NYC08FA184

Weight and Balance Calculations for May 17, 2008 accident at Eagles Nest Airport (K31E) involving a Cessna CE 337-A aircraft, registered as N5382S

Prepared June 7, 2008 in support of NTSB Accident File: NYC08FA184

Compiled by Frederick H. Blauth

Principal Maintenance Inspector

FAA Inspector in Charge (IIC)

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N5382S CE-337-A

- Max Gross Weight (GW) is 4200 lbs. Per FAA TCDS Sheet A6CE.
- BEW of the aircraft is calculated on last know record dated Nov 5, 1969 at 2856 lbs.
- No aircraft records, other than those maintained at the FAA Aircraft Records branch in Oklahoma City, have been made available.
- Total Crew, passengers and equipment (payload) totaled 1060 lbs.for all flights or a operating weight of (BEW + Payload) = (BOW) 3916 lbs.
- In this condition, only 284 lbs. for fuel or 47.3 gals. could be added to remain at the aircraft GW.
- Conclusion: The pilot likely operated the aircraft higher than published limits.

WARNING - CURRENT CONFIGURATION OUT OF LIMITS

WEIGHT AND BALANCE CLEARANCE FORM F - TRANSPORT

LEMAC	123.26		
MAC	64.50		
Constant	1000.00		
DATE: 2008/06/07	MDS: CE-337-A	FROM: KMIV	Station: KCQX
Mission: Accident K31E	SERIAL NO: 337-4082	TO: K31E	Pilot: Ambroult

REMARKS

Ref 1: BEW based on last known calculation: FAA 337 dated 11-06-69.
Ref 3: Pilot Wt (Ambroult): 263 lbs, Front R/H Pax Wt.(Toth): 163 lbs.
Ref 4: Standard carry-on. Wts. 20lbs/ea., (Cabin Centroid).
Ref 5: Two boxes containing aircraft tire tubes (Cargo Compartment).
Ref 6: 4 immersion suits(10lbs. ea.), 1 life raft (20 lbs.) (Cargo Compartment)
Ref 7: Video camera, range finders and computer (Cabin Centroid)
Ref 8: Clothing,Misc. (Cabin Centroid)
Passeneger Aft L/H (Claussen) 196 lbs.
Passeneger Aft R/H (Salinas) 143 lbs.
Personal Flotation Devices (10 lbs./ea. x4), Misc. (Cabin Centroid)
Ref: 10: Main Fuel Tanks L & R 46 gals. ea. 93 gals useable at Arm 150.
Aux Fuel Tanks L & R 22 gals. ea. 36 gals useable at Arm 150.

CORRECTIONS	Weight	H. Mom/
Weight and Balance condition fully loade	0	0.0
with full fuel, pilot and passengers	0	0.0
and equipment.	0	0.0
Total Corrections	0	0.0

EXPENDABLES	WEIGHT	H. Mom/
Total Expendables	0	0.0

LIMITATIONS		
Ramp Weight vs Limit	4731.70 < 4200.00	
Takeoff Weight vs Limit	4725.70 < 4200.00	
Landing Weight vs Limit		
Zero Fuel Weight vs Limit		
Load vs Max Allowable Load	0.00 < -531.70	
Remaining Allowable Load	-531.70	
CG LIMITS	FWD CURRENT AFT	
Ramp CG (Gear Down)	137.00 < 140.63 < 142.50	
Takeoff CG (Gear Down)		
Takeoff CG (Gear Up)	137.00 < 140.81 < 142.00	
Landing CG (Gear Up)		
Landing CG (Gear Down)	137.00 < 138.68 < 142.00	
Zero Fuel CG (Gear Down)	137.00 < 138.68 < 142.00	
LATERAL LIMITS	LT CURRENT RT	
Lateral Ramp (Inches)		
Lateral Takeoff (Inches)		
Lateral Landing (Inches)		

