

# ETOPS

## LOT Polish Airlines



Prepared by Filip Reszke  
B787 Lead Engineer

Based on Boeing Materials

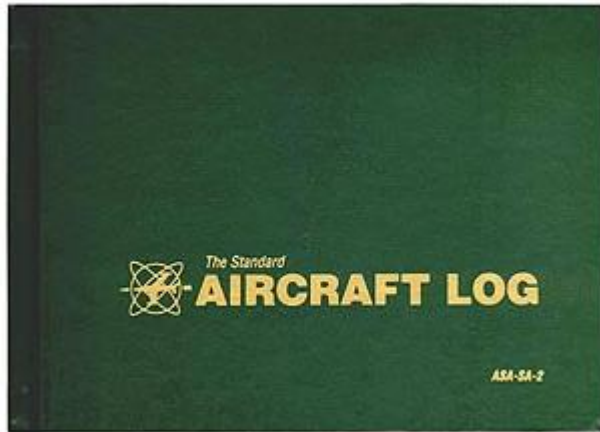
LOT Polish Airlines ETOPS Briefing

Reference for training purposes only

# Presentation Contents

- ☐ Introduction to ETOPS Maintenance Requirements
- ☐ ETOPS Configuration
  - Documentation
- ☐ ETOPS Significant Systems
- ☐ Continuous Airworthiness Maintenance Program (CAMP)
  - ETOPS Maintenance Elements
- ☐ ETOPS Dispatch Considerations
- ☐ ETOPS Guides, Templates, and Support Materials

# Introduction to ETOPS Maintenance Requirements



| NO. IN LOG | DATE | TIME | FROM | TO | TYPE | REMARKS | INITIALS |
|------------|------|------|------|----|------|---------|----------|
| 749940     |      |      |      |    |      |         |          |
| 749941     |      |      |      |    |      |         |          |
| 749942     |      |      |      |    |      |         |          |
| 749943     |      |      |      |    |      |         |          |
| 749944     |      |      |      |    |      |         |          |
| 749945     |      |      |      |    |      |         |          |
| 749946     |      |      |      |    |      |         |          |
| 749947     |      |      |      |    |      |         |          |

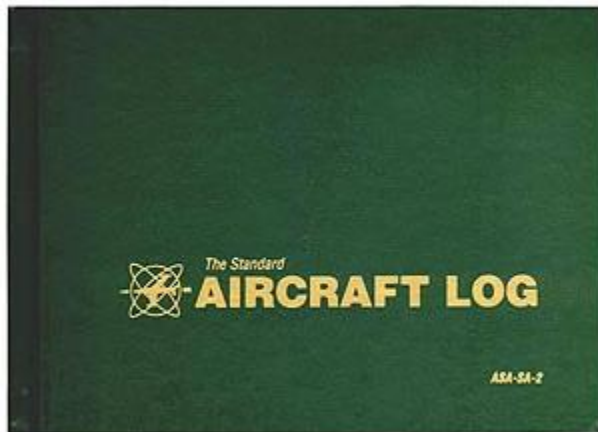
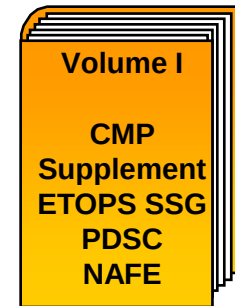
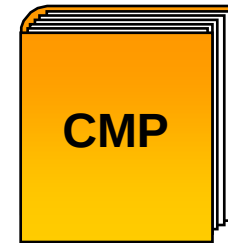
# Introduction to ETOPS

## Maintenance Requirements

- ❑ 14 CFR 121.374 codifies ETOPS Maintenance program requirements
- ❑ AMC 20-6 Rev 2, December 2010
- ❑ Latest ETOPS maintenance program requirements remain applicable only to two engine airplanes
  - Some future configuration requirements for passenger airplanes with more than two engines
- ❑ AC 120-42B defines means of compliance for the operator
- ❑ Boeing ETOPS Guide Volume II reflects 14 CFR 121.374



# ETOPS Configuration





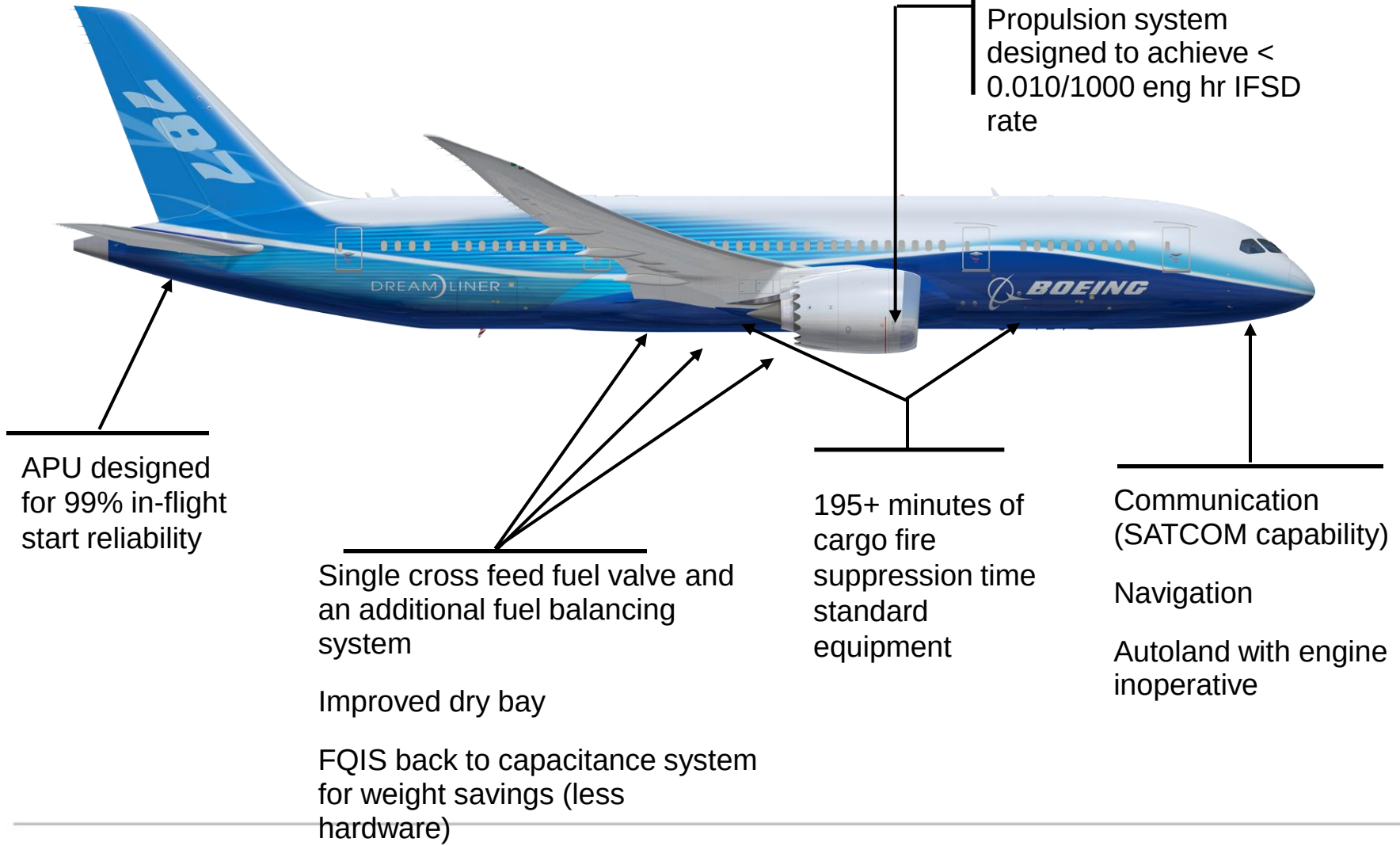
# ETOPS Configuration

*Today's Airplane Design Accounts for ETOPS Consideration as required by 14 CFR 25.1535...777 / 787 / 747-8*

- ☐ Propulsion system
- ☐ Electrical system
- ☐ APU start reliability
- ☐ Aircraft system
- ☐ Extensive Flight Test program to validate ETOPS
- ☐ Type certificated at EIS (entry into service) for 180 minutes and beyond



# 787 ETOPS Configuration



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# ETOPS Configuration - Documentation

## Configuration, Maintenance and Procedures (CMP)

- ☐ CMP sets the minimum standard
- ☐ FAA approved document published by the manufacturer
- ☐ Separate document for each airplane model
- ☐ Revision by configuration change or Airworthiness directive process and other contributing factors
- ☐ Identifies operational and/or maintenance procedures as required to maintain ETOPS design standards

