Boeing, the U.S. Federal Aviation Administration, and 747 operators have completed a three-year effort to update the required scheduled maintenance programs for the 747-100/-200/-300 and the 747-400. The revisions offer significant cost savings for both new and current operators of 747 airplanes.
In response to customer requests to improve maintenance programs for out-of-production airplanes, Boeing initiated an effort in 1999 to update the maturing maintenance program for the 747-100/-200/-300 (i.e., 747 Classic). Because the 747 Classic and 747-400 are structurally similar, Boeing and the industry decided to update the maintenance program for the 747-400 at the same time.

The revised maintenance requirements comply with industrywide maintenance practices developed by the Air Transport Association (ATA) Maintenance Steering Group (MSG), a group of airframe manufacturers, airlines, U.S. Federal Aviation Administration (FAA) representatives, and suppliers. These MSG Level 3, Revision 2 (MSG-3 Rev. 2) standards are the same as those used to develop scheduled maintenance requirements for the 777, 737-600/-700/-800/-900, and 717. MSG-3 Rev. 2 methodology also was used to update maintenance programs for the MD-80, DC-9, DC-10, and DC-8 during the late 1990s. Updated maintenance programs for the 727 and 737-200/-300/-400/-500 are scheduled for completion by year-end 2002 and third-quarter 2003, respectively.

Two industry steering committees (ISC) were formed in 1999 to revise the 747 maintenance programs—one for the 747 Classic and the other for the 747-400. Each ISC was made up of representatives from 747 operators, Boeing, and the FAA. More than 50 percent of the 747 Classic fleet and 70 percent of the 747-400 fleet were involved in the three-year effort. The resulting 747 Classic and 747-400 Maintenance Review Board Reports (MRBR), which have been approved by the FAA, can help 747 operators significantly reduce maintenance costs. Based on data reported by operators using MSG-3 Rev. 2 maintenance programs for the MD-80, DC-9, DC-10, and DC-8, annual savings for 747 operators...
could be as much as 30 percent. Savings are achieved through

1. Increased intervals between maintenance checks.
2. Elimination of redundant and inefficient maintenance tasks.
3. Efficient packaging of maintenance requirements.
4. Enhanced commonality between models.
5. Refined requirements for the 747-400 systems and power plant.
6. Alternative methods of compliance to corrosion requirements.

**1 Increased intervals between maintenance checks**

Under the revised MRBRs, 747 operators can perform extensive maintenance inspections (i.e., letter checks such as D-checks) less frequently (table 1). This allows operators greater airplane utilization between scheduled downtimes.

Increasing the intervals between scheduled maintenance checks was supported by significant operator in-service data gathered during the MSG-3 Rev. 2 analysis. In addition, the flight-hour parameter for D-checks was eliminated because data indicated that the parameter had a minimal effect on the maintenance tasks performed during those checks.

**2 Elimination of redundant and inefficient maintenance tasks**

During the MSG-3 Rev. 2 analysis of the 747 Classic and 747-400 MRBRs, the ISCs identified and eliminated redundant maintenance tasks in the areas of systems and power plant maintenance and structures maintenance. The 747 Classic ISC also added a zonal maintenance program for the 747 Classic that complies with MSG-3 Rev. 2 standards.

**Systems and power plant maintenance.** The following systems and power plant maintenance tasks were identified as redundant or inefficient: the escape slide testing cycle for both the 747 Classic and 747-400, condition monitoring and on-condition maintenance control processes for the 747 Classic, certain FAA-mandated tasks for the 747-400 that had not been analyzed using the MSG-3 process, and several general visual inspection (GVI) tasks for the 747-400.

**747 Classic and 747-400 escape slide testing cycle.** The three-year cycle for testing the emergency escape slides on both the 747 Classic and 747-400 was extended to a 12-year cycle. Because escape slide inflation is costly and time consuming, this change offers operators significant cost savings.

**74 Classic condition monitoring and on-condition maintenance control processes.** Condition monitoring and on-condition maintenance control processes were eliminated from the 747 Classic systems maintenance program. These processes are unnecessary because all tasks previously defined as condition monitoring are inspected as part of the new zonal maintenance program.

**747-400 Non–MSG-3 tasks.** During the development of the original 747-400 scheduled maintenance program in 1988, the FAA required the inclusion of several tasks in the systems section of the MRBR that did not result from the original MSG-3 analysis. The MSG-3 Rev. 2 analysis conducted during Revision C showed that many of these tasks (e.g., visual inspections of auxiliary power units) were not necessary and could be deleted from the MRBR.

**747-400 GVI tasks.** The GVI tasks listed in the systems section of the original 747-400 MRBR also were included in the zonal inspection program. To prevent inadvertent duplication of effort, these tasks were deleted from the systems maintenance section during the analysis conducted for the new revision (i.e., Revision C). A list of the transferred tasks was added to the MRBR as an appendix.
The structures maintenance program for the 747-400 is based on that of the 747 Classic, which was developed using MSG Level 1 guidelines. In 1990, the FAA issued Airworthiness Directive (AD) 90-25-05, which mandated the development of additional structures maintenance requirements involving CPCP inspections for both the 747 Classic and 747-400. Because many 747 operators have not integrated the structures maintenance and CPCP requirements into a single program, structural areas of the airplane may be inspected twice, once for the MRBR requirements and once for the CPCP requirements.