DISTRIBUTION OF ALLOWABLE LOAD

REF	ITEM	WEIGHT	H. Mom/
1	Basic Aircraft(From Chart C)	2856	399.5
3	Crew [Pilot and FWD Pax (Arm 102	426	43.5
4	Crew Bags [Carry -On (Arm 122)]	80	9.8
5	Steward Equip [Misc. (Arm 355)]	10	3.5
6	Emerg Equip [Overwater (Arm 355)]	60	21.3
7	Extra Equip [Survey Gear (Arm 122)]	75	9.2
8	Jackets, Misc.(Arm 122)	20	2.4
	Passenger L/H Rear (Arm 141)	196	27.6
	Passenger R/H rear (Arm 141)	143	20.2
	PFDs, Other Equipment (Arm 122)	50	6.1
	Corrections	0	0.0
9	OPERATING WEIGHT	3916	543.0
10	Int / Main Fuel (92 Gal)	552	82.8
	Ext / Aux Fuel (44 Gal)	264	39.6
12	TOTAL AIRCRAFT WEIGHT	4732	665.4
13			
16	RAMP WEIGHT	4732	665.4
17	RAMP CG (GD) (Inches)		140.63
18	TAXI FUEL (1 Gal)	-6	0.0
19	TAKEOFF WEIGHT	4726	665.4
20	TAKEOFF CG (GD) (Inches)		140.81
	Expendable Fuel at Takeoff	-810	-122.4
21	ZERO FUEL WEIGHT	3916	543.0
22	LESS EXPENDABLES / AIR DROP	0	0.0
23	EST LANDING FUEL (0 Gal)	0	0.0
24	EST LANDING WEIGHT	3916	543.0
25	EST LANDING CG (GD) (Inches)		138.68

COMPUTED BY SIGNATURE *WARNING: Out-of-Limits*

Frederick H. Blauth - Principal Maintenance Inspector

WEIGHT & BALANCE AUTHORITY *WARNING: Out-of-Limits*

FAA AEA-FSDO-17 (PHL)

PILOT SIGNATURE *WARNING: Out-of-Limits*

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- Max Fuel is 92 gals. in Main Tanks and 44 gals in AUX tanks for a total of 136 gals., or 816 lbs.
- Aircraft was last fueled with 55 gals (Main Tanks Only) on May 15, 2008. Witnesses state that the AUX tanks were not serviced at that time per the pilot's request.
- Data from the GPS and hand written notes located at the crash site confirm that the aircraft flew 4.7 hours on May 15, 2008.
- A company pilot, familiar with the aircraft, stated that average fuel burn is 12 gals./hr/ engine. This is a questionable burn rate as this analysis will show. A burn rate of 9 gals./hr/engine is a far more reasonable assumption.
- Based on witness statements and FBO fuel records, the aircraft was not fueled prior to takeoff on May 17, 2008.

WARNING - CURRENT CONFIGURATION OUT OF LIMITS

WEIGHT AND BALANCE CLEARANCE FORM F - TRANSPORT

LEMAC	123.26		
MAC	64.50		
Constant	1000.00		
DATE: 2008/06/07	MDS: CE-337-A	FROM: KMIV	Station: KCQX
Mission: Accident K31E	SERIAL NO: 337-4082	TO: K31E	Pilot: Ambroult

REMARKS

Ref 1: BEW based on last known calculation: FAA 337 dated 11-06-69.
Ref 3: Pilot Wt (Ambroult): 263 lbs, Front R/H Pax Wt. (Toth): 163 lbs.
Ref 4: Standard carry-on. Wts. 20lbs/ea., (Cabin Centroid).
Ref 5: Two boxes containing aircraft tire tubes (Cargo Compartment).
Ref 6: 4 immersion suits(10lbs. ea.), 1 life raft (20 lbs.) (Cargo Compartment)
Ref 7: Video camera, range finders and computer (Cabin Centroid)
Ref 8: Clothing, Misc. (Cabin Centroid)
Passenger Aft L/H (Claussen) 196 lbs.
Passenger Aft R/H (Salinas) 143 lbs.
Personal Flotation Devices (10lbs ea. x 4) Misc. (Cabin Centroid)
Ref 10: Main Fuel Tanks L & R, 56 gals. total at Arm 150.
Aux Fuel Tanks L & R, 22 gals. total at Arm 150

