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THE BOEING EDGE

Expanding the
Boeing Family

**Regulatory
Operational
Approval for
Entry into
Service**

Preventing Main
Landing Gear
Shimmy Events

New Flight Crew
Reminder Function

AERO

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AERO

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The Boeing Edge 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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Expanding the Boeing family

At the 2013 Paris Air Show, Boeing launched the new 787-10 Dreamliner — the third and largest member of our very successful 787 family — with 102 orders and commitments from five customers.

With this outstanding start, it's clear that the market understands the extraordinary value the 787-10 will bring to the 787 family and to our customers around the globe.

When we set out to define the 787-10, airlines and leasing companies asked us to optimize the airplane for efficiency and versatility, with all the passenger-pleasing features for which the 787-8 is known. By maintaining a common maximum takeoff weight with the 787-9, we've created the most efficient jet in history, but without sacrificing range. The 787-10 will fly up to 7,000 nautical miles — more than 90 percent of today's twin-aisle routes — with fuel efficiency that is 25 percent better than the airplanes it will replace and 10 percent better than anything the competition is offering for the future.

The value of the 787-10 continues below deck with its amazing cargo capacity, another way our airplanes help operators maximize their profitability. The 787-10 adds another 13 percent revenue cargo capacity over the 787-9, already an excellent cargo carrier.

On the operational side, the 787-10 will share a common type rating with the 787-8, the 787-9, and the popular 777, giving



operators additional flexibility in scheduling and training flight crews.

Boeing's emphasis on commonality and versatility is the hallmark of our overall twin-aisle strategy. Just as the 787-8, 787-9, and 787-10 complement each other in size and range, the 747-8, 777, and 787 families do as well. Boeing offers these three families of highly fuel-efficient, twin-aisle airplanes that match in speed and reliability — in sizes that span the market — to provide operators with unmatched flexibility.

Our progression from the 787-8 to the 787-9, and now the 787-10, has been

a very natural one. With the new 787-10, we are excited about growing both our 787 family and twin-aisle portfolio to most efficiently serve your needs.

SCOTT FANCHER

Vice President and General Manager,
Airplane Development
Boeing Commercial Airplanes



First-delivery celebrations mark the completion of regulatory operational approvals.

Regulatory Operational Approval for Entry into Service

Boeing provides a high level of support to operators seeking operational approval from their regulatory authorities to add new airplane models to their fleet.

By **Jerry Bauer**, Program Manager, Operational Regulatory Affairs

Boeing can help operators coordinate with regulatory authorities to gain operational approval of new airplane models. Boeing provides documentation, training, planning assistance, engagement with regulatory authorities, and consulting agreements for specific support. Areas of focus include e-enabling implementation, such as network security, accelerated Extended Operations (ETOPS) approval, and advanced navigation capabilities. Boeing recognizes the importance of an efficient operational approval process to enable operators to enter their new airplanes into revenue service quickly.

This article outlines the operational approval process and describes the support that Boeing offers to operators

seeking regulatory approval when adding a new model to their fleet.

THE ENTRY-INTO-SERVICE PROCESS

When an airline adds a new airplane model to its fleet, it must meet a number of regulatory requirements to receive operational approval for the new model from its national aviation authority. The basic process for operational approval is consistent across airplane models but varies due to technology, airplane capabilities, and time since initial certification of the airplane (see fig. 1). Boeing provides additional assistance to launch customers who must coordinate closely with their regulatory authorities

using preliminary documents and data while type certification is being achieved.

Operational approval occurs between the operator and its regulatory authority. Requirements vary among the U.S. Federal Aviation Administration (FAA), European Aviation Safety Agency (EASA), and other national aviation authorities (NAAs).

New ETOPS rules, e-enabling, and advanced navigation capabilities have necessitated increased focus on operational approval requirements. In the 747-8 and 787 programs, additional focus was placed on assisting operators with regulatory engagement and operational approval. Lessons learned from the 747-8 and 787 introductions are being applied to the introduction of other airplane models.

Operational approval is separate from airplane certification, but it is necessary to demonstrate certified airplane capabilities to gain operational approval. Outside the United States, type certification validation and operational approval requirements are determined by the country where the operator is based and registers its airplanes. Operators that are headquartered in one country but register their airplanes in another country are subject to certification and operational approval requirements of both countries.

Boeing provides support for operational approval as a basic service provided with the airplane sale, and with fee-based services and through consulting agreements, if requested by the operator.