PW4000 Series Engines

### 5.3 Part A.PW4000 Engine Manufacturer Items

| 5.3 Part A.PW4000 Engine Manufacturer Items<br>PW4000 Series Engines                            |                                                                                                                                                                         |                                                                                                                                                                          |           |          |
|-------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------|----------|
| Approval for operation up to 180 minutes diversion time from an alternate airport per AC120-42A |                                                                                                                                                                         |                                                                                                                                                                          |           |          |
| Item                                                                                            | Item Description                                                                                                                                                        | Reference Documentation                                                                                                                                                  | Ref. Rev. | CMP Rev. |
| 72-01                                                                                           | * Engine - Blades; 2nd Stage, High Pressure Turbine (HPT) - Replacement of                                                                                              | PWA S/B PW4ENG 72-106 (Incorporate no later than 1000 cycles on 2nd stage turbine blade P/N 50L232. Must be incorporated prior to start of 180 minutes ETOPS operation.) | R3        | K        |
| 72-02                                                                                           | Main Gearbox - Guide, Roller Bearing Assembly, Oil Pump Idler Gear - Installation of                                                                                    | PWA S/B PW4ENG 72-208                                                                                                                                                    | R1        | F        |
| 72-03                                                                                           | Engine - Tube Assemblies, No. 3 Bearing Pressure and Breather - Borescope Inspection of, and Replacement of                                                             | PWA S/B PW4ENG 72-207                                                                                                                                                    | ORIG      | F        |
| 72-04                                                                                           | Engine - Shroud Set, High Pressure Compressor (HPC) 5th Stage, Incorporating a Deeper Pretrench and Increased Diameter Flowpath; and Blades, 5th Stage - Replacement of | PWA S/B PW4ENG 72-215                                                                                                                                                    | ORIG      | F        |
| 72-05-1                                                                                         | * Engine - Bolts, No. 1.5 Bearing Outer Race Retaining - Coating With Locktite Compound                                                                                 | PWA S/B PW4ENG 72-225 (Incorporate no later than next engine removal)                                                                                                    | ORIG      | M        |
| OR                                                                                              |                                                                                                                                                                         |                                                                                                                                                                          |           |          |
| 72-05-2                                                                                         | * Engine - Bolts, No. 1.5 Bearing Outer Race Retaining - Replacement of with Hexhead Bolts and Keywashers                                                               | PW S/B PW4ENG 72-253 (This item is an alternative to Item 72-05-1. For incorporation see Item 72-05-1.)                                                                  | R1        | M        |
| 72-06                                                                                           | * Engine - High Pressure Compressor (HPC) Variable Stator Lever Clevis Bolts, Inlet Through 7th Stage - Replacement of                                                  | PWA S/B PW4ENG 72-227 (Incorporate no later than June 30, 1991. Must be incorporated prior to start of 180 minutes ETOPS operation.)                                     | ORIG      | K        |

767 CMP sample page shown



# ETOPS Configuration - Documentation



CAGE Code 81205

## 787 ETOPS Configuration, Maintenance and Procedures

DOCUMENT NUMBER: D021Z002-01  
RELEASE/REVISION: REV A  
RELEASE/REVISION DATE: August 21, 2011

CONTENT OWNER:

Operational Regulatory Affairs (66-ZB-H001)

All revisions to this document must be approved by the content owner before release.

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REV A

D021Z002-01

III

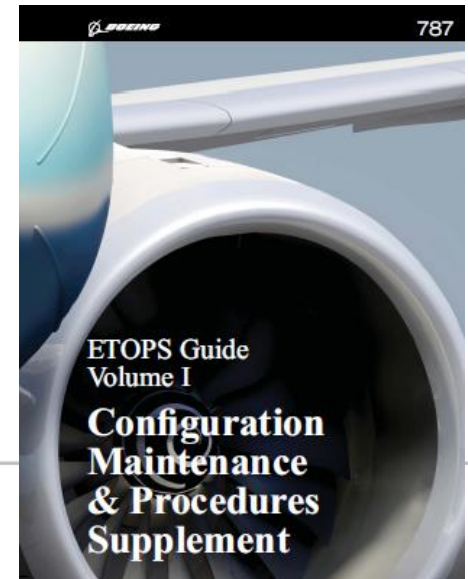
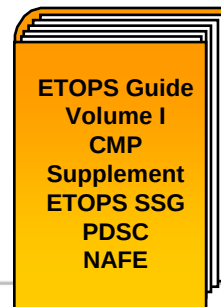
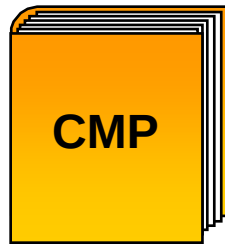
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# ETOPS Configuration - Documentation

## ☐ CMP Concerns

- Detail requirements are not stated in the CMP
- Superseding or alternative Service Bulletins not shown
- Periodic maintenance requirements not easily identified
- Retrofit documentation and production incorporation unclear

## ☐ CMP Supplement created to address concerns



# ETOPS Configuration - Documentation

## ETOPS Guide Volume I (CMP Supplement)

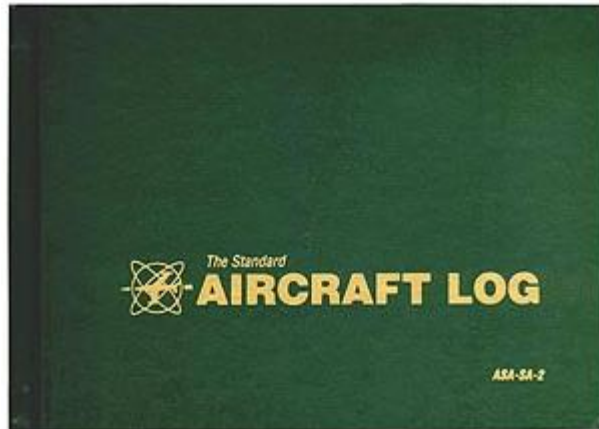
- ☐ Written and maintained by Boeing
- ☐ Provides supplemental information to CMP requirements
- ☐ Follows the same flow as the CMP requirements
- ☐ Clarification language provided for specific areas where operators are having interpretation problems and where we can provide consistency

| 5.2 PART A – ENGINE MANUFACTURER ITEMS                                                                                                                                                                           |                |                                                   |                    |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------|---------------------------------------------------|--------------------|
| CMP Supplemental Data                                                                                                                                                                                            |                |                                                   |                    |
| A/P Model: 767                                                                                                                                                                                                   | Engine: PW4000 | CMP Part: A                                       | Item Number: 72-01 |
| <b>Description:</b><br>Engine – Blades; 2nd Stage, High Pressure Turbine (HPT) – Replacement of                                                                                                                  |                |                                                   |                    |
| <b>CMP Referenced Documentation:</b><br>PWA S/B PW4ENG 72-106<br>Incorporate no later than 1000 cycles on 2nd stage turbine blade P/N 50L232. Must be incorporated prior to start of 180-minute ETOPS operation. |                |                                                   |                    |
| Revision: R3                                                                                                                                                                                                     |                | Date: 2/3/89                                      | CMP Revision: K    |
| <b>CMP Incorporation Schedule:</b> *<br>Per manufacturer's schedule.                                                                                                                                             |                |                                                   |                    |
| <b>Manufacturer's Schedule:</b> None.                                                                                                                                                                            |                |                                                   |                    |
| <b>Comments:</b><br>The intent of this item is to prevent IFSDs due to 2nd stage HPT blade cracks leading to fractures. The intent is accomplished by replacing existing blades with blades with thicker walls.  |                |                                                   |                    |
| <b>References:</b> None.                                                                                                                                                                                         |                |                                                   |                    |
| <b>Production Incorporation and Effectivity</b>                                                                                                                                                                  |                | <b>Retrofit Options and Applicability</b>         |                    |
| PW4ENG 72-106<br>Eng SN P717501, P717503, P717505, P717507 and on, P723701 and on, P724101 and on, P724201 and on, P724501 and on                                                                                |                | PW4ENG 72-106<br>Eng SN P717502, P717504, P717506 |                    |

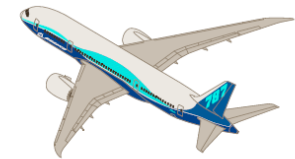
767 CMP Supplement  
sample page shown



# ETOPS Significant Systems



BOEING



787  
Dispatch Deviations Guide  
(DDG)  
Draft

**WARNING:** The technology herein is controlled by U.S. Export Administration Regulations. Any export or re-export of this technology must comply with EAR.  
Controlled by ECCN: 9E001 Date: 16 October 2006

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Document Number D830Z004-01  
March 28, 2008



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# ETOPS Significant Systems

## ☐ History;

- Inconsistent terminology in ETOPS documents
- “Primary”, “Essential”, “Critical” Systems
  - Primary systems, essential airframe systems, critical systems, critical and essential systems, ETOPS critical systems and systems critical to ETOPS
- Boeing performed a study to clarify
- Identified groups of Airplane systems that affect the ETOPS mission (ETOPS Significant System)

