At the end of this module, participants will understand the maintenance requirements supporting EDTO operations.
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
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
• 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
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 Verification Program

Reliability Program

Centralized Maintenance Control

Multiple Similar Systems

Procedural Changes

ETOPS Maintenance Document

ETOPS Parts Control

Propulsion System Monitoring (IFSD)

Oil Consumption Monitoring

Pre-departure Service Check

Task Identification

Maintenance Training

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

- ETOPS Maintenance Program
- Work on / Significant Systems
- Engine Condition Monitoring
- Oil Consumption Monitoring
- Verification Program
- Reliability Program
- ETOPS Parts Control
- Training

Objective

Maintain the risk at a minimum constant value
Goal of EDTO Maintenance Program

Risk

- EDTO Maintenance Program
  - Work on // Significant Systems
  - Engine Condition Monitoring
    - Oil Consumption Monitoring
  - Verification Program
  - Reliability Program
  - EDTO Parts Control
  - Training

Diversion time
EDTO rule

EDTO Maintenance Program

Identify Procedures

EDTO Maintenance Procedures Manual (EMPM)

Apply EDTO Procedures

- Engine Condition Monitoring
- Oil Consumption Monitoring
- Reliability Program
- EDTO training

EDTO training
**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.
Risk

- EDTO Maintenance Program
- Work on // Significant Systems = Dual Maintenance
- Engine Condition Monitoring
  - Oil Consumption Monitoring
- Verification Program
- Reliability Program
- EDTO Parts Control
- Training

Goal of EDT O Maintenance Program

Diversion time
**EDTO / ETOPS Significant System**

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**.
- 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: Title 14 CFR §121.374 (ETOPS Significant Systems)
- ETOPS maintenance emphasis

### ETOPS Significant Systems

<table>
<thead>
<tr>
<th>Air Conditioning</th>
<th>777 ETOPS Significant Systems</th>
<th>ATA Mili Section</th>
<th>Criteria Group 1</th>
<th>Criteria Group 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>21</td>
<td>Cabin Pressure Control Systems, Pack Flow Control, Cabin HVAC and Temperature Control Systems</td>
<td>-31</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>22</td>
<td>Autopilot Flight Director System, Thrust Management Computing System</td>
<td>-11</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>23</td>
<td>High-Frequency (HF) Communication System, SATCOM</td>
<td>-11</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>24</td>
<td>Generator Drive - TG, Generator Drive - Backup Generator, Generator Drive - APU, DC Generation</td>
<td>-30</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>25</td>
<td>Engine Fire Detection, APU Fire Detection, Lower Cargo Compartment Smoke Detection, Lower Cargo Compartment Fire Extinguishing</td>
<td>-11</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>36</td>
<td>Engine Air Supply, Air Supply Distribution System</td>
<td>-30</td>
<td>X</td>
<td>X</td>
</tr>
</tbody>
</table>

*Example of Boeing recommended list*
• 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

