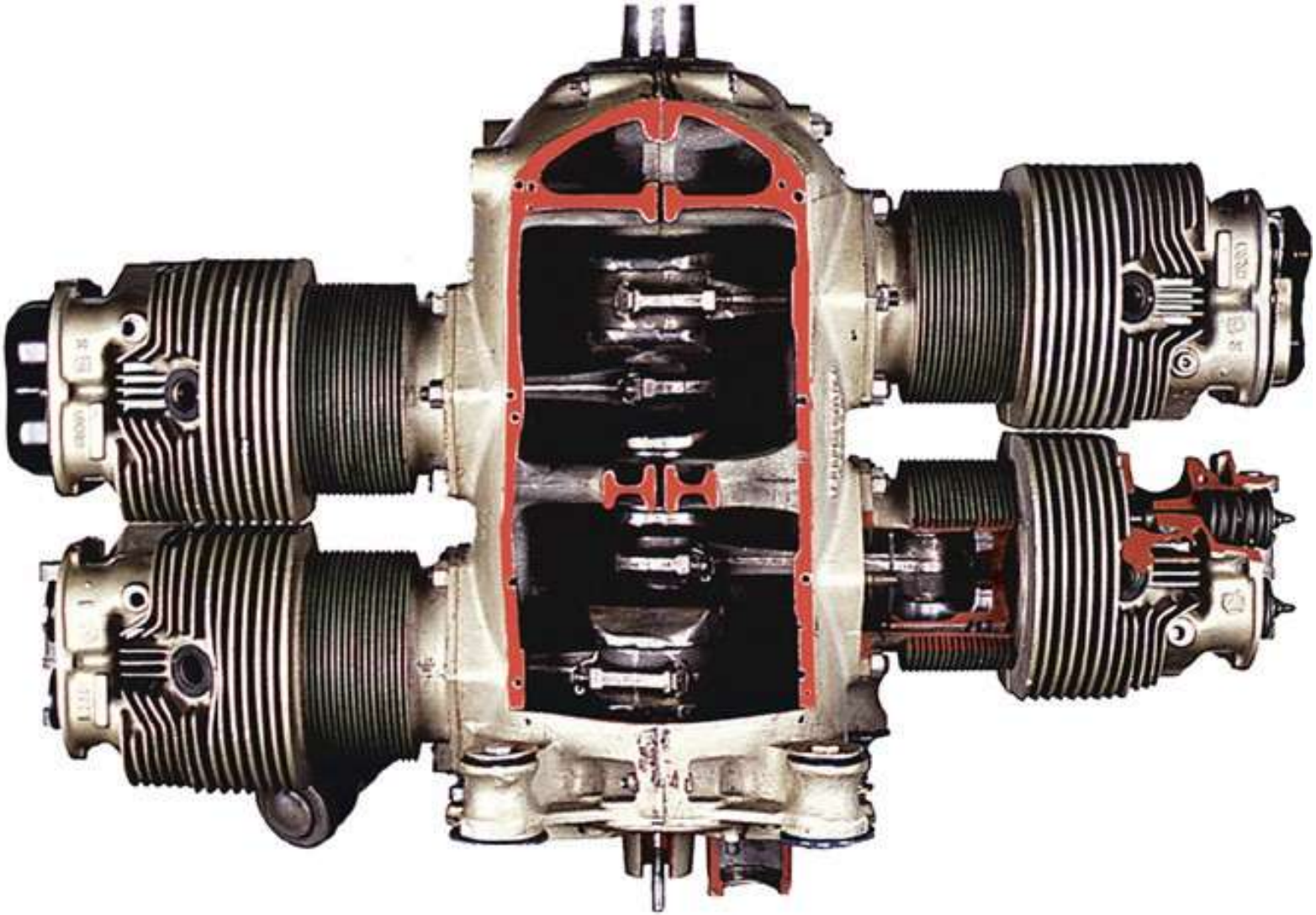
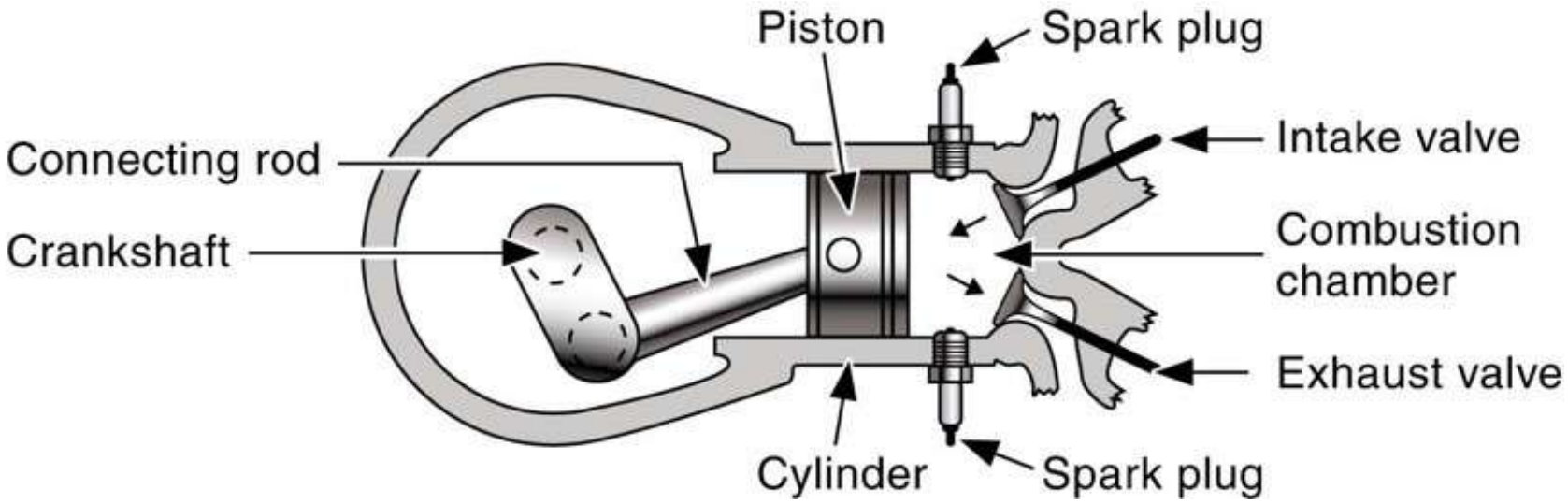
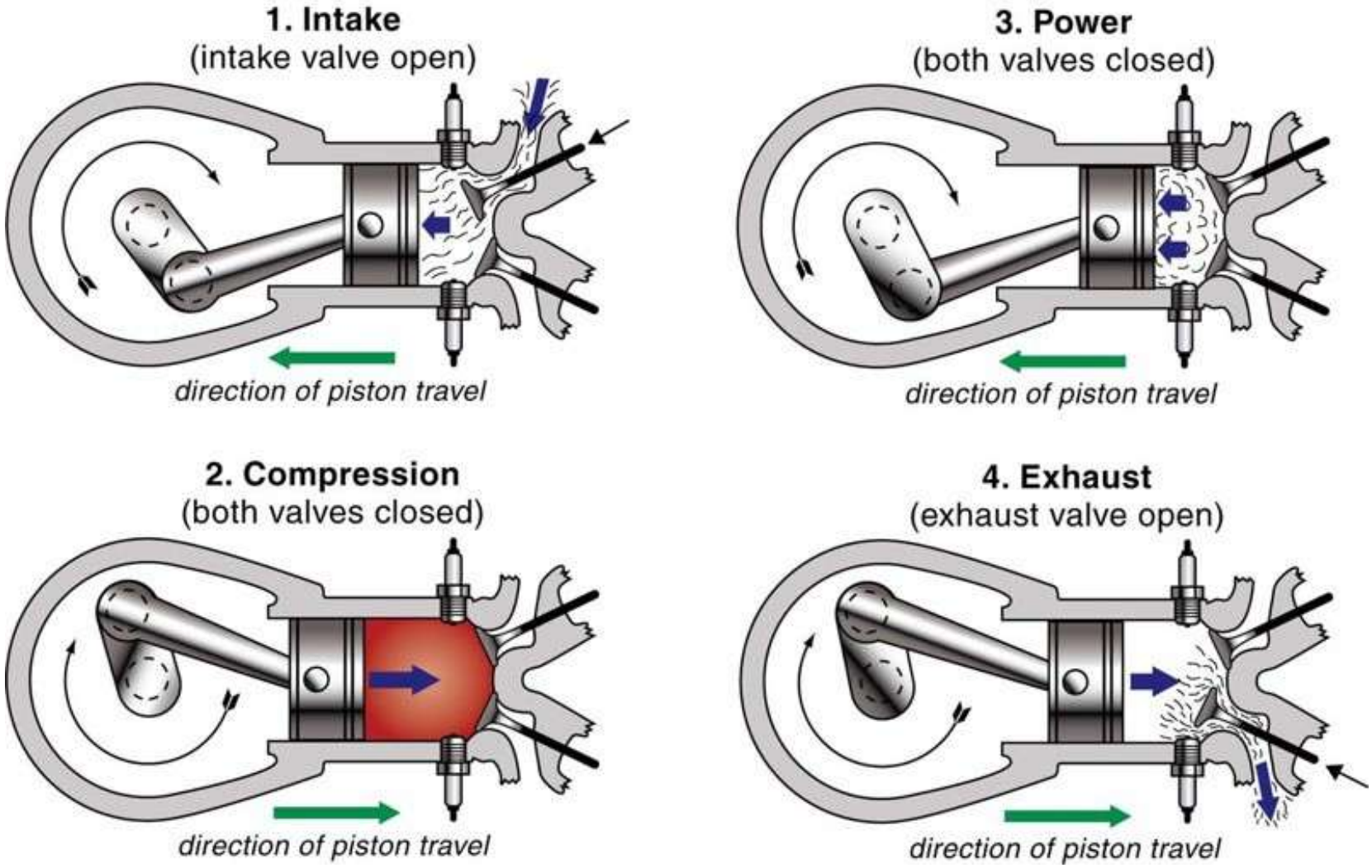
Powerplant and Related Systems

