



U.S. National Transportation Safety Board

Off-Balance

Nose-heavy Challenger would not rotate for takeoff.

BY MARK LACAGNINA

The flight crew's failure to calculate the airplane's weight and balance, and the charter operator's failure to ensure compliance with safety regulations were blamed for the Feb. 2, 2005, crash of a Bombardier Challenger 600 during takeoff at Teterboro (New Jersey, U.S.) Airport.

In its final report on the accident, the U.S. National Transportation Safety Board (NTSB) said that the airplane's center of gravity (CG) was substantially beyond the forward limit. The captain was unable to rotate the airplane at the intended rotation speed and rejected the takeoff about five seconds later. The Challenger ran off the end of the runway, passed through an airport-perimeter fence, struck a vehicle while crossing a six-lane highway, struck five more vehicles in a parking lot and crashed into a building. Both pilots and two occupants of the vehicle struck on the highway were seriously injured. The cabin aide, all eight passengers and a person

inside the building received minor injuries. The airplane was destroyed.

The passengers were affiliated with a company that had operated two of its own airplanes. However, one airplane had been sold and the other was in maintenance. The company used a charter broker, Blue Star Jets, to arrange the charter flight to Chicago Midway Airport. The broker selected Platinum Jet Management (PJM) of Fort Lauderdale, Florida, to conduct the flight. PJM was not certified to conduct on-demand service under U.S. Federal Aviation Regulations (FARs) Part 135 but had a charter management agreement with Darby Aviation, a certified Part 135 operator based in Muscle Shoals, Alabama.

The captain, 58, had 16,374 flight hours, including 3,378 flight hours in type. He was retained by PJM as a contract pilot on Jan. 6, 2005. He had conducted several flights for PJM under the general operating and flight rules of Part 91

Overrun

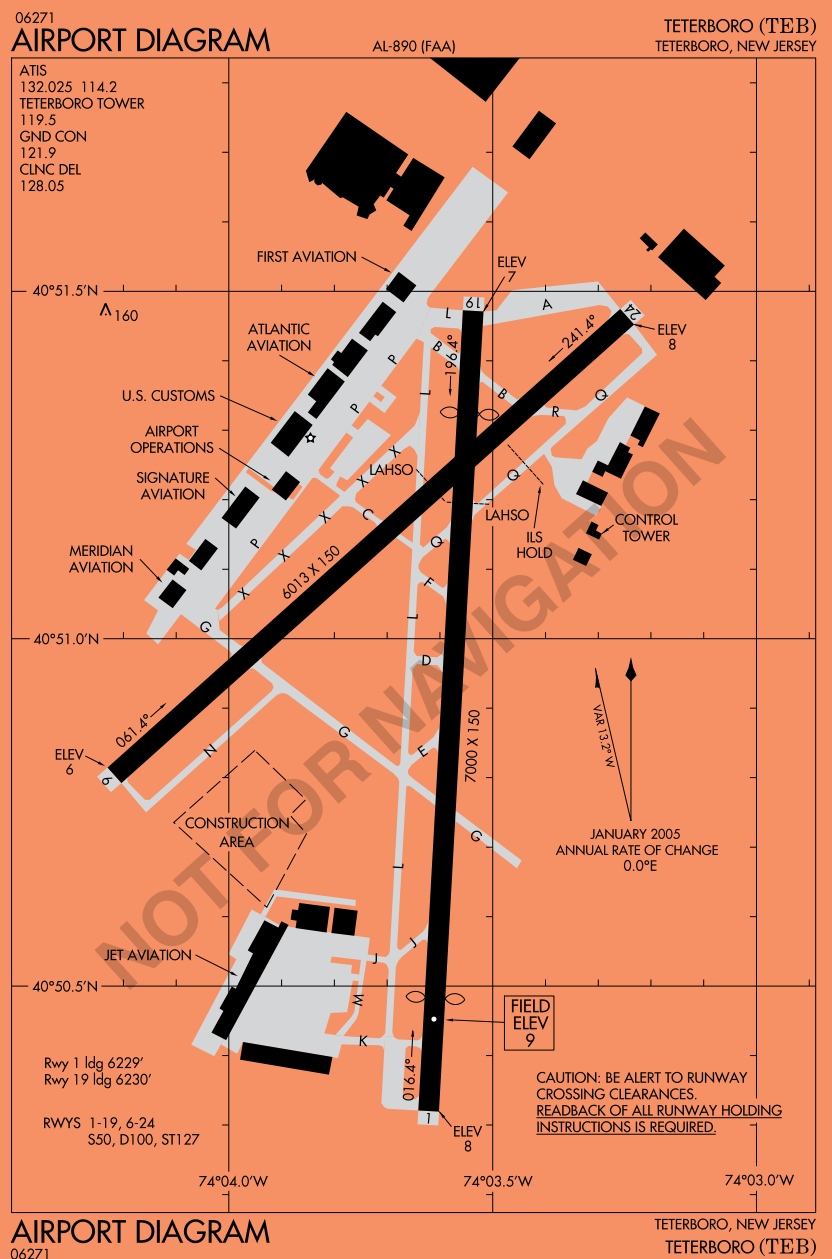
but had not received the training required to conduct Part 135 flights for Darby Aviation.

