



# National Transportation Safety Board

Washington, D. C. 20594

Safety Recommendation

Log 2157A

Date: June 5, 1989

In reply refer to: A-89-26

Mr. Joseph D. Carr  
President  
Trans World Airlines, Inc.  
605 Third Avenue  
New York, New York 10158

On August 22, 1987, at 1312 central daylight time, a Trans World Airlines (TWA) Boeing 767, N609TW, landed at Scott Air Force Base in Belleville, Illinois, with the right main landing gear fully retracted. The airplane came to rest in a nose-high, right-wing-low attitude with the right engine supporting the weight of the right wing. The 181 persons aboard evacuated using the emergency exits and slides. Three passengers received minor injuries; there were no serious injuries. The airplane sustained minor damage.<sup>1</sup>

The TWA Boeing 767, operating as flight 756, was a scheduled domestic passenger flight from San Francisco (SFO), California, to St. Louis (STL), Missouri, and had departed SFO in accordance with instrument flight rules at 1047 central daylight time. The captain stated that the flight was normal until the approach to STL. On the approach to runway 30 left and just before reaching the outer marker, the landing gear handle was lowered. Afterward, the engine indicating crew alerting system (EICAS) displayed "Gear Disagree, Gear Doors," and an aural gear unsafe warning sounded. The instrument panel displayed the following landing gear configuration: nose gear light--green; left main gear light--green; right main gear light--not illuminated; amber door light--illuminated; and the amber gear light--illuminated.

The captain broke off the approach, departed the traffic pattern, and recycled the landing gear in accordance with the "Gear Disagree" procedure. However, the right main landing gear continued to show an unsafe condition. When the flightcrew informed TWA's St. Louis maintenance facility of the landing gear difficulty, they received instructions to perform the alternate gear extension procedure. Despite the crew's attempts, the right main landing gear remained in an unsafe condition. The

<sup>1</sup>For more detailed information, read Aircraft Accident/Incident Summary Report--Boeing 767-231 ER, N609TW, Operated by Trans World Airlines, August 22, 1987, Scott Air Force Base, Belleville, Illinois (NTSB/AAR-89/02/SUM)

flightcrew then attempted to free the right main landing gear by inducing positive and negative "G" forces on the airplane (performing vertical maneuvers). However, these maneuvers also failed to free the right main landing gear. The crew had followed all applicable emergency procedures to extend the right main landing gear, but they were unsuccessful.

The captain of flight 756 decided to land at Scott Air Force Base because of a more favorable runway wind component and because of the availability of on-base medical facilities and aircraft rescue and firefighting equipment. The flight attendants prepared the cabin and the passengers for an emergency landing. When the airplane stopped and the evacuation alarm sounded, the flight attendants opened their assigned emergency doors and ensured that the slides were inflated. Evacuation was orderly and rapid.

There was no damage to the right main landing gear. The airplane received minor damage to the right engine cowl and right wing tip. The postincident examination of the right main landing gear revealed that the brake rod had separated from the brake torque arm, had moved in a horizontal plane, and had become jammed over the top of the gear door pad in the landing gear wheel well. The bolt that was used to hold the pin in the brake torque arm was still in place with a new cotter key installed in the nut. The pin used to hold the brake rod to the brake torque arm was missing and could not be found in the wheel well or landing gear doors. The seven pins and bolts that remained in the other wheel/brake assemblies were removed, metallurgically examined, and found serviceable.

An examination of the bottom of the brake rod showed no evidence of scuffing. The bushing in the brake rod end and the bushings in the brake torque arm were clean, smooth, and not distorted or damaged.

TWA company records showed that the right main landing gear's No. 3 brake and wheel assembly was replaced during routine Aircraft Service One (AS-1) maintenance/inspection of N609TW during a layover at SFO early on the morning of the incident. Mechanics, who found an unserviceable brake and tire, requested a work order, and sometime between 0300 and 0500, they removed and replaced the No. 3 brake and wheel assembly on the right main landing gear.

According to the Boeing 767 maintenance manual, the correct procedure to remove the main gear wheel/brake assembly requires mechanics to first remove the bolt that holds the pin in the brake torque arm. When the pin is pulled out far enough from the brake torque arm, the brake rod is free to move vertically. The mechanics who changed the brake and wheel at SFO stated that they removed the bolt and then, without the use of a puller, slid the pin out only far enough to free the brake rod from the brake. The free end of the rod was placed on the ground with the pin still retained in the rod.

