# NTSB MEMORANDUM OF RECORD

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**National Transportation Safety Board**

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**NTSB Accident Number: ERA22LA298**
**Subject: Fuel Calculations**
**Date: 12/1/2022**

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The following fuel calculations were made for the July 4, 2022, accident flight of N12115, a 1973 Cessna 172M, in Akron, Ohio. The airplane was equipped with a Lycoming O-320-E2D; s/n L-46738-27A. Note that none of the calculations account for fuel used during start, taxi or run-up.

The pilot reported that he typically set the power to 2350-2400 RPM. Referencing the Owner's Manual Cruise & Performance Range Chart, at maximum gross weight with standard conditions, zero wind and lean mixture, the fuel burn would be 8.1 gallons per hour (gph) at 75% power and 5,000 ft msl. However, not all these conditions for the accident flight were determined. The flight altitude was known, the pilot reported that he did not lean the fuel mixture on the accident flight and the weather reports indicated a 5 kt headwind. Per the Skyhaven Airport owner's statement, the aircraft was topped off at Chester Airport (SNC), Chester, Connecticut. The aircraft would have 38 gallons of usable fuel. According to ADS-B data, the first flight was 2 hours and 10 minutes long (2.2 hours). Adding 1.75 gallons for takeoff, the fuel burn would be 19.57 gallons. Per the airport owner's statement, the pilot performed a go-around on his first landing attempt at Skyhaven Airport (76N), Tunkhannock, PA. Adding an additional gallon for the go-around, the total burn was 20.57 gallons. The fuel receipt from 76N indicates 11.23 gallons were purchased, bringing the total fuel available for the second leg of the day to 28.66 gallons. According to ADS-B data, the flight was 2 hours and 33 minutes (2.6 hours) with a total fuel burn of 22.92 gallons including 1.86 gallons for takeoff. Using the above-described standard conditions, at the time of the accident, the aircraft should have had 5.74 gallons of fuel remaining. However, the fuel mixture was not leaned. The Owner's Manual states that: "Allowances for fuel reserve, headwinds, take-off and climb, and variations in mixture leaning technique should be made and are in addition to those shown on the chart."

TOTAL FUEL USAGE SUMMARY: Given the top off at SNC of 38 gallons and the additional 11.23 gallons added at 76N, the total fuel available for both flights would be 49.23 gallons. Subtracting 4.61 gallons for the two takeoffs and one go around leaves 46.23 gallons available. Dividing the total fuel available by total flight time indicates a 9.29 gph fuel burn to reach fuel exhaustion.

The Operator's Manual for the Lycoming O-320 Series indicated at 2350 RPM, 65% economy cruise, the fuel burn would be 8.8 gallons per hour.

First flight – Climb fuel 1.75 gallons, 2.2 hours at 8.8 gph, plus one gallon for the go around gives a total fuel burn of 22.11 gallons leaving 15.89 gallons fuel available.

Fuel purchased – 11.23 gallons gives 27.12 gallons available for the second flight

Accident flight – Climb fuel 1.86 gallons, 2.6 hours at 8.8 gph gives a total fuel burn of 24.74 gallons

That leaves only 2.38 gallons which could easily be the leaning procedure or fuel used during start, taxi, and run-up.

