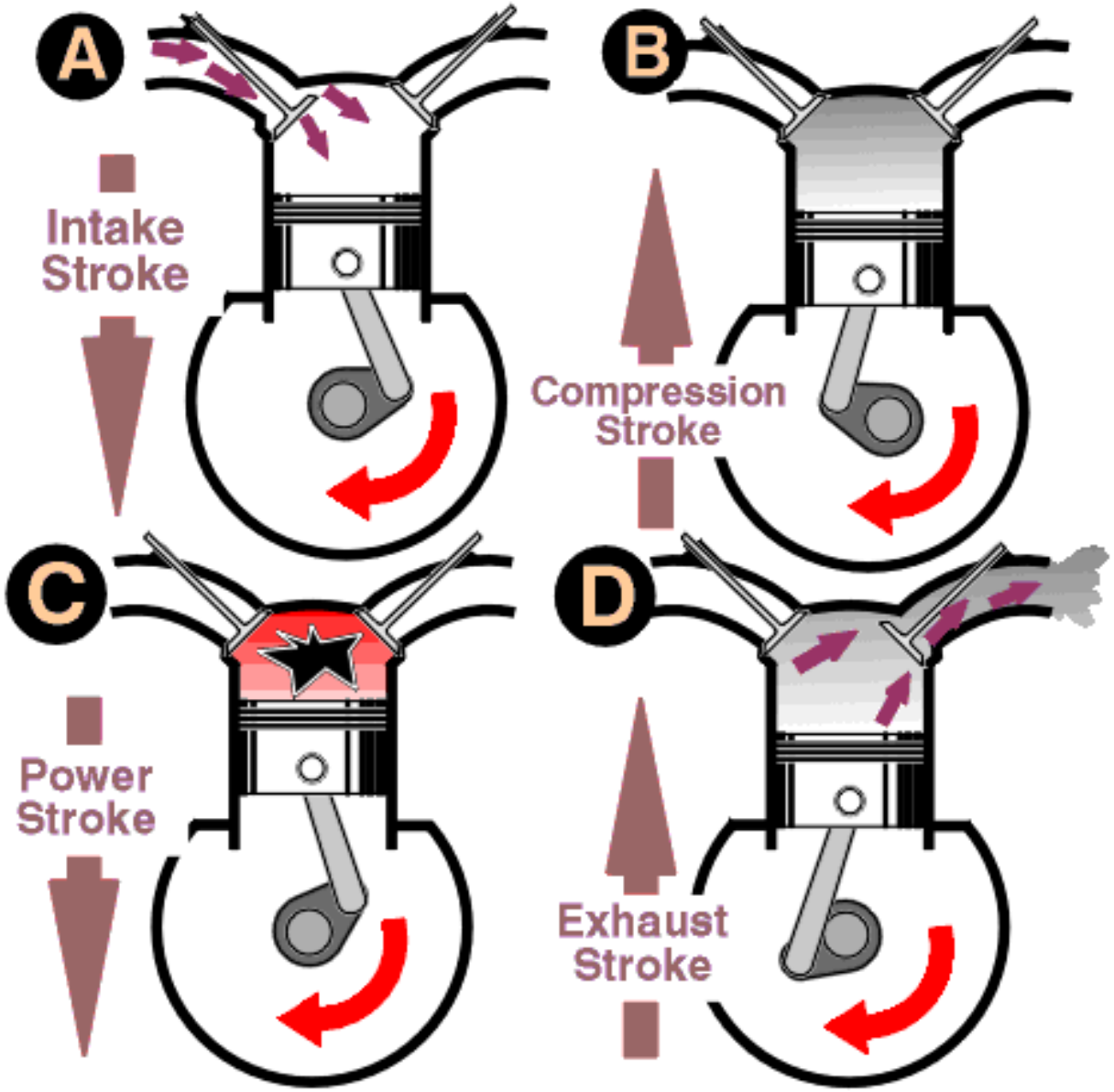
Engines

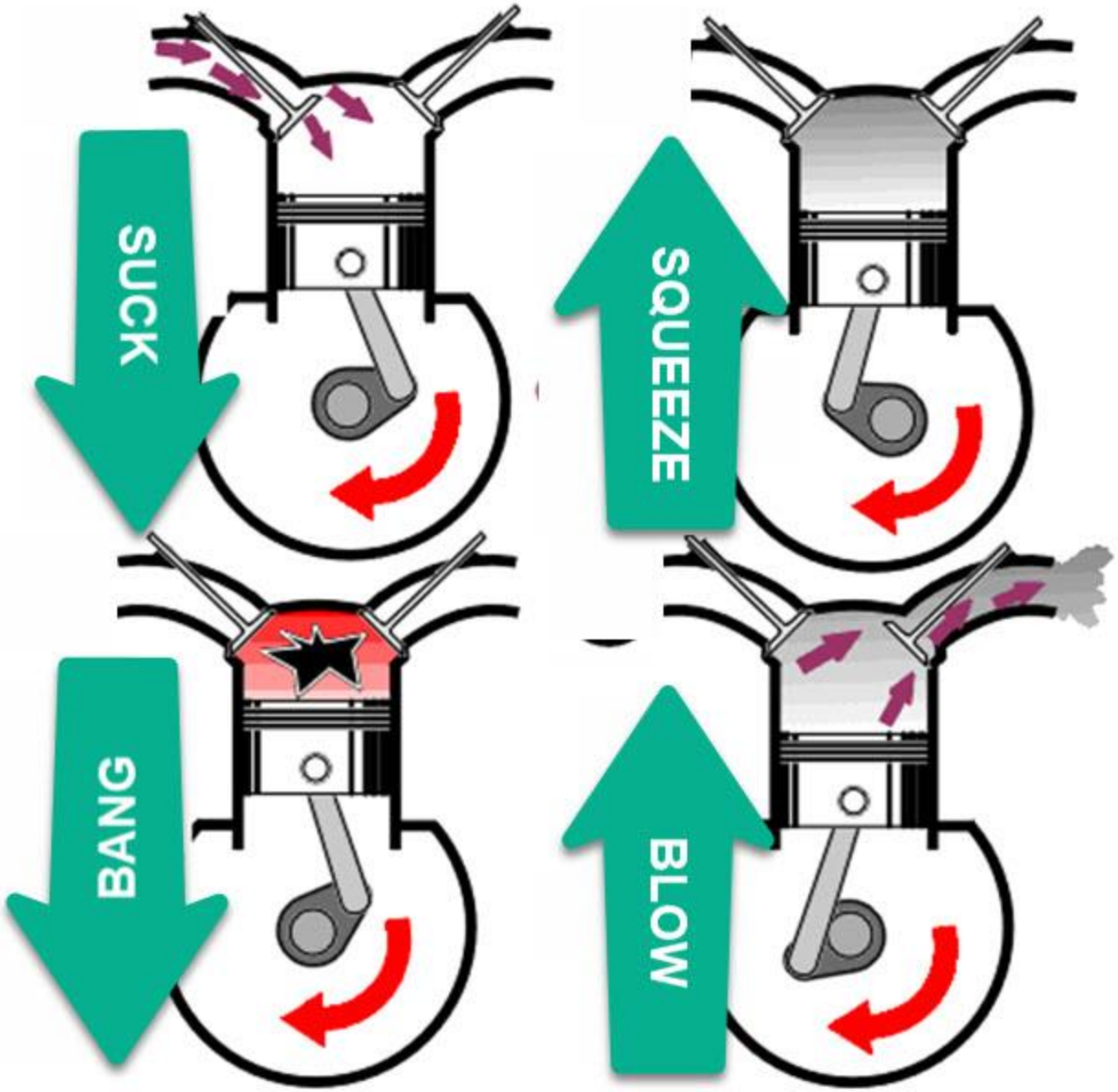
Reciprocating Engines

THE FOUR STROKE ENGINE

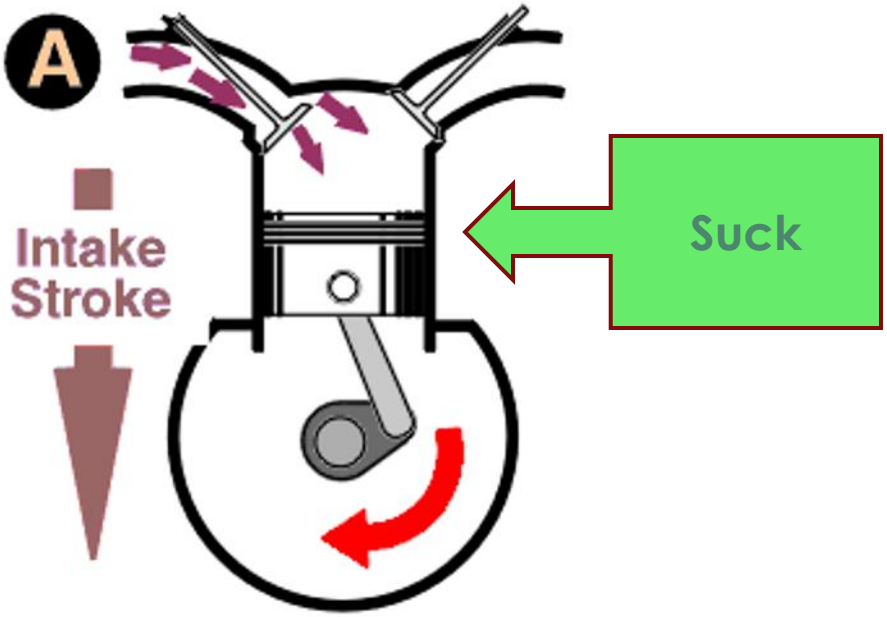


3-3

THE FOUR STROKE ENGINE



THE FOUR STROKE ENGINE



A normally aspirated engine sucks

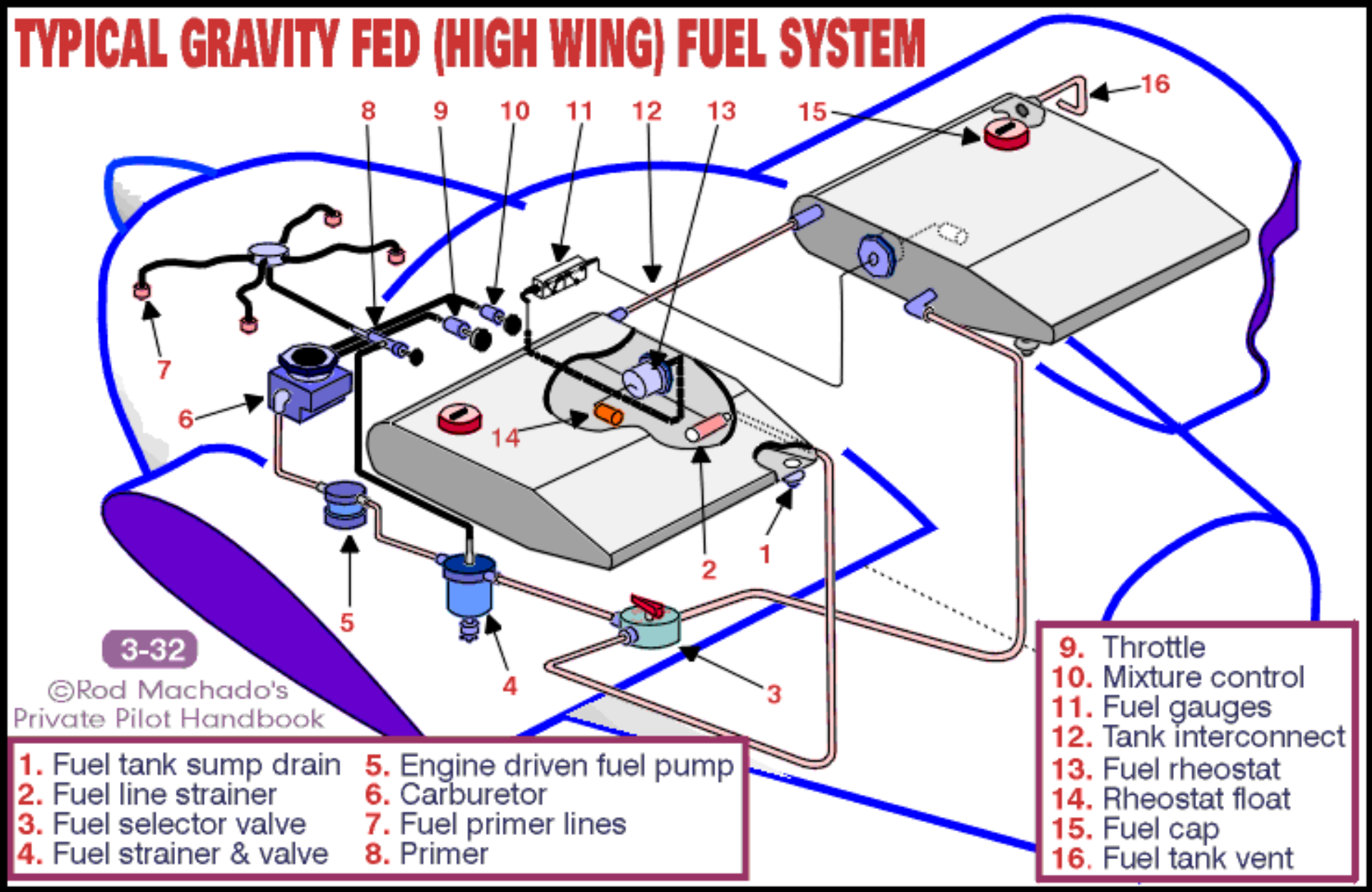
fuel

air

3-3

Fuel and Air

TYPICAL GRAVITY FED (HIGH WING) FUEL SYSTEM

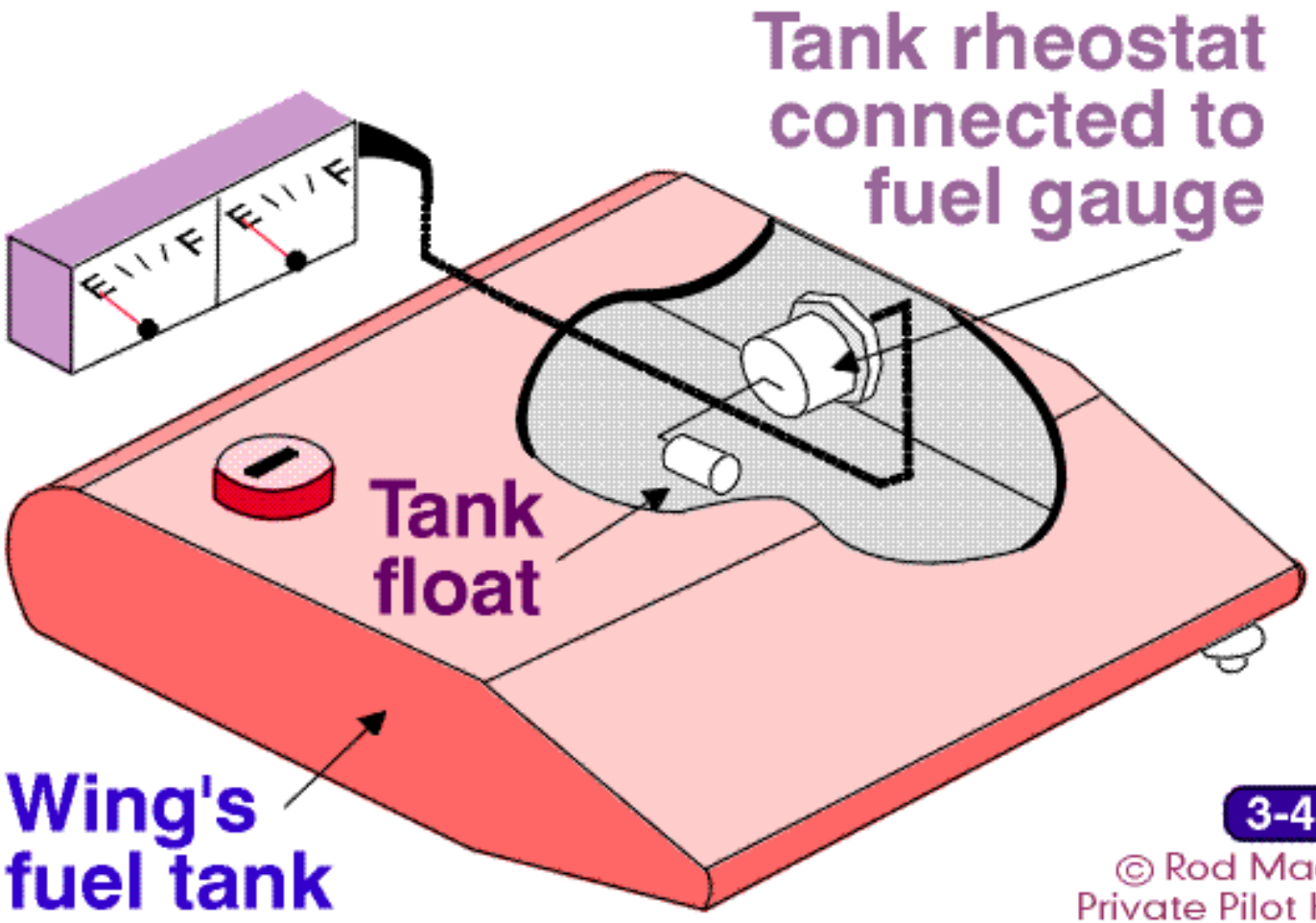


3-32

1. Fuel tank sump drain
2. Fuel line strainer
3. Fuel selector valve
4. Fuel strainer & valve
5. Engine driven fuel pump