After the new wheel/brake assembly was installed, the brake rod was aligned with the torque arm on the brake assembly. (Attaching the brake rod to the brake torque arm prevents the entire brake stack from moving in the direction of wheel rotation and keeps all four wheels on the ground when brake pressure is applied.) According to the mechanics, the retaining bolt was inserted through the hole in the torque arm and through the pin. The mechanics used a new cotter key to hold the nut on the retaining pin. TWA does not require that the removal and replacement of a wheel assembly be inspected by a mechanic with inspection authority when the work is completed. In this case, the mechanic who completed the work also signed off

completion of the work on the company nonroutine maintenance record dated August 22, at 0800.

According to TWA personnel, the maintenance performed was not required to be entered into the daily aircraft log. Therefore, the flightcrew who performed the preflight check of the airplane for the first flight after the maintenance was not aware that the No. 3 brake and wheel on the right main landing gear had been changed. The Safety Board believes that flightcrews should be informed of maintenance on items that are required to be airworthy for flight.

The mechanics who had performed the maintenance were long-time TWA employees--one had been employed since 1964, and the other had been employed since 1968. Both mechanics held FAA airframe and powerplant certificates and were company-qualified to perform airplane maintenance. Neither had ever changed the wheel/brake assembly on a Boeing 767. TWA training records showed that neither mechanic had been trained or instructed regarding the "differences" between changing the wheel/brake assembly on the Boeing 767 and on other Boeing airplanes.

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The changing of the wheel/brake assembly on N609TW was done at the terminal gate where the passengers board. The mechanics stated that they used the lighting that was available from the terminal gate area and from flashlights. They did not set up floodlights to illuminate the work area.

The Safety Board believes that during the installation of the wheel/brake assemblies, the mechanics installed the pin through the end of the brake rod, but only partially into the brake torque arm. The bolt used to secure the pin in the torque arm and prevent it from migrating outward probably was not inserted through the hole in the pin. The Safety Board believes that the brake rod was partially attached to the brake torque arm throughout taxi, takeoff, and gear retraction because the brake stack had not moved in the direction of rotation when brake pressure was applied during taxi; the hydraulic lines were not broken; and the bottom of the brake rod was not marred or scratched from dragging on the ground. However, when the landing gear was retracted, the No. 3 brake rod connector pin would have been head end downward. The Safety Board believes that during the en route phase of the flight, the pin dropped out of the brake torque housing allowing the brake rod to move horizontally until coming to rest on the landing gear door pad, preventing the landing gear from extending before landing.

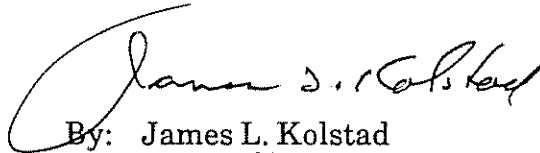
During the investigation, the Safety Board examined the procedure for removal/installation of the main landing gear wheel/brake assembly. There were specific procedures pertaining to the removal/installation of the assembly that were not clear, and there were inconsistencies in existing nomenclature. These anomalies were discussed with Boeing, and it published and distributed revisions to the Boeing 767 maintenance manual to provide more specific and clear procedures. These changes included illustrating a larger and clearer cross section of the axle with the wheel removed, positive identification of the "brake housing torque arm," the listing of a "cotter pin" as a part of the pin retaining bolt assembly, and a procedure to re-install the pin and retaining bolt to the brake torque arm housing.

Therefore, as a result of its investigation, the National Transportation Safety Board recommends that Trans World Airlines:

Review and amend maintenance assignment policies to ensure that persons performing maintenance actions are properly trained on the specific piece of equipment, aircraft, or engine. (Class II, Priority Action) (A-89-26)

Also, as a result of its investigation, the Safety Board issued Safety Recommendations A-89-24 and -25 to the Federal Aviation Administration.

KOLSTAD, Acting Chairman, and BURNETT, LAUBER, NALL, and DICKINSON, Members, concurred in this recommendation.

A handwritten signature in cursive script, appearing to read "James L. Kolstad".

