

# Engine Management Guidelines and Flight Data Review for Normally Aspirated SR22s

The Good, The Bad and The Ugly

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# Engine Management – Ground ops

- Warm up
  - RPM at or below 1000 RPM until oil at 75F! No taxi until oil at 75F.
  - Oil at 100F before run-up (over 1200 RPM)
  - Takeoff: Oil 130F minimum; CHTs 200F minimum
- The #1 way to damage the IO-550 is to push power too high before engine is warmed
- Preheats: recommended below 40F; required below 20F. Tannis takes 6 hrs to warm a “cold-soaked” engine.
- Taxi – lean to smooth engine if too rich (runs rough). The engine cannot be over-leaned on the ground; it simply doesn’t generate enough heat to hurt anything.
- Fuel pump – leave ON for hot engine (can vapor lock at low power), especially after landing.

# Engine Management - Climb

- High Altitude Takeoff (over 4000 MSL Density Altitude or so)
  - Line up, hold brakes, full power, set FF
  - Use table in checklist section of POH
- Best to climb ROP (Rich of Peak)
- Use FF table placard or hold engine temps – typically between 1350 and 1425F EGT
- Do not rush leaning – pull mixture slowly to avoid overheating or overshooting FF settings
- Intermediate leveling (temporary)
  - Pull power back to 75% or less
  - Pull FF to 18.5 gph for a quick ROP setting
  - LOP is ok also (follow LOP limitations), but go back to ROP for next climb
  - If resuming a climb, make sure FF is at least 18.5 gph, THEN go to full power and check FF against full power climb table

# Engine Management – LOP Ops

- LOP (Lean of Peak) is STANDARD OPERATING PRACTICE – only reasons NOT to run LOP:
  - CHTs too cold (below 240F – bars turn white). May happen in cold weather. May have to run ROP to get CHTs above 240.
  - Engine does not run smoothly LOP. Usually due to old or damaged spark plugs. Can also be mag timing. Report this condition ASAP. Mag check during LOP cruise can isolate the plugs in question – may run rough for a few seconds but watch EGTs to identify plug before going back to ROP cruise.
- Why LOP?
  - Better for engine! Less gunk, lower CHT's, better for overhead cam, etc.
  - Safety! Much better fuel reserves and range.
  - Economy! Saves as much as \$25/hr or more over ROP cruise.
- High Power Operations limit engine life!
  - Pushing high power and high FF over time damages overhead cam; there's no fix other than a major overhaul
  - High power operations tend to also run the engine too hot (unless burning excessive fuel), limiting cylinder life, damaging valves, damaging heat exchanges and flame arresters, etc.

# Engine Management – Cruise

- Pull power back to 75% MAXIMUM (a little lower is better)
- Use Lean Assist System to properly set FF
  - Will always be less than 15 gph. If higher than that the power is too high!
  - Can do “quick pull” to LOP if desired cruise EGT is known – pull to 13.5 to 14 gph, then tweak to correct temperatures.
  - Do NOT push power up after leaning!! The indicated % power is NOT correct (it shows a lower-than-actual value on MFD)
- EGT Temperature Limits
  - After establishing LOP operations, if EGT is greater than 1500F pull the power back! Power is set too high. If one cylinder runs significantly hotter than others (like 40F or more) it IS limiting – power must be reduced – but report it. Might be an injector issue that can be resolved.
  - Under no circumstances should any EGT be above 1530F for more than a minute or so during the leaning process. Operating above this temperature does the following:
    - Melts and/or distorts the internal components in the flame arrester or heat exchanger
    - Causes exhaust valve damage, resulting in blow-by (lost compression) or worse

