turbine deployment should be demonstrated to be sufficiently reliable and not require main electrical or engine-dependent power for deployment.

NOTE: (1) Following the loss of all normal generated electrical power, continuity of electrical power for essential service (e.g. by use of batteries) should be assured until the non-time limited emergency or standby power source can be brought into operation.

(2) If loss of all engines can prevent the operation of the non-time limited power source, emergency or standby, sufficient battery capacity should be provided to allow a controlled descent and emergency landing.

2.10 In the event of any single failure or any combination of failures not shown to be Extremely Improbable, it should be shown that electric power is provided for essential flight instruments, avionics, communications, navigation, required route or destination guidance equipment, support systems and/or hardware, and any other equipment deemed necessary for EDTO, to continue safe flight and landing at a suitable aerodrome. Information provided to the flight crew should be of a sufficient accuracy for the intended operation.

2.11 Communications facilities for updated diversion weather; indications of residual systems capabilities; and crew procedures, should all be such that the flight crew have the necessary information to make decisions on diversion at any point on the route.

2.12 EDTO are not permitted where any time limited system, that is essential for continued safe flight and landing has a minimum endurance that is less than the intended Rule Time, plus a 15 minute allowance for approach and landing at a suitable aerodrome, e.g. a cargo compartment fire suppression system.

2.13 If enhanced scheduled maintenance, replacement, and/or inspection are utilised to obtain type design approval for EDTO, then the specified maintenance should be clearly identified in an appropriate approved maintenance manual and schedule.

3. ANALYSIS OF FAILURE EFFECTS AND RELIABILITY

3.1 General

The analysis and demonstration of system failure effects and reliability should be based on the maximum declared endurance of the aeroplane used in EDTO.

3.2 Propulsion Systems

(a) An assessment of the propulsion systems reliability for particular airframe/engine combinations will be made in accordance with Appendix A.

(b) The analysis will review, in the context of EDTO, the effects of operation with a single propulsion system, including probable damage that could result from failure of the first engine. Effects of failures, external conditions, or crew errors, that could jeopardise the operation of the remaining propulsion system under single power unit operating conditions, will be examined.

NOTE: Consideration should be given to any adverse effect of electrical failure on the aeroplane fuel supply system e.g. loss of fuel boost and transfer pumps.

3.3 Hydraulic Power and Flight Control

Consideration of these systems may be combined, since many commercial aeroplanes have full hydraulically-powered controls. For aeroplanes with all primary flight controls hydraulically powered, evaluation of hydraulic system redundancy should include a determination of the ability to maintain continued safe flight and landing after the complete loss of any two hydraulic systems and either engine, unless it can be shown that a combination of events is Extremely Improbable.

3.4 Electrical Power

Electrical power is provided to a small group of instruments and devices required for continued safe flight and landing, and to a much larger group of instruments and devices needed to allow the flight crew to cope effectively with adverse operating conditions. Multiple sources (engine-driven generators, APUs, etc.) should be provided to meet both the continued safe flight and landing requirements and the adverse conditions requirements. The analysis should establish that electrical power can be maintained to essential instruments and other services for continued safe flight and landing, and to allow the flight crew to cope with adverse operating conditions. When re-assessing the aeroplane against requirements of JAR 25.903(d)(1) as noted in 2.4 above and its Advisory Joint Circular (ACJ), it should be demonstrated that the design of the system is such that the risk of losing all non-time limited power sources has been minimised.

3.5 Equipment Cooling

The analysis should establish that the required electronic equipment for EDTO has the ability to operate acceptably, considering failure modes in the cooling system not shown to be Extremely Improbable. Adequate indication of the proper functioning of the cooling system should be demonstrated, to ensure system operation prior to despatch and during flight.

3.6 Cargo Compartment

The cargo compartment design and the fire protection system capability (if required) should be consistent with the following:

(a) Design
The cargo compartment fire protection system integrity and reliability should be suitable for the intended operations, considering fire detection sensors, liner materials, etc.

(b) Fire Protection
A test or a combination of analysis and tests should be made to show that considering the time required to terminate an EDTO, the ability of the system to suppress or extinguish fires is adequate to assure safe flight and landing at a **suitable** aerodrome.

3.7 Communication, Navigation, and Basic Flight Instruments (Altitude, Airspeed, Attitude, and Heading)

It should be shown that, under all combinations of propulsion and/or airframe system failures which are not Extremely Improbable, reliable communication, sufficiently accurate navigation, basic flight instruments, and any required route and destination guidance needed to comply with contingency procedures for EDTO, will be available.

3.8 Cabin Pressurisation

It should be shown that as a result of general system redundancy and "fail safe" features of the system, the loss of cabin pressure is Extremely Improbable under single engine operating conditions. Aeroplane performance data should be provided to verify the ability to continue safe flight and landing after loss of pressure and subsequent operation at a lower altitude.
(See also Paragraph 4.4 of Chapter 4)

3.9 Modifications

All modifications proposed for embodiment to EDTO configured aeroplane /engines, subsequent to Type Certification, must be assessed for their possible effect on such operations.
(See Paragraph 3.1 of Chapter 4)

4. ASSESSMENT OF FAILURE CONDITIONS

In assessing the design fail-safe features and effects of failure conditions, account should be taken of:

4.1 The variations in the performance of the system, the probability of the failure(s), and the complexity of the crew action.

4.2 Factors alleviating or aggravating the direct effects of the initial failure condition, including consequential or related conditions existing within the aeroplane which may affect the ability of the crew to deal with direct effects, such as the presence of smoke, aeroplane accelerations, interruption of air-to-ground communication, cabin pressurisation problems, etc.

5. TYPE DESIGN APPROVAL

5.1 Upon satisfactory completion of an evaluation an EDTO type design approval will be issued.

5.2 The type design approval is normally reflected in the approved AFM or supplement, and Type Certification Data Sheet, which will contain the following pertinent information, as applicable:

(a) Special limitations relating to EDTO operation;

(b) Markings or placards (if required);

(c) Revision to the performance section (if required);

(d) The airborne equipment, installation, and flight crew procedures required for EDTO;

(e) Description of the approved aeroplane configuration;

(f) A statement to the effect that: The type design reliability and performance of this airframe/engines combination has been evaluated in accordance with this Publication and found suitable for EDTO with maximum diversion time not exceeding xxx minutes as limited by the capability of yyy system. This finding does not on its own constitute approval to conduct EDTO.

NOTE: The Rule Time will not normally exceed a figure that is 15 minutes less than the nominal endurance of any time-related required system.

6. TYPE DESIGN MONITORING

The Basic Certification Authority for the aeroplane and for the engine will monitor the continued airworthiness in EDTO, and will identify any significant problems through the normal airworthiness directive process for the approved type design.

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CHAPTER 3 INSERVICE EXPERIENCE

1. WORLDWIDE EXPERIENCE

1.1 In addition to substantiating a type design in accordance with Chapter 2 of this Sub-Section, and as a prerequisite to obtaining continuing airworthiness/ operational approval in accordance with the criteria of Chapter 4 of this Sub-Section, it should be shown that an acceptable level of propulsion system reliability has been achieved inservice by the world fleet for that particular airframe/engine combination.

1.2 Subsequent to the type design approval, it should be shown that the world fleet of the particular airframe/engine combination for which approval is sought has achieved an acceptable and reasonably stable level of single propulsion system inflight shutdown (IFSD) rate necessary for EDTO. When considering the acceptability of a propulsion system for EDTO, maturity should be assessed not only in terms of total fleet hours but also to take account of fleet leader time. In order that the assessment can be made with confidence, the minimum requirement should comprise both world fleet hours and calendar time. There is justification for the view that modern propulsion systems achieve a stable reliability level by 100,000 hours for new types and 50,000 hours for derivatives. 3000 to 4000 hours is considered to be the minimum time in service for a specific unit to indicate problem areas. The minimum service experience required for new propulsion systems will be 100,000 hours and 12 months service, for derivative propulsion systems 50,000 hours and 12 months service. The latter may vary according to the degree of commonality. The determination of propulsion system reliability is derived from a world fleet data base, containing all in-flight engine shutdown events for all design and operations related causes during all phases of flight, significant engine reliability problems, and the available data on cases of significant loss of thrust, including those where the engine failed or was throttled back/shutdown by the pilot, except where throttling back is required by operational procedures.

