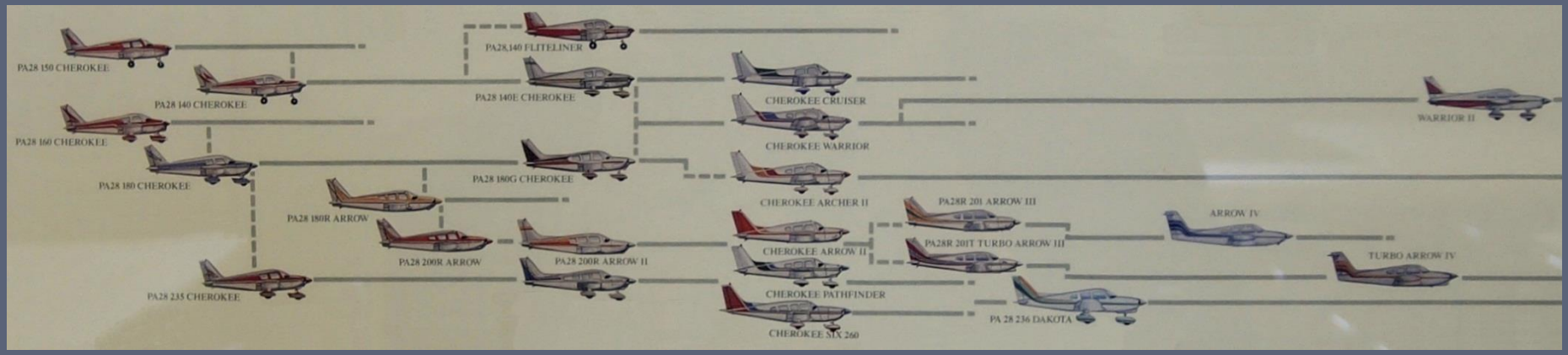
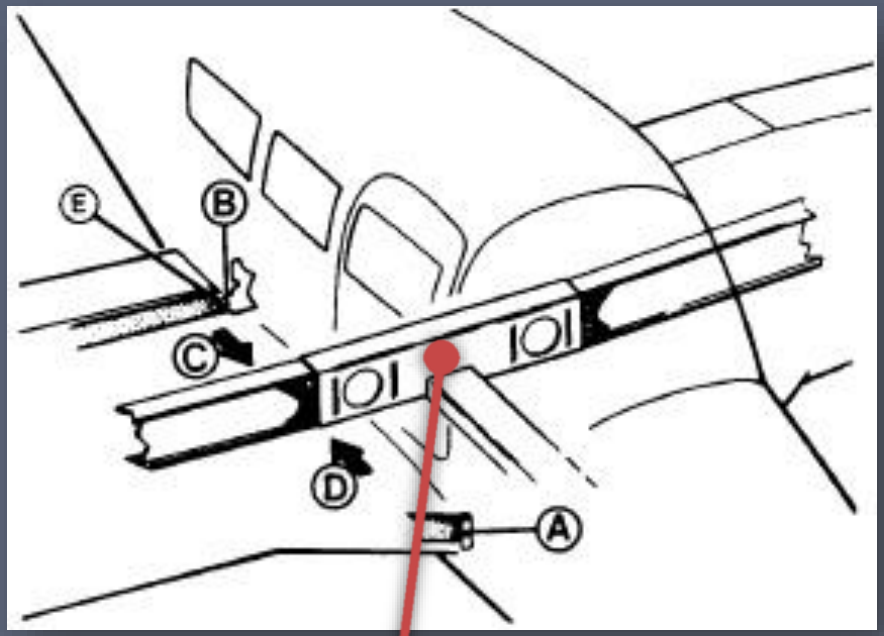


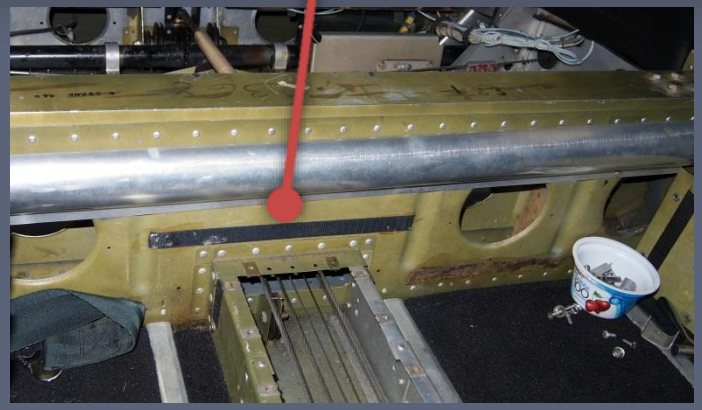
Aircraft Systems & Emergencies Review

Piper Cherokee-Series

Piper PA-28 "Cherokee" Series Overview

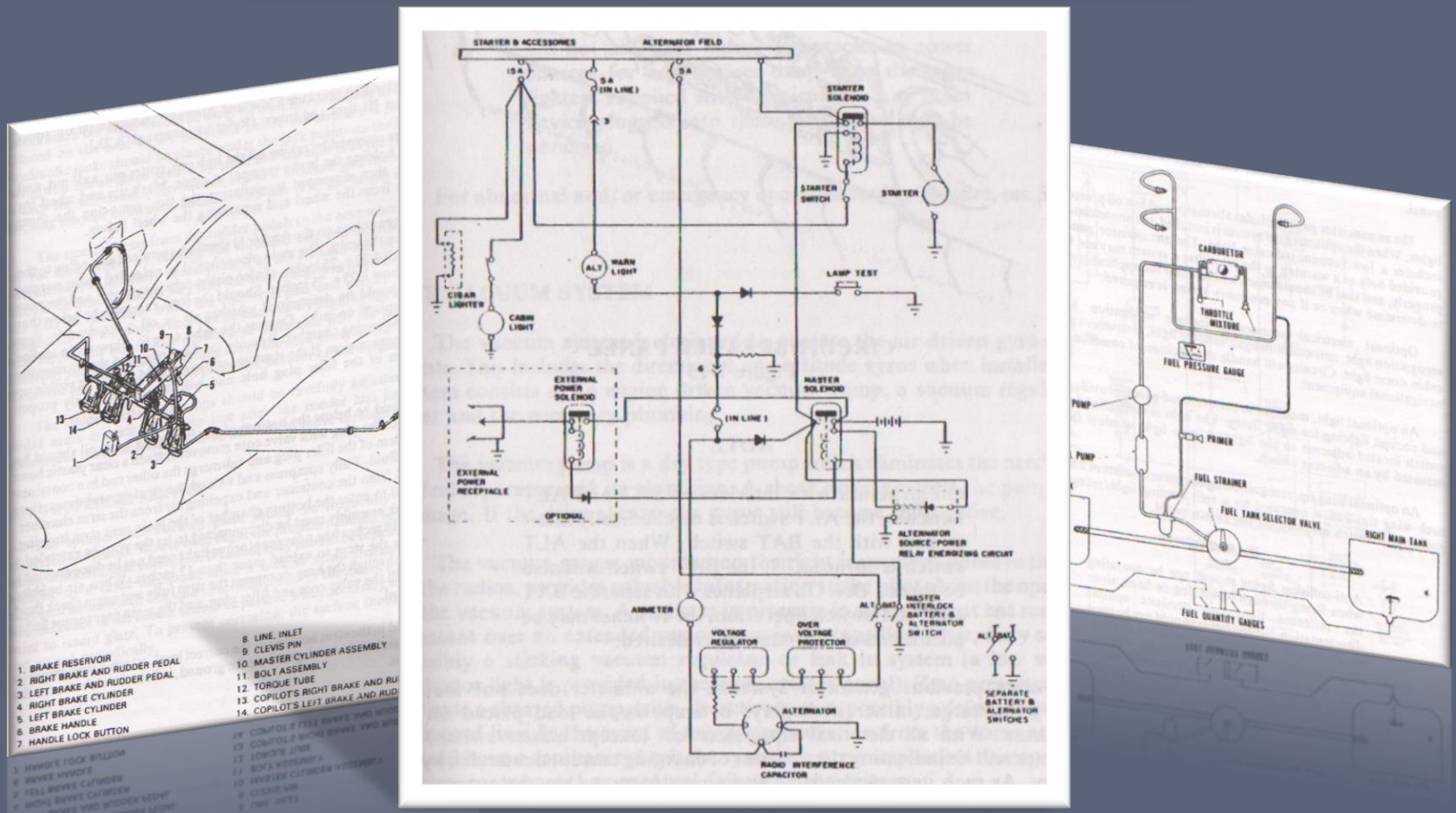
- All metal, semi-monocoque structure
  - The skin provides part of the structural strength
    - 0.051" (1.3mm) – 0.016" (0.4mm) thick
- Wings are of a full cantilever design with removable tips
  - No external bracing





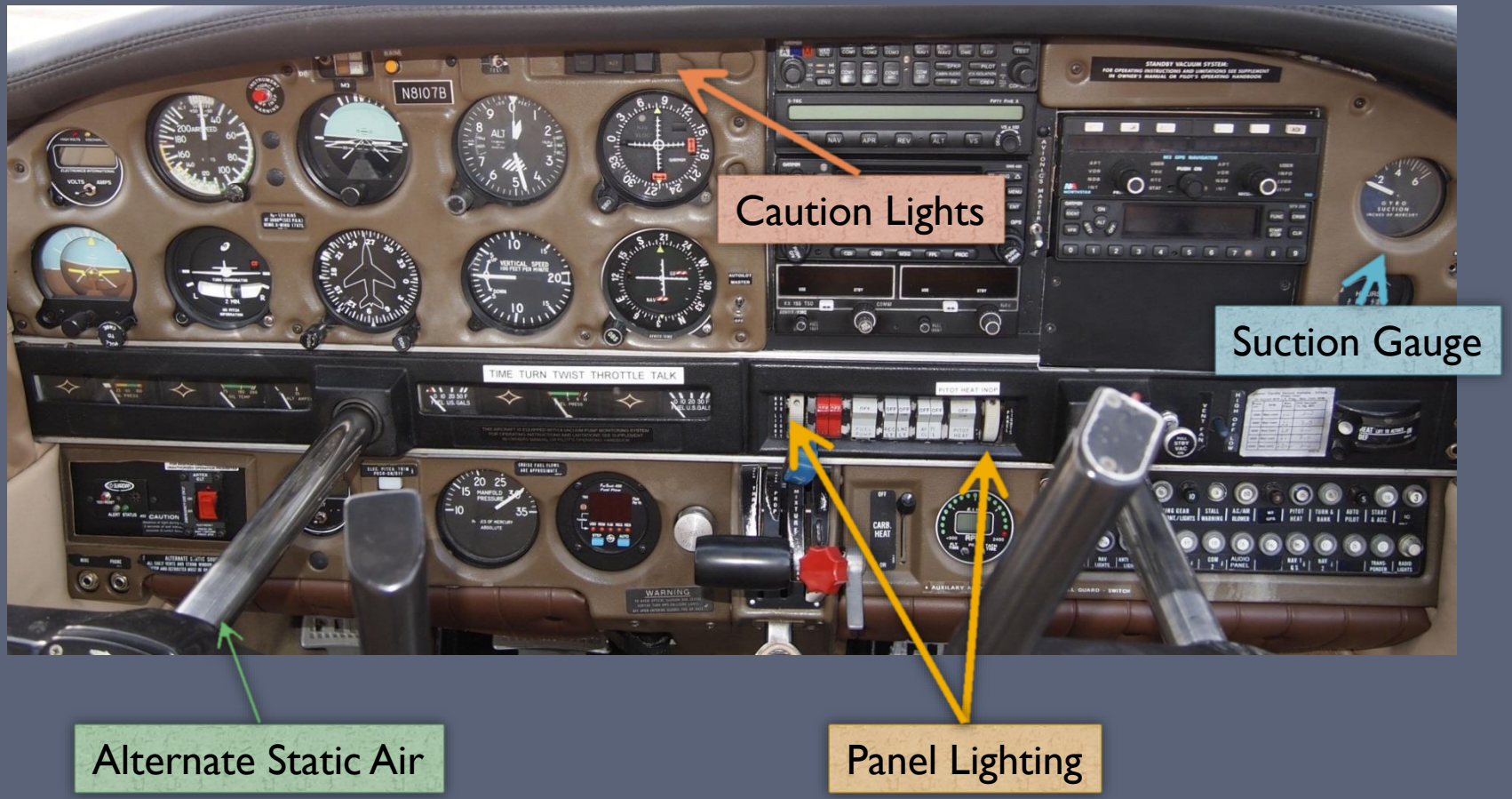
Systems Review

Understanding the aircraft systems can save your life!



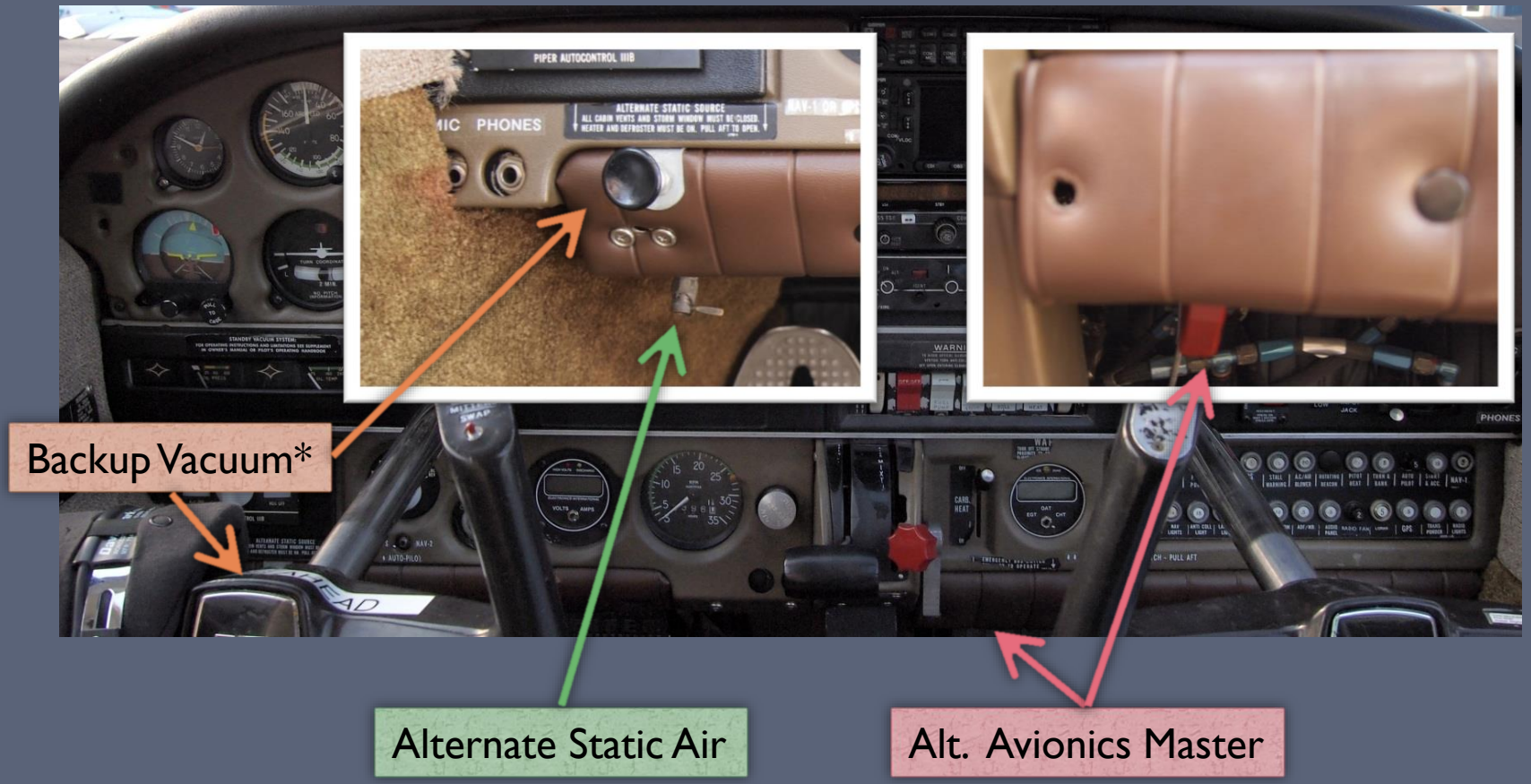
Cockpit Layout – "Classic" Cherokee

- Know where all the switches and circuit breakers are by memory



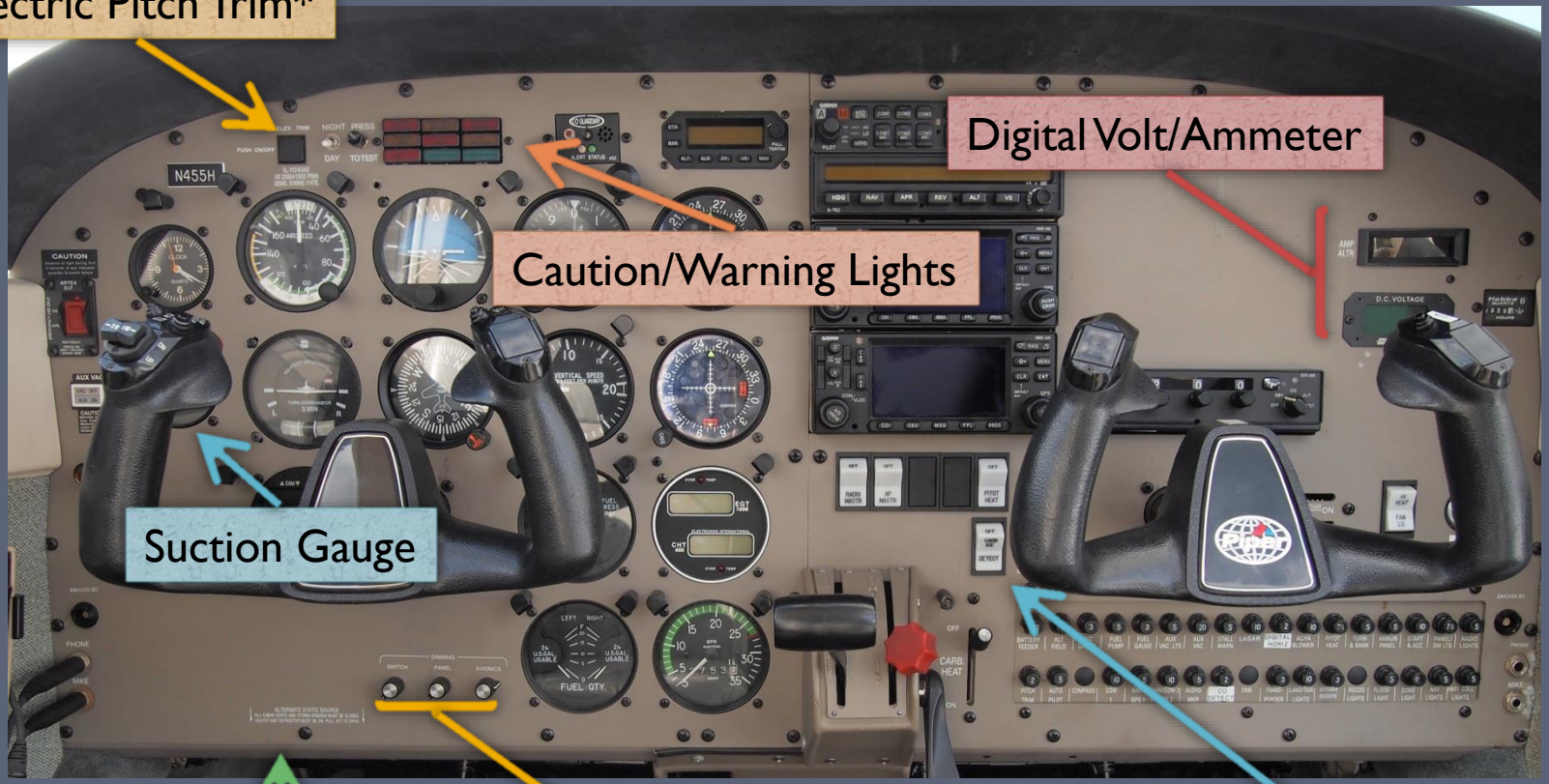
Cockpit Layout – "Classic" Cherokee (Cont.)