## ☐ Today: 14 CFR 121.374 (ETOPS Significant systems)

## ☐ ETOPS maintenance emphasis

| ATA Chapter                   | 737-600/700/800/900 ETOPS Significant Systems | ATA M/M Subsection | Criteria Group 1 | Criteria Group 2 |
|-------------------------------|-----------------------------------------------|--------------------|------------------|------------------|
| 21<br>Air Conditioning        | Pressurization Control System                 | -31                |                  | X                |
|                               | Pack Flow Control and Pack Cooling System     | -51                |                  | X                |
|                               | Zone Temperature Control and Indication       | -61                |                  | X                |
| 24<br>Electrical Power        | AC Generator Drive System                     | -11                | X                |                  |
|                               | AC Generation System                          | -21                | X                |                  |
|                               | Transformer Rectifier Unit                    | -32                |                  | X                |
| 26<br>Fire Protection         | Engine Fire Detection System                  | -11                | X                |                  |
|                               | APU Fire Detection                            | -15                | X                |                  |
|                               | Cargo Bay Smoke Detection System              | -16                |                  | X                |
|                               | Cargo Fire Extinguishing                      | -23                |                  | X                |
| 28<br>Fuel                    | Engine Fuel Feed System                       | -22                | X                |                  |
|                               | APU Fuel Feed System                          | -25                | X                |                  |
| 30<br>Ice and Rain Protection | Wing Thermal Anti Ice System                  | -11                |                  | X                |
|                               | Engine Cowl Anti Ice System                   | -21                | X                | X                |
|                               | Air Data Sensor Anti-Icing                    | -31                |                  | X                |
|                               | Control Cabin Window Anti-Icing System        | -41                |                  | X                |
| 34<br>Navigation              | Weather Radar                                 | -43                |                  | X                |

Example of Boeing recommended list



# ETOPS Significant Systems

- ❑ The operator must develop their own ETOPS Significant Systems List
- ❑ The operator ETOPS Significant Systems list must be agreed to and approved by the regulatory authority
- ❑ Boeing has developed ETOPS Significant System Guides for operator use

| ATA Chapter                   | 737-600/700/800/900 ETOPS Significant Systems | ATA M/M Subsection | Criteria Group 1 | Criteria Group 2 |   |  |
|-------------------------------|-----------------------------------------------|--------------------|------------------|------------------|---|--|
| 21<br>Air Conditioning        | Pressurization Control System                 | -31                |                  | X                |   |  |
|                               | Pack Flow Control and Pack Cooling System     | -51                |                  | X                |   |  |
|                               | Zone Temperature Control and Indication       | -61                |                  | X                |   |  |
| 24<br>Electrical Power        | AC Generator Drive System                     | -11                | X                |                  |   |  |
|                               | AC Generation System                          | -21                | X                |                  |   |  |
|                               | Transformer Rectifier Unit                    | -32                |                  | X                |   |  |
| 26<br>Fire Protection         | Engine Fire Detection System                  | -11                | X                |                  |   |  |
|                               | APU Fire Detection                            | -15                | X                |                  |   |  |
|                               | Cargo Bay Smoke Detection System              | -16                |                  | X                |   |  |
|                               | Cargo Fire Extinguishing                      | -23                |                  | X                |   |  |
| 28<br>Fuel                    | Engine Fuel Feed System                       | -22                | X                |                  |   |  |
|                               | APU Fuel Feed System                          | -25                | X                |                  |   |  |
| 30<br>Ice and Rain Protection | Wing Thermal Anti Ice System                  | -11                |                  | X                | X |  |
|                               | Engine Cowl Anti Ice System                   | -21                | X                | X                | X |  |
|                               | Air Data Sensor Anti-Icing                    | -31                |                  | X                | X |  |
|                               | Control Cabin Window Anti-Icing System        | -41                |                  | X                |   |  |
|                               |                                               |                    |                  |                  |   |  |
| 34<br>Navigation              | Weather Radar                                 | -43                |                  | X                |   |  |
|                               |                                               |                    |                  |                  |   |  |
|                               | APU Ignition and Start System                 | -41                |                  | X                |   |  |
|                               | APU Surge Control Valve                       | -52                |                  | X                |   |  |
|                               | APU Controls                                  | -61                |                  | X                |   |  |
|                               | EGT Indicating System                         | -71                |                  | X                |   |  |
|                               | APU Indicating System                         | -72                |                  | X                |   |  |
|                               | APU Lubrication System                        | -91                |                  | X                |   |  |
|                               | APU Oil Indication System                     | -94                |                  | X                |   |  |
|                               | CFM56-7                                       |                    |                  |                  |   |  |
| 71                            | Power Plant                                   |                    | ALL              | X                |   |  |
| 72                            | Engine                                        |                    | ALL              | X                |   |  |
| 73                            | Engine Fuel and Control                       |                    | ALL              | X                |   |  |
| 74                            | Engine 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                |   |  |

737NG ETOPS Significant Systems List



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# ETOPS Significant Systems (*continued*)

- ETOPS Significant system defined:
  - An airplane system, including the propulsion system, the failure or malfunction of which could adversely affect the safety of an ETOPS flight, or the continued safe flight and landing of an airplane during an ETOPS diversion.
- ETOPS Significant systems are classified as either:
  - Group 1, or
  - Group 2



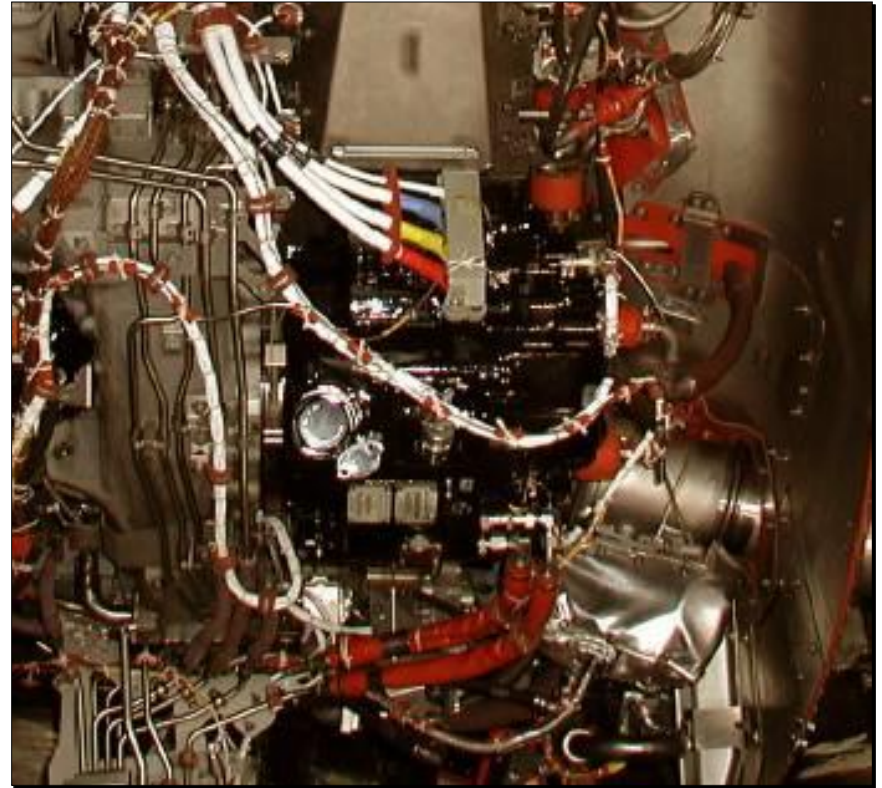
# ETOPS Significant Systems

## *Group 1 Characteristics*

- Has failsafe characteristics directly linked to the degree of redundancy provided by the number of engines on the airplane

### *Examples:*

- Secondary power systems
  - Pneumatic
  - Electrical



**777 Generator installation**

# ETOPS Significant Systems

## *Group 1 Characteristics (continued)*

- ☐ Is a system, the failure or malfunction of which could result in an IFSD, loss of thrust control, or other power loss.

### *Examples:*

- ☐ Engine control system
- ☐ Engine fire detection systems
- ☐ Fuel Systems





# ETOPS Significant Systems

## *Group 1 Characteristics (continued)*

- ☐ Contributes significantly to the safety of an ETOPS diversion by providing additional redundancy for any system power source lost as a result of an inoperative engine.

### *Examples:*

- ☐ Backup generator/backup systems
- ☐ APU generator
- ☐ Fuel cross-feed valve



# ETOPS Significant Systems

## *Group 1 Characteristics (continued)*

- ☐ Is essential for prolonged operation of an airplane at engine inoperative altitudes

*Examples:*

- ☐ Anti-Icing system





# ETOPS Significant Systems

## Group 2 Characteristics

- ☐ From the regulation;
  - An ETOPS Significant System that is not an ETOPS Group 1 Significant System **(14 CFR 121.374)**

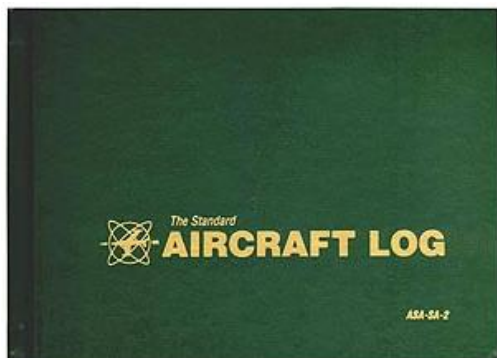
### *Examples:*

- ☐ Long range communications
- ☐ Cargo fire suppression
- ☐ Weather Radar

***Systems whose failure would result in excessive crew workload for an ETOPS diversion (e.g., flight control forces that would be exhausting for a maximum ETOPS diversion, or system failures that would require continuous fuel balancing to ensure proper CG)***

