



National Transportation Safety Board

Office of Aviation Safety
Washington, D.C. 20594

Group Chairman's Factual Report

OPERATIONAL FACTORS

WPR19FA230

Table of Contents

A.	ACCIDENT	5
B.	OPERATIONAL FACTORS GROUP.....	5
C.	SUMMARY OF ACCIDENT	5
D.	DETAILS OF THE OPERATIONS INVESTIGATION	5
E.	FACTUAL INFORMATION.....	6
1.0	The Operator.....	6
2.0	History of Flight	6
3.0	Flight Crew Information.....	6
3.1	The Pilot in Command.....	7
3.2	The PIC's Recent Training and Proficiency Checks Completed.....	7
3.3	The Second-in-Command (SIC), Co-Captain	7
3.4	The SIC's Recent Training and Proficiency Checks Completed.....	8
3.5	Medical and Pathological Information	8
4.0	Airplane Information.....	8
5.0	The Flight Crew's Trip Schedule	9
5.1	The Flight Crew's Duty Time and Opportunity for Rest	10
6.0	Weight and Balance.....	10
6.1	Weight and Balance Calculators.....	11
6.2	Maintaining of Weight and Balance Calculators.....	11
6.3	Maximum Certificated Weight Limitations	12
6.4	The Original Weight and Balance Record.....	12
6.5	DPJ Recreation of the Weight and Balance (Standard Weights)	13
6.6	DPJ Recreation of the Weight and Balance (Actual Weights).....	13
6.7	Recreation of Weight and Balance (Actual Weights for Occupants and Baggage) ..	14
7.0	Meteorological Information.....	15
8.0	Airport Information	15
9.0	Takeoff Performance Definitions	17
9.1	Takeoff Performance	18
10.0	DPJ's Electronic Flight Bag (EFB) Program	19
10.1	DPJ's EFB Program Application.....	19
10.2	DPJ's EFB Securing Policy.....	19
10.3	DPJ's Chart and Map Utilization Policy	20
10.4	FAA EFB Advisory Circulars	20
11.0	Relevant Airplane Systems.....	21

11.1	Flight Controls.....	22
11.2	Hydraulics.....	23
11.3	The Parking Brake.....	23
11.3.1	Parking Brake Lever Location.....	23
11.3.2	Use of Parking Brake During the Accident Flight.....	26
11.4	Annunciator Panel	27
11.4.1	No Takeoff Warning Annunciator.....	28
11.4.2	CE-560XL Airplane Flight Manual Supplements	29
11.5	Cabin Door	31
11.6	Emergency Exit	31
11.7	Autopilot Control Panel.....	31
12.0	Relevant Normal Procedures.....	33
12.1	Checklist Usage Instructions	33
12.2	Switch Movement/ System Manipulation	33
12.3	DPJ Normal Checklist Definitions	33
12.4	Before Start Checklist.....	33
12.4.1	Takeoff Briefing.....	34
12.5	Taxi Checklist.....	35
12.5.1	Rudder Bias Check	37
12.6	Before Takeoff Checklist	38
12.7	Cessna Pilot’s Takeoff Checklist.....	40
12.8	Standard Takeoff Calls	41
13.0	The Accident Flight Takeoff	42
14.0	Relevant Emergency Procedures.....	43
14.1	DPJ SOP’s, Non-Normal Operations	43
14.2	DPJ SOP’s, Rejected Takeoff Policy	44
14.3	Engine Failure or Other Emergency During Takeoff.....	44
14.4	FAA Guidance on Aborted Takeoff’s After V1	45
14.5	Emergency Evacuation Procedure.....	46
15.0	DPJ Operational Control	47
15.1	DPJ Flight Control Responsibilities	47
15.2	Captain Responsibilities	47
16.0	Relevant DPJ Policies.....	48
16.1	DPJ Rest, Flight, and Duty Times Policies	48
16.2	DPJ Fatigue/ Unfit for Duty Policies.....	48

16.3	Flight Crew Upgrade Policy	48
17.0	DPJ Safety Management System.....	48
17.1	Aviation Safety Action Program	49
17.1.1	Aviation Safety Action Program Review	50
17.2	Flight Data Monitoring.....	50
18.0	Relevant Training	50
18.1	CAE Ground and Simulator Training.....	50
18.2	CAE Hydraulics, Landing Gear, and Brakes Ground Training.....	50
18.3	CAE Instructor’s Training of Parking Knowledge and Procedures	50
18.4	CAE Training Modules: Crew Resource Management	51
18.5	CAE Flight Profiles	51
18.6	Simulator Used for Flight Training	53
F.	List of Attachments	54

A. ACCIDENT

Location: Oroville, California (CA)
Date: August 21, 2019
Time: 1132 Pacific daylight time¹
Airplane: Cessna CE-560XL

B. OPERATIONAL FACTORS GROUP

Adam Gerhardt – Group Chairman
Air Safety Investigator
National Transportation Safety Board

Patrick D. Lusch
Air Accident Investigator, AVP-100
Federal Aviation Administration

Henry Soderlund
Senior Air Safety Investigation
Textron Aviation

Don Coulter
Captain/ Line Check Airman
Delta Private Jets

C. SUMMARY OF ACCIDENT

On August 21, 2019, about 1132 Pacific daylight time, a Cessna 560XL airplane, N91GY, overran the departure end of runway 2 following a rejected takeoff from Oroville Municipal Airport (OVE), Oroville, California. The two pilots and 8 passengers were not injured. The airplane was destroyed by a post-crash fire that consumed a majority of the airplane. The airplane was registered to Jotts LLC, and was operated by Delta Private Jets, as a Title 14 *Code of Federal Regulations (CFR)* Part 135 on-demand charter flight. Visual meteorological conditions prevailed, and an instrument flight rules flight plan was filed. The flight was destined for Portland International Airport (PDX), Portland, Oregon.

D. DETAILS OF THE OPERATIONS INVESTIGATION

On August 21, 2019, the operations group chairman was notified of the accident and arrived at the accident site in Oroville, California on August 22, 2019. The operations group formed on August 22, 2019 and began the on-site examination of the wreckage and preliminary operational document gathering. The flight crew was interviewed at the OVE airport on August 22, 2019. The on-site launch activities concluded on August 25, 2019, where preliminary factual field notes were completed and agreed to by all operations group party members present, which did not include the Federal Aviation Administration (FAA).

On August 26, 2019 an exemplar CE-560XL airplane located at the Textron Aviation Sacramento Service was toured. The cockpit and the landing gear and brakes were documented. On August 28, 2019 the operations group chairman traveled to the Delta Private Jets Headquarters in Erlanger, Kentucky and conducted follow-on flight crew interviews and toured the operational facilities.

On September 23-24, 2019, select members of the operations group participated in the cockpit voice recording transcription. The operations group chairman continued gathering factual information and completed this factual report in April 2020.

¹ All times are Pacific Daylight Time (PDT) unless otherwise noted.

E. FACTUAL INFORMATION

1.0 The Operator

Delta Private Jets (DPJ), held a Title 14 CFR Part 135 air operator certificate with the FAA. Their headquarters were located in Erlanger, Kentucky. DPJ had 68 airplanes on their air operations certificate at the time of the accident, ranging from light, mid-size, super-midsize, large and long-range business jets. They employed 207 full-time pilots and were a wholly owned subsidiary of Delta Air Lines. The operator reported the following details regarding their fleet:

<u>DPJ Fleet Overview</u>	<u>Total Number of Airplanes</u>
Total Airplanes:	68
Cessna 560 XL:	17 (<i>accident make and model</i>)
Cessna 560 XLS:	6
Cessna 560 XLS+:	2

2.0 History of Flight

The flight crew started an 8-day trip assignment on August 15, 2019 and were scheduled to fly the accident airplane (N91GY) for the duration of the trip.² The day before the accident, the flight crew began flying with the group of the 8 passengers that were onboard the accident flight, where they completed two flights.³ Their flight activities concluded the day prior to the accident when the airplane landed at 1804 in OVE. The flight crew reported off duty at 1935.

The flight crew came on duty at 0900 the morning of the accident and arrived at the OVE airport at 1011. They flight crew performed a preflight, boarded the passengers, loaded the bags, and received 220 gallons of Jet A fuel from the local fixed base operator (FBO).⁴ The airplane subsequently taxied from the ramp area to the hold short area for runway 2.

Review of the surveillance video showed the airplane hold short of runway 2 for three minutes and 44 seconds. The airplane then taxied forward toward runway 2 and appeared to cross the hold short line but stopped again for 18 seconds on heading perpendicular to the runway 2 heading. The airplane subsequently moved again and lined up with the runway 2 heading. The airplane remained stationary lined up on the runway 2 heading, for about 16 seconds, and then the takeoff roll commenced. The pitch attitude of the airplane did not appear to change while it was in the camera's view.⁵

The airplane subsequently departed the runway surface, the landing gear collapsed, and the airplane skidded to a stop about 2,000 ft beyond the departure end of runway 2. The flight crew and passengers completed an emergency evacuation. A postimpact fire ignited in the grass and subsequently consumed a majority of the airplane.

3.0 Flight Crew Information

The flight crew consisted of two company designated Captains. The pilot seated in the left seat was designated as the pilot-in-command (PIC), and was the pilot flying for the accident flight. The pilot

² Source: DPJ Flight Crewmember Activity Summaries

³ The group of 8 passengers worked for the same company and completed their travel plans as a group booking.

⁴ Source: A fuel receipt provided by the OVE airport.

⁵ Source: Surveillance camera video located at the airport main terminal building.

seated in the right seat was designated as the second-in-command (SIC) and pilot monitoring for the accident flight.⁶

3.1 The Pilot in Command

According to Federal Aviation Administration (FAA) airman and operator records, the PIC was hired on November 4, 2014. He held an Airline Transport Pilot Certificate, airplane multi-engine land, with type ratings for the CE-525S and the CE-560XL. He also held a commercial pilot certificate with an airplane single-engine land rating. His most recent first-class medical certificate was issued in March 2019.

According to the PIC's DPJ Pilot Logbook, from December 2014 through March 2019 the PIC was assigned to the CE-525S. He was designated by DPJ as a Captain in the CE-525S in April 2015 after completing the 14 *CFR* 135.299 proficiency check.⁷

The operator reported the following flight experience for the PIC:

<u>Flight Time:</u>	<u>Hours:</u>
Total Flight Time:	6,482
Total PIC Time:	2,191
Total Time in Accident Make and Model:	192
Total PIC Time in Make and Model:	152
Total time in Past 90/30 days:	122/41

3.2 The PIC's Recent Training and Proficiency Checks Completed

According to DPJ training records, on March 26, 2019 the PIC began ground school for the accident make and model airplane (CE-560XL) type rating training at the CAE Dallas West Training Center, Dallas, Texas. On April 9, 2019, he completed the initial pilot and PIC instrument proficiency checks (14 *CFR* 135.293, and 135.297 checks). The PIC's 25 flight hours of supervised operating experience began on April 21, 2019 and was completed on April 28, 2019. The PIC's most recent proficiency check (14 *CFR* 135.299) was on May 10, 2019 for the accident make and model airplane.

3.3 The Second-in-Command (SIC), Co-Captain

According to FAA airman and operator records, the SIC was hired into the position of First Officer on May 3, 2015. He held an Airline Transport Pilot Certificate, airplane multi-engine land, with type ratings for the CE-560XL, CE-750, ERJ-170/190. He was limited to SIC only for the ERJ-170/190 type rating. He also held a commercial pilot certificate with an airplane single-engine land rating. His most recent first-class medical certificate was issued in April 2019.

According to the SIC's DPJ Pilot Logbook, from June 2015 through June 2017 the SIC was assigned to the CE-750 airplane. He transferred to flying the CE-560XL in July 2017 and was designated by DPJ as a Captain in September 2017 after completing the 14 *CFR* 135.299 proficiency check in the CE-560XL.

The operator reported the following flight experience for the SIC:

⁶ The Captain (left seat pilot) is referred to as the PIC, and the pilot in the right seat is referred to as the SIC throughout this factual report.

⁷ Title 14 *CFR* 135.299 required a PIC to pass a flight check in one of the types of aircraft which that pilot is to fly.

Flight Time:

Total Flight Time:
 Total PIC Time:
 Total Time in Accident Make and Model:
 Total PIC Time in Make and Model:
 Total time in Past 90/30 days:

Hours:

4,748
 2,219
 858
 736
 99/27

3.4 The SIC's Recent Training and Proficiency Checks Completed

According to DPJ training records, on June 26, 2017 the SIC began ground school for the accident make and model airplane (CE-560XL) type rating training at the CAE Dallas West Training Center, Dallas, Texas. He completed the training on July 10, 2017 and subsequently completed the 14 CFR 135.299 proficiency check on September 19, 2017. The SIC's most recent recurrent pilot and PIC instrument proficiency checks (14 CFR 135.293, and 135.297 checks) were completed on July 23, 2019. His most recent proficiency check (14 CFR 135.299) was on August 7, 2019 for the accident make and model airplane.

3.5 Medical and Pathological Information

Both pilots were drug and alcohol tested post-accident with negative results.

4.0 Airplane Information

The airplane was a Cessna CE-560XL Excel manufactured in 2003. It was powered by two Pratt & Whitney PW545A turbine engines. The airplane required two type-rated flight crew members and was equipped with 8 passenger seats.



Photo 1: Photo of the accident airplane (N91GY)

The airplane had two exits, with the first being the main cabin door located at the forward left side of the fuselage. The airplane was equipped with one emergency exit door located at the aft right side of the fuselage. Figure 1 notes the location of the exits and how the accident airplane's 8 passenger seats were configured. Reference the relevant systems section below for additional information.

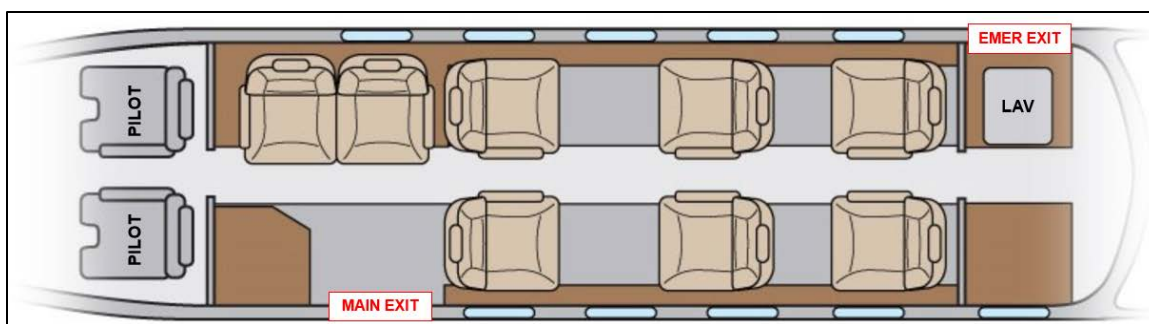


Figure 1: Seating diagram for the accident airplane

5.0 The Flight Crew's Trip Schedule

DPJ utilized a home base system for flight crew to originate and end their trips from. The PIC resided in Wooster, Ohio, and his base airport was Port Columbus International Airport (CMH), Columbus, Ohio. The SIC resided in Seattle, Washington and his base airport was Seattle International Airport (SEA), Seattle, Washington. Pilots were normally assigned to an 8-day on-duty rotation, followed by 6-days off-duty.

