CFI Bootcamp

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Systems

Fuel Mismanagement

What happened and what should have happened

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Today's Bootcamp+ Network Programming

What's on for Today?

Live Show – 1st Hour – Wings Credit

Open Mic – 2nd Hour – End

Monitor the Chat – Links/Info

Wings Credit - End of the Live Show

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Today's Bootcamp+ Network Programming

What's New?

PH Rebroadcasts Wed – 8 pm EDT

Power Hour Podcasts – Full shows

CFI Knowledge Gaps Course and CFI Smart Study Pro

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Fuel Mismanagement Statistics

~50	95%	56%	35%
per year	of cases	of fuel accidents	of fuel accidents
Fuel-related GA accidents (NTSB avg.)	Attributed to pilot error	Fuel exhaustion (ran out)	Fuel starvation (fuel aboard, didn't reach engine)

FUEL EXHAUSTION	Ran completely out of fuel. Tanks empty.	**FUEL STARVATION**	Fuel aboard but couldn't reach the engine.

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Case Study #1

1 NTSB CEN22FA383 — August 13, 2022 — Hanna City, Illinois

FUEL EXHAUSTION

AIRCRAFT
Mooney M20K (1982)

INJURIES
2 Fatal

FUEL SYSTEM
Fuel-injected Continental TSIO-360 engine; two wing tanks, 75.6 gal usable; separate left/right selector. Equipped with Shadin MiniFlo digital fuel management system.

PILOT EXPERIENCE
Commercial certificate, ~2,900 total hours, single/multi-engine land, instrument rated. BasicMed expired. No flight review on record.

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Case Study #1 – Probable Cause

PROBABLE / ACTUAL CAUSE: Total loss of engine power due to fuel exhaustion. The pilot failed to ensure adequate fuel on board for the flight, likely departing with only 54 gallons for a route requiring up to 64.9 gallons at cruise power settings. He did not stop for fuel despite a 4.8-hour flight near the limits of his fuel load.

Case Study #1 – Correction

WHAT SHOULD THE PILOT HAVE DONE?

- **Calculate fuel endurance before every flight.** At 10–12.5 GPH, 54 gallons yields only ~4.3–5.4 hours. The pilot's planned route was nearly at the edge of that window with zero margin.
- **Use fuel totalizers as advisory tools only.** The Shadin MiniFlo must be manually reset at each fueling. An un-reset totalizer gives false confidence. Always cross-check with actual tank readings.
- **Apply the 45-minute VFR reserve rule.** 14 CFR §91.151 requires 30 minutes at night; conservative practice adds 45+ minutes. Plan fuel stops for long cross-countries.
- **Do not skip fuel stops to save time.** A 15-minute fuel stop is far preferable to a forced landing or worse.