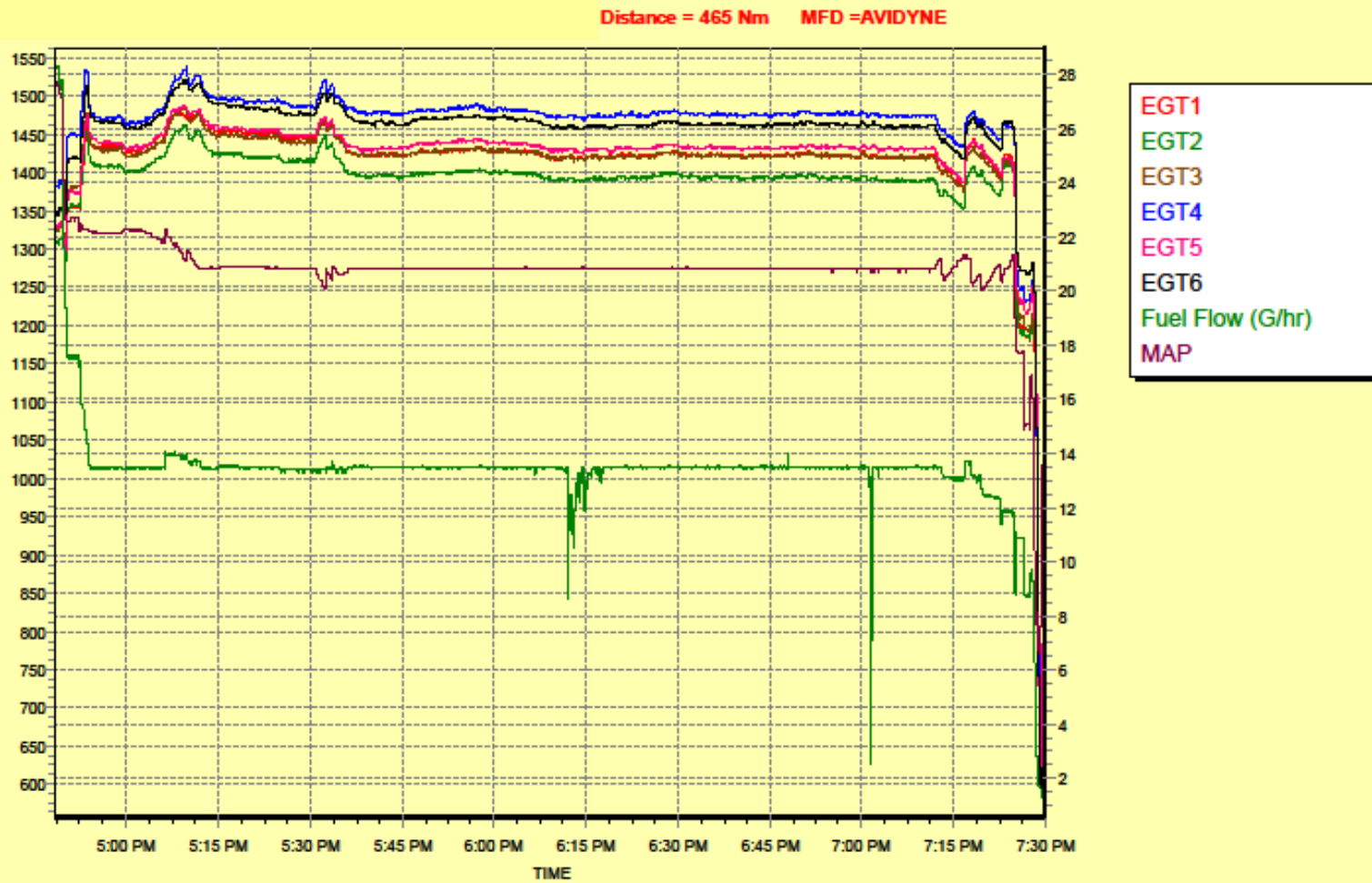
# Engine Management - Descent

- Keep engine in LOP operation until pulling power back to 15" or less
- At start of cruise descent, do NOTHING with the engine
- As descent continues:
  - Reduce power to hold indicated % power constant (will increase during descent, about 1" Hg/1000 feet)
  - Increase (richen) mixture SLIGHTLY to
    - Hold FF constant at cruise value, and
    - Hold EGT constant at cruise value or less (it will decrease during LOP descent at a fixed mixture)
- Pull power back when time to slow down; at 15" Hg do pre-landing checks, including full rich (unless at high MSL airport) and fuel pump ON. There is usually no need to run ROP at higher power settings during descent to landing.
- NOTE: if cruising ROP due to LOP limitations (too cold or not running smoothly) then make sure to richen mixture BEFORE temperatures climb in descent.

# Now to the examples!

- The Good, the Bad and the Ugly
  - Good: shows techniques outlined above
  - Bad: operation issues, probably no damage but hard to tell
  - Ugly: flights that caused engine damage
- First flight data – no comments. Try to interpret
- Repeated slide with comments follows

# Good, Bad or Ugly?

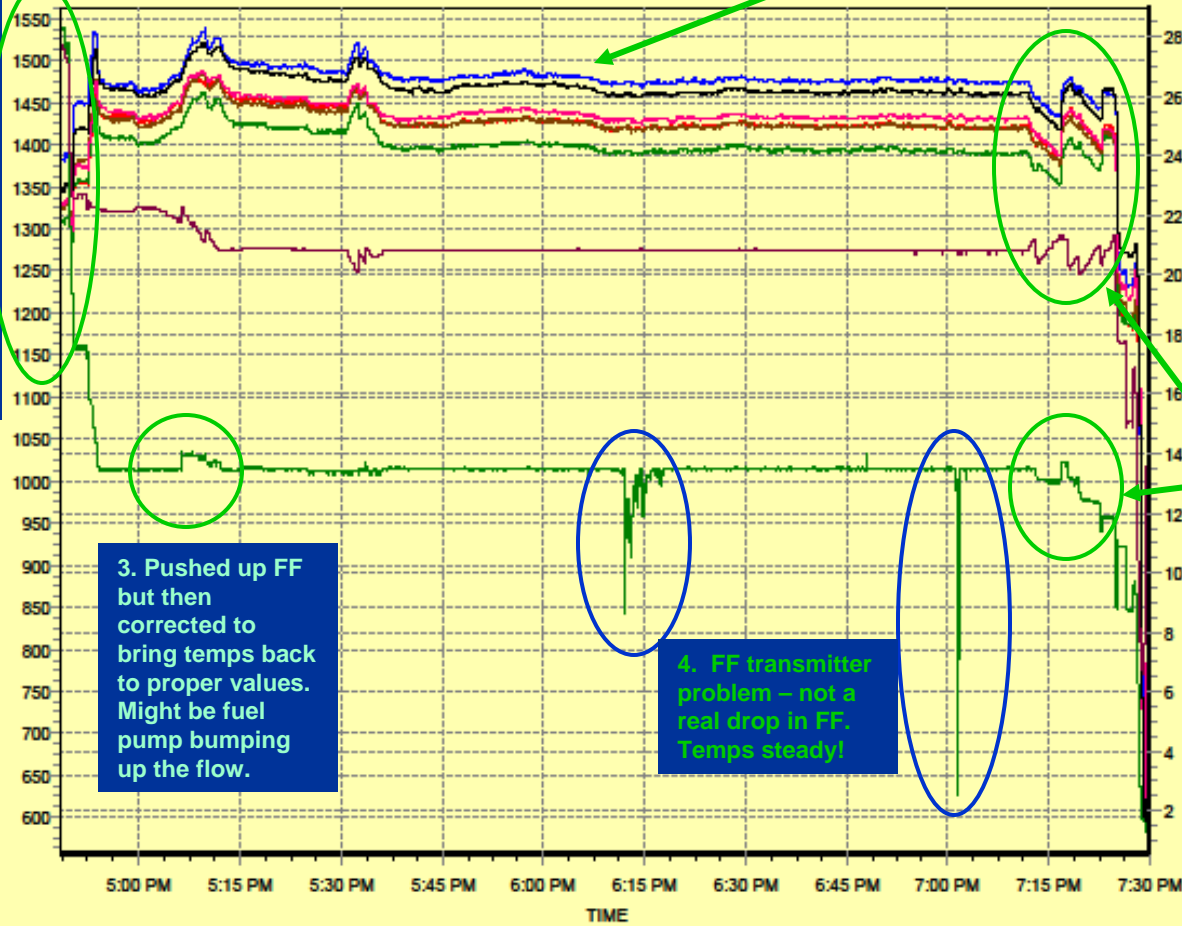


Good!