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

Reciprocating Engine




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



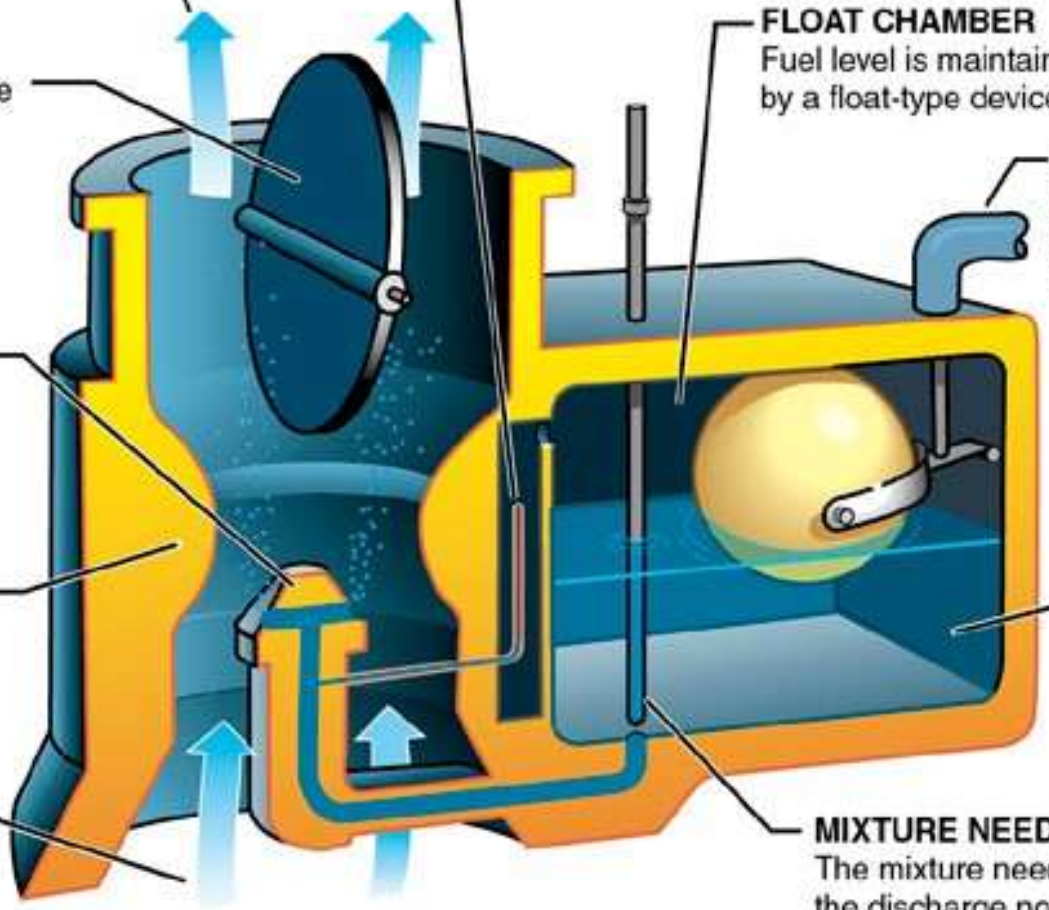
four strokes of the reciprocating engine

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



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.

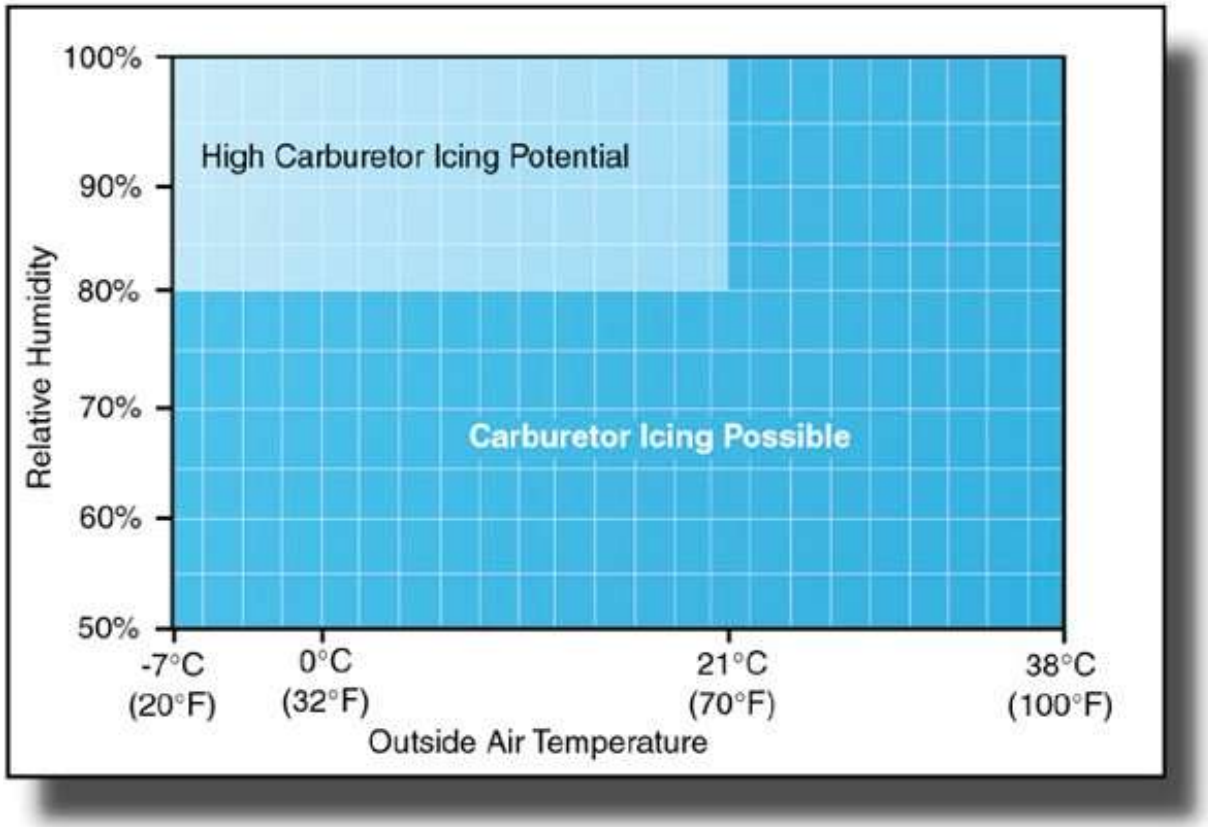
MIXTURE NEEDLE
The mixture needle controls fuel to the discharge nozzle. Mixture needle position can be adjusted using the mixture control.

