A turbocharged engine?

1. A turbocharged airplane, depending on the type of missions you intend to fly, a _______ is worth the additional investment of _______ and _____________, and could easily be among the most important flying decisions you make -- both from a _______ and _____________ perspective.

Standard Day: How Aircraft Engines are Rated for Power

1. To understand the impact of a turbocharger, it is helpful to understand how _______ _______ aircraft power and performance.
2. Because the _______ changes with altitude – and because these changes impact aircraft _______ – aircraft engines are almost always rated for power at universally agreed conditions known as ‘_______ _____.’
3. Standard day conditions are based on common atmospheric _______ such as air pressure and temperature.
4. Rating aircraft engine power in this manner provides a _______ to which all aircraft engines can be compared.
5. Standard day is defined to include barometric pressure of _____ inches of mercury (1013.2 millibars), density of ______ lbs./square inch (PSI) and air temperature of ____ degrees Celsius (59 degrees Fahrenheit) at sea level.
6. When an aircraft manufacturer specifies an aircraft engine’s horsepower rating, this rating refers to the engine _______ that can be achieved at these _______ _______.

How Altitude Affects Aircraft Performance

For those new to the world of flying a _______ _______, a common misconception is that manufacturer rated aircraft engine power is maintained throughout aircraft operation. In
other words, if an aircraft is rated for 300 horsepower, it is not always _________________that this does not mean the aircraft engine will continue to perform at 300 horsepower as it climbs.

Because all aircraft engines are dependent on the ________________ of air for fuel combustion, the amount of __________ an aircraft engine can produce is directly ______________ upon air being pumped into the engine at consistent pressure and density. However, because atmospheric __________ as an aircraft gains altitude, air density is diminished, causing a relative __________ in engine horsepower.

A normally aspirated engine in fact typically loses about 3% of __________ for every ______ feet of altitude.

**How Turbochargers Work**

Turbocharging, also known as ‘______ ______,’ involves the use of a gas compressor to force more ______ into the engine’s combustion chamber than would be ________ with a naturally aspirated engine, therefore allowing the engine to maintain _______ ________ ________ as altitude increases. In other words, feeding more ______ to the engine allows the engine to burn more ______ and create more energy to power the aircraft – and-________, ________rated power - despite increasing altitudes.

The turbocharger is typically housed in a circular casing that contains a small turbine connected by shaft to an impeller wheel. Aircraft ________ is sent directly into the__________, where the turbine converts it into rotating energy which in turn spins the impeller wheel and compresses ________ air. The turbine and impeller found in a turbocharger behave in a very similar manner to the ________ and __________ found in a turboprop (turbine) engine. Following compression, compressed air is discharged directly into the engine’s ________ ________.

Turbochargers work in one of two ways: A ‘ground boosted’ turbocharger directly increases overall power output of the engine to achieve its sea-level rated power. A ‘turbo-normalized’ turbocharger works to assure that ____ ________ ________ performance is maintained as it reaches higher altitudes.
Turbocharger Cons:

Non-pressurized Aircraft Considerations

The FAA dictates that pilots flying above 12,500 feet for thirty minutes or longer ________ ________ supplemental oxygen -- and many find it necessary at or before 10,000 feet in order to avoid the ________ of hypoxia. Therefore, a non-pressurized turbocharged aircraft calls for oxygen on-board in order to take advantage of the higher altitudes turbocharging affords.

Therefore, when considering the use of a turbocharger, it is important to consider both the type of missions you intend to fly, as well as the type of passengers... For families with small children, oxygen masks can at times be challenging to deploy.

TLC for Turbo Charging

Turbocharged aircraft engines tend to be more prone to pilot abuse than ________ ________ aircraft engines.

Ground-boosted turbo engines, in particular, call for more ________ ________ treatment. Because it is possible to push these aircraft beyond stated power, it’s important to fly at a ________ power setting when flying at ________ altitudes so as not to ________ ________ the engine.

A turbo-normalized engine is a better candidate for engine longevity... especially for the less diligent pilot. (Though with proper training on_______ _______, any attentive pilot can properly operate a turbocharged aircraft.)

Turbocharger technology has also come a long way since early designs first appeared on the market. Even though, today’s more modern turbochargers typically have ________ ________ that reduce the potential for pilots to over-boost the engine, however, attentive engine management is still ________.

a. The engine for this airplane is manufactured by: ________ ________.
b. The Engine Model Number for this airplane is: ________________
c. The Engine Type for this airplane is: Turbocharged, ________, ______ horizontally opposed.
d. The Engine is: fuel injected, six-cylinder with ________ cu. in. displacement.
e. The Engine has a Horsepower Rating and Engine Speed: ________ rated BHP at ___ in. hg. and ________ RPM
The following Quiz is based on the SPORTY’S ADVANCED EQUIPMENT air Facts: Turbochargers & Flight Level Flying, DVD. Print your answers

1. Why do turbocharged airplanes seem to have higher accident rates than normal?

______________________________________________________________________

2. Why is it that turbo charged airplanes with the same fuel flow have slower airspeeds at lower altitudes?

______________________________________________________________________

3. Does the public record show an increased risk in mechanical failures and engine repair?

Explain:
______________________________________________________________________

4. What is considered the real risk in flying a turbocharged airplane?

______________________________________________________________________

5. What two turbocharger components are mentioned and separated by a “hefty” element?

______________________________________________________________________

6. The color associated with the compressor in the video of the turbocharged airplane is ________?

7. How does manifold pressure (MP) relate to power output?

______________________________________________________________________

8. The higher you fly a turbocharged airplane, the higher the engine temperature. Explain

______________________________________________________________________

9. What is an Intercooler?

______________________________________________________________________

10. Is the Intercooler an SST?

______________________________________________________________________

11. Preferred Turbine Inlet temperature (TIT). Explain:

______________________________________________________________________

12. Turbo-normalized means? Explain:

______________________________________________________________________

13. What would be the advantage of speed brakes related to operation of the airplane and engine?

______________________________________________________________________

14. Fuel planning is much more demanding. Why?

______________________________________________________________________

15. Altitude chamber check out? What would be the reasoning?

______________________________________________________________________
16. What is a new consideration with flying weather with a turbocharged airplane? 
   Explain:__________________________________________________________

17. What altitudes are usually encountered flying a turbocharged airplane? Why?

18. How should the answer to question #17 affect your flight planning when flying turbocharged airplanes?
   ________________________________________________________________

19. How does the turbocharger work? In your own words, what would be an appropriate answer?
   ________________________________________________________________

20. Duty cycle on starter. Often an issue for cold weather or hot starts. What is the duty cycle and why is there a concern?
   ________________________________________________________________

21. What is “Shock Cooling”? ________________________________

22. What is the most commonly used method a pilot can use to hopefully preclude shock cooling?
   ________________________________________________________________

23. When descending from altitude, discuss the power management, necessary to maintain engine and turbo charger best performance, and minimization of shock-cooling potential
   ________________________________________________________________

24. Explain, at what TIT, the engine power can be used as if the turbo charger did not exist.
   ________________________________________________________________

25. Discuss the leaning (mixture control) for takeoff, climb, descent, and power setting when exiting the Runway.
   ________________________________________________________________