The first officer, 31, had 5,962 flight hours, including 82 flight hours in type. He was retained by PJM as a contract pilot in November 2003. He had received 22 of the 31 hours of training required to serve as second-in-command of Part 135 flights for Darby Aviation. His medical certification to conduct commercial flights had expired.

The cabin aide was not a qualified flight attendant, but a qualified flight attendant was not required aboard the Challenger for Part 135 flights because it has fewer than 20 passenger seats. She had not worked in aviation before she was retained by PJM as a contract customer-service representative in October 2004. She told investigators that she received on-the-job training in the company's Challengers from the lead cabin aide and received some emergency training in the accident airplane.

Sleep Deficit Discounted

The pilots and cabin aide took a commercial flight from Fort Lauderdale to New York the evening before the accident and arrived at their hotel soon after midnight. The Challenger was flown from Las Vegas by another crew and arrived at Teterboro Airport about 0040. The flight to Chicago was scheduled to depart at 0700, and the accident crew arrived at the airport about 0520. The report said that although the pilots received less sleep than normal the night before the accident, "they had had



adequate sleep during the previous two nights. ... There was no evidence that fatigue affected the pilots' performance on the morning of the accident."

Both pilots performed preflight inspections of the Challenger and found no discrepancies. "The captain stated that there were no entries in the airplane logbook and added that the airplane was 'absolutely clean,'" the report said. "The pilots requested that line-service technicians top off the fuel, and the first officer monitored

the airplane as 1,842 gallons [6,972 liters] of fuel were loaded."

Airport weather observers and line-service technicians on duty that morning told investigators that there was no frost on vehicles left outside overnight or on the accident airplane. The pilot of an airplane parked next to the Challenger said that he found no frost on his airplane.

Reported weather conditions included calm winds, 10 mi (16 km) visibility, clear skies, temperature minus 6 degrees C (21 degrees F) and dew point minus 8 degrees C (18 degrees F). Runway 06, which is 6,015 ft (1,835 m) long, was in use; Runway 01/19, which is 987 ft (301 m) longer, was closed because of a nearby construction project.

Bombardier CL-600 Challenger



©Tomás Cubero Maingot-SJO Spotter/jetphotos.net

The Challenger series of business jets was developed from the LearStar 600, designed by William P. Lear Sr. and acquired by Canadair in 1976. The prototype featured an advanced-design, "supercritical," airfoil developed by Robert Whitcomb of the U.S. National Aeronautics and Space Administration, and high-bypass-ratio Avco Lycoming — now Honeywell — ALF502L turbofan engines. Canadair incorporated design changes that included a larger fuselage for an 18-passenger "stand-up" cabin, a larger wing for more fuel capacity and a T-tail, and began production of the CL (Canadair/Lear)-600 Challenger in 1980. The Challenger 601 was introduced in 1982 with winglets and more powerful General Electric CF34 engines.

Bombardier Aerospace, which acquired Canadair in 1986, continues production of the Challenger 604, introduced in 1995; the 13-passenger Challenger 300, which has Honeywell HTF7000 engines; and the Challenger 800, a corporate version of the CRJ200 regional jet.

Source: *Jane's All the World's Aircraft*

Full Fuel = Forward CG

The passengers intended to return to Teterboro later that day, and they brought aboard only light baggage, which was stowed throughout the cabin. "The only bags stowed in the aft baggage compartment were suitcases belonging to the pilots and cabin aide," the report said.