# ETOPS Significant Systems

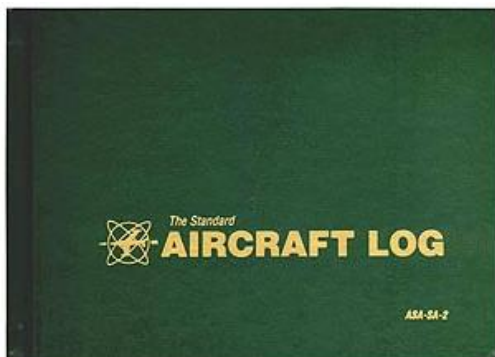
## Boeing Suggested List of ETOPS Significant Systems – 787



| ATA Chapter            | 787 ETOPS Significant Systems                    | ATA M/M Subsection | Criteria Group 1 | Criteria Group 2 |
|------------------------|--------------------------------------------------|--------------------|------------------|------------------|
| 21<br>Air Conditioning | Equipment Cooling System                         | -27                |                  | X                |
|                        | Cabin Pressure Control System                    | -31                | X                |                  |
|                        | Pack Flow Control System                         | -51                | X                |                  |
|                        | Pack Cooling and Pack                            |                    |                  |                  |
|                        | Temperature Control System                       | -52                |                  | X                |
|                        | Zone Temperature Control System                  | -61                |                  | X                |
|                        | Power Electronics Cooling System                 | -81                |                  | X                |
| 22<br>Auto Flight      | Autopilot Flight Director System                 | -11                |                  | X                |
|                        | Thrust Management System *                       | -31                |                  | X                |
| 23<br>Communications   | High Frequency Communication System              | -11                |                  | X                |
|                        | Satellite Communications (SATCOM) System *       | -15                |                  | X                |
| 24<br>Electrical Power | Generator Drive System                           | -11                | X                |                  |
|                        | Electrical Power Generation and Start System     | -21                | X                |                  |
|                        | AC Generation and Bus Control                    | -22                | X                |                  |
|                        | DC Power                                         | -32                |                  | X                |
| 26<br>Fire Protection  | Engine Fire Detection                            | -11                | X                |                  |
|                        | APU Fire Detection                               | -15                | X                |                  |
|                        | Cargo Compartment Smoke Detection                | -16                |                  | X                |
|                        | Cargo Compartment Fire Extinguishing             | -23                |                  | X                |
| 28<br>Fuel             | Engine Fuel Feed System                          | -22                | X                |                  |
|                        | APU Fuel Feed System                             | -25                | X                |                  |
|                        | Fuel Quantity Indicating System*                 | -41                |                  | X                |
| 29<br>Hydraulics       | Ram Air Turbine System - Hydraulic function only | -21                |                  | X                |

# ETOPS Significant Systems

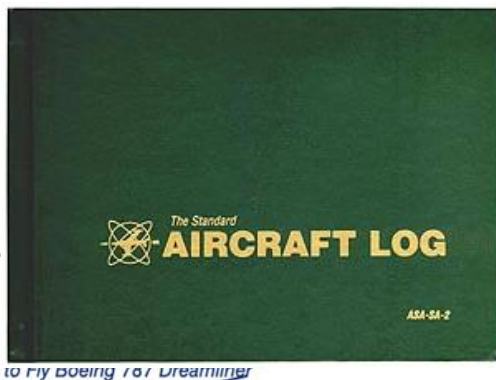
## 787 ETOPS Significant Systems List continued



| ATA Chapter                      | 787 ETOPS Significant Systems                     | ATA M/M Subsection | Criteria Group 1 | Criteria Group 2 |
|----------------------------------|---------------------------------------------------|--------------------|------------------|------------------|
| 30<br>Ice and Rain Protection    | Wing Ice Protection System                        | -11                | X                |                  |
|                                  | Engine Anti-Ice                                   | -21                | X                |                  |
|                                  | Cabin Air Compressor Inlet Ice Protection         | -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<br>Navigation                 | Integrated Surveillance System-Weather Radar Only | -42                |                  | X                |
|                                  | Flight Management Function                        | -61**              |                  | X                |
| 49<br>Airborne Auxiliary Power * | Auxiliary Power Unit                              | -11                | X                |                  |
|                                  | APU Mounts                                        | -13                | X                |                  |
|                                  | APU Electrical                                    | -14                | X                |                  |
|                                  | APU Air Inlet System                              | -15                | 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 Exhaust Gas Temperature Indicating System     | -71                | X                |                  |
|                                  | APU Oil Indicating System                         | -94                | X                |                  |

# ETOPS Significant Systems

|    | 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 |  |
|    |                                                                                                                                                                                    |     |   |  |
|    | * Must be operational for beyond 180 minute ETOPS diversion times (including 207 minutes)<br>** Fault Isolation Reference (FIM) and may refer to other ATA chapters for resolution |     |   |  |



**787 ETOPS Significant Systems List continued**

# ETOPS Significant Systems

## *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
  - Dispatch

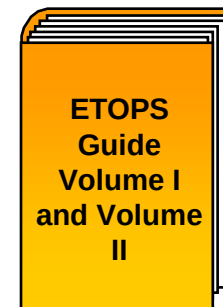
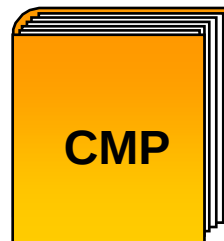
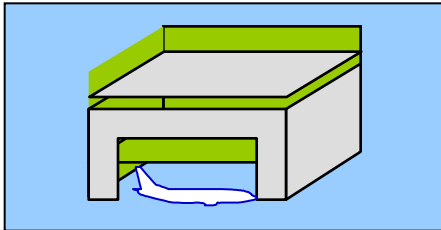






# Continuous Airworthiness Maintenance Program (CAMP) for Two Engine ETOPS

*Airline Maintenance  
Program*



# Maintenance Program for ETOPS-Defined

- ❑ The Continuous Airworthiness Maintenance Program (FAA) or Approved Maintenance Program (outside FAA regulation) for the airplane being considered for ETOPS, must:
  - Identify the manufactures or operators Instructions for Continued Airworthiness
  - Be approved by the local regulating authority
- ❑ The approved program must be enhanced to include the requirements of 14 CFR 121.374 or AMC20-6 Rev 2



# Maintenance Program for ETOPS



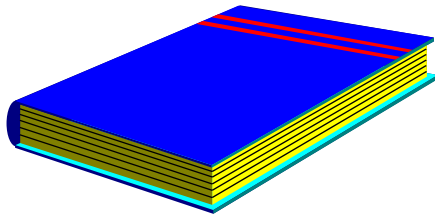
□ No Change  
(AC 120-42A)

□ Slight Revision  
from AC 120-  
42A

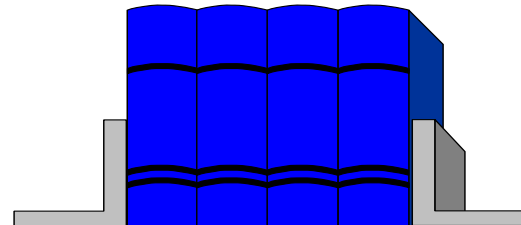
□ Old Concept –  
New to Previous  
Regulation

# Maintenance Document

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



or

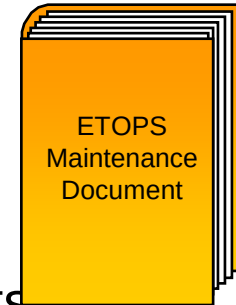


- ☐ Part of General Maintenance Manual
- ☐ A Single Source of Information on ETOPS
- ☐ Easily accessed

# Maintenance Document

## Contents

- ☐ Introduction
- ☐ ETOPS Approved Airplanes – add 787 airplanes
- ☐ Configuration control – plan for 787
- ☐ Dispatch configuration and maintenance requirements as it relates to the 787
- ☐ ETOPS Pre-Departure Service Check – add the 787
- ☐ ETOPS Significant Systems – develop one for the 787
- ☐ ETOPS Reliability Program – revise to include the new 787 systems
- ☐ Maintenance Control for ETOPS – 787 differences

