Engine Management

Prepared by Lt Col Lee Saage, SWR-TX-371

Contents

- Mixture management theory
- Ground operations
- Takeoff and climb
- Cruise
- Descent and landing

Ground Operations Theory

For all ground operation, including runup, lean to max RPM.

(Max RPM = Best Power Mixture)

Mike Busch

Savvy Aviation

Why full rich is TOO rich

Full rich mixture is horrendously rich

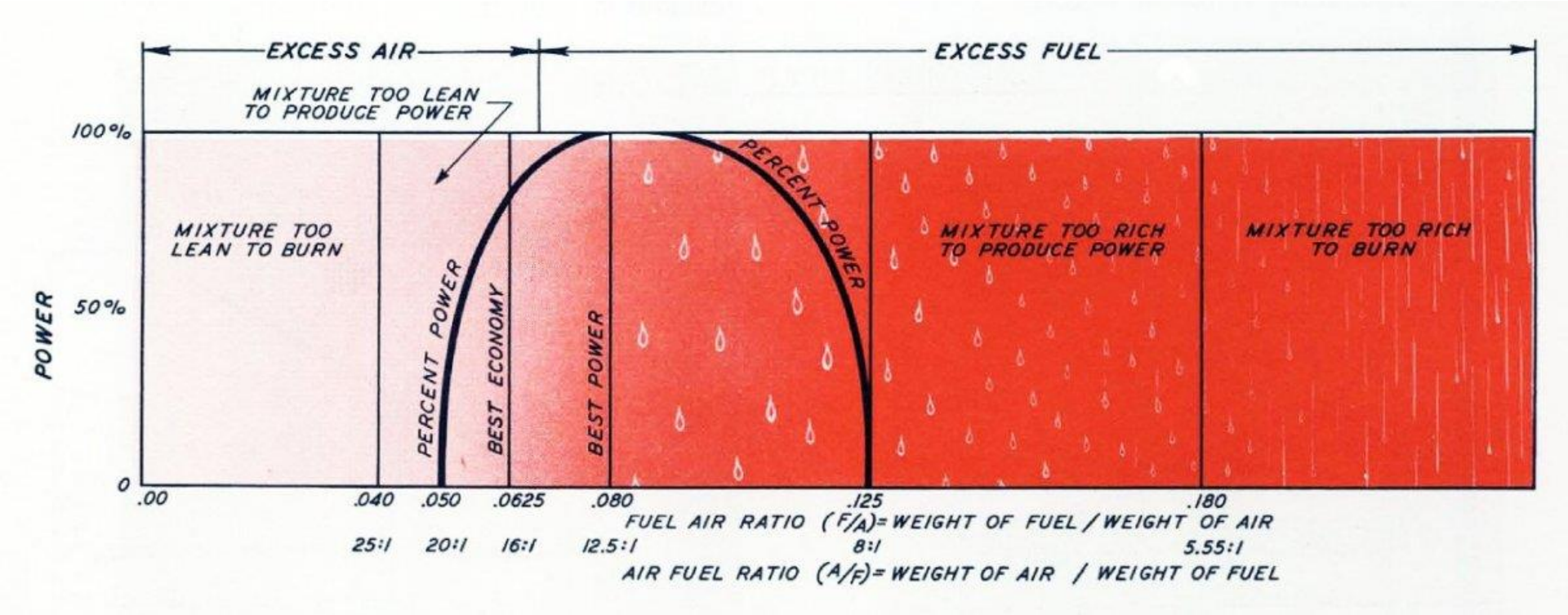
- Necessary to engines can be started when cold (no choke)
- Necessary to maintain adequate detonation margin during full-power operations (takeoff)

Flight Operations Theory

Interesting Mixtures

- Stoichiometric
  - Chemically perfect
  - Peak EGT
- Best Power
  - 20% excess fuel
  - 3% more power and 1.5% more speed
- Best Economy
  - 20% less fuel
  - 10% less power and 5% less speed