On August 15, 2019 both pilots began their 8-day rotation, departing from their respective home bases to San Francisco International Airport (SFO), San Francisco, California via commercial air carriers.⁸ The flight crew was scheduled to complete their entire rotation together, and on the accident airplane (N91GY). From August 15-19, 2019, the pilot who was the SIC during the accident flight was assigned as the PIC. On August 20, 2019, the flight crew swapped assigned positions and the PIC during the accident flight assumed the duties of PIC for the first flight that day.⁹

On August 20, 2019, the flight crew began flying with the group of 8 passengers that were on-board the accident flight, completing two legs of flying with the group the day prior to the accident. On August 21, 2019, the flight crew was scheduled to complete their final flight with the group of 8 passengers from OVE to PDX. The flight crew was scheduled to complete one additional non-revenue repositioning flight after the accident flight. The flight crew's 8-day rotation was scheduled to end on August 22, 2019, the day after the accident. Table 1 details the flight crew's schedule. The accident flight is noted in red.

Date	Departure City	Arrival City	Flight Time ¹⁰	# of Passengers
8/15/2019	SFO (San Francisco, CA)	BUR (Burbank, CA)	0.9	3
8/16/2019	BUR (Burbank, CA)	SEZ (Sedona, AZ)	1.0	0
8/16/2019	SEZ (Sedona, AZ)	COD (Cody, WY)	1.6	3
8/17/2019	COD (Cody, WY)	SEZ (Sedona, AZ)	1.7	3
8/17/2019	SEZ (Sedona, AZ)	SLC (Salt Lake City, UT)	1.1	0
8/18/2019	SLC (Salt Lake City, UT)	SAN (San Diego, CA)	1.6	2
8/18/2019	SAN (San Diego, CA)	SNA (Santa Ana, CA)	0.4	0
8/19/2019	SNA (Santa Ana, CA)	SFO (San Francisco, CA)	1.0	1
8/19/2019	SFO (San Francisco, CA)	SBA (Santa Barbara, CA)	0.8	0

⁸ Source: DPJ Crewmember Activity Summary

⁹ According to the DPJ FOM Section 10.2.1, it is the flight crew's discretion as to who is designated as PIC or SIC when two Captains are assigned to a trip. However, prior to a swap, the crew must notify the DPJ Flight Coordinator prior to a swap; the flight crew accomplished this notification.

¹⁰ Source: DPJ Flight Crewmember Activity Summary

8/20/2019	SBA (Santa Barbara, CA)	SNA (Santa Ana, CA)	0.5	0
8/20/2019	SNA (Santa Ana, CA)	VIS (Visalia, CA)	0.7	8
8/20/2019	VIS (Visalia, CA)	OVE (Oroville, CA)	0.7	8
8/21/2019	OVE (Oroville, CA)	PDX (Portland, OR)	--	8
8/21/2019	PDX (Portland, OR)	SAN (San Diego, CA)	--	--

Table 1: The flight crew's schedule (accident flight in red).

5.1 The Flight Crew's Duty Time and Opportunity for Rest

According to the DPJ Flight Crewmember Activity Summary, the day before the accident, the flight crew landed at OVE at 1804 and came off duty at 1935 local time. The flight crew's overnight hotel was in Chico, California, which according to the PIC took about 45 minutes to get to from OVE. The flight crew reported that they came on duty at 0900 the morning of the accident, which coincided with the time they began their drive back to the OVE airport. Table 2 shows the total duty day and rest overnight during their entire trip rotation.

Date	Total Duty Day ¹¹ (HH:MM)	Rest Overnight (HH:MM)
8/15/2019	15:22 (PIC ¹²) 11:42 (SIC)	11:21
8/16/2019	10:12	18:30
8/17/2019	09:00	12:30
8/18/2019	10:00	12:31
8/19/2019	12:29	15:24
8/20/2019	10:11	13:25
8/21/2019	--	--

Table 2: The flight crew's duty day and rest overnight.

The PIC reported that he recalled that the opportunity for rest was available throughout the trip and he did not recall feeling fatigued during the accident day.¹³ The PIC further reported that accident day was the 7th day of the trip and that when he saw the SIC in the morning at their hotel, the SIC could see he was "dragging," but he told the SIC that he was "good to go."

The SIC reported that he did not recall any issues with rest throughout the trip and added that he lived on the west coast and most of the trip overnights were in the time zone he was acclimated to.¹⁴

6.0 Weight and Balance

According to the DPJ Flight Operations Manual (FOM), the Captain, which was the PIC for the accident flight, was solely responsible for completing weight and balance and a load manifest was required for all flights.¹⁵ The PIC should normally submit the data to DPJ's Flight Operation System (FOS) from their company smart phone or Electronic Flight Bag (EFB).

According to DPJ's FAA operation specification (OpSpec) A097 and FOM, flight crews were permitted to use standard passenger and baggage weights, rather than weighing each passenger and

¹¹ On August 15, 2019, the flight crew departed from their respective home bases and their duty days were different. For the remainder of the 8-day trip, their duty days were the same. The duty time and rest overnight information was obtained from the DPJ Flight Crewmember Activity Summary.

¹² The PIC is in reference to who was the PIC during the accident flight.

¹³ Source: PIC interview transcript #2.

¹⁴ Source: SIC interview transcript #2.

¹⁵ Source: DPJ FOM Section 14.5.1.

bag.¹⁶ The FOM stated that utilizing standard weights was the primary method to complete weight and balance.

The FOM further stated that an alternative method to complete weight and balance was by using actual weights for the passengers and baggage. According to the FOM, the use of actual weights should be used if the weight and balance calculator is not available, or if the calculated center of gravity using standard weights is outside of the curtailed envelope, but within the certificated envelope.¹⁷ The FOM stated that standard weights cannot be used for some passenger or baggage, if actual weights are used for any passengers or baggage. The FOM stated that the one exception to this policy was for flight crew weights, as the Basic Operating Weight included the flight crew.¹⁸

The FOM stated that when actual passenger weights were used, the following means will be used to determine the weight:¹⁹

- Weighing the passenger
- Asking the passenger their weight and adding 10 lbs.
- Obtaining the actual weight from a current government issued ID
- Estimate the passenger weight and adding 10 lbs.

The PIC reported that he utilized passenger weights submitted via DPJ FOS, which coincided with their government issued identification listed weight. The PIC further reported that a scale was available for use in the cargo compartment of the airplane, but he did not weigh the bags with the scale prior to any flights with the passengers.²⁰

6.1 Weight and Balance Calculators

According to the FOM, the flight crew were required to use approved weight and balance calculators listed on the EFB Catalog of approved applications.²¹ The DPJ Director of Safety reported that two applications were permitted to be used; the iPreflight application-based program and the website based ARINC Direct. Both could be accessed via the flight crew EFB's.

6.2 Maintaining of Weight and Balance Calculators

According to the FOM, each calculator was preloaded with aircraft specific data, such as the basic empty weight (BEW) and weight and balance envelopes. The FOM stated that whenever the basic empty weight is updated, for events such as an equipment change, DPJ maintenance control was responsible for updating the weight and balance calculators to reflect the updated BEW.

¹⁶ For additional information on standard passenger and baggage weights, see FAA AC 120-27E Aircraft Weight and Balance Control (dated June 10, 2005).

¹⁷ According to the DPJ weight and balance substantiation report, the 'curtailed' center of gravity envelope accounted for flight crew and passenger movement, meaning that the certificated envelope was curtailed to permit the movement of flight crew and passengers within the cabin during flight.

¹⁸ According to the FOM, the basic operating weight (BOW) is the total of the operational empty weight, plus the flight crew. The standard weight of each flight crewmember was 190 lbs. Flight crew baggage was not included in the BOW and should be accounted for in the baggage.

¹⁹ Source: DPJ FOM, Section 14.5.6

²⁰ Source: PIC interview #2 transcript.

²¹ Source: DPJ FOM, Section 14.5.5.

Review of the weight and balance calculators found that the basic empty weight for the ARINC Direct reflected an outdated BEW of 12,693 lbs. The iPreflight application listed the accurate BEW²² of 12,716 lbs, which was an additional 23 lbs.

6.3 Maximum Certificated Weight Limitations

According to the Airplane Flight Manual²³, the following weight limitations were published:

WEIGHT LIMITATIONS	
Maximum Design Ramp Weight	20,200 Pounds
Maximum Design Takeoff Weight	20,000 Pounds
Maximum Design Landing Weight	18,700 Pounds
Maximum Design Zero Fuel Weight	15,000 Pounds
Minimum Flight Weight	12,400 Pounds
Maximum Tailcone Baggage Weight	700 Pounds
Takeoff weight is limited by the most restrictive of the following requirements:	
Maximum Certified Takeoff Weight	20,000 Pounds
Maximum Takeoff Weight Permitted by Climb Requirements	Refer to Procedures for Use of Takeoff Performance Tables in Section IV
Takeoff Field Length	Refer to Procedures for Use of Takeoff Performance Tables in Section IV
Landing weight is limited by the most restrictive of the following requirements:	
Maximum Certified Landing Weight	18,700 Pounds
Maximum Landing Weight Permitted by Climb Requirements or Brake Energy Limit	Refer to Procedures for Use of Approach and Landing Performance Tables in Section IV
Landing Distance	Refer to Procedures for Use of Approach and Landing Performance Tables in Section IV

Figure 2: Airplane Flight Manual Weight Limitations

6.4 The Original Weight and Balance Record

The PIC reported that he could not recall completing weight and balance the night before the accident, or the morning of the accident.²⁴ He reported that the day prior (August 19, 2019) to the flights commencing with the group of 8-passengers, he evaluated multiple weight and balance scenarios with the iPreflight and ARINC Direct calculators. He reported that he used standard passenger and baggage weights for some scenarios in iPreflight, where he received a warning that the airplane was over the zero fuel weight limitation, but within the center of gravity envelope, and under the maximum takeoff weight limitation.²⁵

The PIC reported that he then completed weight and balance scenarios with ARINC Direct utilizing actual passenger weights (as submitted by the passengers in the DPJ FOS) and his own estimation of passenger baggage weight. He initially utilized 300-400 lbs. for baggage weight in the cargo compartment, but still received a warning about being over zero fuel weight. He reported that he then completed weight and balance with 160 or 150 lbs. of baggage which reduced the zero fuel weight below the 15,000 lbs. limitation. He reported that he did not physically weigh the baggage prior to flight, but when he loaded them onto the airplane for a previous flight the day before the accident, he believed they were not heavy and were about what he estimated them to be (150-160 lbs.).

²² Source: The current BEW weight and balance document for the accident airplane

²³ Source: Airplane Flight Manual, page 2-3.

²⁴ Source: PIC interview #2 transcript.

²⁵ The FAA's Weight and Balance Handbook defined maximum zero fuel weight as the maximum authorized weight of an aircraft without fuel. This is the total weight for a particular flight minus the fuel. It includes the aircraft and everything that is carried on the flight except the weight of the fuel.

The original itemized weight and balance planning the Captain may have performed, was only retained locally within the pilot's EFB, which was destroyed in the post-crash fire. However, DPJ's FOS received the following limited weight and balance data sent by the flight crew for the accident flight and the preceding two flights with the 8-passengers:

SNA-VIS	
Gross Takeoff Weight	19,013 lbs.
Gross Landing Weight	17,617 lbs.
Center of Gravity	23.91

Table 3: FOS Data Received for Flight #1, with 8-Passengers

VIS-OVE	
Gross Takeoff Weight	18,998 lbs.
Gross Landing Weight	17,739 lbs.
Center of Gravity	23.75

Table 4: FOS Data Received for Flight #2, with 8-Passengers

OVE-PDX	
Gross Takeoff Weight	18,998 lbs.
Gross Landing Weight	17,739 lbs.
Center of Gravity	23.75

Table 5: FOS Data Received for Flight #3 (Accident Flight), with 8-Passengers

The data submitted by the flight crew for the accident flight was identical to the data sent from the previous flight flown. The zero fuel weight was not retained in DPJ's FOS.

6.5 DPJ Recreation of the Weight and Balance (Standard Weights)

The DPJ Captain/line check airman assigned to the NTSB operations group was asked to recreate the weight and balance for the accident flight utilizing standard weights in ARINC Direct and iPreflight. The recreation results showed that the iPreflight and ARINC Direct calculators provided a warning that the weight was over the maximum Zero Fuel Weight by 98 lbs, but the airplane was within the maximum allowable takeoff weight and center of gravity limitations.²⁶

6.6 DPJ Recreation of the Weight and Balance (Actual Weights)

The passengers were requested to submit their weight and estimated weight of their baggage, as the majority of the baggage was consumed by the post-crash fire and could not be weighed by the investigative team. Utilizing the passenger self-reported weights, the DPJ Captain assigned to the NTSB operations group was asked to recreate the weight and balance for the accident flight utilizing the actual weights in ARINC Direct and iPreflight.²⁷ The recreation results showed that the iPreflight and ARINC Direct calculators provided a warning that the weight was over the maximum Zero Fuel Weight by 92 lbs., but the airplane was within the maximum allowable takeoff weight and center of gravity limitations.²⁸

²⁶ The ARINC Direct application stated that the airplane was over maximum zero fuel weight by 75 lbs., rather than 98 lbs., due to the inaccurate basic empty weight listed in the ARINC Direct system.

²⁷ The carry-on baggage weights reported were added to the passenger weights.

²⁸ The ARINC Direct application stated that the airplane was over maximum zero fuel weight by 69 lbs., rather than 92 lbs., due to the inaccurate basic empty weight listed in the ARINC Direct system.

6.7 Recreation of Weight and Balance (Actual Weights for Occupants and Baggage)

The weight and balance utilizing actual weight and balance for the flight crew, passengers, and reported baggage weight was calculated with a weight and balance spreadsheet provided by Textron Aviation. Table 6 details the results.

Accident Aircraft Weight and Balance ²⁹			
	Weight	Arm	Moment
Basic Empty Weight	12716	336.5416	4279463
Left Seat Pilot	280	143.9	40292
Right Seat Pilot	229	143.9	32953
Seat 9 Side Facing Seat	190	179.92	34185
Seat 10 Side Facing Seat	184	203.9	37518
Seat 3	175	229.46	40156
Seat 4	200	229.46	45892
Seat 5	198	283.65	56163
Seat 6	180	283.65	51057
Seat 7	220	327.18	71980
Seat 8	148	327.18	48423
Chart case	20	158.1	3162
LH Ref ctr	45	173.2	7794
RHF closet		165.6	0
RHA mag rack		339.8	0
LHA storage		357.5	0
AFT closet	20	374	7480
Baggage Compartment	337	431	145247
Zero Fuel Weight	15,142		
Takeoff Fuel	3970		1373912
Takeoff Weight	19,112	328.36	6275675
		C/G	

Table 6: Recreation of Weight and Balance Utilizing Actual Weights for All Occupants and Baggage

²⁹ The flight crew weights were obtained from their FAA medical certificates. The passengers reported their weight to the NTSB via interviews after the accident. The passenger's carry-on baggage was added to their seats. The passengers reported 240 lbs. of luggage that was stowed in the baggage compartment, and the flight crew bags were estimated to weigh a total of 60 lbs. According to a DPJ weight and balance document, the accident airplane was equipped with 122 lbs. of aircraft items that were not accounted for in the basic empty weight. These items were distributed throughout the cabin and cargo in this calculation, as their exact location could not be determined due to the post-crash fire.

