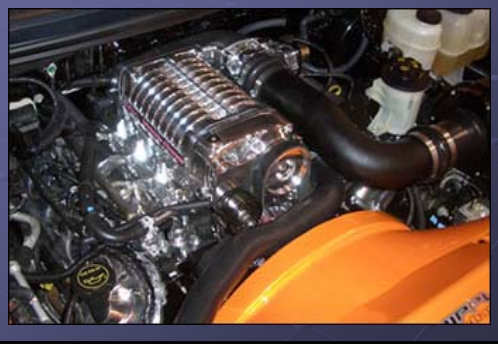
Superchargers



Why supercharge?

- MORE POWER
- Supercharging increases an engine's volumetric efficiency past 100%.
- Can provide greater fuel economy.

History

- 1906 American Chadwick had a supercharger.
- Early 1916 the needs of increased war plane performance was a major driving factor. (the thin atmosphere hampered the performance of the fighting planes of war time)
- The early "Roots" style air pump was actually used for supplying air to mines.

Other methods of increasing performance. Larger engine.

- PRO: With a larger engine you are provided with more air and fuel available to provide power.
- CON: With more air and fuel means lower fuel mileage.
- CON: Heavier and may not fit.

Other methods of increasing performance. (modification)

- PRO: Increasing the efficiency of the fuel system, ignition system, or base engine (higher compression) yields more power.
- CON: Increase in power output is likely to be small.

Other methods of increasing performance. (induction)

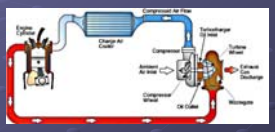
- PRO: increasing the ability of the engine to pull in atmospheric air and exhaust it. Straighter intake runners and larger exhaust systems. Provide increased power.
- CON: Increase in power output is likely to be small.

SUPERCHARGE IT!!!

- PRO: Not increasing efficiency of the engine to pull air in, but force more air in the engine. May provide a substantial increase in horsepower.
- May be done by supercharging or turbo-charging.
- CON: possible cost and increased maintenance. (that's not so bad for another 50 hp.

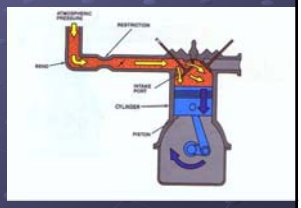
Turbo vs.Super

- The difference between the two are the method in which they are driven.
- Turbochargers are driven by exhaust flow.
- Superchargers are driven by the engine via a belt from the crankshaft. (the 1906 American Chadwick used a leather belt to drive the supercharger)

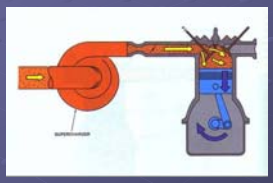


Natural Aspiration (N/A)

- A naturally aspirated engine has an unseen supercharger. There is roughly 14.7psi of air pressure forcing air into the engine at sea level.
- But in may never go past the 14.7psi.
- The effectiveness of the intake to deliver air and fuel reflects on the amount of air is pushed by the 14.7psi. Any bends or restrictions will inevitably reduce this volumetric efficiency.
- Notice the density of the air.

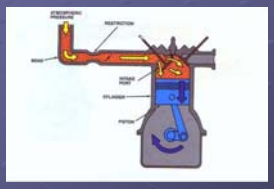


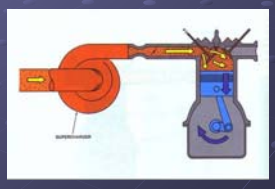
Supercharging



- By using a large air pump we can go even higher than the 14.7psi.
- The forced air can also vary in it's pressure.
- This increase past 14.7 increases the engines volumetric efficiency.
- Note the density of the air in the cylinder.

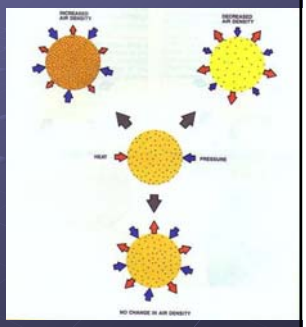
COMPARE (density of the air)





Why it works.

- It works by manipulating the density of the in coming air/fuel charge.
- It manipulates the density by pressurizing the air.
- But, with increased pressure comes increased temperature, which decreases the density.
- Either the pressure overcomes the temperature air expansion or the resulting pressurized air/fuel charge can be cooled.
- Increasing the amount of air introduced will require a larger amount of fuel in the system. This will provide a greater explosion and more power.



Questions???

- Increasing the volumetric efficiency of the engine will increase it's ____?
- A turbocharger is driven using the engine's _____?
- A supercharge is driven using the engine's _____?
- The higher the altitude the _____the air?
- Supercharging and turbocharging increases the air _____ within the cylinder?
- What car was the first to employ a supercharger for increased power output?
- What is the atmospheric air pressure a sea level?

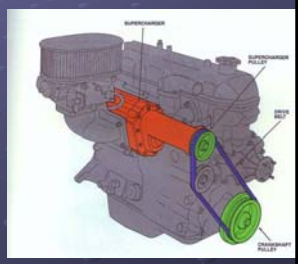
- Power output
- Exhaust
- Crankshaft
- Thinner
- Density
- 1906 Chadwick American
- 14.7psi

Types of superchargers.

