

Extended Diversion Time Operations Workshop



ETP1

ETP2

Module 4

Type Design & Reliability Considerations



ICAO

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AIRBUS





Module 1
Course Introduction

Module 2
EDTO Foundation

Module 3
Approval Process

Module 4
Type Design & Reliability
Considerations

Module 5
Flight Operations
Considerations

Module 6
Maintenance
Considerations

Module 7
Continued Surveillance

Module 8
Implementing EDTO
Regulations

Module 9
Assessment

Module 10 – Wrap Up



At the end of this module, participants will be familiar with the affected areas of Type Design and Reliability, supporting the demonstration of the EDTO capability of the aeroplane as well as the aspects of continued validity of the EDTO certification .

Doc 10085: Extended Diversion Time Operations (EDTO) Manual



Chapter 1: Policy and general information

- 1.5 Continuity of EDTO certification — aeroplanes with two turbine engines (not applicable to aeroplanes with more than two engines)

Chapter 2: Aircraft airworthiness considerations for EDTO

- 2.1 Background
- 2.2 Airworthiness considerations for aeroplanes with two turbine engines
- 2.3 Airworthiness considerations for aeroplanes with more than two turbine engines

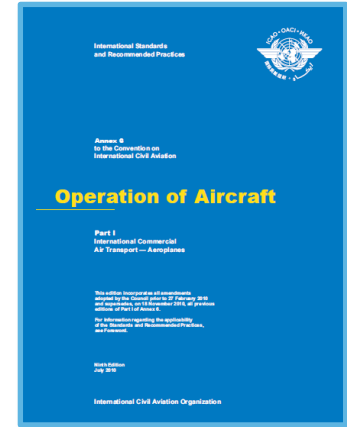


- Part I — Aircraft airworthiness considerations for EDTO**
- Part II — Type Design Assessment**
- Part III — Reliability & Maturity Assessment**
- Part IV — Continued validity of EDTO certification**
- Part V — EDTO Documentation (CMP, AFM, ...)**
- Part VI — Summary**
- Part VII — Practical Exercise**



Annex 6, Part 1 (4.7.2.3):

4.7.2.3 When approving the appropriate maximum diversion time for an operator of a particular aeroplane type engaged in extended diversion time operations, the **State of the Operator** shall ensure that:



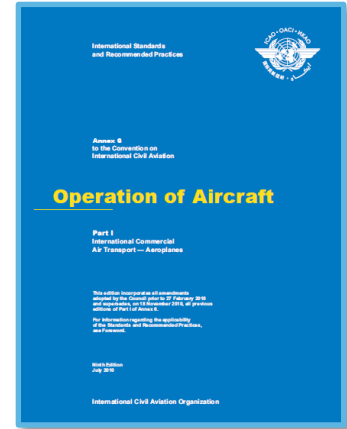
- a) **for all aeroplanes:** the most limiting EDTO significant system time limitation, if any, indicated in the aeroplane flight manual (directly or by reference) and relevant to that particular operation **is not exceeded**; and
- b) **for aeroplanes with two turbine engines:** the aeroplane is **EDTO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



Annex 6, Part 1 (4.7.2.6):

4.7.2.6 The State of the Operator shall, when approving maximum diversion times for **aeroplanes with two turbine engines**, ensure that the following are taken into account in providing the overall level of safety intended by the provisions of Annex 8:

- a) **reliability of the propulsion system;**
- b) **airworthiness certification for EDTO of the aeroplane type;** and
- c) EDTO maintenance programme.





EDTOM

Additional guidance from EDTO Manual *(extracts)*

Aeroplanes with 2 engines

2.2.1.1 The EDTO certification of the aircraft is granted by the **State of Design** of the aircraft manufacturer. This EDTO certification may also be called **EDTO type design and reliability approval** of the aircraft.

2.2.1.3 The EDTO certification is always granted to a given **aeroplane/engine combination** (AEC). It is not granted indefinitely and is **subject to continued surveillance** by the State of Design of the in-service reliability of the worldwide fleet of the concerned aeroplane/engine combination.

2.2.1.6 The **certified EDTO capability** of the aeroplane is reflected in the Type Certificate Data Sheet (**TCDS**), the aircraft flight manual (**AFM**) or AFM EDTO supplement, as applicable, and the **EDTO CMP document**.

2.2.1.7 The **EDTO certification** of the aircraft granted by the State of Design should then be **validated or accepted** by the State of Registry and, if different, the State of the Operator prior to the intended start of EDTO operations by the operator.



Additional guidance from EDTO Manual *(extracts)*

Aeroplanes with more than 2 engines

2.1.5 The airworthiness considerations for **aeroplanes with more than two turbine** engines were discussed during the development of the EDTO criteria. In this context, a review was performed of the reliability of operations on extended diversion time routes with aeroplanes with more than two engines, and it was concluded that both the basic type certification standards and maintenance programme provided the required level of safety for EDTO and remained suitable for EDTO operations.

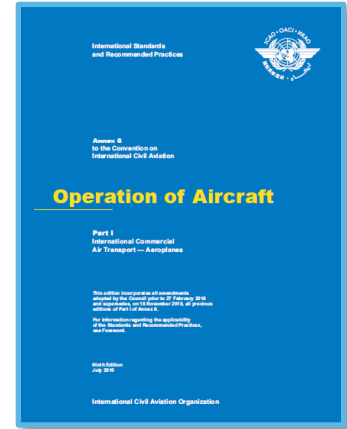
2.1.5.1 Accordingly, **the EDTO Standards do not introduce additional maintenance requirements or any additional certification requirements for aeroplanes with more than two engines.** This means that for EDTO with Tris/Quads, there is no need for a review; both remain acceptable for EDTO operations.



Annex 8, Part III: Operating limitations and information

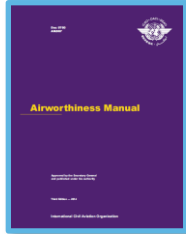
Chapter 9.2.7 in Part IIIA or Chapter 7.2.8 in Part IIIB*

**Note:*
 Part IIIA applies to Aeroplanes over 5 700 kg for which application for certification was submitted between June 1960 and March 2004
 Part IIIB applies to Aeroplanes over 5 700 kg for which application for certification was submitted on or after 2 March 2004



Flying time limitation after system or engine failure

The systems limitations shall include the maximum flying time for which system reliability has been established in relation to the **approval of operations by aeroplanes with two turbine engines beyond the threshold time** established in accordance with 4.7 of Annex 6, Part I.



Additional guidance from Airworthiness Manual Doc 9760 *(extracts)* Chapter 5 – Airworthiness Requirements for EDTO

5.1.3 [...] **Chapter 5.2** of this manual contains the airworthiness considerations for **aeroplanes with more than two turbine engines**, and the **subsequent chapters** contain guidance on the continuing airworthiness and airworthiness approval for **aeroplanes with two turbine engines**.

5.2 Airworthiness Considerations for aeroplanes with more than 2 engines

5.2.1 The most limiting EDTO significant system time limitation, if any, must be indicated in the aircraft flight manual (directly or by reference) and relevant to that particular operation.

5.2.2 There are no additional EDTO airworthiness certification, maintenance procedures or maintenance programme requirements for aeroplanes with more than two engines.



Aircraft airworthiness considerations for EDTO

Summary

**Annex 6, Part 1
Section 4.7.2**

**Doc 10085
EDTO Manual**

**Annex 8, Part IIIA
Section 9.2.7**

**Doc 9760
A/W Manual**



§ 4.7.2.3
EDTO certification is required

§ 2.2.2
Elements of the EDTO certification

§ 9.2.7 / 7.2.8
Flying time limitations are established

§ 5.6
Systems performance and reliability assessment



§ 4.7.2.3
EDTO certification is **NOT** required

§ 2.3.1
Identification of Time capability of most limiting relevant EDTO significant system

§ 5.2.1
Identification of Time capability of most limiting relevant EDTO significant system



Both Aeroplane Manufacturers and Operators have to develop an EDTO Significant Systems List

A system is identified as “**EDTO Significant**” when it has a unique influence for EDTO, i.e. it specifically participates to the EDTO philosophy : "Preclude and Protect the diversion“.

Accordingly, a EDTO Significant System is either:

- A system whose functional failure or degradation could **adversely affect the safety particular to an EDTO flight**, or
- A system whose continued functioning is **specifically important to the safe flight and landing of an aeroplane during an EDTO diversion** (for the contemplated maximum diversion time)

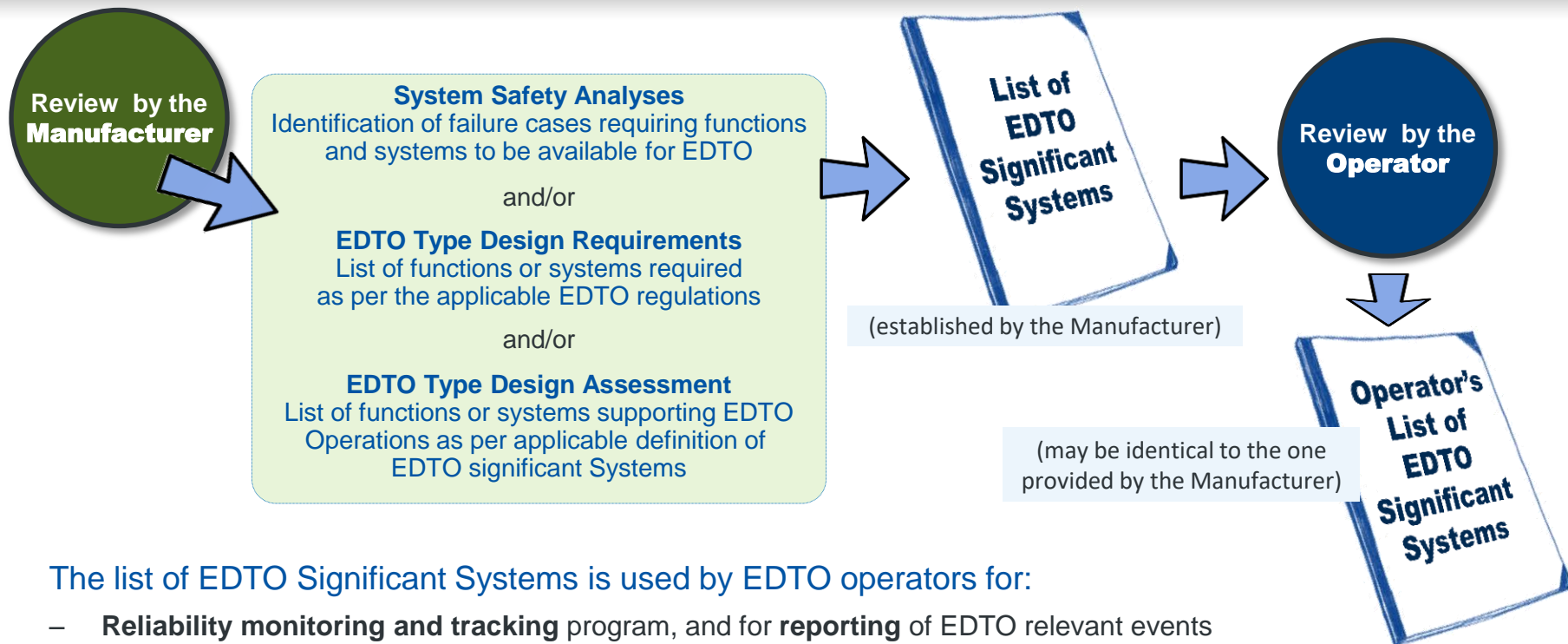


Question 4.1 :

Which of the following systems is an EDTO Significant System?

- Landing Gear
- Thrust Reverser
- Flight Controls
- Toilets
- Ram Air Turbine





The list of EDTO Significant Systems is used by EDTO operators for:

- **Reliability monitoring and tracking** program, and for **reporting** of EDTO relevant events
- Maintenance (**verification program, Dual Maintenance restrictions**, elements of **training program** which has to bring special attention for **qualified maintenance personnel**)



EDTO Significant Systems may be divided in two Groups

- EDTO Significant Systems Group 1 and Group 2
 - **Note:** this classification is mainly relevant for Manufacturers and of limited value to the Operator. Indeed Group 1 and Group 2 systems must be equally considered by the Operator except for the selection of EDTO related tasks in the frame of maintenance staff EDTO qualification (see Module 6).
- The identification of **Group 1 Significant Systems** is done through the assessment of the **consequence of an engine failure**. Accordingly, Group 1 EDTO Significant Systems are:
 - Systems related to number of engines and that drive the systems redundancy (e.g. engines, fuel feed, electrical system, bleed system...)
 - Systems that may affect the proper functioning of the engines
 - Could result in an in-flight shutdown or loss of thrust and consequently to diversion
 - Systems that contribute to the safety of EDTO flight, as well as to the safety of a maximum length diversion and landing at an alternate airport
- The Group 1 systems participate to both the “preclude” and “protect” concepts



EDTO Significant Systems may be divided in two Groups

- The **Group 2 EDTO Significant Systems** are:
 - **Systems not related to number of engines** and therefore equally important for an aeroplane engaged in EDTO operation regardless of the number of engines e.g. autopilot, navigation system, communication systems...
 - Among those, there are also the **Time Limited Systems** that may size the maximum diversion time, such as the cargo fire suppression system, or the oxygen on freighter aircraft.
- The failure of Group 2 EDTO Significant Systems would reduce the capability of the aeroplane or the ability of the crew to cope with a maximum length diversion and landing at an alternate airport
 - As such they participate mainly to the “protect” concept as they alleviate the crew workload during a maximum length diversion
- Therefore Group 2 systems are typically common to both twins and aeroplane with more than 2 engines



- Part I — **Aircraft airworthiness considerations for EDTO**
- Part II — Type Design Assessment**
- Part III — **Reliability & Maturity Assessment**
- Part IV — **Continued validity of EDTO certification**
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- Part VI — **Summary**
- Part VII — **Practical Exercise**



To operate beyond EDTO Threshold, two conditions must be met:

EDTO Type Design (AEC) Evaluation

(Certification required for Twins only)

Applicant:

MANUFACTURER



Annex 8 + EDTO Manual



CS 25 + AMC 20-6



FAR 25/33 + AC25XX (TBC)

Prime Certification Authority

+

Validation Authorities



EDTO Operational Evaluation

Applicant:

OPERATOR



Annex 6 + EDTO Manual



AIR OPS + AMC 20-6



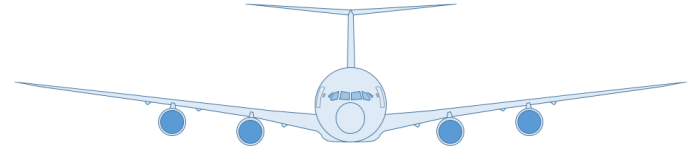
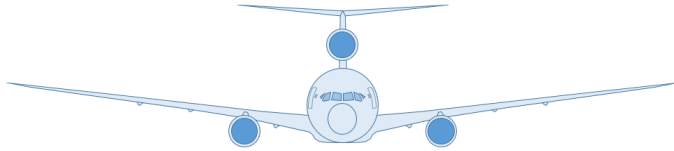
FAR121/135 + AC120-42B



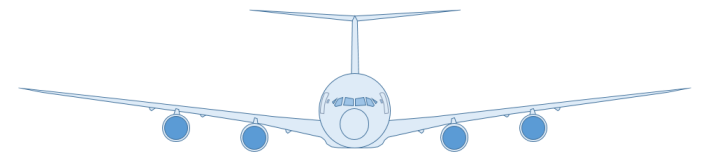
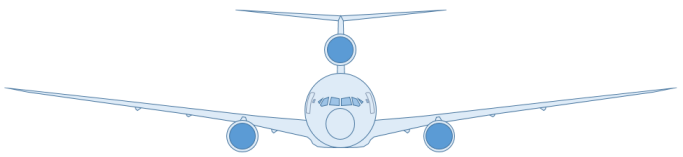
NAA Rules

National Aviation Authority

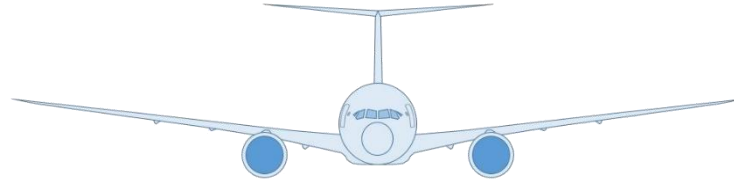
EDTO Type Design Evaluation must be completed **before** granting of operational approval of Operator for EDTO



- An assessment of the aeroplane and engine design should be performed to identify relevant EDTO Significant Time Limited Systems, if any, and to confirm the capability of the most limiting one :
 - In most cases, it is the capability of the Cargo Fire Suppression system which defines this limitation for EDTO
 - The capability of this most limiting EDTO Significant Time Limited System must be considered at dispatch for the purpose of identification and selection of en-route alternates (verification of weather)
- This assessment should be performed by the manufacturer
 - Corresponding time limitation should be provided in relevant aeroplane documentation

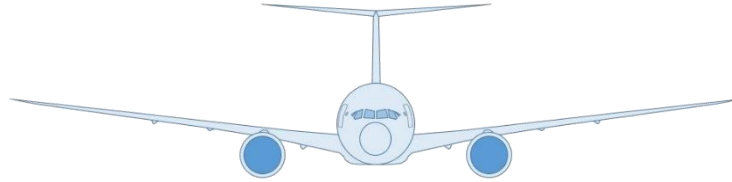


- **No dedicated certification for EDTO is required**
 - The systems configuration and the maintenance standards defined through the basic type certification of an aeroplane with more than two engines are considered as adequate for EDTO operations.
 - Note: a given State may require an EDTO certification provided related design and reliability criteria have been defined (engine reliability objective is usually not considered)
- There are also **no additional maintenance requirements for EDTO**.
 - Basic maintenance program remains valid to support EDTO
- The EDTO certification requirements detailed in the following slides are therefore applicable to Twin engine aircraft only.



- It is the responsibility of the aircraft manufacturer to obtain the **EDTO certification** of the aeroplane.
 - The EDTO certification is always granted to a given aeroplane/engine combination
 - It is subject to a continued surveillance of the in-service reliability

- It is a prerequisite to the start of the EDTO operations (EDTO operational approval).



