Powerplant and Related Systems

RECIPROCATING ENGINES

Radial

Horizontally Opposed

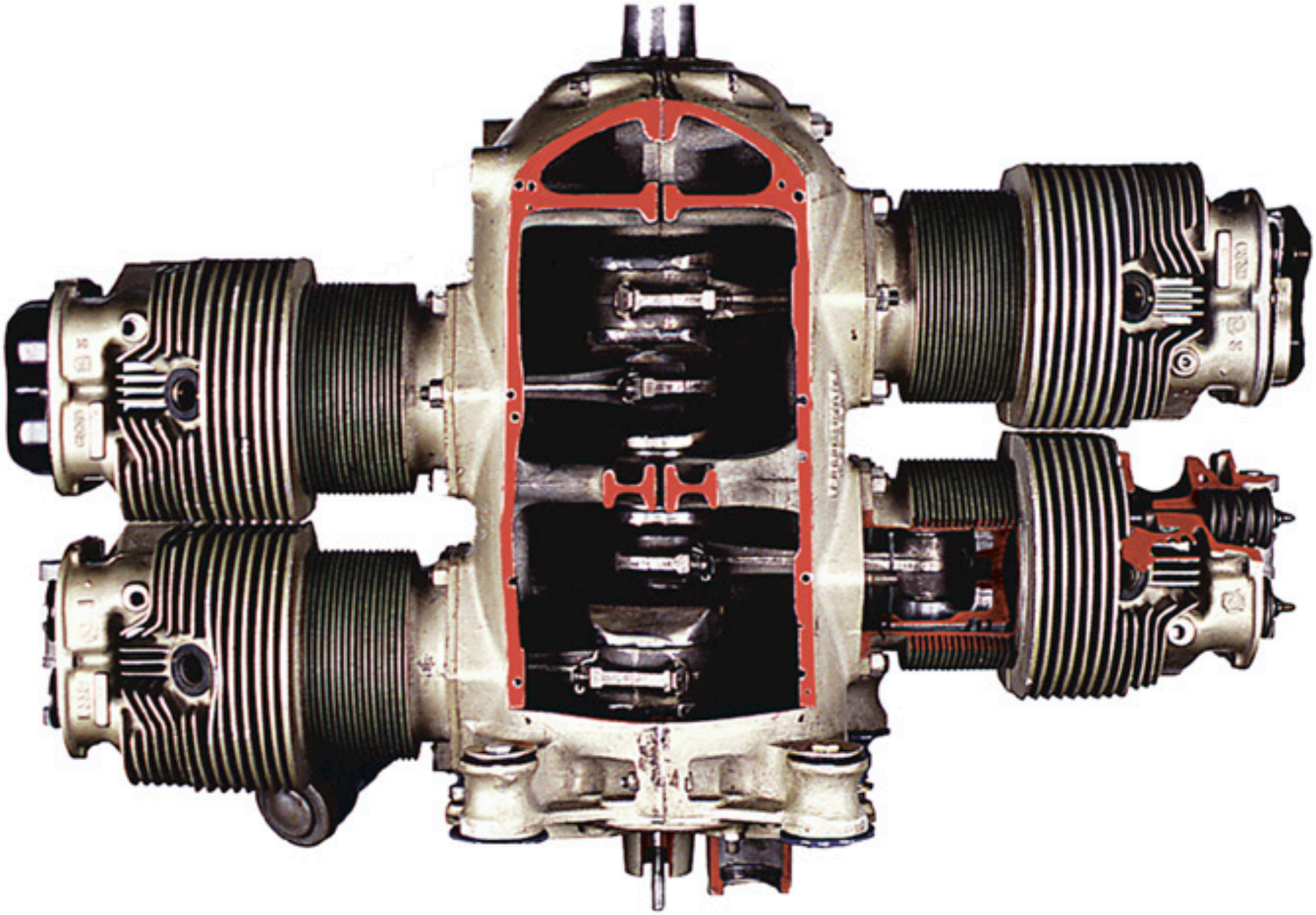
TURBINE ENGINES

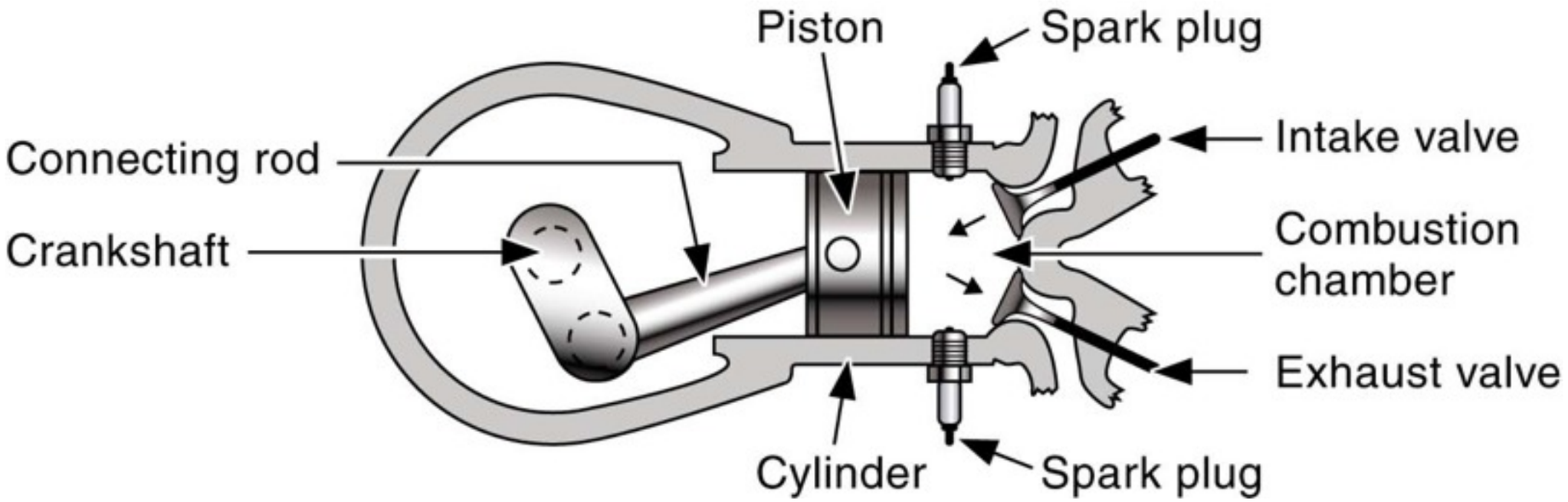
Turboprop

Turbojet

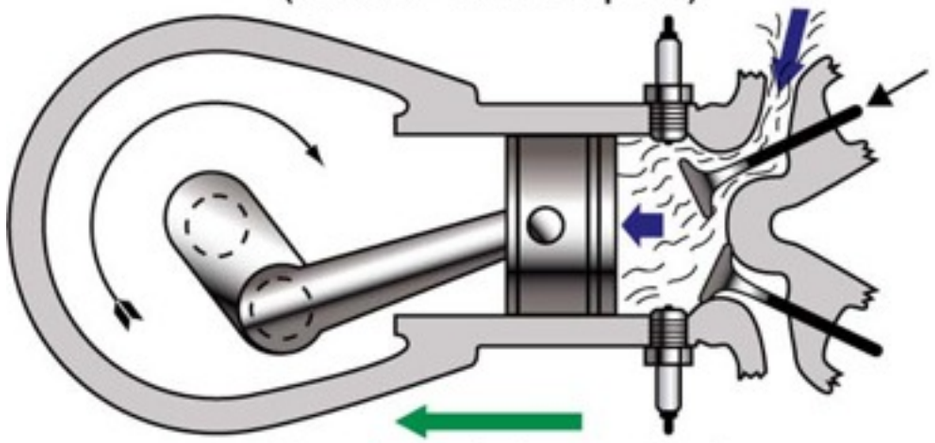
- Reciprocating Engines
- Induction System
- Ignition System
- Fuel System
- Cooling System
- Exhaust System

Reciprocating Engine



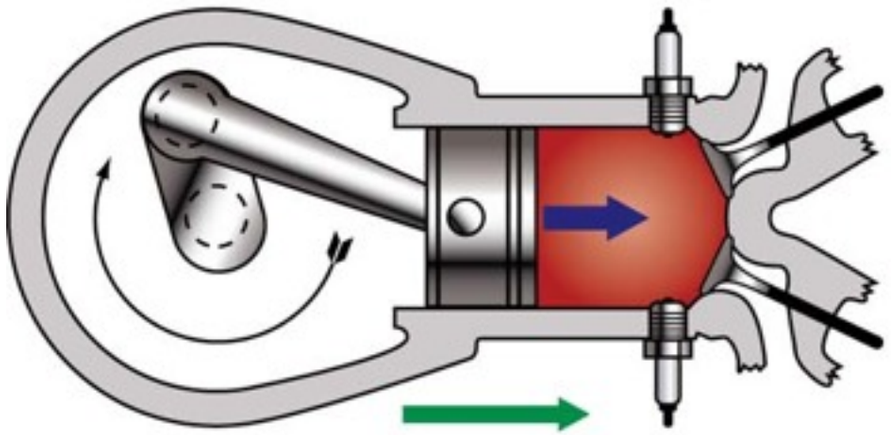

Piston
Spark plug
Intake valve
Connecting rod
Crankshaft
Combustion chamber
Exhaust valve
Cylinder
Spark plug

