BOEING

AERO

QTR_04
09
A QUARTERLY PUBLICATION
BOEING.COM/COMMERCIAL/
AEROMAGAZINE

Cover photo: *747 Thrust Reverser.*

AERO

Contents

***AERO* Readership Survey**

Please help us deliver the best content possible by sharing your opinions, insights, and ideas for *AERO*. See page 27.

AERO

Publisher
Shannon Frew

Editorial director
Jill Langer

Editor-in-chief
Jim Lombardo

Design
Methodologie

Writer
Jeff Fraga

Distribution manager
Nanci Moultrie

Cover photography
Jeff Corwin

Printer
ColorGraphics

Web site design
Methodologie

***AERO* Online**
www.boeing.com/commercial/aeromagazine

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.

Correction: In the fourth quarter, 2007 issue of *AERO*, there was an error in the table on page 27 labeled “Entered Cost Index (CI).” The numbers for the first two models were incorrect. For the 717-200, the correct information for the Typical Airline CI Values should be 5 to 25 and the Approximate LRC Equivalent should be 25. For the 737-3/4/500, the Typical Airline CI Values should be 10 to 30 and the Approximate LRC Equivalent should be 30. We regret any inconvenience to our readers.

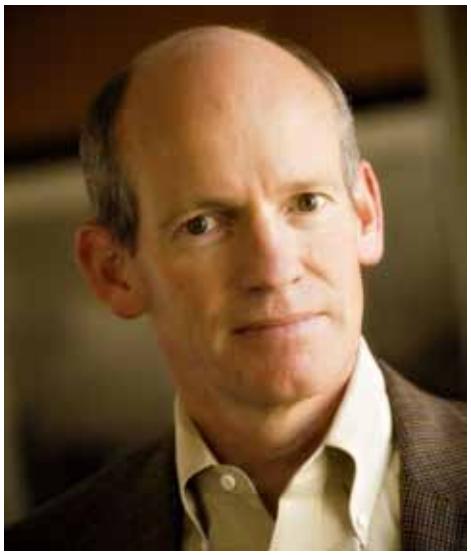
Print copies of *AERO* are not available by subscription, but the publication may be viewed on the Web at www.boeing.com/commercial/aeromagazine.

Please send address changes to me.boecom@boeing.com. Please send all other communications to *AERO* Magazine, Boeing Commercial Airplanes, P.O. Box 3707, MC 21-72, Seattle, Washington, 98124-2207, USA.
E-mail: WebMaster.BCA@boeing.com

AERO is printed on Forest Stewardship Council Certified paper.

Collaborating on Safety

Working together to make a safe global air transportation system even safer.



MIKE DENTON
Vice President of Engineering,
Boeing Commercial Airplanes

Ensuring safe air travel is our primary focus at Boeing as we design, build, test, deliver, and support our airplanes. Boeing airplanes are designed to be inherently safe, but we know that air transportation safety also depends on safe operation and proper maintenance and training. For that reason, we are committed to working with our airline customers, industry associations, and governments to make a safe global air transportation system even safer.

We firmly believe a collaborative approach to safety is more effective than regulatory action alone. Aviation safety is the result of regulatory oversight combined with how airplanes are designed and produced, how crews operate and maintain them, and how the air traffic and airport infrastructure support them. To enhance system safety, a deep understanding of how our products are used in service — coupled with a strong understanding of how they are designed and built, including our supplier-provided commodities — is essential to improving operational requirements and product design. By working together — as members of industry, civil aviation associations, government regulatory authorities, and operators — we can help ensure safety efforts are effective and aligned worldwide.

One recent safety effort is the Global Aviation Safety Roadmap featured on page 5 of this edition of *AERO*. The Global Aviation Safety Roadmap is a blueprint for coordinating and guiding safety policies and initiatives worldwide.

Its purpose is to reduce the accident risk for commercial aviation, avoid duplication of efforts and uncoordinated strategies, and encourage close industry and government cooperation on common safety objectives. One of its main objectives is to help all regions of the world achieve the high levels of excellence maintained by the regions with the best aviation safety performance.

Another industry effort to improve safety involves sharing more in-service airplane operational data. Traditional safety efforts have relied on investigating past accidents to prevent future ones; however, the aviation community is evolving toward a more predictive approach by examining operational data to identify less obvious or emerging patterns and potential conditions before accidents occur. This approach relies on all aviation stakeholders freely sharing and combining data (and assumes agreement among all parties that the information is protected from inappropriate use). You can read more about this effort on page 9 of this issue.

Within Boeing, we are using in-service airplane performance data to review, update, and enhance the designs of our commercial jets. We also are developing new systems and technologies to enhance the safety of the air transportation system. We are committed to developing safety improvements throughout the world by providing technical expertise gained from decades of experience.

The primary objective of the safety roadmap is to provide a common frame of reference for all stakeholders.

Industry Program Promotes Safe Global Air Transportation

Working with industry, Boeing has contributed to the development of a safety plan that focuses on promoting a safe and efficient global air transportation system. Its main objective is to help all regions of the world achieve the high levels of excellence maintained by the regions with the best aviation safety performance.

By Terry McVenes, Senior Manager, Aviation System Safety, and **Gerardo M. Hueto,** Program Manager of Regional Safety

This article outlines how Boeing is working with industry to further reduce the accident rate in various regions of the world through the creation and implementation of a Global Aviation Safety Roadmap.

A COMMITMENT TO SAFETY

Boeing believes that safe flight should be a basic expectation of citizens everywhere. Enhancing aviation safety performance depends on industry and government working together to focus their combined energy on the most significant problems.

Working with the members of an Industry Safety Strategy Group (ISSG) — International Air Transport Association, Airbus, Flight Safety Foundation, Airports Council International, Civil Air Navigation Services Organization, and International Federation of Air Line Pilots' Associations — Boeing has developed a Global Aviation Safety Roadmap for the International Civil Aviation Organization (ICAO). ICAO has aligned its Global Aviation Safety Plan with the roadmap, including activities from its Cooperative Development of Operational Safety and Continuing Airworthiness Program (COSCAP).

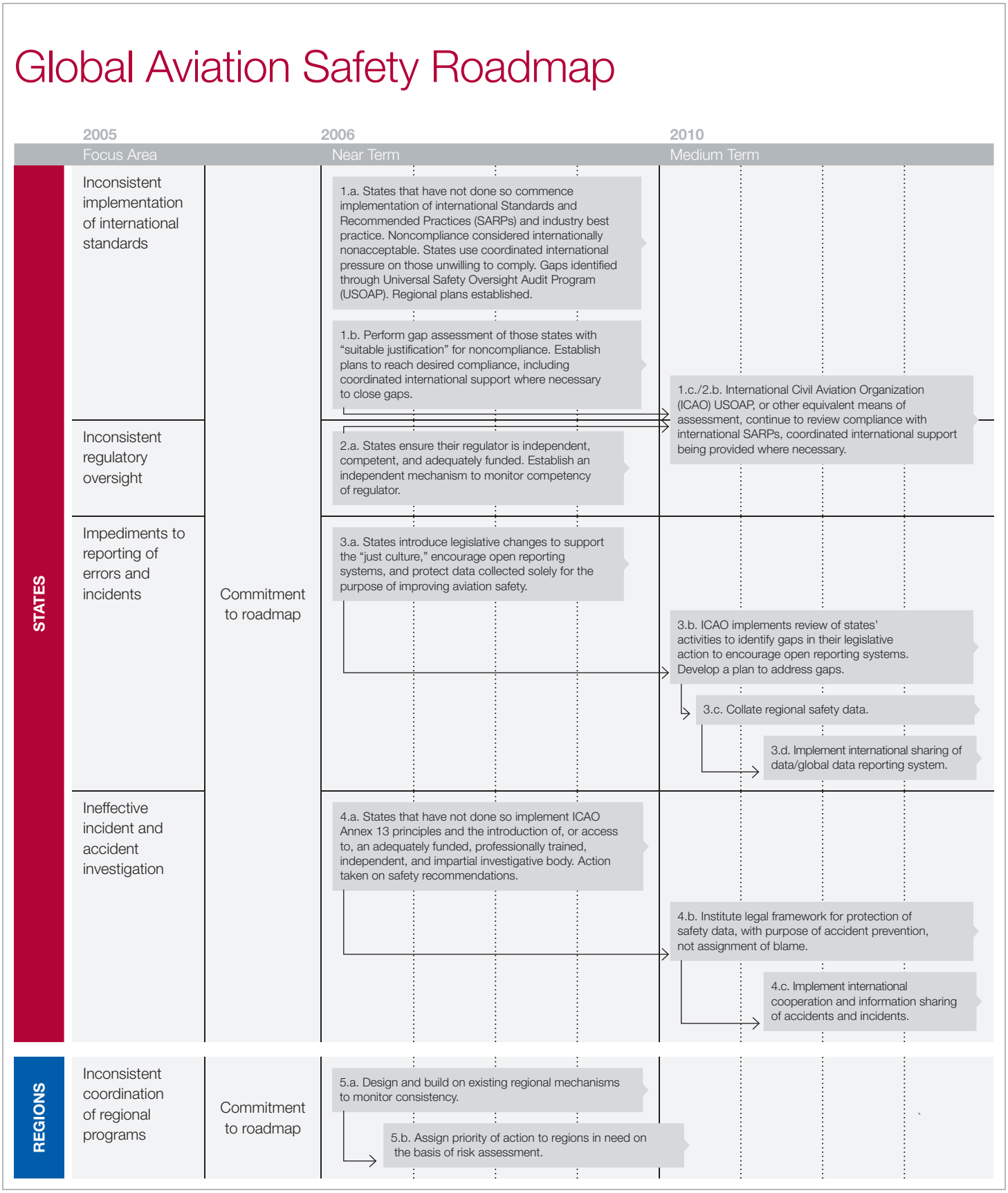
At a glance

The Global Aviation Safety Roadmap:

- Is the primary guide for states and industry to work together to improve global aviation safety.
- Requires that a logical process be followed so regions are always investing their energy in the most critical actions.
- Provides metrics and measurement that enable rigorously managed improvement.
- Channels efforts through existing mechanisms, not new bureaucracies.

Figure 1: The roadmap

The Global Aviation Safety Roadmap is designed to coordinate and guide safety policies and initiatives worldwide to reduce accident risk.