- Know where all the switches and circuit breakers are by memory
- * = Optional item



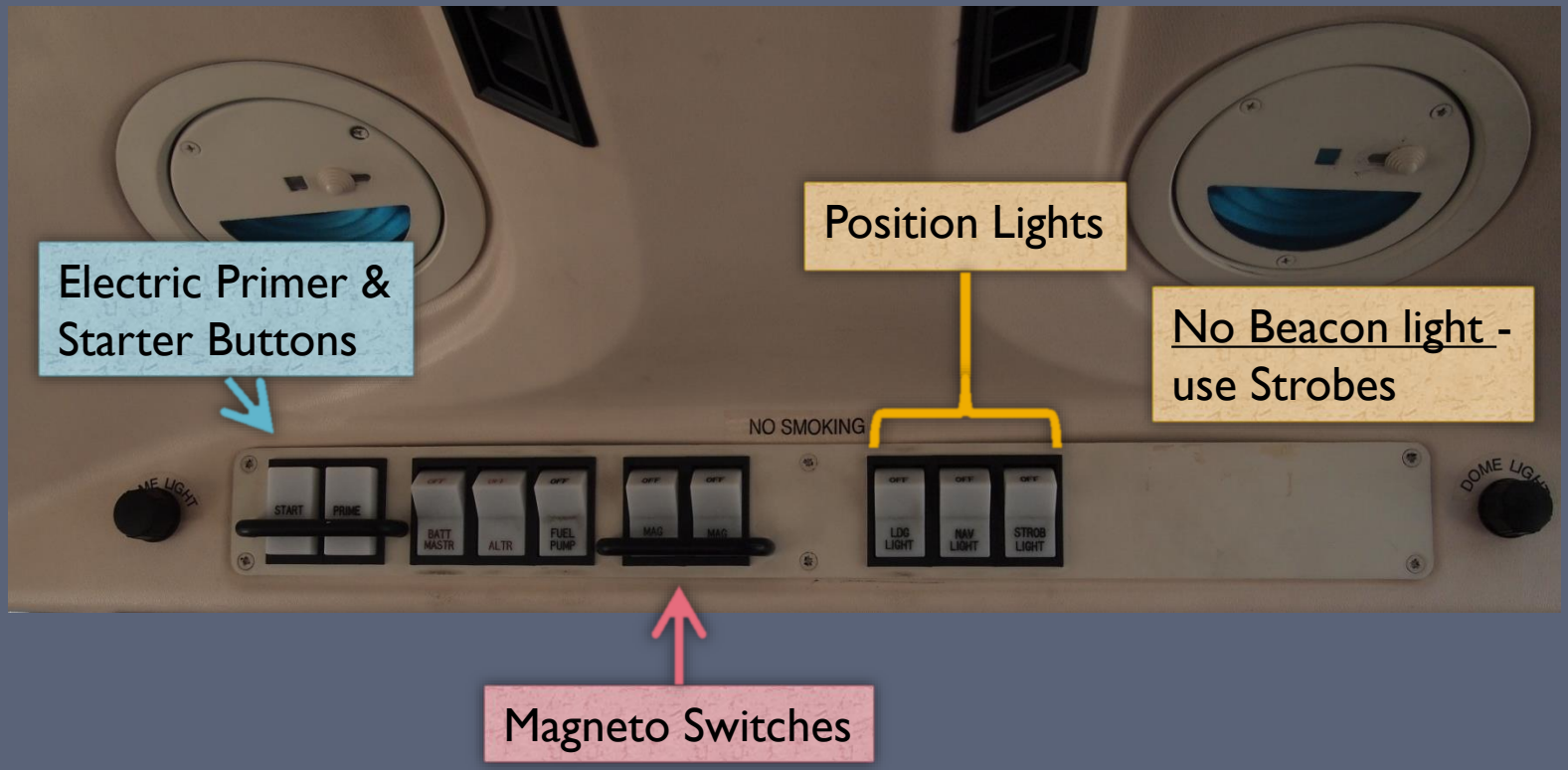
Cockpit Layout – "Modern" Cherokee

- Know where all the switches and circuit breakers are by memory
- * = Optional item

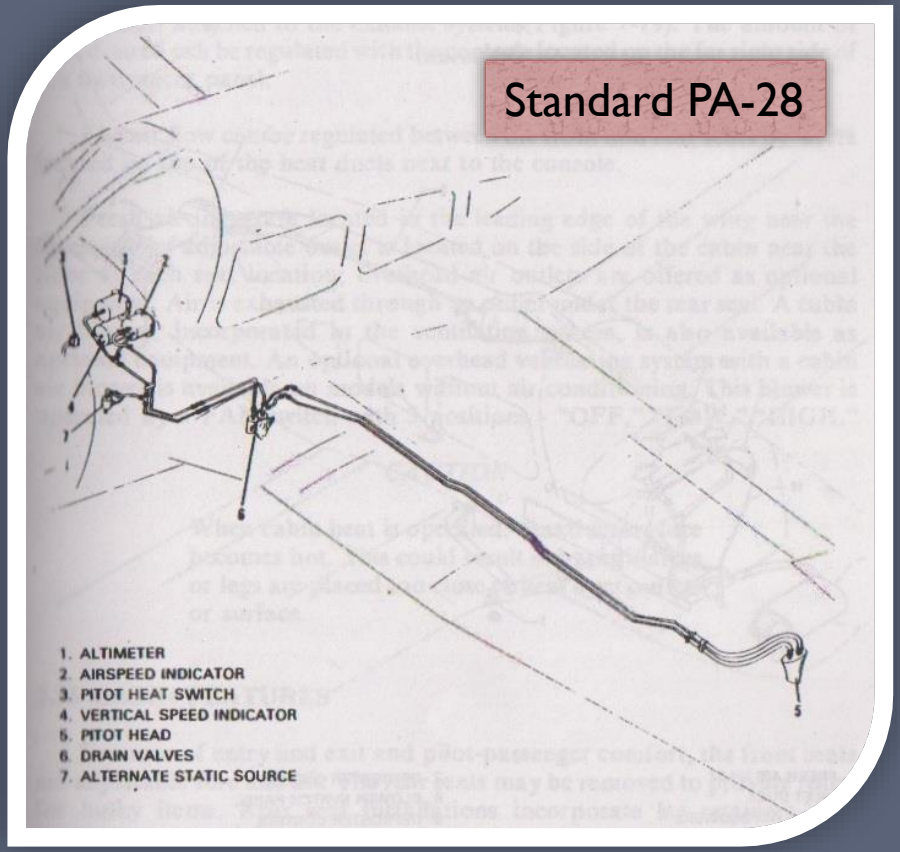


Cockpit Layout – Overhead Switches

- Know where all the switches and circuit breakers are by memory

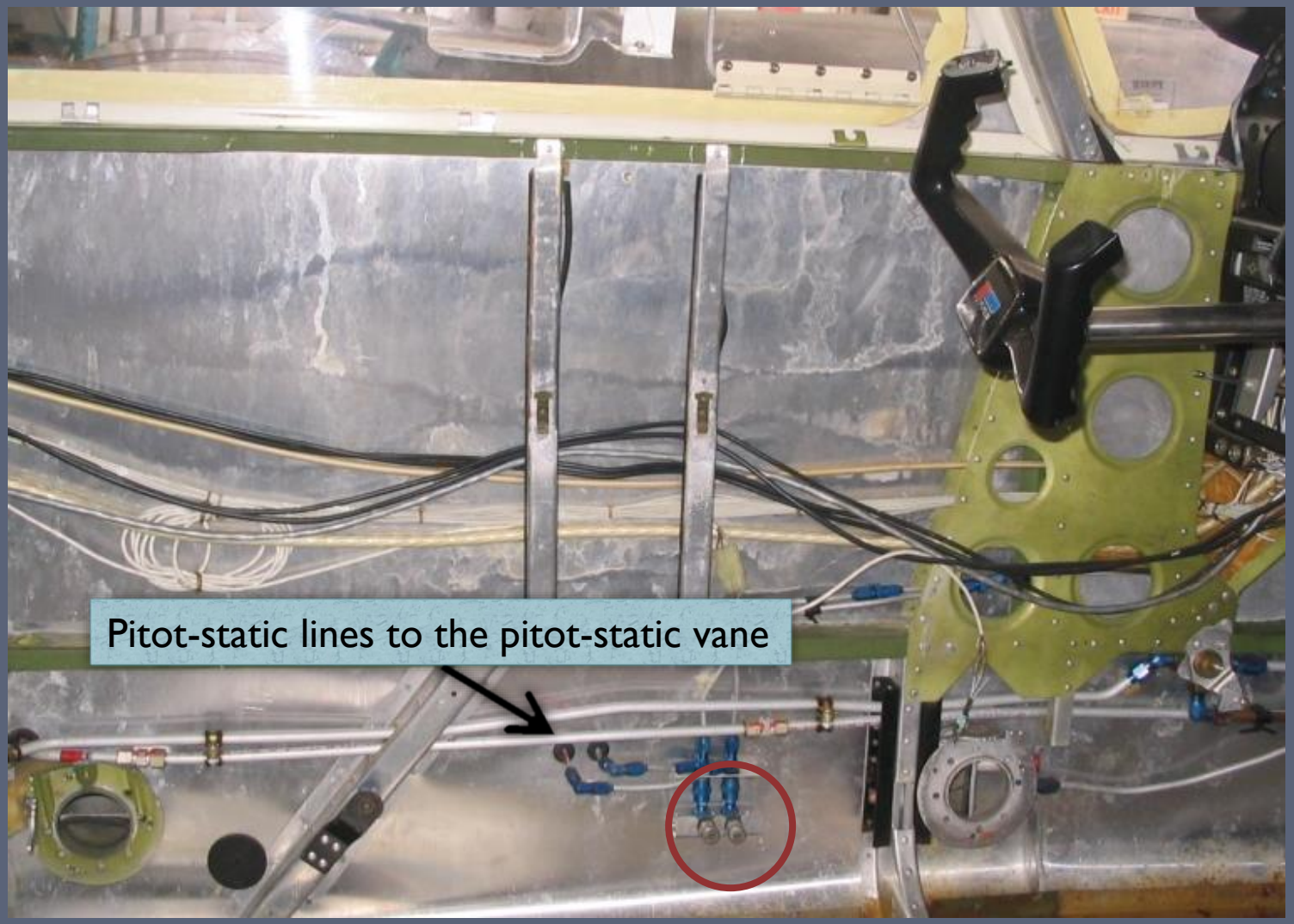


Pitot-Static System

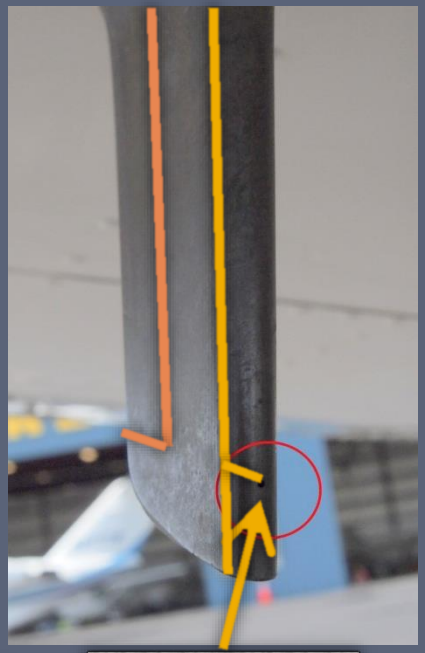


- The ASI, altimeter, and VSI static lines are plumbed in parallel
- *The pitot and static lines should be drained prior to each flight*
  - *Not included on most checklists!*

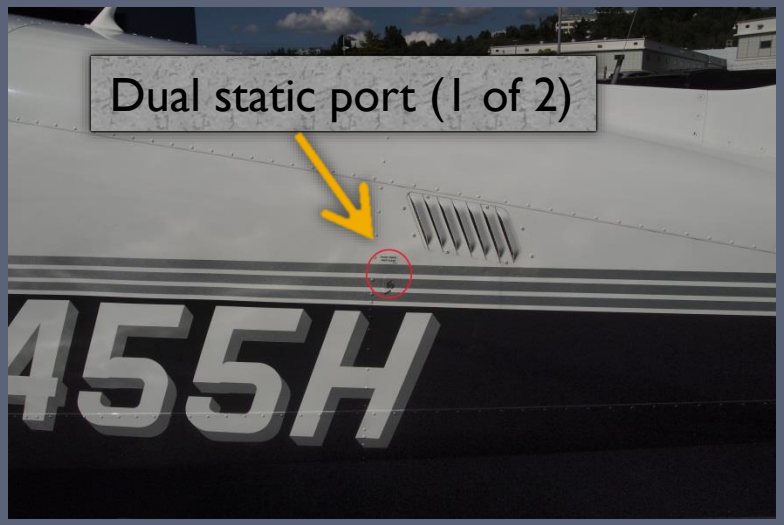
Pitot-Static System – Close-up



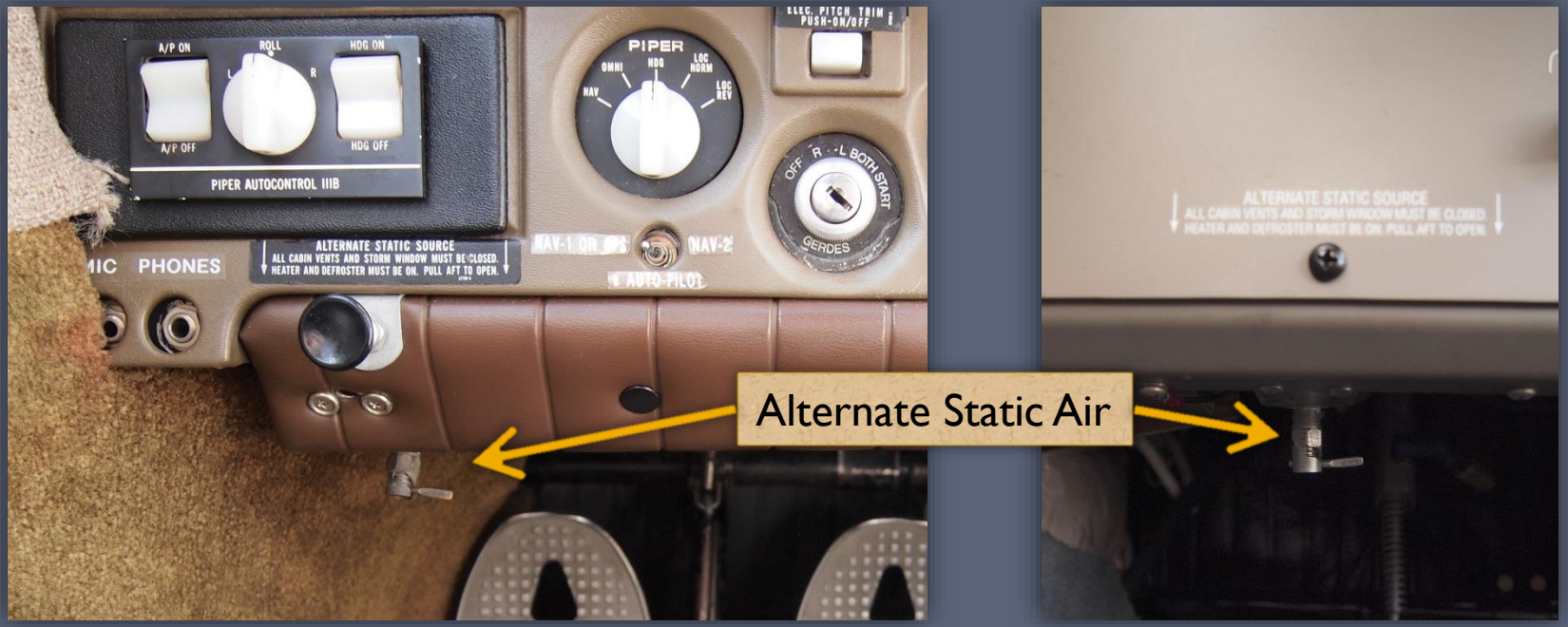
Pitot-Static System - Components



- Heated pitot-static vane
- No external pitot drain
  - Cabin pitot-static drain valves must be opened prior to each flight
- Some models have separate dual static ports



Pitot-Static System - Continued

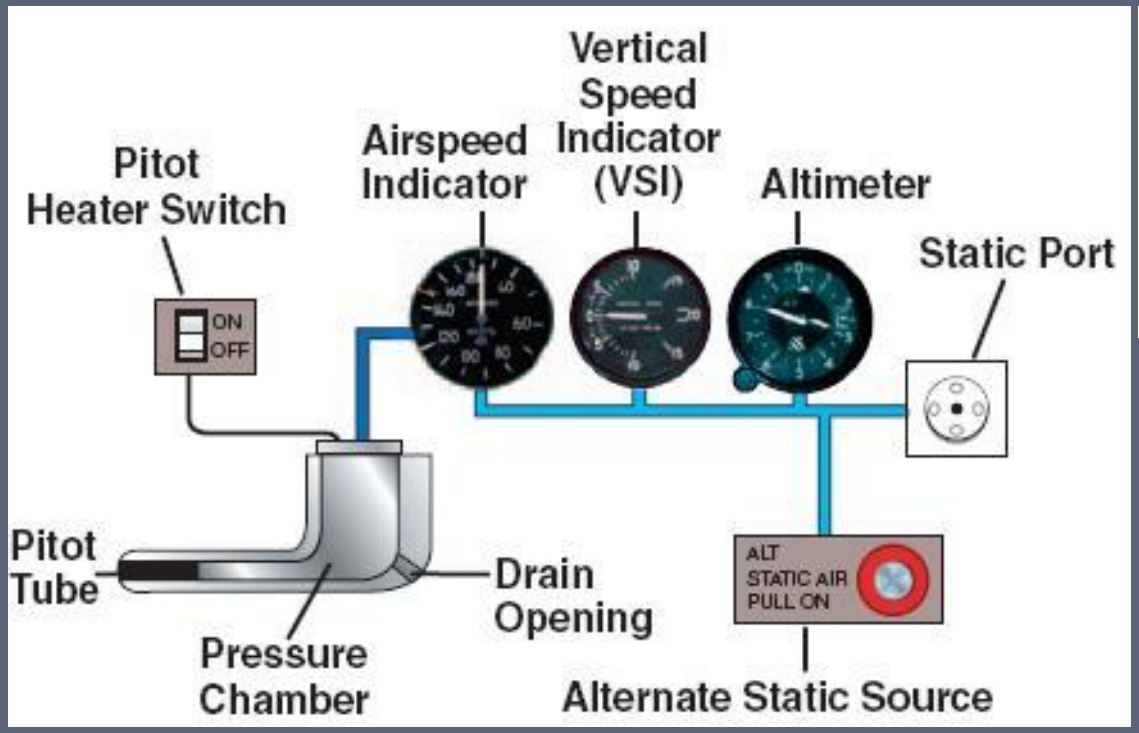


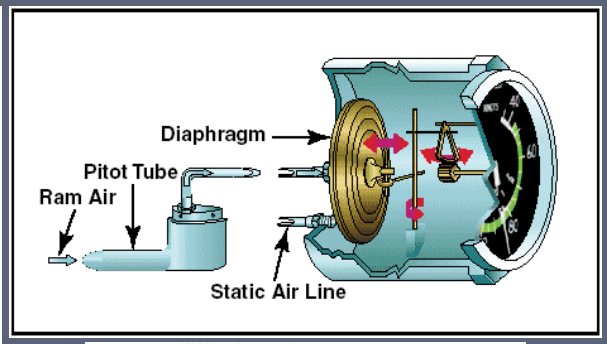
Using alternate static air	
Storm window and vents	CLOSED
Cabin heater and defroster	FULL ON

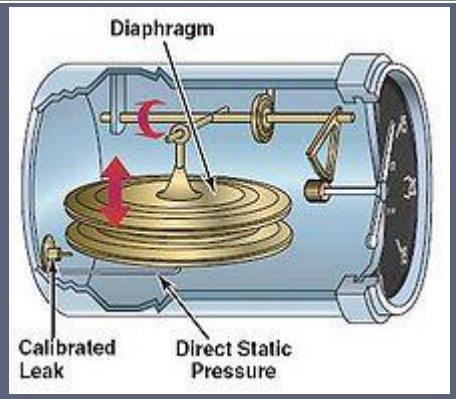
Instrument	Indication
Airspeed Indicator	Reads higher
Altimeter	Reads higher (error <50')
Vertical Speed Indicator	Momentary climb