1. Intake
(intake valve open)



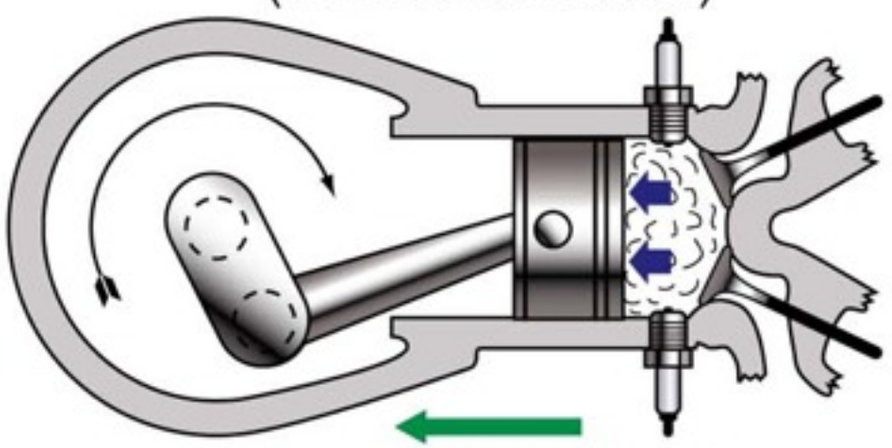
direction of piston travel

2. Compression
(both valves closed)



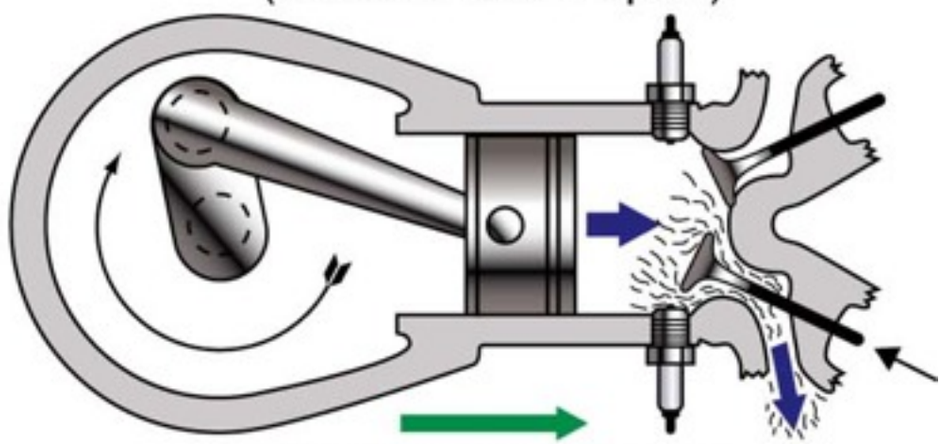
direction of piston travel

3. Power
(both valves closed)



direction of piston travel

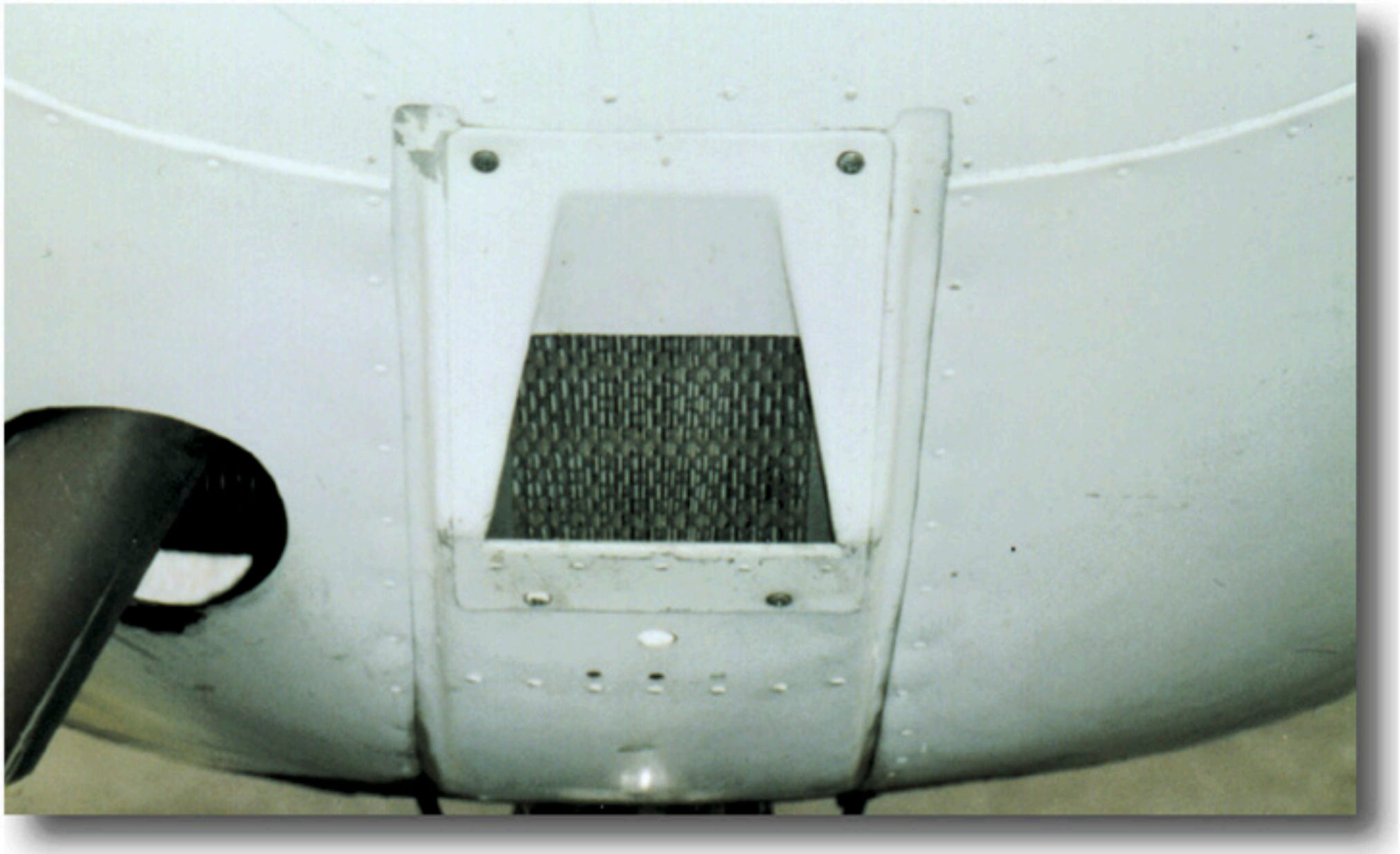
4. Exhaust
(exhaust valve open)



direction of piston travel

four strokes of the reciprocating engine

Induction System



Air Intake

Carburetor System

- mixes fuel with air
- ideal range 1:8 to 1:20 (fuel/air)
- rich mixture has excess fuel
- lean mixture has a shortage of fuel

Aero Advantage

FUEL/AIR MIXTURE
The blend of fuel and air is routed to the combustion chambers to be burned.

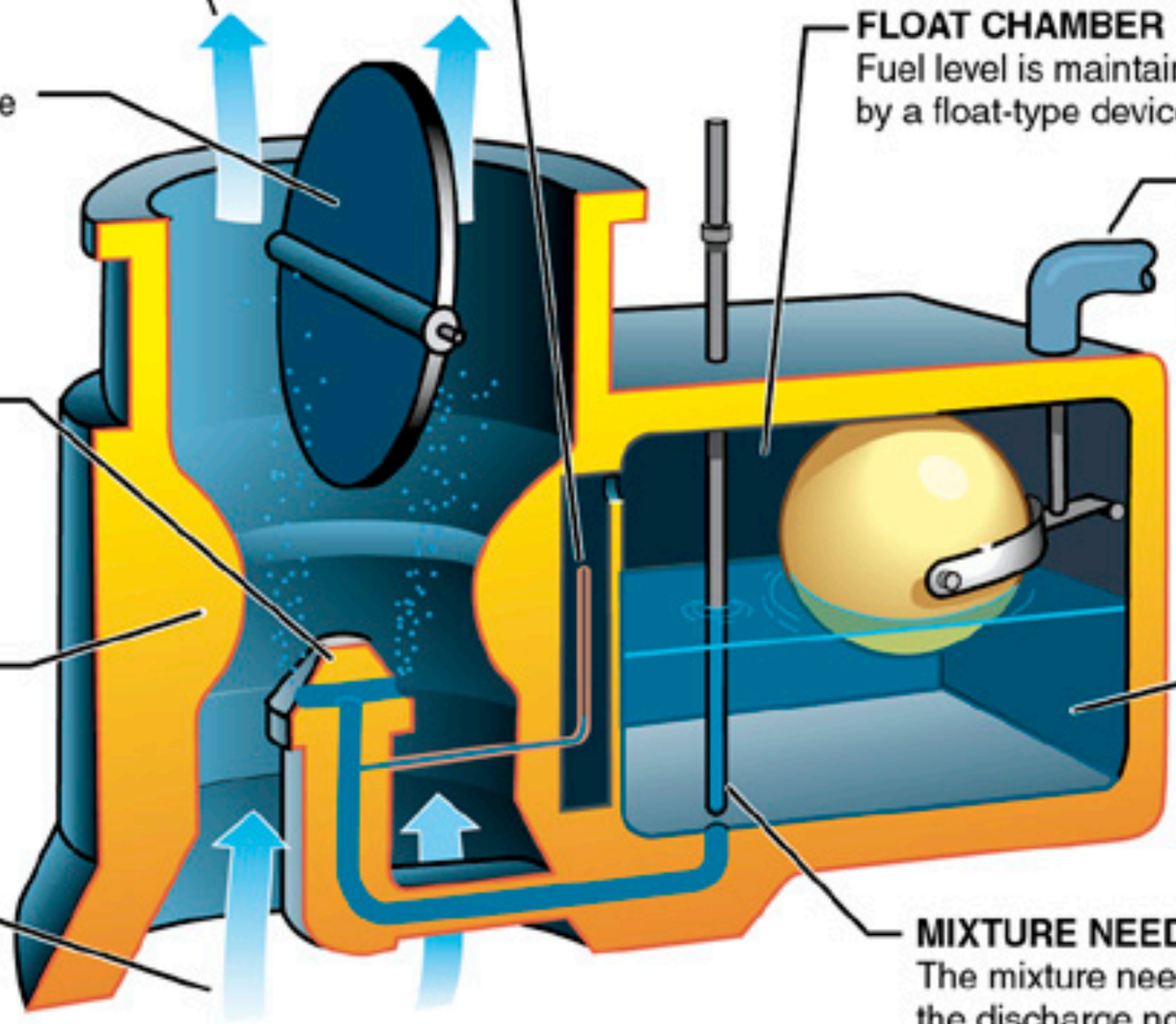
AIR BLEED
The air bleed allows air to be mixed with fuel being drawn out of the discharge nozzle to decrease fuel density and promote fuel vaporization.

THROTTLE VALVE
The flow of the fuel/air mixture is controlled by the throttle valve. The throttle valve is adjusted from the cockpit by the throttle.

FLOAT CHAMBER
Fuel level is maintained by a float-type device.

FUEL INLET
Fuel is received into the carburetor through the fuel inlet.

DISCHARGE NOZZLE
Fuel is forced through the discharge nozzle into the venturi by greater atmospheric pressure in the float chamber.



VENTURI
The shape of the venturi creates an area of low pressure.

FUEL

AIR INLET
Air enters the carburetor through the air inlet.

MIXTURE NEEDLE
The mixture needle controls fuel to the discharge nozzle. Mixture needle position can be adjusted using the mixture control.

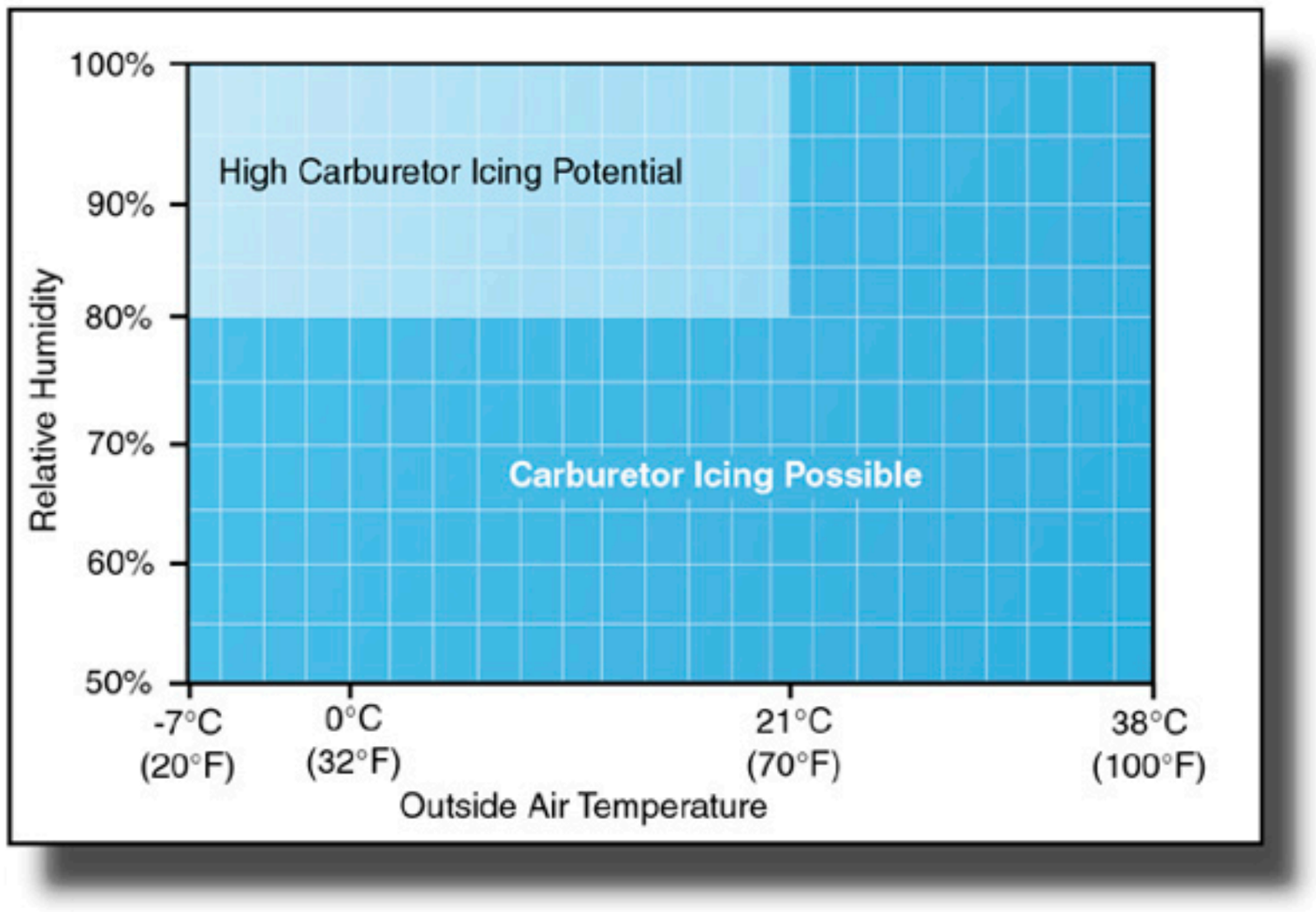
Leaning

- Carburetor calibrated at sea level
- Air density decreases with altitude
- Leaning decreases fuel in fuel/air mixture
- MUST lean engine to realize fuel range

