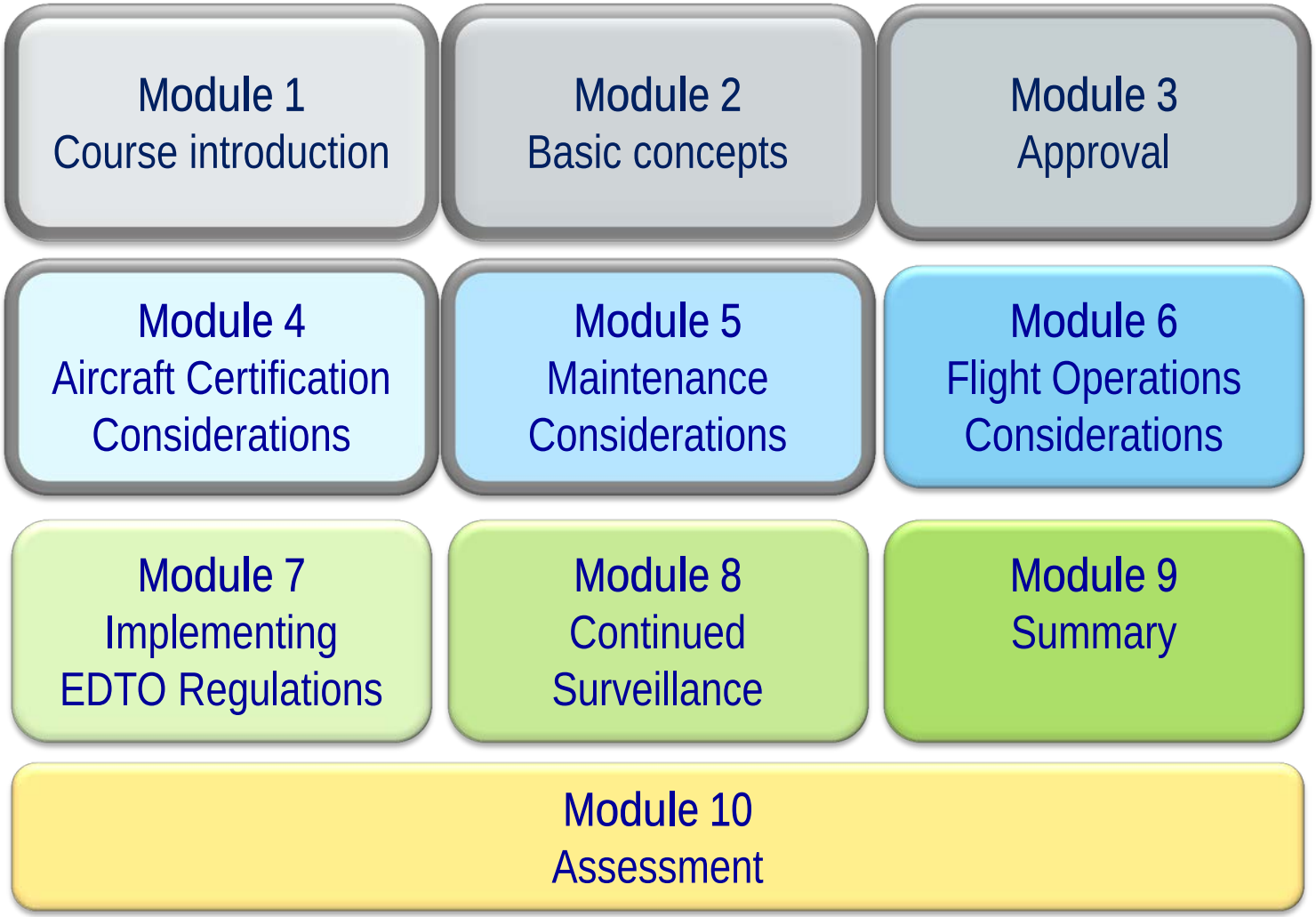
EDTO Workshop

Module N° 5 – Maintenance considerations

Course Structure



Objectives

- *At the end of this module, participants will understand the maintenance requirements supporting EDTO operations.*

Outline

- EDTO Maintenance Program Overview
- Configuration management (CMP)
- EDTO Significant Systems (time limited and others)
- EDTO Maintenance Organization Document
- EDTO Maintenance Program Elements:
  - ✓ Reliability Program
  - ✓ Aircraft Technical status follow-up (degrading/regarding EDTO status)
  - ✓ Dual Maintenance
  - ✓ EDTO Service Check
  - ✓ EDTO MMEL/MEL Considerations
- EDTO Training and Qualification

Agenda

- EDTO Maintenance Program:
  - EDTO Significant Systems
  - EDTO Training and Qualification
- EDTO Maintenance Organization Document
- EDTO Maintenance Program Elements:
  - ✓ Configuration control
  - ✓ Reliability Program
  - ✓ Aircraft Technical status follow-up (degrading/regarding EDTO status)
  - ✓ Dual Maintenance
  - ✓ EDTO Service Check
  - ✓ EDTO Dispatch Considerations
- Conclusions

Introduction to ETOPS

Maintenance Requirements

- Title 14 CFR § 121.374 identifies the requirements for an ETOPS Maintenance Program
- ETOPS Maintenance Program requirements are not applicable to three- and four-engine airplanes
  - Some future configuration requirements
- AC 120-42B now provides a means of compliance to the ETOPS operator
- AMC20-6 Rev 2 – Two-engine airplanes
- ETOPS Guide Volume II is now revised to reflect Title 14 CFR § 121.374 requirements

Maintenance Program
for ETOPS Defined

The approved ETOPS Maintenance Program for the airplane being considered for ETOPS must:

- Identify the manufacturer's or operator's Instructions for Continued Airworthiness
- Be approved by the local regulating authority

The approved program must be enhanced to include the requirements of Title 14 CFR § 121.374, or equivalent.

Title 14 CFR § 121.374, AMC 20-6 Rev 2, and other equivalent regulatory requirements identify maintenance requirements for approval of two-engine ETOPS operation.

AC 120-42B describes the means of compliance for operators seeking approval.

Maintenance Program for ETOPS

Configuration

Engine Condition Monitoring

ETOPS Parts Control

ETOPS Verification Program

Propulsion System Monitoring (IFSD)

Reliability Program

Oil Consumption Monitoring

Centralized Maintenance Control

Pre-departure Service Check

Multiple Similar Systems

Task Identification

Procedural Changes

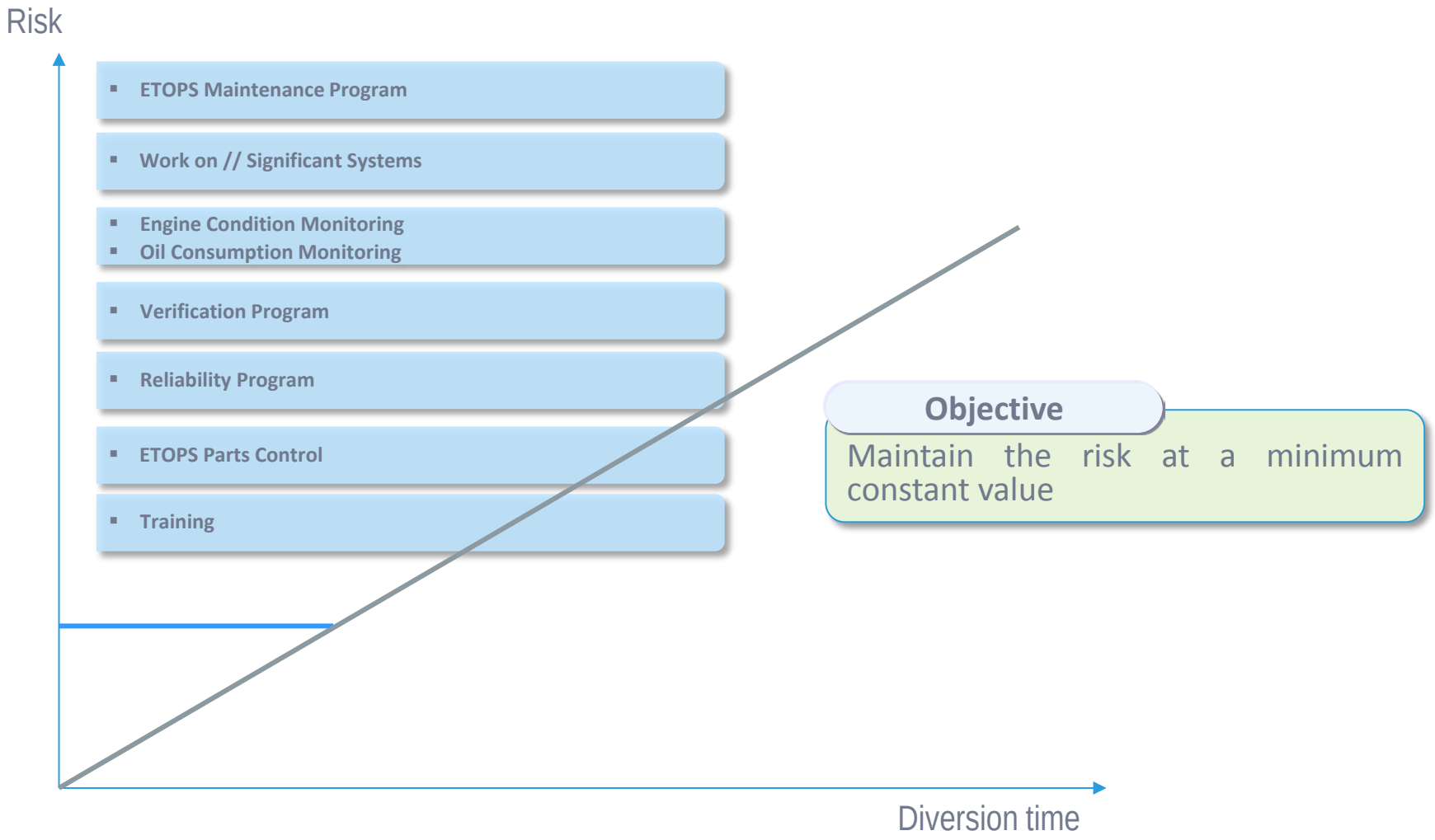
Maintenance Training

ETOPS Maintenance Document

APU Start Reliability

- No Change (AC 120-42A)
- Slight Revision from AC 120-42A
- Old Concept – New to Previous Regulation

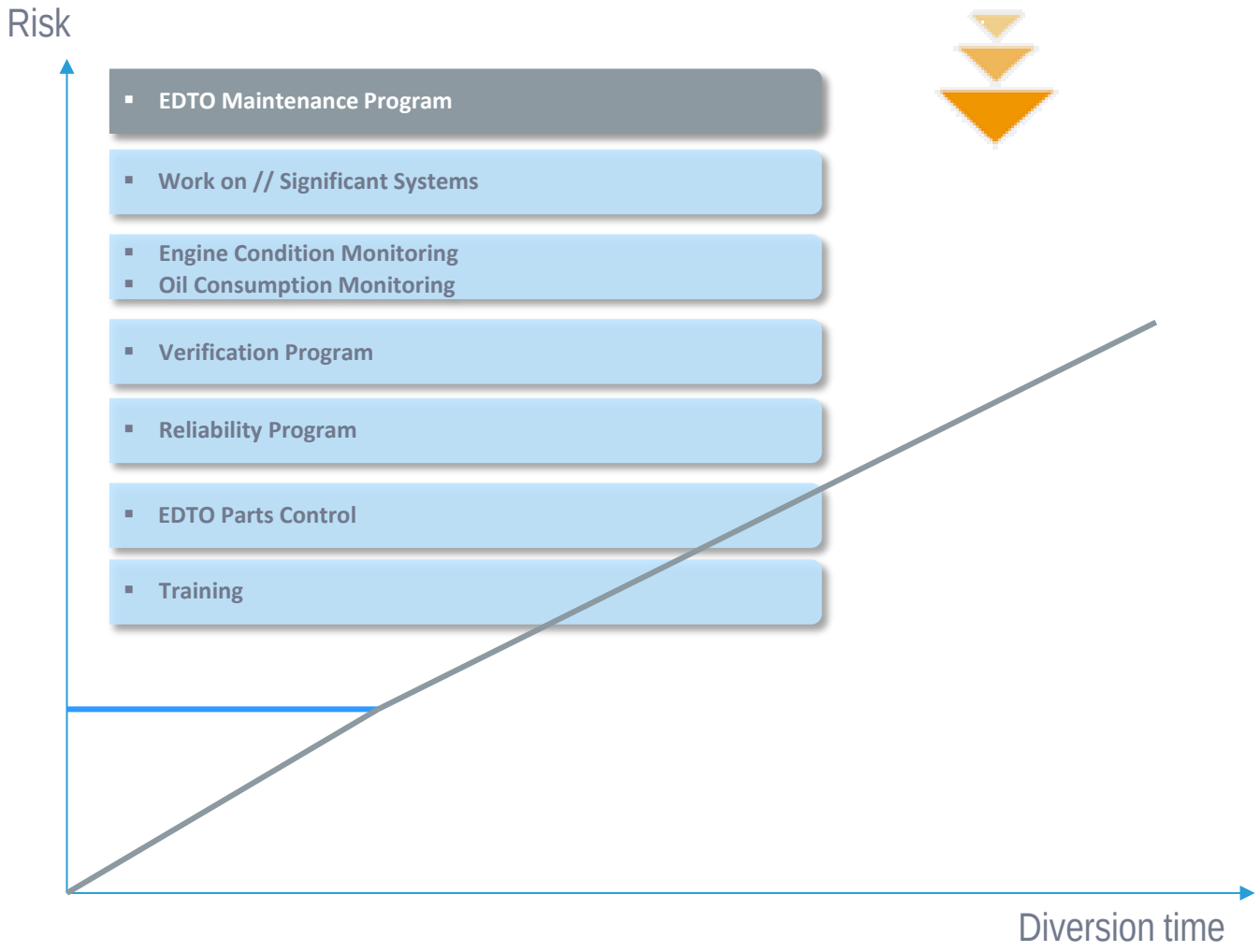
Goal of EDTO Maintenance Program



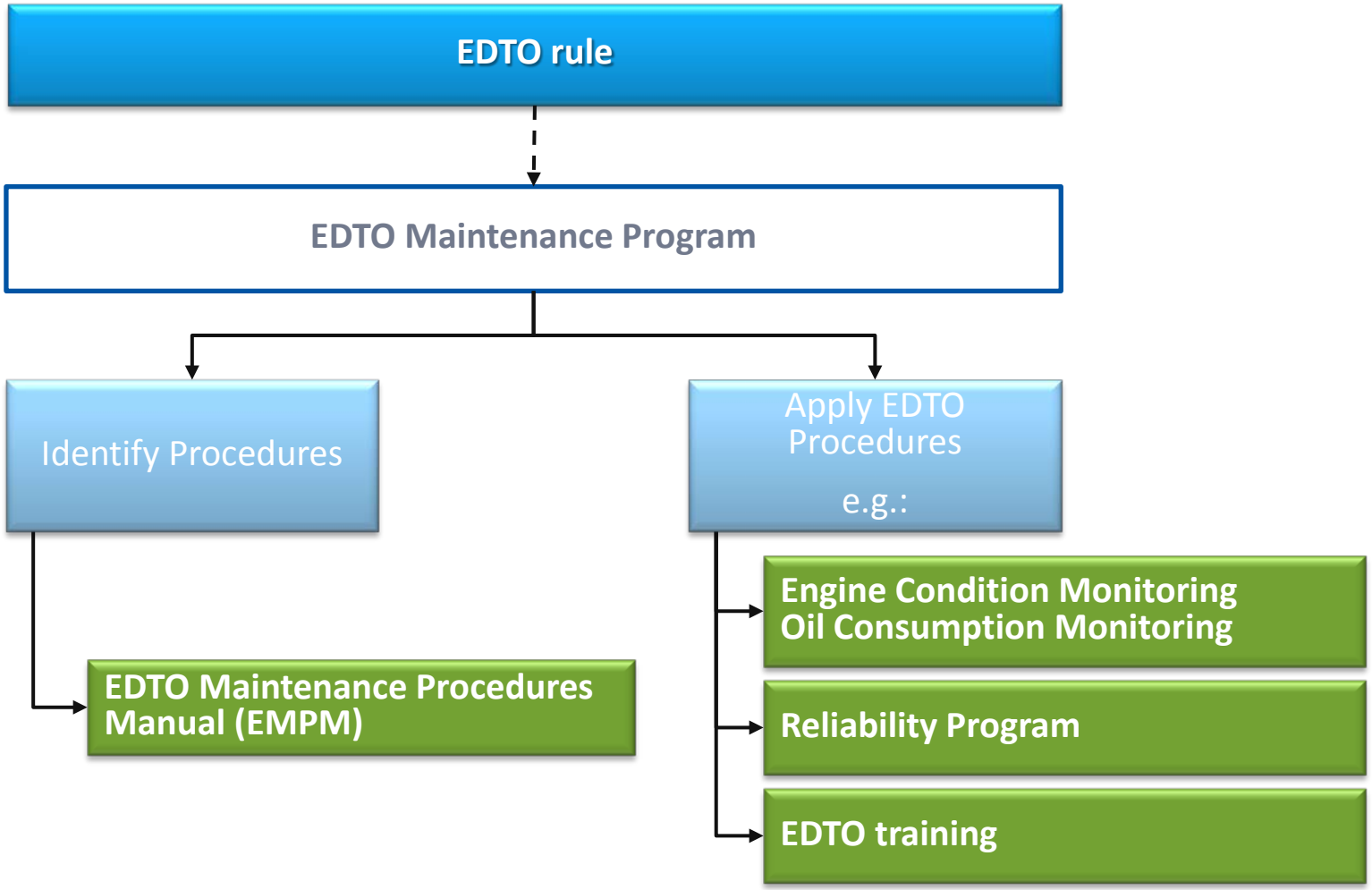
Objective

Maintain the risk at a minimum constant value

Goal of EDTO Maintenance Program



EDTO Maintenance Program



ETOPS Task Identification

Purpose: To promote ETOPS awareness by ensuring only ETOPS qualified maintenance personnel accomplish tasks specific to ETOPS.

