Fuel and Injection System Development

From Component Expertise to Overall System
We Make Things Move

IAV – Your Partner for Automotive Engineering

Our engineering is at the heart of vehicles across the globe. As one of the leading development partners to the automotive industry, IAV offers more than 30 years of experience and a range of skills second to none. With our expertise in the entire vehicle, and the passion to match, we provide technically perfected solutions that balance both rational and emotional aspects. Employing 5,000 members of staff and first-class facilities, we assist manufacturers and suppliers in carrying out their projects wherever they are in the world – from concept to start of production: Your goals are our mission.

Philosophy

IAV specializes in the entire process of developing fuel and injection systems for diesel and gasoline engines. In particular, we concentrate on designing, optimizing and testing hydraulic components. Our aim is to provide further impetus for improving mixture formation and clean combustion technologies with a focus on future generations of fuel and injection systems.

Incorporating combustion, electronics, the engine as well as the overall vehicle, IAV provides a start-to-finish approach in reaching the best possible solution that meets future vehicle consumption and emission requirements. To make sure it does, we work closely with our customers every step of the way.

This brochure gives you an idea of the services we offer in developing injection systems. But as competent consultants, the support we can give extends much further.

Do not hesitate to get in touch with us. We will be pleased to get down and discuss the specific challenges you are facing.

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Swift progress in fuel injection technology over the years has played a key part in developing engines with higher fuel efficiency and lower emissions. The injection system itself is highly complex, and each step forward (e.g. higher injection pressure) pushes materials and functions ever further toward their limits. At the same time, the injection system also has a significant effect on the combustion process as well as exhaust-gas quality and emission standards.

Our experts adopt a start-to-finish approach in identifying and satisfying the demands placed on the entire powertrain. This way, consideration is not restricted to optimizing internal engine aspects but also covers the entire fuel supply system.
Testing influences, such as market and country-specific fuels, complements our global approach.

In addition to its widely ranging test facilities, IAV utilizes special measurement technology that is constantly advanced and adapted to meet changing customer requirements – e.g., for evaluating massflow rate.

Prototyping
- Setting up prototypes
- Prototype construction by specialized partners

Testing
- Detailed component tests and assessment
- System validation (hydraulic and optical)
- Test methodology
- High-performance test benches
- Capability of using real fuels (diesel, gasoline, E85 etc.)
- Testing at variable ambient temperatures
- Endurance tests, followed by component assessments

Production
- Assessment of production processes
- Development of production processes
- End-of-line test support
- Supplier sourcing
ever-tighter emission legislation means injection systems need to become even more efficient. This can only be done if the injection systems operate within narrow tolerances in relation to pressure, fuel quality etc. Fuel supply systems play a particularly important part in this context.

The electric fuel pump and fuel filter in particular must give the injection system a level of stability that is so high as to ensure performance continuity and durability. When it comes to testing components in extreme climate conditions, IAV uses test benches that are capable of reproducing temperature situations ranging from -40°C to +140°C. IAV also provides customers with support during field tests when results need obtaining from the real-world environment.

Alongside fuel supply, the SCR system has become increasingly relevant to meeting today’s emission standards. Besides the AdBlue® tank, this system also incorporates a system for injecting the AdBlue® into the exhaust system. The demands it needs to satisfy are as rigorous as those required of the supply system, making packaging and testing equally as sophisticated as for the whole fuel supply system.

### Fuel Tank (Including Filler Inlet)
- Performance testing
- Assessment

### Electric Fuel Pump
- Component testing
- Stability testing (e.g. supply rate, durability)
- Packaging (e.g. in-tank, in-line)

### Fuel Filter
- Filter concept
- Component testing (e.g. filter, housing, line)
- Performance testing (e.g. plugging, water separation, durability using FAME)
- Freezing tests down to -30°C
- Activated carbon canister testing

### High-Tech Systems and Methods
- Test benches for a wide temperature range
- Automated test benches for endurance tests
- Use of real-world fuels (diesel, gasoline, gaseous)
- Validation of components at vehicle tests

Components and installation of the fuel supply system
SCR System

- Preliminary development / simulation
  - Concept
    (ventilation, fluid-level indication)
  - Packaging (design verification plan)
- Component testing
  - Heater
  - Supply module
  - Fill-level detection
  - Quality sensor
  - Reservoir
  - Dosing line
- Vehicle testing and calibration
  - Verification of all functions under extreme conditions
  - Behavior around the AdBlue® freezing point
  - Acoustic behaviour
- Production Support
From Tank to Nozzle

Fuel Injection System (FIS)

Extreme conditions on test benches
IAV Injection Analyzer
Optical analysis
To avoid making development mistakes with far-reaching consequences, it is important to optimize the injection system with all its components at an early stage. To do this, IAV takes into account both the engine manufacturer’s requirements and the supplier’s situation. Our engineers are experts in resolving trade-offs, aiming at all times to meet the demands of minimizing cost, emissions and fuel consumption while maximizing durability.

This integrated view of the fuel and injection system coupled with profound component expertise creates the ideal basis for the competent support we provide. The result we arrive at is validated by the use of high-precision measuring systems, such as the IAV Injection Analyzer for injection rates and quantity, or the pressure chamber for optically analyzing injection events.

The overriding goal is to enhance the quality of combustion, reduce fuel consumption and emissions as well as improve the power and harmony of the engine itself.

**High-Pressure Pumps (HPP)**
- Component testing
- Endurance testing
- Testing with poor-quality fuels
- Design and packaging of new pumps

**Rails and Pressure-Control Valves**
- Performance testing
- Stability testing (pressure)
- Development of control strategies

**Injectors**
- Injector concepts
- Nozzle concepts
- System concepts
- Design and packaging
- Component testing
- System testing

**High-Tech Systems and Methods**
- Test benches for wide temperature range
- Automated test benches for endurance tests
- Optical spray visualization (Schlieren, MIE etc.)
- Measuring system developed in-house (IAV Injection Analyzer)
- Use of real-world fuels (diesel, gasoline, gaseous fuels)

**Combustion Principles**
- Focus on mixture formation
- Support in relation to combustion principles
- Close meshing with engine and vehicle tests

Components and installation of the fuel injection system
Our Portfolio
Our activities do not stop at passenger cars or commercial vehicles. They also cover off-highway and marine applications. This means we can provide our broad knowledge and experience for whatever the application.

For example, IAV has developed injection systems for off-highway usage – from concept to simulation, prototyping and testing right through to mass production. Implementing new and optimized approaches, IAV uses its experience gathered from projects on applications and engines of various sizes. New combinations of materials and innovative coatings increase robustness and prolong service life. Newly developed ECU algorithms ensure stability over vehicle life, with OBD ensuring compliance with legislation. To make injection measurements comparable for all applications, we use the IAV Injection Analyzer, a measuring system developed in-house.

Not only available at our headquarters in Germany, IAV’s expertise and state-of-the-art test facilities are at your service across the globe.

Germany (Gifhorn, Lower Saxony)
Our main development center is located in Germany. This is where we provide all of the services described for developing and testing fuel supply systems, SCR systems and fuel injection systems.

France (Guyancourt, Île-de-France)
At Guyancourt we develop and test fuel injection systems using our special hydraulic test benches.

USA (Northville, Michigan)
At Northville we use component test benches for developing and testing fuel injection systems.

Operation range from Passenger Cars to naval application
IAV injection system sites around the world