6. Carburetor
7. Fuel primer lines
8. Primer

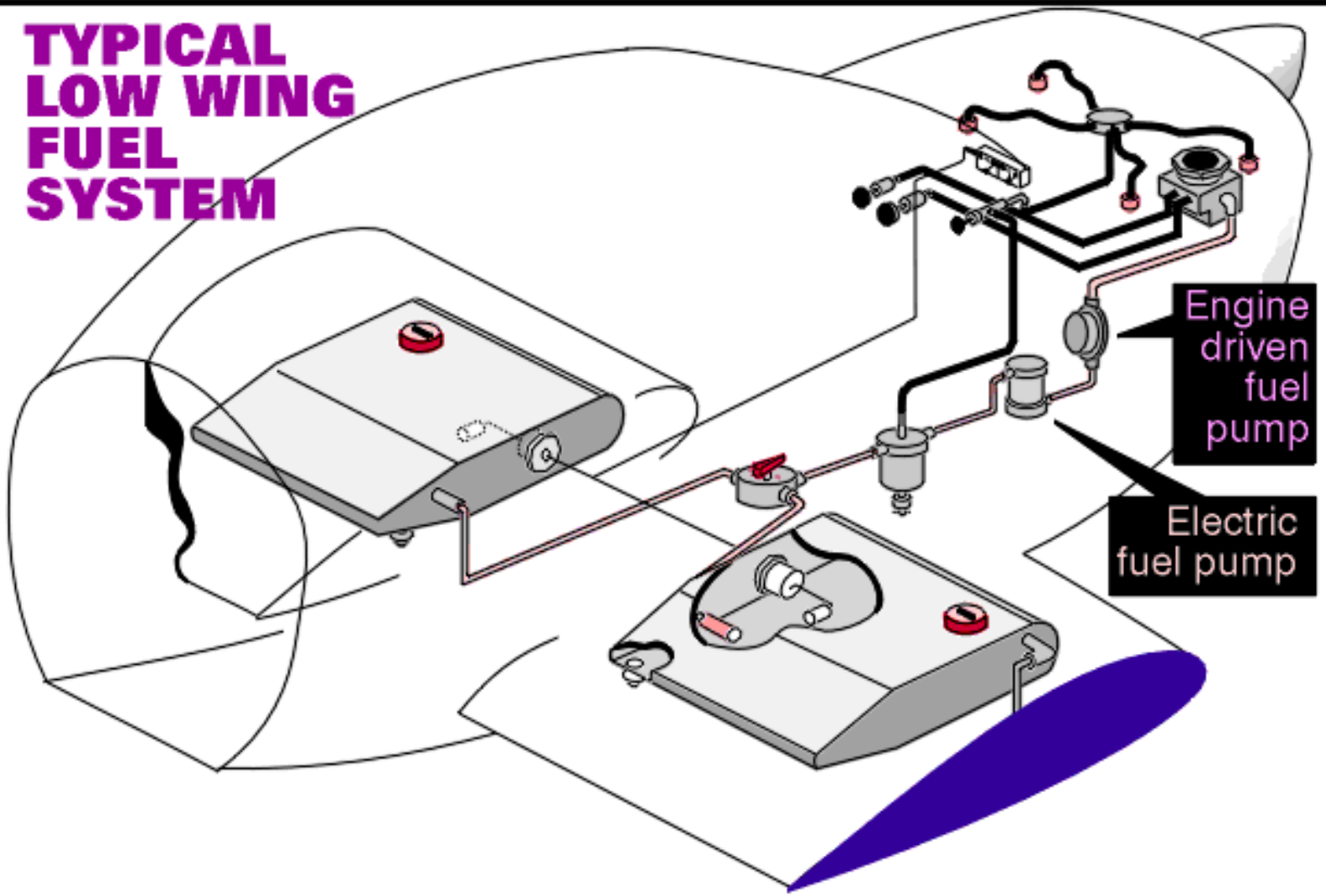
9. Throttle
10. Mixture control
11. Fuel gauges
12. Tank interconnect
13. Fuel rheostat
14. Rheostat float
15. Fuel cap
16. Fuel tank vent

RHEOSTAT-TYPE FUEL MEASURING SYSTEM



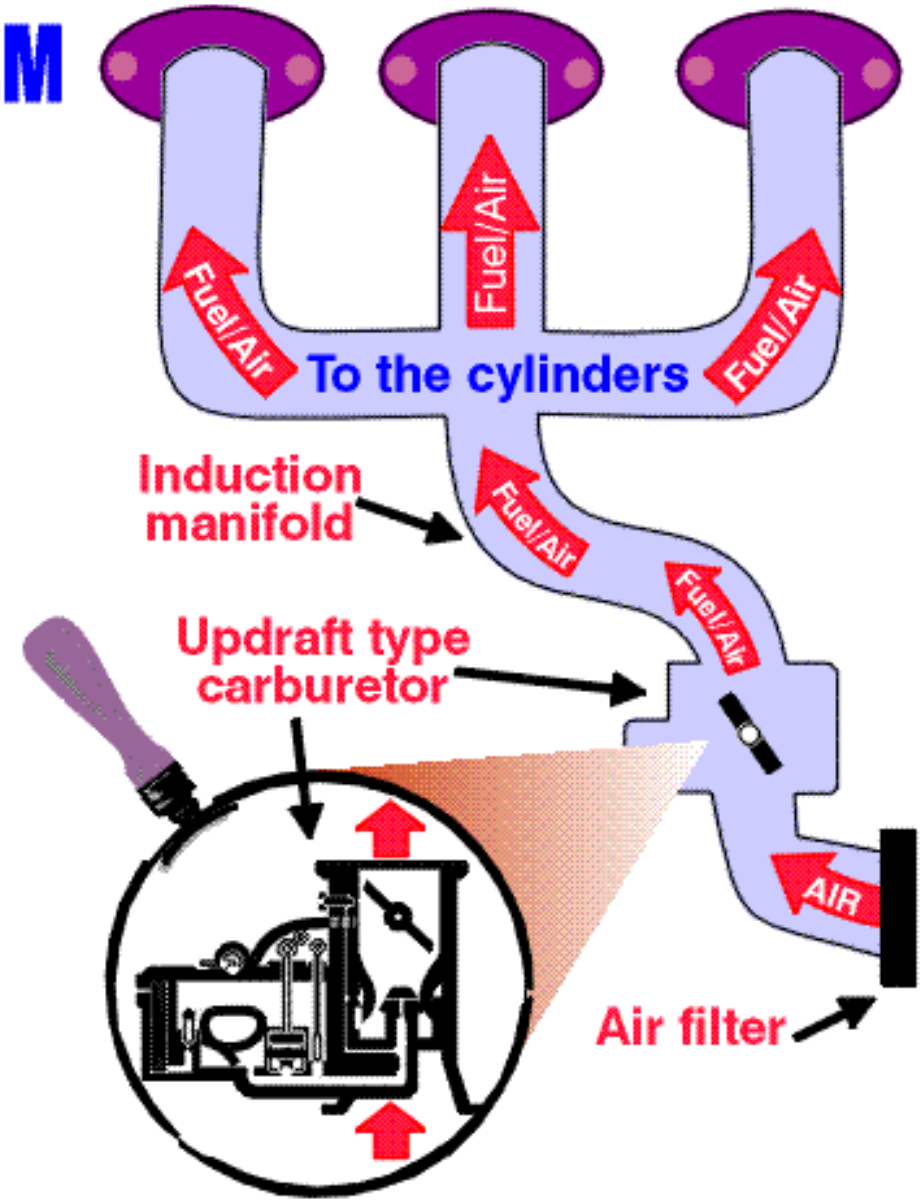
3-41

TYPICAL LOW WING FUEL SYSTEM



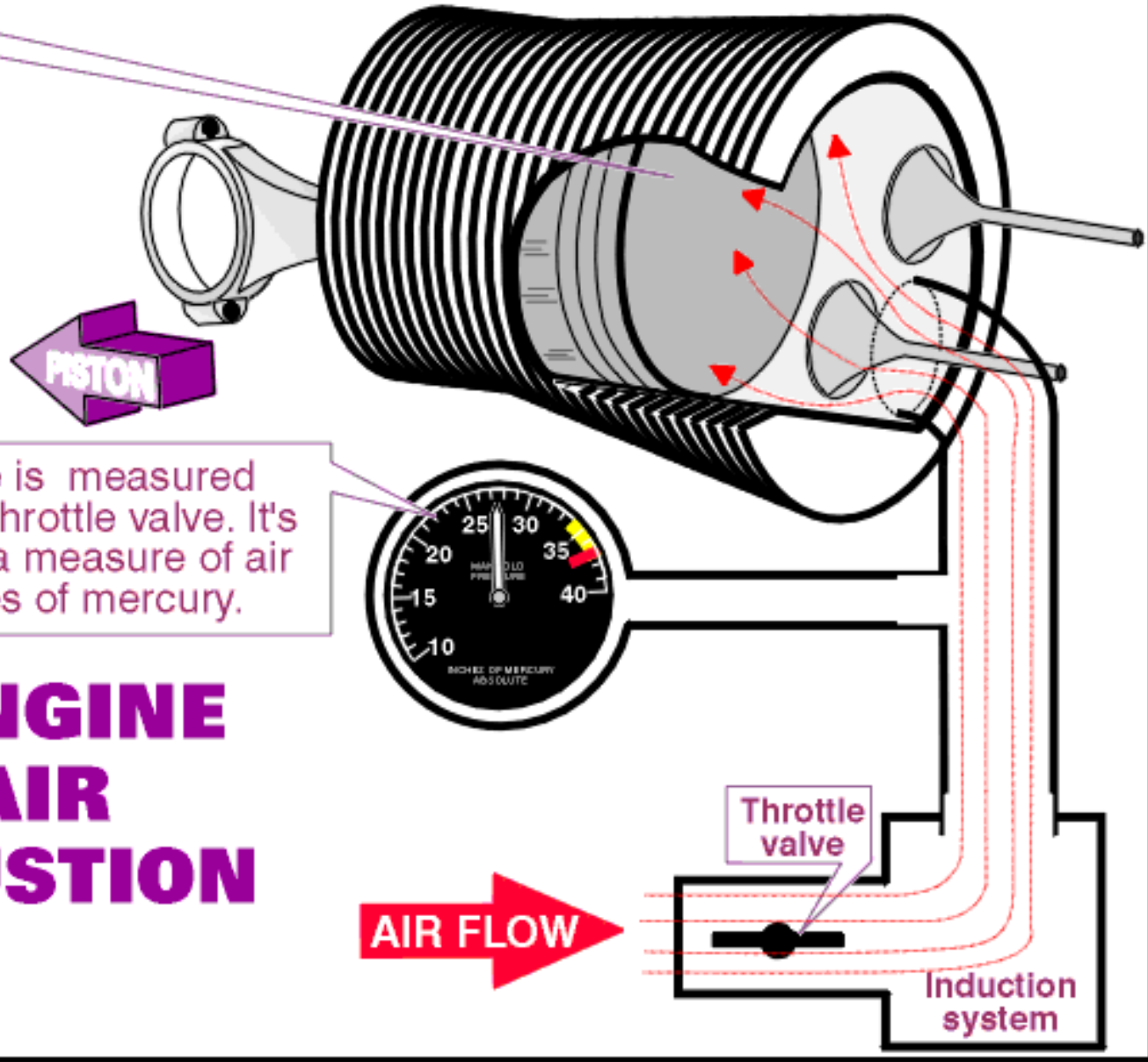
Low wing fuel systems are slightly different from high wing systems in that most have an electric fuel pump in addition to an engine driven fuel pump.