One of the most significant benefits of conducting the MSG-3 Rev. 2 analysis was the integration of the CPCP requirements into the structures maintenance section of the MRBRs, which eliminated the possibility of redundant inspections. The integration was validated on-airplane at an ISC member location with the FAA Maintenance Review Board chairperson in attendance.

### 747 Classic and 747-400 CPCP inspections.

The ISCs adopted a definition of GVIs that was part of MSG-3 Revision 2002, a successor to MSG-3 Rev. 2. The new definition states that a GVI can be conducted from within touching distance unless otherwise specified and that a mirror can be used to ensure visual access to all surfaces in the inspection area. As a result, structures maintenance tasks for detailed visual inspections can be considered part of the GVIs. Some of these GVI tasks were transferred to the zonal maintenance sections of the 747 Classic and 747-400 MRBRs, thereby allowing a broader skill base to perform these tasks.

### CPCP inspections are integrated into the structures and zonal programs under the revised MRBRs.
Zonal maintenance.
The ISCs made the zonal inspection requirements common to both airplane models wherever possible to increase the commonality of the 747 Classic and 747-400 MRBRs.

The specific structures GVI tasks (as defined by MSG-3 Revision 2002) transferred to the zonal maintenance program were those tasks related to the CPCP requirements mandated by AD 90-25-05. All qualifying systems maintenance tasks that are considered to be GVI tasks were transferred to the zonal maintenance program.

All zonal maintenance inspection tasks were validated on-airplane with FAA and industry participation to ensure completeness and correct access requirements.

Efficient packaging of maintenance requirements
As a result of the MSG-3 Rev. 2 analysis, the number of total maintenance tasks was reduced significantly by optimizing the inspection criteria for structures and zonal maintenance requirements (table 2). This efficient packaging of maintenance requirements is expected to reduce administrative costs for airlines.

Enhanced commonality between models
The MSG-3 Rev. 2 analysis established a common foundation for the 747 Classic and 747-400 scheduled maintenance programs. The commonality of the two programs aligns program execution as much as possible. Because the format and organization of the maintenance programs are identical, administrative control of the programs is more straightforward for operators.

Refined requirements for the 747-400 systems and power plant
The systems and power plant section of the original 747-400 MRBR already complied with MSG-3 Rev. 2 standards. During the development of Revision C, additional improvements were made to the section, including the incorporation of five MRBR temporary revisions. Another improvement was the inclusion of all recurring maintenance tasks associated with thrust reverser ADs issued since Revision B and the inclusion of tasks associated with Rolls-Royce RB211-524 engine derivatives.

The 747-400 ISC also included additional ATA Chapter 28 Fuel Systems tasks resulting from early Special Federal Air Regulation 88 (SFAR 88) activity. The committee chose to include these tasks in the 747-400 MRBR in anticipation that they may be relevant to final regulatory requirements related to SFAR 88.

Alternative methods of compliance to corrosion requirements
As mentioned previously, AD-mandated CPCP requirements were integrated into the structures and zonal sections of the 747 Classic and 747-400 MRBRs during the MSG-3 Rev. 2 analysis. The FAA Aircraft Certification Office approved the MRBRs as alternative methods of compliance (AMOC) to AD 90-25-05. These AMOCs preclude the possibility of duplicate inspections of 747 structures. The supporting FAA AMOC letter (i.e., no. 120S-01-1319 for the 747-400 or no. 120S-02-194 for the 747 Classic) is supplied with each copy of the MRBR.
In addition to economic advantages, two significant safety enhancements are derived from the 747 MSG-3–based maintenance programs:

- The MSG-3 analysis comprehensively and thoroughly identifies systems and power plant maintenance tasks and clearly separates safety-related tasks from those that are strictly economic. The systems and power plant section in each MRBR identifies and addresses all safety items.

- In the structures and zonal sections of the MRBRs, CPCP reporting requirements are mandated for any inspection that finds corrosion, whether the maintenance requirement is systems, structures, or zonal. This change is expected to improve the industry’s ability to monitor how effectively maintenance programs control corrosion.
Operators of the 747 Classic and 747-400 can realize significant cost savings by adopting the required scheduled maintenance programs that have been revised in accordance with MSG-3 Rev. 2 standards. Under the revised MRBRs, CPCP inspections are completely integrated into the structures and zonal programs, resulting in fewer tasks to be performed, tracked, and recorded and providing AMOCs to CPCP airworthiness directives. The time between letter checks is increased, reducing airplane downtime and increasing revenue-generating opportunities for airlines.

To complete the updating of scheduled maintenance programs for out-of-production airplanes, Boeing is leading efforts to revise those for the 727 and 737-200/-300/-400/-500. The revised programs are scheduled for completion by year-end 2002 and third-quarter 2003, respectively. Revised maintenance programs are available for the MD-80, DC-8, DC-9, and DC-10.
Boeing offers customized 747 Classic MSG-3 maintenance programs for 747 convertible, freighter, and passenger airplanes. On-site support during bridging and transition activities and regulatory review is available. Boeing also offers assistance to 747-400 operators during their bridging and transition to Revision C of the 747-400 MRBR and the June 2002 revision of the Maintenance Planning Data Document and supporting task cards. (It should be noted that Boeing issued Revision D of the 747-400 MRBR in early 2002. This revision is identical to Revision C except that it includes maintenance information for the new 747-400 Longer Range airplane.)

For assistance, e-mail Paul Beuter at paul.f.beuter@boeing.com or José Gómez-Elegido at jose.m.gomez-elegido@boeing.com.