FAA EVALUATION FOR OPERATIONAL APPROVAL

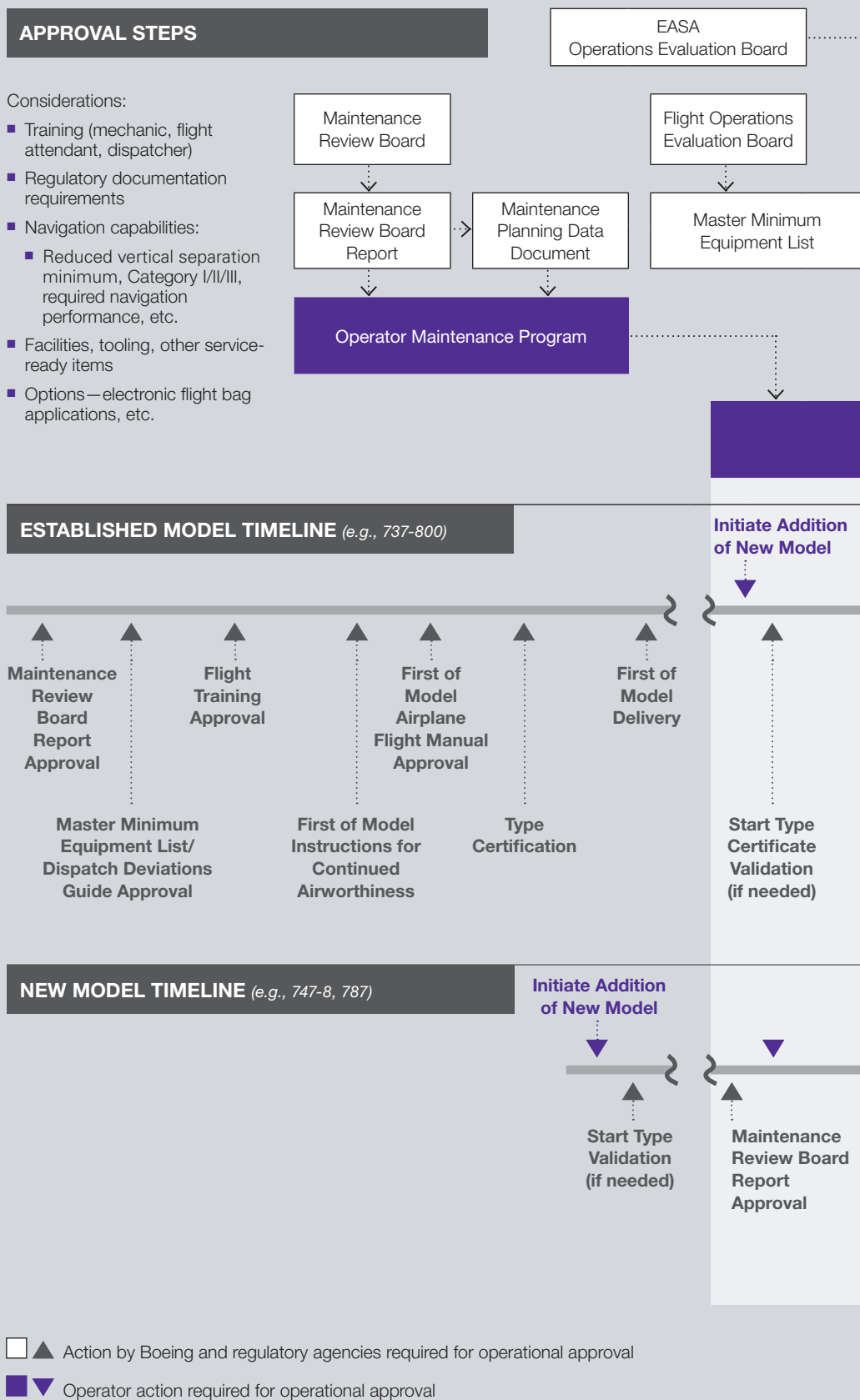
An FAA Aircraft Evaluation Group (AEG) evaluation for operational suitability occurs at the same time as type certification. Operational suitability must be achieved before customers can obtain operational approval of a new airplane type. The AEG evaluation includes:

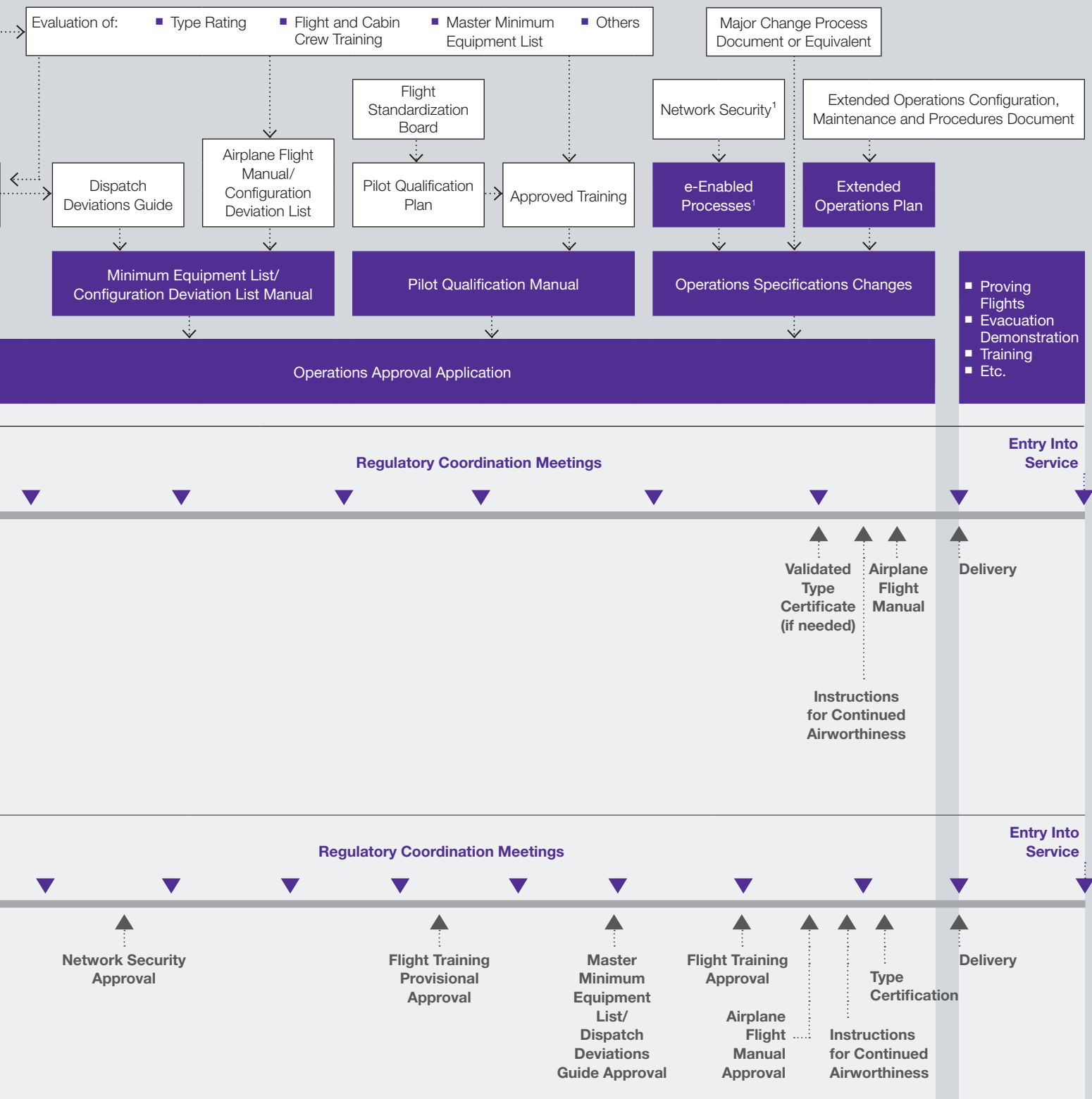
- Flight crew-type rating requirements, set by the FAA Flight Standardization Board.
- Minimum equipment required for dispatch, determined by the FAA Flight Operations Evaluation Board.
- Continued airworthiness, determined by the FAA Maintenance Review Board.
- Acceptance of Instructions for Continued Airworthiness, which specify necessary maintenance.

