



B-747 Collision With Airbridge Follows Apparent Brake Failure

Passenger behavior — described by the chief cabin attendant as a ‘riot’ prompted by observations of wing-tank fuel venting — complicated the flight crew’s return to the gate in response to a failed engine instrument. Failure to manually connect an auxiliary hydraulic pump rendered the aircraft brake system inoperative for taxi.

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FSF Editorial Staff

On Sept. 14, 2002, at 1547 local time, the flight crew of Iberia Airlines of Spain Flight 6403, a Boeing 747-300, after brake failure while taxiing to the gate, collided with the T1 airbridge at Madrid–Barajas (Spain) Airport. The aircraft had been pushed back from gate T1, and the crew was returning to the gate after identifying a failure of the exhaust-gas-temperature (EGT) indicator for engine no. 3.

Brakes were applied normally to stop the aircraft. When the brakes failed, the crew steered the aircraft toward the T1 airbridge to avoid a collision with a B-747 parked at the T2 gate. The taxiing B-747 struck the airbridge at a ground speed of about three knots. None of the 355 passengers or 18 crewmembers was injured. Major damage to the fuselage skin occurred, and the airbridge received major damage. No injuries occurred to ground personnel.

The Spanish Air Accidents and Incidents Investigation Commission (CIAIAC), in its final report, said that the probable cause of the incident was “that the electrically driven hydraulic pump (ACP) was not manually connected again after its switch automatically released as a result of the initiation of the starting process of engine no. 4 and once that starting process had not been completed.” Neither visibility nor weather was a factor in the collision, the report said. The



report said that the following were contributing factors:

- “The behavior of some of the passengers who were complaining, refusing to fly and standing in the passenger cabin, and who made the chief cabin attendant enter at least twice the cockpit to inform the [captain];
- “The failure to complete the ‘After Start’ checklist detailed in the operations manual of the operator; [and,]
- “The failure to connect the [alternate] or emergency hydraulic systems when the brake failure was noticed.”

Mexico City, Mexico, was the destination of the scheduled international passenger flight, which had a planned departure time of 1230. The captain and first officer boarded the aircraft at 1650 after a delay of more than four hours caused by late arrival of the aircraft and maintenance issues, the report said.

“Upon arrival to the aircraft, the flight crew observed that there was [a significant] spillage of fuel from the starboard [right] wing tanks, which were being refueled,” the report said. “The relief flight engineer was already there and was talking to the



The Boeing 747-300 decelerated in about 12 meters (39 feet) after striking the T1 airbridge at Madrid-Barajas (Spain) Airport, and the rotating roof of the airbridge was embedded in the fuselage. (Spanish Air Accidents and Incidents Investigation Commission photo)

ground crew in an attempt to stop the fuel [leak]. [Aircraft rescue and fire fighting (ARFF) personnel] were also in the area applying water to the ground to prevent any fire hazard. ... The crew knew that this was a normal situation due to an excess of fuel during the refueling of the aircraft.”

Fuel leakage continued while the passengers were boarding the aircraft through the T1 airbridge, and the chief cabin attendant told the captain that some passengers were observing the fuel leakage through the cabin windows. During the refueling procedure, passengers also observed ARFF personnel and a maintenance technician walking over one wing. A flight attendant near a passenger who had seen the maintenance technician on the wing tried to calm the passenger. The flight attendant did not know the nature of the maintenance problem.

One of the airline’s tug operators conducted the pushback while a ground-support technician, using a headset that was plugged into the aircraft interphone system, assisted the flight crew with safe separation from passing vehicles. Rotation of turbines during the engine-start sequence — no. 1, no. 2, no. 3 and no. 4 — was to be confirmed visually by the ground-support technician.

As routine passenger safety briefings and demonstrations were conducted during the pushback, passengers again observed fuel leaking from the right wing tip.

“A few moments later, several passengers were observed to be standing,” the report said. “Some of them had taken their hand luggage, [saying] that they wanted to disembark. One of the passengers, who reportedly had symptoms of some previous alcohol consumption, was the most active person who was refusing to fly. Some passengers [said] that they thought the aircraft was not safe to [begin] the flight.”

The chief cabin attendant entered the flight deck and told the captain about the mood of the passengers and the fuel leakage, and asked for instructions.

The flight crew was conducting engine-start procedures for engine no. 3. After starting engine no. 3, the flight crew abruptly applied brakes during pushback because of a misunderstood message from the ground-support technician, and the tow bar struck the nose-gear leg. Parked in a position near Taxiway B2, the flight crew then applied the parking brake. The tug was disconnected and the other ground personnel left the area.