Case Study #1 – Fuel System

MOONEY M20K

FUEL SYSTEM

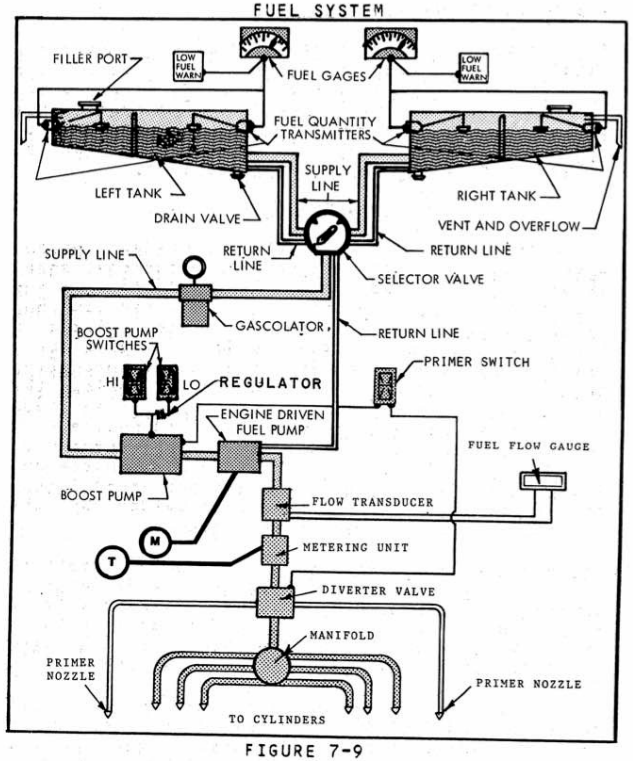

FIGURE 7-9

Fuel is carried in two integrally sealed sections of the forward inboard area of the wings. Total usable fuel capacity is 75.6 gallons (286.4 liters) (63 Imp. Gals.). There are sump drains at the lowest point in each tank for taking fuel samples to check for sediment contamination or condensed water accumulation.

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Case Study #2

2 NTSB ERA23FA087 — December 13, 2022 — Kellyton, Alabama

FUEL STARVATION

AIRCRAFT
Mooney M20B (1961)

INJURIES
1 Fatal

FUEL SYSTEM
Lycoming O-360 carbureted engine; two separate wing fuel tanks (~27.4 gal each); floor-mounted black fuel selector beneath pilot's seat. STC bladder tank modification.

PILOT EXPERIENCE
Commercial certificate, ~520 total hours, instrument rated. First flight in this make/model was the day before the accident. Had not switched tanks in the airplane before.

Case Study #2 – Probable Cause

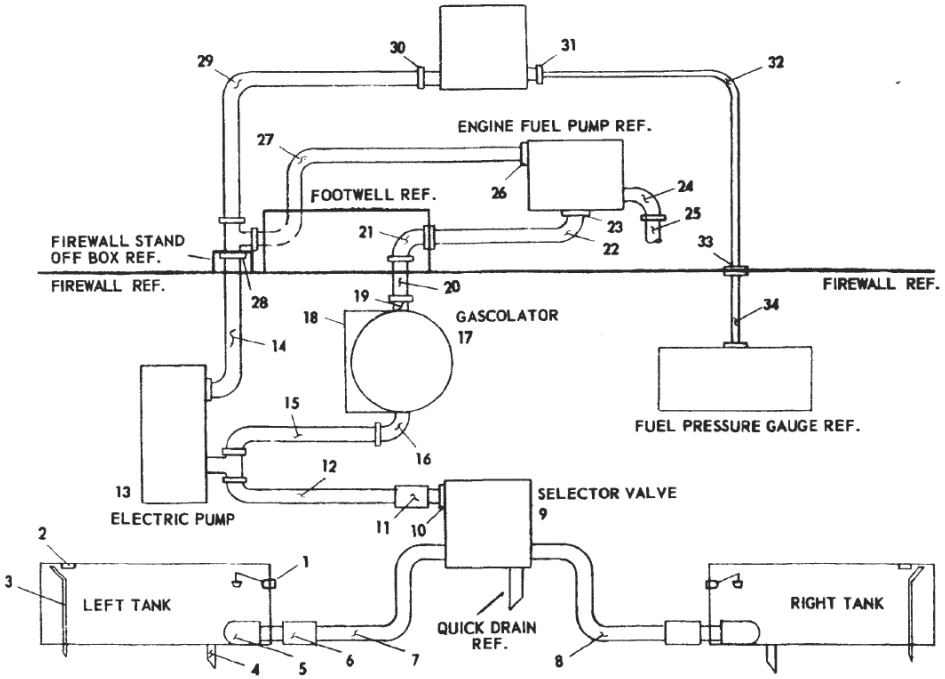
PROBABLE / ACTUAL CAUSE: Total loss of engine power due to fuel starvation. The pilot flew on one tank until it was exhausted without switching to the left tank, which still had 18 gallons. Task saturation from hand-flying in IMC without a functioning autopilot, combined with unfamiliarity with the aircraft's fuel system and the non-obvious floor-mounted fuel selector, contributed to the failure to switch tanks.

Case Study #2 – Correction

WHAT SHOULD THE PILOT HAVE DONE?