In the United States, FAA operational approval occurs at the local level through the principal operations inspector, principal maintenance inspector, and principal avionics inspector. The FAA Major Change Process Document (MCPD) is used when adding a new type to an existing operator's fleet. The systems safety concepts of the

Figure 1: Operational approval maps

Operators must develop a maintenance program, establish a minimum equipment list, and perform other functions to receive operational approval. As part of the operational approval process, Boeing works with the FAA to set the baseline to ensure the airplane is ready to enter service. Launch customers must seek operational approval prior to conclusion of type certification activities.





¹ Network Security and e-Enabled Processes were approval steps for the 747-8 and 787 but not for the 737-800.

Electronic flight bags provide flight crew and maintenance personnel with information that has traditionally been accessed by paper documents, as well as takeoff and landing calculations.

Air Transportation Oversight System are incorporated into the MCPD. Revisions to operations specifications and operating manuals are required for a new airplane type. Other regulatory authorities have similar processes to assist operators as they introduce a new airplane type.

OTHER REGULATORY AUTHORITIES' EVALUATIONS FOR OPERATIONAL APPROVAL

EASA requires a review by the Operations Evaluation Board (OEB) prior to airplane introduction by European operators. The OEB review includes:

- Flight crew training, checking, and currency.
- Operational suitability and compliance to European Union regulations, EU-OPS, Subparts K and L.
- Master minimum equipment list.
- Electronic flight bag (EFB).
- Required navigation performance with authorization required (RNP AR) approach capability.
- Simulator qualification.
- Type rating designation.

Other regulatory authorities have similar requirements to document airplane capabilities that meet operational requirements. The Civil Aviation Administration of China specifies this in its Advisory Circular AC-91-13, Operational Evaluation Requirements for Import Aircraft, and related document MD-FS-AEG004, Guide for Developing and Use of Operational Compliance Checklist.

REGULATORY CONSIDERATIONS FOR OPERATOR'S INTRODUCTION

In addition to the airplane's operational approval by regulatory agencies, the operator itself must comply with all pertinent FAA, EASA, or NAA regulations governing the new airplane. These regulatory considerations include areas such as:

- **EFBs.** EFBs provide flight crew and maintenance personnel with information that has traditionally been accessed by means of various paper documents, as well as applications such as takeoff and landing calculations. Regulatory approval is needed to implement EFBs.

- **Network security.** Regulatory oversight of the security of e-enabled features was increased on the 747-8 and 787. FAA OpSpec D301 and guidance material in FAA Order 8900.1 specify security requirements.
- **Airline modifiable information.** This software is considered user-modifiable software and is designed to be modified within the specified modification constraints and with approved modification procedures without further involvement by the certification authority. Modifications may be made to data, executable code, or both. Modification of data such as electronic checklists requires operational approval.
- **Airline selectable options (ASOs).** These software-enabled features are provisioned by onboard operational program software that operators can configure on their own. ASOs are equivalent in form and function to option selection software, which is historically known as an operational program configuration. An example of an ASO is the ability to specify weights, flow rates, and volumes

either in English units (e.g., pounds, pounds/hour, quarts) or metric units (e.g., kilograms, kilograms/hour, liters). Boeing guidance for use of ASOs contains operational approval requirements.

- **ETOPS rules.** ETOPS diversion time capability from an adequate airport requires operational approval of an operator's maintenance program, dispatch process, and flight operations.
- **Category II landing weather minima.** Use of the capabilities of Boeing airplanes for operations in Category II landing weather minima requires procedures, training qualification, and demonstration by the operator.
- **Category III landing weather minima and low-visibility takeoff.** Use of the capabilities of Boeing airplanes for operations in Category III landing weather minima and low-visibility takeoff requires procedures, training qualification, and demonstration by the operator.
- **RNP.** RNP operational approval must be obtained prior to flying RNP AR approach procedures. RNP is a statement of the navigation accuracy required for operation within a defined airspace.
- **Reduced vertical separation minimum (RVSM).** Within RVSM airspace, air traffic control separates airplanes by a minimum of 1,000 feet (305 meters) vertically between flight level (FL) 290 and FL 410, inclusive. RVSM airspace is special qualification airspace: the operator and the airplane used by the operator must have operational approval.

BOEING OPERATIONAL APPROVAL SUPPORT

Boeing offers support to operators in gaining various types of operational approval. Basic support includes:

- **Boeing Operational Regulatory Affairs.** This team provides direct support to

various new-model operators and their regulatory authorities for introduction of the new airplane type, including on-site visits. The team can provide advice to any operator seeking regulatory operational approval for addition of a Boeing airplane type into their fleet. The team can also facilitate engagement between the regulatory authority and the FAA to address operational concerns.

- **Regulatory Operations Support.** This organization can produce an operational conformance evaluation report, which documents airplane feature/capability compliance with global operational regulations (e.g., Parts 91, 121, 125, 129, and 135). Following airplane delivery, this team provides continuing fleet support by helping customers resolve regulatory issues.
- **Crew Information Systems.** Boeing support for EFB deployment includes meetings with the operator and its regulatory authority to establish an operational approval plan.
- **ETOPS Specialists.** Boeing ETOPS maintenance and flight operations specialists offer an ETOPS support visit and other services to operators and their regulatory authorities to assist with ETOPS program development and approval.
- **747-8 and 787 E-enabling Deployment.** A deployment manager is assigned to each operator of e-enabled airplanes. Regulatory approval of network security plans is considered in the overall deployment plan.
- **Flight Operations Engineering.** An airline support engineer is assigned to each operator as a point of contact for flight operations issues and can address issues related to airplane capabilities discussed in documents such as the airplane flight manual, flight crew operations manual, and quick reference handbook.

- **Customer Engineering.** An account manager is assigned to address airplane configuration issues in support of operational approval. The organization also provides delivery documents, which explain the airplane's capabilities.

In addition to this basic support, Boeing can provide specialized support to an operator seeking regulatory approval when adding a new model to its fleet. This support includes:

- **Boeing Professional Services.** This organization offers consulting services for airline operations, airport planning and operations, supply chain management, maintenance and engineering, information technology systems, and cybersecurity (www.boeing.com/commercial/aviationservices/information-services/professional-services.html).
- **Boeing Navigation Services.** This organization offers fee-based consulting services for operators wanting to implement performance-based navigation operations, including RNP AR and RNP approach (www.boeing.com/boeing/commercial/aviationservices/integrated-services/pbn.page).
- **Startup Boeing.** This organization offers advice for starting an airline, including market analysis, airplane sourcing, operating environment, Boeing resources, business planning, and airplane selection (www.boeing.com/commercial/startup/).