Aero Advantage

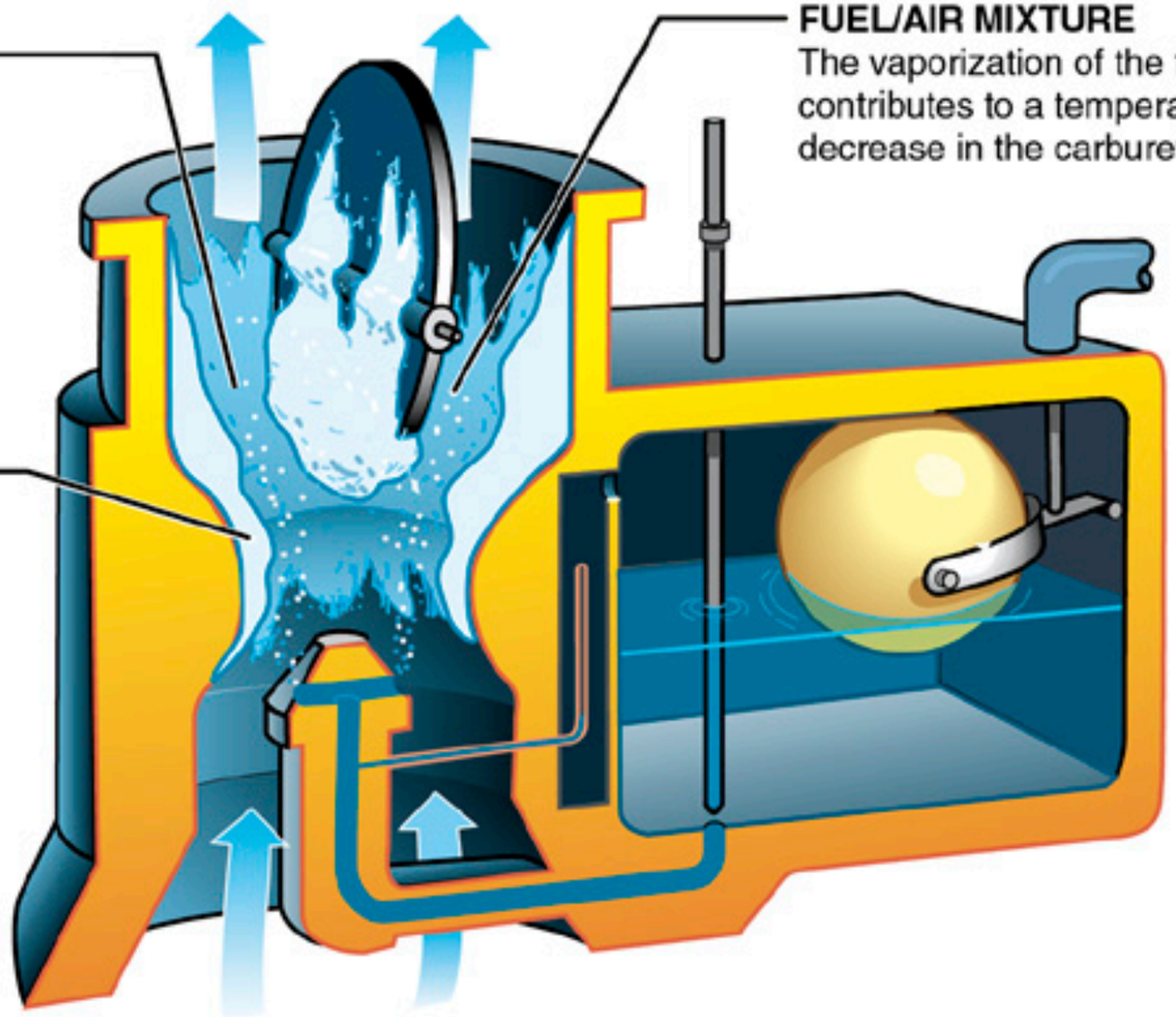
Carburetor Ice

- Disadvantage of float type carburetor



ICE
If conditions warrant, ice will generally form in the vicinity of the throttle valve.

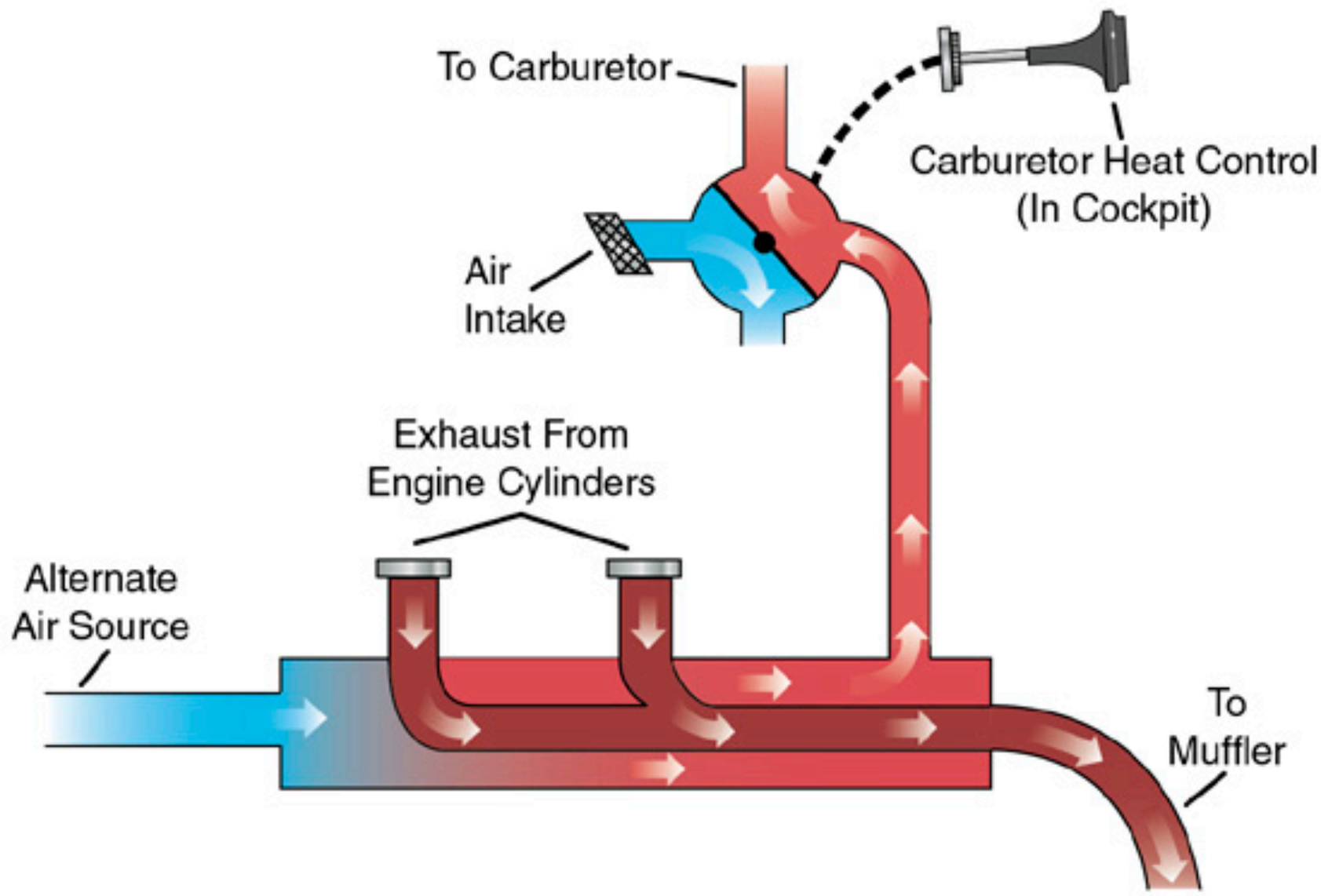
VENTURI
The reduced air pressure at the venturi throat creates a temperature decrease.



FUEL/AIR MIXTURE
The vaporization of the fuel contributes to a temperature decrease in the carburetor.

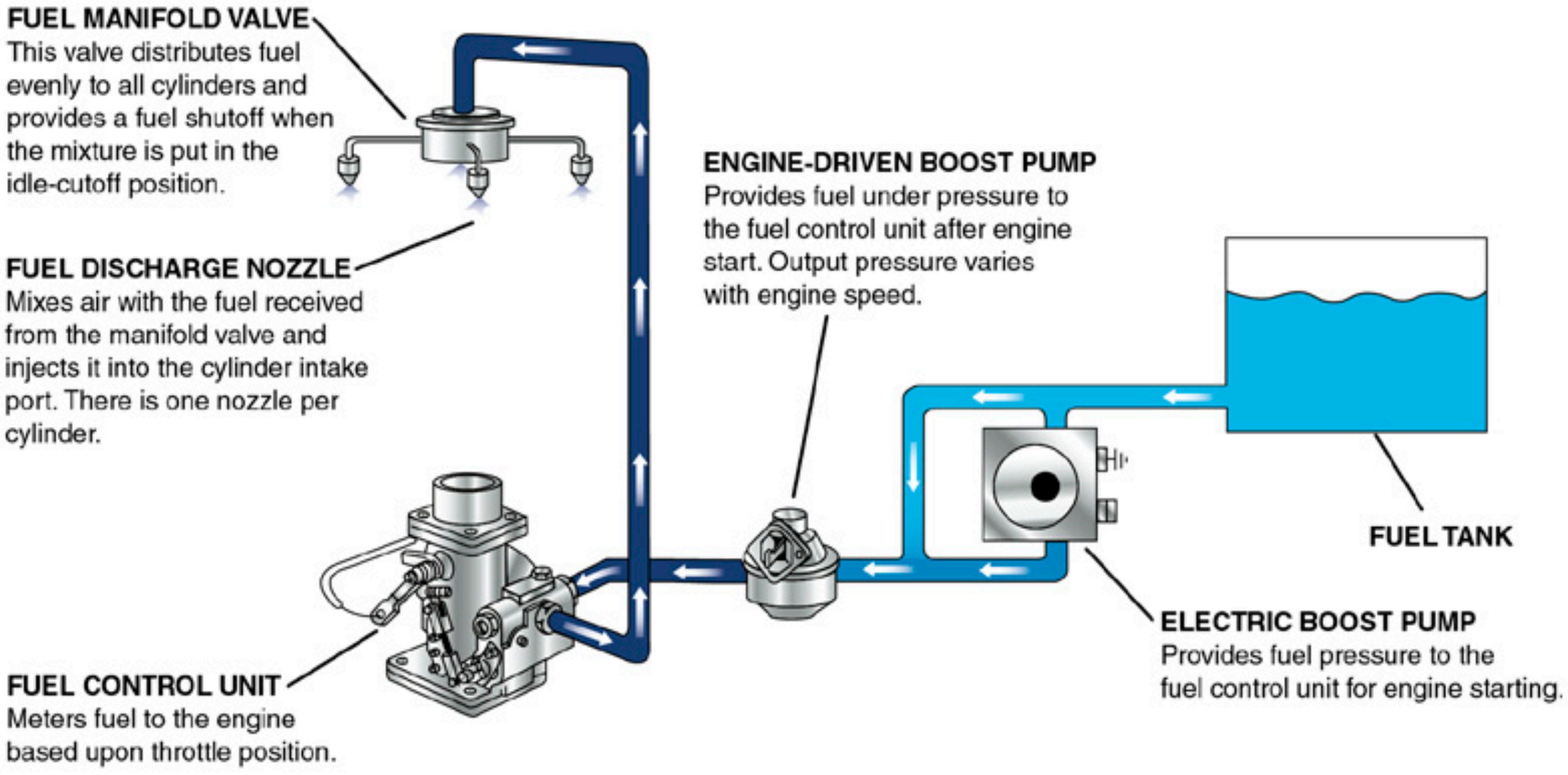
INTAKE AIR
Carburetor ice is most likely to occur when intake air temperature is below 21°C (70°F) and the relative humidity is above 80%.