<table>
<thead>
<tr>
<th>ATA Chapter</th>
</tr>
</thead>
<tbody>
<tr>
<td>21 Air Conditioning</td>
</tr>
<tr>
<td>22 Auto Flight</td>
</tr>
<tr>
<td>23 Communications</td>
</tr>
<tr>
<td>24 Electrical Power</td>
</tr>
<tr>
<td>26 Fire Protection</td>
</tr>
<tr>
<td>28 Fuel</td>
</tr>
<tr>
<td>30 Ice/Rain Protection</td>
</tr>
<tr>
<td>34 Navigation</td>
</tr>
<tr>
<td>36 Pneumatic</td>
</tr>
<tr>
<td>49 Airborne Auxiliary Power*</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>777 ETOPS Significant System</th>
<th>ATA M/M Subsection</th>
<th>Criteria Group 1</th>
<th>Criteria Group 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cabin Pressure Control System</td>
<td>21.1</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Cabin A/C and Temperature Control System</td>
<td>21.5</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Autopilot Flight Director System*</td>
<td>22.11</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Thrust Management Computing System*</td>
<td>22.31</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>High Frequency (HF) Communication System SATCOM*</td>
<td>23.11</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Generator Drive - IDG</td>
<td>24.10</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Generator Drive - Backup Generator</td>
<td>24.10</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Generator Drive - APU</td>
<td>24.10</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>DC Generation</td>
<td>24.99</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Engine Fire Detection</td>
<td>26.11</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>APU Fire Detection</td>
<td>26.15</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Lower Cargo Compartment Smoke Detection</td>
<td>26.16</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Lower Cargo Compartment Fire Extinguishing</td>
<td>26.23</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Engine Fuel Feed System</td>
<td>28.22</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Fuel Quantity Indicating System*</td>
<td>28.25</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>-40</td>
<td>X</td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>Wing Anti-Ice System</td>
<td>30.11</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Engine Anti-Ice System</td>
<td>30.21</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Pitot/Static Anti-Ice System</td>
<td>30.30</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Probe Heat</td>
<td>30.31</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Engine Probe Heat</td>
<td>30.34</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Flight Compartment Window Anti-Ice System</td>
<td>30.41</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Weather Radar System</td>
<td>34.43</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Flight Management Computer System</td>
<td>34.43</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Engine Air Supply</td>
<td>36.11</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Air Supply Distribution System</td>
<td>36.12</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>APU Power Plant</td>
<td>49.10</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>APU Engine</td>
<td>49.20</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>APU Fuel System</td>
<td>49.30</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>APU Ignition System</td>
<td>49.40</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>APU Boost Air System</td>
<td>49.50</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>APU Controls</td>
<td>49.60</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>APU Indicating System</td>
<td>49.70</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>APU Exhaust System</td>
<td>49.80</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>APU Lubrication System</td>
<td>49.90</td>
<td>X</td>
<td>X</td>
</tr>
</tbody>
</table>

* Must be operational beyond 180 minutes duration time, including 207 minutes plus MEL delay
Airplane systems comply with Appendix K25.1 Design Requirements

- Electrical
- Propulsion
- APU
- ECS
- Other...
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
Interchanging
Swapping components, computers

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

- EDTO Maintenance Program
- Work on Significant Systems = Dual Maintenance
- Engine Condition Monitoring
- Oil Consumption Monitoring
- Verification Program
- Reliability Program
- EDTO Parts Control
- Training

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

- EDTO Maintenance Program
- Work on Significant Systems = Dual Maintenance
- Engine Condition Monitoring
- Oil Consumption Monitoring
- Verification Program
- Reliability Program
- EDTO Parts Control
- Training

Risk vs. Diversion time graph with lines indicating risk levels.
The content of the decision tree and verification actions are detailed in the section “EDTO Maintenance Program Elements” of this presentation.

Verification program may be based on:
- Verification actions published by the manufacturer
- Engineering Judgment
- EDTO Maintenance Program
- Work on Significant Systems = Dual Maintenance
- Engine Condition Monitoring
- Oil Consumption Monitoring
- Verification Program
- Reliability Program
- EDTO Parts Control
- Training
EDTO rule

Reliability Program

Identify and prevent re-occurrence of EDTO related problem

EDTO Significant systems

Event orientated as well as statistically orientated

Objective

Monitor

System or component malfunction

Check of a system or a component

Corrective actions

Reduce

Operational interruption “EDTO relevant”
Detailed information on this topic is provided in the section “EDTO Maintenance Program Elements” of this presentation.
- EDTO Maintenance Program
- Work on Significant Systems = Dual Maintenance
- Engine Condition Monitoring
  - Oil Consumption Monitoring
- Verification Program
- Reliability Program
- EDTO Parts Control
- Training
Two Levels of Training:

- EDTO awareness
- EDTO Initial Qualification
- EDTO Recurrent Training

Content

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

Inputs/Assistance

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

Public

- Mechanics
- Fleet engineers
- MCC team

Two Levels of Training:

- EDTO awareness
- EDTO Initial Qualification
- EDTO Recurrent Training

Content

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

Inputs/Assistance

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

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

- Part of the General Maintenance Manual
- A single source of information on ETOPS
- Easily accessed
• **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.*
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
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
1 - Configuration items
2 - Maintenance items