1.3 Engineering judgement applied in accordance with the assessment considerations outlined in Appendix A will then be used to establish that the probability of dual engine failure for all independent causes in cruise of 0.3 x 10-8 per hour or less can be achieved. This assessment is in addition to the determination in paragraph 2.2 of Chapter 2 for type design approval, and will take due account of the diversion time to a suitable aerodrome, rectification of identified propulsion system problems, as well as events where inflight starting capability may be a significant factor.

2. SPECIFIC OPERATOR EXPERIENCE

Each operator requesting approval will be required to have appropriate experience. A summary shall be provided to the Department, indicating the operator's capability to maintain and operate the specific airframe/engine combination for the intended EDTO. This summary should include: experience with the engine type or related engine types, experience with the particular airframe/engine combination on non-extended range routes. Approval would be based on a review of this information.

NOTE: Not less than 12 consecutive months experience with the specified airframe/engine combination will normally be required, unless the operator can show extensive in-service experience with a related power unit on another aeroplane which has achieved good reliability. However the operator will still need, in the latter case, to demonstrate his capability to maintain and operate the new airframe/engine combination at a similar level of reliability.

CHAPTER 4 OPERATIONAL APPROVAL CONSIDERATIONS

1. GENERAL

Any operator requesting approval for EDTO with twin-engined aeroplanes (after providing evidence of an acceptable evaluation of the considerations in Chapters 2 and 3) should submit the requests with the required supporting data, to the Department, at least 60 days prior to the proposed start of EDTO with the specific airframe/engine combination. In considering an application from a operator to conduct EDTO, an assessment will be made of the operator's overall safety record, past performance, flight crew training, and maintenance programmes. The data provided with the request should substantiate the operator's ability to safely conduct and support these operations, and should include the considerations outlined in this Chapter. Any reliability assessment obtained, either through analysis or service experience, will be used as guidance in support of operational judgments regarding the suitability of the intended operation.

2. ASSESSMENT OF THE OPERATOR'S PROPULSION SYSTEM RELIABILITY

Following the accumulation of adequate operating experience by the world-wide fleet of the specified airframe/engine combination, and the establishment of an IFSD rate in accordance with Chapter 3 and approved in accordance with Appendix A for use in assuring the propulsion system reliability required for EDTO, an assessment will be made of the applicant's ability to maintain this level of propulsion system reliability. This assessment will include trend comparisons of his data with other operators as well as the world fleet average values, and the application of a qualitative judgement that considers all of the relevant factors. The operator's past record of propulsion system reliability with related types of power units will also be reviewed, as well as his record achieved with the airframe/engine combination for which authorisation is sought to conduct EDTO.

3. ENGINEERING MODIFICATIONS AND MAINTENANCE PROGRAMME CONSIDERATIONS

Although these considerations are normally part of the operator's continuing airworthiness programme, the following items will be reviewed to ensure that these programmes are adequate for EDTO:

3.1 Engineering Modifications

A summary of the titles and numbers of all modifications, additions and changes which were made to qualify airframe and propulsion systems for EDTO should be provided to the Department. Details of any non-manufacturer modifications introduced for initial operation by an operator should also be submitted to the Department for an assessment to be carried out of their possible effect on EDTO. All modifications proposed for subsequent embodiment to EDTO configured aeroplane/engines should be assessed for their possible effect on this operation. The assessment should be conducted by the operator in consultation with the appropriate constructor. (See paragraph 3.9 of Chapter 2)

3.2 Maintenance and Training Procedures

Maintenance and training procedures, practices and limitations established for extended rage operations should be submitted to the Department for approval. Any subsequent changes to these arrangements should be submitted to the Department for acceptance 30 days before such changes are adopted.

3.3 Reliability Reporting

A reliability reporting programme should be developed and implemented prior to approval and continued after approval. Appendix C contains additional information concerning reliability reporting. Regular reports, in terms of both reliability trends and occurrences, should be directed to both the Department and the manufacturer.

3.4 Modifications and Inspections

There should be procedures for the prompt implementation of modifications and inspections which could affect propulsion system and airframe system reliability.

3.5 Aeroplane Despatch

Procedures should be established which would preclude an aeroplane being despatched for EDTO after power unit shutdown or primary system failure on a previous flight, or significant adverse trends in system performance, unless appropriate corrective action has been taken. Confirmation of such action as being appropriate may, in some cases, require the successful completion of a subsequent flight prior to despatch on an EDTO.

3.6 Maintenance Programme

The operator's maintenance programme should ensure that the aeroplane, engine and equipment will continue to be maintained at the level of performance and reliability required for EDTO.

Any maintenance requirement which has been enhanced to support type design approval should be identified in the programme and may not be varied without the approval of the Department.

3.7 Engine Condition Monitoring

An engine condition monitoring programme should be developed which may include hard time inspection intervals for component condition which is not otherwise observable and which could adversely affect failure rates.

3.8 Oil Consumption

There should be an engine and APU (where appropriate) oil consumption monitoring programme.

4. FLIGHT DESPATCH CONSIDERATIONS

4.1 General

The flight despatch considerations specified herein are in addition to, or amplify, the requirements contained in Article 32 of the Air Navigation (Hong Kong) Order, and specifically apply to EDTO. Although many of the considerations in this Publication are currently incorporated into approved procedures for other aeroplanes or route structures, the nature of EDTO necessitates a re-examination of these operations, to ensure that the approved procedures are adequate for this purpose.

4.2 Minimum Equipment List (MEL)

Primary system redundancy levels appropriate to EDTO will be reflected in the MEL. For aeroplanes already in operational service, the existing MEL will be re-evaluated and adjusted appropriately, to reflect primary system redundancy levels necessary for EDTO. Primary airframe systems are considered to be those systems which have a fundamental influence on flight safety and could be adversely affected by the shutdown of a power unit. Such systems may include, but are not limited to:

(a) Electrical, including battery;

(b) Hydraulic;

(c) Pneumatic;

(d) Flight instrumentation;

(e) Fuel;

(f) Flight control;

(g) Ice protection;

(h) Engine start and ignition;

(i) Propulsion system instruments;

(j) Navigation and communications;

(k) Auxiliary power-units;

(l) Air conditioning and pressurisation

(m) Cargo fire suppression;

(n) Emergency equipment;

(o) Engine fire detection and extinguishing systems; and

(p) Any other equipment required for EDTO.

4.3 Communication and Navigation Facilities

An aeroplane shall not be despatched on an EDTO unless:

(a) Communications facilities are available to provide, under all expected conditions of propagation at the normal OEI cruise altitudes, reliable two-way voice communications between the aeroplane and the appropriate air traffic control unit over the planned route of flight and the routes to any suitable alternate to be used in the event of diversion; and

(b) Non-visual ground navigation aids are available and located so as to provide, taking account of the navigation equipment installed in the aeroplane, the navigation accuracy required over the planned route and altitude of flight, and the routes to any alternate and altitudes to be used in the event of diversion for whatever reason; and

(c) Approved visual and non-visual aids are available at the specified alternates for the authorised types of approaches and operating minima.

4.4 Fuel and Oil Supply

(a) General

An aeroplane shall not be despatched on an extended range flight unless it carries sufficient fuel and oil to meet the requirements of the Air Navigation (Hong Kong) Order, as amplified in CAD 360 Air Operator's Certificates Requirements Document; and in addition, such additional fuel and oil as may be required to fly to a **suitable** aerodrome for landing in the event of the shutdown of an engine, or in the event of airframe system failure(s), which may require diversion to an alternate. It should be assumed that this event occurs at the most critical point in terms of overall fuel and oil requirements along the planned route of flight.

(b) Critical Fuel Scenario

The following describes the assumptions to be used in determining the fuel reserve required to cover the en-route diversion case. The operator should confirm that this scenario is operationally the most critical, having considered also the possibilities of no engine failure but total pressurisation failure, and no pressurisation failure but one engine failure.