Air-Fuel Ratio Range



Mixture vs Key Parameters

Stoichiometric

Peak EGT

Best Economy

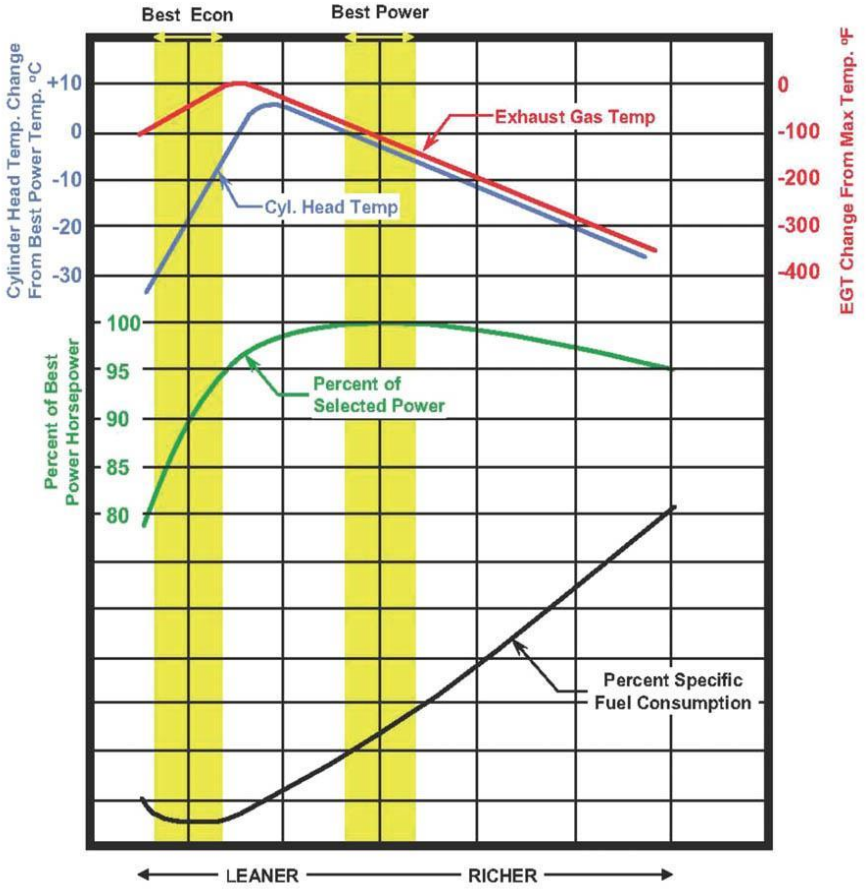
30º-70º Lean of Peak

Best Power

75º-100º Rich of Peak

Max CHT and ICP

40º-50º Rich of Peak



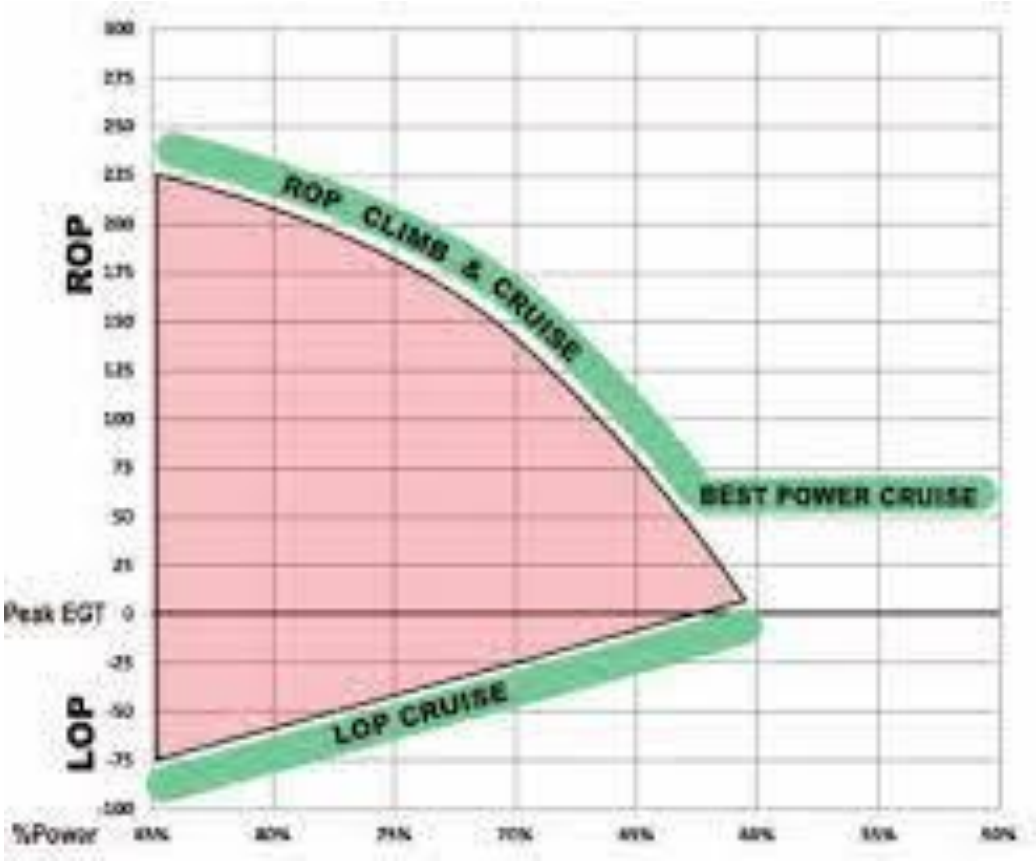
Cylinder Head Strength vs Temperature



