AVL Dynamometers and Actuators

APPROACH DYNAMOMETERS AND ACTUATORS

The pressure to shorten development time and increase the complexity of testing is increasing, as is the demand on test cells and dynamometers. Dynamometers are the main element in a test cell. They are the components exposed to the hardest working conditions.

The range of performance of modern engines demands dynamometers that are of the highest quality technologically, while also highly reliable and equipped with precise measurement devices. AVL dynamometers meet these requirements in an optimal way.

BENEFITS AT A GLANCE

- Dynamometers are available for different applications
- Test cell design results in a long life span and low maintenance
- Fast torque response is provided by rotorflux vector control of the stator current
- Low mass moment of inertia allows a high-speed gradient
- IGBT converters with random pulse pattern reduce the electrical noise in the machine
- Recuperation of energy especially in endurance tests saves costs and energy
- Compact and maintenance-friendly design

TASK

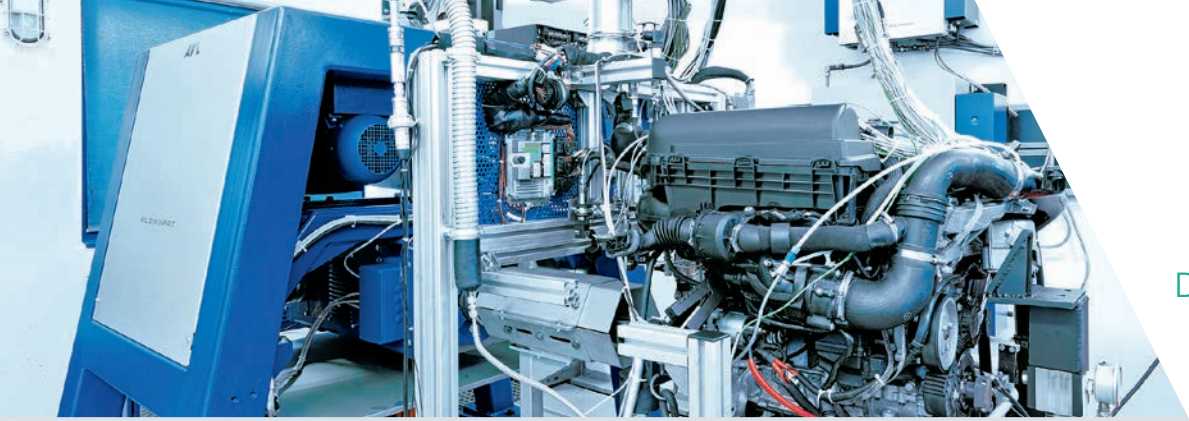
Different test procedures and different engines require different dynamometers. Engine testing with the original vehicle exhaust system requires space where the dynamometer is normally mounted.

A dynamic dynamometer is needed to run dynamic test cycles. The development of intelligent powertrain components through to hybrid systems puts a load on all components, which is comparable to the road test. Therefore, the inertia of the dynamometer should be equal to the inertia of the vehicle's wheel.

Combustion engines with high power are also calibrated and tested in low power ranges. Therefore, the requirements for torque measuring systems and their accuracy increase.

Torque peaks should not influence any technical values of the torque-measuring system. Measuring units can be changed, but the dynamometer must run with low maintenance during its whole lifetime. In case of disruption, the fast delivery of spare parts and well trained engineers must be available to support the customer.

It is also important that it is possible to upgrade dynamometers.



DIFFERENT TEST PROCEDURES AND ENGINES REQUIRE DIFFERENT DYNAMOMETERS AND FLEXIBLE ACTUATORS.

DYNAMOMETERS AND ACTUATORS

Engine test cells

AVL offers dynamometers for different engines and test procedures ranging from eddy current dynamometers, asynchronous and synchronous motors to hydraulic dynamometers for testing even the largest crosshead engines. High measuring accuracy and dynamic control are a must for AVL.