ENGINE INDUCTION SYSTEM AS SEEN ON ONE SIDE OF THE AIRPLANE



3-9

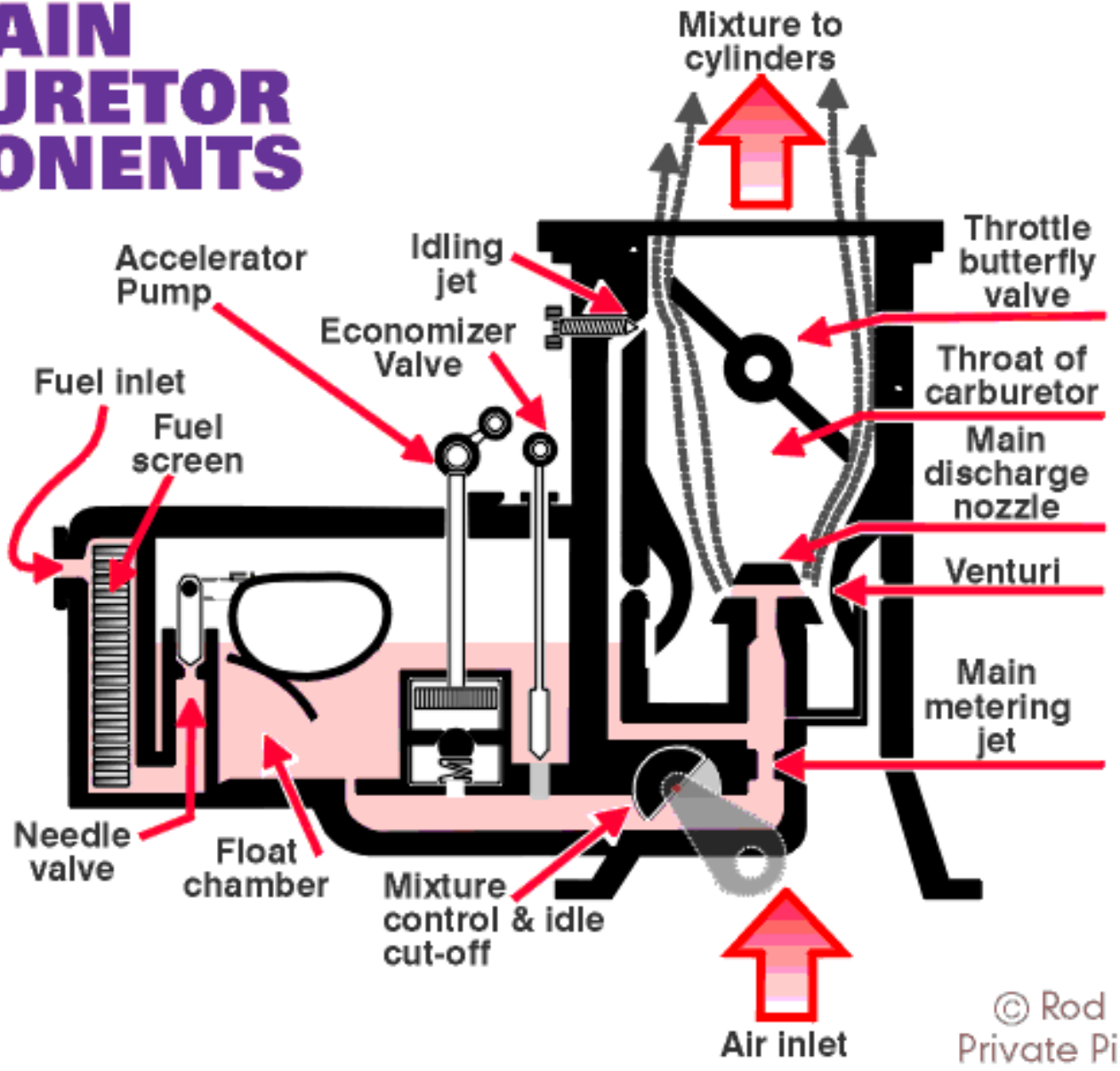
As the piston moves downward, it creates a suction in the cylinder similar to the plunger in a hypodermic needle. Low pressure is created which draws air in through the induction system.



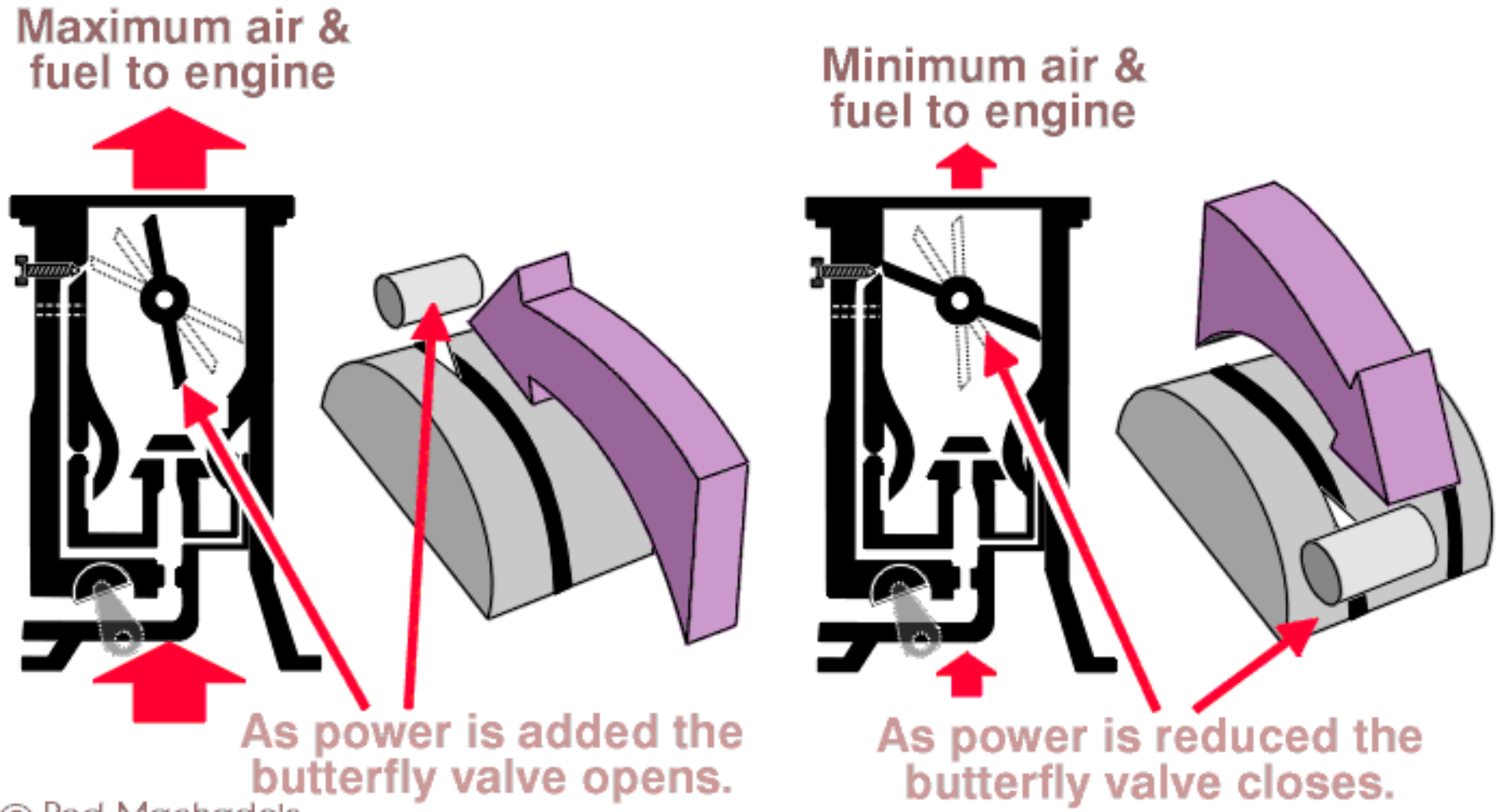
HOW THE ENGINE DRAWS IN AIR FOR COMBUSTION

3-49

MAIN CARBURETOR COMPONENTS

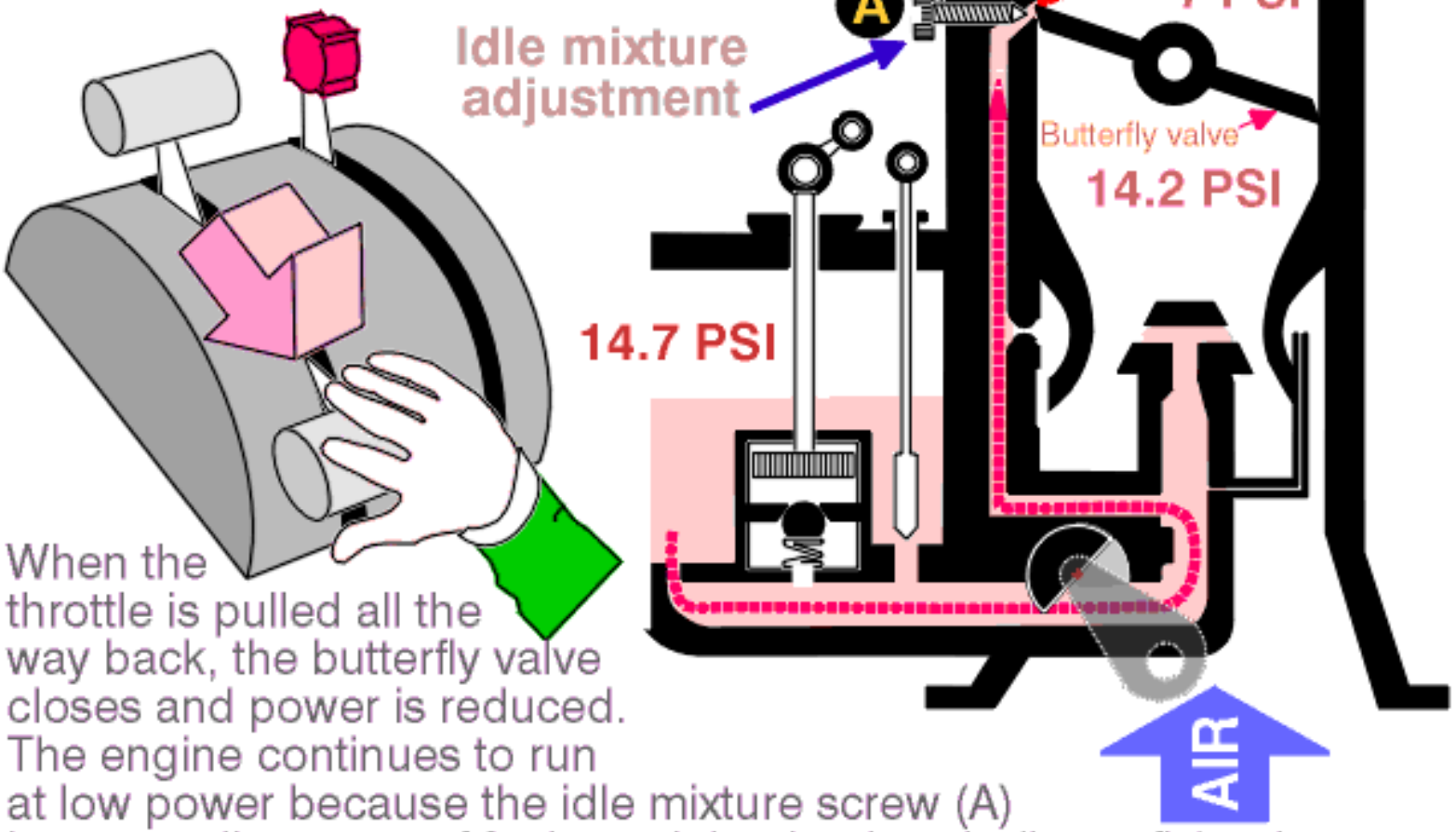


THROTTLE MOVEMENT & BUTTERFLY VALVE POSITION



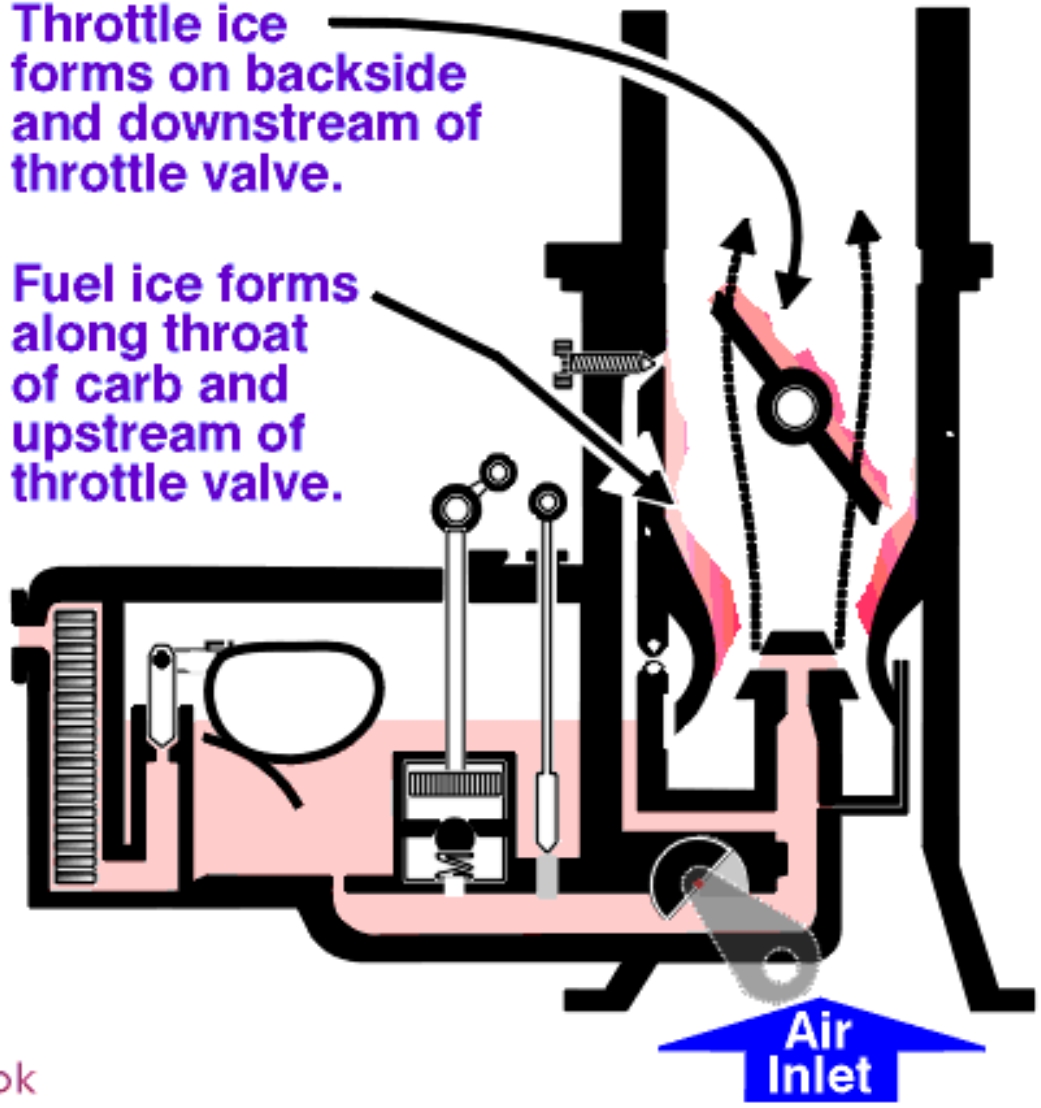
THE CARBURETOR'S IDLING SYSTEM

Low pressure on engine side of carb sucks fuel out of idling jet at position (A).