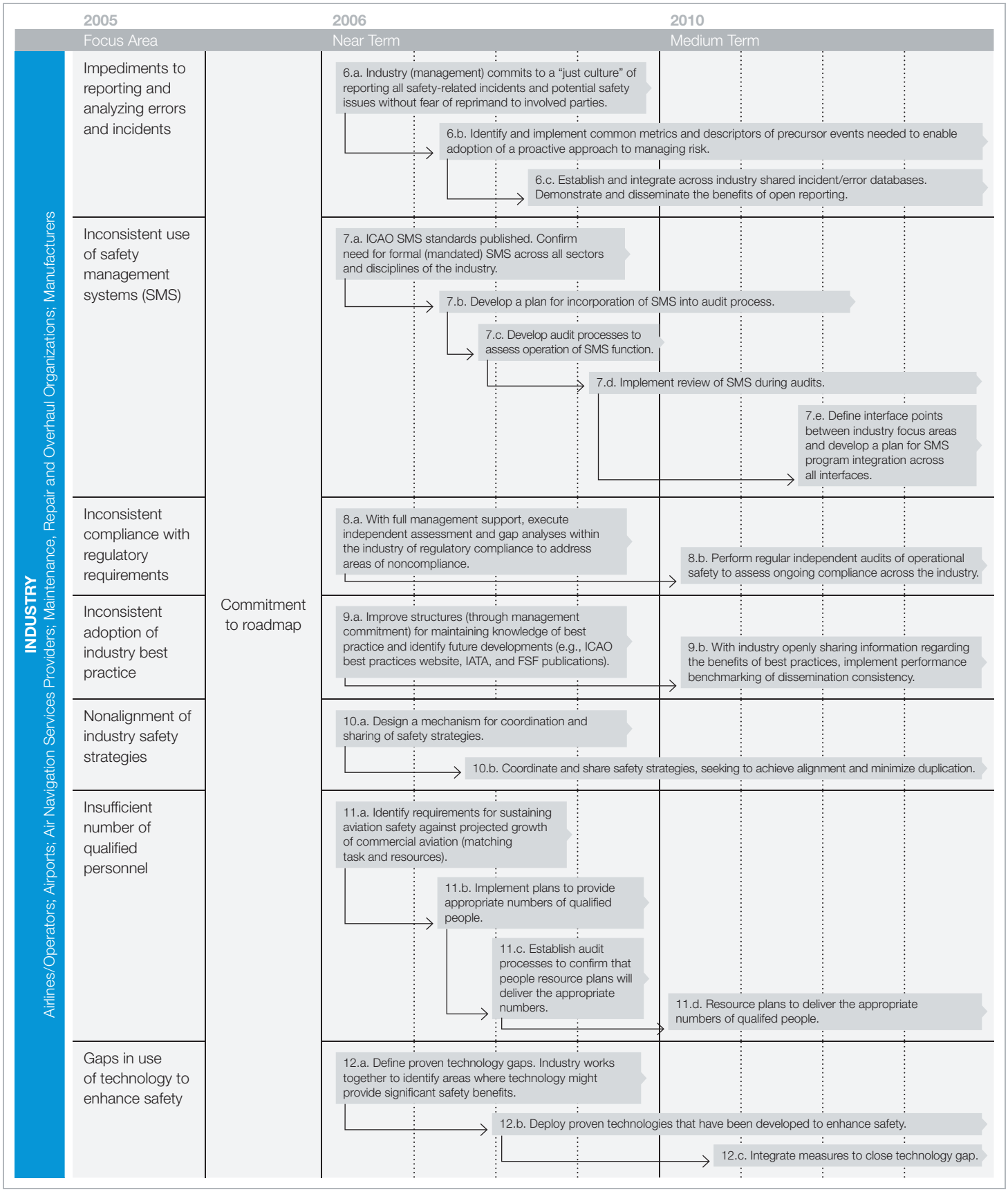
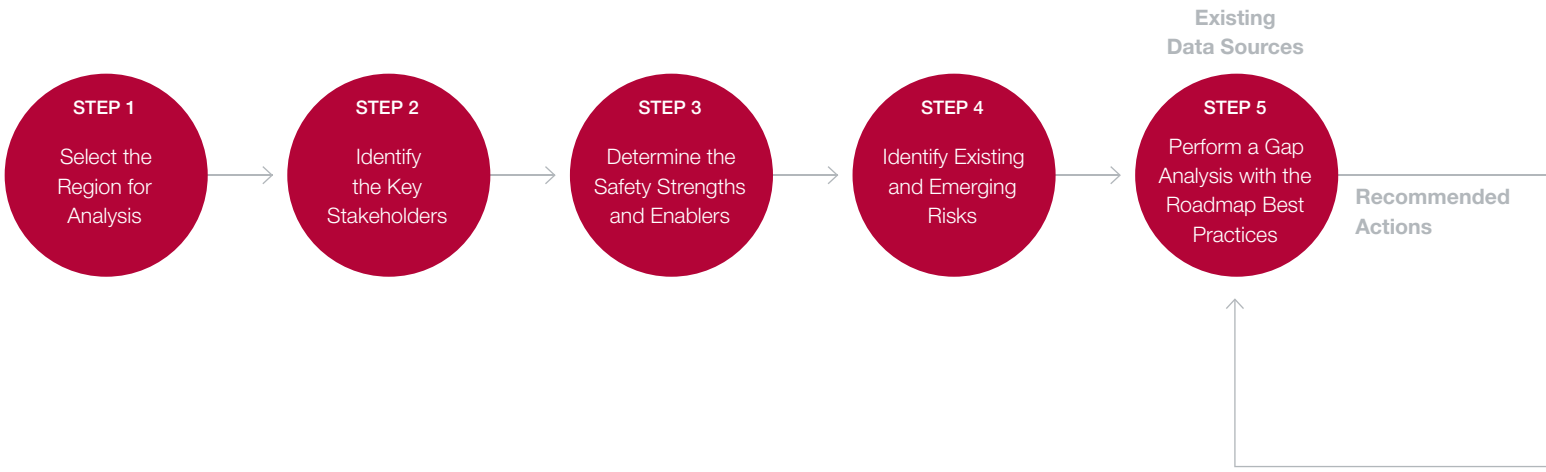

2005
2006
2010
Focus Area
Near Term
Medium Term
INDUSTRY
Airlines/Operators; Airports; Air Navigation Services Providers; Maintenance, Repair and Overhaul Organizations; Manufacturers
Impediments to reporting and analyzing errors and incidents
Inconsistent use of safety management systems (SMS)
Inconsistent compliance with regulatory requirements
Inconsistent adoption of industry best practice
Nonalignment of industry safety strategies
Insufficient number of qualified personnel
Gaps in use of technology to enhance safety
Commitment to roadmap
6.a. Industry (management) commits to a "just culture" of reporting all safety-related incidents and potential safety issues without fear of reprimand to involved parties.
6.b. Identify and implement common metrics and descriptors of precursor events needed to enable adoption of a proactive approach to managing risk.
6.c. Establish and integrate across industry shared incident/error databases. Demonstrate and disseminate the benefits of open reporting.
7.a. ICAO SMS standards published. Confirm need for formal (mandated) SMS across all sectors and disciplines of the industry.
7.b. Develop a plan for incorporation of SMS into audit process.
7.c. Develop audit processes to assess operation of SMS function.
7.d. Implement review of SMS during audits.
7.e. Define interface points between industry focus areas and develop a plan for SMS program integration across all interfaces.
8.a. With full management support, execute independent assessment and gap analyses within the industry of regulatory compliance to address areas of noncompliance.
8.b. Perform regular independent audits of operational safety to assess ongoing compliance across the industry.
9.a. Improve structures (through management commitment) for maintaining knowledge of best practice and identify future developments (e.g., ICAO best practices website, IATA, and FSF publications).
9.b. With industry openly sharing information regarding the benefits of best practices, implement performance benchmarking of dissemination consistency.
10.a. Design a mechanism for coordination and sharing of safety strategies.
10.b. Coordinate and share safety strategies, seeking to achieve alignment and minimize duplication.
11.a. Identify requirements for sustaining aviation safety against projected growth of commercial aviation (matching task and resources).
11.b. Implement plans to provide appropriate numbers of qualified people.
11.c. Establish audit processes to confirm that people resource plans will deliver the appropriate numbers.
11.d. Resource plans to deliver the appropriate numbers of qualifed people.
12.a. Define proven technology gaps. Industry works together to identify areas where technology might provide significant safety benefits.
12.b. Deploy proven technologies that have been developed to enhance safety.
12.c. Integrate measures to close technology gap.

Figure 2: Regional safety plan development process

The roadmap provides regional safety teams with clearly defined implementation methods.



THE NEED FOR A SAFETY ROADMAP

Efforts to improve safety have been most successful when industry and government have worked together. Better use and coordination of industry and government resources can reduce or eliminate factors that could possibly lead to accidents.

Achieving the next major breakthrough in reducing regional accident rates requires moving beyond the traditional government-industry model, with its adversarial position of regulator versus the regulated. The ISSG opted to develop an action plan of global dimensions that clearly identified the roles played by regulators and industry, while emphasizing their complementary nature.

ABOUT THE GLOBAL AVIATION SAFETY ROADMAP

The Global Aviation Safety Roadmap is focused on reducing accident rates, harmonizing best practices worldwide, and applying resources wisely. It provides a means to ensure that safety initiatives throughout the world deliver improved safety by coordinating efforts, thereby reducing inconsistency and duplication.

The primary objective of the safety roadmap is to provide a common frame of reference for all stakeholders, including states, regulators, airline operators, airports, aircraft manufacturers, pilot associations, safety organizations, and air traffic service providers. The roadmap coordinates and guides safety policies and initiatives globally.

The roadmap is based upon high-level principles that have been accepted by industry as vital to the enhancement of safety levels within global commercial aviation. It recognizes that there will always be reactive elements in safety management, but emphasizes near- and midterm mileposts against which stakeholders must plan for the future and gauge their progress (see fig. 1).

The roadmap is not designed to provide detailed guidance to achieve a desired endpoint. Depending upon specific developments and circumstances, there may be multiple routes to gain the same objective. The importance and utility of the roadmap is to ensure that stakeholders' collective efforts converge upon common objectives.

ROADMAP FOCUS AREAS

The Global Aviation Safety Roadmap has 12 focus areas grouped into three sets, according to the primary aviation sector that is most responsible for carrying out measures to achieve them.