SUMMARY

Adding new Boeing airplane models to an operator's fleet requires regulatory authority operational approval. Boeing can assist airlines with this complex process through a variety of services ranging from basic to highly specialized support. Operators benefit from an efficient operational approval process that gets the new airplane model into revenue service in the shortest time possible. ■



When a torsion link is completely severed as a result of a shimmy event, it can leave oscillating tire marks on the runway.

Preventing Main Landing Gear Shimmy Events

Main landing gear (MLG) shimmy is a rare event that starts at airplane touchdown and continues during rollout. Boeing has determined several causes of shimmy, particularly for the 737-200/-300/-400/-500 fleet and offers specific actions that can prevent this vibration from occurring.

By Warren Malkowicz, Senior Engineer, Landing Gear Structures, Service Engineering, and
Christopher Dubuque, Senior Engineer, Landing Gear Systems, Service Engineering

Based on operator reports, MLG shimmy is an infrequent event that is characterized by strong vibration, usually from one MLG, that begins at touchdown and continues until the airplane is fully stopped. Historically, there have been two or three shimmy events a year in the worldwide 737-200/-300/-400/-500 fleet. However, in the last few years, the rate of shimmy events has increased sharply on these models. In a few particularly severe shimmy events, the affected main landing gear collapsed during the landing.

This article discusses causes of shimmy and recommended actions operators can take to reduce the likelihood of it occurring.

UNDERSTANDING SHIMMY EVENTS

Boeing sometimes receives reports from operators of what is assumed to be a hard landing because of the violent nature of the landing and the observation of a torsion link fracture. However, Boeing's experience with these landings reveals that such damage actually suggests a shimmy event occurred.

Despite the presence of shimmy damper hardware, which is attached to the apex lugs on each MLG and is designed to reduce the torsional vibration energy generated during landing, airplanes occasionally experience MLG shimmy. Shimmy events almost always result in damaged torsion links and shimmy dampers (see fig. 1). When a torsion link is completely severed, it can leave oscillating tire marks on the runway. Following a shimmy event, the airplane typically needs to be temporarily removed from revenue-generating service for inspections and repairs.

Figure 1: Fractured torsion link

A main-landing-gear shimmy event fractured the lower torsion link and damaged the wheel, tire, and shimmy damper.



Boeing has studied shimmy events in an attempt to understand their root causes and to develop preventative actions or recommendations. Shimmy can occur on large or small commercial, commuter, and military airplanes with a single-axle MLG. In-service history indicates that shimmy events usually stem from maintenance errors in installation, excessive wear and freeplay in the landing gear joints, improper servicing of the damper or shock strut, or landings with extremely low sink rates.

The number of reported shimmy events has increased somewhat during the past several years. But the rate has significantly increased due to new operators with less familiarity in maintaining and operating 737-200/-300/-400/-500 airplanes along with the decreasing number of these airplanes in the worldwide fleet (see fig. 2). Because some operators mistakenly categorize the event as a hard landing instead of a shimmy, the amount of shimmy reports is considered to be lower than what actually occurs.

ABOUT SHIMMY

Shimmy is a torsional vibration excitation of the landing gear in which the inner cylinder, wheels, and tires rotate (or oscillate) relative to the outer cylinder that is fixed to the airplane structure (see fig. 3).

For shimmy to occur, the landing gear must have a force applied to it that excites this torsional vibration mode. The 737 has a vibration frequency of approximately 15 Hertz (Hz). Boeing engineers theorize that the force needed to initiate shimmy is probably an alternating drag force, such as if one tire touches down, causing a twisting motion of the inner cylinder in one direction and the second tire touches down a fraction of a second later, causing the inner cylinder to twist in the opposite direction. If the timing between the first tire and second tire contacting the runway is similar to the shimmy frequency, the gear can oscillate in the shimmy mode.

