Runway Overrun and Collision
Platinum Jet Management, LLC
Bombardier Challenger CL-600-1A11, N370V,
Teterboro, New Jersey
February 2, 2005

ACCIDENT REPORT

NTSB/AAR-06/04
PB2007-910401

National Transportation Safety Board

this page intentionally left blank

Aircraft Accident Report

Runway Overrun and Collision
Platinum Jet Management, LLC
Bombardier Challenger CL-600-1A11, N370V,
Teterboro, New Jersey
February 2, 2005

NTSB/AAR-06/04
PB2007-910401
Notation 7715C
Adopted October 31, 2006

National Transportation Safety Board
490 L'Enfant Plaza, S.W.
Washington, D.C. 20594

National Transportation Safety Board. 2006. ***Runway Overrun and Collision, Platinum Jet Management, LLC, Bombardier Challenger CL-600-1A11, N370V, Teterboro, New Jersey, February 2, 2005.*** **Aircraft Accident Report NTSB/AAR-06/04. Washington, DC**.

Abstract: This report explains the accident involving a Bombardier Challenger CL-600-1A11, N370V, operated by Platinum Jet Management, LLC, which ran off the departure end of runway 6 at Teterboro Airport, Teterboro, New Jersey, during a rejected takeoff. Safety issues addressed in this report include weight and balance procedures; flight crew actions, training, and procedures; company oversight and operational control; Federal Aviation Administration responsibility and oversight; cabin aide actions, training, and procedures; and runway safety areas.

The National Transportation Safety Board is an independent Federal agency dedicated to promoting aviation, railroad, highway, marine, pipeline, and hazardous materials safety. Established in 1967, the agency is mandated by Congress through the Independent Safety Board Act of 1974 to investigate transportation accidents, determine the probable causes of the accidents, issue safety recommendations, study transportation safety issues, and evaluate the safety effectiveness of government agencies involved in transportation. The Safety Board makes public its actions and decisions through accident reports, safety studies, special investigation reports, safety recommendations, and statistical reviews.

Recent publications are available in their entirety on the Web at <http://www.ntsb.gov>. Other information about available publications also may be obtained from the Web site or by contacting:

National Transportation Safety Board
Records Management Division, CIO-40
490 L'Enfant Plaza, S.W.
Washington, D.C. 20594
(800) 877-6799 or (202) 314-6551

Safety Board publications may be purchased, by individual copy or by subscription, from the National Technical Information Service. To purchase this publication, order report number **PB2007-910401** from:

National Technical Information Service
5285 Port Royal Road
Springfield, Virginia 22161
(800) 553-6847 or (703) 605-6000

Contents

Figures . . . vi

Abbreviations . . . vii

Executive Summary . . . ix

1. Factual Information . . . 1
1.1 History of Flight . . . 1
1.1.1 Flight Crew Postaccident Statements . . . 4
1.1.2 Cabin Aide Postaccident Statement . . . 5
1.1.3 Passenger Postaccident Statements . . . 6
1.2 Injuries to Persons . . . 8
1.3 Damage to Aircraft . . . 9
1.4 Other Damage . . . 9
1.5 Personnel Information . . . 9
1.5.1 The Captain . . . 9
1.5.1.1 The Captain's Employment History . . . 10
1.5.1.2 The Captain's 72-Hour History . . . 11
1.5.2 The First Officer . . . 12
1.5.2.1 The First Officer's Employment History . . . 12
1.5.2.2 The First Officer's 72-Hour History . . . 13
1.5.3 The Cabin Aide . . . 13
1.5.3.1 The Cabin Aide's Employment History . . . 14
1.5.3.2 Federal Requirements Regarding Flight Attendant Responsibilities . . . 14
1.6 Airplane Information . . . 15
1.6.1 General Airplane Information . . . 15
1.6.2 Airplane Weight and Balance Information . . . 16
1.6.2.1 Actual Airplane Weight and Balance Information . . . 16
1.6.2.2 Flight Crew Weight and Balance Information . . . 17
1.6.2.3 Federal Weight and Balance Requirements . . . 17
1.6.2.4 Fuel Load Information . . . 18
1.6.2.5 Airplane Pitch Trim Information . . . 19
1.6.3 Longitudinal Flight Control System . . . 21
1.6.4 Main Cabin Door . . . 22
1.7 Meteorological Information . . . 22
1.8 Aids to Navigation . . . 23
1.9 Communications . . . 23
1.10 Airport Information . . . 23
1.10.1 General Airport Information . . . 23
1.10.2 Airport Runway Safety Areas . . . 24
1.11 Flight Recorders . . . 25
1.11.1 Cockpit Voice Recorder . . . 25
1.11.2 Flight Data Recorder . . . 25
1.11.3 Sound Spectrum Study . . . 26

1.12 Wreckage and Impact Information . . . 27
1.12.1 Wreckage Path . . . 27
1.12.2 Wreckage Documentation . . . 27
1.12.3 Longitudinal Flight Control System Components . . . 29
1.13 Medical and Pathological Information . . . 30
1.14 Fire . . . 30
1.15 Survival Aspects . . . 30
1.16 Tests and Research . . . 32
1.16.1 Airplane Performance Study . . . 32
1.16.1.1 Rotation Characteristics Simulation Results . . . 32
1.16.1.2 Rejected Takeoff Simulation Results. . . . 32
1.17 Organizational and Management Information . . . 33
1.17.1 Airplane Ownership . . . 33
1.17.2 Airplane Management . . . 33
1.17.2.1 Platinum Jet Management, LLC . . . 33
1.17.2.2 Darby Aviation. . . . 34
1.17.2.3 The Relationship Between PJM and Darby Aviation . . . 35
1.17.2.3.1 Operational Control. . . . 35
1.17.2.3.2 Maintenance . . . 36
1.17.2.3.3 Record-keeping . . . 37
1.17.2.4 Blue Star Jets, Inc. . . . 37
1.17.3 FAA Oversight . . . 38
1.17.4 Federal Lease Requirements . . . 39
1.17.5 Postaccident Actions . . . 40
1.17.5.1 FAA and DOT Emergency Orders to PJM . . . 40
1.17.5.2 FAA Emergency Order of Suspension to Darby Aviation . . . 40
1.17.5.3 Additional Postaccident DOT and FAA Actions. . . . 41
1.18 Additional Information . . . 42
1.18.1 Other Challenger CL-600 Runway Overrun Accidents . . . 42
1.18.2 Previous Safety Recommendations . . . 43
1.18.2.1 Engineered Materials Arresting System Recommendation . . . 43
1.18.2.2 Crew Resource Management Training for Part 135 Pilots . . . 44
1.18.2.3 Part 135 Operator Information Recommendation . . . 45

2. Analysis . . . 46
2.1 General . . . 46
2.2 The Accident Sequence . . . 48
2.3 Flight Crew and Airplane Performance Issues . . . 49
2.3.1 Preflight Airplane Weight and Balance Issues. . . . 49
2.3.2 Pilot Decisions and Actions During the Rejected Takeoff . . . 51
2.3.3 Crew Resource Management Issues. . . . 52
2.4 Operational Control and Noncertificated (Unauthorized) Carrier Issues . . . 54
2.4.1 PJM and Darby Aviation Operational Control. . . . 54
2.4.2 FAA Oversight of PJM and Darby Aviation . . . 56
2.5 Cabin Aide Actions, Performance, and Training . . . 59
2.6 Runway Safety Areas . . . 61

3. Conclusions 62
3.1 Findings 62
3.2 Probable Cause 64

4. Recommendations 65

5. Appendixes 69
A: Investigation and Public Hearing 69
B: Cockpit Voice Recorder Transcript 70
C: Weight and Balance Information 101

Figures

1. The airplane wreckage partially embedded in the building after the postimpact fire was extinguished. 4

2. A diagram of the accident airplane's cockpit and cabin configuration. 7

3. Photograph of a CL-600 pitch trim position indicator similar to that in the accident airplane. 20

4. The accident airplane's pitch trim position indicator display, as documented postaccident. 20

5. The side-facing, three-passenger divan from the accident airplane with the burned seat cushions removed. Note: the arrows indicate the row of folded seatbelts that were found beneath the seatback cushions. 29

6. The accident airplane, the impacted building and several impacted vehicles, and the HRET/skin-penetrating nozzle-equipped firefighting vehicle. 31

Abbreviations

AC	advisory circular
AD	airworthiness directive
AFFF	aqueous film-forming foam
AFM	airplane flight manual
APU	auxiliary power unit
ARAC	aviation rulemaking advisory committee
ARFF	aircraft rescue and firefighting
ASOS	automated surface observing system
ATC	air traffic control
C	Celsius
CAM	cockpit area microphone
CAMP	continuous airworthiness maintenance program
CASS	continued analysis and surveillance system
CEO	chief executive officer
CFR	*Code of Federal Regulations*
CG	center of gravity
CIMMS	computer integrated maintenance management system
CRM	crew resource management
CVR	cockpit voice recorder
dba	doing business as
DO	director of operations
DOM	director of maintenance
DOT	Department of Transportation
EMAS	engineered materials arresting system
EWR	Newark International Airport
FAA	Federal Aviation Administration

FBO	fixed base operator
FDR	flight data recorder
FLL	Fort Lauderdale International Airport
FMS	flight management system
FSDO	flight standards district office
GMM	general maintenance manual
HRET	high-reach extendable turret
IFR	instrument flight rules
LAS	McCarran International Airport
LGA	LaGuardia Airport
MAC	mean aerodynamic chord
MDW	Chicago Midway Airport
NPRM	notice of proposed rulemaking
NWS	National Weather Service
PCU	power control unit
PJM	Platinum Jet Management
PMI	principal maintenance inspector
POI	principal operations inspector
RII	required inspection item
RSA	runway safety area
RTO	rejected takeoff
S/N	serial number
SB	service bulletin
TEB	Teterboro Airport

Executive Summary

On February 2, 2005, about 0718 eastern standard time, a Bombardier Challenger CL-600-1A11, N370V, ran off the departure end of runway 6 at Teterboro Airport (TEB), Teterboro, New Jersey, at a ground speed of about 110 knots; through an airport perimeter fence; across a six-lane highway (where it struck a vehicle); and into a parking lot before impacting a building. The two pilots were seriously injured, as were two occupants in the vehicle. The cabin aide, eight passengers, and one person in the building received minor injuries. The airplane was destroyed by impact forces and postimpact fire. The accident flight was an on-demand passenger charter flight from TEB to Chicago Midway Airport, Chicago, Illinois. The flight was subject to the provisions of 14 *Code of Federal Regulations* (CFR) Part 135 and operated by Platinum Jet Management, LLC (PJM), Fort Lauderdale, Florida, under the auspices of a charter management agreement with Darby Aviation (Darby), Muscle Shoals, Alabama. Visual meteorological conditions prevailed for the flight, which operated on an instrument flight rules flight plan.

The National Transportation Safety Board determines that the probable cause of the accident was the pilots' failure to ensure the airplane was loaded within weight-and-balance limits and their attempt to take off with the center of gravity well forward of the forward takeoff limit, which prevented the airplane from rotating at the intended rotation speed.

Contributing to the accident were: 1) PJM's conduct of charter flights (using PJM pilots and airplanes) without proper Federal Aviation Administration (FAA) certification and its failure to ensure that all for-hire flights were conducted in accordance with 14 CFR Part 135 requirements; 2) Darby Aviation's failure to maintain operational control over 14 CFR Part 135 flights being conducted under its certificate by PJM, which resulted in an environment conducive to the development of systemic patterns of flight crew performance deficiencies like those observed in this accident; 3) the failure of the Birmingham, Alabama, FAA Flight Standards District Office to provide adequate surveillance and oversight of operations conducted under Darby's Part 135 certificate; and 4) the FAA's tacit approval of arrangements such as that between Darby and PJM.

The safety issues addressed in this report include weight and balance procedures; flight crew actions, training, and procedures; company oversight and operational control; FAA responsibility and oversight; cabin aide actions, training, and procedures; and runway safety areas.

this page intentionally left blank

1. Factual Information

1.1 History of Flight

On February 2, 2005, about 0718 eastern standard time,[1] a Bombardier Challenger CL-600-1A11, N370V, ran off the departure end of runway 6 at Teterboro Airport (TEB), Teterboro, New Jersey, at a ground speed of about 110 knots; through an airport perimeter fence; across a six-lane highway (where it struck a vehicle); and into a parking lot before impacting a building. The two pilots were seriously injured, as were two occupants in the vehicle. The cabin aide,[2] eight passengers, and one person in the building received minor injuries. The airplane was destroyed by impact forces and postimpact fire. The accident flight was an on-demand passenger charter flight from TEB to Chicago Midway Airport (MDW), Chicago, Illinois. The flight was subject to the provisions of 14 *Code of Federal Regulations* (CFR) Part 135, and operated by Platinum Jet Management, LLC (PJM), Fort Lauderdale, Florida, under the auspices of a charter management agreement with Darby Aviation (Darby), Muscle Shoals, Alabama.[3] Visual meteorological conditions prevailed for the flight, which operated on an instrument flight rules (IFR) flight plan.

Postaccident interviews revealed that a brokerage company had arranged for PJM to conduct the accident flight for a charter customer.[4] The accident airplane was scheduled to arrive at TEB from McCarran International Airport (LAS), Las Vegas, Nevada, early on February 2, 2005, and to depart about 0700. The accident pilots and cabin aide were assigned the flight on the afternoon of February 1.[5] Later that day, they traveled on a commercial flight from Fort Lauderdale International Airport (FLL), Fort Lauderdale, Florida, to LaGuardia Airport (LGA), New York, New York, arriving about 2315. They arrived at their hotel in Hasbrouck Heights, New Jersey, slightly after midnight.[6]

Early the next morning, fixed based operator (FBO) personnel from TEB picked up the pilots and cabin aide at the hotel and transported them to the FBO where the airplane had been parked overnight, arriving about 0520. According to postaccident statements, when the pilots arrived at the airport, they both performed preflight inspections of the airplane and noted no discrepancies. The captain stated that there were

[1] Unless otherwise indicated, all times are eastern standard time based on a 24-hour clock.

[2] Federal regulations did not require a qualified flight attendant for the accident flight. For more information about the role and responsibilities of the cabin aide, see section 1.5.3.2.

[3] For additional information regarding PJM, Darby, and the relationship between and responsibilities of the two entities, see section 1.17.2.

[4] For additional information regarding the brokerage company, see section 1.17.2.4.

[5] The arriving crew would not be available for the morning departure because of Federal flight and duty/rest regulations applicable to flights operated under Part 135.

[6] Postaccident interviews indicated that, upon arrival at the hotel, the accident captain contacted one of the fixed base operators at TEB to see if the airplane had arrived, and he learned that it had not yet arrived. Records indicated that the airplane arrived at TEB from LAS about 0041 on February 2.

no entries in the airplane logbook and added that the airplane was "absolutely clean." The pilots requested that line service technicians top off the fuel, and the first officer monitored the airplane as 1,842 gallons of fuel were loaded.[7]

The pilots stated that, after their preflight duties were performed and the airplane was refueled, they started the engines and waited for the catering to arrive. After the catering arrived (about 0608), the pilots taxied the airplane to another FBO on the airport to meet the passengers for the flight. The captain stated that he performed another "walk around" inspection of the airplane after it was repositioned because it was in better light.

The passengers arrived between about 0630 and 0705. The captain stated that after all of the passengers had arrived he loaded the airplane. According to postaccident statements and physical evidence, the passengers carried only light baggage, such as coats and briefcases or laptop cases, which was stowed in various locations throughout the cabin. The only bags stowed in the aft baggage compartment were suitcases belonging to the pilots and cabin aide. The captain stated that the passengers told him that their company operated its own Challenger (a CL-601) and that they were "very familiar" with the airplane. He stated that, after briefing the passengers regarding expected turbulence during the flight to Chicago, he went to the cockpit and began the "starting engines checklist," believing the cabin aide would finish the safety briefing.[8]

According to the cockpit voice recorder (CVR)[9] and air traffic control (ATC) transcripts, about 0711, the first officer contacted TEB ground control and indicated that they were ready to depart. The ground controller issued instructions to taxi to runway 6. As they taxied, the pilots discussed their departure and applicable noise abatement procedures and programmed the airplane's flight director. About 0715:43, the captain suggested that they perform the before takeoff checklist, and the first officer responded with taxi checklist items, including the trim setting and flight control checks. CVR information indicated that the pilots checked the movement of the flight controls (the elevator, rudder, and ailerons) from about 0716:09 to 0716:21. The pilots stated that the movement of the flight controls was satisfactory and unrestricted during this check. They further reported that there were no abnormal lights or indications during the performance of the checklists, the taxi, or the attempted takeoff.

About 0716:22, while they were still taxiing to runway 6, ATC instructed the pilots to taxi into position on the runway and hold, pending an IFR release. The first officer acknowledged. About 0716:36, the first officer announced that the taxi checklist was completed and began the before takeoff checklist. When the first officer read the

---

[7] According to the FBO's records, the airplane received 1,390 gallons from one fuel truck and 452 gallons from a second fuel truck. For additional information, see section 1.6.2.4.

[8] The captain told investigators that it was his understanding that the cabin aide should perform the safety briefing. However, according to PJM's chief executive officer (CEO), it was the company's policy to have one of the pilots brief the passengers before each flight. The PJM CEO acknowledged that the captain would not have known of this policy because he had not yet received the required Part 135 indoctrination training from Darby. For additional information on the captain's training, see section 1.5.1.

[9] A complete transcript of the CVR is included in appendix B of this report.

"windshield…heater" before takeoff checklist item, the captain responded "they…briefed the standard for us." The first officer read no more checklist items aloud, but, about 0716:54, he announced that the before takeoff checklist was complete.[10] About 15 seconds later, as the airplane was taxiing onto runway 6, ATC cleared the flight for takeoff, advising them to "keep it on the roll…traffic is a Learjet on 4 mile final." The controller repeated the takeoff clearance about 0717:19, and the pilots acknowledged the clearance. About 0717:32, the captain stated, "let's go," and, about 1 second later, the CVR recorded sounds similar to an increase in engine power.

The captain was the flying pilot for the accident flight, and he stated that he steered the airplane onto the runway with his left hand and increased engine power for the takeoff with his right hand. The captain stated that, as the airplane accelerated on the runway, he kept his left hand on the tiller and his right hand on the power levers while the first officer held the control yoke. The first officer monitored the airplane's acceleration and announced 80 knots and V_1, and V_R.[11] According to the captain, as the airplane accelerated, he transferred first his left and then his right hand to the control yoke to prepare for liftoff. He stated that the airplane's acceleration to this point had seemed normal and that he did not notice anything out of the ordinary when he first grasped the control yoke. However, airport surveillance videotapes and postaccident witness statements indicated that the airplane's nose never lifted off the runway, even at an apparently higher-than-normal liftoff speed.[12]

CVR evidence indicated that, about 5 seconds after the airplane accelerated through the rotation speed, the captain commanded a rejected takeoff (RTO), and the CVR recorded sounds similar to decreasing engine power. The captain told investigators that he applied brakes, speed brakes, and thrust reversers in an attempt to stop the airplane and that all of those systems appeared to be working. The airplane was decelerating as it ran off the end of the runway and hit a building. After the airplane hit the building, a postimpact fire ensued. Figure 1 shows the airplane partially embedded in the building after the postimpact fire was extinguished.

[10] The CVR did not record either pilot performing a takeoff briefing or verbalizing several items on the taxi and before takeoff checklists, including items involving checking the ground spoilers and radar settings, activating the transponder, and performing an annunciator recall. (Physical evidence indicated that the ground spoiler toggle switch was in the on position, consistent with the accomplishment of that checklist item.) During postaccident interviews, the captain told investigators that he had also performed a stall protection system check and verified the target speeds before the passengers arrived.

[11] V_1, the takeoff decision speed, is the maximum speed during the takeoff at which the pilot must take action(s) (apply brakes, reduce thrust, deploy speed brakes) to stop the airplane within the accelerate-stop distance. For the accident flight, V_1 was about 127 knots. V_R, the rotation speed, is the speed to which an airplane must accelerate to become airborne when a pilot makes a control input to increase the angle of attack and allow the airplane to lift off the runway. The captain recalled that V_R for the accident flight was about 133 to 134 knots. Investigators calculated it to be about 135 knots.

[12] For additional information, see the docket for this accident.

Figure 1. The airplane wreckage partially embedded in the building after the postimpact fire was extinguished.

The pilots were initially trapped in their seats by wreckage and, therefore, were unable to open the main cabin door promptly after the accident. The cabin aide failed to open the main cabin door; therefore, a passenger rotated the door handle and, with another passenger, pushed and kicked the door open.[13] All of the airplane occupants successfully evacuated the airplane.

1.1.1 Flight Crew Postaccident Statements

During postaccident 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 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.

Both pilots reported being trapped in their seats because their legs were entangled in the rudder pedals and wreckage that intruded through the cockpit floor after impact. The pilots stated that they urgently wanted to exit the airplane because fuel was spilling and

[13] For additional information regarding main cabin door operation, see section 1.6.4.

they could see smoke and flames. The captain reported that he shut down the engines and master battery switch and that he then grabbed 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 first officer reported that he was then able to crawl out the main cabin door. After he exited the airplane and crawled over the wing, two passengers helped pull him away from the airplane.

The captain reported that he freed his legs from the wreckage by pulling himself up using the overhead bar. He stated that, after freeing his legs, he crawled through the cabin area to ensure that everyone else was out of the airplane before he exited through the main cabin door and walked away from the airplane. The captain stated that, after he exited the airplane, he located the first officer and passengers and coordinated with the aircraft rescue and firefighting (ARFF) and other emergency personnel. Although he did not see the cabin aide, the captain knew that she was no longer in the airplane because he had checked the cabin area, and several passengers told him that they had seen her outside the airplane.

1.1.2 Cabin Aide Postaccident Statement

The cabin aide stated that, when the passengers boarded the airplane, she helped them with their coats and carry-on bags and provided them with refreshments. She stated that the main cabin door seemed to operate normally when the pilots closed it before takeoff.[14] She stated that she did not conduct a passenger safety briefing/demonstration and added that the pilots were responsible for such briefings. The cabin aide said she thought that the captain conducted a passenger safety briefing; however, because she was standing behind him, she could not hear what he said. The cabin aide told investigators that she performed a pretakeoff cabin walkthrough and ensured that all of the passengers had fastened their seatbelts.[15]

The cabin aide told investigators that she was seated on the forward-facing jumpseat with her seatbelt fastened during the takeoff roll. She stated that she did not notice any problems during the takeoff until she saw that they were rapidly approaching the airport perimeter fence. She remembered the captain saying, "hold on," as the airplane ran off the runway and closing her eyes and trying to brace for the impact as the airplane headed toward the building.

The cabin aide stated that, when the airplane came to a stop and she opened her eyes, she could see that the pilots were alive but injured. She stated that the pilots were concerned about fire and told her to get the passengers out of the airplane and run. She stated that she unbuckled her seatbelt and moved to open the main cabin door.[16] The cabin

[14] The cabin aide indicated that she thought that the pilots were responsible for operating the main cabin door during normal and emergency operations and that a cabin aide would only operate the door in an emergency if the pilots were unable to do so.

[15] Postaccident passenger statements indicated that only four of the eight passengers had their seatbelts fastened before takeoff. For additional information, see section 1.1.1.3.

aide told investigators that she believed she "got the lever open" and that she then tried to use the electric "lever at the top [of the bulkhead] but it was not working." She stated that the passengers began pushing and kicking the door, which eventually opened. The cabin aide stated that she jumped out of the airplane, fell, and then got up and ran away from the airplane. She stated that she was picked up by a passerby in a car, driven to a police officer and ambulance, and subsequently taken to the hospital.

1.1.3 Passenger Postaccident Statements

During postaccident interviews, the eight passengers described various aspects of the preflight, taxi, attempted takeoff, RTO, and evacuation sequence. Six of the eight passengers stated that they did not remember receiving a safety briefing before takeoff. Only two passengers remembered the captain addressing them, and only one of those passengers stated that the captain's address was a "short briefing." Another passenger was certain he had not received a safety briefing because he would have fastened his seatbelt immediately if told to do so. Another passenger remembered specifically that no one showed them how to open the main cabin door.

Many of the passengers stated that the cabin aide offered them beverages after they boarded the airplane and that at least four accepted. The cabin aide served the beverages in glasses or ceramic/china cups except for one bottled water that was specifically requested by a passenger. (Several glasses and/or cups were recovered on or near passenger seats after the accident.) The passenger in seat 4L told investigators that he picked up his coffee cup with his right hand during the takeoff roll to prevent spillage. (Figure 2 is a diagram of the airplane's cockpit and cabin configuration.) He added that he believed that injuries to his right hand were caused by the coffee cup breaking during the accident sequence.

[16] The cabin aide indicated that she considered using the overwing emergency exit (which she was trained to use as the primary emergency evacuation route) during the evacuation but that she elected to use the main cabin door because the cabin was filling with smoke and the main cabin door was closer. Postaccident evidence showed that there were several burning vehicles near the right overwing exit.

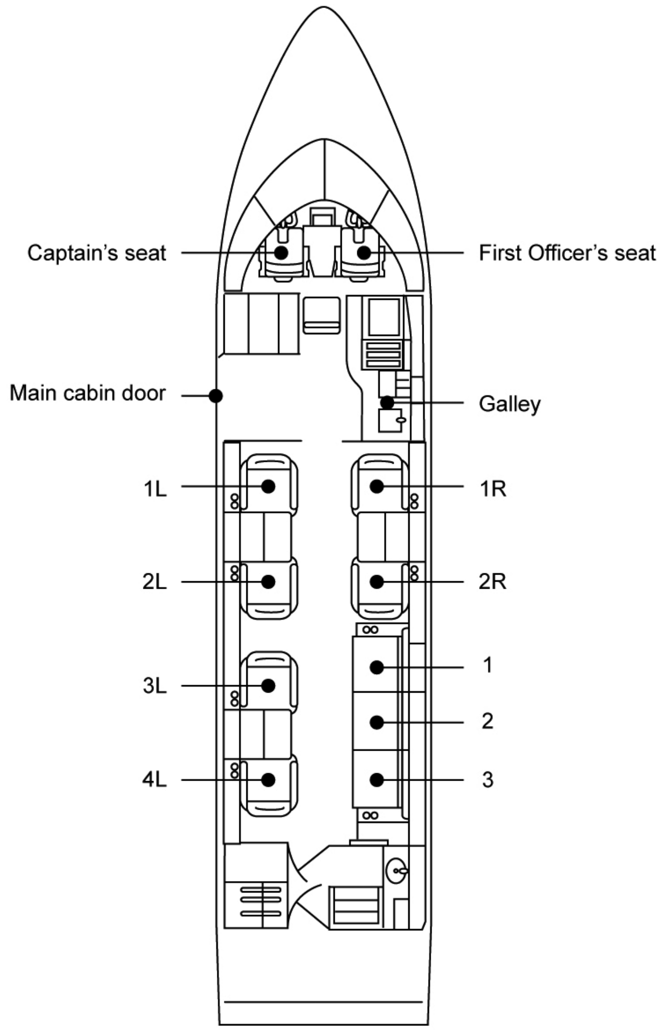


Figure 2. A diagram of the accident airplane's cockpit and cabin configuration.

Postaccident interviews indicated that, at the beginning of the takeoff roll, only four of the eight passengers (in seats 1L, 1R, 2L, and 2R) had their seatbelts fastened. Two of the four remaining passengers (in seats 3L and 4L) fastened their seatbelts during the takeoff roll.[17] The two passengers seated on the divan (in seats 2 and 3) could not locate and, therefore did not fasten, their seatbelts.[18] Passenger statements indicated that the two unrestrained passengers were thrown to the cabin aisle floor during the RTO.

Passengers indicated that it was dark and smoky in the cabin after the airplane came to a stop. The cabin aide had not opened the main cabin door, so the passenger who

[17] During postaccident interviews, the passenger in seat 3L stated that he "half-heartedly" looked for his seatbelt as the airplane began rolling but that he could not immediately locate it. He stated that, moments later, when he saw the passenger in seat 4L fasten his seatbelt, he again looked for his seatbelt and then located and fastened it.

