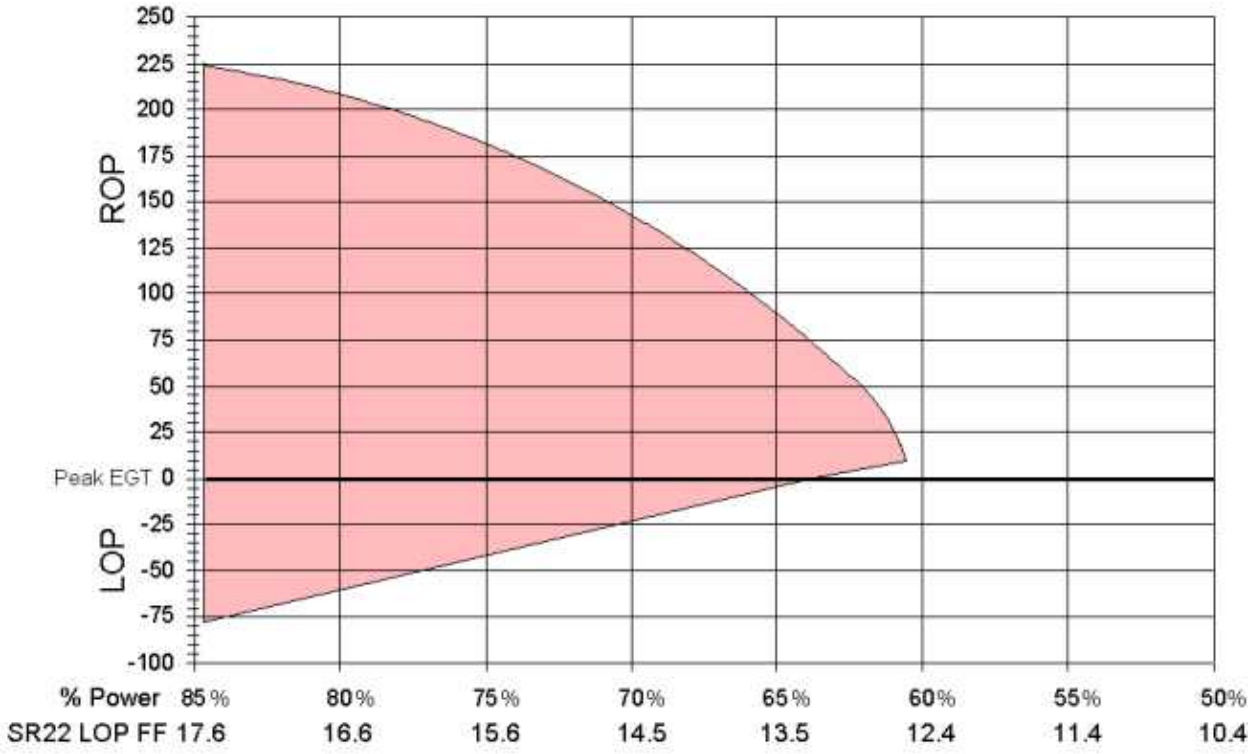
PWR	SR22 FF	SR20 FF	Min LOP	Min ROP
85%	17.7	11.4	75	220
80%	16.7	10.8	60	200
75%	15.7	10.1	40	180
70%	14.6	9.4	25	125
65%	13.6	8.8	0	100
60%	12.5	8.1	-	-
55%	11.5	7.4	-	-



2000’ ..... 2500 RPM
(Max MP at 2500)

4000’ ..... 2600 RPM

6000’ or above..... 2700 RPM

CHECK LISTS

TAXI

Mixture .....LEAN BRUTALLY

TAKEOFF

Mixture .....FULL RICH (or per POH for altitude)

CLIMB

Power Lever.....FULL FORWARD
500 Feet AGL .....EMAX NORMALIZE
Mixture .....MAINTAIN NORMALIZED 0

Step-Climb level off:

Fuel Flow .....NOTE
Mixture .....BIG MIXTURE PULL

Resumption of climb:

Mixture .....SET TO NOTED FUEL FLOW
Pitch.....CLIMB
Mixture .....MAINTAIN NORMALIZED 0

CRUISE

Pitch.....LEVEL OFF UNTIL A/S STABILIZES
Power Lever / RPM .....
2000' .....2500 RPM
4000' .....2600 RPM
6000'+.....2700 RPM
Mixture .....BIG MIXTURE PULL
Finding peak EGT (from lean side):
MFD.....EMAX PAGE
EMAX.....ABSOLUTE
Wait until EGT's stabilize (~ 1 minute)
EMAX.....LEAN ASSIST
Mixture .....SLOWLY ENRICHEN
When first cylinder peaks:
EMAX.....NORMALIZE
Mixture .....LOP or ROP per Red Box Table

DESCENT

Pitch.....DESCENT
Power Lever.....AS NECESSARY
Mixture .....LEAVE AT CRUISE SETTING
If engine roughness encountered:
Mixture .....ENRICHEN UNTIL SMOOTH

This seminal work was first created by Gordon A. Feingold - October 5, 2003 Based on Deakin, Braly, Atkinson With thanks to Curt Sanford

Examples are for SR22

TAXI

After start, and after the engine has warmed up for 2-3 minutes, lean the engine until a rise in RPM is noted. You know you're in the right place if any further leaning results in roughness. Maintain this setting for taxi and runup (yes, runup), going to takeoff rich setting as you're taking the runway. For taxi, you should be leaned "brutally" enough so that any attempt to set full throttle will result in the engine stumbling. (No, this will not hurt your engine – only your ego!)

TAKEOFF

The MFD should be on the EMAX page for takeoff. Use FULL RICH or set fuel flow according to the POH table for the pressure altitude. After application of full power, watch for all 6 EGT's to rise in concert, and "sweep" the eMax's engine "gauges" to ensure all are in the green.

During takeoff, note fuel flow. At sea level, you should be getting at least 28 GPH (for the SR22). If not, get your shop to adjust your fuel flow to obtain at least 28 GPH. If they balk, get another mechanic.

CLIMB

Just after takeoff, press the Normalize button the eMax page. You are capturing the takeoff EGT, which you will maintain by gradually leaning during the climb to altitude. I do this at 500', and then switch to the MFD Map page, where I have the engine monitoring block displayed.

During climb, watch the display of normalized EGT. As you climb, the numbers will display increasing negative values (-10, -20, etc.). What you want to do is to maintain "0". If you see negative numbers, you will lean the mixture. (I think: "minus means pull the red knob back, plus means push the red knob forward.") Note that a bug in the MFD software exists such that any time you are at a normalized zero the engine data block will display dashes ---- for all three parameters! So until this bug is fixed you are actually trying to maintain "dashes" instead of zero.

If you are given a step-climb intermediate level-off, pitch to level off and note your fuel flow. Then do a "Big mixture pull" (see below) and just leave it in that safe state until you get your clearance to resume climb. Then enrichen the mixture back to the fuel flow you had noted, and refine it to again maintain that normalized "0" EGT as you climb.

LEVEL OFF

When reaching your final cruise altitude, level off and leave everything alone until the airspeed stabilizes. This seems to take a good 2-3 minutes in the Cirrus. Then position the power lever / RPM as follows:

2000' ..... 2500 RPM (Max MP at 2500)

4000' ..... 2600 RPM

6000' or above..... 2700 RPM

The IO-550 is perfectly happy running at 2700 RPM all day long. This is where a good noise- canceling headset pays off! For running LOP, you generally want to be WOT: Wide Open Throttle (or as wide open as the above RPM guide will place you).

BIG MIXTURE PULL

The so-called “Big Mixture Pull” is a means of setting the mixture control to “park” your engine in a safe place. This will place your engine well lean of peak by moving rapidly “through the mountain” of peak temperatures and pressures to a safe place on the lean side.

