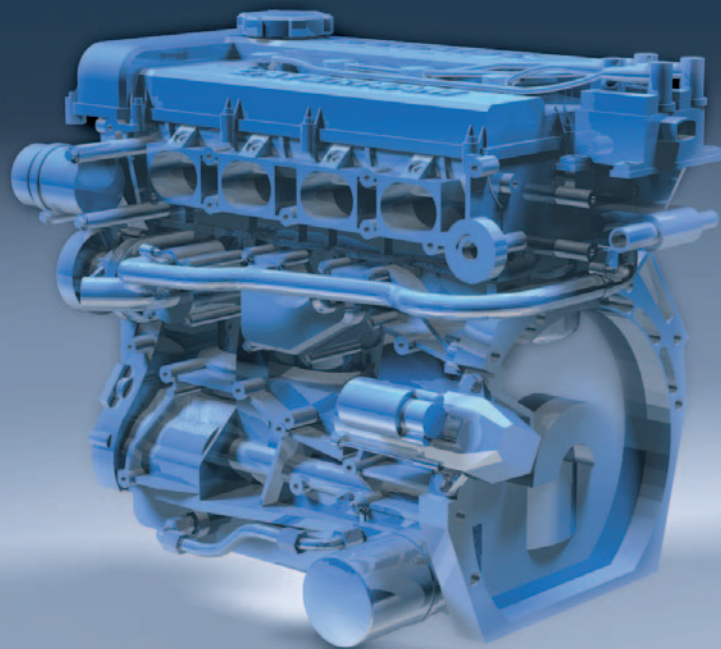


# IAV Engine Design and Development

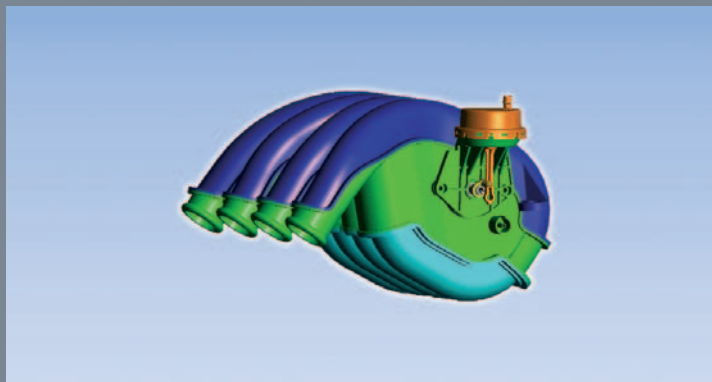
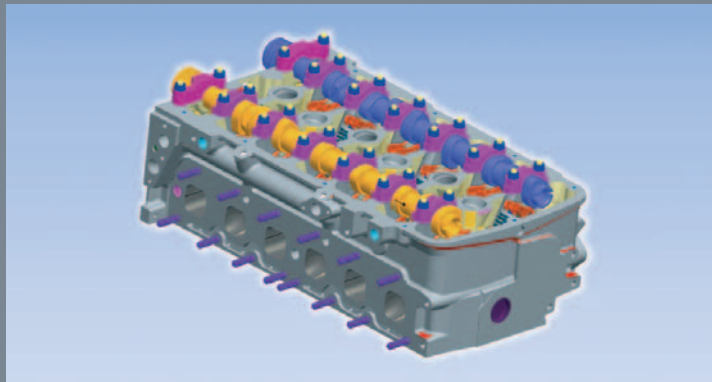
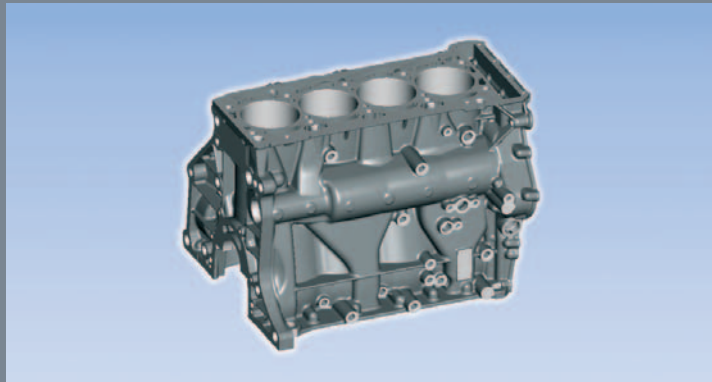
> Hardware Design > Calculation & Simulation > Engine Testing > IAV Processes > IAV Innovative Concepts