[18] For additional information on the divan seatbelts, see section 1.12.2.

had occupied seat 1L felt around the door until he found the door handle, which he then rotated. He stated that, when the door did not open, he pushed and kicked it. He added that, with help from the passenger who had occupied seat 1R, he was able to open the main cabin door, and the passengers and cabin aide were able to evacuate the airplane. Although the cabin aide told investigators that she exited the airplane after all the passengers had evacuated, the passenger who had occupied seat 2R stated that he fell onto the cabin aide when he exited the airplane, and the passenger who had occupied seat 4L stated that he saw the cabin aide outside of the airplane before he exited.

When asked, six of the eight passengers reported speaking with the captain after the accident.[19] The passenger who had occupied seat 1R indicated that the captain stated, "she just wouldn't rotate" and "she wouldn't come over. She wouldn't rotate." The passenger who had occupied seat 2L told investigators that the captain stated, "I just pulled back…just didn't have any lift,"[20] and the passenger who had occupied seat 2R reported that the captain stated, "no lift, no lift." The passenger who had occupied seat 3L stated that the captain told him that the airplane "got to a point where it should have rotated [or lifted] and nothing happened." The passenger who had occupied divan seat 1 stated that the captain told him that he "couldn't get it up off the ground" and that he "tried to get the plane up and it just wouldn't get up off the ground." The passenger who occupied divan seat 3 reported that the captain stated, "didn't have any lift…the plane had no lift."

1.2 Injuries to Persons

Table 1. Injury chart.

Injuries	Flight Crew	Cabin Crew	Passengers	Other	Total
Fatal	0	0	0	0	0
Serious	2	0	0	2	4
Minor	0	1	8	1	10
None	0	0	0	0	0
Total	2	1	8	3	14

Note: Title 14 CFR 830.2 defines a serious injury as any injury that (1) requires hospitalization for more than 48 hours, starting within 7 days from the date that the injury was received; (2) results in a fracture of any bone, except simple fractures of fingers, toes, or the nose; (3) causes severe hemorrhages or nerve, muscle, or tendon damage; (4) involves any internal organ; or (5) involves second- or third-degree burns or any burns affecting more than 5 percent of the body surface.

[19] No passengers reported speaking with the first officer.

[20] The passenger who had occupied seat 2L indicated that, while the pilot made this statement, he motioned with his arms as if holding onto a control yoke and pulled and pushed back and forth.

1.3 Damage to Aircraft

The airplane was destroyed by impact forces and postimpact fire.

1.4 Other Damage

This accident resulted in damage to airport property (a navigational system antenna and the airport perimeter fence), a vehicle on a highway, five vehicles in a parking lot, and a building across the highway from the airport.

1.5 Personnel Information

1.5.1 The Captain

The captain, age 58, obtained his commercial pilot certificate in 1981. The captain held an airline transport pilot certificate, issued June 7, 1984, with airplane multiengine land ratings and a type rating in the CL-600, issued January 15, 1998. PJM retained him as a contract pilot on January 6, 2005. The captain's most recent FAA first-class airman medical certificate was issued on August 9, 2004.[21]

According to information provided by the captain and obtained from PJM records and other documents, at the time of the accident, the captain had accumulated about 16,374 total flight hours, including about 3,378 hours in the CL-600/-601.[22] The captain had flown about 35, 15, and 5 hours in the last 90, 30, and 7 days, respectively. In addition, the captain told investigators that he had flown about 200 total hours in the year preceding the accident. A review of Federal Aviation Administration (FAA) records found no accident, incident, or enforcement action history, and a search of records at the National Driver Register revealed no evidence of convictions or violations.

The captain's records and statements indicated that, in December 2004, he independently paid for and received CL-600/-601 ground training, differences training, and simulator flight training.[23] According to PJM records, in January 2005, the captain demonstrated his proficiency as a CL-600 pilot during a preemployment evaluation flight

---

[21] The captain's FAA medical records indicated that he was receiving treatment for mild hypertension and that he had lost about 30 pounds during the previous year. The captain stated that, except for the hypertension, which he was able to control with medication, his health was good.

[22] The captain stated that his personal flight experience records had been stored in a computer that he claimed was destroyed in the accident. Résumés submitted by the captain to various companies in February 2001, April 2004, and January 2005 indicated total flight times of 12,885+, 15,670+, and 15,902+ hours, respectively. The résumés showed that the captain's total flight time increased by 142 hours from April 2004 to January 2005; however, they also showed that he had flown 200 hours in Raytheon King Airs and 760 hours in CL-600/-601 airplanes during that time.

[23] The captain's records did not indicate that this training included sections on cabin evacuation, emergency equipment, or hands-on emergency drills.

with PJM's chief executive officer (CEO). The CEO stated that, after the evaluation flight, he approved the captain to conduct Part 91 flights in PJM airplanes and he endorsed the captain for further ground and flight training, which was required to perform Part 135 flight operations for Darby Aviation[24] and would include company-specific procedures for preflight planning, cabin evacuation, emergency equipment, and hands-on emergency drills. However, the captain had not yet received the additional Darby-specific Part 135 indoctrination, ground, or flight training at the time of the accident; therefore, he was restricted to operating flights under Part 91.[25]

The captain told investigators that his financial situation was stable during the previous year; however, he had not maintained a consistent place of residence during that time. According to the captain, he stayed with friends and family and lived in various forms of temporary housing in Virginia, Florida, and other states.

1.5.1.1 The Captain's Employment History

Records indicated that the captain worked for a government contract airline in Germany from 1986 to 1988 and that he then worked as a senior captain for a Cincinnati, Ohio-based company until 1990. The captain's résumé indicated that he worked as a pilot under "various part time contracts"[26] from 1990 to 1998 and that he was employed as a corporate CL-600/-601 captain from 1998 to 2001.

The captain's résumé and postaccident interviews indicated that from 2001 to 2004 he was employed as a pilot in various aircraft under government subcontracts. The captain told investigators that, under one of these subcontracts, he flew Cessna Citation airplanes for a Harrisonburg, Virginia-based company from 2001 to late 2003. A review of the captain's personnel records with that company revealed an October 3, 2003, letter written by the company's chief pilot that described a "worsening personnel problem" involving the captain. The chief pilot indicated that the pilot had exhibited "poor judgment and decision making processes" on numerous occasions on the ground and in the air and had violated Federal regulations during an approach.[27] Company records indicated that the captain submitted a letter of resignation on October 7, 2003.

The captain told investigators that, in addition to his government contracts from 2001 to 2004, he worked as a temporary contract pilot for various aviation companies in

[24] For additional information regarding Darby Aviation, see section 1.17.2.2.

[25] Title 14 CFR Part 91 contains general operating and flight regulations for all civil airplanes and pilots operating within the United States and addresses the responsibilities and authority of the pilot-in-command. The captain told investigators that he had been scheduled to begin Part 135 indoctrination, ground, and flight training the day after the accident.

[26] According to the captain's résumé, during this time, he worked as a first officer, captain, check airman, chief pilot, director of operations, and director of training.

[27] The October 3, 2003, letter described a flight that occurred on September 27, 2003, for which the captain claimed he was fit for duty when he appeared to be sick, initiated a late descent for an instrument approach, descended rapidly, and continued 1 mile beyond the missed approach point before acquiring the visual cues necessary to continue the approach. The chief pilot stated that the captain failed to initiate the required missed approach despite repeated challenges to do so.

Texas, Florida, California, North Carolina, South Carolina, Ohio, and Missouri.[28] He stated that these assignments typically lasted a few days.

The captain told investigators that, in early 2004, he began a government contract, under which he was assigned to fly for different agencies and organizations and that this government contract was scheduled to end on April 30, 2005. When asked for details, the captain stated that his work was classified, and he declined to reveal the identity of his employer or supervisor under this contract. He stated that he worked as a pilot for another Virginia-based company from January to June or July 2004 and that he left when the project for which he was hired came to an end. Representatives of the Virginia-based company told investigators that the captain had responded to an advertisement seeking pilots with security clearances and that he was hired in April 2004 to work on an aviation project in Iraq but was never sent overseas. Company documents indicated that the captain's employment with the company was terminated on May 28, 2004, for safety-related issues, including deficiencies in aircraft knowledge, lack of adherence to company procedures, poor airmanship, and "interpersonal" problems. These documents noted that the captain claimed to have experience that was not consistent with his performance and that he was not receptive to feedback about deficiencies in his performance.

1.5.1.2 The Captain's 72-Hour History

On Sunday, January 30, 2005, the captain returned from flying a 2-day trip (documented in PJM records as several Part 91 flights with varying numbers of passengers) for PJM with the accident first officer.[29] He stated that he could not recall his activities that evening or what time he went to sleep. The captain told investigators that he awoke about 0930 on January 31 and engaged in routine activities at home that day. He reported that he briefly visited PJM's office to report on the previous days' trip and that he went to sleep about 2130 that night, which he noted was earlier than usual for him.[30]

The captain stated that, on Tuesday, February 1, he awoke about 0930, relaxed and ran errands during the day, and took a nap. About 1630, PJM contacted the captain to notify him of an airplane certification test flight the following day. The captain ate dinner at home and, about 1730, was notified by PJM that the test flight had been cancelled and that he was scheduled for the accident flight. The captain stated that he traveled with the first officer and cabin aide on a commercial airline flight from FLL to LGA, where they arrived about 2315. The pilots and cabin aide were transported from LGA to their hotel in

[28] During the investigation, Safety Board investigators found identification cards, ramp access passes, and patches from numerous operators and agencies in the captain's bag, which was salvaged from the aft cargo compartment after the accident.

[29] The captain told investigators that he had flown with the accident first officer several times since he was hired by PJM. He stated that the first officer was an "excellent copilot, one of the sharpest…right on top of everything."

[30] The captain stated that he usually needed about 6 hours of sleep per night to feel rested and that he usually slept about 6 hours per night during extended nonworking periods.

Hasbrouck Heights. The captain contacted the FBO at TEB to see if the airplane had arrived, found out that it had not, and subsequently went to sleep.

The captain stated that, on February 2, he awoke about 0500 and traveled to TEB with the first officer and cabin aide for the accident flight. The cabin aide and other witnesses at both TEB FBOs indicated that the captain appeared alert and cheerful that morning and did not appear fatigued. Several passengers spoke with the captain at the FBO while waiting for other passengers to arrive, and they reported that he was friendly and did not appear fatigued.

1.5.2 The First Officer

The first officer, age 31, obtained his commercial pilot certificate and instrument and multiengine ratings in 1992. PJM retained the first officer as a contract pilot on November 4, 2003. The first officer's most recent FAA first-class airman medical certificate was issued on January 4, 2004; however, this medical certificate was not valid for commercial operations after January 31, 2005.

According to PJM's records, at the time of the accident, the first officer had accumulated about 5,962 total flight hours, including about 82 hours in the CL-600/-601. The first officer had flown about 20, 10, and 5 hours in the last 90, 30, and 7 days, respectively. In addition, the first officer stated that he had flown about 82 total hours in the year preceding the accident. A review of FAA records found no accident, incident, or enforcement action history, and a search of records at the National Driver Register revealed no evidence of convictions or violations.

Darby Aviation's records indicated that the first officer completed 22 hours of company initial indoctrination training in November 2003.[31] However, Darby's Flight Operations Manual stated that pilots are required to complete 31 hours of initial training—14 hours of indoctrination, 15 hours of initial aircraft equipment ground training, and 2 hours of flight training. The first officer stated that he did not receive a flight check in the CL-600 until he received recurrent ground training in November 2004 because a CL-600 airplane was not available when he received his indoctrination training.

Investigators found no evidence that the first officer had experienced any major life changes in the year before the accident.

1.5.2.1 The First Officer's Employment History

The first officer is a Venezuelan citizen who began his aviation career with a small Venezuelan airline. During his 9-month training period with that airline, another airline purchased the company; subsequently, that airline declared bankruptcy in 1997. The first

[31] Records and postaccident interviews indicated that the first officer received emergency procedures training and performed hands-on drills related to operating the overwing exit and fire extinguishers; however, this training did not include operation of the main cabin door. There was no indication that the first officer ever received hands-on training on the operation of the main cabin door.

officer stated that he flew for two small aviation companies before accepting a job with a major Venezuelan airline, where he served as a flight engineer on Douglas DC-10 and Boeing 727 airplanes. After that major airline ceased operations, the first officer flew business jets for individuals and companies in Florida.

The first officer stated that, in recent years, he had been working in the United States in aviation and nonaviation fields. He completed some indoctrination and ground school training for PJM/Darby Aviation in November 2003; however, PJM did not have enough work for him at the time. The first officer stated that he did some other contract flying before he began flying revenue trips for PJM/Darby in November 2004.

1.5.2.2 The First Officer's 72-Hour History

On Sunday, January 30, 2005, about 1700, the first officer returned home from flying the 2-day trip (documented as Part 91 flights with varying numbers of passengers) for PJM with the accident captain. He reported that he went to sleep about 2200 that night and awoke about 0800 on January 31. He stated that he did not work that day but that he ran errands and engaged in routine activities at home before going to sleep about 2200.

The first officer reported that, on Tuesday, February 1, he awoke about 0800 and engaged in routine activities at home for most of the day. About 1400, PJM notified him that he was scheduled for the accident flight. The first officer stated that he ate dinner at FLL before departing for LGA on a commercial flight, which arrived about 2315. He stated that he checked into the hotel in Hasbrouck Heights, telephoned home briefly, and then fell asleep. He stated that he awoke about 0430 the next morning and that he felt rested. According to the cabin aide, the first officer looked alert on the morning of the accident.

1.5.3 The Cabin Aide

The cabin aide was retained by PJM as a contract employee in October 2004. She stated that she received on-the-job training[32] from PJM's lead cabin aide during flights on the company's CL-600s (including the accident airplane) in October 2004 and that she received some emergency training from PJM staff on the accident airplane in November 2004.[33] The cabin aide stated that, during the emergency training, she operated each of the CL-600's exits and was familiarized with the airplane's emergency exits, fire extinguishers, first aid kit, oxygen masks, flashlights, life vests, and life raft.

In addition, procedures regarding emergency evacuations and smoke in the airplane were discussed during PJM's cabin aide training. The cabin aide and PJM's lead cabin aide told investigators that the company's cabin aide training indicated that the

[32] The cabin aide stated that, during the on-the-job training, PJM addressed company policies, aircraft familiarization, and customer service.

[33] Interviews with PJM management personnel and the cabin aide indicated that PJM intended to send the cabin aide for additional training after her 4-month probationary period but that she had not completed the training at the time of the accident.

primary evacuation route was through the emergency overwing exit and that they were required to demonstrate proper operation of this exit during training. Both cabin aides also stated that the main cabin door was a secondary emergency exit and that the pilots were responsible for operating it during normal operations and in emergencies if they were able to do so. The accident cabin aide stated that she had received verbal instruction regarding main cabin door emergency operation and that she had operated the main cabin door handle and electric toggle switch in a simulated emergency scenario during her training. She stated that the door was disarmed during this training rather than armed, as it would be during an actual emergency (and as it was for the accident flight). She stated that she had not operated the main cabin door when it was armed and that she was not familiar with the arm/disarm handle.

1.5.3.1 The Cabin Aide's Employment History

The cabin aide told investigators that before her position with PJM, she had never worked in aviation or as a flight attendant or cabin aide. She said that she had been a model and a waitress before she began working for PJM. The cabin aide indicated that, between November 2004 and the day of the accident, she worked regularly (about three times a week) as a cabin aide for PJM on an "on-call" basis.[34]

1.5.3.2 Federal Requirements Regarding Flight Attendant Responsibilities

According to 14 CFR 135.107, "no certificate holder may operate an aircraft that has a passenger seating configuration, excluding any pilot seat, of more than 19 unless there is a flight attendant crew member on board the aircraft." The accident airplane was equipped with only 9 passenger seats; therefore, Section 135.107 did not require that the flight have a qualified flight attendant. PJM provided the cabin aide to serve as a customer service representative on the accident flight. The cabin aide was not trained or qualified as a flight attendant; however, during postaccident interviews, several passengers referred to her as a flight attendant.

According to 14 CFR 135.295, no person may serve as a flight attendant on a Part 135 flight unless the certificate holder "has determined by appropriate initial and recurrent testing that the person is knowledgeable and competent" in numerous areas, including the following:

- Crewmember assignments, functions, and responsibilities during ditching and evacuation of persons who may need the assistance of another person to move expeditiously to an exit in an emergency;
- Briefing of passengers;
- Location and operation of portable fire extinguishers and other items of emergency equipment; and
- Location and operation of all normal and emergency exits, including evacuation chutes and escape ropes.

[34] The cabin aide stated that she continued to work as a model and waitress while working for PJM.

Further, 14 CFR 135.117 requires that, for airplanes certificated to carry 19 passengers or less, a crewmember or other qualified person must brief passengers on "smoking…the use of safety belts…location and means for opening the passenger entry door and emergency exits…location of survival equipment…location and use of fire extinguishers." PJM's policy required pilots to accomplish the passenger safety briefing before each takeoff, regardless of whether all of the passengers were present on previous flights.

According to 14 CFR 135.122, "no certificate holder may move an aircraft on the surface, take off, or land when any food, beverage, or tableware furnished by the certificate holder is located at any passenger seat." According to 14 CFR 135.128, "each person on board an aircraft operated under this part shall occupy an approved seat or berth with a separate safety belt properly secured about him or her during movement on surface, takeoff, and landing."

1.6 Airplane Information

1.6.1 General Airplane Information

The accident airplane, N370V, a Bombardier Challenger CL-600-1A11, serial number (S/N) 1014, was manufactured in Montreal, Canada, in November 1980 and was delivered new to TAG International.[35] Records indicated that the Canadian Department of National Defense purchased the airplane in June 1984 and operated it until DDH Aviation, LLC, purchased it on March 6, 2001.[36] The airplane interior was refurbished in September 2001, and the airplane was then leased and flown by various operators in the United States. In February 2004, DDH leased the airplane to PJM.[37]

Records indicated that, at the time of the accident, the airplane had accumulated about 6,901 flight hours and 4,314 cycles.[38] The airplane was equipped with two Honeywell ALF502L-2C turbofan engines. The left engine had accumulated about 3,941 hours total flight time, including about 428 hours since its April 2004 installation on the accident airplane. The right engine had accumulated about 3,890 hours total flight time, including about 428 hours since its March 2004 installation on the accident airplane. The airplane's most recent inspection (other than preflight inspections) was a 50-hour inspection, which was accomplished on January 14, 2005, in Fort Lauderdale, Florida. Records show that, during this inspection, a functional test of the horizontal stabilizer trim actuator brake was conducted and the pitch trim system was exercised (in accordance with airworthiness directive [AD] 95-17-14).

---

[35] The accident airplane was 1 of 20 CL-600 airplanes that were manufactured to fill an order from Federal Express. TAG International bought the accident airplane when the original Federal Express order was cancelled.

[36] The airplane was registered to 448 Alliance, which is a wholly owned subsidiary of DDH.

[37] For additional information regarding PJM's operations, see section 1.17.2.1.

[38] An airplane cycle is one complete takeoff and landing sequence.

The accident airplane was configured with two flight crew seats in the cockpit, a forward-facing jumpseat aft of the cockpit throttle console, and nine passenger seats (six fore-or-aft-facing individual seats and a three-seat, side-facing divan) in the cabin (see figure 2). The main cabin door was located on the forward left side of the fuselage, aft of the cockpit and across from the galley. The overwing emergency exit was located on the right side of the fuselage, behind the seatbacks of the side-facing divan.

1.6.2 Airplane Weight and Balance Information

1.6.2.1 Actual Airplane Weight and Balance Information

Records indicated that the airplane was most recently weighed when the interior was refurbished in September 2001. At that time, the airplane's empty weight was 24,736.5 pounds, and its empty weight center of gravity (CG) was located at 29.3 percent mean aerodynamic chord (MAC). Review of the records revealed no indication that the airplane's weight and balance had changed since that time. (During postaccident interviews, PJM personnel claimed that the airplane had been reweighed recently; however, neither PJM nor Darby were able to provide documentation of a more recent weighing.)

During the investigation, investigators determined the weights and locations for passengers, crew, cabin aide, equipment, baggage, service items, and carry-on bags using on-scene evidence and passenger and crew statements.[39] For detailed documentation of these items and additional weight and balance information, see appendix C. For additional information regarding the fuel load, see section 1.6.2.4. The calculated and maximum allowable ramp and takeoff weights and CGs for the accident flight are shown in table 2.

Table 2. The calculated and maximum allowable ramp and takeoff weights and centers of gravity for the accident flight.

Airplane Condition				
	Calculated Ramp	**Maximum Ramp**	**Calculated Takeoff**	**Maximum Takeoff**
Weight in Pounds	41,620	41,400	41,320	41,250
CG in percent MAC (percent MAC forward of forward limit)	12.79 (3.21)		12.47 (3.53)	
CG range in percent MAC		16.0 to 33.0		16.0 to 33.0

[39] During the on-scene portion of the investigation, all of the loose and recognizable items from the airplane were documented and weighed. Due to the extensive postimpact fire and firefighting efforts, most of the items from the cockpit and main cabin were charred and/or soaked with water; items from the aft baggage compartment were damp but not sooted or charred. All of the items were weighed as recovered (without drying).

1.6.2.2 Flight Crew Weight and Balance Information

During postaccident interviews, the captain and first officer told investigators that they did not perform manual balance calculations or use the airplane-specific weight and balance graph that was in the accident airplane. Darby Aviation's Part 135 operations specifications require pilots to compute the weight and balance of the loaded airplane using actual passenger weights to ensure that the airplane is operated within safe weight-and-balance limits.[40] Neither pilot recalled calculating the airplane's CG before their attempted departure, and they stated that the only weight assessment calculated for the accident flight was performed using the flight management system (FMS) calculator. The FMS calculator totaled the passenger, fuel, and baggage weights based on input (or default) values; however, it did not calculate the balance information.

The Safety Board's examination of the weight and balance form that was completed for the inbound flight from LAS revealed that the airplane empty weight that was printed on the form had been modified by hand and that it was lower than the actual airplane empty weight. This lower airplane empty weight resulted in an incorrect (farther-aft-than-actual) empty weight CG. Further, the airplane empty weight that had previously been entered into the FMS (24,500 pounds) was incorrect (also lower than the airplane's actual empty weight).[41] The airplane's empty weight was listed correctly (based on the September 2001 weighing) in the airplane flight manual (AFM).

A review of Darby Aviation's records showed that some PJM pilots routinely modified the printed weight and balance forms when performing preflight weight and balance calculations by reducing the airplane empty weight that was printed on the forms by various amounts. Investigators noted that all reviewed weight and balance forms reflected total weights and CGs within the airplane's operating limits.

1.6.2.3 Federal Weight and Balance Requirements

Title 14 CFR 135.185, "Empty Weight and Center of Gravity: Currency Requirement," states, in part:

> (a) No person may operate a multiengine aircraft unless the current empty weight and center of gravity are calculated from values established by actual weighing of the aircraft within the preceding 36 calendar months.

[40] Operations specifications contain the authorizations, limitations, and certain procedures under which operations are to be conducted by the certificate holder.

[41] Review of the FMS calculator keystroke log indicated that the pilots did not enter an airplane empty weight into the system on the morning of the accident. The keystroke log reflected inputs for number of passengers (eight), 300 pounds of cargo, and 14,600 pounds of fuel on the morning of the accident. No actual passenger or crew weights were entered.

Additionally, 14 CFR 135.63, "Recordkeeping Requirements," states, in part:

> (c) For multiengine aircraft, each certificate holder is responsible for the preparation and accuracy of a load manifest in duplicate containing information concerning the loading of the aircraft. The manifest must be prepared before each takeoff and must include:
>
> 1) The number of passengers;
>
> 2) The total weight of the loaded aircraft;
>
> 3) The maximum allowable takeoff weight for that flight;
>
> 4) The center of gravity limits;
>
> 5) The center of gravity of the loaded aircraft, …
>
> (d) The pilot in command of an aircraft for which a load manifest must be prepared shall carry a copy of the completed load manifest in the aircraft to its destination. The certificate holder shall keep copies of completed load manifests for at least 30 days…

Also, according to 14 CFR 91.7, "Civil Aircraft Airworthiness," the pilot-in-command of any civil aircraft is responsible for determining whether that aircraft is in condition for safe flight. Additionally, Section 91.9, "Civil Aircraft Flight Manual, Marking, and Placard Requirements," states the following, in part:

> (a) no person may operate a civil aircraft without complying with the operating limitations specified in the approved Airplane…Flight Manual, markings, and placards.

The AFM contains the airplane weight and CG limits and includes information and charts for pilots to use in determining proper loading to ensure the airplane operates within takeoff and landing limitations.

1.6.2.4 Fuel Load Information

Investigators received inconsistent information about the accident airplane's fuel load and the pilots' planning and supervision of the airplane refueling. For example, the captain and the first officer recalled specifying the amount of fuel to add, and both pilots recalled that the total fuel weight after refueling was about 13,900 pounds (the captain estimated from 13,800 to 13,900 pounds). However, a copy of the pilots' FBO fuel receipt showed a handwritten notation reading, "top off." FBO records indicated that 1,842 gallons of fuel (about 12,434 pounds) were added to the approximately 2,200 pounds of fuel that remained on the airplane when it arrived from LAS, which would bring the estimated fuel load to about 14,634 pounds.[42] Data downloaded from the airplane's navigational computer unit indicated that a departure fuel weight of

14,600 pounds was entered into the control display unit on the first officer's side of the cockpit before the accident flight.

During postaccident interviews, the captain was asked to perform manual weight and balance calculations for the accident flight.[43] The captain acknowledged that his postaccident calculations showed that, after the airplane was fueled, its weight exceeded its maximum allowable limit, and the forward CG exceeded the forward limit. However, he stated that the operation of the auxiliary power unit (APU) and engines during ramp and taxi operations would have consumed sufficient fuel to bring the weight and CG back within limits before takeoff. He stated that they took no actions to reduce the airplane's fuel load before takeoff.

Airplane, APU, and engine performance information provided by the manufacturers indicated that the CL-600 APU and engine operation described by the captain could have resulted in sufficient fuel burn to reduce the airplane's weight to its maximum allowable takeoff weight. However, the fuel consumed by the engines and APU during taxi operation would have come from the main fuel tanks located in the wings and would have resulted in the CG moving farther forward, thus further exceeding the forward CG limit.[44] The Safety Board's postaccident calculations (based on the completed weight and balance form for the airplane's inbound leg and documentation regarding fuel and other preflight servicing; postaccident information regarding passenger, crew, and baggage weights; and other airplane data and performance information) indicated that the airplane might have been about 100 pounds over its maximum takeoff weight and that its CG exceeded the forward balance limits by 3.53 percent MAC, about 20 percent of the entire allowable CG envelope at takeoff (see table 2).

1.6.2.5 Airplane Pitch Trim Information

Pitch trim setting guidance contained in a CL-600 training manual advises pilots to set the pitch trim "to appropriate takeoff position taking into account center of gravity." Figure 3 shows a photograph of a CL-600 pitch trim position indicator similar to that in the accident airplane.

[42] Jet fuel weights were calculated using a ratio of 6.75 pounds per U.S. gallon of fuel. The airplane's 14,634 pound fuel load is 99 percent of the airplane's published fuel tank capacity. According to Bombardier, the airplane's fuel tank can only be loaded to 100 percent capacity if the airplane is parked on a slight downgrade.

[43] Neither pilot had performed manual weight and balance calculations for the accident flight before the attempted takeoff.

[44] CL-600 training documents state that fuel burned during start, taxi, and takeoff will come from the main tanks "because of the float mechanism on the transfer ejector." The training documents also note the following: "Initial fuel burn will be from the main tanks. When the main tanks have burned down to 93 percent of full (less 7 percent), fuel will now be burned using the auxiliary tank… . The worst-case scenario is that all 7 percent from the mains is burned before takeoff, thus resulting in … the most forward [CG] of the flight. Ensuring proper [CG] loading in all phases of flight is essential to flight safety."

Figure 3. Photograph of a CL-600 pitch trim position indicator similar to that in the accident airplane.

Postaccident examination of the accident airplane's trim position indicator showed that the needle on the stabilizer trim display was located near the middle of the green band, below the takeoff (TO) and nose-up (NUP) indicators.[45] Figure 4 shows the accident airplane's pitch trim position indicator display, as documented postaccident.

Figure 4. The accident airplane's pitch trim position indicator display, as documented postaccident.

[45] As noted in table 3, the CL-600 AFM indicates that, for forward CGs within CG limits, the pitch trim should be set in the top of the display range (NUP).

