

Aug 5, 2024

Mr. Timothy W. Monville
Sr. Air Safety Investigator
National Transportation Safety Board

Washington, DC

Subject: Update Energy State Analysis NTSB Report ERA22LA404

Dear Mr. Monville,

This updated information is submitted per your request and updated to reflect data extracted from the "Recorded Data Specialist's Factual Report" with identified data frames.

	Line	Time	Altitude (PA1) Column L
	2989	14:59:39	1742
CAPS Handle Pull	3005	14:59:55	3150
	3007	14:59:56	3240
	3008	14:59:57	3471

The meteorological report stated the flight terminated in "extreme precipitation." The following calculations were explored to further corroborate that the airplane's flight behavior was due to the convective activity associated with the surrounding weather phenomena. The energy calculation information was provided by the Cirrus engineering flight test office.

Kinetic Energy (Velocity based): $KE = \frac{1}{2}m \cdot V^2$

Potential Energy (Height based): $PE = m \cdot g \cdot h$

Total Energy state for aircraft is:

$$KE + PE = \frac{1}{2}m \cdot V^2 + m \cdot g \cdot h = m \left(\frac{1}{2}V^2 + gh \right)$$

Considering trades in speed versus altitude, keeping aircraft at constant energy state the total energy at one speed/altitude would match the total energy at another state. So, one can estimate the potential height gain associated with trading KE for PE by this formula:

$$KE + PE = \frac{1}{2}m \cdot V^2 + m \cdot g \cdot h = \text{CONSTANT}$$

Therefore:

$$m \left(\frac{1}{2}V_1^2 + gh_1 \right) = m \left(\frac{1}{2}V_2^2 + gh_2 \right)$$

$$\Delta h = h_2 - h_1 = \frac{1}{2 \cdot g} (V_1^2 - V_2^2)$$

The airplane at the bottom of its descent was about 170 knots true airspeed (287 ft/sec); at the top of its climb it was 126 KTAS (213 ft/sec); that speed trade alone would equate to a height increase of $\Delta h =$

$$\frac{1}{2 \cdot 32.2} (287^2 - 213^2) = 575 \text{ feet}$$

Using the data from the table above, the aircraft actually climbed from 1742 feet to 3240 feet in 18 seconds, a height change of 1,498 feet. This resulted in a calculated rate of climb of 4,993 ft/min during those 18 seconds.

Assuming that 575 feet of this would have been a normal and natural result of trading speed for altitude, that leaves a climb of 923 feet over 18 seconds unaccounted for. Excess thrust (more thrust than needed for level flight) will also generate climb, but the available thrust in the SF50 would not explain the additional 923 feet of climb in 18 seconds.

A reasonable estimated weight for this aircraft was;

Aircraft BEW	3,658 lbs
Pilot	300 lbs
Forward Passenger	155 lbs
Aft Passenger	148 lbs
Baggage	60 lbs
<u>98 gallons fuel</u>	<u>660 lbs</u>
Total	4,981 lbs

With an outside air temperature of 22° C and average altitude of 2,000 ft, the AFM performance for these conditions would be 1,971 fpm, or 591 feet in 18 seconds. Since the observed climb was significantly greater, it is likely that there was a significant rising air mass affecting the aircraft's flight path.

Sincerely,

A black rectangular redaction box covering the signature of Chris Glaeser.

Chris Glaeser
Director Air Safety