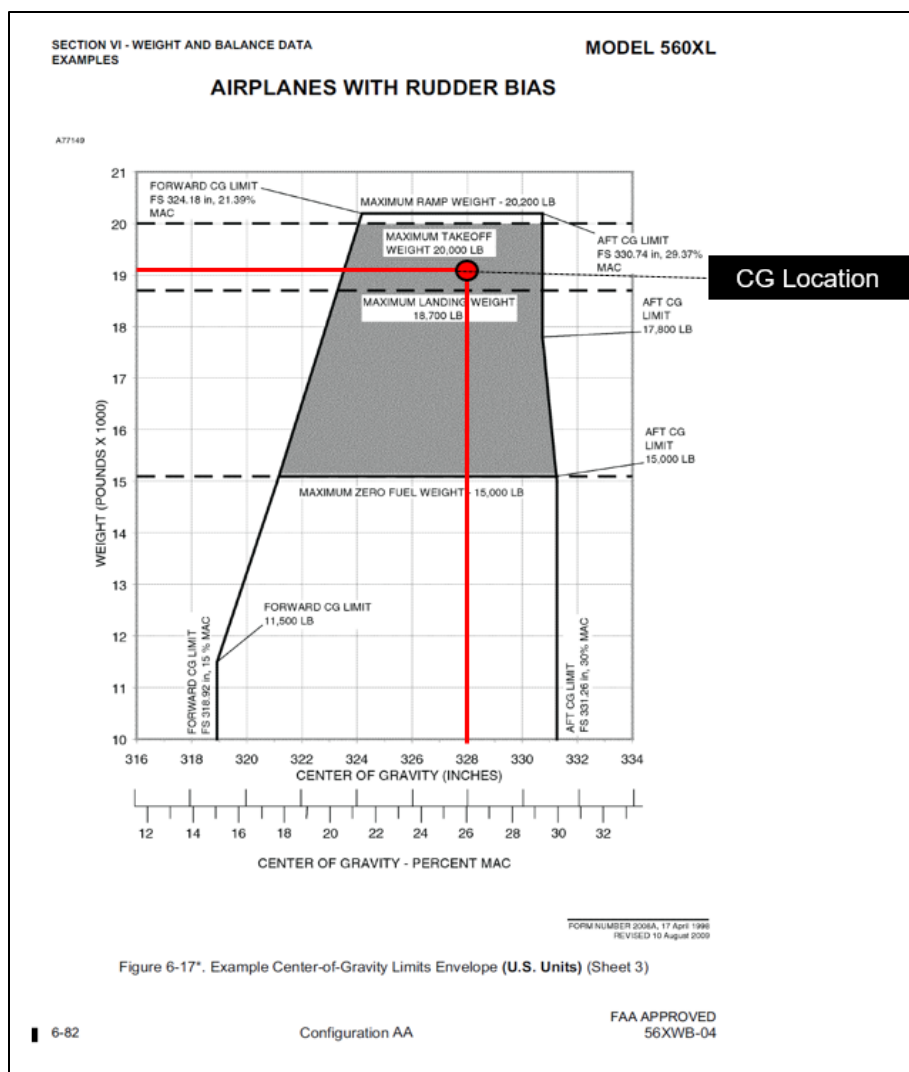


Figure 3: Center of Gravity Location Utilizing Actual Weights for all Occupants and Baggage

The recreation of weight and balance utilizing the actual reported weights for all passengers and baggage resulted in the airplane being 142 lbs. over the maximum zero fuel weight limitation of 15,000 lbs. The takeoff weight was 19,112 lbs., which was under the maximum takeoff weight of 20,000 lbs., and according to the AFM center of gravity envelope, the airplane was within the limits.

7.0 Meteorological Information

The 1153 recorded weather observation at OVE, included wind variable at 3 knots, clear sky, and visibility 10 statute miles. The temperature was 28° C, the dew point was 14° C; and the altimeter setting was 29.94 inches of mercury. The density altitude was 1,700 ft mean sea level.

8.0 Airport Information

The OVE airport was an uncontrolled airport with no Air Traffic Control (ATC) tower that had two runways available for takeoff and landing. According to surveillance video, the airplane parked on the ramp area in front of the fixed-base operator terminal building overnight. The airplane taxied to runway 2, via the parallel taxiway to runway 2-20 and subsequently held short of runway 2. The

accident flight subsequently departed runway 2, which was 6,020 ft long.³⁰ According to the DPJ FOM and OpSpec A009 Airport Aeronautical Data, Jeppesen navigation charts were approved and provided to the flight crew via the Electronic Flight Bag (EFB). The airport diagram denoting the parking location, taxi route, and takeoff direction is referenced in Figure 4.

³⁰ For detailed pictures of the runway environment, reference the NTSB Drone Factual Report in the public docket for this investigation.

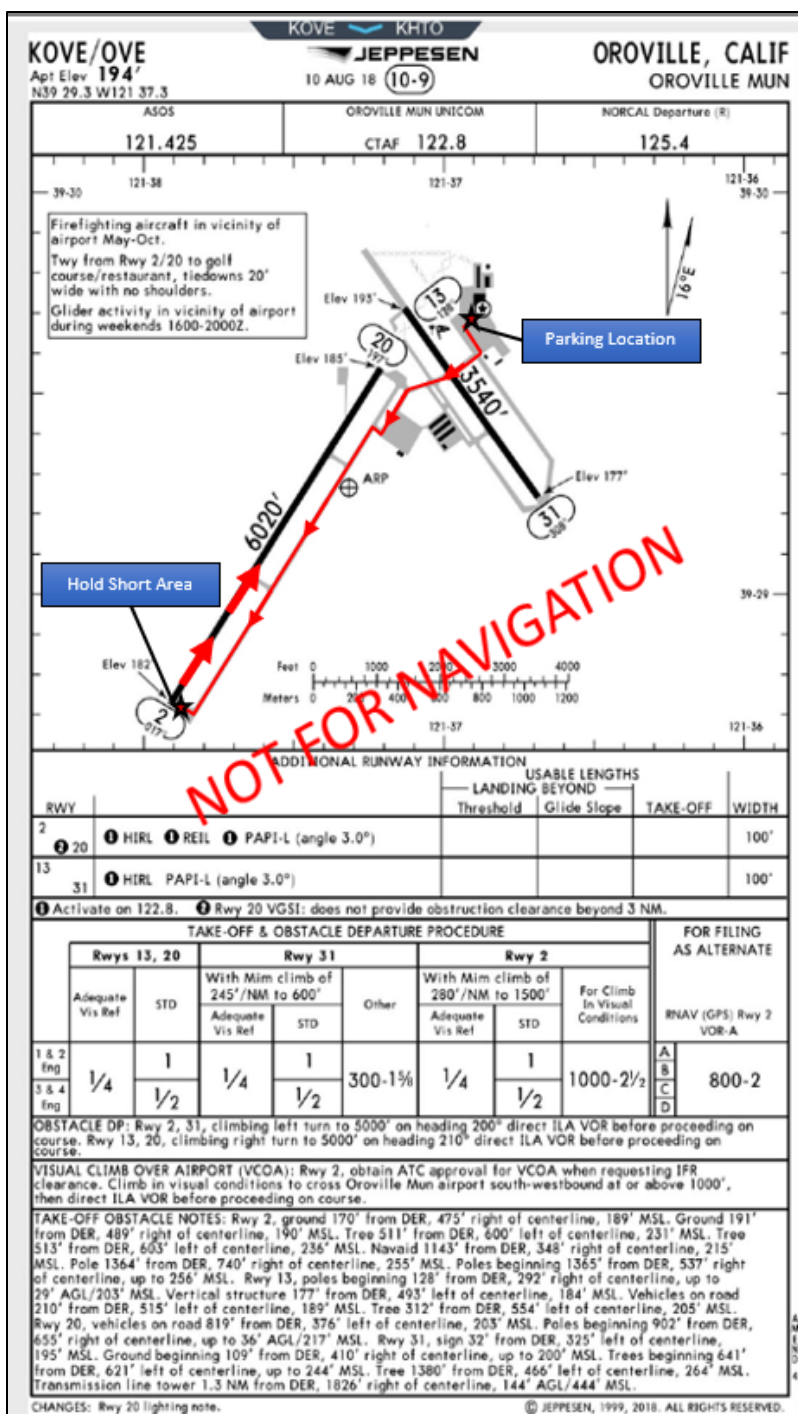


Figure 4: The OVE Airport Diagram and Taxi Route

9.0 Takeoff Performance Definitions

According to the airplane's AFM, the following definitions were provided regarding takeoff V-speeds:

V1 Takeoff Decision Speed: The distance to continue the takeoff to reference zero will not exceed the scheduled takeoff field length if recognition occurred at V1 (accelerated-go).

The distance to bring the airplane to a full stop (accelerated-stop) will not exceed the scheduled takeoff field length provided that maximum brakes are applied at V1.

VR Rotation: The speed at which rotation is initiated during takeoff to attain the V2 climb speed at or before a height of 35 feet above runway surface has been reached.

V2 Takeoff Safety Speed: This climb speed is the actual speed at 35 feet above the runway surface as demonstrated in flight during takeoff with one engine inoperative.

Takeoff Field Length: The Takeoff Field Length given for each combination of gross weight, ambient temperature, altitude, wind and runway gradients is the greatest of the following:

- a. 115% of the two-engine horizontal takeoff distance from start to a height of 35 feet above runway surface.*
- b. Accelerate-stop distance. Wet or dry runway, as appropriate.*
- c. The engine out accelerate-go distance to 35 feet for dry runways and 15 feet for wet runways.*

No specific identification is made on the charts as to which of these distances governs a specific case.

9.1 Takeoff Performance

The takeoff and landing data with environmental and weight conditions experienced during the accident flight was recreated by using a Textron Aviation performance calculator. The following data was generated for the accident flight and is detailed in table 8.

Takeoff Performance (Citation Excel)	
Condition	
Departure Airport, Runway	OVE, runway 02
Available Takeoff Runway Length	6,020 ft
Runway Gradient	0.05%
Runway Surface	Dry, Paved
Airport Elevation	194 ft
Altimeter Setting	29.94inHG
Outside Air Temperature	28° C
Wind Direction/ Speed ³¹	200° / 3 knots
Obstacle Analysis	No obstacle
Takeoff Flap Setting	7°
Anti-ice Setting	Off
Takeoff Weight	19,112 lbs.
Takeoff Performance to 35ft Output	
N1 Setting	89.1%
V1 / VR / V2	106 / 106 / 123 Knots Indicated
Takeoff Field Length Required	4,638 ft

Table 7: Takeoff Performance Data

³¹ Review of surveillance video that showed the accident airplane's departure also showed the airport's windsock, which was indicating a light quarterly tailwind.

The performance calculations revealed that the takeoff field length was 4,638 ft. The actual takeoff and landing data performed by the flight crew was retained locally on their EFB's, which were consumed by the post-crash fire.

10.0 DPJ's Electronic Flight Bag (EFB) Program

According to DPJ's OpSpec A061, flight crew were permitted to use EFB's during flight operations. The DPJ FOM stated in part, flight crews should use EFB's, which were iPads, as the primary reference for navigation, terminal chart information, and manuals.

10.1 DPJ's EFB Program Application

The FAA certificate managing office provided the original DPJ EFB program application that was used to approve their EFB program. The application was submitted in February 2012 and utilized a series of evaluation checklist items to determine if EFB's were suitable for flight operations. The application was reviewed to determine how EFB's may be secured and viewable during all flight operations. The following excerpts were stated in the application:

EFB Evaluation Question	YES	NO
<i>"7. Does the EFB mount³² allow appropriate access to flight controls and displays?"</i>	X	
<i>"9. Are crews able to adjust and lock the EFB for optimal viewing?"</i>	X	
<i>"24. Can the kneeboard EFB be positioned such that the pilot has full control authority?"</i>	X	

Table 8: Excerpts from EFB Evaluation Question Checklist

10.2 DPJ's EFB Securing Policy

According to statements provided by the flight crew, neither EFB mounts nor kneeboards, were used during the accident flight. Both flight crew additionally reported that they had used kneeboards during past flights in the CE-560XL, but both experienced issues with the EFB interfering with the full movement of the flight controls.

According to the DPJ FOM, "EFB's should be hand-held while conducting briefings. This improves communication and reduces "heads down" situations." The FOM further stated in part: "Each EFB must be secured prior to takeoff and landing. Securing methods include placing the EFB in the mount or stowing. Use of leg mount is sufficient." The FOM further stated that "RAM Mount suction cup securing devices" may be used.

According to the CE-560XL DPJ line check airman assigned to the operations group, with exception to a kneeboard, suction cup style mounts, or other types of mounts, were not commonly used during line operations on the CE-560XL. Consistent with the accident flight crew report, the line check airman also reported that he had experienced that the kneeboard would interfere with the full movement of flight controls when used in CE-560XL flight operations.³³ In Figure 5, red circles note the position the line check airman commonly observed EFB's placed during flight.

³² An email memorandum dated February 14, 2012, the DPJ Director of Operations (at that time) clarified 'mount' to mean 'kneeboard.'

³³ Source: NTSB Memorandum for Record, Background on EFB Usage



Figure 5: Red circles denoting the common placement of EFB's in the CE560XL cockpit.

10.3 DPJ's Chart and Map Utilization Policy

The DPJ FOM stated in part that for all operations, “pilots will have adequate charts available for immediate reference. Strict adherence to Minimum Safe Altitudes will be conducted in reference to Airway, SID/ STAR, and Approach charts as applicable to the phase of flight.”

10.4 FAA EFB Advisory Circulars

The FAA Advisory Circular (AC) 120-76A, Guidelines for the Certification, Airworthiness, and Operational Approval of Electronic Flight Bag Computing Devices, issued in March 2003, was in effect at the time the operator applied for approval of an EFB program.

The FAA AC stated in part:

PURPOSE. This joint Flight Standards Service (AFS) and Aircraft Certification Service (AIR) advisory circular (AC) provides an acceptable method of compliance for the certification, airworthiness, and the operational approval of both portable and installed Electronic Flight Bag (EFB) aircraft computing devices. This AC does not constitute a regulation but sets forth an acceptable means, but not the only means, for operators conducting flight operations under Title 14 of the Code of Federal Regulations (14 CFR) part 91, 121, 125, 129, or 135, to obtain both certification and approval for the operational use of EFBs.

The AC provided the following definition³⁴:

Mounting Device. May include arm-mounted, kneeboard, cradle, or docking-stations, etc. May have ship's power and data connectivity. May require quick-disconnect for egress.

³⁴ Source: FAA Advisory Circular (AC) 120-76A, Guidelines for the Certification, Airworthiness, and Operational Approval of Electronic Flight Bag Computing Devices, pages 2, 11, 16

Additional guidelines were provided as it related to EFB system design and Usability, which stated in part:

EFB System Design and Usability

(2) Design of Mounting Device. The mounting device (or other securing mechanism) that attaches or allows mounting of the EFB system may not be positioned in a way that obstructs visual or physical access to aircraft controls and/or displays, flightcrew ingress or egress, or external vision. The design of the mount should allow the user easy access to the EFB controls and a clear view of the EFB display while in use. The following design practices should be considered:

(a) The mount and associated mechanism should not impede the flightcrew in the performance of any task (normal, abnormal, or emergency) associated with operating any aircraft system.

