**NTSB Identification: ERA12FA120**
**Accident occurred December 22, 2011 in Nashville, PA**
**Aircraft: Cessna 441 Conquest II, Registration: N48BS**

**Date of Report: February 17, 2012**

## Introduction:

The following analyses were performed by Honeywell based on information provided during the preliminary and on-scene investigations into this accident. Honeywell was requested by the NTSB to perform a fuel burn estimate of two model TPE331-10N-535S installed on the subject aircraft along the provided flight path.

Two separate, independent analyses were performed. One was a purely analytical analysis while the second was a fuel usage estimate from a pilot's planning perspective.

## Summary:

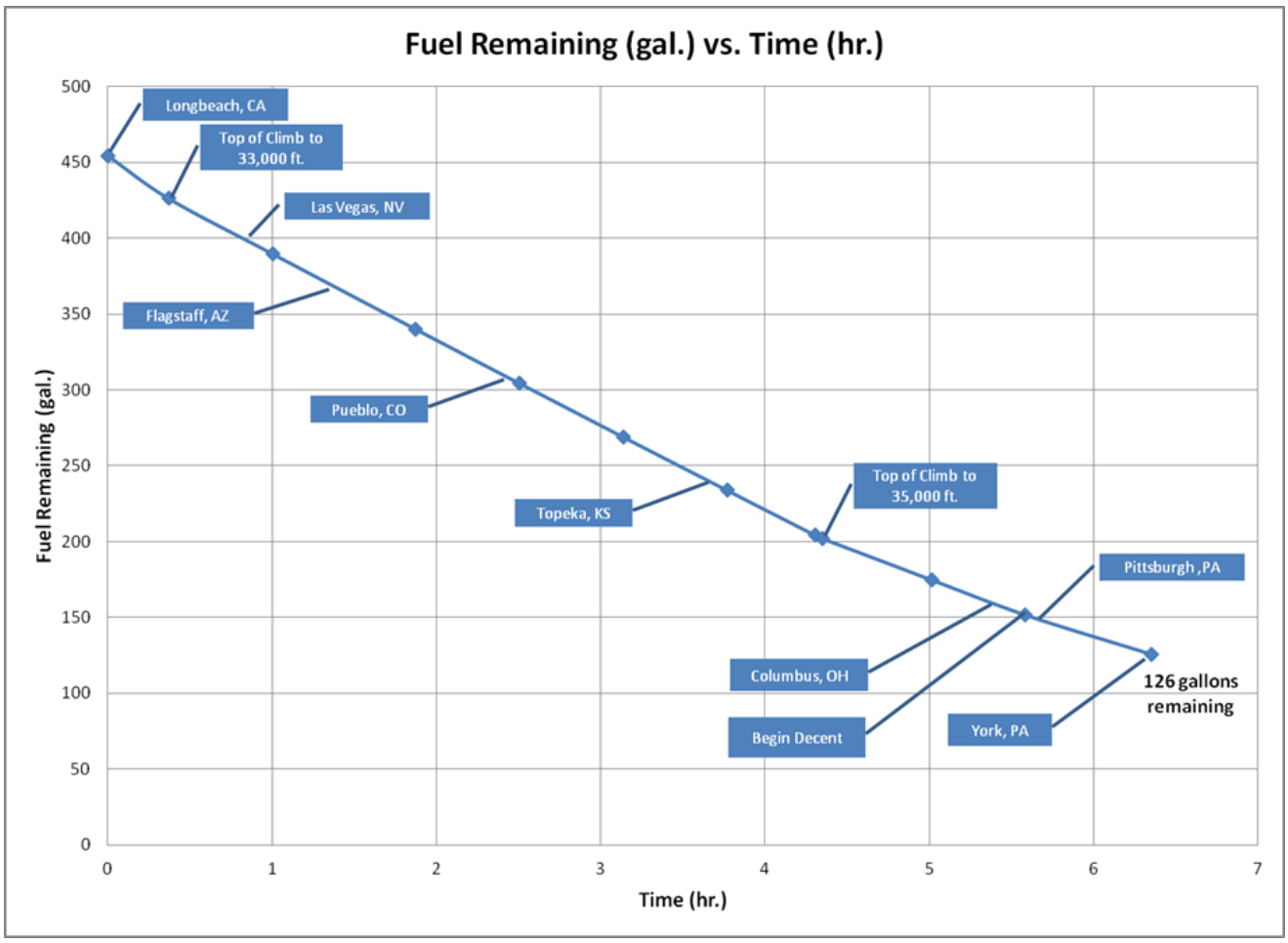
Both, independent, analyses concurred that, given specific assumptions (as detailed below), there should have been sufficient fuel remaining to complete the flight into York, PA with IFR reserve fuel remaining.