- Dynamic:
  - Centrifugal *
  - Axial flow
  - Pressure wave
- Positive displacement:
  - Roots *
    - two lobe *
    - Three lobe *
  - Twin screw *
  - Vane airflow

(* discussed in detail)

Types of drives and mounting



Dynamic Superchargers.

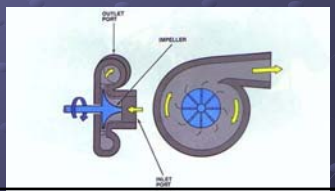
- The operation of a dynamic supercharger is similar to that of a turbocharger. The faster the crankshaft turns this type of supercharger, the better it operates. The centrifugal type whose pumping output increases roughly as a square of the engine's speed. This means that when the engine speed is doubled, the supercharger provides four times as much boost pressure.
- Question: How much pressure increase occurs when the engine speed triples?
- Nine times pressure increase.

Dynamic Superchargers

- The main "CON" : A centrifugal supercharger which provides three pounds of pressure (psi) at an engine speed of 2000rpm will provide 12 pounds at 4000rpm. This is a substantial increase in boost pressure, but the reverse holds true at lower engine speeds. Using the same example, less than one pound of pressure will be produced at 1000rpm. For this reason the dynamic supercharger is best at higher rpm's.

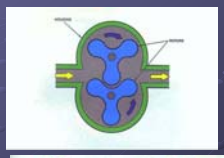
Centrifugal Supercharger

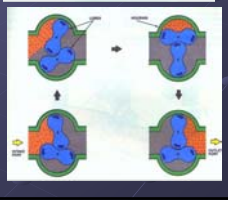
- A centrifugal supercharger moves air using a bladed fan, or impeller.
- The impeller is housed within a circular casing.
- The air enters the an inlet port located at the center of the impeller. From that point it is accelerated by centrifugal force by the spinning blades and pumped out the outlet port.
- The centrifugal super charger does not heat the air as much as the alternative methods of supercharging.
- Impeller speeds of 50000rpm are possible in this type.



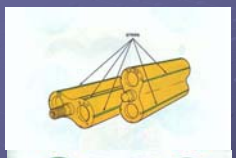
Positive Displacement

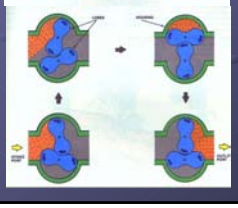
- The positive displacement style of supercharger is measured in capacity. (measured in cubic inch or cubic centimeter capacity)
- The volume between the lobe and the housing is the measure.
- A positive displacement supercharger will deliver the same volume of air per revolution regardless of engine rpm's. For this reason this type is effective equally well at low and high rpm's. So there will be no noticeable lag in power.





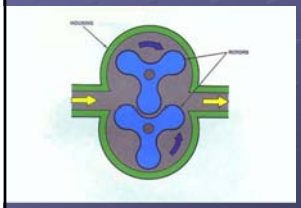
Two Lobe rotors





- Two figure eight shaped rotors spin in the opposite direction. As the rotors spin past the inlet they each scoop in air. The air is then directed around the outside of the housing to the outlet port. Flow is straight down.
- CON: All lobe superchargers have a pulsing airflow, especially at low rpm's. This continuous back and fourth motion of the air produces friction in the air.
- Question: What is the result of friction?
- Heat!!!

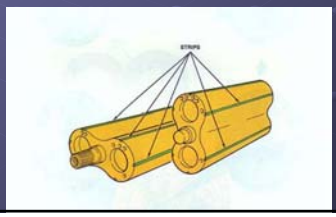
Three Lobe Rotors



- To reduce the pulsing air engineers developed three lobe rotors.
- The decreased time in between air delivery reduces the pressure spikes produced.

Clearance Between Lobes

- Lobe timing is crucial so high tolerance drive gears are used between the two lobes.
- The two lobes never touch each other, but they are very close together. To provide a seal from escaping air.
- Some performance superchargers actually have Teflon strips which make contact preventing any and all leaking of air pressure



Twin Screw

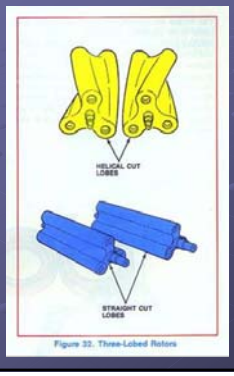


Figure 32. Three-Lobed Rotors

- To further decrease the pulsing of the supercharger, twin screw or helical lobe superchargers are used.
- The screw design provides a much smoother air flow due to the constant flow of in coming air.
- As opposed to the roots style of downward air flow the twin screw forces the air from one end to the other.

Questions???

- What type of supercharger operates better as the engine rpm increases?
- What type of supercharger may have internal rpm's of 50,000rpm?
- The roots style supercharger is a _____ displacement style.
- What are the rotating members of a twin screw supercharger?
- The impellers are the rotating members of the _____ supercharger.
- Which supercharger is less prone to produce a lag in power?

- Dynamic
- Centrifugal
- Positive
- Lobes
- Centrifugal
- Positive displacement