The operator must identify all tasks that must be accomplished by ETOPS qualified maintenance personnel

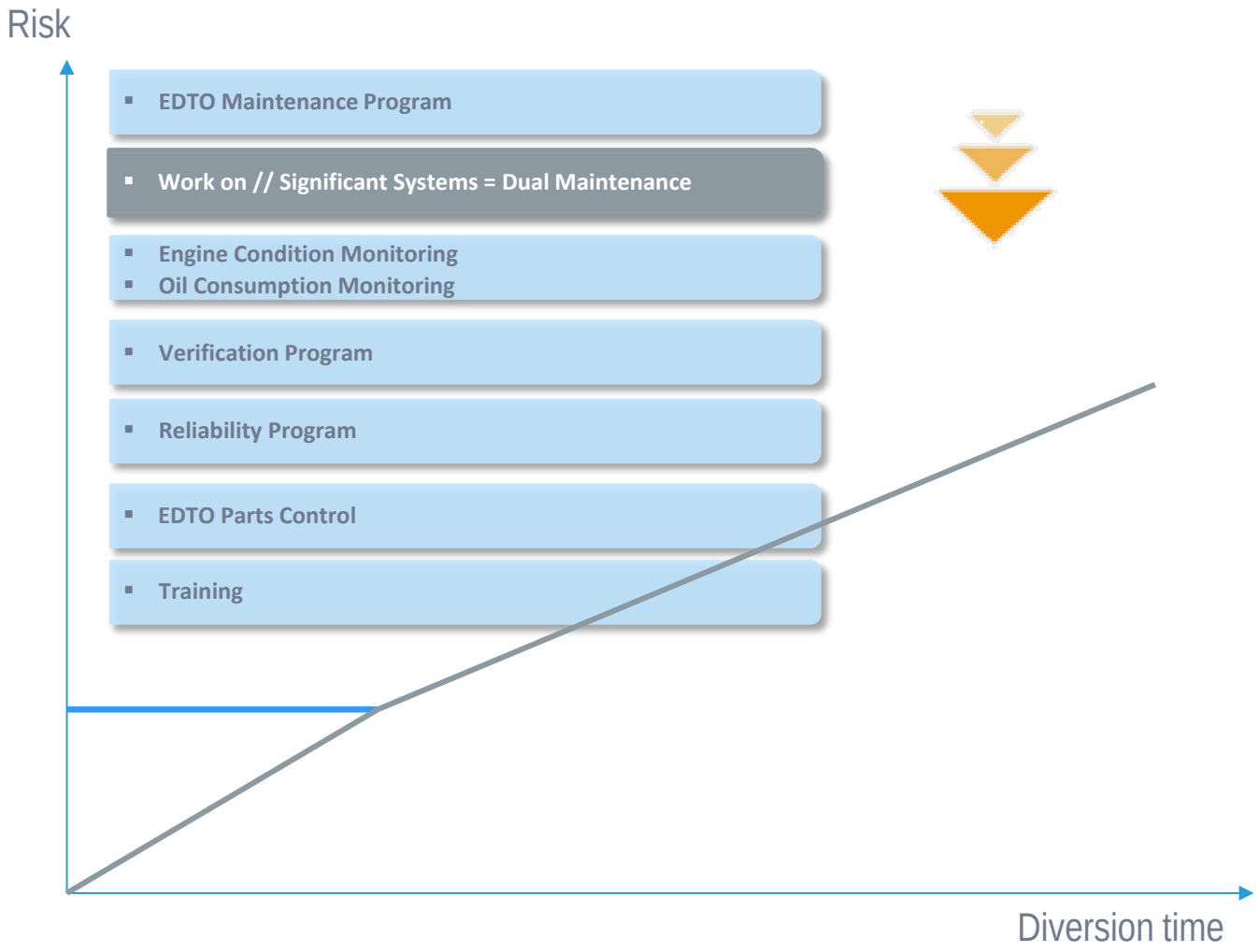
- Identified on the certificate holder's routine work/task cards
- Parceled together and identified as an ETOPS package

An operator may elect to not identify ETOPS related tasks in their maintenance program. However, all *tasks* must be accomplished by ETOPS qualified maintenance personnel.

A/C Number	Flight Hours	Flight Number	Station	Date

Item	787 Maintenance Task List	Signature
	Check is to be completed within 2-4 hours of ETOPS departure unless a higher level check has been completed.	
1.	Review aircraft logbook for reported discrepancies and oil consumption from previous flights. Correct as necessary.	
2.	Verify status level messages and higher are resolved or approved dispatch paperwork is applied. **ETOPS Qualification Required.**	
3.	General Visual Inspection (GVI) of the fuselage access/service panels, hatches, navigation/ communication antennas and radome from ground level, for obvious damage and security.	
4.	GVI of the nose and main landing gear tires, wheels and brakes for obvious damage and wear.	
5.	GVI of the static ports, Total Air Temperature probe, pitot probes, Primary Ice Detector Probes, and Angle-of Attack Sensors for obvious damage.	
6.	GVI of the left and right wing leading edge and associated devices, trailing edge and associated devices, wing lower surface, wing tip area, and wing to fuselage section for general condition.	
7.	GVI of the fuselage and APU in areas of drain masts and drains for fluid leakage.	
8.	GVI of all air inlet/exhaust doors and cabin pressure outflow valve to ensure there are no obstructions.	
9.	GVI of the vertical stabilizer, rudder, horizontal stabilizer, and elevators for obvious damage.	
10.	GVI of the left engine thrust reverser, exhaust area, strut, and visible turbine blades for obvious damage and evidence of metal/oil accumulation.	
11.	GVI of the left engine cowling, inlet cowl, nosedome and visible fan blades for obvious damage. GVI of access panels and blowout doors for condition and security. Also GVI for open latches and signs of fluid leakage.	
12.	Verify the left engine oil level and service as necessary. **ETOPS Qualification Required.** Indicate amount added: _____	
13.	GVI of the right engine thrust reverser, exhaust area, strut, and visible turbine blades for obvious damage and evidence of metal/oil accumulation.	
14.	GVI of the right engine cowling, inlet cowl, nosedome and visible fan blades for obvious damage. GVI of access panels and blowout doors for condition and security. Also GVI for open latches and signs of fluid leakage.	
15.	Verify the right engine oil level and service as necessary. **ETOPS Qualification Required.** Indicate amount added: _____	
16.	Verify the APU oil level and service as necessary. It is acceptable to use flight deck indications for this task. **ETOPS Qualification Required.** Indicate amount added: _____	
	Final Check Sign-Off	
	All ETOPS Checks performed by ETOPS qualified mechanic.	
	Any abnormal engine and/or APU oil consumption requirements should be coordinated with Maintenance Control.	

Goal of EDTO Maintenance Program

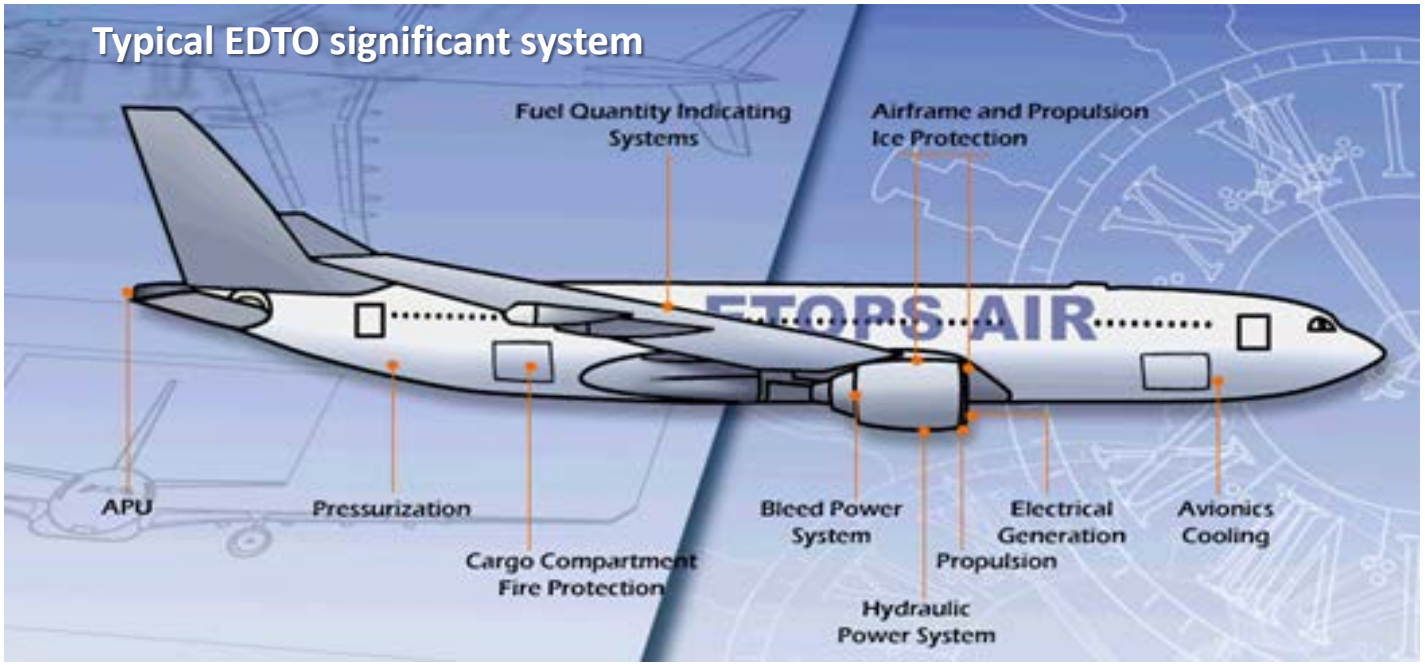


EDTO Significant System

EDTO/ ETOPS Significant System

EDTO / ETOPS Significant System means systems :

1. Whose failure could adversely affect the **safety** of an ETOPS flight
2. Whose functioning is important to continued safe flight and landing **during an airplane diversion.**



EDTO Significant System

- Inconsistent terminology in AC 120-42A
- Primary, Essential, and Critical Systems
  - Systems critical to ETOPS
  - Boeing study to clarify
    - Identified groups of Airplane systems that affect the ETOPS mission (ETOPS Significant Systems)
- Today: Title14 CFR §121.374 (ETOPS Significant Systems)
- ETOPS maintenance emphasis

777 ETOPS Significant Systems

ATA Chapter	777 ETOPS Significant System	ATA M/M Subsection	Criteria Group 1	Criteria Group 2
21 Air Conditioning	Cabin Pressure Control System	-31	X	
	Pack Flow Control	-51	X	
	Cabin A/C and Temperature Control System	-61		X
22 Auto Flight	Autopilot Flight Director System*	-11		X
	Thrust Management Computing System*	-31		X
23 Communications	High Frequency (HF) Communication System	-11		X
	SATCOM*	-15		X
24 Electrical Power	Generator Drive - IDG	-10	X	
	Generator Drive - Backup Generator	-10	X	
	Generator Drive - APU	-10		X
	DC Generation	-30		X
26 Fire Protection	Engine Fire Detection	-11	X	
	APU Fire Detection	-15		X
	Lower Cargo Compartment Smoke Detection	-16		X
	Lower Cargo Compartment Fire Extinguishing	-23		X
28 Fuel	Engine Fuel Feed System	-22	X	
	APU Fuel Feed System	-25		X
	Fuel Quantity Indicating System*	-40		X
30 Ice/Rain Protection	Wing Anti-Ice System	-11		X
	Engine Anti-Ice System	-21	X	
	Pitot/Static Anti-Ice System	-30		X
	Probe Heat	-31		X
	Engine Probe Heat	-34	X	
	Flight Compartment Window Anti-Ice System	-41		X
34 Navigation	Weather Radar System	-43		X
	Flight Management Computing System	-61		X
36 Pneumatic	Engine Air Supply	-11		X
	Air Supply Distribution System	-12		X
49 Airborne Auxiliary Power*	APU Power Plant	-10		X
	APU Engine	-20		X
	APU Fuel System	-30		X
	APU Ignition System	-40		X
	APU Bleed Air System	-50		X
	APU Controls	-60		X
	APU Indicating System	-70		X
	APU Exhaust System	-80		X
	APU Lubrication System	-90		X

* Must be operational beyond 180-minute diversion time, including 207-minutes (no MMEL relief).

Example of Boeing recommended list

EDTO Significant System
Continued

- The operator is to develop his own ETOPS Significant Systems List (SSL)
- The operator's ETOPS SSL must be agreed to and approved by the regulatory authority
- Boeing has developed ETOPS Significant System Guides for operator use

777 ETOPS Significant Systems

ATA Chapter	777 ETOPS Significant System	ATA M/M Subsection	Criteria Group 1	Criteria Group 2
21 Air Conditioning	Cabin Pressure Control System	-31	X	
	Pack Flow Control	-51	X	
	Cabin A/C and Temperature Control System	-61		X
22 Auto Flight	Autopilot Flight Director System*	-11		X
	Thrust Management Computing System*	-31		X
23 Communications	High Frequency (HF) Communication System	-11		X
	SATCOM*	-15		X
24 Electrical Power	Generator Drive - IDG	-10	X	
	Generator Drive - Backup Generator	-10	X	
	Generator Drive - APU	-10		X
	DC Generation	-30		X
26 Fire Protection	Engine Fire Detection	-11	X	
	APU Fire Detection	-15		X
	Lower Cargo Compartment Smoke Detection	-16		X
	Lower Cargo Compartment Fire Extinguishing	-23		X
28 Fuel	Engine Fuel Feed System	-22	X	
	APU Fuel Feed System	-25		X
	Fuel Quantity Indicating System*	-40		X
30 Ice/Rain Protection	Wing Anti-Ice System	-11		X
	Engine Anti-Ice System	-21	X	
	Pitot/Static Anti-Ice System	-30		X
	Probe Heat	-31		X
	Engine Probe Heat	-34	X	
	Flight Compartment Window Anti-Ice System	-41		X
34 Navigation	Weather Radar System	-43		X
	Flight Management Computing System	-61		X
36 Pneumatic	Engine Air Supply	-11		X
	Air Supply Distribution System	-12		X
49 Airborne Auxiliary Power*	APU Power Plant	-10		X
	APU Engine	-20		X
	APU Fuel System	-30		X
	APU Ignition System	-40		X
	APU Bleed Air System	-50		X
	APU Controls	-60		X
	APU Indicating System	-70		X
	APU Exhaust System	-80		X
	APU Lubrication System	-90		X

* Must be operational beyond 180-minute diversion time, including 207-minutes (no MMEL relief).