## Analytical Analysis:

The first, independent, analysis performed was a purely analytical analysis of fuel burn based on information provided to the engineering team along with assumptions which included:

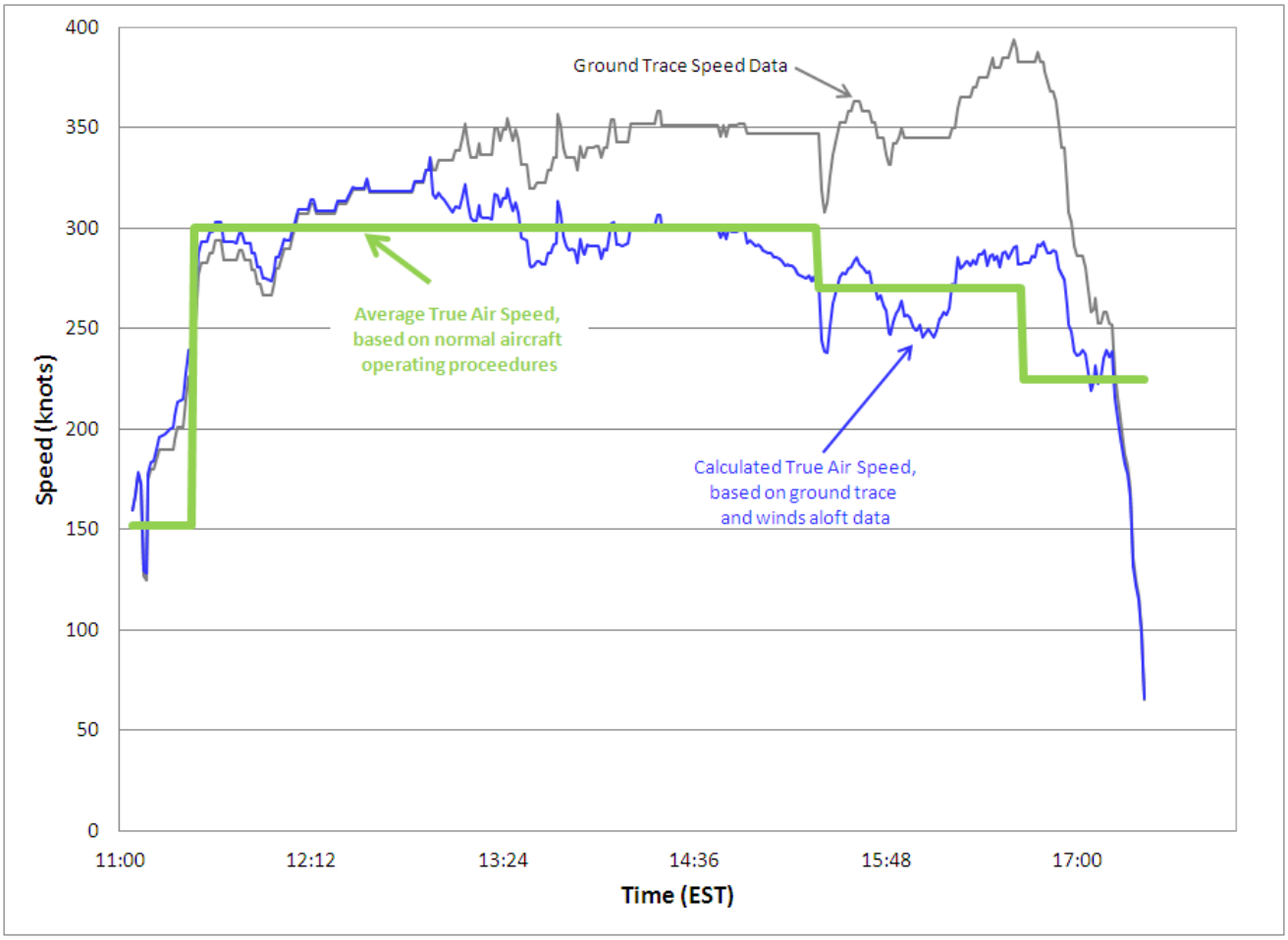
- Flight path as provided by Flight Aware
- Winds aloft as provided by the NTSB
- Propeller performance characteristics as provided by Hartzell
- Fuel burn characteristics as given in the West Star Aviation, Inc. Pilots Operating Handbook and FAA Approved Airplane Flight Manual Supplement for Cessna Model 441 Airplanes Serial No. -0173 and On Equipped with Garrett TPE331-10N engines.
- Take Off Weight: 9200 lb
- Fuel: Full fuel / 475 gal. (3230 lb)
- Empty Weight: 5700 lb.
- Pilot Weight: 170 lb.
- Baggage: 100 lb
- Cruise Speeds: Averaged from winds aloft and ground track data