“[Engine no. 3] started in a normal mode, but when the EGT indication started to [decrease], it showed oscillations in both the needle [indication] and the digital indication,” the report said. “Finally, the needle fell to zero and the flag appeared on the indicator, [showing that the indicator was] inoperative.”

The captain told the flight engineer to determine from the aircraft minimum equipment list (MEL) the required action in response to the inoperative EGT indicator. The captain told the chief cabin attendant to speak to the passengers and to try to calm them. The chief cabin attendant used the public-address (PA) system to tell the passengers that “there was no problem on the aircraft” and to instruct passengers to be seated. The ground-support technician told the flight crew that there was no fuel leakage, and that the engine no. 4 turbine also was rotating. The flight crew told the ground-support technician that the failure was a “no-go” item on the MEL, and that a return to the departure gate was required. The flight crew discussed with the ground-support technician two options: requesting a tug or taxiing the aircraft to the gate. “Tow vehicles are in high demand in ground operations at Barajas Airport,” the report said. The flight crew told the ground-support technician that they would taxi the aircraft. A ground-movement air traffic controller, after calling airport operations personnel, cleared the flight crew to taxi to the T1 parking position. The airbridge operator was not told that the aircraft would return to the gate, and the airbridge remained in the same position as when retracted from the aircraft for pushback. The captain then “gently applied” power to engine no. 1, engine no. 2 and engine no. 3.

“When the aircraft [was moving at about three knots], as indicated by the inertial [navigation] system in the flight management system, he returned the thrust levers to idle,” the report said. “He then gently applied brakes and noticed no [response from] the brake system at all. The [first officer] then applied brakes but the aircraft did not reduce the speed at all.”

In the collision, the left side of the fuselage struck the airbridge operator’s cabin.

“The fuselage then impacted with the [airbridge] structure and came finally to a stop, with the circular metal part that forms the floor of the [airbridge] at the end of the [airbridge] tunnel

[penetrating] the fuselage just before the frame of door 2R,” the report said. ARFF personnel at the T2 gate saw the collision, went to the collision location and stopped ground traffic in the vicinity. Three more ARFF vehicles, ambulances and police vehicles arrived at the collision location. ARFF personnel did not observe any indications of fire.

The chief cabin attendant entered the flight deck, asked the captain for evacuation instructions and then used the PA system to tell passengers that “everything was under control” and that passengers would deplane via airstairs. About 12 minutes later, airstairs were placed at door 5L and all passengers exited through this door.

The investigation found that although the operator had a refueling checklist that required review of maintenance issues, deployment of fire extinguishers, pulling the circuit breaker for the volumetric-shutoff unit during refueling with manual (stick) measurement and recording of fuel spillage, there was “no evidence that this checklist was followed during the refueling.”

Three of four hydraulic systems on the B-747 provide pressure to the brake system. An engine-driven pump and an air-driven pump pressurize each hydraulic system; each system operates because of air circulating in the pneumatic system. When the auxiliary power unit (APU) is operating and providing pressurized air to the pneumatic systems, the air-driven pumps provide pressure to the hydraulic systems. Hydraulic system no. 4 also incorporates an auxiliary electric pump, powered by alternating current, to provide brake pressure for ground operations when the engine-driven pump and the air-driven pump are not operating, such as when the aircraft is being towed. Electric power for the pump can be provided by the APU or by an external source. A “LOW PRESS” annunciator light extinguishes on the instrument panel to indicate that brake pressure for ground operations is being provided by this auxiliary electric pump.

“The flight crew must be aware that the magnetically held, electrically driven hydraulic-pump control switch will release ([i.e.,] will go to “OFF”) when any of the following conditions occur: either the engine no. 4 [engine-driven pump] or [air-driven pump] start to pressurize hydraulic system [no.] 4 and/or when electrical power is transferred from the APU or external power to airplane generators on early airplanes,” the report said.

The flight engineer selects whether normal hydraulic system no. 4 or alternate hydraulic system no. 1 is the source of pressure for the brake system, and may select the auxiliary electric pump to pressurize system no. 4.

The captain’s instrument panel included a flashing light to indicate low pressure in the brake-pressurization source when the pressure of the selected brake system was low and the switch for the auxiliary electric pump of hydraulic system no. 4 was in the “OFF” position.

Parking position T1 was equipped with a visual docking guidance system, designed to substitute for guidance from a marshaller. Airport procedures did not require use of this system when taxiing an aircraft to a gate and did not recommend when or under what conditions the system should be used. If pilots do not request help to park the aircraft, there is no ATC procedure or airport ground operations procedure to automatically provide this system or a marshaller.

