UNREPORTED HARD LANDING

A 737 had what later was determined to be a hard landing. During a subsequent walk-around inspection, damage was found to the left engine cowling. Repairs were made. During the next three flights, there was persistent leakage of the left main landing gear shock strut, which led to the discovery that the inner cylinder had buckled (fig. A). The shock strut apparently was functioning and serviceable, but the persistent leakage led to further maintenance and removal of the buckled inner cylinder from service. Investigation concluded that the buckling of the inner cylinder became more pronounced with the continued service. Subsequent examination of the quick access recorder data showed a 3.8-g vertical acceleration landing. The landing was on the left gear with subsequent drag of the left engine on the runway. The pitch and roll attitude of the airplane indicated neither the nose gear nor the right main gear contacted at the high-vertical acceleration; when the contacted, the accelerations were below 1.6 g.

Noteworthy observations:
- Any shock-strut leakage after hard landings may indicate damage to the internal components of the gear.
- Review flight data recorder (FDR) data as soon as possible after a landing has resulted in structure damage.

A 737 experienced tire-burst during takeoff on a rough runway. The airplane came to a full stop and both left main gear tires were flat and severely damaged. Secondary damage to the gear, flight control surfaces, and pylon was evident. All systems, such as anti-skid and autobrake, were found to be functionally satisfactory. FDR charts showed no anomaly. Drag loads were not recorded, and no excessive vertical loads were evident.

The likely scenario is that, after both tires shredded, combinations of vertical and high drag (drag impact) loads, which were caused by runway roughness and a locked brake, produced sufficient loads to fracture the main landing gear forward trunnion fuse bolt (fig. 4 on p. 17). The forward trunnion fuse bolt that fractured is not visible unless the trunnion link is removed. When the forward trunnion fuse bolt fractured because of the high drag loads, the loads were transferred to two links that attach the main landing gear beam to the wing rear spar (fig. 2 on p. 16). Because these links are not designed to react to drag loads, the pins that attach the links to the rear spar fractured at the shear planes (fig. 3 on p. 17). Boeing is revising the conditional inspections in the 737 AMM, section 05-51, to include inspection of these two pins during a phase I inspection as an indication that the forward trunnion fuse bolt is intact without removal of the trunnion link.

Noteworthy observations:
- High drag-load conditions, including off-runway excursions, may result in damage to landing gear structure and control surfaces.
- FDR data may not provide indications of high drag loads.
- All gear fuse pins need to be closely inspected after such conditions.
- A forward trunnion fuse pin fracture preserves the integrity of the fuel tank.

INTERPRETATION OF FDR DATA

An operator reported a hard landing in which one main gear inner cylinder was buckled, and latches were broken in the passenger service units. The FDR data showed no anomaly. Drag loads were not recorded, and no excessive vertical loads were evident.

Noteworthy observations:
- Observed damage can be the most meaningful indication that a hard landing has occurred and AMM conditional inspections should be completed.
- Operators should not hesitate to obtain technical reviews from Boeing through their Field Service representatives.
- Vertical acceleration guidelines to initiate conditional inspections are helpful when used in conjunction with flight crew observations.

NON-NORMAL LANDING SERVICE EXPERIENCE