States

- Consistent implementation of international standards.
- Consistent regulatory oversight.
- No impediments to reporting errors and incidents.
- Effective incident and accident investigation.

Regions

- Consistent coordination by both states and industry across several states.

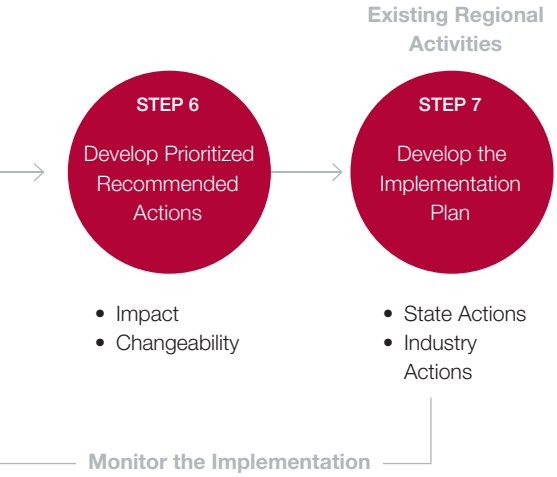
Industry

- No impediments to reporting and analyzing errors and incidents.
- Consistent use of safety management systems.
- Consistent compliance with regulatory requirements.
- Consistent adoption of industry best practices.
- Alignment of global industry safety strategies.
- Sufficient number of qualified personnel.
- No gaps in use of technology to enhance safety.

Organizing the focus areas in this manner emphasizes that the roadmap is intended to be a joint effort at a regional level.

IMPLEMENTING THE ROADMAP

Teams in regions throughout the world can use a step-by-step process to develop safety enhancement plans in accordance with the roadmap focus areas (see fig. 2). Depending on the region, these teams are



made up of regulators, airline managers, pilots, manufacturers, and airport managers.

As part of the Global Aviation Safety Roadmap implementation, Boeing and other members of the ISSG are conducting regional workshops designed to develop viable, self-sustaining industry-government regional safety teams and implementation plans throughout the world. The workshops build a rigorous foundation that regional teams are using to develop sustainable, detailed regional plans.

SUMMARY

Boeing is committed to further reducing the accident rate in all regions of the world and has helped lead the creation of the Global Aviation Safety Roadmap as well as its global implementation. The roadmap is a blueprint for coordinating and guiding safety policies and initiatives worldwide to reduce the accident risk for commercial aviation, avoid duplication of efforts and uncoordinated strategies, and encourage close industry and government cooperation on common safety objectives.

For more information, please contact Terry McVenes at terry.l.mcvenes@boeing.com or Gerardo Hueto at gerardo.m.hueto@boeing.com.

How the aviation industry is moving to improve safety by sharing operational data

By Paul Russell, Chief Engineer, Aviation System Safety/U.S. and European Safety Programs

For years, members of the aviation industry have studied accidents after the fact in an attempt to determine why they occurred. During many of these studies, investigators were able to identify the presence of a factor or factors that contributed to the accident within the data being studied. If these factors could have been identified sooner — from incident or normal operational data — actions could have been implemented to reduce or eliminate them and possibly prevent an accident.

Many people within industry are now evolving to a more predictive approach, examining aviation operational data to identify less obvious or emerging patterns and potential conditions before accidents occur. The approach relies on all aviation stakeholders freely sharing, combining data, protecting proprietary data, and adhering to nonpunitive ground rules.

Major advances in the collection and sharing of routine operational data are helping operators enhance the safety of their own operations. Two examples are Flight Operations Quality Assurance (FOQA) and Aviation Safety Action Partnerships (ASAP). The Aviation Safety Reporting System (ASRS) of the U.S. National Aeronautics and Space Administration, which collects voluntary reports from pilots, is another system designed to identify safety issues before they become accidents.

Under the newly developed Aviation Safety Information Analysis and Sharing program, all of the data that is collected by the U.S. Federal Aviation Administration (FAA), as well as data collected by operators through FOQA/ASAP, can be analyzed to identify possible safety issues. Digital data such as FOQA is also routinely trended to evaluate the effectiveness of safety enhancements that have been implemented and to identify degradation of system safety metrics.

Data-mining techniques are being developed and used on the text of ASAP and ASRS reports to identify possible safety issues that are being encountered by flight crews, air traffic controllers, maintenance personnel, and other participants in the air transport system.

There is growing recognition within the aviation community that these proactive approaches can be effective in enhancing the safety of the global air transportation system.

An example of this data-merging capability is a study recently completed on unwarranted terrain warnings that were being experienced during approaches to some mountainous terrain airports. Although individually these alerts were harmless events, there was the very real potential that flight crews could become desensitized to the warnings and not respond rapidly to a valid alert. One of the areas identified for investigation was the approach to Oakland International Airport in California.

The study combined FAA radar data, FOQA data, ASRS data, weather data, air traffic control procedures, and minimum vectoring altitude maps for a complete and comprehensive analysis of the situation. The study identified the factors that were contributing to the warnings and developed three safety enhancements that are expected to reduce the false alerts by more than 90 percent. The study is now being expanded to other airports throughout the United States on a priority basis.

For more information, please contact Paul Russell at paul.d.russell@boeing.com.

The Component Services Program provides operators with an inventory option that minimizes maintenance costs and airplane downtime.

Component Exchange Helps Operators Reduce Costs

Boeing's Component Services Program offers airlines a way to reduce component inventory costs without compromising airplane dispatch reliability. The program provides access to a pool of parts, available to ship within 24 hours of request.

By Leo Kniestedt, Senior Manager, Operations, Material Management

Boeing created the Component Services Program as a low-risk method for airlines to reduce airplane maintenance costs. The program provides 24-hour access to a dedicated inventory pool of selected high-value, dispatch-critical components, such as avionics, actuators, and precision mechanical assemblies. The program is available to operators of Next-Generation 737 (in cooperation with KLM Engineering & Maintenance) and 777 (in cooperation with Air France Industries) airplanes.

This article describes the program and explains how operators can make use of it.

PROGRAM OVERVIEW

Boeing created the Component Services Program to give airlines quick, worldwide access to critical components while significantly reducing their inventory, repair, and administrative costs. It's also designed so airlines can stabilize long-term maintenance budget planning.

The program allows participating airlines to shrink their inventory of dispatch-critical, high-value line replaceable units (LRUs). The acquisition of these high-value LRUs can cost an airline millions of dollars annually. Savings from the program can be as much as 30 percent of an airline's component repair and inventory costs.

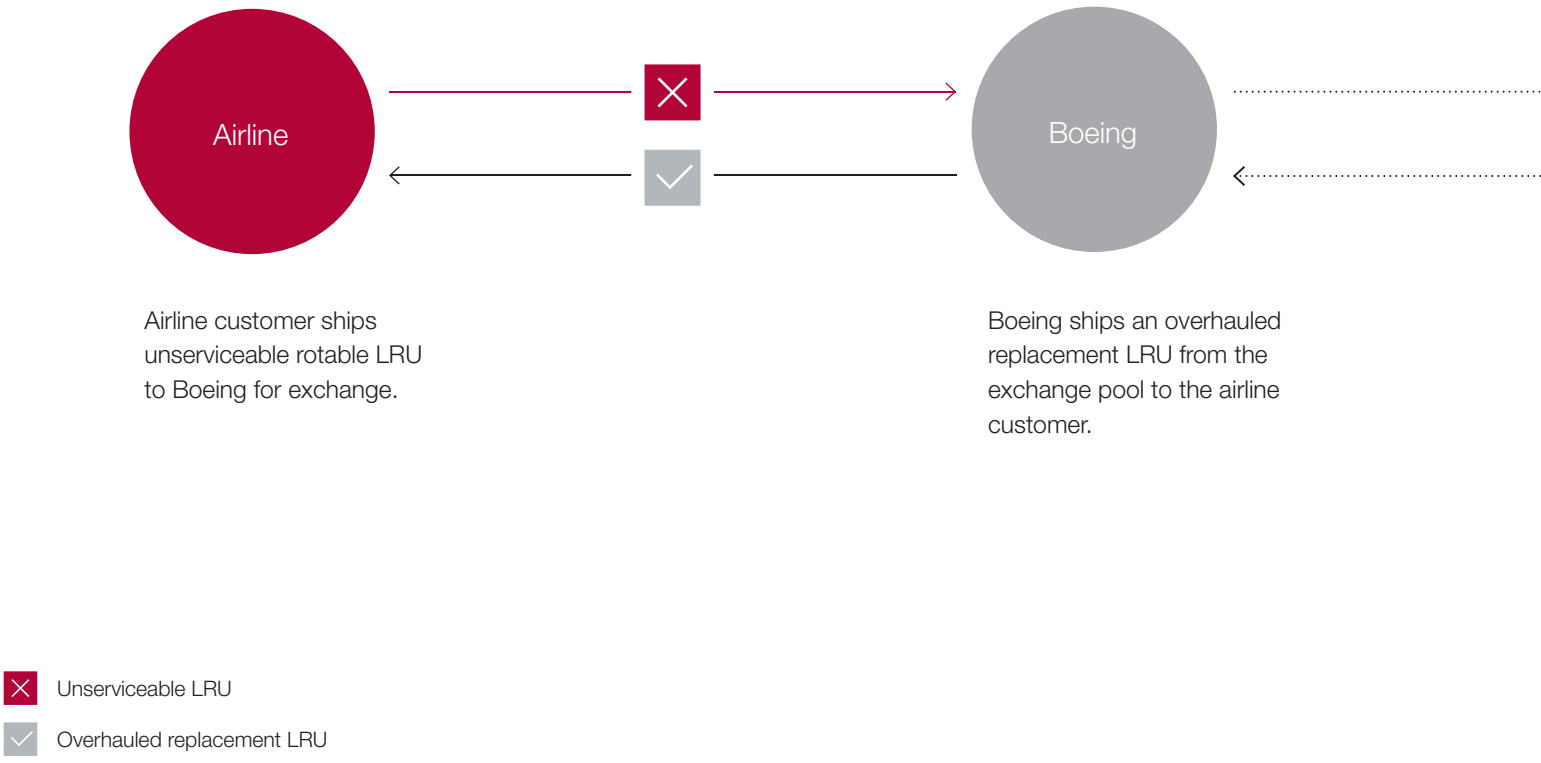
Customers sign up for a standard term of up to 10 years, paying a per-flight-hour rate that covers a potential exchange of 300 or more different LRUs. The program currently supports 10 airlines operating 777s and 17 airlines operating Next-Generation 737s.