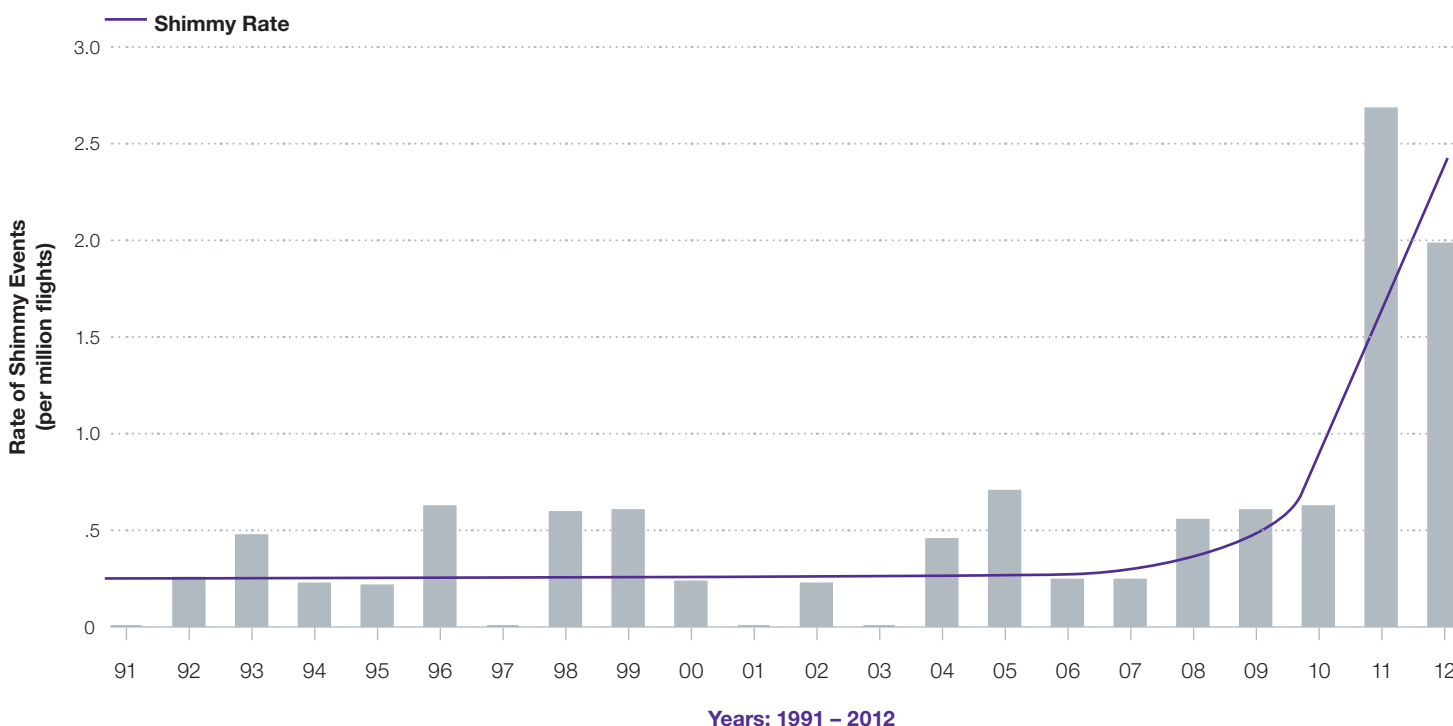
HOW BOEING HAS ADDRESSED SHIMMY

To prevent this vibration mode, all Boeing 737 airplanes use a hydraulic shimmy damper. The damper is connected between the upper and lower torsion links on the MLG and allows a small, but highly damped, motion to occur around the torsional axis of the gear.

Due to the geometry of the torsion links, the shimmy damper is most effective when the landing gear strut is compressed in the ground mode. With the shock strut fully or near fully extended, the torsion links hang in a near vertical position, which gives the damper less mechanical advantage to perform its function. MLG shimmy on a takeoff roll has never been reported, most likely because severe twisting forces are never applied to the gear during a takeoff and the gear is compressed into the ground mode.

Figure 2: Increase in shimmy occurrence

The shimmy rate is calculated by dividing the number of reported shimmy events by the average flight cycles accumulated by the fleet annually. The rate has significantly increased due to new operators with less familiarity in maintaining and operating 737-200/-300/-400/-500 airplanes along with the decreasing number of these airplanes in the worldwide fleet.



HOW DAMPERS CAN LOSE THEIR EFFECTIVENESS

Although shimmy dampers have been very successful at preventing shimmy, problems can arise that render the dampers ineffective. Detailed studies of 737-200/-300/-400/-500 shimmy events have revealed several root causes. In approximate order of likelihood, they are:

- **Excessive wear or freeplay in the joint where the shimmy damper connects to the lower torsion link (referred to as the apex joint).** Wear at this location allows undamped torsional freeplay to exist in the landing gear at the apex joint, which greatly increases the likelihood of shimmy.
- **Wear or freeplay in the torsion link bushings (e.g., where the torsion links connect to the outer and inner cylinder).** Wear at these locations also allows undamped torsional freeplay.

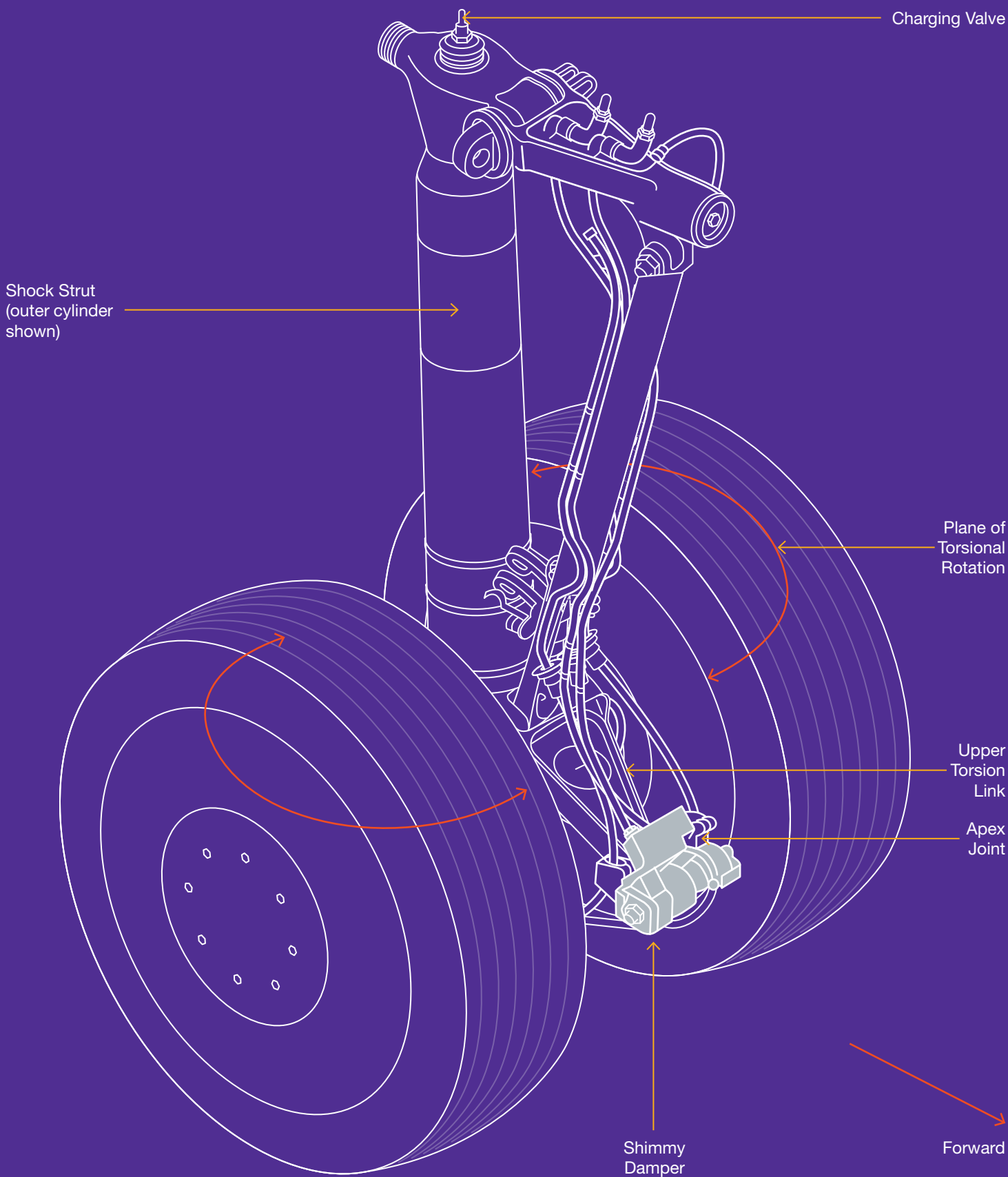
- **Landing with extremely low sink rates.** This type of landing is more likely to experience shimmy than a firmer landing because the torsion links remain in an extended, vertical position where the damper has less mechanical advantage for longer periods of time.
- **Air in the damper.** Several shimmy events occurred within a few flights after a new or overhauled damper was installed. In these cases, it is suspected that a thorough bleeding of air from the damper was not performed, thus preventing proper damper operation.
- **Damper piston fracture.** In a small number of events, it is suspected that the damper piston fractured due to a preexisting fault (e.g., a fatigue crack).
- **Overserviced shock strut.** In several events, an overserviced shock strut has been suspected to have been a contributing factor. A shock strut overserviced with nitrogen allows the torsion links to have a reduced mechanical advantage to react to the torsional motion of the inner cylinder.