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

Carburetor Ice

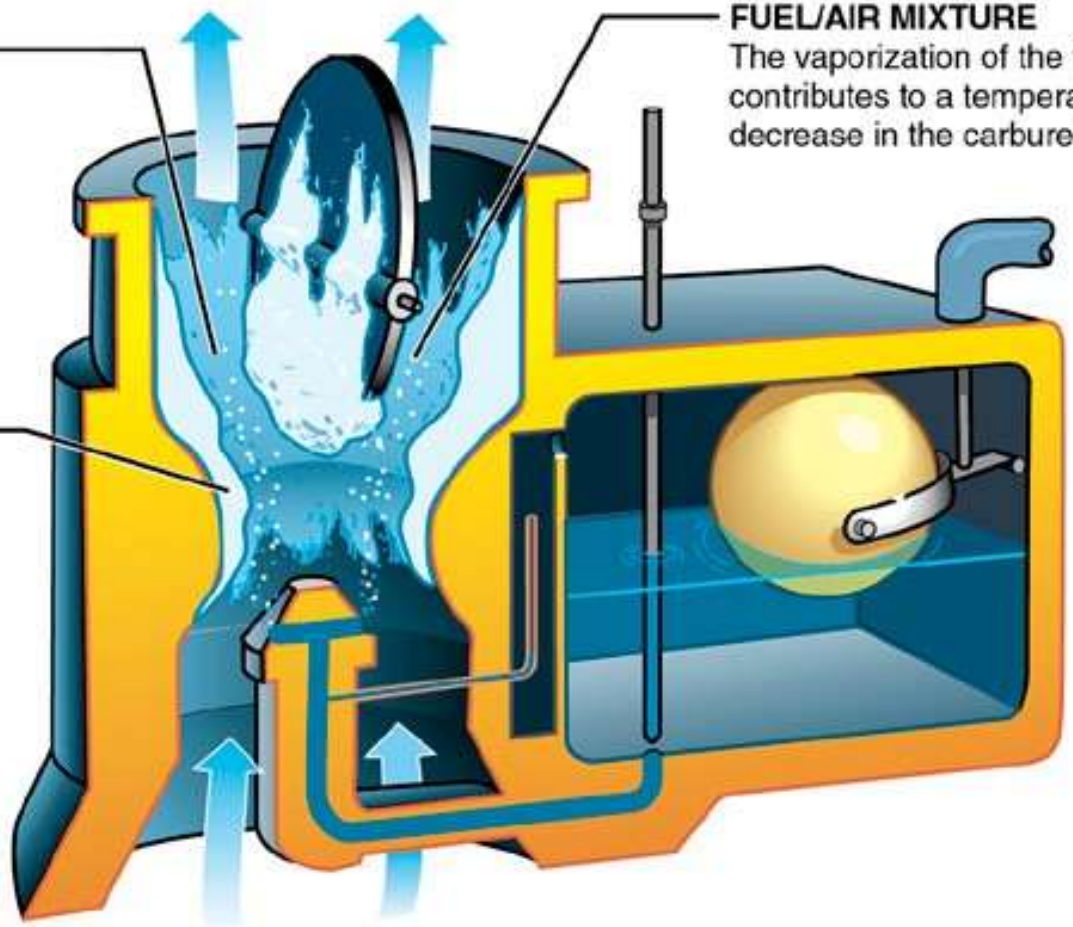
- Disadvantage of float type carburetor



Aero Advantage

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

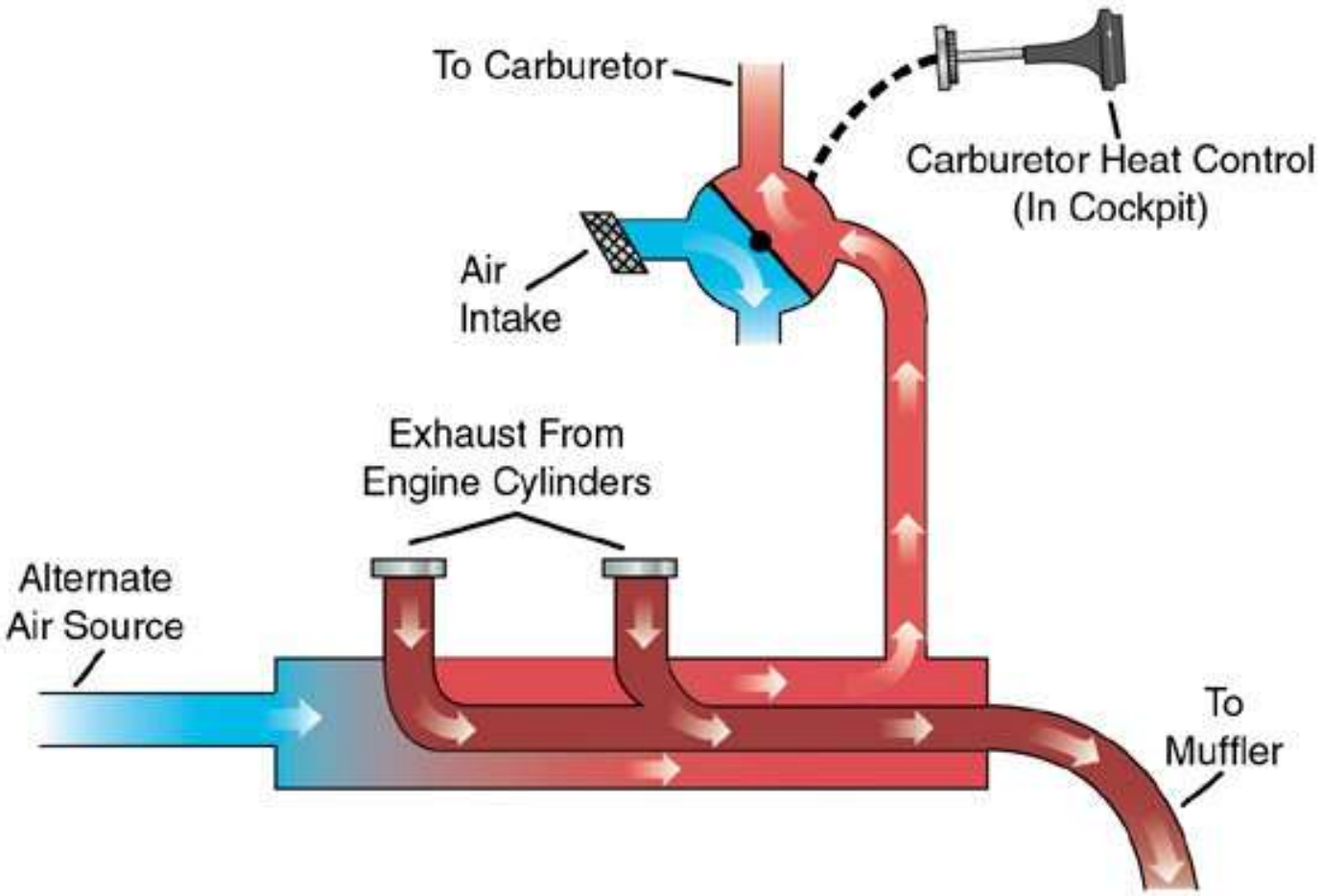
VENTURI
The reduced air pressure at the venturi throat creates a temperature decrease.



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

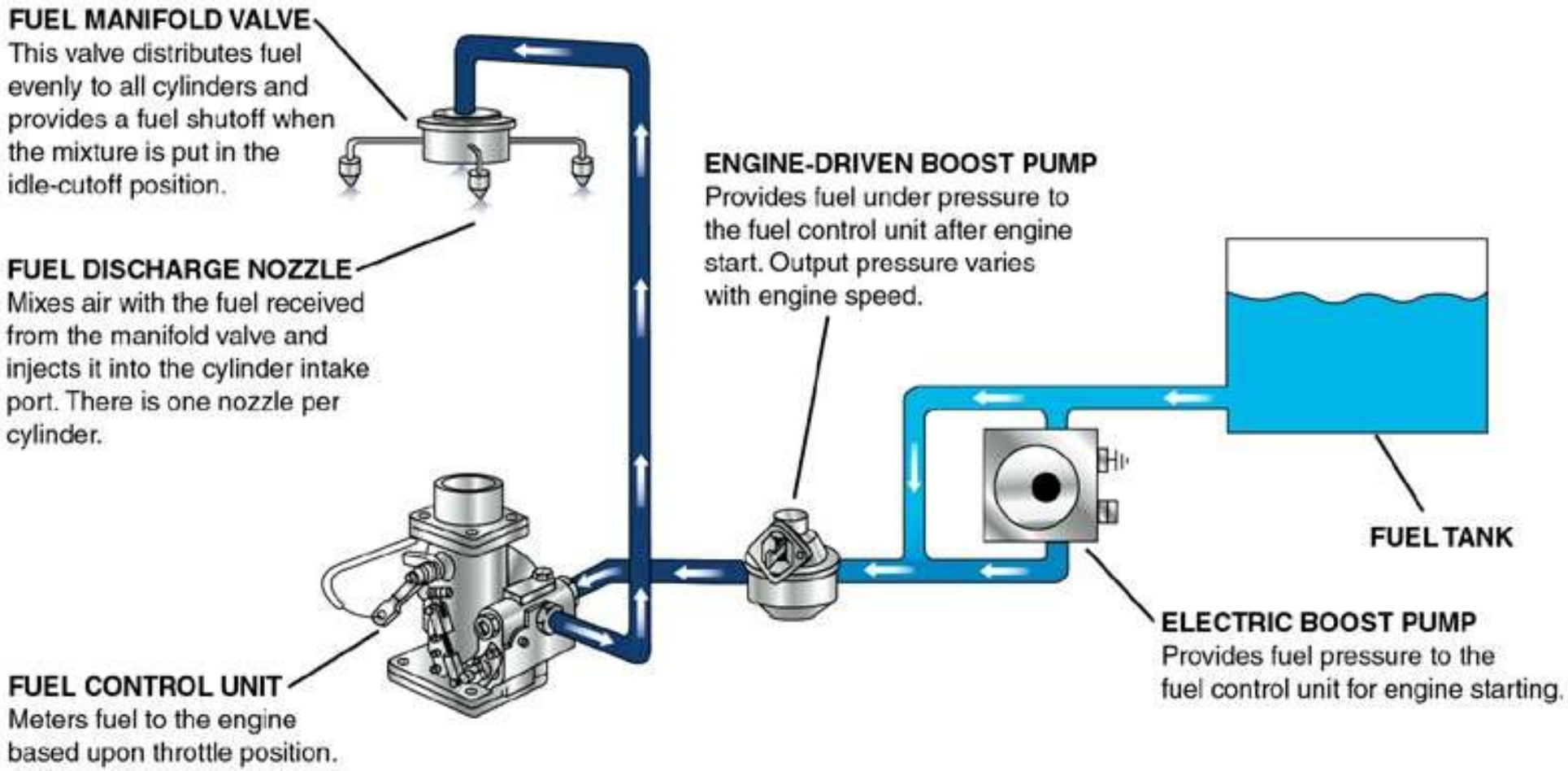
INTAKE AIR
Carburetor ice is most likely to occur when intake air temperature is below 21°C (70°F) and the relative humidity is above 80%.