Stowage Area for EFB Systems. A stowage area with a securing mechanism for these EFBs is recommended for storage of portable units when they are not in use. EFB systems that are not secured in a mounting device during use should be designed and used in a manner that prevents the device from jamming flight controls, damaging flightdeck equipment, or injuring flight crewmembers should the device move about as a result of turbulence, maneuvering, or other action.

Placement of Mounting Device. The device should be mounted so that the EFB is easily accessible when stowed. When the EFB is in use and is intended to be viewed or controlled, it should be within 90 degrees on either side of each pilot's line of sight. If an EFB is being used to display flight critical information such as for navigation, terrain and obstacle warnings that require immediate action, takeoff and landing V-speeds, or for functions other than situational awareness, then such information needs to be in the pilot's primary field of view.

11.0 Relevant Airplane Systems

The Cessna Model 560 Excel was certified in accordance with 14 CFR Part 25 airworthiness standards. Figure 6 provides a three view of the airplane.

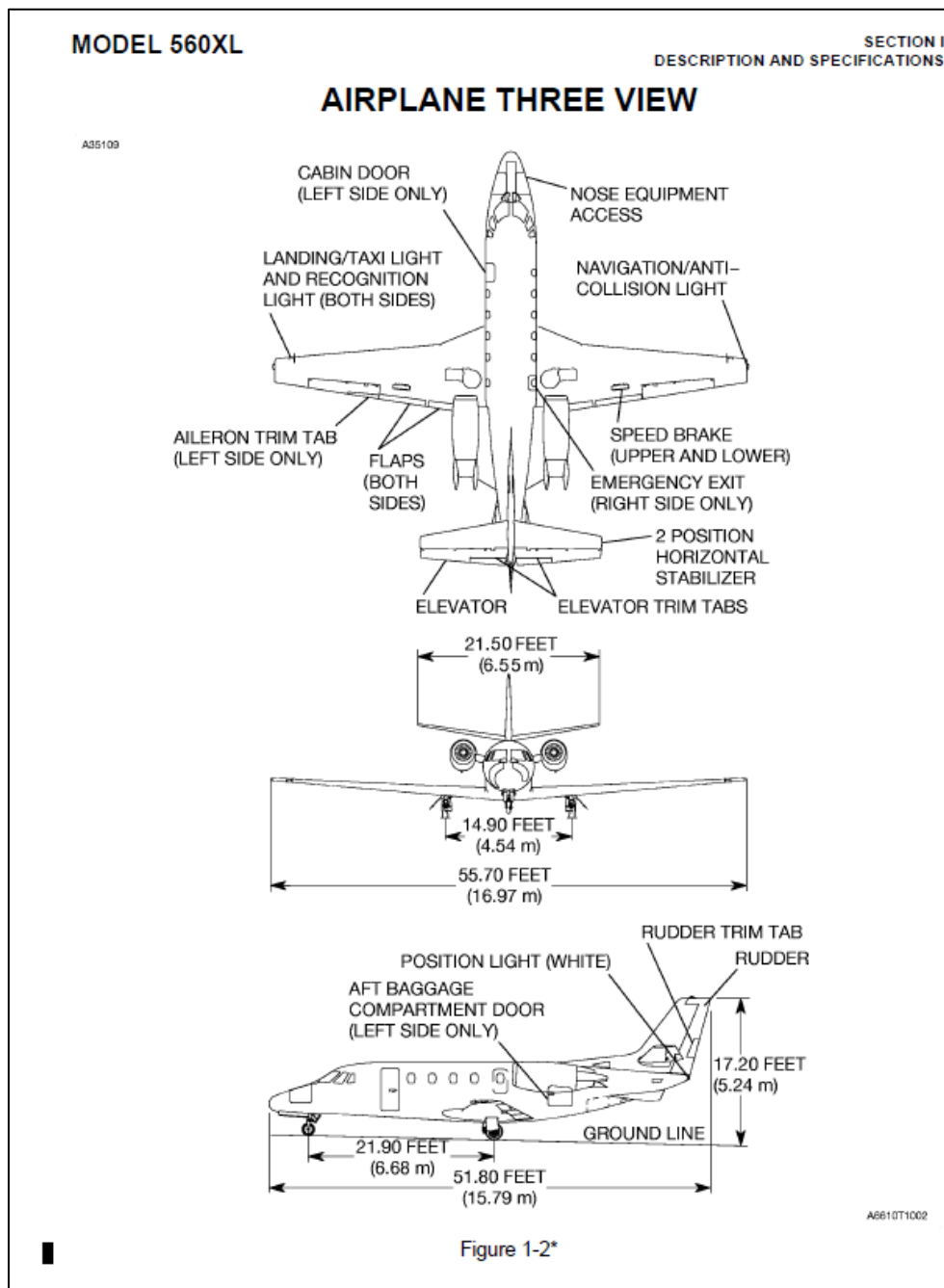


Figure 6: Operating Manual Three View of Airplane³⁵

11.1 Flight Controls³⁶

Primary flight control was accomplished through conventional cable-operated surfaces. Trimming was provided by aileron, elevator, and rudder tabs. Hydraulically operated speed brakes were installed on the upper and lower surface of both wings. The horizontal stabilizer with a two-position angle-of-incidence setting (cruise versus takeoff/landing) was hydraulically actuated. Trailing edge

³⁵ Source: Airplane Operating Manual, Page 1-9/1-10.

³⁶ Source: Airplane Operating Manual, Page 2-32.

flaps were powered hydraulically. Nose wheel steering was mechanically controlled by the rudder pedals.

11.2 Hydraulics³⁷

Engine-driven pumps supplied pressure for operation of the landing gear, flaps, thrust reversers, horizontal stabilizer actuator and speed brakes through an open center system. The main gear was equipped with wheel brakes actuated hydraulically from a separate, closed system. Pneumatic backup was available for landing gear extension and braking.

11.3 The Parking Brake³⁸

The parking brake was a part of the normal brake system and employed controllable check valves that could prevent the return of fluid after the brakes were set. The parking brake is set by depressing the toe brakes and pulling out the black parking brake handle. Figure 7 denotes the complete description of the parking brake valve as stated in the airplane operating manual.

During a post-accident examination and test of an exemplar CE-560XL parking brake system, it was determined that the parking brake power (or resistance) could vary. The parking brake power ultimately was dependent upon the force applied to the toe brakes, prior to pulling the parking brake lever.³⁹

PARKING BRAKE VALVE

The parking brake is a part of the normal brake system and employs controllable check valves that can prevent the return of fluid after the brakes have been set. Parking brakes are set by depressing the toe brakes and pulling out the black parking brake handle located under the lower left side of the instrument panel. The parking brake should not be set if the brakes are very hot. This increases brake cool-down time due to decreased airflow, and may result in sufficient heat transfer from the brakes to cause the parking brake thermal relief valves to open or to melt the thermal relief plugs in the wheel, causing deflation of the tire.

Figure 7: The Airplane Operating Manual, Parking Brake Valve Section

Review of the airplane operating manual, flight manual and normal checklist procedures manual found that there was no guidance on how a pilot may achieve maximum brake pressure (stopping power) through the use of the parking brake as it relates to the toe brake pressure required, prior to manipulating the parking brake lever.

11.3.1 Parking Brake Lever Location

The parking brake lever was a black push-pull lever located in the lower left side of cockpit. Figure 8 notes the location of the lever in the cockpit as referenced in the exemplar cockpit photo.

³⁷ Source: Airplane Operating Manual, Page 2-25.

³⁸ Source: Airplane Operating Manual, Page 2-27

³⁹ Reference the NTSB Systems Group factual report in the public docket for this investigation.



Figure 8: Overview of exemplar cockpit and location of parking brake lever

Figure 9 and 10 show an exemplar parking brake lever, in the set (on) and stowed (off) position. The parking brake lever extends to a length of about 4 inches when set (on).



Figure 9: Exemplar parking brake lever, extended (On)



Figure 10: Exemplar parking brake lever, stowed (Off)

11.3.2 Use of Parking Brake During the Accident Flight⁴⁰

During post-accident interviews, the flight crew was questioned about the operation of the parking brake throughout the flight. The flight crew reported that the parking brake was set the night before the accident, and the SIC added that when he completed his preflight duties the morning of the accident, he reset the parking brake, by stowing the lever, re-applying toe brake pressure, and re-engaging the lever.

The PIC reported that due to the congested ramp area at OVE, he performed the rudder bias check while holding short of runway 2.⁴¹ In addition, there was a short delay in receiving their ATC clearance to depart OVE while holding short of runway 2. For those two reasons, the PIC believed he would have set the parking brake while holding short of the runway. The PIC was asked if he had any recollection turning the parking brake off prior to takeoff, and he stated, “I do not.” He was further asked if he believed the parking brake was on, or engaged for takeoff, and he stated, “I do not, but I don’t know.”

⁴⁰ Source: PIC and SIC interview transcript #2.

⁴¹ Refer to section 13.6 in this report for further description of the rudder bias check.

The PIC was asked how he normally remembered to stow the parking brake if he sets it in the hold short runway area. He stated that he typically announced the parking brake setting to the SIC by stating, “parking brake on, parking brake off,” but for the accident flight, he stated, “I wouldn’t have probably verbalized it because he’s [SIC] on the phone.”⁴² The SIC stated that he could not recall any parking brake callouts during the accident flight.

The PIC was asked how he normally engaged the parking brake. He stated that he normally pressed on the toe brakes enough to stop the airplane’s taxi movement, and then pushed the toe brakes “a little bit more” and pulled the lever. He added that “you’re not standing on them [toe brakes].” He reported that he had no issues disengaging the parking brake prior to the taxi and noticed no abnormalities with the airplane and how it was rolling or taxiing to runway 2. The PIC reported that it was his understanding that if the parking brake was set on the CE-560XL, the airplane “shouldn’t move” even with takeoff power applied. The SIC reported that “I have no expectations for anything” when asked if he believed the airplane could move with the parking brake engaged.

11.4 Annunciator Panel

The airplane was equipped with an annunciator panel located in the upper center section of the cockpit instrument panel. Takeoff could not be initiated⁴³ with a red annunciator illuminated or an amber annunciator illuminated unless the associated system or component was deferred per an approved Minimum Equipment List (MEL). The airplane operating manual stated in part: ⁴⁴

ANNUNCIATOR PANEL

The annunciator panel is designed to provide the pilot with an easily interpreted display of both normal and abnormal system conditions. Two flashing master warning lights (MASTER WARNING RESET) are used in conjunction with the panel to ensure rapid recognition of any red annunciator light. In addition, the master warning light will flash if both amber GEN OFF lights should illuminate.

The master warning lights can be reset by pressing either light. Resetting the master warning light rearms the system so that it will function should another failure occur. The annunciator system is powered from the main direct current (DC) buses through the WARN LTS 1 and 2 circuit breakers on the left cockpit panel. All system light bulbs can be tested by placing the rotary TEST selector on the center pedestal to the ANNU position. This will illuminate all lights and cause the master warning lights to flash.

Burned out bulbs can be replaced by pushing in the light assemblies to the left and right of the failed bulb; then use a tool to remove the assembly with the burned out lamp. If the MASTER WARNING light illuminates in a steady mode, it indicates that there has been a loss of power to the annunciator panel from either the left or right DC electrical bus.

Figure 11 and 12 denotes the location and overview of the panel.

⁴² The SIC reported that he utilized his company cell phone during taxi to obtain the air traffic control departure clearance.

⁴³ Source: Airplane Flight Manual, page 2-13.

⁴⁴ Source: Airplane Operating Manual, page 2-69.

[illegible]

WPR19FA230

the master caution will cause the flashing annunciator to change to steady on and the master caution to extinguish.

According to the AFM that applied to the accident airplane, the following procedure was associated with the No Takeoff Annunciator light in the cockpit:

■ NO TAKEOFF (NO TAKEOFF WARNING)		
1. Takeoff		ABORT
2. Flap Position		CHECK
3. Speed Brakes		RETRACT
4. Elevator Trim		CHECK
5. STAB MIS COMP Annunciator		CHECK
PROCEDURE COMPLETED		

Figure 13: No Takeoff Warning Conditions and Procedures

An exemplar CE-560XL annunciator panel was photographed by the NTSB operations group chairman. Figure 14 shows an exemplar No Takeoff annunciator light, located near the center of the annunciator panel in the center of the cockpit panel.

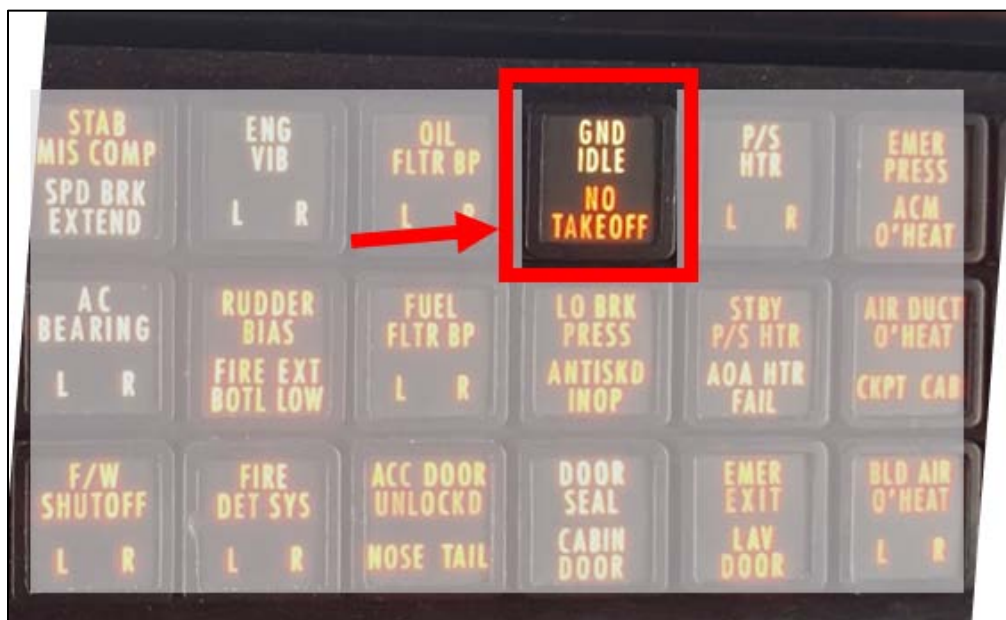


Figure 14: Exemplar No Takeoff Annunciator

According to the CVR Factual Report, about one minute and 30 seconds prior to takeoff, the flight crew discussed a no takeoff annunciator illuminated in the cockpit and that the autopilot had engaged. The flight crew discussed that an iPad (EFB) had accidentally shifted and engaged the autopilot. Subsequently, a sound consistent with the autopilot being disconnected was heard.

11.4.2 CE-560XL Airplane Flight Manual Supplements

Review of the AFM found that some CE-560XL airplanes incorporated the parking brake position into the no takeoff warning annunciator. The CE-560XL AFM Supplement 39 approved in February 2002, which was not applicable to the accident airplane, stated in part:⁴⁶

⁴⁶ Source: Airplane Flight Manual, pages S39-1, 5.