- **Get a thorough checkout before flying an unfamiliar aircraft.** The pilot had only one hour of ground instruction and one short flight in the M20B. A proper checkout includes in-flight fuel system practice.
- **Know where the fuel selector is located — and verify it.** The Mooney's selector is on the floor, painted black, unlike the red sidewall selectors in Pipers. Cockpit differences can be fatal.
- **Set a fuel-switching timer.** Switching tanks every 30–45 minutes prevents a single tank from running dry. Use the timer on your watch, EFB, or GPS.
- **Never rely on unfamiliar aircraft's fuel status assumptions.** If you are not certain how much fuel is on board, verify it visually — do not assume.
- **Manage workload before adding IMC.** Flying a new aircraft type in IMC without autopilot is extremely high-risk. Know your aircraft's systems thoroughly before filing IFR.

Case Study #2 – Fuel System



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Case Study #3

3 NTSB CEN20LA370 — August 30, 2020 — Bryan, Texas

FUEL STARVATION

AIRCRAFT
Piper PA-24-250 Comanche (1961)

INJURIES
3 Fatal, 1 Serious

FUEL SYSTEM
Lycoming O-540, 250 HP; four fuel tanks (2 main inboard, 2 auxiliary outboard); separate tank selectors. Total capacity approximately 60 gallons.

PILOT EXPERIENCE
Private certificate, ~226 total hours, no instrument rating. Had purchased the airplane approximately 2 weeks before the accident.

Case Study #3 – Probably Cause

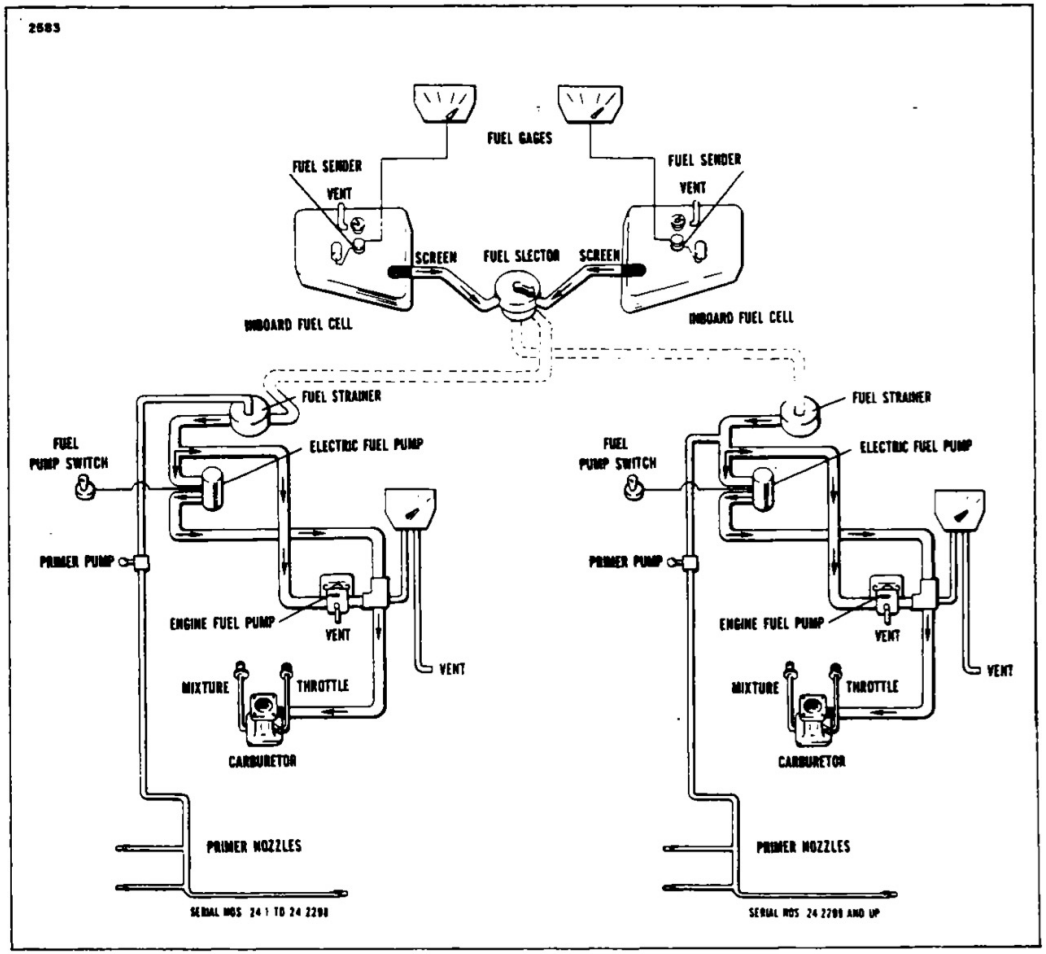
PROBABLE / ACTUAL CAUSE: Total loss of engine power on takeoff due to fuel starvation from an empty selected tank. The pilot apparently did not conduct an adequate preflight check of fuel quantity or selector position. With only 2 weeks of ownership and no transition training documented in a complex four-tank aircraft, the pilot likely did not understand the fuel system or the importance of selecting the fullest tank for takeoff.