The pilots did not prepare a load manifest, as required by Part 135. "Although they obtained an estimate of the airplane's weight by inputting fuel-load information and average passenger weights into the airplane's FMS [flight management system], they did not calculate the airplane's CG in any way," the report said.

According to investigators' calculations, the airplane's takeoff weight was 41,320 lb (18,743 kg) — 70 lb (32 kg) over maximum takeoff weight. The CG was 12.47 percent mean aerodynamic chord (MAC), which exceeded by 3.53 percent MAC the forward CG limit of 16 percent MAC (Figure 1, p. 34).

"Review of weight-and-balance materials for the accident airplane indicated that, under many loading configurations, the airplane could not be loaded with fuel without exceeding its forward CG limit," the report said. "Further, investigators found that this fuel-loading characteristic appeared common among corporate

The Challenger struck a building after running off the end of the runway and over a six-lane highway.



U.S. National Transportation Safety Board

jet airplanes with interior cabin furnishings designed for luxury business transport.”

The airplane flight manual (AFM) for the Challenger includes stabilizer-trim — pitch-trim — settings for approved CG locations. The first officer did not consult the AFM when he selected a setting appropriate for a mid-range CG. “The captain told investigators that he checked the pitch-trim setting selected by the first officer while they taxied and that he believed that the trim setting was satisfactory,” the report said. “The captain stated that he recalled a table in one of the airplane’s manuals that specified trim settings but that he thought the trim could be adjusted to various settings depending on the pilot’s preference.”

Hasty Departure

The passengers did not receive a preflight safety briefing. Under Part 135, the pilot-in-command is required to ensure that a preflight briefing on specific items, including the use of seatbelts, is conducted. While boarding the airplane, the captain told the passengers

only that turbulence was expected during the flight. He believed that the cabin aide would conduct the safety briefing. The cabin aide believed that the captain had conducted the briefing.

The crew began taxiing the airplane about 0711. Cockpit voice recorder (CVR) data indicated that at 0715, the captain told the first officer, “OK, let’s do the before takeoff [checklist]. Go to tower and tell them we’re ready.” The first officer, however, continued the “Taxi” checklist, which included checks of the pitch-trim setting and the hydraulically actuated flight controls. The pilots told investigators that movement of the flight controls was satisfactory and unrestricted.

Immediately after the flight-control check was conducted, the tower controller

This trim indicator is similar to the one in the accident airplane, in which stabilizer trim had been set for a mid-range, rather than a forward, center of gravity.



U.S. National Transportation Safety Board

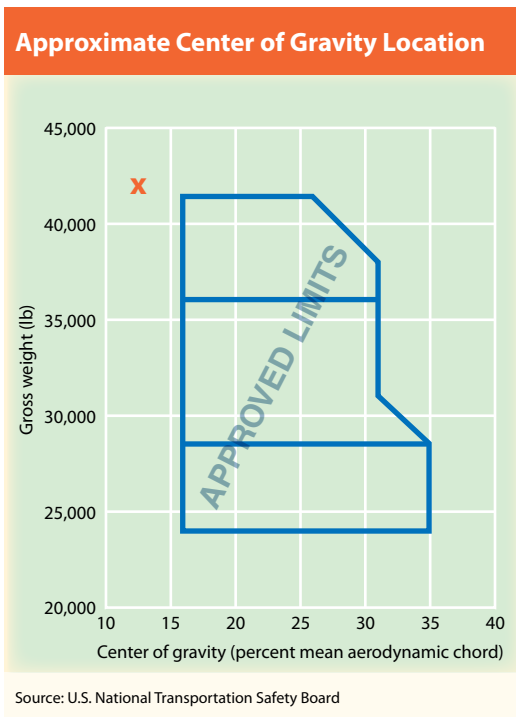


Figure 1

told the crew to taxi the airplane into position on the runway and hold. The crew began conducting the “Before Takeoff” checklist at 0716:36, and the first officer announced that the checklist was complete at 0716:54. About 15 seconds later, as the airplane was being taxied onto the runway, the controller told the crew to “keep it on the roll, runway six, cleared for takeoff. Traffic is a Learjet [on a] four-mile final.” The

first officer verbalized an acknowledgement of the clearance but apparently did not key his microphone; the CVR recorded the acknowledgement as an intra-cockpit communication. A few seconds later, at 0717:17, the captain said, “Hurry up, we’re on the roll.”