CARBURETOR HEAT ON

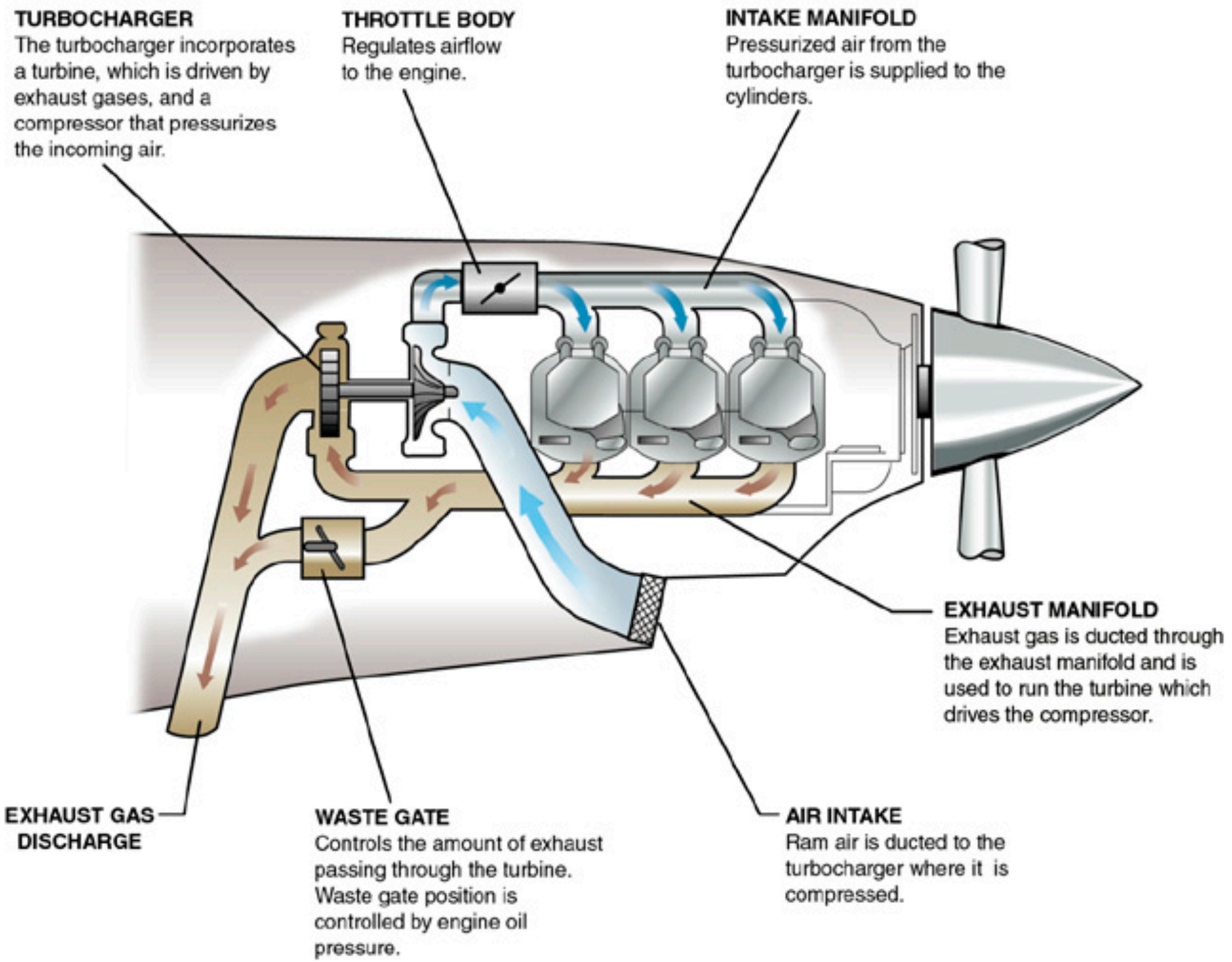


- Fuel injection
- Turbo charger

Fuel Injection



Turbocharger



Ignition System

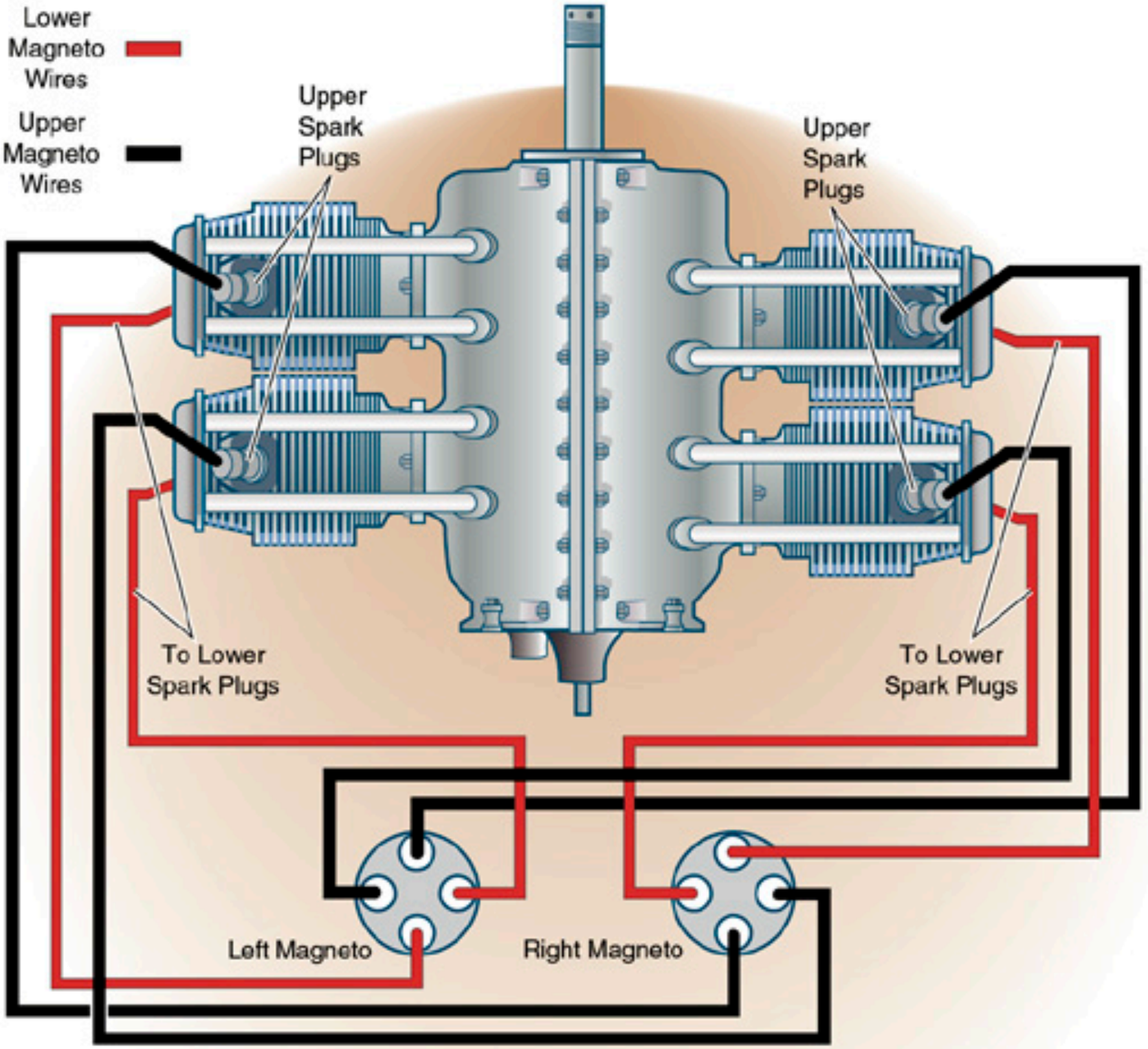
- Provides Spark
- Dual Redundant System

Aero Advantage

Magnetos

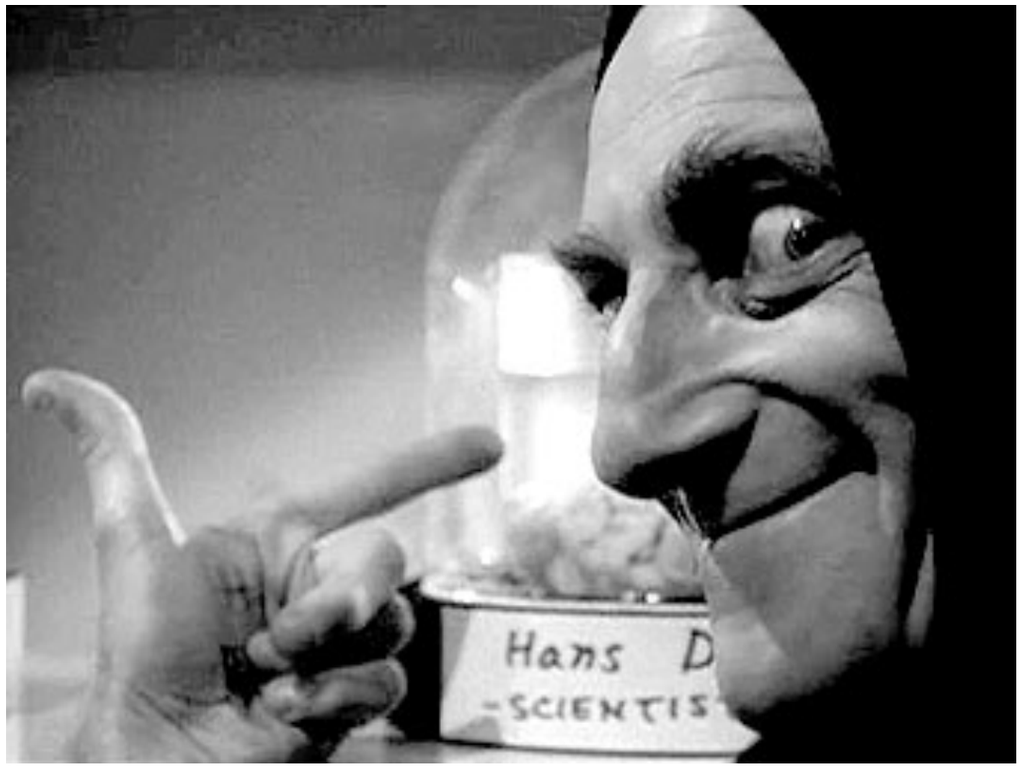
- Self contained system
- Moving magnets
- Ground check

Aero Advantage


Lower
Magneto
Wires
Upper
Magneto
Wires
Upper
Spark
Plugs
Upper
Spark
Plugs
To Lower
Spark Plugs
To Lower
Spark Plugs
Left Magneto
Right Magneto