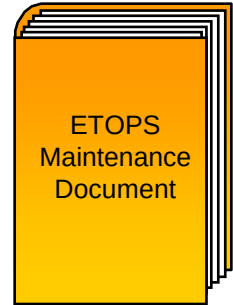




# Maintenance Document

## Contents (Continued)

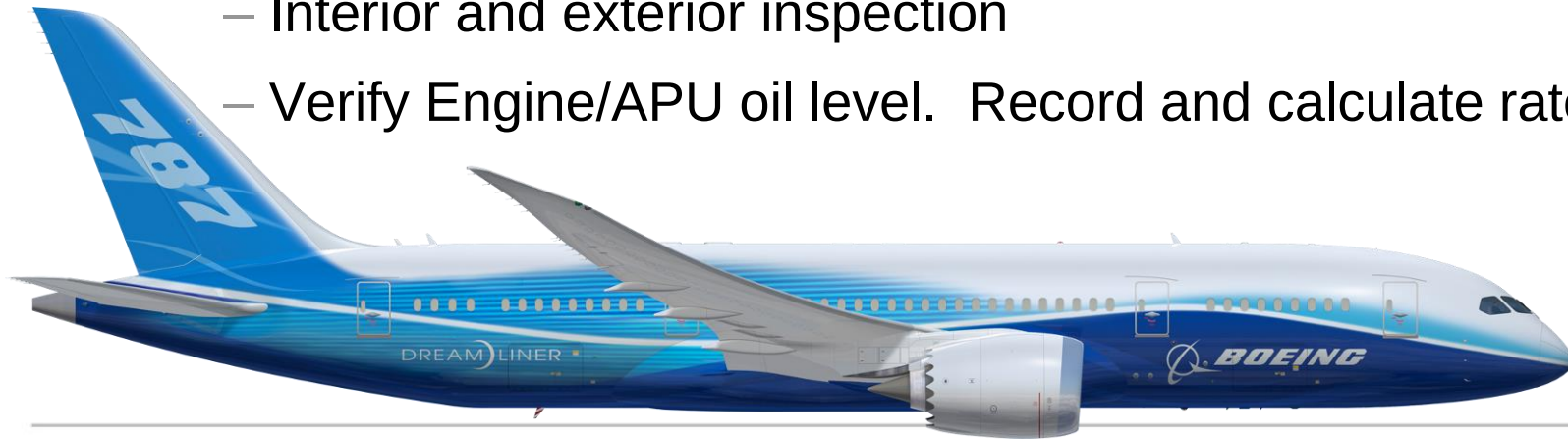
- ☐ Propulsion System Monitoring Program – revised for the 787
- ☐ Oil Consumption Monitoring Program – include 787 engine and APU considerations
- ☐ Engine Condition Monitoring Program – what is different for the 787
- ☐ ETOPS Maintenance Operating Restrictions Policy
  - Limitations on Dual Maintenance for new 787 systems
- ☐ Resolution of Airplane Discrepancies
  - Verification Program – planning for the 787
- ☐ ETOPS Training Program – proactive scheduling and proficiency challenges



Boeing provides a “**Template**” to generate the ETOPS Manual

# Pre-Departure ETOPS Check

- ☐ Performed prior to each ETOPS flight
- ☐ Signed-off by an ETOPS qualified mechanic
- ☐ Check consists of the following tasks “14 CFR 121.374 (b) “
  - Verify condition of all ETOPS significant systems
  - Review applicable maintenance records (logbook)
  - Interior and exterior inspection
  - Verify Engine/APU oil level. Record and calculate rate



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LOT Polish Airlines ETOPS Briefing

# Pre-Departure ETOPS Check

- ☐ ETOPS PDC/Dy Tasks are in B787 Line Maintenance Instruction
- ☐ Sample of LOT ETOPS PDC
- ☐ Some of DY Tasks are also ETOPS ones

| ETOPS PDC MASTER CARD                 |               |                                                         |  | Ref-number<br>LOT/787/01/ETOPS-PDC |                              |
|---------------------------------------|---------------|---------------------------------------------------------|--|------------------------------------|------------------------------|
| AVC registration:<br>SP-LR....        |               | AVC version:<br>B 787- 8                                |  | Issue date:<br>NOV 01/2013         | Rev. date:<br>ORIG           |
| Prepared by:<br>Engineering Dept. Mgr |               | Approved By:<br>Continuous Airworthiness<br>Postholder. |  | Date:                              | Check start<br>Hour/Min.     |
| No.                                   | Ref.          | Title                                                   |  |                                    | Sign/stamp                   |
| 01                                    | 05-008-LOT    | Aircraft Technical Log Check (ETOPS)                    |  |                                    |                              |
| 02                                    | 49-700-00-LOT | APU Oil Level Check (ETOPS)                             |  |                                    |                              |
| 03                                    | 79-701-00-LOT | Oil Level Check Both Engines (ETOPS)                    |  |                                    |                              |
|                                       |               |                                                         |  |                                    |                              |
|                                       |               |                                                         |  |                                    |                              |
|                                       |               |                                                         |  |                                    |                              |
|                                       |               |                                                         |  |                                    |                              |
|                                       |               |                                                         |  |                                    |                              |
|                                       |               |                                                         |  |                                    |                              |
|                                       |               |                                                         |  |                                    |                              |
| Check completed by:                   |               | Sign:                                                   |  | Approval Document No.              | Check completed<br>Hour/Min. |
| .....                                 |               | .....                                                   |  | .....                              | .....                        |

# Limitations on Dual Maintenance

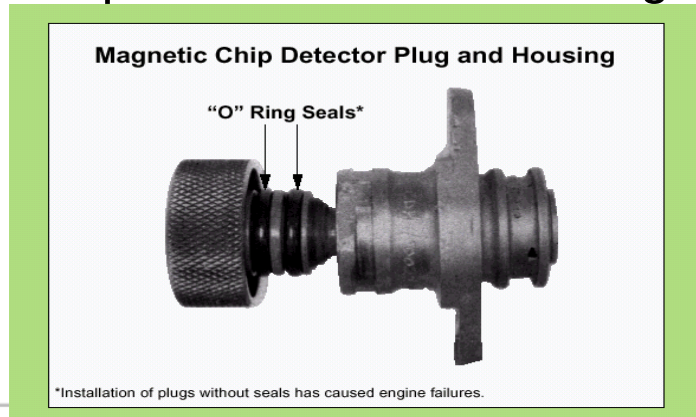
- Dual Maintenance as defined in AC 120-42B:

*“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

- **Purpose** 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 IDG



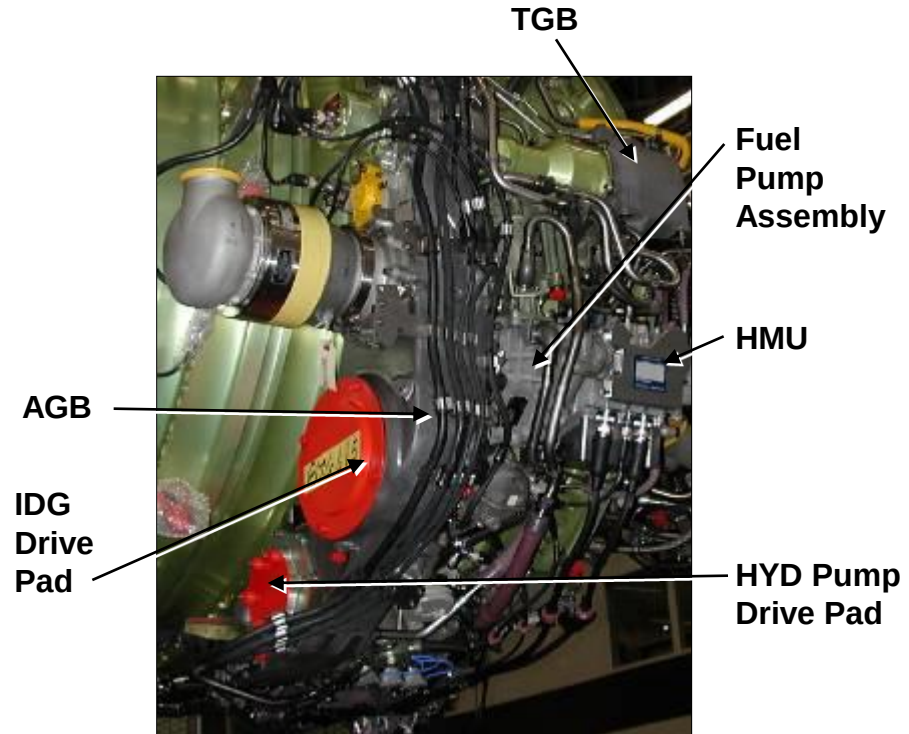
MCD





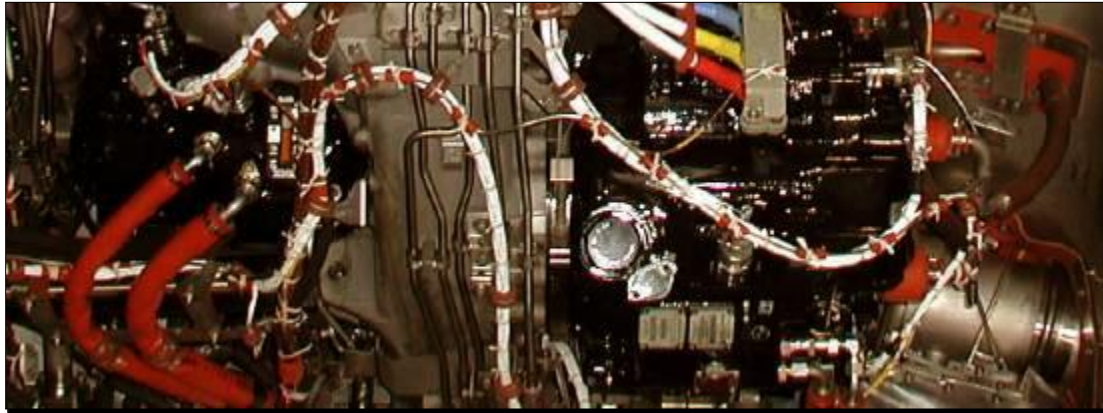
# Limitations on Dual Maintenance

- 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 could include:
  - Replacement of number one IDG (Integrated Drive Generator) and the number two EDP (Engine Driven Pump)



# Limitations on Dual Maintenance

- If dual maintenance cannot be avoided (AC 120-42B):
  - Use different technicians, or
  - Utilize an inspector or supervisor to inspect the work being performed
  - In both cases, perform sufficient verification tests on both systems