The assessment indicates that the aircraft likely had 126 gallons of fuel left at the time of the accident.




| | | | Track Data | | | | Aircraft Mission Analysis Results | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Segment | Type | Altitude (ft) | Air Speed (KTAS) | Head Wind (knots) | Seg. Time (hr) | Seg. Ground Distance (n-mile) | Air Speed (KTAS) | Head Wind (knots) | Seg. Time (hr) | Seg. Ground Distance (n-mile) |
| 1 | Taxi | 0 | 0 | 0 | 0.00 | 0 | 0 | 0 | 0 | 0 |
| 2 | Takeoff | 0 | 0 | 0 | 0.00 | 0 | 0 | 0 | 0.00 | 0 |
| 3 | Climb | 33000 | 152 | 7 | 0.37 | 53 | 152 | 7 | 0.37 | 53 |
| 4 | Cruise | 33000 | 294 | 9 | 0.63 | 181 | 300 | 14 | 0.63 | 181 |
| 5 | Cruise | 33000 | 310 | 2 | 0.87 | 267 | 300 | -8 | 0.87 | 267 |
| 6 | Cruise | 33000 | 317 | -20 | 0.63 | 213 | 300 | -37 | 0.63 | 213 |
| 7 | Cruise | 33000 | 295 | -45 | 0.63 | 215 | 300 | -40 | 0.63 | 215 |
| 8 | Cruise | 33000 | 301 | -52 | 0.63 | 224 | 300 | -53 | 0.63 | 224 |
| 9 | Cruise | 33000 | 282 | -63 | 0.53 | 184 | 300 | -45 | 0.53 | 184 |
| 10 | Climb | 35000 | 272 | -72 | 0.05 | 10 | 270 | -72 | 0.04 | 10 |
| 11 | Cruise | 35000 | 272 | -83 | 0.67 | 237 | 270 | -86 | 0.67 | 237 |
| 12 | Cruise | 35000 | 267 | -99 | 0.57 | 207 | 270 | -96 | 0.57 | 207 |
| 13 | Descent | 0 | 225 | -50 | 0.77 | 211 | 225 | -50 | 0.77 | 211 |
| | | | | Total | 6.35 | 2004 | | Total | 6.35 | 2003 |

Due to the scatter in the winds aloft data and the resolution of the ground track data, this analysis used average cruise speeds for the assessment. The last chart below illustrates the level of scatter in cruise speeds calculated from the winds aloft and ground track data.