To perform the Big Mixture Pull, pull back on the mixture control smoothly and fairly rapidly until you feel the airplane decelerate. Stop! You’re there. The pull should take about 5 seconds or so. Do NOT enrichen a little when you feel the deceleration. At altitudes below 10,000 this usually results in a fuel flow of about 13-14 GPH. Less if you’re higher.

Any time you want to park your engine in a known safe place, such as before finding peak EGT or for level offs during climb or decent, just perform a Big Mixture Pull.

FINDING PEAK EGT

Since you’ve just done a Big Mixture Pull after leveling off, you’re done with maintaining takeoff EGTs for your climb, so switch back to the MFD’s engine page and press the Absolute button. Give the engine a minute or two until the EGT’s stabilize.

Now we’ll use the eMax’s “Lean Find” capability to find peak EGT, but we’re doing it from the lean side of peak rather than the rich side. This is better for two reasons. First, the power curves are steeper on the lean side of peak, so you’ll be spending less time in the “red box,” and second you are looking for the first cylinder to peak rather than the last, also resulting in less time spent in the red box.

Press the “Lean Find” button and begin slowly enriching the mixture. Watch for the first cylinder to peak (it will turn blue on the screen). (When I say “first cylinder, I do not mean cylinder #1 – I mean whichever cylinder reaches peak first! You’ll likely find it will be the same one every time.) When that first cylinder peaks, immediately press the Normalize button to “zero” that cylinder at its peak EGT. Then pull the mixture back lean again to a “safe” place well lean of peak, or, once you’ve gotten familiar with the “red box,” you can usually lean pretty close to what will be your final setting.

SETTING MIXTURE USING THE RED BOX TABLE

The “Red Box” table depicts the “edges” of the red box, based on the amount of power you are producing. The “Red Box” defines a region where higher internal cylinder pressures, and the resulting higher cylinder head temperatures, may result in decreased engine life. The limits of the red box are defined in terms of degrees rich or lean of peak EGT, and the “width” of the red box changes depending on how much power you are producing (NOT altitude).