- The Authority in charge of this approval is the **Primary Certifying Authority** of the manufacturer (**State of Design**), e.g. EASA for Airbus or FAA for Boeing.
- The EDTO certification of an aircraft is an assessment of the compliance of the candidate aeroplane/engine combination (AEC) with all the design provisions and reliability objectives of the applicable EDTO criteria (e.g.: EASA AMC 20-6, FAA Part 25.1535, ...).
 - These design and reliability requirements are further detailed in the following slides



Methods for EDTO Certification:

2 In-service experience

- Review of in-service data
- Flight tests for ESS failures (incl. OEI diversions)

> 100 000 EH (EASA)
> 250 000 EH (FAA)

1 + 2 Combined service experience and Early EDTO

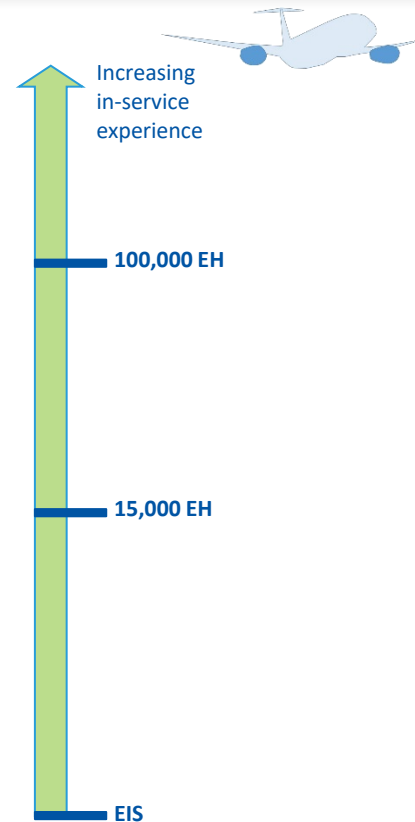
- Review of in-service data
- Flight tests for ESS failures (incl. OEI diversions)
- 3000 cycles tests (APU + Engine)**

> 15 000 EH (FAA)

1 Early EDTO


- Flight tests for ESS failures (incl. OEI diversions)
- 3000 cycles tests (APU + Engine)
- Flight + Bench Tests for maturity purpose**
- Lessons learnt activity**
- Early EDTO reporting and tracking**

No prior in-service experience





The 5 Main Elements of Early-EDTO Ensure EDTO Capability at Service Entry:



EDTO philosophy

PRECLUDE
Avoid the diversion

PROTECT
Ensure that the diversion is safe



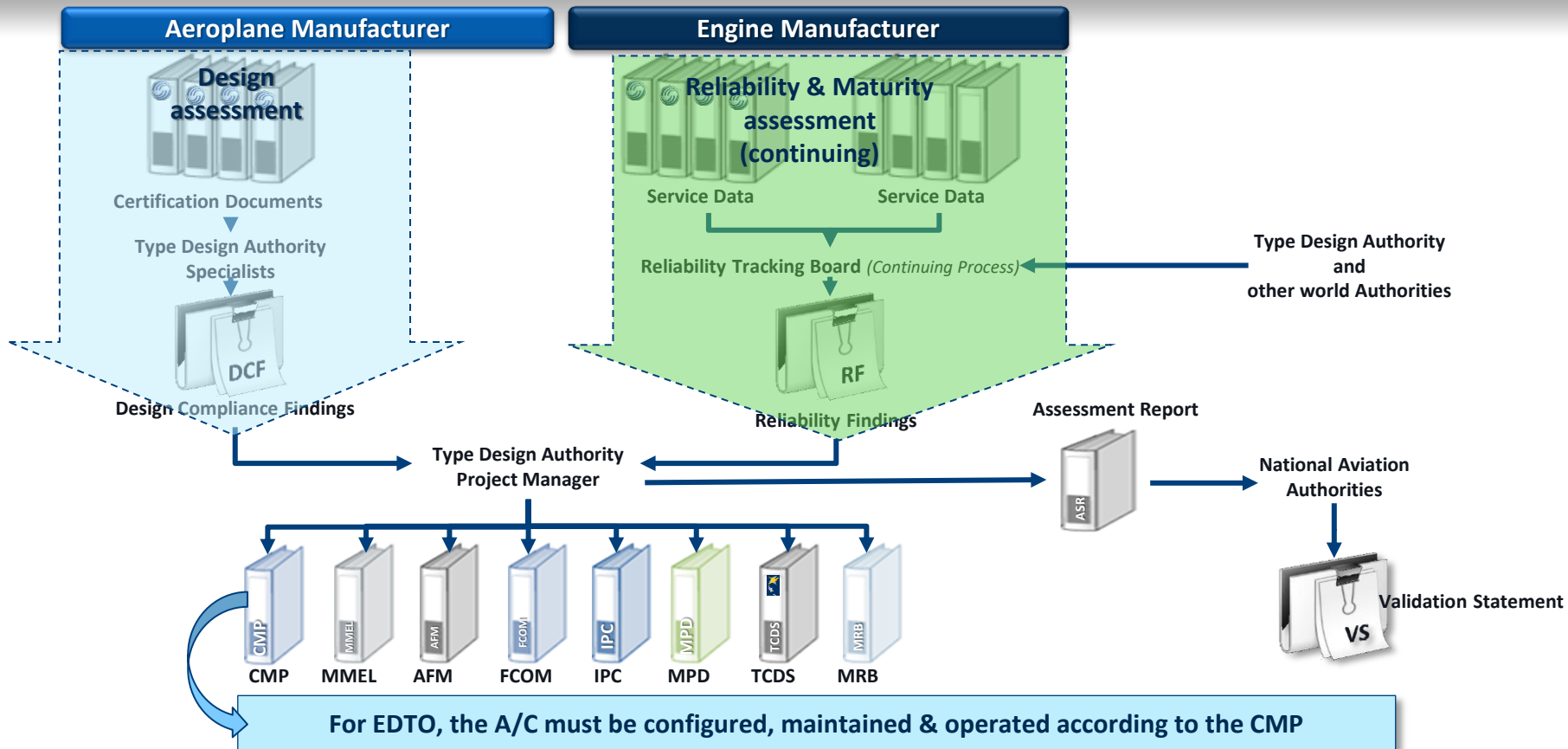
Early-EDTO Type Design Certification Process

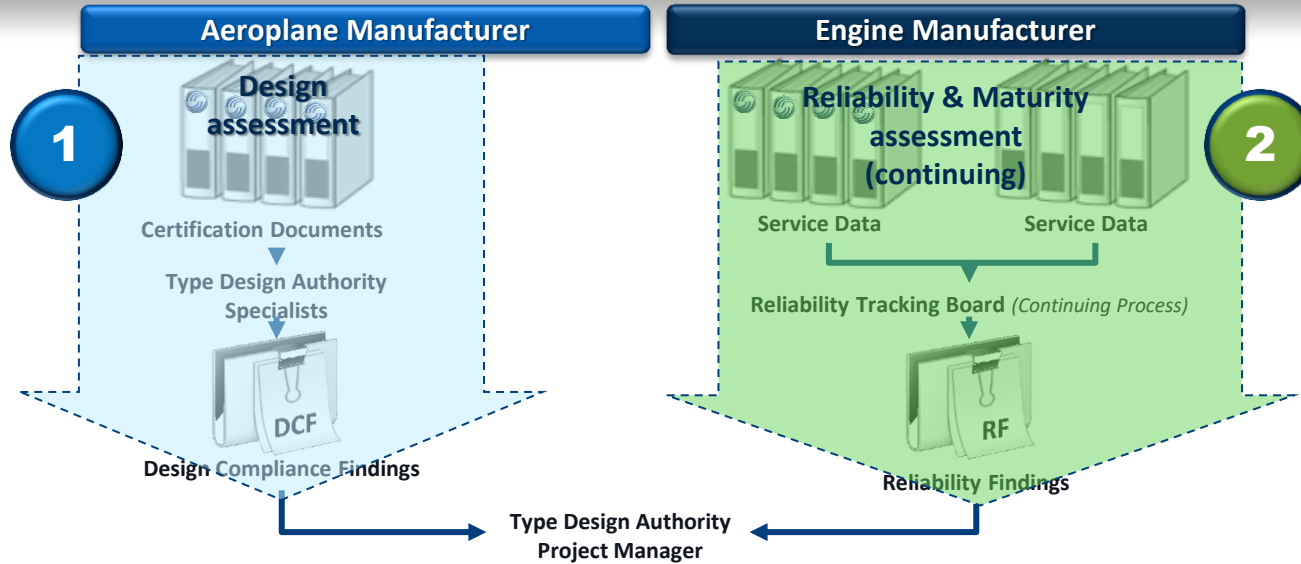
- 1 Design for EDTO
- 2 Relevant Experience (Lessons Learned)
- 3 Maintenance & Operations Procedures Validation
- 4 EDTO Testing (Ground & Flight tests)
- 5 Problem Tracking and Resolution



EDTO Type Design and Reliability Approval

Deliverables / documentation





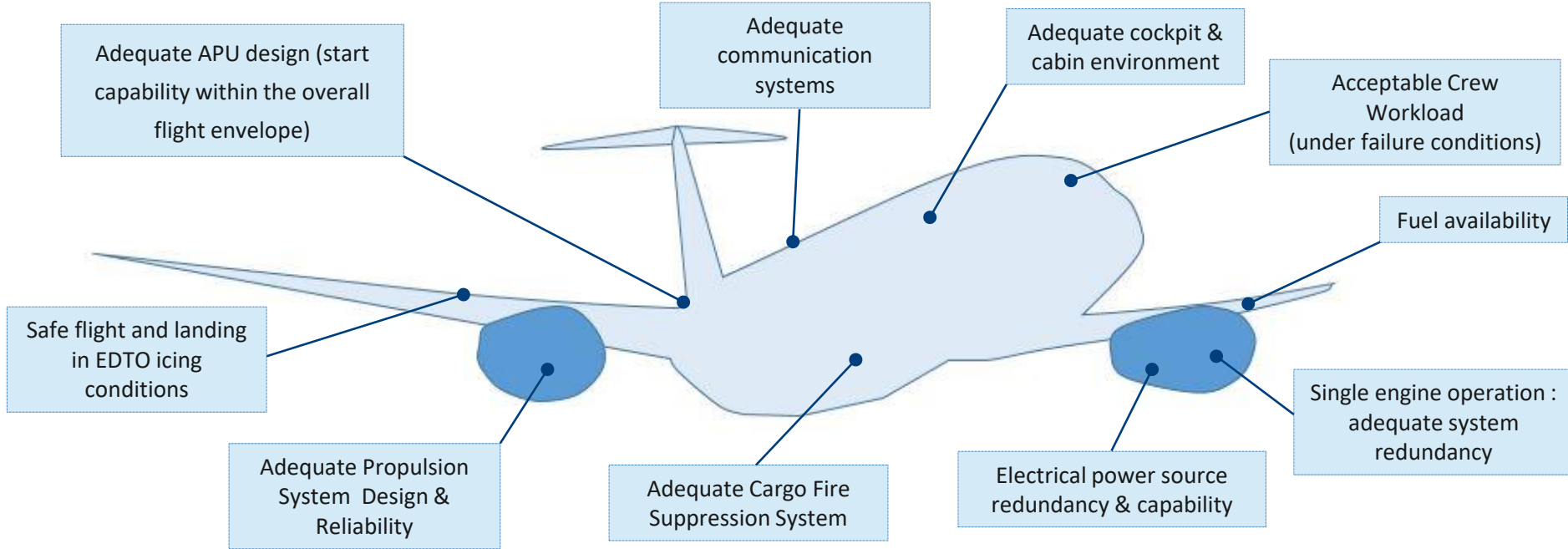
1
Design assessment is detailed in following slides

2
Reliability & Maturity assessment is detailed in following section of this module

- Both the Design and the Reliability & Maturity assessments are performed in parallel for the initial EDTO certification of the candidate Aeroplane/Engine Combination (AEC).
 - The Design assessment is performed once whereas the Reliability & Maturity assessment is a continuing process.
 - The Design assessment is also performed in case of Change to Type Design in case of potential impact on the already certified EDTO configuration.



To obtain an EDTO certification of the candidate AEC, the Manufacturer must show :

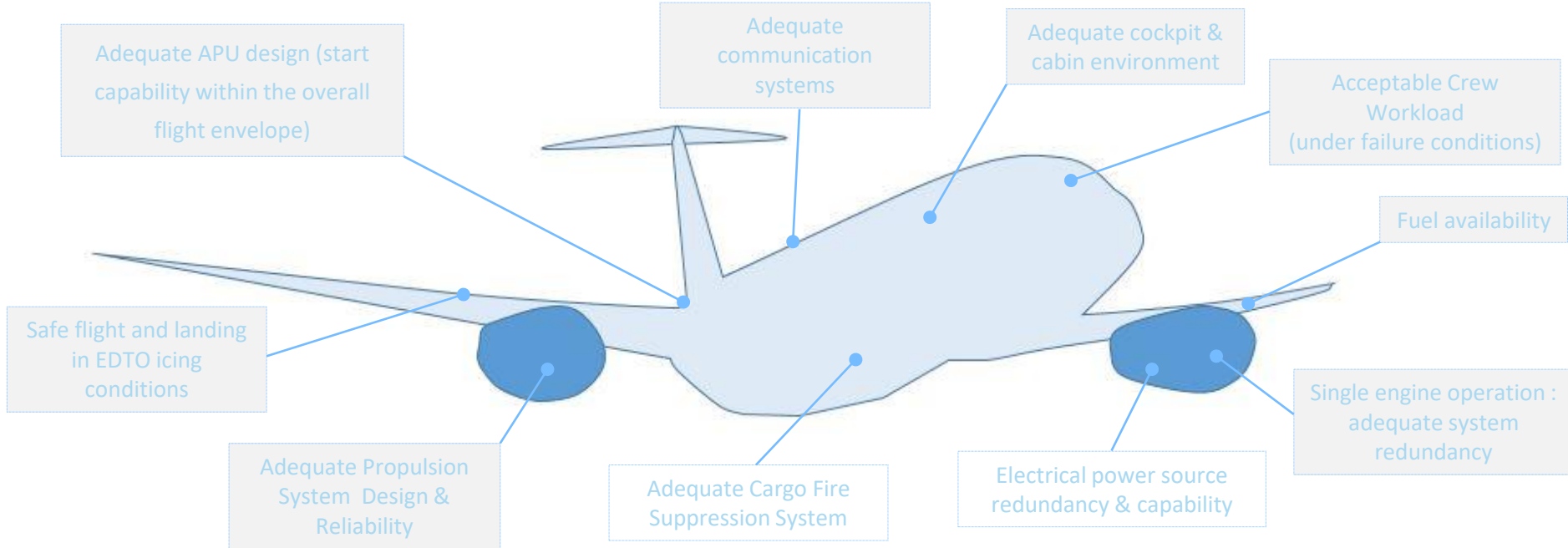


Demonstration and analyses must consider failure conditions for the maximum diversion time/distance

Each particular assessment is detailed in the following slides



To obtain an EDTO certification of the candidate AEC, the Manufacturer must show :



Demonstration and analyses must consider failure conditions for the maximum diversion time/distance



Safety Analyses

Safety analyses (FHA and SSA) are reviewed to consider the EDTO mission times:

- Contemplated Maximum Diversion Time
- Mean Flight Time (which is expected to be more than the non-EDTO mean flight time)

The criteria for assessing the safety risk severity vs probability is the same as for basic Type Design assessment :

- Same **classification of failure severity vs expected/targeted probability**

Probability (per FH)	Probable 1×10^{-5}	Remote 1×10^{-7}	Extremely remote 1×10^{-9}	Extremely Improbable
Severity	Minor	Major	Hazardous	Catastrophic



Question 4.2 :

Is it correct to say that the increased length of the EDTO diversion always increases the severity of a given system failure ?

- Yes
- No



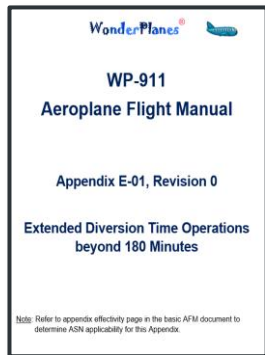


Safety Analyses

The Maximum Diversion Time (and distance, if relevant) considered in the Safety Analyses are usually sizing the Time limitation of the EDTO Significant Most Time Limited System (Other than Cargo Fire Suppression System).

- Corresponding value(s) must be published in the EDTO limitations section of the Flight Manual
- These limitations may also be repeated in the EDTO CMP document

Example of WP-911 AFM EDTO supplement for EDTO > 180 min capability:



Aeroplane Flight Manual

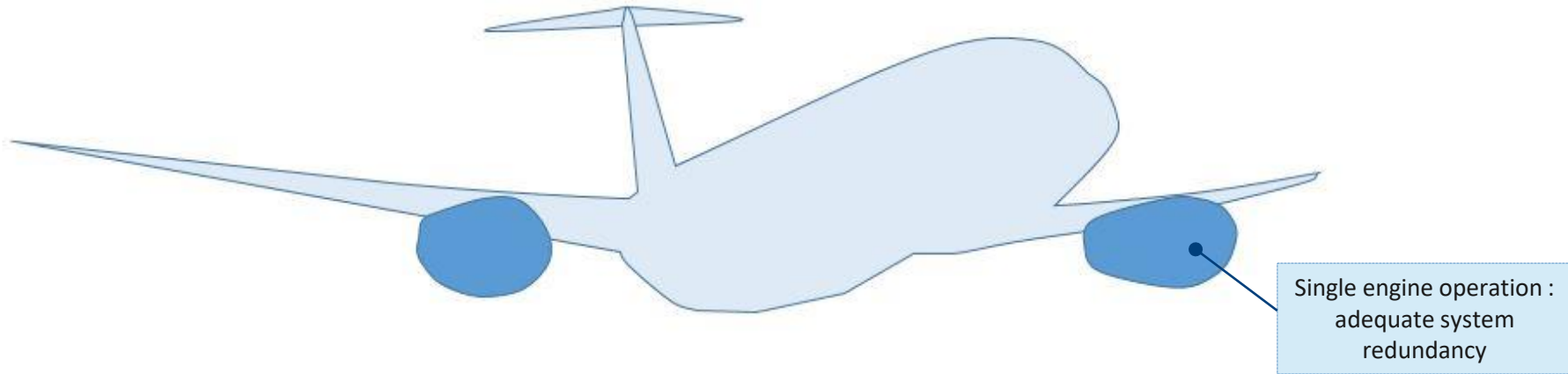
EDTO Beyond 180 Minutes - Time Limited System Capability

The time capability of the cargo fire suppression system is **225 minutes**

The time capability of all other EDTO significant systems is at least **290 minutes**



To obtain an EDTO certification of the candidate AEC, the Manufacturer must show :



Demonstration and analyses must consider failure conditions for the maximum diversion time/distance



Adequate System Redundancy

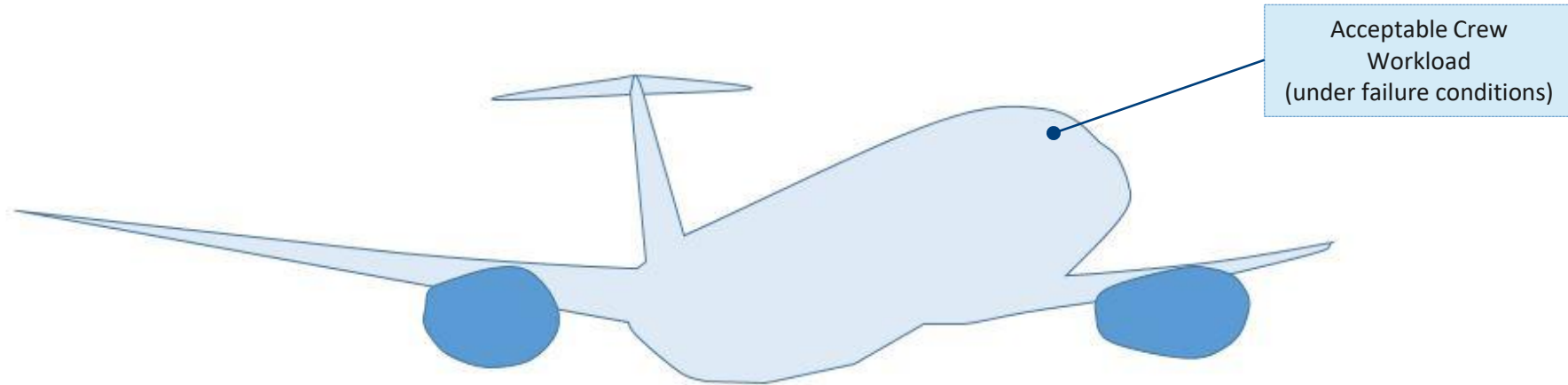
In case of engine failure, the remaining electrical, hydraulic and pneumatic power (as applicable) must be sufficient for safe flight and landing.