The Red Box



The Red Fin


ROP
LOP
Peak EGT
%Power
ROP CLIMB & CRUISE
BEST POWER CRUISE
LOP CRUISE

Ground Operations

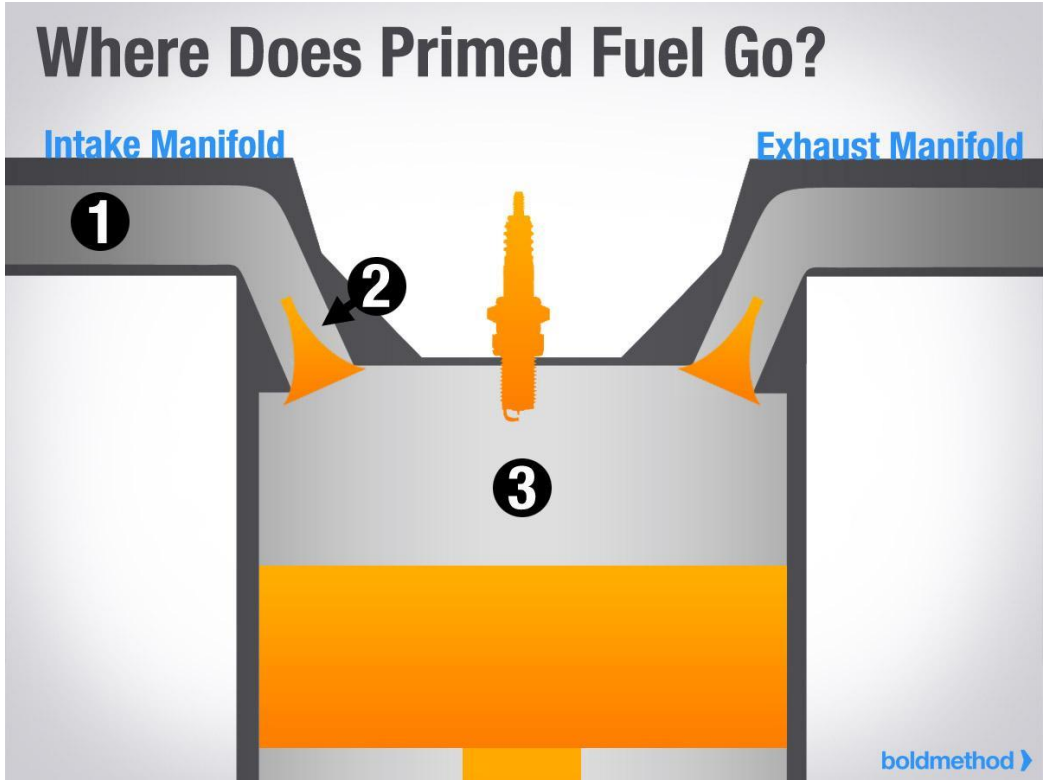
- Priming

Where Does the Fuel Go?

A fuel-to-air ratio of approximately 1:15 is needed to start the engine.

Too much priming changes the fuel-to-air ratio and the mixture won't ignite.