2. Max temps under 1500F for most of cruise

Distance = 465 Nm MFD = AVIDYNE

1. Short climb and power reduced; quick pull to ROP cruise for a minute (17.5 gpm) then lean assist used to go to LOP operation almost immediately.



EGT1  
EGT2  
EGT3  
EGT4  
EGT5  
EGT6  
Fuel Flow (G/hr)  
MAP

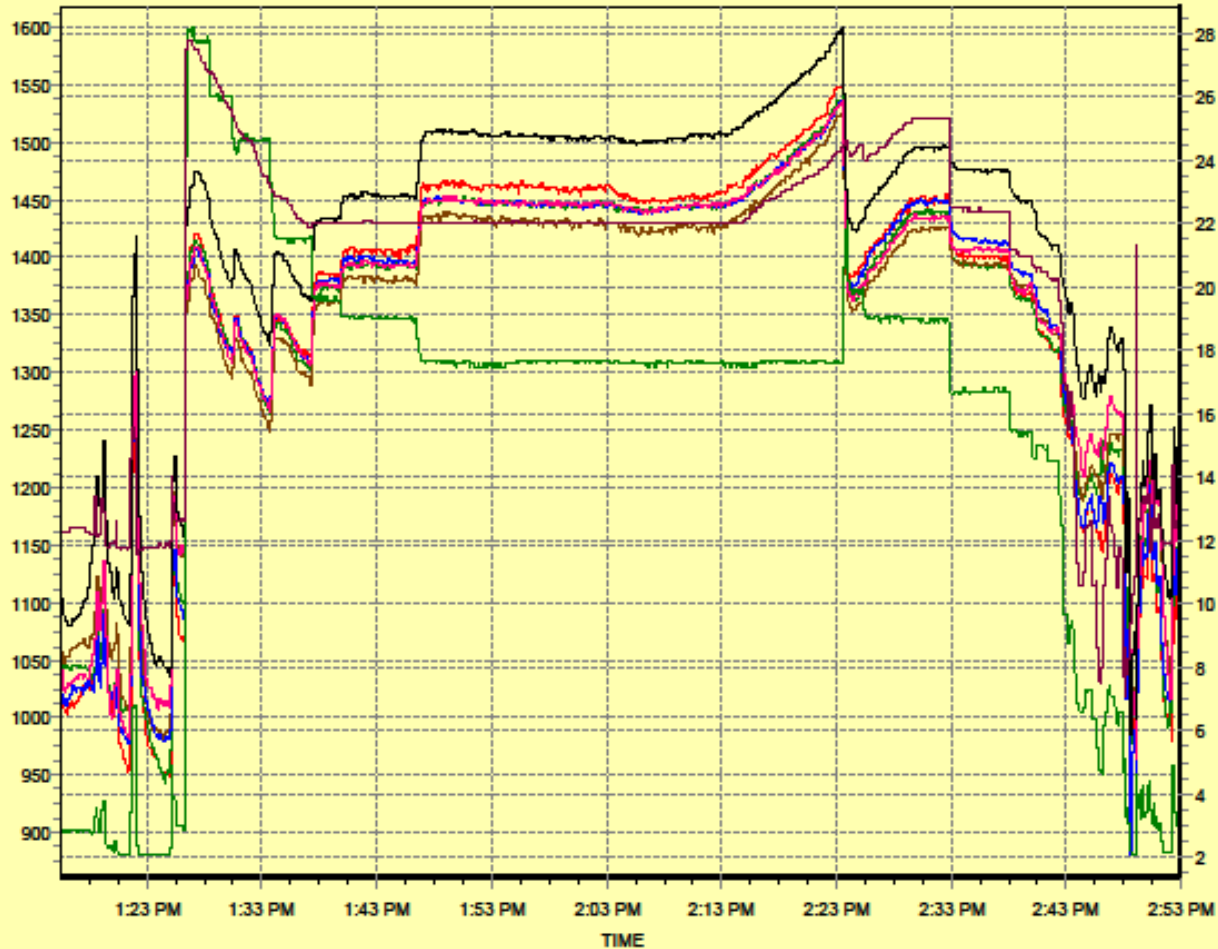
4. Power and FF adjusted during descent to hold temps constant. LOP maintained during descent.