(i) At that particular critical point, consider simultaneous failure of an engine and the pressurisation system; (critical point based on time to a suitable alternate at the one-engine-inoperative cruise speed, for existing conditions, using forecast winds at the appropriate flight level).

(ii) Immediate descent to the continued cruise altitude of 10 000 feet at the relevant OEI cruise speed (or above 10 000 feet if the aeroplane is equipped with sufficient supplemental oxygen in accordance with the Air Navigation (Hong Kong) Order, Schedule 5, Scale L1).

(iii) When approaching the diversion aerodrome, descend to 1 500 feet above destination, hold for 15 minutes, initiate an approach followed by a missed approach, and then continue to a normal approach and landing.

(iv) Unless the operator has an established value for inservice deterioration in cruise fuel mileage, the fuel calculated under (i) and (ii) above should be increased by 5 per cent.

(c) Fuel Planning Considerations

In computing fuel and oil requirements, advantage may be taken of driftdown, where appropriate, and at least the following should be considered as applicable:

(i) Current forecast winds and meteorological conditions along the expected flight path at the OEI cruising altitude and throughout the approach and landing; to allow for errors in wind forecasts and navigation, a contingency figure of 5 per cent should be added to calculated fuel burn from the critical point of Chapter 4 paragraph 4.4 (a) of this Sub-Section;

(ii) Any Configuration Deviation List items;

(iii) Any necessary operation of ice protection systems, and any performance loss due to ice accretion on unheated surfaces of the aeroplane, if icing conditions are likely to be encountered during the diversion.

(iv) Any necessary operation of an auxiliary power unit and/or RAT;

(v) Any known Air Traffic Control constraints.

4.5 Alternate Aerodromes

An aeroplane must not be despatched on an EDTO unless the required take-off, destination and alternate aerodrome, including suitable en-route alternate aerodromes to be used in the event of power-unit shutdown or system failure(s) which require a diversion, are listed in the cockpit documentation (e.g. computerised flight plan). **Suitable** en-route alternates must be identified and listed in the ATC flight plan and the despatch release (if applicable) for all cases where the planned route of flight contains a point more than 60 minutes flying time at the OEI speed from an **adequate** aerodrome. Since these suitable en-route alternates serve a different purpose from the destination alternate aerodrome, and would normally be used only in the event of an engine failure or the loss of primary airframe systems, an aerodrome should not be listed as a suitable en-route alternate unless:

(a) The landing distances required as specified in the AFM for the altitude of the aerodrome, for the runway expected to be used, taking into account wind conditions, runway surface conditions, and aeroplane handling characteristics, permit the aeroplane to be stopped within the landing distance available as declared by the aerodrome authorities and computed in accordance with the Air Navigation (Hong Kong) Order, Regulation 4 of Schedule 15;

(b) The aerodrome services and facilities are adequate for the operator's approved approach procedure(s) and operating minima for the runway expected to be used;

(c) The latest available forecast weather conditions for a period commencing one hour before the established earliest time of landing, and ending one hour after the established latest time of landing at that aerodrome, equal or exceed the Planning Minima for alternate aerodromes in the AOC holder's operations manual, calculated in accordance with Appendix V; and

(d) For the period commencing one hour before the established earliest time of landing, and ending one hour after the established latest time of landing at that aerodrome, the forecast crosswind component, including gusts, for the intended landing runway is at or less than the maximum permitted crosswind for landing, with one engine inoperative.

4.6 Aeroplane Performance Data

No aeroplane should be despatched on an extended range flight unless the Operations Manual contains:

(a) Detailed one-engine-inoperative performance data covering:

(i) Drift-down;

(ii) Cruise (altitude coverage including 10 000 feet);

(iii) Holding;

(iv) Altitude capability;

(v) Missed approach.

(b) Details of any other conditions relevant to EDTO which can cause significant deterioration of performance, such as ice accretion on the unheated surfaces of the aeroplane; Ram Air Turbine (RAT) deployment; etc.

5. FLIGHT CREW TRAINING AND EVALUATION PROGRAMME

The operator's ground training programme in respect of EDTO should provide training for flight crew members in the following areas:

5.1 Performance:

(a) EDTO Flight planning.

(b) EDTO Flight performance progress monitoring.

5.2 Procedures:

(a) Diversion procedures;

(b) Use of appropriate navigation and communication systems;

(c) Abnormal and emergency procedures to be followed in the event of failures, including:

(i) Procedures for single and multiple in-flight equipment failures that would require flight to the nearest suitable aerodrome;

(ii) Operational restrictions associated with these failures;

(iii) Procedures for airborne start of the propulsion systems, including the APU, if required;

(iv) Crew incapacitation;

(d) Use of the EDTO MEL.

5.3 Evaluation

In addition to initial training given to crew members, operators should arrange an annual evaluation programme in order to ensure that the level of awareness on matters relating to EDTO is kept at a satisfactory level. The evaluation must include a written test paper which may be included in the annual line check.

6. OPERATIONAL LIMITATIONS

6.1 Area of Operations

An operator may be authorised to conduct EDTO with a particular airframe/engine combination within a particular area where the maximum diversion time, from any point along the proposed route of flight to an adequate aerodrome, is up to 180 minutes or less as specified by the Hong Kong CAD at the normal OEI cruise speed (under standard conditions, in still air). The particular areas may be specified on the permission issued by the Hong Kong CAD for the purpose of approving EDTO.

6.2 Operations Manual Instructions

Operations Manual instructions should specify the maximum diversion time from a **suitable** aerodrome to be used when planning a particular EDTO. The maximum diversion time in still air at the normal one-engine-inoperative cruise speed cannot be any greater than that established by paragraphs (a) and (b) of this section. Authorisation for operations beyond these values will not be permitted until operational experience, in EDTO with twin-engined aeroplanes, clearly indicates that further credit is appropriate.

(a) Use of Standard Maximum Diversion Time

The Operations Manual instructions should ensure that EDTO are limited to flight plan routes where a maximum diversion time of 120 minutes or less at the normal OEI cruise speed in still air to **suitable** aerodromes can be met. Operators should also give instructions that :

(i) Upon occurrence of an in-flight shutdown of an engine, the pilot should fly to and land at the nearest suitable aerodrome, under the prevailing conditions, at which a safe landing can be made; and

(ii) In the event of a single or multiple primary system failure, the pilot should fly to and land at the nearest suitable aerodrome, under the prevailing conditions, unless it has been demonstrated that no substantial degradation of safety results from continuation of the planned flight.

(b) Increased Maximum Diversion Time

Although still constrained by the area of operation authorised in accordance with paragraph 6.1 above, those operators who also choose to demonstrate all or some of the additional capabilities discussed in this section may be approved, on a case by case basis, for an increase in diversion time from a suitable alternate. Six months satisfactory operations are required at 120 minutes in order to increase maximum Rule Time up to 138 minutes. An increase beyond 138 minutes Rule Time (e.g. to a maximum of 180 minutes) may be approved provided all items in sub-paragraphs (i) to (vi) below are complied with.

(i) Special Maintenance Practices and Procedures

which result in the operator’s engine in-flight shutdown rate being significantly better than the minimum level required for the maximum diversion time for the particular airframe/engine combination, and achieve a very low number of carried forward defects by thorough and timely action on maintenance discrepancies.

(ii) Special Operating Practices and Procedures

for use of such items as: Category 2/3 authorisation, special MEL provisions, communications links for weather dissemination, and pre-planned contingency actions, based on current data for each EDTO flight, for at least the five most probable operating contingencies, i.e. engine fire/failure, pressurisation, electrical, hydraulic and cargo fire.

(iii) Special Crew Training

which includes procedures for use in all appropriate operating contingencies, and other special qualifications such as Category 2/3, and navigational practices such as point of no return/radius of action and the associated use of the Flight Management Systems.

(iv) Special Equipment

which would enhance the capabilities of the aeroplane and flight crew in EDTO. Examples are: approved category 2/3 capability, flight management computers which would provide readily accessible range, performance, and navigation information to all required alternate aerodromes, VHF/HF/satellite data link equipment to enhance reliability and timeliness of communications.