# Contents

Design	4
Calculation/Simulation	5
Engine Testing - Mechanical Development	6
IAV Engineering Processes	7
Innovative Concepts	8
Our Services	9



## Design

### Crankcase/Oil Circulation

- ▶ Structure and base concept
- ▶ Liner-design
- ▶ Ventilation/aerating
- ▶ Oil pump development
- ▶ Detail design

### Cylinder Head

- ▶ Cooling optimization
- ▶ Combustion chamber
- ▶ Charge-exchange ports
- ▶ Mounting/lubrication
- ▶ Integration valve train
- ▶ Oil drain/aerating
- ▶ Design of versions

### Engine Mechanics

- ▶ Crankshaft, piston, conrod and bearing
- ▶ Cranktrain concepts
- ▶ Timing train
- ▶ Valve train, variable valve train
- ▶ Balance shaft system

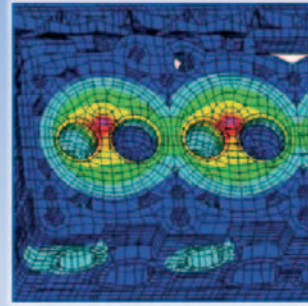
### Charge Exchange

- ▶ Charge exchange dimensioning
- ▶ Intake system/exhaust system
- ▶ Supercharging

## Calculation/Simulation

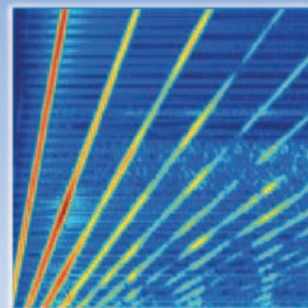
### Structural Mechanics

- ▶ Strength/stiffness
- ▶ Material
- ▶ System analysis
- ▶ Thermo mechanics
- ▶ Optimization



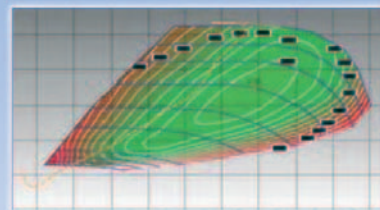
### Dynamics/Acoustics

- ▶ Vibrations
- ▶ Sound radiation
- ▶ Sound design
- ▶ Engine mounting
- ▶ Optimization



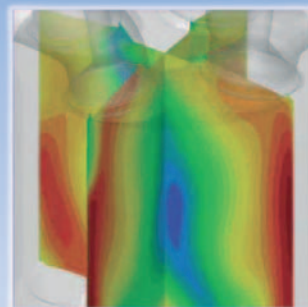
### Fluid Mechanics 1D

- ▶ Charge-cycle
- ▶ Thermo dynamics
- ▶ Engine systems
- ▶ Supercharging
- ▶ Optimization



### Fluid Mechanics 3D

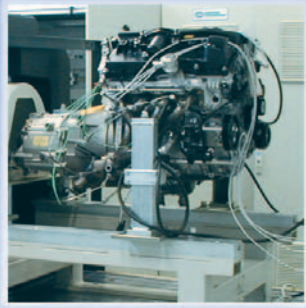
- ▶ Intake system/exhaust system
- ▶ Cooling system
- ▶ Components
- ▶ Combustion system
- ▶ Optimization



## Engine Testing - Mechanical Development

### Mechanics

- ▶ Power loss
- ▶ Crank train
- ▶ Timing train
- ▶ Valve train



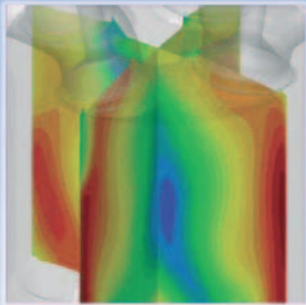
### Lubrication/Cooling

- ▶ Cooling system
- ▶ Oil circuit
- ▶ Aeration
- ▶ Lubricant



### Vibration/Acoustics

- ▶ Airborne-sound emission
- ▶ Sound-source-detection
- ▶ Structure borne sound transmission
- ▶ Psycho acoustics



### Strength/Production Support

- ▶ Component strength
- ▶ Component deformation
- ▶ Durability test
- ▶ Wear analysis



## IAV Engineering Processes

### Virtual Powertrain

- ▶ Methodology development  
Digital Mock-Up
- ▶ Data strategy management
- ▶ Data integration into customer processes
- ▶ Process support/consulting



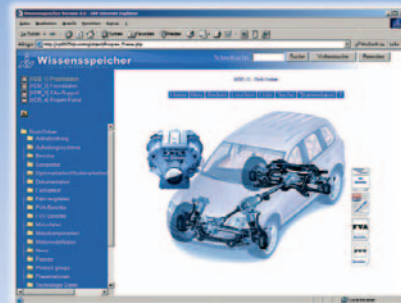
### IAV Dimensioning Tools for Design, Computation and Testing