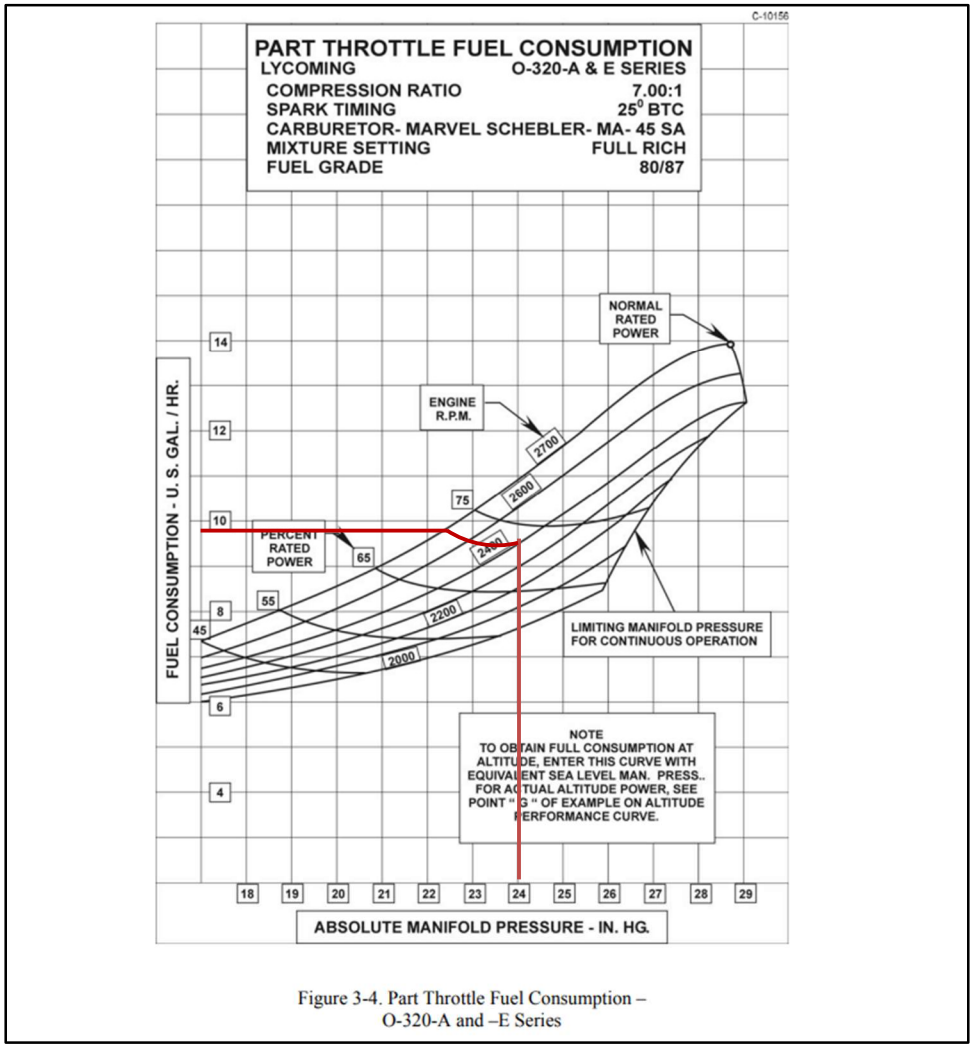


Figure 3-4. Part Throttle Fuel Consumption –
O-320-A and –E Series

*Figure 1- Lycoming O-320-E Series Fuel Consumption Chart*

| Operation | RPM | HP | Fuel Cons. Gal./Hr. | Max. Oil Cons. Qts./Hr. | *Max. Cyl. Head Temp. |
|---|---|---|---|---|---|
| **O-320-A, -E** Series** | | | | | |
| Normal Rated | 2700 | 150 | ------ | .67 | 500°F (260°C) |
| Performance Cruise (75% Rated) | 2450 | 110 | 10.0 | .37 | 500°F (260°C) |
| Economy Cruise (65% Rated) | 2350 | 97 | 8.8 | .33 | 500°F (260°C) |
| **O-320-B, -D† Series** | | | | | |
| Normal Rated | 2700 | 160 | ------ | .72 | 500°F (260°C) |
| Performance Rated (75% Rated) | 2450 | 120 | 10.0 | .40 | 500°F (260°C) |
| Economy Cruise (65% Rated) | 2350 | 104 | 8.8 | .35 | 500°F (260°C) |

* - At Bayonet Location – For maximum service life of the engine, maintain cylinder head temperatures between 150°F (66°C) and 435°F (223.86°C) during continuous operation.

** - O-320-E2A and –E2C have alternate rating of 140 HP at 2450 RPM.

† - O-320-D2H has alternate rating of 150 HP at 2500 RPM. O-320-D2J has alternate rating of 150 HP at 2500 RPM and 155 HP at 2600 RPM.