(v) One year's satisfactory and extensive operations at a maximum rule time of not more than 138 minutes in order to increase maximum rule time up to 180 minutes.

(vi) Any additional restrictions the Department may seek to impose.

6.3 Contingency procedures or plans should not be interpreted in any way which prejudices the final authority and responsibility of the pilot-in-command for the safe operation of the aeroplane.

7. OPERATIONS MANUAL

7.1 The Operations Manual must make it clear that without the appropriate and relevant Permission, EDTO are not authorised and may not be conducted.

7.2 Information in the operations manual for EDTO should specifically include provisions covering at least the following:

(a) Designation of the particular airframe/engine combination, including specification of modifications required for EDTO;

(b) Approved area of operation, and all relevant ATC requirements;

(c) Minimum altitudes to be flown along planned and diversionary routes, and maximum altitudes if restricted by EDTO considerations (e.g. APU start capability);

(d) Rule Distance;

(e) The power setting, speeds, and flight levels to be used after the failure or shutdown of an engine;

(f) Aerodromes authorised for use, including alternates and associated instrument approaches, operation minima, and planning minima (see Appendix B);

(g) A clear statement that it is the commander's responsibility not to accept ATC clearances that would take the aeroplane outside the approved EDTO envelope in terms of Rule Distance and Flight Level;

(h) Reference to the approved maintenance schedule requirements for EDTO, including those items specified in the type design approval of the EDTO variant;

(i) Identification of those aeroplanes designated for EDTO by make and model, as well as by serial number and registration letters.

(j) Minimum crew qualifications and recency to allow them to operate unsupervised on extended range flights.

(k) Guidance on minimum acceptable system and equipment levels of serviceability in order to continue an EDTO in the event of an in-flight failure. Full information should be provided as and when a flight may continue in these circumstances at the normal or at a reduced Rule Distance from suitable alternate.

(l) Procedures to enable the flight to be conducted on an alternative rule as non-EDTO, i.e. not more than 60 minutes from a suitable alternate. Otherwise a statement in the Operations Manual that non-EDTO flights are not approved on that route.

8. OPERATIONS VALIDATION

The operator should demonstrate that he has the competence and capability to safely conduct and adequately support the intended operation. A validation flight, in the aeroplane or an approved simulator, should also incorporate a demonstration of the most critical of the following emergency condition:

8.1 Total loss of thrust of one engine; and

8.2 Total loss of engine-generated electrical power, or any other condition considered to be equivalent in airworthiness, crew workload, or performance risk.

9. EDTO APPROVAL

Following a type design approval for EDTO, and satisfactory application of the other criteria in this Publication, including a validation flight or acceptable simulation, an operator may be authorised to conduct EDTO with twin-engined aeroplanes through the machinery of a Permission.

10. PROVISION OF OPERATING DATA

Operators should collate data in order to provide statistics to the Civil Aviation Department for each year ending 31 December. The following information should be provided:

(a) Number of extended range flights operated in the year.

(b) Incidents experienced which were relevant to EDTO.

(c) Details of any diversion from an EDTO.

(d) The number of occasions (with details) when flights were not despatched on EDTO due to aeroplane unserviceability or weather below planning minima at the available adequate alternates.

11. RETENTION OF OPERATION DATA

Operators should review their EDTO operations in order to ensure that their flights are despatched and operated in accordance with the Operations Manual procedures. To facilitate this, as a minimum, the meteorological data and other aeronautical information used by the crew at the despatch stage should be retained for three months after the date of the flight.

CHAPTER 5 CONTINUING SURVEILLANCE AND ENGINE RELIABILITY REPORT

1. CONTINUING SURVEILLANCE

The fleet average In Flight Shut Down (IFSD) rate for the specified airframe/engine combination will continue to be monitored in accordance with Appendix A. As with all other operations, the Department will monitor all aspects of the EDTO it has authorised, to ensure the levels of reliability achieved in EDTO remain at the necessary levels, and that the operation continues to be conducted safely. In the event that an acceptable level of reliability is not maintained, or if significant deficiencies are detected in the conduct of operations, the Department will require the operator to take all necessary action to resolve the problems in a timely manner, or will withdraw the authorisation for EDTO.

2. ENGINE RELIABILITY REPORT

A propulsion system reliability report will be published, providing the results of the assessment of the world fleet engine reliability as it relates to design and operations for a particular airframe/engine combination. This will be done in accordance with Appendix A.

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APPENDIX A PROPULSION SYSTEM RELIABILITY ASSESSMENT

1. ASSESSMENT PROCESS

1.1 To establish whether a particular airframe/engine combination has satisfied the propulsion systems reliability requirements for EDTO, an assessment will be made by the Department using all pertinent propulsion system data. To accomplish the assessment, the Department will need world fleet data and data from various sources (the operator, the engine manufacturer and the aeroplane manufacturer) which should be extensive enough and of sufficient maturity to enable the Department to assess with a high level of confidence using engineering and operational judgement and standard statistical methods, where appropriate, that the risk of total power loss from independent causes is sufficiently low. The Department will state whether or not the current propulsion system reliability of a particular airframe/engine combination satisfies the relevant criteria. Included in the statement, if the operation is approved, will be the engine build standard, propulsion system configuration, operating condition and limitations required to qualify the propulsion system as suitable for EDTO.

1.2 If an approved engine CMP is maintained by the responsible engine Authority and is duly referenced on the engine Type Certificate Data Sheet, then this shall be made available to the Department.

2. SERVICE EXPERIENCE

2.1 When considering the acceptability of a propulsion system for EDTO, maturity should be assessed not only in terms of total fleet hours and fleet leader time over a calendar time, but also on the extent to which test data and design experience can be used as an alternative.

2.2 There are two extremes in the EDTO process with respect to maturity; one is the demonstration of a stable reliability by the accumulation of service experience and the other is by an agreed design and test program between the manufacturers and authorities. The extent to which a propulsion system is a derivative of previous EDTO-rated systems is also a factor of the level of maturity.

2.3 There is justification for the view that modern propulsion systems achieve a stable reliability level by 100,000 hours for new type and 50,000 hours for derivatives. 3000 to 4000 hours is considered to be the necessary time in service for a specific unit to indicate problem areas. Normally, the service experience will be:

(a) For new propulsion systems: 100,000 hours and 12 months service. Where experience on another aeroplane is applicable, a significant portion of the 100,000 hours should normally be obtained on the candidate aeroplane.

(b) For derivative propulsion systems: 50,000 hours and 12 months service. These values may vary according to the degree of commonality. To this end in determining the derivative status of a propulsion system, consideration should be given to technical criteria referring to the commonality with previous EDTO-rated engines. Prime areas of concern include:

(i) Turbomachinery

(ii) Controls and accessories and control logic

(iii) Configuration hardware (piping, cables etc.)

(iv) Aircraft to engine interfaces and interaction, e.g.

- Fire
- Thrust reverser
- Avionics, etc.

2.4 The extent to which the inservice experience might be reduced would depend upon the degree of commonality with previous EDTO-rated engines using the above criteria, and would be decided on a case-by-case basis. Also on a case-by-case basis, relevant test and design experience could be taken into account when arriving at the inservice experience required.

2.5 Thus the required experience to demonstrate propulsion system reliability should be determined by :

(a) The extent to which previous service experience of common EDTO-rated propulsion systems can be considered.

(b) To what extent compensating factors such as design similarity and test evidence can be used.

(c) The two preceding considerations would then determine the amount of service experience needed for a particular propulsion system proposed for EDTO.

2.6 These considerations would be made on a case-by-case basis and would need to provide a demonstrated level of propulsion system reliability in terms of IFSD rate of the order of .05 per 1000 hours (for a maximum diversion time of 60 minutes), as is necessary also for new propulsion systems.