777 ETOPS SSL Sample

EDTO Significant System

787 ETOPS Type Design

ATA Chapter	787 ETOPS Significant Systems	ATA M/M Subsection	Criteria Group 1	Criteria Group 2
30 Ice and Rain Protection	Wing Ice Protection System	-11	X	
	Engine Anti-Ice	-21	X	
	Cabin Air Compressor Inlet Ice Protection System	-22		X
	Pitot-Static Anti-Ice System	-31	X	
	Angle-of-Attack (AOA) Anti-Ice System	-32	X	
	Total Air Temperature Heat	-33	X	
	Engine Probe Heat	-34	X	
	Window Heat System	-41		X
34 Navigation	Integrated Surveillance System-Weather Radar	-42		X
	Flight Management Function	-61		X
49 Airborne Auxiliary Power	Auxiliary Power Unit	-11	X	
	APU Electrical	-14	X	
	APU Air Inlet	-27	X	
	APU Engine Fuel System	-31	X	
	APU Drain System	-16	X	
	APU Engine	-21	X	
	APU and Generator Lubrication System	-27	X	
	APU Engine Fuel System	-31	X	
	APU Ignition System	-41	X	
	APU Control System	-61	X	
	APU EGT Indicating System	-81	X	
	APU Oil Indicating System	-94	X	
	All models			
71	Power Plant	All	X	
72	Engine	All	X	
73	Engine Fuel and Control	All	X	
74	Ignition	All	X	
75	Engine Air	All	X	
76	Engine Controls	All	X	
77	Engine Indicating	All	X	
79	Engine Oil	All	X	
80	Engine Starting	All	X	

Airplane systems comply with Appendix K25.1 *Design Requirements*

- Electrical
- Propulsion
- APU
- ECS
- Other…

EDTO Significant System
Continued

Maintenance Program Impact

- ETOPS verification program
- Event-oriented reliability program
- Regulatory authority reports
- Dual Maintenance Practices as applicable
- Pre-Departure Service Check (PDSC)
- Centralized Maintenance Control

Dual Maintenance Limitations

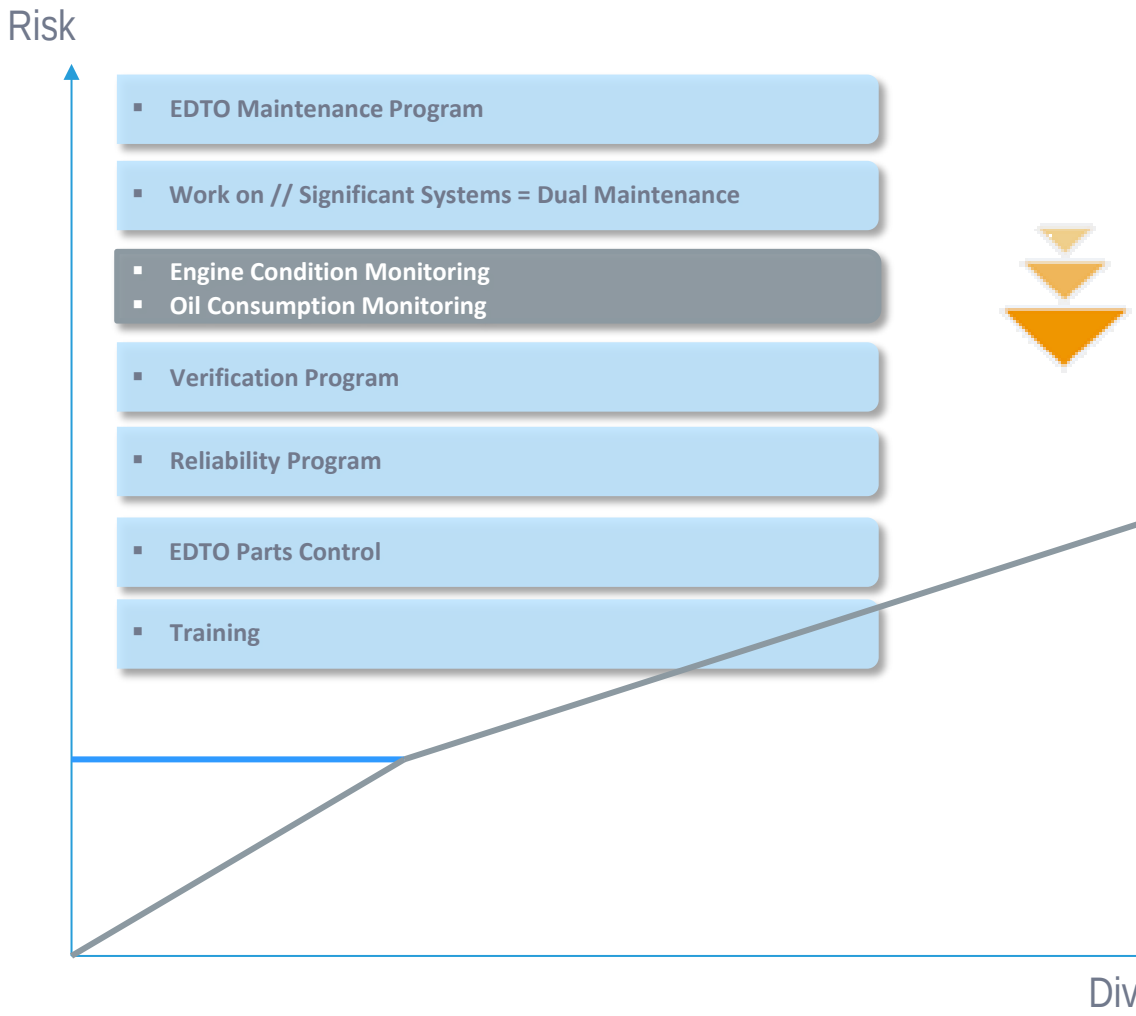
Maintenance work on 2 // systems must be avoided **when possible**

- Lubrication, restoration, discard
- Interchanging
- Swapping components, computers

Different people must work on each system **in case it is not possible**

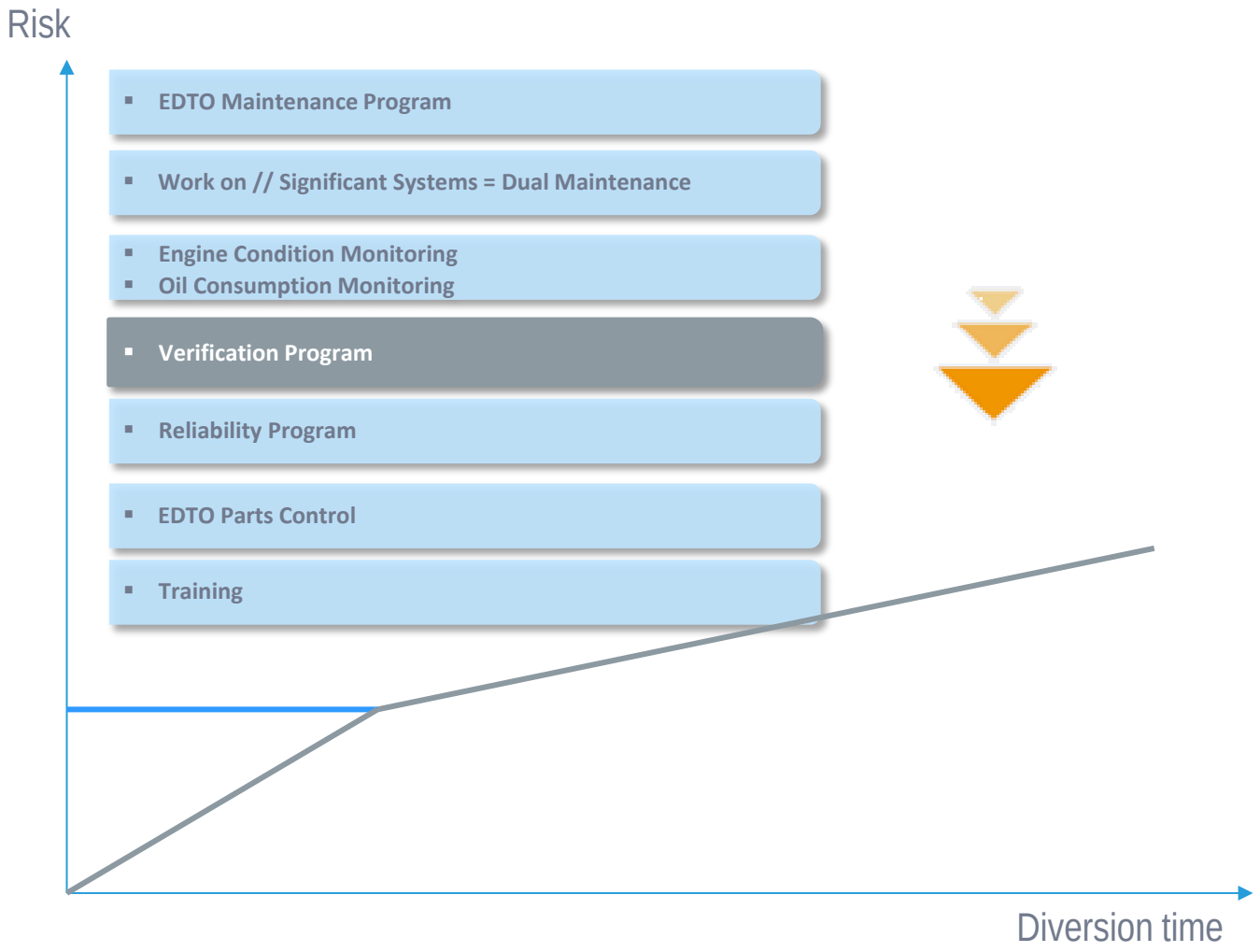
// maintenance work are accepted for servicing tasks, operational or visual checks/inspections

Goal of EDTO Maintenance Program

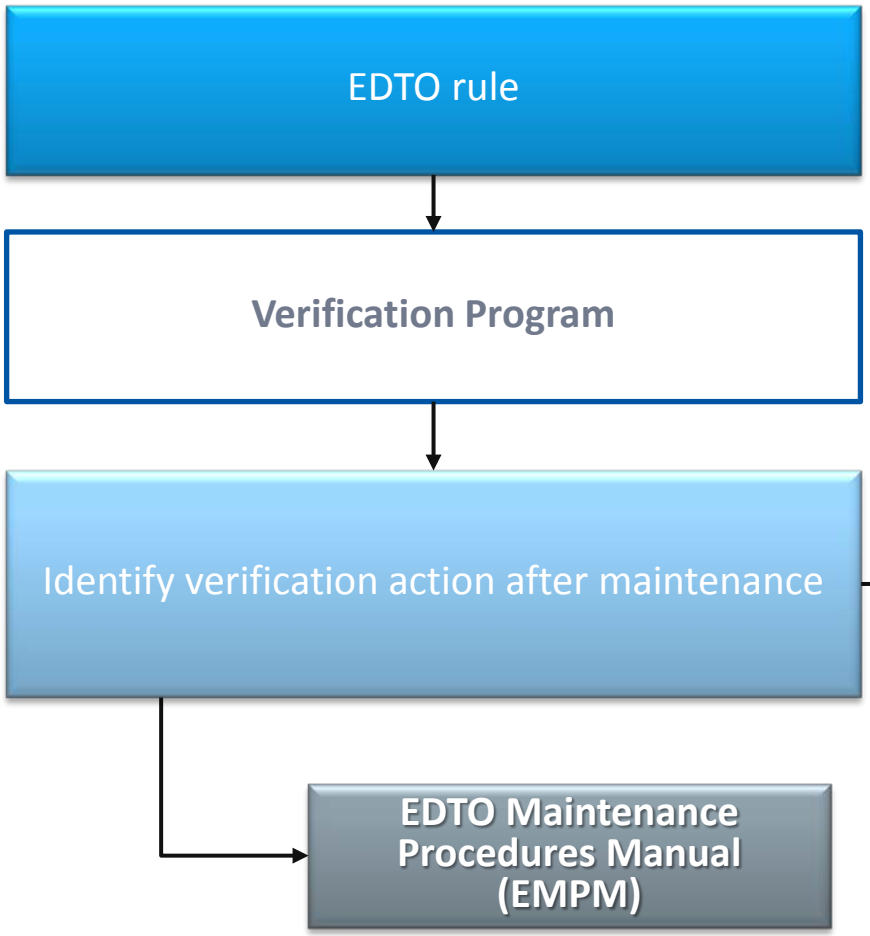


Detailed information on this topic is provided in the section "EDTO Maintenance Program Elements" of this presentation.

Goal of EDTO Maintenance Program



Verification Program



Verification program may be based on :

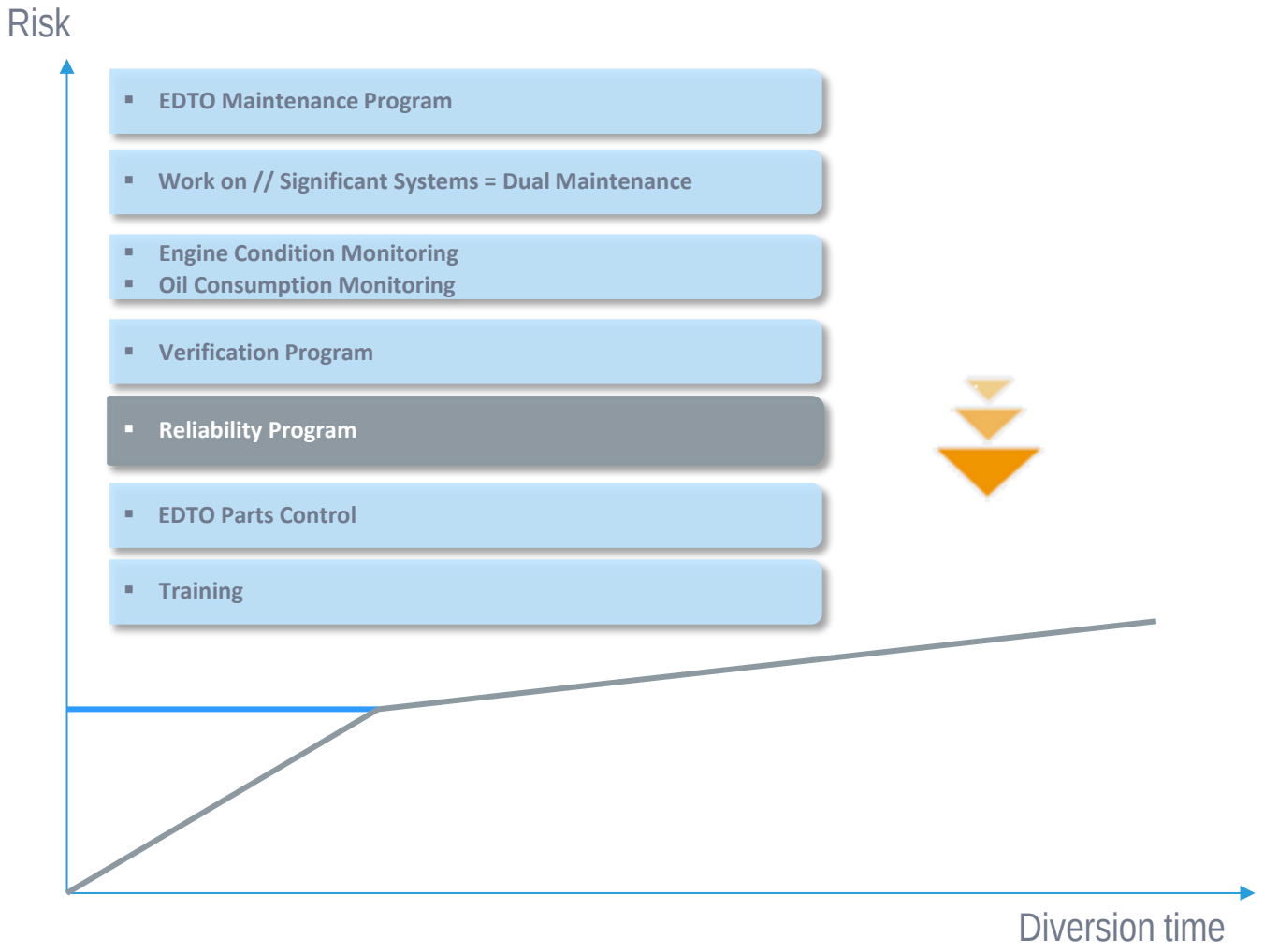
-Verification actions published by the manufacturer

- Engineering Judgment

The content of the decision tree and verification actions are detailed in the section “EDTO Maintenance Program Elements” of this presentation.