Pitot-Static Problems

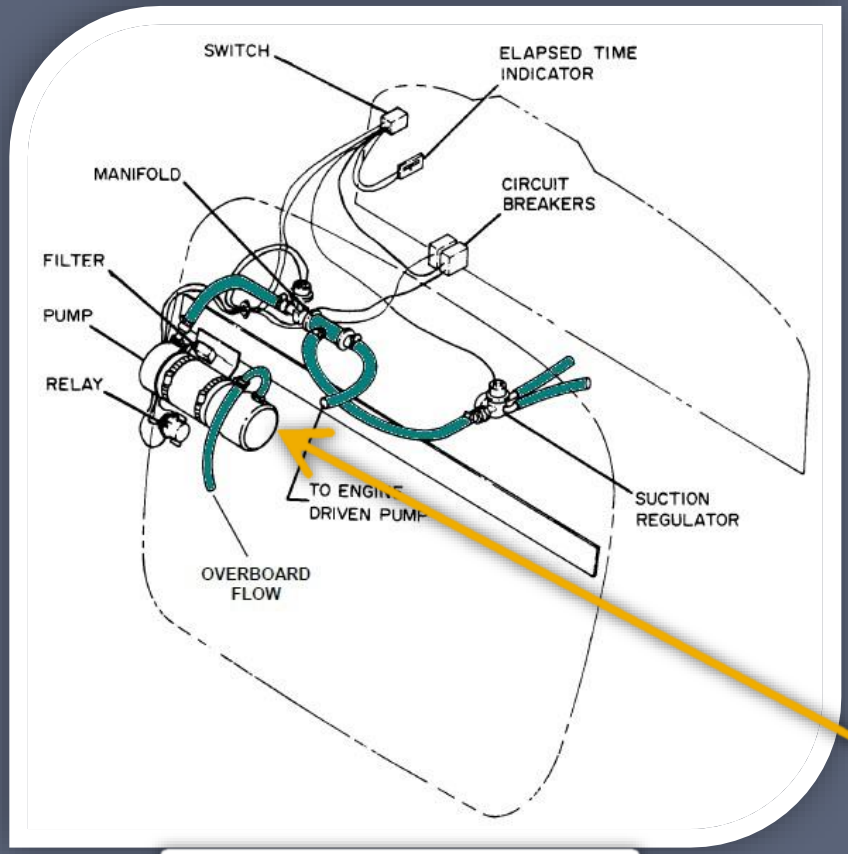
- Know specific power settings that give a known airspeed
- Pitot-heat is anti-ice; turn on *before* entering visible moisture when close to freezing temperatures





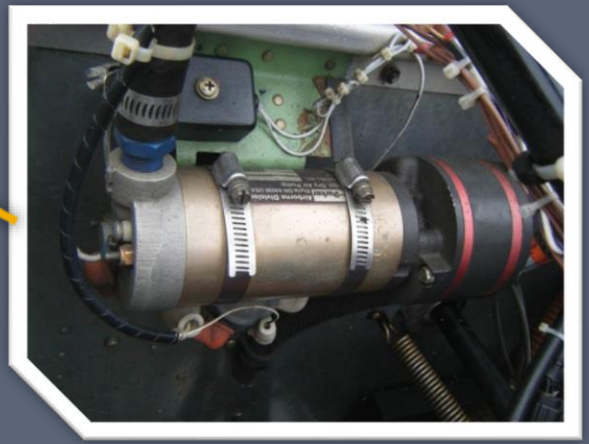


Vacuum System



Electric Vacuum Pump

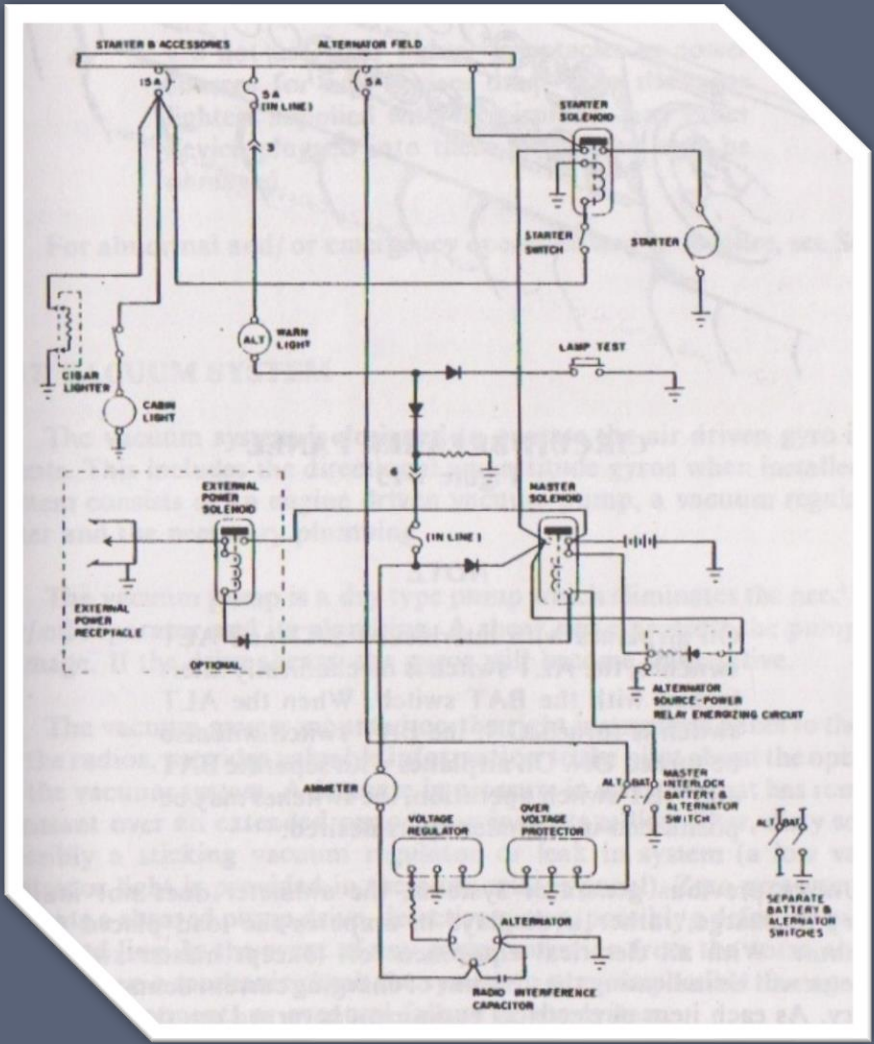
- Normal vacuum range: 4.5” – 5.5” at cruise RPM.
- The vacuum warning light will illuminate when the differential pressure is less than 3.5” hg.
  - At low RPMs (such as during taxiing or idling), the vacuum light may come on.
  - This is normal, and momentarily raising the RPMs should clear the light.



Vacuum Failure

- If instrument rated, be sure to include the vacuum gauge in your scan
  - Know where it is on the instrument panel
- Affected systems
  - Attitude Indicator
  - Directional Gyro
- Know your backups
  - Turn Coordinator – electrically-powered gyro
    - Rate-based autopilots will still be operational
  - Some aircraft have a backup electrical Attitude Indicator
- Backup vacuum pump
  - Electric: Monitor electrical load when turned on
  - Manifold Vacuum: Observe RPM/MP limitations

Electrical System



- The alternator warning light will illuminate when the alternator output drops to zero.
- "Classic" PA-28
  - 14V system
  - 12V battery
  - 60A alternator
- "Modern" PA-28
  - 28V system
  - 24V battery
  - 70A alternator
  - The "low bus voltage" light will illuminate when the voltage drops to 24.5v or less.

Electrical System (Cont).

- Normal Voltages
  - 12v system: 13.8-14.2
  - 24v system: 27.5-28.5
- Ammeter vs Load Meter
  - Ammeter shows charge/discharge of the battery
  - Load meter shows the current draw on the electrical system
  - Know which one your aircraft has
- Typical battery life: 3-5 years
  - Older than that, the battery most likely won't pass a load test
- Alternator Off-line
  - Try recycling the alternator (ALT switch off/on)
  - Check if the alternator field circuit breaker is popped

Circuit Breakers

- **Know the layout of the circuit breaker panels**
- **Never reset a popped circuit breaker more than once!**
- Know which circuit breakers can be pulled

Classic

Only some can be pulled

Modern

All can be pulled

Magnetos

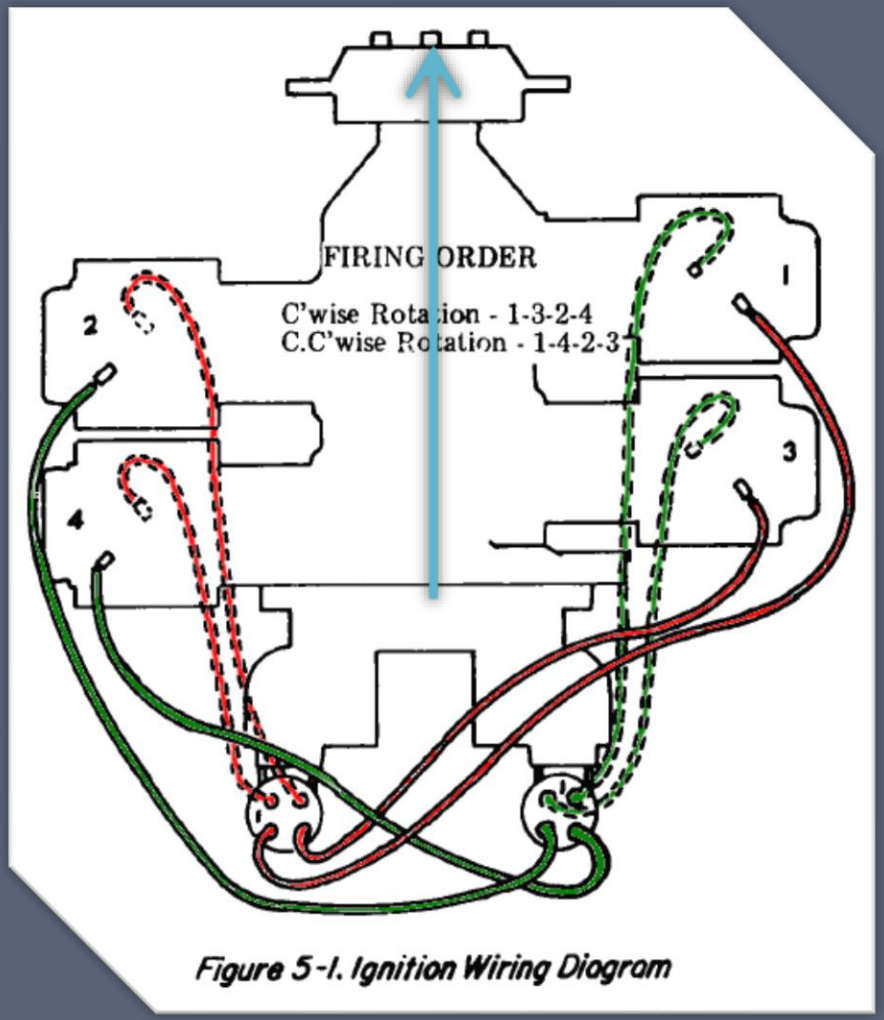


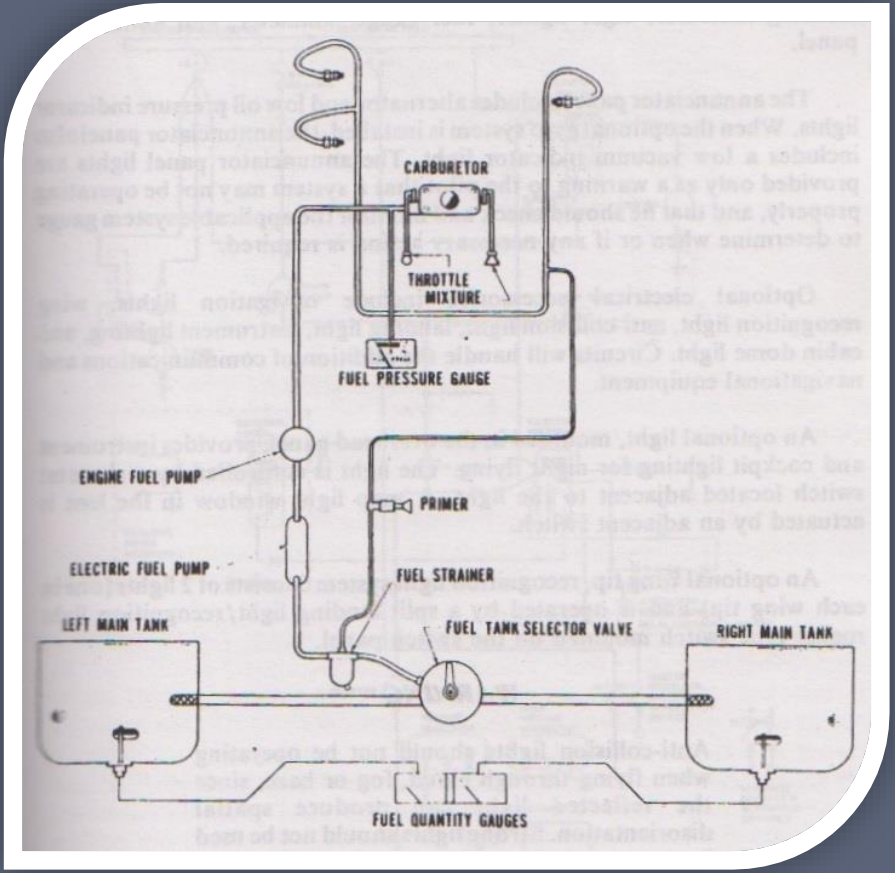
Figure 5-1. Ignition Wiring Diagram

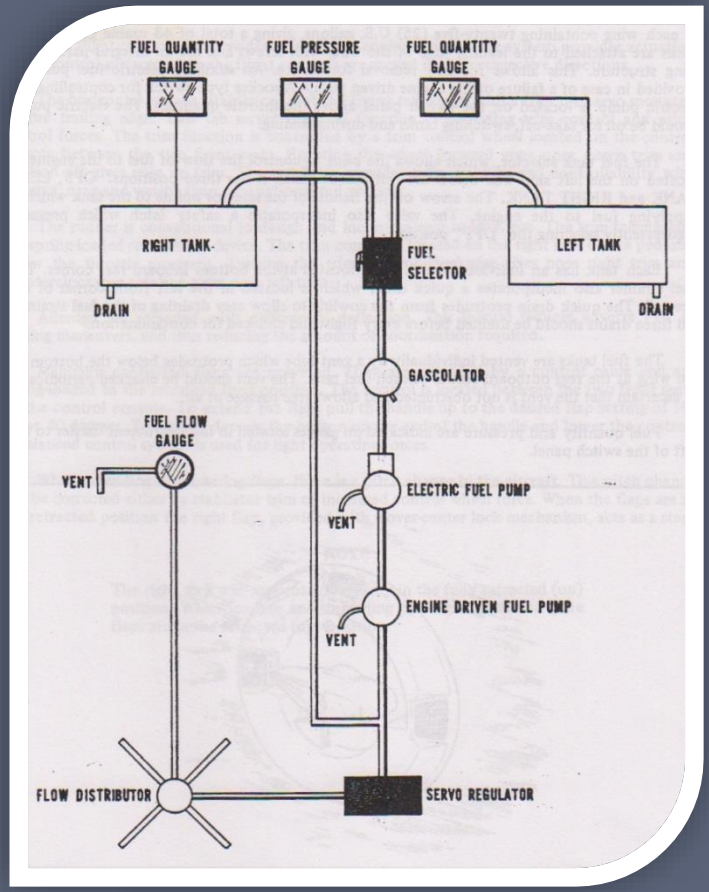
- Completely independent power system
  - Two magnetos
  - Two spark plugs per cylinder
    - Each from a different magneto
    - *NOTE: "Dual" magnetos are powered from the same input shaft!*
- Magnetos are grounded out via a P-lead to disable them
- Magnetos need to be timed properly
  - To each other
  - To the engine crankshaft

Fuel System

- One fuel sump and two vents per tank (venting fuel cap), one main fuel strainer sump

Carburetor System





Fuel-Injection System

Fuel and Oil System

Fuel (Priming)

- Use a minimum amount of primer
  - The primer lines inject fuel on the backside of the intake valves, so excess fuel will drain down the intake manifold
- Do not pump the throttle in lieu of priming
  - The carburetor is an updraft design, below the engine
    - Fuel will pool at the bottom of the carburetor, creating a fire hazard

Oil

- The carburetor is attached below the oil cooler on Piper Lycomings, so you're essentially always running with partial carb heat.
- FAR 33.39 requires that a certified aircraft engine be able to operate with only ½ of its oil capacity.

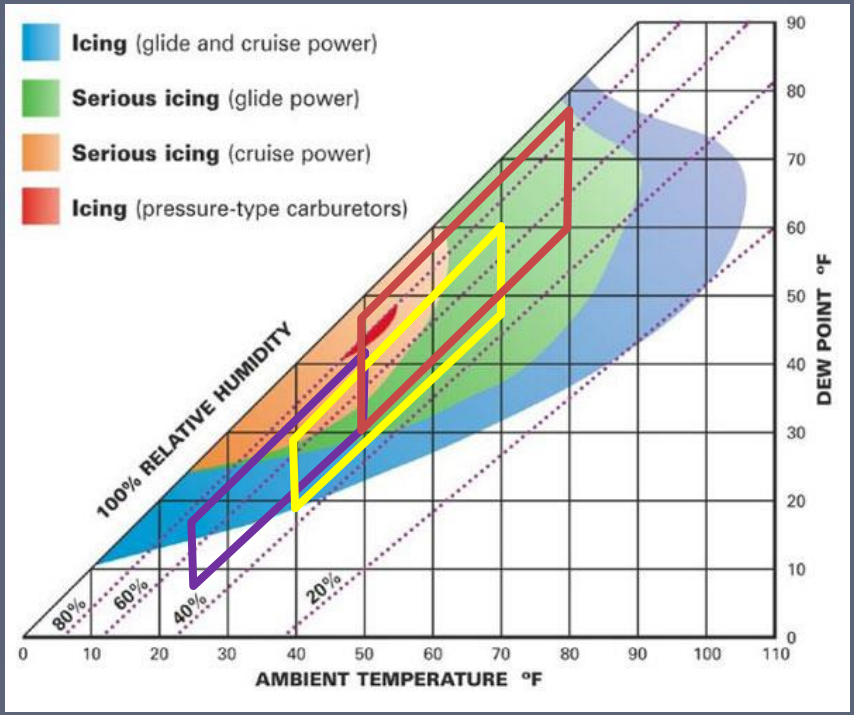
Engine Instrumentation

- Engine Tachometer
  - Hour meter only accurate (1:1) at approximately 75% power
  - Pointer oscillations (without corresponding change in engine sound) could be due to a bad tachometer cable, or internal instrumentation failure

- Manifold Pressure
  - Errors could be caused by internal failure, moisture in the line, or leaking line
  - Reading should be close to the ambient air pressure with the engine off
    - Sea level pressure minus 1”/1000’

Carb Icing (N/A for fuel-injected engines)

- Be aware of the potential for carb icing
  - When is carb icing more of a threat: the winter or the summer?
    - Answer: More likely in the summer
      - But there's the potential for it nearly year-round
    - See more with AC 20-113, Lycoming SI 1148C

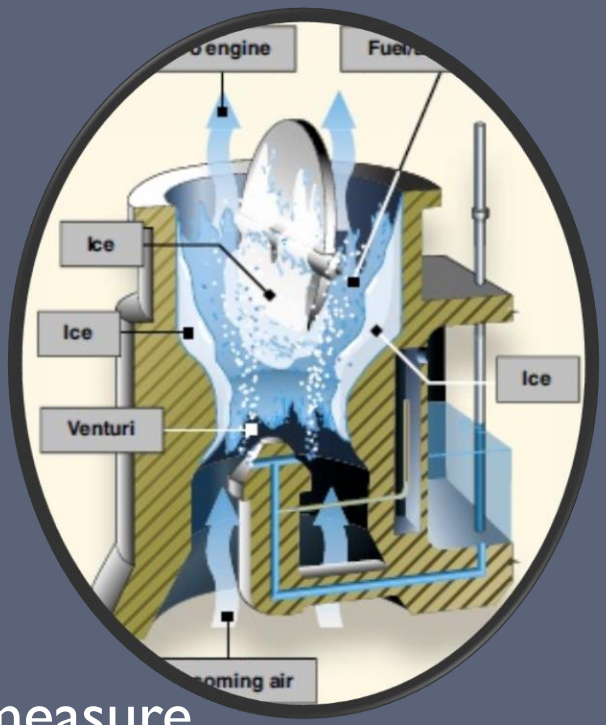


- ALWAYS use full carb heat!
  - Don't use partial heat: ice could reform in the intake system
  - Partial heat is only acceptable with a carb temperature gauge (avoid -10C to +10C)
- During run-up, note a 100-300 RPM drop with carb heat applied
  - An engine analyzer will show drop in all EGTs
  - If engine roughness and/or RPM increase, indicates potential carb icing
- Detecting carb ice
  - Fixed-pitch
    - Unexplained decrease in RPM
  - Constant-speed
    - Unexplained decrease in MP
- If carb ice is suspected*
  1. Slowly add full power
  2. Apply carb heat
  3. Wait for a decrease in engine roughness and/or increase in RPM

