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A QUARTERLY PUBLICATION
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AEROMAGAZINE

Building Better
Communication

**New Air Traffic
Surveillance
Technology**

Complying with
the Aging Airplane
Safety Rule

New Tool for
Collaboration on
In-Service Issues

Fuel Conservation
Strategies:
Descent and
Approach

AERO

AERO

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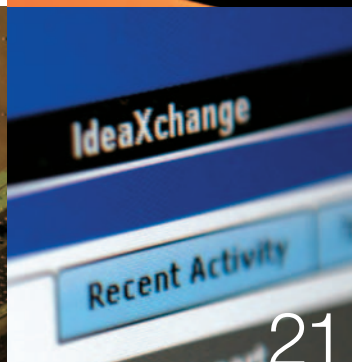
The descent and approach phases of flight are the flight crew's final opportunities to reduce fuel consumption.



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AERO

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AERO magazine is published quarterly by Boeing Commercial Airplanes and is distributed at no cost to operators of Boeing commercial airplanes. *AERO* provides operators with supplemental technical information to promote continuous safety and efficiency in their daily fleet operations.

The Boeing Company supports operators during the life of each Boeing commercial airplane. Support includes stationing Field Service representatives in more than 60 countries, furnishing spare parts and engineering support, training flight crews and maintenance personnel, and providing operations and maintenance publications.

Boeing continually communicates with operators through such vehicles as technical meetings, service letters, and service bulletins. This assists operators in addressing regulatory requirements and Air Transport Association specifications.

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Building Better Communication



LOU MANCINI

Senior Vice President
Boeing Commercial Aviation Services

Four years ago, we reintroduced *AERO* magazine in response to a Boeing customer support survey, in which you told us how much you value information from and communication with Boeing.

As a matter of daily business, we continually communicate with Boeing operators through such vehicles as technical meetings, service letters, and service bulletins. Our goal in bringing back *AERO* magazine was to provide supplemental technical information that helps you operate your Boeing fleets efficiently and increases your awareness of Boeing products and services.

Late last year, we went back to you to find out how well we were doing. We conducted an *AERO* readership survey (see figs. 1–4), and more than 900 of you responded. Thank you!

We were very pleased to learn that a significant majority of readers (92 percent of survey respondents) “agree” to “strongly agree” that *AERO*’s content is valuable and timely. Specifically, respondents said they value articles about engineering (86 percent), maintenance (84 percent), safety (82 percent), and flight (80 percent).

People overwhelmingly (80 percent) read all four issues per year, with half reading the entire issue every quarter and a third focusing on articles pertaining to their jobs.

Respondents said they read *AERO* both on the Internet and in print. Of the respondents who work for the airlines and have

Figure 1: Total survey respondents' locations by continent

AERO readership is evenly spread across the globe.

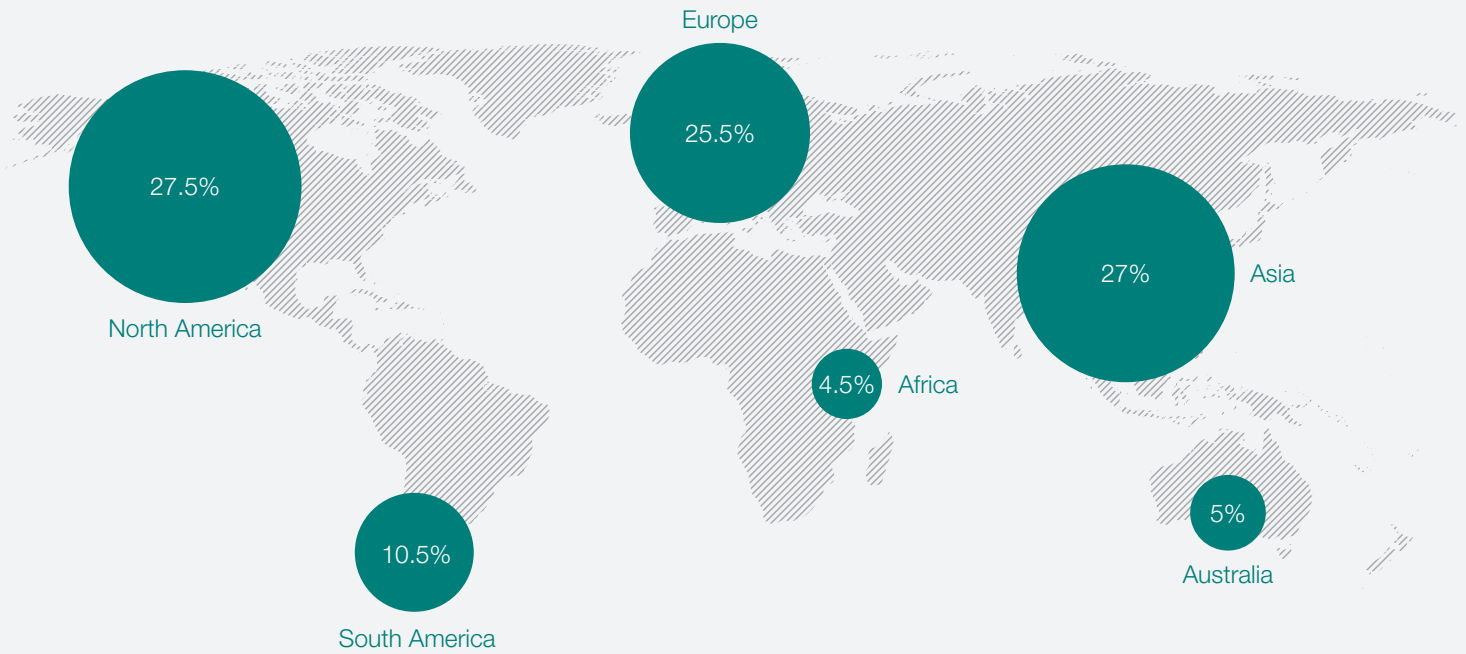
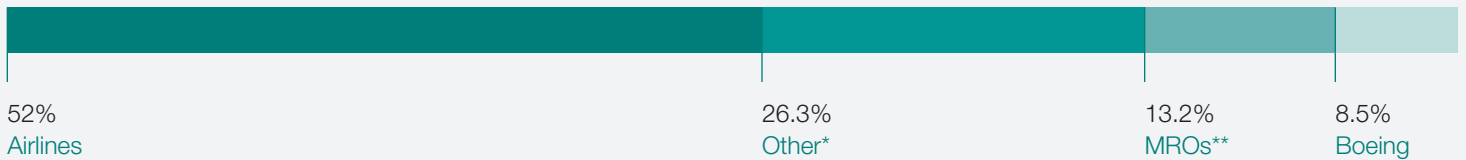


Figure 2: Demographics of AERO readership survey respondents

Airlines continue to be the most frequent readers of AERO.



* Other = Variety of statistically small categories: supplier, regulator, school, library, trade association, media

** Maintenance, repair, and overhaul organizations

Figure 3: Airline respondents' locations by country

More than 65 percent of survey respondents who work at airlines are from 16 countries.

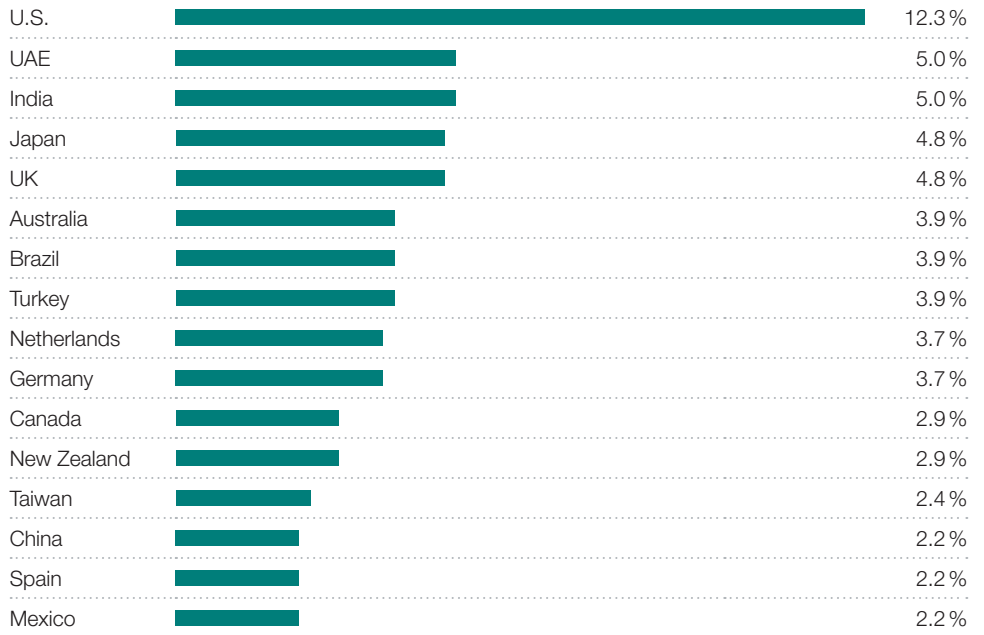
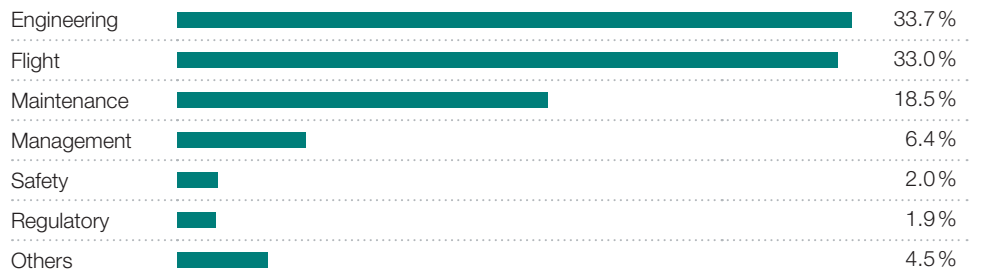


Figure 4: Airline respondents' areas of expertise

Most airlines respondents' expertise is in engineering, flight, or maintenance.



access to print copies, more than half prefer reading the magazine in print and a quarter prefer reading it online.