“This system was in working condition the day of the incident, but it was not connected before the aircraft [was taxied] back to the [T1 airbridge],” the report said.

The captain later said that he did not attempt to activate the thrust reversers to stop the aircraft. He said that he had estimated the distance of the aircraft to the parking position to be 50 meters (164 feet) and that he had parked the aircraft in an “adequate position” at other times — without a marshaller or the visual docking guidance system — by visual reference to the yellow centerline and the yellow lines of the apron markings.

“When [the flight engineer] heard that the aircraft did not brake, he remembered looking at the auxiliary [electric] pump ... and seeing that it was on (the cover was lifted) and that there was 3,000 pounds per square inch of pressure in hydraulic system [no.] 4,” the report said. “He acknowledges that he could have connected hydraulic system [no.] 1, but [he] did not think of it as everything happened in a very short period of time.”

In an analysis of human factors, the report said that the Spanish words for “riot” and “uprising” were used by the chief cabin attendant to describe to the flight crew the cabin situation.

“This factor could have affected the flight crew’s state of mind and performance, introducing a disturbing factor during the pushback, the period of decision about what to do with the flight, and later the taxi back to the [gate],” the report said. The flight crew had about one hour remaining in which to conduct the takeoff without exceeding their flight/duty time limits.

The report said that the flight engineer possibly activated the ground-start ignition switch of engine no. 4 without waiting for the captain’s instruction, as required by the aircraft operations manual and checklist.

“Therefore, engine no. 4 was cranked, but the [captain] thought they had never tried to start that engine by moving the corresponding fuel lever,” the report said. “The [flight engineer] had activated the ignition switch, but maybe he did that as a routine action, in an automated mode, and when the problem with [engine no. 3 EGT] indication was evident, he was absorbed by the solution of that problem and forgot about the previous cranking of engine [no.] 4. At that point, a relevant change of configuration had taken place without being noticed by any crewmember: the [auxiliary electric] hydraulic pump ... [designed] precisely to provide braking pressure [during] ground operations when engine [no. 4] is not running, had automatically come to “OFF” as a result of the cranking of

engine [no. 4]. If [the flight engineer] had consciously noticed that the starting sequence of engine [no. 4] had been initiated and had remembered the engine-start procedure that specifically [says]: 'If engine [no.4] start is aborted, move again the switch of [the auxiliary electric hydraulic pump] to ON,' maybe the chain of circumstances that led to the incident would have broken. An indication of the degree of anxiety or rush inside the cockpit is the fact that there is no evidence that the 'After Engine Start' checklist was read before releasing the parking brake and starting the taxi back to the [gate]. If it had been read, the hydraulic systems would have been checked before initiating the taxi."

Possible corrective actions under the circumstances included the flight engineer selecting alternate hydraulic system no. 1 and the captain selecting emergency hydraulic system no. 2. "The close proximity of the [airbridge] left little time to react at those moments, and they did not have time to think of those corrective measures," the report said.

Other factors cited in CIAIAC's analysis included the following:

- Maintenance work to the engine no. 3 EGT indicator did not include engine operation to confirm that the replacement indicator functioned properly;
- Delays caused by maintenance prompted the refueling with passengers aboard the aircraft; and,

- Absence of an available tow vehicle to move the aircraft to the parking position.

The report recommended additional training of pilots on emergency procedures for brake failures in the B-747 and on announcements to passengers explaining excess-fuel leakage.

Among other CIAIAC recommendations were: review by the airline of line-repair procedures and maintenance procedures to ensure that work on engine-instrument indicators is checked for adequate completion; establishment by Spanish Airports and Air Navigation (AENA) of clear boundaries between the maneuvering areas and apron areas of Madrid-Barajas Airport; assignment of traffic control responsibilities for the apron to an identified department; and introduction in the aeronautical information publication (AIP) of Madrid-Barajas Airport of requirements and procedures for mandatory use of marshallers or visual docking guidance systems before and during aircraft taxi toward an airbridge.♦

[FSF editorial note: This article, except where specifically noted, is based on Technical Report no. IN-069/2002 of the Spanish Air Accidents and Incidents Investigation Commission (CIAIAC), *Incident Involving Boeing B-747-300 Aircraft, Registration TF-ATH, at Madrid-Barajas [Spain] Airport on 14 September 2002*. The 62-page report contains tables, photographs, an illustration and appendixes.]

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