**Pilot's Fuel Usage Estimates:**

The second, independent, analysis performed was from a pilot's perspective using typical fuel burn estimates as would be performed prior to flight departure.

Proviso:

- All aircraft performance data is based the West Star Aviation, Inc. STC SA5682NM, dated September 30, 1993 for Cessna Model 441 Airplanes Serial No.-0173 and on (note: the FAA registry identifies the aircraft serial number for N48BS as -0125).
- The take off gross weight (TOGW) is assumed to be 9,850 Lbs
- The zero flight weight (ZFW) is assumed to be 6,667 Lbs
- The take off fuel load is assumed to be 3183 Lbs
- Aircraft is flown using AFM recommended power settings

From a flight planning point of view, the intended flight on Dec 22, 2011 from KLGB to KTHV [KLGB direct DAG, DAG to KTHV along a great circle path], at a total distance of 2,008 NM can be made with sufficient IFR reserve fuel remaining at the destination.

This assessment is based on the following 3 different sources of information:

Data from the STC AFM Supplement (Standard Atmosphere no wind).

1. PERFORMANCE AND SPECIFICATION (Page i)
   Maximum Cruise Power
   At 35,000 Feet — Range 2,248 NM
   8.81 Hrs
   259 KTAS
2. RANGE PROFILE (Page 5-24)
   Maximum Range Power Curve
   At 35,000 Feet — Approximate Range 2,160 NM
   257 KTAS

Data from the STC AFM Supplement (Non-Standard Atmosphere and Wind Component)

3. PLANNING NAV LOG (Table A)
   Total Distance KLGB – KTHV — 2,008 NM
   5.8 HRS
   Fuel Remaining 764 LBS

Note: PLANNING NAV LOG (Table A) is based on STC AFM Supplement data as follows:

(Page 5-14) TIME, FUEL, AND DISTANCE TO CLIMB – MAXIMUM CLIMB
(Page 5-17) MAXIMUM RECOMMENDED CRUISE POWER

Note: Data from NWS Forecast Winds and Temperature Aloft (FD) Valid Dec 22, 1800Z

(Table B) NWS FORECAST WINDS AND TEMPERATURE ALOFT (FD) – DATA BASED ON DEC 22, 1200 Z
(Table C) FL330 INTERPOLATION WIND AND $\Delta$T FROM SA
(Table D) FL330 EFFECTIVE TAILWIND/HEADWIND COMPONENT (+T/-H).

NAV PLAN KLGB - KTHV
N48BS

FL 330 at ISA*

| 3,183 lbs Fuel | | 6,667 lbs ZFW | | | | | Fuel | | | GW |
|---|---|---|---|---|---|---|---|---|---|---|
| KLGB | NM | TC | KTAS | +T/-H | GS | MINUTES | FF | Burn | Remain | 9,850 |
| L/O | 72 | | 196 | 10 | 206 | 22.0 | 600 | 220 | 2963 | 9,630 |
| DAG | 31.9 | 48 | 305 | 10 | 315 | 6.1 | 401 | 41 | 2922 | 9,589 |
| BCE | 255.4 | 69 | 307 | 10 | 317 | 48.3 | 401 | 323 | 2599 | 9,266 |
| GJT | 191.3 | 72 | 308 | 20 | 328 | 35.0 | 401 | 234 | 2365 | 9,032 |
| ALS | 92.9 | 73 | 309 | 53 | 362 | 15.4 | 410 | 105 | 2260 | 8,927 |
| PUB | 76.4 | 76 | 309 | 53 | 362 | 12.7 | 410 | 87 | 2174 | 8,841 |
| DEN | 14.7 | 74 | 309 | 39 | 348 | 2.5 | 410 | 17 | 2156 | 8,823 |
| GLD | 130.3 | 77 | 310 | 53 | 363 | 21.5 | 410 | 147 | 2009 | 8,676 |
| GCK | 23.2 | 80 | 310 | 60 | 370 | 3.8 | 410 | 26 | 1983 | 8,650 |
| SLN | 151.8 | 78 | 311 | 52 | 363 | 25.1 | 410 | 171 | 1812 | 8,479 |
| MKC | 142.2 | 80 | 312 | 54 | 366 | 23.3 | 410 | 159 | 1653 | 8,320 |
| STL | 194.1 | 83 | 313 | 72 | 385 | 30.2 | 410 | 207 | 1446 | 8,113 |
| SPI | 29.3 | 86 | 313 | 70 | 383 | 4.6 | 410 | 31 | 1415 | 8,082 |
| IND | 164.8 | 86 | 314 | 96 | 410 | 24.1 | 410 | 165 | 1250 | 7,917 |
| CMH | 159.8 | 88 | 314 | 77 | 391 | 24.5 | 410 | 168 | 1082 | 7,749 |
| AGC | 133.7 | 89 | 315 | 102 | 417 | 19.2 | 410 | 131 | 951 | 7,618 |
| KTHV | 144.3 | 91 | 316 | | 316 | 27.4 | 410 | 187 | 764 | 7,431 |
| TOTAL | 2008.1 | NM | | | | 5.8 | hrs | 2,419 | lbs | |

