



SWANSEA METROPOLITAN UNIVERSITY

PRIFYSGOL FETROPOLITAN ABERTAWE

Advanced Engine Technology

Lecture 1: Module Introduction and Overview

Pedro Monteiro Ferreira

Advanced Engine Technology

Contents

- Introduction / Module Overview
- Review of 4-stroke Cycle
- Parameters affecting Engine Performance
- Induction and Exhaust Systems
- Cylinder Head introduction

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- Engine Design and Performance
 - Cylinder head / combustion chamber design
 - Valve port geometry
 - Combustion Efficiency
 - Flow Bench Tests
- Engine Intake and Exhaust Systems
 - Induction and Exhaust Manifold Design
 - Influence on air/fuel ratio
 - Practical flow bench tests
- Pressure Charging
 - Turbo and Super Chargers
 - Analysis and selection methods

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Module Overview

- Assessment
 - Coursework
 - Two assignments (50% each)
 - One per semester
 - Semester Two: Using Flow Bench

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Contents

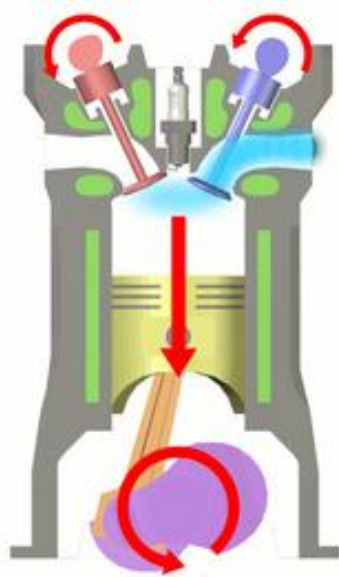
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Four Stroke Cycle

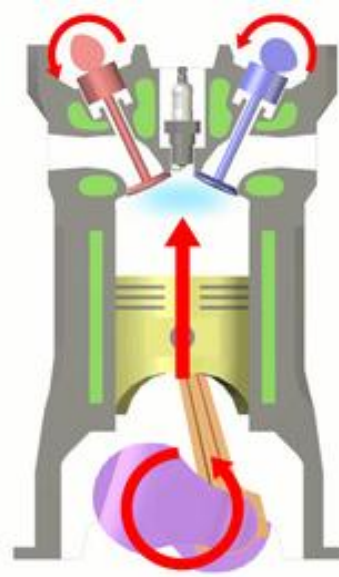


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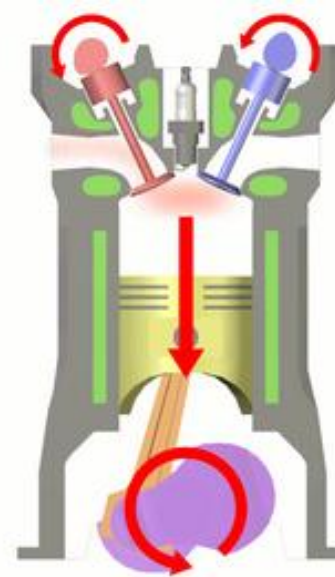
INDUCTION