Powertrain test cells

Road to rig reduces development time. Dynamometers with the inertia of a vehicle wheel fulfil the requirements of real test conditions. Powertrain test cells are available for gearboxes, passenger cars with one or more driven axles and for Formula 1 vehicles.

Actuators

Most of AVL's test cells are equipped with the AVL throttle actuator THA. For transmission and powertrain test cells, AVL offers solutions for gear shift and clutch actuation.

AVL test systems

For research and development in the vehicle industry, AVL offers tailored solutions in test, control and measuring technology. Delivered dynamometers can be upgraded with new control systems to satisfy future demands.

LOAD UNIT FOR ENGINE TEST CELLS

AVL DynoPerform

Eddy current dynamometers in the AVL DynoPerform series are equipped with drum rotors. An adjustment of the air gap is not necessary. A DC current flows through the excitation coil. This creates a variable magnetic field that is dependent on the excitation current. The magnetic field of the rotating rotor creates eddy currents at the surface of the cooling chambers. This converts the mechanical energy of the engine into thermal energy. The energy is absorbed by the cooling water which can be retroactively cooled via a cooling tower, as it is the case for the cooling water for the combustion engine.

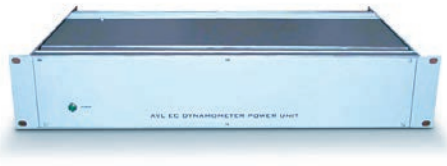
TORQUE MEASUREMENT

The eddy current dynamometer is a cradled dyno. The reaction force of the brake torque is measured with a strain gauge-based load cell. The measuring accuracy is influenced by the linearity of the load cell and the hysteresis of the dyno. The torque measuring system is calibrated by load beams and dead weights. The measuring error of the load cell can be compensated by the measuring amplifier.

APPLICATION

Cost-effective dynamometer for tests in R&D, quality control and endurance

- Steady-state and transient applications
- R&D for engines and components
- Tests for fuel and lubrication oil



Using the power unit LSE 410 for eddy current dynamometers, very quick load changes are achieved due to the modern IGBT technology with PWM control

BENEFITS AT A GLANCE

- Excellent full-range torque and speed control stability
- No axial forces on the shaft bearings due to drum rotor design
- No air gap adjustment required
- Very fast loading and unloading thanks to an IGBT full bridge power unit with a 4-quadrant PWM controller (substantially faster than a thyristor bridge power unit)
- High permissible coupling weights

LOAD UNIT FOR ENGINE TEST CELLS

AVL DynoDur Compact

AVL DynoDur Compact™ is optimized to the requirements of basic R&D, durability and end-of-line engine test cell applications. The system is fully regenerative and fulfils stringent EU EMC norms EN 61800-3 category C3 for operation in industrial mains environment and as an optional category C2 for operation in residential mains environments. The drive cabinet enclosure is equipped with mains switch, choke and filter as well as a 4Q IGBT power unit. It is, however, very compact and its mains requirements are less than many competitive systems.

CHARACTERISTICS

Energy is recovered on the mains with high efficiency and installation costs fully optimized. High reliability and, therefore, a high number of yearly operating hours are guaranteed by using a combination of an induction motor approved for its robustness in engine testing field together with an industry-based power drive system.

APPLICATION

The AVL DynoDur Compact™ motors are designed to minimize temperature drift on the motor drive-end-side which is equipped for the mounting of a HBM torque flange. This leads to best-in-class torque measurement accuracy and temperature stability. By using the AVL patent-pending calibration system, the calibration check can be done with higher accuracy than when using common calibration levers available on the market. The AVL DynoDur Compact™ was developed based on precise requirements and is the perfect cost-optimized solution.