HOW THE PROGRAM WORKS

Under the Component Services Program, a replacement part will be ready for shipment within 24 hours of receiving an order, enabling an operator to replace a faulty unit quickly and easily without having to maintain its own large inventory. Boeing manages the repair of the faulty unit to

Figure 1: The Component Services Program in operation

The Boeing Component Services Program enables operators to exchange unserviceable LRUs for an overhauled replacement.



airworthy condition, upgrades it to reflect the latest design changes, and returns it to the exchange inventory pool, available for the next customer request (see fig. 1).

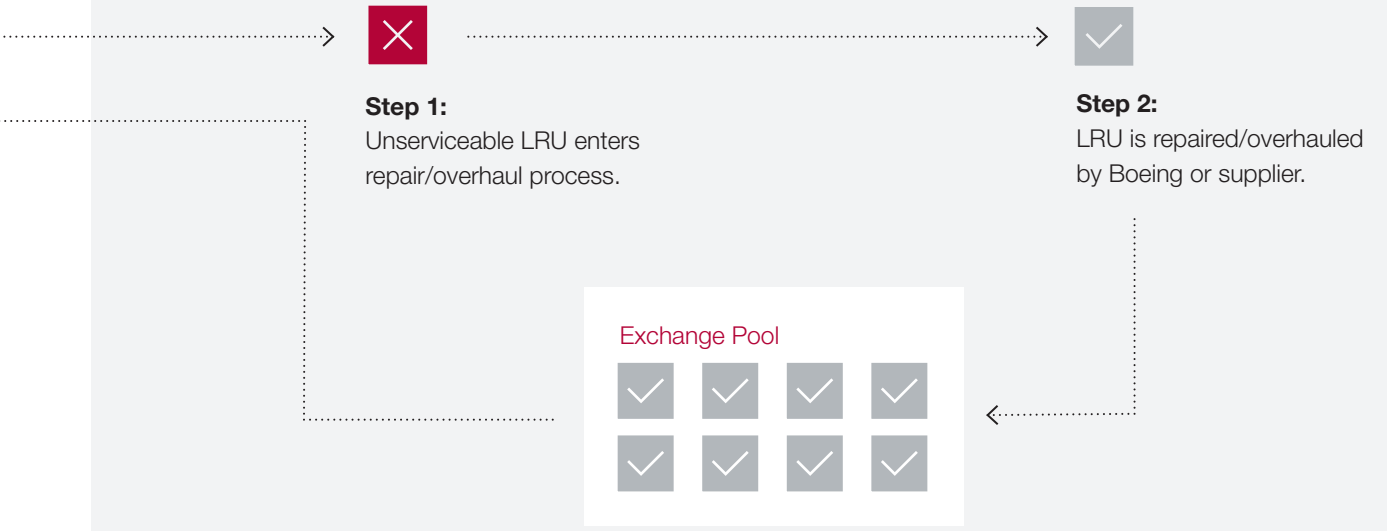
The program includes a customized recommended spare parts list (RSPL) based on customer data such as mean time between unscheduled removals, fleet size, maintenance base locations, and airplane turnaround time. The RSPL includes dispatch-critical parts and both avionics and non-avionics LRUs in recommended quantities to support each airline's dispatch reliability requirements.

BENEFITS TO OPERATORS

The Component Services Program provides operators with an inventory option that minimizes maintenance costs and airplane downtime. Program benefits include:

- Reduced provisioning and inventory-holding costs. The Component Services Program allows airlines to reduce their initial investment in parts inventory. That can result in lower taxes, depreciation, and warehousing costs, in addition to reduced repair and modification costs.
- Reduced lead times. Because parts are supplied from the exchange pool, availability is not limited to the airline's own inventory. As a result, airlines are assured that they can always get the required part to support their operational needs without waiting for a part to be repaired.
- Around-the-clock airplane-on-ground (AOG) support. Although routine orders are typically ready for shipment within 24 hours of the receipt of the order, AOG orders are handled on a priority, expedited basis.

ONGOING REPAIR/OVERHAUL PROCESS



Step 1:
Unserviceable LRU enters repair/overhaul process.

Step 2:
LRU is repaired/overhauled by Boeing or supplier.

Step 3:
Repaired LRU is placed in exchange pool available for next customer request.

- Improved financial and forecasting performance. The Component Services Program lets operators spread out high-dollar expenditures by eliminating large initial provisioning expenditures. It also provides operators with lower upfront costs and a lower total cash flow. Flight-hour-based rates enable airlines to more accurately predict maintenance costs based on the flight hours they expect to be flying.
- Configuration, reliability, and warranty management. The program manages configuration and warranty for all covered parts. This frees airlines of significant overhead activity and cost by reducing the time they need to spend evaluating service bulletins.
- Better management of the component repair cycle. The program reduces operators' need to carry excess inventory to cover parts that are being repaired. It also cuts down on the time and effort required to manage vendors, approve repair quotes, ship and track parts, and process repair invoices.

SUMMARY

The Boeing Component Services Program enables Next-Generation 737 and 777 operators to reduce their inventory cost while providing quick access to selected high-value, dispatch-critical spare parts.

For more information, contact Leo Kniestedt at leo.g.kniestedt@boeing.com.

Airlines are responsible for MagVar updates, which can be performed during scheduled maintenance.

Correcting the Effects of Magnetic Variation

Airlines should make sure they update their inertial reference systems to the latest magnetic variation (MagVar) tables in order to avoid potentially hazardous magnetic heading-related navigation errors.

By Benjamin Weinstein, Avionics Design Engineer

MagVar tables need to be updated periodically to ensure their accuracy since the Earth's magnetic field is constantly changing. Responsibility for MagVar updates falls to the airlines, depending on their areas of operation. While the most recent MagVar tables were updated in 2005, some airlines are still using the 1980 version of the tables. Airplanes using these tables as the primary source for heading while flying raw-data non-directional beacon (NDB) approaches in certain parts of the world can have significant heading errors. In certain situations, the heading error may result in the airplane flying off course when trying to acquire a specific NDB bearing. In the approach environment, this significantly increases the risk of striking obstacles outside of the Terminal Instrument Procedures secondary area during the approach.

While no NDB incidents have been reported in service, crews have commented about MagVar-related system effects.

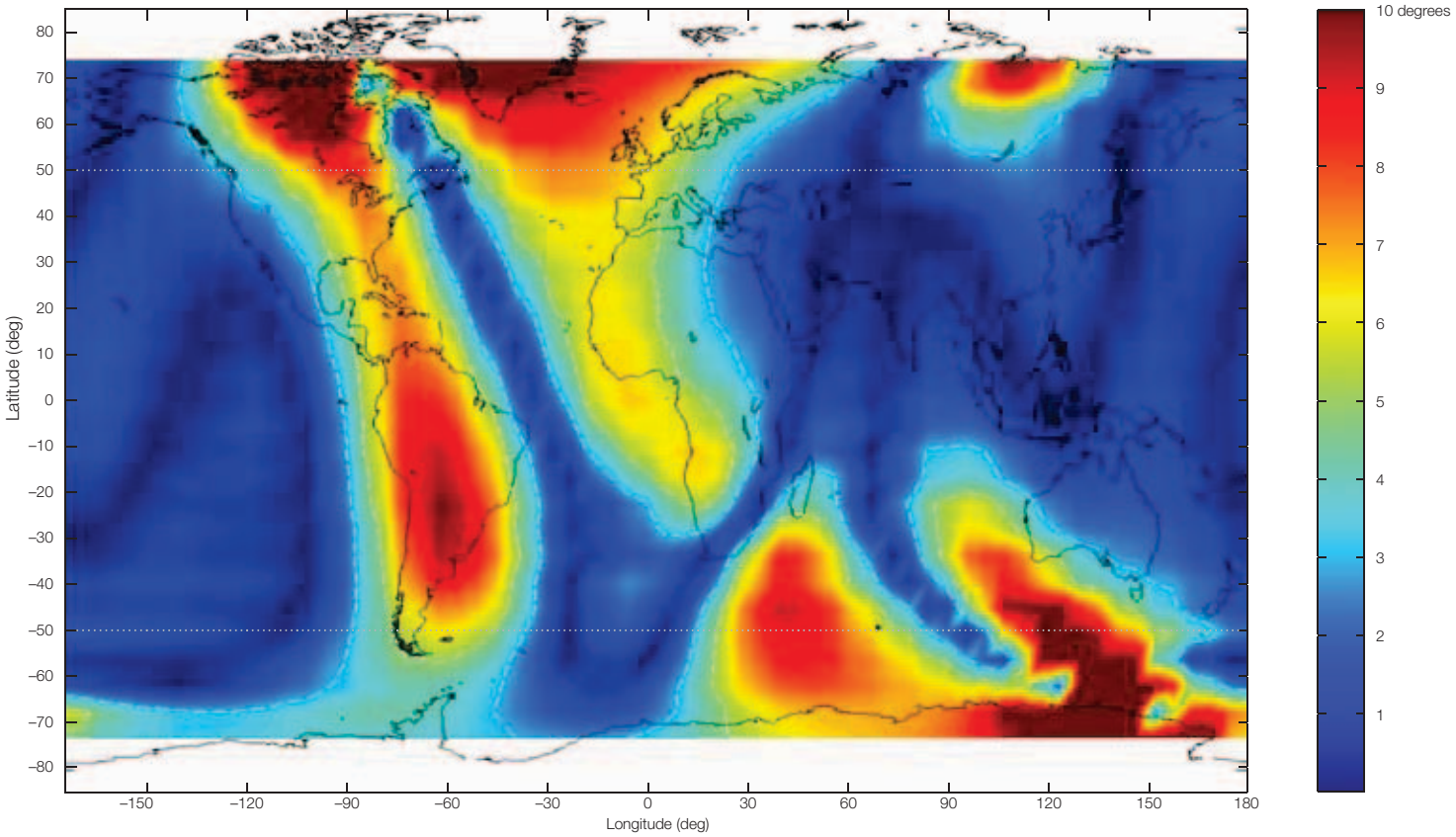
This article provides background information about MagVar tables, explains the NDB approach issue, and provides recommendations for airlines that are not using current versions of the tables.