AIRPLANES CERTIFIED TO IRISH CONFIGURATION

This FAA Approved Airplane Flight Manual Supplement is approved by the U.S. Federal Aviation Administration (FAA) on behalf of the Irish Aviation Authority (IAA) in accordance with Irish Civil Airworthiness Requirements. This Supplement was prepared in accordance with FAA requirements of 14 CFR 25, FAA Special Conditions and 14 CFR 36 Noise Standards.

INTRODUCTION

This supplement is part of, and must be placed in, the basic FAA Approved Airplane Flight Manual for airplanes certified to Irish configuration. The information contained herein supplements the information in the basic FAA Approved Airplane Flight Manual. For limitations, procedures and performance information not contained in this supplement, consult the basic FAA Approved Airplane Flight Manual. References to United States FAR operating rules may not be applicable. Refer to appropriate applicable operating rules.

A review of Supplement 39 revealed that the no takeoff warning conditions and procedures included the parking brake.

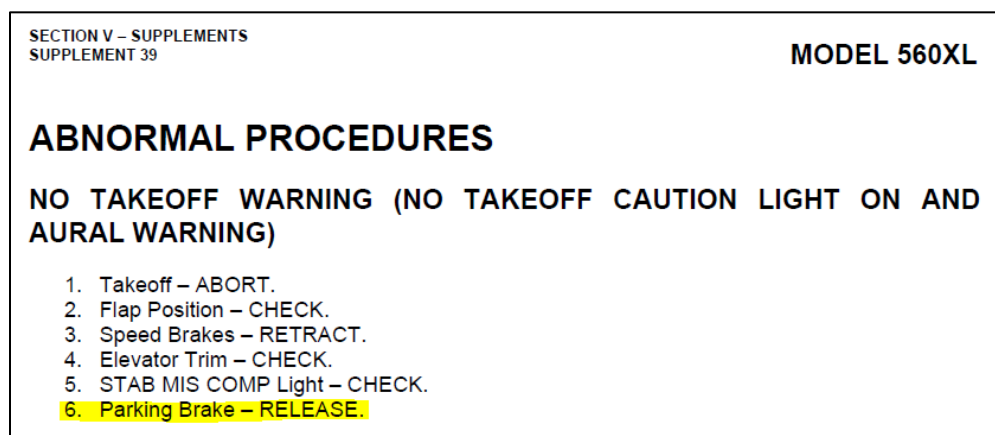


Figure 15: AFM Supplement 39, No Takeoff Warning Procedures

The CE-560XL AFM Supplement 57 approved in June 2007, which was also not applicable to the accident airplane, stated in part:⁴⁷

AIRPLANES BUILT TO THE U.K. BUILD STANDARD

This Airplane Flight Manual Supplement is approved by the US Federal Aviation Administration (FAA) on behalf of the European Aviation Safety Agency (EASA).

INTRODUCTION

This supplement is part of and must be placed in the FAA Approved Airplane Flight Manual for airplanes built to the U.K. Build Standard. The information contained herein supplements the information of the basic FAA Approved Airplane Flight Manual. For

⁴⁷ Source: Airplane Flight Manual, pages S57-1, 5.

limitations, procedures and performance information not contained in this supplement, consult the basic FAA Approved Airplane Flight Manual.

A review of Supplement 57 revealed that the no takeoff warning conditions and procedures included the parking brake.

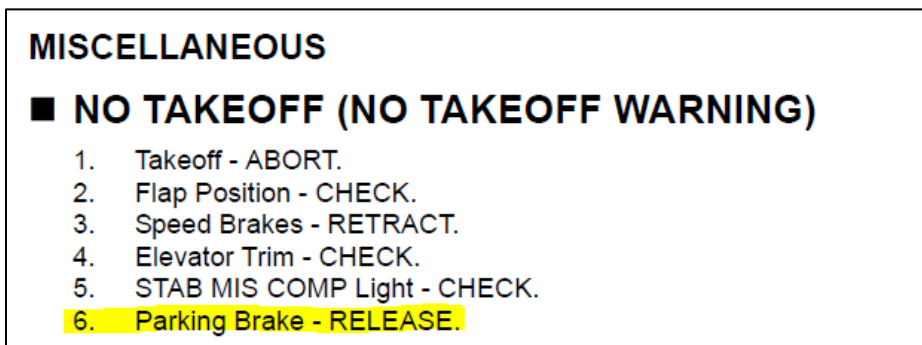


Figure 16: AFM Supplement 57, No Takeoff Warning Procedures

11.5 Cabin Door⁴⁸

The passenger/crew entry door was located on the left side of the fuselage at the forward end of the passenger compartment. The door could be opened from either the inside or the outside of the airplane. The air stair door, when opened, served as steps into the interior of the airplane.

11.6 Emergency Exit

A removable emergency exit door was located on the right side of the fuselage at the aft end of the passenger compartment. The aft most right passenger compartment window was located in the door. The door was of the plug type and was installed or removed from inside the airplane. The exit was an alternate to the cabin door and was not used during the emergency evacuation.

11.7 Autopilot Control Panel⁴⁹

The autopilot control panel, mounted at the aft end of the center pedestal between the two pilot seats, provided the means of engaging the autopilot and yaw damper, as well as manually controlling the autopilot through the turn knob and pitch wheel. The autopilot (AP) engage switch was used to engage the autopilot and yaw damper.

The turn knob located within the autopilot control panel allowed manual bank control of the airplane proportional to and in the direction of knob movement. Turns with a maximum bank angle of 30° could be performed with the turn knob. The turn knob must be in the center detent position before the autopilot could be engaged. Rotation of the turn knob out of detent canceled any other previously selected lateral mode.

⁴⁸ Source: Airplane Operating Manual, Page 1-4.

⁴⁹ Source: Airplane Operating Manual, Page 3-41.

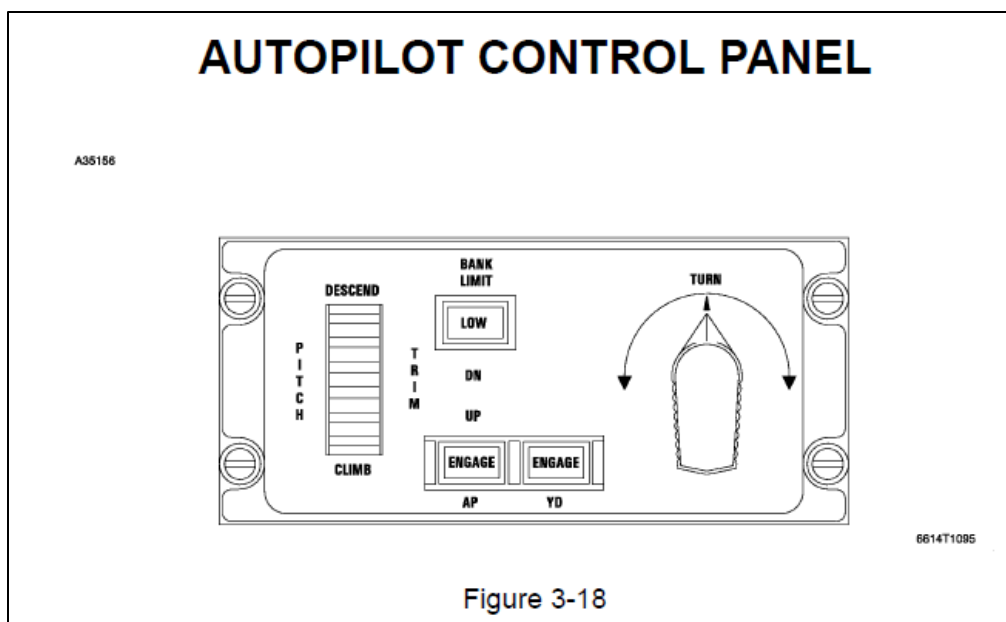


Figure 17: Autopilot Control Panel (Airplane Operating Manual)

When the autopilot turn knob is out of center, an amber TRN KNB will annunciate on the primary flight display (PFD), and the autopilot will not engage when the turn knob is out of center. Figure 18 displays an exemplar TRN KNB amber annunciation.

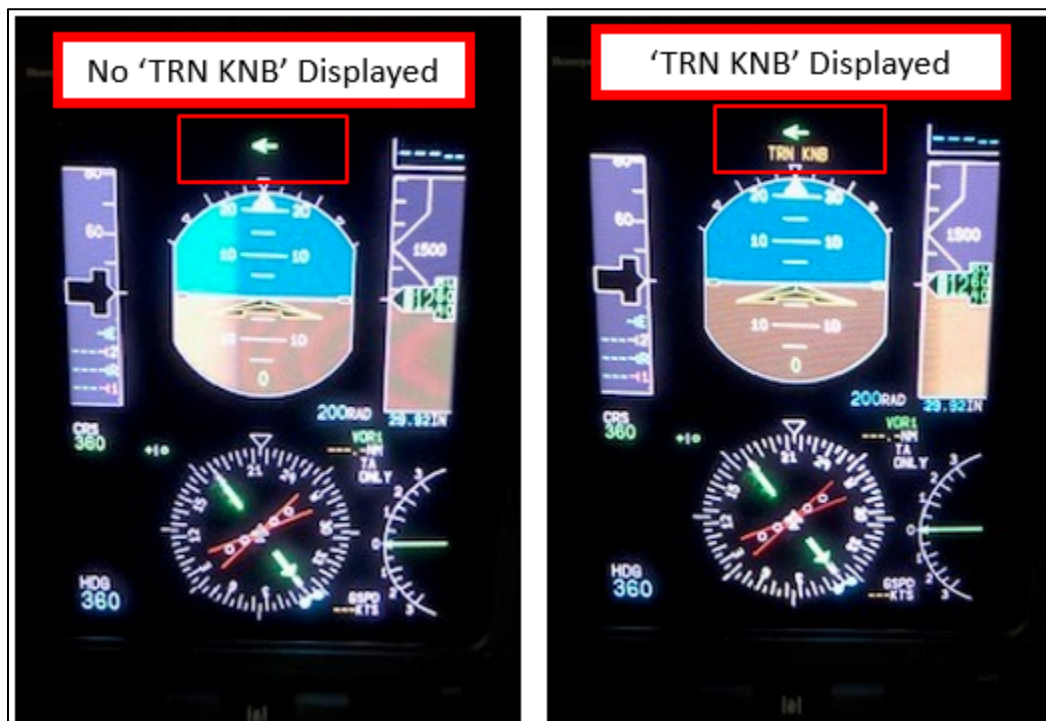


Figure 18: Exemplar Turn Knob Annunciator Message

According to the CVR Factual Report, about 30 seconds prior to the application of takeoff thrust, the flight crew discussed a turn knob annunciator that had illuminated in the cockpit. The SIC discussed that he did not know the meaning of the message and asked whether the PIC wanted to

continue with the flight. The PIC responded affirmatively and stated they would resolve the issue later. Takeoff thrust was set about 7 seconds later.

12.0 Relevant Normal Procedures

12.1 Checklist Usage Instructions⁵⁰

The DPJ Standard Operating Procedures (SOPs) CE-560XL manual provided general instructions to flight crew on how checklists will be accomplished. The SOPs stated in part that when two flight crewmembers are on the flight deck, the checklist “will be read aloud.” The DPJ SOPs also provided flows that corresponded to checklist tasks, such as how to complete the before takeoff checklist. The DPJ SOPs required that “the crew will use the checklist on every flight and for every phase of flight for which a checklist has been established.”

The normal CE-560XL checklist required to be used by the flight crew was produced by DPJ, as adapted from the airplane flight manual checklist, and was accepted by the FAA certificate managing office in May 2017. The checklist was revision 1, dated April 20, 2017. The checklist stated that flight crew will use “Approved Cessna Checklist for External and Interior Preflight, and Emergency and Abnormal procedures.” The CE-560XL normal procedures Cessna Pilot’s Checklist and the DPJ checklist were reviewed in this section.

12.2 Switch Movement/ System Manipulation⁵¹

The DPJ SOP’s CE-560XL manual stated in part that “with the exception of an individual flight crewmember’s own display and radio settings, and aside from checklist items, no switches should be moved or systems manipulated without advising the other flight crewmember regardless of seat position or PM/ PF designation. This policy ensures that both flight crewmembers remain aware of the current status of all systems at all times and promotes a healthier CRM environment.”

12.3 DPJ Normal Checklist Definitions

The DPJ SOP’s CE-560XL manual defined the abbreviations included in the normal checklist:

- PIC: Means the company designated Pilot in Command
- SIC: Means the company designated Second in Command
- PF: Means the pilot flying
- PM: Means the pilot monitoring
- LP: Means the pilot in the left seat
- RP: Means the pilot in the right seat
- B: Means both pilots

12.4 Before Start Checklist

The before start checklist called for the parking brake to be set by the pilot seated in the left seat. Figure 19 denotes the complete before start checklist:

⁵⁰ Source: DPJ SOP CE-560XL manual, section 2.1.1.

⁵¹ Source: DPJ SOP CE-560XL manual, section 2.1.4.

BEFORE START	
PARKING BRAKE.....	SET (L)
STEERING PIN.....	INSTALLED (B)
WHEEL CHOCKS.....	REMOVED
FUEL PANEL DOOR.....	CHECKED (B)
WINDOWS.....	CLOSED AND LOCKED (B)
FUEL QUANTITY.....	VERIFIED (B)
CREW BRIEFING.....	COMPLETE (FP)
PASSENGER BRIEFING.....	COMPLETE (L)
DEPARTURE MESSAGE/PHONES.....	SENT/OFF (B)
ENGINE FANS.....	ROTATING FREELY (L)

Figure 19: DPJ's Before Start Checklist

There was no checklist flow provided in the DPJ CE-560XL SOP's for the before start checklist.

The Cessna Pilot's Checklist called for the "park brake" to be set during the "Before Starting Engines Checklist." There were no further references in the Cessna Pilot's Checklist to the "park brake" until the shutdown checklist.

MODEL 560XL		NORMAL PROCEDURES
BEFORE STARTING ENGINES		
1. Passenger Briefing	COMPLETED	
2. BATT Switch	ON (check 24 Volts)	
3. GEN Switches	ON (OFF if GPU start)	
4. EMER LTS Switch	ARM	
5. PARK BRAKE	SET	
6. Wheel Chocks	REMOVE	
7. Cabin Door	CLOSE and LOCK	
	(check green indicators for proper door pin position and handle stowed)	
8. Seats/Belts/Harnesses/Pedals	ADJUSTED/SECURED	
9. Windows	CLOSED and LOCKED	
10. FLOOD Lights	FULL BRIGHT (night only)	
11. STBY PWR Switch	ON	
12. Exterior Lights	AS REQUIRED	
a. GND REC Switch	ON	
b. NAV Switch	ON (during night operations)	
13. Annunciators	CHECK	

Figure 20 : Cessna Pilot's Before Starting Engines Checklist

12.4.1 Takeoff Briefing

According to the DPJ CE-560XL SOP's and the normal procedures checklist, the flight crew were required to complete a crew briefing as part of the before start checklist. The DPJ CE-560XL SOP's stated in part:⁵²

CREW BRIEFINGCOMPLETE (FP)

⁵² Source: DPJ CE-560XL SOP's, section 4.3.2.

Plan to complete initial takeoff briefing after ATC clearance is received; FMS is programmed and prior to arrival of passengers.