BENEFITS AT A GLANCE

- Fast return on investment thanks to highly efficient energy recovery
- Fulfils stringent EMC EU norms EN 61800-3 category C3, category C2 available as an option
- Low installation costs through compact cabinet dimensions and optimized mains requirements
- High reliability due to robust motors
- Best-in-class torque measurement accuracy and temperature stability

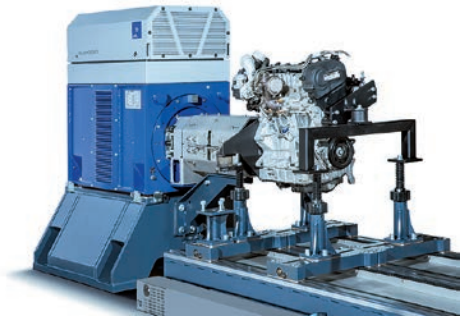
LOAD SYSTEM FOR ENGINE TESTING

AVL DynoFORCE™

The AVL DynoFORCE™ load system consists of a foot-mounted asynchronous AC-induction dynamometer combined with a 4Q-frequency converter cabinet. Together with accessories, it is a unique solution from a single source for professional testing of transient and dynamic engine applications. The series combines well-established components with innovative solutions and offers an optimized balance between TCO and performance.

PRINCIPLE

Thanks to the high power coverage of each dynamometer, a broad engine portfolio can be handled with just twelve performance classes. This ensures highest flexibility with less testbed variants. With its significantly improved torque/inertia ratio, the system is ready for testing today's and future combustion and hybrid engine generations. To achieve real vehicle load transitions, the frequency converter cabinet has a fast torque rise time and a high-speed interface to the controller. High-precision torque and speed measuring instruments ensure highest repeatability of load conditions and therefore a fast progress in engine development. Finally, designed for 24/7 operation, best testbed efficiency is guaranteed.



The new dynamometer series combines highest robustness and extraordinary dynamics. This provides a very wide application range and gives the testbed highest flexibility in various applications.

APPLICATION

The DynoFORCE™ series, designed for stationary, transient and dynamic test runs, can be used for various applications, such as vehicle simulation and exhaust emission measuring of passenger car and truck engines. In addition, other applications such as component testing and friction tests are possible.

BENEFITS AT A GLANCE

- Efficient testbed usage thanks to a flexible load system solution for transient and dynamic testing tasks.
- Easy and subsequent system upgradeability ensures futureproof solution ahead of challenges.
- Optimized Total Cost of Ownership is achieved by improved maintainability and reduction of operation cost.

The new converter cabinet combines latest industrial quality standards with high performance in order to make vehicle simulation reality.

LOAD UNIT FOR ENGINE TEST CELLS

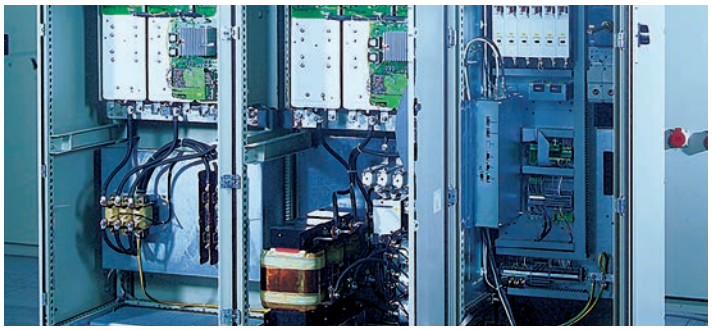
AVL DynoExact

The outstanding measuring accuracy and control dynamics offer engineers a universal tool for research and development related to engines and powertrain systems. More than 1,400 systems have already been installed. The dynamometer was developed by AVL under real test cell conditions. Existing dynos can be upgraded with new control systems.

CHARACTERISTICS

It is possible to choose between two different types of cradle bearings. The first type uses ball bearings as used in eddy current dynamometers, and the second type uses friction- and maintenance-free hydrostatic bearings. The bending beam used allows more movement than a load cell in the cradle bearings which increases the life span of the bearings. All cradle parts are covered for safety reasons.