3. Pushed up FF but then corrected to bring temps back to proper values. Might be fuel pump bumping up the flow.

4. FF transmitter problem - not a real drop in FF. Temps steady!

# Good, Bad or Ugly?

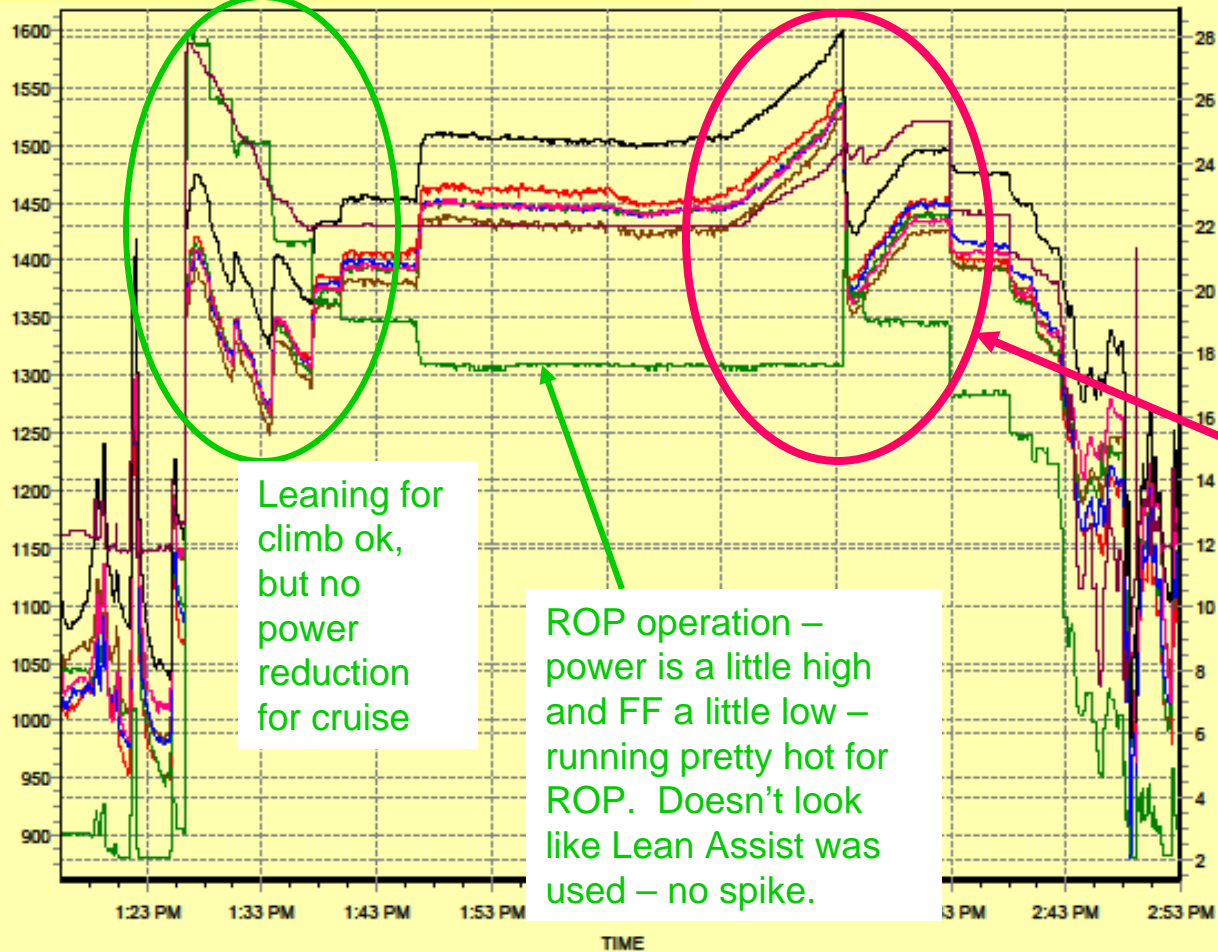
Distance = 221 Nm MFD =AVIDYNE



- EGT1
- EGT2
- EGT3
- EGT4
- EGT5
- EGT6
- Fuel Flow (G/hr)
- MAP

Bad!

Distance = 221 Nm MFD =AVIDYNE





Ugly!!

Distance = 122 Nm MFD =AVIDYNE



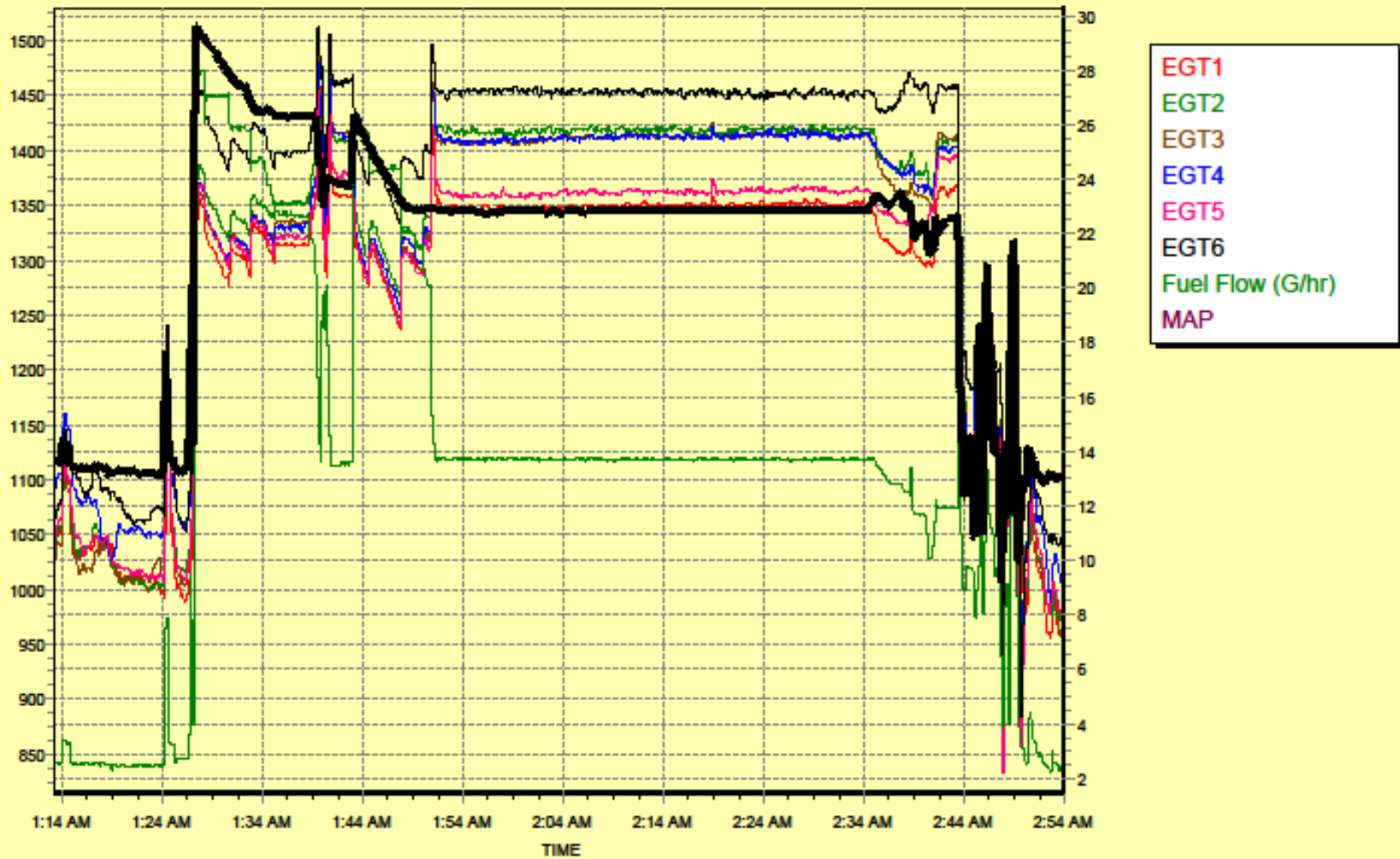
- EGT1
- EGT2
- EGT3
- EGT4
- EGT5
- EGT6
- Fuel Flow (G/hr)
- MAP