More specific information regarding pitch trim settings for a range of CGs is contained in the CL-600 AFM and Flight Crew Operating Manual and is shown in table 3.

Table 3. The accident airplane's pitch trim settings for a range of centers of gravity as described in the CL-600 Airplane Flight Manual.

Center of gravity (within limits)[a]	Pitch trim position on indicator
Forward CG (16 to ~23 percent MAC)	Top of display range (nose up [NUP])
Mid-range CG (~23 to ~28 percent MAC)	Middle of display range
Aft CG (~28 to 33 percent MAC)	Bottom of display range

[a]The AFM does not list pitch trim settings for CGs forward or aft of the allowable CG limits.

During postaccident interviews, the first officer stated that he typically set the stabilizer trim to the indexed takeoff position (the TO line located above the middle of the green range) when the airplane was loaded lightly but that he set it slightly above the takeoff position when the airplane was heavy. 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 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 pilots' preference.

1.6.3 Longitudinal Flight Control System

The CL-600 is equipped with dual flight controls, such that the control wheels, control columns, and rudder pedals are interconnected and work in unison. With the exception of the flaps and trim controls, the flight control surfaces are hydraulically actuated from pilot inputs through a network of cables, pulleys, and push-pull rods.

Longitudinal control is provided by two hydraulically operated elevator surfaces, which are hinged to the rear spar of the horizontal stabilizer. When the pilots move the control columns, a system of cables and pulleys activates the elevators. Each elevator is driven by two power control units (PCU), each of which is powered by two redundant hydraulic systems. A pitch feel simulator unit provides the control column with the expected "stick force," which is varied relative to the horizontal stabilizer position.

The longitudinal flight control system has a pitch disconnect mechanism (a spring-loaded locking pin and two half-shafts linking the control columns) to ensure that the control columns can be separated in case one of them jams. If a jam occurs, the elevator and control column of the unjammed system would remain normally operational.

1.6.4 Main Cabin Door

The accident airplane's main cabin door is located on the forward left side of the fuselage, aft of the captain's seat and across the aisle from the galley. The top-hinged door opens upward, and entrance stairs are installed on tracks inside the cabin. An interior handle near the bottom of the door is connected to several tension fittings and latch cams by a series of pushrods and torque tubes. The interior handle is linked to the exterior handle and is stowed in a handle guard in the 10 o'clock position when the door is closed and latched. The interior handle is moved to about the 11 o'clock position when the door is opened and unlatched.

The main cabin door interior also has an arm/disarm T-handle at its upper right side. After the door is closed and latched for flight, this T-handle is moved to the armed position, which disengages the T-handle from the door lift mechanism and electric motor. Before opening the door again under normal circumstances, the T-handle would be moved to the disarmed position, and the door lift mechanism and motor would reengage.

There are two methods of opening the main cabin door—normal and emergency. To open the door under normal circumstances, the T-handle is moved to the disarmed position, the lower door handle is rotated clockwise from the 10 to the 11 o'clock position, the electric motor is activated via a switch on the forward bulkhead, and the door lift mechanism opens the door fully. However, to open the door in an emergency situation, the lower door handle is rotated from the 10 to the 11 o'clock position without first moving the T-handle to the disarmed position. According to the system's design, in this case, when the tension fittings and latch cams rotate off of the door stops, a gas spring provides sufficient force to open the door and allow evacuation.

1.7 Meteorological Information

The National Weather Service (NWS) surface analysis chart for the time of the accident showed an area of high pressure over the northeastern United States, including TEB. The NWS area and TEB terminal forecasts predicted clear skies and visual flight rules conditions in the area at the time of the accident.

TEB is equipped with an automated surface observing system (ASOS),[46] which is overseen/augmented by NWS-certificated weather observers. The ASOS continuously measures wind direction and speed, visibility, present weather (for example, precipitation and obstructions to vision), sky condition (cloud height and sky cover), temperature, dew point, and altimeter setting. The ASOS observation at 0651 (closest to the time of the accident) reported calm winds, visibility 10 miles, clear skies, temperature -6° Celsius (C), dew point -8° C, and an altimeter setting of 30.53 inches of mercury.

Postaccident interviews with two NWS-certificated weather observers who worked at TEB on the morning of the accident indicated that there was no evidence of

[46] The ASOS sensor suite is located near the departure end of runway 6.

frost on the ground or paved surfaces or on the vehicles that had been left outside overnight. Additionally, two line service technicians who handled the accident airplane on the morning of the accident told investigators that they did not observe frost on the airplane, and the pilot of an airplane that was parked adjacent to the accident airplane that morning stated that there was no frost on his airplane.[47]

1.8 Aids to Navigation

No difficulties with the navigational aids were known or reported.

1.9 Communications

No communications problems were reported between the pilots and any of the air traffic controllers who handled the flight.

1.10 Airport Information

1.10.1 General Airport Information

TEB is located about 1 mile southwest of Teterboro, New Jersey, at an elevation of 9 feet above sea level. Runway 6/24 (runway 6 was used by the accident airplane) is 6,015 feet long and 150 feet wide. Runway 1/19, which was closed at the time of the accident because of a nearby construction project, is 7,000 feet long and 150 feet wide. Both runways are constructed of grooved asphalt. TEB is owned by the Port Authority of New York and New Jersey.

The airport was certificated under 14 CFR Part 139, with Index A ARFF capabilities.[48] According to the TEB Airport Certification Manual, the airport had three ARFF vehicles for emergency response.

[47] There were, however, some reports of frost earlier that morning. For example, an ATC supervisor stated that he observed frost on car windows when he arrived at work more than an hour before the accident, a line service technician reported that there was frost on the windshield of his car when he drove to work earlier that morning, and another line service technician reported that there was light frost on an airplane that he had deiced, which had been parked outside all night.

[48] Title 14 CFR 139.315, “Aircraft Rescue and Firefighting: Index Determination,” defines Index A as an airport with fewer than five average daily departures of air carrier aircraft that are more than 90 feet in length. Section 139.317 requires an Index A airport to have one ARFF vehicle carrying at least (1) 500 pounds of sodium-based dry chemical, Halon 1211, or clean agent or (2) 450 pounds of potassium-based dry chemical and water with a commensurate quantity of aqueous film-forming foam (AFFF) to total 100 gallons for simultaneous dry chemical and AFFF.

1.10.2 Airport Runway Safety Areas

According to Advisory Circular (AC) 150/5300-13, "Airport Design," the TEB runway safety areas (RSA) should have extended 1,000 feet beyond the departure end of each runway and been 500 feet wide. FAA documentation indicated that the RSA at the departure end of runway 6 extended about 90 feet beyond the end of the runway and was 500 feet wide. The FAA's RSA determination for TEB, dated September 25, 2000, indicated that it was "not practicable to improve" the TEB RSAs to the standards listed for TEB in AC 150/5300-13. Specifically, the FAA stated that the improvement of the RSA at the departure end of runway 6 was not practicable because of the "highway…and buildings along the north side of the highway." FAA Order 5200.9, "Financial Feasibility and Equivalency of Runway Safety Area Improvements and Engineered Material Arresting Systems," dated March 15, 2004, indicated that the maximum feasible cost for RSA improvements on both ends of a runway was $10.15 million.[49] A subsequent FAA RSA determination (revised after the TEB accident and dated April 14, 2005) stated that the RSA at the departure ends of runways 6 and 24 could be enhanced with the installation of an engineered materials arresting system (EMAS).

The Port Authority of New York and New Jersey contracted with a company to perform an analysis of the RSAs at airports under its purview, including TEB. After comparing each alternative's cost, operational impact, and environmental considerations, the resultant draft report (dated March 29, 2004) recommended installing EMAS arrestor beds at both ends of the runway. The draft report stated that an EMAS arrestor bed at the departure end of runway 6 would be 265 feet long and 162 feet wide and would be capable of stopping Gulfstream III/IV, CRJ-200, Learjet 35, and Citation X airplanes at runway exit speeds from 60 to 65 knots. The estimated cost for this installation was $15.6 million. The investigation revealed that the accident airplane entered the runway overrun area at a speed of about 110 knots and ran off the far end of the runway 6 RSA at about 105 knots. Simulations performed by the EMAS manufacturer indicated that, if a 265-foot long EMAS bed had been installed at the departure end of runway 6, the accident airplane would have exited the EMAS at a speed of about 97 knots.

In a late May 2005 meeting, TEB Port Authority staff reported that it would install an EMAS on the departure end of runway 6 by the end of 2006. Subsequently, the FAA granted funds to facilitate the engineering and design of the planned TEB RSA improvements. (For additional information on the Safety Board's recommendations to the FAA regarding EMAS, see section 1.18.2.1.)

---

[49] The FAA considers both runway ends as one project when resolving an RSA issue.

1.11 Flight Recorders

1.11.1 Cockpit Voice Recorder

The CVR installed on the accident airplane was an L-3 Communications/Fairchild model A-100A, S/N 55843, magnetic tape CVR. The CVR showed no significant damage, and the tape was played back successfully. The CVR recording consisted of four channels, three of which contained good quality[50] audio information. One channel contained audio information recorded by the cockpit area microphone (CAM), and two other channels contained audio information recorded through the radio/intercom audio panels at the captain and first officer positions. The fourth channel was not used (nor was its usage required) on this recording. Investigators correlated the CVR to local time by establishing an offset between the CVR elapsed time and ATC local time for a radio transmission that was recorded on both the CVR and ATC audio recordings.

The recording began about 0648:45 and ended at 0718:15.7, after the CVR recorded the sounds of numerous impacts. A partial transcript that included the last 13 minutes 37.7 seconds of the CVR recording was prepared (from about 0704:38 to 0718:15.7).[51] See appendix B for the transcript of the CVR recording.

1.11.2 Flight Data Recorder

Although Federal regulations did not require the accident airplane to be equipped with an FDR,[52] it was equipped with a Lockheed Aeronautical Systems Model 319, S/N FA7438, six-track, tape-based recorder. The outer case of the FDR showed evidence of thermal damage, but the recorder was otherwise in good condition. Twenty-five hours of data were successfully extracted, and these data included portions of the accident takeoff roll and eight previous flights. The FDR recorded multiple parameters of airplane flight information, including time, altitude, indicated airspeed, vertical acceleration, heading, pitch and roll attitude, control surface positions, various engine parameters, radio transmission status, and various autopilot and trim status parameters. The FDR was correlated to local time using the ground track of the airplane and information from the CVR, which was then correlated to the ATC audio recording.

Review of the accident FDR information revealed that valid data were recorded for only about 10 seconds of the accident sequence (from about 0718:04 to 0718:14). The first speed value for the accident takeoff was 153.4 knots, which was recorded about 0718:05 as the airplane decelerated during the RTO. The final speed value of 91.4 knots was recorded about 0718:14.

---

[50] The Safety Board rates the quality of CVR recordings according to a five-category scale: excellent, good, fair, poor, and unusable. See appendix B for a description of these ratings.

[51] Before the start of the transcript, the CVR recorded conversation between the first officer and the cabin aide that was not related to the flight or to the operation, control, or condition of the airplane.

[52] Federal regulations require airplanes with 10 or more passenger seats to have FDRs installed and properly maintained. As noted previously, the accident airplane had only nine passenger seats.

According to documentation provided by Bombardier, an FDR installed on a CL-600 should begin recording when there is power to the airplane and the anticollision lights are on. The FDR should stop recording when the airplane is on the ground, the anticollision lights are off, and power is removed from the 28-volt direct current essential bus or in the event of rapid deceleration.[53] The FDR stopped recording about 1 second before the CVR stopped recording, as the airplane was rapidly decelerating. The Safety Board reviewed documentation for the initial installation of an FDR on the accident airplane in 1980 and the subsequent installation of the accident FDR in 1986. The wiring diagrams from the 1980 installation supported Bombardier's statements; however, the anticollision switch was upgraded to a three-way switch in 1986, and neither Darby nor PJM were able to provide a wiring diagram for the upgraded switch.

The Safety Board's review of the available FDR data for the accident takeoff and the eight previous takeoffs for which data were recorded revealed that the FDR began recording at different stages of airplane operation during each of those nine departures.[54] In addition, the Board's examination of FDR data relative to flight log information revealed that two of the recorded flights were shorter than the flight logs indicated. Further, three short flights were noted in the flight logs but were not reflected in the FDR data. The PJM chief operating officer could not explain these inconsistencies.

1.11.3 Sound Spectrum Study

Because the FDR only recorded about 10 seconds of data, the Safety Board studied the sounds and frequencies recorded by the CVR and physical evidence to reconstruct the airplane's ground speed, calibrated airspeed, and distance traveled during portions of the takeoff roll. As the landing gear tires roll over the lateral grooves in the runway surface, the frequency of the noise they produce is determined by the groove spacing and the airplane's speed, and higher frequency noise corresponds to higher speeds. A review of the CVR data revealed that the CAM recorded a background noise during the attempted and rejected takeoff, the frequency and strength of which increased, peaked, and then decreased. The Board determined that this noise was produced by the tires and analyzed its frequency content to calculate the resultant airplane speed.

---

[53] An inertia switch is used to detect significant deceleration and trigger the FDR and CVR to stop recording.

[54] During one of the eight previous departures for which data were recorded, the FDR began recording when the airplane accelerated through about 157 knots, about the speed at which it began recording during the accident takeoff roll. During five of the departures, the FDR began recording during the engine start. For two of the departures, the FDR recorded continuously from the previous touchdown because the engines were not shut down between flights.

1.12 Wreckage and Impact Information

1.12.1 Wreckage Path

Postaccident examination of runway 6 revealed several tire marks from the accident airplane, the first of which (the left main landing gear inboard tire mark) began about 1,297 feet before the departure end of the runway. All four main landing gear tire marks started out relatively light and got heavier and darker in the direction of travel. The main landing gear tire marks remained relatively straight until about 440 feet from the departure end of the runway, where they veered slightly left. The tire marks tracked approximately parallel to the centerline striping with the right tire marks just left of the runway centerline and the left tire marks about 20 feet left of the centerline at the end of the runway.

Tire marks continued through the snow and dirt off the departure end of runway 6, past the left side of the localizer structure, through the airport perimeter fence, and across a drainage ditch. Scrape marks, tire marks, and debris from the airplane, airport fence, and other vehicles were located on and across the six lanes of the highway that traversed the northeast edge of the airport. The marks and debris continued through a nearby parking lot to the airplane wreckage. The airplane came to rest after it impacted a building on a heading of about 15°, with the forward fuselage (to about the wing root area) intruding through the brick wall of the building. In addition, six vehicles on the ground were impacted and damaged—one on the highway and five in the adjacent parking lot.

1.12.2 Wreckage Documentation

Postaccident examination revealed that, although some small pieces of airplane structure and other debris were found between the end of the runway and the building, all of the major pieces of the airplane were located at the main wreckage site. The fuselage, empennage, and left inboard wing remained intact. The outboard portion of the left wing separated from the inboard portion near the outboard end of the inboard flap, and there was red paint transfer and impact damage in the area of the left wing separation and on a red car adjacent to the separated portion of the wing.

All of the longitudinal flight control surfaces were found intact and attached to associated mounting structures,[55] and the engines remained attached to the aft fuselage. The right wing was separated from the fuselage at the wing root area but remained somewhat intact adjacent to the fuselage. The right winglet was separated from the right wing and was located near a small building at the edge of the parking lot.

There was crushing damage and moderate-to-heavy fire damage to the forward fuselage and the right-wing leading edge where they impacted the building and burned. The cockpit was extensively fire damaged, and a layer of soot covered all of the interior

[55] For additional information about the longitudinal flight control system components, see section 1.12.3.

surfaces. All of the circuit breakers located in the aft cockpit bulkhead panels were melted. All of the instrument panels and displays, including the pedestal instruments, were sooted, and some were melted.

The cockpit floor in front of the crew seats was structurally deformed, with floor, rudder pedals, and other wreckage displaced aft toward the pilot seats. Deformation was more severe on the first officer's side than on the captain's. Both pilot seats were found attached to the floor via seat rails, and the seats and cushions were extensively charred and sooted. The jumpseat located aft of the throttle console and adjacent to the galley was found in the unstowed position. The jumpseat cushions were covered with soot but were not burned.

The main cabin door was found propped open about 4 feet by a board. Continuity was established between the door's center handle and all of the latch cams and tension fittings. When the piece of lumber was removed, the door closed; however, a 1/8- to 1/4-inch overlap between the latch cams and the aft doorframe prevented the door from closing completely.

The entire passenger cabin sustained substantial postcrash fire damage and was heavily sooted. The floor remained intact but was covered by a thick layer of debris and ash. The ceiling and interior panels were consumed by fire. All of the individual passenger seats and the divan were found heavily burned and sooted but otherwise intact and in place. Investigators identified the remains of the seatbelts on the individual passenger seats (including shackles, most buckles, some insert tabs, and very little webbing), and the identified components exhibited heavy sooting and heat and fire damage. The seatbelts (webbing, buckles, insert tabs, and shoulder harness fittings) at all three divan positions were found folded beneath the divan seatback cushions and were partially sooted but showed little or no fire or heat damage.

Postaccident examination of another PJM CL-600 revealed that its divan seatbelts had been placed beneath or behind the divan seatback cushions. Further, during postaccident interviews, a corporate flight attendant instructor told investigators that, "in many cases," she had seen airplanes in which the divan seatbelts had been intentionally folded and stowed beneath the seatback cushions. She stated that some corporate airplane operators had told her that they preferred to fold and stow seatbelts beneath the seatback cushions, likely for a tidier appearance. Investigators noted that passengers would have to locate the seatbelts between the seat cushions tactilely or remove the divan seatback cushions to locate seatbelts stowed in this position. Figure 5 shows the side-facing, three-passenger divan with the burned seat cushions removed.

Figure 5. The side-facing, three-passenger divan from the accident airplane with the burned seat cushions removed. Note: the arrows indicate the row of folded seatbelts that were found beneath the seatback cushions.

1.12.3 Longitudinal Flight Control System Components

Although postaccident examination revealed impact-related damage to the control columns and some of the forward flight control attachments among other severe impact damage at both pilot positions, investigators were able to establish longitudinal flight control continuity from the forward quadrant (just aft of the control columns) to the elevator PCU input arms. All cables appeared to be traveling over the appropriate pulleys correctly, no jams were noted, and there was no evidence of obstructions that would have prevented free cable movement during the accident sequence. When the pitch cables were pulled in the rear of the airplane, free and proper movement was seen at the damaged forward quadrants and at the PCU input arms. Examination of all of the longitudinal control system components included functional testing and disassembly, and the examination of the autopilot servo and stickpusher actuators also involved radiographic inspections. No evidence of a jammed condition or signs of a previous jam were revealed during these examinations.

The Safety Board examined the autopilot system to determine whether it may have been activated inadvertently. The examination revealed that, if the autopilot had been activated, the pilots would have felt additional resistance during the flight control check (the pilots reported that the controls moved freely and easily). Additionally, if the autopilot were engaged during the takeoff roll, the pilots could have overridden its effects by increasing the amount of force on the control column (about 40 pounds of aft pressure on the yoke would have been required). Further, activation of the autopilot system would have required specific selection of the autopilot engagement pushbutton (which neither pilot reported), and FDR data did not indicate that the autopilot had been activated.

1.13 Medical and Pathological Information

The 11 airplane occupants were transported to local hospitals for treatment of their injuries. The flight crew's injuries were serious and were mainly limited to lower body injuries (including fractures, dislocations, and lacerations) caused by airplane wreckage that intruded on the cockpit floor space after impact. The cabin aide and all eight passengers sustained minor injuries (including contusions, abrasions, lacerations, sprains, and strains) during the impact and evacuation. In addition, three people who were not airplane occupants were transported to local hospitals for treatment of injuries. Two of these people sustained serious head injuries when the airplane struck the automobile they occupied, and the third person, who was in the building at the time of impact, received minor injuries caused by falling debris.

A blood specimen collected from the first officer about 0858 on the day of the accident tested negative for ethanol and a wide range of drugs, including drugs of abuse;[56] however, the first officer's blood specimen tested positive for morphine. Medical records revealed that the first officer was administered morphine after the accident, about 0802 and again about 0810. A blood specimen collected from the captain about 1008 was lost by a commercial shipping company while being shipped to the FAA's Bioaeronautical Sciences Research Laboratory for toxicological analysis. Therefore, no toxicological results were obtained for the captain.

1.14 Fire

A postcrash, fuel-fed fire occurred.

1.15 Survival Aspects

Postaccident interviews with TEB air traffic controllers indicated that the airplane's acceleration initially appeared normal; however, they stated that the airplane did not lift off when they expected it to do so. Air traffic controller statements indicated that they notified ARFF personnel before the airplane ran off the end of the runway.

[56] The drugs tested in the postaccident analysis include, but are not limited to, marijuana, cocaine, opiates, phencyclidine, amphetamines, benzodiazapines, barbiturates, antidepressants, antihistamines, meprobamate, and methaqualone.

Postaccident interviews with passengers and ARFF and ATC personnel indicated that ARFF personnel responded within 1 minute of notification and reached the airplane within 3 to 4 minutes of the accident.[57]

Several passengers and witnesses indicated that ARFF vehicles arrived just after the occupants exited the airplane and immediately initiated efforts to extinguish the exterior airplane fires. All the airplane occupants evacuated and moved away from the airplane to await medical evaluation. Firefighting personnel from neighboring communities[58] also arrived promptly to assist in the firefighting effort; however, the interior fire was not extinguished until a high-reach extendable turret (HRET) vehicle equipped with a skin-penetrating nozzle arrived from the Newark International Airport (EWR), Newark, New Jersey.[59] The HRET/skin-penetrating-nozzle-equipped vehicle arrived about 0851, and the interior fire was extinguished within minutes thereafter (see figure 6).

Figure 6. The accident airplane, the impacted building and several impacted vehicles, and the HRET/skin-penetrating nozzle-equipped firefighting vehicle.

57 During postaccident interviews, ARFF personnel stated that they responded to the accident site by the most expeditious routes possible. They stated that it was not feasible to follow the airplane's path to the site because of the steep walls of the drainage ditch just outside the airport's perimeter fence.

58 TEB has mutual aid agreements with other area fire departments, including those from Moonachie and Hasbrouck Heights, New Jersey.

59 The HRET/skin-penetrating-nozzle device is an optional piece of equipment that can be attached to some ARFF vehicles to improve interior firefighting capabilities. The device consists of an elevated extendable boom and a multifunction nozzle/turret, which can be equipped with options such as piercing tips of varying lengths, aerial nozzles, halogen lights, a color video camera, and a forward-looking infrared camera. The EWR vehicle's HRET/skin-penetrating-nozzle turret was equipped with a color video camera, an infrared camera, and a piercing tip and was specifically requested to assist in fighting the accident airplane's interior fire.

1.16 Tests and Research

1.16.1 Airplane Performance Study

The Safety Board conducted a study to determine the rotation and RTO performance that would have been expected from the airplane under the loading conditions of the accident flight and to identify the airplane's trajectory during the RTO. The Board used the airplane's wreckage location and condition, ground scars and markings, CVR and FDR information, weather data, airplane weight and balance information, and simulator tests for this study.

1.16.1.1 Rotation Characteristics Simulation Results

The Safety Board conducted simulations in a CL-600 level C crew training simulator using various CGs and stabilizer trim settings to determine the rotation characteristics of the accident airplane during the takeoff roll and to identify the control column displacement and force and the airspeed that would have been required for rotation.[60] In all cases, the simulator pilots began to move the control column aft as the airplane accelerated through the expected rotation speed (about 135 knots).

The airplane performance study concluded that, during the accident sequence, the acceleration portion of the takeoff roll was normal and that the airplane reached rotation speed (V_R, about 134 to 135 knots) with about 3,300 feet of the 6,015-foot-long runway remaining. However, the airplane continued to accelerate beyond V_R to about 160 knots calibrated airspeed without lifting off. The results of the simulator testing indicated that, for the accident conditions, even with the control column moved to its aft limit, the accident airplane would not have started a noticeable rotation until it reached about 160 knots. A Bombardier performance study based on the accident airplane conditions estimated that the captain initiated the RTO at a speed of about 160 knots. Bombardier stated that a minimum accelerate-stop distance of 6,550 feet would be required under those circumstances.[61]

1.16.1.2 Rejected Takeoff Simulation Results

The Safety Board used a full-motion simulator to determine the airplane's acceleration and deceleration performance during the accident sequence and to obtain information regarding the airplane's stopping capabilities/distances with different RTO timing and/or technique. A Bombardier test pilot and three other experienced airline transport pilots performed the simulator runs under the accident conditions. During these

[60] The conditions tested included, in part, the accident conditions (CG at 12.4 percent MAC with a stabilizer trim setting of -3.9°); a CG within the CG limits but at the forward CG limit of 16.0 percent MAC with a stabilizer setting of -6° (the NUP limit of the trim display range); and the accident CG (12.4 percent MAC) with a stabilizer setting of -6°.

[61] Bombardier's report also stated that, based on the accident airplane's weight, CG, and stabilizer trim setting, the airplane would not have started to rotate until it reached about 154 knots with full aft elevator input and about 170 knots with partial (half) aft elevator input.

runs, the simulator pilots rejected takeoffs at various speeds (V_1, V_R, V_R+20 knots, etc.). All rejected takeoffs performed in the simulator involved the immediate and aggressive application of reverse thrust,[62] brakes, and spoilers when the RTO was initiated. Therefore, the deceleration performance obtained during the simulator runs was considered the maximum performance available from the CL-600.

According to the study, the RTO for the accident flight was likely initiated about 160 knots, and the airplane began to decelerate with about 2,100 feet of runway remaining. The study indicated that the airplane ran off the departure end of the runway at a ground speed of about 110 knots, penetrated the airport perimeter fence at a speed of about 95 knots, and was moving at a speed of about 85 knots when the FDR stopped recording about 70 feet from the airplane's final resting place.

Consistent with the 6,550-foot accelerate-stop distance calculated in the Bombardier performance study, the Safety Board's simulator runs resulted in runway excursions beyond the end of the runway; however, in all simulator cases, the airplane left the runway at a slower speed than the accident airplane. The Board's performance study noted that the required stopping distance and speed at runway departure depended not only on the performance available from the airplane but also greatly on pilot expectations, technique, and timing.[63] The performance study also showed that the accident captain did not immediately employ all available deceleration devices, such as immediate deployment of maximum thrust reverse, to maximum effect after he decided to reject the takeoff, which resulted in the accident airplane departing the runway at a higher speed than in the simulations.

1.17 Organizational and Management Information

1.17.1 Airplane Ownership

The accident airplane was owned by 448 Alliance, a wholly owned subsidiary of DDH Aviation. DDH/448 Alliance leased the airplane to PJM for its exclusive use.

1.17.2 Airplane Management

1.17.2.1 Platinum Jet Management, LLC

PJM was formed as a jet management company by three partners in August 2002. It was based at Fort Lauderdale Executive Airport, Fort Lauderdale, Florida. Jet management companies typically provide administrative and logistical support for flight

[62] A delay (typically about 5 seconds) is designed into the thrust reverser system. This delay is based on engine fan speeds and ensures that engine thrust decreases adequately before the thrust reversers deploy.

[63] The Safety Board notes that the simulator pilots were aware that they would be performing a high-speed RTO and were therefore more likely to react immediately and perform all of the required RTO steps promptly.

operations, including maintenance management, flight crew scheduling, developing cost estimates, providing catering services, making hotel reservations, repositioning airplanes and crews for flights, and coordinating for services with FBOs. PJM advertised its company operations as aircraft management, jet sales, and charters.

Initially, PJM did not operate any airplanes; however, in January 2003, it took over a lease agreement for a Bombardier CL-600. According to postaccident interviews with PJM's CEO, shortly thereafter, PJM began to pursue a Part 135 certificate for this airplane and its operations, ultimately entering into a charter management agreement with Darby Aviation, which held a Part 135 certificate.[64] PJM did not hold a Part 119 approval or 135 operating certificate[65] or any economic authority from the Department of Transportation's (DOT) Office of the Secretary and was therefore not authorized to advertise for or conduct Part 135 charter flights. According to 14 CFR 119.5(g), an operator must hold an appropriate air carrier certificate to operate as an air carrier and to advertise its services to the public for compensation or hire. Although PJM did not hold an appropriate certificate, the company advertised its charter services and represented itself (on its Web site, business cards, and brochures) to the public as an authorized charter operator.