Abnormal Combustion

- Detonation
- Preignition



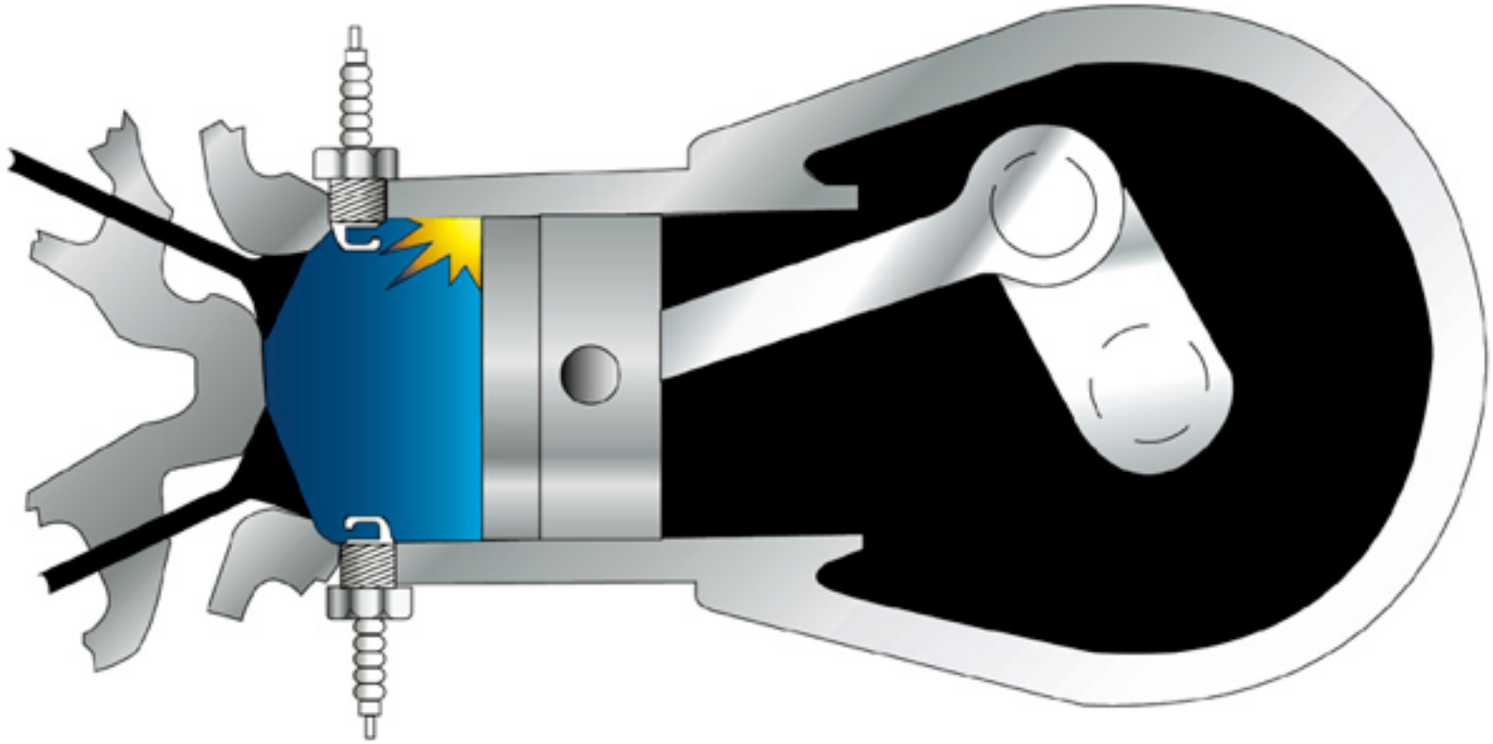
Aero Advantage

Detonation

- Engine Overheat
- Lower than Recommended Octane
- Excessive Leaning

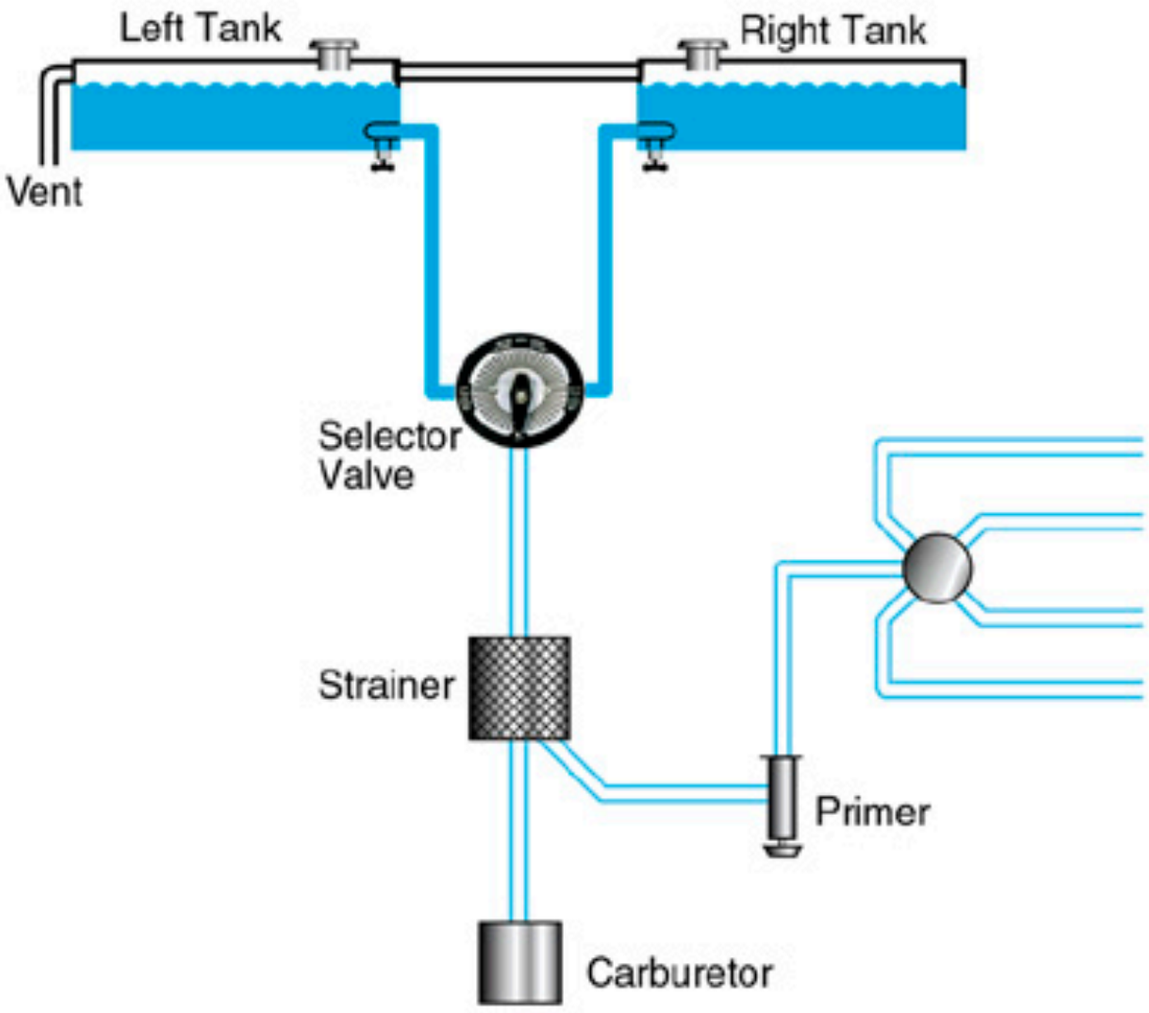
Preigntion

- Uncontrolled combustion

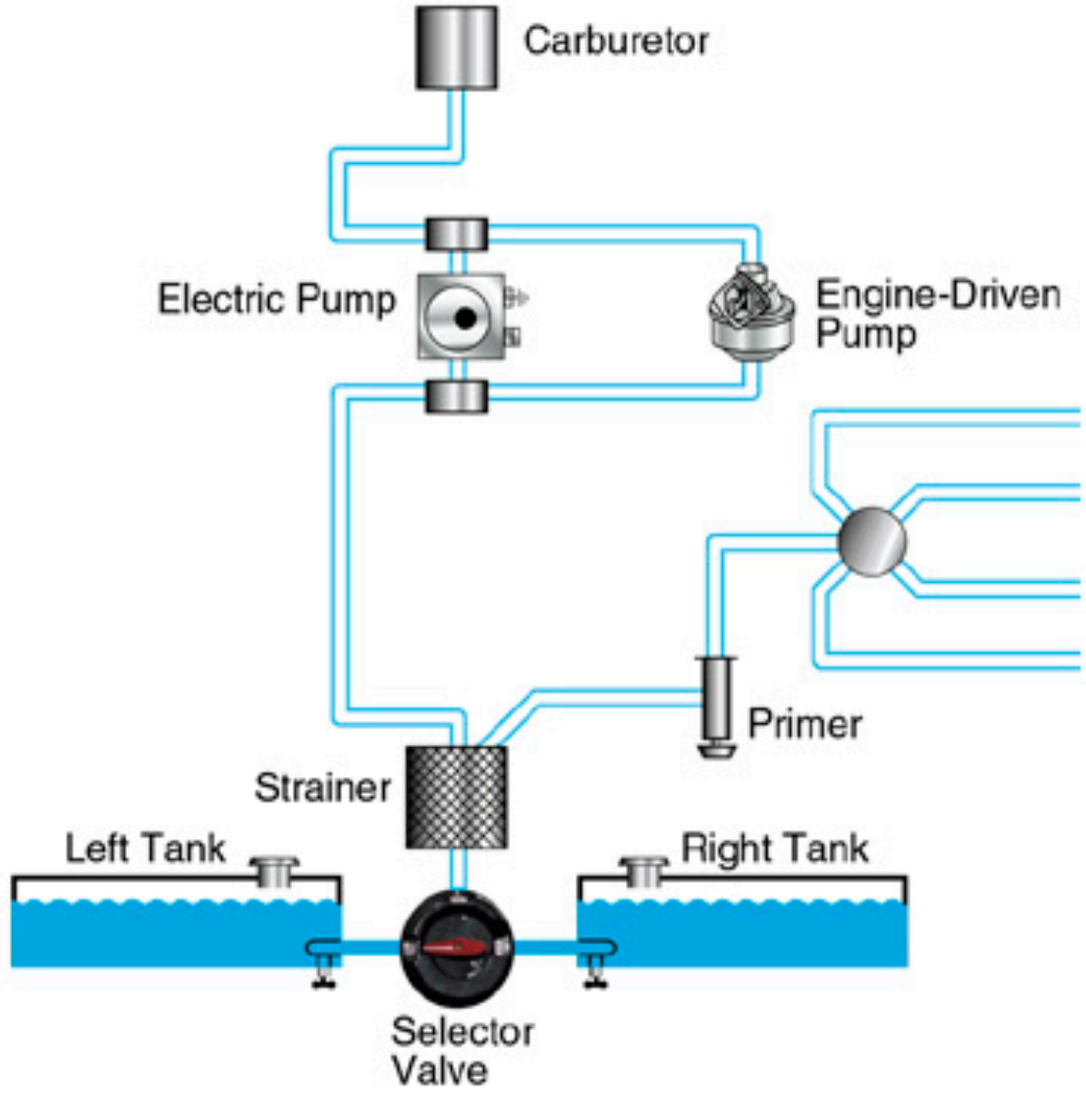


Aero Advantage

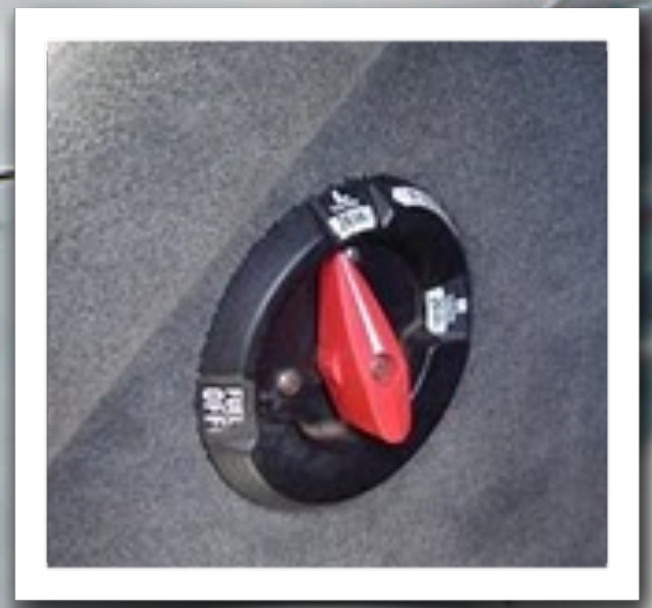
Fuel System



GRAVITY-FEED SYSTEM



FUEL-PUMP SYSTEM




LBS 30 60 90 120
E
F
GALS 5 10 15 20
FUEL QTY
LBS 30 60 90 120
E
F
GALS 5 10 15 20
FUEL QTY
LEFT TANK
RIGHT TANK


ALT
PRIMER
PHONE

Refueling

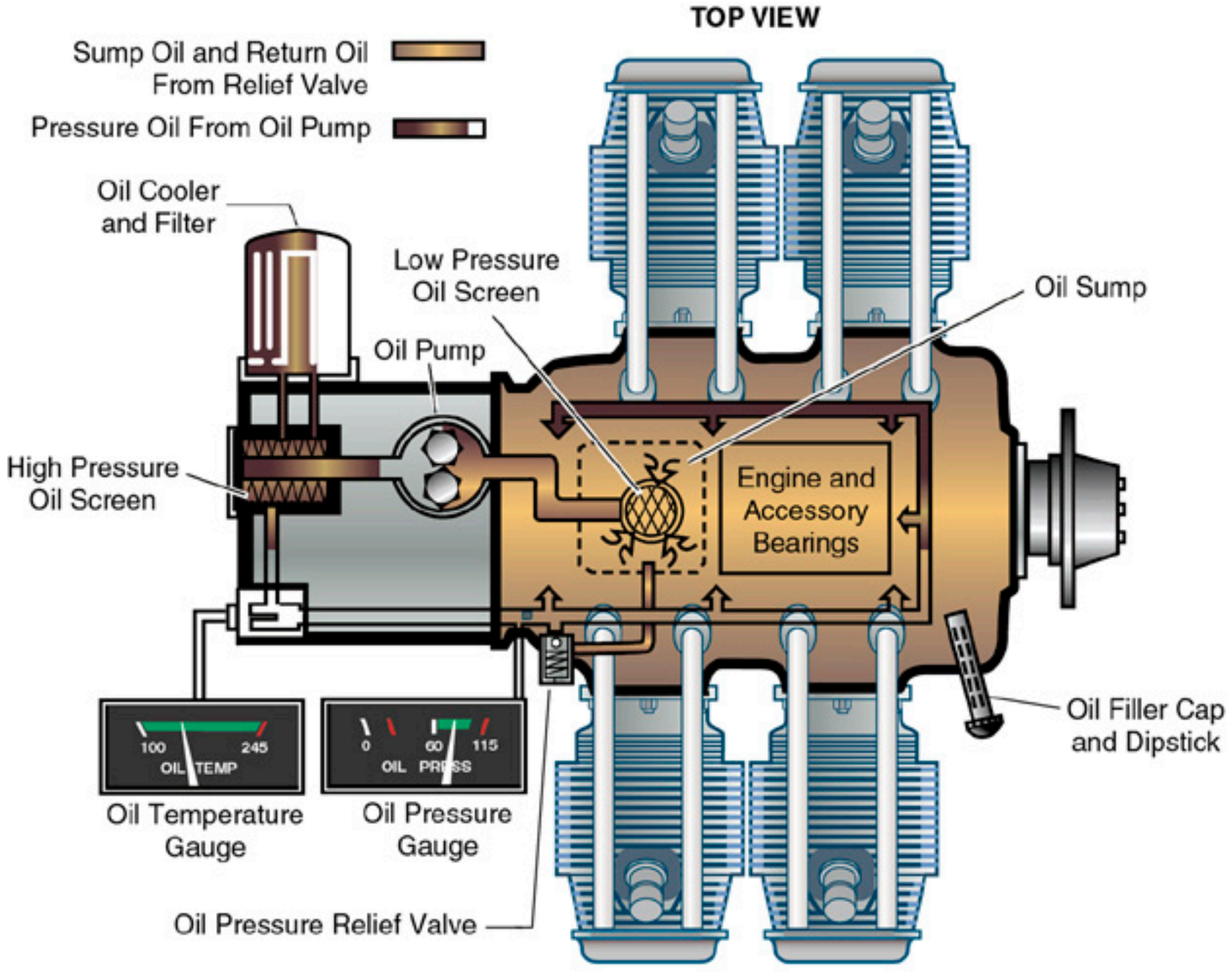
100LL Blue

Air in tanks can cause condensation and moisture

Oil System

- lubricates moving parts
- prevents high temperatures by reducing friction
- cools engine; carries heat away from the pistons
- removes contaminants from the engine
- improves efficiency; seals cylinder walls