Case Study #3– Correction

WHAT SHOULD THE PILOT HAVE DONE?

- **Always select the fullest tank for takeoff.** In multi-tank aircraft, the POH specifies which tank to use. Never depart on a tank showing near-empty.
- **Verify fuel quantity visually, not just by gauge.** Pre-flight photos showed the gauge near empty. The pilot either missed it or misread it. Dip the tanks or use a calibrated dipstick.
- **Get formal transition training in any new aircraft.** A Comanche with 4 tanks and a retractable gear is a significant step up. The pilot had no documented checkout in this airplane.
- **Scan all fuel gauges during the run-up checklist.** Before taking the runway, note both the quantity and the selector position for each tank as part of the before-takeoff checklist.

Case Study #3– Fuel System



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Case Study #4

4 NTSB ERA23LA151 — March 14, 2023 — Scottsmoor, Florida

FUEL EXHAUSTION

AIRCRAFT
Beechcraft 35-B33 Bonanza (1964)

INJURIES
1 Serious

FUEL SYSTEM
Continental IO-470, 260 HP, fuel-injected; four tanks (2 main + 2 wingtip auxiliaries); boost pump and separate wingtip fuel pump switches required for aux tanks.

PILOT EXPERIENCE
ATP certificate, Flight Instructor (CFII), ~21,764 total hours, 605 hours in type.