ABOUT MAGVAR TABLES

MagVar tables are used to convert true heading to magnetic heading in an airplane's inertial reference unit (IRU). Magnetic heading accuracy is also the basis for requirements of other systems, including displays and autoflight.

Figure 1: Deviation in degrees of magnetic variation tables, 2005 vs. 1980

Airplanes operating in certain areas of the world — primarily South America and northern parts of North America — can have heading errors exceeding 10 degrees. (Dark red indicates greater than 10 degrees of error; dark blue indicates 0 degrees of error.)



These tables, which are the primary source of magnetic variation for adjusting the heading from true to magnetic, are updated in 10-year intervals due to changes in the Earth's magnetic field and primarily to correct for movement of the magnetic poles. Updates were made in 1995 and 2005; the next scheduled update is 2015.

For example, a pilot using outdated MagVar tables as the primary source for an airplane's heading while flying NDB approaches in certain parts of the world can experience heading errors exceeding 10 degrees (see fig. 1).

NDB APPROACH ISSUE

When flying an NDB approach, a pilot is using raw data that includes magnetic heading information. Similar to other approach types, the NDB procedure final approach segment is designed as a trapezoid with primary and secondary obstruction clearance zones. Obstruction clearance is assured within the final approach segment when complying with the published altitude constraints. Obstacles outside these areas have no assured vertical obstacle clearance. Consequently, operating the airplane during an NDB instrument approach outside these areas can be hazardous. Pilots can use the NDB for an approach directly to the runway or for an arrival setup to locate the instrument landing system.

MagVar information that is off by 10 degrees can result in these situations:

When flying toward the NDB: Can rotate the perceived approach into the secondary area, which may allow the airplane to be outside the secondary area and increases the hazard to the airplane (see fig. 2).

Figure 2: Effect of 10-degree MagVar error when flying toward NDB

Flying toward the NDB with MagVar information that is off by 10 degrees may cause a pilot to be in the path of obstacles or other dangers.

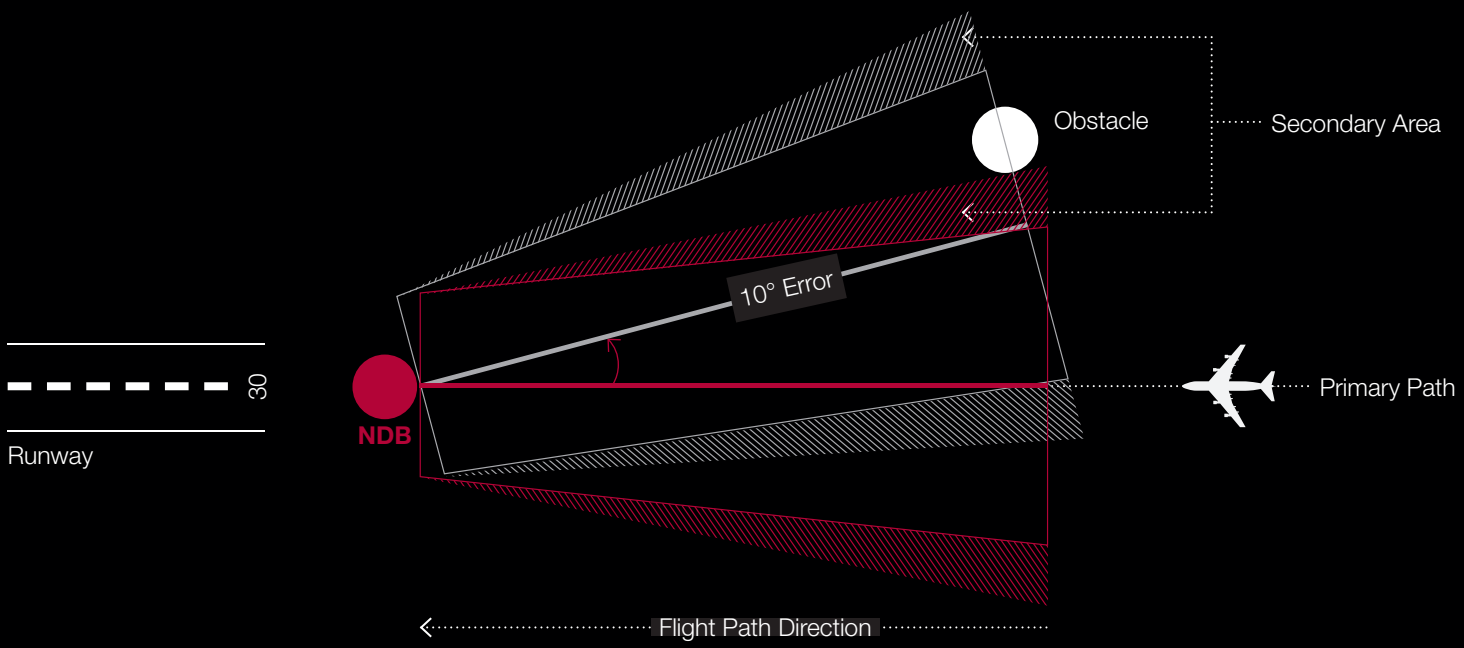


Figure 3: Effect of 10-degree MagVar error when flying away from NDB

Flying away from the NDB with MagVar information that is off by 10 degrees can cause the pilot to be off course up to 2.5 miles to the right or left of the runway on final approach.

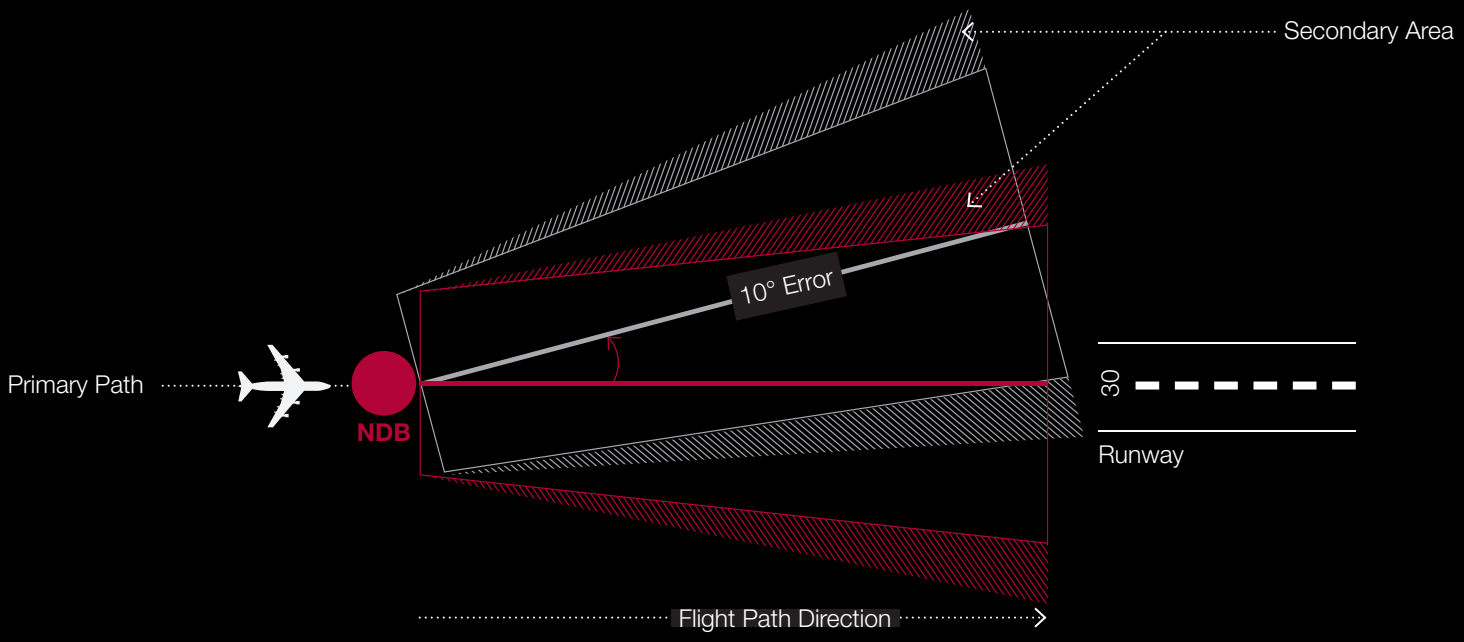


Figure 4: Service bulletins (SBs) and service letters (SLs) that address outdated MagVar tables

	AIR DATA INERTIAL REFERENCE UNIT (ADIRU) 2005 MAGVAR			
	737-600/-700/-800/-900	757-300	767-400	777
Boeing SBs (Released)	737-34-1721 (March 6, 2003)	757-34-0269 (May 1, 2003)	767-34-0407 (August 28, 2003)	777-34A0138 (November 22, 2005)
Boeing SLs (Released)	737-SL-34-161-C (February 21, 2003)	757-SL-34-141-C (February 21, 2003)	767-SL-34-137-C (February 21, 2003)	Not applicable

	INERTIAL REFERENCE UNIT (IRU) 2005 MAGVAR				
	767-200/-300	747-400	757-200	737-300/-400/-500	MD-11
Boeing SBs (Released)	767-34-0411 (July 15, 2004)	747-34-2805 (July 15, 2004)	757-34-0303 (June 9, 2005)	737-34-1812 (July 21, 2005)	MD-11-34-141 (October 4, 2007)
Boeing SLs or Fleet Team Digest article (Released)	767-SL-34-151 (July 21, 2004)	747-SL-34-125 (July 21, 2004)	757-SL-34-155 (July 21, 2004)	737-SL-34-177 (July 21, 2004)	MD-11-FTD-34-05002 (February 26, 2007)

Boeing strongly recommends that airlines flying with 1980 MagVar upgrade to the latest MagVar tables. IRU MagVar software updates are performed by Honeywell at its service centers, by approved third-party repair centers, or by airlines approved by Honeywell. Airlines should incorporate these updates into their established maintenance schedule.

When flying away from the NDB: Can cause the pilot to be off course up to 2.5 miles to the right or left of the runway on final approach (see fig. 3).