Policies - Minimizing risk

Reliability program



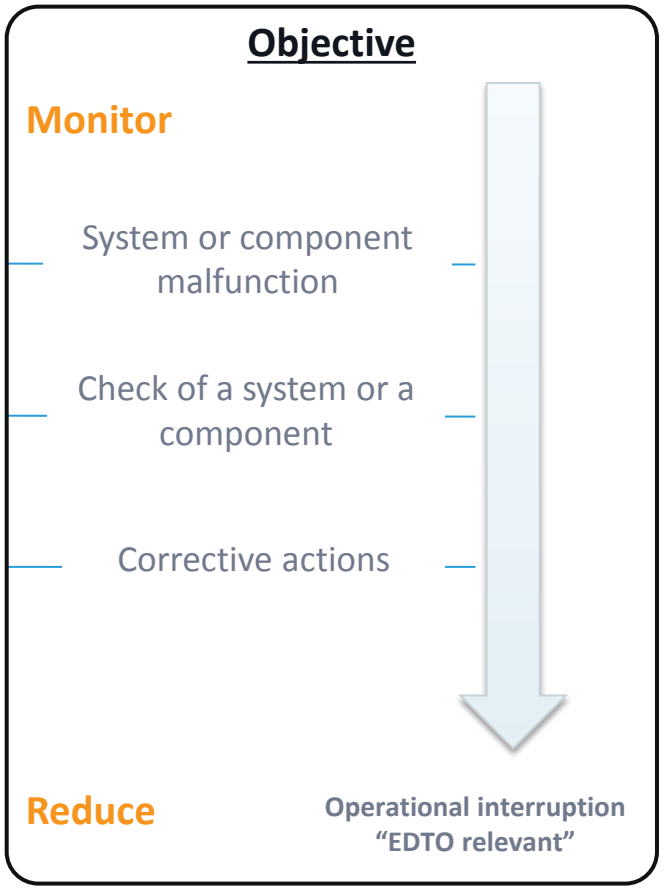
Reliability Program

EDTO rule

Reliability Program

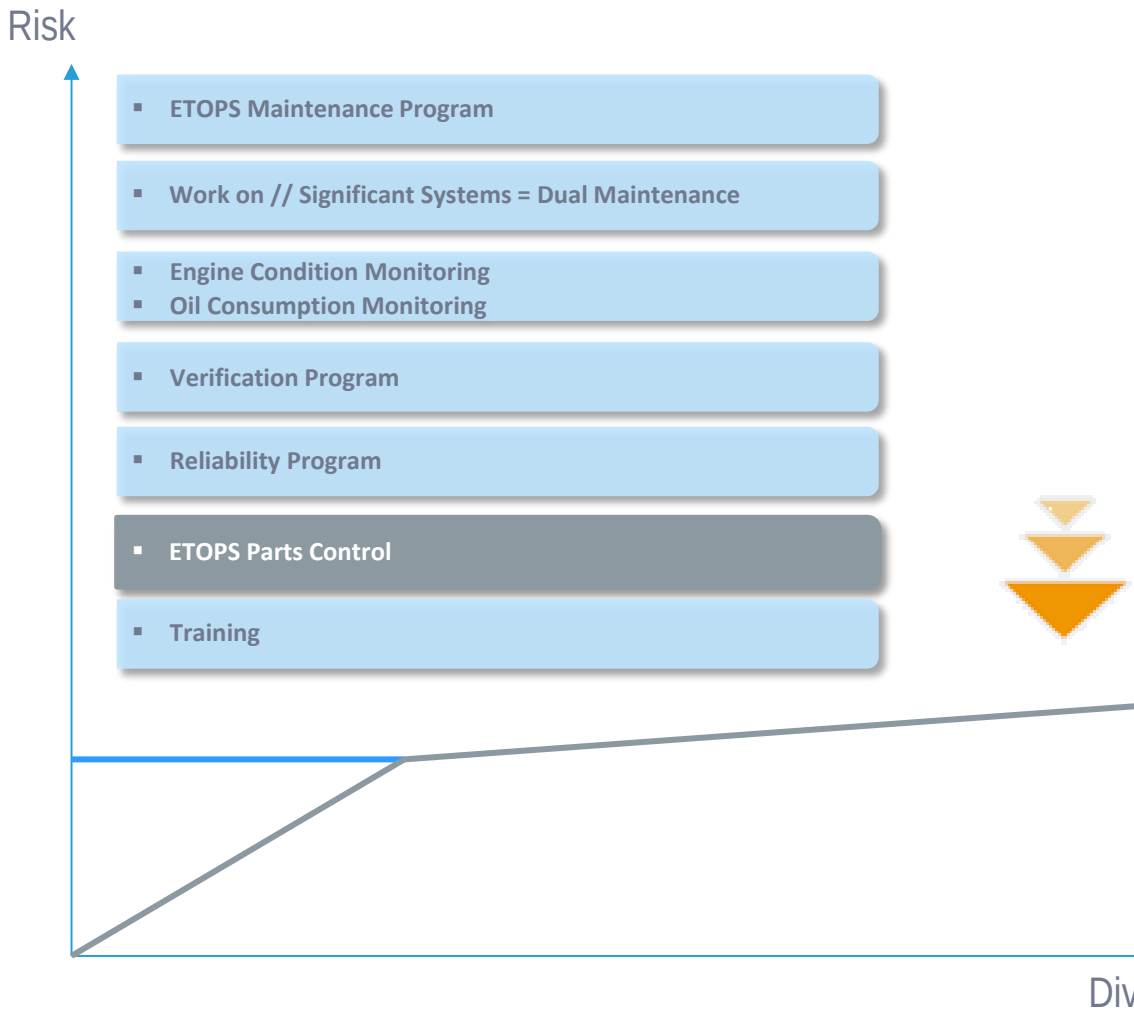
Identify and prevent re-occurrence of EDTO related problem

- EDTO Significant systems
- Event orientated as well as statistically orientated



Policies - Minimizing risk

ETOPS parts control



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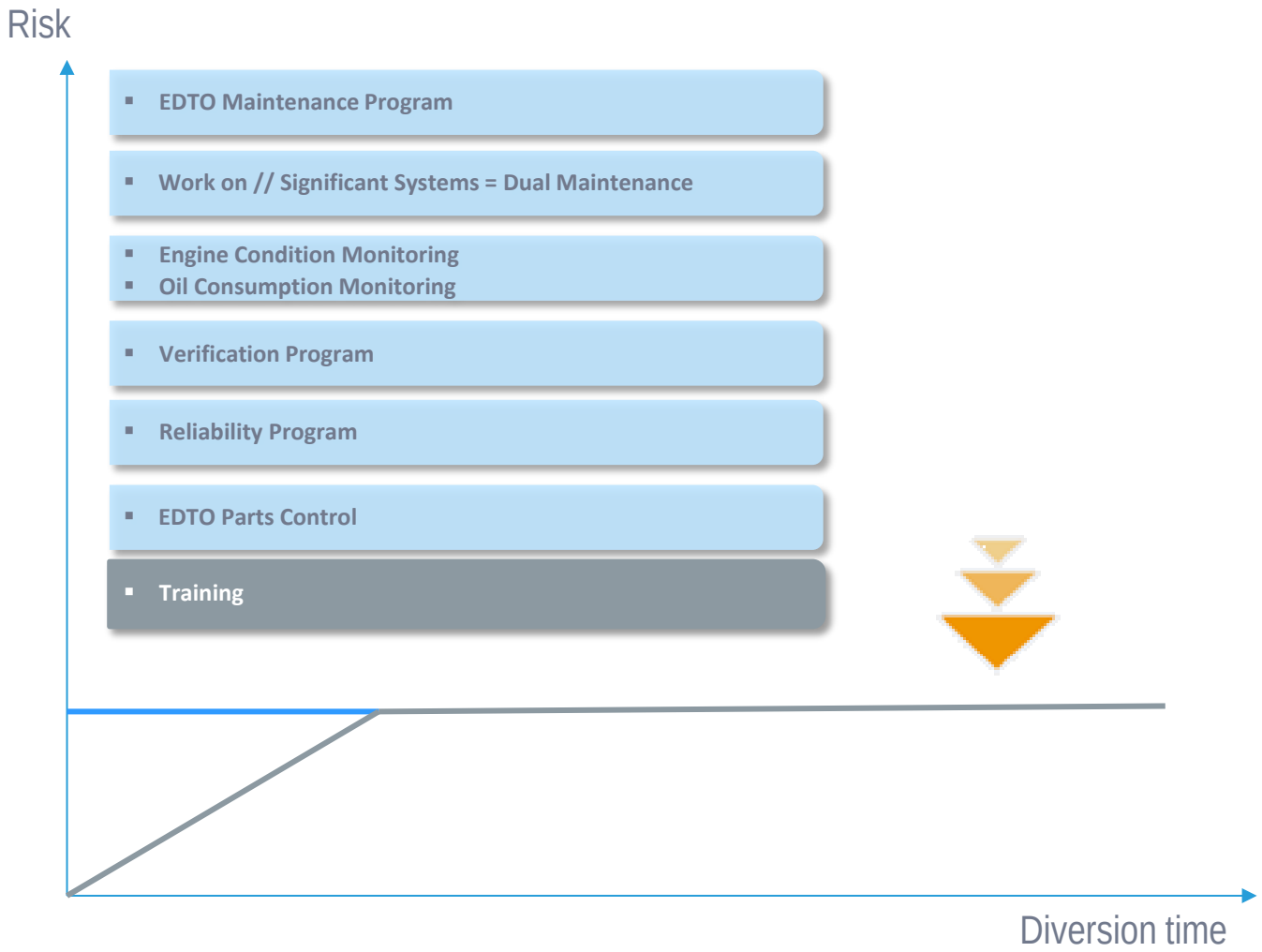
EDTO Maintenance Program Elements



ETOPS Training

Two Levels of Training:

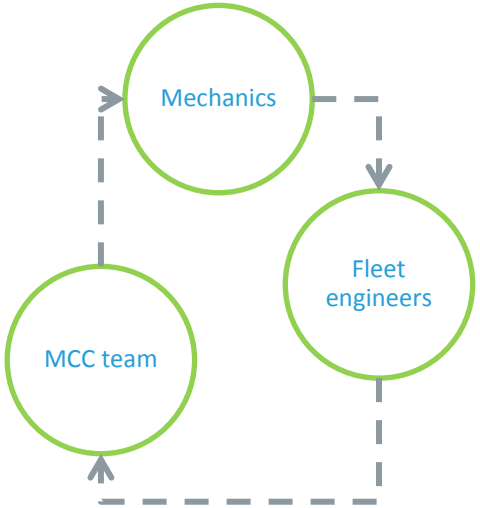
- EDTO awareness
- EDTO Initial Qualification
- EDTO Recurrent Training

Content

TRAINING PROGRAM

- EDTO policies and procedures
- EDTO Manual
- Familiarization with EDTO Significant systems
- MEL and CMP Documents

Public



Inputs/ Assistance

- Manufacturer support
  - Recommendations
  - Briefing
  - Training
- EDTO assistance
  - Manufacturer
  - Third party Organization (subcontractors)

→ TRAINING PROGRAM

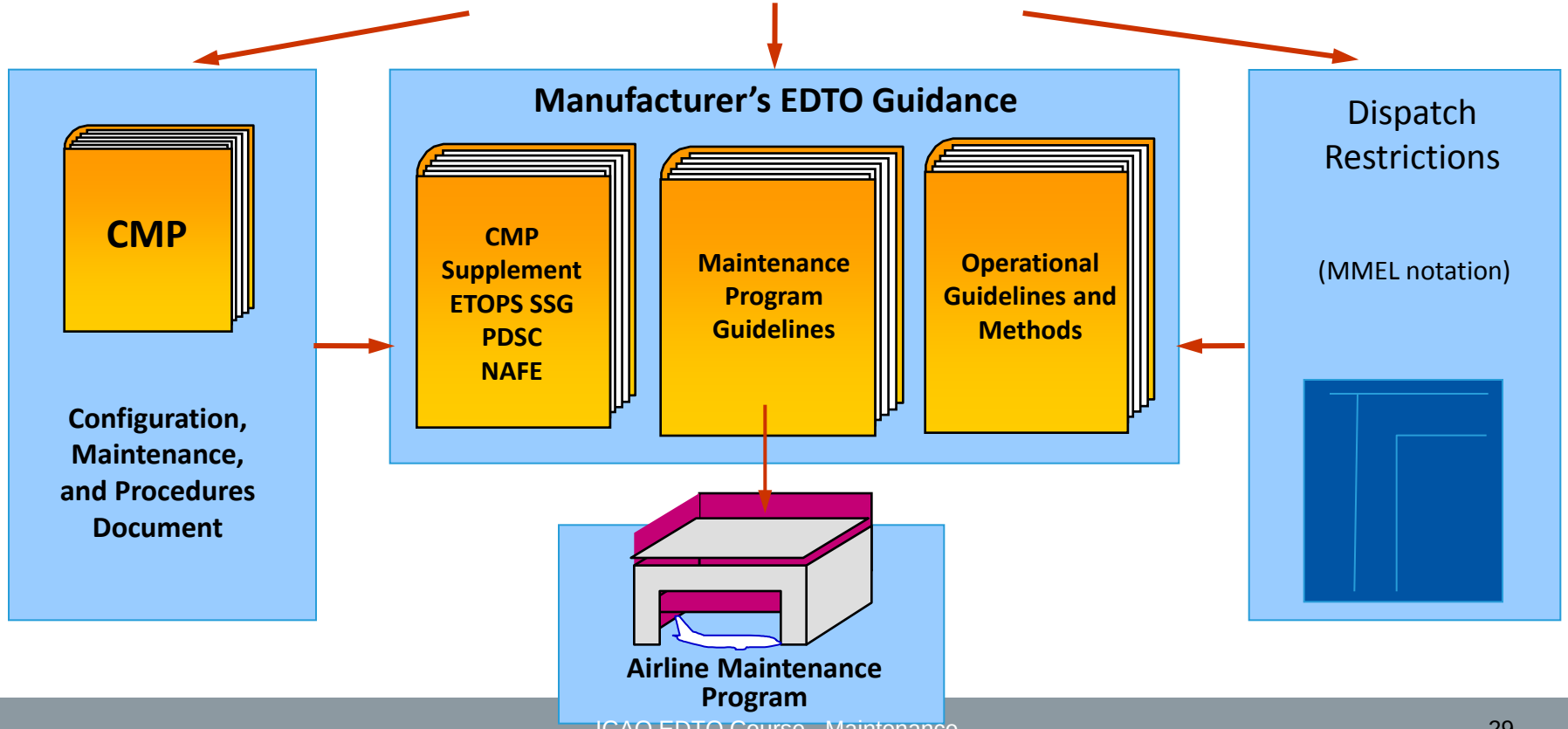
Operator's ETOPS Training Program

- ETOPS philosophy and special nature
- Meets Title 14 CFR § 121.374 (or equivalent) maintenance requirements
- Airline-specific maintenance procedures and forms

The ETOPS qualified maintenance person will have:

- Previous experience on airframe/engine used
- Completed operator's ETOPS course
- Performed tasks under qualified supervision

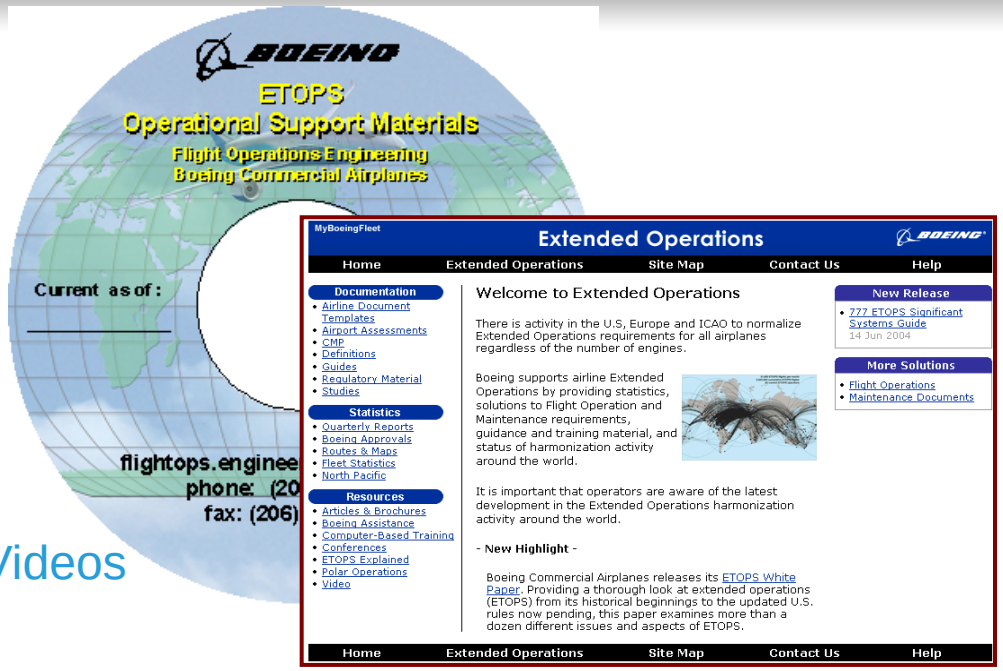
- Configuration Requirements
- Airline Maintenance Programs
- Dispatch Restrictions



ETOPS Guides

Templates and Supporting Materials (Cont)