- Examples of power sources redundancies:

Systems	Normal	One engine shutdown
Hydraulic	3 systems 1 RAT backup	2 systems 1 RAT backup
Electrical	4 generators - 2 engines - 1 APU - 1 Emergency Gen	3 generators - 1 engine - 1 APU - 1 Emergency Gen
Pneumatic	3 air bleed sources - 2 engines - 1 APU	2 air bleed sources - 1 engine - 1 APU



To obtain an EDTO certification of the candidate AEC, the Manufacturer must show :



Demonstration and analyses must consider failure conditions for the maximum diversion time/distance



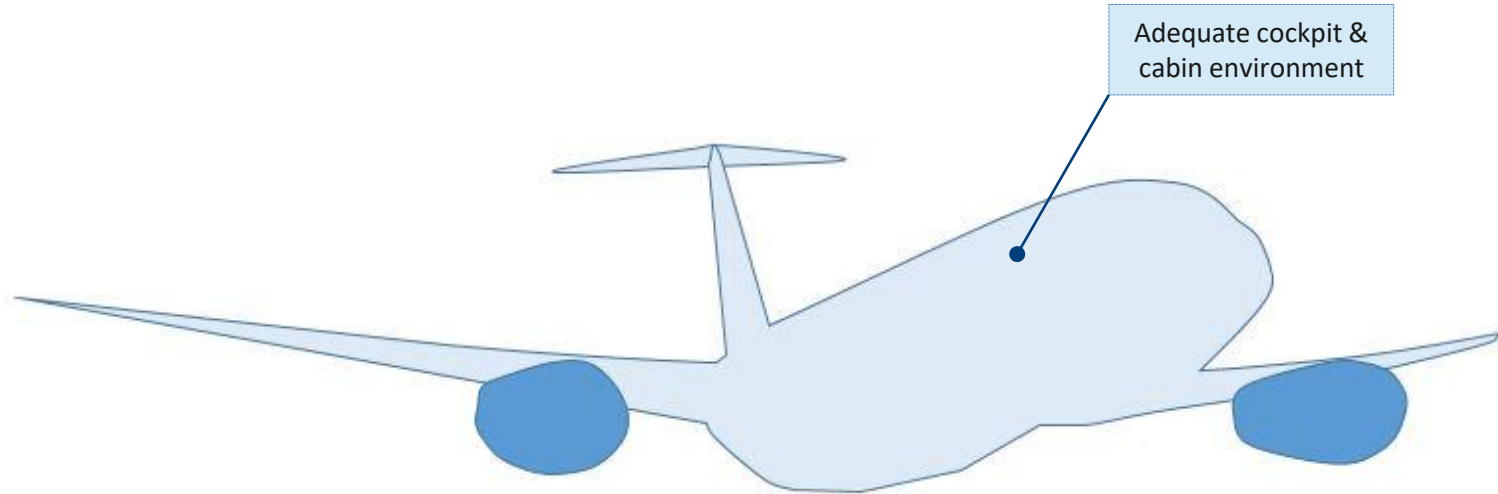
Crew Workload and Passenger Physiological needs

For **failure conditions** not shown to be extremely improbable and for the maximum diversion time/distance, the Manufacturer must demonstrate that :

- The crew workload remains acceptable
- The Crew and Passenger physiological needs are adequately fulfilled (see also cabin environment)
- Flight tests are performed to validate **acceptable flight crew workload** and adequacy of procedures, and to confirm that no more than average piloting skills or crew co-ordination is required
 - e.g. One-Engine-Inoperative test flights combined with various system failure simulations are performed
 - Diversions conducted in emergency electrical configuration,
 - Emergency descent and diversion at FL 100,
 - Failure of autopilot, autothrust, etc...
- Availability of toilets and cabin lights is assessed (for failure cases not extremely improbable).



To obtain an EDTO certification of the candidate AEC, the Manufacturer must show :



Demonstration and analyses must consider failure conditions for the maximum diversion time/distance



Air Conditioning (ATA 21)

Adequate cockpit and cabin environment must be preserved following all combinations of propulsion and electrical system failures which are not shown to be extremely improbable (e.g. in emergency electrical configuration)

On modern EDTO aircraft, **pressurization** and **equipment cooling** can typically be ensured with air from one **engine air-bleed** system only or the **APU air-bleed** system (up to a given altitude or FL).

Excess **temperature in avionics compartment** must be extremely improbable

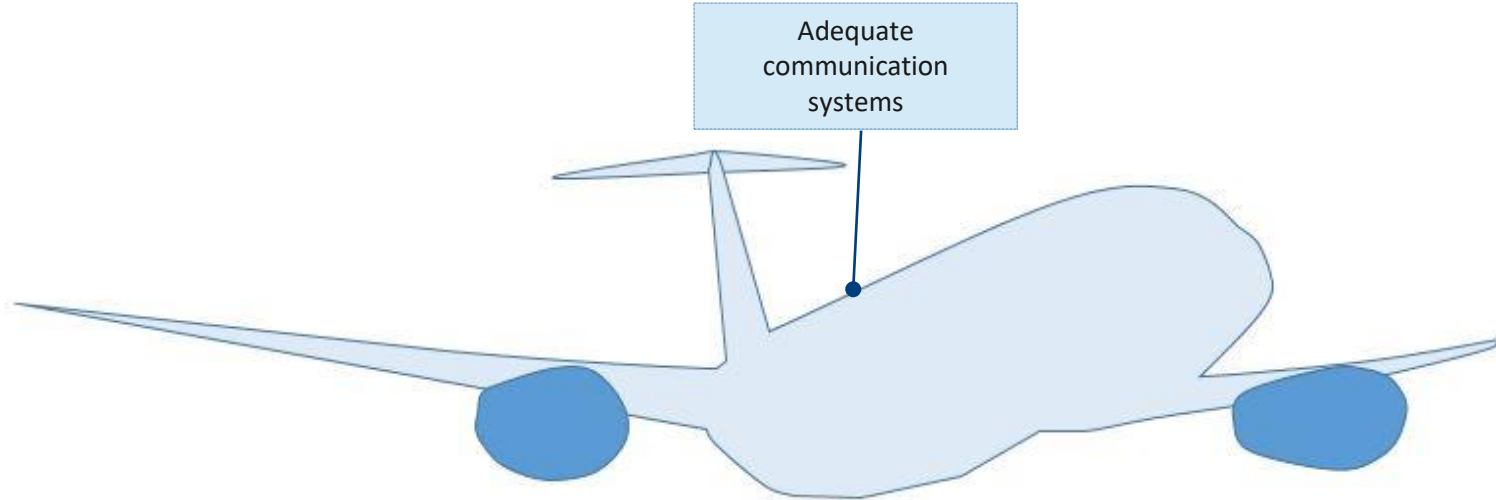
- Degraded avionics cooling configuration considered (unless shown to be extremely improbable)

Body Core Temperature analyses performed to assess impact of loss of cabin temperature control.

- Assessment performed for both hot and cold conditions
- Conservative assumptions considered for outside air temperature and cabin occupancy (i.e. low for cold temperature, high for hot temperature)



To obtain an EDTO certification of the candidate AEC, the Manufacturer must show :



Demonstration and analyses must consider failure conditions for the maximum diversion time/distance

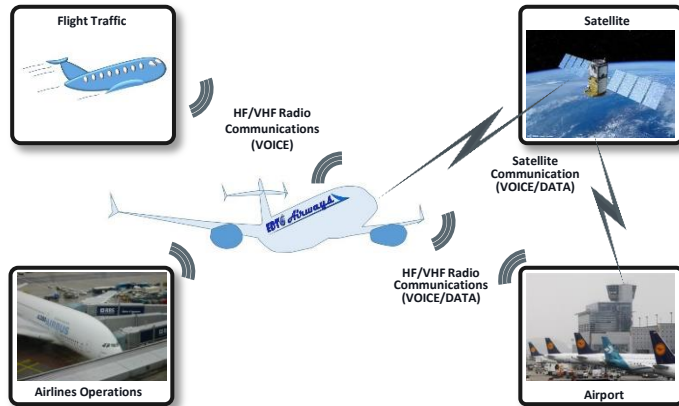


Adequate Communication Systems (ATA 23)

One voice based communication system is required for all EDTO operations up to 180 min DT.

Satellite-based Voice Communication system required for EDTO beyond 180 minutes operations

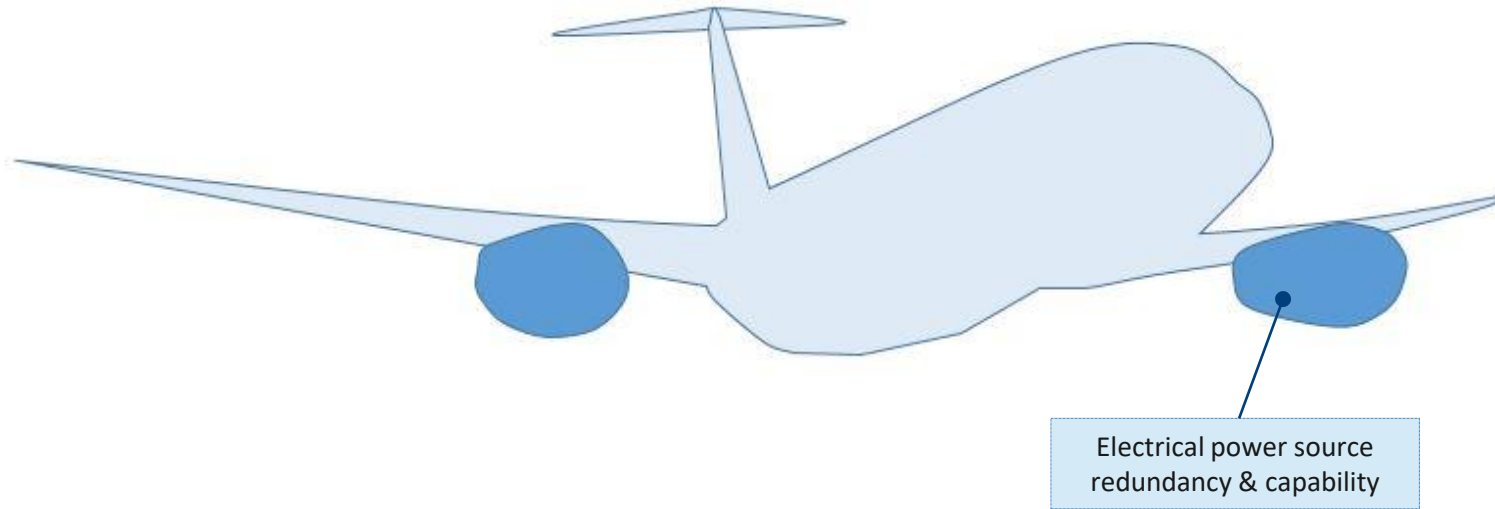
- In areas where SATCOM is not available (Polar regions) or does not allow voice communication, a backup voice system is required (HF)



Satellite-based Voice Communication system
must be operative
for **EDTO beyond 180 min**



To obtain an EDTO certification of the candidate AEC, the Manufacturer must show :



Demonstration and analyses must consider failure conditions for the maximum diversion time/distance



Electrical Power sources (ATA 24)

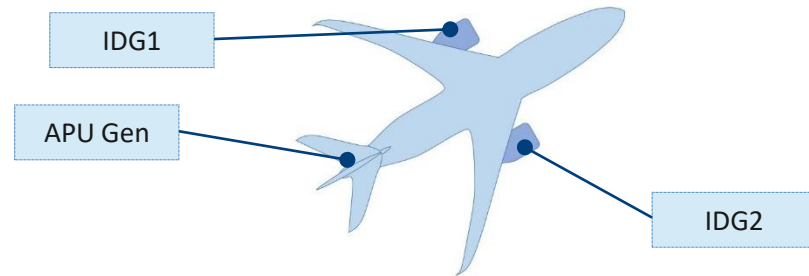
The aeroplane must be fitted with at least three independent and reliable generators

- Each generator must be capable of supplying enough services to ensure continued safe flight and landing under adverse operating conditions

Additional requirement EDTO > 180 min: a 4th generator is required unless the loss of the 3 independent sources is showed to be extremely improbable (EASA requirement)

- Note: FAA has a prescriptive requirement for a 4th generator which shall power one cross-feed valve and one fuel boost pump in each tank

EDTO aeroplane are fitted with at least 3 independent electrical generators

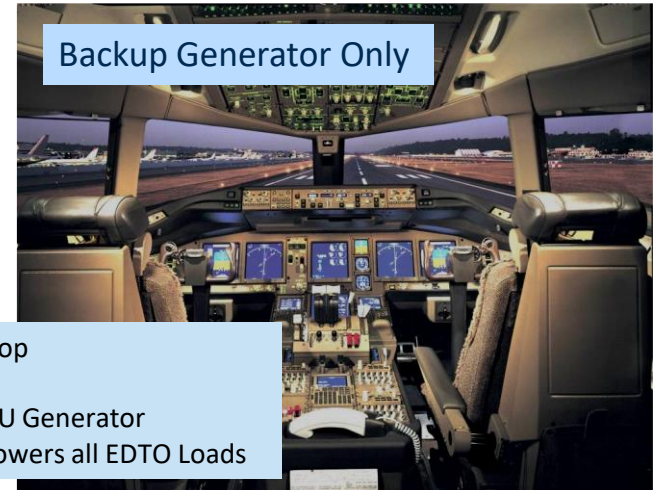
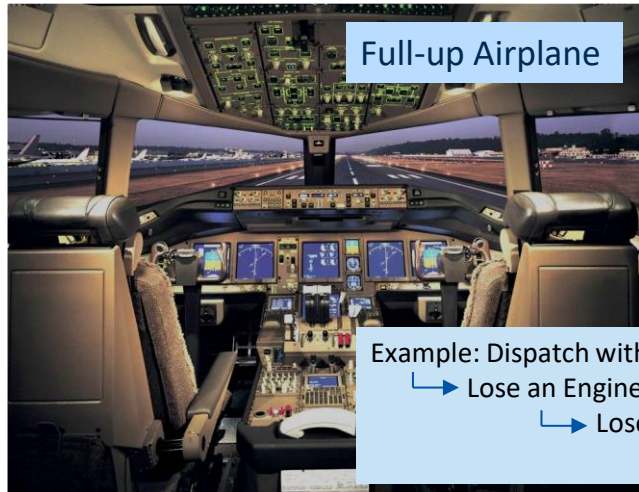




Electrical Power sources - Backup Electrical Power

Additional back-up electrical power sources are considered in the EDTO assessment if they provide all electrical loads for a safe EDTO diversion and landing

- This additional redundancy allows EDTO dispatch with main gen inoperative (e.g. IDG)



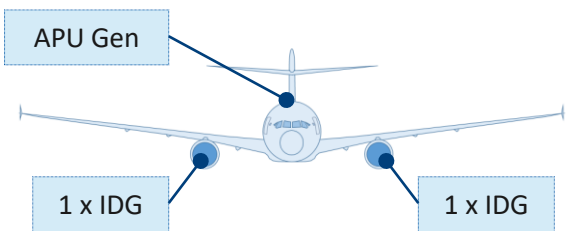
Example: Dispatch with Generator or APU/APU Gen Inop

- ↳ Lose an Engine
- ↳ Lose another Generator or APU/APU Generator
- ↳ Backup Gen Powers all EDTO Loads