CORRECTIONS	Weight	H. Mom/
Note: Fuel Burn est. to be at 12 gals./hr.	0	0.0
15 May 2008 flight was 4.7 hrs.	0	0.0
Main Tanks were toped off 15 May 2008	0	0.0
Actual AUX Tank Qty. estimated.	0	0.0
Aircraft not fueled prior to 17 May flight.	0	0.0
Total Corrections	0	0.0

EXPENDABLES	WEIGHT	H. Mom/
Total Expendables	0	0.0

LIMITATIONS			
Ramp Weight vs Limit	4224.70 < 4200.00		
Takeoff Weight vs Limit	4218.70 < 4200.00		
Landing Weight vs Limit			
Zero Fuel Weight vs Limit			
Load vs Max Allowable Load	0.00 < -24.70		
Remaining Allowable Load	-24.70		
CG LIMITS	FWD	CURRENT	AFT
Ramp CG (Gear Down)	137.00 <	139.51 <	142.50
Takeoff CG (Gear Down)			
Takeoff CG (Gear Up)	137.00 <	139.70 <	142.50
Landing CG (Gear Up)			
Landing CG (Gear Down)	137.00 <	139.03 <	142.50
Zero Fuel CG (Gear Down)	137.00 <	138.68 <	142.50
LATERAL LIMITS	LT	CURRENT	RT
Lateral Ramp (Inches)			
Lateral Takeoff (Inches)			
Lateral Landing (Inches)			

DISTRIBUTION OF ALLOWABLE LOAD

REF	ITEM	WEIGHT	H. Mom/
1	Basic Aircraft(From Chart C)	2856	399.5
3	Crew [Pilot and FWD Pax (Arm 102	426	43.5
4	Crew Bags [Carry -On (Arm 122)]	80	9.8
5	Steward Equip [Misc. (Arm 355)]	10	3.5
6	Emerg Equip [Overwater (Arm 355)]	60	21.3
7	Extra Equip [Survey Gear (Arm 122)]	75	9.2
8	Jackets, Misc.(ARM 122)	20	2.4
	Passeneger L/H rear (Arm 141)	196	27.6
	Passeneger R/H rear (Arm 141)	143	20.2
	PFDs, Other Equipment (Arm 122)	50	6.1
	Corrections	0	0.0
9	OPERATING WEIGHT	3916	543.0
10	Int / Main Fuel (30 Gal)	177	26.6
	Ext / Aux Fuel (22 Gal)	132	19.8
12	TOTAL AIRCRAFT WEIGHT	4225	589.4
13			
16	RAMP WEIGHT	4225	589.4
17	RAMP CG (GD) (Inches)		139.51
18	TAXI FUEL (1 Gal)	-6	0.0
19	TAKEOFF WEIGHT	4219	589.4
20	TAKEOFF CG (GD) (Inches)		139.70
	Expendable Fuel at Takeoff	-303	-46.4
21	ZERO FUEL WEIGHT	3916	543.0
22	LESS EXPENDABLES / AIR DROP	0	0.0
23	EST LANDING FUEL (21 Gal)	126	18.9
24	EST LANDING WEIGHT	4042	561.9
25	EST LANDING CG (GD) (Inches)		139.03

COMPUTED BY SIGNATURE *WARNING: Out-of-Limits*

Frederick H.Blauth- Principal Maintenane Inspector

WEIGHT & BALANCE AUTHORITY *WARNING: Out-of-Limits*

FAA - AEA-FSDO-17 (PHL)

PILOT SIGNATURE *WARNING: Out-of-Limits*

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- Fuel measured from the aircraft fuel tanks are as follows:
  - Right Main Tank: Empty (Trace)
  - Right AUX tank: 7/8 full or 19.25 gals.
  - Left Main Tank: Empty (Trace)
  - Left AUX Tank: 2 gals.
- Total fuel measured post accident was approximately 21 gals. or 126 lbs.
- The May 17, 2008 flight lasted 1.8 hours. At a 12 gal./hr/engine burn rate approximately 43.2 gals. or 259 lbs. of fuel would have been consumed during the flight. Combining the May 15, 2008 flight time of 4.7 hours and the May 17, 2008 flight time of 1.8 hours, totaling 6.5 hours, the aircraft would have consumed approximately 156 gals., or 936 lbs., which is impossible due to the max capacity of the aircraft being 136 gals., or 816 lbs. In addition, 21 gals., or 126 lbs. were recovered at the accident site.