SUCK



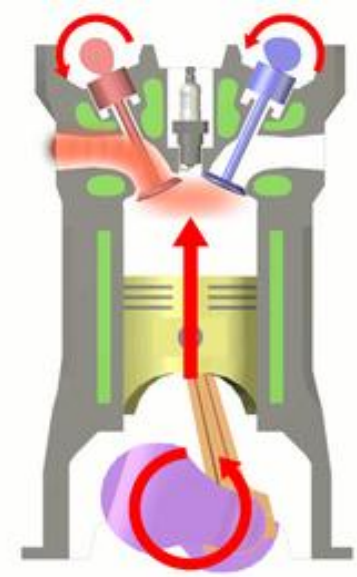
COMPRESSION

SQUISH



POWER

BANG



EXHAUST

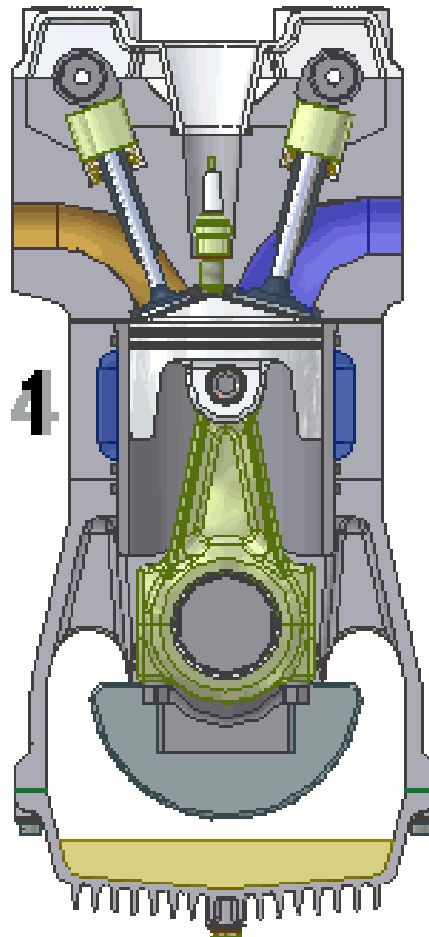
BLOW

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Four Stroke Cycle



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Performance Parameters

- What parameters are engine designers looking to optimise?



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Performance Parameters

- What parameters are engine designers looking to optimise?



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Performance Parameters

- What parameters are engine designers looking to optimise?
- **POWER**
- **FUEL EFFICIENCY**
- **EMISSIONS**
- **RELIABILITY**



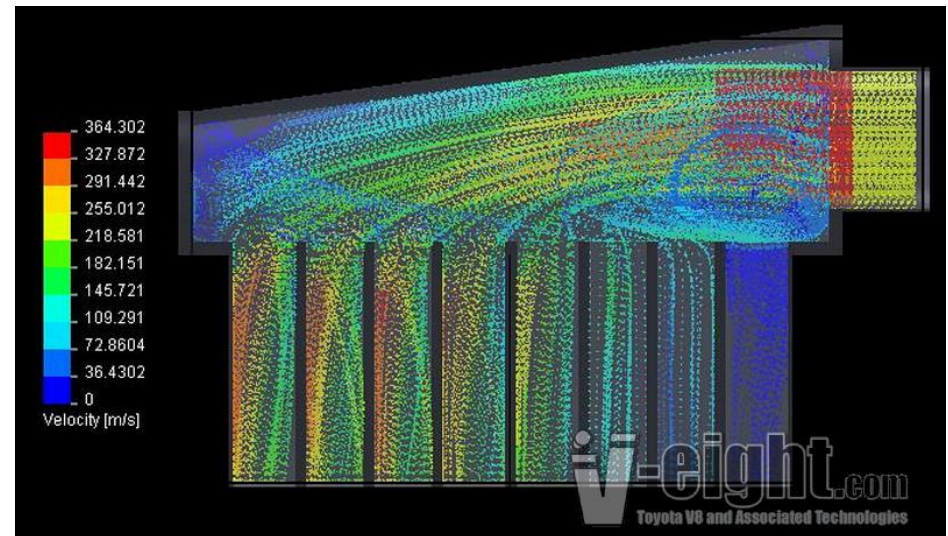
- What do you need to achieve the power, efficiency and emissions targets?
 - Engine design
 - Cylinders
 - Bore
 - Stroke
 - compression ratio etc
 - Cylinder head design
 - Valves
 - Combustion chamber
 - Spark plug position
 - Induction/Exhaust systems
 - Delivering / removing correct amounts of air/exhaust gases
 - Pressure drops etc

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Induction & Exhaust

- So how important is engine breathing?



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Induction & Exhaust

- So how important is engine breathing?
 - Is it harder to do things only breathing through a straw?
- Let's consider two nominally identical engines
- **System 1:**
 - Intake positioned next to radiator/above exhaust manifold
 - Inlet manifold itself heated by hot air downstream of radiator
 - Engine itself is hot – 95° C – so intake air collects heat from port walls etc
 - Restrictive exhaust system
 - Overheated / blocked Catalytic Converter
 - Dirty air filter, carbon build-up on valves

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Induction & Exhaust

- **System 2:**
 - Intake at front of car collecting cold air
 - Free-flowing manifold, heat shielded from exhaust manifold
 - Free-flowing, clean air filter
 - Water temperature regulated at 85° C
 - Free-flowing exhaust with low back-pressure
- So which system produces a higher power output?
- Why?