Examples of Electrical Power architectures for EDTO

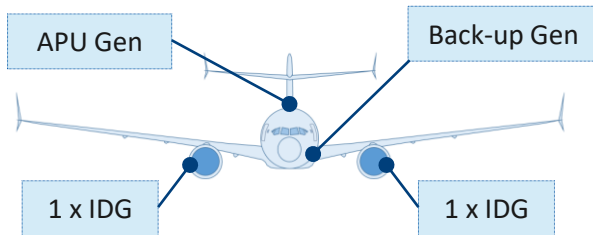
WonderPlanes®
WP-911



All 3 generators are **required for EDTO**

Additional back-up generator must be installed for EDTO > 180 min

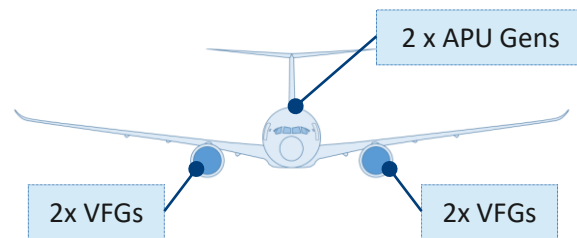
WonderPlanes®
WP-911SP+



APU GEN or one IDG may be inop **for EDTO up to 180 min**

All 4 generators are **required for EDTO > 180 min**

WonderPlanes®
WP-Millennium

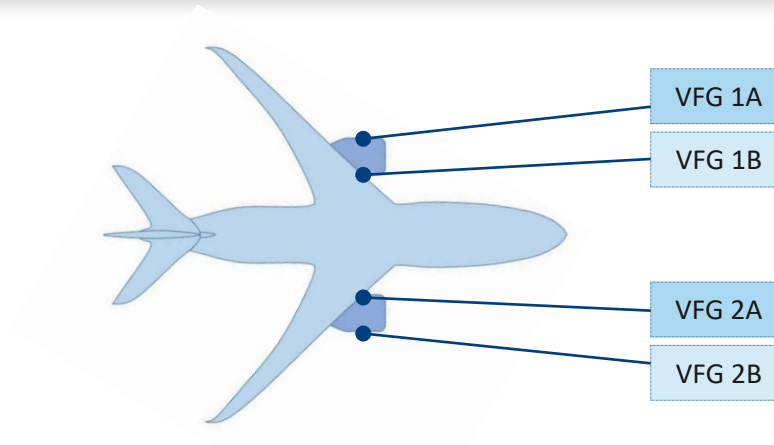


2 GENs (APU or VFG) may be inop **for EDTO up to 180 min**

APU GEN or one VFG may be inop **for EDTO > 180 min**



Question 4.3 :



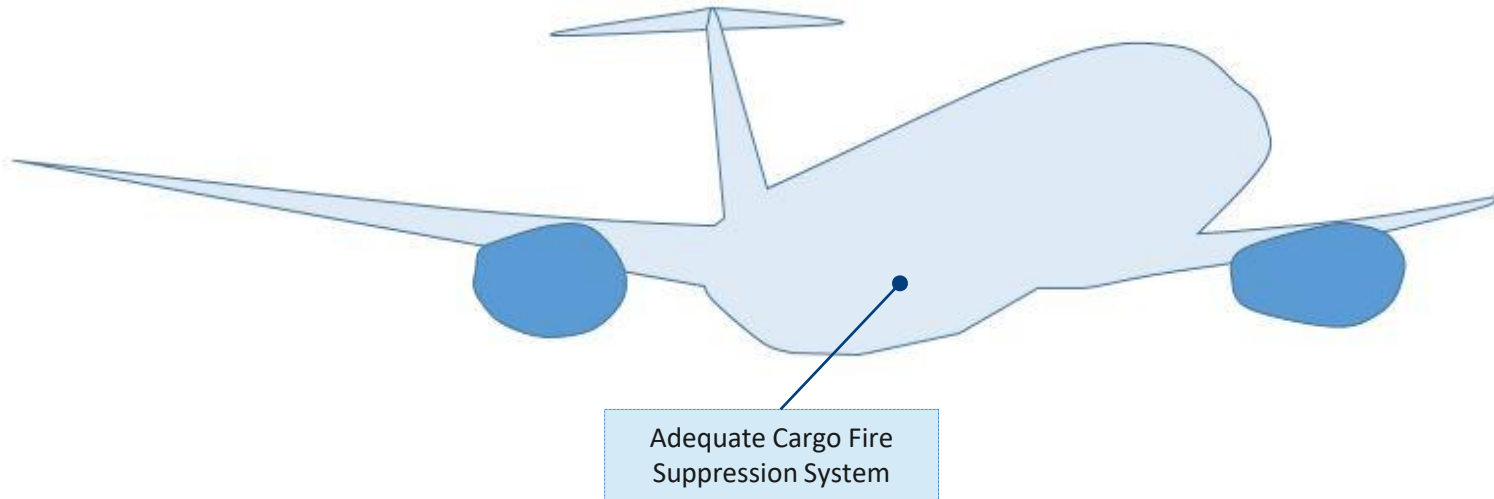
The above aeroplane is fitted with 4 electrical generators (2 on each engine). Is it correct to say that this configuration complies with the EDTO requirement to have at least 3 independent generators?

- Yes
- No





To obtain an EDTO certification of the candidate AEC, the Manufacturer must show :



Demonstration and analyses must consider failure conditions for the maximum diversion time/distance



Cargo Fire Suppression System (ATA 26)

EDTO regulations require the **cargo fire suppression system** to cover the **maximum approved diversion time plus an additional 15 minutes** allowance for approach and landing, e.g.:

- For 120 min EDTO → 135 min minimum protection time needed
- For 180 min EDTO → 195 min minimum protection time needed

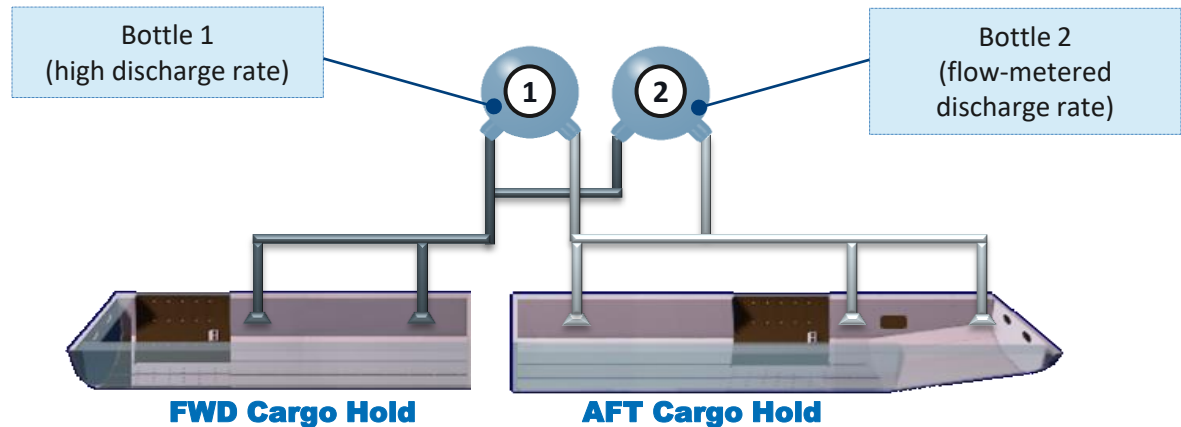
Cargo smoke **detection** and **control of ventilation/heating** (Isolation valves) must be available on each **single electrical power source** considered for EDTO assessment (see ATA 24)



Cargo Fire Suppression System (ATA 26)

Cargo holds **fire protection times** are demonstrated by flight tests and/or analyses

- Same requirement of fire extinguishing agent concentrations level as for basic Type Certification
- Most “Class C” systems are made of fire extinguishing bottle, with the first bottle providing a high rate flow of extinguishing agent, and the other bottle(s) being flow metered.



**Example of typical
Cargo Fire Protection System**

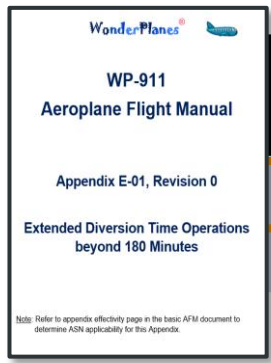


Cargo Fire Suppression System (ATA 26) – Impact on AFM

The Cargo Fire Suppression Time demonstrated in Flight Test (or analyses) is the time limitation that must be identified in the aeroplane documentation

- Corresponding value must be published in the EDTO limitations section of the Flight Manual
- These limitations may also be repeated in the EDTO CMP document

Example of WP-911 AFM EDTO supplement for EDTO > 180 min capability:



Aeroplane Flight Manual

EDTO Beyond 180 Minutes - Time Limited System Capability

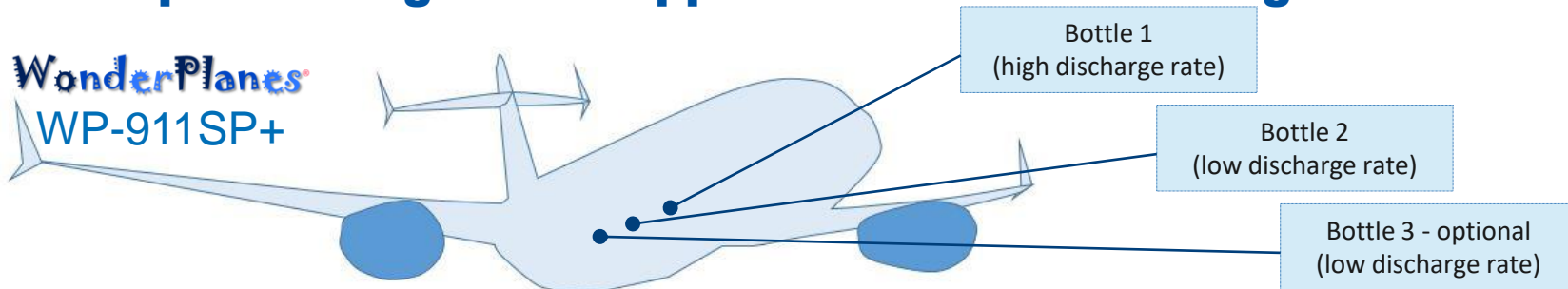
The time capability of the cargo fire suppression system is **225 minutes**

The time capability of all other EDTO significant systems is at least **290 minutes**



Example of Cargo Fire Suppression Times & configurations

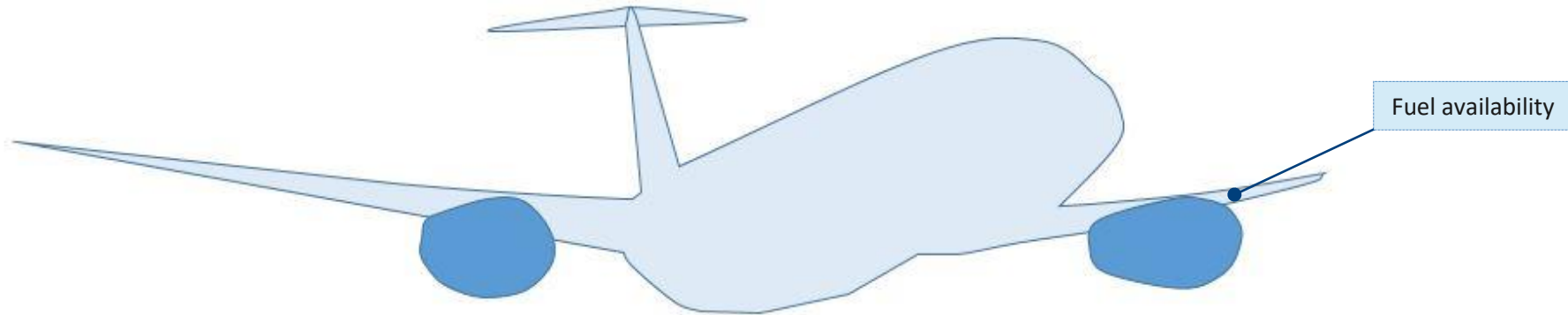
WonderPlanes®
WP-911SP+



	Basic	180 min EDTO	EDTO>180 min Option 1	EDTO>180 min Option 2
Bottle 1	1800 cu.in.	1800 cu.in.	1800 cu.in.	1800 cu.in.
Bottle 2	1100 cu.in.	1800 cu.in.	2200 cu.in.	1800 cu.in.
Bottle 3	-	-	-	1100 cu.in.
Suppression time	135 min	195 min	225 min	310 min



To obtain an EDTO certification of the candidate AEC, the Manufacturer must show :



Demonstration and analyses must consider failure conditions for the maximum diversion time/distance



Fuel System (ATA 28) – Fuel cross feed & engine operation

Fuel cross feed to operative engine during single engine operation (twin engine aircraft) must be protected against single malfunctions:

- The normal procedure for fuel cross-feed is by opening the fuel cross-feed valve
- Cross feed function must remain available in single electrical power source configuration

Engine operation: Effect of turbulence and negative “G” must be evaluated if:

- fuel boost pumps are not powered (e.g. limitation in emergency electrical configuration)
- the loss of all fuel boost pumps is not showed to be extremely improbable



Example of Fuel X-Feed configurations

WonderPlanes WP-911

Single X-Feed valve
Dual actuator

Preflight check of the fuel X-feed valve is required.

Note: per FAA policy, check of the X-Feed valve must be performed at end of cruise (instead of preflight)

WonderPlanes WP-Millennium

Two X-Feed valves
In parallel

Preflight check of the fuel X-feed valve is NOT required.

Note: the valves must be checked as per applicable maintenance task interval.



Fuel System (ATA 28) – Low Fuel Alert

An alert must be displayed to the Flight Crew when the quantity of fuel available to the engines falls below the level required to fly to the destination.

- The alert must be given when there is enough fuel remaining to safely complete a diversion.

Low Fuel Alert for EDTO is typically made of :

Detection of important fuel leaks due to system failure(s)



- Fuel System Alerts (e.g. FU/FOB DISAGREE) on the system warning display (e.g. ECAM, EICAS)
- Fuel Leak Detection downstream the Fuel Flowmeter - FADEC based alert, comparison between the 2 engines fuel flows and fuel used

Detection of small leaks, flight plan anomalies, unexpected adverse operating conditions



- FMS “DEST EFOB BELOW MIN” alert



Example of FMS generated low fuel alert

FUEL PRED			
AT	UTC	EFOB	
LFPG	1230	4.5	
LFBO	1320	2.0	
RTE	RSV / %	ZFW / ZFWCG	
	0.0 / 0.0	50.0 / 23.2	
ALTN	TIME	FOB	
	2.5 / 0050	20.6 / FF + FQ	
FINAL	TIME	GW / CG	
	1.0 / 0030	70.6 / 25.6	
EXTRA	TIME	MIN DEST	FOB
	1.0 / 0058		3.5



MIN DEST FOB = ALTN + FINAL

EXTRA = DEST EFOB – (ALTN + FINAL)

If **DEST EFOB** becomes lower than **MIN DEST FOB** :

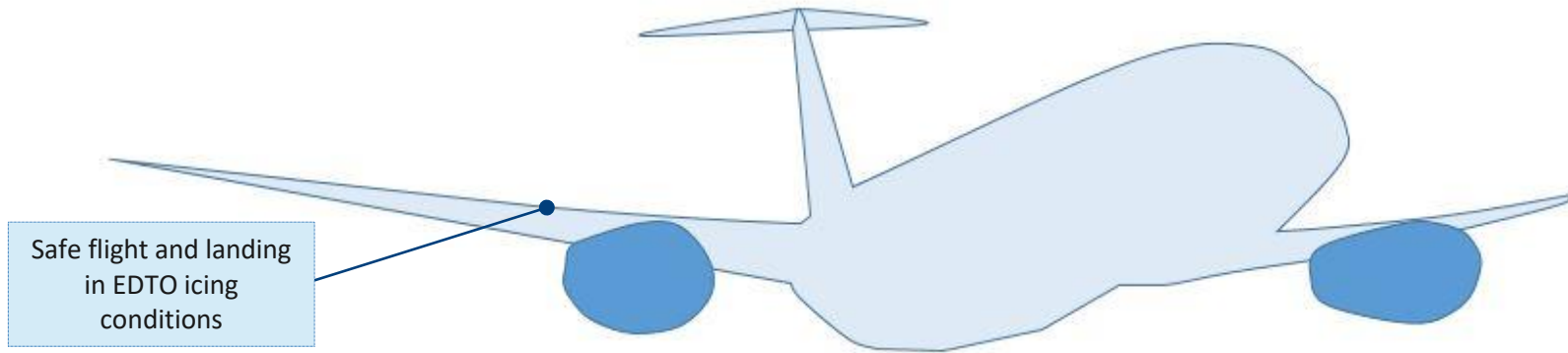
- **DEST EFOB** turns amber; and
- **DEST EFOB BELOW MIN** is generated by FMS



DEST	UTC	DIST	EFOB
LFBO32L	1320	347	2.0
DEST EFOB BELOW MIN			



To obtain an EDTO certification of the candidate AEC, the Manufacturer must show :



Demonstration and analyses must consider failure conditions for the maximum diversion time/distance



Ice and Rain Protection (ATA 30)

EDTO regulations require analyses to be performed to assess the aircraft capacity to fly for prolonged exposure duration in icing conditions

- For failure cases not extremely improbable leading to fly at altitudes where icing conditions can be met (e.g. engine failure, depressurization)

EDTO ice shapes are computed for the 3 following EDTO diversion scenarios (considering contemplated maximum diversion time and/or distance) :

- OEI FL and max OEI speed (VMO target)
- AEO at FL100 and LRC speed
- OEI at FL100 and max OEI speed (VMO target)



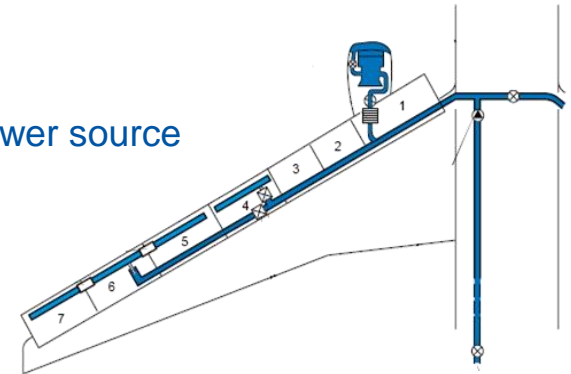
Ice and Rain Protection (ATA 30)

Impact of the accretion (ice shapes) on handling qualities and performance are assessed.