WEIGHT AND BALANCE CLEARANCE FORM F - TRANSPORT

LEMAC	123.26		
MAC	64.50		
Constant	1000.00		
DATE: 2008/06/07	MDS: CE-337-A	FROM: KMIV	Station: KCQK
Mission: Accident K31E	SERIAL NO: 337-4082	TO: K31E	Pilot: Ambroult

REMARKS

Ref 1: BEW based on last known calculation: FAA 337 dated 11-06-69.
Ref 3: Pilot Wt (Ambroult): 260 lbs, Front R/H Pax Wt. (Toth): 163 lbs.
Ref 4: Standard carry-on. Wts. 20lbs/ea., (Cabin Centroid).
Ref 5: Two boxes containing aircraft tire tubes (Cargo Compartment).
Ref 6: 4 immersion suits (10lbs. ea.), 1 life raft (20 lbs.) (Cargo Compartment
Ref 7: Video camera, range finders and computer (Cabin Centroid)
Ref 8: Clothing, Misc. (Cabin Centroid)
Passeneger Aft L/H (Claussen) 196 lbs. at Arm 141)
Passeneger Aft R/H (Salinas) 143 lbs. at Arm 141)
Personal Flotation Devices (10 lbs./ea. x 4, Misc. (Cabin Centroid)
Ref 10: Main Fuel Tanks L/H & R/H Trace fuel only. i gal. at Arm 150.
Aux Fuel Tanks L/H: 2 gals. R/H 19 gals. at Arm 150.

CORRECTIONS	Weight	H. Mom/
Total Corrections	0	0.0

EXPENDABLES	WEIGHT	H. Mom/
Total Expendables	0	0.0

LIMITATIONS			
Ramp Weight vs Limit	4042.70	<	4200.00
Takeoff Weight vs Limit	4036.70	<	4200.00
Landing Weight vs Limit			
Zero Fuel Weight vs Limit			
Load vs Max Allowable Load	0.00	<	157.30
Remaining Allowable Load	157.30		

CG LIMITS	FWD	CURRENT	AFT
Ramp CG (Gear Down)	137.00	< 139.03 <	142.50
Takeoff CG (Gear Down)			
Takeoff CG (Gear Up)	137.00	< 139.24 <	142.50
Landing CG (Gear Up)			
Landing CG (Gear Down)	137.00	< 139.03 <	142.50
Zero Fuel CG (Gear Down)	137.00	< 138.68 <	142.50

LATERAL LIMITS	LT	CURRENT	RT
Lateral Ramp (Inches)			
Lateral Takeoff (Inches)			
Lateral Landing (Inches)			

DISTRIBUTION OF ALLOWABLE LOAD

REF	ITEM	WEIGHT	H. Mom/
1	Basic Aircraft(From Chart C)	2856	399.5
3	Crew [Pilot and FWD Pax (Arm 102	426	43.5
4	Crew Bags [Carry -On (Arm 122)]	80	9.8
5	Steward Equip [Misc. (Arm 355)]	10	3.5
6	Emerg Equip [Overwater (Arm 355)]	60	21.3
7	Extra Equip [Survey Gear (Arm 122)]	75	9.2
8	Jackets, Misc.(Arm 122)	20	2.4
	Passeneger L/H Rear (Arm 141)	196	27.6
	Passeneger R/H Rear (Arm 141)	143	20.2
	PFDs, Other Equipment (Arm 122)	50	6.1
	Corrections	0	0.0
9	OPERATING WEIGHT	3916	543.0
10	Int / Main Fuel (0 Gal)	0	0.0
	Ext / Aux Fuel (21 Gal)	127	19.1
12	TOTAL AIRCRAFT WEIGHT	4043	562.1
13			
16	RAMP WEIGHT	4043	562.1
17	RAMP CG (GD) (Inches)		139.03
18	TAXI FUEL (1 Gal)	-6	0.0
19	TAKEOFF WEIGHT	4037	562.1
20	TAKEOFF CG (GD) (Inches)		139.24
	Expendable Fuel at Takeoff	-121	-19.1
21	ZERO FUEL WEIGHT	3916	543.0
22	LESS EXPENDABLES / AIR DROP	0	0.0
23	EST LANDING FUEL (21 Gal)	126	18.9
24	EST LANDING WEIGHT	4042	561.9
25	EST LANDING CG (GD) (Inches)		139.03