Media and Other Support



- ETOPS Media
  - Computer Based Training
  - Maintenance and Operations Videos
  - *YourManufacturer*.com
  - ETOPS CD
- Other ETOPS Support
  - Manufacturer Communication System
  - E-mail
  - Regulatory Affairs, Flight Operations, Maintenance
  - Manufacturer Field Service Representative

Agenda

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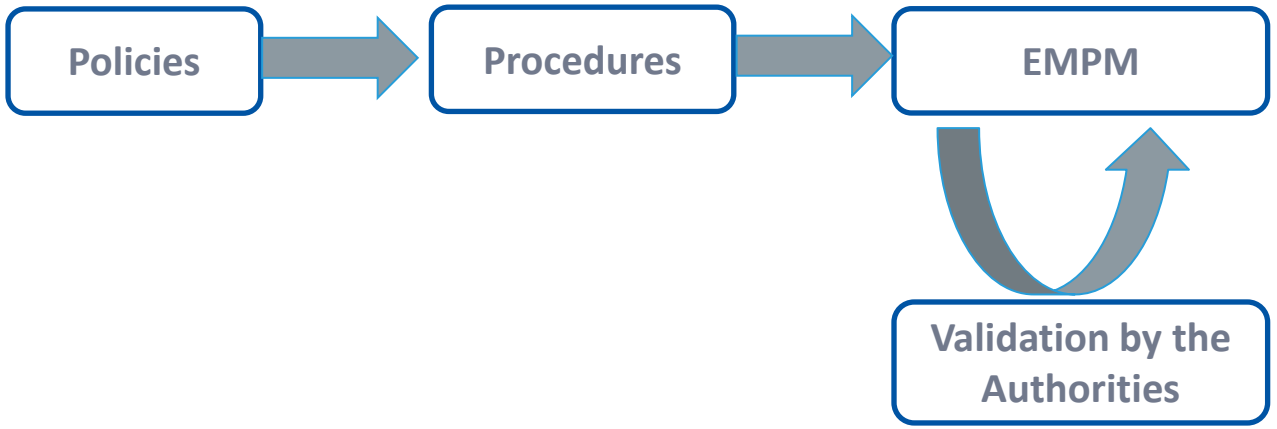
  - ✓ EDTO Dispatch Considerations
- Conclusions

EDTO Maintenance Procedures Manual (EMPM)

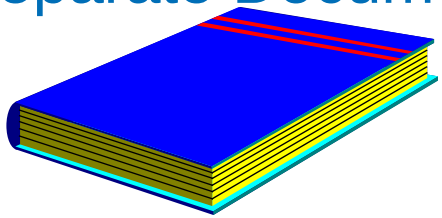
The previously described policies should be gathered in a document subject to revision control and validated by the local authorities.



This document is usually called the EMPM. It contains the Operator's requirements, policies, procedures, roles and responsibilities for EDTO

Maintenance Document

- Required by Title 14 CFR § 121.374
- Identifies specific operator ETOPS Maintenance Policies,
  Procedures, and responsible persons and organizations
- Separate Document



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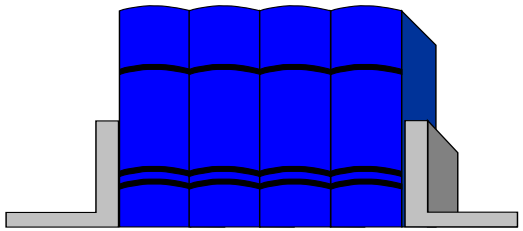

- Part of the General Maintenance Manual
- A single source of information on ETOPS
- Easily accessed

ETOPS Procedural Changes

- ***Substantial*** changes to the ETOPS maintenance or training program after ETOPS authority has been granted must be submitted to the Regulatory Authority
- The operator and Regulatory Authority should negotiate what constitutes a substantial change to allow flexibility

What is considered substantial for a new ETOPS operator may be considerably different than for an operator with many years of ETOPS experience.

Agenda

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  - EDTO Significant Systems
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EDTO Configuration Documentation

The operator must ensure that:

- Configuration features are installed in the airplanes and engines
- Maintenance procedures are incorporated into the maintenance program
- Demonstrated capabilities are accounted for in the flight operations program and MEL as required
- Requirements remain incorporated in programs and manuals throughout the operational life of the airplane
- Deviations must be approved by the Certificate Holding District

Subsequent mandatory CMP changes will be made through approved revisions or the Airworthiness Directive (AD) process

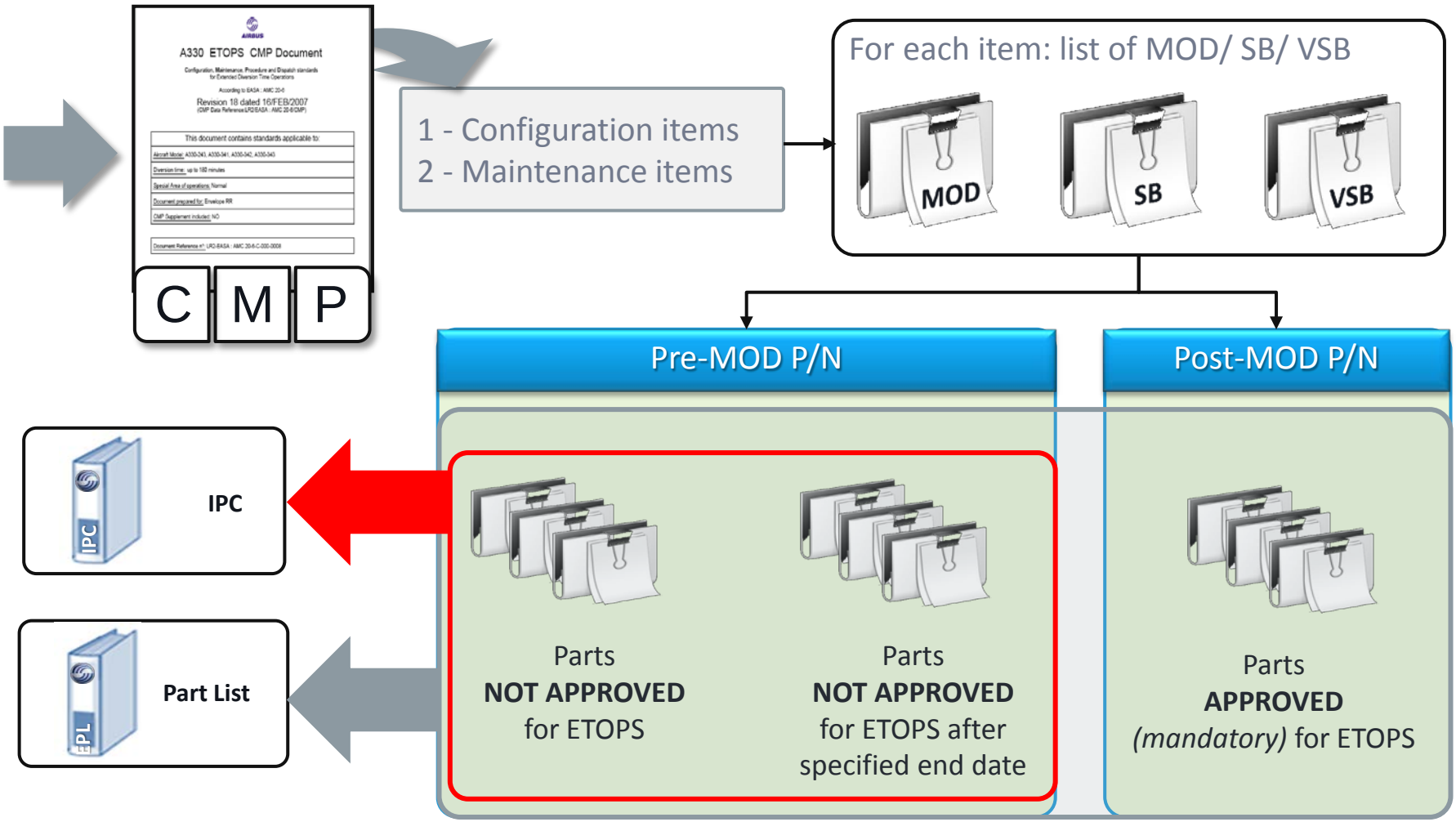
EDTO Parts Control Program

Purpose: To ensure that ETOPS required parts are obtained and used and that parts not authorized for ETOPS are not used

- Program ensures compliance with CMP configuration standards
- Maintain Type Design ETOPS Certification
- Parts Control
  - Engineering Drawings
  - CMP
  - Illustrated Parts Catalog/Data

Configuration control

Parts identification



EDTO Parts Control Program
Continued

- Illustrated Parts Catalogue (IPC) identifiers . . .
  - "NOT APPROVED FOR ETOPS"*
  - APPROVED FOR ETOPS UNTIL SB XXXX IS INSTALLED"*
- All other parts in IPC/IPD are approved for ETOPS
- Material Services ensures correct parts are available
- Borrowed or purchased parts should be cleared through the MCC or material

ATA Chapter 26

COMPONENT	PART NUMBER NOT APPROVED FOR ETOPS	PART NUMBER ETOPS-APPROVED BUT RESTRICTED	COMMENTS/DESCRIPTION	CMP REFERENCE
Fire Detection Control Module		901950-2 S/N 663 through 770	Not approved for 180-minute ETOPS.	26-3
Cargo Fire Bottles		473957 and 473957-1	Not approved for ETOPS in metered position (right hand side looking forward).	Part D, Items 3a and 3b

ATA Chapter 28

COMPONENT	PART NUMBER NOT APPROVED FOR ETOPS	PART NUMBER ETOPS-APPROVED BUT RESTRICTED	COMMENTS/DESCRIPTION	CMP REFERENCE
APU Fuel Feed Check Valve		2S2666	One-time inspection per Boeing Telex M-7200-99-07770. Required prior to operating 180-minute ETOPS mission.	28-3

REV A D044A007-1 APP A-2

BOEING
737-600/700/800/900
PARTS CATALOG (MAINTENANCE)

Single configuration reflects only the "after" Service Bulletin incorporation components in accordance with Spares Letter No. 309, Option 2.

A record of the Service Bulletins submitted for incorporation in the IPC is shown in the Service Bulletin/ Modification List.

24. FILTER MAINTENANCE KITS - Boeing defines a kit part number which contains all of the parts necessary to support the removal and maintenance of a filter on the airplane. The kit is a convenience to the operator and contains the filter/module element(s), packing(s)/O-ring(s), gaskets and all standard parts necessary for maintaining the element. The filter Maintenance Kit part number is referenced in the nomenclature column of the element entry. The definition of the Filter Maintenance Kit contents are detailed in the Filter Maintenance Kit section of the IPC.

25. ELECTRICAL EQUIPMENT NUMBER - The Wiring Diagram equipment numbers are referenced in the IPC nomenclature as applicable to a documented part. Electrical Equipment Numbers also appear in the IPC on placards for identifying equipment.

26. ETOPS ENTRIES - The IPC defines parts which are required to support Extended Twin Operation (ETOPS) for two (2) engine aircraft. ETOPS notes appear in the nomenclature field of the IPC under the following conditions:

"Not Approved for ETOPS" Means that part can not be installed to meet ETOPS flying requirements.

"Not Approved For ETOPS After Service Bulletin or Service Letter Incorporation" Means that the part is not certified for ETOPS if the referenced Service Bulletin or Service Letter is incorporated on the airplane.

27. MAINTENANCE MANUAL REFERENCE - A cross reference to the applicable Boeing Maintenance Manual location which contains the procedure for removal and repair of that part.

QAN FEB 10/07 EXPLANATION OF PARTS LIST DATA PAGE 8

BOEING
737-600/700/800/900
PARTS CATALOG (MAINTENANCE)

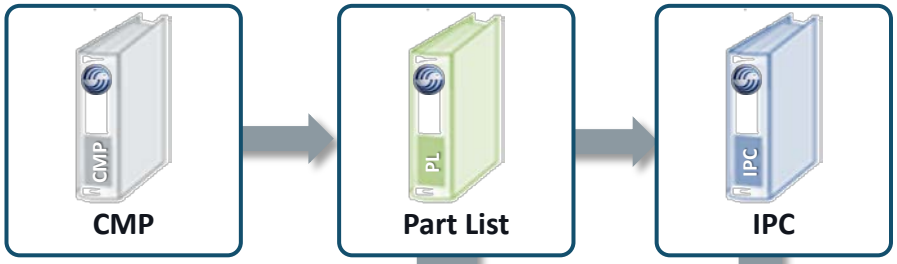
FIG ITEM	PART NUMBER	1234567 NOMENCLATURE	EFFECT FROM TO	UNITS PER ASSY
1				
R - 2	MODREF252147	EQUIPMENT INSTL-E/E BAY E2 RACK (FIRE PROTECTION ONLY) MODULE NUMBER: 284A0421-7 REV A FOR OTHER SYS DETAILS SEE: 21-31-01-02C 24-21-81-02A 24-32-11-04 30-41-11-02 49-41-61-01 49-41-71-01	028032	1
10	901950-02	.MODULE-ENG AND APU FIRE/OVERHEAT DETECTION CONT SUPPLIER CODE: V25693 FUNCTIONAL DESCRIPTION: CONTINUOUSLY MONITORS THE ENGINE AND APU FIRE/OVERHEAT DETECTORS AND PROVIDES AN ALARM SIGNAL WHEN TEMPERATURE SET POINTS HAVE BEEN EXCEEDED. SPECIFICATION NUMBER: S332A250-2 NOT APPROVED FOR ETOPS. MISCELLANEOUS DATA: APPROVED FOR 120 MINUTE ETOPS FOR S/N 663-S/N 770 AND NOT APPROVED FOR 180 MINUTES ETOPS FOR S/N 663-S/N 770 ELECTRICAL EQUIP NUMBER: M00279		1
-504	286A0220-086	WIRE BUNDLE ASSY-	016024	RF
-504	286A0220-095	WIRE BUNDLE ASSY- POST RAPID REVISION: RR97164-8A RR97164-8E	001015	RF
-507	286A0220-131	WIRE BUNDLE ASSY-	025999	RF

- ITEM NOT ILLUSTRATED MISSING ITEM NUMBERS NOT APPLICABLE

QAN 26-10-01-01 26-10-01 FIG. 01 PAGE 2 FEB 10/07

Configuration control

Parts identification



P/N not approved for ETOPS beyond 180 min

36-11-06-10-EQUIPEMENT INSTL Zone(s) : 453,463				
FIG - ITEM	PART NUMBER	NOMENCLATURE	FIN ACCESS/PANEL	UNIT PER ASSY
** ON A/C 001-002, 051-051				
***	ZRA380-00	.TRANSDUCER-PRESSURE SEE 36-11-16-01 001C FOR DET Additional Spares NOT APPROVED FOR ETOPS BEYOND 180 MIN AFTER(20131231)		

AIRBUS

A330 ETOPS PARTS LIST

ATA 36

AI Mod No.	AI or vendor SB	P/Ns NOT ETOPS Approved	MINIMUM STANDARD P/N ETOPS APPROVED
Pressure Transducer CMP Eff : All Applicability: - ETOPS beyond 180 min: to be incorporated no later than 31/12/2013 - ETOPS up to 180 min: recommended CMP Item: 36-1-0000-005 202028	Mod 202028: none	Pre-mod 202028: ZRA380-00 (not approved only for ETOPS beyond 180 min after 31/12/2013)	Mod 202028: ZRA691-00 ZRA380-00 (until 31/12/2013 for ETOPS beyond 180 min only) more advanced stds: Consult IPC

EMB SB 36-3039 for A/C 003-008, 053-057, 501-511

10B 070C	ZRA691-00	.TRANSDUCER-PRESSURE SEE 36-11-16-01 001D FOR DET Additional Spares EMB SB 36-3039 (ON A/C 003-008, 053-057, 501-511) POST SB 36-3039 (ON A/C 101-102) (Ref. SIL 36-051)	8HA1	001

No ETOPS message → P/N approved for ETOPS

Configuration control

Parts provisioning

The Assessment of

Airlines

- ETOPS MEL requirements
- CMP Document-Configuration Standards / Parts List
- Reliability Data
- Area of operation / Route structure

Allows to define

Provisioning of ETOPS parts

- For Main Base and Outstations
- In ETOPS Flight Kit (dependent of type/area of operation)

Configuration control

Storage

Airlines

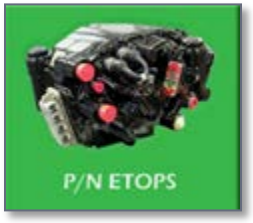
Parts to be stored

CMP

Part List

When parts are in compliance with ETOPS CMP document and Parts List

→ Parts Identified as **ETOPS Parts**



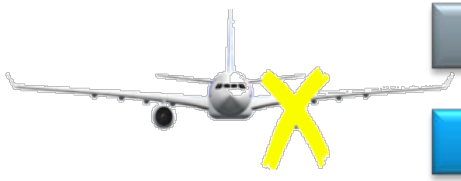
When parts are not in compliance with ETOPS CMP document and Parts List

→Parts Identified as **NOT APPROVED FOR ETOPS**

→ May be segregated from other parts

Configuration control

Parts replacement



A part needs to be replaced

P/N of the available spare part ?