3. DATA REQUIRED FOR ASSESSMENT

3.1 A list of all engine shutdown events, both ground and inflight, for all causes (excluding normal training events) including flameout. The list should provide the following for each event:

(a) date;

(b) airline;

(c) aeroplane and engine identification (model and serial number);

(d) power-unit configuration and modification history;

(e) engine position;

(f) symptoms leading up to the event, phase of flight or ground operation;

(g) weather/environmental conditions and reason for shutdown and any comment regarding engine re-start potential.

3.2 All occurrences where the intended thrust level was not achieved, or where crew action was taken to reduce thrust below the normal level, for whatever reason:

(a) unscheduled engine removals/shop visit rates;

(b) total engine hours and aeroplane cycles;

(c) all events should be considered to determine their effects on EDTO operations;

(d) additional data as required.

3.3 The Department will also consider relevant design and test data.

4. RISK MANAGEMENT AND RISK MODEL

4.1 Propulsion systems approved for EDTO must be sufficiently reliable to assure that defined safety targets are achieved.

4.2 A review of information for modern fixed wing jet powered aircraft over a recent six year period shows that the rate of fatal accidents for all causes is in the order of 0.3 x 10-6 per flying hour. The reliability of aeroplane types approved for EDTO should be such that they achieve at least as good an accident record as equivalent technology equipment. The overall target of 0.3 x 10-6 per flying hour has therefore been chosen as the all-causes safety target.

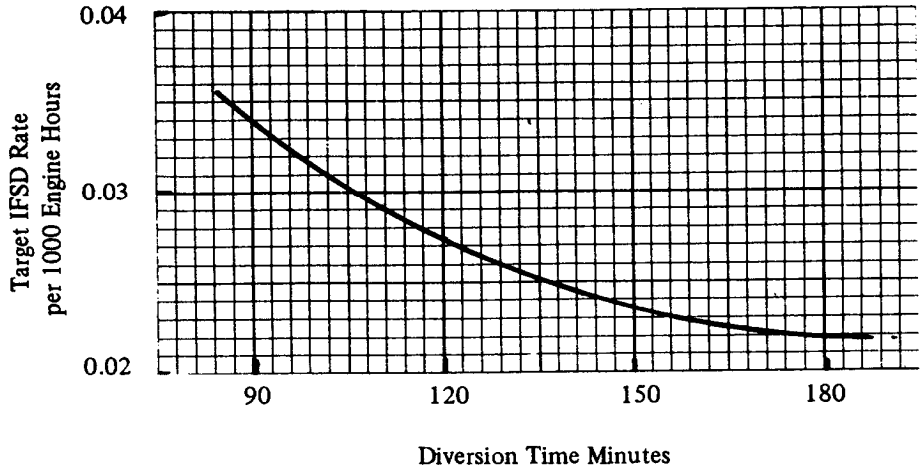
4.3 When considering safety targets, an accepted practice is to allocate appropriate portions of the total to the various potential contributing factors. By applying this practice to the overall target of 0.3 x 10-6 per flying hour in the proportions previously considered appropriate, the probability of a catastrophic accident due to complete loss of thrust from independent causes must be no worse than 0.3 x 10-8 per flying hour.

4.4 Propulsion system related accidents may result from independent cause events but, based on historical evidence, result primarily from events such as uncontained engine failure events, common cause events, engine failure plus crew error events, human error related events and other. The majority of these factors are not specifically exclusive to EDTO.

4.5 Using an expression developed by ICAO (ref AN-WP/5593 dated 15/2/84) for the calculation of engine in-flight shutdown rate, together with the above safety objective and accident statistics, a relationship between target engine in-flight shutdown rate for all independent causes and maximum diversion time has been derived. This is shown in Figure 7.

4.6 In order that type design approval may be granted for EDTO, it will be necessary to satisfy the Department that after application of the corrective actions identified during the engineering assessment (see paragraph 5.1 of this Appendix), the target engine in-flight shutdown rates will be achieved. This will provide assurance that the probability objective for loss of all thrust due to independent causes will be met.

Figure 7:



5. ENGINEERING ASSESSMENT

5.1 There are maintenance programmes, engine on-wing health monitoring programmes, and the promptness and completeness in incorporating engine service bulletins, etc, that influence an operator's ability to maintain a level of reliability. The data and information required will form a basis from which a world-fleet engine shutdown rate will be established for use in determining whether a particular airframe/engine combination complies with criteria for EDTO.

5.2 An analysis will be made on a case-by-case basis of all significant failures, defects and malfunctions experienced in service (or during testing) for the particular airframe/engine combination. Significant failures are principally those causing or resulting in in-flight shutdown or flameout of the engine(s), but may also include unusual ground failures and/or unscheduled removal of engines. In making the assessment, consideration will be given to the following:

(a) The type of propulsion system, previous experience, whether the power-unit is new or a derivative of an existing model, and the operating thrust level to be used after one engine shutdown.

(b) The trends in the cumulative twelve month rolling average, updated quarterly, of in-flight shutdown rates versus propulsion system flight hours and cycles.

(c) The demonstrated effect of corrective modifications, maintenance, etc on the possible future reliability of the propulsion system.

(d) Maintenance actions recommended and performance and their effect on propulsion system and APU failure rates.

(e) The accumulation of operational experience which covers the range of environmental conditions likely to be encountered.

(f) Intended maximum flight duration, and maximum diversion in the EDTO segment, used in the EDTO under consideration.

5.3 Engineering judgment will be used in the analysis of paragraph 5.2 of this Appendix such that the potential improvement in reliability, following the introduction of corrective actions identified during the analysis, can be quantified.

5.4 The resultant predicted reliability level and the criteria developed in accordance with paragraph 4 of this Appendix will together be used to determine the maximum diversion time for which the particular airframe/engine combination qualifies.

5.5 The type design standard for type approval of the engine-airframe combination for EDTO will include all modifications and maintenance actions for which full or partial credit is taken in paragraph 5.3 of this Appendix and other such actions required by the Department to enhance reliability. The schedule for incorporation of type design standard items should normally be established in the Configuration Maintenance Procedures (CMP) for example in terms of calendar time, hours or cycles.

APPENDIX B EN-ROUTE ALTERNATE AERODROMES

1. GENERAL

1.1 One of the distinguishing features of extended range twin-engined operations is the concept of a suitable (see paragraph 2 of this Appendix) en-route alternate being available, to which an aeroplane can divert after a single failure or failure combinations which require a diversion. Whereas most twin-engined aeroplanes operate in an environment where there is usually a choice of diversions available, the EDTO aeroplane may have only one aerodrome within a range dictated by the endurance of a particular airframe system (e.g. cargo fire suppressant), or by the approved maximum diversion time for that route.

1.2 It is, therefore, important that any aerodromes designated as en-route alternates should have the capabilities, services, and facilities to safely support that particular aeroplane. The weather conditions at the time of arrival should provide a higher than normal assurance that adequate visual reference will be available upon arrival at decision height (DH) or minimum decision altitude (MDA), and the surface wind conditions and corresponding runway surface conditions should be within acceptable limits to permit the approach and landing to be safely completed with an engine inoperative. These considerations shall apply to all aerodromes which are considered as alternates when flying the EDTO segment, thus possibly including the departure and/or destination aerodromes.

1.3 Designated alternates and all their associated performance and planning data should be specified in the Operations Manuals.

2. DEFINITIONS OF AERODROMES

2.1 Adequate

For the purpose of this Publication, an **adequate** aerodrome is an aerodrome which the operator of the aeroplane considers to be adequate, having regard to his responsibilities pursuant to Article 27(1)(c) and Regulations 4 and 14 of Schedule 15 of the Air Navigation (Hong Kong) Order. In particular, it should be expected that at the anticipated time of use:

(a) the aerodrome will be available, and equipped with necessary ancillary services, such as ATC, sufficient lighting, communications, weather reporting, navaids, and safety cover; and
(b) at least one letdown aid (ground radar would so qualify) will be available for an instrument approach.