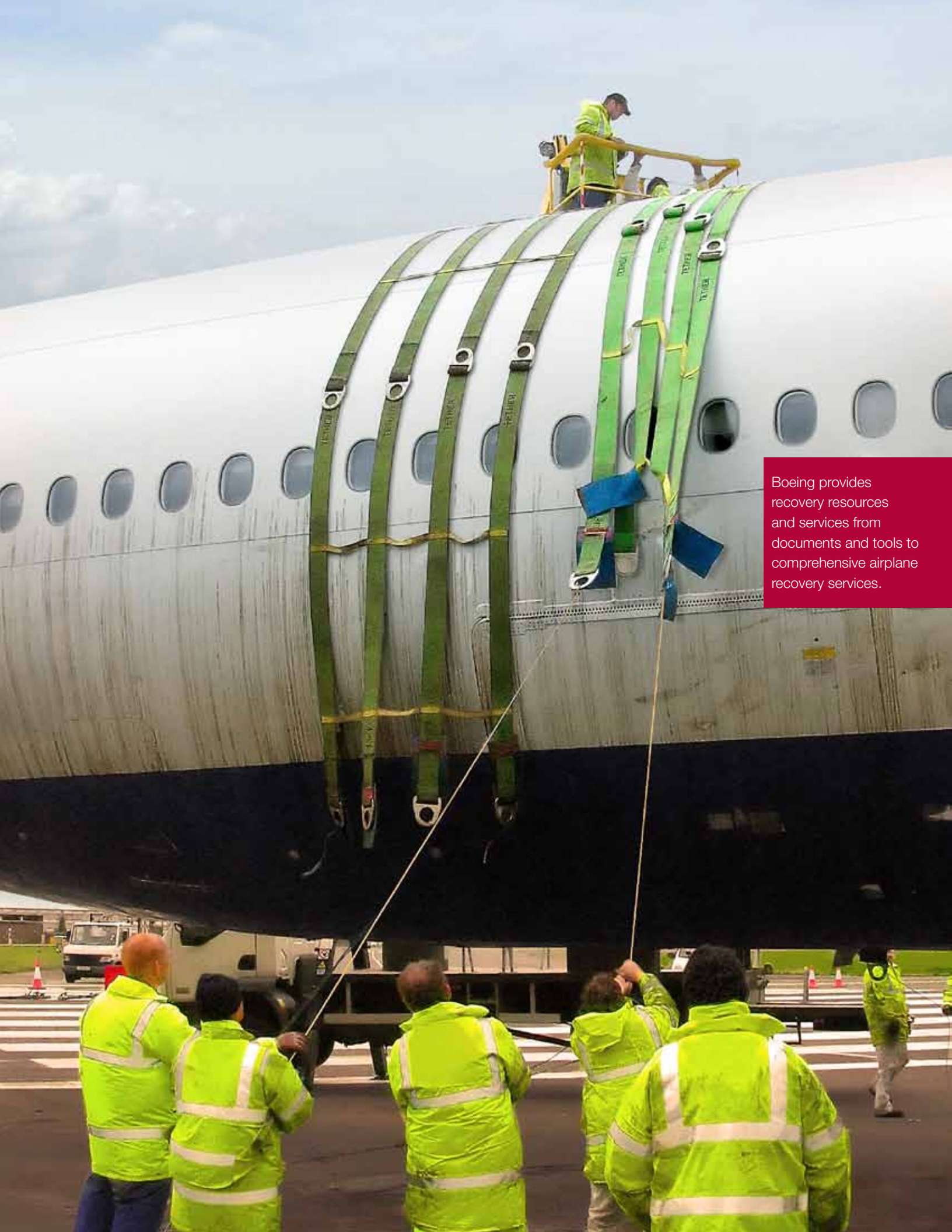
Boeing strongly recommends that airlines flying with 1980 MagVar upgrade to the latest MagVar tables. IRU MagVar software updates are performed by Honeywell at its service centers, by approved third-party repair centers, or by airlines approved by Honeywell. Airlines should incorporate these updates into their established maintenance schedule. The MagVar update is also necessary to maintain certification compliance in areas of large magnetic change. Consult your local regulatory agency for local compliance requirements.

Current deliveries of Boeing airplanes incorporate the most recent 2005 MagVar tables. However, updated MagVar tables may or may not be available depending on the product model and the entry into service date (see fig. 4).

SUMMARY

Older MagVar tables will result in magnetic heading errors in the IRUs. These heading errors can have an effect on NDB approaches. These potential problems can be avoided by updating the IRUs with the most recent MagVar table data. Airlines are responsible for MagVar updates based on their areas of operation. The update can be performed during scheduled maintenance.

For more information, please contact Steve Hopkins at steven.a.hopkins@boeing.com.



Boeing provides recovery resources and services from documents and tools to comprehensive airplane recovery services.

Boeing Assistance in Airplane Recovery

Airlines need to have an effective plan in place to quickly recover an airplane following an incident. Boeing has a team of experienced airplane recovery experts that advise airlines on how to prepare and execute effective airplane recovery. The goal is to minimize the time required to perform a safe and successful recovery operation with no secondary damage.

By Jerry Paluszek, Lead Principal Engineer, Maintenance Tooling and Facilities/Airplane Recovery, Maintenance and Ground Operation Systems

Quick and decisive actions are essential for effective airplane recovery. Boeing can help operators develop recovery plans and offers on-site airplane recovery assistance. In roughly 80 percent of recoveries the airplane involved has left a hard surface during inclement weather.

This article explains Boeing's role in airplane recovery, including designing recovery options during airplane development, special recovery tools, airplane recovery documents, ongoing customer support, and complete incident recovery and repair services.

PLANNING FOR AIRPLANE RECOVERY DURING NEW AIRPLANE DEVELOPMENT

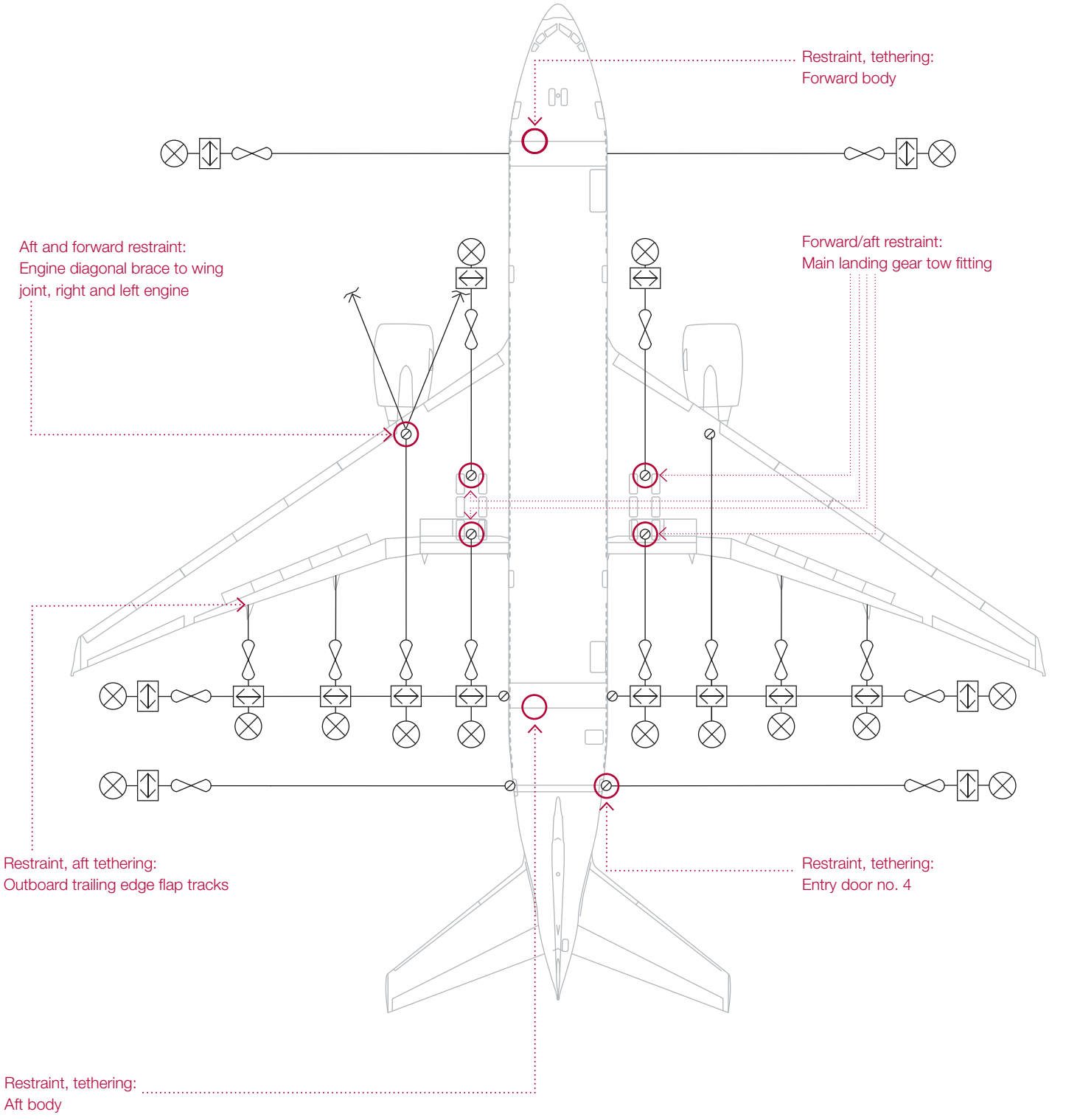
During airplane development, Boeing designs tool commonality and a number of airplane recovery options into the airplane to help ensure future airplane recoveries occur with no or minimal secondary damage.

Boeing establishes airplane recovery requirements in five key areas during airplane development:

- Weight and center of gravity (CG) management. Boeing uses CG calculations to help ensure that the airplane's design will allow for safe defueling, fuel transfer, cargo removal, and component removal.
- Emergency defueling with no power on. Boeing has developed special tools and methods for suction and gravity defueling. For example, Boeing plans to incorporate a defueling fitting for the 787 using the airplane's main and override jettison pumps. A portable external power control unit is available for defueling all Boeing models.
- Lifting/shoring. Drawing on past experiences, Boeing analyzes and establishes the best lifting scenarios and then designs lifting locations on the airplane that are best suited to support lifting in those scenarios. Boeing determines the loads required at those locations to adequately lift the airplane to eliminate or minimize secondary damage.

Figure 1: Tethering on the 777

Boeing provides operators with detailed diagrams showing locations for tethering to reduce or eliminate the chances of secondary damage.