- Fuel penalty resulting from EDTO ice shapes and accretion are then included in relevant aeroplane's operational documentation for flight operations engineers/dispatchers
- Those penalties have to be taken into account during fuel planning, for computation of fuel reserves for EDTO

The anti-ice system control must remain available on single electrical power source (i.e. those considered for the EDTO assessment – see ATA 24) :

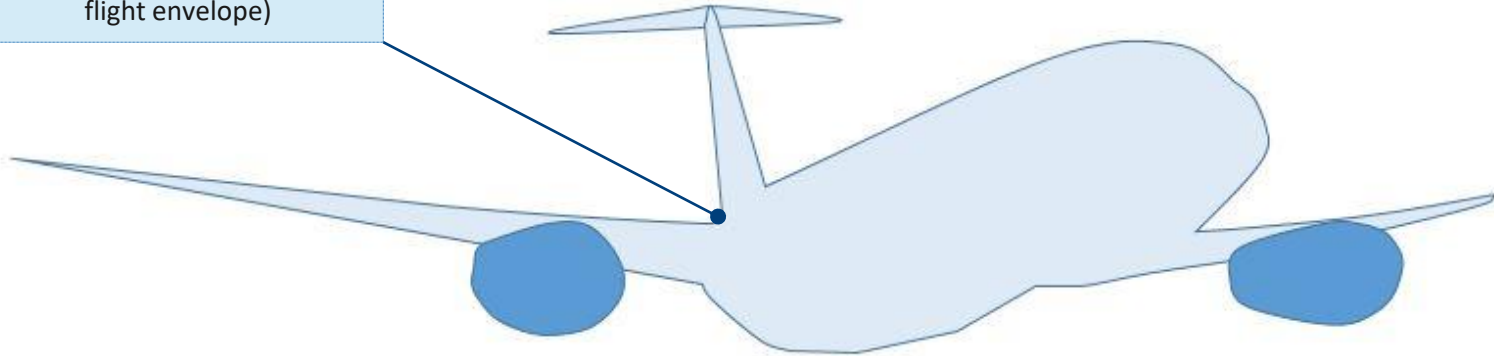
- Engine air-intake anti-ice
- Wing anti-ice
- At least one alpha probe anti-ice
- At least one pitot probe de-ice





To obtain an EDTO certification of the candidate AEC, the Manufacturer must show :

Adequate APU design (start capability within the overall flight envelope)



Demonstration and analyses must consider failure conditions for the maximum diversion time/distance



Question 4.4 :

Is it correct to say that any aeroplane designed for EDTO must be fitted with an APU ?

- Yes
- No





Auxiliary Power Unit (ATA 49)

APU may provide electrical or bleed power and may therefore be one of the required sources for EDTO.

APU installation should meet normal certification requirements :

- APU does **not** need to be certified as essential even if considered as one power source for EDTO

APU should meet **additional EDTO requirements** to demonstrate its intended function (e.g. third electrical generator for EDTO) :

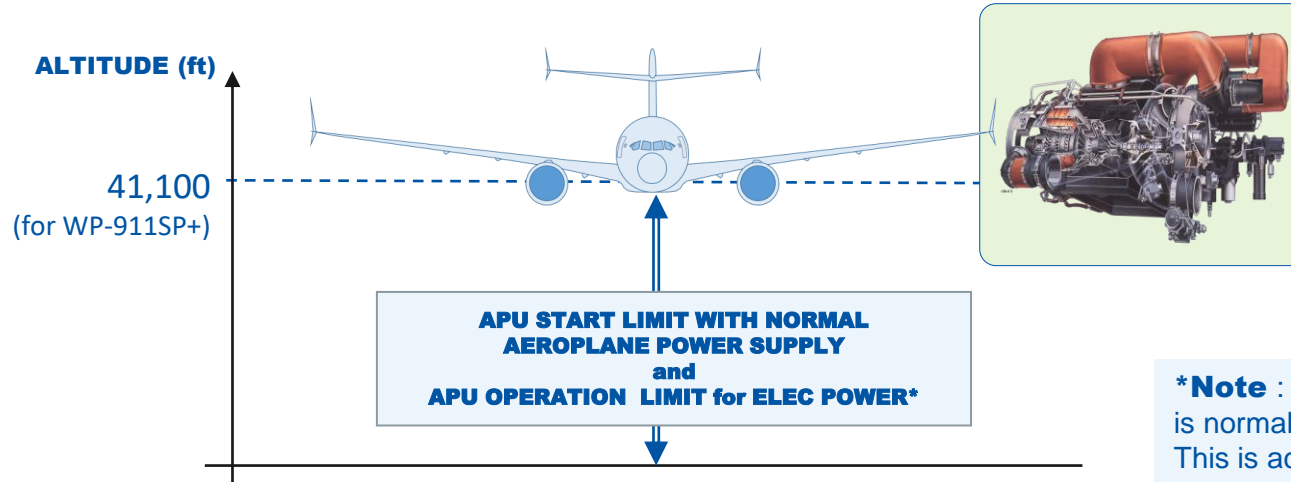
- **In-flight start capability : 95%**
- **Run reliability** : failure rate less than 1×10^{-3} per APU operating hour (**MTBF > 1,000 H**)
- Compliance with above reliability objectives must be demonstrated through service experience or as part of Early EDTO program in case of EDTO certification with reduced service experience



Auxiliary Power Unit (ATA 49) – High altitude start capability

APU must be able to be started up to the maximum operating altitude, in cold soak conditions

- If the in-flight start capability of the APU has not been demonstrated, the APU must be started and kept running throughout the EDTO sector of the flight



***Note** : the ceiling for APU bleed output is normally lower (typically around FL220) This is acceptable for EDTO.



Auxiliary Power Unit (ATA 49) – High altitude start demonstration

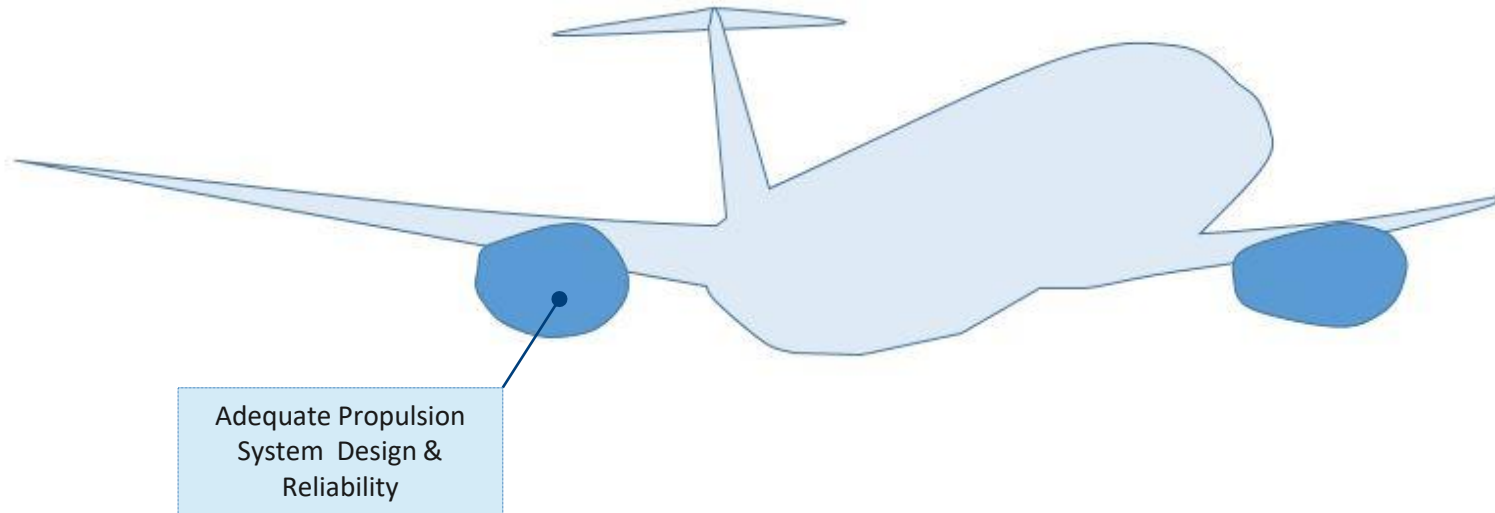
Accordingly an APU In Flight Start demonstration has to be **performed by the Manufacturer**

- Statistical demonstration of the APU capability to **start at any altitude** up to the maximum aircraft operating altitude, in **cold soak conditions**.
- Number of starts should provide a representative sample to meet regulatory start success rate of **95%**. Typical number of in-flight starts is between **60 to 300 starts**.
- A successful start is typically when the APU starts within **3 attempts**
- **Cold soak** should demonstrate **stabilized APU parameters**, in particular lowest temperatures for the APU, fuel and oil. Typical duration of the cold soak is **2 to 4 hours in cruise** before APU in flight start attempt.

This APU In Flight Start capability has to be **monitored by the EDTO operators** (see Module 6)



To obtain an EDTO certification of the candidate AEC, the Manufacturer must show :



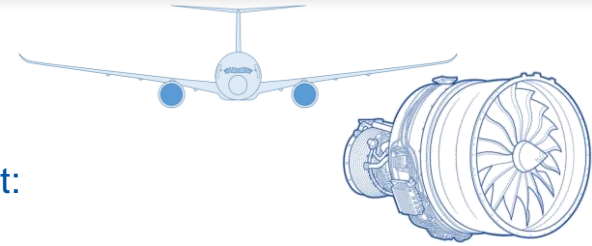
Demonstration and analyses must consider failure conditions for the maximum diversion time/distance



Powerplant (ATA 71 to ATA 80)

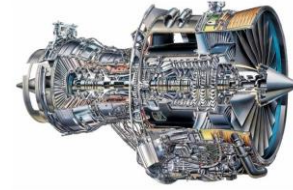
There is no EDTO specific design criteria on the powerplant, except:

- EDTO engines must be fitted with an **oil tank filler cap**
- Failures (contained or not) of propulsion system should not adversely affect remaining system or equipment :
 - **Propulsion System Safety analyses** (including Uncontained Engine Rotor Failure analyses) consider average **EDTO mission time** and contemplated **maximum diversion time**
 - Sustained Engine Imbalance (**SEI**) analyses are normally performed with a maximum diversion time of **180 min.**
 - Demonstration of continued **engine rotation in windmilling** configuration without oil for contemplated maximum diversion time
- **Sizing of oil tank** should consider **longest duration flight** dispatched with both engine recorded at **maximum allowed oil consumption**, with engine failure and remaining engine at MCT thrust for a **maximum duration diversion.**



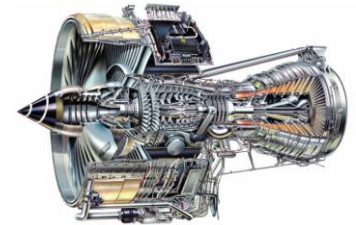


Powerplant (ATA 71 to ATA 80)



Engines must meet EDTO reliability objectives (**IFSD target rate**) :

- Compliance with these reliability objectives must be demonstrated through in service experience and Early EDTO demonstration in case of EDTO certification with reduced service experience – See *next section of this module*.
- This requirement may lead to design change mandatory for EDTO



An **Engine Condition Monitoring** program must be available

- The **procedures and tools** for engine condition monitoring have to be validated and included in relevant maintenance instructions (aircraft and/or engine documentation)



- Part I — **Aircraft airworthiness considerations for EDTO**
- Part II — **Type Design Assessment**
- Part III — Reliability & Maturity Assessment**
- Part IV — **Continued validity of EDTO certification**
- Part V — **EDTO Documentation (CMP, AFM, ...)**
- Part VI — **Summary**
- Part VII — **Practical Exercise**



Initial reliability & maturity demonstration

To obtain an EDTO certification, a demonstration of the initial reliability and maturity must be performed through either :

- The **In-service experience method** when the world fleet of candidate aircraft has the required minimum amount of service experience (as discussed in Part II of this module).
 - The reliability and maturity demonstration is based on available in-service data
- The **Early EDTO program method** when the candidate aircraft has no or reduced in-service experience (as discussed in Part II of this module).
 - The reliability and maturity demonstration is done through a dedicated Early EDTO program:
 - Dedicated tests (e.g. engine 3,000cy test, aircraft flight tests, ...)
 - Operations and reliability validation flights
 - Lessons Learned analyses
 - Events tracking and reporting
 - A typical Early EDTO Program is detailed in the following slides →

More info on
NEXT
slides! →



Typical Early EDTO Program

The Early EDTO certification of the WP-Millennium required specific maturity and reliability demonstrations:

- **Design Goals** (e.g. Cargo Fire Suppression) and consideration of EDTO Certification Basis
 - Contemplated 350 min maximum diversion time (OEI) capability
- Specific **ground testing** and EDTO airplane demonstration (**flight testing**)
- **Validation** of Maintenance Tasks and Operational Procedures
- Events **Reporting and Tracking**
- Consideration of **relevant experience** and **maturity demonstration** for EDTO Significant Systems



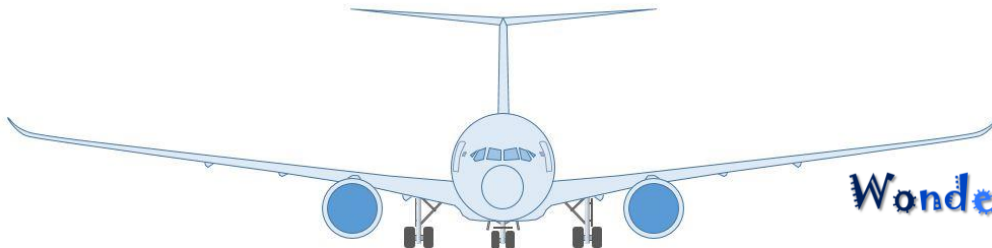
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Typical Early EDTO Program – Specific ground testing

The propulsion system (engine and aeroplane accessories) completed 3000 simulated flight cycles:

- Electrical generator and hydraulic **systems fully loaded**
- Engine intentionally **imbalanced** to validate engine accessories durability
- Operational thrust reverser
- 3 x **maximum diversion time cycles** (350 min +15 min)
- Full post test tear down and inspection



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Typical Early EDTO Program – Specific ground testing

The APU also completed 3000 simulated flight cycles:

- Electrical generators fully loaded and Post test tear down and inspection

Design for in-flight start reliability

- 200 simulated in-flight altitude starts including cold soak
- Collected APU in-flight start data during flight test program
- Cold weather demonstration

APU maintenance task validations

- 3 airlines and 122 tasks validated

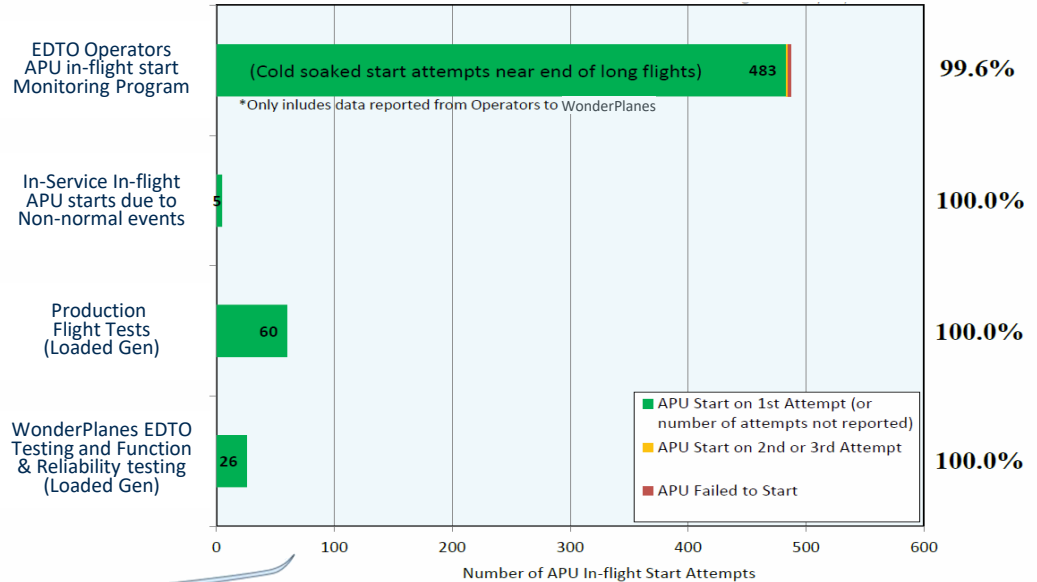


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Typical Early EDTO Program – Specific ground testing

Demonstrated APU in-flight start capability higher than 95%

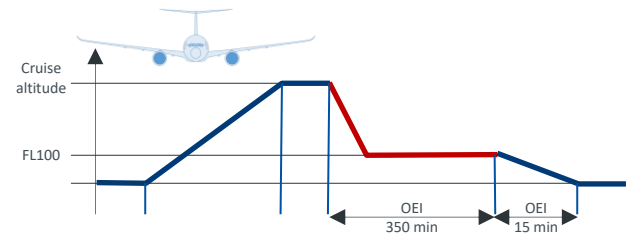
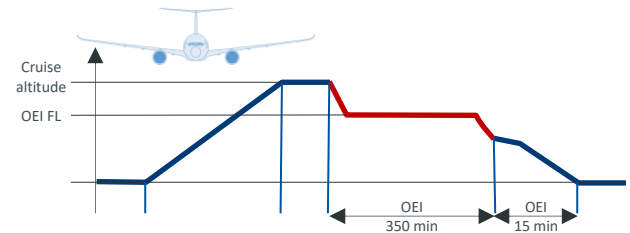


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Typical Early EDTO Program – Demonstration flight tests

- Multiple 365 minute engine-out diversion demonstrations
 - MCT (2 repeated on same engine)
 - Decompression at 10,000 ft
 - Drift down profile
- Multiple degraded system diversion scenarios (365 minutes)
- Multiple cycles from humid environment to cold soak at altitude
- Maximum duration flight demonstration
- Use of in-service manuals and procedures
- Post test inspection





Typical Early EDTO Program – Demonstration flight tests

Scenarios/Other	MegaThrust MT2050	MegaThrust MT2050 Package +	Totals
Number of Aeroplanes	3	2	5
Flights	29	2	31
Flight hours	217	14	231*
Humidity cycles	10	–	10
Engine-out conditions (365 minutes)	8	2	10
Degraded electrical (365 min)	6	2	8
Single VFG	2	–	2
APU only	1	–	1
Degraded Avionics & Cabin ventilation (365 min)	6	–	6
Max EDTO mission	20:19	–	–
Diversion airports	3	–	3
Post-test inspections	Yes	Yes	–



* 3,100 total WP-MIL flight test hours thru today



Typical Early EDTO Program – Maintenance & Operational Task Validations

- All EDTO significant system maintenance & operational tasks validated as part of Early EDTO certification
- Airplane and engine tasks validated by several means:
 - Desk top validation / Lab test and ground tests / Flight tests
- EDTO Propulsion & APU 3000-cycle tests
 - Normal scheduled maintenance that would be expected to occur during 3000 cycles
- WonderPlanes WP-Millennium aeroplane demonstration Flight Test
 - Test airplanes operated and maintained using recommended procedures



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Typical Early EDTO Program – Maintenance & Operational Task Validations

Examples of Operational Procedures validated:

Fuel System

- Fuel Leak
- Fuel Press Eng L, R
- Fuel Pump Center L, R
- Fuel Pump L, Aft, Fwd
- Fuel Pump L, Aft, Fwd
- Fuel Qty Low
- Fuel Temp High
- Fuel Temp Low
- Fuel Valve APU