When the throttle is pulled all the way back, the butterfly valve closes and power is reduced. The engine continues to run at low power because the idle mixture screw (A) lets a small amount of fuel sneak by the throttle (butterfly) valve.

TWO FORMS OF CARBURETOR ICE



New Carburettor icing-probability chart

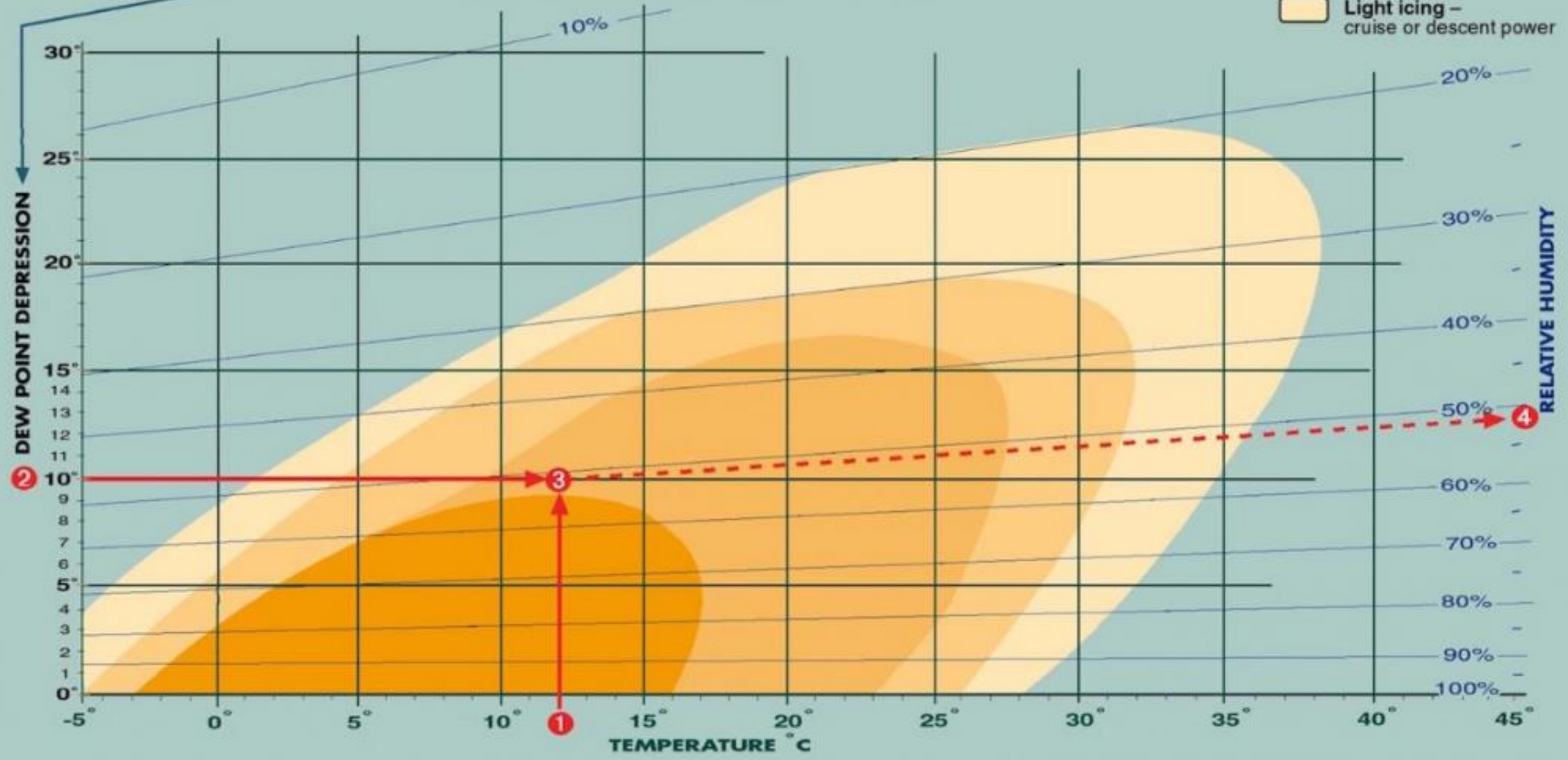
To use this chart:

- obtain the temperature and dew point
- calculate the difference between the two. This is the 'dew point depression'
- for example, if the temperature is 12° C (1) and the dew point is 2° the dew point depression will be 10° (2)
- for icing probability, refer to the shading legend appropriate to the intersection of the lines (3)
- for relative humidity, refer to the right hand scale (4)

To work out dew point depression:

Temp Minus Dew Pt. = Dew Pt. Depression (2)

- **Serious icing** – any power
- **Moderate icing** – cruise power; **Serious icing** – descent power
- **Serious icing** – descent power
- **Light icing** – cruise or descent power



DETECTING & RIDDING CARB-ICE WITH CARB-HEAT

A

RPM decreasing
(you suspect carb ice)

B

You apply full carburetor heat
(RPM decreases further)

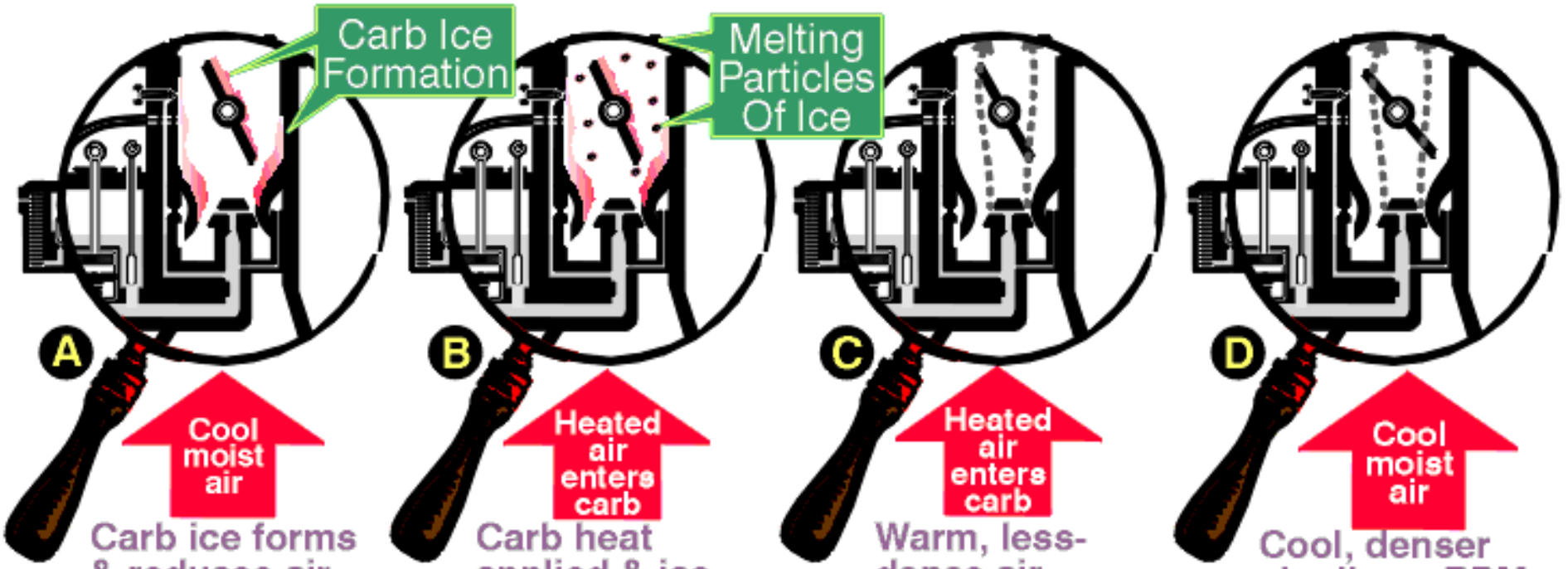
C

As ice melts the RPM increases
(it rises then stops)

D

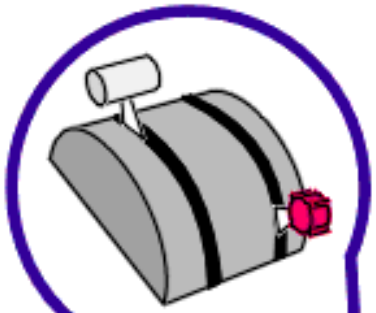
Carb heat is then turned off
(RPM rises again)

DETECTING & RIDDING CARB-ICE WITH CARB-HEAT



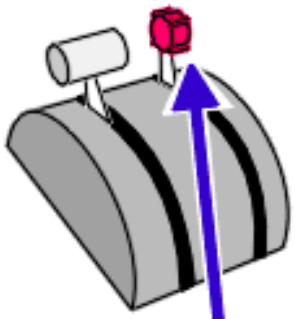
Throttle and Mixture Control

THE MIXTURE CONTROL



Idle cutoff position

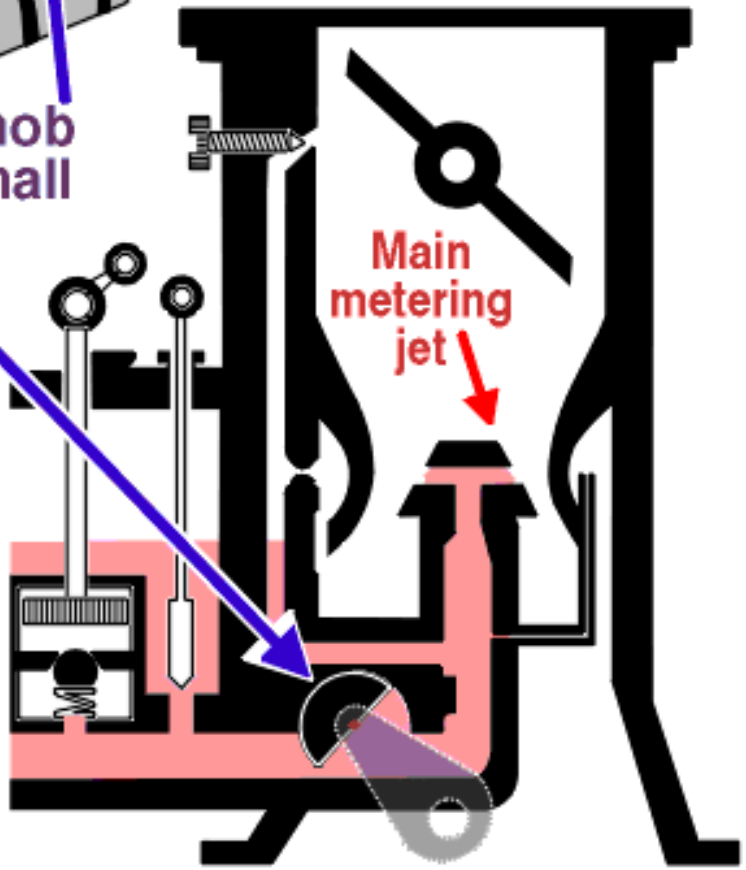
In the idle cutoff position the fuel flow is restricted through the main metering jet. Thus, no fuel flows.



Mixture knob rotates small valve

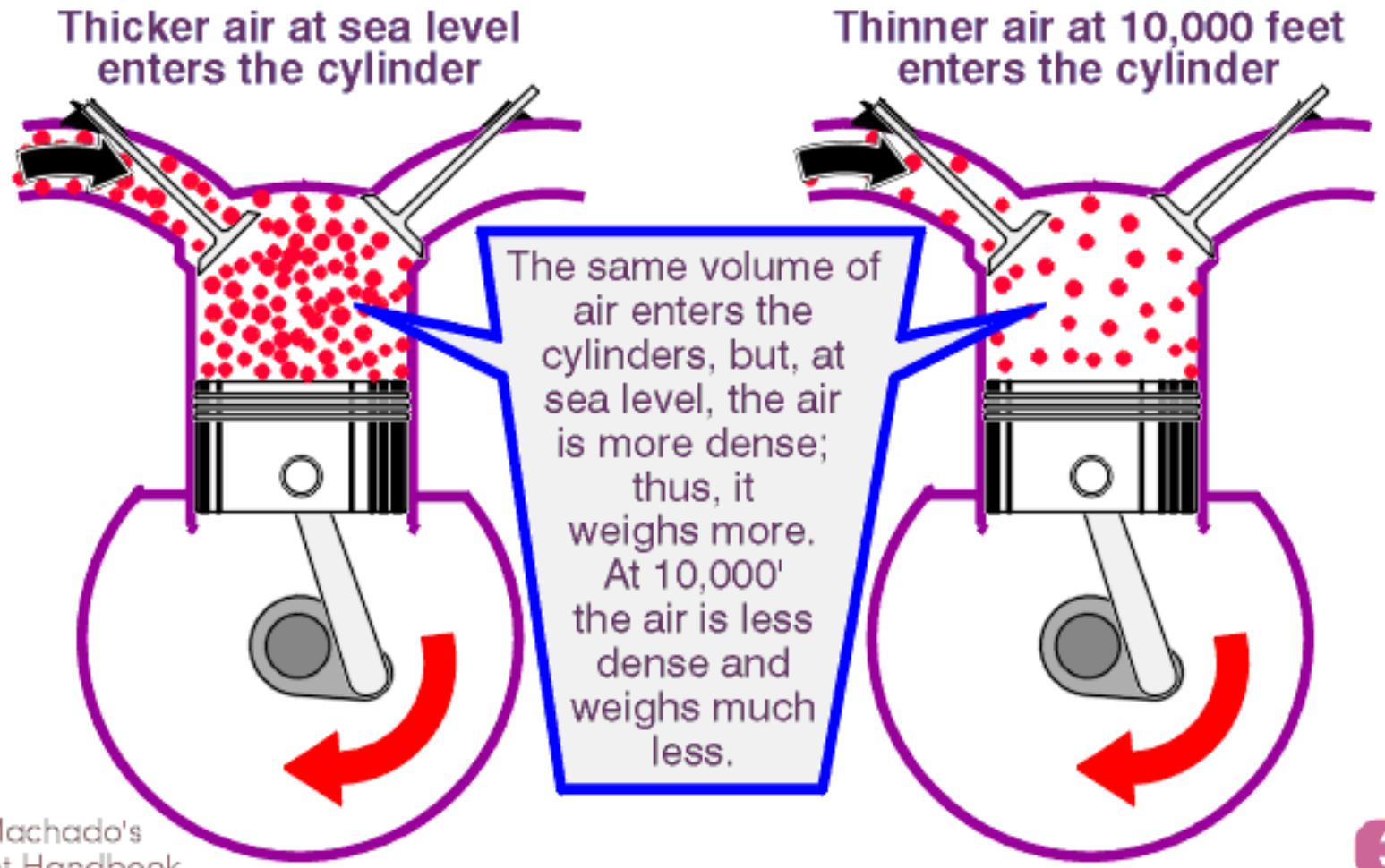
"Restriction" type of mixture control system