According to PJM's CEO, although PJM did not hold a Part 135 certificate, it had a director of maintenance (DOM) who maintained maintenance records and coordinated maintenance on the company's airplanes. The CEO stated that, in addition to his other business duties, he himself performed many of the functions that would normally be performed by a director of operations (DO) or chief pilot.[66] At the time of the accident, the company operated three CL-600 airplanes and contracted with about five captains and five or six first officers for Part 135 flight operations. All pilots and cabin aides used by PJM were independent contractors and not direct employees. The company also used a contract employee to provide quotes, schedule flights, and notify crews.

On March 3, 2005, the FAA issued a cease and desist order against PJM, which ceased operations effective March 25, 2005. For more information, see section 1.17.5.1.

1.17.2.2 Darby Aviation

In 1992, Darby Aviation (a Muscle Shoals, Alabama-based operator) applied for and received a Part 135 operating certificate from the Birmingham, Alabama, Flight Standards District Office (FSDO). According to Darby's DO, he was selected for his

[64] The accident airplane was one of three CL-600 airplanes that were subsequently placed on Darby's certificate as a result of Darby's charter management agreements with PJM. For additional information on Darby Aviation, see section 1.17.2.2.

[65] Title 14 CFR Part 135 addresses the operating requirements for commuter and on-demand flights and personnel. Title 14 CFR Part 119 provides guidance to Part 135 (and Part 121) operators regarding the certification, operational, maintenance, and other regulatory requirements with which they must comply and describes the certification process.

[66] The CEO told investigators that PJM hired a DO in fall 2004 but that, shortly thereafter, the individual was fired for poor performance. The CEO assumed those responsibilities and attributed PJM's failure to appropriately designate the accident flight as a Part 135 flight to his own failure to oversee the operation.

position in 1992 and had served as DO ever since. In 1994, Darby received FAA approval to conduct operations under the business name AlphaJet International. AlphaJet advertised on-demand medical evacuation and worldwide charter services in various types of jet and turbopropeller-powered airplanes. Darby also entered into lease agreements with other owners and operators (including PJM) to operate other airplanes. However, PJM was not specifically listed in Darby's operations specifications, and there were no doing business as (dba) names similar to PJM.

On March 23, 2005, the FAA issued an emergency suspension of Darby's Part 135 operating certificate. Ultimately, the Safety Board upheld the emergency suspension in a May 26, 2005, decision, Administrator v. Darby Aviation, NTSB Order No. EA-5159 (2005).[67]

1.17.2.3 The Relationship Between PJM and Darby Aviation

In September 2003, PJM contacted Darby Aviation about establishing a Part 135 CL-600 operation under Darby's Part 135 certificate. PJM and Darby entered into a charter management agreement (sometimes termed "certificate sharing" or "piggybacking") covering the accident airplane in November 2003. Similar agreements covered other airplanes operated by PJM.

1.17.2.3.1 Operational Control

PJM operated all of its Part 135 flights in its CL-600 airplane(s) under Darby's certificate, for which it paid Darby a flat monthly "certificate fee." The PJM CEO told investigators that, under the auspices of the charter management agreements with Darby Aviation, Darby was required to maintain operational control of all on-demand Part 135 operations conducted by PJM, and PJM provided an airplane (one of its three CL-600s), a flight crew, maintenance support, and scheduling services for all of the Part 135 flights it operated under Darby's certificate. Darby was responsible for crew training and record-keeping. Postaccident interviews with Darby personnel indicated that they were to receive a fax of the airplane's weight and balance form, a manifest, and a cellular telephone number for the crew before any Part 135 charter flight and that this was one way that Darby maintained operational control of flights conducted under its certificate.

According to 14 CFR 1.1, "General Definitions," "operational control" is defined as the exercise of authority over the initiation, conduct, and termination of a flight. FAA Order 8400.10, "Air Transportation Operations Inspectors Handbook," Volume 3, Chapter 6, further defines operational control as follows:

> Operators conduct operational control by making those decisions and performing those actions on a daily basis that are necessary to operate flights safely and in compliance with the regulations. Operational control functions include crew and aircraft scheduling, accepting charter flights from the public, reviewing weather and notices to airmen, and flight planning. Another aspect consists of developing

[67] The decision can be found on the Safety Board's Web site at <http://www.ntsb.gov/alj/O_n_O/docs/aviation/5159.pdf>.

and publishing flight control policies and procedures for flight crews and other operations personnel to follow in the performance of their duties.

In addition, Order 8400.10 states that providing adequate oversight of flight operations is an integral part of the exercise of operational control.

1.17.2.3.2 Maintenance

According to Darby Aviation's general maintenance manual (GMM), the accident airplane was maintained under a continuous airworthiness maintenance program (CAMP), in accordance with Darby's GMM and applicable airplane, engine, and APU manuals. The GMM indicated that Darby would provide each contract maintenance station with a GMM. PJM's DOM provided investigators with PJM's GMM, revision 11, dated March 22, 2004, which was supplied to PJM by Darby.

The GMM stipulated that Darby Aviation's DOM was responsible for planning and implementing the company's maintenance program in accordance with Federal regulations. Title 14 CFR 135.427 required Darby to list all vendors "with whom it has arranged for the performance of any of its required inspections, other maintenance, preventative maintenance, or alterations" in its GMM. Maintenance records indicated that PJM was accomplishing most of the accident airplane's maintenance and inspections at its maintenance facility in Fort Lauderdale. (Darby's DOM stated that Darby did not have any maintenance personnel trained to work on the CL-600.) The investigation also revealed that, on occasion, PJM contracted with Bombardier and other third-party vendors to perform maintenance on the airplanes. However, a review of Darby's approved vendor list revealed that it did not list PJM or Bombardier as approved vendors. Further, the investigation revealed that most, if not all, of the accident airplane's maintenance records were maintained by PJM, not by Darby.

Darby Aviation's GMM also indicated that a continued analysis and surveillance system (CASS)[68] was required to audit the effectiveness of Darby's CAMP. During a postaccident interview, Darby's DOM stated that he had performed quarterly audits of the PJM maintenance facility, in accordance with the GMM; however, no vendor audit forms for the PJM maintenance facility were found. PJM's DOM told investigators that PJM personnel regularly communicated by telephone with Darby regarding maintenance and reliability issues; however, no documentation of these communications was found. Investigators also did not find any condition reports documenting PJM maintenance or administrative activities, which PJM should have been required to provide Darby under the CASS.

Darby Aviation and PJM used a system known as the computer integrated maintenance management system (CIMMS) to track CL-600 airplane maintenance. A

[68] As required by 14 CFR 135.431, each certificate holder shall establish and maintain a system for the continuing analysis and surveillance of the performance and effectiveness of its inspection program and the program covering other maintenance, preventative maintenance, and alterations and for the correction of any deficiency in those programs, regardless of whether those programs are carried out by the certificate holder or by another person.

review of the accident airplane's CIMMS records (obtained from PJM) indicated that all required ADs and service bulletins (SB) had been complied with. However, Darby was not able to provide the Safety Board with the airplane's original maintenance documentation describing how the ADs and SBs were accomplished or showing that they were accomplished in accordance with regulations.

According to Darby Aviation's GMM, Darby was required to ensure that maintenance technicians and required inspection item (RII) inspectors attended training before maintaining airplanes listed on Darby's certificate (including the accident airplane). Further, Darby was required to maintain individual training records for each technician who worked on its airplanes. At the Safety Board's request, Darby provided training records for the PJM DOM, but the company was not able to provide training records for other PJM maintenance personnel. According to the PJM DOM, he was the only PJM maintenance person provided training by Darby[69] and the only RII inspector-authorized maintenance technician for Darby. However, records and postaccident interviews indicated that, in addition to its DOM, PJM had three other maintenance technicians who worked on its CL-600 airplanes. These technicians had been fully trained at FlightSafety International facilities; however, their training records were maintained by PJM, not by Darby.

1.17.2.3.3 Record-keeping

Numerous record-keeping discrepancies were noted by investigators during this investigation, including flight logbook discrepancies, lack of AD and major repair and alterations records, inadequate retention of PJM maintenance documentation by Darby Aviation, no minimum equipment list for the accident airplane, incomplete CIMMS records, lack of adherence to Darby's GMM or CAMP by PJM, and no current weight and balance information for the accident airplane. Additionally, although the accident airplane and some PJM pilots were listed in Darby's operations specifications, PJM was not listed in Darby's FAA-approved operations specifications (as required).

1.17.2.4 Blue Star Jets, Inc.

Blue Star was formed in April 2001 as a charter broker company. Blue Star does not own or hold exclusive leases on any airplanes nor does it hold a Part 119 or 135 operating certificate or any economic authority from the DOT's Office of the Secretary. According to the DOT, a charter broker links consumers with certificated air transportation providers that are certificated under Parts 119, 135, 121, or other parts, as appropriate, and that hold the appropriate economic authority.

The DOT defines direct air carriers as operators that provide transportation on their own aircraft. Indirect air carriers contract with a customer for air transportation and then contract separately with a direct air carrier to conduct the flight. Brokers that do not hold certificates or DOT economic authority must act as (1) an agent of either the charter

[69] Records indicated that the PJM DOM attended a 2-week initial CL-600 maintenance course at FlightSafety International, Montreal, Canada, in November 2002.

customer or the direct air carrier or (2) as an entity that simply identifies prospective charter customers for direct air carriers or vice versa and then places them in direct contact with each other. (Travel agencies typically perform this function as agents of air carriers.) Charter brokers may enter into written agreements with either the charter customer or the direct air carrier. Records indicated that Blue Star had entered into such an agreement with the charter customer for the accident flight.[70]

According to Blue Star representatives, at the time of the accident, the company assessed the qualifications of the operators it used by obtaining a copy of their certificates of insurance, checking quality audits from independent companies, and/or reviewing the "Air Charter Guide."[71] Blue Star representatives stated that they originally located PJM through the Air Charter Guide and obtained a copy of the airplane's certificate of insurance before Blue Star arranged the accident flight.[72] They indicated that they considered the insurance document and Air Charter Guide reference sufficient evidence that PJM was operating properly under a current Part 135 certificate. Blue Star representatives stated that, at that time, they did not specifically check a company's Part 135 operating certificate when arranging a flight; therefore, they did not ask to see a Part 135 operating certificate for PJM when they arranged the accident flight.[73] Blue Star did not maintain records on the flight crews or airplanes used by the operators it used, although the company would occasionally get an airplane registration number and/or a crewmember name and cellular telephone number before a flight for customer convenience.

1.17.3 FAA Oversight

The Birmingham FSDO provided oversight of Darby Aviation's Part 135 certificate. A principal operations inspector (POI) and principal maintenance inspector (PMI) were assigned to manage Darby's certificate.

The POI for Darby had been assigned oversight responsibility for Darby's Part 135 certificate for about 18 months at the time of the accident. In addition to his Darby duties, the POI was responsible for oversight of 9 or 10 other Part 135 operators, 6 pilot examiners, 3 Part 141 training schools, and 1 Part 125 operator. He stated that he had an assistant POI because of the number of Part 135 operators and airplanes he oversaw. He

---

[70] Blue Star representatives and the charter customer's chief pilot stated that their companies had worked together regularly during the year before the accident. They indicated that the accident trip was scheduled because the charter customer had sold one of its two airplanes and the other airplane was undergoing maintenance.

[71] For additional information, see <http://www.aircharterguide.com>.

[72] DDH held a hull insurance policy on the accident airplane. PJM provided Blue Star with copies of that policy and its lease for the airplane.

[73] Blue Star personnel noted that if, at the time of the booking, they had asked to see PJM's Part 135 operating certificate and PJM had presented them with a copy of Darby's certificate (under which PJM was operating), they would have considered that acceptable based on their practices at that time. Since the accident, Blue Star has obtained a copy of Darby's Part 135 operating certificate and worked with a charter audit company to institute a review system to ensure use of only properly certificated Part 135 operators.

stated that he was aware of PJM's charter management agreements with Darby but that he did not oversee PJM operations because PJM did not hold a Part 135 certificate. (He also claimed that budget issues and the geographical distance between the Birmingham FSDO and Fort Lauderdale-based PJM were issues.) The POI stated that all of his interactions with PJM were conducted through Darby's DO. He indicated that he had not visited PJM's facility at FLL nor had he requested oversight assistance from the Fort Lauderdale, Florida, FSDO.

The PMI for Darby Aviation had been assigned to Darby's Part 135 certificate for about 12 months at the time of the accident. In addition to his Darby duties, the PMI was responsible for oversight of eight Part 145 repair stations, one airframe and powerplants school, and another Part 135 operator. During postaccident interviews, the PMI told investigators that he visited Darby twice per quarter, staying 3 or 4 days per visit. He stated that he accomplished all of the required oversight and surveillance items during these visits, including ramp inspections and review of Darby's GMM, airplane maintenance manuals, and other paperwork. The PMI stated that, although Darby was responsible for the accident airplane's maintenance, he was aware that the maintenance was performed by PJM. He indicated that he had never visited PJM's facility at FLL nor had he asked Fort Lauderdale FSDO personnel to visit the facility.

During postaccident interviews, the PMI stated that Darby Aviation had arrangements similar to its arrangement with PJM with other operators on its Part 135 certificate and that he believed that Darby maintained operational control of all its flights. He stated that, to his knowledge, Darby maintained all original maintenance paperwork and that PJM was on Darby's approved vendor list. He told investigators that he had not seen any recurring problems with the company.

1.17.4 Federal Lease Requirements

Typical aircraft lease agreements are described by the FAA as "dry leases" or "wet leases." In a dry lease agreement, an owner supplies an airplane to a certificated operator, typically allowing the owner to defray the costs of airplane ownership while allowing the operator to increase fleet size and/or flexibility. For a Part 135 flight under a dry lease agreement, the certificated operator supplies the flight crew and is responsible for other operational aspects of the flight. In a wet lease agreement, an airplane and a flight crew are provided as a package between Part 135- or Part 121-certificated operators and contractors, typically allowing one of the parties to temporarily increase fleet size and/or flexibility.

According to 14 CFR 119.53(b), wet lease agreements are only permitted between certificated operators. However, a postaccident FAA sampling of operators indicated that charter management arrangements similar to that between PJM and Darby Aviation in which one of the operators did not have a Part 135 operating certificate (contrary to 14 CFR 119.53) were common.[74] Historically, these agreements have been considered acceptable and tacitly permitted by the FAA. The Safety Board requested information from the FAA regarding the number of noncompliant arrangements between certificate holders and noncertificated entities that were identified and how many of those arrangements have been amended and/or resolved;[75] to date, the FAA has not provided this information.

1.17.5 Postaccident Actions

1.17.5.1 FAA and DOT Emergency Orders to PJM

On March 3, 2005, the FAA issued an emergency cease and desist order to PJM as a result of an investigative report that concluded that the company "violated and threatened to violate" various Federal regulations. In part, the order indicated that PJM had agreed to operate charter flights when it did not hold an air carrier certificate under Part 119 and that PJM operated flights subject to Part 135 without appropriate operations specifications from November 17, 2003, to February 2, 2005. In addition, the order stated that PJM "violated and threatened to violate" 49 U.S.C. [United States Code] section 44711(a)(4), which states that no person may operate as an air carrier without an air carrier operating certificate. Later in March 2005, PJM ceased operations.[76]

On June 12, 2006, the DOT entered into a consent order with PJM to cease and desist from operating without proper licensing authority. The DOT concluded that, because PJM personnel conducted direct advertising rather than using Darby Aviation to schedule its flights, they were in violation of 49 U.S.C., sections 41301 and 41712. The DOT also noted that the owner of PJM was not a U.S. citizen; therefore, PJM could not legally operate for compensation between two points within the United States.

1.17.5.2 FAA Emergency Order of Suspension to Darby Aviation

On March 23, 2005, the FAA issued an emergency (immediately effective) order of suspension to Darby Aviation as a result of an investigative report that concluded that Darby, a Part 135 operating certificate holder, had caused, permitted, or allowed PJM to unlawfully operate passenger-carrying flights for compensation or hire. The report cited the accident flight and numerous other flights as examples.

In addition, the FAA's emergency order indicated that Darby Aviation had failed to maintain responsibility for operational control of flight operations, allowing PJM to exercise such control for passenger-carrying flights for hire when PJM did not hold an appropriate air carrier operating certificate. The FAA's order further stated that Darby had violated 14 CFR 119.5(g), which states, in part, "no person may operate as a direct air

[74] In one such case, on May 19, 2006, the FAA took enforcement action against an operator and an air ambulance company for alleged violations of Section 119.53 and loss of operational control.

[75] Safety Board requests for this information included a June 21, 2006, e-mail request, a July 6, 2006, follow-up e-mail, and an August 22, 2006, official investigative request (request number 06-108).

[76] DOT records show that, after PJM ceased operations, the three partners involved in PJM attempted to set up a new "jet management company" in Boca Raton, Florida, in early 2005 and that the new company shut down after about 3 months.

carrier or as a commercial operator without, or in violation of, an appropriate certificate and appropriate operations specifications."[77]

As a result of these and other circumstances set forth in the FAA's order, the FAA required an indefinite suspension of Darby Aviation's air carrier certificate until such time as it could demonstrate that it had not surrendered operational control of the certificate. On April 21, 2005, a Safety Board administrative law judge reversed the emergency order, finding that PJM, not Darby, was responsible for the accident flight. On May 5, 2005, the FAA Administrator appealed the initial decision of the Safety Board's law judge. Upon further review of all of the evidence, on May 26, 2005, the Board issued Order EA-5159, which affirmed the FAA administrator's emergency order of suspension and reversed the initial decision of the Safety Board's law judge.

Subsequently, the FAA has approved rewritten operations specifications for Darby, which include an expanded, detailed section on operational control, similar to the FAA's draft Operations Specifications A-008. Darby's operating certificate is no longer under suspension and the company owns all but one of the airplanes it operates. Darby has a dry lease agreement with the owners of that airplane and does not operate any airplanes under wet-lease-type agreements similar to that which it held with PJM.

1.17.5.3 Additional Postaccident DOT and FAA Actions

According to the DOT, Blue Star was subject to the provisions of a DOT notice issued in October 2004, which provided guidelines for brokers to avoid giving the appearance that they were acting as air carriers. In a settlement issued in October 2005,[78] the DOT found that, although there was no deception related to the accident flight, certain phrases used in Blue Star's advertising and on its Web site gave the impression that Blue Star was operating as an air carrier and implied that the company only contracted with certificated carriers.

On June 10, 2005, the FAA issued Notice 8400.83, titled "Responsibility for Operational Control During Part 135 Operations and the Use of a DBA (Doing Business As) Name."[79] This notice reiterated existing guidance to FAA inspectors regarding their certificate management and surveillance of operators that conduct Part 119 and 135 operations and directed inspectors to ensure that the operators they oversee understand their obligations to maintain operational control of flights conducted under their certificates.

Additionally, on October 25, 2005, the FAA issued a public notice in the *Federal Register* (70 FR 61684-01) that reiterated existing guidance and regulations regarding wet

---

[77] Title 14 CFR 135.77 states, "each certificate holder is responsible for operational control of operations conducted under its certificate and shall list, in the manual required by Section 135.21, the name and title of each person authorized by it to exercise such operational control."

[78] An electronic version of this document (Order 2005-10-24) can be found at the DOT's Web site at <http://dms.dot.gov>.

[79] See section 1.18.2.3 for information regarding a dba-related safety recommendation.

lease agreements. The notice stated, in part, "it has long been contrary to Federal Aviation Regulations for an air carrier to 'wet lease' an aircraft from an individual or entity that is not separately authorized to engage in common carriage." This notice further specified that "a carrier has inadequate operational control if it lacks either timely knowledge about the flight and duty status of its pilots, the means to communicate an order to the crew to delay, cancel, or divert a flight, or sufficient leverage or authority over its crews to assure compliance with the carriers lawful instructions."

Further, between March and June of 2006, the FAA hosted 10 seminars to educate attendees on the FAA's guidance and requirements related to wet leases and operational control, use of business names, and select case studies.[80] Additionally, in concert with industry, the FAA began an expansion of the operational control section of FAA Order 8400.10, "Air Transportation Operations Inspectors Handbook," and revision of section A-008 of the standard Operations Specifications (which pertains to operational control), which were to be accomplished by August 31, 2006. On September 19, 2006, FAA staff informed Safety Board investigators that the revisions have not yet been finalized but are now scheduled for release on or about October 31, 2006.

1.18 Additional Information

1.18.1 Other Challenger CL-600 Runway Overrun Accidents

The Safety Board has investigated two other recent accidents involving CL-600 runway overruns. In one case, on December 16, 2003, the pilots of a CL-600 performed an RTO at a speed of about 139 knots when the airplane did not rotate at the expected rotation speed. The airplane came to a stop about 15 feet beyond the departure end of runway 19 at TEB. The Board determined that the airplane did not rotate at the expected speed because it was loaded such that it exceeded its maximum takeoff weight and forward CG limit.[81]

In the other recent CL-600 runway overrun, on March 9, 2005, a CL-600 ran off the end of a runway at Tupelo Regional Airport, Tupelo, Mississippi, after the pilots initiated an RTO at a speed of about 140 to 145 knots. The Safety Board determined that the airplane did not rotate at the expected speed because the first officer's microphone holder, which was installed on the base of the control column, had rotated 90° and was interfering with the aft movement of the column.[82] (The Board's investigation of the February 2, 2005, Teterboro accident revealed that the microphone holder in the accident airplane had a different design and could not have caused such interference.)

---

[80] Educational program attendance was strictly voluntary for FAA principal inspectors and industry personnel. Specific training for FAA principal inspectors has not been implemented.

[81] Postaccident investigation revealed that the airplane's CG was about 13.6 percent MAC. Additional information regarding this accident NYC04IA054, can be found on the Safety Board's Web site at <http://www.ntsb.gov>.

[82] Additional information regarding this accident, ATL05FA061, can be found on the Safety Board's Web site at <http://www.ntsb.gov>.

1.18.2 Previous Safety Recommendations

1.18.2.1 Engineered Materials Arresting System Recommendation

As a result of its investigation of the May 6, 2003, accident involving a Southwest Airlines airplane that overran the end of the runway after landing at Burbank, California,[83] the Safety Board issued Safety Recommendations A-03-11 and -12, which addressed RSAs. Safety Recommendation A-03-11 asked the FAA to do the following:

> Require all 14 *Code of Federal Regulations* Part 139 certificated airports to upgrade all runway safety areas that could, with feasible improvements, be made to meet the minimum standards established by Advisory Circular 150/5300-13. These upgrades should be made proactively, not only as part of other runway improvement projects.

Safety Recommendation A-03-12 asked the FAA to do the following:

> Require all 14 *Code of Federal Regulations* Part 139 certificated airports to install engineered materials arresting systems in each runway safety area available for air carrier use that could not, with feasible improvements, be made to meet the minimum standards established by Advisory Circular 150/5300-13, "Airport Design." The systems should be installed proactively, not only as part of other runway improvement projects.

In an August 7, 2003, letter, the FAA indicated that it agreed with the intent of these recommendations and stated that FAA Order 5200.8, "Runway Safety Area Program," established a program to bring all RSAs up to current standards, whenever possible. The letter stated that the FAA's goal was to upgrade RSAs at the 456 identified affected airports by 2007 and that such improvements "may be initiated at any time." However, with regard to Safety Recommendation A-03-12, the FAA stated that the installation of an EMAS should be a choice rather than a requirement because "there may be other systems that might be developed as technologies occur."

In late 2003, Safety Board and FAA personnel met to discuss the RSA/EMAS issue and available alternative systems that would quickly and safely stop an airplane running off the end of a runway. In a January 30, 2004, letter, the Board stated that it "did not intend to specify a single product in this recommendation and agrees that the FAA should have the flexibility to allow systems that provide an equivalent level of performance." The Board asked the FAA to provide annual updates on RSAs that could not meet the standards and the specific alternatives that would be used to improve the safety of these RSAs.[84] The Board classified Safety Recommendations A-03-11 and -12, "Open—Acceptable Response," pending receipt of the requested information.

[83]For additional information, see National Transportation Safety Board, Aircraft Accident Brief NTSB/AAB-02/04 (Washington, DC: NTSB, 2002).

[84] The FAA stated that its goal was to upgrade at least 65 RSAs per year through 2007 and that 71, 68, and 74 RSAs were upgraded in fiscal years 2000, 2001, and 2002, respectively. The FAA also noted that eight EMAS beds had already been installed and that several more installations were planned.

In a July 7, 2006, letter, the FAA indicated that 208 RSA upgrades and 15 EMAS installations had been completed though fiscal year 2005. The letter further stated that more than 90 percent of the RSA upgrades would be completed by 2010, and all RSA upgrades would be completed by 2015. The latest FAA response is under Board review at this time.

The issue of RSA improvements was discussed at the Safety Board's public hearing on the December 8, 2005, accident at Chicago Midway Airport (MDW) involving Southwest Airlines flight 1248. In response to questioning during this hearing, FAA personnel indicated that, under current FAA policy, it is possible that some RSAs will not meet the dimensional standards or have arrester beds installed even after the FAA considers its improvement projects successfully completed.

1.18.2.2 Crew Resource Management Training for Part 135 Pilots

As a result of its investigation of the October 25, 2002, accident involving a Raytheon (Beechcraft) King Air A100 that crashed on approach to Eveleth-Virginia Municipal Airport, Eveleth, Minnesota,[85] the Safety Board issued Safety Recommendation A-03-52 on December 2, 2003. Safety Recommendation A-03-52 asked the FAA to do the following:

> Require that 14 *Code of Federal Regulations*…Part 135 on-demand charter operators that conduct dual-pilot operations establish and implement a Federal Aviation Administration-approved crew resource management [CRM[86]] training program for their flight crews in accordance with 14 CFR Part 121, subparts N and O.

In an April 12, 2004, response, the FAA indicated that an aviation rulemaking advisory committee (ARAC) was in session "to revise and improve 14 CFR Part 135 in many respects, including requiring crew resource management training for 14 CFR Part 135 operators of airplanes with two pilots." The FAA indicated that it anticipated receiving recommendations from the ARAC and issuing a related notice of proposed rulemaking (NPRM) in "fiscal year 2005."

In its January 12, 2005, response letter to the FAA, the Safety Board acknowledged that the pending revisions to 14 CFR Part 135 would incorporate many operational changes, including the requirement for CRM training, and encouraged the FAA to expedite those revisions. The Board classified Safety Recommendation A-03-52 "Open—Acceptable Response," pending completion of the 14 CFR Part 135 revisions.

---

[85] For additional information, see National Transportation Safety Board, *Loss of Control and Impact with Terrain, Aviation Charter, Inc., Raytheon (Beechcraft) King Air A100, N41BE, Eveleth, Minnesota, October 25, 2002,* Aircraft Accident Report NTSB/AAR-03/03 (Washington, DC: NTSB, 2003).

[86] CRM has been defined as, "the effective use of all available resources: human resources, hardware, and information" to achieve safe and efficient flight. For additional information, see FAA AC 120-51E, "Crew Resource Management Training."

This issue was further addressed as a result of the Safety Board's investigation of the November 28, 2004, accident involving a CL-600-2A12 that crashed during takeoff from Montrose Regional Airport, Montrose, Colorado.[87] During this investigation, it was noted that, although the ARAC had provided the FAA with its recommendations regarding improvements to Part 135 operations, no related NPRM had yet been issued, and the Board reiterated Safety Recommendation A-03-52 and reclassified it "Open—Unacceptable Response," on May 2, 2006. During a briefing on June 13, 2006, the FAA told Board personnel that the related NPRM would be issued in mid-2007.

1.18.2.3 Part 135 Operator Information Recommendation

On May 2, 2006, also as a result of its investigation of the accident in Montrose, Colorado, the Safety Board issued Safety Recommendation A-06-43, which asked the DOT to do the following:

> Require that, for all 14 *Code of Federal Regulations*…Part 135 on-demand air taxi flights, the following information be provided to customers and passengers at the time the flight is contracted and at any point there is a substantial change: the name of the company with operational control of the flight, including any "doing business as" names contained in the operations specifications; the name of the aircraft owner; and the name(s) of any brokers involved in arranging the flight.

Safety Recommendation A-06-43 is classified "Open—Await Response."