* Always refer to the POH for the manufacturer's recommended procedure

Carb Icing - Prevention

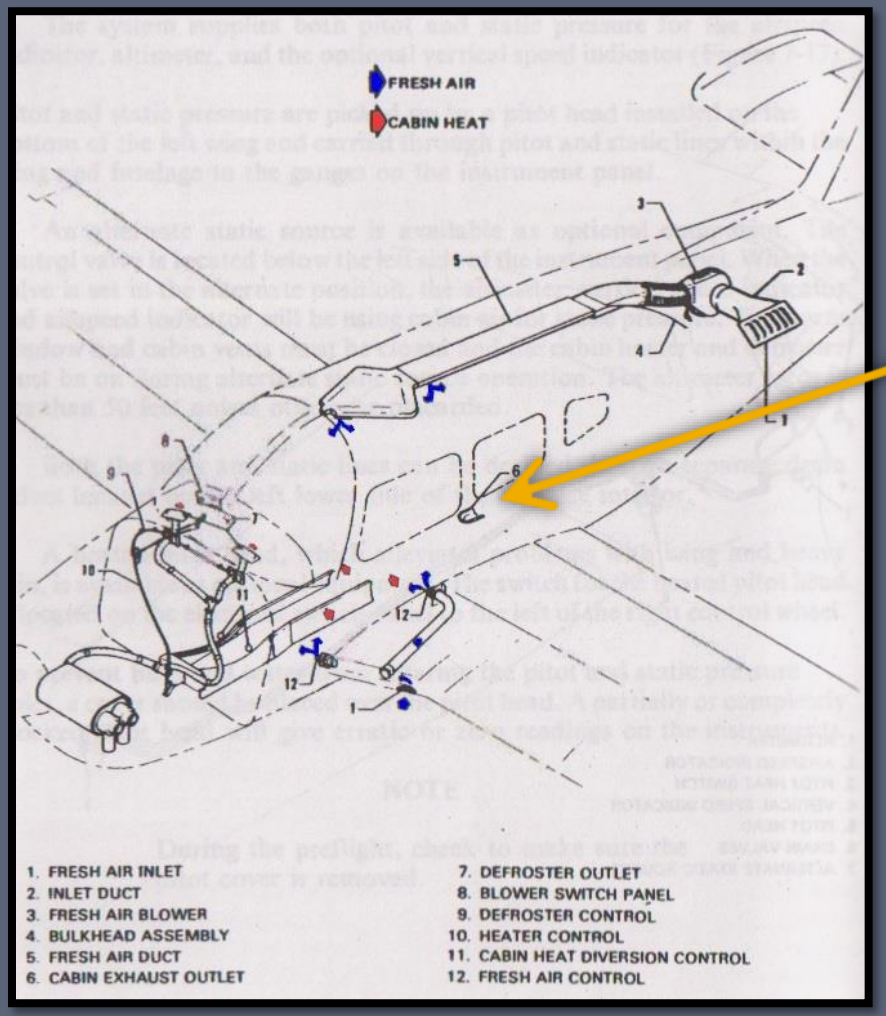
1. Perform a carb ice check just prior to takeoff
2. If flying in conditions conducive to cruise-power carb ice, it is permissible to cruise with carb heat on
   - Be sure to readjust the mixture
     - Heated air is less dense, so re-lean the mixture
3. Avoid extended power-off descents
   - Engine is producing less heat, so carb heat will be less effective
4. Carb heat works best as a <u>preventative measure</u>
   - Don't wait for carb icing to form; if at all in doubt, use carb heat
   - Use at the first sign of carb icing
     - If you wait too long, there may not be enough engine heat left!
   - Consider applying carb heat at regular intervals during cruise



Engine Problems

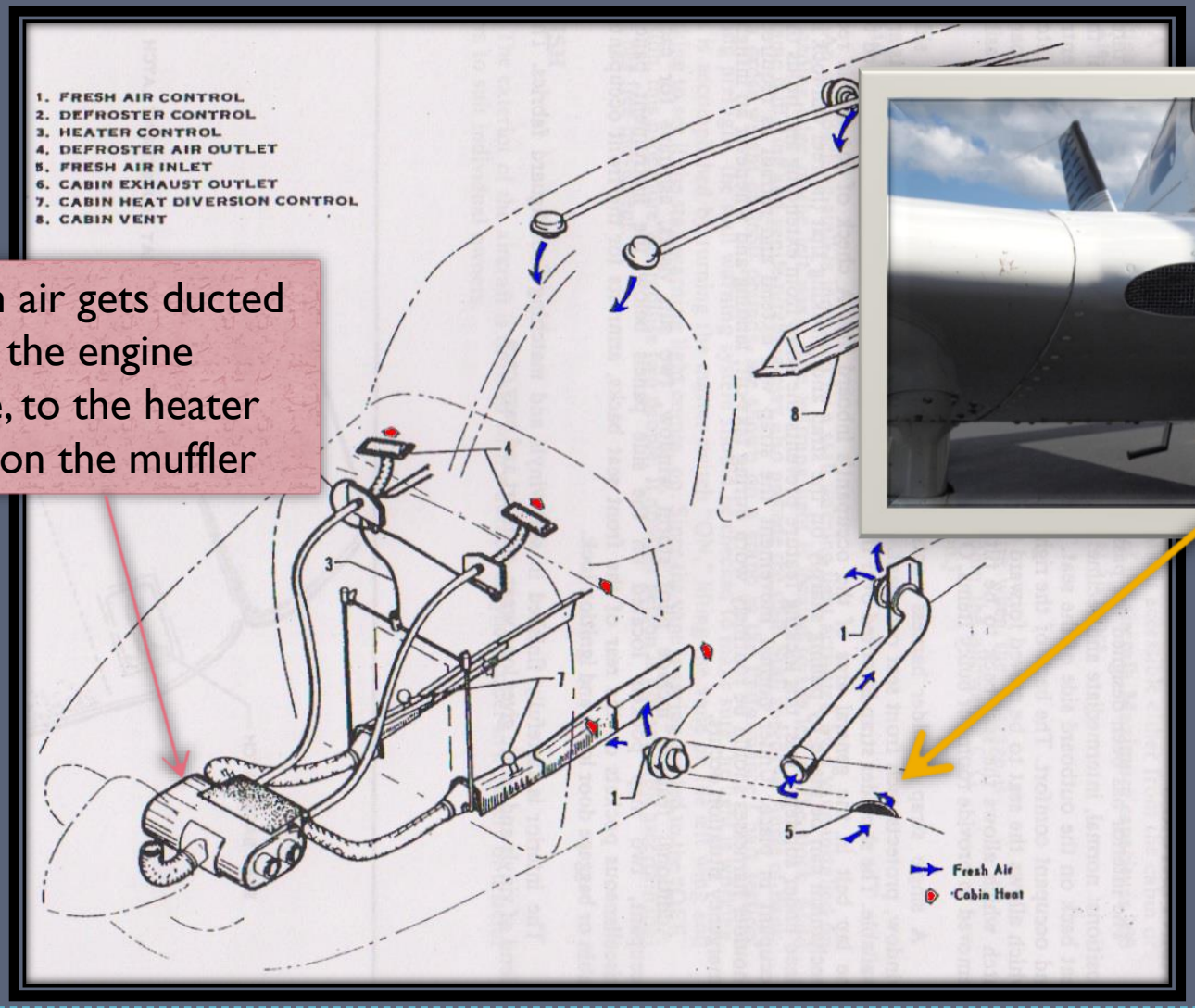
- Above all else, maintain a safe airspeed!
  - If doing so means having to do a controlled crash, *so be it* – better to crash land under control, than to stall/spin into the ground
    - Nearly all low-altitude stall/spin crashes are fatal!
    - But controlled crash landings have much more favorable outcomes
- When you have an engine problem, "think FAST"
  - Fuel – Fuel pump on, switch tanks, adjust mixture
  - Air – Carb Heat / Alternate Air, adjust throttle
  - Spark – Magnetos
  - Trim - For best glide

Heating & Ventilation



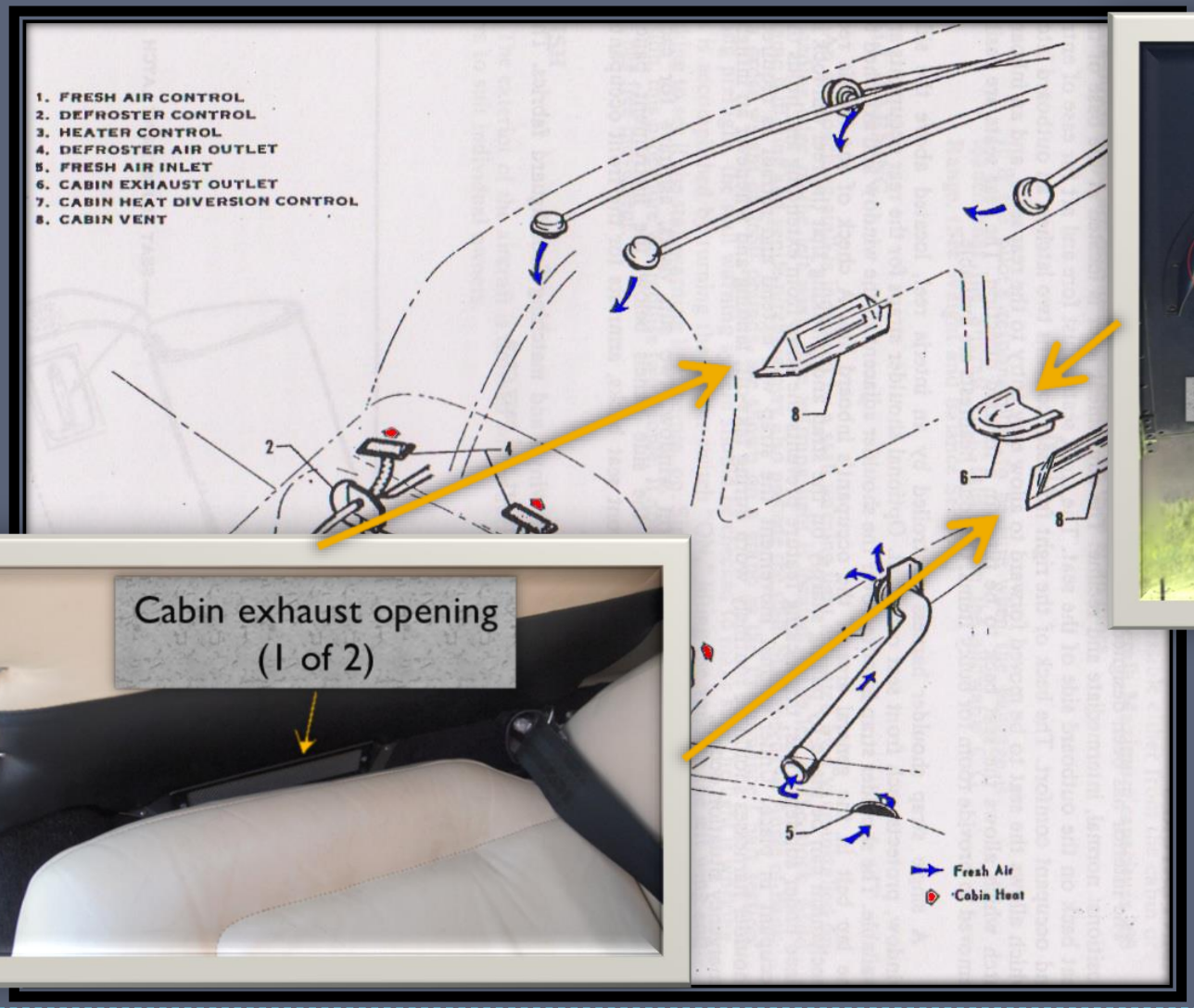
- Airflow is regulated between front and rear seats by levers
- Air is exhausted by an outlet under the rear seats
- Heater and defroster
  - Ram-air: ineffective until you are moving
  - Heat comes from a muffler shroud
    - Cracks in muffler could lead to CO poisoning

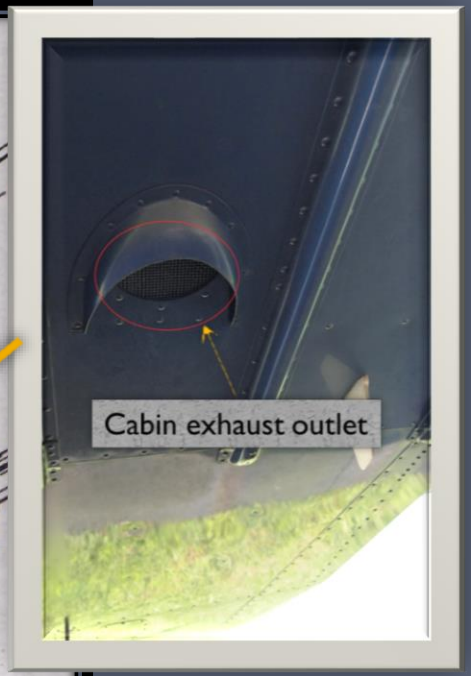
Heating & Ventilation – Close Up



Fresh air gets ducted from the engine baffle, to the heater muff on the muffler

Heating & Ventilation – Close Up (Cont.)

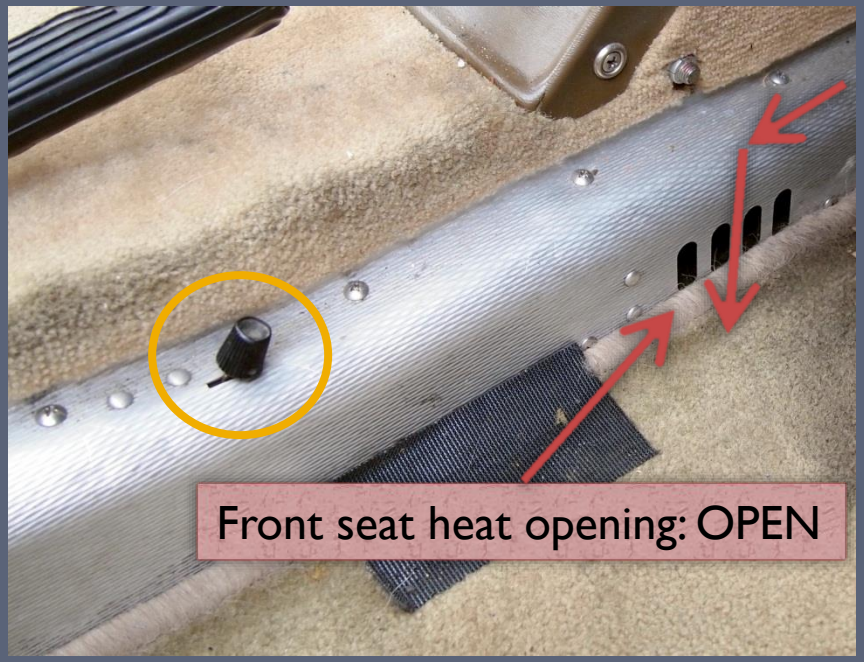


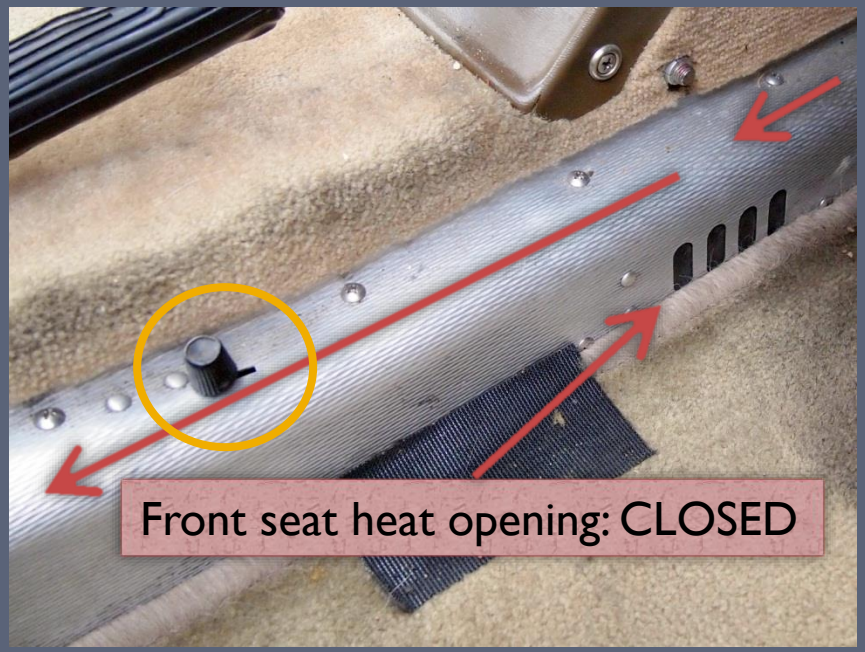


Heating & Ventilation – Heat Diversion

Push forward to divert heat to the front seat

Push rearward to divert heat to the back seat





Carbon Monoxide

Concentration	Symptoms
35 ppm (0.0035%)	Headache & dizziness within 6-8 hours of constant exposure
200 ppm (0.02%)	Slight headache, fatigue, and nausea within 2-3 hours
400 ppm (0.04%)	Headache within 1-2 hours
800 ppm (0.08%)	Dizziness, nausea, and convulsions within 45 minutes
1600 ppm (0.16%)	Headache, dizziness, and nausea within 20 minutes; death in less than 2 hours
3200 ppm (0.32%)	Headache, dizziness, and nausea within 5-10 minutes; death within 1 hour
6400 ppm (0.64%)	Death within 25 minutes
12800 ppm (1.28%)	Death in less than 3 minutes

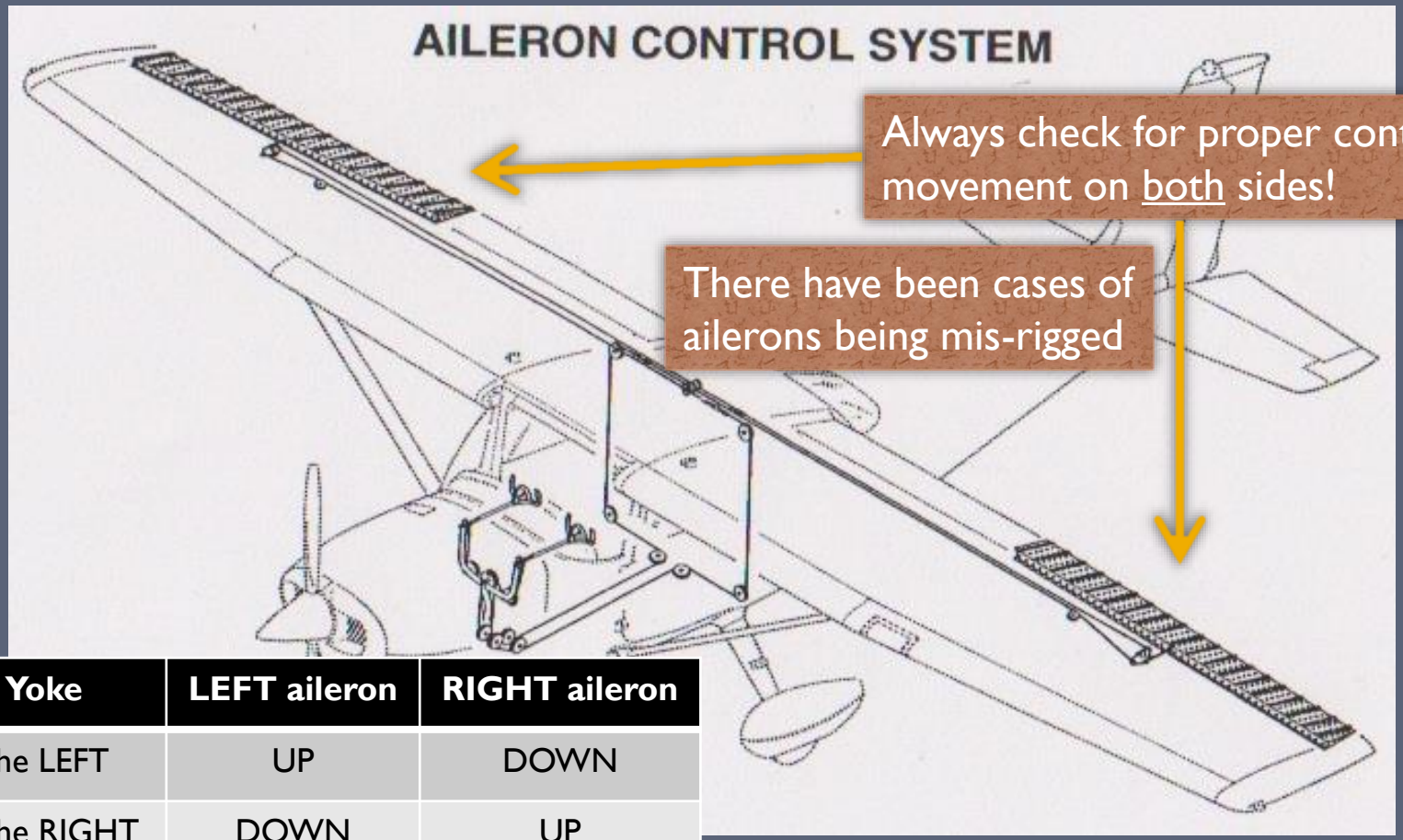
- Effects are cumulative over time; even small concentrations over time can be hazardous
- Altitude intensifies the effects
- Smoking also intensifies the effect
  - Smoking is roughly equivalent to a 5000' altitude