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Cylinder Heads

- What does a cylinder head do?
- What components does it contain?

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Cylinder Heads

- Camshafts
- Valves
- Springs
- Combustion Chamber
- Inlet and Exhaust Ports
- Spark Plugs



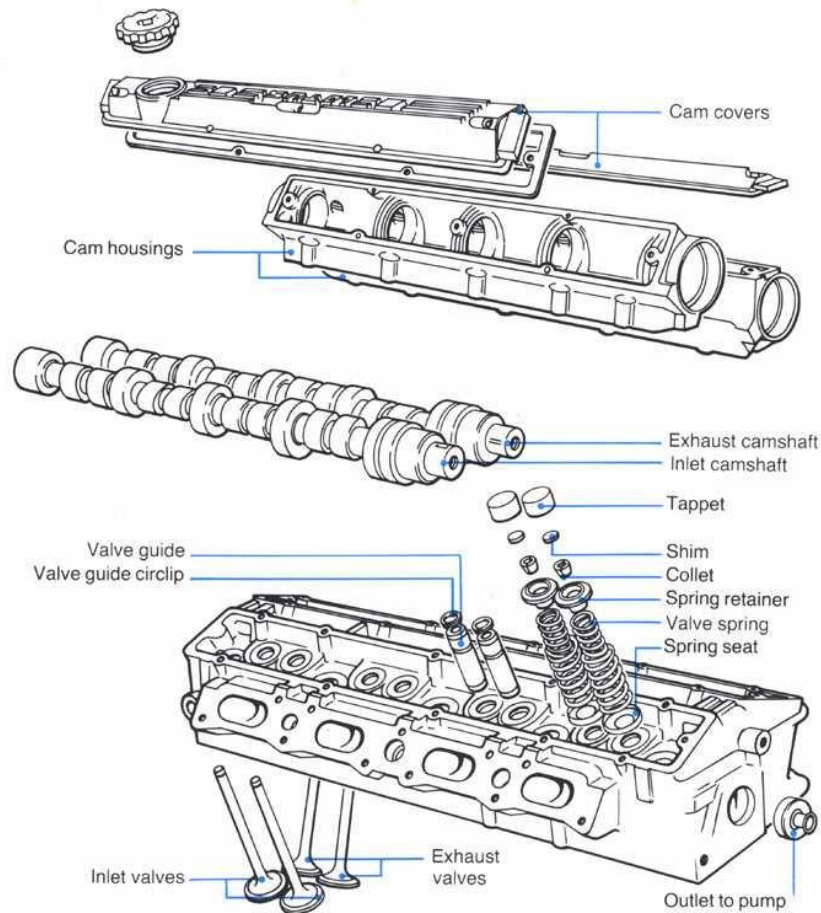
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Cylinder Heads



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CYLINDER HEAD AND CAM HOUSINGS



**Lotus Esprit 910
engine cylinder head
and cam housings**

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Cylinder Heads

- Engine torque, power and fuel consumption are all profoundly affected by
 - Compression ratio
 - Combustion chamber shape
 - Piston crown shape
 - Number and size of inlet and exhaust valves
 - Position of spark plug

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Cylinder Heads

- Objective of good combustion chamber design is to
 - optimize filling of cylinder with fresh charge (air/fuel)
 - optimize emptying of exhaust gases from cylinder
 - create conditions in cylinder to produce thoroughly mixed air/fuel
 - to create highly turbulent charge
- **i.e. to achieve complete combustion in the shortest possible time**

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Cylinder Heads

- To achieve these, we need to be aware of the factors that contribute towards
 - inducing the charge into the cylinder
 - mix the charge thoroughly
 - to burn rapidly and smoothly
 - to expel the burnt gases
- We will review the parameters which must be appreciated to achieve good combustion chamber design in the next lecture
 - <http://www.bing.com/videos/search?q=two+stroke+engine&view=detail&mid=844D61F5B52FA9514632844D61F5B52FA9514632&first=0>