This briefing should include, but not be limited to the following items:

- *Rolling or static takeoff,*
- *Standard takeoff (see callouts) or deviations from standard,*
- *SID/departure briefing, including initial altitude and routing, nav aids and any other restrictions,*
- *Planned landing runway in the event of an emergency,*
- *Special requirements, e.g., anti-ice, radar, contaminated runway, engine-out (APG) procedure, obstruction clearance,*
- *Communication duties in the event of an emergency.*
- *A request directed to the PM for any questions, comments or additional items*

The PIC reported that he recalled that his crew briefing was “very short” and abbreviated. He briefed that “standard company calls” were to be used, it would be a “left seat takeoff, right seat callouts.” He briefed that if the flight experienced an emergency, they would return to OVE “if needed,” or “continue along the route to a better alternate.” The SIC recalled that the crew briefing was a “standard brief.”⁵³

12.5 Taxi Checklist

The taxi checklist called for the pilot flying, which in the accident flight was the PIC seated in the left seat to check the ‘Brakes/ Steering.’ A review of the taxi checklist found no reference to the parking brake. Figure 21 denotes the taxi checklist:

TAXI	
EXTERIOR LIGHTS.....	AS REQUIRED (PM)
BRAKES/STEERING.....	CHECKED (PF)
AVIONICS/FLT INSTS.....	SET & CROSS CHECKED (B)
TRIMS.....	THREE SET FOR TAKEOFF (PM)
THRUST REVERSERS.....	CHECKED (PF)
RUDDER BIAS SYSTEM.....	CHECKED (PF)

Figure 21: DPJ’s Taxi Checklist

Figure 22 denotes the taxi checklist flow as provided in the DPJ CE-560XL SOP’s. In reference to brakes in the taxi flow, the number one icon was labeled on the toe pedal brakes, rather than the parking brake.

⁵³ Source: PIC and SIC interview #2 transcript.

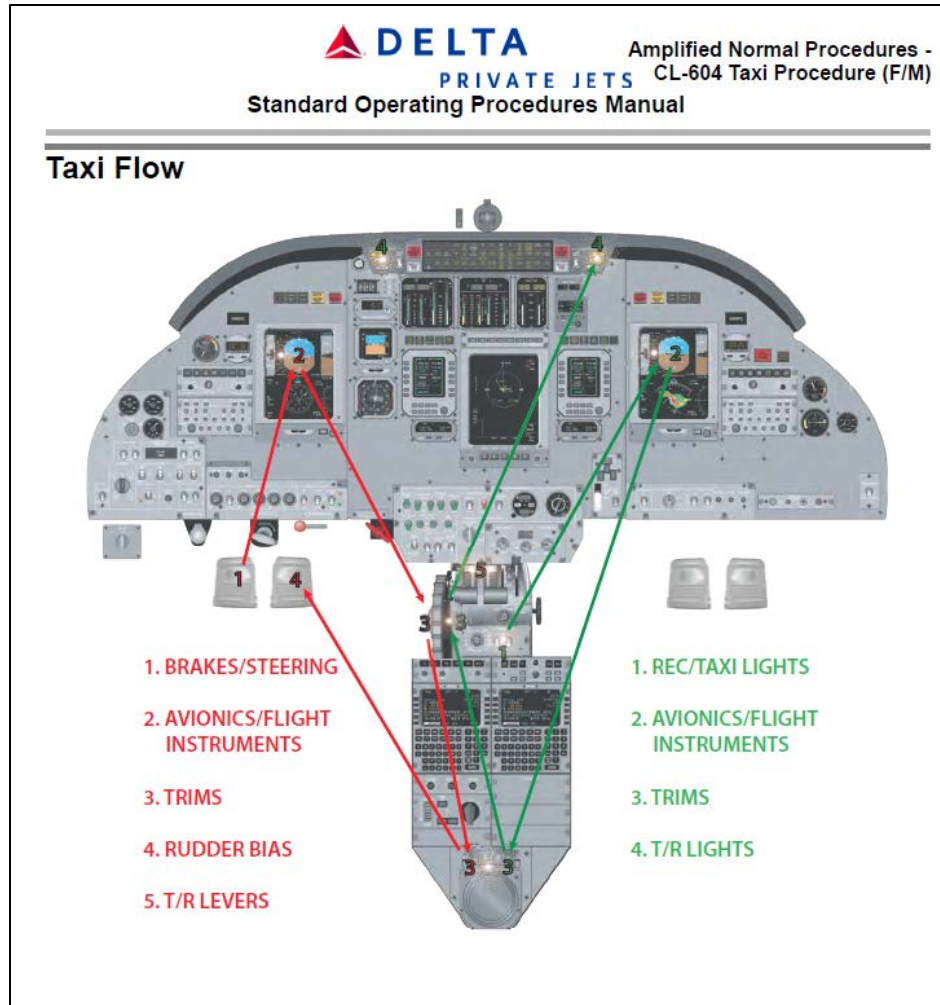


Figure 22: The Taxi Flow Checklist

The Cessna Pilot's Checklist called for the "brakes" to be checked during the "Taxi" checklist.

MODEL 560XL		NORMAL PROCEDURES
TAXI		
1. Passenger Safety Switch	PASS SAFETY ON	
2. External Lights	AS REQUIRED	
3. Brakes	CHECK	
CAUTION		
If, during taxi, a hard brake pedal - no braking condition is encountered, operate the emergency brake system as required. Correct prior to flight.		
4. Steering	CHECK	
NOTE		
When taxiing in strong crosswinds, differential braking can be required to supplement nosewheel steering.		
5. Thrust Reversers	CHECK	
a. Deploy thrust reversers, check sequencing and timing of lights.		
b. Verify that RUDDER BIAS caution does not illuminate.		
c. Select EMER STOW, check sequencing and timing of lights.		
d. Stow thrust reversers, check sequencing and timing of lights.		
e. Deselect EMER STOW, verify all thrust reverser lights extinguished.		
NOTE		
The frequency of thrust reverser checks must be done as defined in the AFM, Section II, Limitations.		
6. Takeoff Speeds	CONFIRM V_1 , V_R , and V_2 displayed on PFD	

Figure 23: Cessna Pilot's Taxi Checklist

12.5.1 Rudder Bias Check

The airplane operating manual stated in part that the rudder bias system was designed to be automatically engaged upon the loss of one engine.⁵⁴ A pneumatic actuator, powered by engine bleed air, will pull the rudder into a position that compensates for asymmetric thrust due to engine failure. This system is comprised of separated LH [left hand] and RH [right hand] actuated pneumatic systems plumbed into one dual acting cylinder. The pneumatic systems are balanced and do not affect rudder position when acting equally together. It is only in an unbalanced engine thrust condition that the rudder bias system delivers rudder assist to compensate for the resulting yaw.

According to the DPJ SOP's for the CE-560XL airplane, the following procedures were to be accomplished with the rudder bias check:⁵⁵

⁵⁴ Source: Airplane operating manual, section 2-33.

⁵⁵ Source: DPJ SOP CE-560XL manual, section 4.6.3.

CE560XL Rudder Bias Check		
Condition	PF	PM
Advance left throttle to approximately 60% N ₁ verify left rudder pedal moves forward	"LEFT THROTTLE, LEFT RUDDER"	
Advance right throttle to approximately 60 N ₁ verify right rudder pedal moves forward	"RIGHT THROTTLE, RIGHT RUDDER"	

Figure 24: Rudder Bias Check Procedures

The PIC reported during post-accident interviews that he completed the rudder bias check while holding short of runway 2 at OVE and noticed no abnormalities. He reported that he normally would complete the rudder bias check away from other airplanes or people, and the ramp area at OVE had people and airplanes around their parking area. During the rudder bias check, it was the PIC's normal habit to set the parking brake during the check.⁵⁶

12.6 Before Takeoff Checklist

The DPJ SOP's manual for the CE-560XL stated in part that when the airplane was "taking the active runway, prior to receiving takeoff clearance," the pilot flying (PF) will state "Before Takeoff Checklist to the Final Items" and the pilot monitoring (PM) will complete the before takeoff checklist items to the final items line. The PM is expected to announce, "Before Takeoff Checklist Complete to the Final Items," and once the takeoff clearance is received, or takeoff is "imminent," the PF will state "Complete the Checklist" and the PM will complete the checklist items below the line and announce the "Before Takeoff Checklist is Complete."⁵⁷

A review of the DPJ before takeoff checklist and the AFM before takeoff checklist found no reference the parking brake. Figure 25 denotes the before takeoff checklist:

BEFORE TAKEOFF	
CABIN ANNOUNCEMENT.....	COMPLETE (PM)
RUNWAY IDENTIFICATION.....	____/____ (B)
IGNITION SWITCHES.....	ON (L)
FINAL ITEMS	
LANDING LIGHTS.....	ON (PM)
ANTI-COLLISION LIGHTS.....	ON (PM)
PITOT & STATIC HEAT *	ON (PM)
ANNUNCIATOR PANEL.....	CHECKED (PM)

Figure 25: DPJ's Before Takeoff Checklist

⁵⁶ Source: PIC interview transcript #2.

⁵⁷ Source: DPJ SOP CE-560XL manual, section 4.7.2.

Figure 26 denotes the before takeoff checklist flow expected to be followed by flight crew:

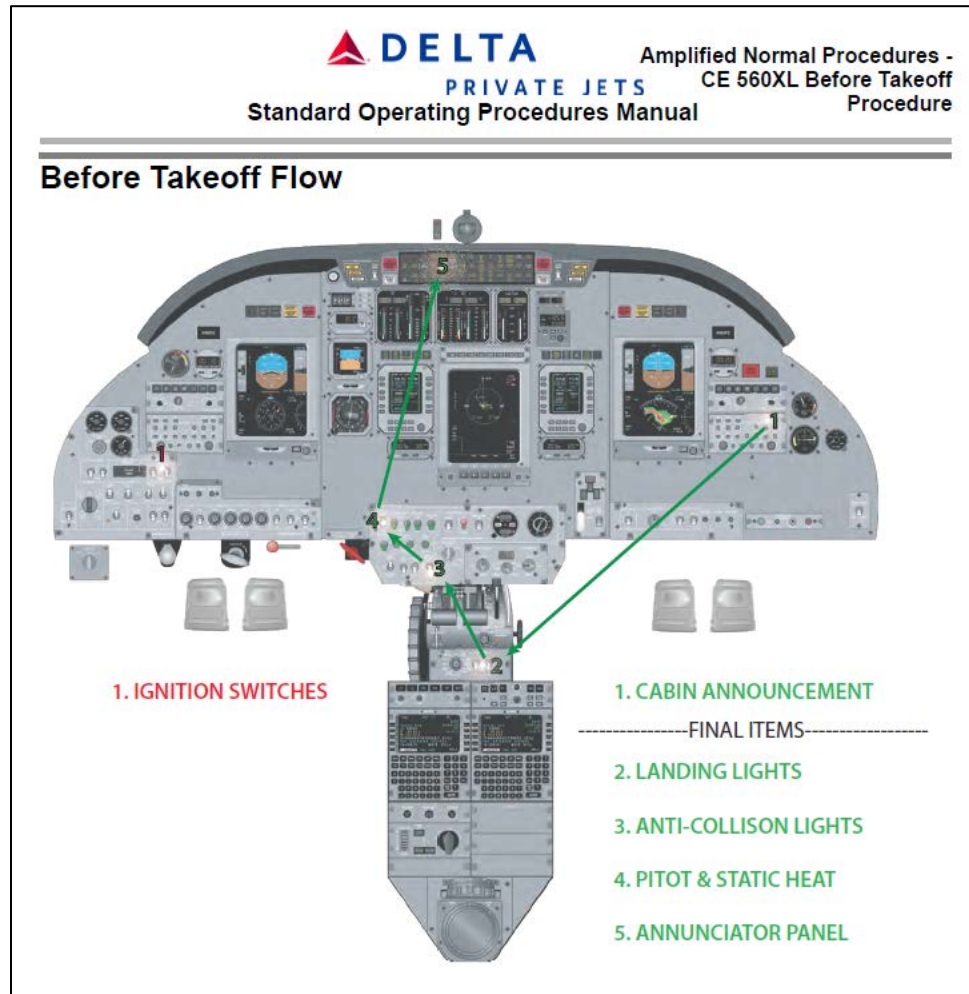


Figure 26: The Before Takeoff Checklist Flow

Figure 27 denotes the before takeoff checklist as stated in the Cessna Pilots' Checklist, Normal Procedures manual.⁵⁸

⁵⁸ Source: Cessna Pilots' Checklist, Normal Procedures, page 46.1

NORMAL PROCEDURES		MODEL 560XL
BEFORE TAKEOFF		
1. Flaps		SET
2. Speed Brakes		RETRACTED
3. Trims (3)		SET
4. Anti-Ice/Deice		AS REQUIRED
	(check anti-ice and deice systems when icing conditions are anticipated)	
CAUTION		
- Do not operate the tail deice boots on the ground when the RAT is less than or equal to -35°C (-31°F) because boot cracking may result. - Limit ground operation of pitot-static heat to 2 minutes to preclude damage to the angle-of-attack system except as required in icing conditions.		
5. Crew Briefing		COMPLETE
-----CLEARED FOR TAKEOFF-----		
6. IGNITION Switches		ON
7. PITOT & STATIC Switch		ON
8. Exterior Lights		AS REQUIRED
NOTE		
Do not operate the anticollision lights in conditions of fog, clouds, or haze as the reflection of the light beam can cause disorientation or vertigo.		
9. Transponder/TCAS		ON/TA/RA
10. Engine Instruments		CHECK NORMAL
	(no dashes, FAIL messages, or incorrect indicators)	
11. Annunciator Panel		CHECK
NOTE		
All annunciators should be extinguished except GND IDLE.		

Figure 27: Airplane Flight Manual Before Takeoff Checklist

12.7 Cessna Pilot's Takeoff Checklist

The Cessna pilot's checklist published an additional takeoff checklist, which was a checklist not contained in DPJ's checklist. Figure 28 details the checklist. The checklist for both rolling and static takeoff's calls for "brakes" to be "released." There was no clarification whether brakes referred to the airplane's toe brakes, or the parking brake. However, "park brake" was specifically stated in the before starting engines, shutdown, and emergency evacuation Cessna Pilot's checklists.

TAKEOFF/CLIMB/CRUISE		
TAKEOFF		
STATIC TAKEOFF		
1. Throttles	TO DETENT (check TO N ₁ 's)	
2. Engine Instruments	CHECK NORMAL (no dashes, FAIL messages, or incorrect indicators)	
3. Brakes	RELEASE	
ROLLING TAKEOFF		
1. Computed Takeoff Distance	ADD 500 FEET	
2. Brakes	RELEASE	
3. Throttles	TO DETENT, Check TO N ₁ 's, WITHIN 500 FEET AFTER BRAKE RELEASE	
4. Engine Instruments	CHECK NORMAL (no dashes, FAIL messages, or incorrect indicators)	
46.1	Configuration AN	56XCLNP-13

Figure 28: Cessna Pilot's Takeoff/ Climb/ Cruise Checklist

12.8 Standard Takeoff Calls

Figure 29 denotes the standard takeoff calls expected from flight crew, as provided in the DPJ SOP's manual for the CE-560XL:⁵⁹

⁵⁹ Source: DPJ SOP CE-560XL manual, section 4.7.4.