Engine damage temperatures – full power, level flight at low altitude, aggressively over-leaned. Burnt exhaust valves.

Cruise – still wide open, high FF and still too hot for cruise flight

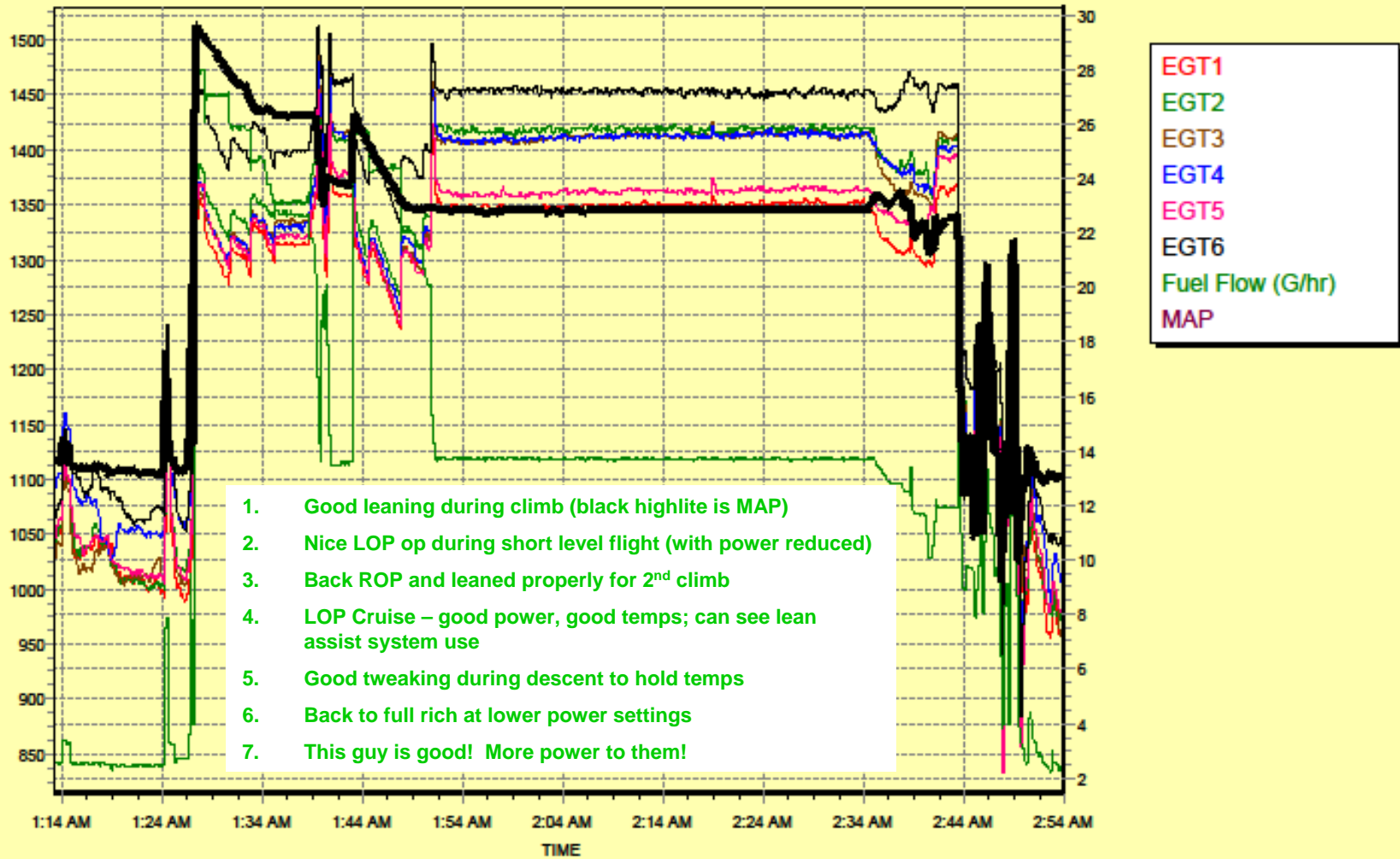
# Good, Bad or Ugly?