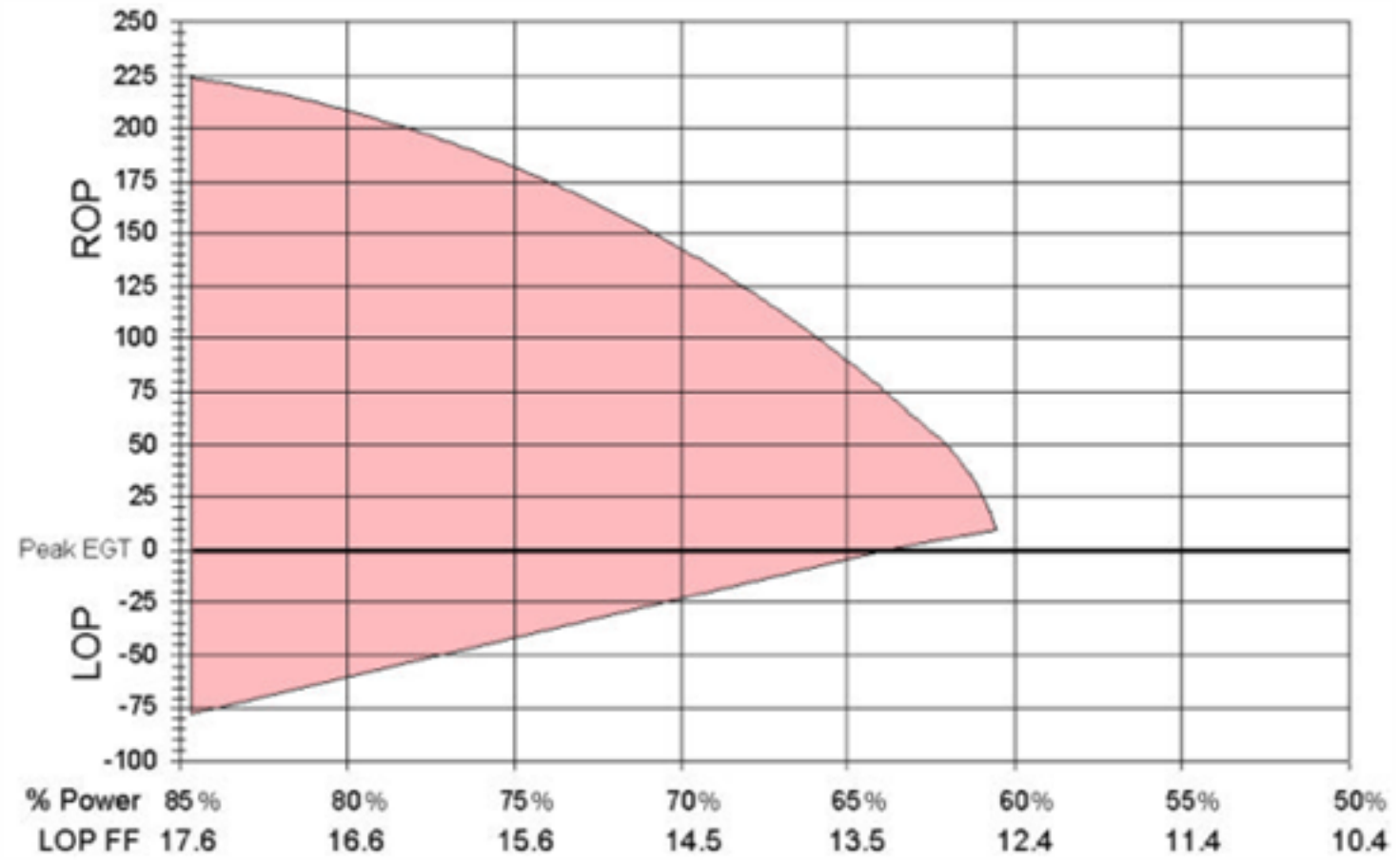
So to set your mixture so as to respect the red box limits, you first need to know, at any point, how much power you are producing. You can then look at the table, find the row for that percentage of power, and make sure you are at or outside of the limits shown for that amount of power.

For example, if I’m developing 70% power, I can look at the table and see that for that power setting I need to be 125 degrees rich of peak or richer, or I can be 25 degrees lean of peak or leaner. It shows me that at 70% power the area between 125 ROP and 25 LOP is to be avoided – that’s the red box at 70% power.

RED BOX			
% Pwr	Min° ROP	LOP FF	Min° LOP
85	220	17.6	75
80	200	16.6	60
75	180	15.6	40
70	125	14.5	25
65	100	13.5	0
60	-	12.4	-
55	-	11.4	-
50	-	10.4	-

So the red box is “wider” at high power settings, and smaller or nonexistent at lower power settings. As a matter of fact, a look at the red box table will show you that at 60% power or less, there is no red box, so you can put the mixture control anywhere! (More on that momentarily.)

Here’s another way to look at it. Same information. Maybe we’ll call this the “red fin!”



So now that you know how to get the EGT limits from the table, you need one piece of information to set your mixture control: “How much power am I developing?” Lean of peak, the answer is surprisingly easy, because when lean of peak, power is directly proportional to fuel flow. It turns out that you can simply

multiply your fuel flow in GPH by 15 to obtain horsepower. Dividing your horsepower by 310 (for the SR22) yields percent power.

To make this easy, the red box table does this for you. Find your fuel flow in the third column and look over to the first column to find your percent power (interpolating if necessary). So the table tells me that if I am lean of peak and my fuel flow is 13.5 GPH I am developing 65% power. You can use the “red fin” graph’s horizontal axis for this purpose as well.

Note that the eMax display of percent power may be way off when LOP! IGNORE IT! Use the red box table (or that factor of 15 and a whiz wheel), not the eMax display, when LOP.

So how do you use all this knowledge to set your mixture in flight? Easy. Here’s an example. Assume you’ve leveled off, done the big mixture pull, found peak EGT and normalized there, and have leaned again back to the safe region.