COMPUTED BY SIGNATURE
Frederick H.Blauth- Principal Maintenane Inspector
WEIGHT & BALANCE AUTHORITY
FAA - AEA-FSDO-17 (PHL)
PILOT SIGNATURE

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N5382S CE-337-A

FAA IIC Observations:

Basis for Weight and Balance Calculations:

•A recent weight and balance report for the aircraft was not located at the aircraft crash scene. These records also were not immediately available through the owner/pilot's family.

•A basic empty weight (BEW) of the aircraft was calculated to be approximately 2856 lbs. as indicated in archived alteration records in the FAA's Aircraft records branch, in Oklahoma City, OK. The last known weight and balance was documented on FAA Form 337, dated November 5, 1989.

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Calculations of pilot and passenger weights were based on information obtained from the Medical Examiners office, and through both the medical care facilities and Geo-Marine, the company in which the passengers had been employed with.

•Calculations for other equipment installed on the aircraft were based on actual observations, and research obtained through the internet. These items included: PFDs, life raft, camera equipment and miscellaneous items. Carry-on equipment is based on stand average weight as identified in FAA Advisory Circular 120-27E, dated June 6, 2005.

•Calculations for seating and cabin and cargo compartment centroids were obtained form the Cessna 337-A Pilot operating handbook.

•Fuel computations are based on witness statements, fuel records and actual fuel quantity amounts obtained at the crash scene. The standard weight of AVGAS 100LL is was used: 1 gallon = 6.0 lbs.

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FAA IIC Observations:

•Fuel consumption is based purely on probable consumption rates for the CE-337-A model aircraft. Although company pilots stated that fuel consumption is 12 gal/hr./engine, this consumption rate does not work using assuming the aircraft had been "toped-off" on May 15, 2008. It is also assumed that since the aircraft was fully loaded over gross weight and operated at approximately 750 feet MSL for the majority of the flight, a higher fuel burn is more than likely the case. All calculations, thus are based on a fuel burn rate of 9 gal./hr/engine.

Weight and Balance Analysis

•A 12 gal./hr. engine burn rate is improbable since the aircraft could not have been operated for 6.5 hours without refueling. A 9.0 gal./hr./engine fuel burn is more in line with fuel remaining amounts obtained at the crash site.

•Pilot operating procedures require that before fuel in the AUX tanks is selected, both engines should be operated utilizing the main fuel tanks for at least one hour into the flight to allow for fuel not burned by the engine to return to the main tanks. Because of system design, approximately twice the amount of fuel required normally flows to each engine with half that amount being returned to the main tank. Once fuel is used from the AUX tank, the tank can not be replenished in flight.

•Assuming the May 15, 2008 flight started out with all fuel tanks topped off to max fuel capacity (136 gals), and the fight duration was 4.7 hours, we assume that the pilot accessed the AUX fuel sometime during the flight for at least an hour, per the published procedures in the POH. In this case both AUX tanks would have had at least one hour of fuel depleted from each tank upon return from the May 15th flight. AUX tank capacity is 22 gals. Fuel load calculations for the May 17th flight are based on the "best case assumption" that that each AUX tank held approximately 13 gals. For a total of 26 gallons.

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FAA IIC Observations:

•Main fuel tank computations are based on the total fuel required to complete a 4.7 hour flight utilizing a burn rate of 9 gal./hr./engine. This computes to 84.6 gallons or 507.6 lbs. required for the flight. Assuming that the aircraft was "topped-off" prior to the May 15th flight to a max capacity of 136 gallons, the total amount of fuel remaining should have been approximately 51.4 gallons, or 308.4 lbs. This amount thus is broken down into 26 gallons (156 lbs) in both AUX tanks and 25.5 (153 lbs.) in both main fuel tanks.