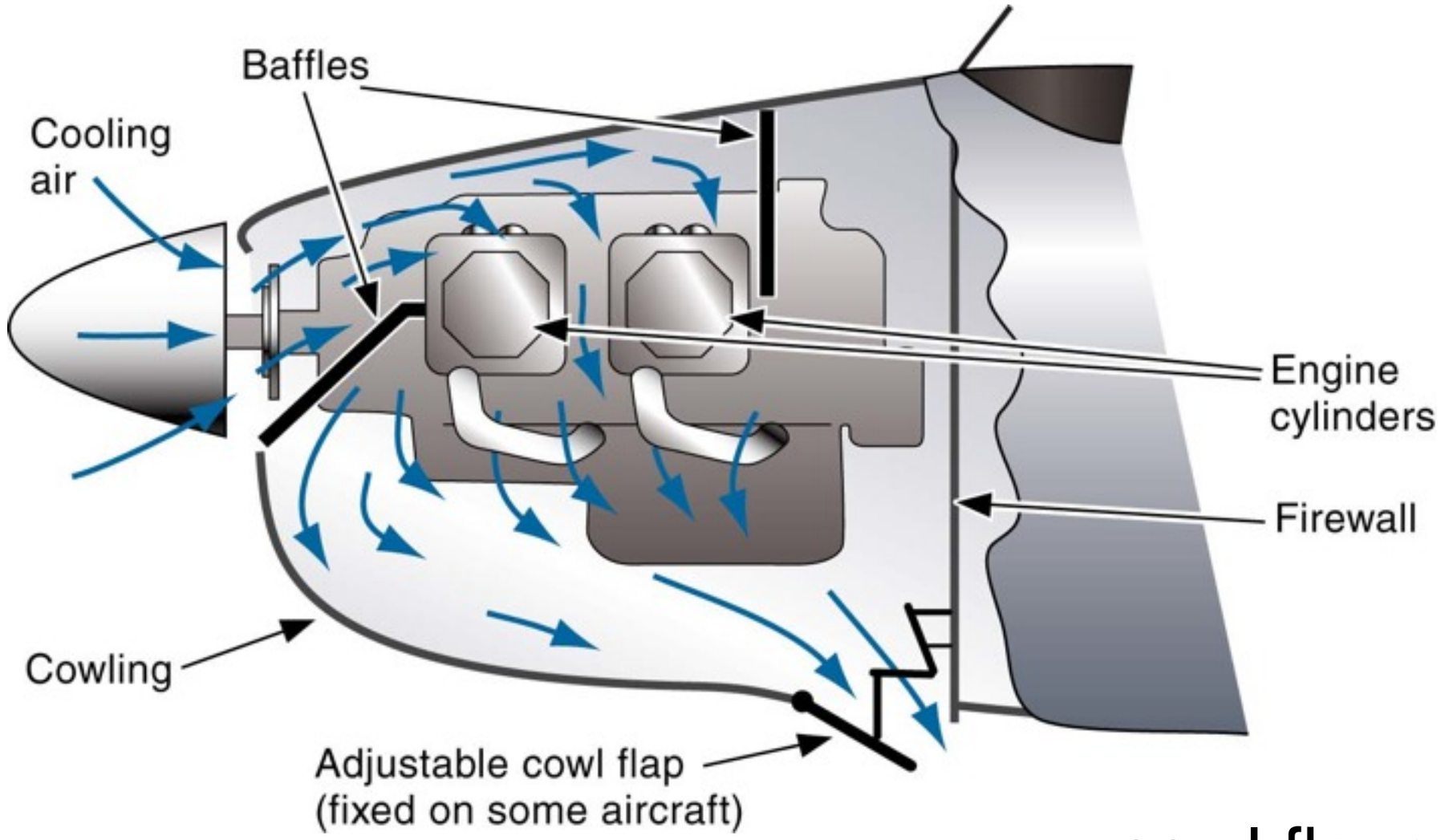
Aero Advantage

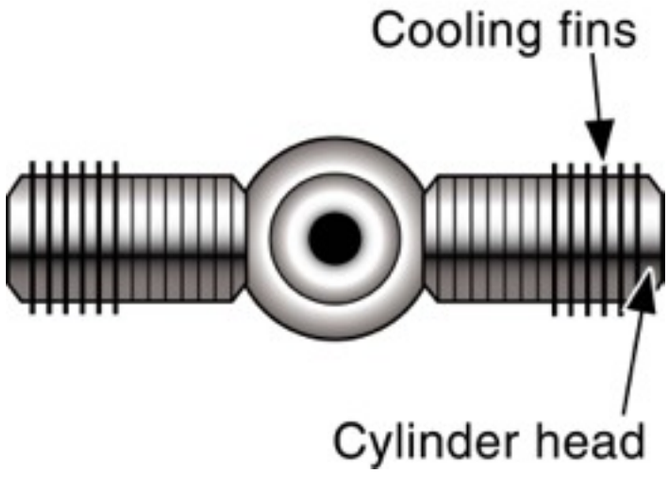

TOP VIEW
Sump Oil and Return Oil From Relief Valve
Pressure Oil From Oil Pump
Oil Cooler and Filter
Low Pressure Oil Screen
Oil Sump
Oil Pump
High Pressure Oil Screen
Engine and Accessory Bearings
100
245
OIL TEMP
0
60
115
OIL PRESS
Oil Temperature Gauge
Oil Pressure Gauge
Oil Filler Cap and Dipstick
Oil Pressure Relief Valve

Engine Cooling System

- burning fuel/air mixture and friction produces engine heat
- cooling system circulates outside air around engine components
- oil system and exhaust system are part of the cooling system

Aero Advantage


Baffles
Cooling air
Engine cylinders
Firewall
Cowling
Adjustable cowl flap (fixed on some aircraft)


Cooling fins
Cylinder head

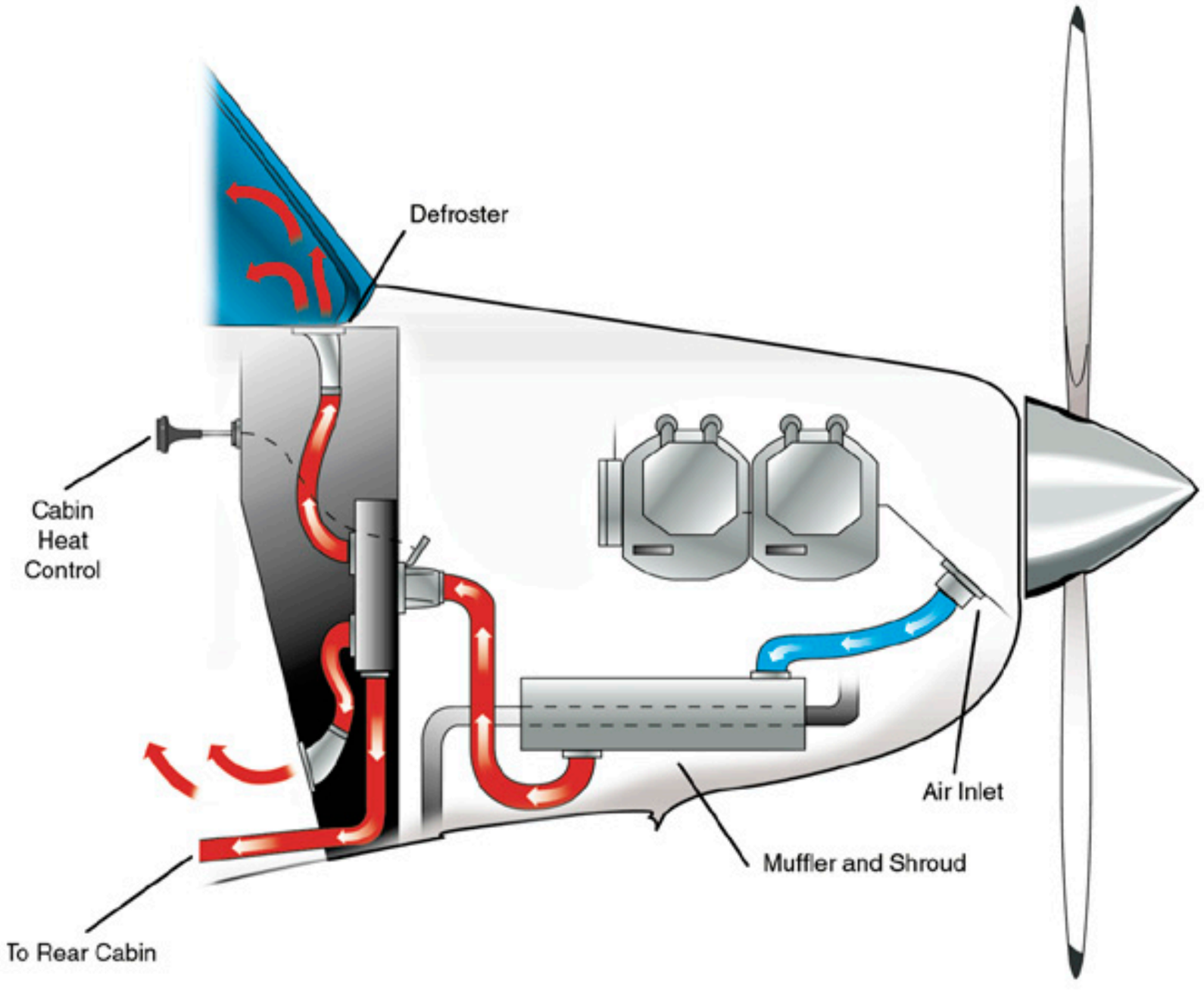
cowl flaps

Excess Temperatures

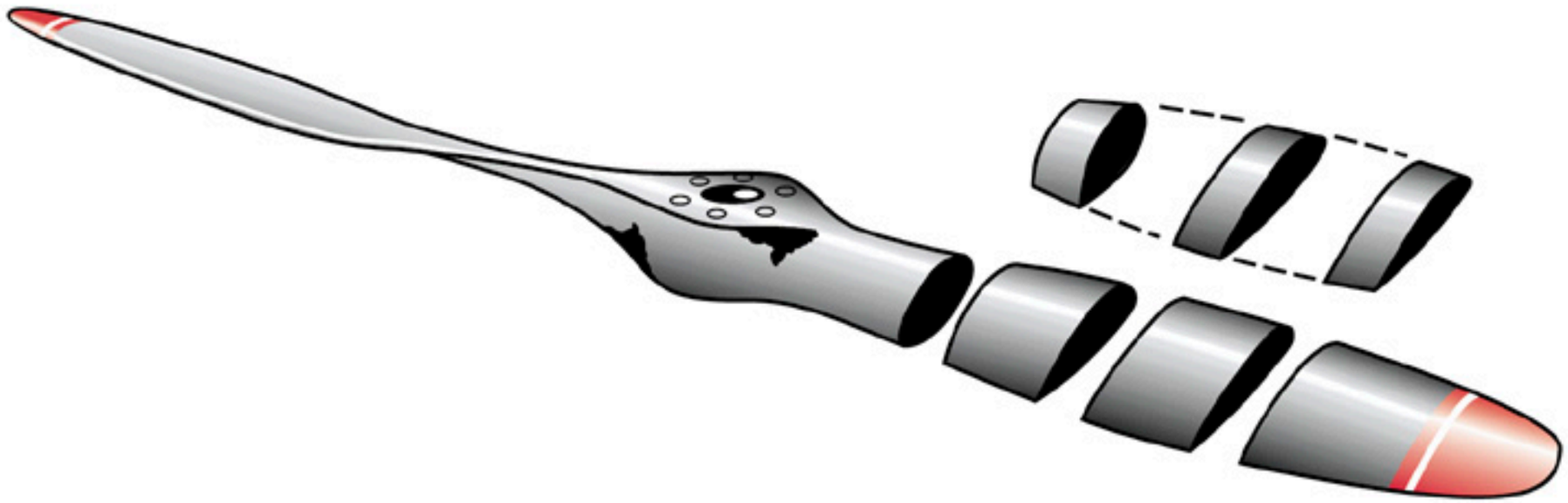
- High power
- Low Airspeed
- Incorrect fuel
- Mixture too lean
- Low oil level