Based on NWS Forescats Winds and Temperature Aloft (FD) FL 300 [Interpolated]

* BCE= ISA +5
GJT= ISA +3

Ref: AFM Supplement S/N -0173 and on, page 5-17 and page 5-24

(Table A)

**NWS Forecast Winds and Temperature Aloft (FD)** Bulletin current prior to the accident was as follows, issued at 1400Z and valid for 1800Z and for use between 1400-2100Z for the first half of the planning:

FBUS31 KWNO 221403 2011356 1404
FD1US1
-DATA BASED ON 221200Z
VALID 221800Z FOR USE 1400-2100Z. TEMPS NEG ABV 24000

| FT | 3000 | 6000 | 9000 | 12000 | 18000 | 24000 | 30000 | 34000 | 39000 |
|---|---|---|---|---|---|---|---|---|---|
| -ONT | 0336 | 0325+01 | 3410-04 | 3234-08 | 3371-21 | 3281-32 | **317846** | **298554** | 298255 |
| -BCE | | | | 0234-19 | 0321-34 | 0325-44 | **321945** | **292945** | 292945 |
| -GJT | | | 1017-12 | 1023-19 | 0817-32 | 1113-45 | **241746** | **262247** | 263247 |
| -ALS | | | | | 1418-17 | 2226-30 | 2453-39 | **246247** | **255149** | 254048 |
| -PUB | | | 0722-13 | 0810-19 | 2015-30 | 2544-40 | **245649** | **255251** | 244950 |
| -DEN | | | 0508-14 | 0806-20 | 1312-32 | 2321-42 | **233750** | **253950** | 254149 |
| -GLD | | 0324 | 0421-12 | 0414-17 | 2209-28 | 2443-39 | **235350** | **245553** | 245152 |
| -GCK | | 0438-08 | 0522-11 | 0508-15 | 2523-26 | 2549-36 | **245649** | **246354** | 245351 |
| -SLN | 0129 | 0423-06 | 0412-10 | 9900-14 | 2518-25 | 2544-35 | **244948** | **236153** | 236053 |
| -MKC | 0120 | 0411-04 | 2710-07 | 2616-13 | 2421-24 | 2630-34 | **235146** | **236551** | 236654 |
| -STL | 9900 | 2809-01 | 2418-03 | 2324-09 | 2442-21 | 2280-29 | **710943** | **711453** | 720659 |
| -SPI | 3005 | 2708-01 | 2323-03 | 2332-08 | 2443-22 | 2282-29 | **710843** | **721654** | 731260 |
| -IND | 9900 | 2511+02 | 2320-02 | 2326-07 | 2346-19 | 2284-27 | **731142** | **741553** | 741661 |
| -CMH | 9900 | 2526+04 | 2436+00 | 2536-06 | 2357-17 | 2384-27 | **740043** | **741152** | 751661 |
| -AGC | 2509 | 2632+01 | 2545+01 | 2544-06 | 2561-17 | 2480-28 | **750342** | **751152** | 761461 |