Carbon Monoxide – CO Alerts

- Some aircraft have panel-mounted CO detectors
  - Good ones trigger when the CO level > 50ppm
- What to do if you suspect CO
  - Shut off the heater and defroster
  - Open fresh-air vents and storm window
  - Descending will reduce the effects of altitude and might buy you needed time
  - Land as soon as practicable
    - Declare an emergency if necessary

Control System – Aileron

- Cessna 172 and Piper PA-28 systems are very similar



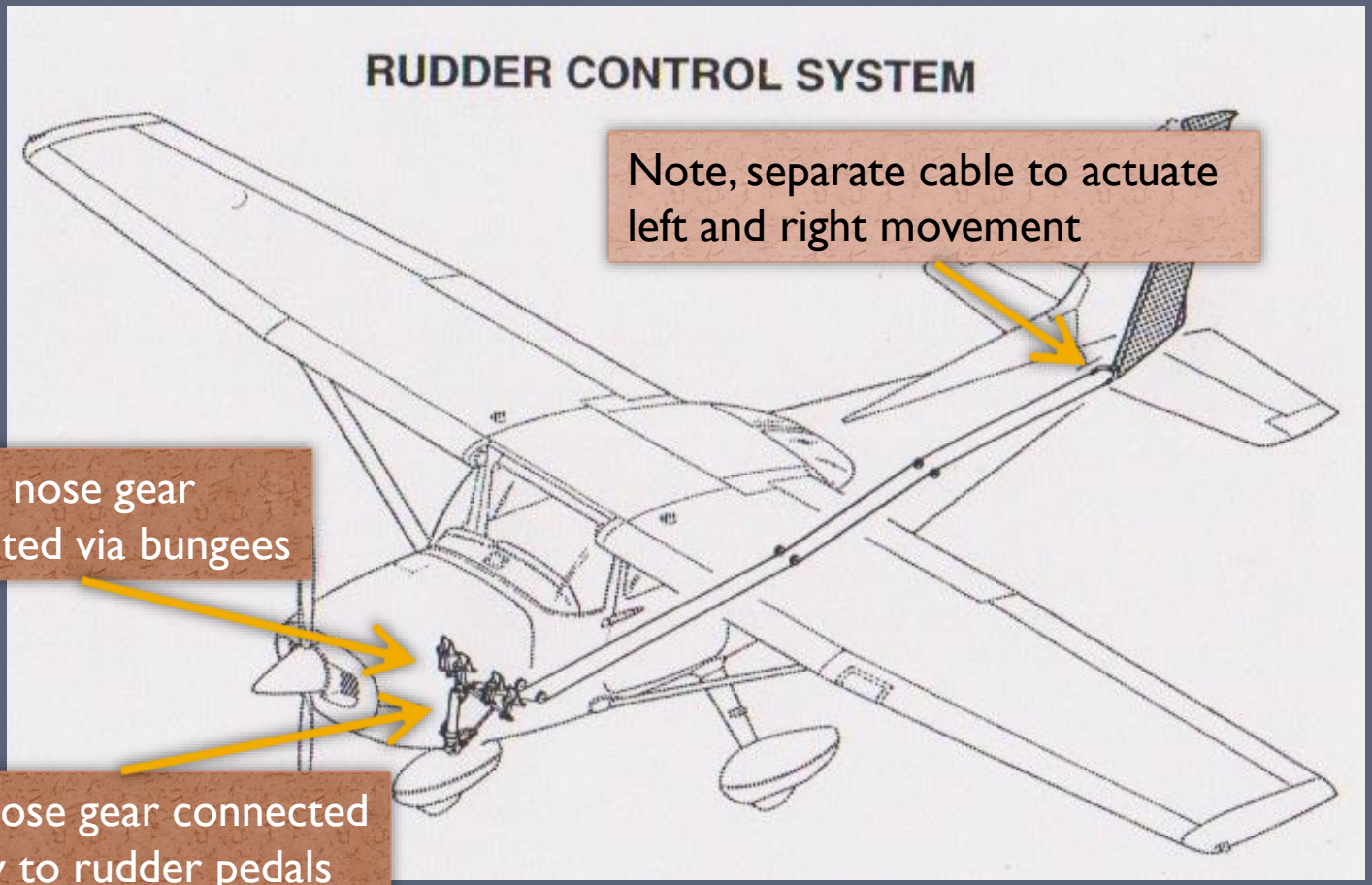
Yoke	LEFT aileron	RIGHT aileron
To the LEFT	UP	DOWN
To the RIGHT	DOWN	UP

Control System – Aileron, Continued

- What to check for during pre-flight
  - **Do both ailerons move in the proper direction?**
    - **And do they move freely?**
  - **Do you get full aileron deflection in both directions?**
    - **If not, this also indicates a rigging issue**
  - Is the control wheel level when both ailerons are neutral?
    - If not, indicates a rigging issue
  - Are there any bulges in the ailerons?
    - Bulges could mean the aileron was used to push the plane forward, and will cause an out-of-trim condition during flight
  - Are there any cracks in the aileron skin?
  - Is there excessive free play in the ailerons (without a resulting deflection in the control wheel)?
    - Too much (>0.24 “) could indicate low cable tension, among other things

Control System – Rudder

- Cessna 172 and Piper PA-28 systems are very similar

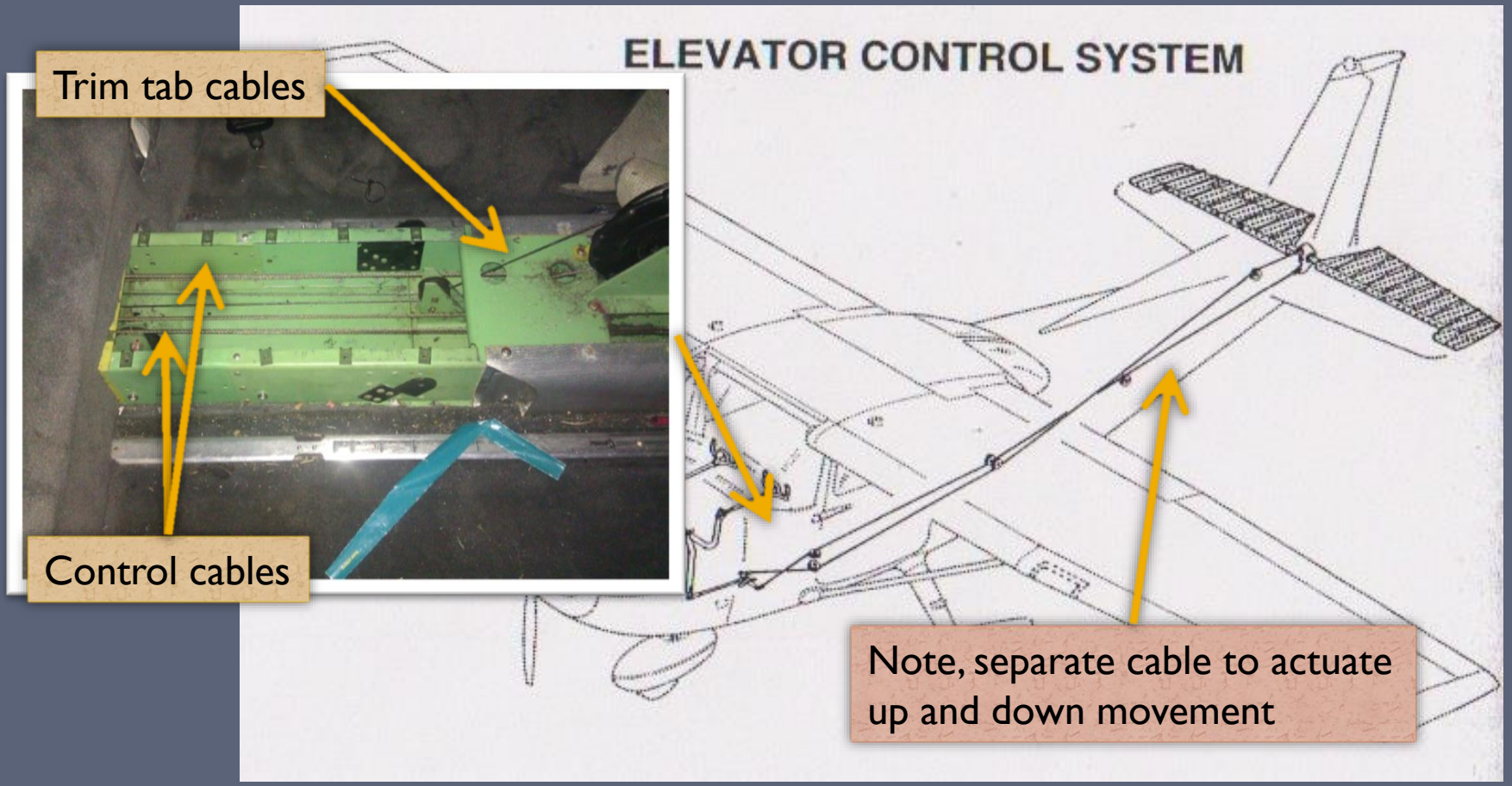


Control System – Rudder, Continued

- What to check for during pre-flight
  - Are the rudder pedals neutral when the rudder is streamlined?
    - If not, indicates a rigging issue
    - This may be difficult to check for – nose gear might not be in neutral position, based on how the aircraft is parked
  - Rudder travel and operation can't be tested during the walk-around (unlike a Cessna)
    - Is there excessive free play in the rudder?
  - Are there any bulges or cracks in the rudder or rudder skin?
    - Since the nose gear is directly connected to the rudder, excessive nose gear shimmy could cause damage

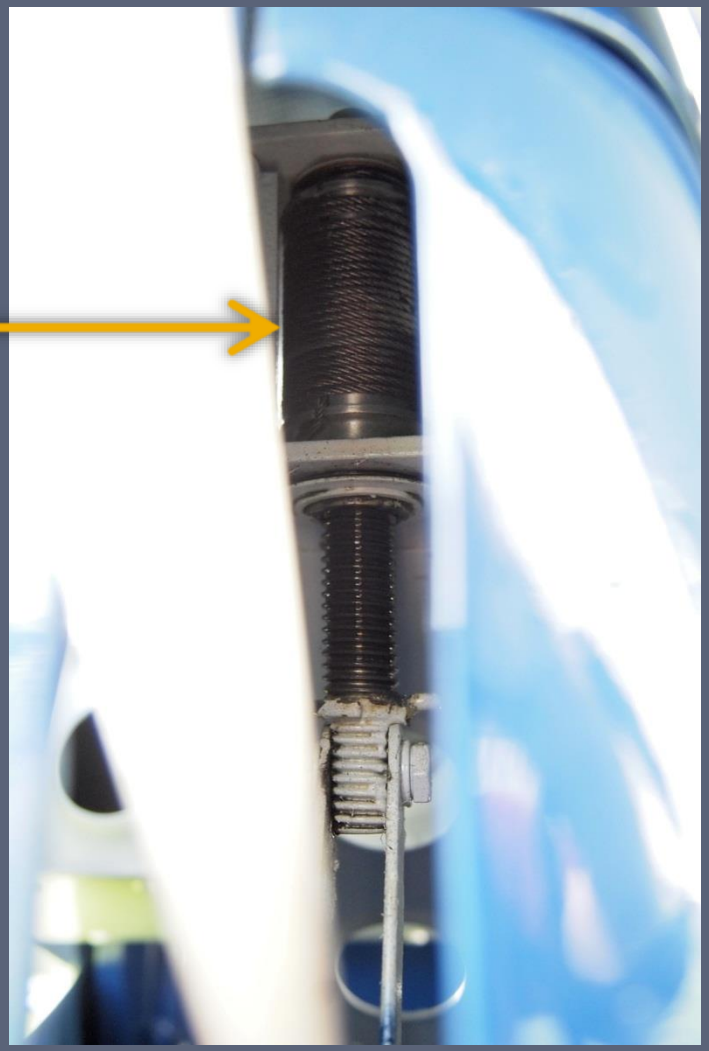
Control System – Stabilator

- Cessna 172 and Piper PA-28 systems are very similar
  - NOTE: Stabilator/elevator and anti-servo/trim tab are rigged separately



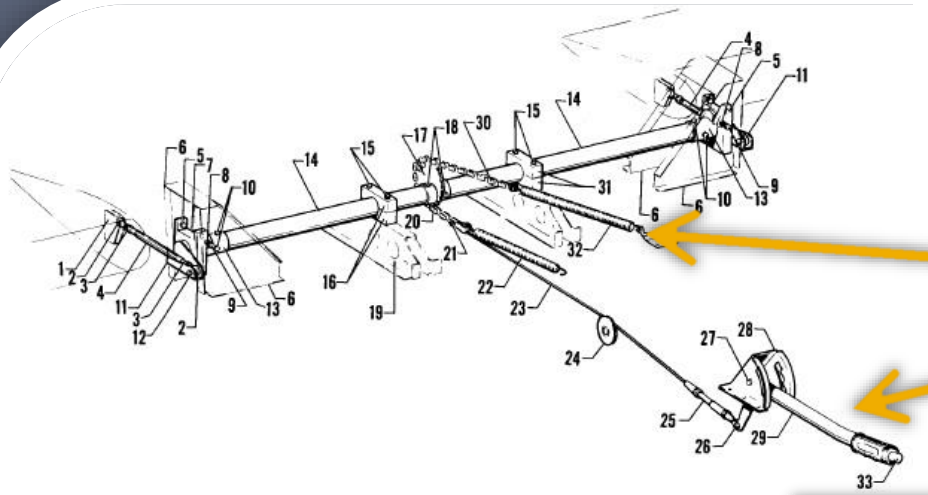
Control System – Stabilator, Continued

- What to check for during preflight
  - Is there excessive free play in the trim tab?
    - Maximum of 0.15 “
  - **Does the trim tab cabling look worn or frayed, or not evenly wrapped around the trim barrel?**
  - Does movement of the trim wheel move the trim tab?
    - And does it move freely, or is there excessive resistance?
  - Does the stabilator and tab move in the proper direction?
    - Trim tab is an “anti-servo tab”, and moves in the *same* direction of the stabilator’s movement
  - Do you get full stabilator deflection in both directions?



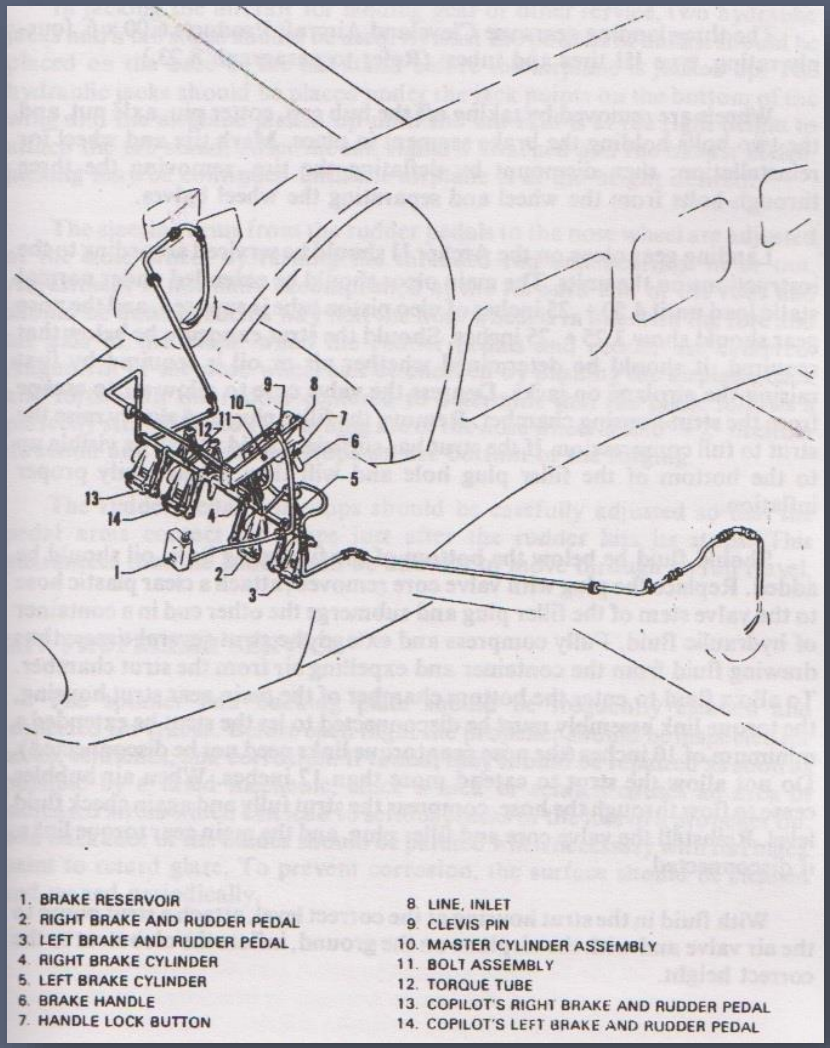
Control System – Flaps

- Two main things to note
  1. Left and right flap are directly linked together
     - Virtually no chance of a split-flap condition
  2. Flap operation
     - Flaps are indirectly pulled UP by spring tension
     - Flaps are *directly* pulled DOWN by the flap handle



1. BRACKET, ROD ATTACHMENT
2. BOLT, WASHER & NUT
3. JAM NUT
4. ROD, FLAP CONTROL
5. BOLT, BEARING BLOCK ATTACHMENT
6. BRACKET, BEARING BLOCK
7. BLOCK, BEARING
8. NUT, LOCK
9. SCREW, FLAP ADJUSTMENT
10. BOLT, WASHER & NUT
11. CRANK (ARM), TORQUE TUBE
12. BOLT, WASHER & BUSHING
13. FITTING, TORQUE TUBE STOP
14. TUBE, TORQUE
15. BOLT, WASHER & NUT
16. BLOCK, BEARING
17. SPROCKET, TENSION SPRING
18. BOLT, WASHER & NUT
19. BRACKET, BEARING BLOCK
20. CHAIN, TENSION SPRING
21. CLEVIS BOLT, BUSHING NUT & COTTE
22. SPRING, TENSION
23. CABLE, FLAP CONTROL
24. PULLEY
25. TURNBUCKLE
26. CLEVIS BOLT, NUT & COTTER PIN
27. BOLT, BUSHING, WASHER & NUT
28. BRACKET, FLAP HANDLE
29. HANDLE, FLAP
30. CHAIN, RETURN SPRING
31. BLOCK, BEARING
32. SPRING, RETURN
33. BUTTON, FLAP RELEASE

Brake System



- One master brake fluid reservoir
- Hand brake, and left & right toe brakes all have separate brake cylinders
  - The hand brake is incorporated into the master brake cylinder
- Pilot and Co-pilot brake pedals are plumbed in series

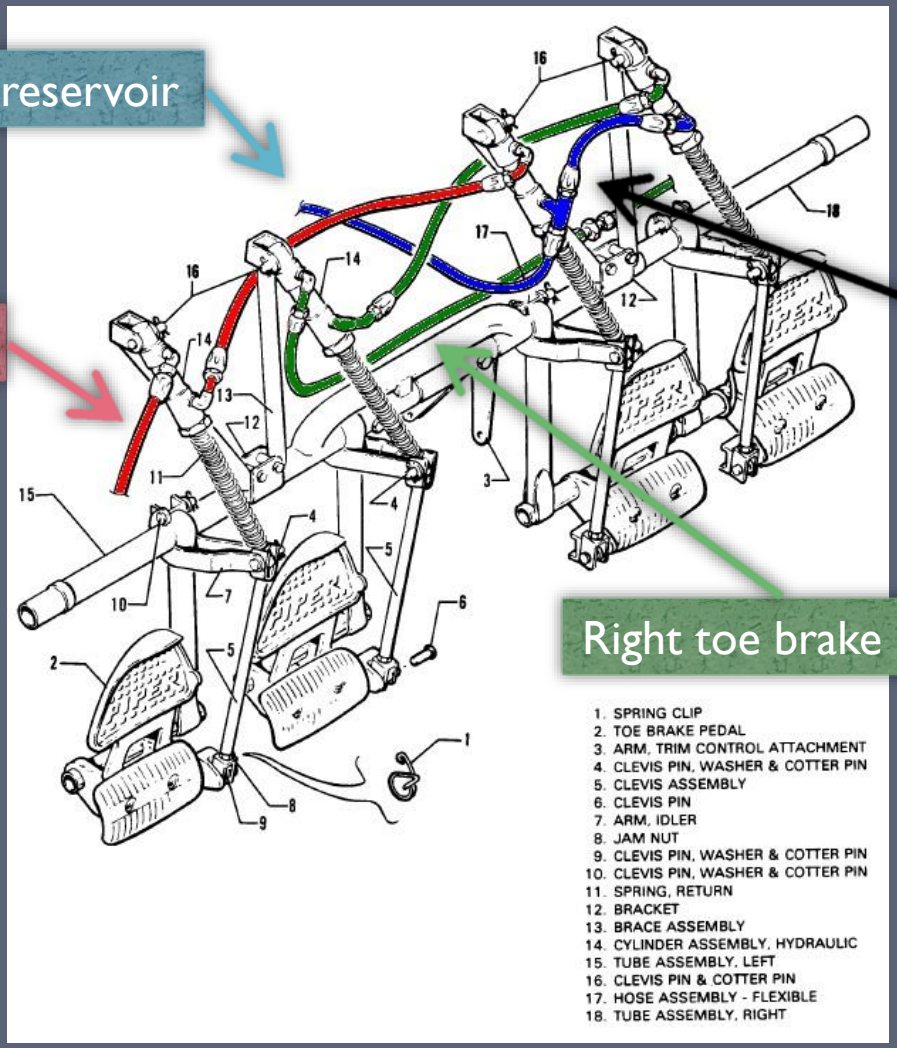
Brake System - Detail

From master brake reservoir

Left toe brake lines

Brake fluid from the master brake reservoir feeds into the left and right toe brakes through the co-pilot's side