2.2 Suitable

For the purpose of this Publication, a **suitable** aerodrome is an **adequate** aerodrome where, at the anticipated time of use, weather reports, or forecasts, or any combination thereof, indicate that the weather conditions are very likely to be at or above the normal operating minima at the time of the intended operation, using the criteria set out in this Appendix. Where a condition is forecast as 'Prob.', provided the probability percent factor is less than 40 percent, then that condition can be ignored for planning minima purposes. 'Tempo.', 'Inter.' and 'Gradu.' conditions are normally qualified by a time band and must be considered in determining the suitability of an aerodrome with respect to planning minima. Where a time band is omitted then the conditions need not be considered with respect to planning minima. The commander is expected however to exercise good judgement in assessing the overall weather conditions when making a decision to exclude 'Tempo.', 'Inter.', 'Gradu.' and 'Prob.' conditions.

3. PLANNING MINIMA

3.1 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 en-route alternate weather minima for despatch purposes (Planning Minima) should be higher than the weather minima required to initiate a normal instrument approach. This is necessary to ensure that the instrument approach and landing can be conducted safely if the flight has to divert to the alternate aerodrome. Additionally, since the visual reference required to safely complete an approach and landing is determined, amongst other things, by the accuracy with which the aeroplane can be controlled along the approach path by reference to instruments, and by the accuracy of ground-based instrument aids, as well as by the tasks the pilot is required to accomplish to manoeuvre the aeroplane so as to complete the landing, the weather minima for non-precision approaches are generally higher than for precision approaches.

3.2 The following standard en-route alternate planning weather minima are to be established for flight planning and despatch purposes with twin-engined aeroplanes in EDTO. These weather minima recognise the benefits of ILS/MLS, as well as the increased assurance of safely completing an instrument approach at aerodromes which are equipped with ILS/MLS approaches to at least two separate runways. A particular aerodrome may be considered to be a suitable aerodrome for flight planning and despatch purposes for EDTO if it meets the criteria of Chapter 4 paragraph 4.5 of this Sub-Section, and has forecast weather (in accordance with Chapter 4) at or better than the following planning minima:

(a) Single ILS/MLS, or PAR:

Cloudbase of 600 feet and a visibility of 3 km (2 statute miles) or a cloudbase of 400 feet and a visibility of 1.5 km (1 statute mile) above the lowest authorised landing minima; whichever is higher.

(b) Non-precision and circling approaches (including SRA):

Cloudbase of 800 feet and a visibility of 3 km (2 statute miles) or a cloudbase of 400 feet and a visibility of 1.5 km (1 statute mile) above the lowest authorised landing minima; whichever is higher.

(c) Two or more ILS/MLS/PAR to separate runways:

Where forecast wind and surface conditions indicate that two or more separate runways will be available within the Rule Distance, whether at one or more aerodromes, the relevant Planning Minima cloudbase may be reduced by 200 feet and the visibility by 1 km (½ statute mile).

3.3 The appropriate planning minima may only be used if the expected wind and surface conditions would permit an engine-out landing on the runway(s) served by the aid(s). For planning purposes the expected cross-winds, including gusts, for a period commencing one hour before the established earliest time of landing and ending one hour after the established latest time of landing at that aerodrome, should not exceed the maximum permitted cross-wind for landing, taking into account the factors of Chapter 4 paragraph 4.5(a) of this Sub-Section, unless otherwise agreed with the Department. In all cases, the Department may direct that higher planning minima shall apply. However, the Department may approve lower aerodrome planning minima for a specific en-route alternate aerodrome on the basis of favourable special meteorological, terrain and operational studies produced by an operator or group of operators.

3.4 Once an EDTO aeroplane has been despatched, the suitability of an en-route alternate aerodrome for an aeroplane flying within an EDTO sector is based on a determination that the aerodrome is still suitable [as used in AN(HK)O Article 27(1)(c)] for the circumstances, and that the weather conditions at that aerodrome will permit an instrument approach to be initiated and landing completed. In the event that the weather deteriorates at a specified alternate, so that it is unlikely that a successful landing could be achieved, the Commander should re-plan the flight to come within the specified Rule Distance of another suitable alternate.

APPENDIX C EDTO MAINTENANCE REQUIREMENTS

1. GENERAL

The maintenance programme should contain the standards, guidance, and direction necessary to support the intended operations. Maintenance personnel involved should be made aware of the special nature of EDTO and have the knowledge, skill and ability to accomplish the requirements of the programme.

2. EDTO MAINTENANCE PROGRAMME

The basic maintenance programme for the aeroplane being considered for EDTO is the continuous airworthiness maintenance schedule currently approved for that operator, for the make and model airframe/engine combination. This schedule should be reviewed to ensure that it provides an adequate basis for development of EDTO maintenance requirements. These should include maintenance procedures to preclude identical action being applied to multiple similar elements in any EDTO critical systems (e.g. fuel control changes on both engines).

(a) EDTO related tasks should be identified on the operator's routine work forms and related instructions.

(b) EDTO related procedures, such as involvement of centralised maintenance control, should be clearly defined in the operator's programme.

(c) An EDTO service check should be developed to verify that the status of the aeroplane and certain critical items are acceptable. This check should be accomplished and signed off by an EDTO qualified maintenance person immediately prior to an EDTO flight.

(d) The Technical Log should be reviewed and documented as appropriate to ensure proper MEL procedures, deferred items and maintenance checks, and that system verification procedures have been properly performed.

3. EDTO MANUAL

The operator should develop a manual for use by personnel involved in EDTO. This manual need not include, but should at least reference, the maintenance programme and other requirements described by this Appendix, and clearly indicate where they are located in the operator's manual system. All EDTO requirements, including supportive programme procedures, duties and responsibilities, should be identified and be subject to revision control. This manual should be submitted for approval to the Department 30 days before implementation of EDTO flights. Subsequently all proposed EDTO manual amendments should be submitted to the Department for approval 30 days before implementation of the amendment.

4. OIL CONSUMPTION PROGRAMME

The operator's oil consumption programme should reflect the manufacturer's recommendations and be sensitive to oil consumption trends. It should consider the amount of oil added at the departing EDTO stations with reference to the running average consumption; i.e. the monitoring must be continuous up to, and including, oil added at the EDTO departure station. 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 added to the oil consumption programme.

5. ENGINE CONDITION MONITORING

This programme should describe the parameters to be monitored, method of data collection and corrective action process. The programme should reflect manufacturer's instructions and industry practice. This monitoring will be used to detect deterioration at an early stage to allow for corrective action before safe operation is effected. The programme should ensure that engine limit margins are maintained so that a prolonged single-engine diversion may be conducted without exceeding approved engine limits (i.e. rotor speeds, exhaust gas temperatures) at all approved power levels and expected environmental conditions. Engine margins preserved through this programme should account for the effects of additional engine loading demands (e.g. anti-ice, electrical, etc.) which may be required during the single-engine flight phase associated with the diversion.

6. RECTIFICATION OF AEROPLANE DEFECTS

The operator should develop a verification programme, or procedures should be established, to ensure corrective action following an engine shutdown, primary system failure, adverse trends or any prescribed events which require verification flight or other action and establish means to assure their accomplishment. A clear description of who must initiate verification actions and the section or group responsible for the determination of what action is necessary should be identified in the programme. Primary systems or conditions requiring verification actions should be described in the operators EDTO manual.

7. RELIABILITY PROGRAMME

An EDTO reliability programme should be developed or the existing reliability programme supplemented. This programme should be designed with early identification and prevention of EDTO related problems as the primary goal. The programme should be event-orientated and incorporate reporting procedures for significant events detrimental to EDTO flights. This information should be readily available for use by the operator and the Department to help establish that the reliability level is adequate, and to assess the operator's competence and capability to safely continue EDTO. The Department should be notified within 96 hours of events reportable through this programme.

(a) In addition to the items addressed by [CAD 418] (Condition Monitored Maintenance) for routine reliability reporting, the following items should be included:

(i) In-flight shutdowns.

(ii) Diversion or turnback.

(iii) Uncommanded power changes or surges.

(iv) Inability to control the engine or obtain desired power.

(v) Problems with systems critical to EDTO.

(vi) Any other event detrimental to EDTO.

(b) The report should identify the following:

(i) Aeroplane identification.

(ii) Engine identification (make and serial number).