Exhaust System

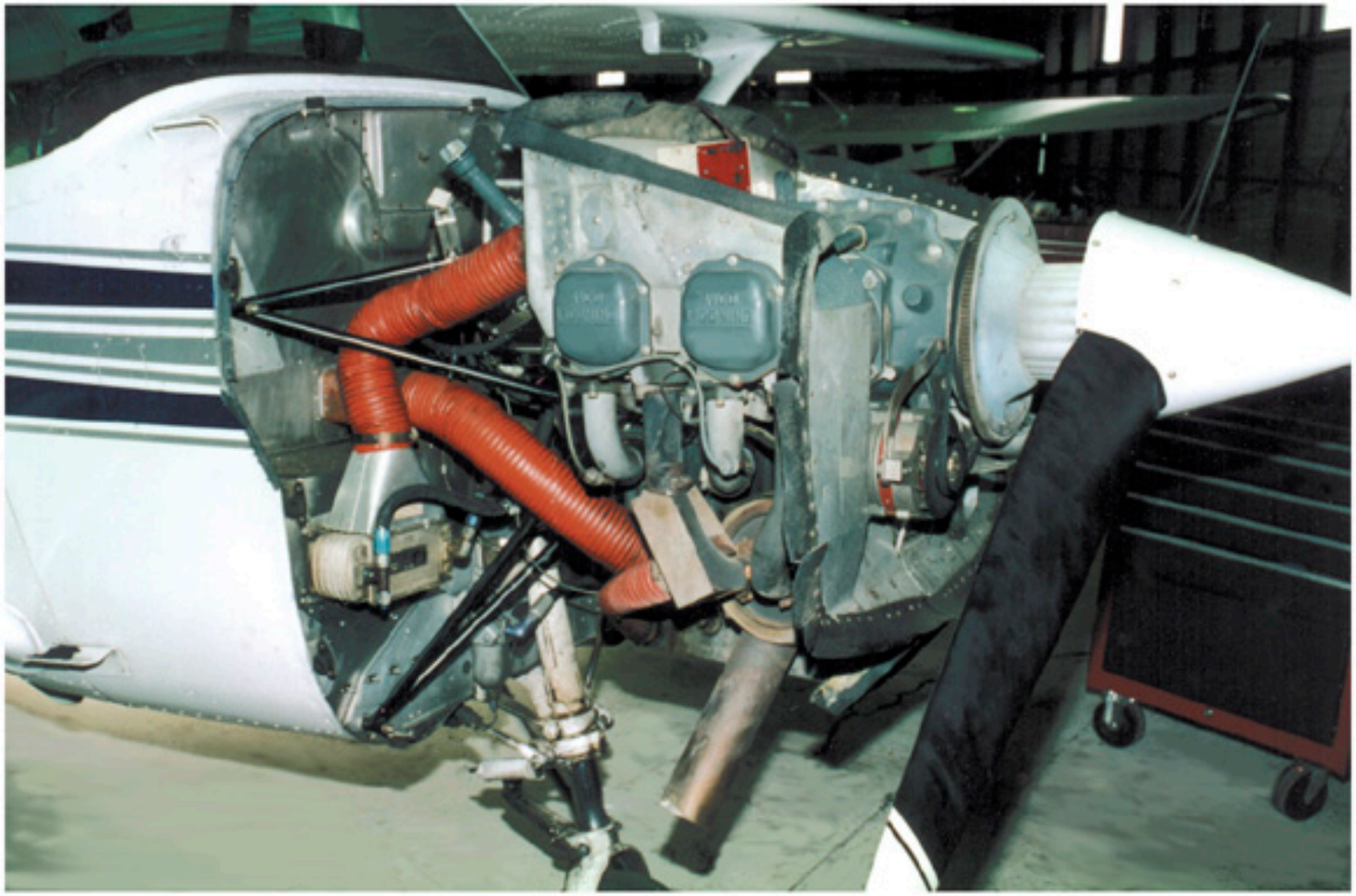
Heating System



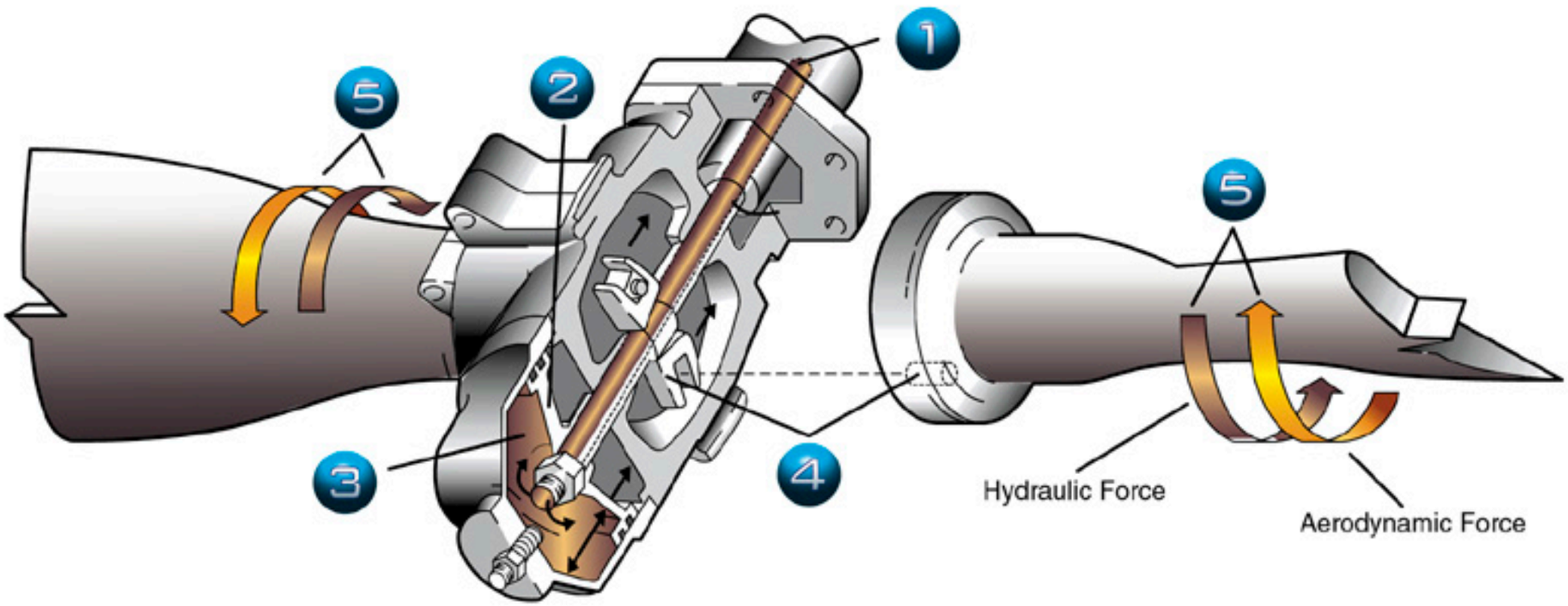
Propellor

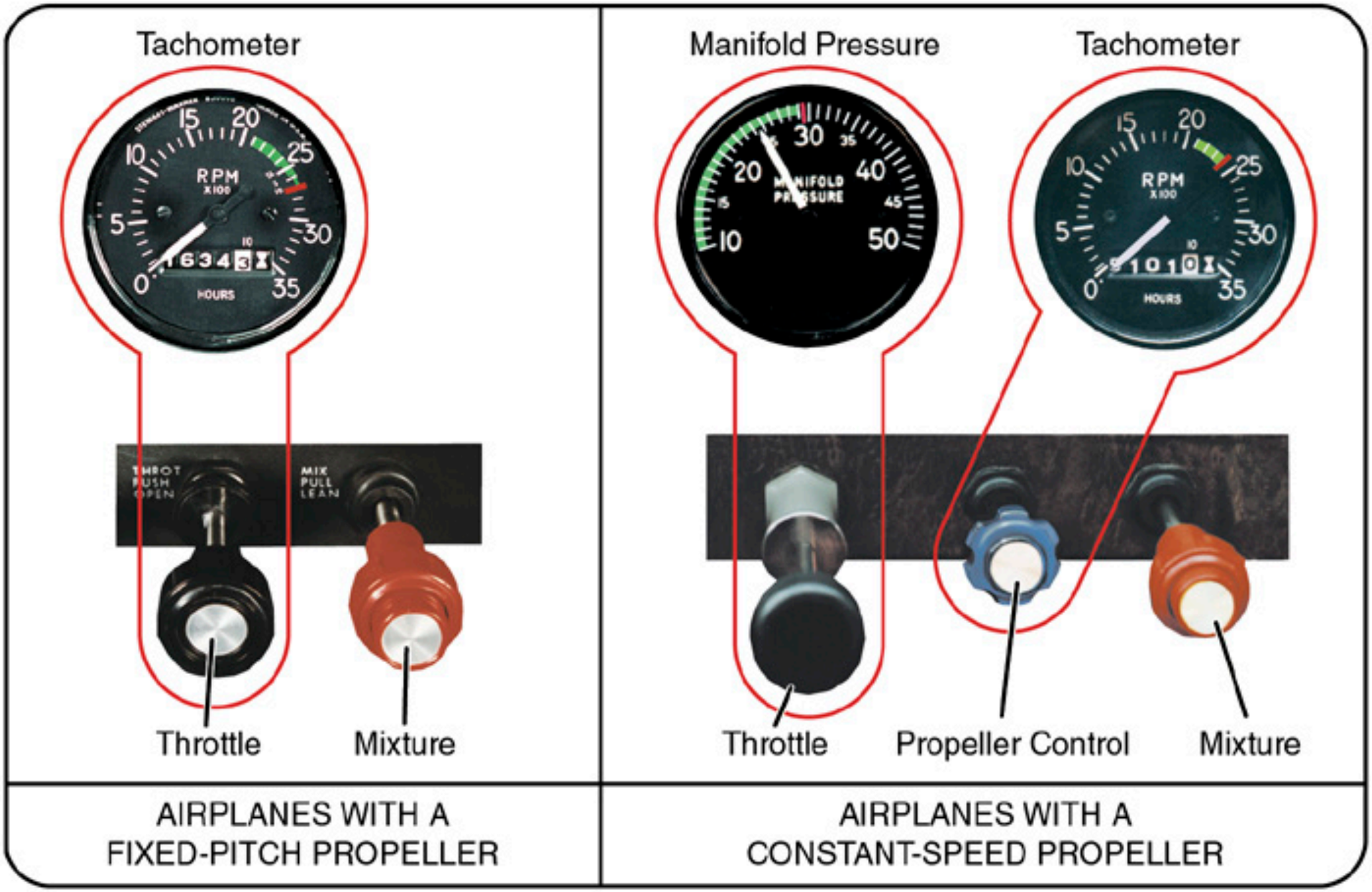


Fixed Pitch



Variable Pitched




Tachometer
RPM
X100
HOURS
Manifold Pressure
MANIFOLD PRESSURE
Tachometer
RPM
X100
HOURS
THROT
PUSH
OPEN
MIX
PULL
LEAN
Throttle
Mixture
Throttle
Propeller Control
Mixture
AIRPLANES WITH A
FIXED-PITCH PROPELLER
AIRPLANES WITH A
CONSTANT-SPEED PROPELLER