Right toe brake lines



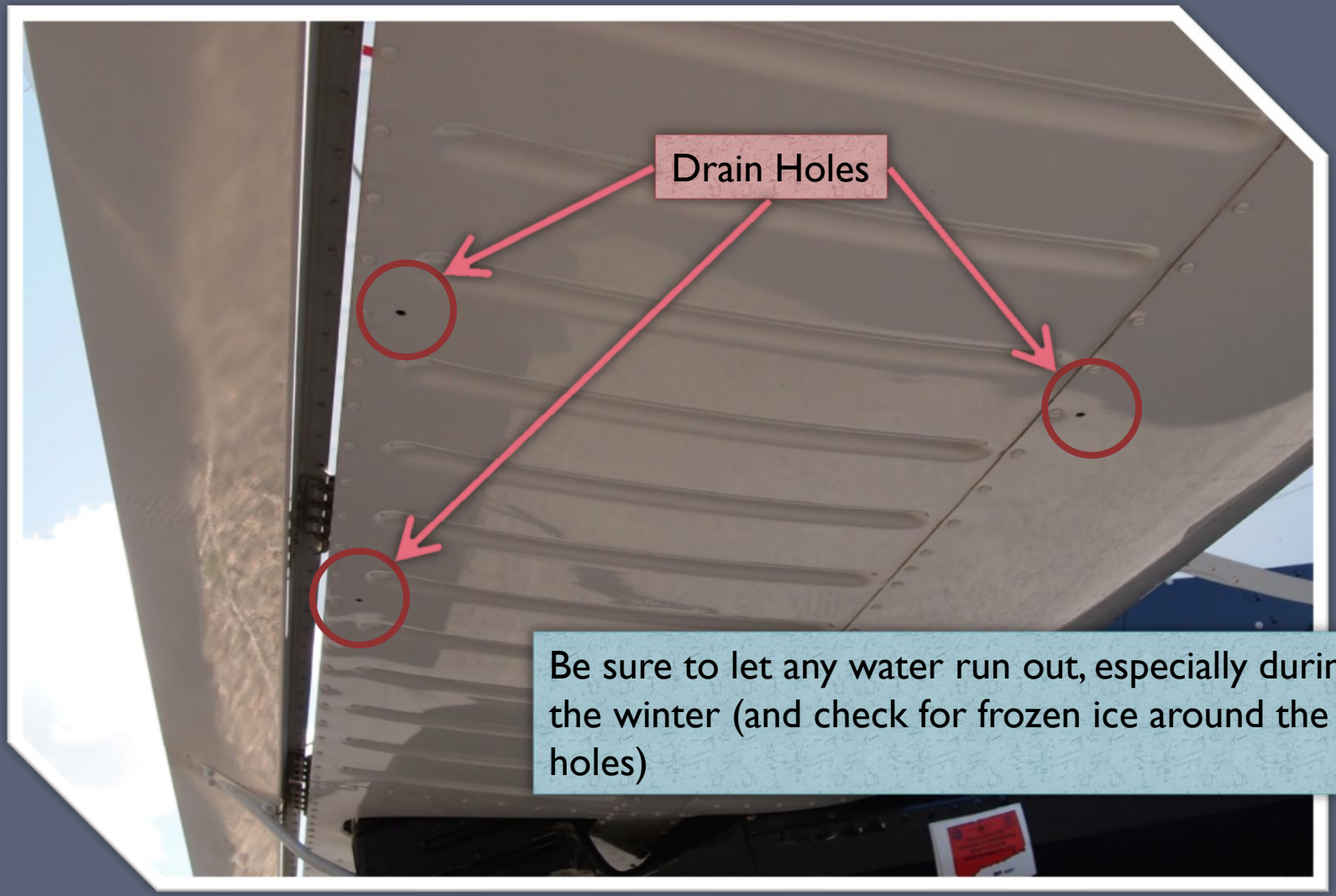
Tires & Landing Gear

- Consider what the tires go through for takeoff versus landing
  - Landing: Sudden acceleration to touchdown speed, then continual deceleration and slow taxiing
  - Takeoff: Taxiing for takeoff (especially at a large airport) builds up heat in the tires, and then continual acceleration during takeoff
- Tires are a critical component

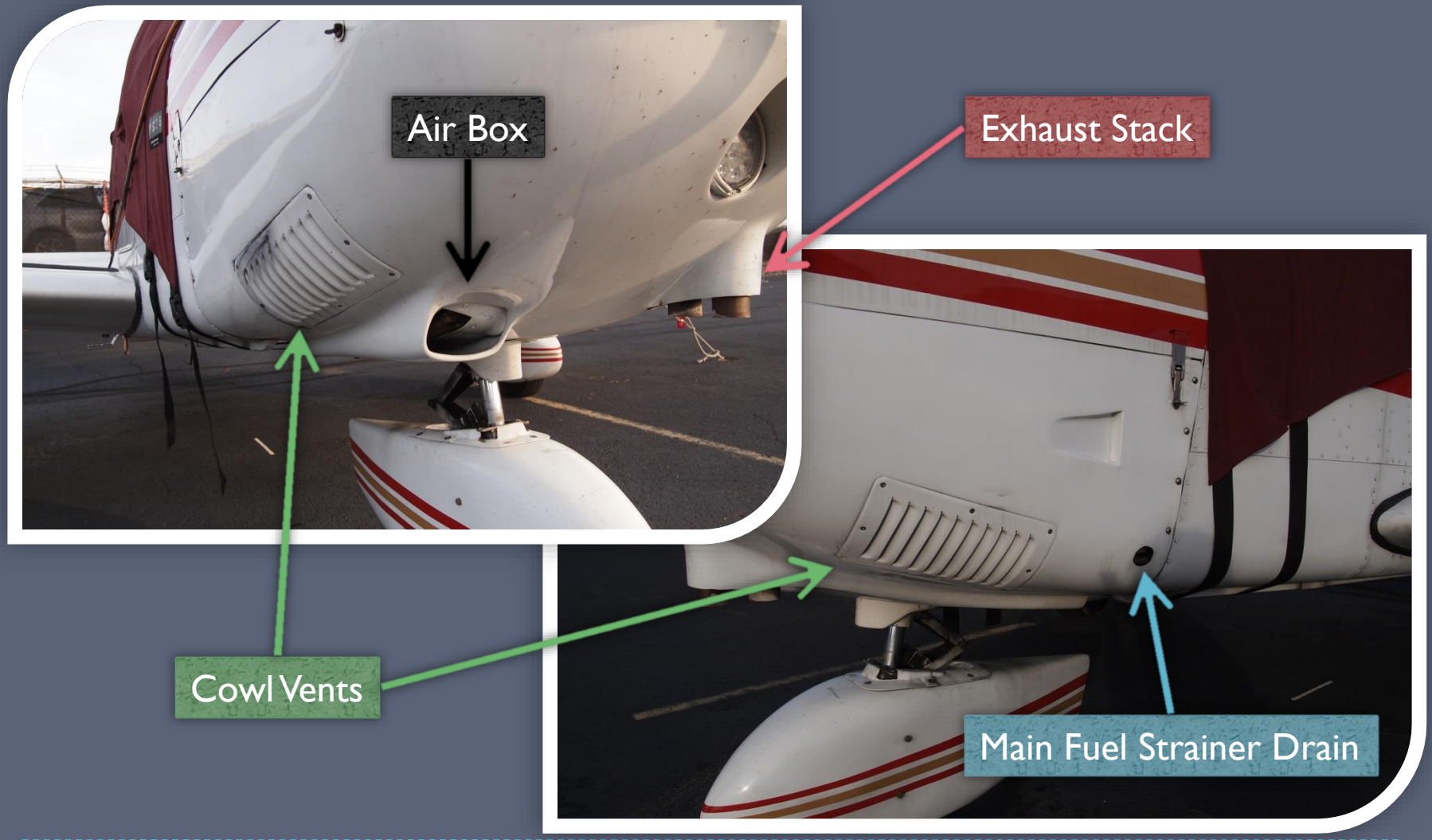
- Over-inflation
  - Can cause uneven tread wear
  - Reduced traction
  - Tread more susceptible to cutting
  - Increased stress on aircraft wheels
- Under-inflation
  - Uneven tire wear
  - Greatly increases stress and flex heating in the tire
    - Shortens tire life
    - Can lead to tire blowouts

- Proper inflation values
  - Archer II/III
    - Nose gear: 18psi
    - Main gear: 24psi
  - Dakota
    - Nose gear: 28-30psi
    - Main gear: 35-40psi
- Proper strut extension
  - Nose gear: 3.25" +/- 0.25"
  - Main gear: 4.5" +/- 0.50"

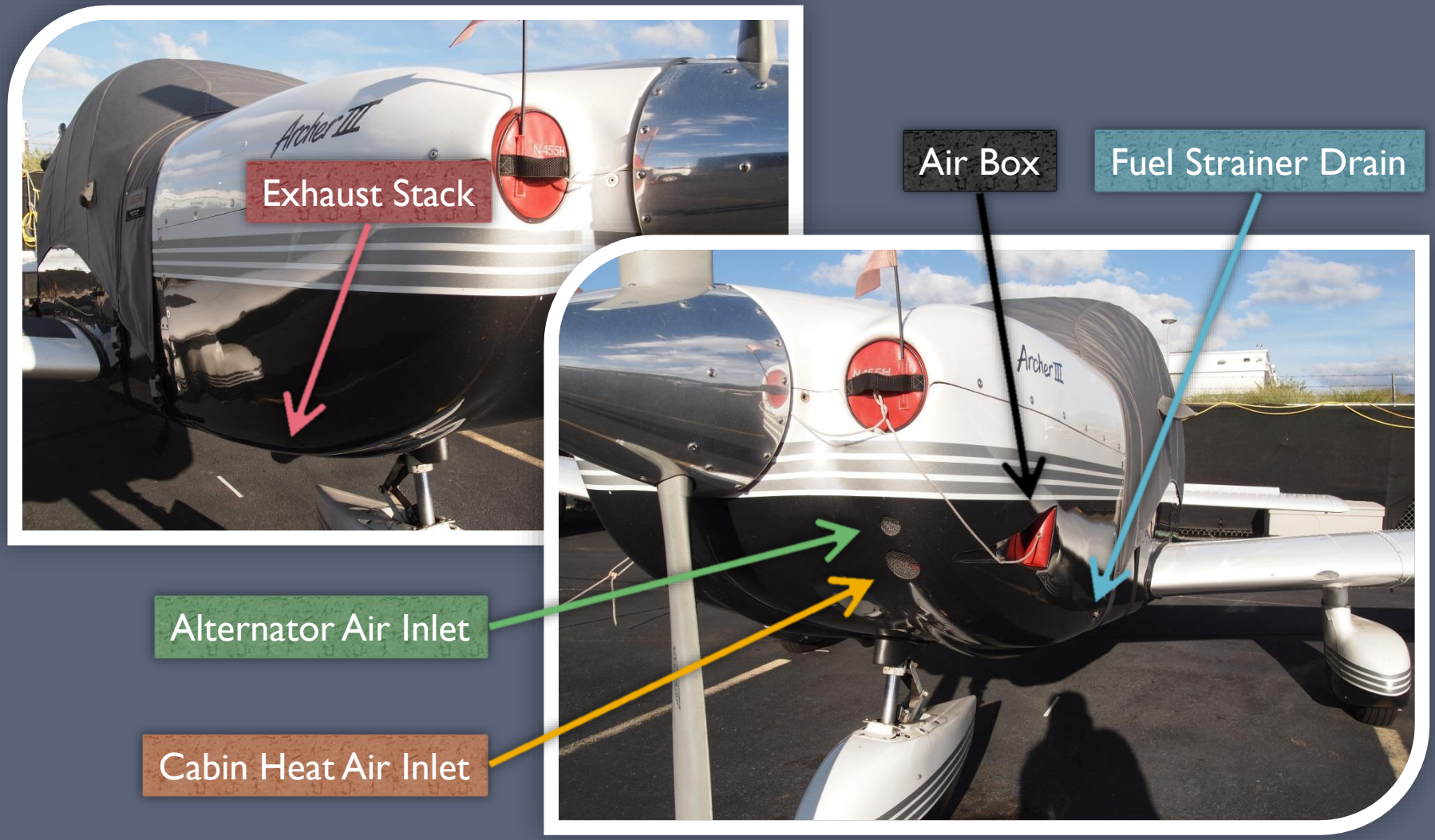
Exterior – Miscellaneous



Exterior – Cowling ("Classic")

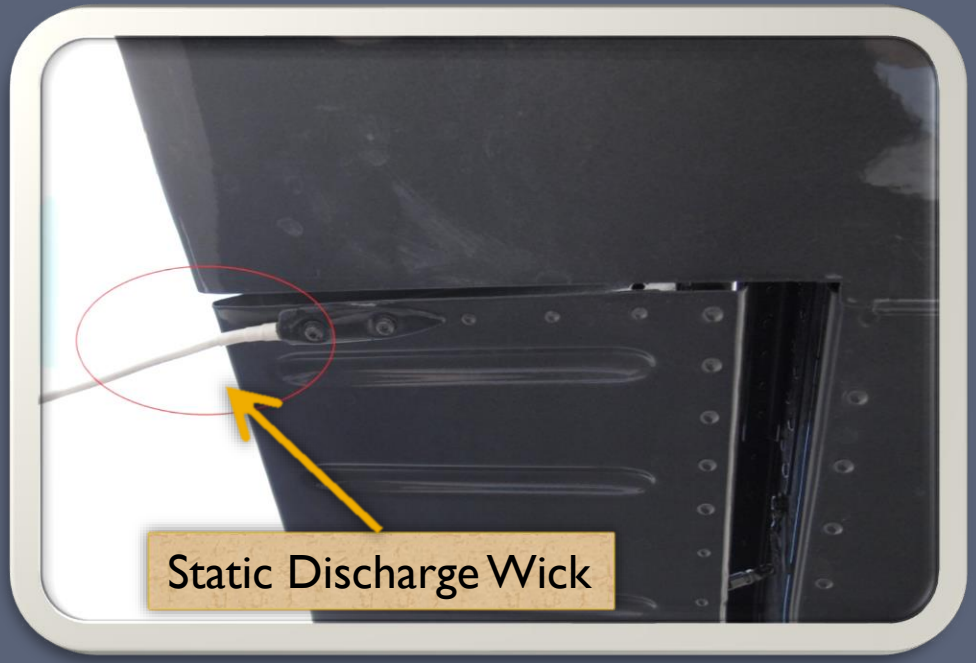


Exterior – Cowling ("Modern")

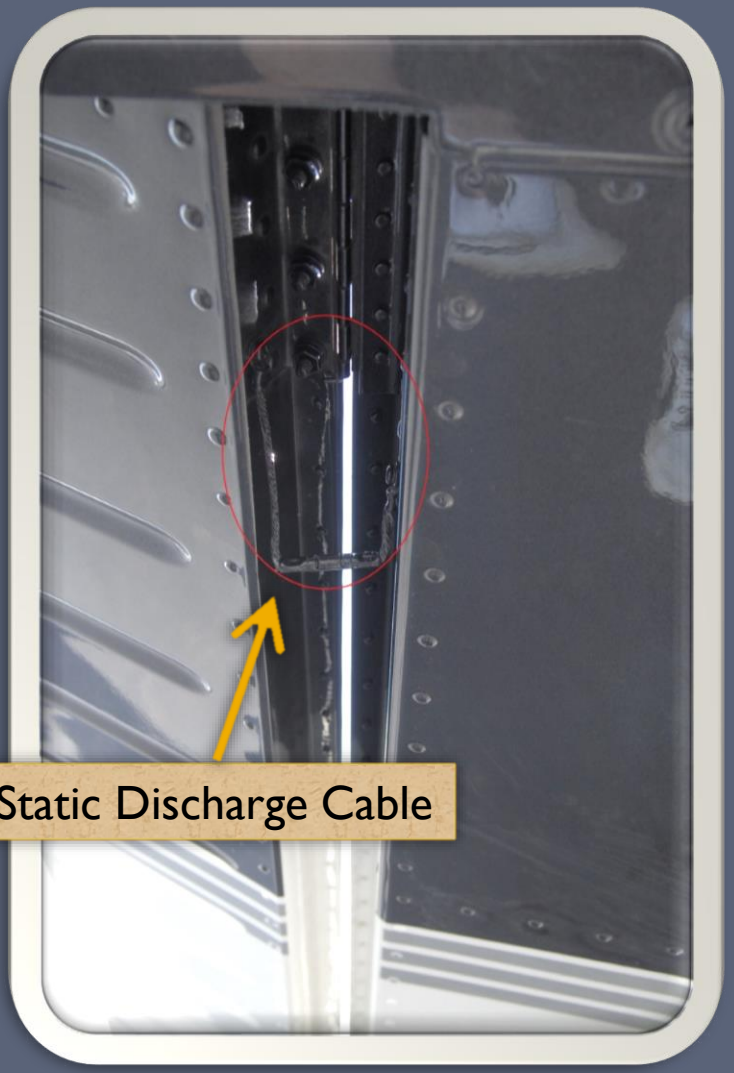


Exterior – Lower Cowling

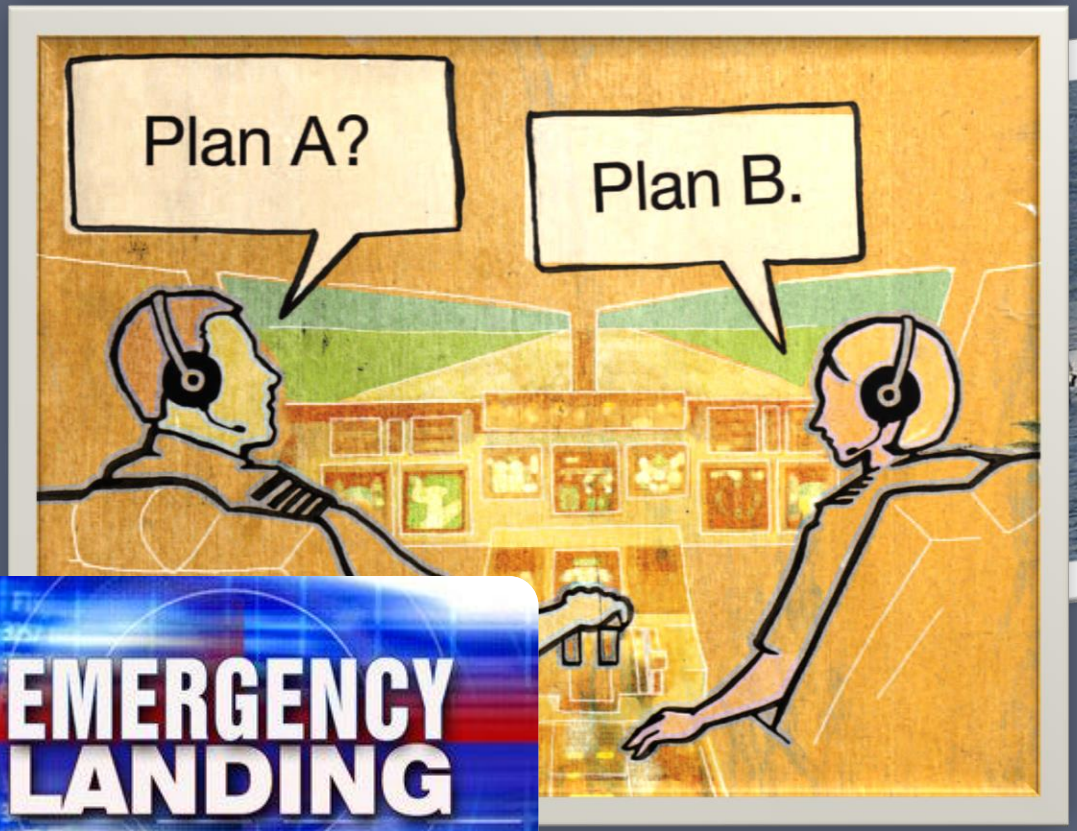
Exterior – Static Discharge Wicks



- As an aircraft moves through the air, it builds up a static charge. Eventually, the charge differential will become large enough that it will discharge into the air.
  - This discharge causes electromagnetic interference that will be picked up in the radios as loud static.
- The static discharge wicks help control the static build-up, and greatly reduces the electromagnetic interference from static discharges.