CARBURETOR HEAT ON

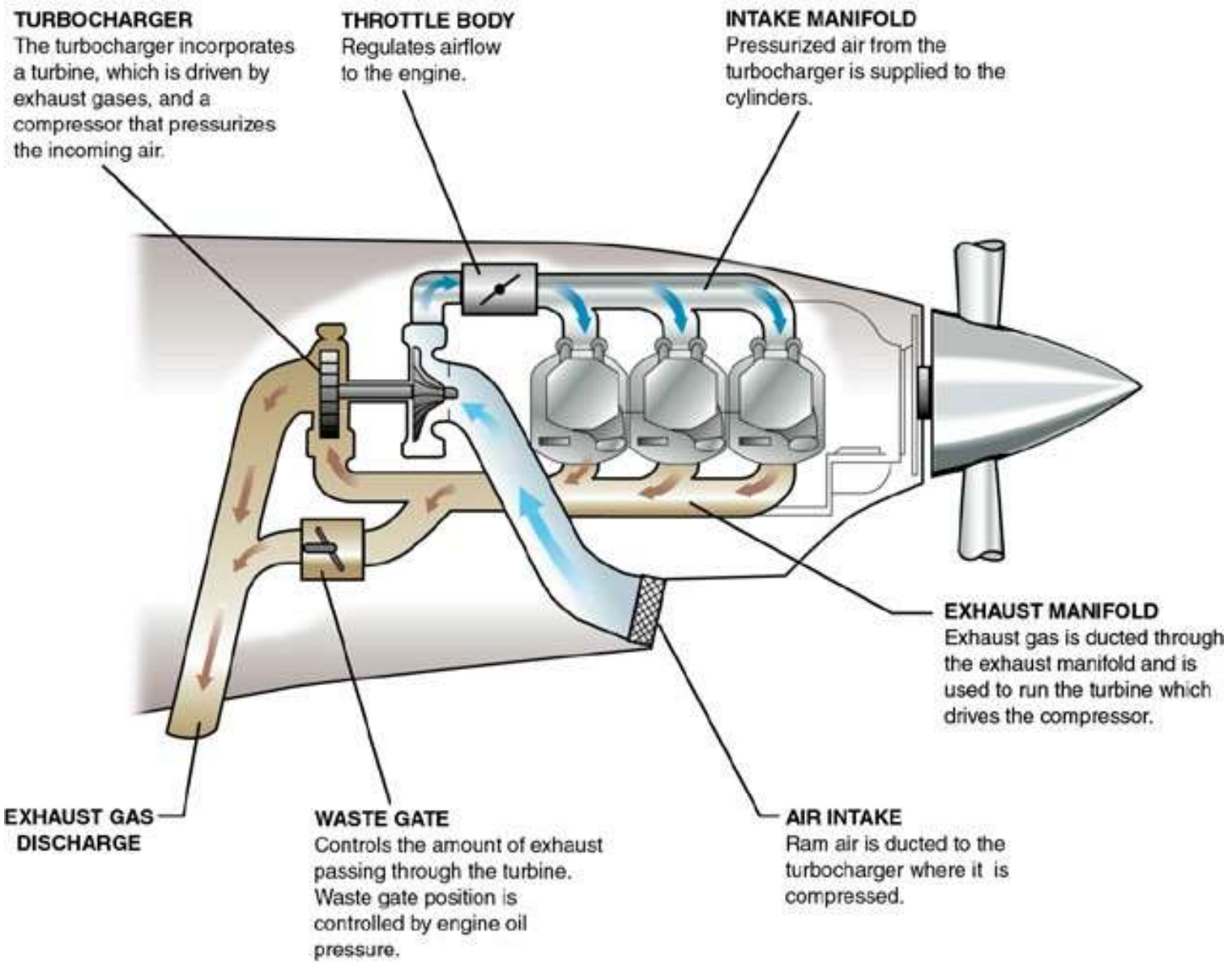


- Fuel injection
- Turbo charger

Fuel Injection



Turbocharger



Ignition System

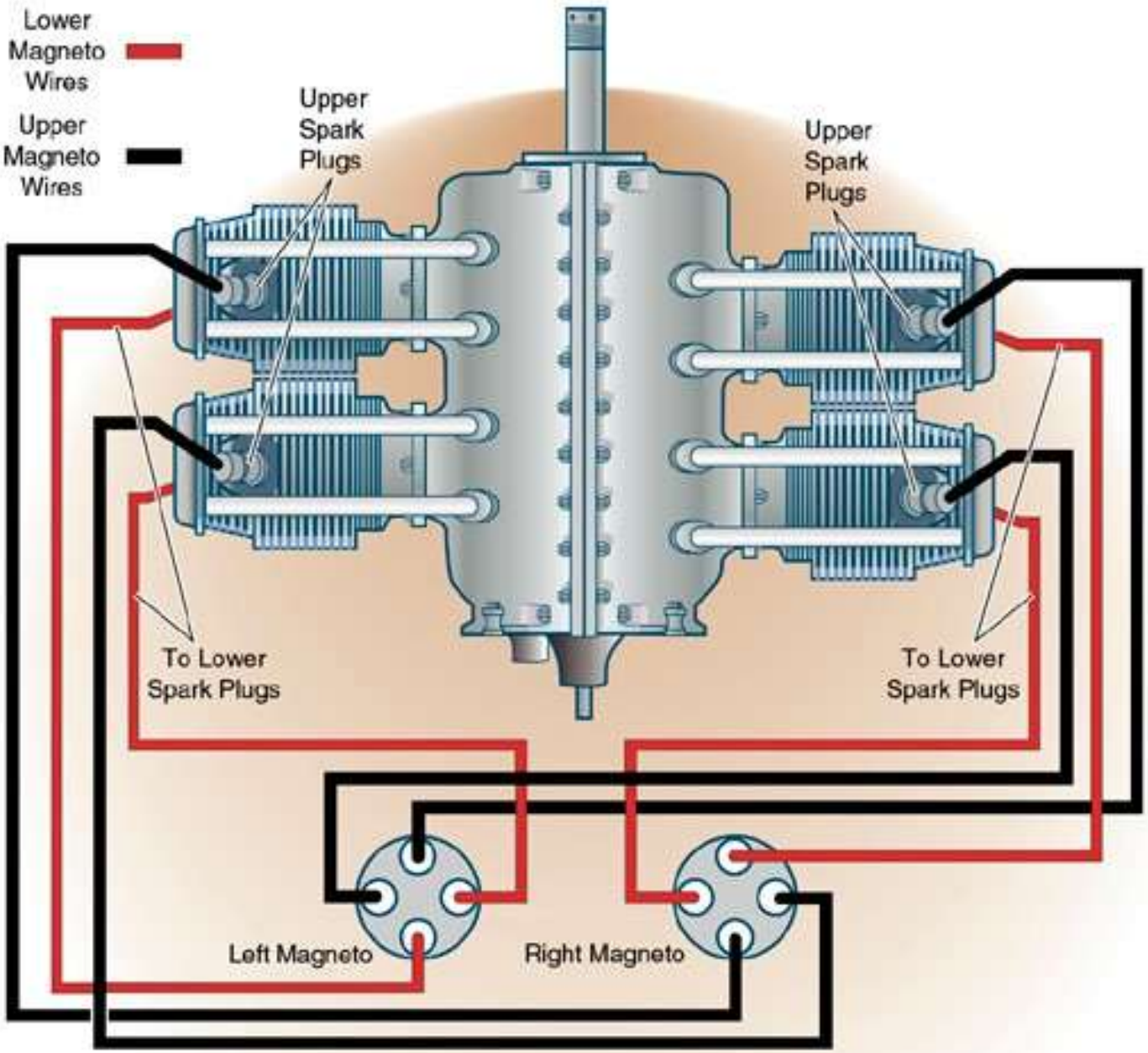
- Provides Spark
- Dual Redundant System

Aero Advantage

Magnetos

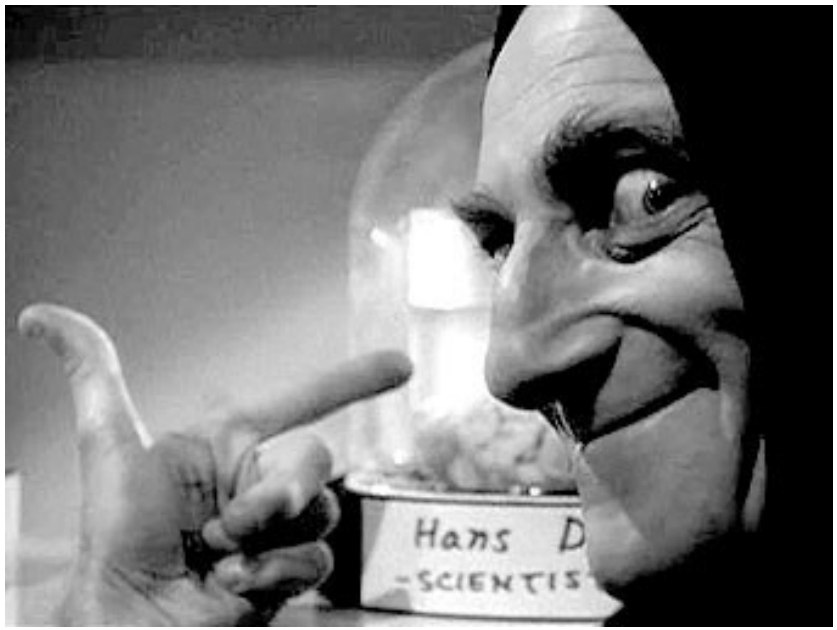
- Self contained system
- Moving magnets
- Ground check