WonderPlanes WP-Millennium Quick Reference Handbook	
Quick Action Index	
Aborted Engine Start L, R	7.1
CABIN ALTITUDE	2.1
Dual Eng Fail/Stall	7.2
Dual Eng Fail/Stall	7.3
ENG AUTOSTART L, R	7.3
ENG LIMIT EXCEED L, R	7.4
ENG SURGE L, R	7.7
Eng Svr Damage/Sep L, R	7.10
Evacuation.....	Back Cover.2
FD DOOR AUTO UNLOCK	1.5
FIRE APU	8.1
FIRE ENG L, R	8.2
Fire Eng Tailpipe L, R	8.5
Smoke, Fire or Fumes	8.6
STABILIZER	9.1

All WP-Millennium **Flight Operations Procedures**
Affecting EDTO Significant Systems



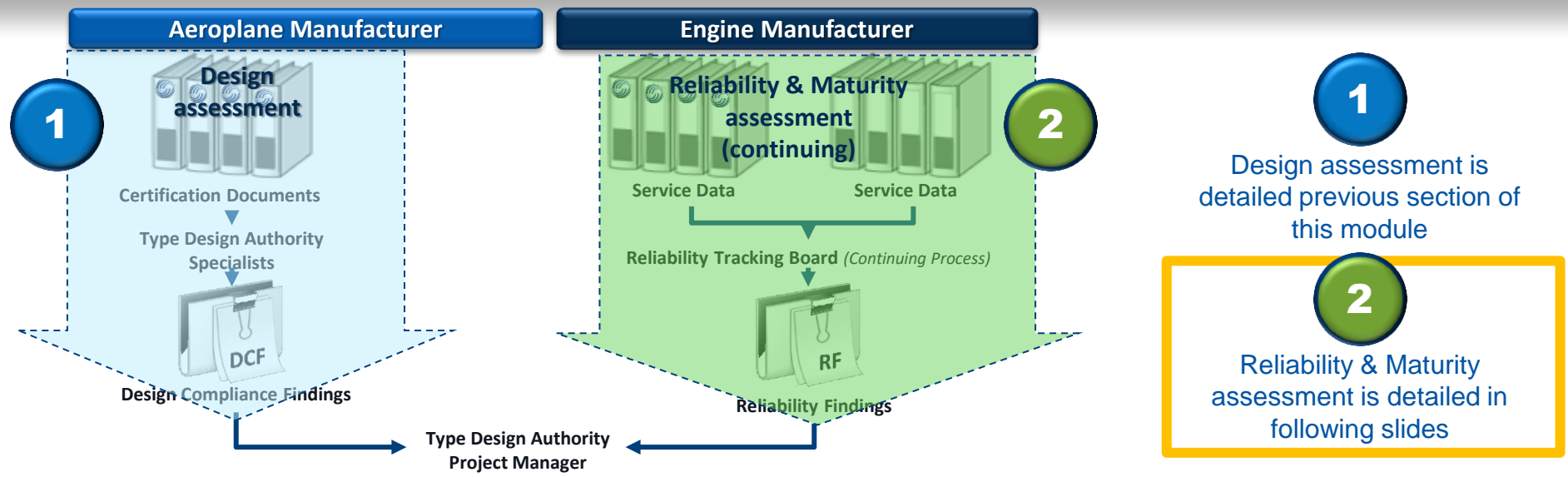
Validate Procedures

- Analysis _____
- Engineering Cab _____
- Flight Test _____



WonderPlanes WP-Millennium





- Both the Design and the Reliability & Maturity assessments are performed in parallel for the initial EDTO certification of the candidate Aeroplane/Engine Combination (AEC).
 - The Design assessment is performed once whereas the Reliability & Maturity assessment is a continuing process.
 - The Design assessment is also performed in case of Change to Type Design in case of potential impact on the already certified EDTO configuration.



EDTO Reliability reviews (Reliability Tracking Board)

In addition to the EDTO Type Design assessment, a **reliability review** has to be performed in the frame of EDTO certification of the candidate aeroplane

- Perform review of the in-service experience of the candidate aeroplane-engine combination
- Should be conducted prior to first EDTO Type Design & Reliability approval and on a continuing basis thereafter (*see next section of this module*)

For initial certification, this first **reliability review** covers the experience accumulated since :

- the Type certification (**In service EDTO certification**); and/or
- during the maturity and reliability demonstration (**Early EDTO certification**).





EDTO Reliability reviews – In service event filtering





EDTO Reliability Requirements – IFSD rate monitoring

The **IFSD target rate** are defined to ensure that dual engine failure for independent causes remains extremely improbable.

Accordingly, the IFSD target rate are usually set as follows:

EDTO	up to 120 min	up to 180 min	Beyond 180 min
IFSD Target Rate per 1,000 Engine Hours	0.050	0.020	0.010

The IFSD rate is normally computed:

- For a given fleet of aeroplane/engine combination e.g. WP-911SP+ models fitted with Greenpush RG3350-SP series of engines
- On a 12 month rolling basis.



Question 4.5 :

The IFSD target rate are defined to ensure that dual engine failure remains extremely improbable. Considering that P1 is the probability of failure of the 1st engine and P2 the probability of failure of the 2nd engine, the probability of the loss of both engines on a twin engine aircraft may be simplified as :

- $P1 \times \text{Flight Time} \times P2 \times \text{Diversion Time}$
- $2 \times P1 \times (\text{Flight Time} - \text{Diversion Time}) \times P2 \times \text{Diversion Time}$
- $2 \times P1 \times \text{Flight Time} \times P2 \times \text{Diversion Time}$
- $P1 \times P2 \times (\text{Flight Time})^2$





EDTO Reliability Requirements - Determination of IFSD target rates



- The next slides provide an overview of the various risk models and concepts developed by ICAO since 1953, and further elaborated since the inception of ETOPS in 1984 (up to the introduction of ETOPS/EDTO >180 min by FAA and EASA from 2007 onwards)
- Terms used :
 - **Pf** – Safety objective (probability) for Total Loss of thrust from independent causes
 - **P** – IFSD target rate (to comply with relevant safety objective Pf)
 - **P1** or **Cr** – Probability of failure of the 1st engine
 - **P2** or **Mr** – Probability of failure of the 2nd engine
 - **T** – Flight time
 - **D** – Maximum diversion time
- Recall: the probability of the loss of both engines on a twin engine aircraft may be simplified as follows:

$$\mathbf{Pf = 2 \times P1 \times \text{exposure time for 1st engine failure} \times P2 \times \text{exposure time for 2nd engine failure}}$$



Determination of IFSD target rates – ICAO 1953



- Summarized Risk model formula for a two-engine aeroplane is:

$$P_f = 2 \times P_1 \times T \times P_2 \times D/2$$

- Assumptions

- Safety objective for Total Loss of thrust from independent causes :

$$P_f = 10E-08$$

- Probability of failure is the same for 1st and 2nd engine and corresponds to average failure rate (P):

$$P_1 = P_2 = P$$

- Average exposure time of a single engine diversion is half of the maximum diversion time (D)
- Full mission time (T) is considered

- Hence the IFSD target rate :

$$P = \sqrt{10E-08 / (T \times D)}$$



Determination of IFSD target rates – ICAO 1984



- Summarized Risk model formula for a two-engine aeroplane is:

$$Pf (T) = 10E-08 \times (0.4T+0.6) = 2 \times P1 \times T \times P2 \times D$$

- Assumptions

- Safety objective for Total Loss of thrust from independent causes is sized as a function of the mission time (T), and is set at 10E-08 for a flight of 1FH, as in 1953 formula:

$$Pf = 10E-08 \times (0.4T+0.6)$$

- Probability of failure of 1st engine (P1) is half of average failure rate (P), and probability of failure of 2nd engine is equal to average rate :

$$P1 = \frac{1}{2} \times P$$

$$P2 = 2 \times P1 = P$$

- Full mission time (T) is considered, and exposure time of a single engine diversion is the max diversion time (D)

- Hence the IFSD target rate :

$$P = \sqrt{10E-08 / (T \times D)}$$



Determination of IFSD target rates – FAA 1984/2007*

**new FAA ETOPS rule*



- The risk model is based upon “the known service records of an established large fleet of twin-engine civil transport-turbo fan powered airplane”.

Concept of “base fleet”

- **Assumptions**

- Safety objective for Probability of engine failure is assumed to be the one achieved by the “base fleet” over a 10-year period:

Average inflight shutdown rate (P) of approximately 0.020/1000 EH

- This figure is considered conservative vs the rates determined with **ICAO 1984 equation**, considering a flight of **7 FH**:
 - **0.049/1,000** for 2 hour diversion time
 - **0.040/1,000** for 3 hour diversion time

- Hence the retained target IFSD rates :

P = 0.050 / 1,000 EH for diversion times up to 120 min

P = 0.020 / 1,000 EH for diversion times up to 180 min

P = 0.010 / 1,000 EH for diversion times beyond 180 min*



Determination of IFSD target rates – EASA 2010 (up to 180 min)



- Summarized Risk model formula for a two-engine aeroplane is:

$$P_f = 2 \times P_1 \times T \times P_2 \times D$$

- Assumptions for EDTO (ETOPS) up to 180 min

- Safety objective for Total Loss of thrust from independent causes is sized as a function of the mission time (T) as in ICAO 1984 equation, but set to a slightly more conservative 3×10^{-9} for a flight of 1FH

$$P_f(T) = 3 \times 10^{-9} \times (0.4T + 0.6)$$

- Probability of failure of 1st (P₁) and 2nd (P₂) engine is derived from average failure rate (P) :

$$P_1 = \frac{1}{2} \times P$$

$$P_2 = 2 \times P_1 = P$$

- Full mission time (T) is considered, and exposure time of a single engine diversion is the max diversion time (D)

- Hence the IFSD target rate :

$$P = \sqrt{3 \times 10^{-9} \times (0.4T + 0.6) / (T \times D)}$$



Determination of IFSD target rates – EASA 2010 (beyond 180 min)



- Summarized Risk model formula for a two-engine aeroplane is:

$$P_f = 2 \times C_r \times (T-D) \times M_r \times D$$

- Assumptions for EDTO (ETOPS) beyond 180 min

- Safety objective for Total Loss of thrust from independent causes is set to $10E-09$ for a flight of 1FH :

$$P_f(T) = 1 \times 10E-09 \times T$$

- Probability of failure of 1st engine (**Cr: Cruise rate**) and of 2nd engine (**Mr: MCT rate**) is respectively half or equal to 2 x the average failure rate (**P**) :

$$C_r = \frac{1}{2} \times P$$

$$M_r = 2 \times P$$

- For the 1st engine failure, the exposure time is Full mission time (**T**) minus the max diversion time (**D**)
- Exposure time of a single engine diversion is the max diversion time (**D**)

- Hence the IFSD target rate :

$$P = \sqrt{\frac{10E-09 \times T}{2 \times (T-D) \times D}}$$



Determination of IFSD target rates – Resulting target rates



Diversion Time (FH)	Flight Time (FH)	ICAO 1953	ICAO 1984	FAA	EASA
2	7	(0.027)	0.049	0.050	0.027
3	7	(0.022)	0.040	0.020	0.022
10	20	(0.007)	(0.021)	0.010	0.010



ICAO

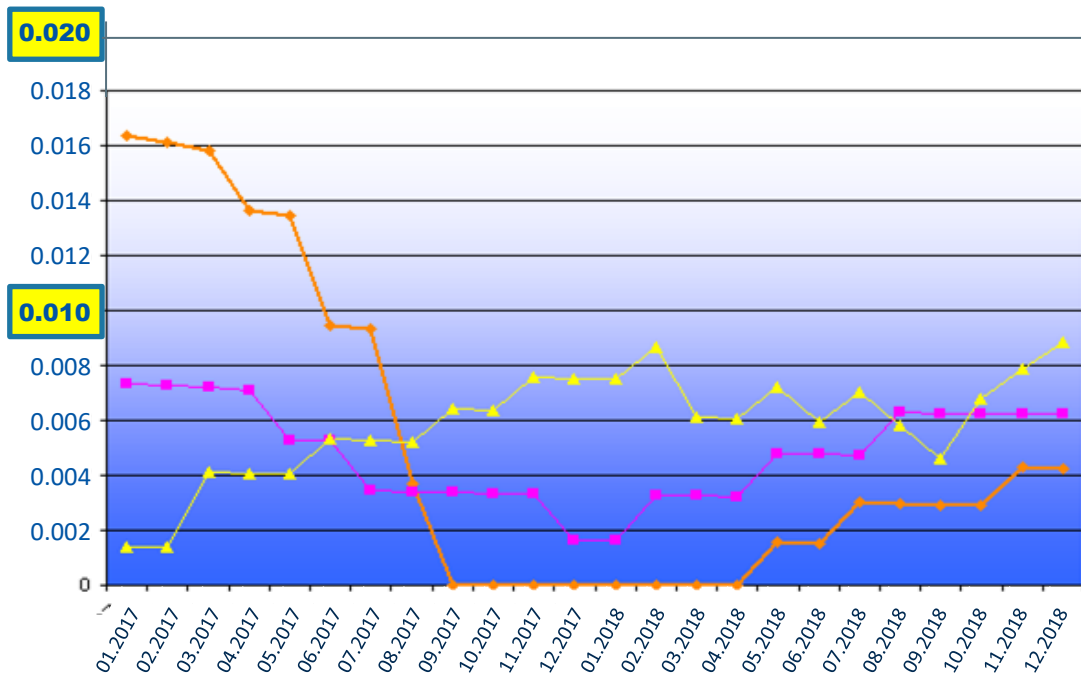
SAFETY



EDTO Type Design and Reliability Approval

EDTO Reliability & Maturity Requirements

EDTO Reliability Requirements – Example of IFSD rate curves



WonderPlanes WP-911

- Manufacturer : Bigfan
Engine Family : Nexus-6
- Manufacturer : Thunderbird
Engine Family : T2
- Manufacturer : Greenpush
Engine Family : RG3350-89



EDTO Reliability Requirements – IFSD definition



The In-flight shutdown (**IFSD**) is when an **engine ceases to function in flight and is shutdown**, whether self induced, flight crew initiated or caused by an external influence, for example (list is not exhaustive) :

- flameout, internal failure, foreign object ingestion, icing,
- flight crew initiated shutdown e.g. when unable to obtain or control desired thrust or power, cycling of the start control (even if the engine operates normally for the remainder of the flight).

The IFSD definition usually excludes the airborne cessation of the functioning of an engine when immediately followed by an automatic engine relight and when an engine does not achieve desired thrust or power but is not shutdown.

- These events as well as engine failures occurring before take-off decision speed or after touch-down, **although not counted as IFSD**, are reviewed in the frame of continued airworthiness for EDTO.



- Part I — **Aircraft airworthiness considerations for EDTO**
- Part II — **Type Design Assessment**
- Part III — **Reliability & Maturity Assessment**
- Part IV — Continued validity of EDTO certification**
- Part V — **EDTO Documentation (CMP, AFM, ...)**
- Part VI — **Summary**
- Part VII — **Practical Exercise**



Section 1.5: Continuity of EDTO Certification (Two Engine Aeroplanes)



“The EDTO certification is not granted permanently. It is submitted to a continued surveillance by the State of Design of the in-service reliability of the worldwide fleet of the concerned aircraft model/type.”

The certified EDTO capability of the aircraft may therefore be reduced, suspended or even revoked if no solution exists to a major problem...”





EDTO Reliability reviews (Reliability Tracking Board)

Once granted, the EDTO certification must be maintained.

EDTO Continued Airworthiness activities typically consist in reviewing the reliability of the aeroplane EDTO Significant Systems, APU and Engines

- These reviews may be performed during dedicated meetings of the so-called EDTO Reliability Tracking Board
- Reliability review meetings are held on a regular basis (typically every 3 to 6 months in the early service life of the aeroplane, and every 1 to 2 years for mature product)
- Statistical reliability indicators are also reported regularly.





EDTO Reliability Requirements



The **continued monitoring on in-service** data aims at ensuring that:

- Aeroplane **systems** failure rates (Mean Time Between Failure - **MTBF**) do not exceed the rates considered in the safety analysis.
- **Engines** meet EDTO reliability objectives (IFSD target rate)

Compliance with these **reliability objectives** must be demonstrated through Early EDTO demonstration in case of EDTO at EIS, and in any case **through in service experience**.

- Corrective action may be mandated to **restore** adequate reliability levels
- EDTO certification may be **reduced** or **suspended** if reliability objectives are not met and no corrective action is available



Implementation of corrective actions

Corrective action(s) may be mandated to restore adequate reliability levels

- e.g. worldwide fleet IFSD rate should be maintained at or below applicable target rate.



It shall be noted that exceedance of applicable reliability targets may not lead to systematic mandatory corrective action. The decision to mandate (or not) a corrective action may also consider the following elements:

- Identification of the root cause
- Affected fleet (all or subset only) and operational specificities (e.g. weather, type of fuel, ...)
- etc...

Conversely, corrective actions may also be mandated even if prescribed worldwide reliability targets are met e.g. to address an issue impacting a sub-fleet of aeroplanes.



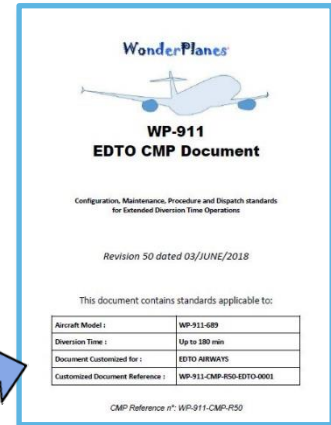
Implementation of corrective actions

A **corrective action** may be :

- Upgraded / new **design**
- Additional **maintenance tasks** or existing tasks with reduced interval
- Revised/new **Flight Crew procedures**
- More stringent **EDTO MMEL dispatch** allowance



EDTO standards are not frozen
and may potentially be impacted / revised



WonderPlanes

WP-911
EDTO CMP Document

Configuration, Maintenance, Procedure and Dispatch standards
for Extended Diversion Time Operations

Revision 50 dated 03/JUNE/2018

This document contains standards applicable to:

Aircraft Model :	WP-911-689
Diversion Time :	Up to 180 min
Document Customized for :	EDTO AIRWAYS
Customized Document Reference :	WP-911-CMP-R50-EDTO-0001

CMP Reference n°: WP-911-CMP-R50

Such corrective action may be **mandated** by the **State of Design** through either a **revision** of the **EDTO CMP document** or a dedicated Airworthiness Directive (**AD**)

- **Continued compliance** of the **EDTO operators** with applicable revision of the EDTO CMP Document or “EDTO” AD is mandatory for **continued EDTO operations**.



