Following an airplane accident in which inadvertent thrust reverser deployment was considered a major contributor, the aviation industry and the U.S. Federal Aviation Administration (FAA) adopted new criteria for evaluating the safety of thrust reverser systems on commercial airplanes. Several airplane models were determined to be uncontrollable in some portions of the flight envelope after inadvertent deployment of the thrust reverser. In response, Boeing and the FAA issued service bulletins and airworthiness directives, respectively, for mandatory inspections and installation of thrust reverser actuation system locks on affected Boeing-designed airplanes. Boeing and the FAA are issuing similar documents for all models of the DC-10.
Boeing has initiated a four-phase safety enhancement program for thrust reverser systems on all DC-10 airplanes. The program is designed to ensure compliance with new criteria, established by the U.S. Federal Aviation Administration (FAA), for evaluating the safety of all thrust reversers on commercial airplanes. According to the new criteria, a thrust reverser system is acceptable if an inadvertent deployment is extremely improbable. If the airplane is controllable at any point in the flight envelope in the event of an inadvertent deployment, or both.

Repetitive “health check” inspections involve checking and testing the thrust reverser systems on all three engines of the DC-10. Boeing recommends that an initial inspection be accomplished within 1,500 flight-hours or 6 months and the repetitive inspections be done at intervals not to exceed 6,000 flight-hours or 18 months. The requirements apply to all models of the DC-10.

1. Repetitive inspections of selected thrust reverser subsystems and hardware
2. Modification of the thrust reverser indication system
3. Installation of thrust reverser actuation system locks for the wing engines
4. Modification of command wires for the tail engine thrust reverser

The safety enhancement program for the DC-10 is designed to improve the reliability of the thrust reverser system throughout the course of four phases. Each phase increases reliability approximately tenfold.

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the thrust reverser actuation system on each half of the reverser, and it will unlock only when the reverse-thrust levers are moved toward the reverser deploy position. The existing in-flight lockout system is modified to prevent unlocking of the newly installed system, even if the deploy command is given in flight. The in-flight lockout system retains its current function of preventing operation of the actuator. The wiring for the new system consists of dedicated wire bundles with complete separation from existing thrust reverser command wiring.

Service bulletins and ADs have been, or will be, released for both GE- and P&W-powered DC-10s. In February 2000, Boeing released Service Bulletins DC10-78-061 and DC10-78-062, recommending installation of the new locking system on GE-powered DC-10 airplanes within five years. In April 2000, the FAA issued an NPRM requesting comments on a proposed AD for the addition of the thrust reverser locking system on all GE-powered DC-10 airplanes. An AD mandating the incorporation of Boeing Service Bulletins DC10-78-061 and DC10-78-062 is expected by the end of 2000.

The complete thrust reverser locking system for GE-powered DC-10s comprises two locks for each thrust reverser and is installed for the wing engines. Lock provisions, rather than the complete locking system, are installed on the tail engine thrust reverser. These installations are accomplished as follows:

1. The throttle module in the flight deck pedestal is modified to add new switches on all three reverse-thrust levers. This keeps the fail and forces identical for all three throttles and reverse-thrust levers to the flight crew.
2. Only the switches on the wing engine reverse-thrust levers are wired. Wire support brackets are added in the pedestal, adjacent to the throttle module.
3. The forward relay panel is modified to connect the existing in-flight lockout system to the new thrust reverser locking system.
4. The upper main circuit breaker panel is modified to provide power to the new system.
5. Relay boxes are installed in the right and left tunnel areas adjacent to the lower forward cargo compartment.
6. Terminal boards are installed on the right and left sides of the center accessory compartment. The new dedicated wire bundles in the wing leading edge terminate at this point.
7. Wiring is installed from the throttle module, forward relay panel, and the upper main circuit breaker panel to a disconnect at station 475. Wiring is installed on the left and right sides of the fuselage from the disconnect to the relay boxes, and from the relay boxes to the terminal boards in the center accessory compartment.

The complete thrust reverser locking system for P&W-powered DC-10s comprises two locks for each thrust reverser and is installed for the wing engines. Lock provisions, rather than the complete locking system, are installed on the tail engine thrust reverser. These installations are accomplished as follows:

1. Relay boxes are installed in the right and left sides of the center accessory compartment. Wiring is installed from the terminal boards in the center accessory compartment, through the wing pressure feedthroughs, along the leading edge of the wing to a disconnect at the pylon.
2. Wiring is installed from the disconnect at the wing, forward through the pylon, to the pylon junction box.
3. Wiring is installed on the wing engine from the pylon junction box to the thrust reverser halves.
4. The wing engine thrust reversers are modified to add the locks and associated wiring and hardware.
5. On GE-powered DC-10s, the pylons are modified and pneumatic tubing is installed; fan cowls are modified to provide clearance for the new locks.

### MODIFICATION OF COMMAND WIRES FOR THE TAIL ENGINE THRUST REVERSER

The fourth and final phase of the safety enhancement program involves separating the command wires of the tail engine thrust reverser from the aft accessory compartment through pylons no. 2. This is designed to reduce the possibility of an inadvertent deployment of the tail engine thrust reverser as a result of electrical failure in both thrust reverser command circuits. Boeing will issue Service Bulletin DC10-78-066 by the end of 2000, recommending the modification of the wire harness within five years. The FAA is expected to issue an NPRM requesting comments on a proposed AD on this subject for all models of DC-10 airplanes.

In addition to the four phases above, Boeing has revised the Flight Crew Operations Manual for DC-10s to recommend that the flight crew disengage the autothrottle in the event of any indication of thrust reverser irregularities, including any indication lights illuminated in flight. The recommendation is based on simulator testing that showed having autothrottle on during an inadvertent deployment diminished the flight crew's ability to control the airplane.

Editor's note: All Boeing-designed airplanes currently in production comply with the new FAA thrust reverser safety requirements. Boeing-designed airplanes in service are being retrofitted with additional locking devices. OnDouglas-designed airplanes, the pylons (DC8, MD11, MD-11F, and MD-11S) require no modification; the MD-11 requires periodic checks and separation of the thrust reverser command circuits; the DC9 is currently under evaluation; but no modifications are expected.

### SUMMARY

Each phase of the four-phased safety enhancement program for the DC-10 thrust reverser increases the reliability of the system approximately tenfold. Because each individual phase provides an independent benefit, Boeing recommends that the operators implement each phase as soon as certified by the FAA. Completion of the enhancement program will ensure compliance to the new FAA safety criteria for thrust reverser systems on commercial airplanes.