- ▶ Engine mechanics (VENTIL, V.-ENGINE, ...)
- ▶ Dimensioning workflows
- ▶ Optimization, calculation of variants
- ▶ Uniform analysis of calculation results and test results



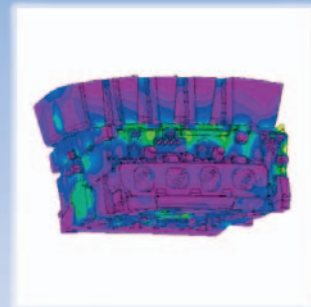
### IAV-Knowledge Data Base

- ▶ Knowledge network (vehicle, engine, gear ...)
- ▶ Knowledge based engineering for Design, Computation and Testing
- ▶ Benchmark of engine parameters
- ▶ Hybrid module
- ▶ Bench mark of competition engines
- ▶ Approx. 3000 engines, 600 gears (as of March 2007)



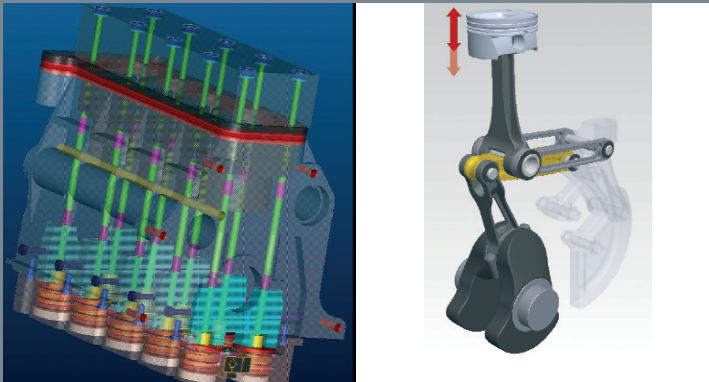
### Frontloading-Methods

- ▶ Development systematics
- ▶ 3D-Tolerance simulation/costs
- ▶ Casting simulation in early stage
- ▶ Fitting simulation und assembly simulation

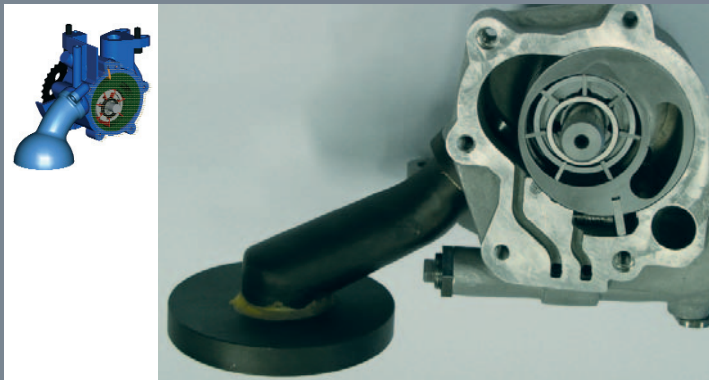


## Innovative Concepts

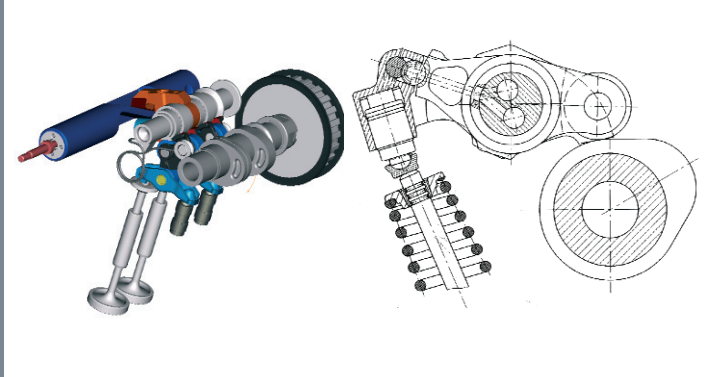
### IAV-Variable Stroke System and Variable Compression