(Table B)

Winds and Temperature Aloft
Valid 221800Z

| | Flight Level | | | Flight Level | | | Flight Level | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | 300 | | | 340 | | | 330 | | | SA |
| Station | W dir | WV | °c | W dir | WV | °c | W dir | WV | °c | ΔT °c |
| BCE | 320 | 19 | -45 | 290 | 29 | -45 | 298 | 27 | -45 | 5 |
| GJT | 240 | 17 | -46 | 260 | 22 | -47 | 255 | 21 | -47 | 3 |
| ALS | 240 | 62 | -47 | 250 | 51 | -49 | 248 | 54 | -49 | 1 |
| PUB | 240 | 56 | -49 | 250 | 52 | -51 | 248 | 53 | -51 | -1 |
| DEN | 230 | 37 | -50 | 250 | 39 | -50 | 245 | 39 | -50 | 0 |
| GLD | 230 | 53 | -50 | 240 | 55 | -53 | 238 | 55 | -52 | -2 |
| GCK | 240 | 56 | -49 | 240 | 63 | -54 | 240 | 61 | -53 | -3 |
| SLN | 240 | 49 | -48 | 230 | 61 | -53 | 233 | 58 | -52 | -2 |
| MKC | 230 | 51 | -46 | 230 | 65 | -51 | 230 | 62 | -50 | 0 |
| STL | 210 | 109 | -43 | 210 | 114 | -53 | 210 | 113 | -51 | -1 |
| SPI | 210 | 108 | -43 | 220 | 116 | -54 | 218 | 114 | -51 | -1 |
| IND | 230 | 111 | -42 | 240 | 115 | -53 | 238 | 114 | -50 | 0 |
| CMH | 240 | 100 | -43 | 240 | 100 | -52 | 240 | 100 | -50 | 0 |
| AGC | 250 | 103 | -42 | 250 | 111 | -52 | 250 | 109 | -50 | 0 |

(Table C)

Winds and Temperature Aloft
Valid 221800Z

| | Flight Level | | | Flight Level | | | Flight Level | | | Effective |
|---|---|---|---|---|---|---|---|---|---|---|
| | 300 | | | 340 | | | 330 | | | Wind |
| Station | W dir | WV | °c | W dir | WV | °c | W dir | WV | °c | +T/-H |
| BCE | 320 | 19 | -45 | 290 | 29 | -45 | 298 | 27 | -45 | 10 |
| GJT | 240 | 17 | -46 | 260 | 22 | -47 | 255 | 21 | -47 | 20 |
| ALS | 240 | 62 | -47 | 250 | 51 | -49 | 248 | 54 | -49 | 53 |
| PUB | 240 | 56 | -49 | 250 | 52 | -51 | 248 | 53 | -51 | 53 |
| DEN | 230 | 37 | -50 | 250 | 39 | -50 | 245 | 39 | -50 | 39 |
| GLD | 230 | 53 | -50 | 240 | 55 | -53 | 238 | 55 | -52 | 53 |
| GCK | 240 | 56 | -49 | 240 | 63 | -54 | 240 | 61 | -53 | 60 |
| SLN | 240 | 49 | -48 | 230 | 61 | -53 | 233 | 58 | -52 | 52 |
| MKC | 230 | 51 | -46 | 230 | 65 | -51 | 230 | 62 | -50 | 54 |
| STL | 210 | 109 | -43 | 210 | 114 | -53 | 210 | 113 | -51 | 72 |
| SPI | 210 | 108 | -43 | 220 | 116 | -54 | 218 | 114 | -51 | 70 |
| IND | 230 | 111 | -42 | 240 | 115 | -53 | 238 | 114 | -50 | 96 |
| CMH | 240 | 100 | -43 | 240 | 100 | -52 | 240 | 100 | -50 | 77 |
| AGC | 250 | 103 | -42 | 250 | 111 | -52 | 250 | 109 | -50 | 102 |