Safe and Efficient Operation of Turbo Normalized Engines

KTronics Aero Services, LLC
www.ktronicsaero.com

Introduction

- Caretaker of 1981 Turbo-Normalized A36
  - 1500 hours in TN'd A36s
- Owner of Ktronics Aero Services
- CFI / CFI / BPPP Instructor
  - Over 300 hours of dual given in Bonanzas
- Software DER – Part 25 / Part 23 DAL A
- Live near Austin, TX with my wife and twin boys

Disclaimer

- This presentation is general advice.
- Every airplane and installation is unique.
- Consult the POH and AFMS for YOUR airplane for specific guidance.
- This presentation is not a substitute for training from a qualified CFI.
- Contact the manufacturer of your TN system for the final word in operation.
- I have a Tornado Alley Turbo system in my airplane, but this advice should apply to most TN airplanes.

Agenda

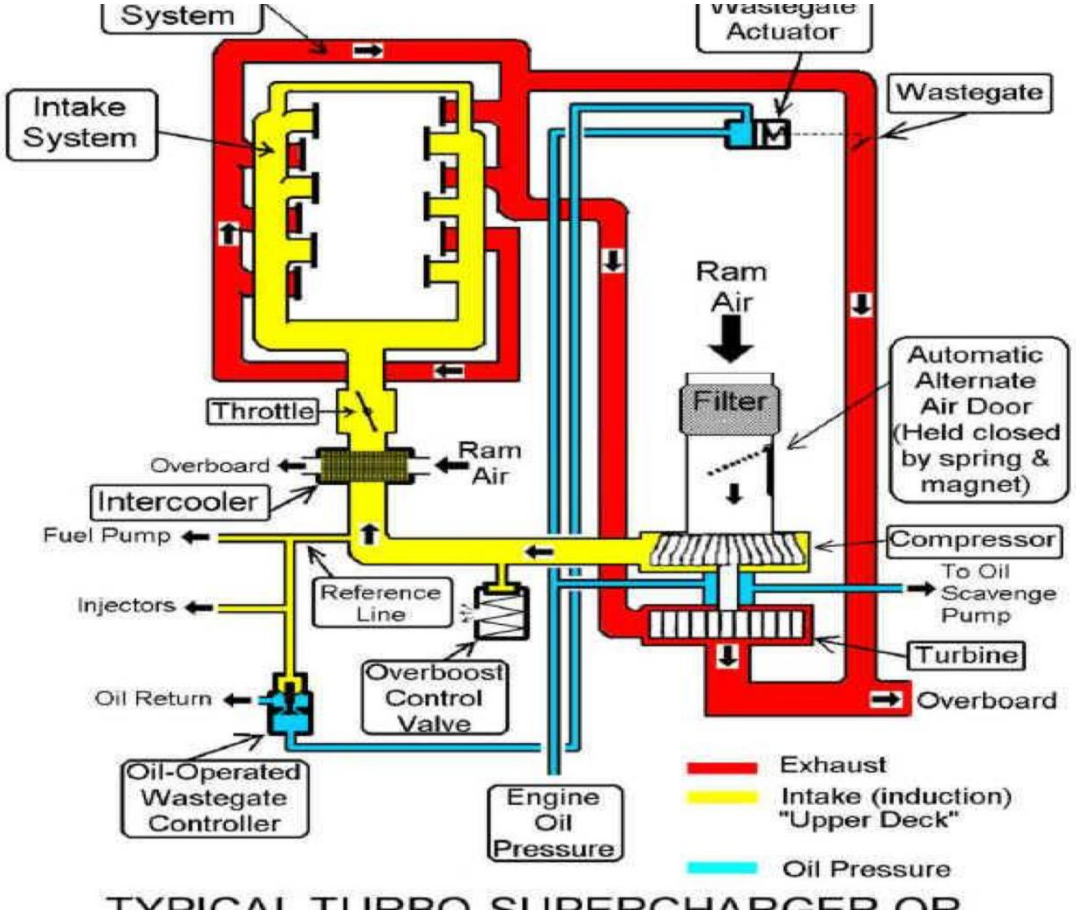
- Who is this presentation for?
- TN Intro
- Operation in each phase of flight
- Tips and Rules of Thumb
- Questions and Wrap up

Audience

- Owners of TN aircraft
- Prospective owners of TN aircraft
- CFIs teaching in TN aircraft

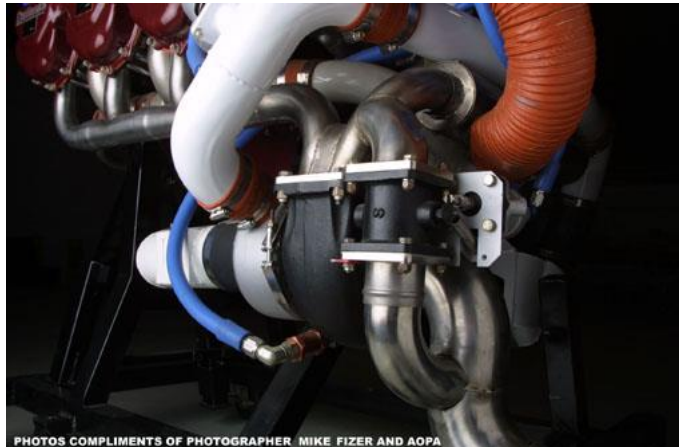
What is a TN (vs TC)?