Emergencies



Pitot-Static Problems – Discussion

- How would you know if you have a static port blockage?
  - Would ATC know? Why, or why not?
  - You make a pitch and/or power change and don't get the expected indication
  - Use and cross-check with GPS altitude
  - What about occasionally switching to alternate air?
    - If your altitude is way off, it may damage the altimeter
- How would you know if you have a pitot port blockage?
  - Would ATC know? Why, or why not?
    - Would they necessarily tell you?
  - You make a pitch and/or power change and don't get the expected indication
  - Use and cross-check with GPS airspeed
    - Remember, GPS is ground speed, not air speed

Pitot-Static Problems – Examples

- Vertical Speed Indicator
  - Pointer not at zero when level
    - Aging diaphragm / zero rate-of-climb out of adjustment
  - Pointer doesn't respond
    - Obstruction in static line
    - Static vents frozen over
    - Water in static line
  - Pointer oscillates
    - Leak in static lines
    - Possibly defective instrument
  - Rate of climb changes reading when airplane is banked
    - Water in static lines
  - Rate of climb reads very low during (obvious) climb or descent
    - Instrument case broken or leaking
- Altimeter
  - Excessive scale error or oscillations
    - Instrument defective
  - Setting knob hard to turn
    - Instrument defective
  - Altimeter stuck / doesn't change with altitude
    - Water or restriction in static line
  - Altimeter changes reading when airplane is banked
    - Water in static line
- Airspeed Indicator
  - Airspeed oscillates
    - Instrument defective
  - Airspeed reads high
    - Instrument defective
    - Leak in static lines
  - Airspeed reads low
    - Instrument defective
    - Leak in static lines
    - Pitot head incorrectly aligned
  - Airspeed changes when airplane is banked
    - Water in static line

Engine Problems

- Three types of problems
  1. Complete power loss
  2. Partial power loss
  3. Pending potential problem
- Three phases of flight
  1. During takeoff
     1. Before obtaining a safe altitude
     2. After obtaining a safe altitude
  2. Cruise
  3. Descent & Approach

- The type of problem you have, and the phase of flight that it occurs, will determine which steps you should take

Engine Problems – Continued

- Complete Engine Power Loss
  - During takeoff, before safe altitude
    - Maintain safe airspeed
    - Use flaps as necessary
    - Make only shallow turns
  - During takeoff, after safe altitude / During descent and approach
    - Switch fuel tanks
    - Verify mixture rich, fuel pump on, and primer is locked
    - Carb heat on
    - Try left or right magneto separately
    - Adjust mixture and/or throttle
  - During cruise
    - Check engine instruments for indication of cause of power loss
- Partial Engine Power Loss
  - Generally, the same steps as before, except less time critical
    - Aviate, Aviate, Aviate
      - THEN Navigate (and Communicate)
- Engine Roughness / Partial Power Loss
  - Carb heat on
    - [Piper POH] If still rough after one minute, carb heat off
  - Adjust mixture for maximum smoothness
    - Even at the same altitude, you may need to occasionally re-lean due to different air densities ("high to low, lookout below", etc)
  - Fuel pump on
    1. In order to switch tanks
    2. In case of engine-driven fuel pump failure
  - Switch tanks
    - Fuel tank may be empty (or nearly empty)
    - Fuel may be contaminated
    - There may be a block in the fuel line to that tank
    - The fuel vent may be blocked
  - Try left or right magnetos separately
    - If operation satisfactory, continue and land at first practical airport

Engine Problems – Indications

- Loss of oil pressure
  - Faulty gauge
    - Most likely if oil temperature doesn't also increase
  - Malfunction in oil pressure regulating system
  - Oil leak
- Land as soon as possible
  - If engine still running, maintain altitude in case of a sudden engine stoppage
- The low oil pressure light will illuminate when the oil pressure drops below 35psi.
- High oil pressure
  - Faulty gauge
  - Malfunction in oil pressure regulating system
- Land as soon as possible
  - High oil pressure can damage the engine seals
- Low oil temperature
  - Engine not pre-heated enough
  - Winterizer plate not installed during cold weather
  - Faulty gauge
- Most likely to happen on the ground – shut engine down and investigate the cause
- High oil temperature
  - Low oil level
  - Obstruction in oil cooler
  - Winterizer plate still installed during warm weather
  - Damaged/improper baffle seals
  - Faulty gauge
- Climb at a higher airspeed or level off
- Increase mixture
- Reduce throttle
- If temperature continues to rise, land as soon as possible

Engine Problems – Indications (2)

- Excessively high CHT (>400F)
  - Use of a lower fuel grade than 100 octane
  - Extremely high manifold pressure with low RPM
  - Extended ground operation or steep climbs in which cylinder cooling is reduced
  - Poor engine baffling
- Climb at a higher airspeed or level off
- Increase mixture
- Reduce throttle
- If temperature continues to rise, land as soon as possible

- Low fuel pressure
  - Faulty gauge
  - Fuel system blockage
  - Engine-drive pump failure
  - Low fuel
- Boost pump on
- Switch tanks

Engine Problems – Miscellaneous

- Excessive engine vibration (other than engine roughness)
  - Could be a propeller out of balance
    - If imbalance is severe enough, it could cause the engine to be pulled off the engine mount
      - If this happens, recovery is likely impossible due to the severe weight & balance imbalance
  - Could also be a more serious engine problem
    - Example: Failed exhaust valve on one cylinder
- Engine fire
  - During start
    - Mixture to idle cutoff
    - Open throttle & continue cranking engine
      - This is to attempt to draw the fire back into the engine
    - If fire continues for more than a few seconds, extinguish it by the best external means
  - In flight
    - Fuel selector off
    - Throttle closed
    - Mixture to idle cutoff
    - Electric fuel pump off
    - Heater & defroster off

Control System Failures

- FAR Part 23
  - 23.147(c) – Directional and lateral control
    - *Summary:* The airplane must be safely controllable without the use of the primary lateral (roll) control system within the approved operating envelope.
  - 23.677 – Trim systems
    - (b) Trimming devices must be designed so that, when any one connecting or transmitting element in the primary flight control system fails, adequate control for safe flight and landing is available with—
      - (1) For single-engine airplanes, the longitudinal (pitch) trimming devices
      - (2) For multi-engine airplanes, the longitudinal and directional (yaw) trimming devices
    - (d) *Summary:* The airplane must be safely controllable following any powered trim system runaway that might be reasonably expected in service, following an appropriate time delay after pilot recognition.

Control System Failures

- Broken throttle cable
  - Adjust power using the mixture control
- Broken stabilator cable
    - Trim for stable, level flight, until ready to land
    - Plan for a no-flap landing
      - Reduces the pitch variations required
  - Can't raise nose
    - Apply substantial nose-up trim
      - Push *forward* to pitch down, *release pressure* to pitch up
  - Can't lower nose
    - Apply substantial nose-down trim
      - Pull *aft* to pitch up, *release pressure* to pitch down
- Jammed rudder
  - Airplane will generally be flyable, but in a slip
    - Keep this in mind as you make any configuration changes
      - Airspeed may be erroneous
      - Unnecessary maneuvering could cause a stall/spin

Control System Failures – Brakes

- Signs of impending brake failure
  - Gradual decrease in braking action after brake application
  - Noisy or dragging brakes
  - Soft or spongy pedals
  - Excessive travel and weak braking action
- Dealing with brake failure
  - Throttle to idle
  - Full aft elevator (to aide in aerodynamic braking)
  - Flaps UP (increased weight on wheels, to aide in frictional braking)
  - If spongy brakes or pedal travel increases
    - Attempt to pump the brakes to build up brake pressure
  - If one brake is weak or fails
    - Use the other brake sparingly, using opposite rudder as required

Miscellaneous Emergencies

- Seat slides back on takeoff or landing
  - DO NOT grab the yoke!
    - Be sure to inform your passengers (especially non-pilots) in the pre-flight briefing
- Sick passenger (airsick or otherwise)
  - What would you do? VFR, IFR
- Runaway pitch trim
  - What would you do?
    - Disconnect autopilot
      - Yoke disconnect
      - Autopilot master switch
      - Pull circuit-breaker
    - Disable electric pitch trim
      - Electric pitch trim master switch
      - Pull circuit-breaker
    - Turn off avionics master switch
    - Turn off master switch
  - Autopilot (including pitch trim) servos are designed to be overpowered
  - There is also a speed sensor that disables the electric trim over 140 KIAS
- Propeller over-speed
  - Fixed-pitch
    - Reduce throttle
      - Stay below red-line
    - Reduce airspeed
  - Constant-speed
    - Reduce throttle
      - Stay below red-line
    - Check oil pressure
    - Reduce prop control
    - Reduce airspeed

Miscellaneous Emergencies

- Spins (unintentional)
  - ***Exact steps vary from plane to plane – read the POH***
    1. Throttle to idle
    2. Ailerons neutral
    3. FULL opposite rudder
       1. Followed by control wheel full forward
    4. Neutralize rudder after rotation stops and smoothly regain level flight
       1. Airspeed will build rapidly, so return to level flight needs to be quick, but smooth so as not to overstress the airframe
- Open door
  - Such a common occurrence that is a non-issue, but frequently causes unnecessary accidents
  - Remember, the doors are double-latched, so it's unlikely it is completely unlatched
  - AVIATE, then determine best course of action
    - Nearly impossible to close the door yourself, but if it's only partially unlatched, it *may* be possible for a passenger to attempt to close the door
    - Otherwise, consider landing as soon as possible and closing on the ground

More Information

- AFM or POH
  - **Dakota: 761-689**
  - **Archer II: 761-722**
  - **Archer III: 761-868**
  - Arrow II: 761-493
  - Warrior II: 761-649
- Operator's Manual
  - Lycoming O/IO-360: 60297-12
  - Lycoming O-540
- Airplane Maintenance Manual
- Pilot's Handbook of Aeronautical Knowledge (FAA-H-8083-25A)
- Type Certificate
  - Aircraft
    - Piper PA-28
  - Engine
    - Lycoming O-360
    - Lycoming O-540
  - Propeller
    - Sensenich 76E-series
    - Hartzell F2YR-series

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Piper PA-28 "Cherokee" Series Overview

- PA-28(S)(R)(T)-###(T)
  - PA – Piper Aircraft
  - 28(S)(R)(T) – Series ID
    - S = Seaplane
    - R = Retractable gear
    - T = T-tail
  - ### – Horsepower
    - ##0/5 = "Hershey bar" wing
    - ##1/6 = Semi-tapered wing
    - ###T = Turbo-charged engine
- Cherokee Lines
  - *150/160*
    - *140 / 140E / Cruiser*
    - *Warrior / II / III*
  - 180/180G
    - Archer II / III
    - **Archer LX & TX**
  - 28R-180/200 Arrow / II
    - 201 Arrow III/201T Turbo Arrow III
    - **Arrow**
  - *235/Charger/Pathfinder*
    - *236 Dakota*

PA-28 Aircraft Examples

- PA-28-235/236
  - 235HP
    - Constant-speed Propeller
  - Fixed Gear

- PA-28R(T)-180/200 & 201
  - 180/200HP
    - Constant-speed Propeller
  - Retractable Gear

- PA-28-180/181
  - 180HP
    - Fixed-pitch Propeller
  - Fixed Gear

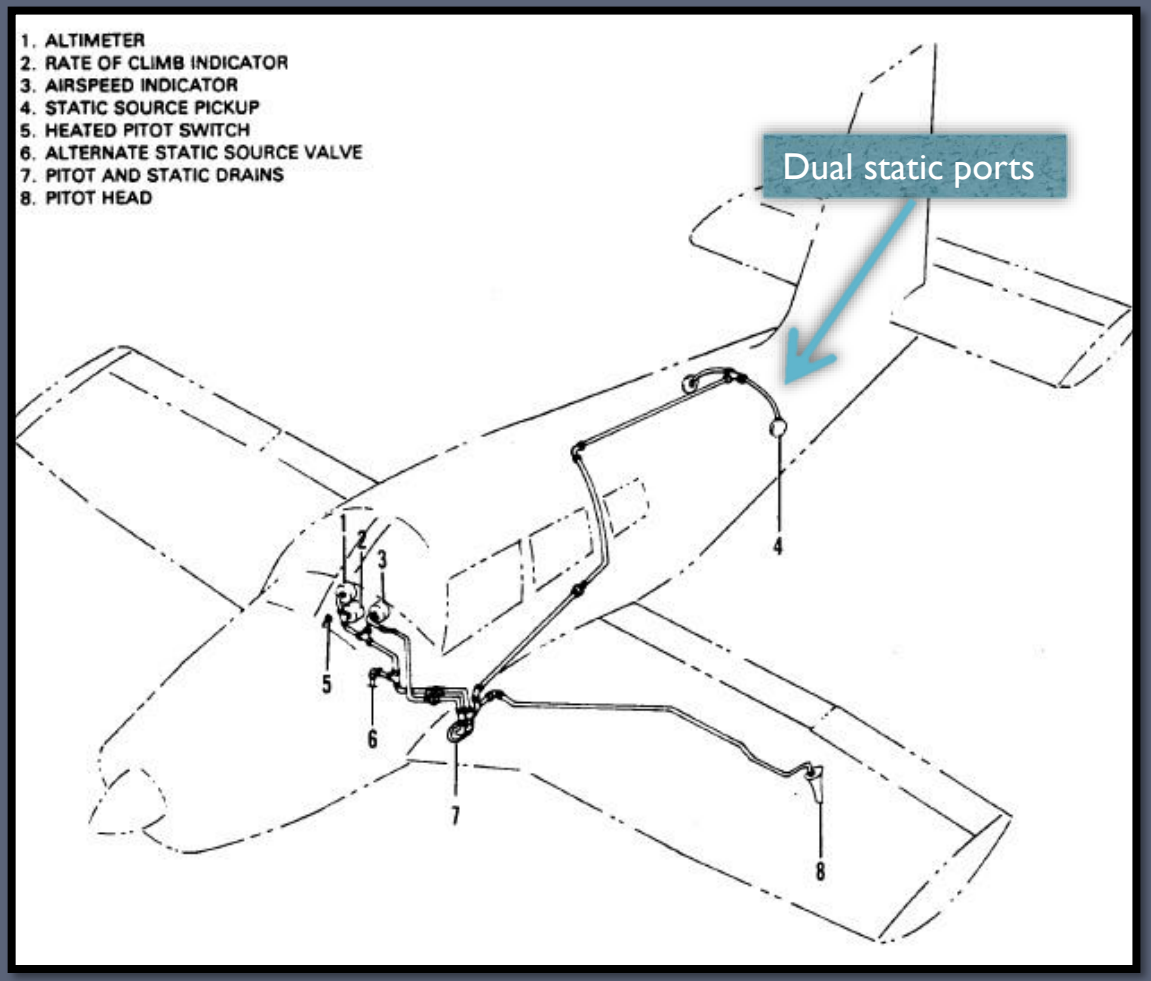
Piper PA-28 Models

	Model	Approved	Engine	Engine Output	Fuel	Fuel Capacity	Max Weight	Max Baggage	Seats
Hershey-Bar Wing	PA-28-160 Cherokee	10/31/1960	O-320-B2B/D2A	160hp @ 2700rpm	91/96	2x25g=50g	2200	125,200	4
	PA-28S-160 Cherokee	2/25/1963	O-320-D2A	160hp @ 2700rpm	100/130	2x25g=50g	2140	125	4
	PA-28-150 Cherokee	6/2/1961	O-320-A2B/E2A	150hp @ 2700rpm	80/87	2x25g=50g	2150	125,200	4
	PA-28-180 Cherokee	8/3/1962	O-360-A3A/A4A	180hp @ 2700rpm	91/96	2x25g=50g	2400/1950	125,200	4/2
		12/6/1966	O-360-A3A/A4A	180hp @ 2700rpm	91/96	2x25g=50g	2400/1950	125,200	4/2
	PA-28S-180 Cherokee	5/10/1963	O-360-A3A/A4A	180hp @ 2700rpm	100/130	2x25g=50g	2222	125	4
	PA-28-235 Cherokee Pathfinder	7/15/1963	O-540-B2B5/B1B5/B4B5	235hp @ 2575rpm	80/87	2x25g + 2x17g = 84g	2900	200	4
		6/9/1972	O-540-B4B5	235hp @ 2575rpm	80/87	2x25g + 2x17g = 84g	3000	200	4
	PA-28-140 Cherokee Cruiser	2/14/1964	O-320-E2A/E3D	150hp @ 2700rpm	80/87	2x25g=50g	2150/1950	100,200,300	2
		6/17/1965	O-320-E2A/E3D	150hp @ 2700rpm	80/87	2x25g=50g	2150/1950	100,200,300	2
		6/17/1965	O-320-E2A/E3D	150hp @ 2700rpm	80/87	2x25g=50g	2150/1950	100,200,300	4/2
	PA-28R-180 Arrow	6/8/1957	IO-360-B1E	180hp @ 2700rpm	100/130	2x25g=50g	2500	200	4
	PA-28R-200 Arrow	1/16/1969	IO-360-C1C	200hp @ 2700rpm	100/130	2x25g=50g	2600	200	4
	PA-28R-200 Arrow II	12/2/1971	IO-306-C1C/C1C6	200hp @ 2700rpm	100/130	2x25g=50g	2650	200	4
	PA-28-180 Archer	5/22/1972	O-360-A4A/A4M	180hp @ 2700rpm	100/130	2x25g=50g	2450/1950	200	4/2
Semi-Tapered Wing	PA-28-151 Cherokee Warrior	8/9/1973	O-320-E3D	150hp @ 2700rpm	80/87	2x25g=50g	2325/1950	200	4/2
	PA-28-181 Archer II	7/8/1975	O-360-A4M/A4A	180hp @ 2700rpm	100/130	2x25g=50g	2558,2550/2138,2130	200	4/2
	PA-28-181 Archer III	8/30/1994	O-360-A4M	180hp @ 2700rpm	100/100LL	2x25g=50g	2558,2550/2138,2130	200	4/2
	PA-28-161 Warrior II/Cadet	11/2/1976	O-320-D3G/D2A	160hp @ 2700rpm	100	2x25g=50g	2332,2325/2020	200,50	4/2
		7/1/1982	O-320-D3G/D2A	160hp @ 2700rpm	100	2x25g=50g	2447,2440/2027,2020	200	4/2
	PA-28-161 Warrior III	7/1/1994	O-320-D3G	160hp @ 2700rpm	100/100LL	2x25g=50g	2447,2440/2027,2020	200	4/2
	PA-28R-201 Arrow III	11/2/1976	IO-360-C1C6	200hp @ 2700rpm	100/100LL	2x38.5g=77g	2750	200	4
	PA-28R-201T Turbo Arrow III	11/2/1976	Continential TSIO-360-F/FB	200hp @ 2575rpm/41" MP	100/130	2x38.5g=77g	2912,2900	200	4
		11/2/1976	Continential TSIO-360-FB	200hp @ 2575rpm/41" MP	100/130	2x38.5g=77g	2912,2900	200	4
	PA-28RT-201 Arrow IV	11/13/1978	IO-360-C1C6	200hp @ 2700rpm	100/130	2x38.5g=77g	2750	200	4
	PA-28-236 Dakota	6/1/1978	O-540-J3A5D	235hp @ 2400rpm	100/130	2x38.5g=77g	3000	200	4
	PA-28-201T Turbo Dakota	12/14/1978	Continential TSIO-360-FB	200hp @ 2575rpm/41" MP	100/130	2x38.5g=77g	2900	200	4

- Models span from 1960 to current
- Semi-tapered wing first available on the 1973 Cherokee Warrior

Pitot-Static System – Dual Static Ports

- Benefits of the dual static-port configuration
  - Less likely that both will become obstructed
  - More accurate during a slip



Pitot-Static Problems

Activate pitot heat

Use Alt. Static Air

Pitot Port	Static Port	Flight Attitude	Result
BLOCKED	CLEAR	Climbing	ASI *increasing*
		Level	ASI frozen
		Descending	ASI *decreasing*

Pitot Port	Static Port	Flight Attitude	Result
BLOCKED	BLOCKED	Climbing	ASI & Alt. Frozen, VSI 0
		Level	
		Descending	

Pitot Port	Static Port	Flight Attitude	Result
CLEAR	BLOCKED	Climbing	ASI *decreasing*
		Level	ASI correct
		Descending	ASI *increasing*

Electrical Problems

What systems are powered by the electrical system?