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



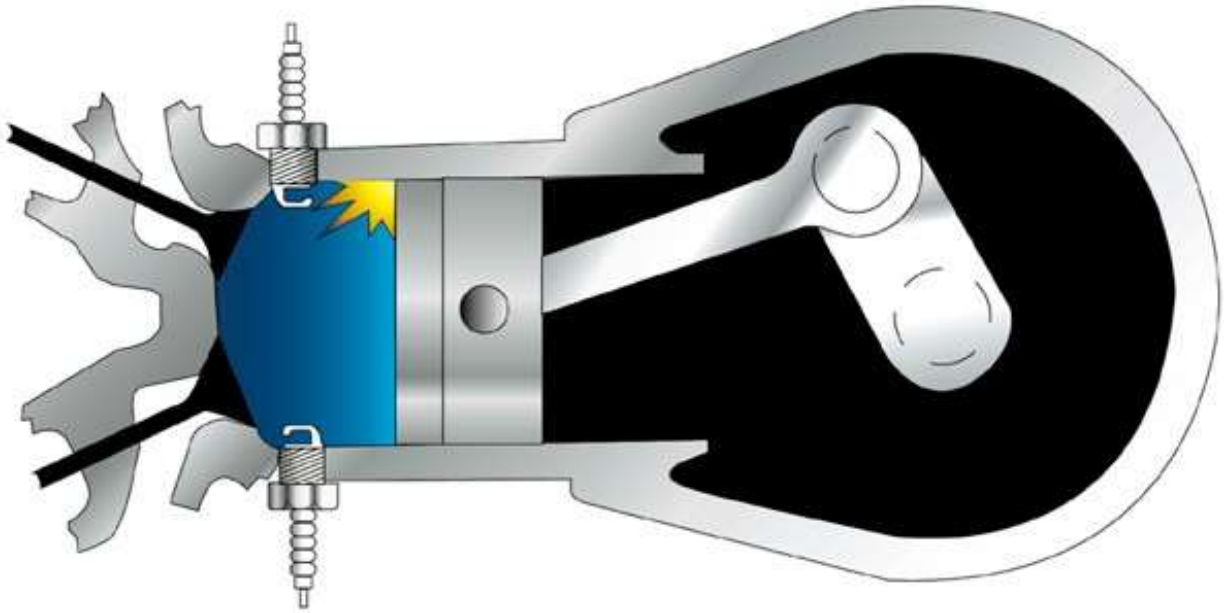
Aero Advantage

Detonation

- Engine Overheat
- Lower than Recommended Octane
- Excessive Leaning

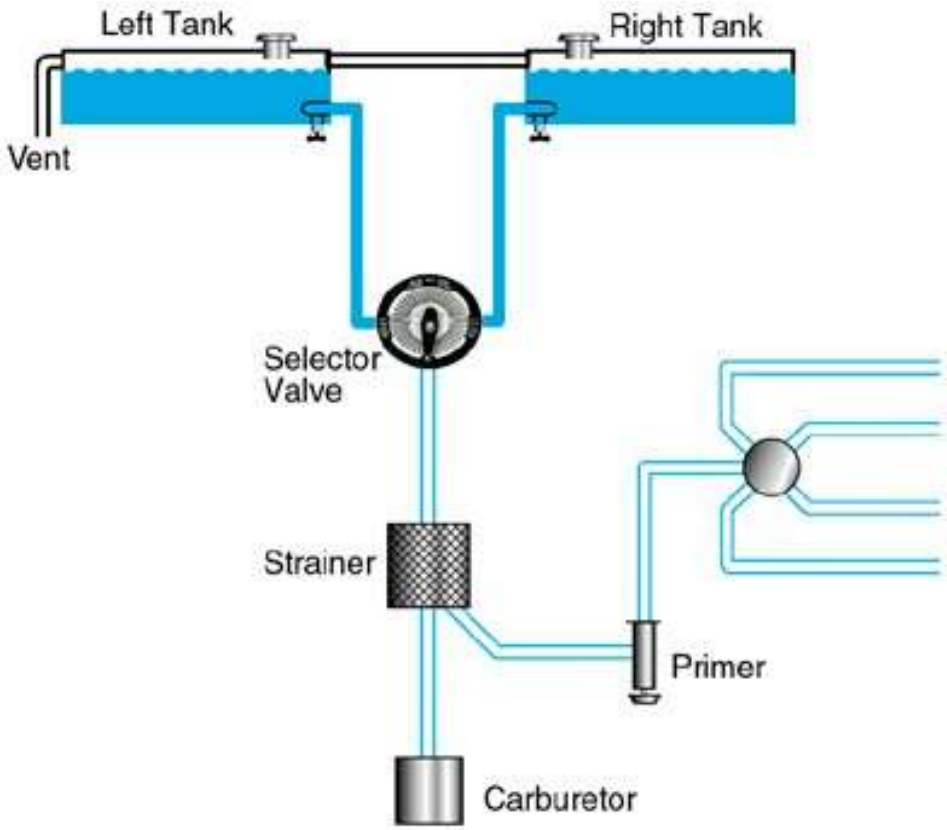
Preigntion

- Early ignition event

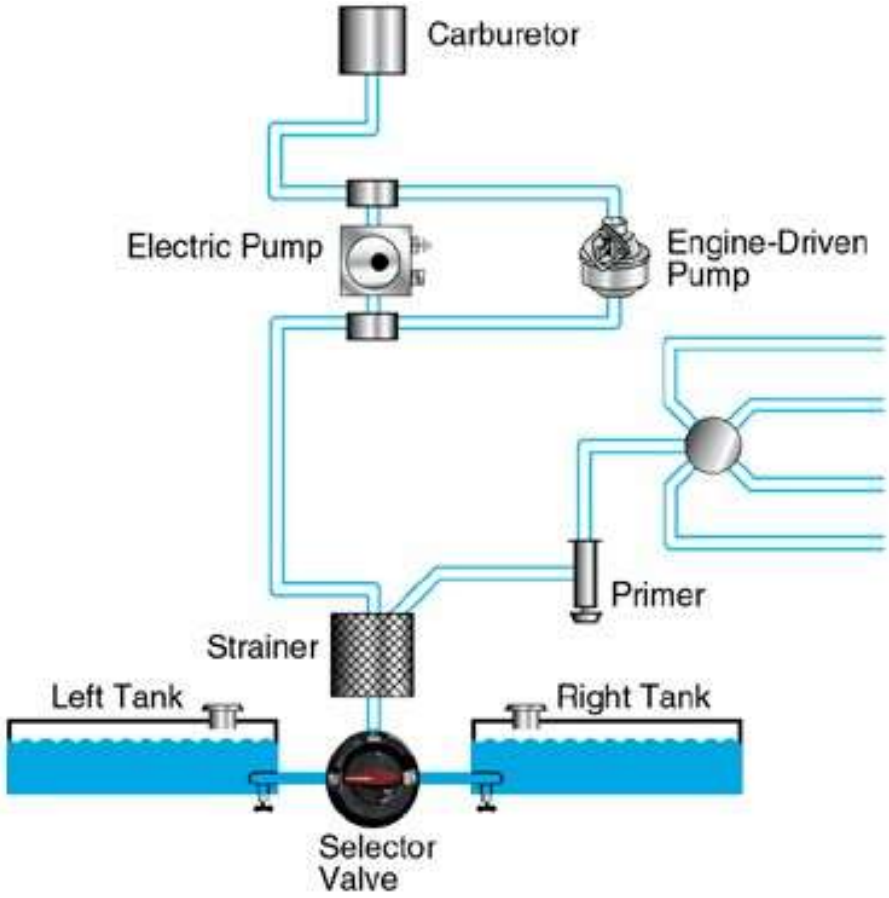


Aero Advantage

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
PRIMER
ALT
PHONE

Refueling

100LL Blue

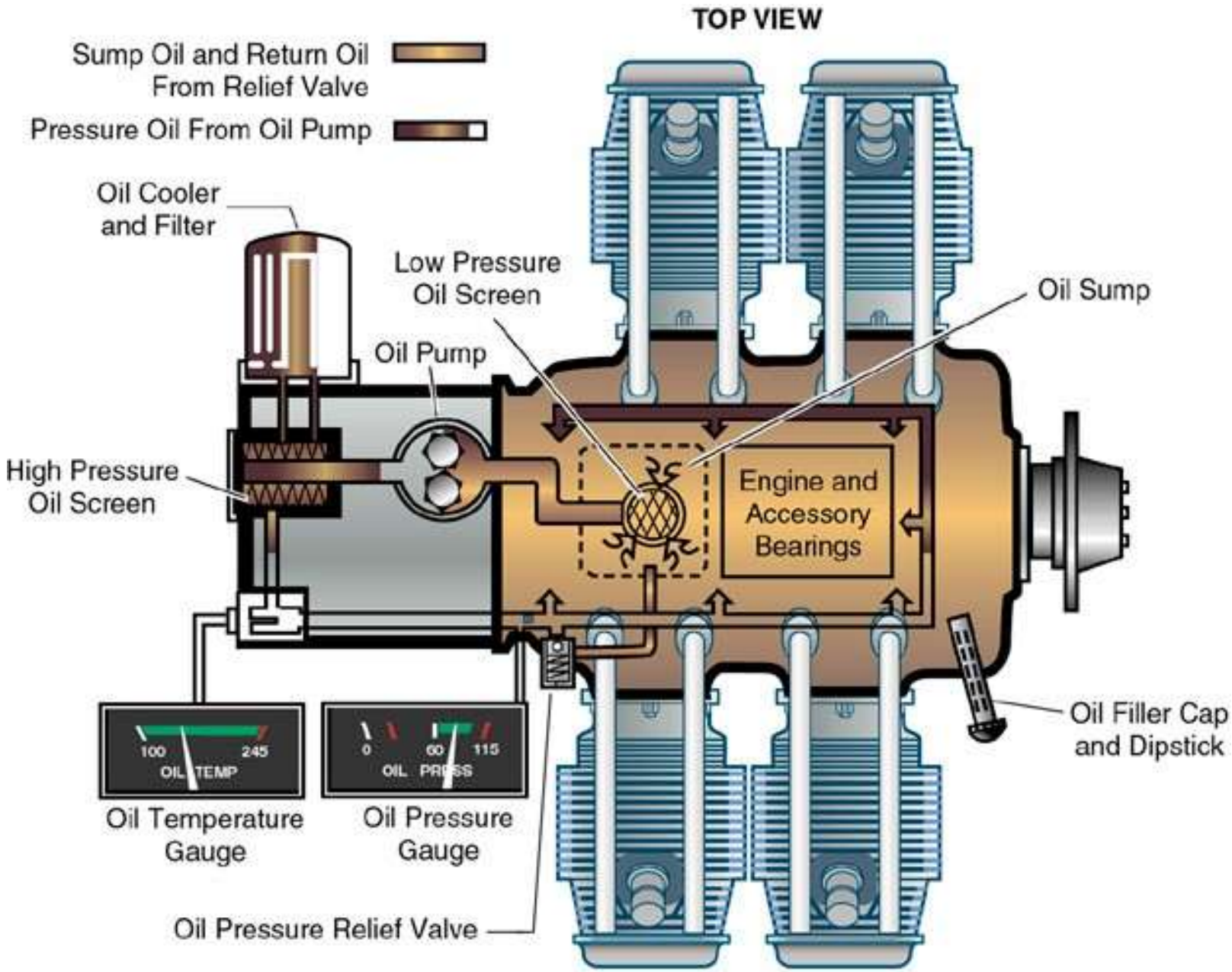
Air in tanks can cause condensation and moisture