Idle cutoff shown



Main metering jet

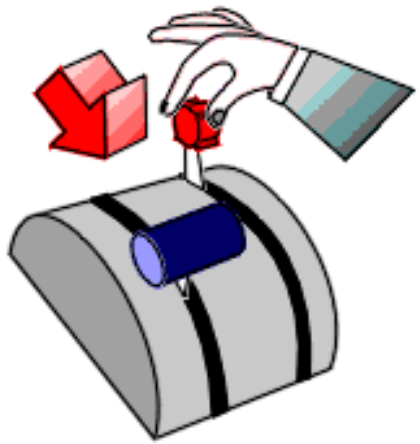
VOLUME VS. WEIGHT OF THE AIR ENTERING THE CYLINDERS



USING THE TACHOMETER TO ADJUST THE MIXTURE

A

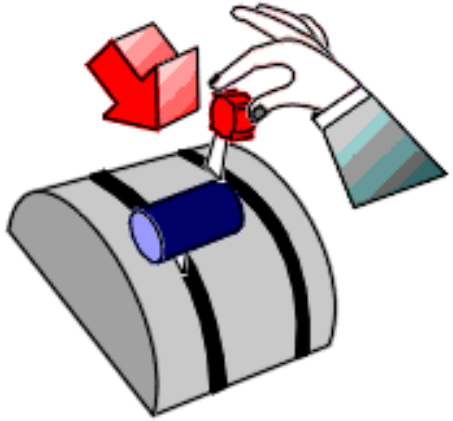
RPM increasing



Mixture is leaned

B

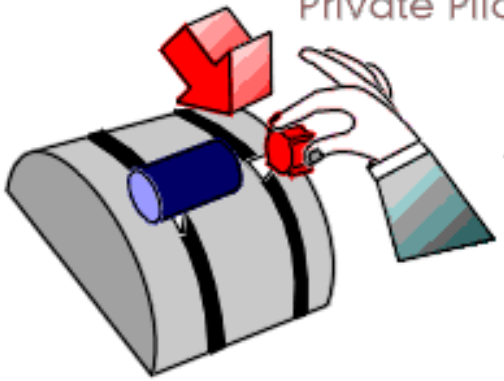
RPM increasing



Mixture is further leaned

C

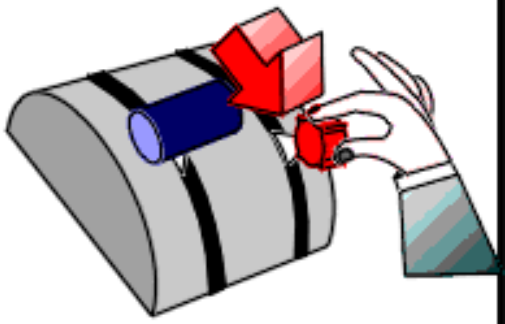
RPM at peak



Mixture leaned to peak RPM

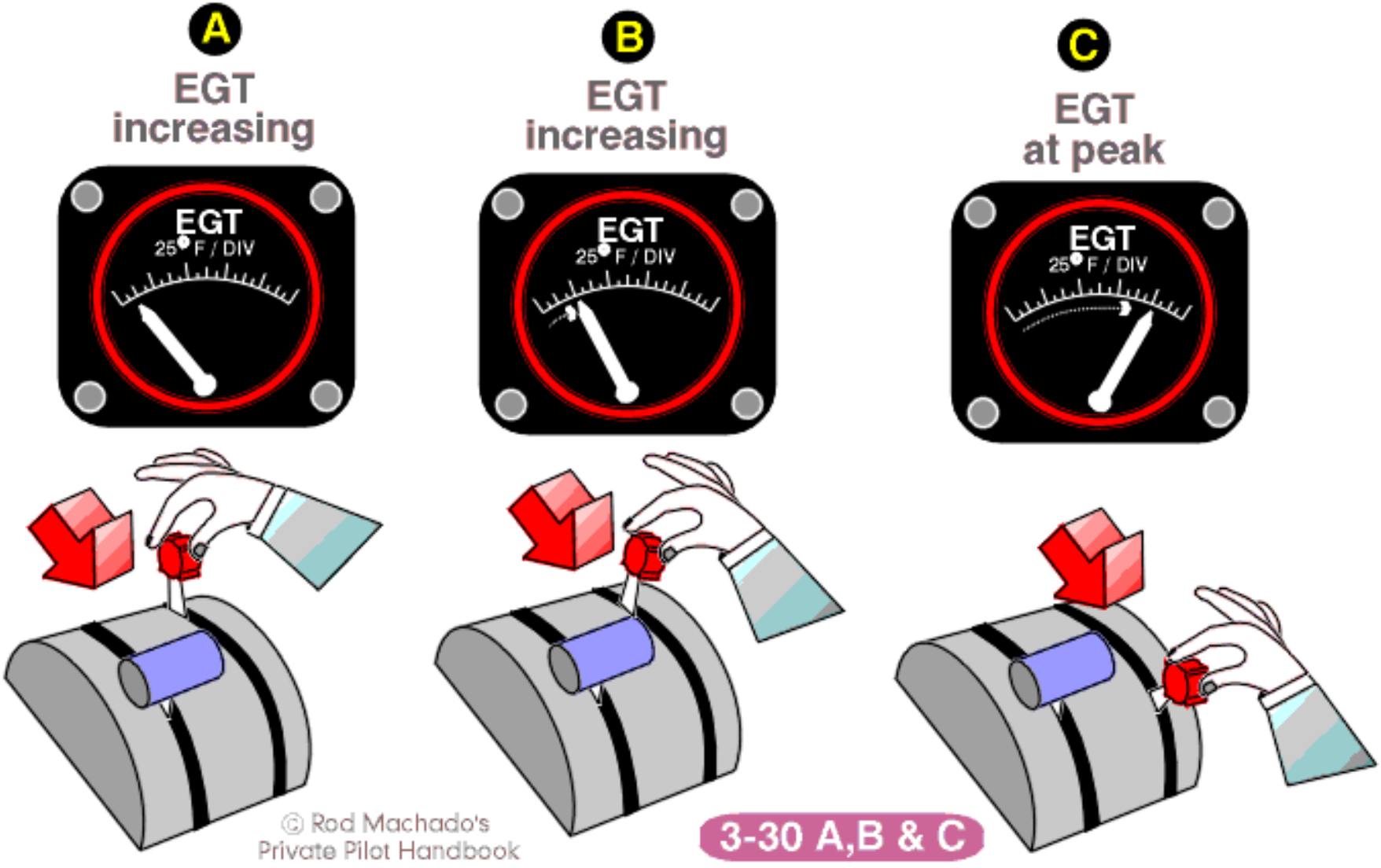
D

RPM decreasing



Mixture is excessively leaned

USING THE EGT GAUGE TO ADJUST THE MIXTURE



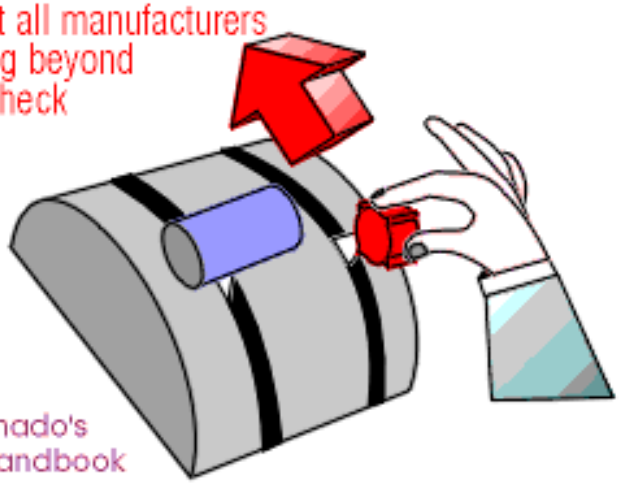
USING THE EGT GAUGE TO ADJUST THE MIXTURE

EGT for Best Economy

Mixture is ***leaned more*** until EGT cools 50°F from peak for best economy*

D

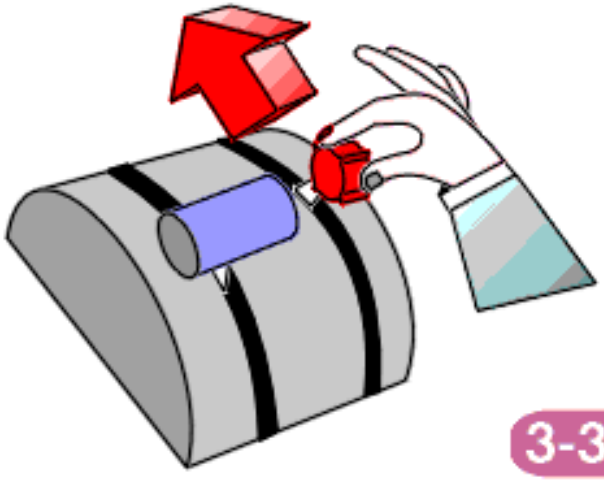
*Caution: Not all manufacturers allow leaning beyond peak EGT. Check your POH!