The majority of respondents (70 percent) can easily access *AERO* on the Internet, and most (82 percent) find *AERO* easily navigable and accessible online. However, we were surprised to learn that about 12 percent of respondents did not know that *AERO* was available on the Internet. As a result, we are planning an awareness

campaign to help advertise the *AERO* Web site at www.boeing.com/commercial/aeromagazine. We also will be looking for opportunities to create even richer interactive experiences for readers on the Internet.

We sincerely appreciate the time you took to let us know what you like about *AERO* — as well as where you hope we'll improve. Please feel free to contact us anytime to let us know what you'd like to see in *AERO*. You may e-mail your ideas

and comments to us at WebMaster.BCA@boeing.com.

Thank you for sharing your thoughts, and thank you for operating Boeing airplanes.

Lou Mancini



ADS-B is intended to transform air traffic control by providing more accurate and reliable tracking of airplanes in flight and on the ground.

New Air Traffic Surveillance Technology

Air traffic service providers and regulators around the world are moving toward airspace and flight operations to enable greater flexibility and adaptability, along with assuring improved traffic flow, capacity, efficiency, and safety. A key part is the transition from radar surveillance to Automatic Dependent Surveillance-Broadcast (ADS-B) to track airplanes in flight and on the ground more accurately and reliably. The changes will require new equipment on Boeing airplanes in production as well as those already in service.

By William R. Richards, Technical Fellow, Avionics and Air Traffic Management;
Kathleen O'Brien, Associate Technical Fellow, Avionics and Air Traffic Management; and
Dean C. Miller, Associate Technical Fellow, Avionics and Air Traffic Management

ADS-B is a new surveillance technology designed to help modernize the air transportation system. It provides foundational technology for improvements related to the Next Generation Air Transportation System (or NextGen) and Single European Sky Air Traffic Management (ATM) Research Programme (or SESAR). NextGen refers to the effort of the U.S. Federal Aviation Administration (FAA) to transform the air traffic control (ATC) system to support a larger volume of airplanes more efficiently. SESAR is a similar effort in Europe.

Developed and certified as a viable low-cost replacement for conventional radar, ADS-B allows ATC to monitor and control airplanes with greater precision and over a far larger percentage of the earth's surface than has ever been possible before. For example, large expanses of Australia and Hudson Bay in Canada, currently without any radar coverage, are now visible on ATC screens after strategic placement of low-cost ADS-B receiving stations.

For NextGen and SESAR, ADS-B is one of the most important underlying technologies in the plan to transform ATC from the current radar-based surveillance to

satellite-based global positioning system (GPS) surveillance. In addition, the FAA states that ADS-B will serve as the cornerstone for this transformation, bringing the precision and reliability of satellite-based surveillance to the nation's skies.

This article explains the new ADS-B technology, how it works in the airplane, how it is used in ATC, and how this technology benefits ATC surveillance on the ground. It will also explain how ADS-B will increase flight crew awareness of other airplanes in the air and on the ground, highlight potential operator benefits, and outline the upcoming equipment mandates.

HOW ADS-B WORKS

ADS-B uses a combination of satellites, transmitters, and receivers to provide both flight crews and ground control personnel with very specific information about the location and speed of airplanes in the area (see fig. 1).

From the airplane perspective, there are two aspects to ADS-B. ADS-B Out signals are sent from the transmitting airplanes to receivers located on the ground or in other airplanes. The ADS-B Out signals travel line-of-sight from transmitter to receiver. ADS-B Out signals are received by ATC ground stations for display of traffic to air traffic controllers. ADS-B Out signals are also received by other airplanes in the vicinity of the transmitting airplanes. After reception of the ADS-B signals by the receiving airplane, the lateral position (latitude and longitude), altitude, velocity, and flight number of the transmitting airplane are presented to the receiving airplane pilot on a Cockpit Display of Traffic Information (CDTI). The received ADS-B signal is called ADS-B In. The maximum range between the transmitting and receiving airplanes is greater than 100 nautical miles (nmi), allowing the CDTI to display traffic both near and far.

Navigation satellites send precise timing information that allows airplanes equipped with global navigation satellite system (GNSS) or GPS receivers to determine their

own position and velocity. Airplanes equipped with ADS-B Out broadcast precise position and velocity to ground ADS-B receivers and to other airplanes via a digital datalink (1090 megahertz) along with other data, such as the airplane's flight number and emergency status. ADS-B receivers that are integrated into the ATC systems on the ground or installed aboard other airplanes (i.e., ADS-B In) provide users with an accurate depiction of real-time aviation traffic.

Unlike conventional radar, ADS-B works at low altitudes and on the ground so that it can be used to monitor traffic on the taxiways and runways of an airport. ADS-B is also effective in remote areas where there is no radar coverage or where radar coverage is limited.

THE BENEFITS OF ADS-B TO AIRLINES

With appropriate ground and airborne equipage updates and operational procedure readiness, ADS-B may provide airlines with several benefits, including:

Safety. ADS-B gives the aviation industry the ability to maintain or improve existing safety standards while increasing system efficiency and capacity.

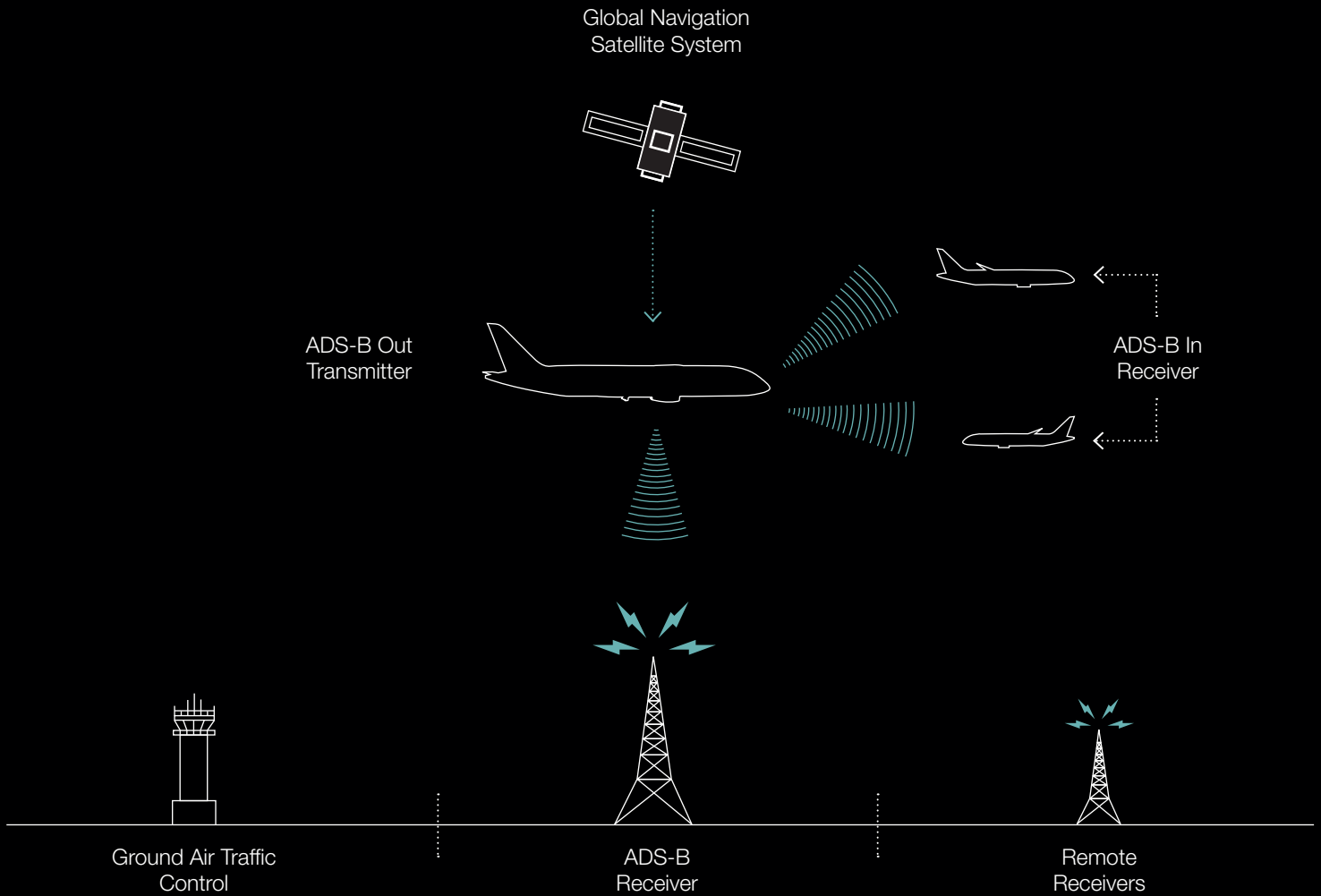
- ADS-B significantly improves flight crews' situational awareness because they know where they are in relation to other airplanes.