- TN aftermarket STC - adds a turbo charger to a NA (Normally Aspirated) IO-520 or IO-550.
- Models are determined by the STC (later model 33s, 35s and most 36s for TATI)
- 8.5:1 Compression Ratio.
- Max Manifold Pressure is ~30” (29.6”) i.e. – sea level.
- TN engine makes “sea level” horse power to its critical altitude (20,000’).
- TC engines come from Continental and are found in 3 Bonanza models.
- Max Manifold Pressure is ~36” – 300 HP for A36TC / B36TC or 32.5” for V35TC - 285HP
- 7.5:1 Compression Ratio



Why wouldn't I want this?

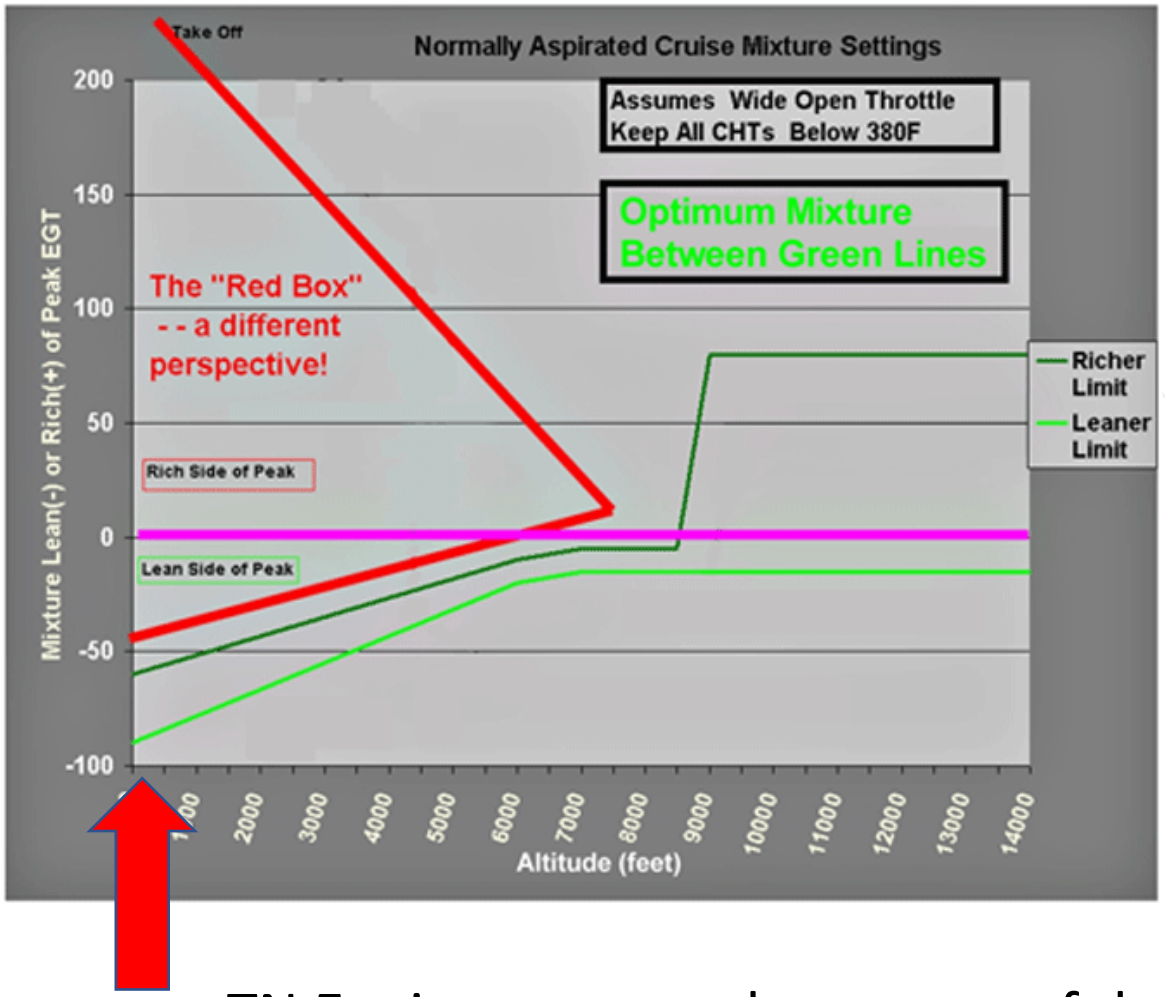
- Slightly higher maintenance costs
  - Additional components to OH, Magetos and plugs need to be in tip top condition
  - Additional "complexity" under the cowl
- Burn more fuel
  - Typical TN fuel flow is 15.5 GPH – 17.5 GPH
- Stylish tubes in your nose.
  - Spending more time in the mid-teens requires O2
- Break out the blankets
  - Can be chilly in the mid-teens