- Part I — **Aircraft airworthiness considerations for EDTO**
- Part II — **Type Design Assessment**
- Part III — **Reliability & Maturity Assessment**
- Part IV — **Continued validity of EDTO certification**
- Part V — EDTO Documentation (CMP, AFM, ...)**
- Part VI — **Summary**
- Part VII — **Practical Exercise**



EDTO Standards and Limitations in the Aeroplane's documentation.



Two engines aeroplanes

- As the aeroplane must be certified for EDTO Certification, the EDTO Standards and Limitations are identified in approved EDTO CMP Document and EDTO Supplement of the AFM.
- The MMEL and Maintenance Review Board report (MRBR) may also include EDTO related information, as these documents are reviewed as part of the EDTO certification exercise



Aeroplanes with more than two engines

- EDTO certification and EDTO maintenance program requirements are not applicable. Accordingly, it is considered that the aeroplane design and maintenance program defined as part of the basic Type Certification exercise are adequately supporting EDTO operations
- Capability of the EDTO Significant Time Limited System(s) is identified in relevant documentation (e.g. FCOM)



EDTO Standards and Limitations in the Aeroplane's documentation.

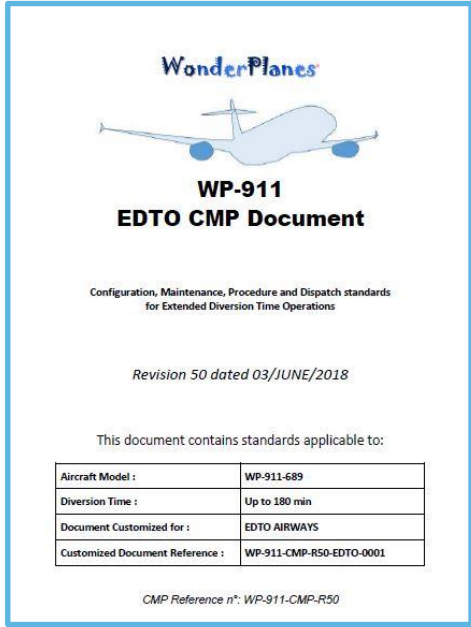
- Unless otherwise stated in the documentation or tools supporting the operations of the aeroplane, there are no specific configuration, maintenance, crew procedures or dispatch standards for EDTO.
 - Note: some States have implemented criteria for EDTO certification of aeroplanes with more than 2 engines. In this case, the Standards and Limitations for EDTO may be found in dedicated EDTO CMP document and EDTO supplement of the AFM.
- The maximum diversion time capability of the aeroplane is sized by the capability of the relevant EDTO Significant Time Limited System
- This information should be reflected in the applicable documentation (e.g. FCOM), as indicated by the Manufacturer of the aeroplane.



EDTO Standards and Limitations in the Aeroplane's documentation.

- The Standards for EDTO are listed in the applicable issue of the EDTO CMP Document
- The limitations for EDTO, and in particular the capability of the EDTO Significant Time Limited Systems, are identified in the approved EDTO supplement of the AFM
- The dispatch restrictions specific to EDTO are listed in the MMEL
- Additional data relevant to EDTO operations may be found in other documents or tools supporting the operation of the aeroplane, such as the MRB Report, IPC, FCOM, etc...

More info on
NEXT
slides! 



The EDTO CMP Document defines:

- The **configuration standards** of the airframe, the engines and the APU for EDTO
- The **maintenance tasks** specific to EDTO (also found in the MRBR)
- The flight crew **procedures** specific to EDTO (also found in the AFM and FCOM)
- The **dispatch limitations** specific to EDTO (also found in the MMEL)

For EDTO, the aircraft must be **configured, maintained** and **operated** according to the applicable CMP Document

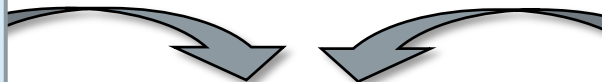


For Entry into Service:

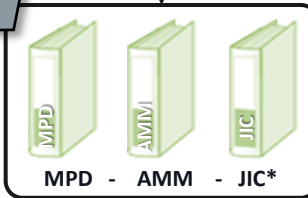
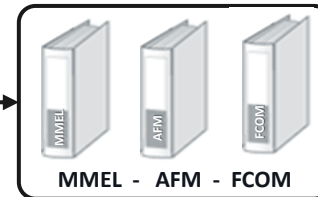
- Flight Test Results
- Simulation
- System Safety Assessment
- Lessons Learned

For Aircraft in-service:

- Reliability trends
- Events
- Modifications
- Other aeroplane related events



CMP



- EDTO Maintenance Practices on EDTO Significant Systems (e.g. Dual Maintenance limitations)
- Non-aeroplane specific maintenance requirements (e.g. oil Consumption monitoring)

*JIC : Job Instruction Card



WonderPlanes WP-911SP+

EDTO CMP Document

Time Limited Systems (EDTO Limitations)

The WP-Millennium type-design has been evaluated and found to comply with the applicable criteria for operations above 60 minute diversion time when the configuration, maintenance and procedures standards contained in this approved ETOPS CMP document are met.

The maximum diversion time(s) shall not exceed the capability of the time-limited systems in accordance with the criteria given in the applicable ETOPS operational regulation. The applicable limitations depend on the aeroplane configuration and selected ETOPS capability (refer to the Mod embodied on the concerned aeroplane). The maximum diversion distance is also limited for ETOPS beyond 180 minutes operations.

Cargo Fire Suppression

The demonstrated suppression time capability of the lower deck cargo fire suppression system is:

Mod	Description	Demonstrated protection time
Basic	Basic lower cargo compartment - 135 min protection time	135 minutes
Mod 180 min	Extend duration of cargo compartment fire suppression to 195 min protection time	195 minutes
Mod 240 min	Extend duration of cargo compartment fire suppression to 225 minutes protection time	225 minutes
Mod 350 min	Extend duration of cargo compartment fire suppression to 310 minutes protection time	310 minutes

Other ETOPS Significant Systems time capability

The demonstrated diversion time capability of all the other ETOPS significant systems is:

Mod	Description	Demonstrated capability
Basic 120 min ETOPS capability	Basic aeroplane definition	135 minutes
Mod 180 min	Optional EDTO 180 min capability	195 minutes
Mod 240 min	Optional EDTO 240 min capability	255 minutes
Mod 350 min	Optional EDTO 350 min capability	365 minutes

Certified maximum diversion distance

Mod	Description	Maximum diversion distance
Mod 240 min	Optional EDTO 240 min capability	3680 NM
Mod 350 min	Optional EDTO 350 min capability	2600 NM

CMP Reference n°: WP-911-CMP-R51



The **EDTO limitations** may also be identified in the CMP:

Cargo Fire Suppression

The demonstrated suppression time capability of the lower deck cargo fire suppression system is:

Mod	Description	Demonstrated protection time
Basic	Basic lower cargo compartment - 135 min protection time	135 minutes
Mod 180 min	Extend duration of cargo compartment fire suppression to 195 min protection time	195 minutes
Mod 240 min	Extend duration of cargo compartment fire suppression to 225 minutes protection time	225 minutes
Mod 350 min	Extend duration of cargo compartment fire suppression to 310 minutes protection time	310 minutes

Other ETOPS Significant Systems time capability

The demonstrated diversion time capability of all the other ETOPS significant systems is:

Mod	Description	Demonstrated capability
Basic 120 min ETOPS capability	Basic aeroplane definition	135 minutes
Mod 180 min	Optional EDTO 180 min capability	195 minutes
Mod 240 min	Optional EDTO 240 min capability	255 minutes
Mod 350 min	Optional EDTO 350 min capability	365 minutes

These limitations are sizing the maximum diversion time / distance for the concerned aeroplane family.



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ATA 21 CMP Standards applicable to WP-911-821SP Fitted with: BASIC FORWARD CARGO VENTILATION (NO TEMPERATURE CONTROL) MOD/SB: 100987 or 105111			
Configuration item n°:	21-1-0000-001	Revision n°1	Area of Operation: Normal
Diversion Time Range:	greater than 60 min.	Compliance Schedule:	No later than 31/DEC/2021
Improved Pack controller.			
Cross Reference: N/A			
Solutions: n°1: MOD 142309			
Configuration item n°:	21-1-0000-002	Revision n°2	Area of Operation: Normal
Diversion Time Range:	greater than 60 min.	Compliance Schedule:	Priority
Introduce Improved Packs and temperature Sensors.			
Cross Reference: N/A			
Solutions: n°1: HERRLOEB SB 9105A-21-01 AND HERRLOEB SB 956A-21-01 n°2: MOD 142309 AND MOD 142629 n°3: SB 21-9010			
Maintenance item n°:	21-2-0000-001	Revision n°1	Area of Operation: Normal
Diversion Time Range:	greater than 60 min.	Compliance Schedule:	Interval: Not to exceed 2500 Flight Hours
Lower deck cargo compartment ventilation and cooling/heating. Operational check to verify automatic closing of isolation valves and shut-off of extraction fans in case of smoke warning.			
Cross Reference: N/A			
Solutions: n°1: MDP WP-212800-01a			
Procedure item n°:	21-3-0000-001	Revision n°2	Area of Operation: Normal
Diversion Time Range:	greater than 60 min	Compliance Schedule:	See text below
Procedure to use APU Bleed For Pressurization in case of failure of both engine bleeds. Flight altitude is limited to 22000 ft.			
Cross Reference: N/A			
Solutions: n°1: FCOM 3.02.36 n°2: FCOM PRO-55N-36			
Dispatch item n°:	21-4-0000-001	Revision n°1	Area of Operation: Normal
Diversion Time Range:	from 60 to 180 min greater than 180 min	Compliance Schedule:	Item not applicable for operations up to 180 min D.T. See text below
Dispatch with one or both Air Conditioning Pack inoperative is not allowed for EDTO beyond 180 minutes.			
Cross Reference: N/A			
Solutions: n°1: MMEL 21-62.01			

CMP Reference n°: WP-911-CMP-R51

Example of EDTO CMP Document page layout:

- The **CMP standards** may typically split by ATA chapter, e.g. ATA 21 standards in this example.

WonderPlanes WP-911SP+

ATA 21 CMP Standards applicable to WP-911-821SP Fitted with: BASIC FORWARD CARGO VENTILATION (NO TEMPERATURE CONTROL) MOD/SB: 100987 or 105111	
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WonderPlanes WP-911SP+

ATA 21 CMP Standards applicable to WP-911-821SP
 Filled with: BASIC FORWARD CARGO VENTILATION (NO TEMPERATURE CONTROL)
 MOD/SB: 1098R or 109111

Configuration item n°:	21-1-0000-001	Revision n°1	Area of Operation: Normal
Diversion Time Range:	greater than 60 min	Compliance Schedule:	No later than 31/DEC/2001
Improved Pack controller.			
Cross Reference: N/A			
Solutions: n°1: MOD 14209			

Configuration item n°:	21-1-0000-002	Revision n°2	Area of Operation: Normal
Diversion Time Range:	greater than 60 min	Compliance Schedule:	Priority
Introduce Improved Packs and temperature Sensors.			
Cross Reference: N/A			
Solutions: n°1: HERRLOEB SB 910A-21-01 AND HERRLOEB SB 956A-21-01 n°2: MOD 14209 AND MOD 14209 n°3: SB 21-9010			

Maintenance item n°:	21-2-0000-001	Revision n°7	Area of Operation: Normal
Diversion Time Range:	greater than 60 min	Compliance Schedule:	Interval: Not to exceed 2500 Flight Hours
Lower deck cargo compartment ventilation and cooling/heating. Operational check to verify automatic closing of isolation valves and shut-off of extraction fans in case of smoke warning.			
Cross Reference: N/A			
Solutions: n°1: MDP WP-212800-01a			

Procedure item n°:	21-3-0000-001	Revision n°2	Area of Operation: Normal
Diversion Time Range:	greater than 60 min	Compliance Schedule:	See text below
Procedure to use APU Bleed For Pressurization in case of failure of both engine bleeds. Flight altitude is limited to 22000 ft.			
Cross Reference: N/A			
Solutions: n°1: FCOM 3.02.36 n°2: FCOM PRO-AN-36			

Dispatch item n°:	21-4-0000-001	Revision n°1	Area of Operation: Normal
Diversion Time Range:	greater than 180 min	Compliance Schedule:	See M. 180 min. for operations up to 180 min D.T. See M. 180 min. for operations beyond 180 minutes.
Dispatch with one or both Air Conditioning Pack inoperative is not allowed beyond 180 minutes.			
Cross Reference: N/A			
Solutions: n°1: MMEI 21-62.01			

CMP Reference n°: WP-911-CMP-R51

Example of EDTO CMP Document page layout:

– The **CMP standards** are split as follows:

1. Configuration
2. Maintenance
3. Procedures
4. Dispatch

Dispatch item n°:	21-4-0000-001
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WonderPlanes WP-911SP+

Configuration item n°:	21-1-0000-001	Revision n°1	Area of Operation: Normal
ATA 21 CMP Standards applicable to WP-911-821SP Filed with: BASIC FORWARD CARGO VENTILATION (NO TEMPERATURE CONTROL) MOD/SB: 100887 or 105111			
Diversion Time Range: greater than 60 min		Compliance Schedule: No later than 31/DEC/2021	
Improved Pack controller.			
Cross Reference: N/A			
Solutions: n°1: MOD 142309			

Configuration item n°:	21-1-0000-002	Revision n°2	Area of Operation: Normal
Diversion Time Range: greater than 60 min		Compliance Schedule: Priority	
Introduce Improved Packs and temperature Sensors.			
Cross Reference: N/A			
Solutions: n°1: HERRLOEB SB 9105A-21-01 AND HERRLOEB SB 956A-21-01 n°2: MOD 142309 AND MOD 142629 n°3: SB 21-9010			

Maintenance item n°:	21-2-0000-001	Revision n°7	Area of Operation: Normal
Diversion Time Range: greater than 60 min		Compliance Schedule: Interval: Not to exceed 2500 Flight Hours	
Lower deck cargo compartment ventilation and cooling/heating. Operational check to verify automatic closing of isolation valves and shut-off of extraction fans in case of smoke warning.			
Cross Reference: N/A			
Solutions: n°1: MDP WP-212800-01a			

Procedure item n°:	21-3-0000-001	Revision n°2	Area of Operation: Normal
Diversion Time Range: greater than 60 min		Compliance Schedule: See text below	
Procedure to use APU Bleed For Pressurization in case of failure of both engine bleeds. Flight altitude is limited to 22000 ft.			
Cross Reference: N/A			
Solutions: n°1: FCOM 3.02.36 n°2: FCOM PRO-58N-36			

Dispatch item n°:	21-4-0000-001	Revision n°1	Area of Operation: Normal
Diversion Time Range: from 60 to 180 min greater than 180 min		Compliance Schedule: Item not applicable for operations up to 180 min D.T. See text below	
Dispatch with one or both Air Conditioning Pack inoperative is not allowed for EDTO beyond 180 minutes.			
Cross Reference: N/A			
Solutions: n°1: MMEL 21-62.01			

CMP Reference n°: WP-911-CMP-R51

Example of EDTO CMP Document page layout:

- Each **CMP item** contains the following information:
 - Diversion Time Range applicability
 - Compliance Schedule (mostly for Configuration and Maintenance items)
 - Description of the items
 - Compliance Solution(s)

Example on
NEXT
slides!



Example of EDTO CMP Document page layout:

- Example of a **configuration** item with a limit date for embodiment

WonderPlanes WP-911SP+

ATA 21 CMP Standards applicable to WP-911-821SP
Filled with: BASIC FORWARD CARGO VENTILATION (NO TEMPERATURE CONTROL)

Configuration item n°:	21-1-0000-001	Revision n°1	Area of Operation: Normal
Diversion Time Range: greater than 60 min	Compliance Schedule: No later than 31/DEC/2021		
Improved Pack controller.			
Cross Reference: N/A Solutions: n°1: MOD 142309			

Configuration item n°:	21-1-0000-002	Revision n°1	Area of Operation: Normal
Diversion Time Range: greater than 60 min	Compliance Schedule: Priority		
Introduce Improved Packs and temperature Sensors.			
Cross Reference: N/A Solutions: n°1: HERRLOEB SB 9105A-21-01 AND HERRLOEB SB 956A-21- n°2: MOD 142309 AND MOD 142629 n°3: SB 21-9010			

Maintenance item n°:	21-2-0000-001	Revision n°1	Area of Operation: Normal
Diversion Time Range: greater than 60 min	Compliance Schedule: Interval: Not to exceed 2500 Flight Hours		
Lower deck cargo compartment ventilation and cooling/heating. Operational check to verify automatic closing of isolation valves and shut-off of extraction fans in case of smoke warning.			
Cross Reference: N/A Solutions: n°1: MDP WP-212800-01a			

Procedure item n°:	21-3-0000-001	Revision n°2	Area of Operation: Normal
Diversion Time Range: greater than 60 min	Compliance Schedule: See text below		
Procedure to use APU Bleed For Pressurization in case of failure of both engine bleeds. Flight altitude is limited to 22000 ft.			
Cross Reference: N/A Solutions: n°1: FCOM 3.02.36 n°2: FCOM PRO-58N-36			

Dispatch item n°:	21-4-0000-001	Revision n°1	Area of Operation: Normal
Diversion Time Range: from 60 to 180 min greater than 180 min	Compliance Schedule: Item not applicable for operations up to 180 min D.T. See text below		
Dispatch with one or both Air Conditioning Pack inoperative is not allowed for EDTO beyond 180 minutes.			
Cross Reference: N/A Solutions: n°1: MMEL 21-62.01			

CMP Reference n°: WP-911-CMP-R51

Configuration item n°:	21-1-0000-001	Revision n°1	Area of Operation: Normal
Diversion Time Range: greater than 60 min	Compliance Schedule: No later than 31/DEC/2021		
Improved Pack controller.			
Cross Reference: N/A Solutions: n°1: MOD 142309			



WonderPlanes WP-911SP+

ATA 21 CMP Standards applicable to WP-911-821SP
 Filled with: BASIC FORWARD CARGO VENTILATION (NO TEMPERATURE CONTROL)
 MOD/SB: 109887 or 109111

Configuration item n°:	21-1-0000-001	Revision n°1	Area of Operation: Normal
Diversion Time Range:	greater than 60 min	Compliance Schedule:	No later than 31/DEC/2021
Improved Pack controller.			
Cross Reference: N/A			
Solutions: n°1: MOD 142309			

Configuration item n°:	21-1-0000-002	Revision n°2	Area of Operation: Normal
Diversion Time Range:	greater than 60 min	Compliance Schedule:	Priority
Introduce Improved Packs and temperature Sensors.			
Cross Reference: N/A			
Solutions: n°1: HERRLÖB SB 9105A-21-01 AND HERRLÖB SB 956A-21-01 n°2: MOD 142309 AND MOD 142629 n°3: SB 21-9010			

Maintenance item n°:	21-2-0000-001	Revision n°7	Area of Operation: Normal
Diversion Time Range:	greater than 60 min	Compliance Schedule:	Interval: Not to exceed 2500 Flight Hours
Lower deck cargo compartment ventilation and cooling/heating. Operational check to verify automatic closing of isolation valves and shut-off of extraction fans in case of smoke warning.			
Cross Reference: N/A			

Procedure item n°:	21-3-0000-001	Revision n°2	Area of Operation: Normal
Diversion Time Range:	greater than 60 min	Compliance Schedule:	See text below
Procedure to use APU Bleed For Pressurization in case of failure of both engine bleeds. Flight altitude is limited to 22000 ft.			
Cross Reference: N/A			
Solutions: n°1: FCOM 3.02.36 n°2: FCOM PRO-58N-36			

Dispatch item n°:	21-4-0000-001	Revision n°1	Area of Operation: Normal
Diversion Time Range:	from 60 to 180 min greater than 180 min	Compliance Schedule:	Item not applicable for operations up to 180 min D.T. See text below
Dispatch with one or both Air Conditioning Pack inoperative is not allowed for EDTO beyond 180 minutes.			
Cross Reference: N/A			
Solutions: n°1: MMEL 21-62.01			

CMP Reference n°: WP-911-CMP-R51

Example of EDTO CMP Document page layout:

- Example of a **maintenance** item with a not to exceed interval in Flight Hours.