Same P/N

Spare can be fitted

A/C released on ETOPS

Different P/N

ETOPS Status ?

CMP Part List IPC

ETOPS Approved P/N

Spare can be fitted

A/C released on ETOPS

P/N NOT APPROVED for ETOPS

Spare can be fitted but

OR

A/C status downgraded to Non ETOPS

Technical concession required to maintain A/C on ETOPS

Configuration control

Tech log management

Airlines

The airline is required to develop procedures to inform Dispatchers and Flight Crews about the aircraft's ETOPS dispatch status.

Addressed in the Technical Logbook:

- Reference to the ETOPS dispatch sheet
- ETOPS dispatch statements
- Both

To clearly reflect the aircraft's ETOPS operational status.

Agenda

- EDTO Maintenance Program:
  - EDTO Significant Systems
  - EDTO Training and Qualification
- EDTO Maintenance Organization Document
- EDTO Maintenance Program Elements:
  - ✓ Configuration control
  - ✓ Reliability Program
  - ✓ Aircraft Technical status follow-up (degrading/regarding EDTO status)
  - ✓ Dual Maintenance
  - ✓ EDTO Service Check
  - ✓ EDTO Dispatch Considerations
- Conclusions

EDTO Reliability Program,

Purpose: Early identification and prevention of ETOPS related problems common to all ETOPS Significant Systems.

- Enhances the operator's current reliability or Continuing Analysis and Surveillance System program
- Must be event-oriented
  - Events must be investigated and reported
    - ETOPS-related events must be reported to the Regulatory Authority within required time (72 hours, 96 hours)
    - Now aligned with 121.703 Service Difficulty Reports

EDTO Reliability Program, Continued

The Reliability Program records and reports ETOPS flight statistics to the Regulatory Authority.

The report will include:

- Date of the event
- Time of the event
- Phase of flight
- Registration Number
- Engine type, Serial Number
- Total cycles and time since last shop visit
- Corrective action taken

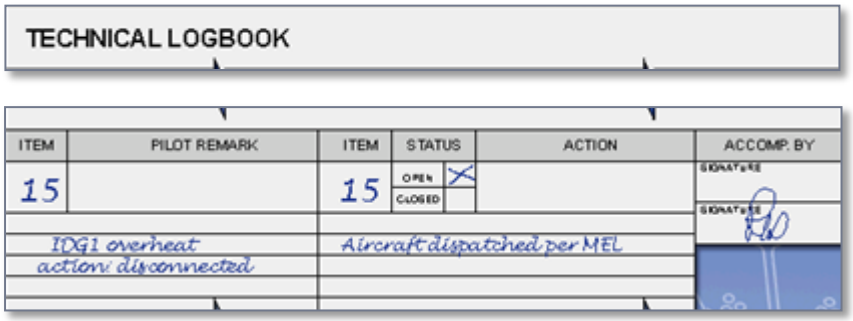
Reportable ETOPS Events include:

- IFSD
- Diversions or turnbacks
- Un-commanded engine power changes or surges
- Inability to control engines
- Problems related to ETOPS Significant Systems
- Any other events detrimental to ETOPS

EDTO Reliability Program,
Reporting standards

Technical Incident Report Content

- General data (Date, A/C registration, Flight number, departure, arrival, ...)
- Failure description (ATA, warnings, flight phase...)
- Corrective action (Maintenance actions carried out...)



TECHNICAL LOGBOOK

ITEM	PILOT REMARK	ITEM	STATUS	ACTION	ACCOMP. BY
15	IDG1 overheat action: disconnected	15	OPEN X CLOSED	Aircraft dispatched per MEL	SIGNATURE SIGNATURE

Technical Incident Report – Additional Information

- Engines (Engine type, position, time since new,...)
- A/C Systems
- Component / Computer (Time since installation...)
- In Flight Shut Down (Engine configuration, Weather, Symptoms leading up to the event...)

EDTO Reliability Program,
APU reliability

The APU must demonstrate a high degree of reliability and availability for ETOPS flights

Reliability targets:
- **APU high altitude Start Success rate**: 95%
- **APU run reliability**: depends on Type Design objectives (typically MTBF > 1000 APU hours)

Recommendation to perform a high altitude cold soak start test after a maintenance action that may impact the start capability of the APU (*) :

- APU change
- Replacement of Electronic Control Box (ECB), Fuel Control Unit (FCU), ignitors...

Related guidelines may be provided by the manufacturer.

(*) Some National Authorities may still ask the Operator to perform the test of the APU on a regular basis, e.g. once every 100 flight or once per month per aircraft.

EDTO APU In-Flight Start Program
Continued

Purpose: To ensure the APU will provide the performance and reliability established by the manufacturer

- APU must be in ETOPS Configuration
- Each airplane's APU is periodically sampled rather than repeatedly
  sampling the same APU in the fleet
- Start intervals are adjusted according to
  system performance and fleet maturity
  and approved by the Regulatory Authority

EDTO APU In-Flight Start Program
Continued

DATE: 02/08/03

XYZ Airlines

ETOPS APU INFLIGHT START REPORT

B777 (GTCP331-500)

Percentage of successful first start attempts, last 3 month period: 96%

	JAN06	FEB06	MAR06	APR06	MAY06	JUN06	JUL06	AUG06	SEP06	OCT06	NOV06	DEC06	JAN07
Total Number of Attempts	9	9	9	9	9	9	9	9	9	9	9	9	9
1st Attempt Success	9	9	9	9	9	9	9	9	9	9	8	9	9
2nd Attempt Success	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0	N/A	N/A
3rd Attempt Success	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Monthly First Start Success Percentage	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**	**89%**	**100%**	**100%**

N/A = Start Not Attempted

Prepared by:
B. Boeing - XYZ Airlines Reliability

Sample Report

EDTO Propulsion System Monitoring

Purpose: To track an airline's IFSD Rate.

- Determine the cause of the IFSD
- Develop, implement and verify corrective action
- Prepare a report for the Regulatory Authority
- Track the airline's IFSD rate as a 12-month rolling average

EDTO Propulsion System Monitoring
Continued

Objective: The ***operator*** is to maintain the IFSD rate below the alert level as specified in the table below – Title 14 CFR §121.374 (i)

Number of Engines	Engine Hours ETOPS "Operational"	Engine Hours ETOPS "Type Design"	ETOPS Authorization
2	.05/1000	.05/1000	Up to, and including 120 Minutes
2	.03/1000	.02/1000	Beyond 120 minutes. Up to, and including 180 minutes, and 207 minutes in North Pacific
2	.02/1000	.01/1000	Greater than 180 minutes (except for 207 minutes in North Pacific)

NOTE: A quality IFSD Program that initiates a positive resolution after each event will reduce or eliminate the need for alert levels.

Reliability Program

Propulsion system reliability

Case 1 : Technical Problem

Engine Type

ETOPS & non ETOPS flights

IFSD

Triggering criteria
(e.g. IFSD > target max rate)

Event analysis

Technical Cause

Engine problem

Airframe problem

Technical solution available

NO

YES

Contact the manufacturer

YES

Applied on A/C

NO

Suspension of ETOPS Operation as necessary

Retrofit program as necessary

NAA decision in coordination with type design AA.

Reliability Program

Propulsion system reliability (Cont)

Case 2 : Human Factor Issue

Engine Type

ETOPS & non ETOPS flights

IFSD

Triggering criteria
(e.g. IFSD > target max rate)

Event analysis

Human Factor Cause

Maintenance / Flight Crew Training Problem

NO

YES

Document problem

NO

YES

Reinforce training program

Impact on system design

Improve document

Contact the manufacturer

Suspension of ETOPS Operation as necessary

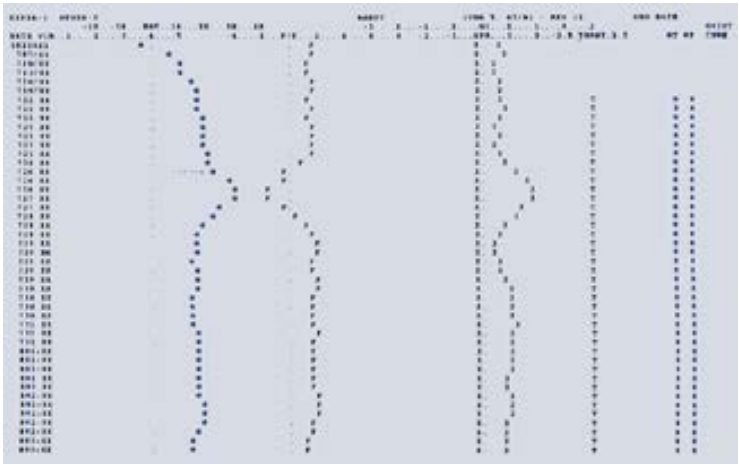
NAA decision in coordination with type design AA.

EDTO Engine Condition Monitoring

Purpose: To detect early deterioration of engines and to allow for corrective action to be taken before diversion capability is affected

Process:

- Engine data is collected during stable cruise portion of the flight, either automatically or manually as programmed by operator
- Powerplant Engineering enters data into computer or by engine manufacturer with agreement
- Any trends noted can alert engineering to pending problems



Sample Report

Reliability Program

Oil consumption monitoring

APU Oil consumption Monitoring

Engine Oil consumption Monitoring

The engine and APU oil consumption monitoring program must :

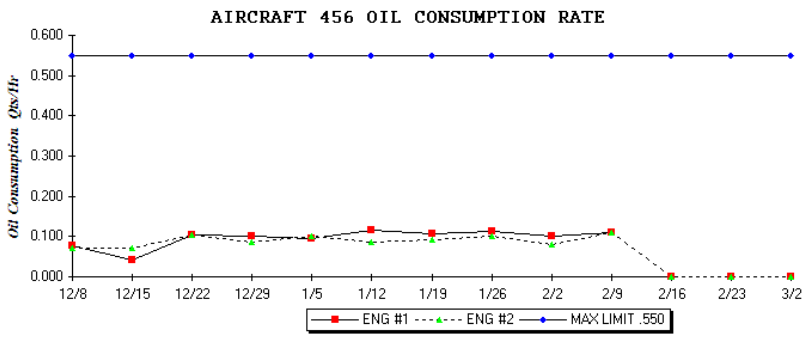
- Be sensitive to oil consumption trend (oil added with reference to a running average).
- Define responsibilities and interfaces.
- Provide a procedure for oil analysis if considered meaningful.

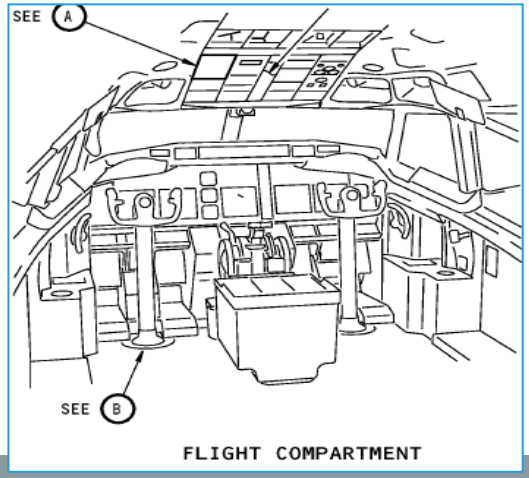
EDTO Oil Consumption Monitoring

Purpose:

- Determine baseline oil consumption rate for each engine and APU
- Identify excessive oil use on previous flight
- Determine any long-term increasing trends in oil consumption rate and not exceed the maximum allowable

Investigation and correction of consumption rate problems could prevent serious failures





Reliability Program

Oil consumption monitoring (Cont)

Engine Oil quantity indicator

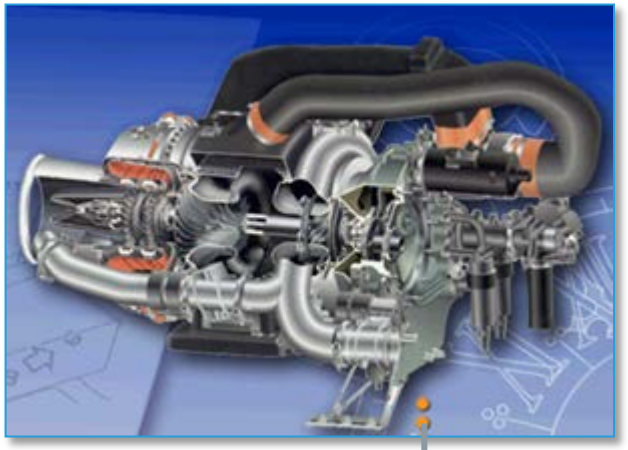
Engine oil tank sight glass reading

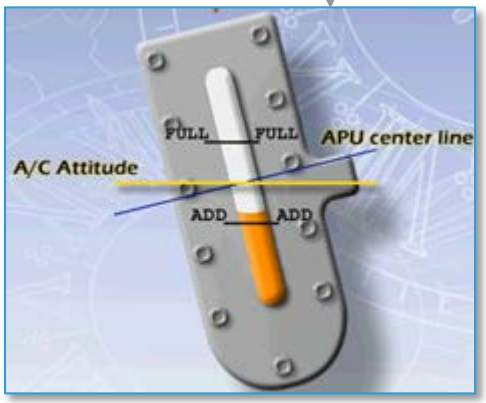
In the “Service check” chapter, we’ll see when to perform cockpit checks or physical checks

Reliability Program

Oil consumption monitoring (Cont)

APU Oil Quantity Indicator





APU oil tank sight glass reading

Reliability Program

Oil consumption monitoring (Cont)

An alert consumption rate is specified on the Pre-flight, Daily and Weekly checks sheet

The alert level is reached

Notify MCC

MCC

Fleet Engineer

Investigation is launched

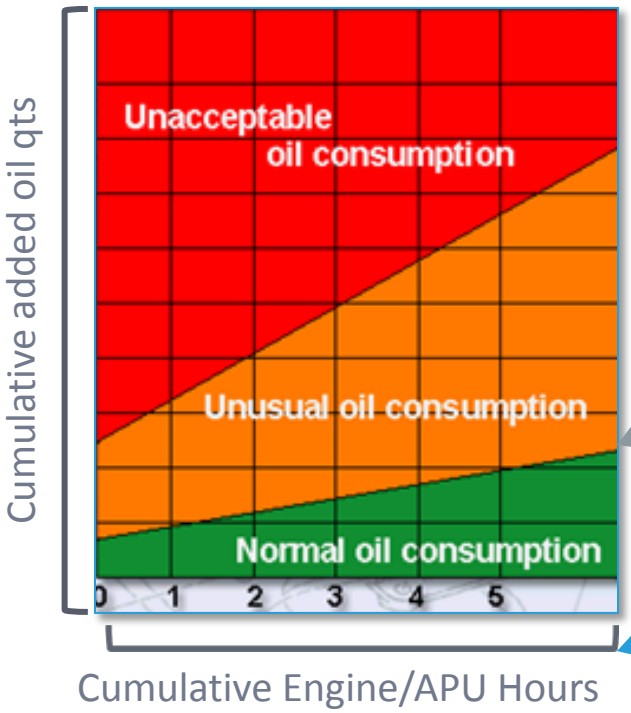
Determine the serviceability and/or actions required to permit release on the aircraft

The oil level consumption must be noted in the aircraft maintenance log and Hold Item List

Reliability Program

Oil consumption monitoring (Cont)

Calculation of oil consumption
Trouble-shooting and dispatch conditions



Max engine Oil consumption permissible (Trouble-shooting initiated)

Advise Maintenance Control (Log Book comment entered)