Distance = 223 Nm MFD = AVIDYNE



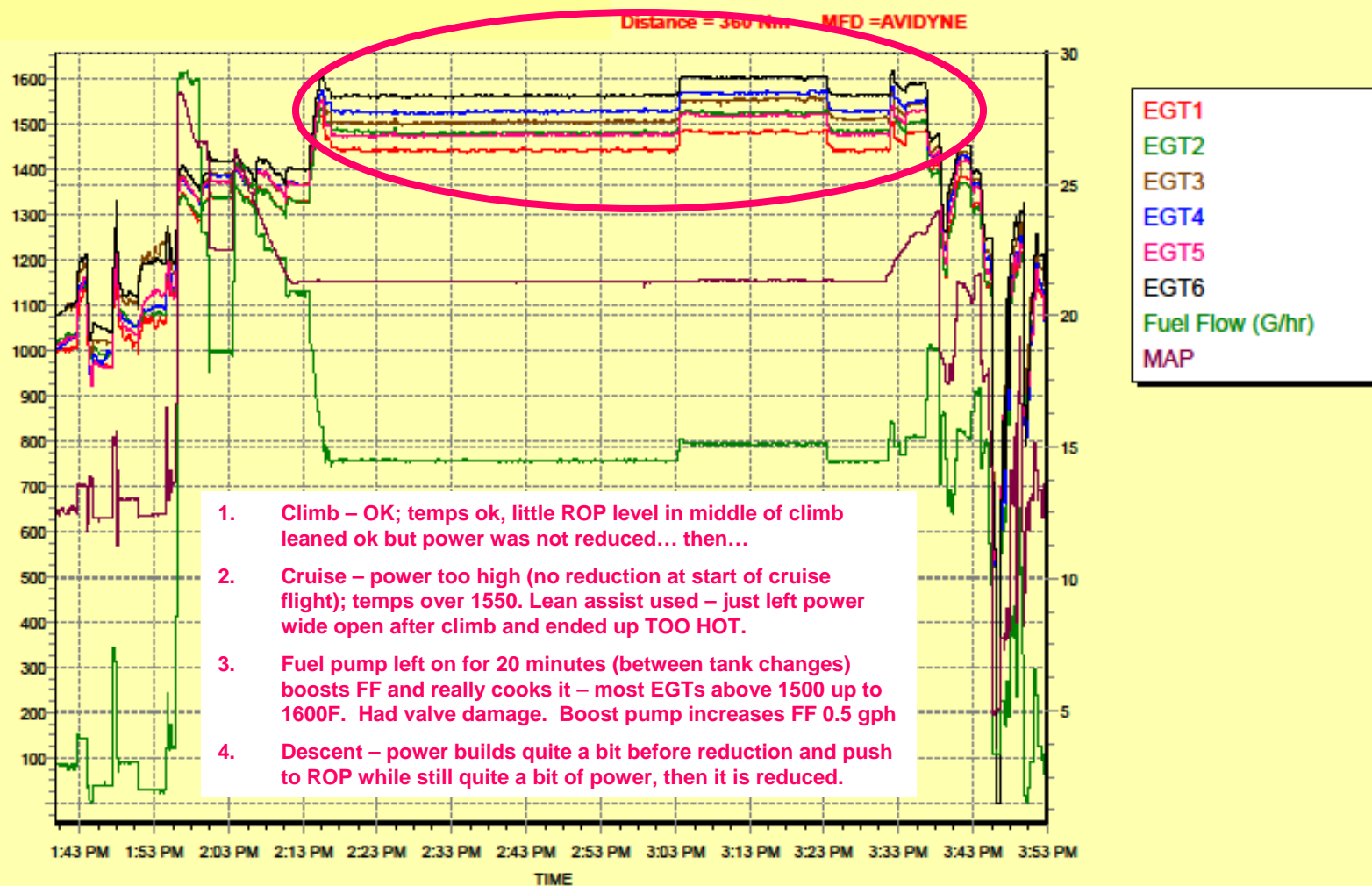
Good!