- Tethering. Normally tethering is necessary during lifting operations, especially during inclement weather. Boeing establishes areas on the airplane that provide the best locations for tethering, monitoring all loads applied to the airplane structure (see fig. 1).
- Transporting. Boeing determines the best interface locations and provides supporting techniques and methods to transport the airplane.

SPECIAL RECOVERY TOOLS

Boeing has designed special tools and equipment to support the lifting, stabilizing, moving, support, and general requirements associated with an airplane recovery operation. These tools include both single- and twin-aisle fuselage lifting/tethering slings and a main landing gear hoist assembly designed for the 777 (see figs. 2, 3, and 4).

Additional resources are also available from the International Airlines Technical Pool. Through the organization, member airlines can obtain recovery kits which include the basic equipment needed for a successful recovery.

AIRPLANE RECOVERY DOCUMENTS

Boeing creates airplane recovery documents specific to each model that specify appropriate recovery tools and methods and address environmental concerns related to airplane recovery. These documents — which are revised for new airplane model derivatives and on an as-required basis for current models — are provided to the airline 90 days prior to its first airplane delivery.

Boeing airplane recovery documents comply with the Air Transport Association (ATA) 100/2100 (digital) specification, which details information such as weight and CG management, preparation, weight reduction, leveling and lifting, moving the airplane, post-recovery, and special recovery tools. The 787 will conform to the new ATA iSpec 2200.

Boeing provides airplane recovery documents for each airplane type:

- 707, 727, 737
- Next-Generation 737
- 747
- 757
- 767
- 777
- MD-80
- DC-10-10
- DC-10-30/40
- MD-11
- MD-90
- 717
- 787
- 747-8

ONGOING CUSTOMER SUPPORT

Boeing is committed to keeping airline customers apprised of new technologies in airplane recovery equipment and methods. To this end, Boeing coordinates with equipment suppliers to learn about new products and their suitability for airplane recovery operations. Airplane recovery procedures and new equipment listings are updated in the recovery documents after their effectiveness has been established.

Airlines can also take advantage of educational opportunities, including airplane recovery exercises. In addition, Boeing provides continuous and ongoing support for special tools and equipment design, information and consultation, technical services support, airplane recovery familiarization training, and on-site airplane recovery technical services.

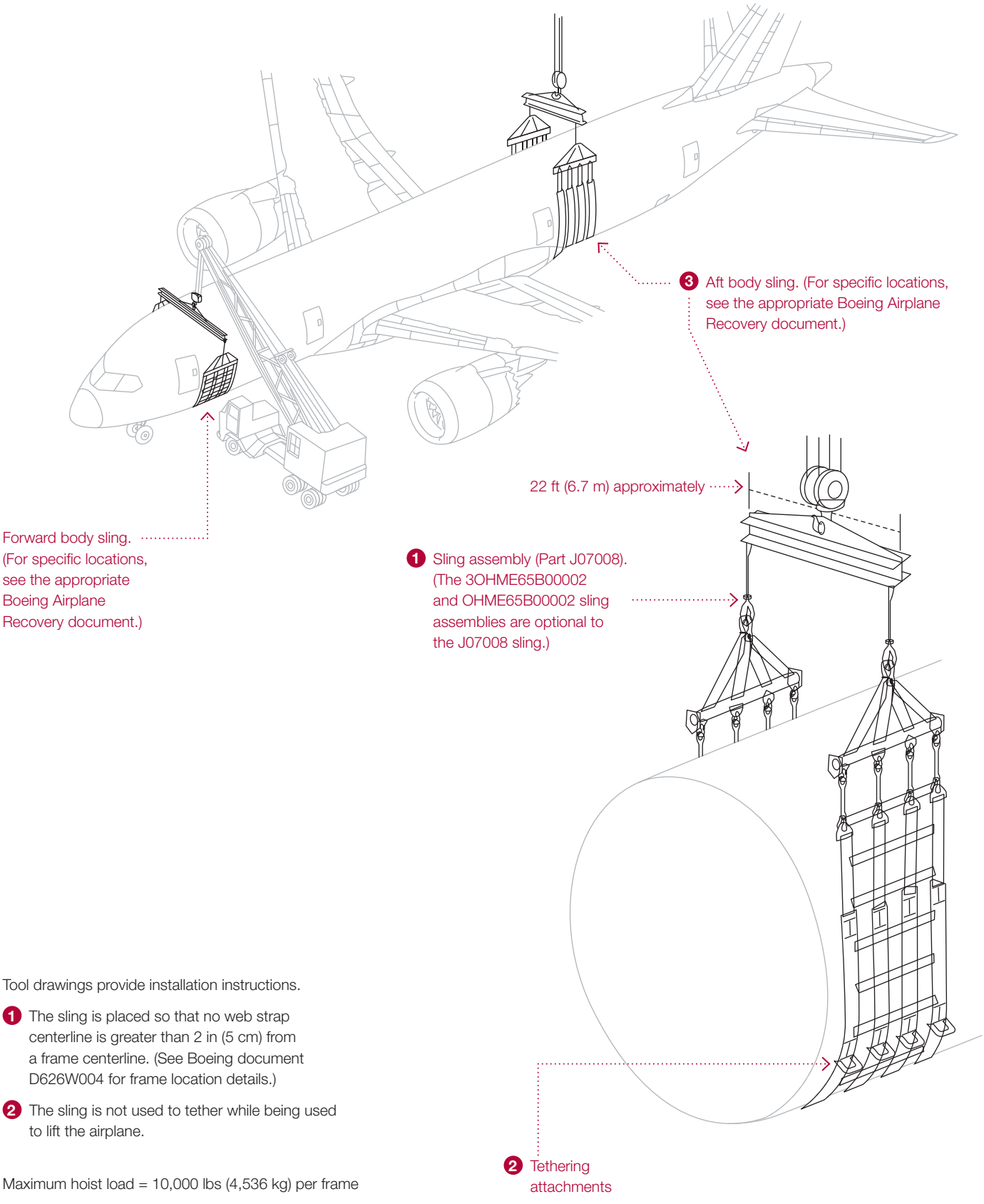
RECOVERY SERVICES

When requested by an airline, Boeing provides on-site comprehensive, integrated assistance to recover a disabled or damaged Boeing airplane wherever in the world it is located. Requests for such assistance are submitted to Boeing Field Service representatives.

Boeing recovery support includes diagnosis, repairs, logistics, parts procurement, certification issues, and other services as dictated by the specific recovery.

Figure 2: Twin-aisle fuselage sling for lifting

Boeing sling assembly in lifting position. Only one sling position is used for primary lifting (forward or aft). The second sling is positioned for stabilization only — not to be used for full airplane lift.



Tool drawings provide installation instructions.

1. The sling is placed so that no web strap centerline is greater than 2 in (5 cm) from a frame centerline. (See Boeing document D626W004 for frame location details.)
2. The sling is not used to tether while being used to lift the airplane.

Maximum hoist load = 10,000 lbs (4,536 kg) per frame

Maximum total hoist load = 40,000 lbs (18,144 kg)

Figure 3: Fuselage sling for tethering

Boeing sling assembly in tethering position.