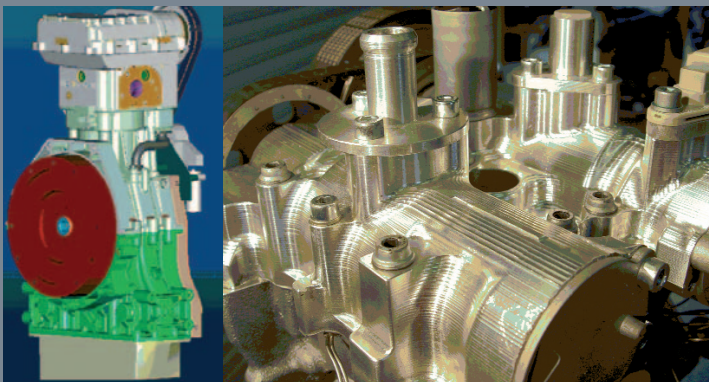
### Oil Supply On Demand With the IAV Controlled Vane-Type Oil Pump



### VVL-System IAV-VARIOVALVE® and Switchable Valve Train Systems



### Modular Single Cylinder Engines for Special Investigations (Combustion, Fuel Injection ...)



# Our Services

Development of new engines, engine derivatives or:	Cylinder head	
<p>Valve train design and optimization (cam optimization and layout optimization, changeover bucket tappet to roller finger follower)</p> <p>Mass balance system development with focus on system development (function, mass, stiffness), manufacturing</p> <p>System development pressure-oil circuit/oil returns/aerating (oil pump layout and oil pump development, dynamical oil level and gas concentration, oil throwing, disposition to freezing-up)</p> <p>New design and optimization of highly stressed cylinder head (Otto, Diesel) - thermomechanics, cooling, port development</p> <p>New design and optimization of cylinder crank cases (AI, GCI)</p> <p>System development engine cooling (water pump, water guidance, thermo-management)</p> <p>Optimization of auxiliary position and auxiliary function (incl. startergenerator/belt startergenerator concepts)</p> <p>New design or optimization of intake and exhaust manifolds (with TC-Integration)</p>	<p>Port layout and design</p> <p>3D CFD port optimization</p> <p>Port measurement and port benchmarking utilizing IAV's DGV measurement method</p> <p>Water jacket and cooling design and optimization</p> <p>Integration of valve train and oil system</p> <p>Layout and design of oil drain, ventilation and separation</p> <p>Entire cylinder head design and structural optimization considering manufacturing demands</p> <p>Layout and optimization of head-block compound considering thermo-mechanical fatigue and gasket behavior</p>	<p>Crankshaft layout, design and optimization using IAV-tools and a proven development method including FEM, fatigue and component testing</p> <p>Plane bearing layout and optimization using IAV-tools (HD) and EHD-calculations</p> <p>Conrod design and optimization</p> <p>Piston optimization</p> <p>Timing train layout and optimization (chain drive, gear drive) utilizing IAV-tools and other calculation software packages for dynamic simulation</p> <p>Valve train layout and optimization (all types) utilizing IAV-tools and other calculation software packages for dynamic simulation, measurements and test rig</p> <p>Balance shaft system layout and optimization</p>

# Our Services

Engine systems	Cylinder block	IAV Software packages for engine development
<p>Charging system layout and optimization (1D; 3D)</p> <p>Transient in-cylinder flow investigation including spray analysis, FIE simulation and measurements on test rig, combustion simulation (diesel/gasoline)</p> <p>Turbo charger system integration, component development (calculation, testing on hot gas test stand)</p> <p>Engine cooling system and water pump layout and optimization (1D/3D calculation and testing)</p> <p>High pressure oil system development, oil pump development incl. simulation and component tests for state-of-the-art pumps and variable displacement pumps</p> <p>Engine ventilation, oil drain and oil separation development (calculation and testing)</p> <p>Engine freezing behavior (testing)</p> <p>Auxiliary drive layout and tuning</p>	<p>Structural layout and design considering material demands and manufacturing demands</p> <p>Liner design and optimization of liner distortion (FEM and measurement)</p> <p>Bulkhead optimization utilizing FEM and hydro pulse testing</p> <p>Ventilation optimization</p> <p><b>Special features</b></p> <p>IAV's variable valve trains for advanced combustion control, exhaust brake etc.</p> <p>IAV's map controlled variable oil pump system</p> <p>IAV's variable compression and variable displacement concept</p> <p>IAV's modular single cylinder research engine</p>	<p>IAV Engine and Hybrid database</p> <p>IAV VENTIL for valve train layout and optimization</p> <p>IAV P-CRANK for crankshaft layout and optimization</p> <p>IAV V-CD for chain drive layout and optimization</p> <p>IAV V.-ENGINE for holistic layout and optimization of engine mechanics</p> <p>IAV V-SiTE for evaluation of simulation and test results</p> <p>IAV EngineeringToolbox for integrated engine layout workflow and optimization technology</p>