- It gives a real-time, common surveillance picture to share information quickly if participating airplanes deviate from their assigned flight paths.
- It offers more precise and commonly shared traffic information. All participants have a common operational picture.
- It provides more accurate and timely surveillance information than radar. ADS-B provides more frequent updates than radar, which rotates once every 6 or 12 seconds for terminal and en route surveillance, respectively.
- It displays both airborne and ground traffic.
- It allows for a much greater margin in which to implement conflict detection and resolution than is available with any other system by providing an effective range of more than 100 nmi with high accuracy.
- It clearly and immediately indicates changes as the conflicting traffic turns, accelerates, climbs, or descends.
- ADS-B In applications can provide automatic traffic call-outs or warnings of imminent runway incursions.

Capacity. ADS-B can provide a substantial increase in the number of flights the ATC system can accommodate. More airplanes can occupy a given airspace simultaneously if separation standards are reduced, and the increased precision of ADS-B enables greatly reduced separation standards

Figure 1: How ADS-B works

By using a combination of satellites and receivers, ADS-B provides both flight crews and ground control personnel with information about the position and velocity of airplanes in the area.



What ADS-B means

Automatic

Position and velocity information is *automatically* transmitted periodically (at least once every second) without flight crew or operator input. Other parameters in the transmission are preselected and static.

Dependent

The transmission is *dependent* on proper operation of on-board equipment that determines position and velocity and availability of a sending system.

Surveillance

Position, velocity, and other airplane information are *surveillance* data transmitted.

Broadcast

The information is *broadcast* to any airplanes or ground station with an ADS-B receiver. Current mode S ATC transponders are interrogated and then send a reply.

Airlines can reduce cost per passenger kilometer by flying more direct routes at more efficient altitudes and speeds with uninterrupted climbs and descents.

while maintaining safety. ADS-B not only increases the accuracy and integrity of the position reports but also increases the frequency of the reports for a better understanding of the air traffic environment in the air and on the ground. ADS-B also:

- Increases runway capacity with improved arrival accuracy to the metering fix.
- Helps maintain runway approaches using cockpit display of traffic information in marginal visual weather conditions.
- Enhances visibility of all airplanes in the area to allow more airplanes to use the same runway.
- Allows 5 nmi of separation in non-radar airspace (NRA) compared to current procedural separation, and potentially allows reduction of separation from 5 to 3 nmi in radar airspace.

Efficiency. ADS-B provides improved flight efficiency as well as increased capacity. It allows substantial improvement in the accuracy of surveillance data within the ATC system. This helps ATC understand the actual separation between airplanes and allows controllers to avoid inefficient vectoring commands to maintain separation assurance. In-trail procedures, which assist airplanes to move to optimal operational altitudes in remote areas, such as oceanic airspace, allow pilots to request and receive changes to a higher, more fuel-

efficient cruise altitude, which also reduces environmental impact. With ADS-B:

- Airplanes can fly closer together because controllers have more precise data updated more often.
- The amount of fuel consumed is reduced because airplanes fly a more efficient path.
- Existing, proven digital communications technology is used, allowing ADS-B to be implemented rapidly for a relatively low cost.
- There is affordable, effective surveillance of all air and ground traffic, even on airport taxiways and runways and in airspace where radar is ineffective or unavailable.
- General aviation airplanes can use ADS-B datalinks to receive flight information services such as graphical weather depiction and textual flight advisories.
- Airlines can reduce cost per passenger kilometer by flying more direct routes at more efficient altitudes and speeds with uninterrupted climbs and descents.
- Engine emissions and airplane noise are reduced through continuous descent and curved approaches.

EQUIPMENT REQUIRED FOR ADS-B

Special equipment is required both on board airplanes and on the ground to transmit and receive ADS-B signals.

Airborne components for ADS-B Out. A Global Navigation Satellite System (GNSS) receiver and associated antennas on board the airplane receive and process GNSS satellite signals to produce the airplane's position and velocity. The position and velocity information is sent to the ATC transponder, which develops ADS-B Out messages that are broadcast from the ATC antennas.

Airborne components for ADS-B In. An airborne collision avoidance system/traffic alert and collision avoidance system unit and associated antennas is used to receive the ADS-B Out message from a target airplane. The target airplane information is then processed and sent to a cockpit display of traffic information (CDTI) for display to the flight crew. Depending on the requirements of the ADS-B In application, other airborne systems that could be affected include flight management computer, control panels, electronic flight bag, displays, and associated wiring.

Ground components. The ATC system must include ADS-B ground stations to receive the ADS-B Out messages from airplanes. ADS-B ground stations include an ADS-B receive antenna with an unobstructed view toward the horizon, an ADS-B receiver, power supply, communications link (satellite or terrestrial), and physical and data security.

Standards are required to assure that the airborne components work properly with the ground components for air navigation service providers (ANSPs) around the world.

ADS-B OUT GROUND APPLICATIONS

ADS-B Out offers several benefits to ground-based ATC. In radar areas, it can be used by ATC to supplement 5- and 3-nmi en-route separation services. Where no other radar or surveillance is available, it can be used by ATC to provide those separation services.

For airport surface surveillance, ADS-B Out provides ground control with a picture of all airplanes and vehicles on the ground.

In the terminal area, ADS-B Out could enable 2.5-nmi separation in-trail approaches, 2-nmi separation for dependent parallel approaches, and separation during independent parallel approaches for runways spaced more than 4,300 feet apart.

ADS-B IN AIRBORNE APPLICATIONS

ADS-B In offers potential benefits across all domains of flight, from departure to arrival (see “ADS-B in various domains of flight” on this page). It provides situational awareness of other airplanes and vehicles on the airport surface (see fig. 2) and situational awareness of other airborne traffic, such as assistance in finding targets

outside the cockpit window using the CDTI. ADS-B In could also enhance situational awareness on approach, allowing continued approaches using the CDTI after initial visual acquisition.

Airborne spacing applications facilitate increased capacity and efficiency in a number of ways. Enhanced sequencing and merging enable precise delivery of airplanes to the meter fix for subsequent continuous descent approaches; in trail procedures assist airplanes in moving to optimal operational altitudes in remote areas; and enhanced crossing and passing operations assist airplanes in flying optimal flight routes and speeds. ADS-B In also enables airplane crews to assume responsibility for separation from up to two other airplanes through delegated enroute separation. In this scenario, the controller retains responsibility for separation from other airplanes beyond the two the crew has assumed responsibility for.

ADS-B AROUND THE WORLD

ADS-B activity is increasing around the world. ANSPs are looking to ADS-B as a means of decreasing the cost of providing services and increasing the operational efficiency and capacity of the regional air transportation system.

Boeing is actively engaged with European regulators and operators and the FAA to gain approval for Boeing airplanes

ADS-B in various domains of flight

ATC provides flow management to coordinate across all domains

Terminal

Surface and Departure

- Surface Situational Awareness

En Route

Domestic Climb and Cruise

- Conflict Detection
- Airborne Situational Awareness

Oceanic

Oceanic and Remote

- In-Trail Procedures
- Reduced Separation
- Enhanced Crossing and Passing Operations
- Airborne Situational Awareness

En Route

Transitional to Arrival

- Continuous Descent Approaches
- Airborne Situational Awareness

Terminal

Arrival and Surface

- Final Approach Runway Occupancy Awareness
- Enhanced Visual Separation on Approach
- Surface Situational Awareness

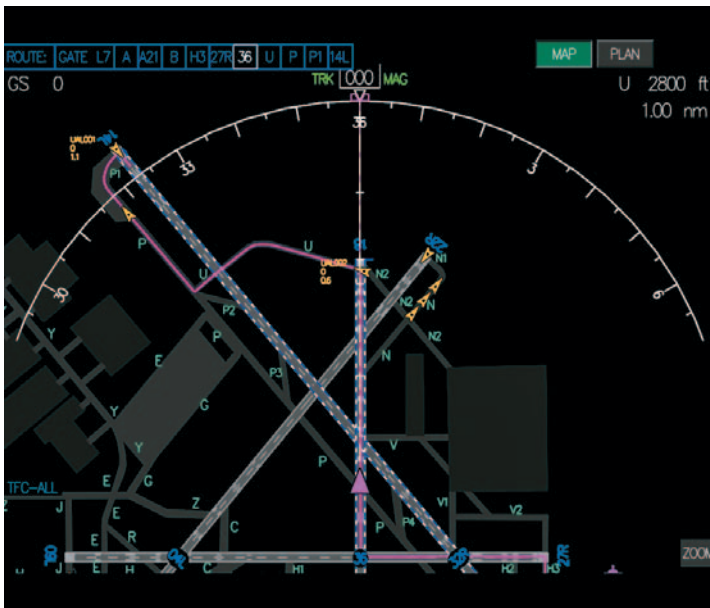


Figure 2: Airport surface situational awareness

Surface situational awareness gives flight crews data about the airport surface for taxi and runway operations, improving safety and reducing taxi time, especially during low-visibility conditions.

to operate current ADS-B equipage in European NRA. Boeing has been installing ATC transponders with 1090ES ADS-B Out since early 2004. Boeing has provided the FAA with documentation supporting the FAA's August 2008 approval that this existing equipage complies with the requirements outlined in European Aviation Safety Agency (EASA) acceptable means of compliance (AMC) 20-24 document regarding ADS-B equipage for NRA. Boeing is updating airplane flight manuals to reflect equipage compliance with EASA AMC 20-24.