Maintenance item n°:	21-2-0000-001	Revision n°7	Area of Operation: Normal
Diversion Time Range:	greater than 60 min	Compliance Schedule:	Interval: Not to exceed 2500 Flight Hours
Lower deck cargo compartment ventilation and cooling/heating. Operational check to verify automatic closing of isolation valves and shut-off of extraction fans in case of smoke warning.			
Cross Reference: N/A			
Solutions: n°1: MPD WP-212800-01a			



Example of EDTO CMP Document page layout:

- Example of a Flight Crew **procedure** item .

WonderPlanes WP-911SP+

ATA 21 CMP Standards applicable to WP-911-821SP
 Filled with: BASIC FORWARD CARGO VENTILATION (NO TEMPERATURE CONTROL)
 MOD/SB: 1098R or 109111

Configuration item n°:	21-1-0000-001	Revision n°1	Area of Operation: Normal
Diversion Time Range:	greater than 60 min	Compliance Schedule:	No later than 31/DEC/2001
Improved Pack controller.			
Cross Reference: N/A			
Solutions: n°1: MOD 142309			

Configuration item n°:	21-1-0000-002	Revision n°2	Area of Operation: Normal
Diversion Time Range:	greater than 60 min	Compliance Schedule:	Priority
Introduce Improved Packs and temperature Sensors.			
Cross Reference: N/A			
Solutions: n°1: HERRLOEB SB 9105A-21-01 AND HERRLOEB SB 956A-21-01 n°2: MOD 142309 AND MOD 142629 n°3: SB 21-9010			

Maintenance item n°:	21-2-0000-001	Revision n°7	Area of Oper: Normal
Diversion Time Range:	greater than 60 min	Compliance Schedule:	Interval: Not to exceed 2500 Flight Hours
Lower deck cargo compartment ventilation and cooling/heating. Operational check to verify automatic closing of isolation valves and shut-off or warning.			
Cross Reference: N/A			
Solutions: n°1: MDP WP-212800-01a			

Procedure item n°:	21-3-0000-001	Revision n°2	Area of Operation: Normal
Diversion Time Range:	greater than 60 min	Compliance Schedule:	See text below
Procedure to use APU Bleed For Pressurization in case of failure of both engine bleeds. Flight altitude is limited to 22000 ft.			
Cross Reference: N/A			
Solutions: n°1: FCOM 3.02.36 n°2: FCOM PRO-ABN-36			

Dispatch item n°:	21-4-0000-001	Revision n°1	Area of Operation: Normal
Diversion Time Range:	from 60 to 180 min greater than 180 min	Compliance Schedule:	Item not applicable for operations up to 180 min D.T. See text below
Dispatch with one or both Air Conditioning Pack inoperative is not allowed for EDTO beyond 180 minutes.			
Cross Reference: N/A			
Solutions: n°1: MMEL 21-62.01			

CMP Reference n°: WP-911-CMP-R51

Procedure item n°:	21-3-0000-001	Revision n°2	Area of Operation: Normal
Diversion Time Range:	greater than 60 min	Compliance Schedule:	See text below
Procedure to use APU Bleed For Pressurization in case of failure of both engine bleeds. Flight altitude is limited to 22000 ft.			
Cross Reference: N/A			
Solutions: n°1: FCOM 3.02.36 n°2: FCOM PRO-ABN-36			



WonderPlanes WP-911SP+

ATA 21 CMP Standards applicable to WP-911-821SP
 Filled with: BASIC FORWARD CARGO VENTILATION (NO TEMPERATURE CONTROL)
 MOD/SB: 109887 or 109111

Configuration item n°:	21-1-0000-001	Revision n°1	Area of Operation: Normal
Diversion Time Range:	greater than 60 min	Compliance Schedule:	No later than 31/DEC/2001
Improved Pack controller.			
Cross Reference: N/A			
Solutions: n°1: MOD 142309			

Configuration item n°:	21-1-0000-002	Revision n°2	Area of Operation: Normal
Diversion Time Range:	greater than 60 min	Compliance Schedule:	Priority
Introduce Improved Packs and temperature Sensors.			
Cross Reference: N/A			
Solutions: n°1: HERRLOEB SB 9105A-21-01 AND HERRLOEB SB 956A-21-01 n°2: MOD 142309 AND MOD 142629 n°3: SB 21-9010			

Maintenance item n°:	21-2-0000-001	Revision n°7	Area of Operation: Normal
Diversion Time Range:	greater than 60 min	Compliance Schedule:	Interval: Not to exceed 2500 Flight Hours
Lower deck cargo compartment ventilation and cooling/heating. Operational check to verify automatic closing of isolation valves and shut-off of extraction fans in case of smoke warning.			
Cross Reference: N/A			
Solutions: n°1: MDP WP-212800-01a			

Procedure item n°:	21-3-0000-001	Revision n°2	Area of Operation: Normal
Diversion Time Range:	greater than 60 min	Compliance Schedule:	See text below
Procedure to use APU Bleed For Pressurization in case of failure of both engine 1: Flight altitude is limited to 22000 ft.			
Cross Reference: N/A			
Solutions: n°1: FCOM 3.02.36 n°2: FCOM PRO-58N-36			

Dispatch item n°:	21-4-0000-001	Revision n°1	Area of Operation: Normal
Diversion Time Range:	from 60 to 180 min greater than 180 min	Compliance Schedule:	Item not applicable for operations up to 180 min D.T. See text below
Dispatch with one or both Air Conditioning Pack inoperative is not allowed for EDTO beyond 180 minutes.			
Cross Reference: N/A			
Solutions: n°1: MMEL 21.52.01			

CMP Reference n°: WP-911-CMP-R51

Example of EDTO CMP Document page layout:

- Example of a Dispatch item referring to MMEL for resolution, applicable to EDTO beyond 180 min only (see description text).

Dispatch item n°:	21-4-0000-001	Revision n°1	Area of Operation: Normal
Diversion Time Range: from 60 to 180 min greater than 180 min	Compliance Schedule: Item not applicable for operations up to 180 min D.T. See text below		
Dispatch with one or both Air Conditioning Pack inoperative is not allowed for EDTO beyond 180 minutes.			
Cross Reference: N/A			
Solutions: n°1: MMEL 21.52.01			



Purpose of the EDTO Parts List

The EDTO CMP document defines the **required EDTO configuration** of the aeroplane in terms of **Modifications** or **Service Bulletin** references

➔ Corresponding **Part Numbers** (P/N) are usually not listed. Hence the **EDTO Parts List** assists the operator in identifying the P/N's, which are either:

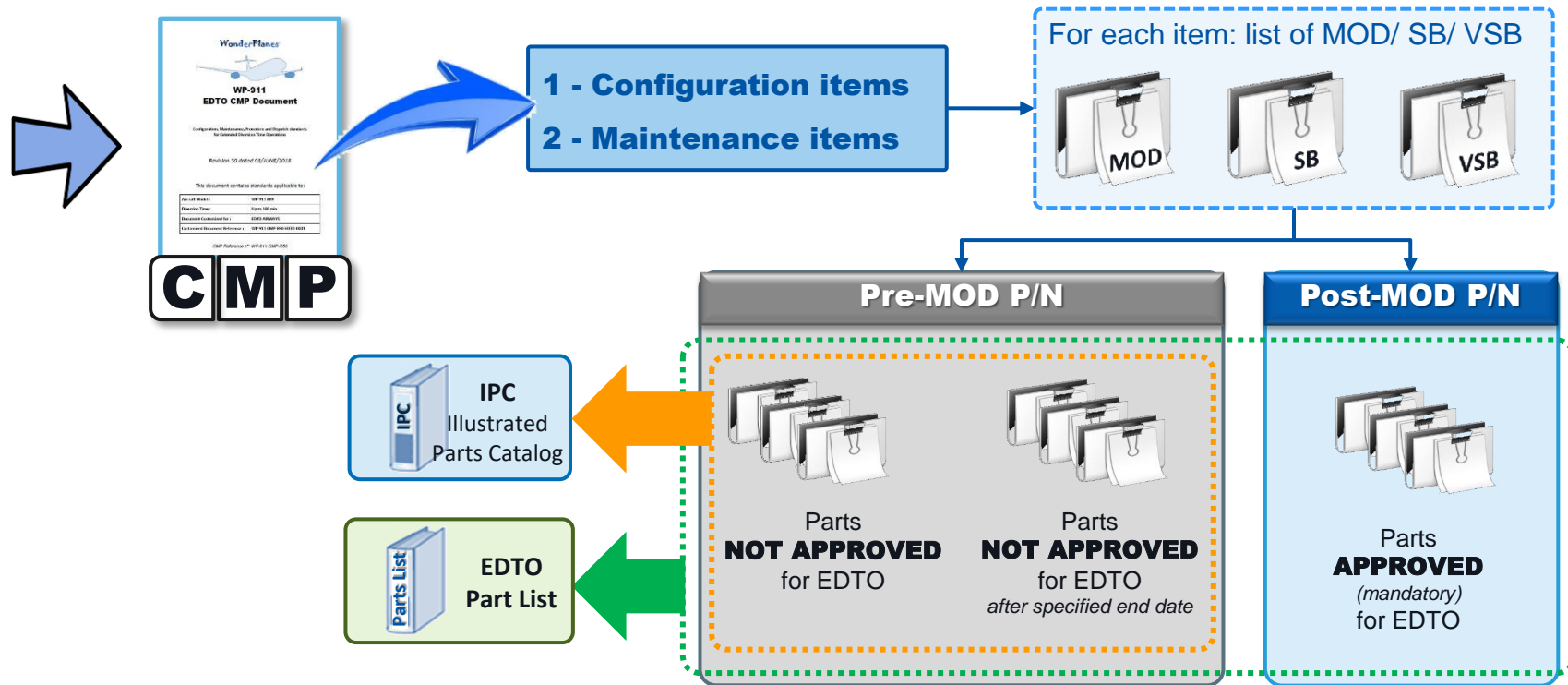
- NOT approved for EDTO** i.e. P/N's not to be fitted on EDTO aircraft; and
- The minimum standards of P/N's required for proper EDTO configuration

The Parts List is not an approved document : in case of any doubt, the EDTO CMP document should be used as the reference for ascertaining the required EDTO configuration.

Note : Except otherwise stated, any P/N above the minimum standard P/N is considered approved for EDTO.



From the EDTO CMP Document to the Parts List and IPC





Question 4.6 :

Is it correct to say that any system listed in the EDTO Significant System list can also be found in the EDTO Parts List ?

- Yes
- No





Approved AFM EDTO supplement

The approved **EDTO Supplement** within Appendices & Supplements section of the AFM, is approved as part of the EDTO certification and applies to EDTO operated aeroplanes.

! This finding does not constitute approval to conduct EDTO

Note that the EDTO supplement is usually for a given EDTO capability of the aeroplane, e.g.:

- 180 min EDTO
- Beyond 180 min capability

Even if certified for a higher diversion time, the aeroplane cannot be operated beyond the EDTO limitations specified in its AFM.

WonderPlanes WP-911SP+ AEROPLANE FLIGHT MANUAL	APPENDICES AND SUPPLEMENTS EXTENDED DIVERSION TIME OPERATIONS (EDTO)
GENERAL	
<p>This supplement is applicable to Extended Diversion Time Operations (ETOPS/EDTO), which applies to operations of turbine powered aeroplanes beyond the applicable threshold specified by the national authority.</p> <p>The type design reliability and performance of this aeroplane-engine combination has been evaluated and found to comply with the applicable criteria for operations above 60 minutes diversion time (including ETOPS/EDTO beyond 180 minutes) when the Configuration, Maintenance and Procedures standards contained in the approved WonderPlanes CMP document reference WP911-CMP-R51 at the latest applicable revision are met.</p> <p>Actual diversion time for this aeroplane cannot exceed the time-limited systems capability identified in the LIMITATIONS sin accordance with the criteria given in the applicable EDTO operational regulations.</p> <p>This supplement does not constitute an operational approval to conduct EDTO. Such approval must be obtained by the operator from the appropriate national authority.</p>	
LIMITATIONS	
<p>The time capability of the cargo fire suppression system is 310 minutes.</p> <p>The time capability of all other EDTO significant systems is 365 minutes.</p> <p>The maximum diversion distance is 2400 NM.</p>	
PROCEDURES	
<p>The procedures given in the approved WP-911SP+ EDTO CMP Document are applicable.</p> <ul style="list-style-type: none"> • In case of failure of one engine or one IDG : Start APU and use the APU electrical channel 	
PERFORMANCE	
<p>For en-route net flight path performance determination associated with the speed used for chosen diversion procedure, the WonderPlanes Performance Program at the latest approved revision must be used.</p> <p>The in-flight performance information are provided in the FCOM One Engine Inoperative chapter.</p>	





Approved AFM EDTO supplement

It confirms whether procedures listed in AFM Emergency Procedures & Abnormal Procedures remain applicable for EDTO (it is usually the case).

It identifies the additional diversion cases for EDTO, if any (e.g. in case of one remaining main generator).

It provides reference to applicable performance data within FCOM and/or performance programs.

WonderPlanes WP-911SP+ AEROPLANE FLIGHT MANUAL	APPENDICES AND SUPPLEMENTS EXTENDED DIVERSION TIME OPERATIONS (EDTO)
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EDTO dispatch restrictions in MMEL

The dispatch restrictions specific to EDTO are identified in the MMEL as part of the EDTO certification activities :

Repair interval	Nbr installed	Nbr required	Placard
C	2	1	Yes

- (o) (m) One may be inoperative provided that:
- 1)EDTO beyond 180 min is not conducted, and

The EDTO Operator’s MEL must include the MMEL restrictions for EDTO operations

- As for non-EDTO, the “EDTO MEL” cannot be less restrictive than the “EDTO MMEL”

MMEL ITEMS			
24 - ELECTRICAL POWER			
24-22 - AC Main Generation			
24-22-01	AC Main Generation (IDG, GCU, Line Contactor)		
Ident: MI-24-22-00007105.0015001 / 12 DEC 18			
Applicable to: MSN 0030-2021			
24-22-01A			
Repair interval	Nbr installed	Nbr required	Placard
C	2	1	Yes
(o) (m) One may be inoperative provided that:			
<ol style="list-style-type: none"> 1)EDTO beyond 180 min is not conducted, and 2)The APU and AC auxiliary generation are operative and used throughout the night, and 3)All buses have power, and 4)Indications for the remaining AC main generation and the AC auxiliary generation are checked operative on the ELEC AC SD page, and 5)The ELEC IDG 1(2) OIL SYS FAULT alert associated with the IDG of the operative AC main generation is not displayed on the EWD, and 6)The FUEL APU AFT PUMP FAULT alert is not displayed on the EWD, and 7)When the AC main generation 2 is inoperative, the automatic switching of the essential electrical network power supply from AC BUS 1 to AC BUS 2 is checked operative before the first MMEL dispatch and then every day, and 8)The aft APU pump shedding in the land recovery configuration is checked operative before the first MMEL dispatch and checked again one time every week, and 9)The APU oil quantity is checked to be adequate before each flight. 			
Reference(s)			
(o) Refer to QpsProc 24-22-01A AC Main Generation (IDG, GCU, Line Contactor)			
(m) Refer to AMM Task 24-22-00-040-801			



- Part I — Aircraft airworthiness considerations for EDTO**
- Part II — Type Design Assessment**
- Part III — Reliability & Maturity Assessment**
- Part IV — Continued validity of EDTO certification**
- Part V — EDTO Documentation (CMP, AFM, ...)**
- Part VI — Summary**
- Part VII — Practical Exercise**



Before it can be operated on EDTO, the aeroplane must be :

Certified for EDTO if it is a **twin engine aeroplane**

- The EDTO certification of twins is a two-step process: **1-Type Design Review** and **2-EDTO Reliability Review**
- This EDTO certification of twins is granted by the State of Design, and supported by the approval of an **EDTO CMP Document** and of an **EDTO supplement to the AFM** which are listing the **EDTO standards and limitations**.
- Once granted, **EDTO certification of twins are maintained** through EDTO Continued Airworthiness activities (Review of in-service events and of engines' IFSD rates)

Assessed for EDTO if it is an **aeroplane with more than two engines**

- The aeroplane design and maintenance program defined as part of the basic Type Certification exercise are adequately supporting EDTO operations
- Capability of the EDTO Significant Time Limited System(s) is identified in relevant documentation (e.g. FCOM)

Assessment or Certification activities of EDTO capability of the aeroplane and identification of applicable time capability of concerned EDTO Significant System(s) are led by the Manufacturer of the Aeroplane.



- Part I — **Aircraft airworthiness considerations for EDTO**
- Part II — **Type Design Assessment**
- Part III — **Reliability & Maturity Assessment**
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EDTO Workshop

End of Module 4 – Type Design & Reliability Considerations