 Amplified Normal Procedures - CE 560XL Before Takeoff Procedure		
Standard Operating Procedures Manual		
CE560XL Standard Takeoff Calls		
CONDITION	PF	PM
Brake release and acceleration	"SET THRUST"	
Takeoff detent attained		"THRUST SET"
Both PFD airspeed tapes moving		"AIRSPEED ALIVE"
At 80 kts and both airspeed tapes agree		"80 KNOTS, CROSS CHECKED"
Any abort criteria met	"ABORTING"	"ABORT"
5 kts prior to V_1	Moves hand from throttles to yoke	" V_1 "
Accelerating through V_R	Rotates aircraft approximately 3° per second to command bars	"ROTATE"
Positive rate of climb indicated on both VSI and altimeter	"GEAR UP"	"POSITIVE RATE"
Gear lever selected to retract position		"GEAR UP"
Passing through 400' AGL		"400'"
400' AGL	"FLAPS UP"	"SPEED CHECKS, FLAPS UP"

Figure 29: Standard Takeoff Calls

13.0 The Accident Flight Takeoff⁶⁰

The PIC reported that at the time he advanced the thrust to enter runway 2, he noticed that his flight controls were "fixed" and would not move. Shortly thereafter, the flight crew noticed that the autopilot had engaged while holding short of the runway, and the PIC believed that the SIC's iPad (EFB) had inadvertently fallen and engaged the autopilot button located in the center avionics console.⁶¹ The PIC reported that the autopilot was disengaged, the stabilator trims were re-checked, and they continued onto runway 2.

The PIC reported that after takeoff power was set, he recalled a comment from the SIC being made about the airplane being "sluggish" or "slow," but he also noticed the "airspeed increasing." The PIC reported that he remembered at this time thinking that the density altitude was high, it was a hot day, they were "heavy," and there was "tons of runway" remaining. He summarized by stating "it was just a slower acceleration," but he experienced no issues with directional control.

⁶⁰ Source: PIC and SIC interview #2 transcripts.

⁶¹ Consistent with the PIC report, a passenger recalled that prior to takeoff he saw an iPad fall onto the cockpit floor. Reference the passenger statement summaries report.

As the takeoff roll progressed, the PIC recalled hearing the SIC call airspeed alive, V1, and rotate. When he heard rotate called, he recalled pulling the yoke back to “where you normally do,” and as he did so, he did not recall feeling any “resistance” as he normally experienced, and subsequently pulled the yoke “clear back in my chest” and the airplane still did not rotate. The SIC reported that he noticed the abnormal pull of the yoke, and the lack of rotation, and subsequently called “abort.”

The SIC added that prior to the abnormal yoke pull by the PIC, he could not recall any reason to abort the takeoff prior to that point. He stated, “the aircraft built speed in the allotted time for the distance of the runway. I called the speeds as they came up.”

The PIC could not recall whether an abort call was stated verbally, but the “decision was made obviously,” and he subsequently applied maximum braking with the toe brakes, reduced throttle to idle, and applied thrust reversers. Both crewmembers reported seeing all six annunciator lights associated with thrust reverser deployment illuminate during the aborted takeoff. The PIC reported that he believed the white touchdown zone markers for runway 20 were still ahead of the airplane at the time he made the decision to abort the takeoff.

The PIC reported that after the toe brakes and thrust reversers were applied, it felt as if the airplane “just kept right on going,” and wasn’t decelerating fast enough to keep the airplane on the runway. The PIC reported he did everything he could to maintain directional control after the airplane departed the runway and skidded to a stop; once the airplane came to rest, the PIC reported that he called for the emergency evacuation procedures to be completed.

According to the CVR Factual Report, about two seconds after the SIC verbally confirmed the application of takeoff thrust, the SIC alerted the PIC to an abnormal takeoff acceleration. The PIC asked the SIC to call the airspeeds as the takeoff roll had already begun. 37 seconds elapsed between the time the engine thrust was heard increasing and when the SIC called the V1 and rotate airspeeds. An abort call was verbalized by the SIC about one minute and six seconds after the sound of takeoff thrust application was heard. The single abort call occurred after sounds similar to the deployment of thrust reversers were heard.

14.0 Relevant Emergency Procedures

14.1 DPJ SOP’s, Non-Normal Operations⁶²

The DPJ CE-560XL SOP manual provided general guidance regarding flight crew actions and responsibilities during non-normal operations for flight crew standardization purposes. All non-normal procedures and checklists the flight crew were expected to follow were to be found in the latest revision of the manufacturer’s operating and flight manuals. The DPJ SOP’s categorized non-normal operations into two categories:

Ground Failures

Ground failures are defined as any aural or visual warning, directional control problem or safety of flight issue that occurs on the ground prior to V1 or after touchdown. In the event of a ground failure, the objective of the crew is to stop the aircraft, address the problem and evacuate if required.

Flight Failures

⁶² Source: DPJ CE-560XL SOP’s, section 3.1.1.

Flight failures are defined as any malfunction that occurs at or above V1 and prior to touchdown. The primary responsibility of the crew during a flight failure is to control the aircraft. Checklists will not be called for until the aircraft is under full control and in a steady state of flight. With the exception of any immediate action items, memory items should not be completed until above 400' AGL.

14.2 DPJ SOP's, Rejected Takeoff Policy⁶³

According to the DPJ FOM, it defined a rejected takeoff (RTO) as a takeoff that has been discontinued after takeoff thrust has been set and/ or initiation of the takeoff roll. The FOM further stated that an RTO decision was the “sole responsibility” of the Captain and that the decision must be made in time to start the RTO maneuver by the V1 airspeed.

The FOM defined 80 knots as the boundary between a low and high-speed abort, and the “80 knots call” on the takeoff roll is the “clear announcement” of entering the high-speed regime, where it is generally safer to continue the takeoff. It stated that the Captain must be knowledgeable with the reasons for rejecting a takeoff in the low-speed versus the high-speed regime.

14.3 Engine Failure or Other Emergency During Takeoff⁶⁴

Figure 30 denotes what the airplane flight manual emergency procedures section stated in part regarding an engine failure or any other emergency during takeoff. A review of the AFM and DPJ CE-560XL SOP's found no procedure stating what the flight crew should do in the event the airplane will not rotate and climb after achieving VR or V1 airspeeds.

⁶³ Source: DPJ FOM, page 2.3.11

⁶⁴ Source: CE-560XL AFM, page 3-7.

MODEL 560XL	SECTION III - OPERATING PROCEDURES EMERGENCY PROCEDURES
EMERGENCY PROCEDURES	
■ ENGINE FAILURE OR ANY OTHER EMERGENCY DURING TAKEOFF	
● SPEED BELOW V_1	
1. Takeoff	ABORT
a. Brakes	APPLY
b. Throttles	IDLE
c. Speed Brakes	EXTEND
d. Thrust Reverser	DEPLOY ON UNAFFECTED ENGINE
e. Thrust Reverser Indicator Lights	CHECK ILLUMINATION of ARM, UNLOCK and DEPLOY LIGHTS
f. Thrust Reverser	REVERSE POWER ON UNAFFECTED ENGINE
NOTE	
- To obtain maximum braking performance from the antiskid system, the pilot must apply continuous maximum effort (no modulation) to the brake pedals. - The Takeoff Field Lengths assume that the pilot has maximum effort applied to the brakes at the scheduled V_1 speed during the aborted takeoff.	
PROCEDURE COMPLETED	
● SPEED AT OR ABOVE V_1	
1. Climb to a safe altitude.	
2. WING XFLOW (if wing anti-ice is ON)	ON
a. Accelerate to V_R , ROTATE.	
b. LANDING GEAR (positive climb)	UP
c. Airspeed	V_2 Minimum
d. FLAP Handle	0° at V_2+10 Knots Minimum
e. Accelerate to V_{ENR} (V_T) (160 KIAS).	
□ IF ENGINE FAILURE	
3. Throttle (operating engine) CLB DETENT, CHECK CLB N_1	
4. Refer to Abnormal Procedures, IN-FLIGHT RESTART - ONE ENGINE or ENGINE FAILURE/PRECAUTIONARY SHUTDOWN.	
PROCEDURE COMPLETED	
□ IF NOT ENGINE FAILURE	
3. Refer to appropriate Emergency or Abnormal Procedure.	
PROCEDURE COMPLETED	
FAA APPROVED 56XFM-13	Configuration AA U.S. 3-7

Figure 30: Emergency Procedure, or Other Emergency During Takeoff

14.4 FAA Guidance on Aborted Takeoff's After V_1 ⁶⁵

According to the Pilot Guide to Takeoff Safety published by the FAA, which was a takeoff safety training aid, page 2.11 stated in part, "It is therefore recommended that pilots consider V_1 to be a limit speed: Do not attempt an RTO once the airplane has passed V_1 unless the pilot has reason to

⁶⁵ Source: Pilot Guide to Takeoff Safety:
https://www.faa.gov/other_visit/aviation_industry/airline_operators/training/media/takeoff_safety.pdf

conclude the airplane is unsafe or unable to fly. This recommendation should prevail no matter what runway length appears to remain after V1.”

14.5 Emergency Evacuation Procedure

Figure 31 denotes what the airplane flight manual, emergency procedures section stated in part regarding an emergency evacuation:⁶⁶

■ EMERGENCY EVACUATION	
1. PARK BRAKE	SET
2. Throttles	BOTH CUT OFF
3. LH ENGINE FIRE Switch	PRESS
4. LH BOTTLE ARMED Switchlight	PRESS (if fire suspected)
5. RH ENGINE FIRE Switch	PRESS
6. RH BOTTLE ARMED Switchlight	PRESS (if fire suspected)
7. APU MASTER Switch (if installed)	OFF
8. BATT Switch	OFF
9. Emergency Locator Transmitter (ELT)	MAKE SURE ACTIVATED (if required for search and rescue services)
10. Airplane and Immediate Area	CHECK FOR BEST ESCAPE ROUTE
● IF THRU CABIN DOOR	
11. Cabin Door	OPEN
12. Move away from airplane.	
PROCEDURE COMPLETED	
● IF THRU EMERGENCY EXIT	
11. Emergency Exit	REMOVE and THROW OUT of airplane
12. Move away from airplane.	
PROCEDURE COMPLETED	

Figure 31: Emergency Evacuation Procedure

The PIC reported that once the airplane stopped in the grass, he gave the evacuation order to the SIC and he subsequently jumped out of his seat and exited the cockpit to open the main cabin door. The PIC added that he shut down the engines and turned off the auxiliary power unit (APU), depressed the engine fire buttons, and disconnected the battery located in aft fuselage area.⁶⁷

The SIC reported that as he was getting up out of his pilot seat, he looked out the left window to see if there was any fire or hazards, and seeing none, he immediately went to open the main cabin door. The SIC reported that the door was “reluctant” to open, and he had to kick it open. He added that the door still did open all the way, but it did open far enough to allow himself to exit. He subsequently stood to the left of the door and assisted all of the 8 passengers in evacuating. He then told the passengers to continue walking to the main terminal building.⁶⁸ The flight crew reported that the right engine continued to run and “surge” even after it was shut down from the cockpit.

The flight crew reported that they observed a grass fire in the terrain the airplane had just skidded through, but the airplane was not on fire immediately after the accident. The flight crew reported they attempted to extinguish the grass fire encroaching on the airplane with a handheld fire

⁶⁶ Source: CE-560XL AFM, page 3-35.

⁶⁷ Source: PIC interview transcripts #1 and #2.

⁶⁸ Source: SIC interview transcripts #1 and #2.

extinguisher, but the fire grew beyond what they believed was manageable to contain and subsequently continued their own evacuation to the main terminal building.

15.0 DPJ Operational Control⁶⁹

According to the DPJ FOM, the Flight Operations System (FOS) located at their headquarters in Erlanger, Kentucky was the primary tool to facilitate DPJ's operational control requirements. Prior to being assigned to a flight, FOS was used to verify and certify each crewmember was in compliance with all flight, duty and rest requirements. FOS normally generated a "Trip Authorization" which designated a Captain.

According to the DPJ FOM, the Flight Coordinator, Captain, and key management personnel that included the Director of Operations, Maintenance, and the Chief Pilot were included in the operational control of DPJ flights.

15.1 DPJ Flight Control Responsibilities

According to the DPJ FOM, Flight Coordinators located at their Headquarters in Erlanger, Kentucky were required to review the planned departure, en route segment, and destination to ensure the flight could be completed in accordance with all FAA regulations and DPJ policies. The task items included ensuring that:

- The aircraft was airworthy, released from DPJ maintenance control, and will not be scheduled to exceed inspection requirements
- Operations control and the appropriate operating regulation was accurately assigned
- Accurate supplemental information, such as passenger requests
- Custom requirements
- The flight crew was current, qualified, and assigned to the appropriate duty positions
- The flight and rest assignments were scheduled in according with DPJ flight scheduling, rest, duty, and fatigue mitigation policies
- Actual and forecast weather reported meet or exceed the prescribed minimums of the regulations and DPJ operations specifications
- AIRMET, SIGMET, NOTAM, TFR, and ATC delays are reviewed
- Reviewing airport curfews

According to screenshots from the DPJ FOS, the accident flight received a Trip Briefing and Trip Authorization (Release) from Flight Control as normally expected.

15.2 Captain Responsibilities

According to the DPJ FOM, the Captain was responsible for determining whether the flight could be initiated, conducted, and terminated safely in accordance with all DPJ OpSpecs, the FOM, and regulations.

⁶⁹ Source: DPJ FOM, section 14.9.4. For more information on 14 CFR Part 135 Operational Control, see also FAA INFO (Information for Operators) 08005 Part 135 Operational Control Questions and Answers (Q&A's), dated February 11, 2008.

16.0 Relevant DPJ Policies

16.1 DPJ Rest, Flight, and Duty Times Policies⁷⁰

According to the DPJ FOM, the flight time limitations, duty period limitations, and rest requirements were established to reduce the probability that a crewmember's fatigue may adversely affect the safety of flight. The FOM further stated that it was a joint responsibility of the crewmember and flight control to maintain these limitations and requirements, and DPJ may not assign, and no crewmember may accept an assignment, if the crewmember reports fatigued. When a crewmember accepts a trip authorization, it was assumed the crewmember was reporting fit for duty. Figure 32 shows the rest, flight, and duty times expected for DPJ flight crew.

Rest, Flight, and Duty Times				
Crew Pairing	Required Rest (hours)	Flight Time (hours)	135 Duty Time (hours)	Time Aloft
1 Captain/1 First Officer	10 consecutive	10 maximum	14 maximum	N/A
2 Captain/1 First Officer	12 consecutive	8 maximum flight deck duty	18 maximum	12 maximum
2 Captains/2 First Officers	12 consecutive	8 maximum flight deck duty	20 maximum	16 maximum

Figure 32: DPJ Rest, Flight, and Duty Times

16.2 DPJ Fatigue/ Unfit for Duty Policies⁷¹

According to the DPJ FOM, it was the responsibility of each flight crewmember to monitor their fatigue. If the crewmember determined they were incapable of safely performing their duties, they were expected to notify flight control immediately. The FOM further stated that crewmembers were free to remove themselves from the flight schedule, without fear of retribution. Flight control was expected to subsequently release the crewmember with no questions asked.

16.3 Flight Crew Upgrade Policy⁷²

The DPJ FOM stated in part that eligibility to upgrade from First Officer to Captain was based on the company's demand for such a position. A candidate will be upgraded based on performance as judged by management, standards personnel, and peers, as well as an annual employee evaluation. The FOM further stated in part that it should be understood that while seniority is considered and weighed as a component of qualification, superior seniority alone does not guarantee upgrade over another candidate.