Blue Star and PJM were named on the documentation for the accident flight, and the personnel involved in scheduling the charter flight knew that PJM would be operating the flight. However, none of the charter paperwork identified Darby Aviation as the actual Part 135 certificate holder. Further, it is unclear whether any of the passengers had access to any pertinent information regarding the companies involved with the accident flight.

[87] For additional information, see National Transportation Safety Board, Aircraft Accident Brief NTSB/AAB-06/02 (Washington, DC: NTSB, 2006).

2. Analysis

Title 14 CFR Part 135 charter operations comprise a growing segment of air transportation for the public. The FAA expects on-demand Part 135 charter operations to increase by about 3 percent a year from 2006 to 2017.[88] However, this investigation revealed a common practice in the aviation industry that undermines the safety of Part 135 operations and the FAA's ability to oversee them. Specifically, noncertificated (unauthorized) charter operators advertise and provide charter flight services to the public under the auspices of an FAA-certificated Part 135 operator through the use of charter management agreements. However, these noncertificated operators are not subject to FAA certification requirements or the ongoing FAA oversight processes that are applied to a Part 135-certificated operator. Under charter management agreements, oversight and operational control of the noncertificated operator is the responsibility of the Part 135 certificate holder. As a result, the oversight and operational control of such operations is performed with varying degrees of diligence. In the case of the operators involved in this accident, Darby maintained minimal oversight and operational control (see section 1.17.2.3). With the expected growth of Part 135 operations, it is now more critical than ever that the FAA provide adequate guidance and oversight to ensure that operational control is maintained by the certificated entity so that the safety of individuals traveling on Part 135 on-demand chartered aircraft is not compromised.

The FAA has recognized this "loophole" in its certification and oversight system and is taking steps to address the issue and instruct the charter industry and FAA principal inspectors on the aspects of operational control and acceptable methods of demonstrating such control. However, as further discussed below, the Safety Board is concerned that the FAA's actions to identify a lack of operational control or provide guidance on acceptable methods to demonstrate operational control to date have not been adequate to fully educate all POIs and operators to ensure compliance.

The analysis and recommendations contained in this report address this lack of operational control and guidance for demonstrating operational control. In addition, this analysis addresses weight and balance procedures; flight crew actions, training, and procedures; company oversight and operational control; FAA responsibility and oversight; cabin aide actions, training, and procedures; and RSAs.

2.1 General

The captain held the certificates required to act as pilot-in-command of CL-600 flights under 14 CFR Part 91, but he had not yet received the training needed to operate 14 CFR Part 135 flights for Darby Aviation.

[88] For additional information, see the FAA's General Aviation and Air Taxi Activity and Avionics Survey, CY2004 at <http://www.faa.gov/data_statistics/aviation_data_statistics/general_aviation/CY2004>.

Information obtained from previous employers and postaccident interviews and the Safety Board's review of FAA records, the captain's rèsumès, and other documentation called into question the validity of the captain's reported experience (his flight times and previous training) as a pilot.

The first officer had received only 22 of the 31 hours of ground training required by Darby's operations specifications to perform second-in-command duties on a CL-600 being operated under Part 135. Additionally, his FAA medical certificate had expired for the purposes of commercial operations. Therefore, he was not properly trained or certificated for the accident flight.

A review of the pilots' 72-hour histories revealed that, although they reported receiving less sleep than normal the night before the accident, they had had adequate sleep during the previous two nights. Both pilots reported feeling alert on the morning of the accident. There was no evidence that fatigue affected the pilots' performance on the morning of the accident.

The accident airplane was properly certificated and was maintained in accordance with industry practices. There was no evidence of any preexisting powerplant, system (including brakes, ground spoilers, and engine thrust reversers), or structural failures. Although the investigation revealed that the FDR did not operate as expected, evidence indicated that it was likely the result of a unique installation and not a systemic problem.

The TEB ASOS was functioning at the time of the accident. Although weather conditions in the area were favorable for frost formation (and an ATC supervisor stated that he observed frost on some car windows when he arrived at work about 0600), the ASOS did not indicate the presence of frost,[89] and witnesses and ground and airport personnel told investigators that they did not observe frost on the ground, paved surfaces, or vehicles that were left outside overnight, including the accident airplane. Additionally, two line service technicians who handled the accident airplane on the morning of the accident told investigators that they did not observe frost on the airplane, and the pilot of an airplane that was parked adjacent to the accident airplane that morning stated that there was no frost on his airplane. The airplane's performance was not consistent with upper wing ice or frost contamination, and the airplane's failure to rotate when the control column was pulled fully aft is not a performance deficiency associated with the presence of upper wing contamination. Therefore, the Safety Board concludes that weather was not a factor in the accident.

The ARFF response from TEB and surrounding communities was prompt, and exterior postaccident fires were extinguished efficiently. A TEB-based HRET/skin-penetrating-nozzle-equipped vehicle, had one been available, would have reached the accident site to extinguish the interior fire more promptly than the EWR-based HRET/skin-penetrating-nozzle-equipped vehicle that responded to this accident site. However, because all airplane occupants had self-evacuated before ARFF personnel

[89] The ASOS does not provide direct information regarding frost, but indirect analysis of the data can determine whether frost was present or not.

arrived, earlier arrival of such a vehicle would not have facilitated passenger evacuation in this case.

The TEB local controllers observed that the airplane was not pitching up at what they believed to be a “normal” liftoff point. Recognizing that the airplane would probably not be able to stop on the remaining runway, the controllers alerted the airport ARFF facility of the situation. The local controllers also promptly issued go-around instructions to an inbound airplane and coordinated that go-around and the cessation of further arrivals at TEB with the approach control facility. Further, the TEB ground controllers ensured that the ARFF responders were aware of the accident location and monitored their progress to the accident site. The Safety Board concludes that the air traffic controllers’ prompt and efficient reaction to this accident was exemplary and facilitated the prompt ARFF response.

All eight of the passengers and the cabin aide received minor injuries (including contusions, abrasions, lacerations, sprains, and strains) during the impact and evacuation. The flight crew’s injuries (which included fractures, dislocations, and lacerations) were more serious but were mainly limited to the lower limbs. All of the passengers and crew evacuated through the main cabin door, and no attempt was made to use the overwing exit on the right side of the airplane. (Use of the overwing exit would have been ill-advised because of its proximity to burning vehicles.) Because the pilots were still trapped in their seats and the cabin aide was unable to open the main cabin door, passengers rotated the door handle and pushed and kicked the door open. A passenger reported that he fumbled to find the door handle in the postimpact darkness; however, the main difficulty opening the door was the result of the door being jammed. Postaccident investigation revealed no evidence of a preimpact door anomaly. The Safety Board concludes that doorframe and/or fuselage distortion caused by impact with the building accounted for the passengers’ difficulty opening the main cabin door.

2.2 The Accident Sequence

The captain was the flying pilot during the takeoff roll/RTO. Both pilots indicated that the flight controls operated freely and normally during the preflight control checks and that no anomalies were noted before the takeoff roll was initiated about 1 minute later. Witness reports, statements from the pilots and passengers, airplane performance calculations, CVR sound spectrum analysis, and airport surveillance videotapes all indicated that the airplane accelerated for takeoff normally.

The captain reported to investigators that, when the airplane accelerated through the planned rotation speed and he tried to move the control column aft, he was not able to move it far, and the airplane did not lift off. However, according to passenger statements, during discussions immediately after the accident, the captain did not report limited control column motion. Rather, he told them that the airplane “had no lift.” One passenger stated that, as he spoke, the captain motioned with his arms as if he were pushing back and forth on a control column. The first officer stated that when he added his efforts to pull back on the control yoke, it did not move, and the airplane did not lift off. 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 airplane continued to accelerate on the runway until the captain rejected the takeoff, and the airplane never rotated. During the RTO, the airplane ran off the end of the runway, through some navigational aid equipment and an airport perimeter fence, across a six-lane highway, struck cars on the road and in a parking lot, and came to rest partially embedded in a brick building about 800 feet from the end of the runway.

2.3 Flight Crew and Airplane Performance Issues

2.3.1 Preflight Airplane Weight and Balance Issues

The accident pilots told investigators that, although they obtained an estimate of the airplane's weight by inputting fuel load information and average passenger weights into the airplane's FMS, they did not calculate the airplane's CG in any way for the accident flight. However, Federal regulations (14 CFR 91.9) prohibit a pilot from operating any civil airplane without complying with the operating limitations specified in the approved AFM, which includes acceptable operating ranges for both weight and CG and determining that the airplane is "in condition for safe flight." In addition, for every charter flight conducted, Federal regulations (14 CFR 135.63) require pilots to calculate an airplane's weight and balance and to retain a copy of that calculation. Further, in this case, the pilots should also have faxed a copy of the airplane's weight and balance calculations to Darby before the accident flight.

PJM provided its pilots with numerous aids to assist them in determining the airplane's weight and CG and ensuring that the airplane was operating within the specified limits. For example, PJM pilots were provided with a commercially produced weight and balance graph for use in preflight calculations. Additionally, the weight and balance report in each airplane included pages with the appropriate locations and values to use in manual weight and balance calculations (in accordance with the AFM). The AFM also included quick reference guide pages that could be used to make an initial estimate of the airplane's loading. All of these materials were available to the flight crew on the morning of the accident.

During its investigation, the Safety Board noted that the airplane empty weight on the PJM weight and balance form (completed by the pilots of the previous flight from LAS to TEB) had been manually modified and indicated an airplane empty weight about 1,000 pounds less than the airplane's actual empty weight, resulting in a baseline CG farther aft than the actual CG for that flight. The Board's calculations indicated that the previous flight likely departed LAS for TEB slightly over its maximum takeoff weight and with a CG slightly forward of its forward limit. FDR data indicated that the airplane rotated at a higher-than-normal speed during that takeoff; however, the runway at LAS was longer than runway 6 at TEB, and there was no RTO.

Review of other PJM weight and balance forms for the accident airplane indicated that when PJM pilots completed this form for Part 135 charter flights, they frequently modified the airplane empty weight. Examination of the modified forms revealed that the modifications involved a variety of airplane empty weights and always resulted in total weights and CGs that were within the airplane's limits. However, if the weight and balance for the LAS-to-TEB flight is representative, it is likely that the airplane was actually operated outside its specified weight-and-balance limits on numerous previous flights.[90] The Safety Board concludes that PJM pilots routinely improperly modified the airplane's weight and balance forms, using a variety of invalid airplane empty weights to ensure that the form indicated that the airplane was operating within its limitations.

The Safety Board's postaccident weight and balance calculations—which were based on the available documentation regarding fuel and other preflight servicing; the effects of fuel burned during pretakeoff operations; postaccident information regarding the weights of the passengers, crew, and baggage; and other airplane documentation—showed that the airplane was about 100 pounds over the maximum allowable takeoff weight and that the forward CG significantly exceeded the forward CG limit. The accident airplane's calculated CG was about 12.47 percent MAC, whereas the forward CG limit was 16 percent MAC. The Safety Board concludes that the airplane, as loaded for the accident flight, had a forward CG that was significantly forward of the airplane's forward limit, which severely degraded the airplane's ability to rotate.

The Safety Board's review of the pilots' flight histories indicated that both pilots were experienced and that the captain in particular had reported significant experience in the CL-600 airplane. He was type-rated in the CL-600/-601 and told investigators that he had about 1,500 hours in the CL-600 and about 1,900 hours in the CL-601.[91] (The first officer reported about 82 hours in the CL-600, some of which was recent.) In addition, the captain had attended a CL-600 recurrent training program, at which weight and balance issues were reviewed, just 2 months before the accident. Both the captain and the first officer had recent experience in the accident airplane. The Board's review of weight and balance materials for the accident airplane indicated that, under many loading configurations, the airplane could not be loaded with full fuel without exceeding its forward CG limit. Further, investigators found that this fuel loading characteristic appeared common among corporate jet airplanes with interior cabin furnishings designed for luxury business transport. This loading characteristic is commonly addressed by varying fuel loads, ballast, and/or passenger loading to remain within operational limits.

Despite their reported familiarity with the airplane and its loading characteristics, and despite Federal regulations requiring them to do so, neither pilot attempted to ensure

[90] The Safety Board notes that an incorrectly modified weight and balance form was not an issue in this accident because the pilots told investigators that they did not use the form for the accident flight.

[91] The Safety Board noted inconsistencies in the amount of CL-600/-601 flight experience the captain reported on résumés he submitted to various companies in the year before the accident. These inconsistencies suggest that the amount of CL-600/-601 flight time reported by the captain may be inaccurate. The Board was unable to locate documentation to verify the captain's actual CL-600/-601 flight experience.

that the airplane's CG would be within limits with the intended loading of eight passengers and full fuel. To remain within the airplane's load limitations, the accident pilots could have modified their fuel load request (if they performed weight and balance calculations before the fuel tanks were topped off) or off-loaded fuel (if the out-of-balance condition was recognized after the fuel tanks were topped off).[92] Even after the accident, the captain expressed disbelief that the airplane's CG could have exceeded the forward limit under the loading conditions present on the morning of the accident.

During postaccident interviews, the first officer stated he typically set the pitch trim slightly above the indexed takeoff position (the TO line within the green range) if the airplane were "heavy." The captain told investigators that the AFM contained a table for pitch trim settings but stated that he believed that the pitch trim could be adjusted to various settings for takeoff, depending on the pilot's preference. However, the pitch trim settings for takeoff contained in the AFM were based on the airplane's CG. The AFM specified using a setting in the upper third of the green band (above the indexed TO position) with CGs that were near (but within) the forward limit. The pilots' statements that pitch trim could be adjusted based on the airplane's weight or the pilot's preference, rather than being selected based on the airplane's CG, showed that they were not considering the effect of the CG on the airplane's flight characteristics. Therefore, the Safety Board concludes that neither pilot used the available weight and balance information appropriately to determine the airplane's weight and balance characteristics for the accident flight and the pitch trim setting selected by the pilots is further evidence that they did not consider the airplane's CG during preflight preparations.

2.3.2 Pilot Decisions and Actions During the Rejected Takeoff

The Safety Board evaluated the pilots' decision to reject the takeoff and their actions during the RTO. Using the Safety Board's calculated weight and balance for the accident flight, investigators reconstructed the attempted takeoff in a full-motion simulator and reviewed multiple possible scenarios. The results from the simulator sessions and the Board's airplane performance study indicated that, under the accident airplane's loading conditions and configuration, the airplane would likely not have achieved nose-up rotation, even with full aft control column input, until after it accelerated past about 160 knots, well in excess of normal takeoff decision or rotation speeds.

Slight differences in airplane responsiveness during a normal takeoff are not uncommon because of variations in airplane loading, trim settings, rotation speed, pilot technique, and other factors during takeoff. Although RTO training is usually based on the premise that an engine failure will occur just before V_1, a pilot should still reject a takeoff if convinced that an airplane is not flyable later in the takeoff roll, regardless of the airplane's speed or the amount of runway remaining. During the accident takeoff, the airplane had accelerated beyond both its safe RTO speed for the accident runway and its expected rotation speed, and its nose never began to lift off the runway. The captain

[92] The FBO's fuel records indicated that another airplane was defueled earlier on the morning of the accident.

concluded that the airplane was not flyable and decided to reject the takeoff (albeit at a higher-than-normal RTO speed). The Safety Board concludes that the captain's decision to initiate the RTO was reasonable, even though the airplane had already reached a higher-than-normal RTO speed.

The Safety Board also evaluated the captain's performance during the RTO by observing numerous RTO runs in a CL-600 simulator configured to match the performance of the accident airplane. The accident airplane's takeoff performance data indicated that the airplane required as much as 5,270 feet of runway to accelerate to V_1 (about 127 knots), initiate an RTO, and come to a stop before the end of the runway. However, the captain initiated the RTO at a speed of about 160 knots (about 33 knots faster than the RTO speed identified in the airplane manuals), and runway 6 at TEB was only 6,013 feet long. RTOs attempted under these conditions in the simulator resulted in runway excursions at various speeds; however, in all cases, the simulator left the runway at a slower speed than the accident airplane. These excursions would likely have resulted in a variety of airplane stopping points at the airport perimeter, the six-lane highway, or the building impacted by the accident airplane.

The deceleration levels observed in the simulator study indicated that throughout the RTO the accident pilot was not using the full capability of the airplane to stop and that the speed at which he exited the runway could have been significantly lower. It is imperative that once pilots make the decision to reject the takeoff, they immediately use all available stopping devices. However, the deceleration performance observed during the simulator runs was not necessarily a realistic representation of what might be attained in the accident scenario because the simulator pilots had several advantages over the accident pilots that could explain the increased deceleration performance during the simulator-run RTOs. First, they were aware in advance that they would be performing a high-speed RTO and were instructed to apply reverse thrust, brakes, and spoilers immediately and aggressively. Second, during these tests, the simulator pilots repeatedly performed high-speed RTOs in the simulator, and they benefited from the practice. Third, the simulator pilots were not subject to the stress that the accident pilots likely experienced in a real-world situation. (Although pilots are expected to perform an RTO expeditiously, doing so in a training simulator when the RTO is expected is very different from a real-world situation.)

Considering the advantages the simulator pilots had and their lack of success during the simulator runs, the Safety Board concludes that most line pilots attempting to abort a takeoff 5 seconds after and at a speed well above the expected rotation speed, like the accident captain, would not have been able to stop the accident airplane in time to avoid departing the end of the runway.

2.3.3 Crew Resource Management Issues

CRM has been defined as the use of "all available resources: human resources, hardware, and information" to achieve safe and efficient flight operations. The Safety Board's evaluation of the accident pilots' actions during the flight revealed CRM skill deficiencies in numerous areas. For example, the captain demonstrated poor leadership and failed to use all of the available resources when he failed to involve the first officer in fuel load planning and other preflight decision-making. The captain also failed to reinforce adherence to regulatory requirements and standard operating procedures in the cockpit. Most importantly, he did not ensure that the airplane's balance was calculated to verify that the flight would be operating within the approved weight-and-balance limits, as required by regulations and company procedures. In addition, the captain rushed the checklist procedures by calling for the before takeoff checklist before the taxi checklist had been initiated and discouraging the first officer from reading the last few items of the before takeoff checklist when he stated, "they...briefed the standard for us." The captain's actions eliminated the protections afforded by standard checklist procedures and increased the chances of crew error.

The captain also exhibited deficiencies in workload management when he failed to ensure timely completion of certain critical tasks (such as reviewing the departure procedure and programming the FMS) before requesting clearance to taxi. This resulted in a higher-than-necessary workload for the first officer as he tried to brief the captain on the departure procedure, program the FMS, communicate on the radio, and complete the required checklists during the short taxi to the runway. As a result of the captain's poor planning, the pilots had not yet completed the taxi checklist when they were cleared to taxi into position on the departure runway. At that point, the captain should have recognized that the first officer was overloaded and told TEB ATC that they were not yet ready to depart, thus providing more time to complete the essential checks and prepare for takeoff. Instead the captain stated, "Okay, set to go," and the first officer acknowledged ATC's clearance.

The pilots' hurried activities during the taxi, resulting directly from the captain's poor planning, increased the likelihood of errors during critical before-takeoff checks. In his haste to depart, the captain failed to perform an adequate takeoff briefing, as called for by the taxi checklist. A thorough takeoff briefing would have addressed the most threatening safety issues for that stage of the flight, including clearance limits, initial steps in the departure procedure, requests for callouts, and a brief review of RTO criteria and procedures. The pilots had briefly discussed the departure procedure during their taxi, but when the takeoff briefing should have occurred, the captain merely reviewed emergency evacuation procedures.

The first officer also exhibited deficiencies in CRM skills, specifically in the area of crew coordination. For example, the pilots shared equal responsibility for ensuring that the airplane's weight and CG were adequately determined during preflight planning. Evidence indicated that the first officer was aware of the airplane's total fuel load and of the anticipated passenger load; therefore, he should have coordinated with the captain or performed calculations himself to ensure that the airplane's weight and CG were properly evaluated before takeoff. The first officer also should have communicated with the captain when he was rushed to complete critical tasks during the short taxi to the runway to ensure that critical checks and briefings could be properly completed. The first officer's failure to challenge the captain's failure to follow standard procedures to determine the airplane's weight and balance allowed the airplane's improper loading to go undetected, and his failure to challenge the captain's poor workload management and deviations from standard procedures during the taxi increased the potential for other errors to occur.

On the basis of its evaluation, the Safety Board concludes that the pilots' failure to ensure that the airplane's weight and CG were within approved takeoff limits was symptomatic of poor airmanship and a broader pattern of deficiencies in their CRM skills (specifically in the areas of leadership, workload management, communications/briefings, and crew coordination) that were exhibited on the day of the accident.

The Safety Board has previously issued recommendations regarding CRM training for Part 135 on-demand charter pilots. For example, on December 2, 2003, as a result of its investigation of the October 25, 2002, accident involving a Raytheon (Beechcraft) King Air A100 at Eveleth, Minnesota, the Board issued Safety Recommendation A-03-52, which asked the FAA to do the following:

> Require that 14 *Code of Federal Regulations*…Part 135 on-demand charter operators that conduct dual-pilot operations establish and implement a Federal Aviation Administration-approved crew resource management training program for their flight crews in accordance with 14 CFR Part 121, subparts N and O.

The Safety Board reiterated this safety recommendation as a result of its investigation of the November 28, 2004, accident involving a CL-600 that crashed during takeoff from Montrose Regional Airport, Montrose, Colorado. On June 13, 2006, the FAA told Board personnel that an NPRM addressing this issue would be issued in mid-2007.

2.4 Operational Control and Noncertificated (Unauthorized) Carrier Issues

2.4.1 PJM and Darby Aviation Operational Control

The accident flight was arranged through a broker agency as an on-demand charter flight, carrying eight passengers for revenue. The charter customer contacted the broker agency, which in turn booked the flight with PJM. Although PJM did not hold a Part 135 operating certificate, it had entered into a charter management agreement with a Part 135 certificate holder, Darby Aviation, which allowed PJM to operate under its certificate and operations specifications. The agreement between PJM and Darby designated Darby as the "exclusive agent" for managing on-demand charter flights conducted in PJM's airplanes and stated that Darby would monitor the flight crews and airplanes used and provide operational control[93] for all such flights. In exchange, PJM would pay Darby a "certificate fee." The certificate fee was a flat monthly fee; therefore, Darby received no

[93] Federal regulations define operational control as the exercise of authority over the initiation, conduct, and termination of a flight, and FAA Order 8400.10 specifies that providing adequate oversight of flight operations is an integral part of the exercise of operational control.

additional funds for monitoring the daily flights and operations of PJM. PJM had been conducting on-demand charter flight operations based on its agreement with Darby (with tacit approval from the Birmingham, Alabama, FAA FSDO) since November 2003.

During this investigation, the Safety Board identified deficiencies in the organizational policies and procedures of both PJM and Darby Aviation with respect to operational control. For example, their procedures indicated that PJM was required to fax an airplane manifest and weight and balance calculation forms to Darby before each on-demand charter flight it conducted. However, there was no requirement for Darby to confirm or authorize the manifest and weight and balance calculation forms before a flight. Because no preflight review was required, Darby Aviation did not recognize instances in which the weight and balance calculation forms submitted by PJM pilots showed inaccurate, modified airplane empty weights, which resulted in lower-than-actual total weights and farther-aft-than-actual CGs, as it should have if it were exercising proper operational control. If Darby had been exercising proper operational control, its review of weight and balance forms from multiple PJM flights would likely have revealed the pattern in which various inaccurate airplane empty weights were used by PJM pilots to result in weights and CGs within the airplane's limits. 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.[94]

PJM was using Darby Aviation's operating certificate to represent its company (on its Web site, business cards, and brochures) to the public as a Part 135 carrier to conduct on-demand charter flights for compensation. Because PJM had not met the FAA requirements for obtaining its own certificate, the FAA was relying on Darby to maintain operational control of PJM's operations. However, Darby was purportedly unaware of the accident flight and others. The Safety Board's review of documentation that Darby maintained on its oversight of PJM indicated that its operational control over flights conducted by PJM was minimal at best. For example, Darby was not properly monitoring the training and certification of pilots used in PJM's on-demand charter flight operations, as illustrated by the accident flight crew. The Safety Board also noted that PJM was not listed in Darby's operations specifications, as required. Further, Darby did not possess/maintain the required maintenance and/or pilot records related to PJM operations and was not properly evaluating the documentation that it did receive from PJM. Additionally, Darby did not recognize that the airplane had not been weighed within the previous 3 years, as required for Part 135 operations.[95]

The Safety Board noted that Darby Aviation and PJM seemed to have accepted responsibility for varying aspects of operational control, depending on the flight. This

[94] The accident pilots told investigators that they assumed that the accident flight was a Part 91 flight—despite clear evidence that it was a revenue flight—because they knew that the captain was not yet qualified to fly Part 135 operations under Darby's certificate.

[95] Although PJM personnel told investigators that the airplane had been more recently reweighed, neither PJM nor Darby were able to provide documentation of a more recent weighing.

situation resulted in a diffusion of responsibility between the two companies regarding the performance of oversight functions that normally serve to ensure the safety of a flight. This lack of clarity in organizational policies and practices led to a lax safety environment in which charter flights were conducted without the safety protections expected by passengers and required under Part 135. On the basis of the many errors and lapses in operational control identified during this investigation, the Safety Board concludes that Darby failed to maintain operational control over on-demand charter flights conducted by PJM under Darby's Part 135 certificate, as required by Federal regulations.

The Safety Board notes that a certificated Part 135 operator must exercise full operational control over all maintenance and flight operations being conducted under its certificate and have the full-time personnel (for example, a DO and a chief pilot), policies, and practices to detect the routine violations of airplane weight-and-balance limits, inadequate documentation, and record-keeping and incomplete pilot training that the Board easily discovered during this investigation. However, in part because of Darby Aviation's limited involvement in the planning, conduct, and oversight of PJM's flights, PJM tried to develop an internal management structure that approximately paralleled the functions normally performed by a certificated Part 135 operator. During postaccident interviews, PJM's CEO stated that he performed many functions that would normally be performed by a DO or chief pilot and attributed PJM's failure to clearly designate the accident flight as a Part 135 charter flight to his inadequate oversight of the operation.

The Safety Board concludes that because neither Darby nor PJM was rigorous about enforcing the Federal requirement for operational control, PJM pilots operated in an environment in which pilot errors and/or omissions during preflight preparation were less likely to be detected before departure.

2.4.2 FAA Oversight of PJM and Darby Aviation

Postaccident interviews revealed that personnel at the FAA's Birmingham FSDO were aware of the charter management agreement between Darby Aviation and PJM and did not object to the details of that agreement. Although Darby Aviation's operations specifications and the charter management agreement stated that Darby would maintain operational control over all charter flights (similar to most Part 135 operations specifications), Birmingham FSDO personnel stated that they were unaware of the lack of compliance with the charter management agreement and that, in practice, the arrangement enabled PJM to operate virtually independently, without meaningful operational control from Darby, the certificate holder. A postaccident FAA survey of Part 135 operators revealed that lack of compliance with the operational control aspects of charter management agreements between certificated and noncertificated entities was not uncommon at the time of the accident. Further, like the Birmingham FSDO inspectors in this case, FSDO inspectors in general had not recognized the situation.

In this case, although FAA personnel reviewed Darby's records, they did not ensure that PJM's airplanes were operated and maintained in accordance with Darby's company requirements or that charter trips flown by PJM were controlled by Darby. The process of developing a structure and operating practices sufficient to qualify for an air carrier certificate provides a positive demonstration of an operator's ability to safely provide transportation. Based on information obtained during this investigation, PJM was never required to demonstrate to the FAA that it was capable of providing the level of safety and service expected of certificated on-demand carriers, which led to the lapses in airmanship directly related to this accident. Additionally, the arms-length relationship with Darby shielded PJM from appropriate FAA oversight. The Safety Board concludes that the FAA's inadequate oversight of the Part 135 charter management agreement between PJM and Darby permitted management failures and a lack of operational control to exist. In effect, this allowed PJM to operate virtually independently as an on-demand air carrier while maintaining little of the structure of a certificated carrier and without demonstrating fitness to conduct such operations.