- Attitude instruments
  - Turn Coordinator
  - Electric Attitude Indicator
  - Vacuum gauge backlight
- Navigation equipment
  - VOR/LOC/GPS
  - Transponder
- Autopilot
  - Electric trim
- Radios
- Engine instruments
  - Fuel level
  - Fuel pressure
  - Oil pressure & temperature
  - EGT/CHT/OAT
    - If digital
  - Volt/ammeter…obviously
  - Digital tachometer (optional)
- Lights
  - Interior
  - Exterior
- Landing Gear (if applicable)
  - Electric landing gear motor
  - Landing gear horn & position lights
- Other
  - CO detector
  - Cabin fan
  - Electric fuel pump
  - Clock
  - Optional
    - Carb ice detector
    - Electric vacuum pump
  - Hobbs meter
    - The one good thing!

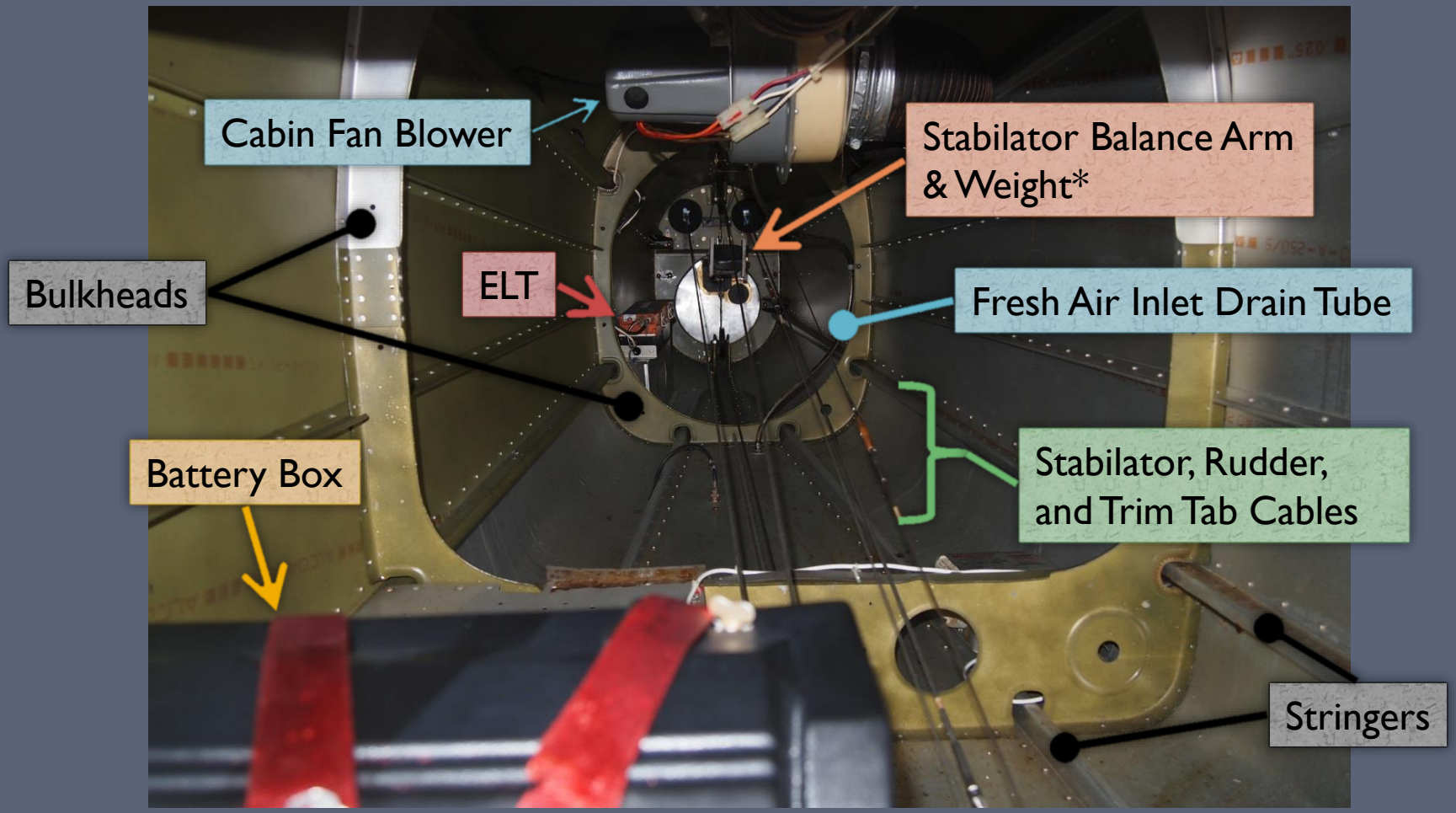
Electrical Problems - Troubleshooting

- If the battery is dead, getting an external power start is not recommended
  - The battery's capacity is very low, and may not provide power very long if the alternator fails

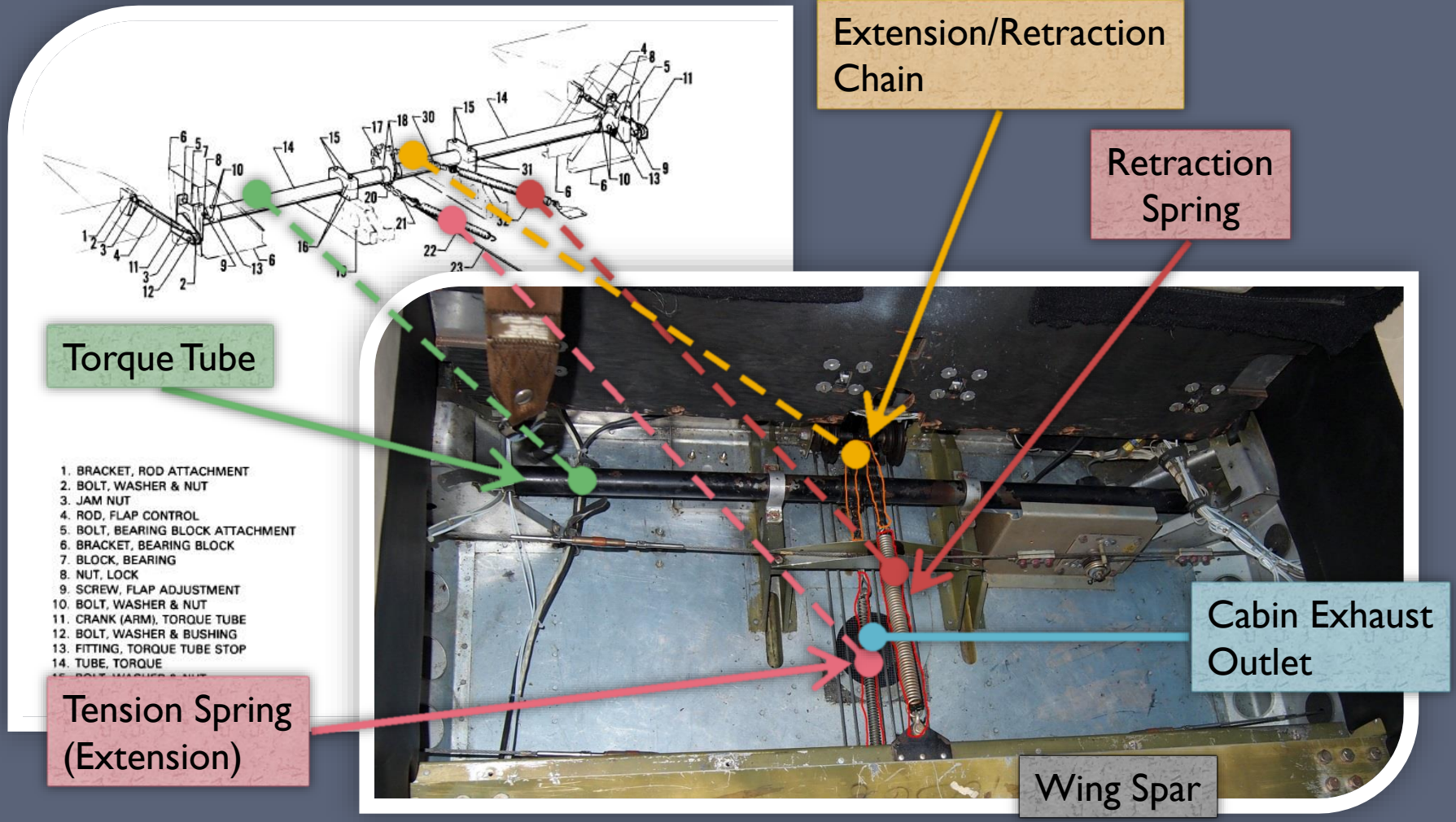
Zero-reading on ammeter	Verify reading isn't simply low by turning on electrical equipment	
	Check for a popped alternator field circuit breaker	
	Reset overvoltage relay (cycle ALT switch)	
	Reduce electrical load and land as soon as practical	
Electrical overload	"Stuck" starter	Starter is acting as a generator; electrical equipment may not function properly
	Possibly a low battery	Indication should decrease within 5 minutes
	Turn BAT switch off, and monitor ammeter	Indication should decrease within 5 minutes
	Turn ALT switch off	
	Reduce electrical load and land as soon as practical	

Control System – Empennage

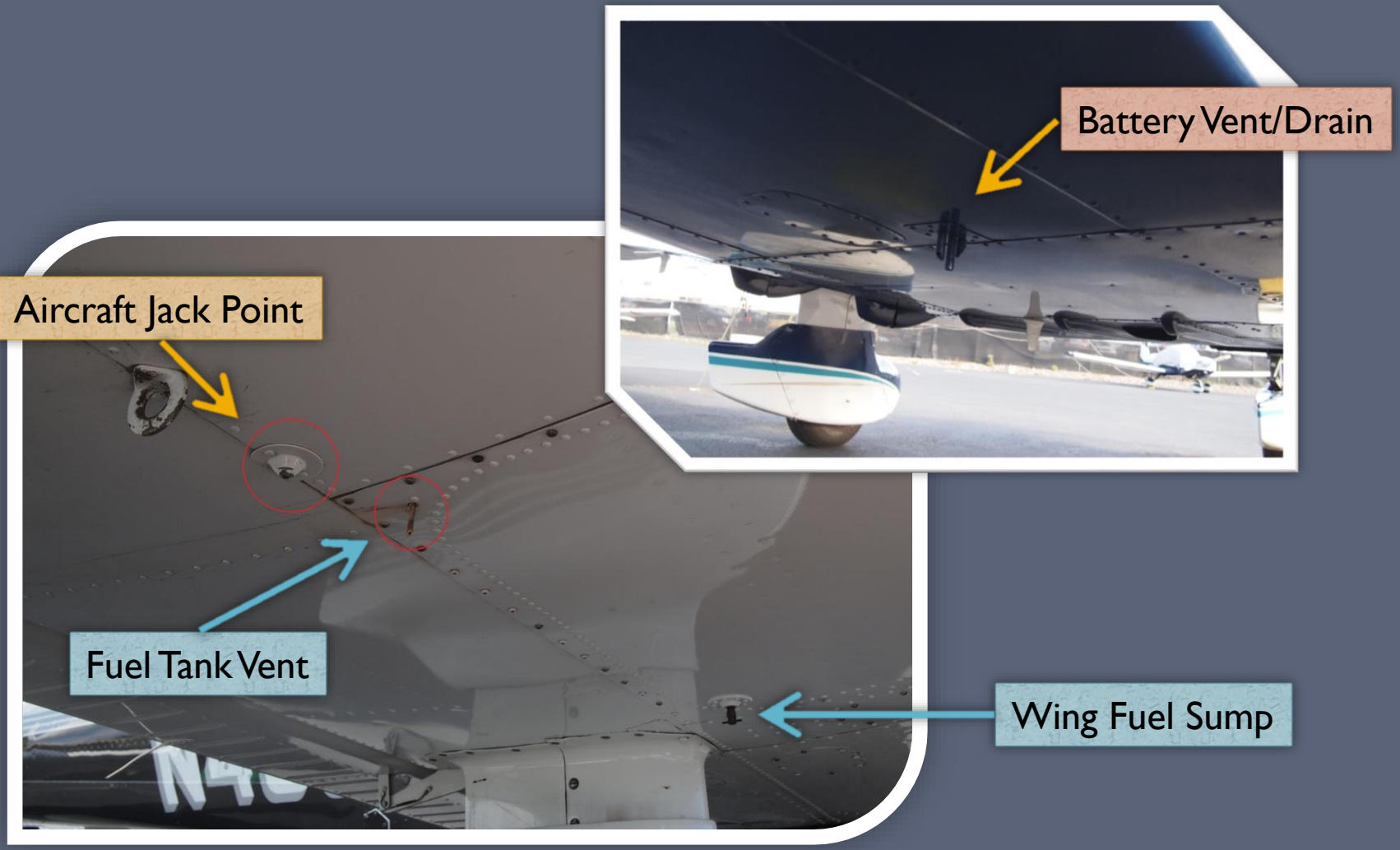
- Empennage access panel (rear of baggage compartment)



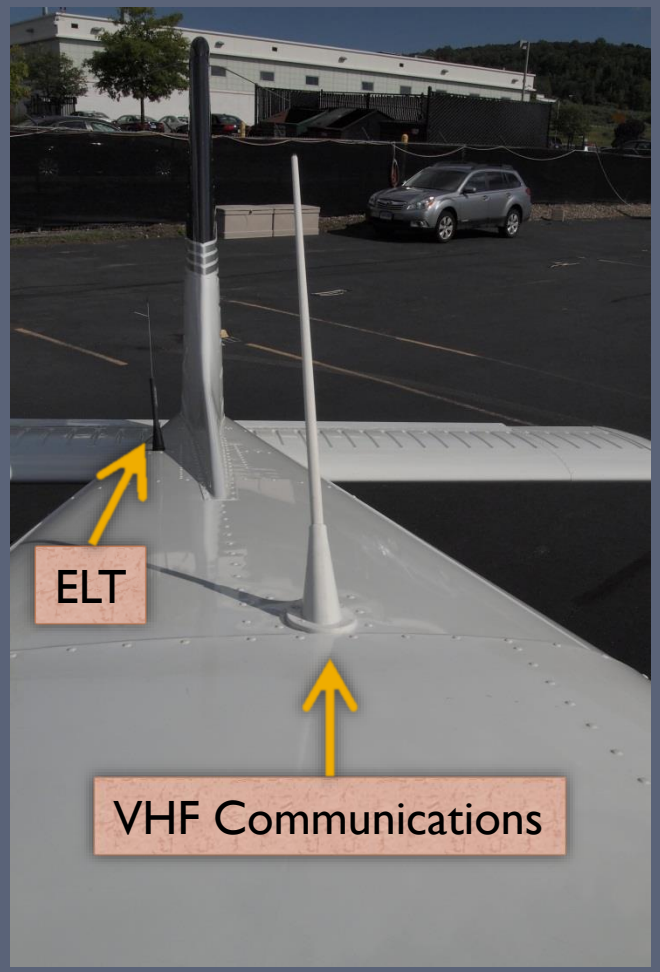
Control System – Flaps (Cont.)



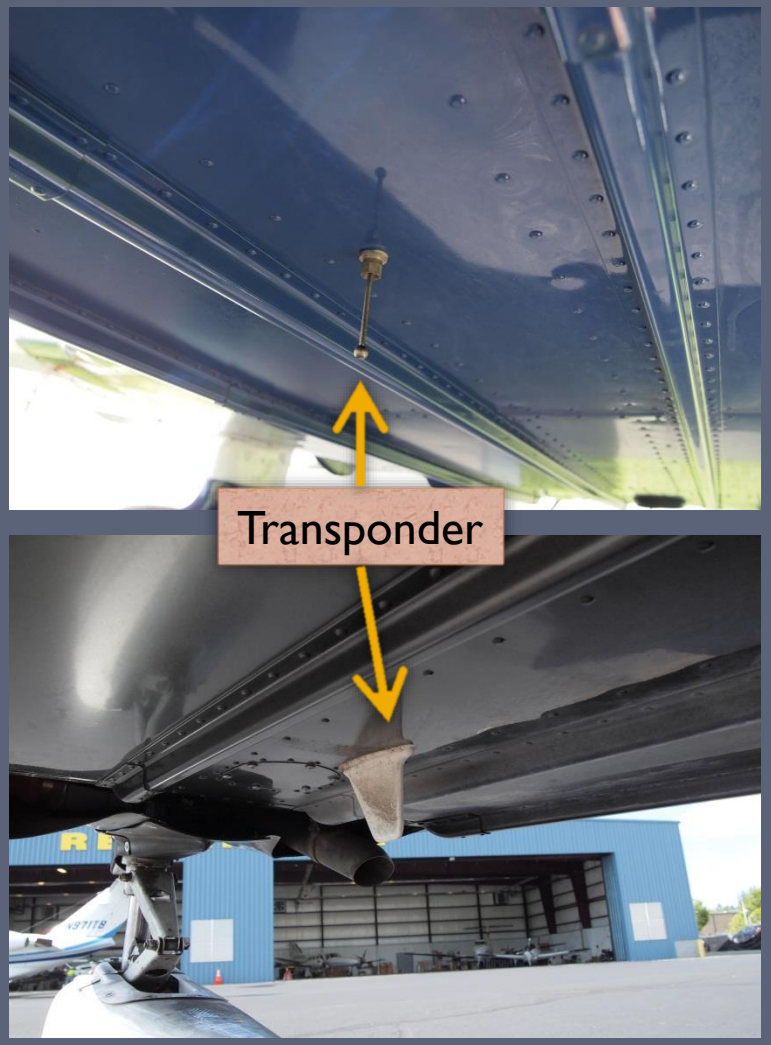
Exterior – Miscellaneous



Exterior - Antennas



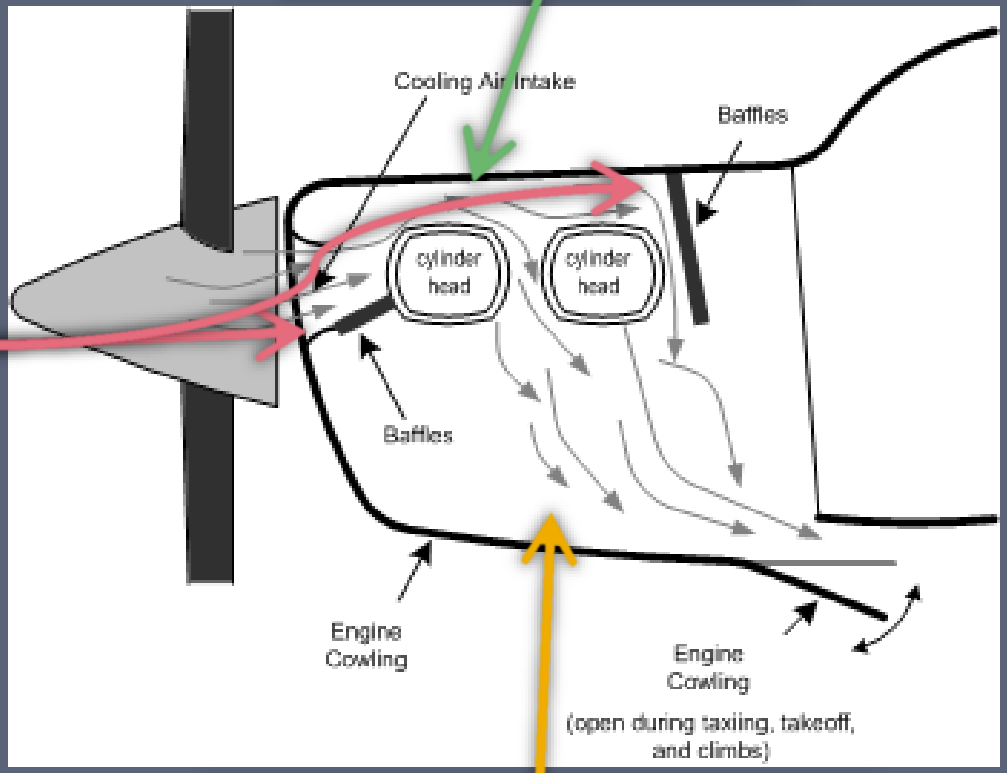
Exterior – Antennas



Fuel Selector

Engine Cooling Airflow

High air pressure on top



Baffles help guide the airflow and separate high air pressure from low air pressure

Low air pressure on the bottom