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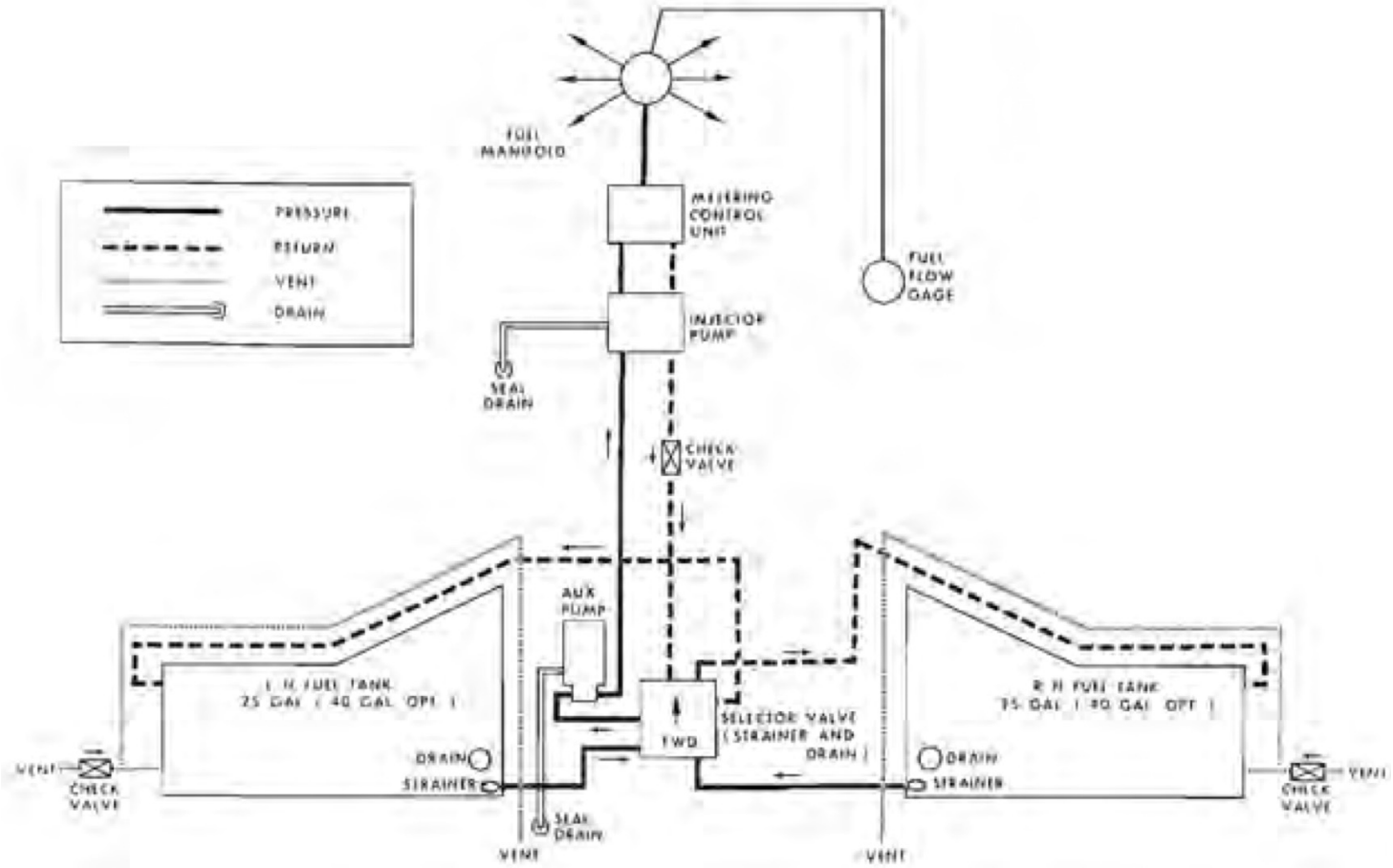
Case Study #4 – Probably Cause

PROBABLE / ACTUAL CAUSE: Fuel exhaustion due to inadequate preflight fuel planning. Despite holding an ATP certificate and 21,764 hours, the pilot departed without verifying that sufficient fuel was on board for the flight. This case demonstrates that complacency — not inexperience — is the primary risk factor in fuel mismanagement accidents.

Case Study #4 – Fuel System



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Case Study #4 – Correction

WHAT SHOULD THE PILOT HAVE DONE?

- **Experience does not prevent fuel mismanagement.** This ATP had 21,000+ hours and still ran out of fuel on an 8-minute flight. Complacency affects everyone. Always verify fuel before every flight.
- **Visually inspect every tank before every flight.** Do not assume the airplane has fuel from a previous flight. Tanks can leak; fuel can be drained; totalizers can be wrong.
- **Know your aircraft's complex fuel system.** The Bonanza 35-B33 has four tanks and separate pump controls for the wingtip tanks. Confirm all tanks are serviceable and selected correctly.
- **Confirm fuel quantity explicitly, even for short flights.** A 33 nm flight requires perhaps 10–15 minutes of fuel. But if the tanks are already near empty, even a short flight is fatal.

Case Study #5

5 NTSB CEN22LA036 — October 30, 2021 — Hudson Oaks, Texas

FUEL EXHAUSTION

AIRCRAFT
Cessna 177 Cardinal (1968)

INJURIES
5 None (substantial aircraft damage)

FUEL SYSTEM
Lycoming O-360-A1A, 180 HP; carbureted; two wing tanks with 'Both' selector position; single overhead fuel selector.

