Effect of Forced Aeromotive Supercharger on Performance of a Diamond Star (DA40) — bit.ly/wam-sc-pirep

Aircraft Pre-Supercharged:

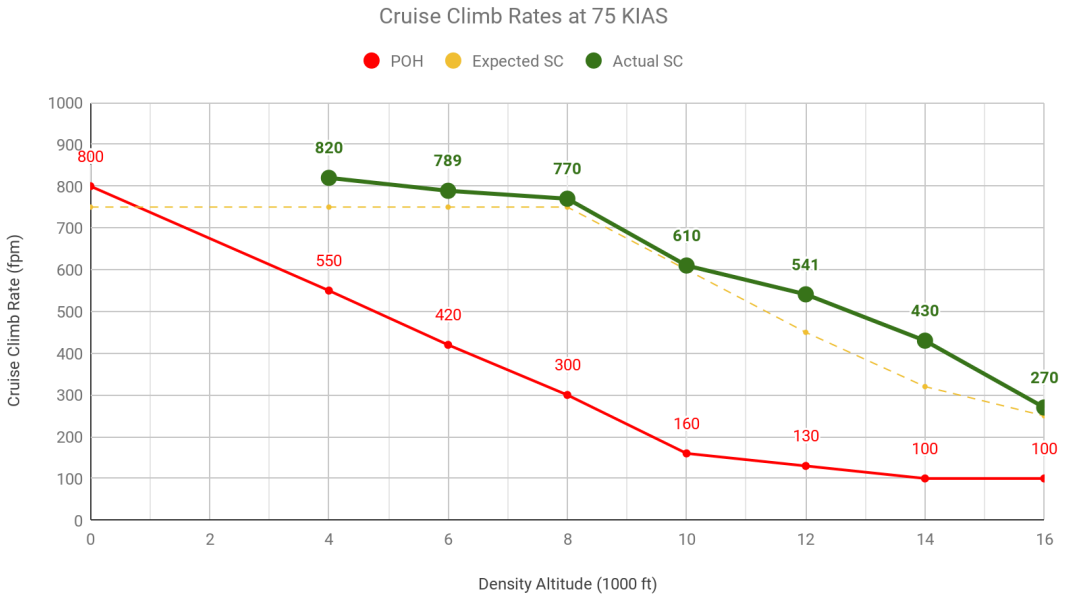
- N211WP, a 2008 DA40 XLS (18 pound nose ballast replaced by 18 pound FA Supercharger) w/ Extended Range Tanks
- MT 3-Blade Composite Prop
- PowerFlow Exhaust
- ElectroAir Electronic Ignition (as left magneto replacement)
- Tested configuration: generally 2400-to-2646 pounds takeoff weight

The information provided herein is simply one pilot's experience, and should not be used as guidance for engine management, which instead should be based upon the DA40 Airplane Flight Manual (AFM).

Climb Performance

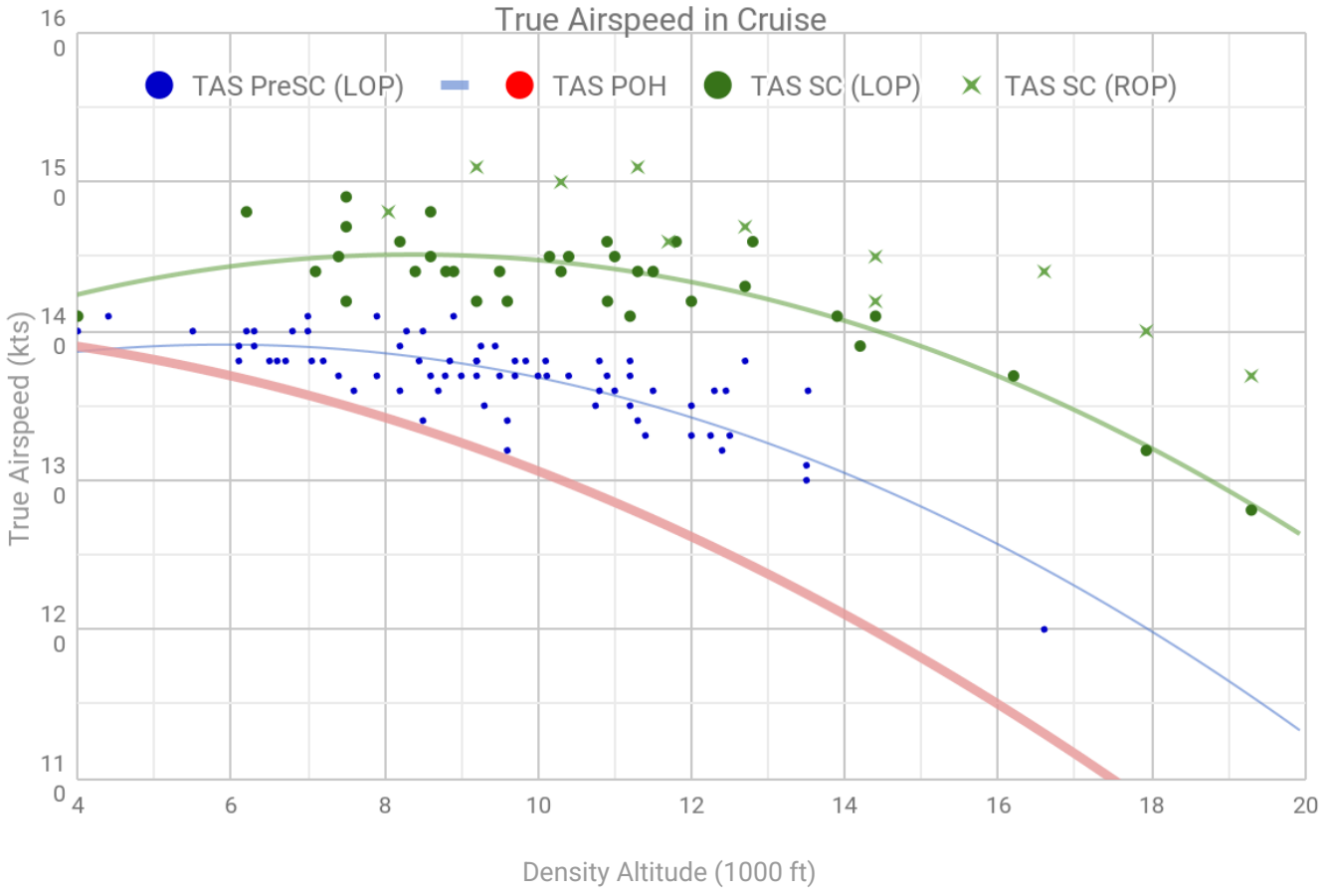
(POH vs ExpectedSupercharged vs Supercharged)