The aircraft did not operate on May 16, 2008 due to weather.

•Based on survivor's statements, approximately 1.5 hours into the May 17, 2008 flight, the pilot experienced a "fuel problem"(Note: Fuel burn at the stated 12 gal./hr rate would have caused the pilot to have a "fuel problem" much earlier in the flight). For a 1.5 hour flight at 9 gals/hr./engine burn rate, approximately 27 gallons, or 162 lbs would have been used. At this juncture only 24.4 gals. (146 lbs) of fuel would be remaining between all AUX and main fuel tanks. It is likely that at Based on survivor's statements, approximately 1.5 hours into the May 17, 2008 flight, the pilot experienced a "fuel problem"(Note: Fuel burn at the stated 12 gal./hr rate would have caused the pilot to have a "fuel problem" much earlier in the flight). For a 1.5 hour flight at 9 gals/hr./engine burn rate, approximately 27 gallons, or 162 lbs would have been used. At this juncture only 24.4 gals. (146 lbs) of fuel would be remaining between all AUX and main fuel tanks. It is likely that at this point the rear engine quit and the pilot was unable to get the engine restarted and connect to the right auxiliary fuel tank, since there is no electric driven pump for the auxiliary tanks and the main tank had been exhausted. The fuel in the Aux tanks can not be utilized if the main tanks or empty. this point the rear engine quit and the pilot was unable to get the engine restarted and connect to the right auxiliary fuel tank, since there is no electric driven pump for the auxiliary tanks and the main tank had been exhausted. The fuel in the Aux tanks can not be utilized if the main tanks or empty.

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N5382S CE-337-A

FAA IIC Observations:

•An additional .3 hrs. flight time elapsed during the pilot's attempted to locate a suitable place to land. It is calculated that this consumed approximately 2.7 gallons or 16.2 lbs. consumed solely by the forward engine. The total fuel "Fuel Used" during the 1.8 hour flight is thus calculated to be 29.7 gallons, or 178 lbs. This leaves approximately 21 gallons, or 126 lbs. of fuel remaining.

•Fuel Remaining", measured at the crash scene, was calculated to be approximately 21 gallons, or 126 lbs.

•Both main tanks were found to be empty with only trace amounts of fuel remaining. The R/H AUX tank contained approximately 19.25 gals or 115.5 lbs. The left AUX tank contained approximately 2 gallons, or 12 lbs.

•It is not known for certain that fuel quantity indication system was working at the time of the accident. Interviews with company pilots indicated that the fuel quantity indication systems in at least one of the CE-337 aircraft operated by Ambroult Aviation were inaccurate and/ or inoperative.

•Maintenance records for the aircraft were not immediately available. Efforts are continuing to obtain records trough the deceassed pilot's family.

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N5382S CE-337-A

FAA IIC Observations:

Summary:

The pilot apparently did not take into consideration the fact that he was fully loaded and would have to make fuel concessions to allow for the extra payload. This was evident by the pilot operating the aircraft for 4.7 hours on May 15, 2008 in excess of the Gross Weight (GW) limitation.

Actual fuel capacity of the aircraft on May 15th, 2008 can not be determined with certainty, since fuel servicing personnel only serviced the main fuel tanks. We can only assume that the AUX tanks were full. A review of fuel servicing history N5382S obtained at the FBO where the aircraft was based confirms that the pilot did not have the aircraft serviced after returning from the 4.7 hour flight on May 15th or prior to the May 17, 2008 flight.

The combined flight time for both dates amounts to 6.5 hours of flight time. This is calculated to be approximately 117 gallons of fuel used, leaving only 19 gallons remaining at the 9 gal.hr/engine burn rate.

Source Data for calculations:

Weight and Balance was calculated using FAA TCDS Sheet A6CE, the CE-327-A Pilot Operating Handbook (POH) and aircraft records archived in the FAA's Aircraft Records Branch located Oklahoma City, OK. Actual calculations were performed using the Lockheed Martin Aircraft Weight and Balance System (AWBS) Version 9.2 designed for the Air Force, Army, Navy and US Coast Guard. This Inspector has been trained in performing weight and balance calculations and the use of this program.