For each item: list of MOD/ SB/ VSB

Pre-MOD P/N

Parts
NOT APPROVED
for ETOPS

Parts
NOT APPROVED
for ETOPS after
specified end date

Post-MOD P/N

Parts
APPROVED
(mandatory) for ETOPS

IPC

Part List

Parts NOT APPROVED for ETOPS

Parts NOT APPROVED for ETOPS after specified end date

IPC

Part List

Configuration control
Parts identification
• 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
No ETOPS message ➔ P/N approved for ETOPS
The Assessment of

- 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 on type/area of operation)
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
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?
    - ETOPS Approved P/N
      - Spare can be fitted
      - A/C released on ETOPS
    - P/N NOT APPROVED for ETOPS
      - Spare can be fitted but
        - A/C status downgraded to Non ETOPS
        - Technical concession required to maintain A/C on ETOPS

ICAO EDTO Course - Maintenance
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.
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
**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
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
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 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...)

TECHNICAL LOGBOOK

<table>
<thead>
<tr>
<th>ITEM</th>
<th>PILOT REMARK</th>
<th>ACTION</th>
<th>ACCOMP BY</th>
</tr>
</thead>
<tbody>
<tr>
<td>15</td>
<td></td>
<td>closed</td>
<td></td>
</tr>
<tr>
<td>15</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

IDG1 overheated, action disconnected. Aircraft dispatched per MEL.
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.
**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
## XYZ Airlines
### ETOPS APU IN-FLIGHT START REPORT
B777 (GTCP331-500)

**DATE:** 02/08/03

<table>
<thead>
<tr>
<th>JAN06</th>
<th>FEB06</th>
<th>MAR06</th>
<th>APR06</th>
<th>MAY06</th>
<th>JUN06</th>
<th>JUL06</th>
<th>AUG06</th>
<th>SEP06</th>
<th>OCT06</th>
<th>NOV06</th>
<th>DEC06</th>
<th>JAN07</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

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

**Total Number of Attempts**

- JAN06: 9
- FEB06: 9
- MAR06: 9
- APR06: 9
- MAY06: 9
- JUN06: 9
- JUL06: 9
- AUG06: 9
- SEP06: 9
- OCT06: 9
- NOV06: 9
- DEC06: 9
- JAN07: 9

**1st Attempt Success**

- JAN06: 9
- FEB06: 9
- MAR06: 9
- APR06: 9
- MAY06: 9
- JUN06: 9
- JUL06: 9
- AUG06: 9
- SEP06: 9
- OCT06: 8
- NOV06: 9
- DEC06: 9
- JAN07: 9

**2nd Attempt Success**

- JAN06: N/A
- FEB06: N/A
- MAR06: N/A
- APR06: N/A
- MAY06: N/A
- JUN06: N/A
- JUL06: N/A
- AUG06: N/A
- SEP06: N/A
- OCT06: 0
- NOV06: N/A
- DEC06: N/A
- JAN07: N/A

**3rd Attempt Success**

- JAN06: N/A
- FEB06: N/A
- MAR06: N/A
- APR06: N/A
- MAY06: N/A
- JUN06: N/A
- JUL06: N/A
- AUG06: N/A
- SEP06: N/A
- OCT06: N/A
- NOV06: N/A
- DEC06: N/A
- JAN07: N/A

**Monthly First Start Success Percentage**

- JAN06: 100%
- FEB06: 100%
- MAR06: 100%
- APR06: 100%
- MAY06: 100%
- JUN06: 100%
- JUL06: 100%
- AUG06: 100%
- SEP06: 89%
- OCT06: 100%
- NOV06: 100%
- DEC06: 100%
- JAN07: 100%

**N/A - Start Not Attempted**

Prepared by:
B. Boeing - XYZ Airlines Reliability
**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
**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)

<table>
<thead>
<tr>
<th>Number of Engines</th>
<th>Engine Hours ETOPS “Operational”</th>
<th>Engine Hours ETOPS “Type Design”</th>
<th>ETOPS Authorization</th>
</tr>
</thead>
<tbody>
<tr>
<td>2</td>
<td>.05/1000</td>
<td>.05/1000</td>
<td>Up to, and including 120 Minutes</td>
</tr>
<tr>
<td>2</td>
<td>.03/1000</td>
<td>.02/1000</td>
<td>Beyond 120 minutes. Up to, and including 180 minutes, and 207 minutes in North Pacific</td>
</tr>
<tr>
<td>2</td>
<td>.02/1000</td>
<td>.01/1000</td>
<td>Greater than 180 minutes (except for 207 minutes in North Pacific)</td>
</tr>
</tbody>
</table>

**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

Contact the manufacturer

Suspension of ETOPS Operation as necessary

NAA decision in coordination with type design AA.