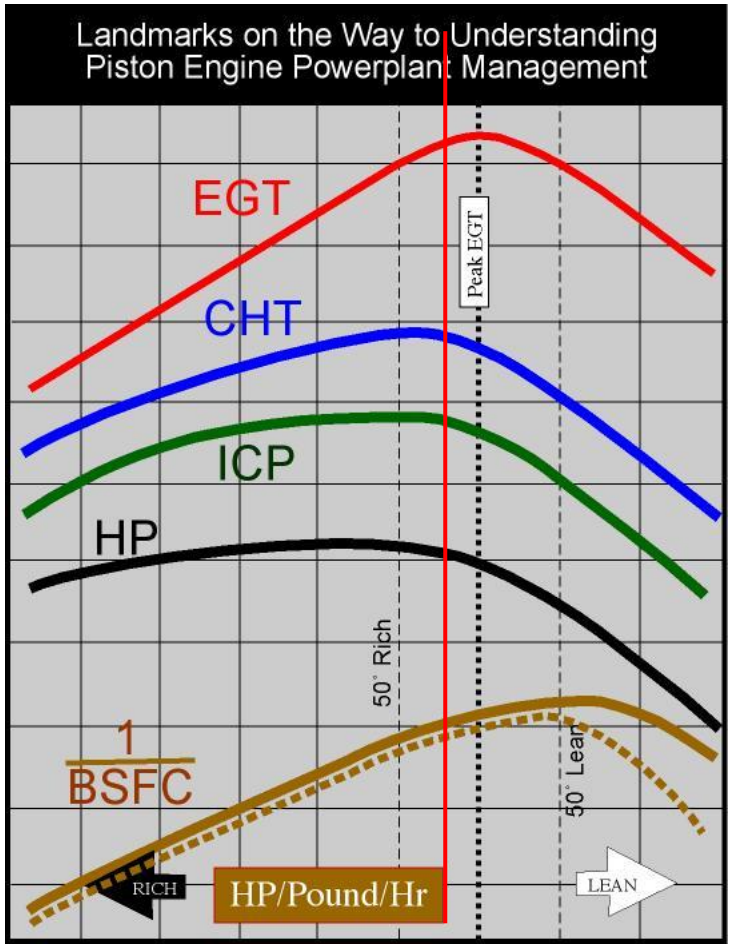


Why would I want this?

- 200 KTAS!
  - Baron like speeds on 30% to 50% less fuel
  - 190KTAS to 200KTAS is typical above 13,000’
- Smoooooth flights and less traffic
  - Above the weather and convection turbulence
  - Less air traffic in the mid-teens
- No more shipping the wife’s luggage to destination
  - Most installations result in a GWI for your airplane
  - For example, TATI installations in A36s with an IO-550 receive a 350lb to 400lb gross weight increase to 4000lbs
- Increased performance at HIGH elevation airports
- Simpler engine operation
  - No need to lean in the climb or for departures at high density altitude airports

Red Box





TN Engines operate here most of their cruising life

Preflight / Startup / Taxi / Runup

- Shake the exhaust pipe
  - Turbo V-bands AD replacement 400 hrs.
- Lean aggressively
  - TN engines tend to be setup very rich
- Run up – Full Rich?
  - I normally don’t - leave it at taxi lean and expect to see a higher than normal RPM drop

Take Off

- Verify engine controls are set: Mixture-Prop-Throttle EVERY TIME you make a power change.
- Mixture Full Forward – Full Rich
  - FULL RICH – EVERY TIME / EVERY AIRPORT
- Prop Full Forward – High RPM – 2700 RPM
- Advance the throttle –
  - Hold the brakes to about 20”
  - Advance to Full Throttle - 30” (well actually 29.6”)
  - May over boost when the oil is cold (32” or so)
  - Confirm 33-35 GPH – may need to manually lean
  - Verify TIT 1250°F – 1310°F