Fuels


80 AVGAS
100 AVGAS
100LL AVGAS
JET A
RED
GREEN
BLUE
COLORLESS OR STRAW
AVGAS 80
AVGAS 100
AVGAS 100LL
JET A

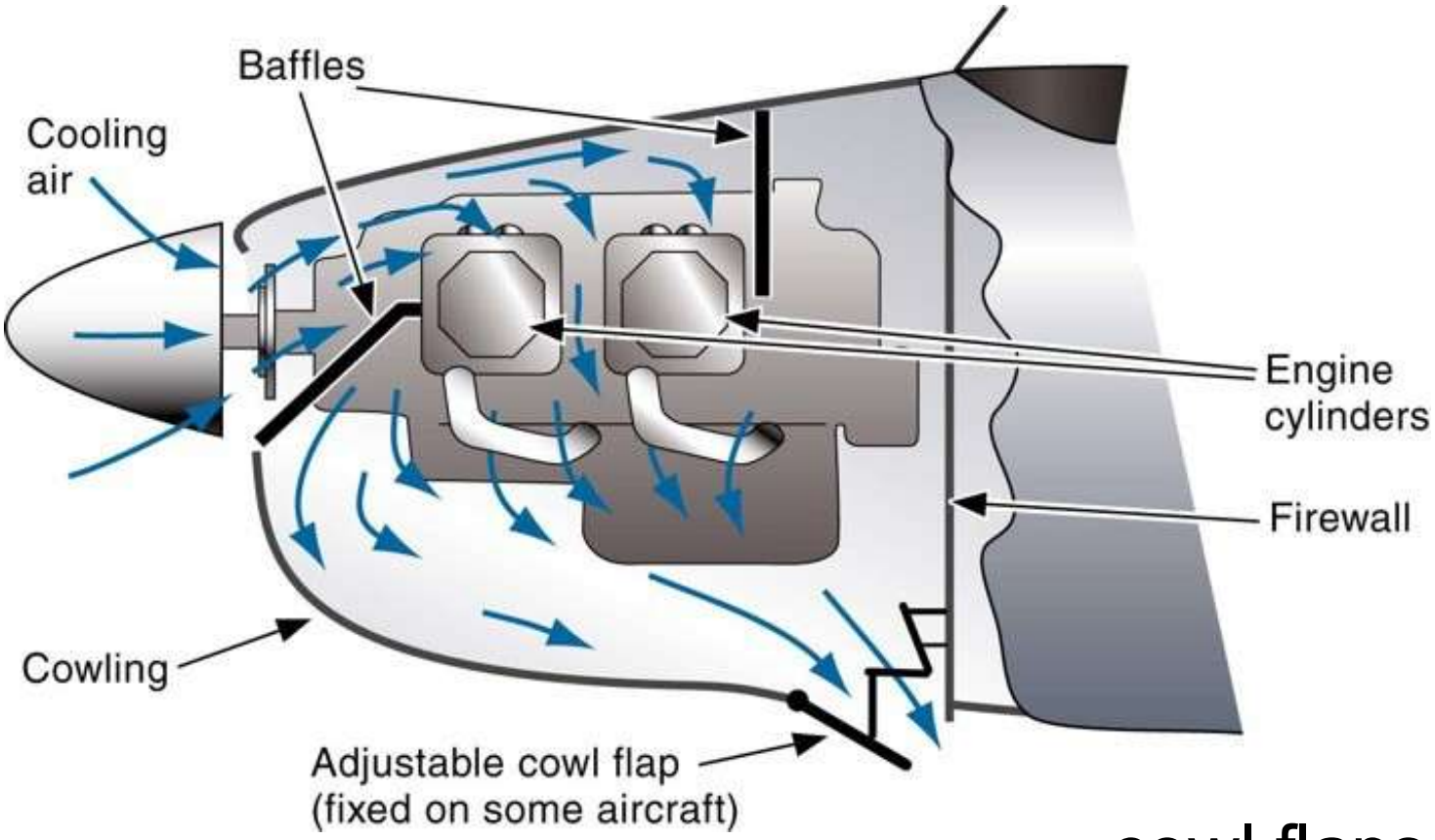
Oil System

- Wet sump or Dry Sump
- lubricates moving parts
- prevents high temperatures by reducing friction
- cools engine; carries heat away from the pistons
- removes contaminants from the engine
- seals cylinder walls

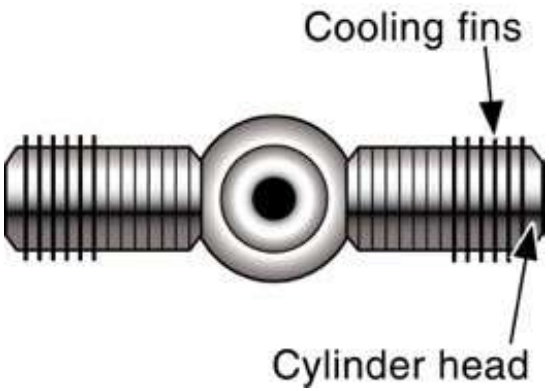

TOP VIEW
Sump Oil and Return Oil From Relief Valve
Pressure Oil From Oil Pump
Oil Cooler and Filter
Low Pressure Oil Screen
Oil Pump
Oil Sump
High Pressure Oil Screen
Engine and Accessory Bearings
100
245
OIL TEMP
0
60
115
OIL PRESS
Oil Temperature Gauge
Oil Pressure Gauge
Oil Filler Cap and Dipstick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