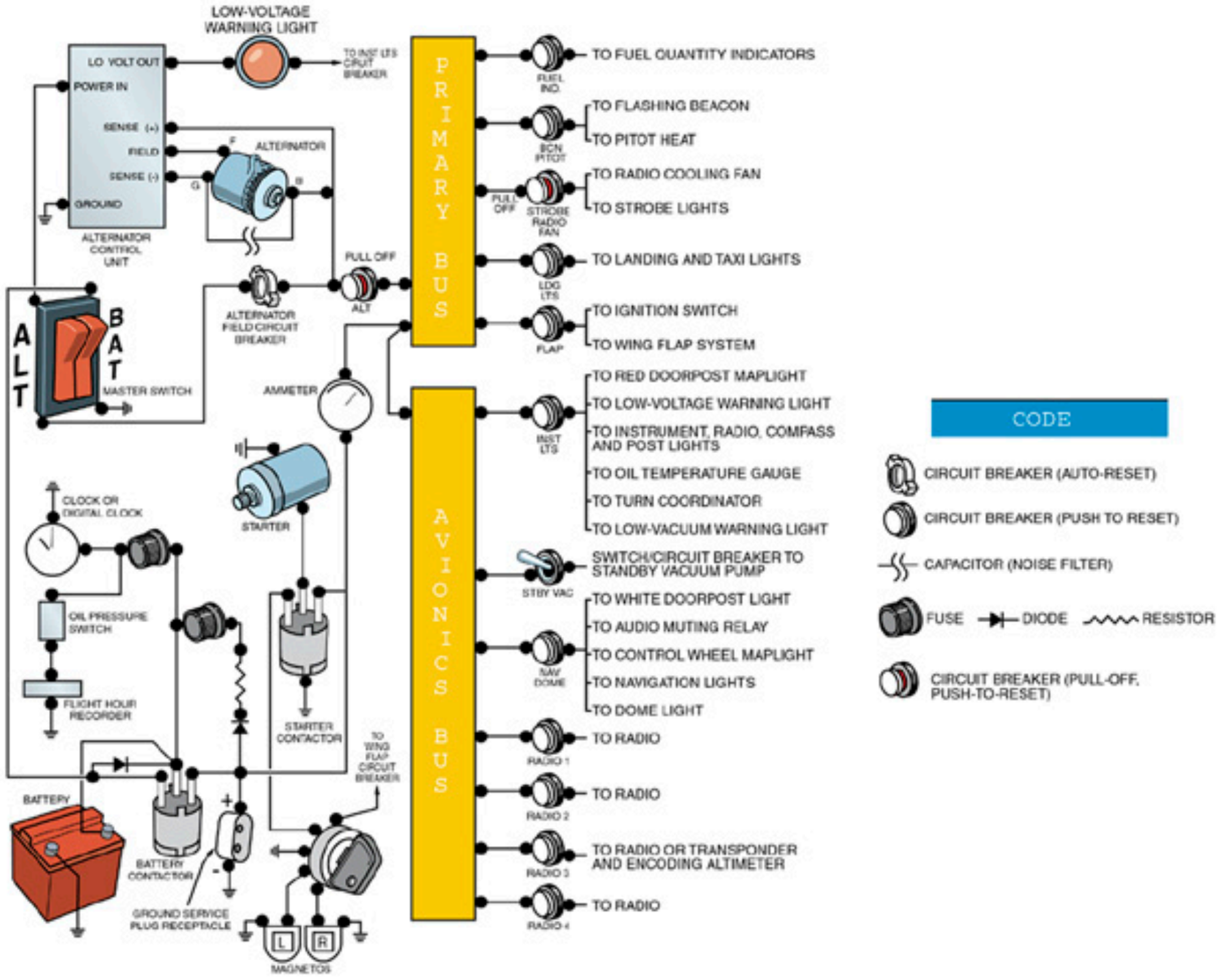
Constant Speed Propeller

- Control
  - Power, Throttle, Manifold Pressure
  - RPM, Propeller Control
- Efficiency
  - select blade angle for efficient operation
- Avoid low RPM and high Manifold Pressure

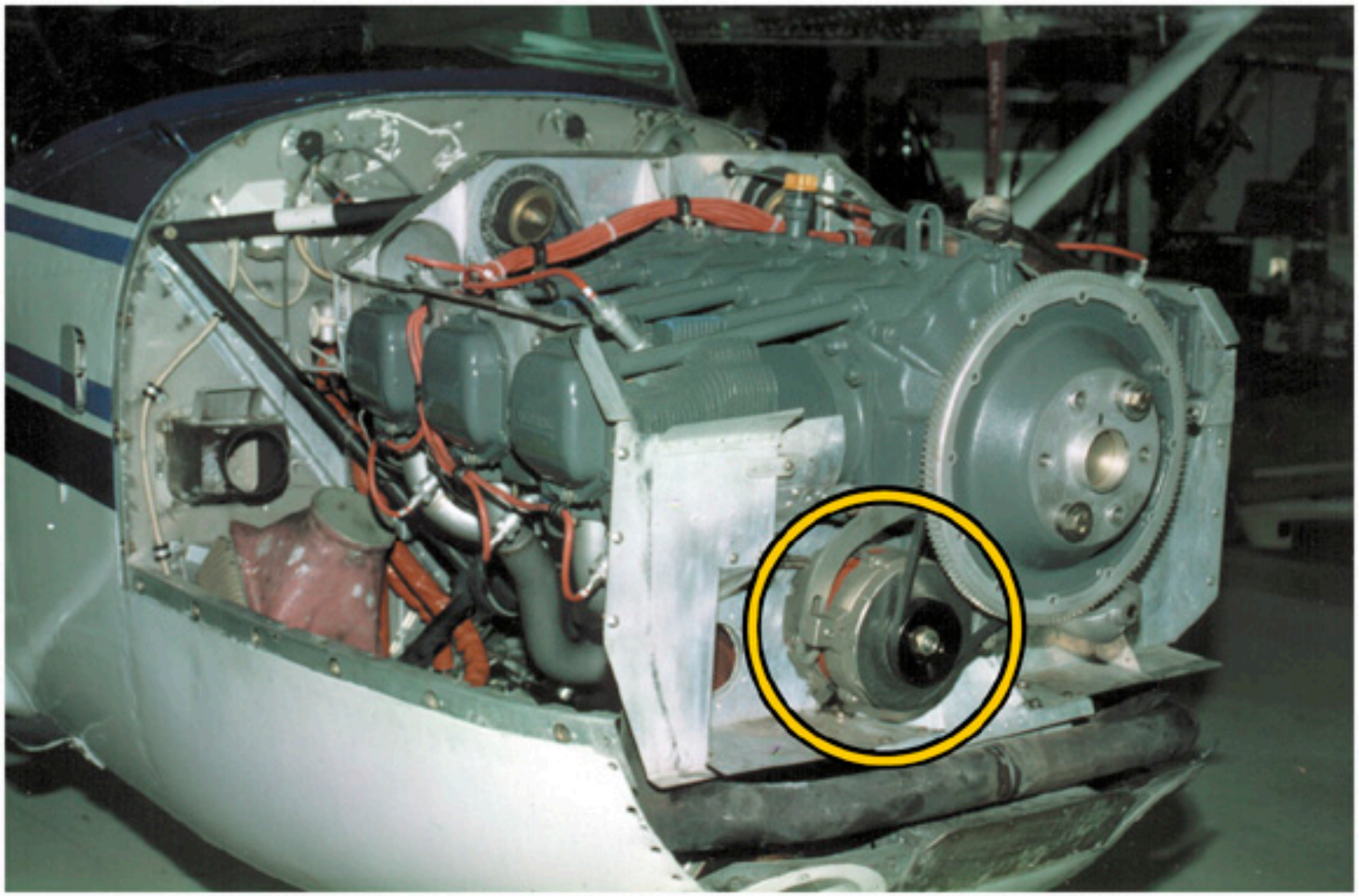
Aero Advantage

Electrical System

- Alternator
- Battery
- Ammeter
- Master Switch
- Circuit Breakers


LOW-VOLTAGE WARNING LIGHT
TO INST LTS CRCUIT BREAKER
LO VOLT OUT
POWER IN
SENSE (+)
FIELD
SENSE (-)
GROUND
ALTERNATOR CONTROL UNIT
ALTERNATOR
F
G
B
PULL OFF
ALT
ALTERNATOR FIELD CIRCUIT BREAKER
ALT
BAT
MASTER SWITCH
AMMETER
STARTER
CLOCK OR DIGITAL CLOCK
OIL PRESSURE SWITCH
FLIGHT HOUR RECORDER
STARTER CONTACTOR
TO WING FLAP CIRCUIT BREAKER
BATTERY
BATTERY CONTACTOR
GROUND SERVICE PLUG RECEPTACLE
L
R
MAGNETOS
PRIMARY BUS
AVIONICS BUS
FUEL IND.
TO FUEL QUANTITY INDICATORS
BCN PITOT
TO FLASHING BEACON
TO PITOT HEAT
PULL OFF
STROBE RADIO FAN
TO RADIO COOLING FAN
TO STROBE LIGHTS
LDG LTS
TO LANDING AND TAXI LIGHTS
FLAP
TO IGNITION SWITCH
TO WING FLAP SYSTEM
INST LTS
TO RED DOORPOST MAPLIGHT
TO LOW-VOLTAGE WARNING LIGHT
TO INSTRUMENT, RADIO, COMPASS AND POST LIGHTS
TO OIL TEMPERATURE GAUGE
TO TURN COORDINATOR
TO LOW-VACUUM WARNING LIGHT
STBY VAC
SWITCH/CIRCUIT BREAKER TO STANDBY VACUUM PUMP
NAV DOME
TO WHITE DOORPOST LIGHT
TO AUDIO MUTING RELAY
TO CONTROL WHEEL MAPLIGHT
TO NAVIGATION LIGHTS
TO DOME LIGHT
RADIO 1
TO RADIO
RADIO 2
TO RADIO
RADIO 3
TO RADIO OR TRANSPONDER AND ENCODING ALTIMETER
RADIO 4
TO RADIO
CODE
CIRCUIT BREAKER (AUTO-RESET)
CIRCUIT BREAKER (PUSH TO RESET)
CAPACITOR (NOISE FILTER)
FUSE
DIODE
RESISTOR
CIRCUIT BREAKER (PULL-OFF, PUSH-TO-RESET)

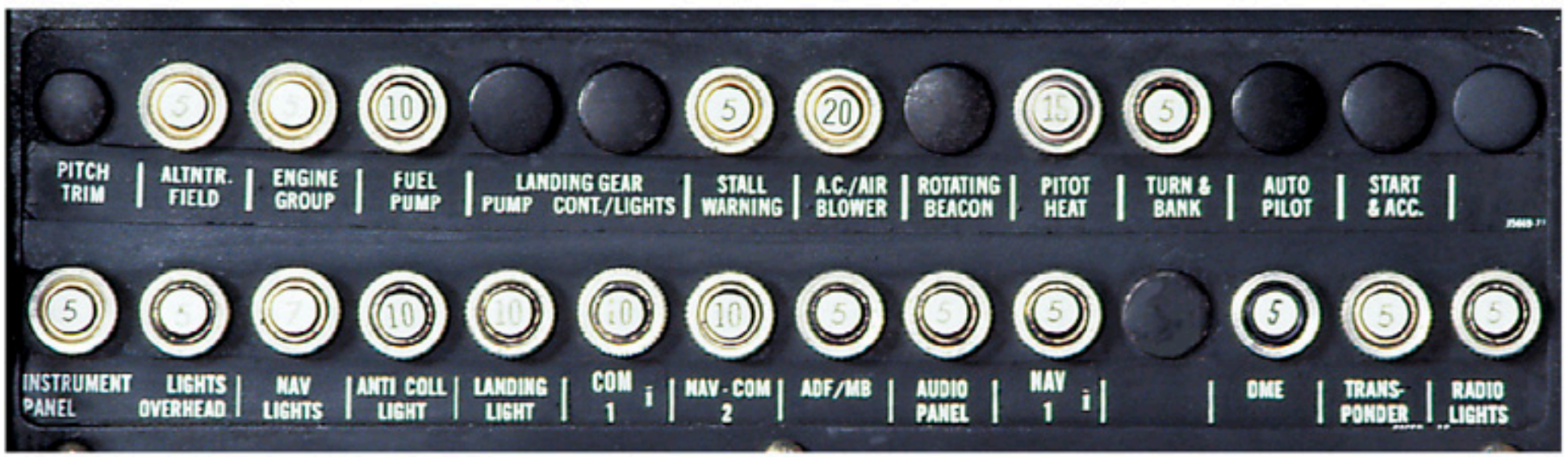
Alternator




60
0
60
AMPERES


0
20
40
60
ALT
AMPERES


ON
ALT
ON
BAT
MASTER


5
5
10
5
20
15
5
PITCH TRIM
ALTNTR. FIELD
ENGINE GROUP
FUEL PUMP
LANDING GEAR PUMP
LANDING GEAR CONT./LIGHTS
STALL WARNING
A.C./AIR BLOWER
ROTATING BEACON
PITOT HEAT
TURN & BANK
AUTO PILOT
START & ACC.
5
10
10
10
10
5
5
5
5
5
5
INSTRUMENT PANEL
LIGHTS OVERHEAD
NAV LIGHTS
ANTI COLL LIGHT
LANDING LIGHT
COM 1
NAV - COM 2
ADF/MB
AUDIO PANEL
NAV 1
DME
TRANS-PONDER
RADIO LIGHTS

Review

- As airplanes climb to you enrich or lean the mixture?
- What is your first indication of carburetor icing?
- Describe two functions of the oil system

Aero Advantage

- True/False, Avoid high manifold pressure and low engine RPM in engine with constant speed propeller

- Immediately after engine start you notice high current. Is this normal?