# 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



# ETOPS Verification Program

- ☐ 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 (FIM, MM, Airline)
  - Verification flight (only if necessary)
- ☐ Verification flight not required unless the discrepancy in question can-not be verified on ground.
- ☐ When required, verification flight should be coordinated through the operators Maintenance Control Center and described in the ETOPS Document



# ETOPS Verification Program

- Necessity of in-flight verification
  - Due to intermittent faults that cannot be verified on the ground (i.e. condition in which fault found has to be replicated in flight)
  - Do to historical system reliability degradation
  - Ground verification should be the first form of resolution followed by an in-flight verification only as necessary
  - If an in-flight verification is required;
    - Can be accomplished on an ETOPS or non ETOPS flight
    - The first 60 minutes of an ETOPS flight should be used for this verification

**If in-flight verification is needed, Technician should make an entry into Tech Log Book.**



# ETOPS Verification Program

- ❑ In-Flight verification procedures;
  - Crew operates equipment/system in flight
  - Communication with MCC for system operational capability
  - Crew records result in logbook
  - If Pass – Crew continues or selects ETOPS route
  - If Fail – Return, divert, or continue on NON-ETOPS route

Coordination between the flight crew and maintenance control is essential



# ETOPS Task Identification

- ❑ **Purpose:** to promote ETOPS awareness by ensuring only ETOPS qualified maintenance personnel accomplish tasks specific to ETOPS
- ❑ All tasks must be accomplished by ETOPS qualified maintenance personnel by;
  - Identifying on the certificate holder's routine work/task cards
  - Parceling them together and identified as an ETOPS package

The following PDSC is recommended by The Boeing Company for the 787 airplane. The operator can elect to use this as their approved check or add/remove items as required to compliment their existing maintenance program.

| 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 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 metal/oil accumulation.                                                                    |           |
| 11.                                                                                                          | GVI of the left engine cowl, 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 cowl, 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: _____                                           |  |
| <b>Final Check Sign-Off</b>                                                                                 |                                                                                                                                                                                                                        |  |
| All ETOPS Checks performed by ETOPS qualified mechanic.                                                     |                                                                                                                                                                                                                        |  |
| Any abnormal engine and/or APU oil consumption requirements should be coordinated with Maintenance Control. |                                                                                                                                                                                                                        |  |

NOTE: Unless otherwise specified, all GVIs are to be performed from ground level.



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# ETOPS 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
      - IPC
- 

# **BOEING** 777 PARTS CATALOG (MAINTENANCE)

FIGURE 1

| ITEM | PART NUMBER | 1234567 | NOMENCLATURE                | EST<br>LEO | APP<br>LEO | 777<br>PCO<br>ASST | ITEM | PART NUMBER                                 | 1234567 | NOMENCLATURE | EST<br>LEO | APP<br>LEO | 777<br>PCO<br>ASST |
|------|-------------|---------|-----------------------------|------------|------------|--------------------|------|---------------------------------------------|---------|--------------|------------|------------|--------------------|
| SP   | 767166A     |         | GENERATOR ASST-             | 99         | A          | 1                  | A    | 6002-4039, 6001-8224, 6401-6405, 6501-6501  |         |              |            |            |                    |
|      |             |         | SUPPLIER CODE:              |            |            |                    | A    | A002-4013, A131-A132, A171-A173             |         |              |            |            |                    |
|      |             |         | 99967                       |            |            |                    | C    | A131-A135, A171-A173                        |         |              |            |            |                    |
|      |             |         | FUNCTIONAL DESCRIPTION:     |            |            |                    | E    | 6018-6025                                   |         |              |            |            |                    |
|      |             |         | PROVIDES PRIMARY            |            |            |                    | G    | 6029-6039, 6208-6224, 6401-6043, 6501-6501  |         |              |            |            |                    |
|      |             |         | AIRCRAFT ELECT. POWER       |            |            |                    | G    | 6012-6013                                   |         |              |            |            |                    |
|      |             |         | BY CONVERTING VARIABLE      |            |            |                    | G    | 6024-6028, 6201-6207                        |         |              |            |            |                    |
|      |             |         | ENGINE INPUT SPEED TO A     |            |            |                    | G    | 6026-6039, 6201-6224, 6401-6043, 6501-6501  |         |              |            |            |                    |
|      |             |         | CONSTANT OUTPUT SPEED,      |            |            |                    | J    | 6002-4017                                   |         |              |            |            |                    |
|      |             |         | SWALLOWING THE GENERATOR    |            |            |                    | K    | B551-B551                                   |         |              |            |            |                    |
|      |             |         | PORTION OF THE IDG TO       |            |            |                    | M    | A002-4013, A171-A173                        |         |              |            |            |                    |
|      |             |         | PRODUCE AC POWER            |            |            |                    | P    | 6002-4039, 6025-6032, 6034-6034, 6036-6036, |         |              |            |            |                    |
|      |             |         | 400 HZ                      |            |            |                    | P    | 6039-6039                                   |         |              |            |            |                    |
|      |             |         | SPECIFICATION NUMBER:       |            |            |                    | S    | 6018-6026, 6027-6031, 6033-6033, 6035-6035, |         |              |            |            |                    |
|      |             |         | 5281001-20                  |            |            |                    | S    | 6027-6038, 6201-6224, 6401-6405, 6501-6501  |         |              |            |            |                    |
|      |             |         | FOR ELEMENT MAINTENANCE USE |            |            |                    | AA   | A171-A172                                   |         |              |            |            |                    |
|      |             |         | FILTER MAINT KIT POWER IN   |            |            |                    | AA   | A131-A135                                   |         |              |            |            |                    |
|      |             |         | FILTER MAINT KIT LIST.      |            |            |                    | AM   | 6018-6018, 6022-6024                        |         |              |            |            |                    |
|      |             |         | FILTER MAINTENANCE KIT REF: |            |            |                    | AM   | A002-4017                                   |         |              |            |            |                    |
|      |             |         | 654W0019-22                 |            |            |                    | XM   | A002-4017, B051-B068                        |         |              |            |            |                    |
| - 7  | M024121     |         | ELECTRICAL GUP NUMBER:      |            |            |                    |      |                                             |         |              |            |            |                    |
|      |             |         | M24001                      |            |            |                    |      |                                             |         |              |            |            |                    |
|      |             |         | COMPONENT MAINT MANUAL REF: |            |            |                    |      |                                             |         |              |            |            |                    |
|      |             |         | 24-2111                     |            |            |                    |      |                                             |         |              |            |            |                    |
|      |             |         | MAINTENANCE MANUAL REF:     |            |            |                    |      |                                             |         |              |            |            |                    |
|      |             |         | 24-11-05                    |            |            |                    |      |                                             |         |              |            |            |                    |
|      |             |         | FOR DETAILS SEE:            |            |            |                    |      |                                             |         |              |            |            |                    |
|      |             |         | 24-11-01-158                |            |            |                    |      |                                             |         |              |            |            |                    |
|      |             |         | GENERATOR ASST-             | 99         | KR         | RF                 |      |                                             |         |              |            |            |                    |
|      |             |         | SUPPLIER CODE:              |            |            |                    |      |                                             |         |              |            |            |                    |
|      |             |         | V9B49                       |            |            |                    |      |                                             |         |              |            |            |                    |
|      |             |         | REFERENCE AIRLINE MOD:      |            |            |                    |      |                                             |         |              |            |            |                    |
|      |             |         | 1CR810758                   |            |            |                    |      |                                             |         |              |            |            |                    |
|      |             |         | VIAL                        |            |            |                    |      |                                             |         |              |            |            |                    |
|      |             |         | NOTE:                       |            |            |                    |      |                                             |         |              |            |            |                    |
|      |             |         | UNITED STOCK NUMBER FOR     |            |            |                    |      |                                             |         |              |            |            |                    |
|      |             |         | PARTS: 767166A, 7640376     |            |            |                    |      |                                             |         |              |            |            |                    |



# ETOPS Parts Control Program

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

\*Example Statements

IPC Example

**BOEING**  
777  
PARTS CATALOG (MAINTENANCE)

FIGURE 1

| ITEM | PART NUMBER | 1234567 NOMENCLATURE                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       | EFF<br>LEG | APPL<br>LEG | UNITS<br>PER<br>ASSY |
|------|-------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------|-------------|----------------------|
| SP   | 767146A     | GENERATOR ASSY-<br>SUPPLIER CODE:<br>V99167<br>FUNCTIONAL DESCRIPTION:<br>PROVIDES PRIMARY<br>AIRCRAFT ELECT. POWER<br>BY CONVERTING VARIABLE<br>ENGINE INPUT SPEED TO A<br>CONSTANT OUTPUT SPEED,<br>ENABLING THE GENERATOR<br>PORTION OF THE IDG TO<br>PRODUCE AC POWER<br>(400 HZ)<br>SPECIFICATION NUMBER:<br>S281W101-20<br>FOR ELEMENT MAINTENANCE USE<br>FILTER MAINT KIT DEFINED IN<br>FILTER MAINT KIT LIST.<br>FILTER MAINTENANCE KIT REF:<br>654W019-22<br>ELECTRICAL EQUIP NUMBER:<br>M24001<br>COMPONENT MAINT MANUAL REF:<br>24-11-11<br>MAINTENANCE MANUAL REF:<br>24-11-03<br>FOR DETAILS SEE:<br>24-11-01-13D<br>GENERATOR ASSY-<br>SUPPLIER CODE:<br>V98649<br>REFERENCE AIRLINE MOD:<br>SC8010758<br>VUAL<br>NOTE:<br>UNITED STOCK NUMBER FOR<br>PARTS: 767146A,764939A | 99         | A           | 1                    |
| - 7  | NR24121     |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            | 99         | XB          | RF                   |