*Figure 2: O-320 Operations Manual Excerpt*

WIND INFORMATION:

Winds Aloft Request for the general route of flight. Cruising altitude near 4,500 ft

FBUS33 KWNO 040800
FD3US3
-DATA BASED ON 040600Z
VALID 041800Z FOR USE 1500-0000Z. TEMPS NEG ABV 24000

| FT | 3000 | 6000 | 9000 | 12000 | 18000 | 24000 | 30000 | 34000 | 39000 |
|---|---|---|---|---|---|---|---|---|---|
| -AVP | 3005 | 3107+10 | 3419+06 | 3325+02 | 2944-08 | 2951-19 | 305434 | 326445 | 328655 |
| -PSB | | 3406+11 | 3515+06 | 3321+03 | 3030-07 | 2940-18 | 315534 | 327343 | 316453 |
| -AGC | 9900 | 9900+13 | 3211+08 | 3218+04 | 3028-06 | 2933-17 | 323532 | 293442 | 283953 |
| -CLE | 1908 | 2106+13 | 3108+07 | 3117+04 | 3037-06 | 2936-16 | 304333 | 304342 | 325754 |
| -FWA | 1913 | 2012+14 | 2308+10 | 2510+06 | 2831-06 | 2935-17 | 314031 | 324342 | 315254 |

A 850-hPa chart for 2000 EDT depicting the conditions at approximately 5,000 ft is included below to help visualize the conditions and shows a high pressure system over the southeast with a anticyclonic flow. General a 5 knots wind from the southwest over the route. Similar to what is depicted at CLE at 6,000 ft. No strong winds noted.

## CRUISE & RANGE PERFORMANCE
### SKYHAWK

Gross Weight- 2300 Lbs.
Standard Conditions
Zero Wind Lean Mixture

NOTE: Maximum cruise is normally limited to 75% power. Cruise speed for the standard Model 172 is approximately one MPH less than shown below for the Skyhawk configuration.

| | | | | | 38 GAL (NO RESERVE) | | 48 GAL (NO RESERVE) | |
|---|---|---|---|---|---|---|---|---|
| ALT. | RPM | % BHP | TAS MPH | GAL / HOUR | ENDR. HOURS | RANGE MILES | ENDR. HOURS | RANGE MILES |
| 2500 | 2700 | 86 | 134 | 9.7 | 3.9 | 525 | 4.9 | 660 |
| | 2600 | 79 | 129 | 8.6 | 4.4 | 570 | 5.6 | 720 |
| | 2500 | 72 | 123 | 7.8 | 4.9 | 600 | 6.2 | 760 |
| | 2400 | 65 | 117 | 7.2 | 5.3 | 620 | 6.7 | 780 |
| | 2300 | 58 | 111 | 6.7 | 5.7 | 630 | 7.2 | 795 |
| | 2200 | 52 | 103 | 6.3 | 6.1 | 625 | 7.7 | 790 |
| 5000 | 2700 | 82 | 134 | 9.0 | 4.2 | 565 | 5.3 | 710 |
| | 2600 | 75 | 128 | 8.1 | 4.7 | 600 | 5.9 | 760 |
| | 2500 | 68 | 122 | 7.4 | 5.1 | 625 | 6.4 | 790 |
| | 2400 | 61 | 116 | 6.9 | 5.5 | 635 | 6.9 | 805 |
| | 2300 | 55 | 108 | 6.5 | 5.9 | 635 | 7.4 | 805 |
| | 2200 | 49 | 100 | 6.0 | 6.3 | 630 | 7.9 | 795 |
| 7500 | 2700 | 78 | 133 | 8.4 | 4.5 | 600 | 5.7 | 755 |
| | 2600 | 71 | 127 | 7.7 | 4.9 | 625 | 6.2 | 790 |
| | 2500 | 64 | 121 | 7.1 | 5.3 | 645 | 6.7 | 810 |
| | 2400 | 58 | 113 | 6.7 | 5.7 | 645 | 7.2 | 820 |
| | 2300 | 52 | 105 | 6.2 | 6.1 | 640 | 7.7 | 810 |
| 10,000 | 2650 | 70 | 129 | 7.6 | 5.0 | 640 | 6.3 | 810 |
| | 2600 | 67 | 125 | 7.3 | 5.2 | 650 | 6.5 | 820 |
| | 2500 | 61 | 118 | 6.9 | 5.5 | 655 | 7.0 | 830 |
| | 2400 | 55 | 110 | 6.4 | 5.9 | 650 | 7.5 | 825 |
| | 2300 | 49 | 100 | 6.0 | 6.3 | 635 | 8.0 | 800 |
| 12,500 | 2600 | 63 | 123 | 7.0 | 5.4 | 665 | 6.8 | 840 |
| | 2500 | 57 | 115 | 6.6 | 5.8 | 665 | 7.3 | 835 |
| | 2400 | 51 | 105 | 6.2 | 6.1 | 645 | 7.8 | 815 |

*Figure 3 - Owner's Manual Cruise Performance Chart*