- **Incorrect damper installation.** In one event, a damper designed for a very early 737-200 had inadvertently been installed on a later airplane that required a more heavy-duty damper.
- **Unconnected hydraulic tube.** In one event, a hydraulic tube for the damper was inadvertently left unconnected after unrelated maintenance, so there was no hydraulic fluid available to the damper.

On the newer Next-Generation 737 airplanes, advances in technology enabled Boeing to redesign the details so that the joint is more robust and less prone to shimmy. Boeing accomplished this by using an improved shimmy damper, strengthening the torsion link apex joint, and by making the links from titanium without the lightening holes. Fleet experience is showing that this joint is now less susceptible to in-service wear than the earlier 737 models. However, appropriate maintenance is still necessary on the Next-Generation 737 models to prevent shimmy.

Figure 3: Torsional vibration is the cause of shimmy

Shimmy is a torsional vibration mode of the landing gear in which the inner cylinder, along with the wheels and tires, rotates (or oscillates) relative to the outer cylinder. To prevent this vibration mode, airplanes have a hydraulic damper installed between the upper and lower torsion links to allow a small, highly damped motion to occur around the torsional axis of the gear.



Boeing also recommends that pilots strive for a landing with normal sink rates with particular emphasis on ensuring that the auto speedbrakes are armed and deploy promptly at touchdown. An overly soft landing, or a landing in which the speedbrakes do not promptly deploy, allows the landing gears to remain in the air mode longer, which makes them more vulnerable to shimmy.

RECOMMENDED OPERATOR ACTIONS

Boeing has published several maintenance documents that advise operators of recommended maintenance to prevent shimmy events. These include:

- Service Letter 737-SL-32-057.
- Multi-Operator Message MOM-MOM-12-0127-01B.
- Fleet Team Digest Article 737-FTD-32-11001.
- 737 Aircraft Maintenance Manual 32-11-00/601, Torsional Free Play Inspection.
- 737 Aircraft Maintenance Manual 32-11-81/501, Main Gear Damper Adjustment.


Boeing has revised the relevant aircraft maintenance manuals (AMMs) and component maintenance manuals (CMMs) to improve the directions and procedures

concerning shimmy damper and torsion link maintenance. For example, Boeing has added 737-300/-400/-500 AMM section 05-51-68, Main Landing Gear Shimmy/Vibration – Maintenance Practices (Conditional Inspection). Boeing recommends that operators review these maintenance publications, which are available on the MyBoeingFleet.com Web portal.

Boeing also recommends that pilots strive for a landing with normal sink rates with particular emphasis on ensuring that the auto speedbrakes are armed and deploy promptly at touchdown. An overly soft landing, or a landing in which the speedbrakes do not promptly deploy, allows the landing gears to remain in the air mode longer, which makes them more vulnerable to shimmy. This is especially true when landing at airports located at higher elevations, where the touchdown speed is increased.

SUMMARY

Dampers have eliminated most MLG shimmy events. However, these events can still occur in certain situations, particularly in the case of maintenance errors in installation, excessive wear and freeplay in the landing gear joints, improper servicing of the damper or shock strut, or during landings with extremely low sink rates. Landing gear collapse is even a possibility if the joints and dampers are not maintained according to Boeing recommendations. Boeing has published several maintenance documents that operators can use to maintain and operate airplanes in a manner that reduces the possibility of shimmy.

For more information, please e-mail lgshimmydamper@exchange.boeing.com. 



A new function lets 777 and 787 flight crews create automated reminders to alert them when specific actions need to be taken.

New Flight Crew Reminder Function

Boeing has developed a comprehensive monitoring and alerting system to reduce flight crew workload by allowing flight crews to set up automated reminders to alert them when specific events are achieved or actions are required. The alerting system is available on the 777 and 787.

By Brad Cornell, Associate Technical Fellow, Flight Deck Product Development, and
Gordon Sandell, Associate Technical Fellow, Avionics and Air Traffic Management

In addition to operating airplane systems, flight crews must perform many specific tasks during a flight, such as fuel checks and crew changes. Historically, flight crews have used a variety of different techniques to help them remember to perform tasks not monitored by the airplane.

Boeing has developed a new function that allows flight crews to easily set up automated reminders to alert them when specific events occur or when actions need to be taken. Available on the 777 and 787,

the function enables operators to use the baseline communication system's airline modifiable information (COMM AMI) to activate the reminders. Alternatively, operators can incorporate the reminder page portion of the baseline AMI into their operator-specific COMM AMI using the ground-based software tool (GBST).

This article explains how the crew reminder function can be used and how flight crews can set up reminders.

THE BENEFIT OF STANDARDIZED CREW REMINDERS

There are several levels of flight crew workload when operating a commercial jet transport airplane, including planning the flight, setting the airplane systems, departing the airport, and operating the airplane systems to maintain the desired flight path.

In addition to operating systems on the airplane, there are many flight crew tasks associated with managing the flight.

Boeing has continuously made a concerted effort to simplify system designs while incorporating comprehensive monitoring and alerting systems. These systems help reduce flight crew workload associated with operating the various systems on the airplane.