PILOT EXPERIENCE
Private certificate, ~1,600 total hours, 253 hours in type, no instrument rating.

Case Study #5 – Probably Cause

PROBABLE / ACTUAL CAUSE: Partial loss of engine power due to fuel exhaustion. The pilot's fuel calculations were inaccurate, resulting in the aircraft running out of fuel before reaching the destination. Contributing factors may have included inaccurate fuel gauges, failure to track actual fuel burn, and possible carburetor icing compounding the issue during descent.

Case Study #5 - Correction

WHAT SHOULD THE PILOT HAVE DONE?

- **Track fuel burn in flight, not just at preflight.** Use a fuel flow meter or EFB to monitor actual consumption vs. planned. Cross-check gauges every 30 minutes.
- **Don't trust the gauges alone.** FAA regulations require fuel gauges to be accurate only when reading 'empty.' Never plan a flight assuming the gauge reading is precise.
- **Apply carburetor heat early in descent.** In carbureted engines, apply carb heat before reducing power in descent, especially in conditions favorable for icing (high humidity, temperatures between -10°C and +20°C).
- **Land with a fuel reserve — always.** Plan to arrive with at least 45 minutes of fuel remaining. If your math shows you'll arrive with 10 gallons, plan a fuel stop before departure.

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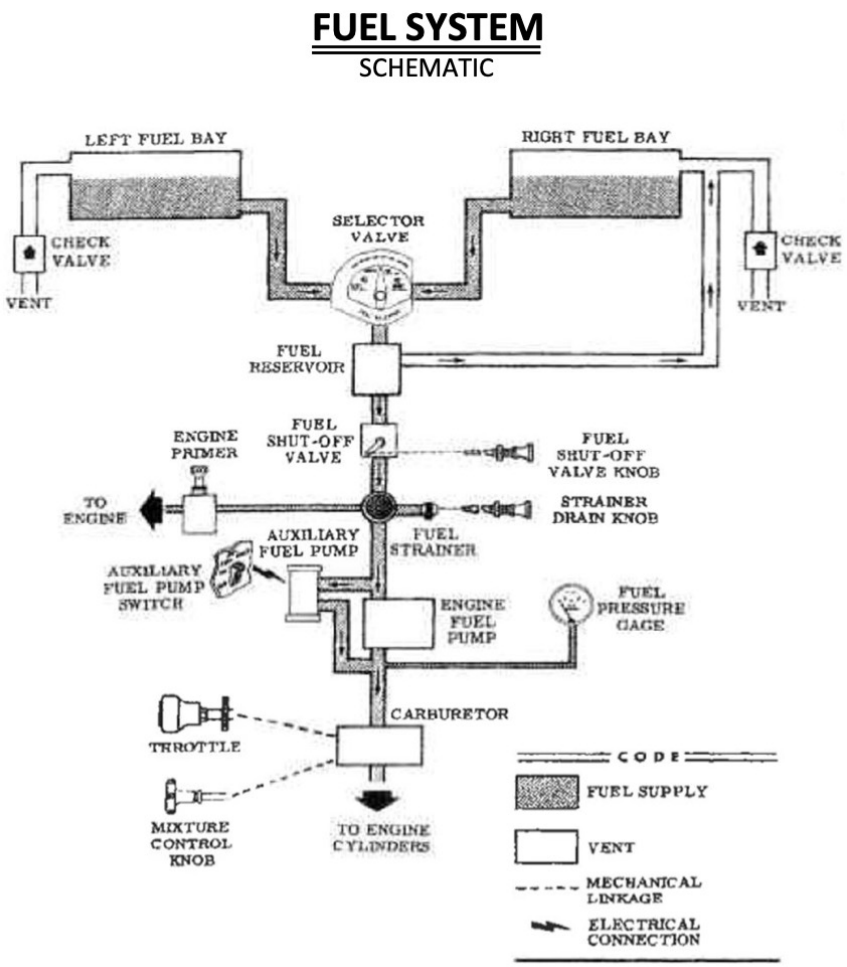
Case Study #5 - Fuel System



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Reminders!

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