The earliest known mandate for ADS-B equipage is November 2010 in Canada's Hudson Bay, where separation will be reduced from 80 nmi to 5 nmi in trail. Transport Canada is allowing use of the 1090ES existing equipage for this NRA application.

The next mandate will be December 2013 in Australia. Because much of Australia's western airspace is not covered by radar systems, the country has selected to aggressively move forward with ADS-B-based surveillance to avoid the costs associated with deployment and maintenance of expensive radar systems. Australia will also allow use of existing transponder equipage but will require selective-availability-aware (i.e., SA-aware) global positioning system receivers for all new production airplanes delivered after June 2012 that operate in Australian airspace.

Europe has near-term plans to deploy ADS-B Out on a voluntary basis for traffic flow improvements in NRA using existing equipage. Europe plans to mandate ADS-B Out on all airplanes entering European airspace in 2015 and in 2013 for new production airplanes. Europe and the United States have decided to mandate transponders that meet the new DO-260B transponder standard published by the Radio Technical Commission for Aeronautics) in December 2009.

The United States plans on mandating ADS-B Out by January 2020 for all airplanes, both air transport and general aviation. With increasing ADS-B Out equipage in the United States from now until the 2020 mandate year, the FAA expects voluntary equipage with ADS-B In to support users with improved operational benefits.

China is exploring ADS-B Out in NRA.

BOEING'S INVOLVEMENT WITH ADS-B

Boeing is working with air navigation service providers and other industry partners to collaboratively define the requirements for airborne equipage that supports ADS-B.

An assessment is under way to define the transition plan for production airplanes to include the mandated DO-260B capability. Airlines and fleet operators will be required to retrofit their airplanes to meet the European ADS-B mandates by 2015

and the U.S. mandate by 2020. Boeing will prepare service bulletins to provide operators with complete information on retrofitting their fleet. Boeing is currently evaluating the fleet to assess for cost-effective ADS-B In/CDTI implementation.

Meanwhile, Boeing recommends that airplanes that have been purchased with 1090 enhanced/elementary surveillance (ES) capability, or have been modified for 1090ES, be certified for NRA operations to achieve early benefits of reduced separation.

If an operator has older airplanes that are not equipped with 1090ES and does not expect to receive future new airplanes, Boeing recommends waiting for the implementation rules around the world to be finalized and published before upgrading and certifying new equipage.

SUMMARY

ADS-B is intended to transform ATC by providing more accurate and reliable tracking of airplanes in flight and on the ground. Boeing is working with ATC providers and the standards communities around the world to enable new globally interoperable surveillance capabilities and to ensure that the appropriate ADS-B equipment is available.


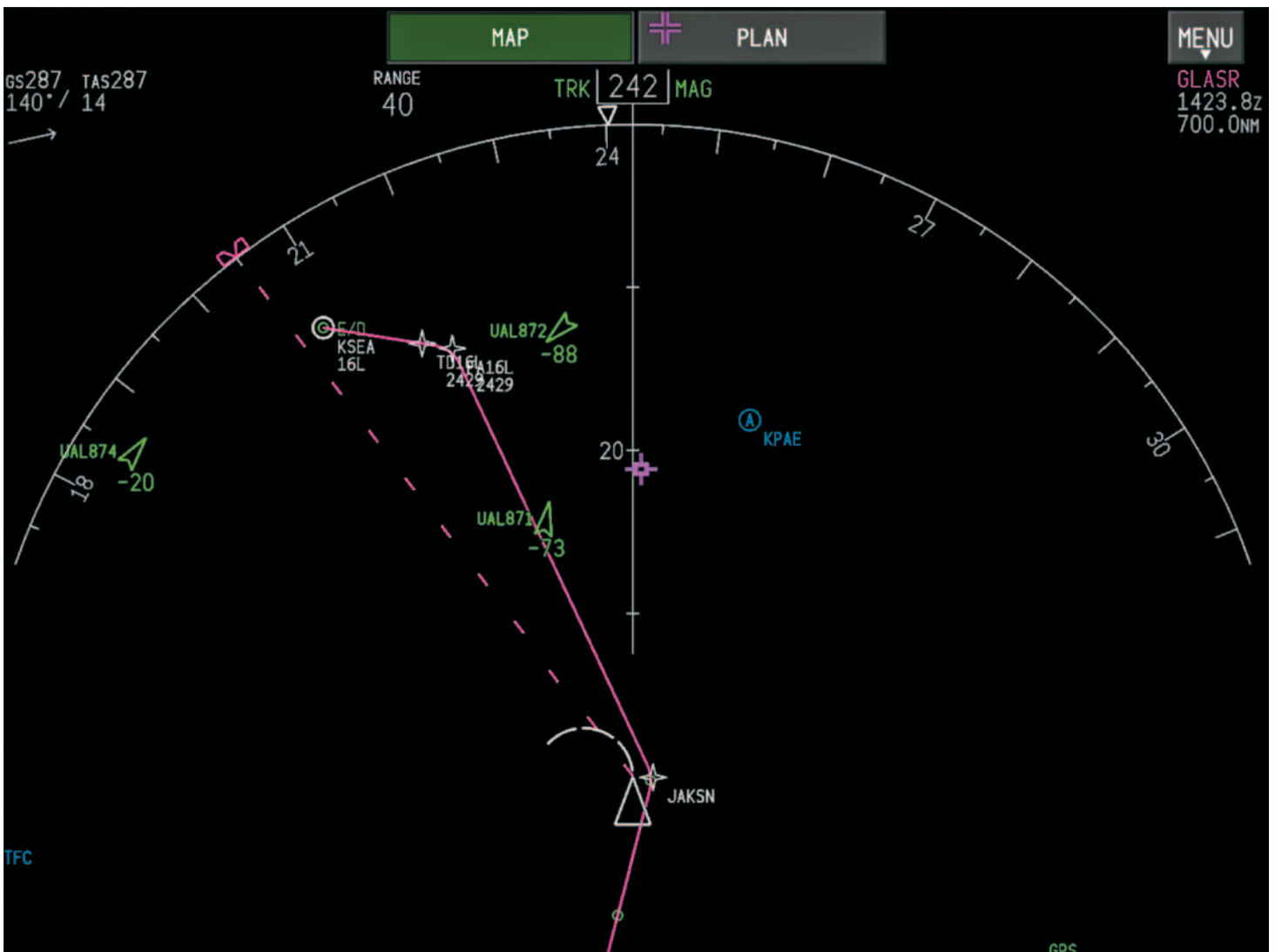
For more information, please contact William Richards at william.r.richards@boeing.com. 

Figure 3: Airborne situational awareness

Airborne situational awareness provides additional data to flight crews during flight operations to enhance flight safety and ATC efficiency. ADS-B information is sent to a CDTI for display to the pilot. The display represents other airplanes with a chevron (triangular symbol), which is oriented to represent the direction of travel, and shows airplane flight ID, altitude, and vertical trend vector to indicate that the airplane is climbing or descending. Other data could be displayed, such as its ground speed and wake vortex category.





After December 20, 2010, airplane operators must ensure that all new repairs to fatigue-critical structure receive a damage tolerance evaluation.

Complying with the Aging Airplane Safety Rule

By December 20, 2010, airlines that operate airplanes under Title 14 of the Code of Federal Regulations (CFR) 121 or 129 must revise their U.S. Federal Aviation Administration (FAA)-approved structural maintenance program to comply with the FAA's Aging Airplane Safety Rule (AASR). This revised maintenance program must include damage-tolerance-based inspections; a means to address the effects that repairs, alterations, and modifications may have on fatigue-critical structure and these inspections; and a means by which all changes to the maintenance program receives FAA approval. Boeing has developed materials to help operators comply with this new rule.

By Roxanne M. Pillo, AASR Deputy Program Manager, Fleet Support Engineering Airframe, and **Amos Hoggard**, Technical Fellow (Retired), AASR Program

The Aging Aircraft Safety Act of 1991 passed by Congress in 1991 — and later codified by the FAA as the AASR — requires airlines to ensure that repairs or modifications made to their airplanes are damage-tolerant. As part of the requirement, airlines must have a damage-tolerance-based maintenance program in place by December 20, 2010. This includes the development of an FAA-approved Operator Implementation Plan that contains the processes and timelines the operator will use for obtaining and incorporating maintenance actions to address the effects of repairs and alterations.

In order to comply with the AASR, operators will need to reassess their structural maintenance program and the way repair approvals are being considered.

Retroactive aspects to this rule require surveys of all active airplanes for the purpose of documenting existing repairs, alterations, and modifications requiring damage tolerance inspections. Specific time periods have been established to obtain the inspection requirements for existing repairs, alterations, and modifications that currently lack the required damage tolerance inspections.

At least 4,000 airplanes (U.S.-registered) and 240 operators are affected by this new rule. While only U.S.-registered airplanes are affected at this time, the number of affected airplanes could more than double if the FAA rule is adopted by other regulatory agencies, including the European Aviation Safety Agency and Transport

Canada. Currently, some operators of non-U.S.-registered airplanes intend to voluntarily comply with the AASR.