You will use the normalized reading from the first cylinder that peaked for this procedure. Ignore the others. Let’s call this cylinder the “key cylinder.”

Look at your fuel flow and find where it is in the table. So let’s say your fuel flow is 13.5 GPH. You can quickly see from the table that you’re developing 65% power. Now look on your eMax page and see where your normalized key cylinder is relative to peak EGT. Let’s say it is showing -40. The red box table says you must be at 0 degrees LOP or leaner at 65% power (in other words, ANY setting at or leaner than peak EGT is OK). Well, you are! You are out of the red box on the lean side by 40 degrees (-40 is less than 0). So if you want to develop more power but still stay out of the red box, you can.

So you can enrichen the mixture, let’s say to 14.5 GPH. A glance at the table says you’re now developing 70% power. Say you look at your normalized key cylinder and see it now shows –25. You look at the table and you see you’re done. Your -25 degree LOP setting is right at the red box limit for 70% power.

If that key cylinder showed -30 at 70% power, you could even be a bit richer if you wanted to max out your LOP power. But if you went to, say, 15.6 GPH and the key cylinder showed, say, -10, ouch! You’re inside the red box, because at 15.6 GPH = 75% power you must be at -40 degrees LOP or leaner and you’re not!

At higher altitudes, your engine will not be able to develop more than 60% power. So where do you set your mixture at high altitudes?

The answer will depend on the mission being flown. If range isn’t an issue and you want to “go fast,” a setting of 50 degrees RICH of peak will always result in the most power and thus the highest airspeed. Peak EGT is going to give you almost the same airspeed but will save a little fuel. For “go far” (economy & range) I use another MFD page – the trip page.

Switch to the MFD trip page, and, assuming your destination airport is the final fix, look at the “fuel remaining” value for your destination. If the fuel remaining at destination is less than your comfort level for the conditions, lean the mixture until the fuel remaining value suits you. (Leaning to idle cutoff to get truly spectacular remaining fuel is not recommended, however!).

For IFR reserves, put your alternate airport and the course to it in your flight plan and use the trip page as described to ensure adequate fuel.

HIGH POWER LOP MAG CHECK

The very best way to test your ignition system is to perform a high-power lean of peak magneto check. The typical ground mag check is next to worthless in terms of really testing your ignition system and plugs. Sure, it will tell you if a plug is completely fouled or not firing, and that’s what it is for. But to really test your system, perform a high-power LOP mag check in cruising flight.

First, switch to the eMax engine monitoring page. Press the Normalize button to zero all EGT's. Then switch to one mag and observe the EGT for each cylinder. Let 20-30 seconds go by. Don't rush it – you're not hurting your engine at all. All EGT's should rise, and by similar amounts (which will be quite a bit more than they will during a ground mag check). If a cylinder's EGT doesn't rise, or rises somewhat less than the others or exhibits erratic indications, you've found a problem (likely a bad or marginal plug) and you'll know exactly where the problem is. Perform the same test on the other mag.

DESCENT

If you're running LOP and you're ready to descend, you can leave the mixture control right where it has been in cruise for the descent. As you descend, the mixture will gradually become leaner, and you'll gradually become increasingly lean of peak and you'll be developing less power. In smooth air, it works out just about right to keep you out of the yellow arc at a 500-700 FPM descent. So for typical descents, do nothing with the red knob!

If you're descending from higher altitudes (>= 10,000'), you may find that you need to enrichen a bit as you get to lower altitudes so as to keep the engine running smoothly.

I reduce RPM to follow the same 2000/4000/6000+ profile as I descend. (2500, 2600, and 2700 RPM respectively.)

If I get a level-off during descent, I'll either leave the mixture where it is or simply do a variation on a Big Mixture Pull to "park" the engine in a safe place during the level-off.

APPROACH

In the approach phase, I'm still leaned, and I leave the mixture right where it is as I reduce to my approach maneuvering speeds (I use 19" MAP).