Flight crews have developed several different techniques to help remind them to perform various tasks associated with managing the flight that are not monitored by the airplane. These techniques range from inserting waypoints into the flight management system's route to writing notes on paper and putting the paper in the forward field of view. Examples of these tasks include fuel checks, crew changes, or starting the auxiliary power unit before descending to an airport that has an unserviceable ground cart.

Boeing has continuously made a concerted effort to simplify system designs while incorporating comprehensive monitoring and alerting systems. These systems help reduce flight crew workload associated with operating the various systems on the airplane. Having already reduced workload in operating the systems, Boeing now focused on reducing crew workload to manage the flight, and came up with the crew reminder function.

REDUCING CREW WORKLOAD THROUGH AUTOMATED REMINDERS

The crew reminder function provides an easy way for crews to set up automated reminders that alert them when specific events are achieved or specific actions need to be taken (see fig. 1). The flight crew reminder function can be implemented in the 777 and 787 COMM system.

Typically, operators develop their own COMM menus and displays compatible with their automation systems and procedures using a GBST. Once the operator-specific pages are finalized, an AMI file is created specifically for the COMM function. The 777 and 787 also come with a baseline COMM AMI, and operators can incorporate any of the functions included in the baseline AMI into their unique COMM AMI without additional cost or effort other than what is required to copy the reminder function from the baseline AMI. The reminder function can also be added to an existing operator's fleet by incorporating the reminder portion

of the Boeing baseline AMI into the operator's current COMM AMI and reloading the revised COMM AMI file on the airplane.

The reminder function allows the flight crew to select from a list of predefined conditions and enter text specific to the reminder, such as "Crew Change" (see fig. 2). When the condition is met, the COMM function posts a message and the flight crew is alerted by a COMM message on the engine-indicating and crew-alerting system and with an aural alert identical to an incoming company uplinked message. The reminder can then be accessed on the COMM display just like any other uplinked company message.

For operators of 777 and 787 airplanes wanting to obtain this feature, Boeing will provide a set of software components with instructions that can be added to an operator's AMI source data and recompiled on the GBST to create a loadable database.

Figure 1: Flight crew reminder function

The crew reminder function provides an easy way for flight crews to set up a variety of automated reminders that alert them with visual and aural reminders when specific events are achieved or specific actions need to be taken.

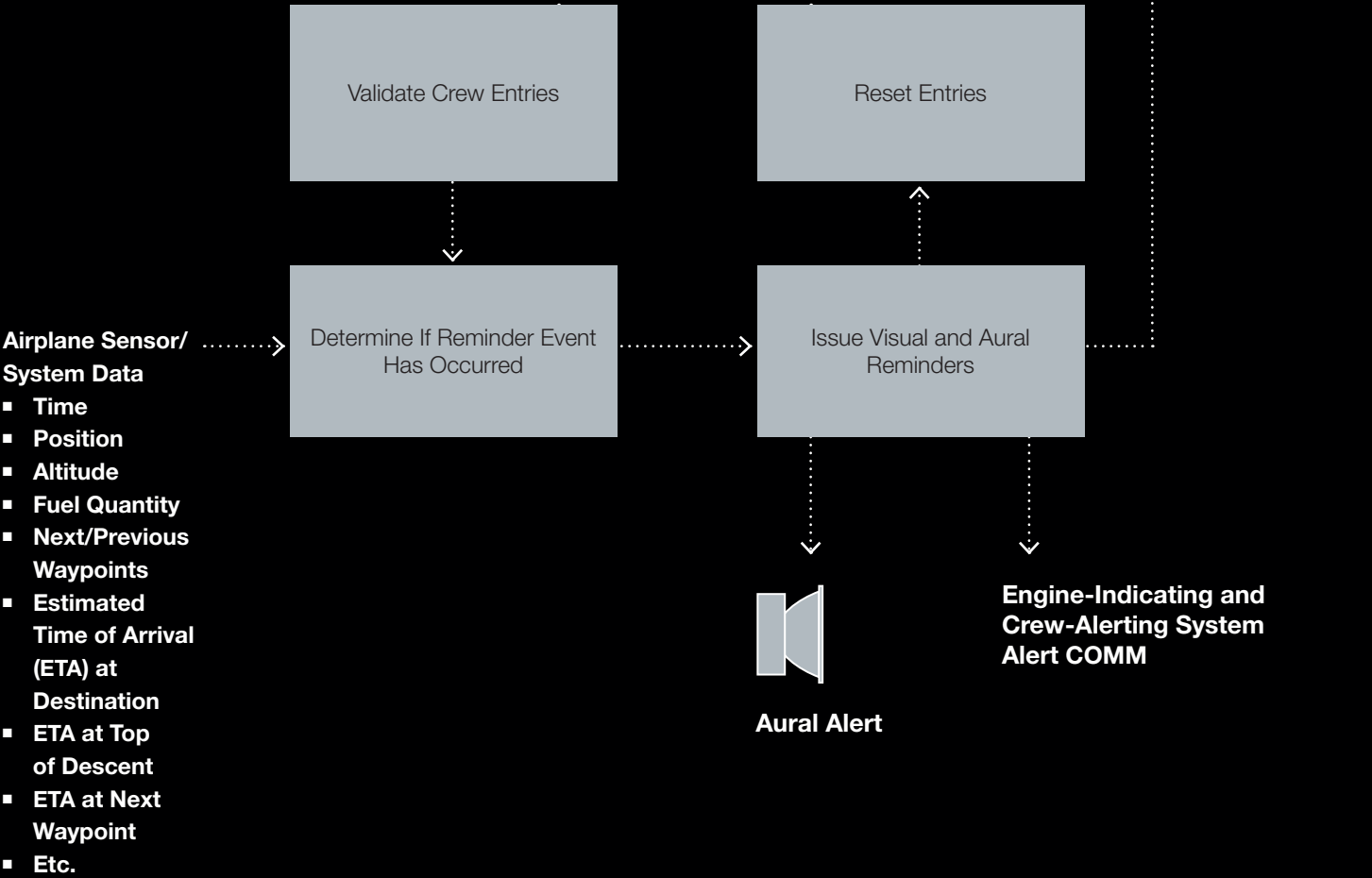
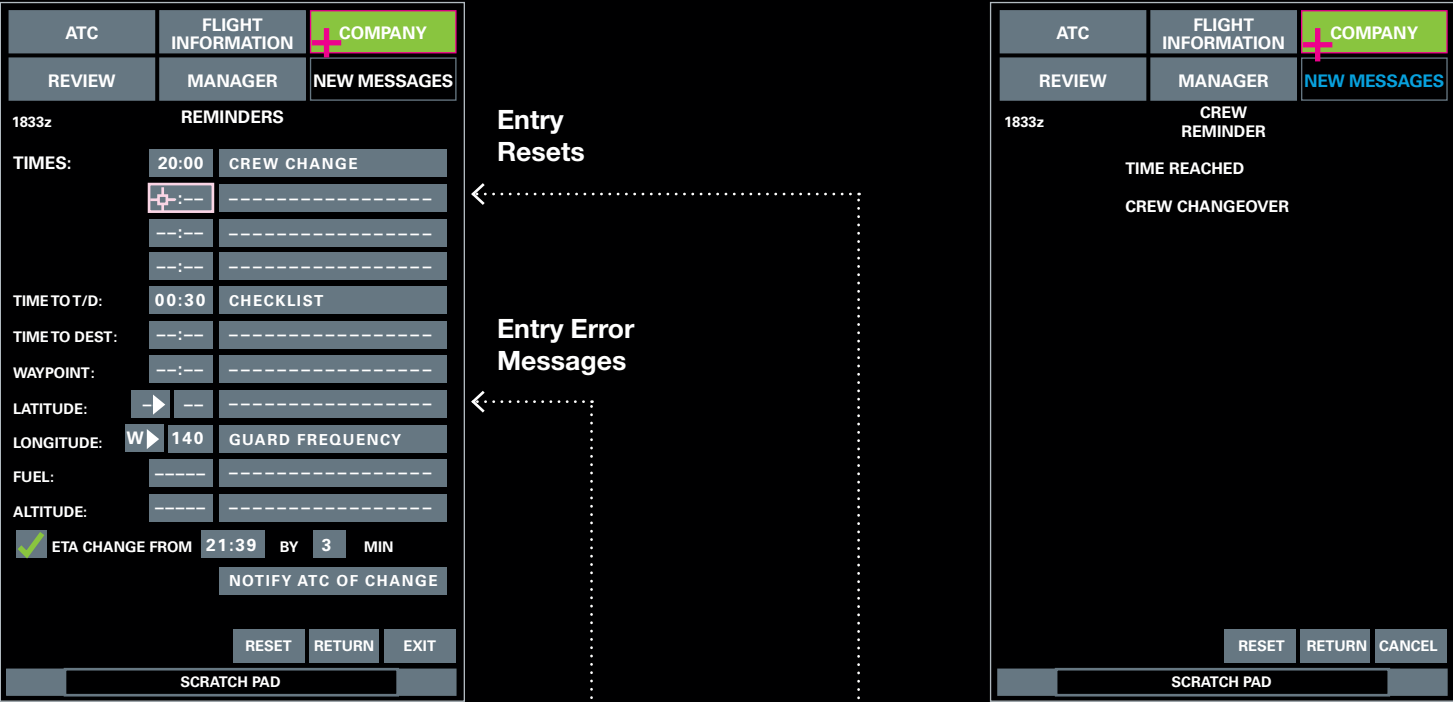