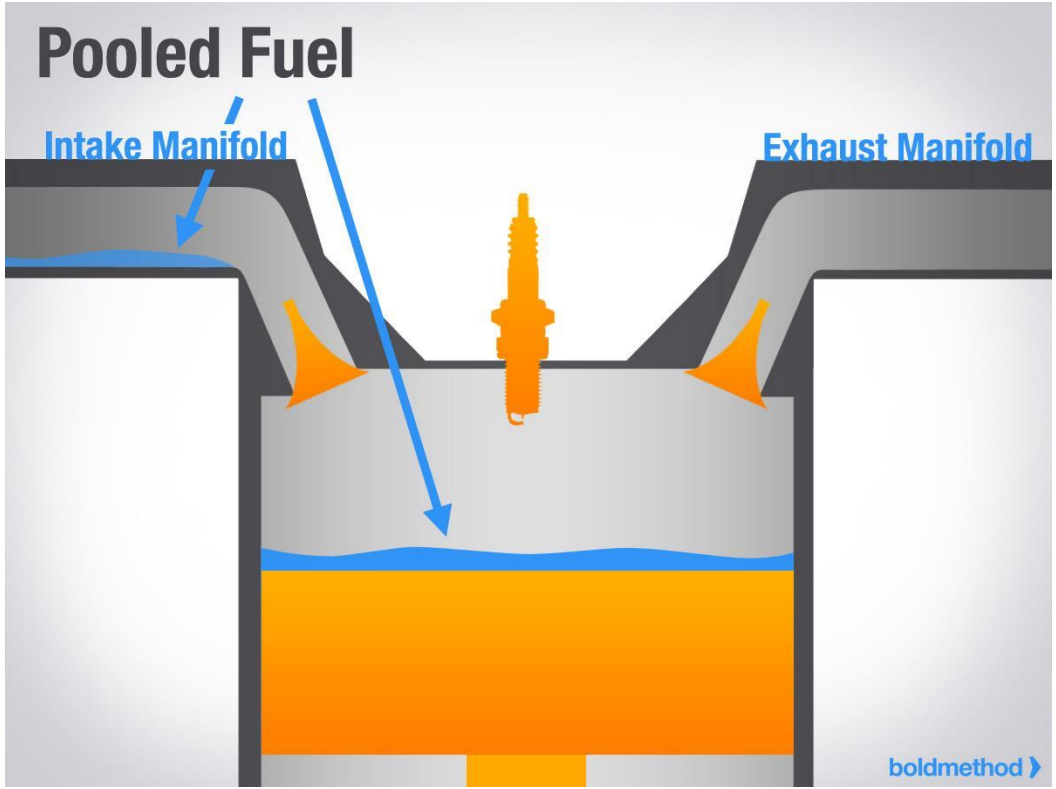
Excess fuel can pool in the manifold or cylinder, leading to problem #2.



Pooled Fuel: A Fire Waiting to Happen

Adding too much fuel during priming and its gaseous state and become liquefied.

Liquid fuel in the cylinder can ignite explosively.