Boeing, working with the industry, has developed FAA-approved methods of compliance to help operators meet the terms of the new rule. The AASR-required changes are complex and require significant revision to the processes and procedures contained in existing maintenance programs. This article provides regulatory background about the new rule, key provisions of the AASR, the compliance method developed by the commercial airline industry, and the information developed by Boeing to support operator compliance with the new rule.

REGULATORY BACKGROUND AND REQUIREMENTS

The AASR was published, in part, to satisfy the Aging Aircraft Safety Act of 1991. The act requires air carriers to demonstrate that maintenance of an airplane's age-sensitive parts and components has been "adequate and timely enough to ensure the highest degree of safety."

The AASR requires operators to have a damage-tolerance-based structural maintenance program for each applicable transport category airplane operated in 14 CFR 121 and U.S.-registered airplanes operated in 14 CFR 129. The requirement extends to the fatigue-critical structure of the baseline, as-delivered airplane structure, as well as to existing and future repairs and alterations that affect fatigue-critical structure. The rule affects all Boeing 7-series, MD, and DC turbofan-powered transport category airplanes. Operators must comply with this rule by December 20, 2010.

Operators are expected to develop and gain FAA approval of an Operator Implementation Plan that details how the operator will comply with the requirements of the operational rules. This plan will consist of both new and existing operator-specific processes the operator will use in demonstrating compliance, including:

- A process to identify repairs and alterations that will require damage tolerance inspections. (The FAA defines damage tolerance inspections as maintenance actions necessary to detect or preclude fatigue cracking that could contribute to catastrophic failure. Damage tolerance inspections are developed as a result of a damage tolerance evaluation.)
- A process to obtain the inspection data and perform the needed inspections.
- A process to conduct surveys of airplanes to determine whether existing repairs will require damage tolerance inspections.

To facilitate operator compliance to the operational rules and to assist in operator development of their implementation plan, the FAA also has required type certificate holders and design approval holders to make available certain new and updated information under 14 CFR 26, Subpart E, including:

- Documents defining fatigue-critical structure.
 - Fatigue-critical baseline structure lists.
 - Fatigue-critical alteration structure lists.
- Updated published information with damage-tolerance-based maintenance data for items affecting fatigue-critical structure, including:
 - Structural repair manuals.
 - Fleet-support service bulletins.
 - Master-change service bulletins.
 - Supplemental type certificates.
- Model-specific compliance documents that contain a repair evaluation guideline.

KEY PROVISIONS AFFECTING OPERATORS

New repair approvals to fatigue-critical structure. As of January 11, 2008, this covers any new or significantly revised repair, master-change service bulletin, or supplemental type certificate approved by Boeing on behalf of the FAA required and contained damage tolerance inspections. Operators must adopt the damage tolerance provisions provided in the approval paperwork for these repairs and alterations for all new installations after January 11, 2008. After December 20, 2010, it is the operators' responsibility to ensure that all new repairs to fatigue-critical structure receive a damage tolerance evaluation and are properly documented in the damage-tolerance-based maintenance program.

Existing repairs. Existing repairs are defined as those installed prior to

December 20, 2010, that affect fatigue-critical structure and do not have approvals indicating a damage tolerance evaluation and the resulting damage tolerance inspections require further action. Operators are expected to identify and document these repairs via an airplane survey. All airplanes delivered prior to December 20, 2010, will require a survey to determine repairs to fatigue-critical structure that do not have damage tolerance inspections. The operator's implementation plan will need to define how they will obtain and implement the damage tolerance inspections for these repairs.

Existing alterations. Existing alterations are those installed prior to December 20, 2010, that affect fatigue-critical structure and do not have approvals indicating a damage tolerance evaluation and the resulting damage tolerance inspections require further action. Operators are expected to utilize the information provided by Boeing or other design approval holders to ensure that a damage-tolerance-based maintenance program exists for all existing alterations.

AN INDUSTRY-DEVELOPED METHOD OF COMPLIANCE

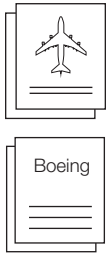
Boeing participated in the Airworthiness Assurance Working Group (AAWG) to establish a method of compliance that could be broadly supported by all stakeholders. The AAWG developed the initial draft of the FAA's advisory circular for this rule, AC 120-93. Boeing continues to participate in the AAWG to enable resolution and awareness of compliance issues at an industry level throughout the implementation of this rule.

After the final rule was published, Boeing organized and held five model-specific Structures Task Group (STG) meetings to guide development of the Boeing documents that operators would use to assist them in the development of

Figure 1: AASR compliance process

Operators use Boeing documents and their existing maintenance programs to develop implementation plans.

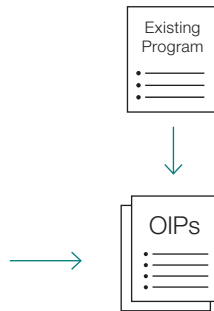
Type Certificate (TC) or Design Approval Holder (DAH)



Compile

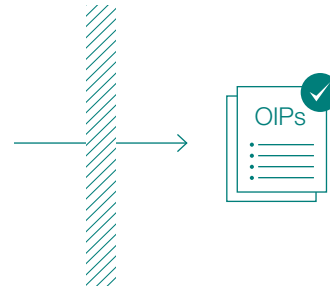
Baseline programs and FAA-Oversight-Office-approved Boeing documents.

Operator



Plan

New Operator Implementation Plans (OIPs) outline damage tolerance inspection and evaluation processes.



Review

OIPs are reviewed by the Principal Maintenance Inspector (PMI).



Deliver

Incorporation of the OIP into the Maintenance Program is approved by the PMI by December 20, 2010.

their implementation plan. The groups were organized according to AAWG guidelines, and each STG had representation of approximately 60 percent of the active airplanes in a specific airplane fleet.

The compliance process developed by these groups involves operators using Boeing documents and their existing maintenance programs to develop operator implementation plans. These plans are reviewed and approved by the operator's FAA principal maintenance inspector (or local regulatory authority). The plan is then used as a means by which the damage tolerance data is aggregated and used to revise the maintenance program after December 20, 2010 (see fig. 1).

INFORMATION FOR OPERATORS PROVIDED BY BOEING

Boeing has developed FAA-approved methods of compliance to support operator compliance. As part of this effort, Boeing is making available both new and updated model-specific material to help ensure operator compliance with AASR (see fig. 2). The model-specific information is currently available for purchase on the Web portal MyBoeingFleet.com unless otherwise noted:

Compliance document and repair evaluation guidelines. The FAA required Boeing to make available an FAA-approved compliance document and repair evaluation guidelines to assist an operator in establish-

ing damage-tolerance-based maintenance programs for existing repairs to fatigue-critical structure. This document is model specific and provides requirements for the operator to perform surveys and establish damage-tolerance-based maintenance programs for existing repairs using the Boeing data listed below. In addition, the document establishes time periods for a variety of actions to be accomplished, including:

- Completion of surveys.
- Determination of damage tolerance inspections.
- Accomplishment of first inspections.
- Available grace periods.

Figure 2: New and updated publications to assist in operator compliance

Boeing has made these materials available to help airlines operating these models comply with the new AASR. This table shows the document numbers for the various categories of published data.