17.0 DPJ Safety Management System⁷³

According to the DPJ Safety Management System manual, DPJ had a fully functional and FAA-approved 14 CFR Part 5 SMS. The manual provided four components of Safety Management:

Four Components of Safety Management

⁷⁰ Source: DPJ FOM, Section 21.1.5

⁷¹ Source: DPJ FOM, section 21.4.1.

⁷² Source: DPJ FOM, section 3.4.9.

⁷³ Source: DPJ SMS manual, page 4-1.

The SMS is organized around four basic components. These four areas are essential for an integrated decision-making system for safety. All SMS guidance shall include basic requirements of the four components of safety management processes for each operational/functional division.

Safety Policy

The policy component of the SMS encompasses Delta Private Jets' documented safety policy, which includes safety objectives, hazard reporting policy, management commitment, and coordination of emergency response planning. The policy component of the SMS also outlines safety accountability, authority, and responsibilities for all Delta Private Jets employees.

Safety Risk Management

The safety risk management component of the SMS includes system analysis, hazard identification, safety risk assessment, and safety risk controls.

Safety Assurance

Safety assurance processes within the SMS function to ensure the performance and effectiveness of safety risk controls, including safety performance monitoring and measurement, safety performance assessment, and continuous improvement.

Safety Promotion

The safety promotion function of the SMS is a combination of training and communication of safety information.

17.1 Aviation Safety Action Program⁷⁴

According to the DPJ SMS manual, an aviation safety action program (ASAP), voluntary safety reporting program was functional at the time of the accident. The DPJ ASAP manual stated in part:

⁷⁵

Purpose

The purpose of the DPJ ASAP is to reduce the likelihood and severity of accidents and incidents by evaluating and investigating CFR deviations, hazards, and safety events identified through voluntary, confidential, not-punitive self-reporting. The ERC seeks to determine the root cause(s) of all reports, in order to make safety recommendations and

⁷⁴ According to the FAA Advisory Circular 120-66B “Aviation Safety Action Program (ASAP)”, the objective of the ASAP is to encourage air carrier and repair station employees to voluntarily report safety information that may be critical to identifying potential precursors to accidents. The Federal Aviation Administration (FAA) has determined that identifying these precursors is essential to further reducing the already low accident rate. Under an ASAP, safety issues are resolved through corrective action rather than through punishment or discipline. The ASAP provides for the collection, analysis, and retention of the safety data that is obtained. ASAP safety data, much of which would otherwise be unobtainable, is used to develop corrective actions for identified safety concerns, and to educate the appropriate parties to prevent a reoccurrence of the same type of safety event.

⁷⁵ Source: DPJ ASAP Administrative Guide, page i.

implement appropriate corrective action designed to reduce the opportunity for safety to be compromised. ASAP reports may be submitted for general safety concerns, inadvertent violation or potential violation of FAA regulations, or inadvertent deviation or potential deviation from DPJ policies/procedures.

Objectives

- a. Support the voluntary, non-punitive, open reporting of safety concerns*
- b. Identification of hazards and threats which may be precursors to incidents/accidents*
- c. Provide a mechanism to report safety concerns*
- d. Serve as a data input for SMS programs*

Both flight crewmembers filed ASAP reports following the accident.

17.1.1 Aviation Safety Action Program Review

DPJ was requested to review their ASAP report database pertaining to the follow subject areas:

- Reports containing electronic flight bag difficulties, specifically problems with securing or placement of EFB in aircraft during flight operations
- Reports containing any issues with parking brake usage

The ASAP program manager reviewed the database and found no reports matching the subject areas.⁷⁶

17.2 Flight Data Monitoring

According to the DPJ Director of Safety, DPJ did not have a flight data monitoring program implemented at the time of the accident.

18.0 Relevant Training

18.1 CAE Ground and Simulator Training

The curriculum delivered to the flight crew for the initial and recurrent training for the CE-560XL airplane was reviewed. The training incorporated the use of classroom-based instruction and flight simulator training.

18.2 CAE Hydraulics, Landing Gear, and Brakes Ground Training

A review of the Hydraulic/Landing Gear and Brakes Abnormal ground training curriculum provided by CAE found that the training in part reviewed the landing gear system schematic and associated annunciators.⁷⁷ The landing gear and brakes training reviewed in part the toe brake pedals and the parking brake location.⁷⁸

18.3 CAE Instructor's Training of Parking Knowledge and Procedures

According to the Head of CAE Training in Dallas, TX, in response to several questions asked by the NTSB Operations Group Chairman, he reported that CAE instructor's routinely discussed the system design and operation of the parking brake, and that it is not annunciated, not included in the

⁷⁶ Source: An email memorandum from the DPJ DOS.

⁷⁷ Source: CAE Citation Excel, Hydraulic/Landing Gear and Brakes Abnormal PowerPoint (March 2014)

⁷⁸ Source: CAE Citation Excel, Landing Gear and Brakes PowerPoint (March 2014)

no takeoff warning, nor is there a checklist item for the parking brake in the before takeoff checklist during ground and flight training.⁷⁹

He added that CAE instructors prior to the accident, were not discussing the possibilities of reaching takeoff speeds with the parking brake set during takeoff, as “Cessna did not have a caution, warning, or note referencing this possibility.” After learning of this accident, he reported that instructors began addressing the airplane “achieving takeoff speeds” depending on how the brake toe pedals are manipulated when the parking brake is set.

18.4 CAE Training Modules: Crew Resource Management

A review of the CAE training modules found that within the general operational subjects, Crew Resource Management (CRM) was its own module.⁸⁰ The curriculum stated in part:

Crew Resource Management (CRM)

1. *Situational Awareness and the Error Chain*
2. *Stress*
3. *Communications*
4. *Synergy and Crew Concept*
5. *Workload Management*
6. *Decision Making*
7. *Advanced/Automated Cockpit*

NOTE: Applied CRM is monitored/practiced in each System integration/ flight Simulator/ Aircraft Module. Areas of applied CRM include checklist utilization, briefings, decision making, stress management, communications, use of automation, and situational awareness.

18.5 CAE Flight Profiles

A review of the CAE training found that flight profiles were provided to flight crewmembers; the curriculum stated in part:⁸¹

The following flight profiles show some normal and emergency operating procedures. They are designed as a general guide for ground training purposes. Actual in-flight procedures may differ due to aircraft configuration, weight, weather, traffic, ATC instructions, etc. Procedures outlined are consistent with the Aircraft Flight Manual (AFM). If a conflict should develop between these procedures and the AFM, the AFM procedures must be followed.

⁷⁹ Source: CAE Head of Training Email Memorandum, dated November 14, 2019

⁸⁰ Source: CAE Part 135 Training Curriculum Citation Excel Series (CE-560XL), Revision 1

⁸¹ Source: CAE Part 135 Training Program, CE-560XL, Flight Maneuvers, Revision 1.

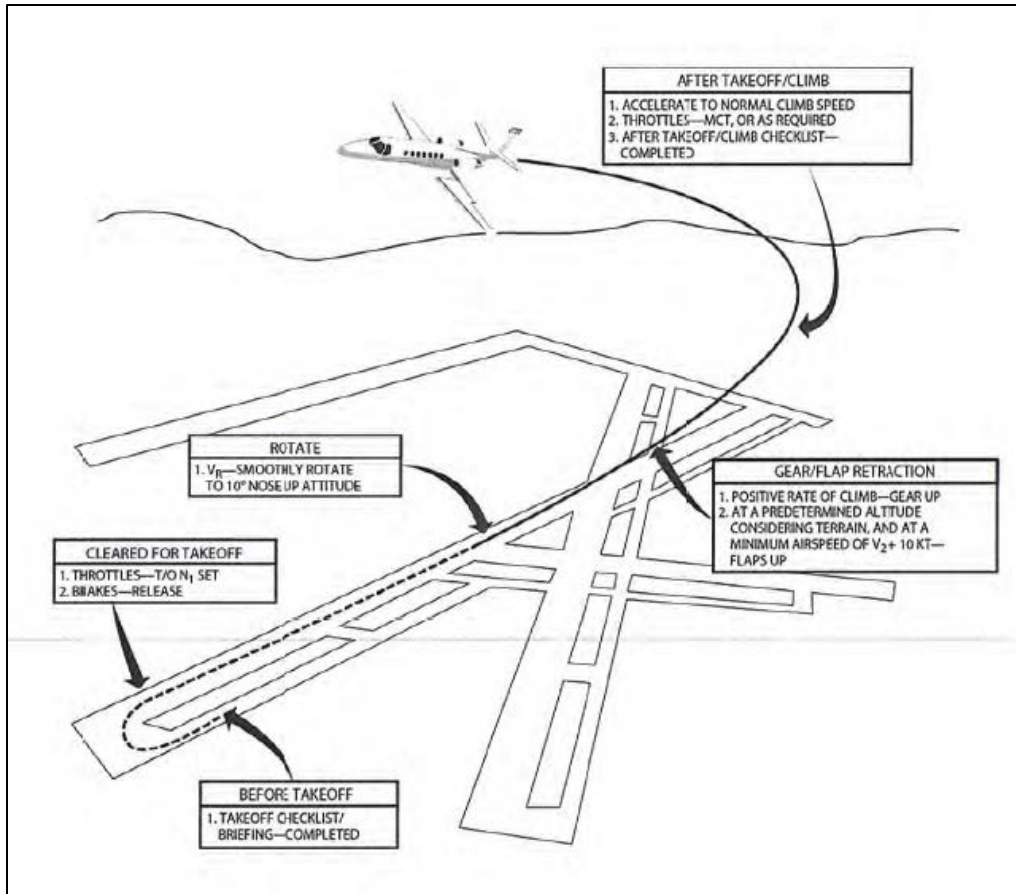


Figure 33: Flight Profile for a Normal Takeoff

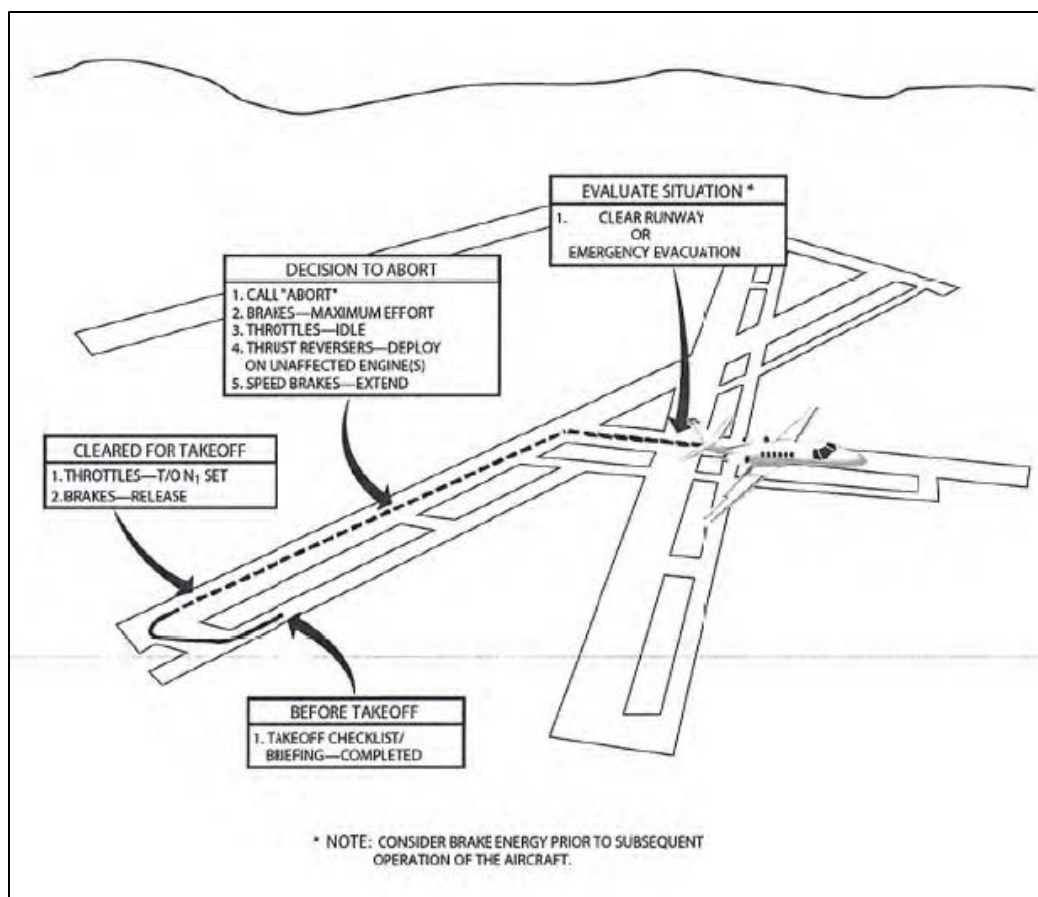


Figure 34: Flight Profile for a Rejected Takeoff

18.6 Simulator Used for Flight Training

Both flight crew utilized a full flight simulator CE-560XL located in Dallas, Texas. CAE was requested to evaluate the simulator on the following parameters:

- Parking brake fidelity and airplane movement when set
- Parking brake annunciations

A CAE simulator engineer reported that in the simulator, if the parking brake is activated with maximum braking pressure, the simulator will hold the airplane position under maximum thrust on a dry or wet runway.⁸² At approximately 50% of full brake pressure on a dry runway, the airplane will accelerate and can achieve V1/VR speeds. In the simulator, deceleration from the takeoff speed with the parking brake set will be difficult because the pedals would not function until the parking brake was released. The engineer also confirmed that the simulator did not have an annunciator associated with the parking brake lever position, nor was the parking brake condition incorporated into the no takeoff warning configuration.

⁸² Source: NTSB Memorandum for Record from CAE Engineering, dated October 3, 2019.

F. List of Attachments

- Attachment 1 – PIC written statement
- Attachment 2 – PIC interview transcript #1 (August 22, 2019)
- Attachment 3 – PIC interview transcript #2 (August 28, 2019)
- Attachment 4 – SIC interview transcript #1 (August 22, 2019)
- Attachment 5 – SIC interview transcript #2 (August 28, 2019)
- Attachment 6 - Flight crewmember activity summary statement
- Attachment 7 – PIC training records
- Attachment 8 – SIC training records
- Attachment 9 - Takeoff and landing data performance
- Attachment 10 - DPJ provided weight and balance information
- Attachment 11 – Investigation weight and balance recreation
- Attachment 12 - DPJ EFB program application excerpts
- Attachment 13 - Flight crew question and answers on EFB usage
- Attachment 14 - DPJ background information of EFB usage
- Attachment 15 - CE-560XL Airplane Operating Manual excerpts
- Attachment 16 - CE-560XL Airplane Flight Manual excerpts
- Attachment 17 - DPJ CE-560XL SOP excerpts
- Attachment 18 - CE-560XL DPJ Normal Checklist Procedures
- Attachment 19 - DPJ FOM excerpts
- Attachment 20 - DPJ review of Aviation Safety Action Program
- Attachment 21 - CAE Head of Training Instructor training information
- Attachment 22 - CAE Engineering simulator performance information

Submitted By:

Adam Gerhardt
NTSB Air Safety Investigator