| ITEM | PART NUMBER                                                                            | 1234567 NOMENCLATURE | EFF<br>LEG | APPL<br>LEG | UNITS<br>PER<br>ASSY |
|------|----------------------------------------------------------------------------------------|----------------------|------------|-------------|----------------------|
| A    | 6002-6039, 6201-6224, 6401-6403, 6501-6501                                             |                      |            |             |                      |
| B    | A002-A013, A131-A132, A171-A173                                                        |                      |            |             |                      |
| C    | A131-A135, A171-A173                                                                   |                      |            |             |                      |
| D    | 6018-6025                                                                              |                      |            |             |                      |
| E    | 6029-6039, 6208-6224, 6401-6403, 6501-6501                                             |                      |            |             |                      |
| F    | 6012-6013                                                                              |                      |            |             |                      |
| G    | 6026-6028, 6201-6207                                                                   |                      |            |             |                      |
| H    | 6026-6039, 6201-6224, 6401-6403, 6501-6501                                             |                      |            |             |                      |
| J    | 6002-6017                                                                              |                      |            |             |                      |
| K    | B551-B551                                                                              |                      |            |             |                      |
| N    | A002-A013, A171-A173                                                                   |                      |            |             |                      |
| P    | 6026-6026, 6032-6032, 6034-6034, 6036-6036, 6039-6039                                  |                      |            |             |                      |
| S    | 6018-6025, 6027-6031, 6033-6033, 6035-6035, 6037-6038, 6201-6224, 6401-6403, 6501-6501 |                      |            |             |                      |
| AA   | A131-A132                                                                              |                      |            |             |                      |
| AB   | A131-A135                                                                              |                      |            |             |                      |
| AD   | 6018-6018, 6022-6024                                                                   |                      |            |             |                      |
| XD   | A002-A017                                                                              |                      |            |             |                      |
| XD   | A002-A017, B051-B048                                                                   |                      |            |             |                      |



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# ETOPS Reliability Program

- ☐ Reliability section records and reports ETOPS flight statistics to regulatory authority
- ☐ Report to Include:
  - Date of event
  - Time of event
  - Phase of flight
  - Registration number
  - Engine type, serial number
  - Total cycles and time since last shop visit
  - Corrective action
- ☐ Reportable ETOPS Events:
  - In-Flight Shut Down
  - Diversions or turnbacks
  - Uncommanded engine power changes or surges
  - Inability to control engines
  - Problems related to ETOPS significant systems
  - Any other events detrimental to ETOPS



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# ETOPS Reliability Program

- ☐ Investigation includes the determination of:
  - Cause of problem
  - Corrective action required
  - Changes to maintenance program, if necessary, to prevent recurrence of problem
  - Verification to ensure that corrective action was effective
- ☐ Report ETOPS events and action taken in monthly reliability report

| XYZ AIRLINES<br>ETOPS Reliability Program – Event Log |               |            |             |             |                   |                |
|-------------------------------------------------------|---------------|------------|-------------|-------------|-------------------|----------------|
| Airplane Model:                                       |               |            |             |             | Page ___ of ___   |                |
| Date of Event                                         | Flight Number | A/C Number | ATA Chapter | Description | Corrective Action | Date Completed |
|                                                       |               |            |             |             |                   |                |
|                                                       |               |            |             |             |                   |                |
|                                                       |               |            |             |             |                   |                |
|                                                       |               |            |             |             |                   |                |
|                                                       |               |            |             |             |                   |                |
|                                                       |               |            |             |             |                   |                |
|                                                       |               |            |             |             |                   |                |
|                                                       |               |            |             |             |                   |                |
|                                                       |               |            |             |             |                   |                |



# ETOPS Propulsion System Monitoring

## The Operator

- The objective: the operator is to maintain the IFSD rate below the *alert level* as specified in the table below “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 an including 120 Minutes                                                    |
| 2                 | .03/1000                         | .02/1000                         | Beyond 120 minutes. up 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.

# ETOPS Propulsion System Monitoring

- From AC 120-42B;
  - “The FAA will not revoke an existing ETOPS operational approval solely because of a high IFSD rate.”
  - “A certificate holder who experiences a type design event need not be operationally penalized for a problem that is design related and may not be of their own making.”
  - “The certificate holder must investigate any indication of a high IFSD rate, however, it should consider that in the case of the smaller fleet, the high IFSD rate may be because of the limited number of engine operating hours used as the denominator for the rate calculation.”

# ETOPS Oil Consumption Monitoring

- ❑ 787 Maximum consumption rate is identified in the AMM (ATA 71) and the airworthiness limitations document
- ❑ 787-8 Oil Consumption Limits;
  - Trent 1000 – 0.53 US quarts per hour (0.50 liters per hour)

787 GE Oil Servicing Port



# ETOPS Oil Consumption Monitoring

- 787 APU Oil Currently Required to be “Type 1”
  - Type 1 oil provides the required viscosity to help high altitude starting.
  - Flight deck indication is available to verify APU oil quantity.
  - Consumption rate is based on APU hours.
  - Some software enhancements
- ETOPS maintenance program must have process and procedures to determine abnormal oil consumption from the previous flight.



# ETOPS APU In-flight Start Program

- **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 once a baseline rate is established
  - Start intervals are adjusted according to system performance and fleet maturity and approved by the Regulatory Authority



Sample  
report

|                                                                                            |       |       |       |       |       |       |       |       |       |       |       |       |       |
|--------------------------------------------------------------------------------------------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|
| DATE: 02/08/03                                                                             |       |       |       |       |       |       |       |       |       |       |       |       |       |
| <b>XYZ Airlines</b><br><b>ETOPS APU INFLIGHT START REPORT</b><br><b>B777 (GTCP331-500)</b> |       |       |       |       |       |       |       |       |       |       |       |       |       |
| Percentage of successful first start attempts, last 3 month period: <b>96%</b>             |       |       |       |       |       |       |       |       |       |       |       |       |       |
|                                                                                            | 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:<br>B. Boeing - XYZ Airlines Reliability                                       |       |       |       |       |       |       |       |       |       |       |       |       |       |



# ETOPS APU In-flight Start Program

- ☐ Start Attempts Made and Recorded
  - On non-ETOPS Flights
  - On Return Leg of ETOPS Flight
- ☐ Start initiated before top of decent, and after a a 2 hour cold soak at altitude
- ☐ Subsequent start attempts are acceptable provided they are within manufacturer specifications as stated in the AMM
- ☐ Reliability Section Tracks Data



# ETOPS APU In-flight Start Program

- If 95% Reliability Achieved - Random Test
- If Not, Attend to System and Resume Test
- **FAA 8900.1, section volume 4**
- Operators must report failed start attempts within 96 hours to the Regulatory Authority
- **Start attempts which exceed the manufactures specifications**
- Final report submitted to the Regulatory Authority including corrective action taken, status of corrective action, and fleet upgrades

Record of  
successful/unsuccessful  
starts after flight



First European Airline  
to Fly Boeing 787 Dreamliner™

LOT Polish Airlines ETOPS Briefing



# ETOPS Maintenance Training

- Maintenance personnel to be trained;
  - All maintenance personnel who will perform maintenance on the 787 fleet
  - Maintenance Control
  - Repair stations that will maintain the 787
  - 787 Venders where your program requires training
  - 787 Contract Maintenance
  - Initial station training
  - Consideration for validation exercise
  - General familiarization for management



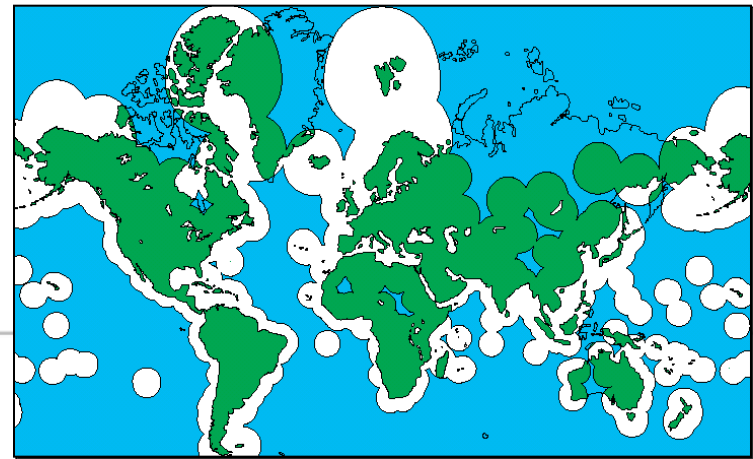
# ETOPS Maintenance Training

- 787 ETOPS Practical Training (OJT) could include;
  - Pre Departure Service Check familiarization
  - On-the-job training on other ETOPS activities
    - Maintenance actions on multiple systems
    - Ground tests (resolution of discrepancies)
    - Data collection and calculations
    - Filling out forms
    - Reporting procedures