The built-in fast torque calculator is optimized with the highly accurate actual torque signal. Therefore, a fast and accurate torque signal is created for highly dynamic control loops.



Highly precise, pendulum-mounted, robust AC drive system with a state-of-the-art 4Q-IGBT converter for speed and torque-controlled operation. A real-time torque calculator also provides the shaft torque of the machine in addition to the electric torque (air-gap torque).

APPLICATION

- R&D, quality and endurance testing for engine and components
- Precise vehicle and driver simulation as well as drivability optimization in an engine test cell
- Dynamic engine test for racing

BENEFITS AT A GLANCE

- Very high torque accuracy with hydrostatic bearings option
- Option of torque calibration check during operation
- Option to recalibrate the dyno down to half of the dynamometer nominal torque to increase the torque measurement accuracy for small engines
- Accurate high dynamic torque control
- Option of precise vehicle simulation in the test cell
- Robust industrial design for operation under extreme ambient and environmental conditions
- Easy installation and commissioning due to precommissioned components examined in a shop test

LOAD UNIT FOR ENGINE TEST CELLS

AVL DynoSpirit

New requirements for engine testing demand new types of dynamometers. Standard dynos cannot be used to test an inline engine with the original vehicle exhaust system on an engine testbed because there is no space for it. The AVL DynoSpirit hangs in a frame and the exhaust system can be installed in the available space below. The motors used for AVL DynoSpirit have a proven, robust design that has already been used in many applications.

TORQUE MEASUREMENT

The low inertia of the dynamometer allows a stiff driveshaft connection to the combustion engine. The stiff connection provides the possibility of fast torque measurement and control. The AVL permanent magnet motors have high torque linearity and high accuracy in the open torque control loop. In combination with the AVL dynamic control package (KIWI, AVL EMCON™, AVL ISAC™), the AVL DynoSpirit offers the highest level of dynamics and accuracy for torque control.

Highly dynamic, compact AC drive system for testing combustion engines consisting of state-of-the-art permanent magnet motor and IGBT frequency converter for 4Q operation with a digital real-time interface. Enables, together with a portal frame, testing of the original exhaust system.

APPLICATION

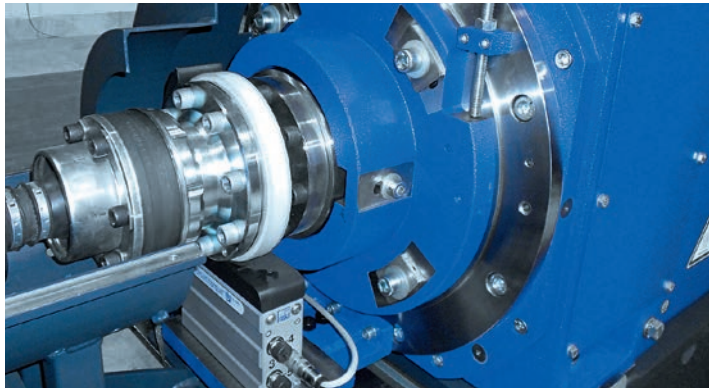
- R&D, quality and endurance testing for engine and components
- Precise simulation of vehicle load on an engine test cell
- Calibration of engine management systems
- The dyno is designed for extreme ambient conditions

BENEFITS AT A GLANCE

- Very high speed gradients thanks to an ultra low rotor inertia
- Particularly well adapted for applications where space is critical due to very small motor dimensions and weight
- Top dynamics and accurate torque control thanks to the very high motor torque linearity
- Higher torque measurement accuracy than with a foot-mounted asynchronous motor thanks to the lower temperature influence from the rotor
- Robust and compact design for operation under extreme ambient and environmental conditions

LOAD UNIT FOR POWERTRAIN TEST CELLS

AVL DynoTrain



BENEFITS AT A GLANCE

- Large choice of machines with a suitable speed and torque range selection
- Flexible and modular system of motors and inverters, with common intermediate circuit for multiple dynamometer configuration
- Robust and service-friendly design

