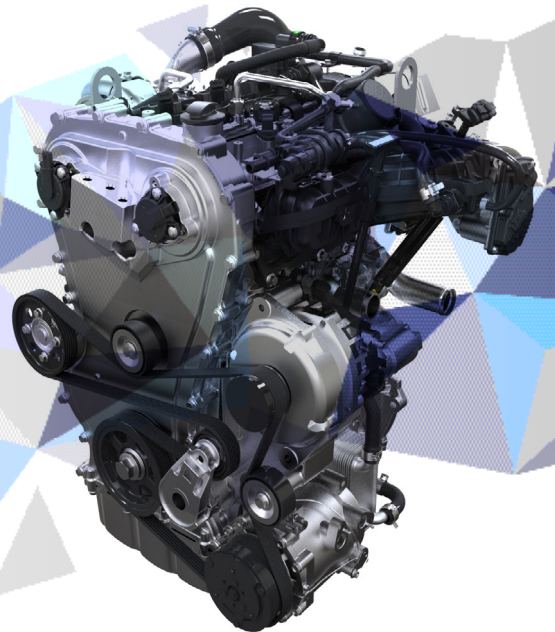


MAHLE Powertrain Design Capabilities

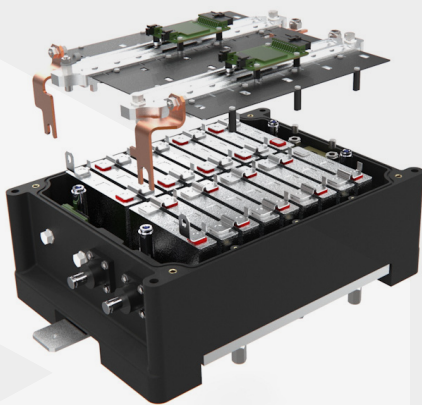


- > Detailed knowledge of powertrain systems
- Full integration with customer systems
- Detailed knowledge of powertrain systems

Design Capabilities

Creating new powertrains for future vehicles is an ever more challenging task. Whether mild or full hybrid, 2WD or 4WD, conventional ICE, battery electric or fuel cell, designers are faced with a huge choice of possible drivetrain configurations.

The engineering details of engines, transmissions, eMotors, battery packs, inverters, cooling systems, fuel systems, intake and exhaust systems all have to be considered at the earliest possible stage in the vehicle development cycle. Critical decisions must be made regarding the interactions between these systems based on an in-depth understanding of numerous factors including packaging constraints, crash behaviour, material properties, durability, serviceability, recyclability, weight and cost. The implications for achieving compliance with the latest vehicle emissions legislation (such as RDE), as well as optimised fuel economy, add even greater degrees of complexity to the powertrain designer's challenge.

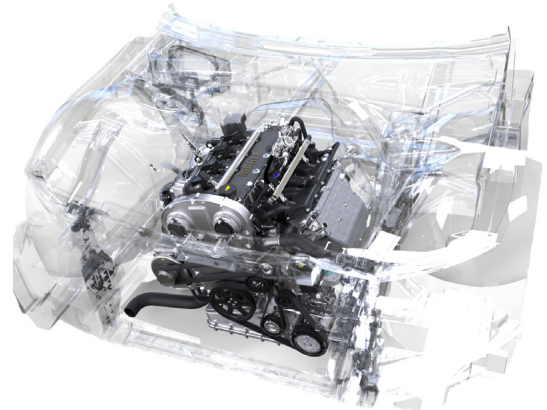


>> 48v high power battery pack

MAHLE Powertrain Design Capabilities

Benefits

- Design team with wealth of knowledge & experience in all areas
- › Reinforced by direct access to MAHLE Group
- Complete product development cycle
- › Initial concept generation to fully approved production design
- Well established quality driven processes
- Software & data transfer tools
- › Integrate seamlessly with customers
- › Ensures cost-effective optimisation of whole powertrain systems



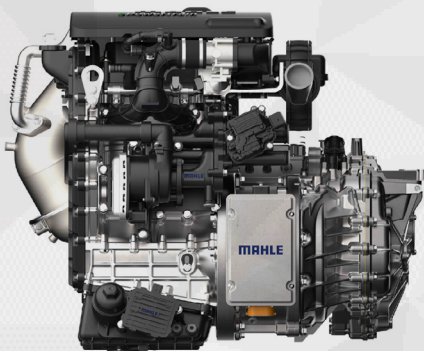
>> Typical engine installation

Concept to Production

- ICE Engines
- Transmissions
- eMotors
- Battery Packs
- Inverter Integration
- Cooling Systems
- Fuel Systems
- Intake / Exhaust Systems
- Vehicle & System Integration
- Topological Optimisation



>> eMotor



>> MAHLE modular hybrid powertrain

Software, Tools & Services

Equipment	
Data Exchange:	Fusion DX, Odette, FTP, Open DXM
PLM Systems:	PTC Windchill, TeamCentre Interface
CAD Systems	PTC Creo, Catia V5/V6, Siemens UG NX
3D Scanning & Printing:	Geomagic Wrap, Geomagic X
3D Tolerance Analysis:	3DCS
Visualisation & \ Clash Detection:	Key Shot Rendering, Catia 4D Navigator, Creoview, Vis Mockup, 3D Caliper (Wall Thickness Analysis)
BOM Management	Windchill, SAP

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