At 0717:19, the controller said, “Challenger seven zero victor, just confirm runway six cleared for takeoff.” The first officer acknowledged the clearance.

At 0717:32, the captain said, “Let’s go,” and engine power was increased. Four passengers did not have their seatbelts fastened when the takeoff was begun. Two passengers fastened their seatbelts as the airplane began to accelerate. The other two, who were seated on a side-facing divan, could not locate their seatbelts because they had been stowed behind the seat cushions.

Both Pilots Pulled

Acceleration appeared normal, and the first officer called out “V one” — 127 kt — at 0717:56 and “rotate” two seconds later. “During post-accident interviews, the captain stated that, when the airplane reached the rotation speed, he

attempted to pull the control yoke aft, but, even though he pulled very hard, the airplane did not lift off,” the report said. “The first officer told investigators that, as the airplane continued to accelerate on the runway without lifting off, he also began pulling back on the control yoke.”

About five seconds after the airplane accelerated through rotation speed — 135 kt — the CVR recorded the sound of decreasing engine power and the captain saying, “Abort.” Groundspeed at this time was about 160 kt, and about 2,100 ft (641 m) of runway remained.

“The captain told investigators that he applied [wheel] brakes, speed brakes and thrust reversers in an attempt to stop the airplane, and that all of those systems appeared to be working,” the report said. A performance study conducted by Bombardier indicated that the minimum accelerate-stop distance under the existing conditions was 6,550 ft (1,998 m).

The airplane came to a stop with the forward fuselage, to near the wing root, embedded in the building. The pilots initially were trapped in their seats by wreckage that entangled their legs. The report said that their injuries included fractures, dislocations and lacerations of their lower limbs.

“The pilots stated that they urgently wanted to exit the airplane because fuel was spilling and they could see smoke and flames,” the report said. “The captain reported that he shut down the engines and master battery switch, and that he then grasped the first officer by the belt and pulled on his lower body while the first officer pulled on an overhead bar with his arms. Through these efforts, the pilots were able to free the first officer’s legs from the wreckage.”

The two unrestrained passengers had been thrown to the cabin-aisle floor on impact. Injuries to the passengers and cabin aide included contusions (bruises), abrasions (scrapes), lacerations, sprains and strains, the report said.

The cabin aide decided not to use the right overwing emergency exit because of the proximity of burning vehicles. However, she was not

able to open the cabin door, which had become partially jammed. The door was pushed and kicked open by two passengers, and the cabin occupants exited the airplane.

The first officer crawled through the cabin door and onto the wing, and was pulled clear of the airplane by two passengers. The captain freed his legs from the wreckage by pulling on the overhead bar. After ensuring that everyone else was out of the airplane, he exited through the cabin door and walked away from the airplane.

Tower controllers had observed the Challenger fail to rotate and had notified aircraft rescue and fire fighting (ARFF) personnel before the airplane overran the runway. ARFF personnel arrived at the accident site as the occupants were exiting the airplane. Fire fighting personnel from neighboring communities also responded. A high-reach extendable turret vehicle with a skin-penetrating nozzle, which was based at Newark Liberty International Airport, was used to extinguish fire that had spread into the cabin.

“Postaccident investigation and extensive component testing revealed no evidence of a flight control system malfunction or failure, and there was no indication of foreign-object obstruction,” the report said.

Similar Accidents

The report included information on two other overrun accidents that occurred after flight crews were unable to rotate Challengers on takeoff. One airplane was brought to a stop in mud 75 ft (23 m) beyond the end of Runway 24 at Teterboro Airport after the crew rejected the takeoff at about 139 kt on Dec. 16, 2003.¹ None of the eight occupants was injured, and damage was minor. The investigation found that the airplane exceeded weight-and-balance limits; the CG was about 13.6 percent MAC.

The other airplane was substantially damaged when the nose landing gear collapsed during an overrun of Runway 36 at Tupelo (Mississippi) Regional Airport on March 9, 2005.²

A microphone holder installed at the base of the first officer’s control column had rotated 90 degrees from its normal position and interfered with aft movement of the column during rotation. The crew rejected the takeoff at 140 to 145 kt. None of the seven occupants was injured in the accident.