Darby Aviation's FAA principal inspectors told investigators that, despite their responsibility for managing Darby's Part 135 certificate, they did not oversee PJM's operations (which were conducted under that certificate), in part, because of budget issues and the geographical distance between the Birmingham FSDO and Fort Lauderdale-based PJM. Although Fort Lauderdale FSDO personnel could have provided assistance in overseeing PJM's operations, Darby's principal inspectors never requested such assistance. Therefore, the Safety Board concludes that Darby's Birmingham, Alabama, FSDO-based principal inspectors should have requested assistance from a FSDO more conveniently located to PJM's Fort Lauderdale-based operations to ensure proper oversight of the operations conducted by PJM under the auspices of Darby's certificate.

Federal regulations (14 CFR 119.5) require an operator to hold an appropriate certificate to advertise its services to the public for compensation or hire. However, PJM routinely advertised for, accepted, and conducted on-demand revenue flights as if it were a Part 135-certificated operator, without appropriate certification or oversight to do so, circumstances of which Birmingham FSDO personnel were unaware. The Safety Board concludes that the FAA failed to perform adequate charter operator surveillance and therefore did not recognize that PJM operated as a de facto Part 135 carrier, despite the lack of necessary personnel; policies; procedures; and FAA approvals, certification, and oversight that would normally be associated with such operations.

On June 10, 2005, the FAA issued a notice to its principal inspectors and, on October 25, 2005, issued a public notice in the *Federal Register* (70 FR 61684), both of which reiterated existing regulations regarding Part 135 certificate management and advised that operations conducted under arrangements similar to that between Darby Aviation and PJM are not permissible. The results of a postaccident review of 85 on-demand operators conducted by the FAA indicated that numerous other charter management agreements similar to the agreement between Darby and PJM likely existed. According to the FAA, the initial purpose of its postaccident review of on-demand operators was to gain an understanding of existing business practices and operations of Part 135 operators. FAA personnel told Safety Board investigators that the contracts and lease agreements they examined during this review varied significantly in size and complexity but that many were similar to the agreement between Darby Aviation and PJM in their failure to ensure operational control by the certificate holder. FAA personnel further stated that several of the operators that were reviewed were modifying their charter management agreements as a result of that review; however, the FAA could not provide more specific details regarding the number and nature of those modifications.

FAA personnel used the information gathered during their review to develop a series of 10 educational seminars explaining the concepts of operational control to principal inspectors and charter industry representatives, which the FAA conducted between March and June 2006. Also on the basis of its review, the FAA is revising FAA Order 8400.10, "Air Transportation Operations Inspectors Handbook," and the standard language for Operations Specifications section A-008, which addresses operational control. Although the Safety Board has reviewed several draft revisions, and final changes were due on October 31, 2006, no changes have been finalized.

The Safety Board acknowledges that the FAA's educational seminars regarding operational control should assist FAA inspectors and Part 135 certificate holders in ensuring that operational control is maintained. However, this education will only be successful if all inspectors and certificate holders participate, and the FAA has no plans to hold additional seminars. Further, attendance at these one-time seminars was strictly voluntary for FAA principal inspectors and industry personnel, and there is no additional detailed training planned for FAA principal inspectors. Therefore, the seminars did not reach all inspectors, certificate holders, or other entities.

The Safety Board also agrees that the increased specificity contained in the proposed revisions will assist FAA inspectors and Part 135 certificate holders in modifying or removing charter management arrangements that allow, in effect, an unauthorized entity to act as an on-demand charter operator (similar to the arrangement between Darby and PJM). However, the Board is concerned that the FAA does not have a clear assessment of the extent to which impermissible charter arrangements exist. Without such an assessment, FAA is unable to ensure that these arrangements are terminated. Further, the Board is concerned that the proposed revisions to FAA Order 8400.10 and Operations Specifications A-008 have not yet been completed.

The Safety Board concludes that without clear and specific guidance on appropriate agreements between certificate holders and other entities that provide airplanes and/or flight crews for charter flights, unauthorized entities could still be performing most, if not all, of the functions of an on-demand charter operator without the controls, oversight, and demonstration of fitness imposed by a Part 135 certificate. Therefore, the Safety Board believes that the FAA should disseminate to all principal inspectors of Part 135 certificate holders and to all Part 135 certificate holders guidance that includes specific procedures, such as those contained in the draft revisions to Operations Specifications A-008, that detail appropriate methods by which a certificate holder can demonstrate to the FAA that it is maintaining adequate operational control over all on-demand charter flights conducted under the authority of its certificate. This guidance should address operations based at locations geographically distant from the certificate holder's base, should be included in all Part 135 certificate holders' operations specifications, and should be required as periodic inspection items for principal inspectors.

Further, the Safety Board is concerned that, as indicated by the results of the FAA's postaccident review of on-demand operators, arrangements similar to that between Darby and PJM may still be common among other companies. By requiring Part 135 operators to maintain full operational control of all of their flights, the FAA will help to ensure that, when customers contract with a Part 135 carrier, they are flying with a carrier that has exhibited a level of safety that has been approved by the FAA. Therefore, the Safety Board believes that the FAA should review all charter management, lease, and other agreements between 14 CFR Part 135 certificate holders and other entities to identify those agreements that permit and/or enable a loss of operational control by the certificate holder and require revisions of any such arrangements.

2.5 Cabin Aide Actions, Performance, and Training

The Safety Board evaluated the cabin aide's actions, performance, and training during its investigation. PJM documentation and guidance regarding cabin aide and flight crew responsibilities was unclear; however, the cabin aide told investigators that she ensured that the cabin was "secure," implying that seatbelts were used and other items secured, before the takeoff roll. Physical evidence and passenger statements indicated that this was not the case. For example, after the passengers boarded the airplane, the cabin aide offered the passengers a beverage and four accepted. The drinks were served in glasses or ceramic/china cups, several of which were recovered on or near passenger seats after the accident, which is not consistent with a secured cabin. One passenger told investigators that he had to pick up his coffee cup during the takeoff roll to prevent spillage. He believed that the lacerations on his right hand were caused by the coffee cup breaking in his hand during the accident sequence.

Additionally, postaccident interviews indicated that at least four of the eight passengers were unrestrained when the takeoff roll began. Two passengers located and fastened their seatbelts during the takeoff roll; however, the other two (both seated on the side-facing divan seat) were unable to locate their seatbelts and were therefore unrestrained during the RTO. The two unrestrained passengers were thrown to the cabin floor during the accident sequence. Postaccident examinations revealed that the seatbelts at the three divan seats would not have been visible to the passengers because they had been intentionally placed beneath the seatback cushions. Postaccident examination of another PJM CL-600 revealed that its divan seatbelts had also been intentionally placed beneath the seatback cushions. Positioning the seatbelts beneath the seatback cushions resulted in a tidier passenger cabin and was reportedly not uncommon among operators of corporate and charter airplanes. However, with the seatbelts stowed in this position, passengers would have had to either reach blindly between the seatback cushions or remove the cushions to locate the seatbelts.

The Safety Board concludes that the cabin aide did not perform a seatbelt compliance check before the accident flight, which resulted in two passengers being unrestrained during the accident sequence. Further, the Safety Board concludes that the intentional positioning of the seatbelts out of the passengers' sight made them difficult to locate and use and resulted in reduced compliance with passenger seatbelt usage requirements. Therefore, the Safety Board believes that the FAA should require all 14 CFR Part 135 certificate holders to ensure that seatbelts at all seat positions are visible and accessible to passengers before each flight.

According to Federal regulations, no person may serve as a "flight attendant" on a Part 135 flight unless that person is knowledgeable and competent in the areas of crewmember functions and responsibilities during ditching and evacuation, briefing of passengers, the location and operation of all normal and emergency exits, portable fire extinguishers, and other items of emergency equipment. Additionally, regulations require that passengers on airplanes certificated to carry 19 passengers or less must be briefed on, among other things, the use of safety belts[96] and the location and operation of the main cabin door and emergency exits. Further, regulations prohibit taxiing, taking off, or landing when any beverage provided by the operator is located at any passenger seat.[97]

The cabin aide was not required to receive any safety-related training because she was not a required crewmember (flight attendant) for the accident flight. Nonetheless, PJM did provide its cabin aides with some training. The accident cabin aide stated that she had received verbal instruction regarding emergency main cabin door operation and had operated the main cabin door handle and electric toggle switch in a simulated emergency scenario during her training. Her description of her efforts to operate the door after the accident was consistent with the training she reported that she had received; however, it revealed that her training had not provided her with an adequate understanding of the door mechanism/operation. The cabin aide told investigators that she was not familiar with the arm/disarm handle and that she tried to use the electric switch at the top of the bulkhead to operate the door; however, this switch is not needed (nor should it be used) during emergency operations.

The Safety Board is concerned that Part 135 operators and/or certificate holders may delegate important safety functions to cabin aides/customer service representatives who are not properly trained and qualified to perform those functions. For example, although PJM policy required one of the pilots to provide passengers with a safety briefing before each flight, the captain believed that the cabin aide was responsible for the preflight safety briefing.[98] Further, the Board is concerned that passengers might mistakenly believe that a cabin aide/customer service representative on board an on-demand charter flight had received safety training equivalent to that received by qualified flight attendants when in fact that aide/representative might have received minimal or no safety training. Providing those individuals with basic safety training could provide valuable safety results in an emergency, especially in the event of flight crew injury.

[96] Title 14 CFR 135.128 states, "each person on board an aircraft operated under this part shall occupy an approved seat or berth with a separate safety belt properly secured about him or her during movement on surface, takeoff, and landing."

[97] For additional information, see 14 CFR 135.295, 135.117, 135.122, and 135.128.

[98] The captain had not yet received PJM policy training.

On the basis of the cabin aide's performance during this accident sequence, including the lack of a seatbelt compliance check, her failure to collect beverage service items before takeoff, and her inability to open the main cabin door and conduct a professional evacuation, the Safety Board concludes that the cabin aide's training did not adequately prepare her to perform the duties with which she was tasked, including opening the main cabin door during emergencies. Therefore, the Safety Board believes that the FAA should require that any cabin personnel on board 14 CFR Part 135 flights who could be perceived by passengers as equivalent to a qualified flight attendant receive basic FAA-approved safety training in at least the following areas: preflight briefing and safety checks; emergency exit operation; and emergency equipment usage. This training should be documented and recorded by the Part 135 certificate holder.

2.6 Runway Safety Areas

The TEB RSAs at all four runway ends did not meet existing FAA standards specifying that RSAs must extend 1,000 feet beyond the departure end of the runway and be 500 feet wide. These nonstandard RSAs had been identified long before this accident, and TEB and New Jersey DOT personnel were actively involved with the FAA in addressing the issue. A related report, contracted by the Port Authority of New York and New Jersey and drafted in 2004, presented alternatives for addressing the nonstandard RSAs, and the FAA concluded that installing a nonstandard (265 feet long by 162 feet wide) EMAS bed at the departure end of runway 6 would be the most practicable solution. In May 2005, the New York and New Jersey Port Authority (which owns TEB) committed to installing an EMAS at the departure end of runway 6. The airport has received grants from the FAA to facilitate the engineering and design of the RSA improvements. The goal for this project's completion is the end of 2006.

The issue of RSA improvements was discussed at the Safety Board's public hearing on the December 8, 2005, accident at MDW involving Southwest Airlines flight 1248. In response to questioning during this hearing, FAA personnel indicated that it is possible that some RSAs will not meet the dimensional standards or have arrester beds installed even after the FAA considers its improvement projects successfully completed.

Studies conducted during the TEB investigation revealed that, if a 265-foot-long EMAS bed had been installed at the departure end of runway 6, the accident airplane would only have been slowed about an additional 8 knots (from 105 to 97 knots) when it departed the RSA. Because of the speed at which the airplane was traveling when it left the runway and the limited EMAS bed size, the airplane would not have stopped on airport property. The Safety Board concludes that the installation of an EMAS at the departure end of runway 6 at TEB (and other similarly affected runways) would provide an additional safety margin; however, although an EMAS would have reduced the energy of the accident airplane as it departed the runway, it would not have prevented the accident because the circumstances of the runway departure exceeded the design capabilities of the EMAS.

3. Conclusions

3.1 Findings

1. The captain held the certificates required to act as pilot-in-command of CL-600 flights under 14 *Code of Federal Regulations* (CFR) Part 91, but he had not yet received the training needed to operate 14 CFR Part 135 flights for Darby Aviation.

2. Information obtained from previous employers and postaccident interviews and the National Transportation Safety Board's review of Federal Aviation Adminstration records, the captain's resumes, and other documentation called into question the validity of the captain's reported experience (his flight times and previous training) as a pilot.

3. The first officer had received only 22 of the 31 hours of ground training required by Darby Aviation's operations specifications to perform second-in-command duties on a CL-600 being operated under 14 *Code of Federal Regulations* Part 135. Additionally, his Federal Aviation Administration medical certificate had expired for the purposes of commercial operations. Therefore, he was not properly trained or certificated for the accident flight.

4. There was no evidence that fatigue affected the pilots' performance on the morning of the accident.

5. The accident airplane was properly certificated and was maintained in accordance with industry practices. There was no evidence of any preexisting powerplant, system (including brakes, ground spoilers, and engine thrust reversers), or structural failures.

6. Weather was not a factor in the accident. The aircraft rescue and firefighting (ARFF) response from Teterboro Airport, Teterboro, New Jersey, and surrounding communities was prompt, and exterior postaccident fires were extinguished efficiently. The air traffic controllers' prompt and efficient reaction to this accident was exemplary and facilitated the prompt ARFF response.

7. Doorframe and/or fuselage distortion caused by impact with the building accounted for the passengers' difficulty opening the main cabin door.

8. Platinum Jet Management pilots routinely improperly modified the airplane's weight and balance forms, using a variety of invalid airplane empty weights to ensure that the form indicated that the airplane was operating within its limitations.

9. The airplane, as loaded for the accident flight, had a forward center of gravity that was significantly forward of the airplane's forward limit, which severely degraded the airplane's ability to rotate.

10. Neither pilot used the available weight and balance information appropriately to determine the airplane's weight and balance characteristics for the accident flight and the pitch trim setting selected by the pilots is further evidence that they did not consider the airplane's center of gravity during preflight preparations.

11. The captain's decision to initiate the rejected takeoff (RTO) was reasonable, even though the airplane had already reached a higher-than-normal RTO speed.

12. Considering the advantages the simulator pilots had and their lack of success during the simulator runs, most line pilots attempting to abort a takeoff 5 seconds after and at a speed well above the expected rotation speed, like the accident captain, would not have been able to stop the accident airplane in time to avoid departing the end of the runway.

13. The pilots' failure to ensure that the airplane's weight and center of gravity were within approved takeoff limits was symptomatic of poor airmanship and a broader pattern of deficiencies in their crew resource management skills (specifically in the areas of leadership, workload management, communications/briefings, and crew coordination) that were exhibited on the day of the accident.

14. Darby Aviation failed to maintain operational control over on-demand charter flights conducted by Platinum Jet Management under Darby's 14 *Code of Federal Regulations* Part 135 certificate, as required by Federal regulations.

15. Because neither Darby Aviation nor Platinum Jet Management (PJM) was rigorous about enforcing the Federal requirement for operational control, PJM pilots operated in an environment in which pilot errors and/or omissions during preflight preparation were less likely to be detected before departure.

16. The Federal Aviation Administration's inadequate oversight of the 14 *Code of Federal Regulations* Part 135 charter management agreement between Platinum Jet Management (PJM) and Darby Aviation permitted management failures and a lack of operational control to exist. In effect, this allowed PJM to operate virtually independently as an on-demand air carrier while maintaining little of the structure of a certificated carrier and without demonstrating fitness to conduct such operations.

17. Darby Aviation's Birmingham, Alabama, Flight Standards District Office (FSDO)-based principal inspectors should have requested assistance from a FSDO more conveniently located to Platinum Jet Management's (PJM) Fort Lauderdale-based operations to ensure proper oversight of the operations conducted by PJM under the auspices of Darby's certificate.

18. The Federal Aviation Administration (FAA) failed to perform adequate charter operator surveillance and therefore did not recognize that Platinum Jet Management (PJM) operated as a de facto 14 *Code of Federal Regulations* Part 135 carrier, despite the lack of necessary personnel; policies; procedures; and FAA approvals, certification, and oversight that would normally be associated with such operations.

19. Without clear and specific guidance on agreements between certificate holders and other entities that provide airplanes and/or flight crews for charter flights, unauthorized entities could still be performing most, if not all, of the functions of an on-demand charter operator without the controls, oversight, and demonstration of fitness imposed by a 14 *Code of Federal Regulations* Part 135 certificate.

20. The cabin aide did not perform a seatbelt compliance check before the accident flight, which resulted in two passengers being unrestrained during the accident sequence.

21. The intentional positioning of the seatbelts out of the passengers' sight made them difficult to locate and use and resulted in reduced compliance with passenger seatbelt usage requirements.

22. The cabin aide's training did not adequately prepare her to perform the duties with which she was tasked, including opening the main cabin door during emergencies.

23. The installation of an engineered materials arresting system (EMAS) at the departure end of runway 6 at Teterboro Airport (and other similarly affected runways) would provide an additional safety margin; however, although an EMAS would have reduced the energy of the accident airplane as it departed the runway, it would not have prevented the accident because the circumstances of the runway departure exceeded the design capabilities of the EMAS.

3.2 Probable Cause

The National Transportation Safety Board determines that the probable cause of the accident was the pilots' failure to ensure the airplane was loaded within weight-and-balance limits and their attempt to take off with the center of gravity well forward of the forward takeoff limit, which prevented the airplane from rotating at the intended rotation speed.

Contributing to the accident were: 1) Platinum Jet Management's (PJM) conduct of charter flights (using PJM pilots and airplanes) without proper Federal Aviation Administration (FAA) certification and its failure to ensure that all for-hire flights were conducted in accordance with 14 *Code of Federal Regulations* (CFR) Part 135 requirements; 2) Darby Aviation's failure to maintain operational control over 14 CFR Part 135 flights being conducted under its certificate by PJM, which resulted in an environment conducive to the development of systemic patterns of flight crew performance deficiencies like those observed in this accident; 3) the failure of the Birmingham, Alabama, FAA Flight Standards District Office to provide adequate surveillance and oversight of operations conducted under Darby's Part 135 certificate; and 4) the FAA's tacit approval of arrangements such as that between Darby and PJM.

4. Recommendations

As a result of the investigation of this accident, the National Transportation Safety Board makes the following recommendations to the Federal Aviation Administration:

> Disseminate to all principal inspectors of 14 *Code of Federal Regulations* Part 135 certificate holders and to all Part 135 certificate holders guidance that includes specific procedures, such as those contained in the draft revisions to Operations Specifications A-008, that detail appropriate methods by which a certificate holder can demonstrate to the Federal Aviation Administration that it is maintaining adequate operational control over all on-demand charter flights conducted under the authority of its certificate. This guidance should address operations based at locations geographically distant from the certificate holder's base, should be included in all Part 135 certificate holders' operations specifications, and should be required as periodic inspection items for principal inspectors. (A-06-66)
>
> Review all charter management, lease, and other agreements between 14 *Code of Federal Regulations* Part 135 certificate holders and other entities to identify those agreements that permit and/or enable a loss of operational control by the certificate holder and require revisions of any such arrangements. (A-06-67)
>
> Require all 14 *Code of Federal Regulations* Part 135 certificate holders to ensure that seatbelts at all seat positions are visible and accessible to passengers before each flight. (A-06-68)
>
> Require that any cabin personnel on board 14 *Code of Federal Regulations* Part 135 flights who could be perceived by passengers as equivalent to a qualified flight attendant receive basic Federal Aviation Administraton-approved safety training in at least the following areas: preflight briefing and safety checks; emergency exit operation; and emergency equipment usage. This training should be documented and recorded by the Part 135 certificate holder. (A-06-69)

BY THE NATIONAL TRANSPORTATION SAFETY BOARD

MARK V. ROSENKER
Chairman

ROBERT L. SUMWALT
Vice Chairman

DEBORAH A. P. HERSMAN
Member

KATHRYN O. HIGGINS
Member

Adopted: October 31, 2006

Board Member Statements

Member Kathryn O. Higgins' Statement

I joined my colleagues in adopting the report for the Platinum Jet accident that occurred at the Teterboro airport on February 2, 2005. While I fully support the findings, probable cause and recommendations embodied in that report, I am concerned that one aspect of this accident was not fully investigated by the Board. My concern goes to the role played by Blue Star Jets in contracting with Platinum for the accident flight.

Blue Star is a large broker of charter flights. In their advertising they claim to be the largest broker in the world with an ability to arrange a flight on one of 4,000 planes to one of 5,000 airports in four hours. On their web site they offer "full service, safety, security, luxury, convenience at the best prices possible, with as little as four hours notice, access anywhere in the world…."

Blue Star is just one of hundreds, perhaps thousands, of companies serving as brokers for corporate and personal jet travel. These companies are the "face" of on-demand air travel to the sector of the flying public that choose to fly by private jet. And yet, very little is known about these companies. They are essentially unregulated. As long as they don't hold themselves out to be "airlines" they can sell flights on planes operated by companies that are regulated by the FAA under part 135.

But how much do these brokers really know about the operators they do business with? How much do they know about the planes these operators fly? How old are they, when were they last inspected? How well trained are the crews, what experience does a particular crew have with the route the customer wants to fly? Have they flown into that airport before? Does this operator have a dispatch function or just flight following? What safety equipment is on the plane? Who will make the decision about de-icing? Does the operator have a safety management program? Are the crews trained in crew resource management? What does the FAA know about this operator?

We saw the consequences of inexperience in the Montrose accident where the flight crew were not only unfamiliar with aircraft operations in significant winter weather conditions, but also were unfamiliar with the Montrose airport from which they departed. Significant total flight hours and significant time in the accident aircraft type did not overcome the inexperience with winter weather at an unfamiliar airport.

A conscientious broker might ask the questions I have asked and might make that information available to its customers. But none of these questions are required. Customers don't usually have direct contact with the operators. In many cases they are relying on the broker to act as their agent. They may not even know which operator they are flying.

But we have seen in both the Montrose and Teterboro accidents that the details matter. In the Montrose accident, the flight was sold by Key Air to Air Castle Corporation (doing business as Global Aviation as Glo-Air flight 73), apparently without the knowledge of the customer. In the report on the Montrose accident, the Board made a recommendation to the Department of Transportation/Office of the Secretary to require more disclosure to the public about the owners of charter aircraft and the operators of charter flights, including the name of any brokers involved in arranging a flight. The Department has replied that it will put those recommendations out for comment.

In the Teterboro accident Blue Star contracted with Platinum, a carrier that did not hold a Part 135 certificate and that operated with a host of irregularities documented in the Board's report. Blue Star is selling safety but they didn't look behind the claims made by Platinum, nor were they required to.

I believe it's time to take a closer look at brokers in the aviation business, including those who provide air ambulance service. Concerns with broker practices in the emergency medical services industry have also been brought to my attention. The advent of very light jets that will be used in many cases for on-demand charters is just one more reason to study the role of brokers in contracting for flights.

I am pleased that the Board agreed to my request to study this issue. The staff has been asked to come back to the Board with a proposal on how to conduct such a study. I look forward to working with the staff, my colleagues and others in the aviation community interested in this important issue.

Vice Chairman Sumwalt and Member Hersman joined Member Higgins in this concurring statement.

Kathryn O'Leary Higgins

November 7, 2006

this page intentionally left blank

5. Appendixes

Appendix A
Investigation and Public Hearing

Investigation

The National Transportation Safety Board learned of this accident on the morning of February 2, 2005. A full go-team traveled to the accident scene. The go-team was accompanied by representatives from the Safety Board's Office of Transportation Disaster Assistance and Public Affairs. Board Member Deborah A.P. Hersman traveled to the accident site.

The following investigative groups were formed during the course of this investigation: Structures, Systems, Powerplants, Air Traffic Control, Meteorology, Operations, Human Performance, Airport/Survival Factors, Airplane Performance, Flight Data Recorder, Cockpit Voice Recorder, Maintenance Records, and Video.

In accordance with Annex 13 to the Convention on International Civil Aviation, an accredited representative from the Transportation Safety Board of Canada and advisors from Transport Canada and Bombardier Aerospace participated in this investigation.

Parties to the investigation were the Federal Aviation Administration, Platinum Jet Management (PJM), and Honeywell. Darby Aviation also participated in the investigation. Observer parties to the investigation were the Port Authority of New York and New Jersey and the Transportation Security Administration. The Safety Board received a submission on this accident from PJM.

Public Hearing

No public hearing was held for this accident.

Appendix B
Cockpit Voice Recorder Transcript

The following is a transcript of the L-3 Communications/Fairchild model A-100 cockpit voice recorder (CVR) installed on the accident airplane. Only radio transmissions to and from the accident airplane were transcribed. The CVR transcript reflects the 29 minutes 31 seconds before power was lost to the CVR. All times are eastern standard time based on a 24-hour clock.

LEGEND	
CAM	Cockpit area microphone voice or sound source
RDO	Radio transmissions from N370V
GND	Radio transmission from the Teterboro airport ground controller
TWR	Radio transmission from the Teterboro airport tower controller
-1	Voice identified as the pilot
-2	Voice identified as the co-pilot
-3	Voice identified as the cabin aide
-?	Voice unidentified
*	Unintelligible word
#	Expletive
@	Non-pertinent word
( )	Questionable insertion
[ ]	Editorial insertion

Note 1: Times are expressed in eastern standard time (EST).

Note 2: Generally, only radio transmissions to and from the accident aircraft were transcribed.

Note 3: Words shown with excess vowels, letters, or drawn out syllables are a phonetic representation of the words as spoken.

Note 4: A non-pertinent word, where noted, refers to a word not directly related to the operation, control or condition of the aircraft.

INTRA-COCKPIT COMMUNICATION		AIRCRAFT-TO-GROUND COMMUNICATION	
Time (EST) SOURCE	CONTENT	Time (EST) SOURCE	CONTENT
0648:45 **START OF RECORDING**	[prior to transcript start: non-pertinent conversation between co-pilot and cabin aide]		
0704:38 **START OF TRANSCRIPT**			
0704:38 **CAM-3**	hello how are ya?		
0704:39 **CAM-?**	good ***.		
0704:41 **CAM-3**	hello.		
0704:42 **CAM-?**	hi how are you doing?		
0704:42 **CAM-3**	good very good how are you?		
0704:43 **CAM-2**	morning.		
0704:45 **CAM-3**	hi how are you ** good morning... good morning.		

INTRA-COCKPIT COMMUNICATION		AIRCRAFT-TO-GROUND COMMUNICATION	
Time (EST) SOURCE	CONTENT	Time (EST) SOURCE	CONTENT
0704:52 **CAM**	[sound of laughing and unintelligible background conversation]		
0704:54 **CAM-3**	good morning.		
0704:55 **CAM-?**	how are you?		
0704:56 **CAM-3**	very good fine yourself **.		
0705:01 **CAM**	[sound of laughing and unintelligible background conversation]		
0705:04 **CAM-3**	**.		
0705:14 **CAM**	[sound of unintelligible background conversation]		
0705:17 **CAM**	[sound of clunks]		
0705:20 **CAM**	[sound of unintelligible background conversation]		

INTRA-COCKPIT COMMUNICATION		AIRCRAFT-TO-GROUND COMMUNICATION	
Time (EST) SOURCE	CONTENT	Time (EST) SOURCE	CONTENT
0705:27 **CAM-1**	*** it helps a little bit ***.		
0705:31 **CAM**	[sound of unintelligible background conversation]		
0705:36 **CAM**	[sound of clunks]		
0705:36 **CAM-1**	*** we know better we know better but I want you all to have a good trip my name's @ that's @. my first officer's @ and we're here to serve you all ***.		
0705:50 **CAM-?**	thanks.		
0705:51 **CAM**	[sound of clunks]		
0705:55 **CAM**	[sound similar to door retraction motor]		
0706:06 **CAM**	[sound of unintelligible background conversation]		
0706:09 **CAM**	[sound of clunks]		

INTRA-COCKPIT COMMUNICATION		AIRCRAFT-TO-GROUND COMMUNICATION	
Time (EST) **SOURCE**	**CONTENT**	Time (EST) **SOURCE**	**CONTENT**
0706:12 **CAM**	[sound of three clunks]		
0706:18 **CAM**	[sound of clunks similar to seat belt clasp operation]		
0706:23 **CAM-1**	green light.		
0706:27 **CAM**	[sound of squeak]		
0706:32 **CAM**	[sound of clunks similar to seat belt clasp operation]		
0706:54 **CAM-1**	okay buddy.		
		0707:00 **RDO**	– five three. I-L-S runway six approach in use. arriving and departing runway six. notices to airmen. runway one one niner closed. partial closure of taxiway Lima between Delta two four. all pilots follow noise abatement procedures. readback hold short instructions. advise on initial contact you have information Hotel. Teterboro airport information Hotel. one one five one Zulu. wind calm. visibility one zero. sky clear below one two thousand. temperature minus six. dew point minus eight. altimeter three zero five three –. [recorded on CAM and crew channels for fifty two seconds]

INTRA-COCKPIT COMMUNICATION Time (EST) SOURCE	CONTENT	AIRCRAFT-TO-GROUND COMMUNICATION Time (EST) SOURCE	CONTENT
0707:10 **CAM**	[sound of unintelligible background conversation]		
0707:11 **CAM-1**	***.		
0707:12 **CAM-2**	okay ***.		
0707:14 **CAM-1**	hey @. @ with ah November three seven zero Victor Platinum Jet. got all my people. headed out of Teterboro. everybody's fine and ah we'll talk to you in Chicago.		
0707:28 **CAM-1**	hey they also said they might have one more coming back just to let you know.		
0707:40 **CAM-1**	ah have eight on here now. in fact I can hope ** I believe this this this one will do it ** I'll I'll talk to you in Chicago sir... thank you sir.		
0707:55 **CAM-1**	okay let's get it started then we can call what's his name.		
0708:01 **CAM-2**	okay hydraulic three B pumps.		