Minimum Time period over which consumption should be calculated

Agenda

- EDTO Maintenance Program:
  - EDTO Significant Systems
  - EDTO Training and Qualification
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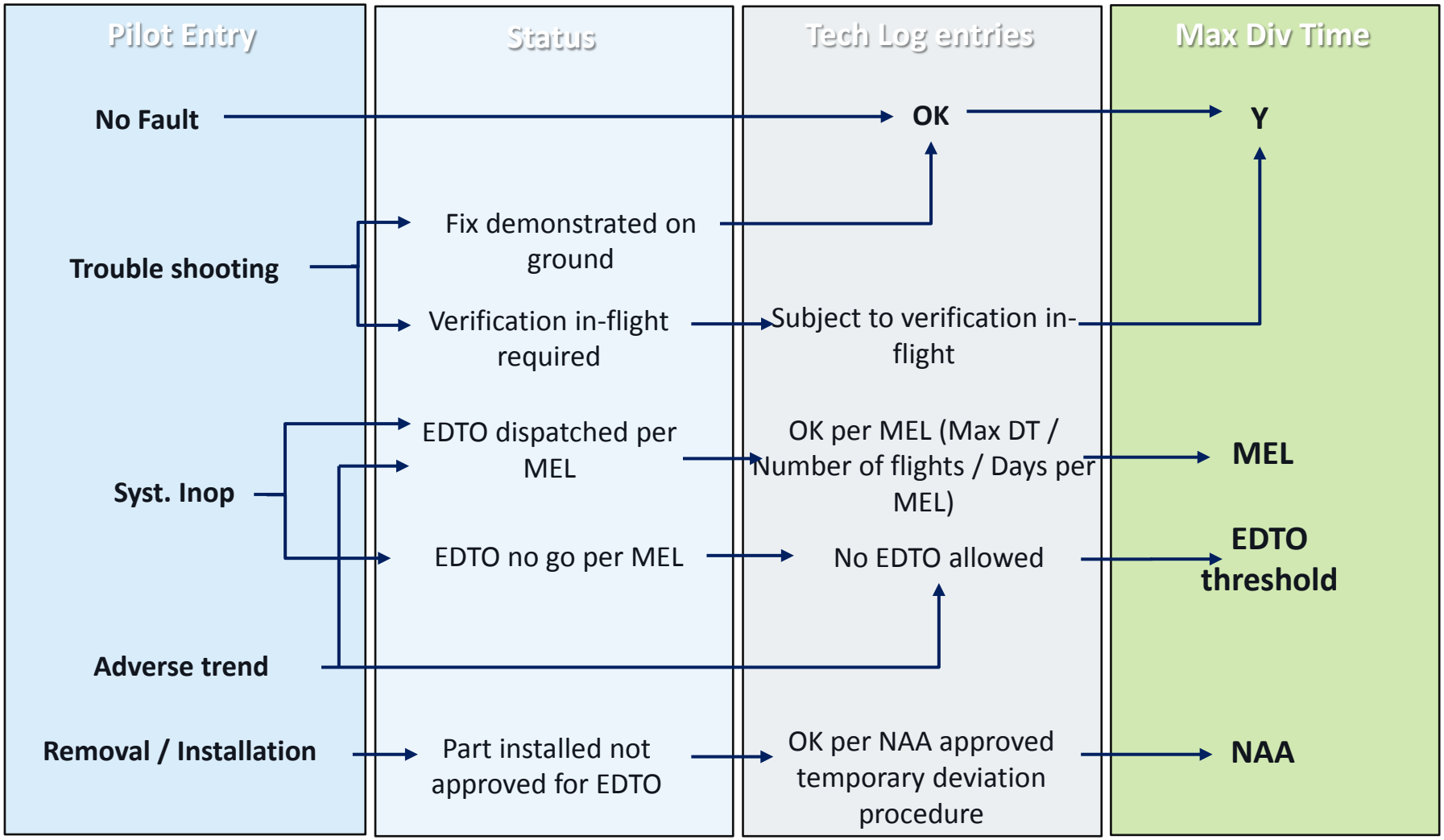
- EDTO Maintenance Program Elements:
  - ✓ Configuration control
  - ✓ Reliability Program
  - ✓ Aircraft Technical status follow-up (degrading/re-grading EDTO status)
  - ✓ Dual Maintenance
  - ✓ EDTO Service Check
  - ✓ EDTO Dispatch Considerations
- Conclusions

Technical status follow-up

Degrading / Re-grading



Technical status follow-up

Verification flight

Maintenance action		Potential in- flight verification action
	APU change or APU oil/fuel/control system break down	APU high altitude cold soak start
	Engine change	Non revenue flight
	Engine system break down (fuel/oil/ignition/control)	Non-ETOPS revenue flight
	Intermittent failure not reproduced on ground	ETOPS flight with verification of the system before entering the ETOPS sector (i.e. at least during the first 60’ of the flight)
	Altitude related failure	

ETOPS Verification Program,

Purpose: To confirm corrective action in specific areas such as:

- Engine shut down
- ETOPS Significant System failure
- Adverse trends
- Any prescribed event that could affect ETOPS operation

The program must ensure prompt corrective action and verify that the corrective action has effectively resolved the problem.

ETOPS Verification Program, Continued

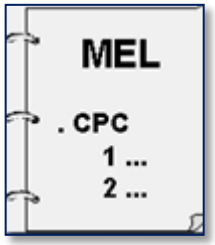
All maintenance actions must be verified to ensure that the problem has been corrected.

Verification Techniques:

- BITE Tests
- Functional Checks
- Operational Checks
- Other ground tests – Examples: Fault Isolation Manual (FIM), Airplane Maintenance Manual (AMM), or airline-specific procedures
- Verification flight required only when the discrepancy in question cannot be verified on the ground.
    - When required, the verification flight should be coordinated through the operator's Maintenance Control Center and described in the ETOPS Document

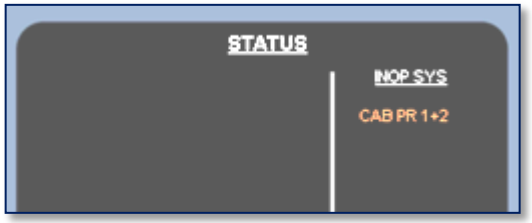
Technical status follow-up

Verification flight - Example



Check in the MEL to defer the rectification of the defect

NO GO item



Fix the problem before the departure ?

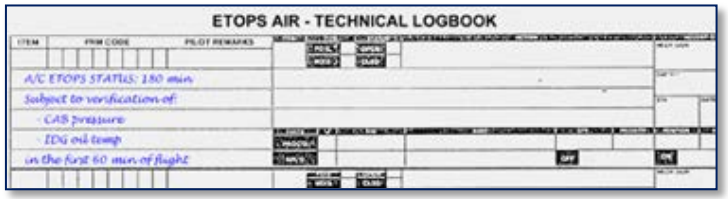
YES

NO

Confirm the fault rectification?

Item closed / Fault cleared

ETOPS status confirmed in logbook



Inform the maintenance control: an in-flight verification is needed

Record in the A/C logbook and provide a notice to the flight crew

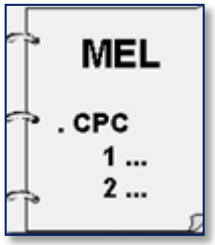
Aircraft is dispatched

If fault not cleared

Downgrade the A/C to non-ETOPS and inform MCC

Technical status follow-up

Verification flight – Example (Cont)



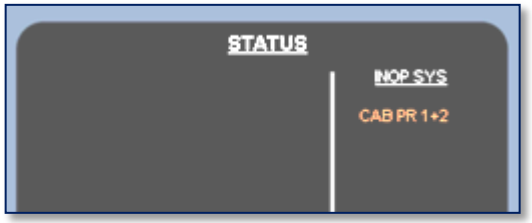
Check in the MEL to defer the rectification of the defect

NO GO item

Fix the problem before the departure ?

YES

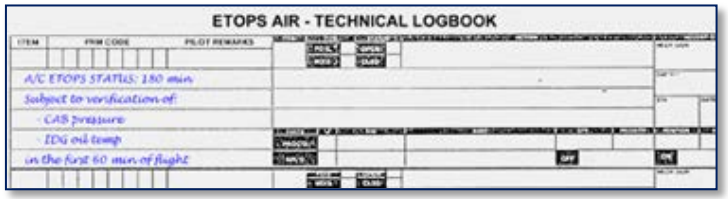
NO



Confirm the fault rectification?

Item closed / Fault cleared

ETOPS status confirmed in logbook



Inform the maintenance control: an in-flight verification is needed

Record in the A/C logbook and provide a notice to the flight crew

Aircraft is dispatched

If fault cleared

A/C released on ETOPS

Agenda

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  - ✓ EDTO Service Check
  - ✓ EDTO Dispatch Considerations
- Conclusions

Dual maintenance on ETOPS significant systems

Tech Log discrepancies analysis

MCC

Work Package

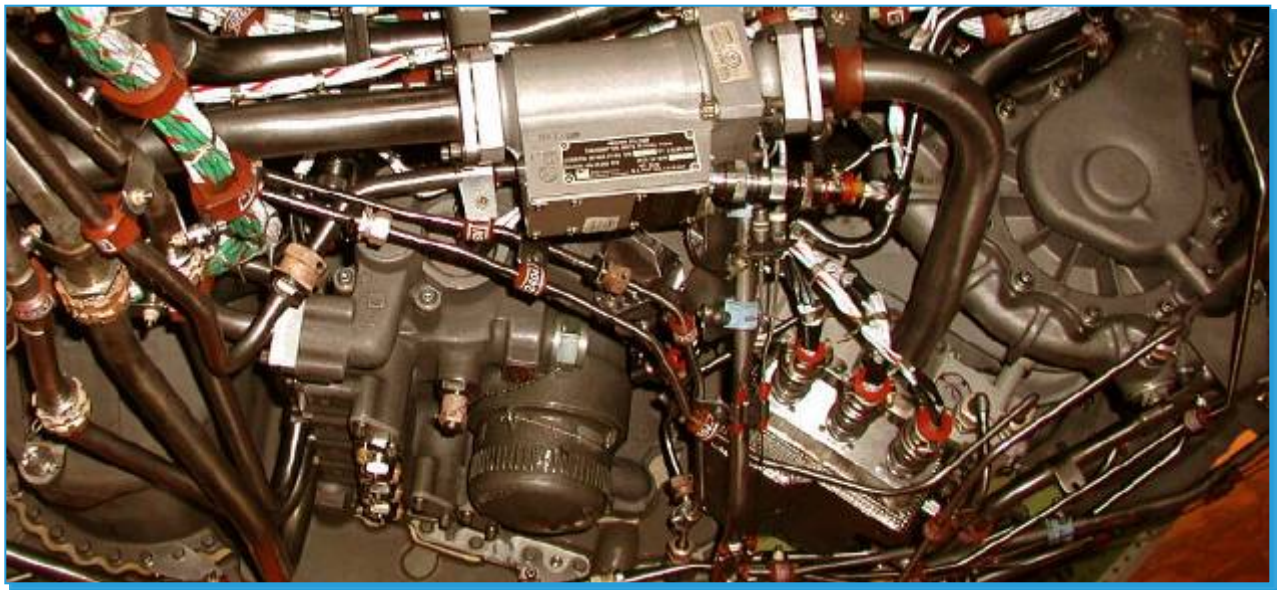
The ETOPS work packages shall be assembled such that the significant parallel systems are **not subject to identical or similar maintenance activities** whenever possible

Dual maintenance restrictions apply to scheduled maintenance and unscheduled maintenance.

Limitations on Dual Maintenance

Dual Maintenance as defined in AC 120-42B:

"ETOPS dual maintenance, otherwise referred to as identical maintenance, multiple maintenance, and simultaneous maintenance, requires special consideration by the certificate holder. This is to recognize and preclude common cause human failure modes."



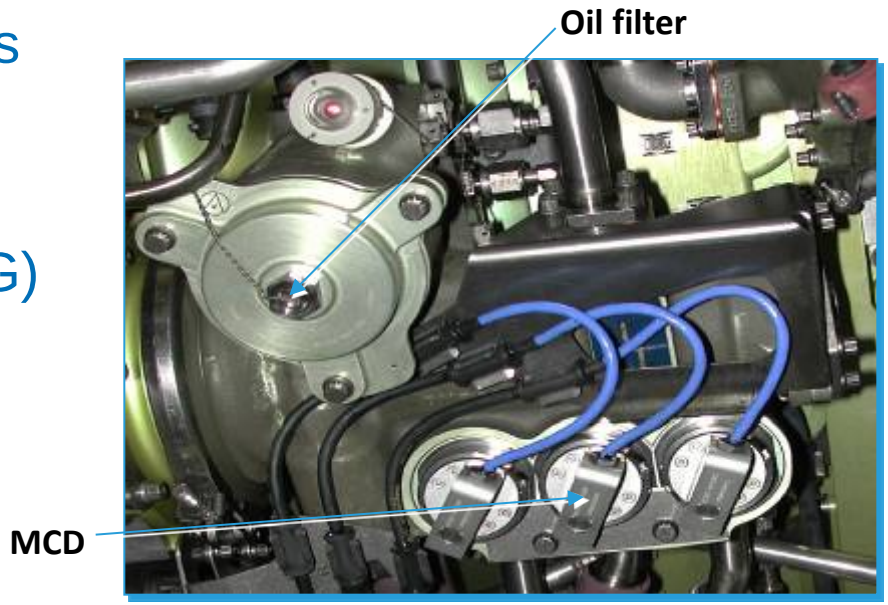
Limitations on Dual Maintenance
Continued

Purpose of Dual Maintenance, as defined in AC 120-42B:

To ensure that actions performed on the same element of identical, but separate ETOPS Significant Systems during the same routine or non-routine visit

Examples of maintenance on the "same" ETOPS Significant System are:

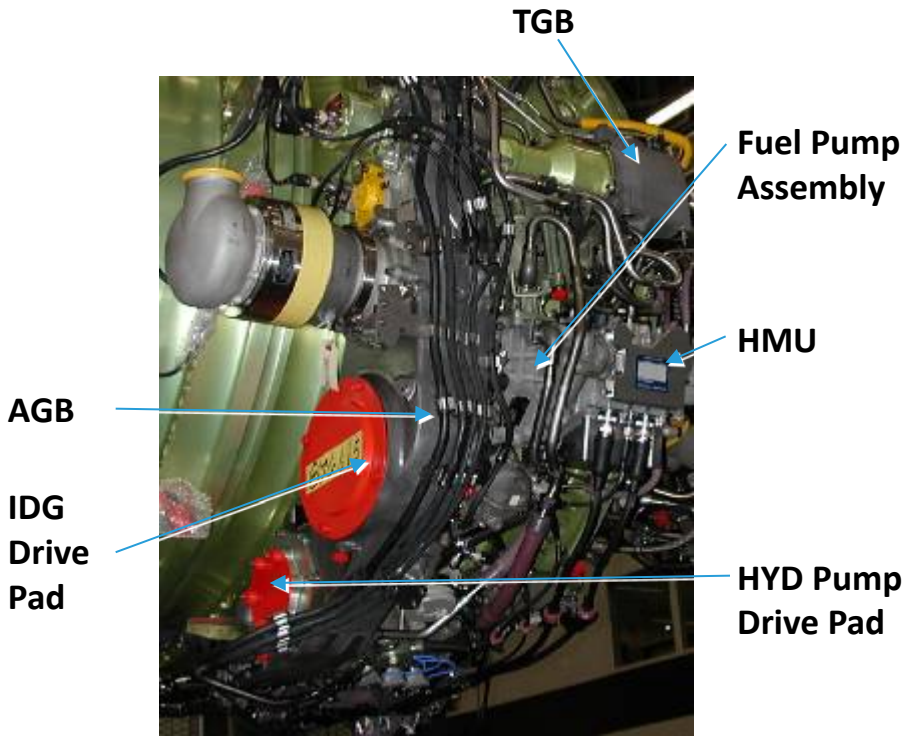
- Removal of both engine oil filters
- Removal of both chip detectors
- Replacement of left and right Integrated Drive Generator (IDG)



Limitations on Dual Maintenance
Continued

- Dual maintenance on "substantially similar" ETOPS Significant Systems specifically addresses maintenance actions on engine driven components on both engines

- An example of dual maintenance on "substantially similar" ETOPS Significant Systems may include:
  - Replacement of the Number One IDG and the Number Two Engine Driven Pump



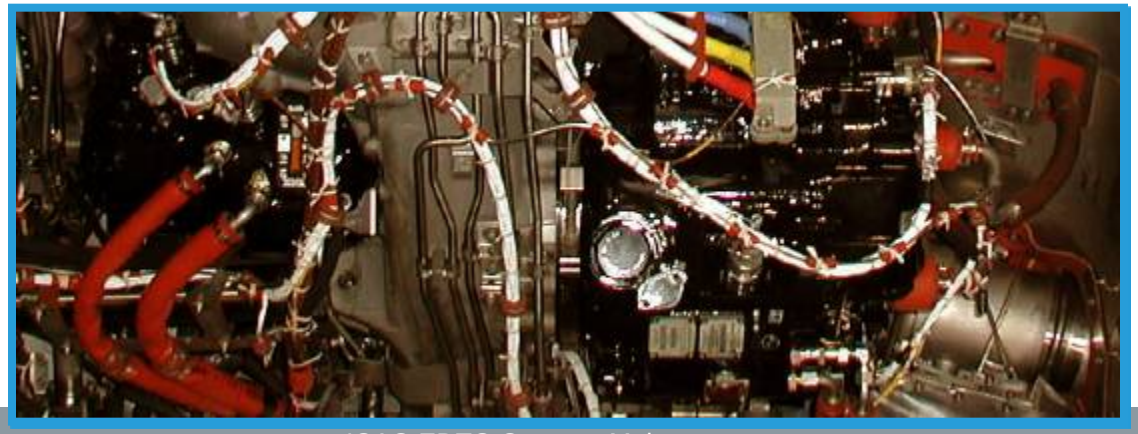
Limitations on Dual Maintenance
Continued

The operator's program should:

- Schedule work at different checks
- Divide work into separate work packages

If Dual Maintenance cannot be avoided, per AC 120-42B:

- Use different technicians
- Utilize an inspector or supervisor to inspect the work being performed
- Perform sufficient verification tests on both systems



Agenda

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  - ✓ EDTO Dispatch Considerations
- Conclusions

EDTO Service check

Verify the condition of A/C Systems prior to the flight

ETOPS service check

Standard items	• Walk around items, wheels, brakes and tyres, ...
Long range items	• Survival equipment, communication, navigation, oxygen, ...
Items specific to the ETOPS dispatch	• e.g. Fuel X-feed valve, ...