Figure 2: Entering and reviewing reminders

The reminder function allows the flight crew to select from a list of predefined conditions and enter text specific to the reminder (left). When the condition is met, the COMM function sends a message to itself and the flight crew is alerted by a COMM message on the engine-indicating and crew-alerting system and with an aural alert.

ATC	FLIGHT INFORMATION	COMPANY
REVIEW	MANAGER	NEW MESSAGES

1833z REMINDERS

TIMES: 20:00 CREW CHANGE

+

:

:

TIME TO T/D: 00:30 CHECKLIST

TIME TO DEST: -----

WAYPOINT: -----

LATITUDE:

→

LONGITUDE:

W

 140 GUARD FREQUENCY

FUEL: -----

ALTITUDE: -----

ETA CHANGE FROM 21:39 BY 3 MIN

NOTIFY ATC OF CHANGE

RESET

RETURN

EXIT

SCRATCH PAD

Crew Reminder Page

ATC	FLIGHT INFORMATION	COMPANY
REVIEW	MANAGER	NEW MESSAGES

1833z CREW REMINDER TIME

UTCTIME: 18:35z

CREW CHANGE

RESET

RETURN

CANCEL

SCRATCH PAD

COMM Reminder Message

REMINDERS FOR A VARIETY OF EVENTS

After reviewing the parameters that were available to the COMM function and consulting with operators and Boeing test pilots, a list of reminders was developed for nine specific events:

- Reaching a specific time (multiple reminders can be set).
- Reaching a specific time-to-go to top-of-descent.
- Reaching a specific time-to-go to the destination.
- Passing a specific waypoint in the flight plan.
- Crossing a specific latitude.
- Crossing a specific longitude.
- Reaching a specific fuel state.
- Reaching a specific altitude.
- The estimated time of arrival (ETA) at the next waypoint changing by a threshold value entered by the crew.

An airline can customize this list by deleting reminders that it finds are not useful in its operations or by adding its own reminders.

USING CREW REMINDERS ON THE FLIGHT DECK

There are a number of ways in which this function can be used on the flight deck. For example, air traffic control (ATC) may send a clearance (e.g., AT 2130z CLIMB TO AND MAINTAIN FL390) that needs to have action taken on it sometime in the future. The times can range from a few minutes to a few hours. Following receipt of such a conditional clearance, the crew can easily set a reminder time or position to comply with the clearance using the crew reminder function.

Routine uses include:

- Adding equal time point reminders between extended-diversion-time-operation airports, such as between Hilo and Los Angeles on Pacific crossings.

- Adding a point-of-no-return reminder as a time or position.
- Adding a fuel state reminder that can supplement the flight management computer “MIN FUEL” calculation.
- Setting a position for change of radio guard (such as 140 degrees west or 20 degrees north on Pacific crossings).
- Setting a time to call the resting crew on supplemented crew operations.
- Notifying ATC when ETA at waypoint changes.
- Setting a reminder to log on to ATC (at a time or location) for a datalink.
- Setting a reminder for when to request an oceanic clearance (for North Atlantic operations).

SUMMARY

Boeing has developed a new function that enables 777 and 787 flight crews to create automated reminders to alert them when specific events are achieved or when actions need to be taken. [A](#)

