Detroit Engineered products (DEP), is an engineering services, product development, software development, consulting and talent acquisition company. Since its inception in 1998 in Troy, USA, DEP is now a global company with footprints in Europe, China, Korea, Japan, and India. DEP uses the accelerated and transformed product development process, accomplished by utilizing our proprietary platform, DEP MeshWorks, which rapidly reduces the development time of products for all segments. The MeshWorks platform delivers tool sets that accelerate virtual validation activities associated with powertrain development across all stages for both conventional and electric powertrain.

Several tools in MeshWorks have been created with deeper understanding of the needs in a powertrain engineering team. Tools like rib addition, feature removal, model checker, fuse welding, wall thickness reduction options, design space building tools and other model assembly tools have accelerated the way engineers perform model changes for what if studies and optimization.

DEP's IC sensor (In-Cylinder) offers comprehensive portfolio of combustion analysis to the engine design and testing teams in terms of real-time gathered data and make decisions considering emissions, combustion, timing, pressure pattern and performance parameters. This is applicable for single and multiple fuel engines.

The DEP TRIO of IC Sensor, MeshWorks tools and proven technological processes like MDO can significantly add value to Powertrain Engineering.

DEP
Smarter solutions. Realized.

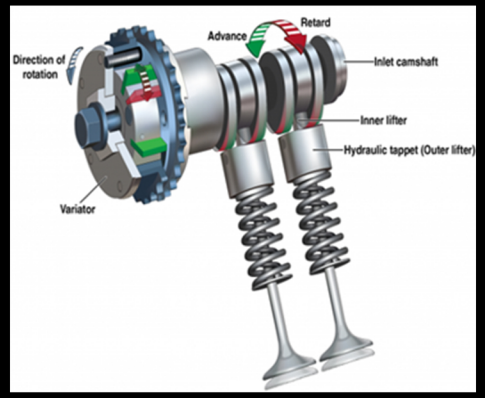
VARIABLE VALVE TIMING SYSTEM DEVELOPMENT

Introduction:

Variable Valve Timing (VVT) is a technology that's used on many advanced engines to improve fuel economy, idle smoothness, emissions and performance. Variable valve timing allows valve timing to change with engine RPM, unlike standard fixed cam drives that never change.

Working Principle:

The rotor inside this vane style cam phaser moves when oil pressure is applied to either side of the rotor vanes. The phaser advances or retards valve timing with the use of internal locating pin that slides into a hole to lock the phaser in position when no oil pressure is applied. When oil pressure is applied it pushes the locating pin out of its locked position allowing the phaser to rotate. The oil flow control valve is, duty cycle controlled (pulse width modulated). This allows the PCM to make step-less or continuous incremental adjustments to valve timing instead of full advance or full retard only. This means, valve timing is no longer a compromise but can be changed to match engine speed and load.



Reverse Engineering:

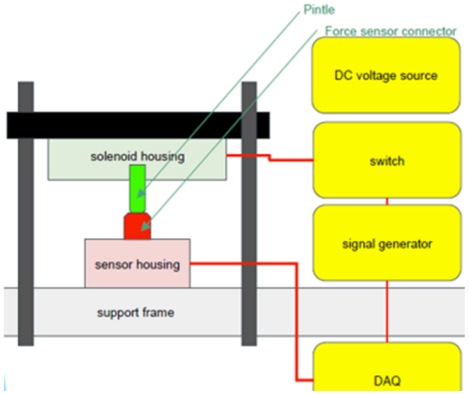
Process includes the scanning of the parts with high level of accuracy and CAD model creation for camphaser assembly.
CAD models verified with physical parts by comparing the mass of the components and key dimensions by physical measurements.

