Piston Twin

- When both engines spinning: easier to fly than a single (less right rudder)
- Training and rating are all about how to fly on one engine
- Six power levers
- Maybe cowl flaps that add drag
- No required climb rate on one engine, even if everything done perfectly
Eisenhower’s Air Force One

Your trainer: Piper Seminole
Where the problems happen

Piston Twin Engine Failure

- Push all six levers forward (throttle, prop, mixture)
- Dead foot, dead engine
- Verify dead engine by pulling back that throttle
- Feather dead engine’s prop by pulling back that prop lever
- Close cowl flaps
- Now the second engine can take you to the scene of the accident!
Within Human Capability?

- World War II pilots did this all the time
- But they also got it wrong
  - Louis Zamperini was in a four-engine B-24 bomber
  - One engine quit
  - Flight engineer feathered the prop on the same-side good engine
  - Floated in raft for 47 days then imprisoned in Japan for two years
- Cape Air does it when necessary
- Most of us don’t, which is why capable twins are almost free to buy and expensive to insure

Baron vs Bonanza Insurance

- 1,000 hour commercial, instrument rated 45 year old pilot with 250 hours in type
- $200,000 hull value
- $1M smooth liability

Bonanza: $2,521/year (planeinsurance.com)
Baron: $3,762/year (50 percent more)
Limits to piston engine power?

Question for the class: *What stops us from getting as much power as we want from a piston engine?*

Frank Whittle

- Cadet at Royal Air Force College
- Filed patent in 1930 at age 23: Adapt gas turbine (John Barber, 1791), with one spinning component, to airplane propulsion
- Volume of air burned no longer limited by volume of pistons
- Struggled with funding; first flight in 1941
- Don’t be too early: Whittle died in 1996 in relative obscurity.
The Science is Settled

National Academy of Sciences, Committee on Gas Turbines (June 1940):

“In its present state ... the gas turbine engine could hardly be considered a feasible application to airplanes mainly because of the difficulty in complying with stringent weight requirements imposed by aeronautics.”

Turbofan (“Turbojet”)

Source: Public Domain
Twin Turbojets

- Engine failure:
  - press on rudder to rectify any yaw (if yaw damper has not dealt with automatically)
  - push both thrust levers forward
  - plane will keep climbing nicely (FAA certification regulations)
  - once at safe altitude, start running checklist
- No propeller to drag back a wing
- Engines often close to fuselage
- Cardinal rule of flying jets: “If you see a switch with dust on it, don’t touch it.”

Pilot Requirements

- Turbojet-powered: requires a type rating on pilot certificate
- Most turbojets require two pilots (but Captain Sully was alone in the Airbus A320!)
- FAR 91.5 says that PIC of a two-pilot aircraft must get an annual proficiency check under FAR 61.58
- FAR 61.58 says the check also required for single-pilot turbojets (aligns with insurance requirements)
Turbojets that you might own

- Single-pilot business jet pioneered by Cessna in the 1970s
- “Very light jets” introduced starting 2006:
  - Cessna Mustang ->
  - Eclipse
  - Embraer Phenom 100
  - HondaJet

All business failures!

Phenom 300 = smallest practical

- Fixed costs of jet ownership are high:
  - Hangar can be $40,000 per year
  - Sim training for two pilots, $50,000
  - Insurance: $30,000
  - Flight planning, landing fees, etc.

Nobody has ever made money with a plane smaller than a Phenom 300 (Cessna CJ3, Pilatus PC-24 are comparable)

$9 million new; $3-5 million used.
Single-engine jets

• F-16 and eject if there is a bird strike
• Cirrus SF50 Vision Jet; pull parachute if necessary

(don’t forget your noise-canceling headset; note the engine right over your head and the composite fuselage acting as a resonator!)

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Twin Turboprops

• Beech King Air (1964-present) best-known example
• Prop enables short takeoff and landing
• Better tolerance for dirt and grass
• Bird Cuisinart
• May have auto-feather after engine failure (not a panacea; TransAsia 235 had this on their new ATR 72-600)
Single Turboprops

- Unpressurized: Cessna Caravan
- Pressurized: Piper Meridian, TBM, Pilatus PC-12

More expensive to purchase than twin-turboprop, but cheaper per hour to run.

Useful when your friends are sea turtles (story).

Jet Maintenance

- Most generic FAA repair guidance and regulations superseded by FAA-approved manufacturer’s maintenance manual
- Intervals may be as long as 600 hours
- Annual inspection costs of $50,000 or $100,000 are common
- Illegal to operate after reaching hour or cycle limit due to stress on pressure vessel
Fun: B737 or A320 type rating

- Nearly 10,000 Boeing 737s have been built
- Nearly 8,000 Airbus A320s are flying
- Sims for these planes are thus the most numerous
- $10,000 gets you a type rating (compare to $25,000 to $50,000 for bizjets)
- Great for proficiency!

Summary

- Multi-engine rating is a good challenge
- Piston multi-engine rating is a typical step toward flying a twin-engine jet
- Engine failure in piston multi usually handled well by people who fly every day or two
- For personal flying, a well-maintained single is just as safe statistically
- Nervous? Get a single-engine plane with a ballistic parachute as the backup!
Questions?