Distance = 223 Nm MFD = AVIDYNE



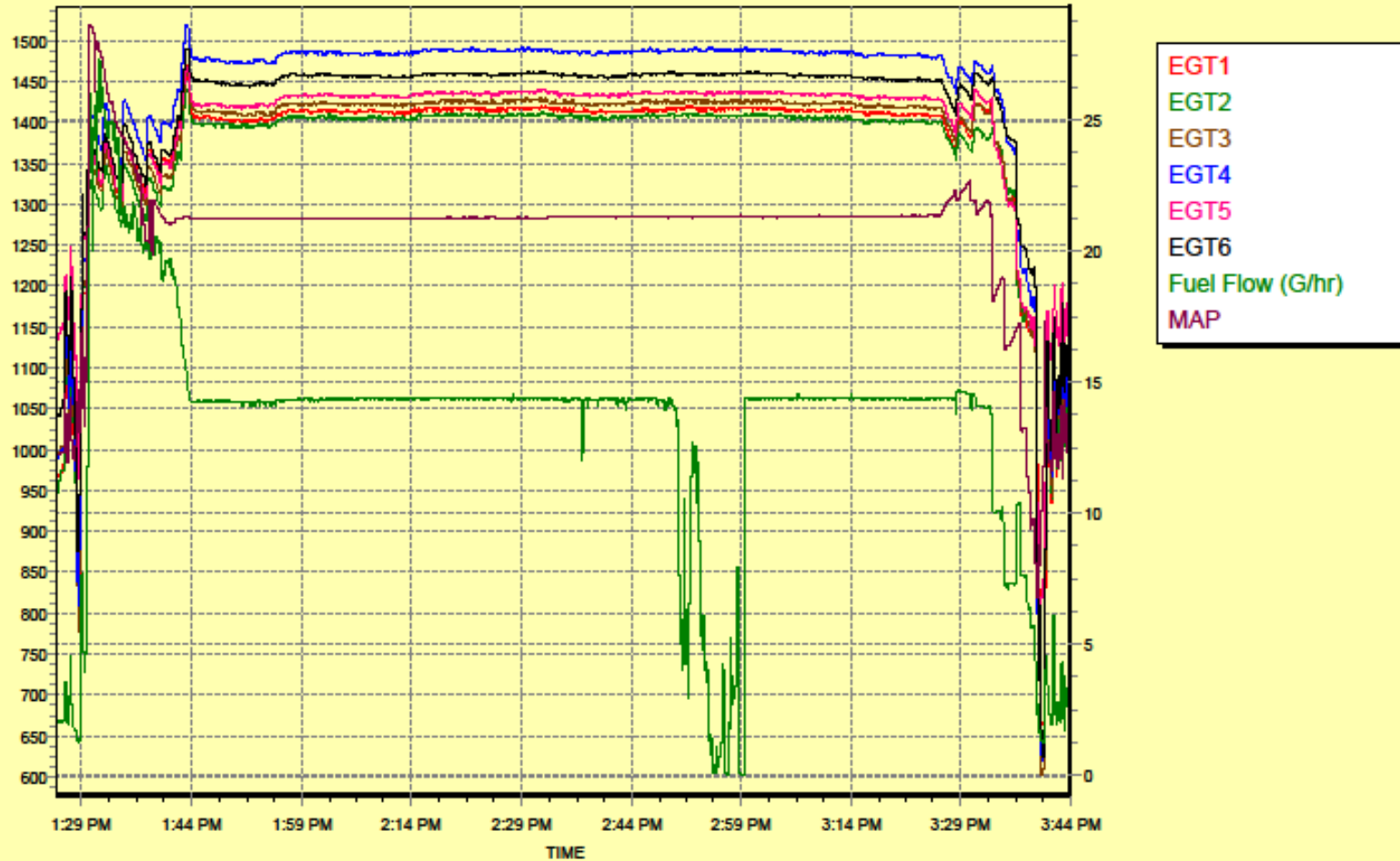


# Ugly!



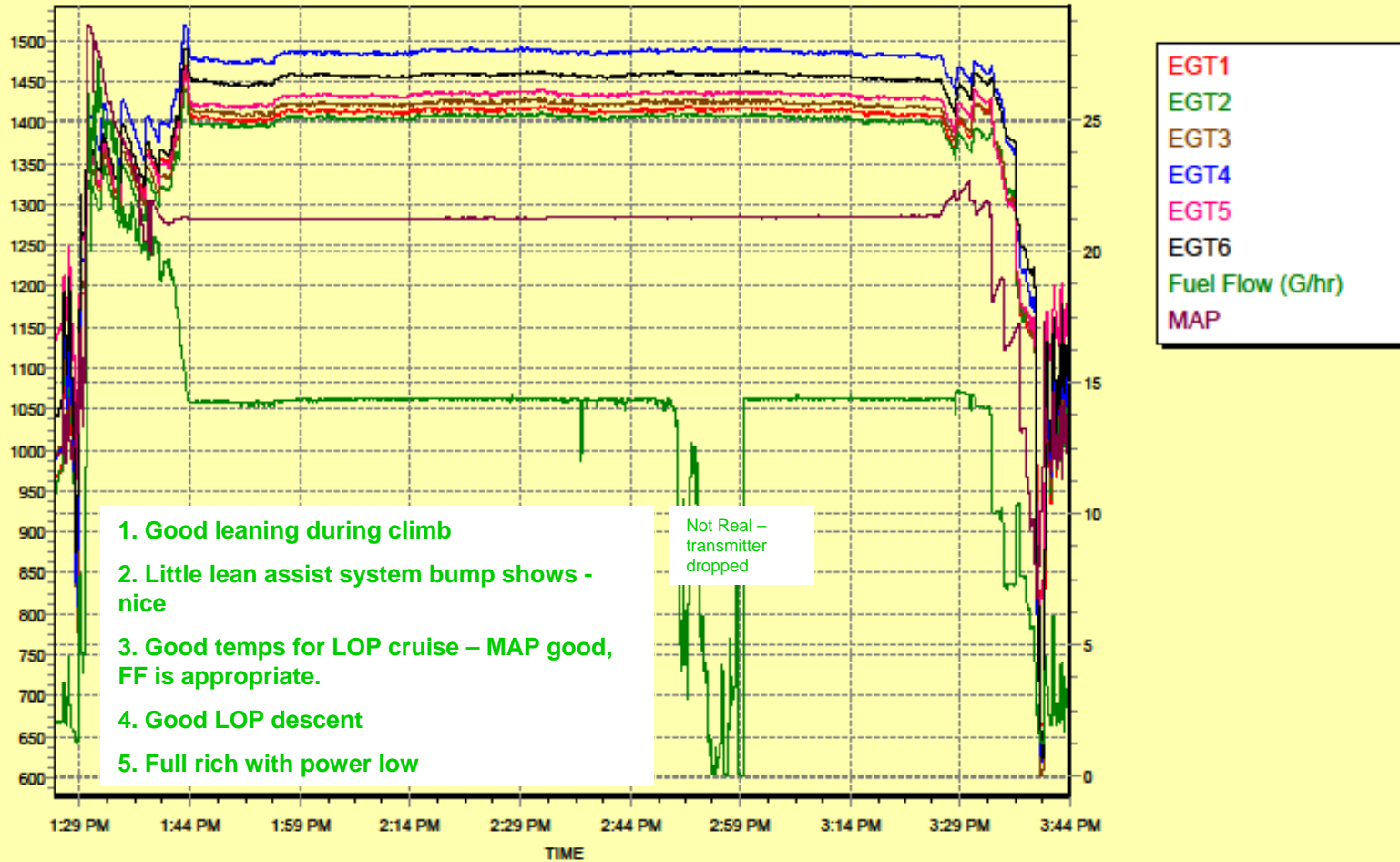
# Good, Bad or Ugly?