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

cowl flaps

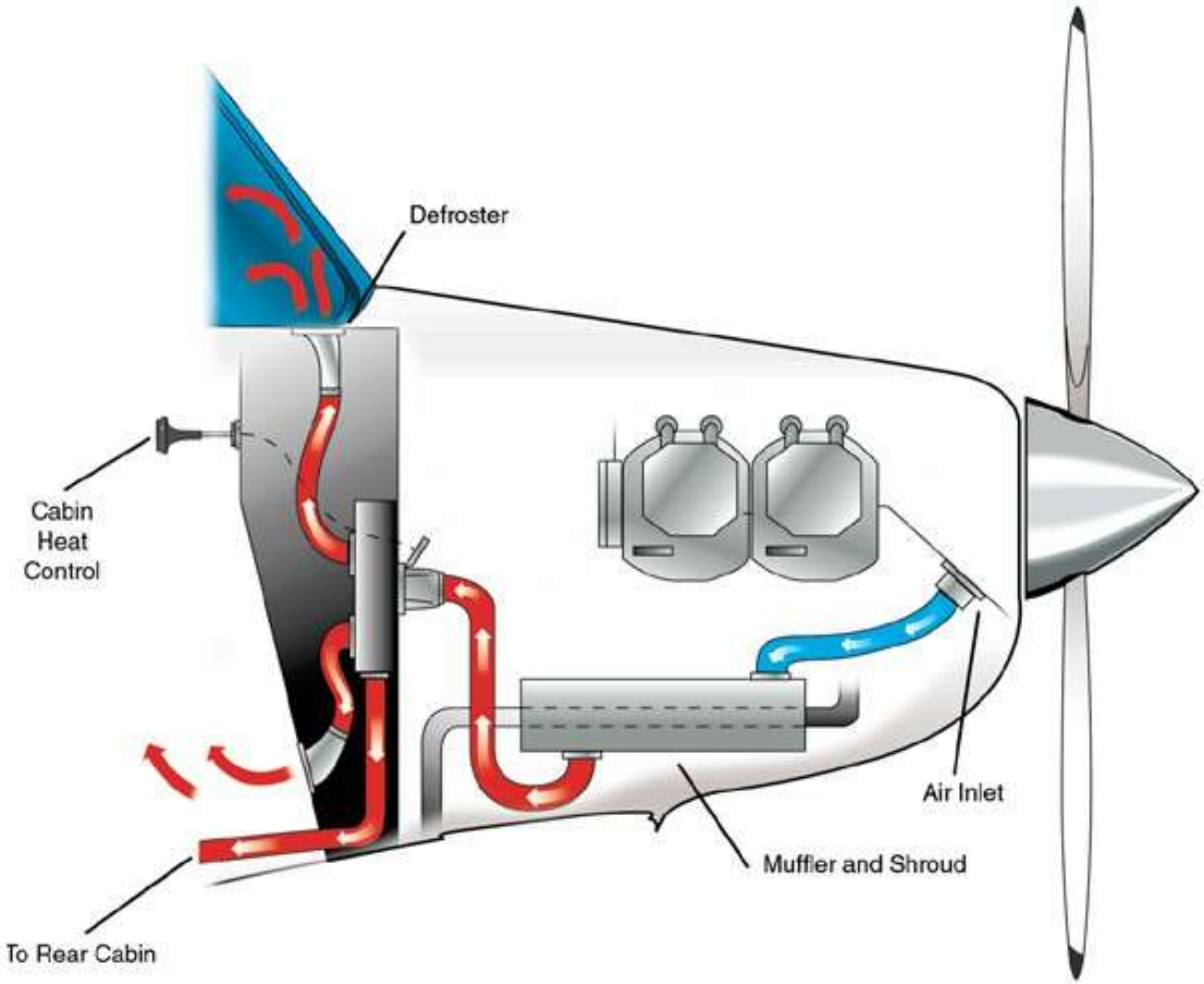

Cooling fins
Cylinder head

Excess Temperatures

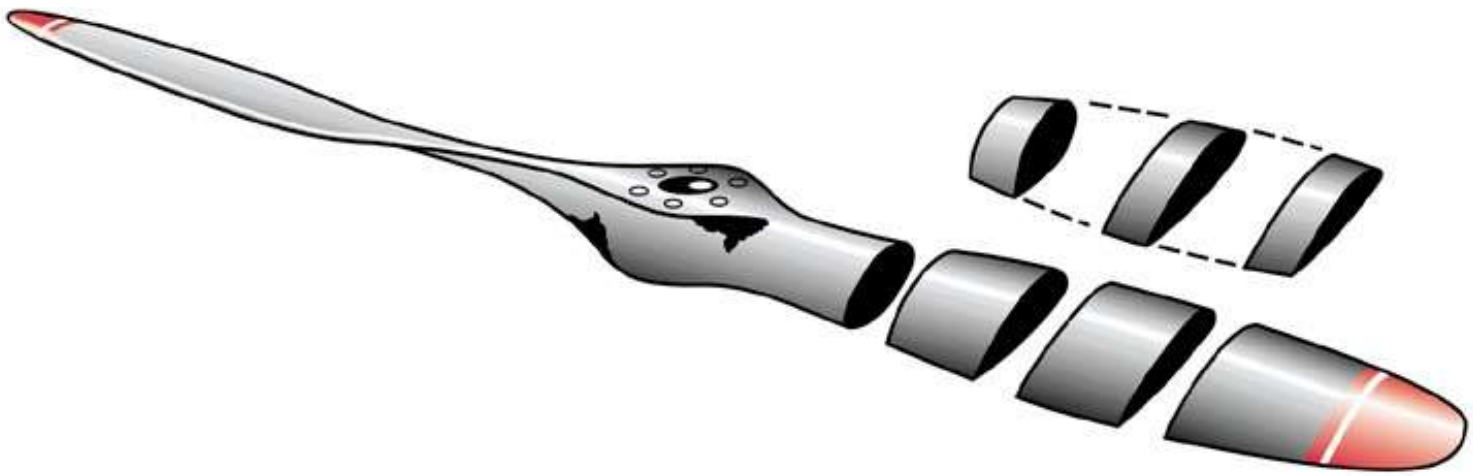
- High power
- Low Airspeed
- Incorrect fuel
- Mixture too lean
- Low oil level