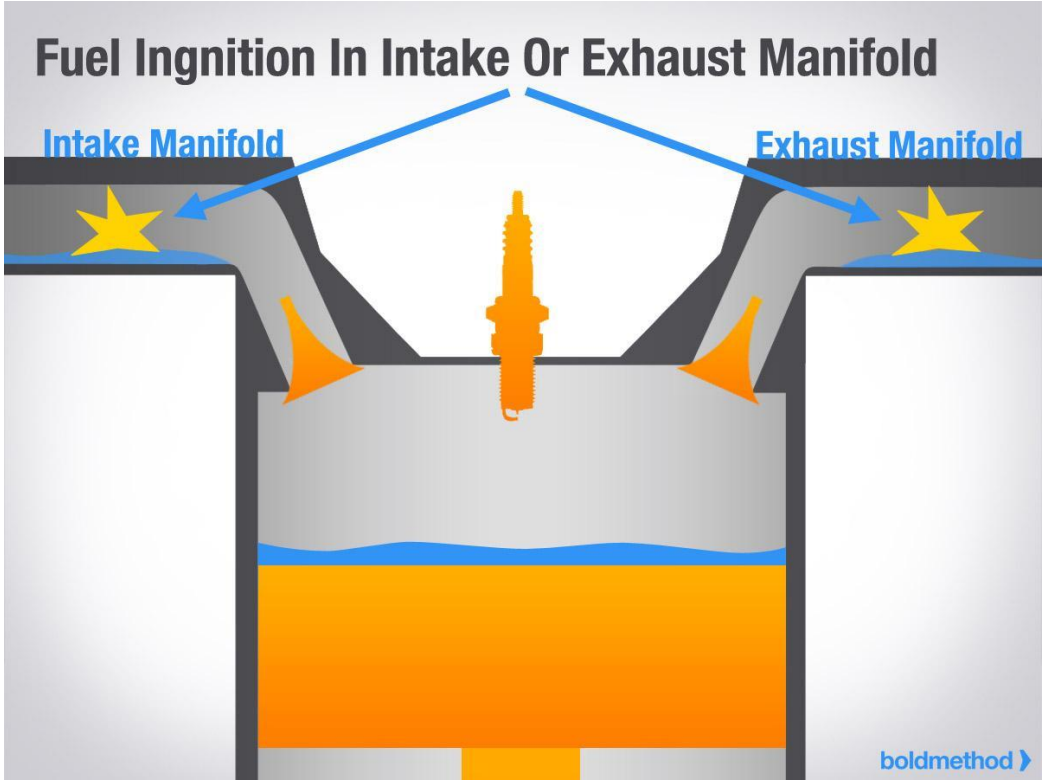


PROUD PAST
ENVISIONING
THE FUTURE

Fuel Ignition in Intake or Exhaust Manifold

Splashing fuel travels to one of two places as it ignites:

- The exhaust manifold: the ignited fuel exits through the fireproof exhaust system and usually not a problem.
- The intake manifold: the splashed fuel can also exit through the intake manifold and into the carburetor or fuel-injector assembly. These parts are not fireproof and can lead to fire.



PROUD PAST
ENVISIONING THE FUTURE

Dealing with Over-Priming

Over-priming usually results in a fuel smell.