Distance = 335 Nm MFD = AVIDYNE



# Good!

Distance = 335 Nm MFD = AVIDYNE

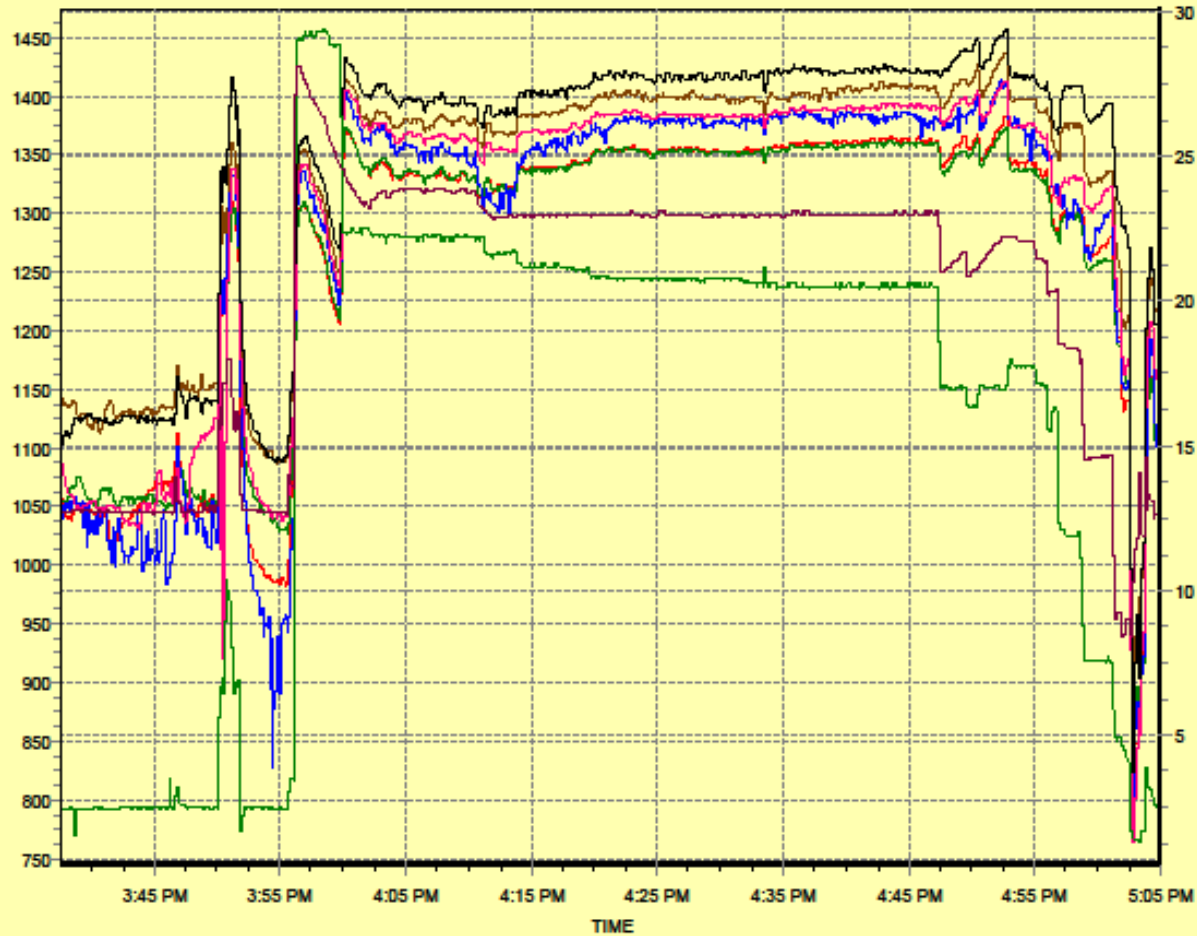


# Good, Bad or Ugly?

Version 22.0 616AS

My Custom Chart

FLIGHT ON 10/25/09 KPWK 15:38:24 >>>> 417 17:05:48 Distance = 174 Nm MFD =AVIDYNE



- EGT1
- EGT2
- EGT3
- EGT4
- EGT5
- EGT6
- Fuel Flow (G/hr)
- MAP

## Bad – At least bad form!

Version 22.0 616AS

My Custom Chart

FLIGHT ON 10/25/09 KPWK 15:38:24 >>>> 417 17:05:48 Distance = 174 Nm MFD =AVIDYNE



EGT1  
EGT2  
EGT3  
EGT4  
EGT5  
EGT6  
Fuel Flow (G/hr)  
MAP

# Summary

- The engine keeps you alive and flying...be nice to it!
- The engine is probably the largest cost factor in ownership
- Incorrect engine operation can cause undue expense, limit engine life or worse – leave you without a powerplant when you need it
- If not comfortable with these techniques let us know and do some training – we'll get you up to speed quickly.
- Let's keep them flying safe and with a minimum of operator caused engine damage
- OptAir will sample operations information and follow up with owners for training as required. In some cases there may be shared costs of engine repairs if guidelines are not followed.
- But most of all – make engine management a priority, but always aviate, navigate and communicate in that order. Be Safe!