EDTO Service check
Continued

Typical example of service check items

ECAM readings are acceptable subject to airworthiness authority approval

ATA 49
APU Oil Level
APU &APU GEN filter
ΔP indicator

ATA 28
Fuel X-feed valve

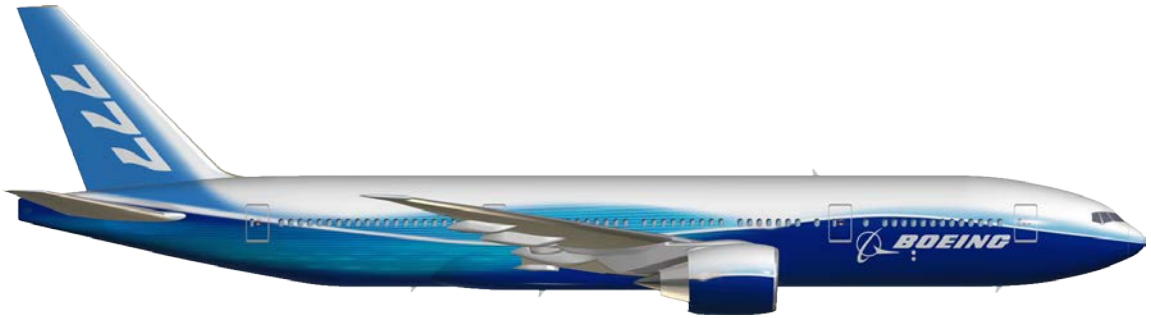
ATA 26
Cargo liner integrity
(class D compartment)

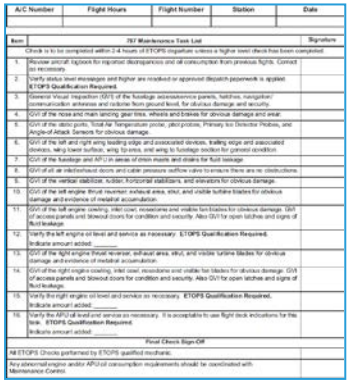
ATA 24
IDG Oil Level & filter
ΔP indicator
CSM/G

ATA 72
Engine Oil Level
Engine Oil Filter
ΔP indicator

Pre-Departure Service Check (PDSC)

- A PDSC is performed prior to each ETOPS flight
- A PDSC consists of the following tasks:
  - Verifying the condition of all ETOPS Significant Systems
  - Reviewing applicable maintenance records (Log Book)
  - Inspecting the interior and exterior
  - Verifying the Engine/APU oil level, then recording and calculating rate.
- The PDSC is signed-off by an ETOPS qualified mechanic





A/C Number	Flight Hours	Flight Number	Station	Date

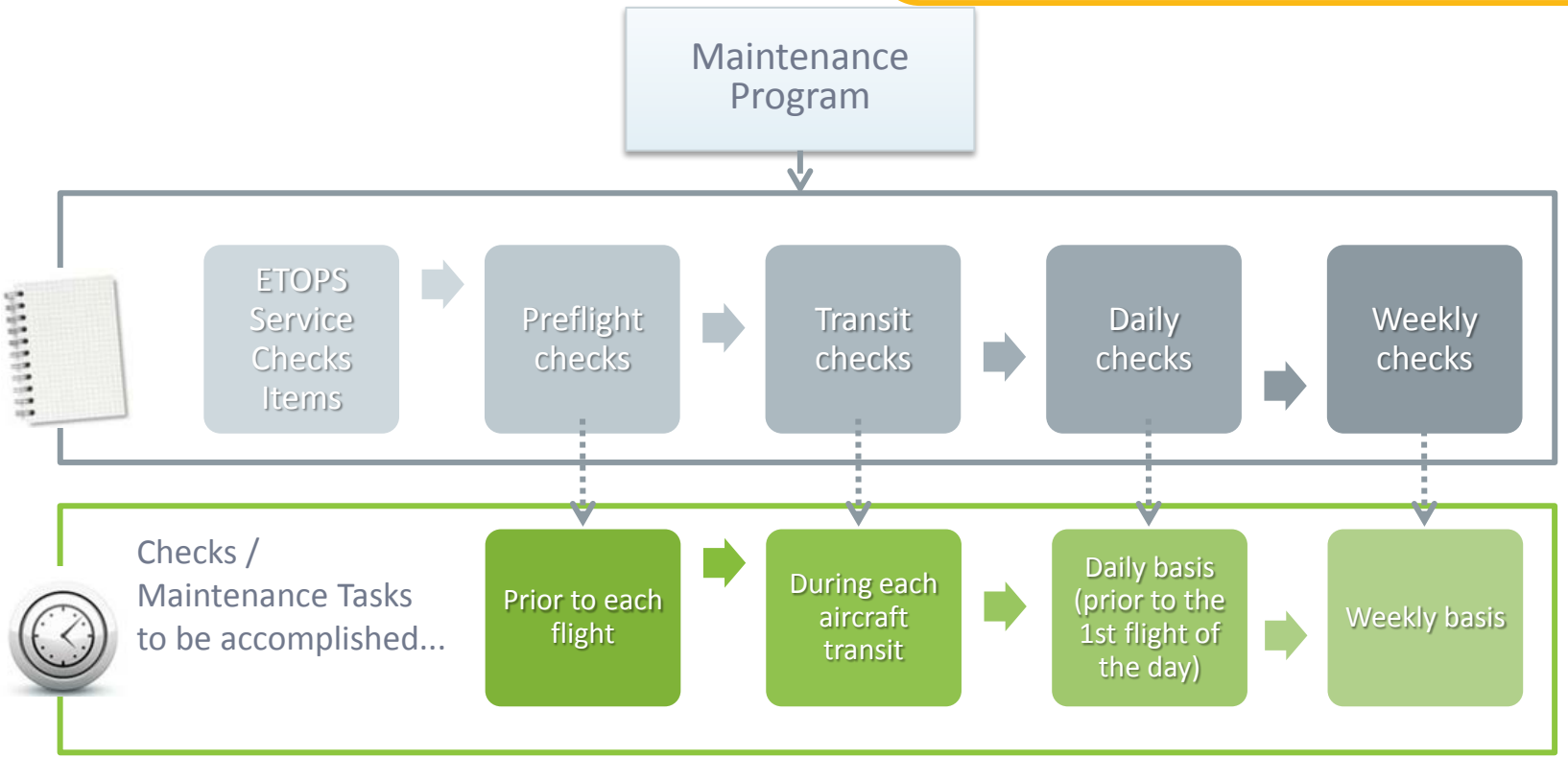
Item	767 Maintenance Task List	Signature
	Check is to be completed within 2-4 hours of ETOPS departure unless a higher level check has been completed.	
1.	Review aircraft logbook for signoff discrepancies and oil consumption from previous flights. Contact as necessary.	
2.	Verify status level messages and higher are resolved or approved dispatch paperwork is applied. ETOPS Qualification Required.	
3.	Exterior Visual Inspection (VI) of the fuselage access/service panels, hatches, navigation/communication antennas and radome from ground level, for obvious damage and security.	
4.	GVI of the nose and main landing gear tires, wheels and brakes for obvious damage and wear.	
5.	GVI of the static ports, Total Air Temperature probe, pitot probes, Primary Ice Detector Probes, and Angle-of-Attack Sensors for obvious damage.	
6.	GVI of the left and right wing leading edge and associated devices, trailing edge and associated devices, wing lower surface, wing tip area, and wing to fuselage section for general condition.	
7.	GVI of the fuselage and APU in areas of drain masts and drains for fluid leakage.	
8.	GVI of all air inlet/exhaust doors and outer pressure outflow valve to ensure there are no obstructions.	
9.	GVI of the vertical stabilizer, rudder, horizontal stabilizers, and elevators for obvious damage.	
10.	GVI of the left engine thrust reverser, exhaust area, strut, and visible turbine blades for obvious damage and evidence of metallist accumulation.	
11.	GVI of the left engine cowling, inlet cowl, nosedome and visible fan blades for obvious damage. GVI of access panels and blowout doors for condition and security. Also GVI for open latches and signs of fluid leakage.	
12.	Verify the left engine oil level and service as necessary. ETOPS Qualification Required. Indicate amount added: _____	
13.	GVI of the right engine thrust reverser, exhaust area, strut, and visible turbine blades for obvious damage and evidence of metallist accumulation.	
14.	GVI of the right engine cowling, inlet cowl, nosedome and visible fan blades for obvious damage. GVI of access panels and blowout doors for condition and security. Also GVI for open latches and signs of fluid leakage.	
15.	Verify the right engine oil level and service as necessary. ETOPS Qualification Required. Indicate amount added: _____	
16.	Verify the APU oil level and service as necessary. It is acceptable to use flight deck indications for this task. ETOPS Qualification Required. Indicate amount added: _____	
	Final Check Sign-Off	
	All ETOPS Checks performed by ETOPS qualified mechanic.	
	Any abnormal engine and/or APU oil consumption requirements should be coordinated with Maintenance Control.	

EDTO Service check
Continued

Airline Line Checks Policy

The regulation allows introducing the ETOPS Service check items in the existing line checks

In this case the single ETOPS pre-departure service check is replaced by an ETOPS service check policy



EDTO Service check

Physical vs. cockpit checks

1. The reliability of today's A/C systems and engines
2. The accuracy of the indicating system
3. The low level oil consumption

The above combined with the ETOPS Service Check policy make it possible to **increase the number of legs between physical checks**

Example of checks policy

Main base (departure point): physical checks– Daily check (including pre-flight check)

Intermediate point (transit) : cockpit based service checks – Pre-flight check

Destination (extended transit) : physical checks + cockpit check for APU parameters – Transit check (including pre-flight check)

Note: Cockpit checks could be performed by the Flight Crew

Agenda

- EDTO Maintenance Program:
  - EDTO Significant Systems
  - EDTO Training and Qualification
- EDTO Maintenance Organization Document
- EDTO Maintenance Program Elements:
  - ✓ Configuration control
  - ✓ Reliability Program
  - ✓ Aircraft Technical status follow-up (degrading/regarding EDTO status)
  - ✓ Dual Maintenance
  - ✓ EDTO Service Check
  - ✓ EDTO Dispatch Considerations
- Conclusions

Centralized Maintenance Control

Purpose: To manage the daily ETOPS operation to *avoid* an airplane being dispatched on an ETOPS flight (without a confirmed resolution or MEL relief) after the following occurrence:

- IFSD
- ETOPS Significant System failure
- Discovery of adverse trends in system performance without corrective action being taken

Should be defined in the ETOPS Maintenance Document.

Dispatch
Tech log handling

An IDG (Integrated Drive Generator) is faulty on this aircraft and must be changed

MCC

Do it!

Line maintenance action in coordination with Maintenance Control

ETOPS Status Update

ETOPS LOG TECH STATUS		DIVERSION TIME		
☒ YES	☐ NO	☐ 90	☐ 120	☒ 180
REF LOG ENTRY/ADDL				

Agenda

- EDTO Maintenance Program:
  - EDTO Significant Systems
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- EDTO Maintenance Program Elements:
  - ✓ Configuration control
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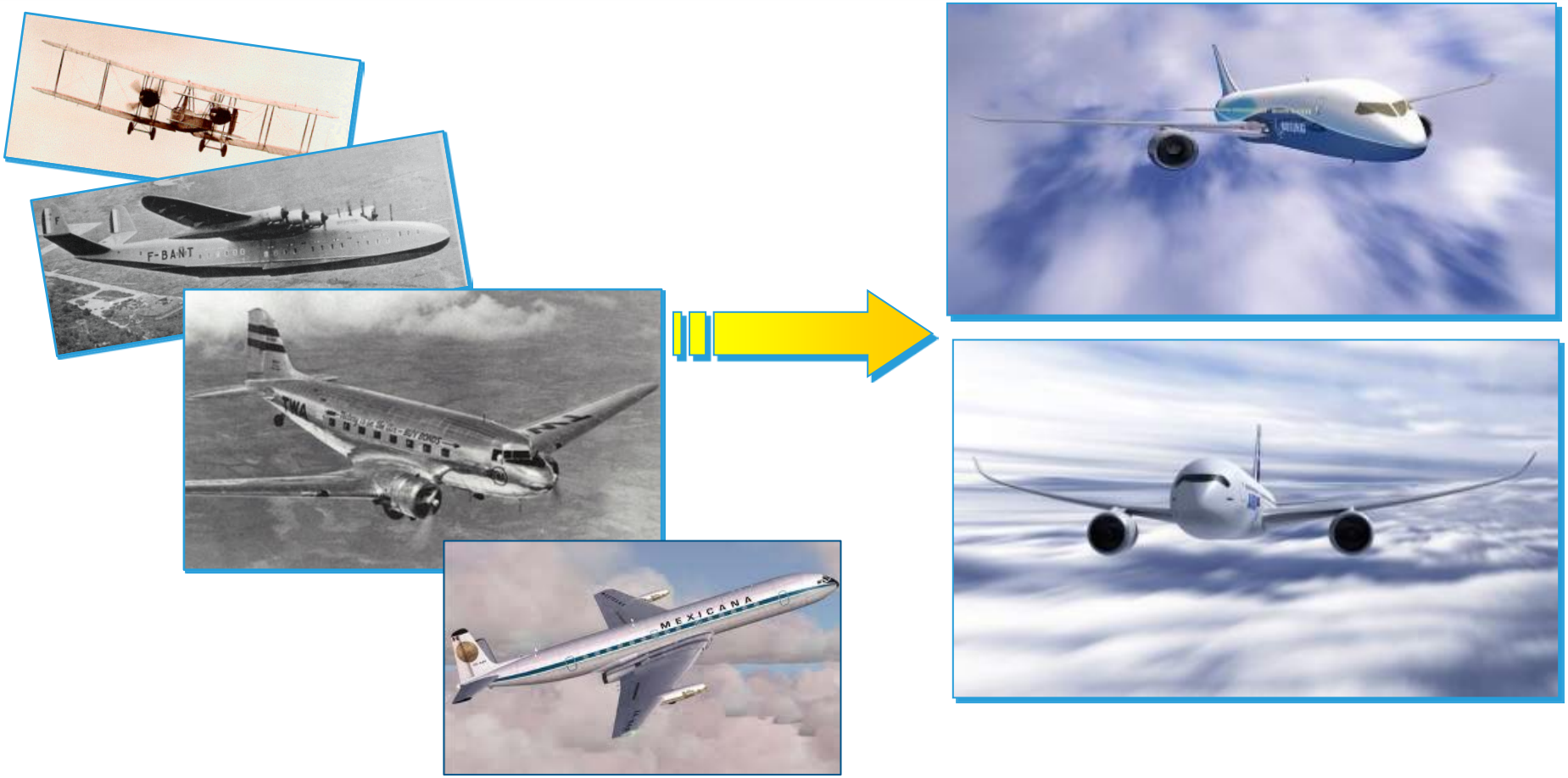
Conclusions

- The objective of EDTO rules is to maintain the risk at a minimum constant value.
  - To do so, procedures such as dual maintenance, service check, monitoring (Engine/APU oil, etc.), configuration control, verification flight and reliability program have to be set.
- In this frame, the airline has to define and implement an EDTO maintenance program to address the items above.
- Roles and responsibilities are detailed in the EMPM, which describes the operator's procedures and requirements for EDTO.
  - Coordination and communication between Maintenance and Flight Operations organizations is necessary for reliable EDTO operations
- Training and qualification of the involved maintenance personnel is also required for EDTO operations.

Module 5
EDTO Maintenance considerations



Thank You !!