Climb

- 2700 RPM – reduce 100 RPM if required for noise abatement – then back to full RPM.
- Vy for the first 1000’ – then115kt - 120kts
- Verify TIT 1270°F to 1310°F – it will increase
- Boost Pump use for unstable fuel flow / high CHTs:
  - Low Speed: TIT > 1310F – above 5000’ D.A.
  - High Speed: TIT > 1310F again – above 10,000’ D.A.
  - REMINDER THAT THE PUMP IS ON!
-  DO NOT REDUCE THROTTLE DURING CLIMB
-  ABSOLUTELY DO NOT LEAN DURING CLIMB

WOTLOPSOP

- Wide Open Throttle
  - Turbo system makes 30”+ of boost ALL THE TIME
  - Does not mean the engine is at 100% power
- Lean Of Peak
  - Lower Inter Cylinder Pressures
  - Cooler Engine Temperatures
  - Cleaner Oil, Exhaust and Less CO
- Standard Operating Procedure
  - Avoid the “Red Box”
  - Aim 80°F LOP – ensures that you are at least 60°F

Finding Peak TIT

To find peak – initially or when engine has been worked on (engine timing changed)

- Set RPM 2500 RPM / Cowl Flaps Open
- Set engine monitor to TIT
- Quickly reduce mixture to ~20GPH
- Slowly reduce mixture to find peak TIT
  - Every airplane will be different
  - Won’t change unless timing has changed
- Lean to 80°F LOP of the peak and note fuel flow.
  - I.e. peak TIT 1630° – 80° = 1550°F Target TIT

Cruise Operation

- Lean to your “known” fuel flow when you found peak
  - Depending installation and OAT: 15GPH – 17GPH
- Finish cruise checklist – close cowl flaps, 2500 RPM, …
- Fine tune mixture to your Target TIT.
- Fuel Flow will vary based on OAT and humidity (air density)
  - Higher fuel flow in winter (Cold Air - Dense Air)
  - Lower fuel flow in summer (Hot Air – Less Dense Air)
- Target TIT will only change because of engine timing
- Monitor CHTs – Above 380F – Open the cowl flaps (start with halfway)
- To fly slower – Reduce RPM (2400RPM or 2300RPM)
  - less fuel flow is less horse power

Descent

- Reduce MP as necessary to maintain safe airspeed for conditions:
  - Smooth Air: yellow line reduce to 25" and then 20”
  - Bumpy Air: Smooth Reduction of MP to 20”
- No need to adjust mixture. The mixture will enrichen as the MP is reduced.
  - Keeps CHT warm during the descent
- Instrument Approach – 20” / 2500RPM / 13.5GPH

Landing

- Listen for the boost pump
  - You turned it off right? Right? RIGHT?
- Add a couple of twists (1 – 2 GPH) on final
- Because the engines are setup rich - do not advance the mixture to full rich.
- Leave propeller control at 2500RPM - do not advance to high RPM.

Go-Around

A Go-Around is not an emergency -

- Advance Mixture to Full Rich
- Advance Prop to High RPM
- Advance the Throttle to Full Open
- If you just firewall the throttle – its ok, once your heart slows down – Just remember Mixture, Prop, Throttle.
- Open the cowl flaps

Taxi / Shutdown

- Already leaned for taxi (since you didn't go full rich on final)
- Normal Shutdown
- Turbo "Cool Down" is completely unnecessary
  - The turbo is as cool as its going to get at landing.
  - Sitting on the ground idling is not going to make it any cooler – may actually increase the temperature.

Turbo Emergencies

- Loss of MP – 2 Possible Causes:
  - Something on the intake has broken
    - Aircraft behaves like an NA airplane
  - Something on the exhaust side has broken
    - Could have 1600F exhaust gas uncontained in the engine compartment
    - REAL EMERGENCY!
  - How do you tell the difference?
  - Why doesn't the engine flood and die?

Turbo Emergencies

- Overboost
  - PRV (Pressure Relief Valve) should prevent damage to engine
  - Pressure controller failure - manage MP with throttle
- Boot Strapping
  - Surging of MP
  - Usually at high altitude
  - Full RICH and then carefully lean
  - Consider descending

Tips / Rules of Thumb

- NA to Turbo Transition
  - need additional 2” or so of MP for same power.
- CHTs above 380F
  - Make sure fuel flow is stable – use boost if necessary; otherwise cowl flaps / lean further.
- ”Magic Power Setting” – 20” /2500 RPM / 13 GPH - 120kts
  - Maneuvering / Sight Seeing / Approaches
- HP when LOP – GPH x 14.9
  - 15GPH x 14.9 = 223 HP / 300 HP = 74% Power

Questions?

- Contact Me – Kevin Crozier
  - 408.910.1191
  - kevin@ktronicsaero.com
- Lets go flying!