# ETOPS Maintenance Training

- ❑ ETOPS awareness training should be considered
- ❑ Training is to be provided to those individual who don't directly touch the airplane examples (shops, Spares, Management)
- ❑ Typically delivered by Computer Based Training (CBT)
- ❑ Purpose of training is to make personnel aware of the special requirements which surround ETOPS





# 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

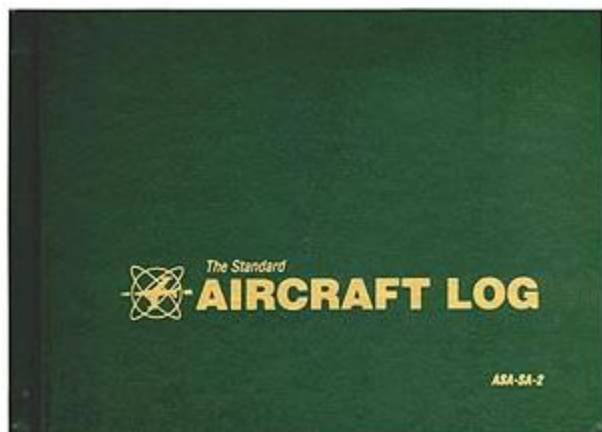
*What is considered substantial for a new ETOPS operator maybe considerably different than for an operator with many years of ETOPS experience*



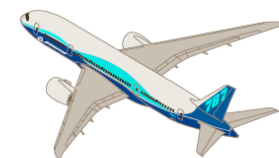




# ETOPS Dispatch Considerations



 **BOEING**



**787**  
**Dispatch Deviations Guide**  
**(DDG)**  
**Draft**

**WARNING:** The technology herein is controlled by U.S. Export Administration Regulations. Any export or re-export of this technology must comply with EAR.  
 Controlled by ECCN: 9E991 Date: 18 October 2008

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Document Number D6302004-01  
 March 28, 2008



*First European Airline  
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# ETOPS Dispatch Considerations

## □ MMEL, MEL, DDG

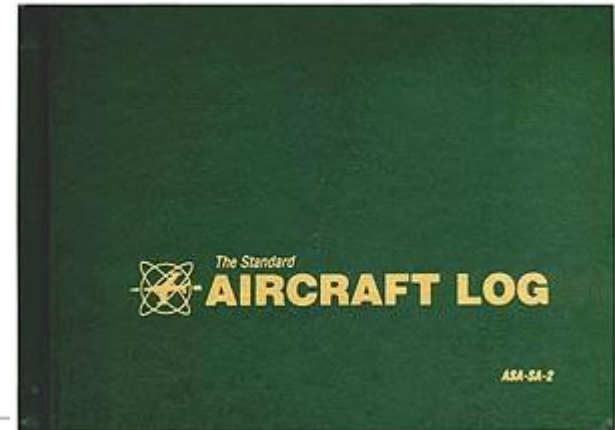
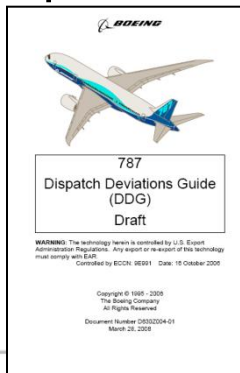
- Master Minimum Equipment List (**MMEL**)
  - FAA document maintained by airplane model
  - Contains all approved deviations for inoperative equipment
- Minimum Equipment List (**MEL**)
  - Airline document required by FAR 121.628
  - Can not be less restrictive than MMEL
- Dispatch Deviation Guide (**DDG**)
  - Boeing document to assist operator interpretation of MMEL
  - Contains expanded operational (**O**) and maintenance (**M**) procedures
  - Also includes approved Configuration Deviation List (**CDL**)



# ETOPS Dispatch Considerations

## □ Purpose:

- “Is intended to **permit operation** with inoperative items of equipment for a limited period of time **until repairs can be accomplished**”
- “When an item of equipment is **discovered to be inoperative**, it is **reported** by making an entry in the Aircraft Maintenance Records/Logbook as prescribed by FAR. The item is then either **repaired** or may be **deferred per the MEL** or other approved means acceptable to the Administrator prior to further operation”



# ETOPS Dispatch Considerations

- 787 MMEL
- 24-22-02 APU Starter Generator

Example of 787 MMEL Item\*

**BOEING**

ATA 24787 DDG Dev DocSection 2

24-22-02

APU Starter Generator Systems

| Interval | Installed | Required | Procedure |
|----------|-----------|----------|-----------|
| C        | 2         | 0        | (M) (O)   |

May be inoperative provided:

a. VFSG Systems operate normally.

b. Flight remains within 180 minutes of landing at a suitable airport.

\* Refer to current revision of MMEL for up to date information

# ETOPS Dispatch Considerations

- 787 MMEL
- 24-22-02 APU Starter Generator

Example



## MAINTENANCE (M)

Prepare the airplane for dispatch with APU starter generator inoperative (AMM 24-00-00/721).

1. Position associated Electrical Panel (P5) APU GEN L or R switch OFF.

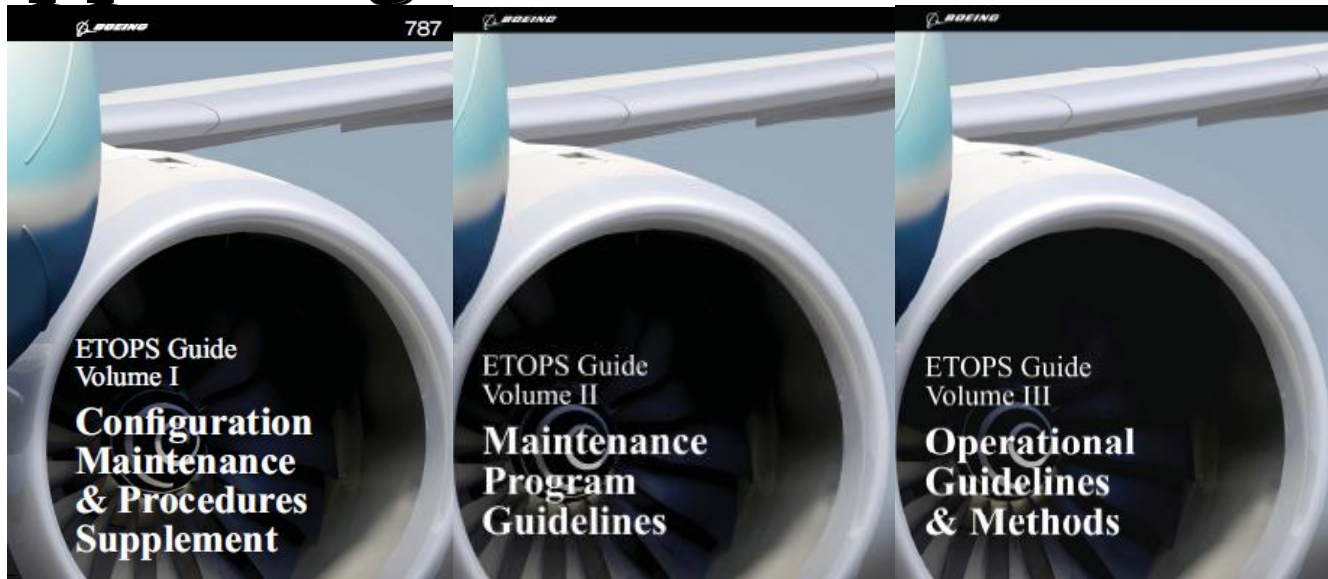
NOTE 1: An inoperative APU starter generator may be removed provided the appropriate dispatch tool is installed.

NOTE 2: With one APU starter generator inoperative and removed, the APU may be operated with the remaining APU starter generator. If the APU is operated for more than 120 hours with an APU starter generator removed, the APU gearbox should be inspected for wear.

## OPERATIONS (O)

1. Flight must remain within 180 minutes of landing at a suitable airport.
2. With one APU starter generator inoperative and removed, the APU may be operated with the remaining APU starter generator.
3. If the APU cannot be operated:
  - A. Start the first engine using the Engine Ground Electrical Start Supplementary Procedure.
  - B. Start the remaining engine using the Engine Cross Start Supplementary Procedure.
4. The following weight and balance information is provided for dispatching with the APU starter generator(s) removed:
  - A. Starter Generator (each):
    - 1) Weight: 120 lb ( 55 kg)
    - 2) Balance arm: 2128 in
  - B. Dispatch Kit (each):
    - 1) Weight: 22 lb (10 kg)
    - 2) Balance arm: 2128 in

# ETOPS Guides, Templates, and Supporting Materials





# ETOPS Guides, Templates and Support Materials



**XYZ AIRLINES**

ACCELERATED ETOPS  
OPERATIONAL APPROVAL PLAN

**XYZ Airlines**

Extended range,  
Two engine Operations  
(ETOPS)  
Manual

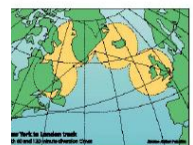
**TRAINING**



**BOEING**  
B787-900 ETOPS FLIGHT CREW GUIDE

Boeing B7X7-Y00

**ETOPS FLIGHT CREW GUIDE**



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# ETOPS Guides, Templates and Support Materials

## *ETOPS Affects*

- ☐ Configuration Requirements
- ☐ Airline Maintenance Programs
- ☐ Dispatch Restrictions