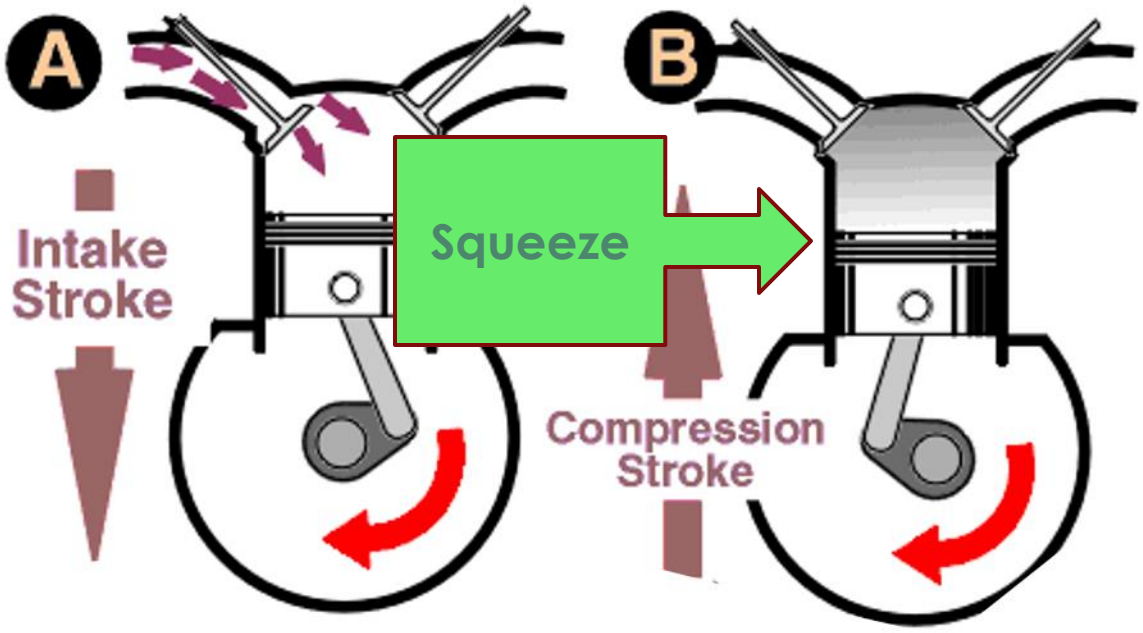
EGT for Best Power

Mixture is ***enriched*** until EGT cools 125°F from peak for best power

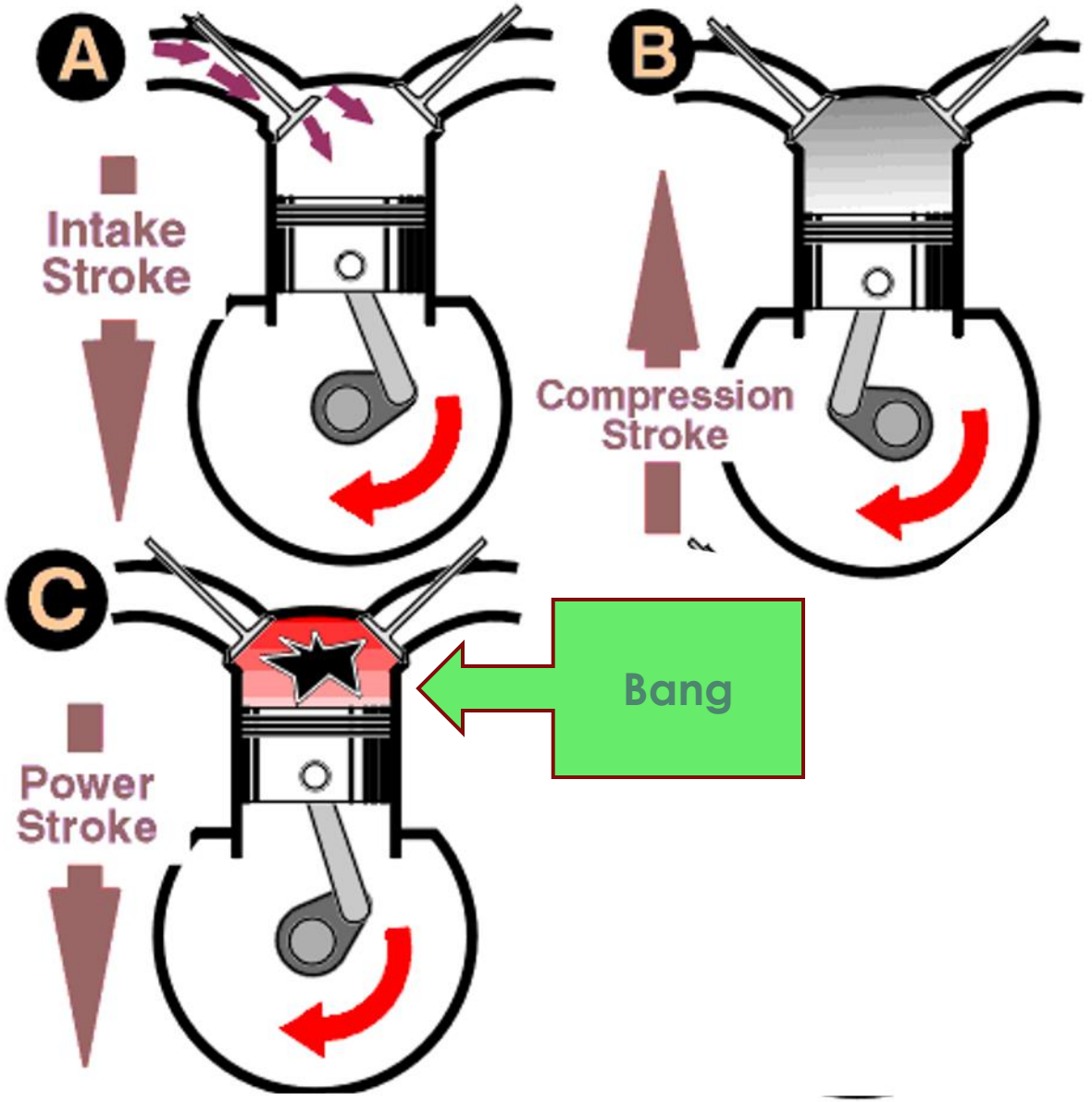
E



THE FOUR STROKE ENGINE



THE FOUR STROKE ENGINE

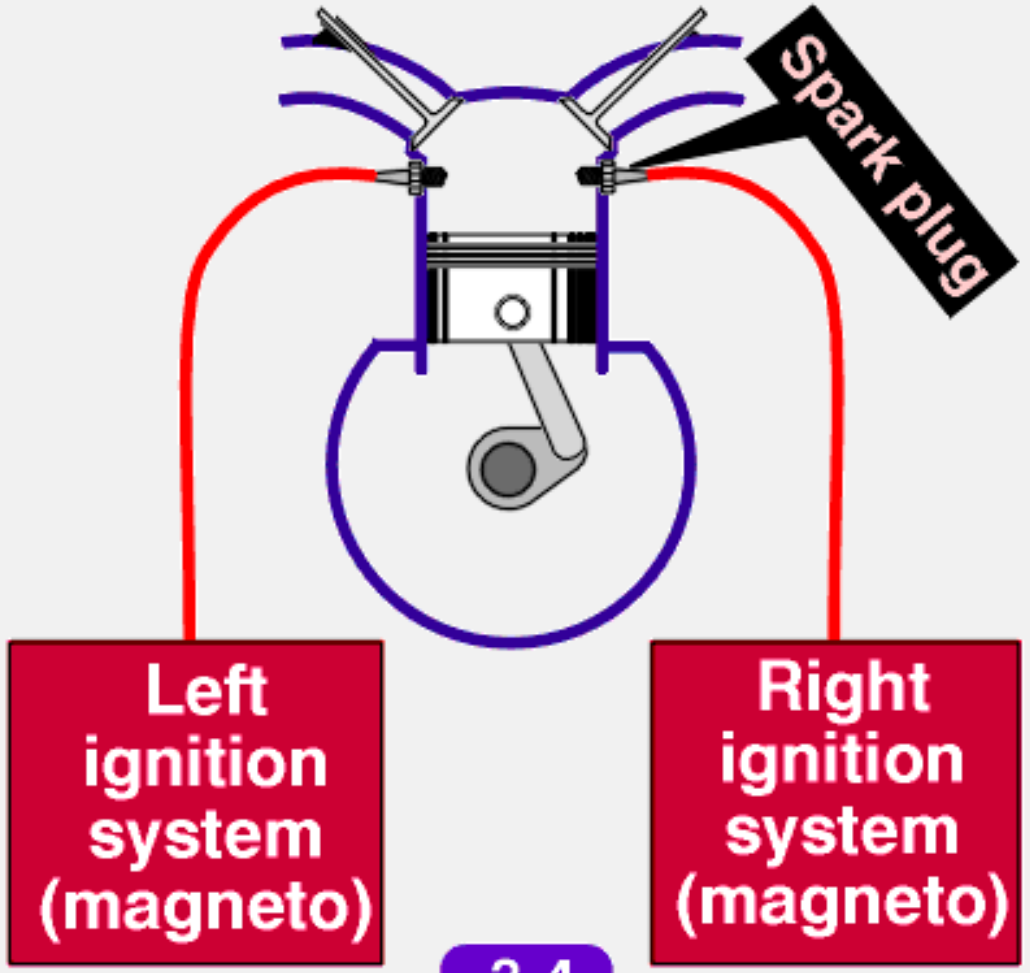


3-3

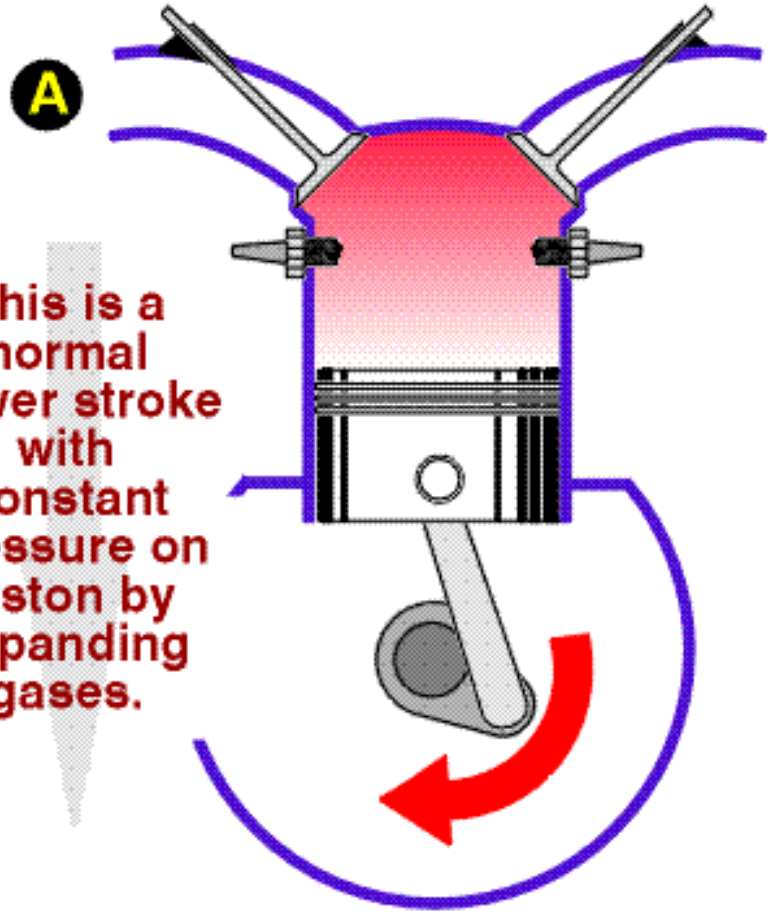
Ignition System

A DUAL IGNITION SYSTEM

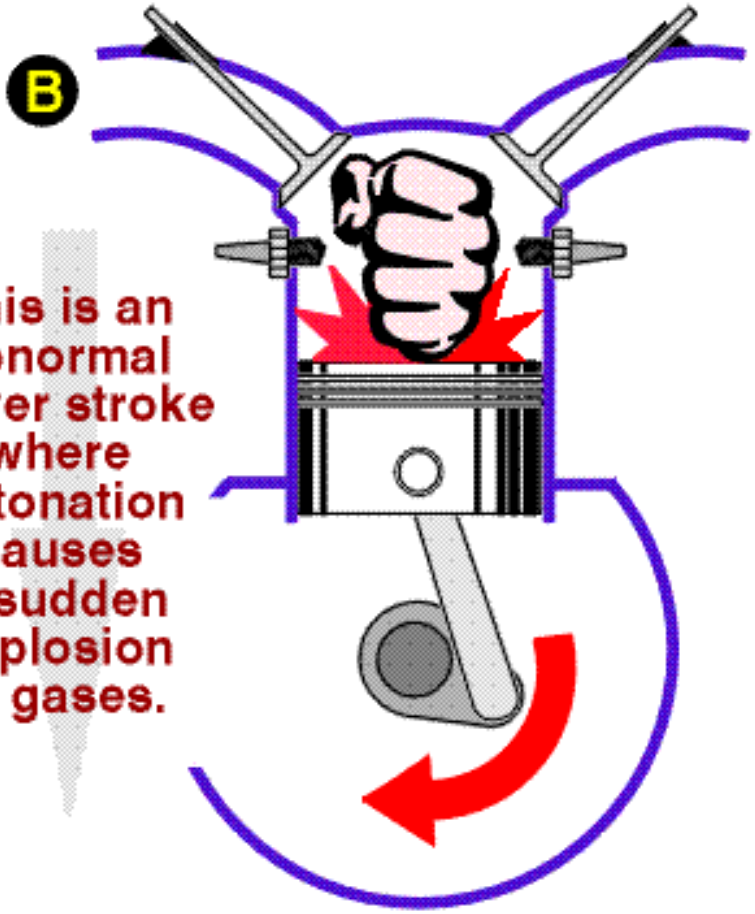
Dual ignition systems are installed in modern airplanes for increased safety. If the event one system fails, the other keeps the engine running.



DETONATION

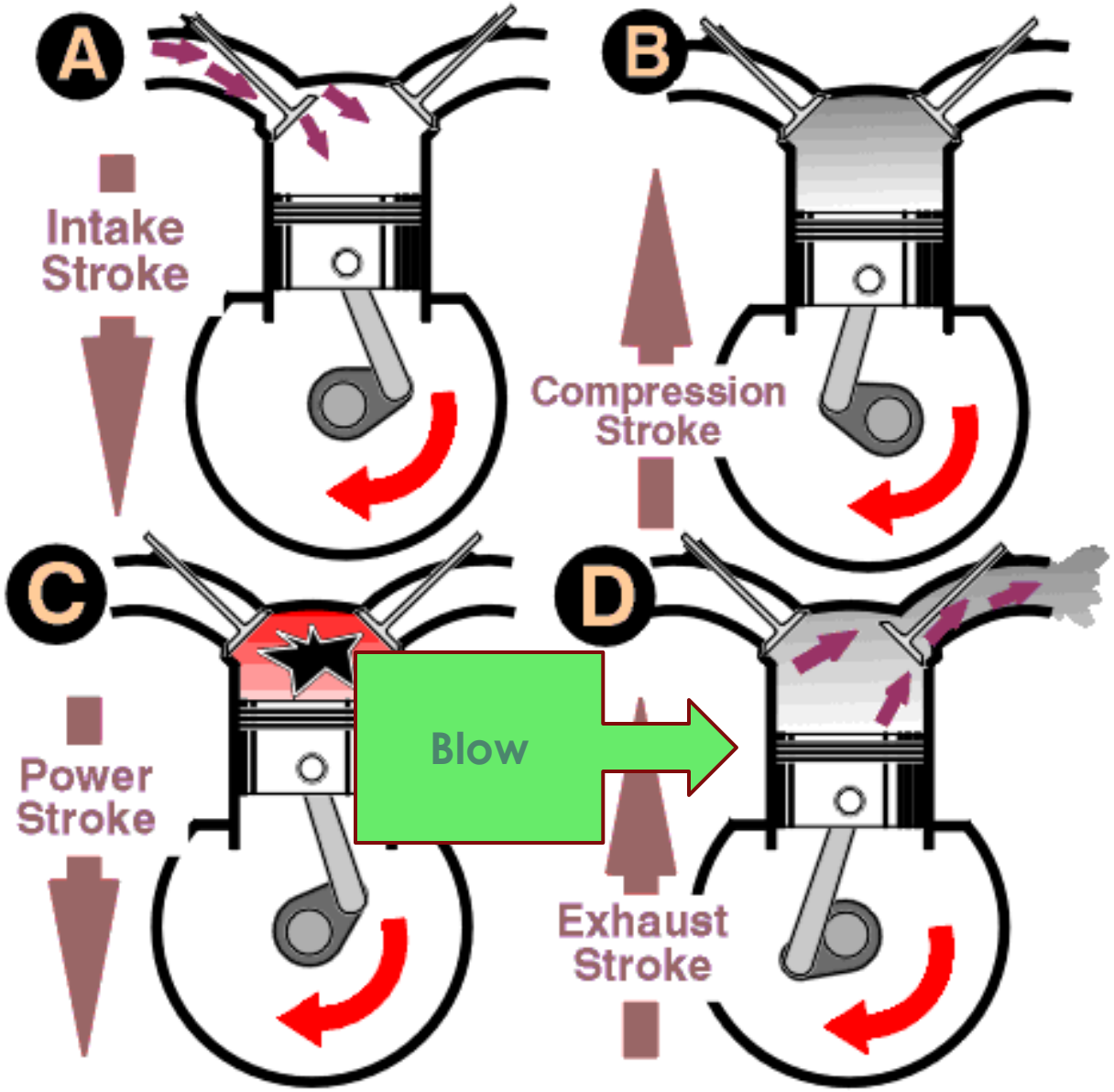


This is a normal power stroke with constant pressure on piston by expanding gases.



This is an abnormal power stroke where detonation causes a sudden explosion of gases.