Model	Baseline Programs			Repair Assessment Guidelines (RAG)	Fatigue Critical Baseline Structure (FCBS)	Fatigue Critical Alteration Structure (FCAS)	Structural Repair Manual (SRM)	Fleet Support Collector Service Bulletin (FSSB)
	Maintenance Planning Data Structures/ Zonal Programs	Maintenance Planning Data/ Airworthiness Limitations Instructions (ALI)	Supplemental Structural Inspection Document (SSID)					
DOUGLAS MODELS								
717	ME717-030 ²	MDC-96K9063	N/A	N/A	MDC-08K9008	MDC-08K9023-Vol-06	D634L201	717-00-0001
DC-8	MEDAC-33652 ¹ ME8-0003 ²	N/A	DM-IS-SID-8-1	MDC-91K0262	MDC-08K9009	MDC-08K9023-Vol-01 MDC-08K9023-Vol-02	-50/-60: TP-8SRM -70: TP87SRM	DC8-00-001
DC-9	ME9-001 ²	N/A	DM-IS-SID-9-1	MDC-91K0263	MDC-08K9010	MDC-08K9023-Vol-01 MDC-08K9023-Vol-03	TP-9SRM	DC9-00-001
MD-80	761-93MSG2 ² ME80-020 ³	N/A	DM-IS-SID-80-1		MDC-08K9011	MDC-08K9023-Vol-04	TP-9SRM	MD80-00-004
MD-90	ME90-040 ²	MDC-94K9000	N/A	N/A	MDC-08K9007	MDC-08K9023-Vol-05	TP-90SRM	MD90-00-001
DC-10	ME10-008 ¹ ME10-38 ²	N/A	DM-IS-SID-10-1	MDC-91K0264	MDC-08K1002	MDC-08K9023-Vol-01 MDC-08K9023-Vol-07	-10: TP-10SRM-10 -30: TP-10SRM-30 -40: TP-10SRM-40 & TP-10SRM-4J	DC10-00-001
MD-10	ME10-017 ¹ ME10-38-ORS ²	MDC-99K1082			MDC-08K1003	MDC-08K9023-Vol-01 MDC-08K9023-Vol-09	-10: TP-10MD10SRM-10 -30: TP-10MD10SRM-30	MD10-00-002
MD-11	ME11-015 ²	MDC-K5225	N/A	N/A	MDC-08K1004	MDC-08K9023-Vol-08	-1F: TP-11SRM-1F -1P: TP-11SEM-1P -CF: TP-11SRM-CF	MD11-00-003
7-SERIES EXCEPT 717								
727	N/A	N/A	D6-48040-1	D6-56167	D6-84024	D6-84179	D6-4062	727-00-0015
737-100/-200	N/A	N/A	D6-37089	D6-38669	D6-84141	D6-84180	D6-15565	737-00-1006
737-300/-400/-500	N/A	N/A	D6-82669				-300: D6-37635 -400: D6-38246 -500: D6-38441	
Next-Generation 737	D626A001	D626A001-9	N/A	N/A	D926A120-01		-600: D634A220 -700: D634A201 -700CONV: D634A202 -700IGW: D634A330 -800: D634D210 -900: D634A211 -900ER: D634A213	737-00-1007
747-100/-200/-300/-SP	N/A	N/A	D6-35022	D6-36181	D926U120-01 D6-84110 ¹	D624U050-03 D6-84110 ¹	-100/-200/-300: D6-13592 -SP: D6-34024	747-00-2157
747-400	N/A	N/A			D926U121-01	-400: D634U102 -400F: D634U103	747-00-2157 CL 747-00-2158-400	
747-400LCF	N/A	N/A			D926U122-01	D634U105		
747-400BCF	N/A	N/A				D634U104		
757	D622N001	D622N001-9	N/A	N/A	D926N120-01	D190N001	-200: D634N201 -200PF: D634N210 -200CB: D634N211 -300: D634N230	757-00-0003
767	D622T001	D622T001-9	N/A	N/A	D926T120-01	D624T050-02	-200: D634T201 -200SF: D634T202 -300: D634T210 -300BCF: D634T235 -300F: D634T215 -400: D634T225	767-00-0048
777	D622W001	D622W001-9	N/A	N/A	D926W120-01	D624W050-01	-200: D634W201 -300: D634W210 -F: D634W215	777-00-0002

Additional documents unique to Douglas models:

Structural Repair Drawings Damage Tolerance Summary	
DC-8	MDC-09K9014
DC-9, MD-80, MD-90, 717	MDC-09K9015
DC-10, MD-10, MD-11	MDC-09K1012

Master Change Collector Service Bulletin (MCSB)	Compliance Document and Repair Evaluation Guidelines (CD/REG)
717-00-002 ³	MDC-09K9009 & MDC-09K9018 ⁴
DC8-00-002 ³	MDC-09K9010 & MDC-09K9018 ⁴
DC9-00-002 ³	MDC-09K9011 & MDC-09K9018 ⁴
MD80-00-003 ³	MDC-09K9012 & MDC-09K9018 ⁴
MD90-00-002 ³	MDC-09K9013 & MDC-09K9018 ⁴
DC10-00-003 ³	MDC-09K1009 & MDC-09K9018 ⁴
MD10-00-004 ³	MDC-09K1010 & MDC-09K9018 ⁴
MD11-00-004 ³	MDC-09K1011 & MDC-09K9018 ⁴
727-00-0016 ²	D6-84300 & D6-84340 ³
737-00-1008 ²	D6-84301 & D6-84340 ³
737-00-1009 ²	D042A525 & D6-84340 ³
747-00-2155 ²	D926U200-01 & D6-84340 ³
757-00-0004 ²	D042N521 & D6-84340 ³
767-00-0049 ²	D926T242-01 & D6-84340 ³
777-00-0003 ²	D926W221-01 & D6-84340 ³

Fatigue-critical structure. Boeing has made available lists of fatigue-critical baseline structure for all affected models. The FAA has defined fatigue-critical structure as “airplane structure that is susceptible to fatigue cracking that could contribute to a catastrophic failure. [It] includes structure that, if repaired or altered, could be susceptible to fatigue cracking and contribute to a catastrophic failure. Such structure may be part of the baseline structure or part of an alteration.” Operators can use the lists provided by Boeing to determine whether a repair or an alteration requires a damage tolerance evaluation and the development of damage tolerance inspections. Boeing has also made available lists of fatigue-critical alteration structure for those master changes and supplemental type certificates held by Boeing.

Published data. Boeing has updated published repair and alteration data for all applicable models to include damage tolerance inspections. This includes structural repair manuals, fleet-support service bulletins, master-change service bulletins, and Boeing-held supplemental type certificates. The damage tolerance inspections for service bulletins have been published in a single service bulletin collector document for each airplane model. In the future, when individual service bulletins (listed in the service bulletin collector document) are revised, the damage tolerance inspection information will be included in the new release and the information in the collector document will no longer apply. (Collector documents for master-change service bulletins will be generated upon request and customized to reflect operator-


specific configurations. Operators purchase a master-change collector document by submitting a request for proposal to Boeing.)

Boeing AASR seminar. Boeing is also conducting AASR seminars focusing on the steps necessary to establish compliance with the new operational rules and the Boeing publications developed to support operator compliance. Availability can be found at <http://active.boeing.com/nosearch/svceng/seminars.cfm>.

SUMMARY

A major change to structural maintenance programs for all 7-series, DC, and MD transport category airplanes operated under CFR 121 and 129 will be required on December 20, 2010. The FAA rule change requires operators to have damage-tolerance-based maintenance programs for affected transport category airplanes and requires a physical survey of airplanes to obtain damage tolerance data for repairs and alterations.

Boeing has published new and updated material to help operators comply with this new rule. All Boeing data needed by operators to comply with the new rule is available for purchase on MyBoeingFleet.com, except for customized master-change service bulletins, which are available by request. Boeing is conducting seminars on this subject

For more information, please contact Roxanne Pillo at roxanne.m.pillo@boeing.com. 

FOOTNOTES: DC, MD and 717

¹ On airplane maintenance planning document for use in MSG-2 maintenance programs.

² Maintenance planning data document for use in MSG-3 maintenance programs.

³ Collector for all master changes. Operators will receive a unique document and document number based on their particular fleet.

⁴ Equivalency guidelines referenced in the CD/REG document.

FOOTNOTES: 7-series except 717

¹ D6-84110 is the list of alteration service bulletins that affect FCBS and FCAS.

² Collector for all master changes. Operators will receive a unique document and document number based on their particular fleet.

³ Equivalency guidelines referenced in the CD/REG document.

N/A = Not applicable

IdeaXchange

Recent Activity

Print / Export

xchange

Models

DC-10, MD-80...

The collaboration process involves the exchange of information and knowledge using the Fleet Team bulletin board, meetings, and teleconferences.

New Tool for Collaboration on In-Service Issues

For more than 10 years, Boeing has been working with airplane owners and operators to address in-service issues using Fleet Team processes and the Fleet Team Resolution Process (FTRP) and Fleet Team Emerging Issues (FTEI) bulletin boards. Boeing recently introduced a new collaboration platform that integrates these two bulletin boards within a single application: the Fleet Team Xchange. The platform includes a number of new features and has the capacity to support the future integration of additional collaboration spaces for special working groups.

By Sue Jacintho, Airplane Systems Design Engineer, and
Krijn de Jonge, 757/767 Fleet Chief

Boeing has developed a new tool to collaborate with airplane owners and operators on issues, best practices, and solutions. The Fleet Team Xchange provides enhancements while preserving the core functionality of the previous FTRP and FTEI applications. This article explains the new collaboration tool and provides an overview of its use.

EVOLUTION OF THE COLLABORATION PROCESS

In 1999, Boeing launched the FTRP bulletin board, a tool to gain customer involvement in addressing in-service economic issues. Boeing and operators use the data posted

on the bulletin board to determine fleet-wide impact of issues and to pursue efficient solutions together. These solutions include airplane modifications that are addressed in airplane or component service bulletins and sharing of best practices.

Based on the FTRP, Boeing subsequently introduced the FTEI bulletin board to raise awareness of safety issues, engage operators in the resolution of these issues, and supplement the Air Transport Association of America (ATA) lead airline process.

As part of the Fleet Team process, Boeing launched the Fleet Team Digest (FTD) and model-specific teams, meetings, and conference calls. The FTD articles provide the latest information about economic issues, all safety issues, in-service

events, fleet improvements, and other major projects. During meetings and conference calls, the model-specific teams review posted issues and responses, discuss which items need to be worked, and collaborate on their resolution.

Ten years after their introduction, Boeing Fleet Team tools are utilized by more than 5,000 users at more than 500 companies worldwide and are among the most frequently accessed programs on the Web portal MyBoeingFleet.com. More than 6,000 FTD articles are available via MyBoeingFleet.com.