By: James L. Kolstad  
Acting Chairman

Brief of Incident

File No. -- 5076      8/22/87      BELLEVILLE, IL      A/C Reg. No. N609FW      Time (Lcl) - 1312 CDT

Basic Information

Type Operating Certificate - AIR CARRIER - FLAG/DOMESTIC      Aircraft Damage  
 Name of Carrier - TRANSWORLD AIRLINES      MINOR  
 Type of Operation - SCHEDULED/DOMESTIC/PAX/CARGO      Fire  
 Flight Conducted Under - 14 CFR 121      NONE  
 Incident Occurred During - LANDING

Aircraft Information

Make/Model - BOEING 767-231ER      Eng Make/Model - P & W JT9D-7R4D  
 Landing Gear - TRICYCLE-RETRACTABLE      Number Engines - 2  
 Max Gross Wt - 410000      Engine Type - TURBOFAN  
 No. of Seats - 192      Rated Power - 40550 HP

Environment/Operations Information

Weather Data      Airport Proximity  
 Wx Briefing - COMPANY      ON AIRPORT  
 Method - IN PERSON      ON AIRPORT  
 Completeness - FULL  
 Basic Weather - VMC  
 Wind Dir/Speed - 330/012 KTS  
 Visibility - 7.0 SM  
 Lowest Sky/Clouds - 5000 FT SCATTERED      Type of Flight Plan - IFR  
 Lowest Ceiling - NONE      Type of Clearance - IFR  
 Obstructions to Vision - NONE      Type Appch/Lndg - TRAFFIC PATTERN  
 Precipitation - NONE      FULL STOP  
 Condition of Light - DAYLIGHT

Personnel Information

Pilot-In-Command      Age - 55      Medical Certificate - VALID MEDICAL - NO WAIVERS/LIMIT  
 Certificate(s)/Rating(s)      Flight Time (Hours)  
 AIF      Total - 16900      Last 24 Hrs - 6  
 SE LAND, ME LAND      Make/Model - 1193      Last 30 Days - UNK/MR  
 GLIDER      Instrument - 100      Last 90 Days - UNK/MR  
 Multi-Eng - 16000

Instrument Rating(s) - AIRPLANE

Narrative  
 REG APCH TO ST. LOUIS AN UNSAFE RT MLGR INDICATION WAS NOTED. NORMAL AND ALT GR EXTENSION PROCEDURES WERE INEFFECTIVE IN LOWERING RT MLGR. DIVERTED TO SCOTT AFB AND LNDG WITH RT MLGR RETRACTED. EVAC WAS ORDERED EXCEPT L3 DOOR WOULD NOT OPEN BECAUSE SLIDE DEPLOYMENT BAR WAS CAUGHT UNDER EXTERNALLY MOUNTED EMERG KIT. AT SFO, TWA HAD REPLACED NO. 3 BRAKE & WHL ASSY. PIN USED TO SECURE THE BRAKE ROD TO THE BRAKE TORQUE ARM WAS NOT INSTALLED PROPERLY AND FELL OUT DRG FLT, ALLOWING BRAKE TORQUE ARM TO MOVE HORIZ TO TOP OF GR DOOR PAD AND TO PREVENT EXTENSION OF GR. MAINT PERS NOT TRAINED ON BOEING DIFFERENCES. MAINT DONE IN EARLY AM HOURS AT GATE.

Brief of Incident (Continued)

File No. - 5076                      8/22/87                      BELLEVILLE, IL                      A/C Reg. No. N6091W                      Time (Lcl) - 1312 CDT

Occurrence #1                      AIRFRAME/COMPONENT/SYSTEM FAILURE/HALFJUNCTION  
Phase of Operation                      APPROACH

Findings(s)

1. LANDING GEAR, NORMAL BRAKE SYSTEM - NOT SECURED
2. MAINTENANCE, INSTALLATION - IMPROPER - COMPANY MAINTENANCE PSNL
3. INSTRUCTIONS, WRITTEN/VERBAL - INADEQUATE - COMPANY/OPERATOR HGHT
4. LIGHT CONDITION - DARK NIGHT
5. MAINTENANCE, INSPECTION OF AIRCRAFT - INADEQUATE - COMPANY MAINTENANCE PSNL

Occurrence #2                      GEAR NOT EXTENDED  
Phase of Operation                      LANDING

- Findings(s)
6. LANDING GEAR, NORMAL RETRACTION/EXTENSION ASSEMBLY - FAILURE, PARTIAL
  7. LANDING GEAR, NORMAL RETRACTION/EXTENSION ASSEMBLY - JAMMED
  8. MISC EGT/FURNISHINGS, SLIDES - BINDING(MECHANICAL)

Probable Cause

The National Transportation Safety Board determines that the Probable Cause(s) of this incident is/are findings(s) 1,2,5