(iii) Total time, cycles, and time since last shop visit.

(iv) For systems, time since overhaul or last inspection of the defective unit.

(v) Phase of flight.

(vi) Corrective action.

8. PROPULSION SYSTEM MONITORING

The operator's assessment of propulsion systems reliability for the extended range fleet should be made available to the Department (with the supporting data) on at least a monthly basis, to ensure that the approved maintenance programme continues to maintain a level of reliability necessary for EDTO. Any adverse trend would require an immediate evaluation to be accomplished by the operator in consultation with the Department. The evaluation may result in corrective action or operational restriction being applied.

9. MAINTENANCE TRAINING

Maintenance training should focus on the special nature of EDTO. This programme should be included in normal maintenance training. The goal of this programme is to ensure that all personnel involved in EDTO are provided the necessary training so that the EDTO maintenance tasks are properly accomplished and to emphasise the special nature of EDTO maintenance requirements. Qualified maintenance personnel are those that have completed the operator's extended range training programme and have satisfactorily performed extended range tasks under supervision, within the framework of the operator's approved procedures for Personnel Authorisation.

10. EDTO PARTS CONTROL

The operator should develop a parts control programme that ensures the proper parts and configuration are maintained for EDTO. The programme includes verification that parts placed on EDTO aeroplane during parts borrowing or pooling arrangements as well as those parts used after repair or overhaul, maintain the necessary EDTO configuration for that aeroplane.

CONTENTS

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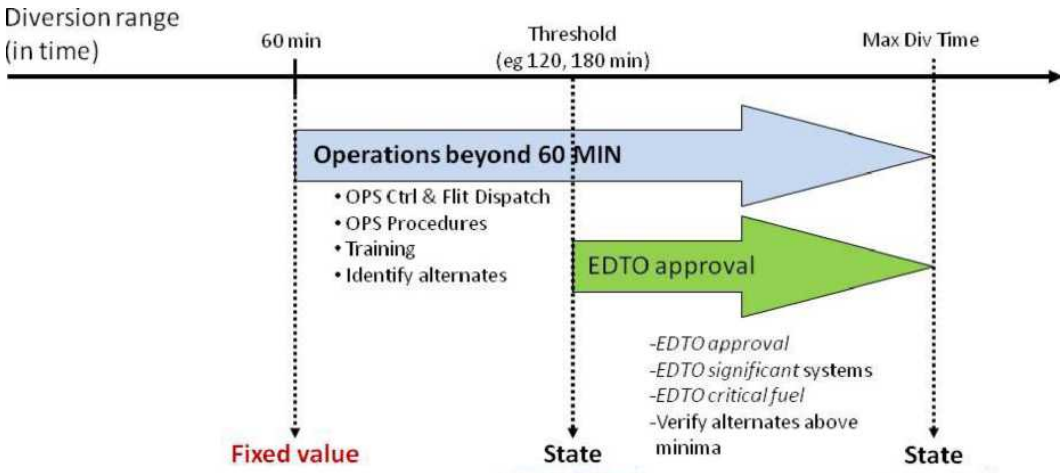
SECTION III - EDTO for Aeroplanes with More than Two Turbine Engines

1. GENERAL

Determination of the 60 minute distance - aeroplanes with more than two turbine engines

1.1 This section addresses provision that apply to aeroplanes with more than two turbine engines in addition to the general clauses in Section I. Figure 8 provides a general pictures on the requirements.

Figure 8: Generic EDTO graphical representation for aeroplanes with more than two turbine engines.



2. OPERATIONAL AND DIVERSION PLANNING PRINCIPLES

2.1 When planning or conducting EDTO, an operator and pilot in command should ensure that:

(a) when planning an EDTO flight, the minimum equipment list, the communications and navigation facilities, fuel and oil supply, en-route alternate aerodromes and aeroplane performance, are appropriately considered;

(b) if no more than one engine is shut down, the pilot-in-command may elect to continue beyond the nearest en-route alternate aerodrome (in terms of time) if he determines that it is safe to do so. In making this decision the pilot-in-command should consider all relevant factors; and

(c) in the event of a single or multiple failure of an EDTO significant system or systems (excluding engine failure), proceed to and land at the nearest available en-route alternate aerodrome where a safe landing can be made unless it has been determined that no substantial degradation of safety results from any decision made to continue the planned flight.

2.2 EDTO critical fuel

2.2.1 An aeroplane with more than two engines engaged in EDTO operations should carry enough fuel to fly to an en-route alternate aerodrome.

2.2.2 The following should be considered, using the anticipated mass of the aeroplane, in determining the corresponding EDTO critical fuel:

(a) fuel sufficient to fly to an en-route alternate aerodrome, considering at the most critical point of the route, simultaneous engine failure and depressurization or depressurization alone, whichever is more limiting;

(b) the speed selected for the diversions (i.e. depressurization, combined or not with an engine failure) may be different from the approved all-engine-operative speed used to determine the EDTO threshold and maximum diversion distance (see paragraph 2.8 of Section III);

(c) fuel to account for icing;

(d) fuel to account for errors in wind forecasting;

(e) fuel to account for holding, an instrument approach and landing at the en-route alternate aerodrome;

(f) fuel to account for deterioration in cruise fuel burn performance; and

(g) fuel to account for APU use (if required).

2.2.3 The following factors may be considered in determining if a landing at a given aerodrome is the more appropriate course of action:

(a) aeroplane configuration, weight, systems status, and fuel remaining;

(b) wind and weather conditions en-route at the diversion altitude, minimum altitudes en-route and fuel consumption to the en-route alternate aerodrome;

(c) runways available, runway surface condition, weather, wind and terrain, in proximity of the en-route alternate aerodrome;

(d) instrument approaches and approach/runway lighting available, rescue and fire fighting services (RFFS) at the en-route alternate aerodrome;

(e) the pilot's familiarity with that aerodrome and information about that aerodrome provided to the pilot by the operator; and

(f) facilities for passenger and crew disembarkation and accommodation.

2.3 Threshold time

2.3.1 In establishing the appropriate threshold time and to maintain the required level of safety, it is necessary for CAD to consider that:

(a) the airworthiness certification of the aeroplane type does not restrict operations beyond the threshold time, taking into account the aeroplane system design and reliability aspects;

(b) specific flight dispatch requirements are met;

(c) necessary in-flight operational procedures are established; and

(d) the operator's previous experience on similar aircraft types and routes.

Considering the above factors, the threshold time set for aeroplanes registered in Hong Kong with three or more engines is **180 minutes** unless otherwise stated.

2.3.2 For determining whether a point on a route is beyond the EDTO threshold to an en-route alternate aerodrome, the operator should use the approved speed as described in paragraph 2.8 of Section III.

2.4 Maximum diversion time

2.4.1 In approving the maximum diversion time, the CAD will take into consideration the aeroplane's EDTO significant systems (e.g. limiting time limitation, if any, and relevant to that particular operations) for a particular aeroplane type and the operator's operational and EDTO experience with the aeroplane type, or if relevant, with another aeroplane type or model.

2.4.2 For determining the maximum diversion distance to an en-route alternate, the operator should use the approved speed.

2.4.3 The operator's approved maximum diversion time should not exceed the most limiting EDTO significant system time limitation identified in the Aeroplane's Flight Manual reduced by an operational safety margin, commonly 15 minutes, specified by the CAD.

2.4.4 The maximum diversion time subject to cargo fire suppression time limitations are considered part of the most limiting EDTO significant time limitations in paragraph 2.5.2 of this section.

2.5 EDTO significant systems

2.5.1 This section addresses particular provisions for aeroplanes with more than two turbine engines.

2.5.2 Consideration of time limitations

2.5.2.1 For all operations beyond the EDTO threshold as determined by the CAD, the operator should consider, at time of dispatch and as outlined below, the most limiting EDTO significant system time limitation, if any, indicated in the Aeroplane's Flight Manual (directly or by reference) and relevant to that particular operation.

2.5.2.2 The operator should check that from any point on the route, the maximum diversion time does not exceed the most limiting EDTO significant system time limitation reduced with an operational safety margin, commonly 15 minutes, specified by the CAD.