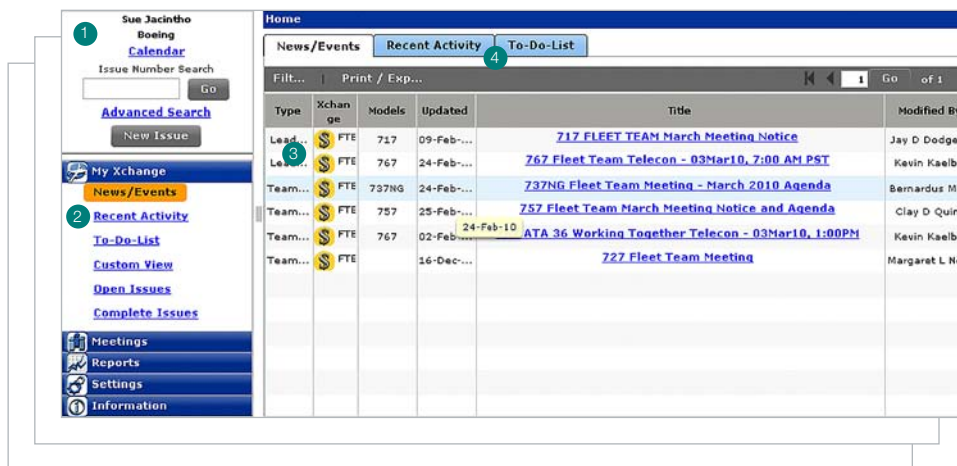
(Additional information about the Fleet Team processes can be found in *AERO* third-quarter 2000 and second-quarter 2007.)

Figure 1: Fleet Team Xchange user home page

The home page contains three panes similar to the FTRP and FTEI applications: (1) a static pane in the upper left, (2) a navigation pane on the left side of the screen, and (3) a main pane that occupies the majority of the screen. When a team member logs in, three tabs are shown in the main pane: News/Events, Recent Activity, and To-Do-List (4).

A new wiki feature enables users to contribute information to refine issues. Once an issue is published, other users can edit the wiki to add relevant information and solutions.

The new application supports expanded bulletin-board discussions for each issue.



THE NEW FLEET TEAM XCHANGE

Fleet Team Xchange, which Boeing introduced in December 2009, is a collaboration tool that integrates the FTEI and FTRP bulletin boards. It offers new and enhanced features and functions specifically designed to address user requests and requirements, while preserving the core functionality of the two previous applications. The issues on the new bulletin board are categorized either as economic (FTE) or safety (FTE). Operators who have used the FTRP and FTEI applications will see a familiar home page when they log in to Fleet Team Xchange (see fig. 1). To enhance the collaboration process, several new capabilities have been incorporated in the new tool, including drafts, a wiki feature, and e-mail.

Once an issue has been published by one operator, other users may contribute to and update the content for that specific issue by using the new wiki feature, by adding to the discussion, or both. The users can co-author and co-edit the collaborative issue article (i.e., wiki). Each wiki is intended to capture and retain knowledge and integrate best practices. The discussion thread complements each collaborative article and is intended to capture ideas, experiences, data, and comments that are worth sharing but do not need to be integrated into the article.

Detailed impact data can be entered for each item that is posted. When other operators post responses and their impact data, a summary is shown. Once a solution for a

specific issue is available, operators can share their opinion about the value in terms of cost, ease of implementation, and overall effectiveness. Item-level access via e-mail is provided as needed to suppliers and partners.

THE FLEET TEAM COLLABORATION PROCESS

The collaboration process involves the exchange of information and knowledge using the new Fleet Team bulletin board and ongoing Fleet Team meetings and teleconferences. All operators are invited to participate in the Fleet Team meetings and teleconferences. The solutions that are jointly developed are documented and published on MyBoeingFleet.com, in service bulletins or service letters, and in FTD articles. The collaboration takes place in three distinct areas (see fig. 2):

Operator Domain. Within a specific company, team members work together to identify and document economic issues. They may also work together on responses to economic and safety items that have already been published on the bulletin board. While in the Operator Domain, the information is in draft stage and is not visible to other operators or Boeing.

Boeing Domain. Boeing team members work together to provide input to economic issues that have been posted by the operators. They also prepare new postings and updates for items that Boeing has deter-

mined to be safety issues. Draft information within the Boeing Domain is not visible to the operators.

Shared Domain. The items and responses that have been published can be accessed by all operators and Boeing. New economic issues are posted as “Discussion” items. During Fleet Team meetings and teleconferences, model-specific teams discuss the posted items. Based on information and impact data that have been posted, the teams also decide which items need to be elevated to “In-Work” status. Safety items are automatically posted by Boeing as “In-Work” items. For items at this stage, the teams collaborate on root cause analyses, documentation of best practices, and development of solutions. Updates are also provided in FTD articles. Once resolved, the status for the items may be changed to “Evaluation” or “Complete.”

SUMMARY

The new Boeing Fleet Team Xchange provides enhanced features and improved performance. Boeing encourages all operators to be involved in the Fleet Team process and collaborate by sharing information and knowledge on this new bulletin board, and by participating in the Fleet Team meetings and teleconferences.


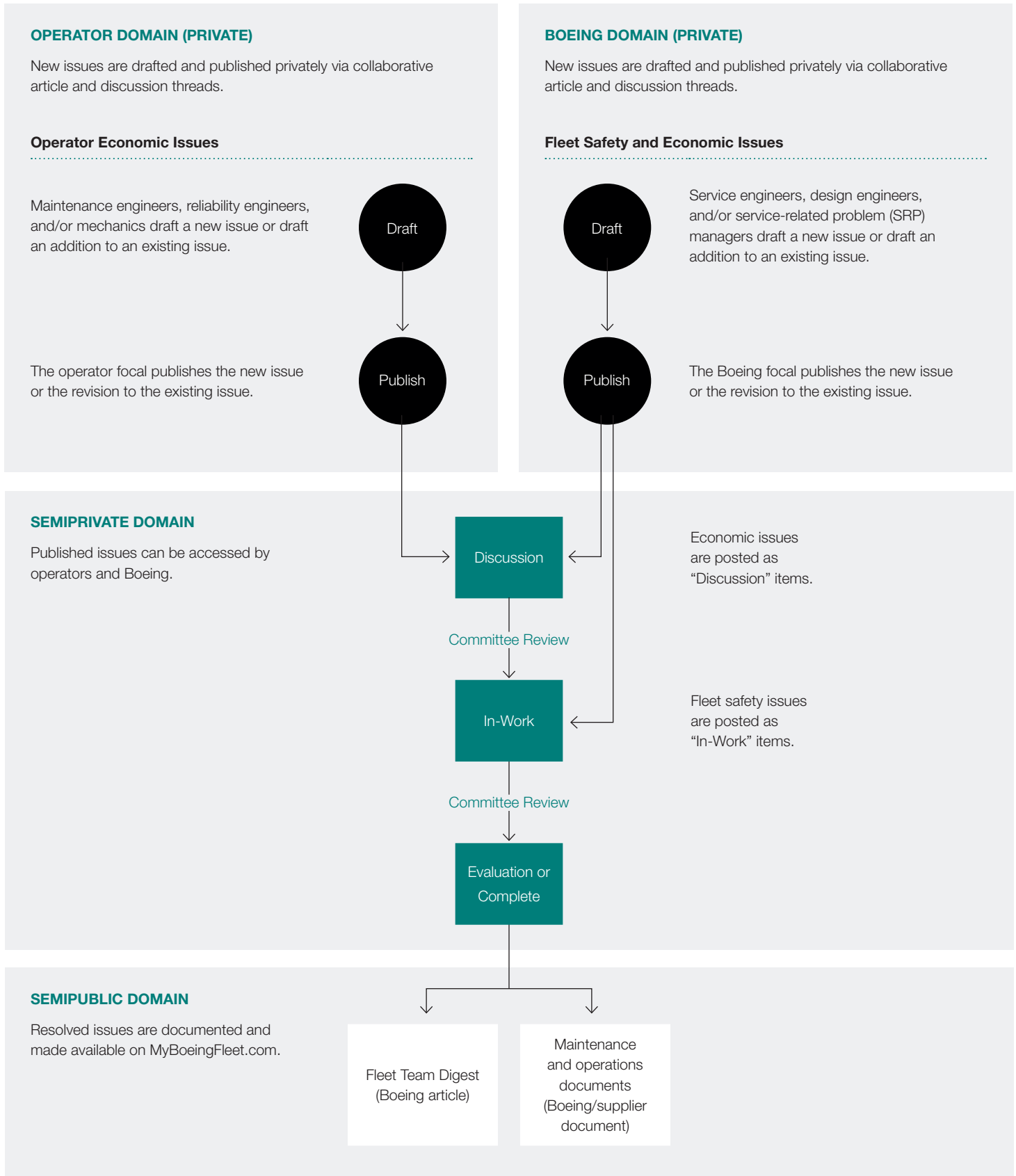
For more information, please contact Krijn de Jonge at krijn.dejonge@boeing.com. 

Figure 2: The Fleet Team collaboration process

Fleet Team Xchange facilitates collaboration among airplane operators and Boeing.





Decisions on which type of approach to use vary with each airline, and sometimes even for each flight.

Fuel Conservation Strategies: Descent and Approach

The descent and approach phases of flight represent the flight crew's final opportunities to reduce fuel consumption during flight. By carefully planning the airplane's descent and appropriately using drag and high lift devices, the flight crew can ensure a safe landing while saving fuel.

By **William Roberson**, Chief Pilot Research, and **James A. Johns**, Flight Operations Engineer, Flight Operations Engineering

This article is the fourth and final in a series exploring fuel conservation strategies. It discusses strategies for saving fuel during the descent and approach phases of flight. The first article in this series, "Cost Index Explained," appeared in the second-quarter 2007 AERO. It was followed by "Cruise Flight" in the fourth-quarter 2007 issue and "Takeoff and Climb" in the fourth-quarter 2008 issue.