INTRA-COCKPIT COMMUNICATION		AIRCRAFT-TO-GROUND COMMUNICATION	
Time (EST) SOURCE	CONTENT	Time (EST) SOURCE	CONTENT
0708:04 **CAM-1**	on.		
0708:05 **CAM**	[sound of electronic click]		
0708:06 **CAM-2**	parking brake and pressure.		
0708:06 **CAM-1**	call call what it is.		
0708:07 **CAM**	[sound of three electronic clicks]		
0708:08 **CAM-1**	on.		
0708:09 **CAM-2**	okay doors check.		
0708:10 **CAM-1**	green light.		
0708:11 **CAM-2**	thrust levers shut off.		

Time (EST) SOURCE	CONTENT	Time (EST) SOURCE	CONTENT
0708:12 **CAM-1**	shut off.		
0708:14 **CAM-2**	scav * ejector scav light on.		
0708:15 **CAM-1**	they're on.		
0708:16 **CAM-2**	fuel pumps on.		
0708:18 **CAM-2**	A-C-U's off.		
0708:20 **CAM-1**	A-C-U-'s.		
0708:21 **CAM**	[sound of two clicks]		
0708:21 **CAM-1**	yeah we will soon as we get started 'kay?		
0708:24 **CAM-2**	and bleed air pressure.		

Time (EST) SOURCE	CONTENT	Time (EST) SOURCE	CONTENT
0708:27 **CAM-1**	got bleed air pressure.		
0708:28 **CAM-2**	and ignition A or B? armed.		
0708:30 **CAM-1**	* use B.		
0708:37	[sound of unidentified tones, recorded on all channels, similar to CVR self test tones]		
0708:45 **CAM-1**	umm I left my phone out here I shouldn't have done it. plus I was trying to talk to you and that's ok * what you've done * (reach center)/(re-center) *** umm *.		
0708:56 **CAM-2**	** call ** said to call @ when you need it ready.		
0709:03 **CAM**	[sound of unintelligible background conversation]		
0709:03 **CAM-1**	we're having trouble with ignitions on the right side.		

INTRA-COCKPIT COMMUNICATION		AIRCRAFT-TO-GROUND COMMUNICATION	
Time (EST) SOURCE	CONTENT	Time (EST) SOURCE	CONTENT
0709:07 **CAM**	[sound of laughing and unintelligible background conversation]		
0709:09 **CAM-1**	that's the B ignition.		
0709:11 **CAM-?**	what? ...***. [sound of laughing in background – not pilot or co-pilot]		
0709:14 **CAM**	[sound of clicks]		
0709:20 **CAM-?**	*** highway. [unintelligible background conversation]		
0709:22 **CAM**	[sound of clicks]		
0709:34 **CAM-1**	'kay we're started.		
0709:36 **CAM-2**	okay after start generator one and two.		
0709:39 **CAM-2**	test and on.		

INTRA-COCKPIT COMMUNICATION Time (EST) SOURCE	CONTENT	AIRCRAFT-TO-GROUND COMMUNICATION Time (EST) SOURCE	CONTENT
0709:41 **CAM-3**	***.		
0709:44 **CAM**	[sound of two unidentified beeps]		
0709:45 **CAM-1**	* that's not right.		
0709:48 **CAM**	[sound of electronic click]		
0709:50 **CAM-1**	always make sure that you're (static)/(steady).		
0709:52 **CAM**	[sound of click]		
0709:54 **CAM-1**	and then take them right up don't stop in the middle. take them right up.		
0709:58 **CAM-1**	A-P-U generator's coming off.		
0710:01 **CAM-2**	engine hydraulic pumps check.		

INTRA-COCKPIT COMMUNICATION Time (EST) SOURCE	CONTENT	AIRCRAFT-TO-GROUND COMMUNICATION Time (EST) SOURCE	CONTENT
0710:03 **CAM**	[sound of clunk]		
0710:03 **CAM-1**	they're checked. they're on.		
0710:04 **CAM-2**	ignition disarmed.		
0710:05 **CAM-1**	ignition's disarmed.		
0710:07 **CAM**	[sound of clunks]		
0710:07 **CAM-2**	isolation.		
0710:08 **CAM**	[sound of clunks]		
0710:10 **CAM-2**	as requires.		
0710:12 **CAM-1**	it's as required.		

Time (EST) SOURCE	CONTENT	Time (EST) SOURCE	CONTENT
0710:13 **CAM-2**	okay emergency pressurization check.		
0710:15 **CAM**	[sound of clunks]		
0710:19 **CAM-1**	okay.		
0710:21 **CAM-2**	A-C-U's on.		
0710:22 **CAM-1**	A-C-U's are on.		
0710:25 **CAM-2**	annn N one fan speed trim.		
0710:27 **CAM-1**	set for take off.		
0710:28 **CAM-2**	rudder.		
0710:29 **CAM-1**	it's good.		

INTRA-COCKPIT COMMUNICATION Time (EST) SOURCE	CONTENT	AIRCRAFT-TO-GROUND COMMUNICATION Time (EST) SOURCE	CONTENT
0710:30 **CAM-2**	checked.		
0710:31 **CAM**	[sound of clunks]		
0710:31 **CAM-2**	nose wheel steering arm.		
0710:32 **CAM**	[sound of clunks]		
0710:34 **CAM-1**	it's armed.		
0710:35 **CAM-2**	reverse thrust arm yaw damp mach trim.		
0710:37 **CAM-1**	yaw damp mach trim.		
0710:42 **CAM-1**	and come on now.		
0710:45 **CAM**	[sound of clunk]		

INTRA-COCKPIT COMMUNICATION Time (EST) SOURCE	CONTENT	AIRCRAFT-TO-GROUND COMMUNICATION Time (EST) SOURCE	CONTENT
0710:47 **CAM-1**	good.		
0710:49 **CAM-2**	after start check list complete.		
0710:51 **CAM-1**	okay let's taxi this baby.		
0710:56 **CAM-1**	y'all ready to call @?		
0710:59 **CAM-2**	he called here and we told him that we are on Atlantic.		
		0711:09 **RDO-2**	and Teterboro ground good morning Challenger November three seven zero Victor at Atlantic and we got information Hotel. ready to taxi.
0711:19 **CAM-1**	***.		
0711:26 **CAM-1**	I'll stop right here.		
0711:29 **CAM**	[sound of clunks]		

INTRA-COCKPIT COMMUNICATION		AIRCRAFT-TO-GROUND COMMUNICATION	
Time (EST) SOURCE	CONTENT	Time (EST) SOURCE	CONTENT
0711:33 **CAM**	[sound of unintelligible background conversation]		
		0711:43 **GND**	Challenger three seven zero Victor Teterboro say request.
		0711:47 **RDO-2**	ah yes sir good morning we are at Atlantic. information Hotel. ready to taxi.
		0711:53 **GND**	'kay Challenger three seven zero Victor ah runway six behind the ah T-B-M pulling into the Atlantic ah you can taxi and hold short of runway six at Golf.
		0712:07 **RDO-2**	roger taxi behind T-B-M. hold short of runway six at Golf.
0712:13 **CAM-2**	* (just park) *.		
0712:15 **CAM-1**	** back there.		
0712:16 **CAM-2**	yeah.		
0712:17 **CAM-1**	see him?		

INTRA-COCKPIT COMMUNICATION Time (EST) SOURCE	CONTENT		AIRCRAFT-TO-GROUND COMMUNICATION Time (EST) SOURCE	CONTENT
0712:18 **CAM-2**	yes.			
0712:23 **CAM**	[sound of laughing and unintelligible background conversation]			
0712:29 **CAM-1**	runway six at Golf.			
0712:34 **CAM-?**	I don't believe it. [in background and sound of laughing]			
0712:35 **CAM-1**	okay see where we are?			
0712:47 **CAM**	[sound of laughing and unintelligible background conversation]			
0712:59 **CAM-2**	** gonna be the next one **.			
0713:00 **CAM**	[sound of laughing and unintelligible background conversation]			

Time (EST) SOURCE	CONTENT	Time (EST) SOURCE	CONTENT
0713:01 **CAM-1**	thank you.		
0713:03 **CAM-1**	what's our departure procedure? pardon me.		
0713:08 **CAM-2**	Teterboro five.		
0713:10 **CAM-1**	yeah.		
0713:10 **CAM-2**	it says.		
0713:11 **CAM-1**	runway six looks like.		
0713:13 **CAM-2**	yeah runway six climb on heading zero four zero.		
0713:16 **CAM-1**	zero four zero.		
0713:18 **CAM-2**	until leaving. that's our heading. okay okay. ***.		

INTRA-COCKPIT COMMUNICATION		AIRCRAFT-TO-GROUND COMMUNICATION	
Time (EST) SOURCE	CONTENT	Time (EST) SOURCE	CONTENT
0713:21 **CAM-1**	we gotta watch this thing.		
0713:23 **CAM-2**	yeah until leaving fifteen hundred 'kay turn left...		
0713:26 **CAM-1**	'kay.		
0713:27 **CAM-2**	...direct to Papa November Juliett which is here three four seven ...		
0713:32 **CAM-1**	'kay. okay.		
0713:33 **CAM-2**	…and maintain two thousand until crossing Papa November Juliett.		
0713:37 **CAM-1**	okay.		
0713:39 **CAM-2**	then climb to three thousand.		

INTRA-COCKPIT COMMUNICATION		AIRCRAFT-TO-GROUND COMMUNICATION	
Time (EST) SOURCE	CONTENT	Time (EST) SOURCE	CONTENT
0713:41 **CAM-1**	okay. now we have noise abatement here. so what I'm gonna do when I get up there. I'm gonna pull the power back and go ahead and do the change.		
0713:50 **CAM-3**	you want me to get you something before taking off?		
0713:51 **CAM-1**	yes ma'am I **.		
0713:53 **CAM-1**	and listen when I tell you we're ready to take off I don't care who asks for what. you sit down and tell them wait a minute. okay?		
0714:03 **CAM-1**	now we're gonna have to do some maneuvering going out of here.		
0714:10 **CAM-1**	there's the sunrise.		
0714:13 **CAM-2**	you want me to put you here Papa November Juliett?		
0714:16 **CAM-1**	yeah.		

Time (EST) SOURCE	CONTENT	Time (EST) SOURCE	CONTENT
0714:17 **CAM-2**	before ELIOT?		
0714:17 **CAM-1**	yeah man.		
0714:26 **CAM-2**	there you go.		
0714:29 **CAM-2**	flight director *.		
0714:31 **CAM**	[sound of clunk]		
0714:32 **CAM-?**	there you go.		
0714:33 **CAM-1**	thank you.		
0714:34 **CAM**	[sound of clunk]		
0714:37 **CAM**	[sound of two clunks]		

INTRA-COCKPIT COMMUNICATION | **AIRCRAFT-TO-GROUND COMMUNICATION**

Time (EST) SOURCE	CONTENT	Time (EST) SOURCE	CONTENT
0714:42 **CAM-1**	there's the sunrise there's the Empire State building.		
0714:45 **CAM-?**	**.		
		0714:47 **GND**	Challenger three seven zero Victor cross runway six. taxi to runway six. the Gulfstream will be holding opposite direction for you at November.
		0714:58 **RDO-2**	roger and * taxi to runway six. seven zero Victor.
0715:02 **CAM-1**	looks like we're going runway one no? we're going **.		
0715:05 **CAM-2**	taxi to runway six .		
0715:11 **CAM-2**	**.		
0715:13 **CAM-1**	'kay we're still turning zero four zero correct?		
0715:17 **CAM-2**	yes zero four zero.		

INTRA-COCKPIT COMMUNICATION		AIRCRAFT-TO-GROUND COMMUNICATION	
Time (EST) SOURCE	CONTENT	Time (EST) SOURCE	CONTENT
0715:18 **CAM-1**	zero four zero up to...		
0715:19 **CAM**	[sound of clinking]		
0715:20 **CAM-1**	... one thousand five hundred then left turn direct to.		
0715:24 **CAM-2**	* right (to) November.		
0715:25 **CAM**	[sound of clunks]		
0715:43 **CAM-1**	okay let's do the before take off. go to tower and tell them we're ready.		
0715:47 **CAM-2**	okay taxi checklist.		
0715:48 **CAM**	[sound of beep]		
0715:53 **CAM-2**	anti skid brakes are checked reverse thrust check.		

INTRA-COCKPIT COMMUNICATION		AIRCRAFT-TO-GROUND COMMUNICATION	
Time (EST) SOURCE	CONTENT	Time (EST) SOURCE	CONTENT
0715:56 **CAM-2**	hydraulic B pumps they're on.		
0715:58 **CAM-1**	they're on.		
0716:00 **CAM-2**	check flaps twenty.		
0716:02 **CAM-1**	flaps are transit.		
0716:03 **CAM-2**	flaps transit.		
0716:05 **CAM-2**	trims.		
0716:06 **CAM-1**	trims are set one two and three.		
0716:09 **CAM-2**	flight controls.		
0716:12 **CAM-1**	you're gonna have to get the tops. I already got the bottoms.		

INTRA-COCKPIT COMMUNICATION Time (EST) SOURCE	CONTENT	AIRCRAFT-TO-GROUND COMMUNICATION Time (EST) SOURCE	CONTENT
0716:14 **CAM**	[sound of clunks]		
0716:15 **CAM-2**	okay.		
0716:21 **CAM-?**	'kay flight control checks.		
		0716:21 **TWR**	Challenger three seven zero Victor Teterboro tower runway six position and hold still waiting I-F-R release.
		0716:25 **RDO-2**	runway six position and hold seven zero Victor.
0716:26 **CAM-1**	okay set to go.		
0716:31 **CAM-2**	spoilers checked.		
0716:32 **CAM**	[sound of tone]		
0716:33 **CAM**	[sound of double chime, similar to seat belt sign]		

INTRA-COCKPIT COMMUNICATION Time (EST) SOURCE	CONTENT	AIRCRAFT-TO-GROUND COMMUNICATION Time (EST) SOURCE	CONTENT
0716:34 **CAM**	[sound of clicks]		
0716:35 **CAM**	[sound of clunk]		
0716:35 **CAM-1**	checked.		
0716:36 **CAM-2**	taxi check * completed. before take off. anti collision landing lights.		
0716:39 **CAM-1**	yeah.		
0716:40 **CAM**	[sound of two clicks]		
0716:40 **CAM-1**	* on.		
0716:41 **CAM-2**	ignition set.		
0716:43 **CAM-2**	windshield A-D-S heater.		

INTRA-COCKPIT COMMUNICATION		AIRCRAFT-TO-GROUND COMMUNICATION	
Time (EST) SOURCE	CONTENT	Time (EST) SOURCE	CONTENT
0716:46 **CAM-1**	they are briefed the standard for us.		
0716:48 **CAM-2**	okay.		
0716:49 **CAM-1**	if there's any anything below eighty knots I need to give her a brief.		
0716:52 **CAM-2**	okay.		
0716:54 **CAM-2**	before take off checklist completed.		
0716:56 **CAM**	[sound of click]		
0716:58 **CAM-1**	uh in case in case we abort * in case I order an evacuation you'll look to the proper side so there's no fire or anything like that ...		
		0717:08 **TWR**	Challenger seven zero Victor...
0717:09 **CAM-1**	... no obstructions.		

INTRA-COCKPIT COMMUNICATION		AIRCRAFT-TO-GROUND COMMUNICATION	
Time (EST) SOURCE	CONTENT	Time (EST) SOURCE	CONTENT
		0717:09 TWR	...keep it on the roll. runway six cleared for take off. traffic is a Learjet four mile final.
0717:14 CAM-2	roger runway six cleared for takeoff seven zero Victor.		
0717:17 CAM-1	hurry up we're on the roll.		
		0717:19 TWR	Challenger seven zero Victor just confirm runway six cleared for takeoff .
		0717:22 RDO-2	runway six cleared for takeoff seven zero Victor.
0717:30 CAM	[sound of unintelligible background conversation]		
0717:29 CAM-3	***.		
0717:31 CAM-1	don't call now.		
0717:32 CAM-3	I'm not.		

INTRA-COCKPIT COMMUNICATION Time (EST) SOURCE	CONTENT	AIRCRAFT-TO-GROUND COMMUNICATION Time (EST) SOURCE	CONTENT
0717:32 **CAM-1**	let's go.		
0717:33 **CAM**	[sound similar to increasing engine RPM]		
0717:34 **CAM-3**	didn't go through.		
0717:37 [tape reverses direction]			
0717:37.4 **CAM**	[sound of increased frequency background noise]		
0717:42.5 **CAM-2**	airspeed alive.		
0717:45.1 **CAM-1**	power set.		
0717:47.6 **CAM-2**	eighty knots.		
0717:48.5 **CAM-1**	my yoke.		

INTRA-COCKPIT COMMUNICATION		AIRCRAFT-TO-GROUND COMMUNICATION	
Time (EST) SOURCE	CONTENT	Time (EST) SOURCE	CONTENT
0717:49.9 **CAM-1**	oh. it's bumpy.		
0717:56.0 **CAM-2**	V one.		
0717:58.0 **CAM-2**	rotate.		
0718:01.3 **CAM**	[sound of clicks]		
0718:02.9 **CAM**	[sound of decreasing engine RPM]		
0718:03.1 **CAM-1**	abort.		
0718:04.2 **CAM**	[sound of clunks]		
0718:07 **CAM-1**	#.		
0718:08 **CAM-1**	#.		

INTRA-COCKPIT COMMUNICATION Time (EST) SOURCE	CONTENT	AIRCRAFT-TO-GROUND COMMUNICATION Time (EST) SOURCE	CONTENT
0718:09 **CAM-2**	#.		
0718:10 **CAM-3**	oh my god.		
0718:11 **CAM-1**	we're going.		
0718:12.2 **CAM**	[sound of thump]		
0718:12.4 **CAM**	[sound of increased background noise – until end of recording]		
0718:14.0 **CAM**	[sound of tone, similar to gear warning]		
0718:15.7 **END OF TRANSCRIPT** **END OF RECORDING**			

Appendix C
Weight and Balance Information

During the on-scene portion of the investigation, all of the loose and recognizable items from the airplane were documented and weighed. Due to the extensive fire and the firefighting efforts, most of the items from the cockpit and main cabin were charred and/or soaked with water. The items from the aft baggage compartment were not wet or charred. The following table lists the items weighed, their location when found, and the weight. All items were weighed as recovered without drying. The seat numbers correspond to the interior layout in Gulfstream's "Weight and Balance Final Report," which follows.

Description	Location	Weight (lbs)
Captain's bag	Aft baggage compartment	20
First officer's bag	Aft baggage compartment	46
Cabin aide's bag	Aft baggage compartment	26
Shoe bag	Aft baggage compartment	6
Briefcase	Aft baggage compartment	16
Cosmetic bag	Aft baggage compartment	7
Starbucks drinks	Aft baggage compartment	3
Engine oil	Aft baggage compartment	17
Sweeper	Aft baggage compartment	1
Floor mat	Aft baggage compartment	1
Flight manuals	On left wing[1]	30
Jacket	On left wing[1]	7
Briefcase	On left wing[1]	19
Miscellaneous clothes and equipment	Outside cabin door	36.7
Airplane manuals	Outside cabin door	16.7
Airplane manuals	Beneath cockpit	36.7
Jacket, soda	Seat 5	6.5
Briefcase, personal effects	Seat 4	14.9
Briefcase, personal effects	Seat 1	12.5
Briefcase, personal effects	Seat 2	26.8
Briefcase, personal effects	Seat 5	25.3

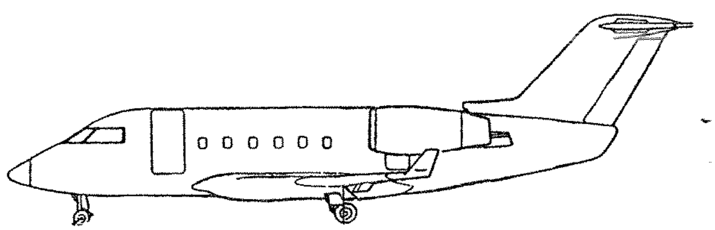
Description	Location	Weight (lbs)
Briefcase, personal effects	Seat 5	17.4
Food, serving ware	Galley	239.8
Purse, personal effects	Cockpit, floor between seats	13.5
Jacket, smoke goggles	L/H forward closet	4.4
Linens	Aft of first officer's seat	5.4
Airway manuals, dispatch paperwork	Right of first officer's seat	22.5
Airway manual	Left of captain's seat	4.3

Notes: 1. Removed from the cockpit by the FAA immediately following accident.

In 2001, when the airplane underwent refurbishment at Gulfstream Aerospace, Gulfstream prepared two weight and balance reports for the airplane, one for two crewmembers and one for three crewmembers. The three crewmember weight and balance information is provided.

Gulfstream®

AIRCRAFT INCORPORATED



REPORT NUMBER

CBA28W1014

WEIGHT AND BALANCE
FINAL REPORT FOR

D.D.H. Aviation

CANADAIR AEROSPACE CL-600-1A11 AIRCRAFT

AIRCRAFT S/N: 1014

PREPARED BY:	APPROVED BY:
Kathy Jahn 12-Sep-01	Grady Ebensberger 12-Sep-01
Kathy Jahn Date	Grady Ebensberger Date
Weight Engineer	Service Engineering Manager

GULFSTREAM
DALLAS, TX.
FAA CRS VJ1R560K
WEIGHING REPORT

BOMBARDIER

A/C MODEL: CL600-1A11
SERIAL NO.: 1014
REGIS. NO.: N370V

DATE: September 9, 2001
JOB NUMBER: 0029962
CUSTOMER: DDH Aviation Inc.

SCALE LOCATION	SCALE READING	CORR/ TARE	WEIGHT POUNDS	ARM IN/LBS	MOMENT IN/LBS
L. MAIN	10,975.00	0.00	10,975.00	544.30	5,973,692.50
R. MAIN	11,000.00	0.00	11,000.00	544.30	5,987,300.00
TOTAL MAINS	**21,975.00**	**0.00**	**21,975.00**	**544.30**	**11,960,992.50**
Nose / Tail	2,695.00	0.00	2,695.00	278.00	749,210.00
TOTAL AS WEIGHED	**24,670.00**	**0.00**	**24,670.00**	**515.21**	**12,710,202.50**

ITEMS DELETED (-)	WEIGHT	ARM	MOMENT
UNUSABLE FUEL	42.50	500.00	21,250.00
TOTAL	42.50	500.00	21,250.00

ITEMS ADDED (+)	WEIGHT	ARM	MOMENT
SYSTEM FUEL	109.00	500.00	54,500.00
TOTAL	109.00	500.00	54,500.00

TOTAL AS WEIGHED	**24,670.00**	**515.21**	**12,710,202.50**
ITEMS SUBTRACTED FROM TOTAL	42.50	500.00	21,250.00
ITEMS ADDED TO TOTAL	109.00	500.00	54,500.00
AIRCRAFT EMPTY WEIGHT	**24,736.50**	**515.17**	**12,743,452.50**
EMPTY WEIGHT % MAC		**29.30 %**	

AIRCRAFT WEIGHED WITH ELECTRONIC SCALES.

CALIBRATION DUE 10-10-01

WEIGHED BY: [signature]

CHECKED BY: [signature]

[signature]
APPROVAL SIGNATURE

GULFSTREAM
DALLAS, TX.
FAA CRS VJ1R560K
BASIC OPERATING WEIGHT

BOMBARDIER

A/C MODEL: CL600-1A11
SERIAL NO.: 1014
REGIS. NO.: N370V

DATE: September 9, 2001
JOB NUMBER: 0029962
CUSTOMER: DDH Aviation Inc.