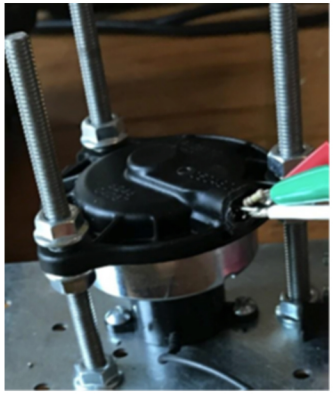
Development Methodology:

DEP has carried out an extensive development work for CAMPHASER which includes the complete test setup for static and dynamic tests for various conditions, 1D simulation model methodology and calibration. Development steps includes:

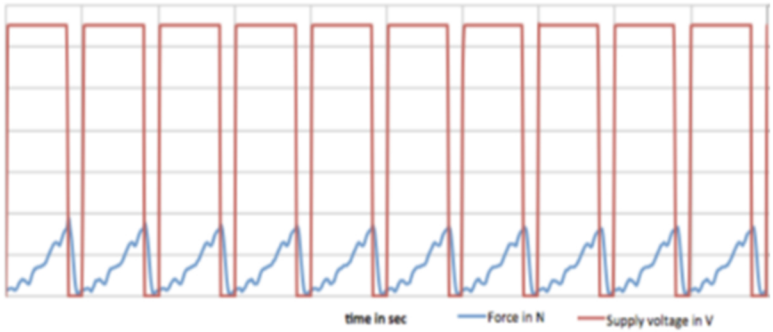
- Reverse Engineering
- Solenoid force measurement
- Static & Dynamic test for slew, flow and leak rate behaviour under various pressure and temperature conditions
- Simulation model development Calibration

Solenoid Force Measurement Setup





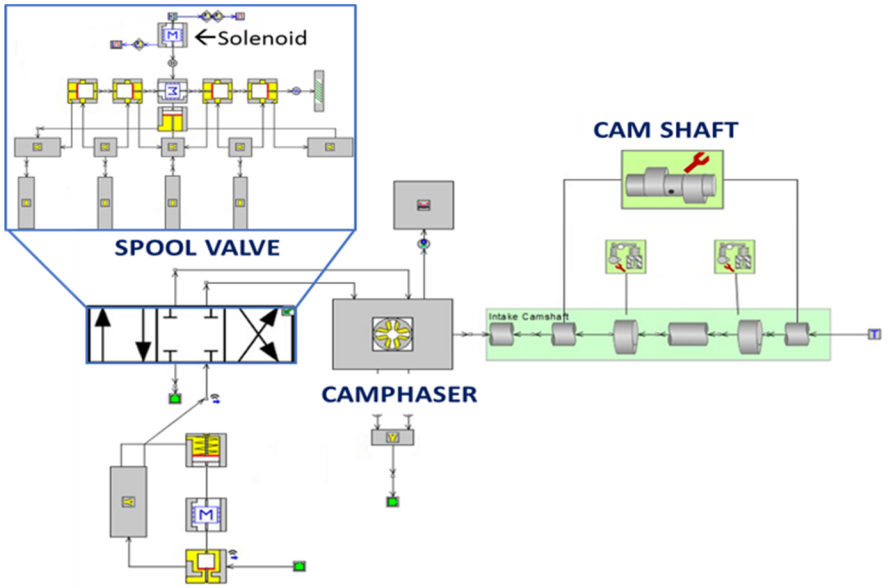
- Solenoid testing carried out to generate the force map w.r.t the Pintle position.
- Schematic shows the solenoid setup – includes the force sensor and data acquisition system.
- Experiment repeated for each Pintle position – for different duty cycle.



Test Measurements

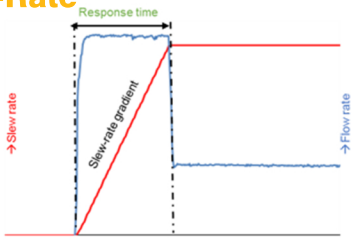
- An extensive measurement campaign has been conducted using a custom build cam-phaser system.
- Static as well as dynamics measurements have been performed.
- Both leak and actuation behaviour has been examined.
- The effect of the following parameters has been extracted
  - Temperature
  - Feed pressure
  - Resistive torque
- The solenoid and spring have been characterized using a dedicated force rig.
- The max displacement of the system has been double checked in the phaser rig.

1D Simulation Methodology & Calibration



Cam Phasing

Slew-Rate



- 1D static and dynamic model calibrated for various operating points with the test results for flow, slew and leak rate
- Design optimization for performance improvement

DEP Capabilities

- Complete CAE solution suite for the Valves.
- Powertrain sub-systems development & simulation solutions
- Reverse Engineering

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