Fuel conservation is a significant concern of every airline. An airline can choose an approach procedure and flap setting policy that uses the least amount of fuel,

but it should also consider the trade-offs involved with using this type of procedure.

In this article, two types of approaches are analyzed: the standard approach and the low-drag or delayed-flaps approach. The cost of a missed approach is also discussed.

THE STANDARD APPROACH

Boeing flight crew training manuals and/or flight crew operating manuals (FCOM) define standard approach profiles for every Boeing model. These profiles include specific flap settings and when to select

them during various parts of the approach (see fig. 1).

THE LOW-DRAG OR DELAYED-FLAPS APPROACH

If the approach is not being conducted in adverse conditions that would make it difficult to achieve stabilized approach criteria, the final flap selection may be delayed until just prior to 1,000 feet above field elevation (AFE) to conserve fuel and reduce noise and emissions or to accommodate speed requests by air traffic control. This approach is known as a low-drag,

Figure 1: Standard approach profile for 737 models

Boeing flight crew training manuals and/or operating manuals include specific instructions for standard approaches.

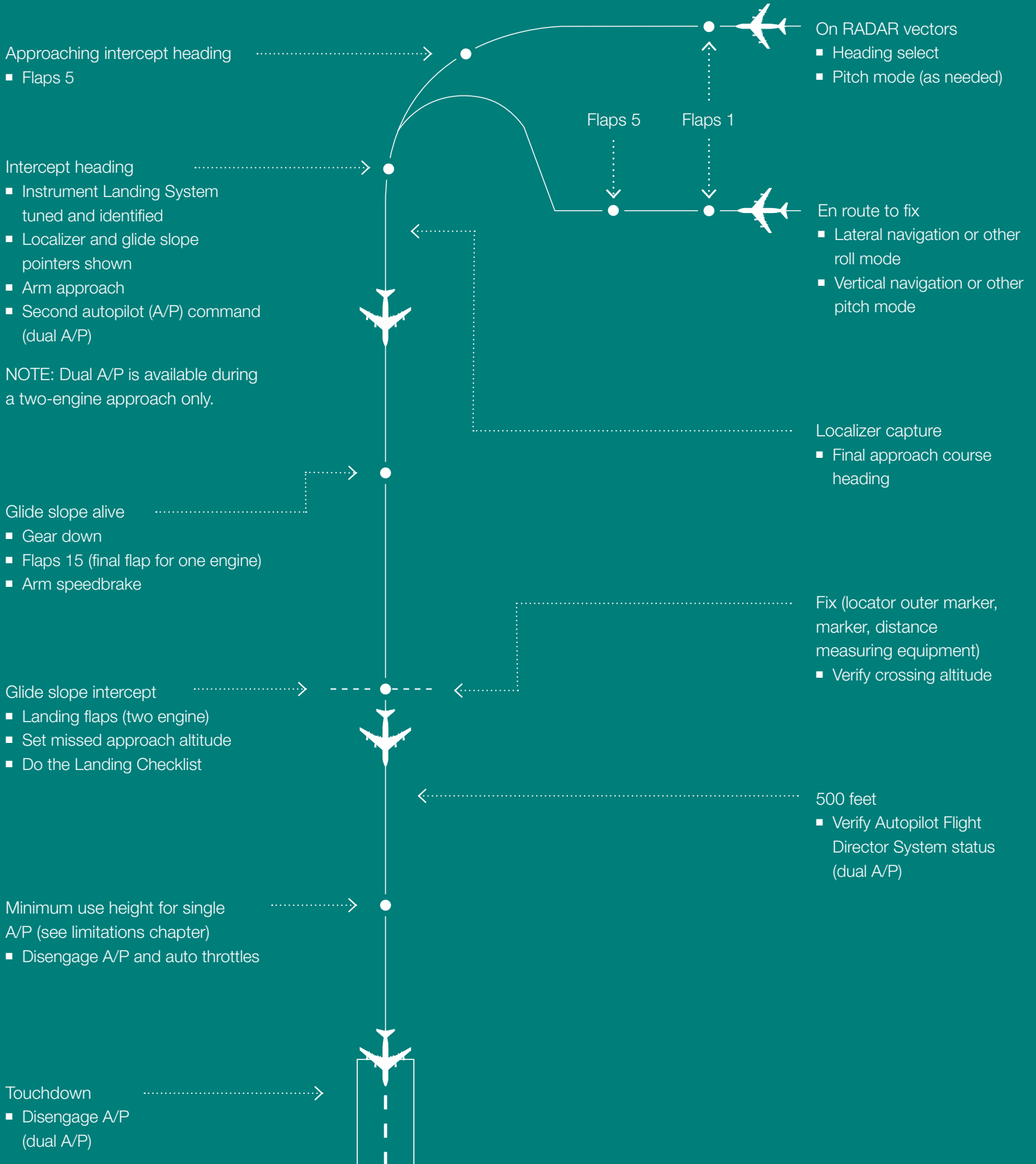


Figure 2: Fuel savings estimates for delayed-flaps approach procedure

The delayed-flaps approach uses 15 to 380 fewer pounds of fuel than the standard approach with the same flap setting.

AIRPLANE ENGINE	LANDING WEIGHT LBS (KG)	LANDING FLAP (DEG)	PROCEDURE	FUEL BURNED LBS (KG)	FUEL DIFFERENTIAL LBS (KG)
737-800 CFM56-7B24	120,000 (54,431)	30	Standard	230 (104)	
			Delayed	213 (97)	17 (8)
		40	Standard	266 (121)	
			Delayed	230 (104)	36 (16)
747-400 CF6-80C2B1F	450,000 (20,411)	25	Standard	590 (268)	
			Delayed	540 (245)	50 (23)
		30	Standard	610 (277)	
			Delayed	230 (104)	380 (172)
767-300 CF6-80C2B4	270,000 (122,469)	25	Standard	400 (181)	
			Delayed	370 (168)	30 (14)
		30	Standard	440 (200)	
			Delayed	390 (177)	50 (23)
777-200 GE90-94B	450,000 (204,411)	25	Standard	850 (385)	
			Delayed	790 (358)	60 (27)
		30	Standard	920 (417)	
			Delayed	820 (372)	100 (45)

delayed-flaps, or noise-abatement approach. The actual steps to use vary by airplane model and are described in the FCOM, flight crew training manual, or airline standard operating policy. These are the general steps for the 737, 757, 767, and 777:

- 737: Intercept the glide slope with gear down and flaps 15 at flaps 15 speed.
757/767/777: Intercept the glide slope with gear down and flaps 20 at flaps 20 speed.

Note: The thrust required to descend on the glide slope may be near idle.

- Approaching 1,000 feet AFE, select landing flaps, reduce the speed to the final approach speed, and then adjust thrust to maintain it.
- Perform the Landing Checklist.

Note for the 757/767/777: In particularly noise-sensitive areas, use the technique above but delay extending the landing gear until 1,500 feet AFE.

FUEL SAVINGS ASSOCIATED WITH DELAYED-FLAPS APPROACH

Depending on the flap setting and airplane model, the delayed-flaps approach uses 15 to 380 fewer pounds of fuel than the standard approach with the same flap setting (see fig. 2). To repeat, this approach should only be conducted in conditions that do not make it difficult to achieve a stabilized approach criteria.

Figure 3: Additional fuel burn attributed to missed approaches

The fuel burned during one missed approach is equivalent to 2 to 28 times the fuel burn required for a descent and approach.

AIRPLANE/ENGINE	ADDITIONAL FUEL BURN LBS (KG)
737-800 CFM56-7B24	280 (127)
747-400 CF6-80C2B1F	1,400 (635)
767-300 CF6-80C2B4	610 (277)
777-200 GE90-94B	880 (399)

Planning an approach to minimize fuel consumption

Seven key points should be considered when planning an approach and descent to minimize fuel consumption:

1. Plan the descent carefully.
2. Start the descent at the proper point.
3. Fly the most economical speed.
4. Use idle thrust for descents.
5. Avoid flying extended periods at low altitudes.
6. Configure flaps and gear for landing at the optimal time.
7. Use the most appropriate final flaps setting for landing.

THE COST OF A MISSED APPROACH

Although reduced-flap, delayed-flap, or low-drag approach procedures can save an airline significant amounts of fuel over time, if these procedures are inappropriately applied resulting in a missed approach, the subsequent additional fuel burn required for the missed approach and additional flight pattern with nullify all the fuel saving efforts employed on the entire flight. It cannot be overemphasized that the first priority of the crew is to fly the descent and approach safely and to be in a position to land at the appropriate time.

The typical missed-approach procedure is to apply go-around thrust, retract the flaps and gear while climbing to a minimum of 1,500 feet AFE, and accelerate to a minimum of flaps-up maneuvering speed. Depending on the airplane model and landing flap configuration, the fuel burned during one missed approach is equivalent to 2 to 28 times the fuel burn required for a

descent and approach (see fig. 3). There will also be the fuel required to fly an additional traffic pattern.

SUMMARY

Flight crews can vary their approach procedures and flap selections to match the flight's strategic objectives, which almost always include fuel conservation, noise abatement, and emissions reduction. Decisions on which type of approach to use vary with each airline, and sometimes even for each flight.

Boeing Flight Operations Engineering assists airlines' flight operations departments in planning low-drag approaches for any airport in the world. For more information, please contact FlightOps. Engineering@boeing.com. 