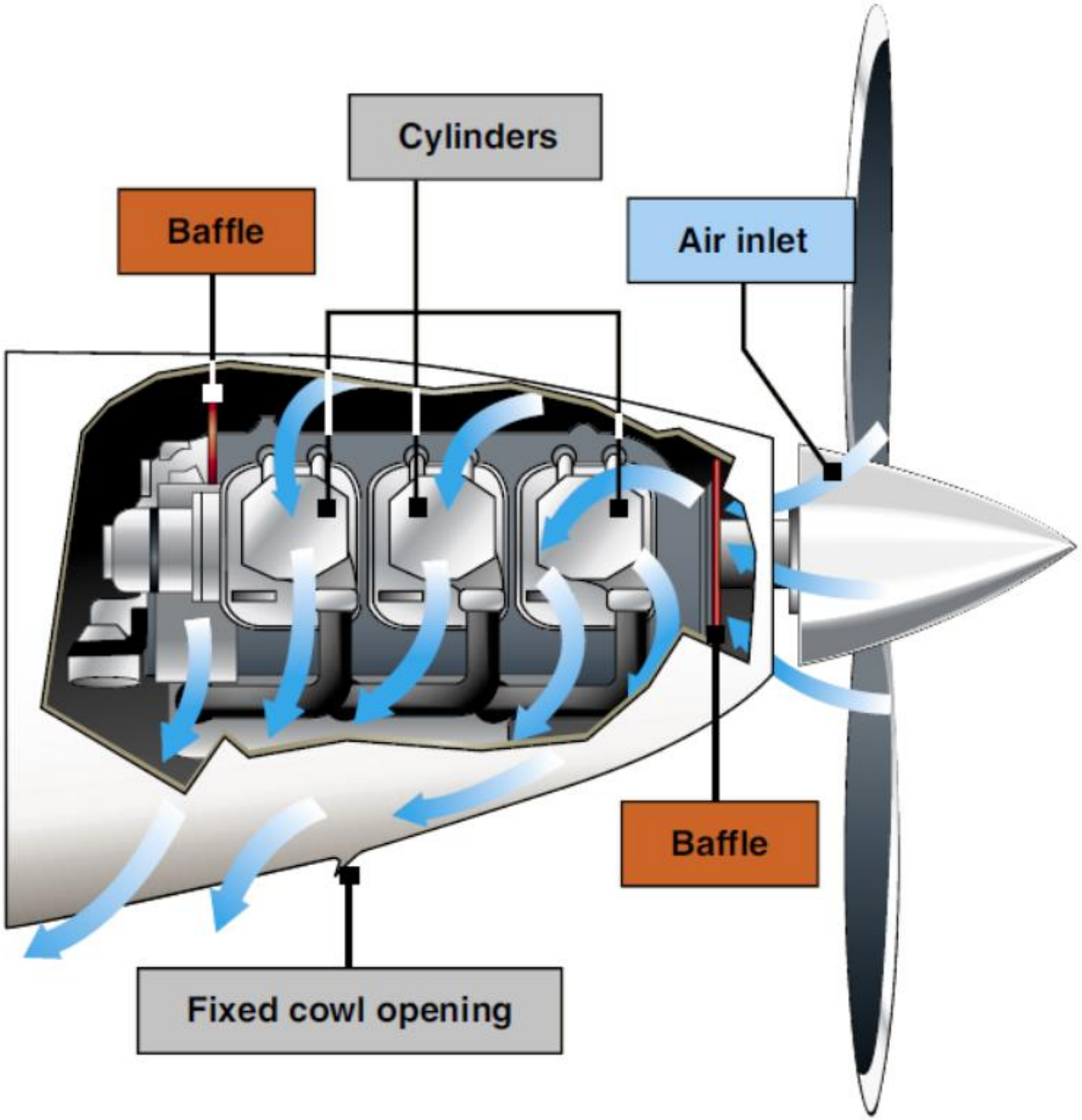
THE FOUR STROKE ENGINE



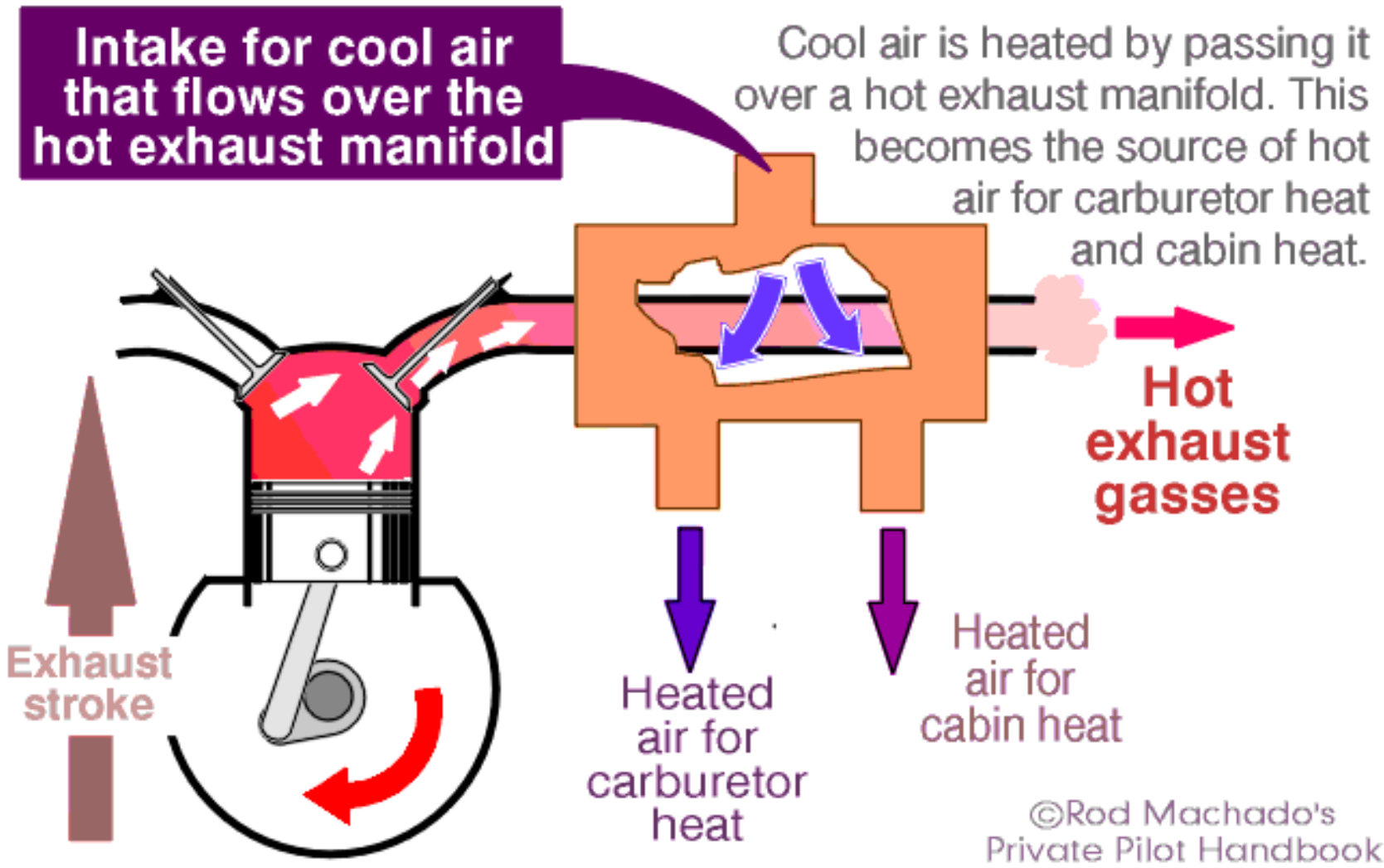
3-3

Exhaust Cycle

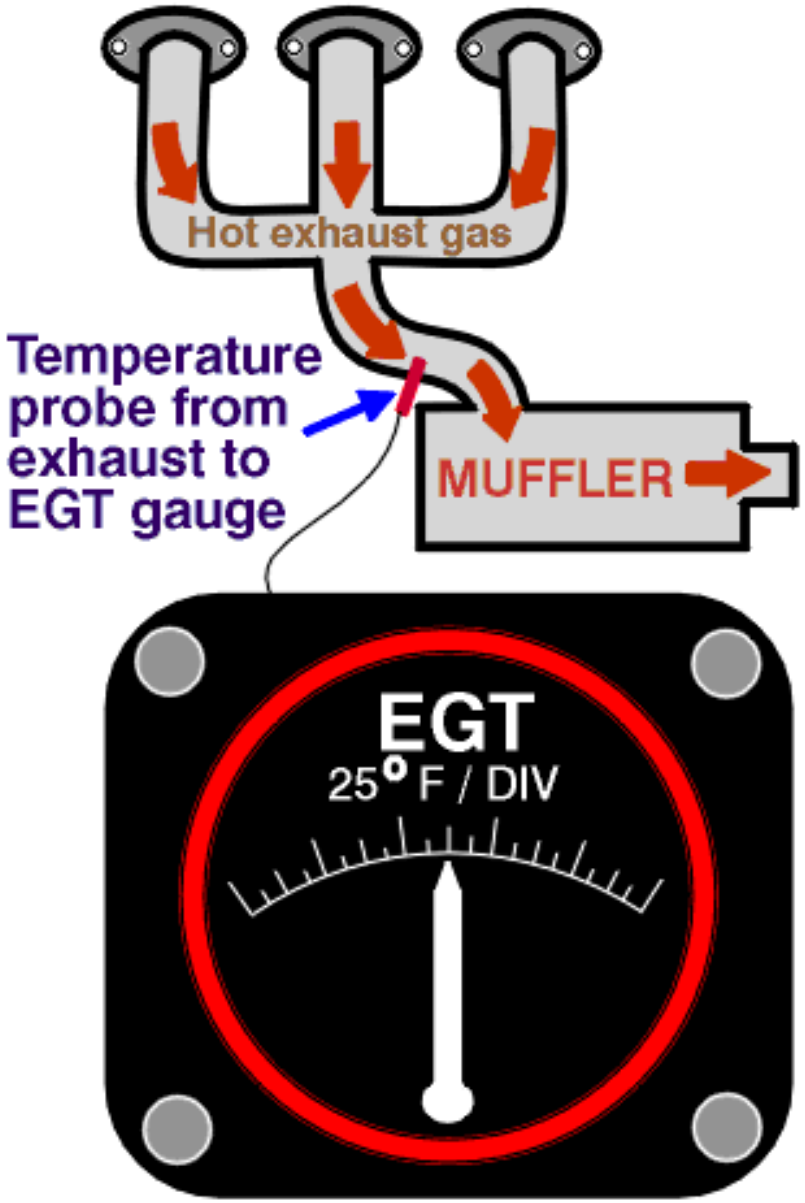
Engine Cooling


Cylinders
Baffle
Air inlet
Baffle
Fixed cowl opening

HOW THE AIRPLANE HEATS AIR FOR CARBURETOR HEAT & CABIN HEAT

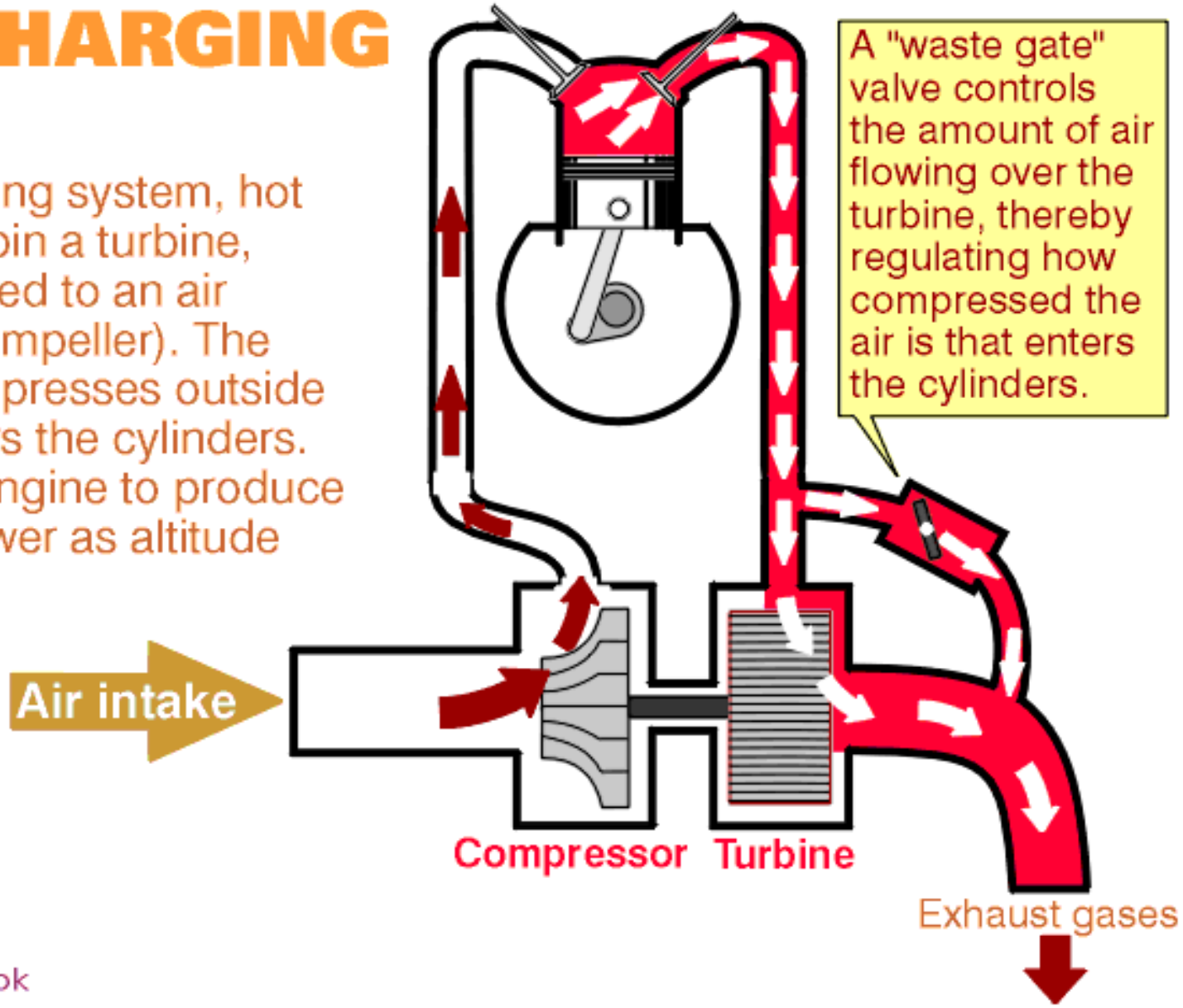


EXHAUST GAS TEMPERATURE GAUGE SYSTEM



TURBOCHARGING SYSTEM

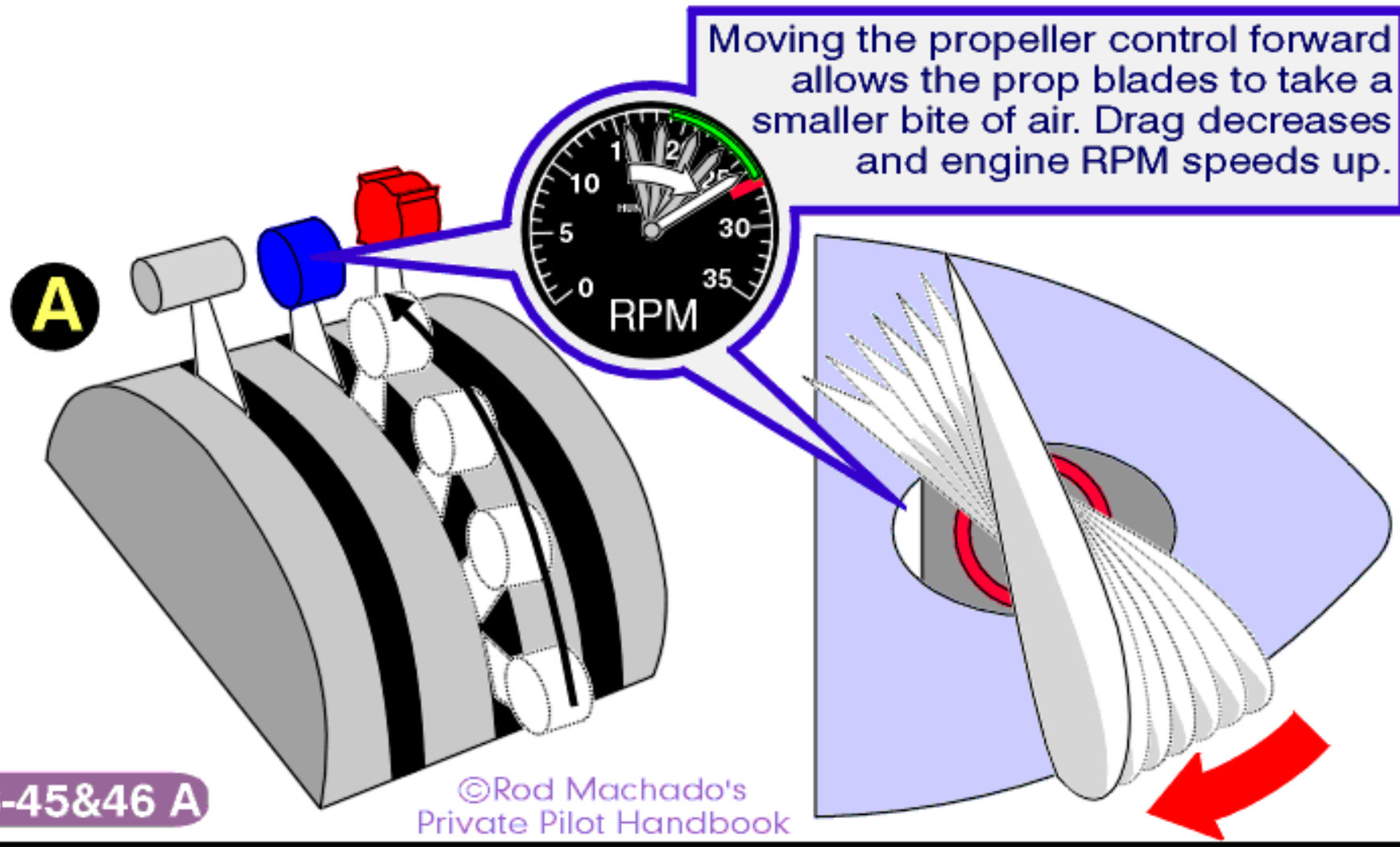
On a turbocharging system, hot exhaust gases spin a turbine, which is connected to an air compressor (an impeller). The compressor compresses outside air before it enters the cylinders. This allows the engine to produce its "sea level" power as altitude increases.