Exhaust System

Heating System

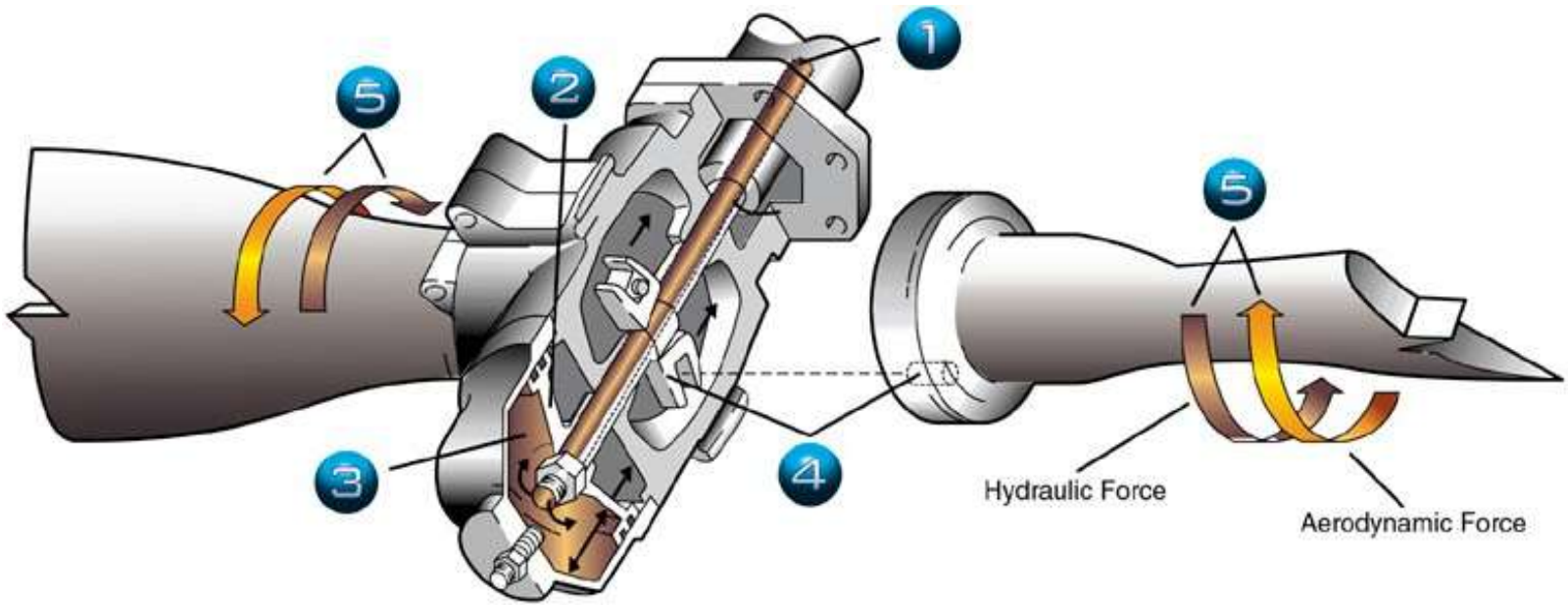


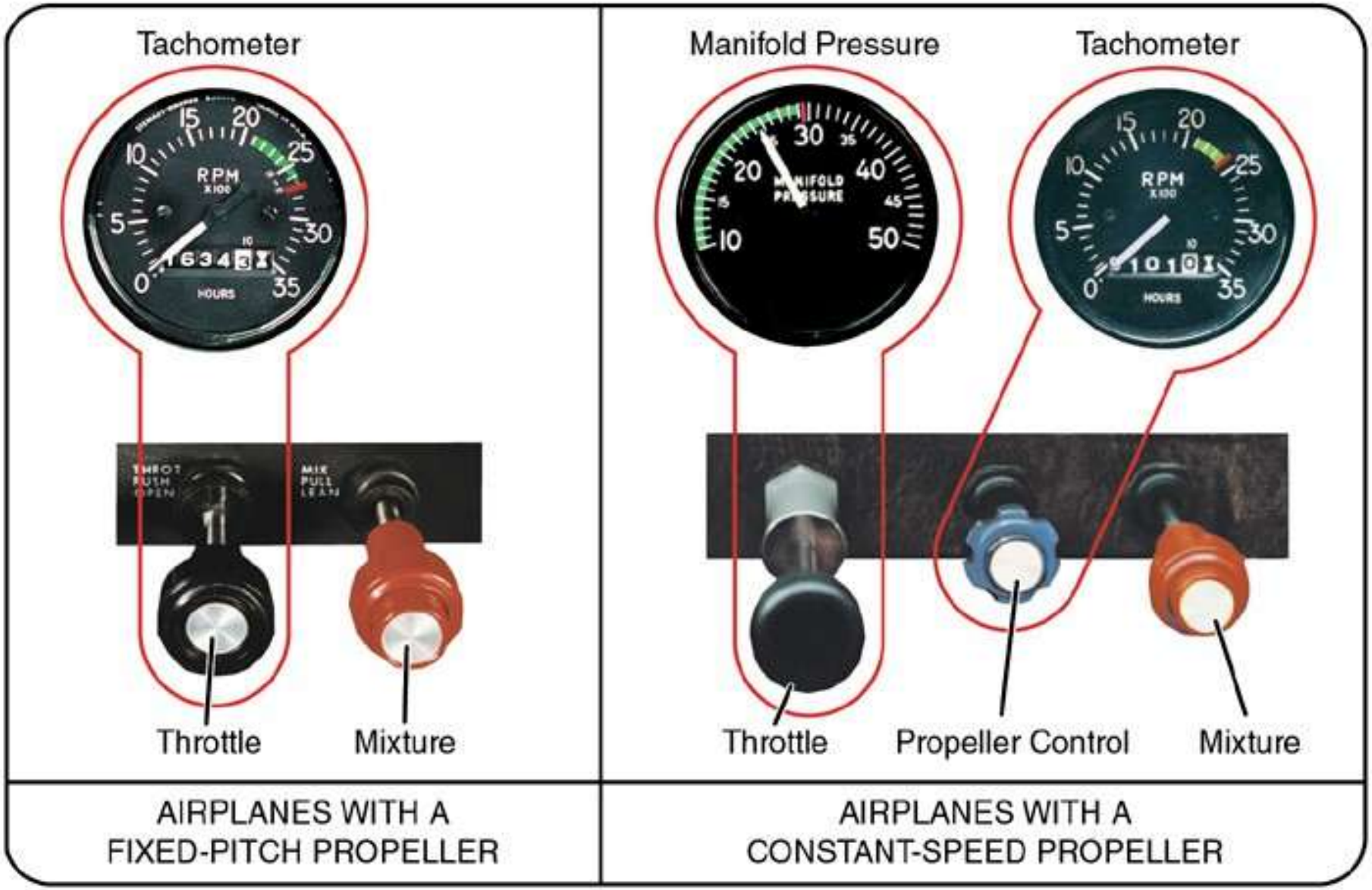
Propellor



Fixed Pitch

Variable Pitched



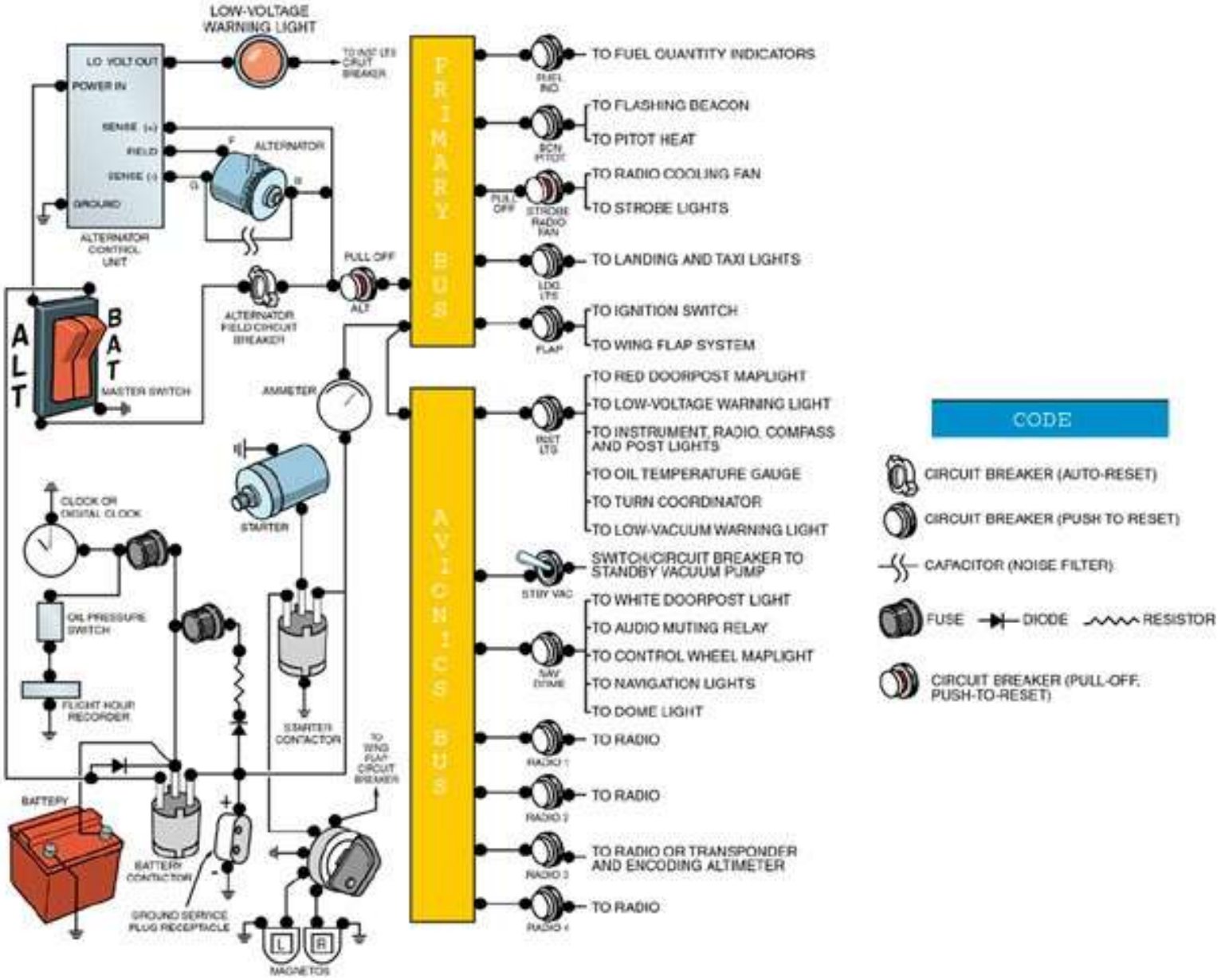

Tachometer
RPM
HOURS
Throttle
Mixture
AIRPLANES WITH A
FIXED-PITCH PROPELLER
Manifold Pressure
Tachometer
MANIFOLD PRESSURE
RPM
HOURS
Throttle
Propeller Control
Mixture
AIRPLANES WITH A
CONSTANT-SPEED PROPELLER

Constant Speed Propeller

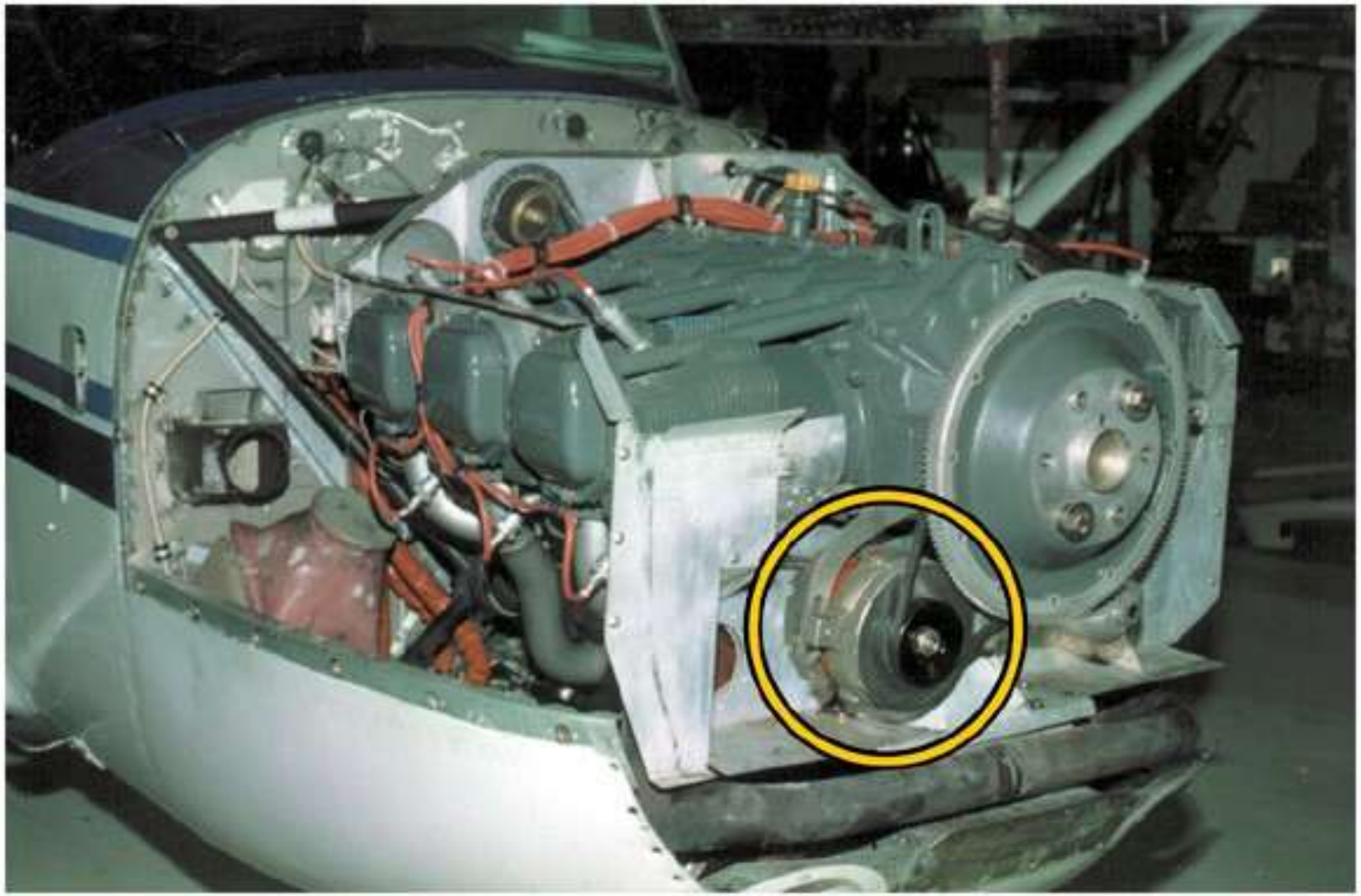
- Control
  - Power, Throttle, Manifold Pressure
  - RPM, Propeller Control
- Efficiency
  - select blade angle for efficient operation
- Avoid low RPM and high Manifold Pressure

Electrical System

- Alternator
- Battery
- Ammeter
- Master Switch
- Circuit Breakers and buses (power strips)


LOW-VOLTAGE WARNING LIGHT
LO VOLT OUT
POWER IN
SENSE (+)
FIELD
SENSE (-)
GROUND
ALTERNATOR CONTROL UNIT
ALTERNATOR
ALTERNATOR FIELD CIRCUIT BREAKER
PULL OFF
ALT
ALT
BAT
MASTER SWITCH
AMMETER
STARTER
CLOCK OR DIGITAL CLOCK
OIL PRESSURE SWITCH
FLIGHT HOUR RECORDER
STARTER CONTACTOR
BATTERY
BATTERY CONTACTOR
GROUND SERVICE PLUG RECEPTACLE
MAGNETOS
L
R
PRIMARY BUS
AVIONICS BUS
TO FUEL QUANTITY INDICATORS
TO FLASHING BEACON
TO PITOT HEAT
TO RADIO COOLING FAN
TO STROBE LIGHTS
TO LANDING AND TAXI LIGHTS
TO IGNITION SWITCH
TO WING FLAP SYSTEM
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
SWITCH/CIRCUIT BREAKER TO STANDBY VACUUM PUMP
TO WHITE DOORPOST LIGHT
TO AUDIO MUTING RELAY
TO CONTROL WHEEL MAPLIGHT
TO NAVIGATION LIGHTS
TO DOME LIGHT
TO RADIO
TO RADIO
TO RADIO OR TRANSPONDER AND ENCODING ALTIMETER
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
ON
ALT
BAT
MASTER


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.
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