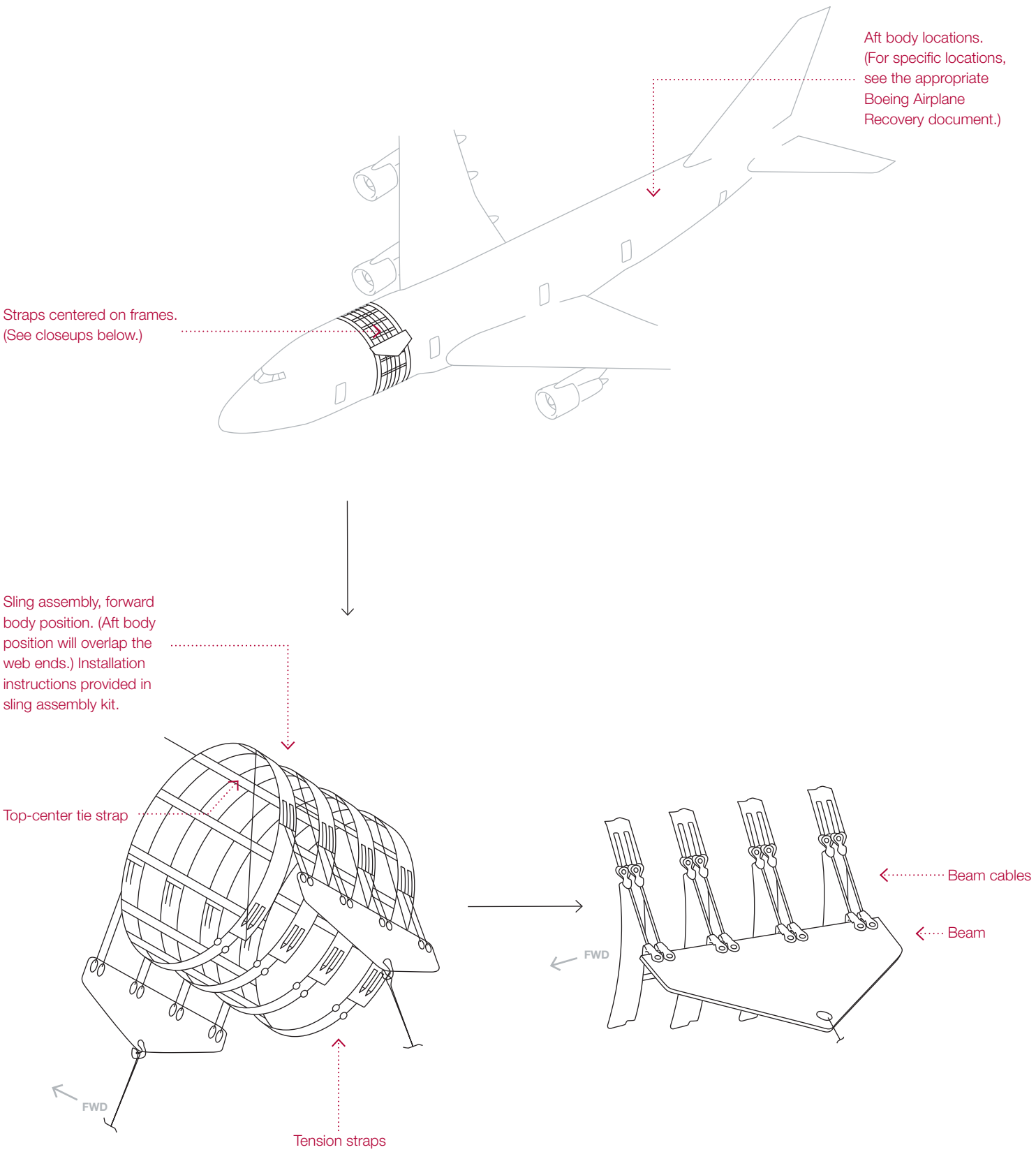
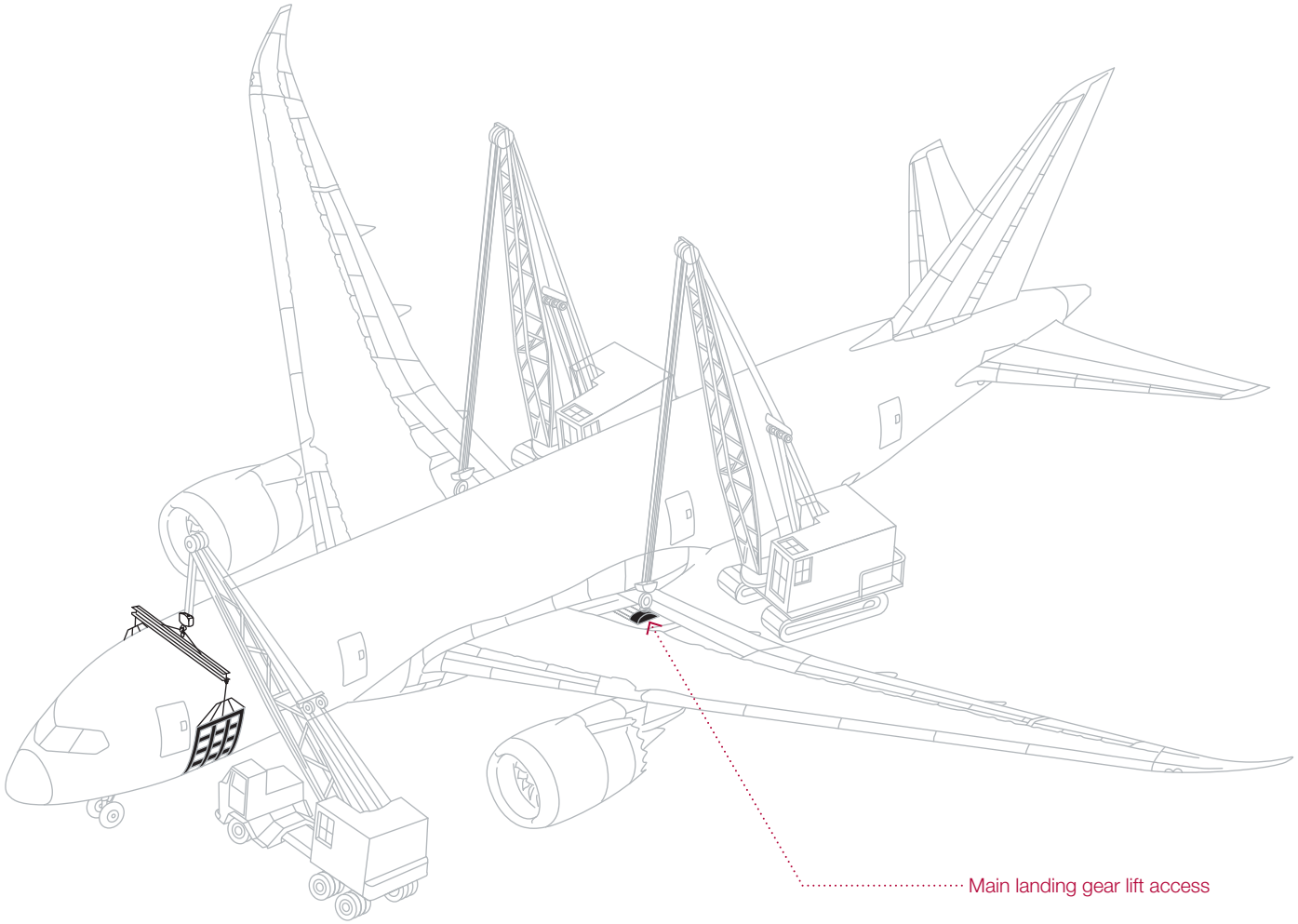


Figure 4: Sling for lifting 777 from main landing gear

Boeing has designed a special hoist assembly that can be used to lift a 777 with intact main landing gear.



Boeing's goal is to assist the airline operator to return the airplane to service with as little disruption to the airline's schedules as possible and to streamline the operator's communication with all departments of Boeing, as well as with applicable regulatory agencies.

Boeing offers:

- On-site technical support to assist in the recovery of severely disabled or damaged airplane.
- On-site consultation on appropriate airplane recovery equipment and methods.
- On-site assistance in the use of airplane recovery documents that provide critical information such as lifting, tethering, transporting, and other data required to recover Boeing airplanes.
- Training on aircraft recovery and assisting airlines in establishing their own airplane recovery teams.

Boeing also assists airlines with:

- Damage survey of airplanes on ground.
- Damage repair.

SUMMARY

Airplane recovery preparedness is essential to the successful operation of every airline. Boeing assists customers with a variety of airplane recovery resources and services, ranging from airplane recovery documents and tools to comprehensive airplane recovery services.

For more information, contact Jerry Paluszek at gerald.j.paluszek@boeing.com.

Tell us what you think!

There's still time to participate in the 2009 *AERO* Readership Survey. Help us deliver the best content to you by sharing your opinions, insights, and ideas for *AERO*. Your participation is anonymous, and no information will be shared outside the given purpose of this survey. It should take less than five minutes to complete.

You can complete the survey online by visiting **www.AeroReaderSurvey.com**. Or simply fill out the survey using the questionnaire on the next page, and mail or fax it back to us using the contact details below.

AERO Magazine
Boeing Commercial Airplanes
P.O. Box 3707, MC 21-72
Seattle, Washington
98124-2207
USA

Fax: 206.766.2934

AERO Readership Survey

1. Where do you work?
CHOOSE ONE

- ○ Airline
- ○ Maintenance, repair, and overhaul (MRO) organization
- ○ Supplier
- ○ Regulator
- ○ School
- ○ Library
- ○ Trade association
- ○ News media
- ○ Boeing
- ○ Other, specifically:

.....

2. What is your primary area of expertise? CHOOSE ONE

- ○ Engineering
- ○ Flight
- ○ Maintenance
- ○ Management
- ○ Regulatory
- ○ Safety
- ○ Other, specifically:

.....

3. Where do you live? CHOOSE CONTINENT, FILL IN COUNTRY

- ○ Africa

.....

- ○ Asia

.....

- ○ Australia

.....

- ○ Europe

.....

- ○ North America

.....

- ○ South America

.....

4. When given a choice, do you prefer to read publications (including *AERO*) in print or on the Internet? CHOOSE ONE

- ○ Printed
- ○ Internet
- ○ No preference

5. Which version of *AERO* magazine do you read the most?
CHOOSE ONE

- ○ Printed magazine only
- ○ Internet version only
- ○ Both printed and on the Internet
- ○ Don't read either

5b. If you answered that you don't read *AERO*, please tell us why.
CHOOSE ALL THAT APPLY

- ○ No print copies available
- ○ Poor Internet access
- ○ Not fluent in English
- ○ Articles of no interest
- ○ Other, specifically:

.....

6. *AERO* is published four times a year. How many issues do you read per year? CHOOSE ONE

- ○ 1
- ○ 2
- ○ 3
- ○ 4

7. Which comment best explains how you read *AERO*?
CHOOSE ONE

- ○ I read the entire issue.
- ○ I read only the articles that apply to my job.
- ○ I skim the magazine.
- ○ I only read articles recommended to me.

8. Overall, *AERO* contains valuable and timely technical information.
CHOOSE ONE

- ○ Strongly agree
- ○ Agree
- ○ Neutral
- ○ Disagree
- ○ Strongly disagree

9. Specifically, *AERO* provides useful information in the following categories:

	STRONGLY AGREE	AGREE	NO OPINION	DISAGREE	STRONGLY DISAGREE
Maintenance	○	○	○	○	○
Engineering	○	○	○	○	○
Flight	○	○	○	○	○
Management	○	○	○	○	○
Safety	○	○	○	○	○
Regulatory	○	○	○	○	○

10. Which comment best describes how easy it is to obtain a printed copy of *AERO*? CHOOSE ONE

- ○ There are many copies of *AERO* magazine at my location.
- ○ A few copies of the magazine are passed around.
- ○ It is very difficult to get a copy of *AERO*.
- ○ I have never seen a copy of *AERO*.

11. Which comment best explains how easy it is to access *AERO* on the Internet? CHOOSE ONE

- ○ I can always access *AERO* on the Internet easily.
- ○ I can sometimes access *AERO* on the Internet.
- ○ I can never access *AERO* on the Internet.
- ○ I did not know *AERO* is available on the Internet.

12. What kind of connection do you have to the Internet?
CHOOSE ONE

- ○ 28.8 Kbps modem
- ○ 56 Kbps modem
- ○ ISDN
- ○ Cable modem
- ○ DSL
- ○ T1 or better
- ○ Do not know

13. Which comment best describes your *AERO* experience on the Internet? CHOOSE ONE

- ○ *AERO* on the Internet allows me to easily find and access articles, see photos and graphics, play videos, and access links.
- ○ *AERO* on the Internet is sometimes difficult to navigate.

13b. If you answered that *AERO* is difficult to read on the Internet, please tell us why.
CHOOSE ALL THAT APPLY

- ○ Navigation confusing.
- ○ Pictures and graphics slow to load.
- ○ Videos do not play.
- ○ Links do not function.
- ○ Unable to access the Internet.

14. Please let us know how we can improve *AERO*:

.....

.....

.....

.....

.....

.....

.....

.....

You can complete our online reader survey at
www.AeroReaderSurvey.com

At Boeing, our passion is to build the finest commercial airplanes in the world. Whether the standard is safety, comfort or affordability, every Boeing plane is built to be the best of its class. It's a commitment to our customers and their passengers that knows no end.

BOEING