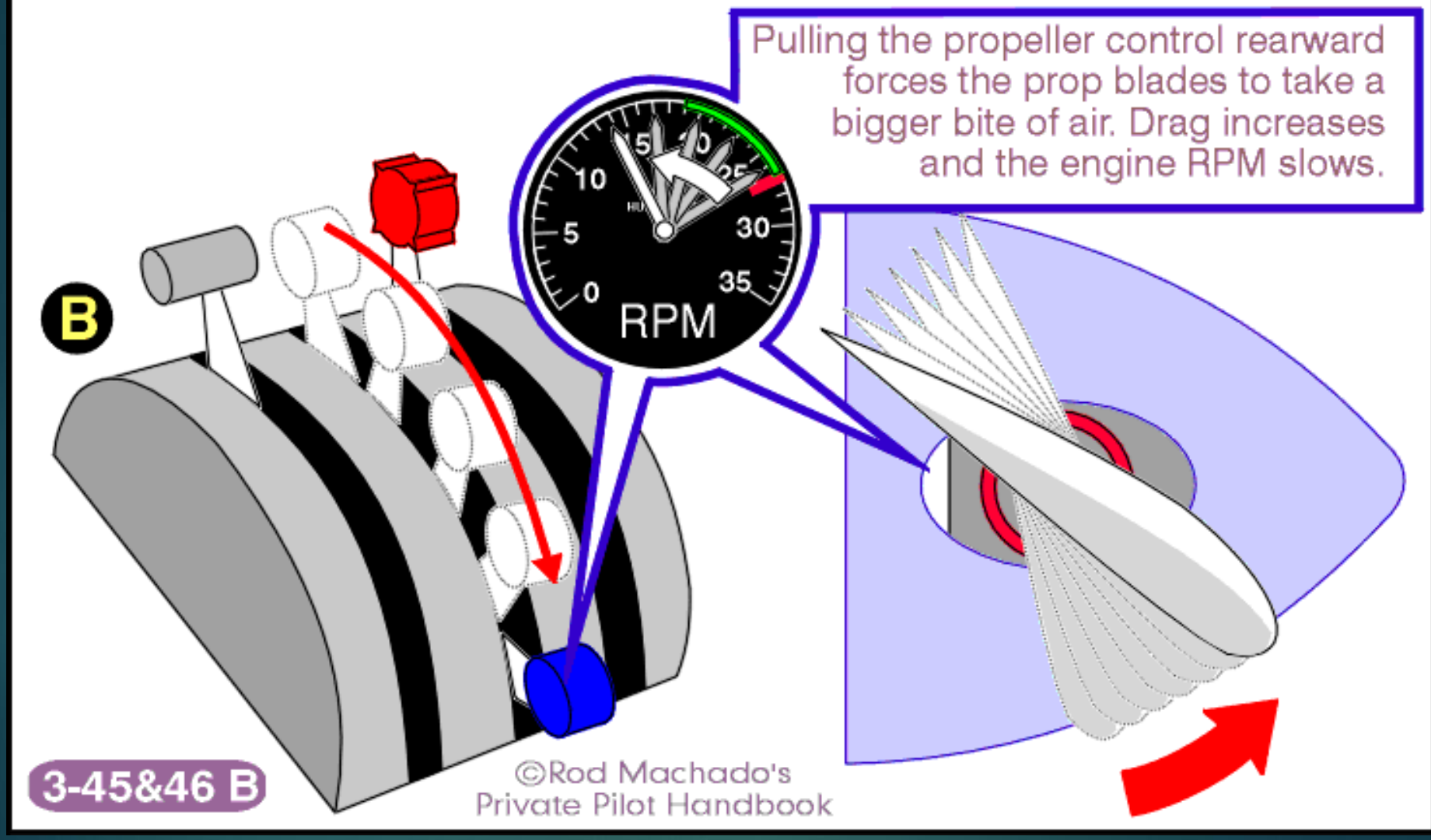
Engine Lubrication

Constant Speed Propellers

THE CONSTANT SPEED PROPELLER

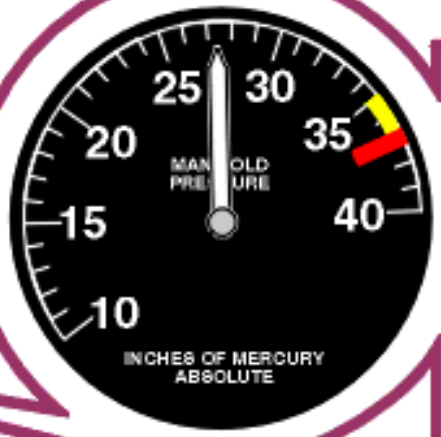


THE CONSTANT SPEED PROPELLER



POWER LEVERS ON AIRPLANES WITH CONSTANT SPEED PROPELLERS

Manifold Pressure Gauge



Manifold pressure is controlled by the throttle and shows the pressure of air downstream of throttle valve. Think of it as a rough measurement of engine power.

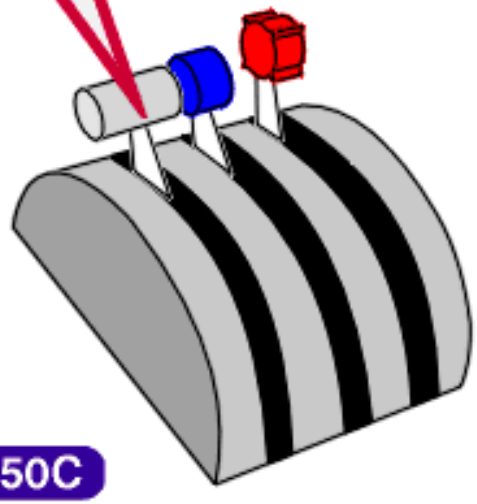
Tachometer

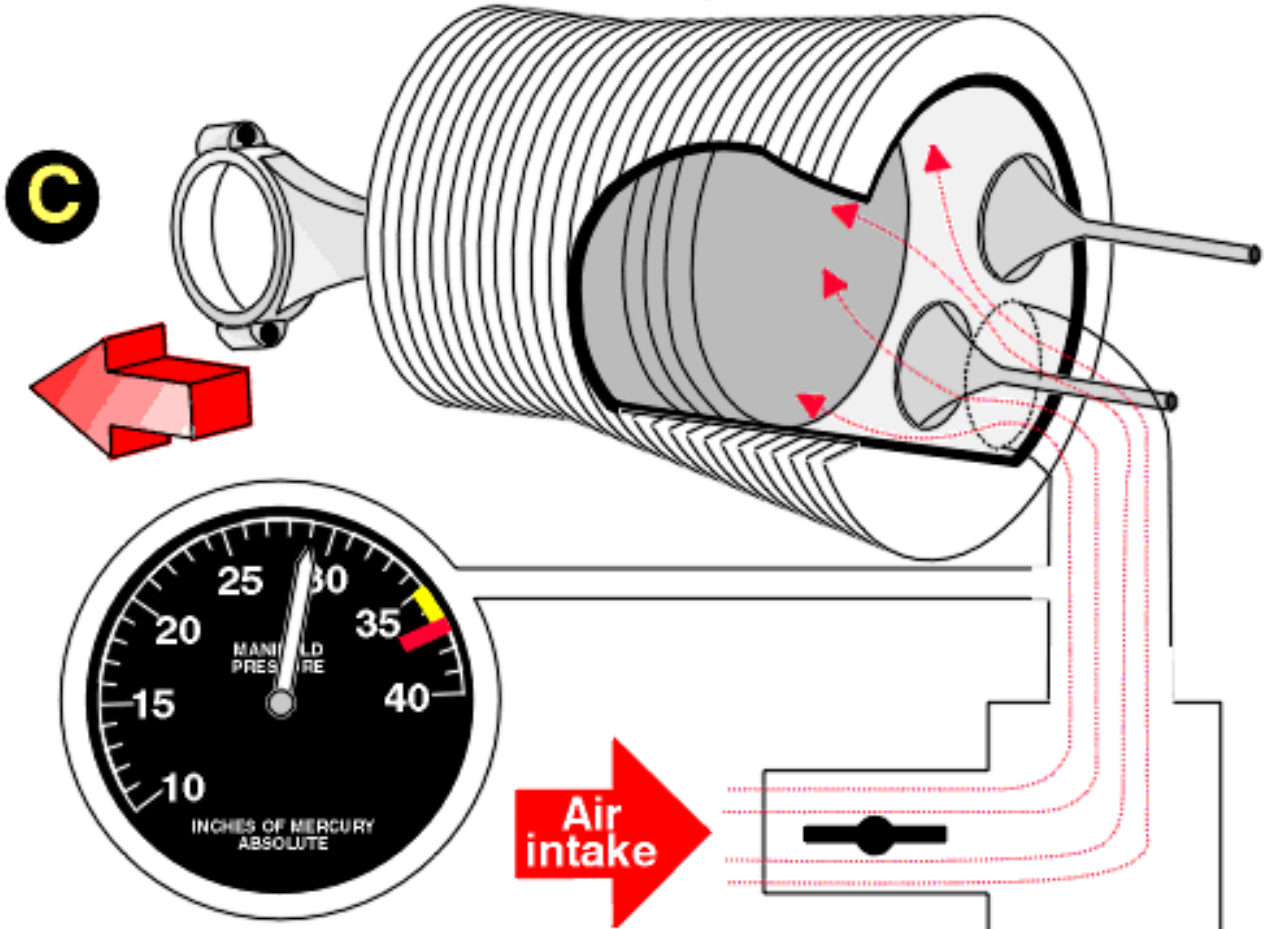
The tachometer shows engine speed. It is a measure of engine efficiency & performance & is controlled by the propeller control.

MANIFOLD PRESSURE

Manifold pressure is measured downstream from the throttle valve and provides an approximate measure of engine power.

At full throttle in a non-turbocharged engine, air can't be forced into the engine at greater than that of atmospheric pressure (which is near 30 inches of mercury).





Induction system

3-50C

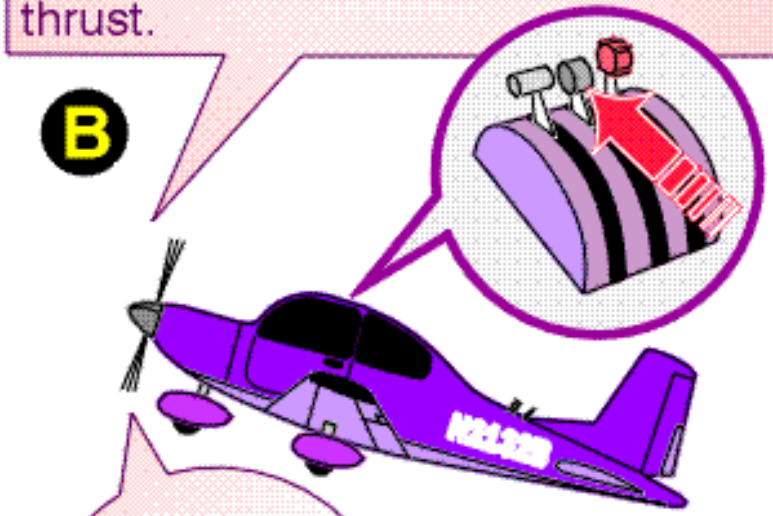
PROPELLER POSITION FOR TAKEOFF & CLIMB

The car starts out in low gear when going up hill. The engine turns fast & more power is delivered to the wheels.

A

Airplane also starts out in low gear when going up hill. In other words, when climbing, the prop is set to its full forward, high RPM position allowing the engine to develop maximum speed, thus maximum power. More power means more thrust.

B

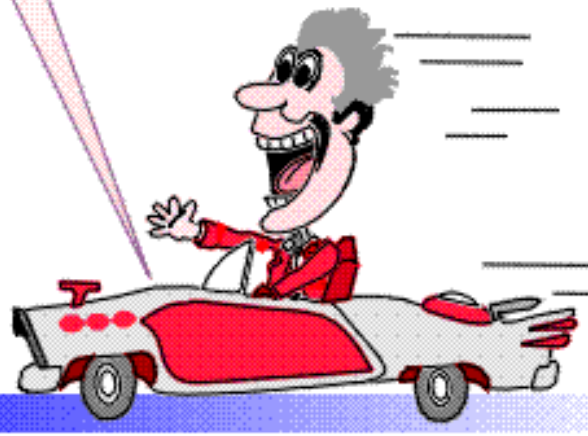


With the prop level set full forward, the prop blades take a small bite of air, which means less drag, thus higher prop speed.

PROPELLER POSITION FOR CRUISE FLIGHT

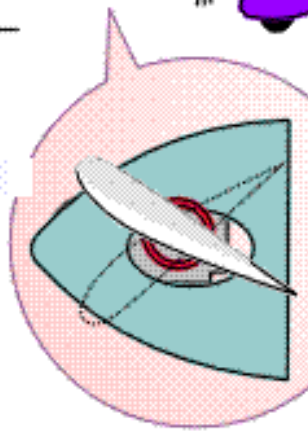
In cruise, the car doesn't need to develop maximum power. Therefore, higher gears allow the engine to turn slower while sufficient power is developed for freeway speeds.

A



Airplanes also cruise in high gear. In other words, in cruise flight the prop is set to a higher pitch (big bite of air). This allows the engine to run slower, use less fuel and still develop the necessary thrust for a reasonably fast cruise speed.

B



With the prop lever pulled slightly aft, the prop blades take a larger bite of air. This results in more drag, less propeller speed (RPM) and better fuel efficiency.

- Excessive manifold pressure raises cylinder compression temperatures – high engine stress

- A combination of high manifold pressure and low RPM can induce damaging detonation

To avoid, follow this sequence for changes:

- When increasing power, increase RPM first, then manifold pressure

- When decreasing power, decrease manifold pressure first, then RPM

PROP ON TOP