- the red curve is published Cruise Climb Rate at ISA temps, 75 KIAS versus Density Altitude from the DA40 AFM ("POH") and subjectively reflects the Pre-Supercharged climb performance of N211WP
- the orange dashed curve is the expected Supercharged performance (from FA product info)
- the green data points are actual measured Supercharged sustained climb performance on N211WP
- [we measured the green data points via 75 KIAS FLC climb on autopilot, flaps up, from 1000' below to 1000' above a given target Density Altitude (per the MFD Aux page), divided by time elapsed -- wide open throttle if MP<30", 2450 rpm, CHTs <400 degF]
- ... e.g. when I took off from Truckee (KTRK, 8-Aug-2019 1:30pm PDT, 8000' Density Altitude) I had a sustained climb rate of 770 feet per minute... versus the pre-supercharged/book rate of 300 fpm... a factor of 2.57 improvement! As we well know, climb rate is king when taking off from, getting around, or getting over the High Sierra, the Rockies, the Andes, the Alps, etc.
- … in an extreme (albeit non-productive) case, supercharged N211WP was flown to 22,000' DA and was climbing at 114 fpm, indicating that the supercharged service ceiling is ~22,000'.



Cruise Performance
(POH vs Pre-Supercharged vs Supercharged)

- the red curve is the "book" (POH) cruise speed versus Density Altitude of the stock DA40 (it's unclear if this is Rich-of-Peak or Lean-of-Peak; likely the former)
- the blue dots and trendline are measured airspeed values of N211WP Pre-Supercharged (which already had a couple mods -- PowerFlow Exhaust, EIS -- that the generic Diamond Star does not have); wide open throttle (WOT) for all data points
- the green dots and trendline are data measured on N211WP since installation of the Supercharger
- [measured blue and green data dots are all… MP<30", 2450 rpm, Lean-of-Peak (LOP), outside the "Red Box, Red Fin", with CHTs <375 degF… resulting fuel flows ~10% more than pre-Supercharged]
- … indicating an increase (green trendline minus blue trendline) in Supercharged cruise airspeed LOP of between 7-to-10 knots at mid altitudes and 10-to-15 knots at higher altitudes
- Note: a handful of light green data "Xs" are provided for measured Supercharged operation at Rich-of-Peak (ROP)… (for ~25% increase in fuel flow plus combustion deposits vs clean, economical LOP operation!)



For those interested, we also collected data on Manifold Pressure… normally aspirated vs expected (per FA product info) vs measured Supercharged (at 2450 rpm), with the FA Supercharger fully delivering as advertised.

Savvy "Report Cards"

The previous pages provided information comparing N211WP Supercharged versus N211WP Pre-Supercharged ("apples to apples") and N211WP Supercharged versus DA40 POH ("apples to standard apples"). The data in the table below comes from "Report Cards" provided by Savvy Analysis and provides additional insight on a big picture basis, i.e. N211WP versus 133 other DA40s.

Measurement	**133 DA40 Cohorts (average)**	**N211WP Pre-Supercharged**	**N211WP Supercharged**
Time Period		2018-07-01 2019-06-30	2019-07-01 2020-06-30
Number of Flights	7234	197	116
Percent Power in Cruise	64.7%	65.5%	72.4%
Altitude in Cruise (MSL)	6120	7280	8770
Speed in Cruise (KTAS)	132	136	141
Fuel Efficiency (nm/gal)	15.4	16.6	15.8
Max CHT in Flight (degF)	389	385	392
Max CHT in Cruise (degF)	372	374	374
Max CHT Spread in Cruise (degF)	26	32	17
Oil Temp in Cruise (degF)	175	181	186

The Savvy Report Cards do not currently provide direct comparisons on my most important priorities… high density altitude takeoff climb rate and cruise climb rate… but nevertheless the comparisons do provide a general idea of how N211WP performs in relation to the overall DA40 fleet.