Applied on A/C

Retrofit program as necessary

Engine Type

ETOPS & non ETOPS flights

Suspension of ETOPS Operation as necessary

NAA decision in coordination with type design AA.
Case 2: Human Factor Issue

Event analysis

Human Factor Cause

Maintenance / Flight Crew Training Problem

YES

Document problem

NO

Impact on system design

Suspension of ETOPS Operation as necessary

Contact the manufacturer

Improve document

YES

Reinforce training program

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

IFSD

ETOPS & non ETOPS flights

Engine Type

IFSD

NAA decision in coordination with type design AA.

Propulsion system reliability (Cont)
**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
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
In the “Service check” chapter, we’ll see when to perform cockpit checks or physical checks.
Oil consumption monitoring (Cont)

APU Oil Quantity Indicator

APU oil tank sight glass reading
An alert consumption rate is specified on the Pre-flight, Daily and Weekly checks sheet.

The alert level is reached

Notify MCC

MCC

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

Fleet Engineer
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
- EDT0 Maintenance Program:
  - EDT0 Significant Systems
  - EDT0 Training and Qualification
- EDT0 Maintenance Organization Document
- EDT0 Maintenance Program Elements:
  - Configuration control
  - Reliability Program
  - Aircraft Technical status follow-up (degrading/re-grading EDT0 status)
  - Dual Maintenance
  - EDT0 Service Check
  - EDT0 Dispatch Considerations

- Conclusions
Pilot Entry:

No Fault

Trouble shooting

Syst. Inop

Adverse trend

Removal / Installation

Status:

Fix demonstrated on ground

Verification in-flight required

EDTO dispatched per MEL

EDTO no go per MEL

Part installed not approved for EDTO

Tech Log entries:

OK

Subject to verification in-flight

OK per MEL (Max DT / Number of flights / Days per MEL)

No EDTO allowed

OK per NAA approved temporary deviation procedure

Max Div Time:

Y

MEL

EDTO threshold

NAA

Technical status follow-up
Degrading / Re-grading

ICAO EDTO Course - Maintenance
Maintenance action

- APU change or APU oil/fuel/control system break down
- Engine change
- Engine system break down (fuel/oil/ignition/control)
- Intermittent failure not reproduced on ground
- Altitude related failure

Potential in-flight verification action

- APU high altitude cold soak start
- Non revenue flight
- Non-ETOPS revenue flight
- ETOPS flight with verification of the system before entering the ETOPS sector (i.e. at least during the first 60' of the flight)
**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.
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
Check in the MEL to defer the rectification of the defect

NO GO item

Fix the problem before the departure?

YES

Confirm the fault rectification?

Item closed / Fault cleared

ETOPS status confirmed in logbook

NO

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
Check in the MEL to defer the rectification of the defect

NO GO item

Fix the problem before the departure?

YES

Confirm the fault rectification?

Item closed / Fault cleared

ETOPS status confirmed in logbook

NO

Inform the maintenance control: an inflight 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
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
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.
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.”
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)
• 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
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
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
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, ...
Typical example of service check items

- **ATA 49**
  - APU Oil Level
  - APU & APU GEN filter
  - $\Delta P$ indicator

- **ATA 28**
  - Fuel X-feed valve

- **ATA 26**
  - Cargo liner integrity
    - (class D compartment)

- **ATA 24**
  - IDG Oil Level & filter
  - $\Delta P$ indicator
  - CSM/G

- **ATA 72**
  - Engine Oil Level
  - Engine Oil Filter
  - $\Delta P$ indicator

ECAM readings are acceptable subject to airworthiness authority approval.
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.
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.
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
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
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.
An IDG (Integrated Drive Generator) is faulty on this aircraft and must be changed.

Do it!

Line maintenance action in coordination with Maintenance Control.
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
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