2.6 En-route alternate aerodromes

2.6.1 In addition to the en-route alternate aerodrome provisions, the following apply:

(a) for route planning purposes, identified en-route alternate aerodromes need to be located at a distance within the maximum diversion time from the route and which could be used if necessary;

(b) in EDTO, before an aeroplane crosses its threshold time during flight, there should always be an en-route alternate aerodrome within the approved maximum diversion time whose conditions will be at or above the operator's established aerodrome operating minima for the operation during the estimated time of use.

If any conditions, such as weather below landing minima, are identified that would preclude a safe approach and landing at that aerodrome during the estimated time of use, an alternative course of action should be determined such as selecting another en-route alternate aerodrome within the operator's approved maximum diversion time.

2.7 Operational approval procedure

2.7.1 In approving an operator with a particular aeroplane type for EDTO, the CAD will establish an appropriate threshold time and maximum diversion time and in addition to the requirements previously set forth, ensure that:

(a) specific operational approval is granted (by the CAD);

(b) the operator's past experience and compliance record is satisfactory and the operator establishes the processes necessary for successful and reliable EDTO and shows that such processes can be successfully applied throughout such operations;

(c) the operator's procedures are acceptable based on certified aeroplane capability and adequate to address continued safe operation in the event of degraded aeroplane systems;

(d) the operator's crew training programme is adequate for the proposed operation;

(e) documentation accompanying the authorization covers all relevant aspects; and

(f) it has been shown (e.g. during the EDTO certification of the aeroplane) that the flight can continue to a safe landing under the anticipated degraded operating conditions which would arise from:

(i) the most limiting EDTO significant system time limitation, if any, for EDTO identified in the Aeroplane's Flight Manual directly or by reference; or

(ii) any other condition which the CAD considers to be equivalent in airworthiness and performance risk.

2.8 Conditions to be used when converting diversion times to distances for the determination of the geographical area beyond threshold and within maximum diversion distances

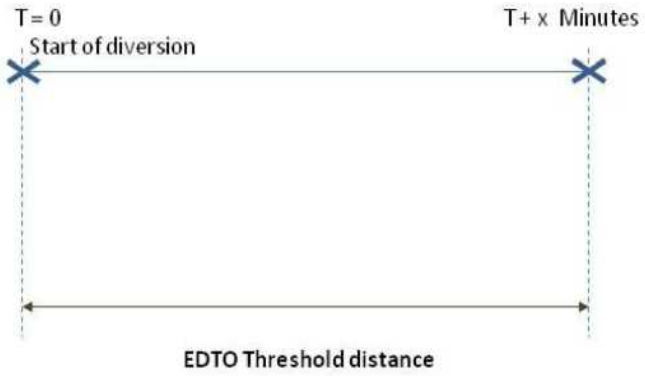
2.8.1 For the purpose of this guidance, an approved AEO speed is any AEO speed within the certified flight envelope of the aeroplane.

2.8.2 When applying for EDTO an operator should identify, and the CAD will approve the AEO speed, considering ISA and still air conditions that will be used to calculate diversion distances. This speed may be different from the speed used to determine the 60-minute and EDTO thresholds.

2.8.3 Determination of the EDTO threshold

2.8.3.1 For determining whether a point of the route is beyond the EDTO threshold to an en-route alternate, the operator should use the approved speed. The distance is calculated from the point of the diversion followed by cruise for the threshold time as determined by CAD as shown on Figure 9 below.

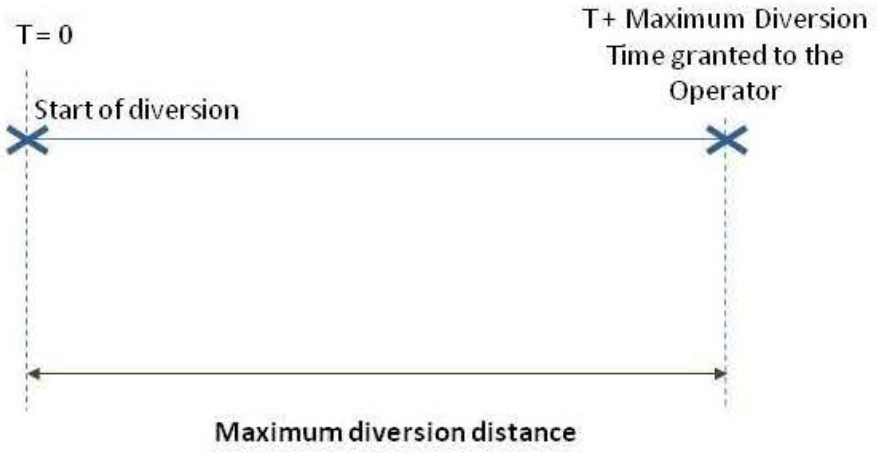
Figure 9: Threshold distance - Aeroplanes with more than two turbine engines



2.8.4 Determination of the maximum diversion time distance

2.8.4.1 For determining the maximum diversion time distance to an en-route alternate, the operator should use the approved speed. The distance is calculated from the point of the diversion followed by cruise for the maximum diversion time as approved by CAD as shown on Figure 10 below.

Figure 10: Maximum diversion distance - Aeroplanes with more than two turbine engines



2.9 Airworthiness certification requirements for EDTO beyond the threshold time

2.9.1 There are no additional EDTO airworthiness certification requirements for aeroplanes with more than two engines.

2.10 Maintaining operational approval

2.10.1 In order to maintain the required level of safety on routes where these aeroplanes are permitted to operate beyond the established threshold time, it is necessary that:

(a) specific flight dispatch requirements are met;

(b) necessary in-flight operational procedures are established; and

(c) specific operational approval is granted by CAD.

2.11 Airworthiness modifications and maintenance programme requirements

2.11.1 There are no additional EDTO airworthiness or maintenance requirements for aeroplanes with more than two engines.

2.12 Examples

2.12.1 On establishing the appropriate threshold and approved maximum diversion time for an operator with a particular aeroplane type, the CAD will consider, but not be limited to, the following; the airworthiness certification of the aeroplane, the operator's experience in conducting operations beyond the 60-minute threshold, flight deck crew experience in conducting such operations, the maturity of that operator's flight dispatch system, the communication capability with the operators operational control centre (ACARS, SATCOM, HF, etc.), the robustness of both the operator's standard operating procedures and the familiarity of the crews with those procedures, the maturity of the operator's Safety Management System, the crew training programme and the reliability of the propulsion system. The following examples are based on those considerations:

(a) Example A: CAD has established the threshold time based on the capability of the operator and the aeroplane type for an aeroplane with more than two engines at 180 minutes and approved a maximum diversion time of 240 minutes. That operator will need to have specific approval to be further than 180 minutes to an en-route alternate aerodrome (AEO speed in ISA and still air conditions), remain within 240 minutes to an en-route alternate airport.

If that operator with the particular aeroplane type plans a route within the threshold time established by the CAD (in the above example this is 180 minutes) to an en-route alternate aerodrome, that operator would not require any additional approval from the CAD and only need to comply with the requirements as specified in paragraphs 2.1.2 and 2.1.3 if the operation was conducted beyond 60 minutes from an en-route alternate aerodrome.

(b) Example B: The CAD is approached by an operator who is in the process of expansion, having acquired aeroplane(s) with more than two engines capable of EDTO. The operator submits an application to amend its AOC to include this new aeroplane type on newly granted routes. These routes take the flight beyond 60 minutes to an en-route alternate, thus requiring the establishment of a threshold time and approval of a maximum diversion time. Taking into account:

(i) that the operator has not had previous experience with the routes and area of operation;

(ii) the new aeroplane type;

(iii) the inexperience of the company and its flight operations/operations control department at planning and dispatching such flights; and

(iv) the new operating procedures to be established.

CAD determines that the threshold time for Operator B should be limited to 120 minutes and approves a maximum diversion time of 180 minutes.

As the operator gains experience with the operation and the procedures over time, CAD may amend the initially established threshold time and approved maximum diversion time.

***** END *****