2 CREWMEMBERS

LOADING CHARTS

MAX RAMP WEIGHT	41,400.00 LBS
MAX TAKEOFF WEIGHT	41,250.00 LBS
MAX LANDING WEIGHT	36,000.00 LBS
MAX ZERO FUEL WEIGHT	28,500.00 LBS

	WEIGHT (LBS)	ARM (IN)	MOMENT (IN/LB)
AIRCRAFT EMPTY WEIGHT	**24,736.50**	**515.17**	**12,743,452.50**
Pilot	170.00	255.00	43,350.00
Copilot	170.00	255.00	43,350.00
Jeppensen Storage	35.00	260.00	9,100.00
Crew Life Vests	4.50	280.00	1,260.00
Fwd L/H Closet	10.00	295.00	2,950.00
Fwd R/H Galley Supplies	280.00	315.00	88,200.00
Passenger Life Vests	6.00	398.00	2,388.00
Fwd Divan Arm Cabinet	10.00	444.50	4,445.00
Life Raft - 12 Man			
Passenger Life Vests	7.50	488.00	3,660.00
Life Raft - 12 Man			
Aft Divan Arm Cabinet	15.00	536.50	8,047.50
R/H Vanity	10.00	559.00	5,590.00
Aft L/H Closet	40.00	574.00	22,960.00
Toilet Charge	15.00	574.00	8,610.00
Potable Water (5 Gal @ 8.33/Gal)	41.65	584.00	24,323.60
Crew Baggage	90.00	605.00	54,450.00
Engine Covers (Soft)	6.00	605.00	3,630.00
TOTAL B.O.W. ITEMS ADDED	**910.65**	**358.33**	**326,314.10**
BASIC OPERATING WEIGHT	**25,647.15**	**509.60**	**13,069,766.60**

B.O.W. % of MAC = **23.29 %**

B.O.W.	25,817.15
Arm	508.15
Moment	13,119,067
% MAC	21.73
Pass Wt	170.00
Bagg Wt	30.00
Bagg Arm	605.00

3 Crew
9 Passenger

DDH Aviation Inc.
0029962

Fwd To Aft
Loading

Serial Number 1014
Model CL600-1A11

		Pass 1 + Bagg 374.00	Pass 2 + Bagg 374.00	Pass 3 + Bagg 424.00	Pass 4 + Bagg 424.00	Pass 5 + Bagg 460.00	Pass 6 + Bagg 468.00	Pass 7 + Bagg 487.30	Pass 8 + Bagg 515.20	Pass 9 + Bagg 520.30
	Crew Only	1	2	3	4	5	6	7	8	9
0 LBS (A) WT	25817.15	26017.15	26217.15	26417.15	26617.15	26817.15	27017.15	27217.15	27417.15	27617.15
ARM	508.15	507.39	506.64	506.21	505.80	505.62	505.50	505.49	505.66	505.86
MOM	13119066.60	13200796.60	13282526.60	13372756.60	13462986.60	13559336.60	13657046.60	13758037.60	13863771.60	13970372.60
%MAC	21.73	20.90	20.09	19.64	19.19	18.99	18.86	18.85	19.04	19.25
1,206 LBS (B) WT	27023.15	27223.15	27423.15	27623.15	27823.15	28023.15	28223.15	28423.15	28623.15	28823.15
ARM	506.83	506.11	505.40	505.00	504.62	504.45	504.34	504.35	504.52	504.71
MOM	13696137.60	13777867.60	13859597.60	13949827.60	14040057.60	14136407.60	14234117.60	14335108.60	14440842.60	14547443.60
%MAC	20.30	19.52	18.75	18.33	17.91	17.73	17.61	17.62	17.80	18.01
2,814 LBS (C) WT	28631.15	28831.15	29031.15	29231.15	29431.15	29631.15	29831.15	30031.15	30231.15	30431.15
ARM	505.80	505.13	504.46	504.10	503.74	503.59	503.49	503.50	503.66	503.86
MOM	14481605.60	14563335.60	14645065.60	14735295.60	14825525.60	14921875.60	15019585.60	15120576.60	15226310.60	15332911.60
%MAC	19.19	18.46	17.74	17.35	16.96	16.80	16.69	16.70	16.88	17.09
4,429 LBS (D) WT	30246.15	30446.15	30646.15	30846.15	31046.15	31246.15	31446.15	31646.15	31846.15	32046.15
ARM	505.45	504.82	504.19	503.84	503.50	503.36	503.27	503.28	503.44	503.63
MOM	15287947.60	15369677.60	15451407.60	15541637.60	15631867.60	15728217.60	15825927.60	15926918.60	16032652.60	16139253.60
%MAC	18.81	18.12	17.45	17.08	16.71	16.56	16.46	16.47	16.64	16.84
6,037 LBS (E) WT	31854.15	32054.15	32254.15	32454.15	32654.15	32854.15	33054.15	33254.15	33454.15	33654.15
ARM	505.64	505.04	504.44	504.11	503.79	503.65	503.56	503.57	503.72	503.89
MOM	16106777.60	16188507.60	16270237.60	16360467.60	16450697.60	16547047.60	16644757.60	16745748.60	16851482.60	16958083.60
%MAC	19.02	18.36	17.72	17.36	17.01	16.87	16.77	16.78	16.94	17.13
7,645 LBS (F) WT	33462.15	33662.15	33862.15	34062.15	34262.15	34462.15	34662.15	34862.15	35062.15	35262.15
ARM	506.20	505.62	505.05	504.73	504.42	504.29	504.20	504.20	504.34	504.50
MOM	16938508.60	17020238.60	17101968.60	17192198.60	17282428.60	17378778.60	17476488.60	17577479.60	17683213.60	17789814.60
%MAC	19.62	18.99	18.37	18.03	17.69	17.55	17.45	17.46	17.61	17.79
8,449 LBS (G) WT	34266.15	34466.15	34666.15	34866.15	35066.15	35266.15	35466.15	35666.15	35866.15	36066.15
ARM	506.66	506.09	505.53	505.22	504.91	504.78	504.69	504.69	504.82	504.98
MOM	17361309.60	17443039.60	17524769.60	17614999.60	17705229.60	17801579.60	17899289.60	18000280.60	18106014.60	18212615.60
%MAC	20.12	19.50	18.90	18.56	18.23	18.08	17.99	17.99	18.13	18.30
9,253 LBS (H) WT	35070.15	35270.15	35470.15	35670.15	35870.15	36070.15	36270.15	36470.15	36670.15	36870.15
ARM	507.35	506.79	506.23	505.93	505.62	505.49	505.39	505.39	505.52	505.67
MOM	17792756.60	17874486.60	17956216.60	18046446.60	18136676.60	18233026.60	18330736.60	18431727.60	18537461.60	18644062.60
%MAC	20.86	20.25	19.66	19.32	18.99	18.85	18.75	18.75	18.88	19.04

Caution: It is the Owner/Operators responsibility to verify the loading is within the Manufactures' specified "Center of Gravity" range.

B.O.W.	25817.15
Arm	508.15
Moment	13119067
% MAC	21.73
Pass Wt	170.00
Bagg Wt	30.00
Bagg Arm	605.00

3 Crew
9 Passenger

DDH Aviation Inc.
0029962

Fwd To Aft
Loading

Serial Number 1014
Model CL600-1A11

			Pass 1 + Bagg 374.00	Pass 2 + Bagg 374.00	Pass 3 + Bagg 424.00	Pass 4 + Bagg 424.00	Pass 5 + Bagg 460.00	Pass 6 + Bagg 468.00	Pass 7 + Bagg 487.30	Pass 8 + Bagg 515.20	Pass 9 + Bagg 520.30
		Crew Only	1	2	3	4	5	6	7	8	9
9,648 LBS (I)	WT	35465.15	35665.15	35865.15	36065.15	36265.15	36465.15	36665.15	36865.15	37065.15	37265.15
	ARM	507.73	507.18	506.63	506.32	506.01	505.88	505.79	505.78	505.91	506.05
	MOM	18006743.60	18088473.60	18170203.60	18260433.60	18350663.60	18447013.60	18544723.60	18645714.60	18751448.60	18858049.60
	%MAC	21.27	20.67	20.08	19.75	19.42	19.27	19.17	19.17	19.30	19.46
10,050 LBS (J)	WT	35867.15	36067.15	36267.15	36467.15	36667.15	36867.15	37067.15	37267.15	37467.15	37667.15
	ARM	507.15	506.60	506.06	505.76	505.46	505.33	505.24	505.24	505.37	505.51
	MOM	18189974.60	18271704.60	18353434.60	18443664.60	18533894.60	18630244.60	18727954.60	18828945.60	18934679.60	19041280.60
	%MAC	20.64	20.05	19.47	19.15	18.82	18.68	18.59	18.59	18.72	18.88
10,854 LBS (K)	WT	36671.15	36871.15	37071.15	37271.15	37471.15	37671.15	37871.15	38071.15	38271.15	38471.15
	ARM	506.18	505.65	505.13	504.84	504.55	504.43	504.34	504.35	504.47	504.62
	MOM	18562106.60	18643836.60	18725566.60	18815796.60	18906026.60	19002376.60	19100086.60	19201077.60	19306811.60	19413412.60
	%MAC	19.59	19.02	18.46	18.15	17.84	17.71	17.62	17.62	17.76	17.92
11,658 LBS (L)	WT	37475.15	37675.15	37875.15	38075.15	38275.15	38475.15	38675.15	38875.15	39075.15	39275.15
	ARM	505.22	504.71	504.20	503.93	503.65	503.54	503.46	503.47	503.60	503.74
	MOM	18933353.60	19015083.60	19096813.60	19187043.60	19277273.60	19373623.60	19471333.60	19572324.60	19678058.60	19784659.60
	%MAC	18.57	18.01	17.46	17.16	16.87	16.74	16.66	16.67	16.81	16.97
12,462 LBS (M)	WT	38279.15	38479.15	38679.15	38879.15	39079.15	39279.15	39479.15	39679.15	39879.15	40079.15
	ARM	504.30	503.81	503.31	503.05	502.78	502.67	502.60	502.61	502.74	502.89
	MOM	19304278.60	19386008.60	19467738.60	19557968.60	19648198.60	19744548.60	19842258.60	19943249.60	20048983.60	20155584.60
	%MAC	17.57	17.03	16.50	16.21	15.93	15.81	15.73	15.75	15.89	16.05
13,266 LBS (N)	WT	39083.15	39283.15	39483.15	39683.15	39883.15	40083.15	40283.15	40483.15	40683.15	40883.15
	ARM	503.40	502.92	502.44	502.19	501.93	501.83	501.76	501.78	501.91	502.06
	MOM	19674641.60	19756371.60	19838101.60	19928331.60	20018561.60	20114911.60	20212621.60	20313612.60	20419346.60	20525947.60
	%MAC	16.60	16.08	15.57	15.29	15.01	14.90	14.83	14.85	14.99	15.15
14,077 LBS (O)	WT	39894.15	40094.15	40294.15	40494.15	40694.15	40894.15	41094.15	41294.15	41494.15	41694.15
	ARM	502.43	501.96	501.50	501.25	501.01	500.91	500.85	500.87	501.01	501.16
	MOM	20044083.60	20125813.60	20207543.60	20297773.60	20388003.60	20484353.60	20582063.60	20683054.60	20788788.60	20895389.60
	%MAC	15.55	15.05	14.55	14.28	14.01	13.91	13.85	13.87	14.01	14.18
14,640 LBS (P)	WT	40457.15	40657.15	40857.15	41057.15	41257.15	41457.15	41657.15	41857.15	42057.15	42257.15
	ARM	501.57	501.11	500.66	500.42	500.18	500.09	500.04	500.06	500.20	500.35
	MOM	20292080.60	20373810.60	20455540.60	20545770.60	20636000.60	20732350.60	20830060.60	20931051.60	21036785.60	21143386.60
	%MAC	14.62	14.13	13.64	13.38	13.12	13.02	12.96	12.99	13.14	13.30

Caution: It is the Owner/Operators responsibility to verify the loading is within the Manufactures' specified "Center of Gravity" range.

B.O.W.	25,817.15
Arm	508.15
Moment	13,119,067
% MAC	21.73
Pass Wt	170.00
Bagg Wt	30.00
Bagg Arm	605.00

3 Crew
9 Passenger

DDH Aviation Inc.
0029962

Aft To Fwd
Loading

Serial Number 1014
Model CL600-1A11

		Crew Only	Pass 9 + Bagg 520.30	Pass 8 + Bagg 515.20	Pass 7 + Bagg 487.30	Pass 6 + Bagg 468.00	Pass 5 + Bagg 460.00	Pass 4 + Bagg 424.00	Pass 3 + Bagg 424.00	Pass 2 + Bagg 374.00	Pass 1 + Bagg 374.00
			1	2	3	4	5	6	7	8	9
9,648 LBS (I)	WT	35465.15	35665.15	35865.15	36065.15	36265.15	36465.15	36665.15	36865.15	37065.15	37265.15
	ARM	507.73	507.87	507.99	507.97	507.86	507.72	507.41	507.11	506.58	506.05
	MOM	18006743.60	18113344.60	18219078.60	18320069.60	18417779.60	18514129.60	18604359.60	18694589.60	18776319.60	18858049.60
	%MAC	21.27	21.42	21.55	21.53	21.42	21.26	20.93	20.60	20.02	19.46
10,050 LBS (J)	WT	35867.15	36067.15	36267.15	36467.15	36667.15	36867.15	37067.15	37267.15	37467.15	37667.15
	ARM	507.15	507.29	507.41	507.40	507.29	507.16	506.85	506.55	506.03	505.51
	MOM	18189974.60	18296575.60	18402309.60	18503300.60	18601010.60	18697360.60	18787590.60	18877820.60	18959550.60	19041280.60
	%MAC	20.64	20.80	20.92	20.91	20.80	20.65	20.32	20.00	19.44	18.88
10,854 LBS (K)	WT	36671.15	36871.15	37071.15	37271.15	37471.15	37671.15	37871.15	38071.15	38271.15	38471.15
	ARM	506.18	506.32	506.44	506.44	506.34	506.21	505.92	505.63	505.12	504.62
	MOM	18562106.60	18668707.60	18774441.60	18875432.60	18973142.60	19069492.60	19159722.60	19249952.60	19331682.60	19413412.60
	%MAC	19.59	19.75	19.88	19.87	19.77	19.63	19.32	19.00	18.46	17.92
11,658 LBS (L)	WT	37475.15	37675.15	37875.15	38075.15	38275.15	38475.15	38675.15	38875.15	39075.15	39275.15
	ARM	505.22	505.37	505.49	505.49	505.40	505.28	505.00	504.72	504.23	503.74
	MOM	18933353.60	19039954.60	19145688.60	19246679.60	19344389.60	19440739.60	19530969.60	19621199.60	19702929.60	19784659.60
	%MAC	18.57	18.72	18.86	18.85	18.76	18.63	18.32	18.03	17.49	16.97
12,462 LBS (M)	WT	38279.15	38479.15	38679.15	38879.15	39079.15	39279.15	39479.15	39679.15	39879.15	40079.15
	ARM	504.30	504.45	504.58	504.58	504.50	504.38	504.11	503.84	503.37	502.89
	MOM	19304278.60	19410879.60	19516613.60	19617604.60	19715314.60	19811664.60	19901894.60	19992124.60	20073854.60	20155584.60
	%MAC	17.57	17.73	17.87	17.87	17.78	17.66	17.36	17.08	16.56	16.05
13,266 LBS (N)	WT	39083.15	39283.15	39483.15	39683.15	39883.15	40083.15	40283.15	40483.15	40683.15	40883.15
	ARM	503.40	503.56	503.68	503.69	503.61	503.50	503.24	502.99	502.52	502.06
	MOM	19674641.60	19781242.60	19886976.60	19987967.60	20085677.60	20182027.60	20272257.60	20362487.60	20444217.60	20525947.60
	%MAC	16.60	16.76	16.90	16.91	16.83	16.71	16.43	16.15	15.65	15.15
14,077 LBS (O)	WT	39894.15	40094.15	40294.15	40494.15	40694.15	40894.15	41094.15	41294.15	41494.15	41694.15
	ARM	502.43	502.58	502.71	502.72	502.66	502.55	502.30	502.05	501.60	501.16
	MOM	20044083.60	20150684.60	20256418.60	20357409.60	20455119.60	20551469.60	20641699.60	20731929.60	20813659.60	20895389.60
	%MAC	15.55	15.72	15.86	15.87	15.79	15.68	15.41	15.14	14.66	14.18
14,640 LBS (P)	WT	40457.15	40657.15	40857.15	41057.15	41257.15	41457.15	41657.15	41857.15	42057.15	42257.15
	ARM	501.57	501.72	501.86	501.87	501.81	501.71	501.47	501.23	500.79	500.35
	MOM	20292080.60	20398681.60	20504415.60	20605406.60	20703116.60	20799466.60	20889696.60	20979926.60	21061656.60	21143386.60
	%MAC	14.62	14.79	14.93	14.95	14.88	14.77	14.51	14.25	13.78	13.30

Caution: It is the Owner/Operators responsibility to verify the loading is within the Manufactures' specified "Center of Gravity" range.

B.O.W.	25,817.15
Arm	508.15
Moment	13,119,067
% MAC	21.73
Pass Wt	170.00
Bagg Wt	30.00
Bagg Arm	605.00

3 Crew
9 Passenger

DDH Aviation Inc.
0029962

Aft To Fwd
Loading

Serial Number 1014
Model CL600-1A11

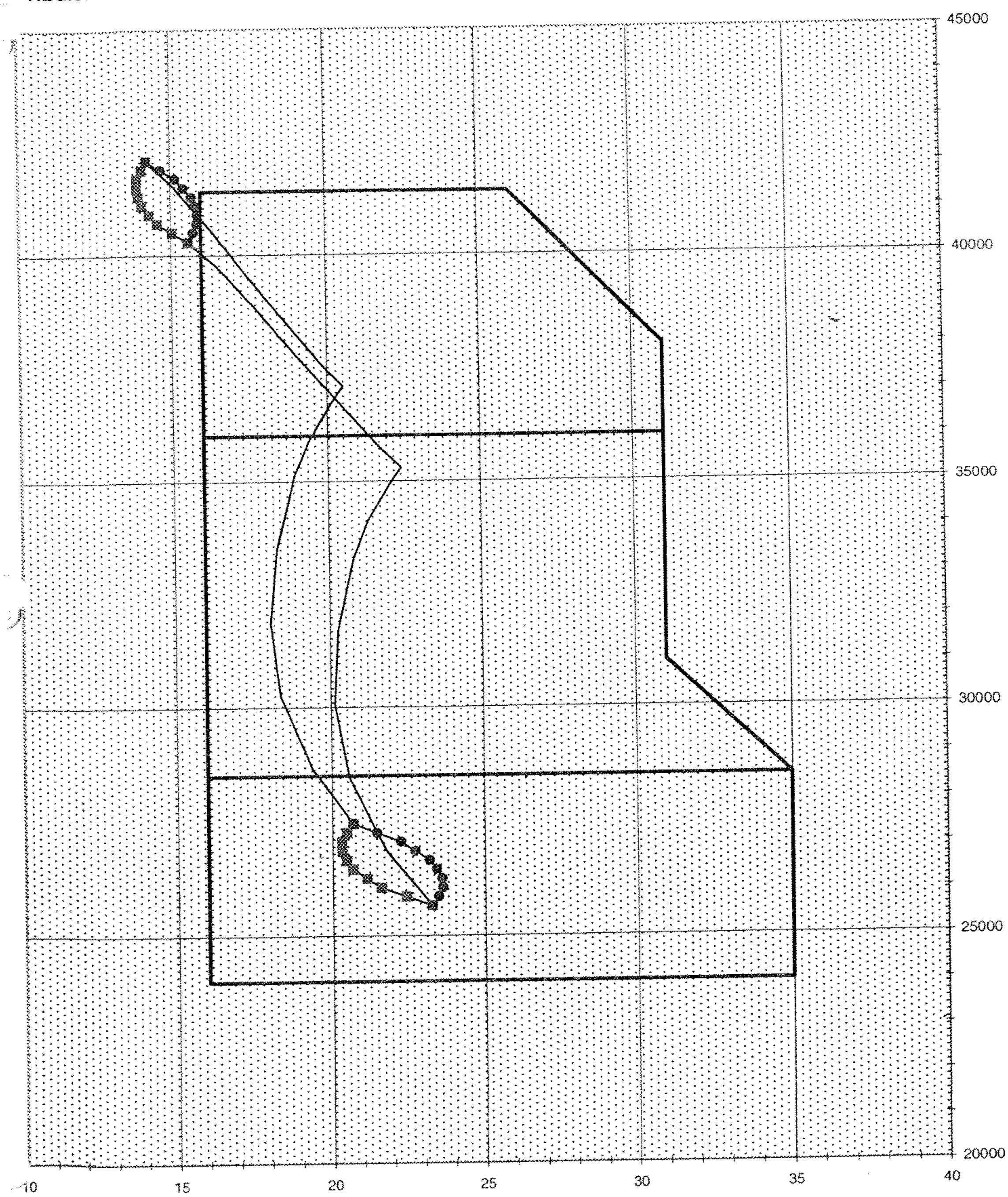
		Pass 9 + Bagg 520.30	Pass 8 + Bagg 515.20	Pass 7 + Bagg 487.30	Pass 6 + Bagg 468.00	Pass 5 + Bagg 460.00	Pass 4 + Bagg 424.00	Pass 3 + Bagg 424.00	Pass 2 + Bagg 374.00	Pass 1 + Bagg 374.00
	Crew Only	1	2	3	4	5	6	7	8	9
0 LBS (A) WT	25817.15	26017.15	26217.15	26417.15	26617.15	26817.15	27017.15	27217.15	27417.15	27617.15
ARM	508.15	508.34	508.50	508.47	508.32	508.12	507.70	507.29	506.57	505.86
MOM	13119066.60	13225667.60	13331401.60	13432392.60	13530102.60	13626452.60	13716682.60	13806912.60	13888642.60	13970372.60
%MAC	21.73	21.93	22.10	22.07	21.91	21.70	21.24	20.79	20.02	19.25
1,206 LBS (B) WT	27023.15	27223.15	27423.15	27623.15	27823.15	28023.15	28223.15	28423.15	28623.15	28823.15
ARM	506.83	507.02	507.18	507.16	507.03	506.85	506.45	506.07	505.39	504.71
MOM	13696137.60	13802738.60	13908472.60	14009463.60	14107173.60	14203523.60	14293753.60	14383983.60	14465713.60	14547443.60
%MAC	20.30	20.51	20.68	20.66	20.51	20.32	19.89	19.47	18.74	18.01
2,814 LBS (C) WT	28631.15	28831.15	29031.15	29231.15	29431.15	29631.15	29831.15	30031.15	30231.15	30431.15
ARM	505.80	505.99	506.14	506.14	506.02	505.85	505.49	505.12	504.49	503.86
MOM	14481605.60	14588206.60	14693940.60	14794931.60	14892641.60	14988991.60	15079221.60	15169451.60	15251181.60	15332911.60
%MAC	19.19	19.39	19.56	19.55	19.42	19.24	18.85	18.46	17.77	17.09
4,429 LBS (D) WT	30246.15	30446.15	30646.15	30846.15	31046.15	31246.15	31446.15	31646.15	31846.15	32046.15
ARM	505.45	505.63	505.78	505.78	505.67	505.51	505.17	504.83	504.22	503.63
MOM	15287947.60	15394548.60	15500282.60	15601273.60	15698983.60	15795333.60	15885563.60	15975793.60	16057523.60	16139253.60
%MAC	18.81	19.01	19.17	19.16	19.04	18.88	18.50	18.14	17.48	16.84
6,037 LBS (E) WT	31854.15	32054.15	32254.15	32454.15	32654.15	32854.15	33054.15	33254.15	33454.15	33654.15
ARM	505.64	505.81	505.95	505.95	505.84	505.69	505.36	505.04	504.46	503.89
MOM	16106777.60	16213378.60	16319112.60	16420103.60	16517813.60	16614163.60	16704393.60	16794623.60	16876353.60	16958083.60
%MAC	19.02	19.20	19.35	19.35	19.23	19.07	18.72	18.37	17.74	17.13
7,645 LBS (F) WT	33462.15	33662.15	33862.15	34062.15	34262.15	34462.15	34662.15	34862.15	35062.15	35262.15
ARM	506.20	506.36	506.49	506.48	506.38	506.23	505.92	505.60	505.05	504.50
MOM	16938508.60	17045109.60	17150843.60	17251834.60	17349544.60	17445894.60	17536124.60	17626354.60	17708084.60	17789814.60
%MAC	19.62	19.79	19.93	19.92	19.81	19.66	19.31	18.97	18.38	17.79
8,449 LBS (G) WT	34266.15	34466.15	34666.15	34866.15	35066.15	35266.15	35466.15	35666.15	35866.15	36066.15
ARM	506.66	506.81	506.94	506.93	506.82	506.68	506.37	506.06	505.52	504.98
MOM	17361309.60	17467910.60	17573644.60	17674635.60	17772345.60	17868695.60	17958925.60	18049155.60	18130885.60	18212615.60
%MAC	20.12	20.28	20.42	20.41	20.29	20.14	19.80	19.47	18.88	18.30
9,253 LBS (H) WT	35070.15	35270.15	35470.15	35670.15	35870.15	36070.15	36270.15	36470.15	36670.15	36870.15
ARM	507.35	507.49	507.61	507.60	507.49	507.35	507.04	506.73	506.20	505.67
MOM	17792756.60	17899357.60	18005091.60	18106082.60	18203792.60	18300142.60	18390372.60	18480602.60	18562332.60	18644062.60
%MAC	20.86	21.01	21.14	21.13	21.01	20.86	20.52	20.19	19.62	19.04

Caution: It is the Owner/Operators responsibility to verify the loading is within the Manufactures' specified "Center of Gravity" range.

A/C MODEL: CL600-1A11
SERIAL NO.: 1014
REGIS. NO.: N370V

GULFSTREAM
DALLAS, TX.
FAA CRS VJ1R560K

DATE: September 9, 2001
JOB NUMBER: 0029962
CUSTOMER: DDH Aviation Inc.

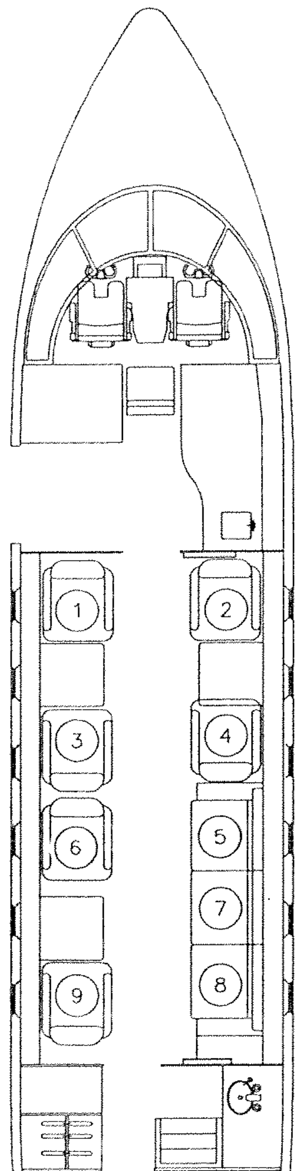


Fwd to Aft Passenger Loading
Aft to Fwd Passenger Loading
0 Low End Fuel
14640 High End Fuel

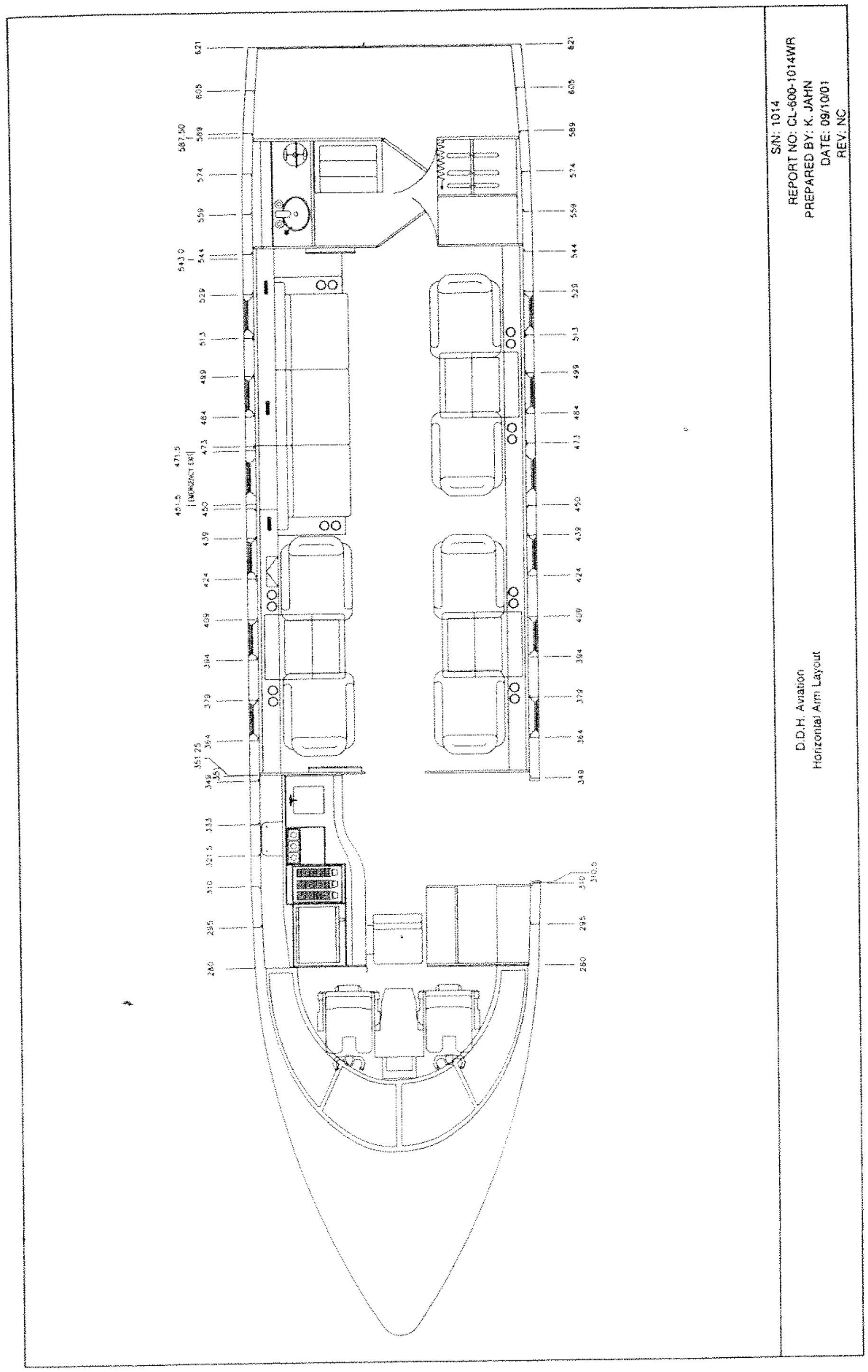
2 Crew
9 Pass

MRW	41400
MTOW	41250
MLW	36000
MZFW	28500

GULFSTREAM AEROSPACE
CANADAIR CHALLENGER WEIGHT & BALANCE
PASSENGER LOADING DIAGRAM - 9 PAX



S/N: 1014
REPORT NO: CBA28W1014
PREPARED BY: K. JAHN
DATE: 09/10/01
REV: NC


S/N: 1014
REPORT NO: CL-600-1014WR
PREPARED BY: K. JAHN
DATE: 09/10/01
REV: NC
D.D.H. Aviation
Horizontal Arm Layout
EMERGENCY EXIT