Nonstandard Safety Area

The runway safety area (RSA) off the end of Runway 06 did not meet U.S. Federal Aviation Administration (FAA) standards, which call for an RSA to be 1,000 ft (305 m) long and 500 ft (153 m) wide. The RSA met the width requirement but extended only 90 ft (27 m) beyond the end of the runway. The FAA had officially determined that extending the RSA was not practicable because of the highway and buildings near the end of the runway.

In April 2005, the FAA issued a revised RSA determination saying that the safety area could be enhanced by the installation of a nonstandard engineered materials arresting system (EMAS; ASW, 8/06, p. 13). Initial studies indicated that an EMAS 265 ft (81 m) long and 162 ft (49 m) wide would be capable of stopping a Bombardier CRJ200, Cessna Citation X, Gulfstream III/IV or Learjet 35 overrunning the runway at 60 to 65 kt.

The burned-out hulk of one of the six vehicles struck during the overrun rests near the airplane’s left overwing exit.



An EMAS this size, however, would not have stopped the Challenger, which overran the runway at 110 kt. “Simulations performed by the EMAS manufacturer indicated that ... the accident airplane would have exited the EMAS at a speed of about 97 kt,” the report said.³

‘Systemic Deficiencies’

The report said that the charter management agreement between PJM and Darby Aviation was, in effect, a “wet lease” that is allowed only between certificated operators. Under the agreement, PJM paid Darby Aviation a monthly “certificate fee” and provided one of its three Challengers, a flight crew, maintenance support and scheduling services for each flight operated under Darby Aviation’s Part 135 operating certificate. Darby Aviation was responsible for crew training and record keeping.

As the certificate holder, Darby Aviation was required by Part 135 to exercise operational control of flights conducted under its certificate by PJM. However, the report said that the company exercised minimal oversight and operational control, which “resulted in an environment conducive to the development of systemic patterns of flight crew performance deficiencies like those observed in the accident.”

For example, Darby Aviation was not aware that PJM pilots frequently modified the empty weight shown on weight-and-balance forms for the accident airplane to ensure that the results of their weight and CG calculations were within approved limits. “It is likely that the airplane was actually operated outside its specified weight-and-balance limits on numerous previous flights,” the report said.

“Further, review of PJM and Darby documentation showed that Darby was often unaware of on-demand charter flights conducted by PJM under Darby’s certificate. For example, in some cases, including the accident flight, PJM conducted on-demand revenue flights under Part 91 when they should have been conducted under Part 135.”

The report said that the FAA failed to recognize that PJM was operating as a de facto Part 135 operator. The agency’s “tacit approval of arrangements such as that between Darby and PJM,” and its inadequate surveillance and oversight of operations conducted under Darby Aviation’s Part 135 certificate were cited by NTSB as contributing factors in the accident.

In March 2005, the FAA ordered PJM to cease operations and suspended Darby Aviation’s Part 135 operating certificate. The FAA subsequently reinstated Darby Aviation’s operating certificate after the company rewrote its operations specifications, in part to include a detailed section on operational control. The report also said that Blue Star Jets established a review system with a charter-audit company to ensure that charter flights are arranged only with properly certified Part 135 operators.

In June 2005, the FAA issued a notice to its principal inspectors, reminding them that operations conducted under wet-lease agreements are not permissible and directing them to ensure that Part 135 operators understand the requirements for maintaining operational control and demonstrate that they exercise operational control of flights conducted under their certificates. ●

This article is based on U.S. National Transportation Safety Board Accident Report NTSB/AAR-06/04, “Runway Overrun and Collision, Platinum Jet Management, LLC, Bombardier Challenger CL-600-1A11, N370V, Teterboro, New Jersey, February 2, 2005.” The 124-page report contains illustrations and appendixes.

Notes

1. U.S. National Transportation Safety Board (NTSB). Report no. NYC04IA054.
2. NTSB. Report no. ATL05FA061.
3. An airport diagram current at press time indicated that a nonstandard engineered materials arresting system measuring 170 ft by 251 ft (52 m by 77 m) had been installed at the end of Runway 06 at Teterboro Airport.