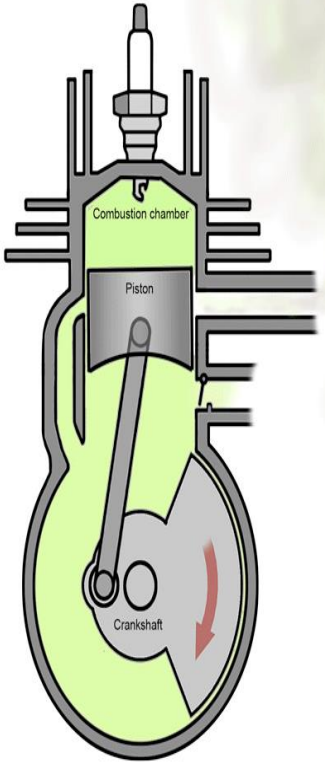
MAE 451 – Experimental Aerodynamics III
Lab 4 – Engine Performance Analysis

Shreyas Narsipur
NCSU
October 15th, 2019

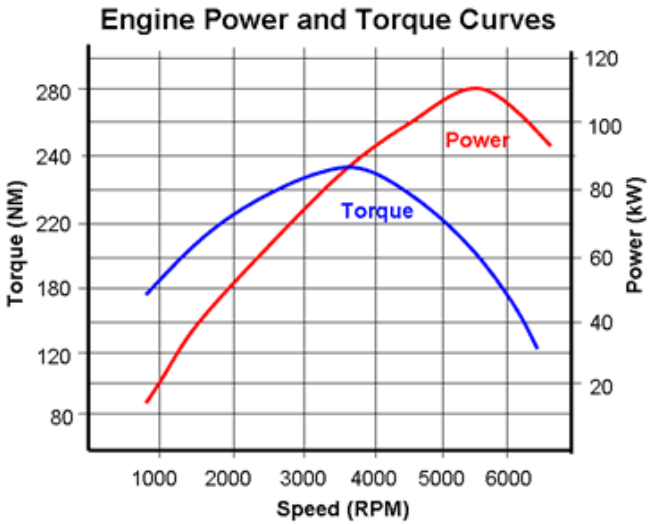


Outline

- Lab 3 - Objective
- Lab 3 – Theory
- Lab 3 - Expectations

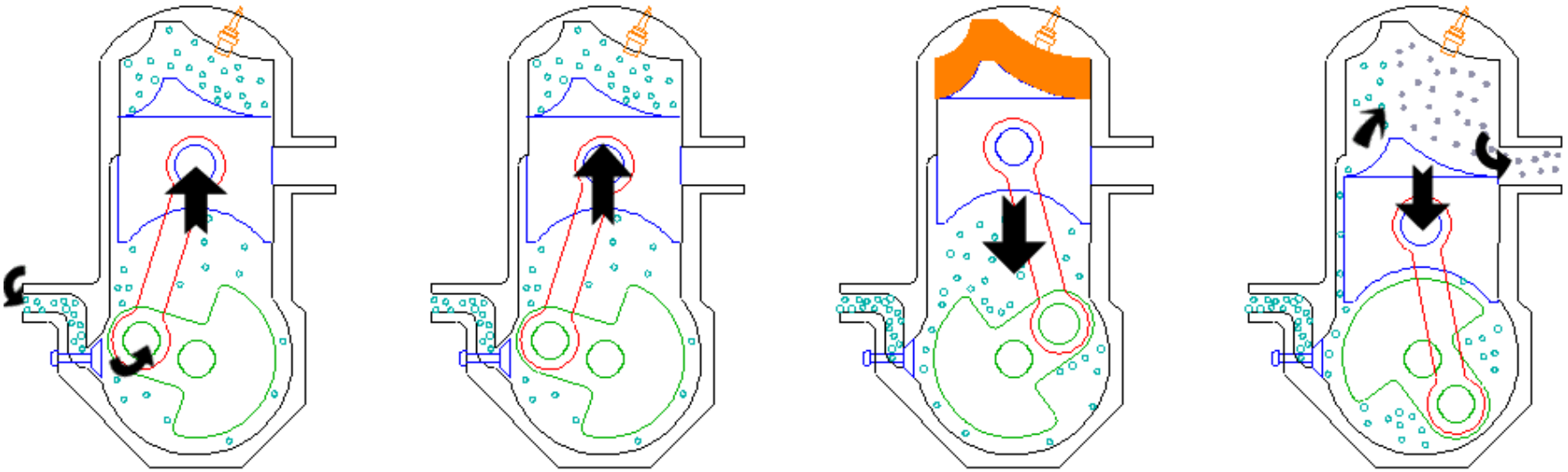
Lab 3 - Objective

- Setup and test a two-stroke OS 46AX II ABL engine.
- Create an engine data sheet
  - Torque vs. RPM
  - Output power vs. RPM
  - Thermal efficiency vs. RPM



Lab 3 - Theory

- A reciprocating engine has 4 main stages:
  - Intake
  - Compression
  - Ignition / Power
  - Exhaust / Transfer
- Two-stroke vs. four-stroke engines?



Lab 3 - Theory

- A two-stroke engine fires on every revolution of the crankshaft making it more powerful than a four-stroke engine.
- However, two-stroke engines are inefficient due to poor volumetric efficiency:
  - Exhaust and intake strokes are combined.
  - Quality of fresh charge (fuel + air mixture) poor.
- Due to the simpler and lighter construction of two-stroke engines, they are widely used in small scale machines.

Lab 3 – Theory

- Important characteristics to define an engine:
  - Torque - applied twisting force (*F x r*).
  - Power – application of force over a distance (work) in a given amount of time.
  - Thermal efficiency – indicates the percentage of energy added by heat that is converted to mechanical energy.
- The power available at the end of the main engine shaft can be calculated as:
  - $P = 2\pi N\tau$
  - N = rotations per second
  - τ = torque
- The thermal efficiency of the of the engine can be calculated as:
  - $\eta_{th} = \frac{P}{\dot{m}_f Q_{HV} \eta_c}$
  - $\dot{m}_f$ = mass flow rate of fuel
  - Q_{HV} = heating value of the fuel (11.3 MJ/kg)
  - η_c = combustion efficiency (assume 99%)

Lab 3 – Expectations

- Using the engine test bench, you will measure:
  - Engine RPM
  - Time for 10cc fuel consumption
  - Force exerted on a lever attached to the engine shaft.
- Create an engine data sheet with the following curves:
  - Engine torque (N-m) vs. RPM
  - Output power (kW) vs. RPM
  - Thermal efficiency vs. RPM
- Analyze the trends obtained and discuss:
  - Why, after a certain RPM, does torque decrease?
  - Why does power increase with decreasing torque?