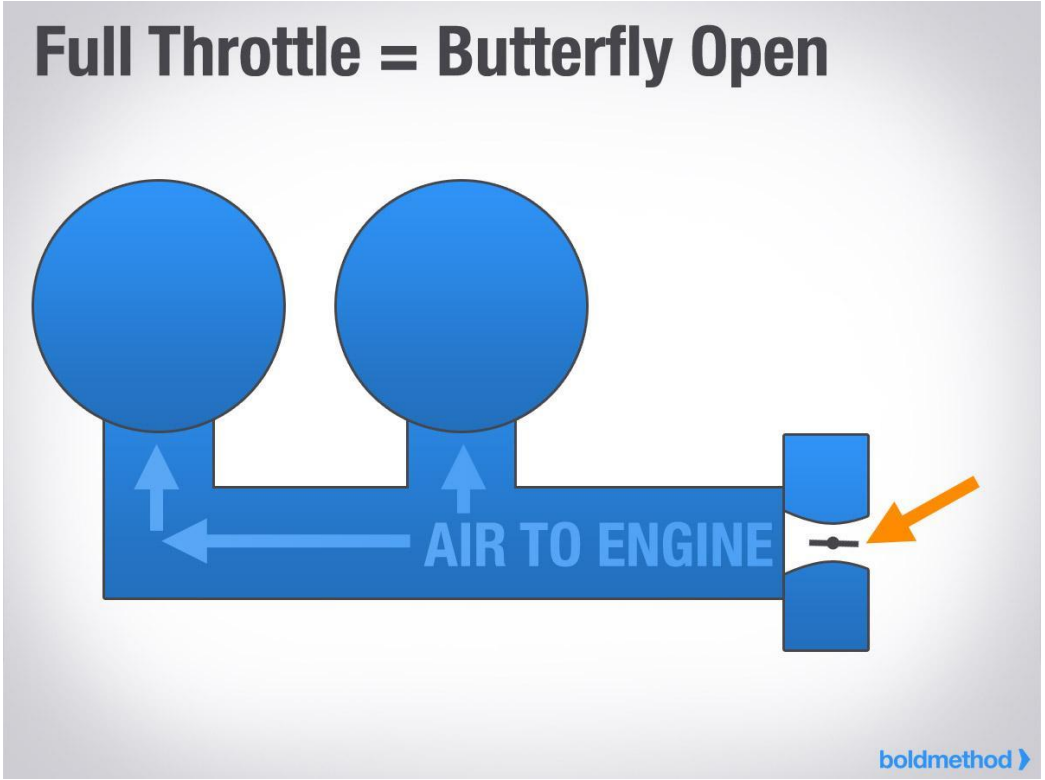
If really over primed, can probably see fuel dripping from the exhaust pipe or other parts of the cowling.

If slightly over-primed, use a specialized start procedure. (Open throttle)

If over-primed to the point where fuel is dripping from the cowling or exhaust pipe, do not start the engine.

Give the engine time to evaporate the extra fuel. To do that, open the throttle to full, which opens the engine's butterfly valve.

Sending air through the engine gives the pooled gas time to vaporize, usually 10-15 minutes.



Ground Operations

- Priming
- Mixture

Lycoming Guidance on Mixture Setting for Fuel-Injected Engines

- Lycoming Service Instruction #1497
  - Minimum prime during engine start
  - Lean to max RPM during ground ops including runup
  - Lean during all climbs above 3000’ density altitude
  - Lean during cruise at all altitudes
- In other words:
  - Full rich only for starting and takeoff
  - All other ground operations lean for max RPM

Continental Guidance on Mixture Setting

C182Q POH

- Does not call for leaning on the ground
- However, leaning won’t hurt and might help to avoid spark plug fouling
- If you do ground lean, lean brutally: taking off with a lean mixture will likely damage engine valves

Takeoff and Climb

- Full rich mixture always unless high-altitude airport
- Adjust for max power at high elevations
- Max power to 1000’ AGL
- Cruise climb per POH
- Cowl flaps open for cooling

Cruise

- Lean per POH
- Various POH mixture settings
  - C182Q POH - Recommended 50ºF ROP
  - C182T POH - Recommended 50ºF ROP; Best Power 125ºF ROP
  - C172S POH - Recommended 50ºF ROP
- Monitor CHT below 400ºF
- Cowl flaps as required to manage CHT

Descent and Landing

Descent

- Mixture as required
- Cowl flaps closed (usually)

Landing

- Mixture rich in case of go-around
- Carb heat

Takeaways

- Even if it’s cold, stick to a normal priming procedure
- Mixture rich for takeoff and initial climb
- Keep CHT below 400ºF

Engine Management Q&A

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