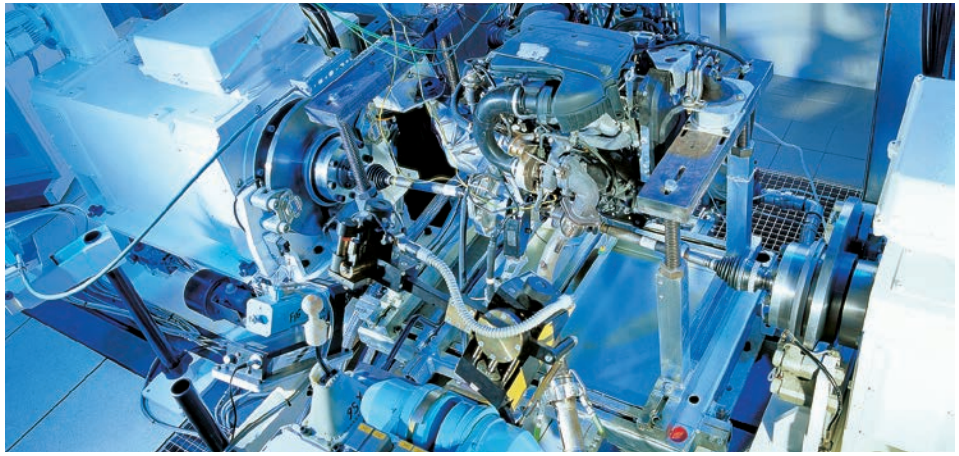
The AVL DynoTrain series is developed especially for use at gearbox and driveline test stands. All parts of the complete AVL DynoTrain family fit into different test applications. This results in a flexible system for different applications.

CHARACTERISTICS

Inline torque meters are used for torque measurement. To extend the measuring range, the inline torque meter can be adjusted to the required torque range. Together with the AVL DynoPrime, the energy runs in a loop and only the losses of the system are taken out of the grid.

APPLICATION

- R&D, quality and endurance tests for gearboxes and drivelines
- Development of drivelines for vehicles with one or more driven axles
- NVH measuring



Modular asynchronous motor and converter system, designed for application at transmission and powertrain test cells. The 4Q-IGBT converter is equipped with a digital real-time Interface.

LOAD UNIT FOR POWERTRAIN TEST CELLS

AVL DynoWheel

The AVL DynoWheel series is designed for use at gearbox test stands. Two different characteristics are provided by this dynamometer: low mass inertia and very high torque at low speed. Together with AVL DynoPrime, the energy runs in a loop and only the losses of the test system have to be supplied by the grid.

CHARACTERISTICS

The inertia of the dynamometer is equal to the mass inertia of a vehicle wheel. It is possible to simulate the same drivability as on the road as well as wheel slip. Not only the vehicle acceleration but also the driveline vibration of the vehicle is similar to reality. Fast control loops make it possible to optimize the driveline for one or two driven axles. The AVL DynoWheel drives are powertrain testing systems with features specially developed to provide the best results when the highest accuracy and control dynamics are required.

APPLICATION

- Application wherever the simulation of the dynamic vehicle values is important
- The AVL DynoWheel is directly coupled to the axle shafts
- The tire stiffness and slip is controlled by the AVL control systems

BENEFITS AT A GLANCE

- Machines with very low inertia adapted to the real vehicle wheel
- Optimized for reproduction of realistic wheel loads and torsional behavior
- Accurate test execution and excellent repeatability due to high torque control linearity
- Flexible and modular system for motors and inverters with common intermediate circuit for multiple dynamometer configuration
- Service-friendly power unit

LOAD UNIT FOR DRIVETRAIN TEST CELLS

AVL DynoPrime

The AVL DynoPrime series is designed to replace a combustion engine on gearbox and powertrain test stands.

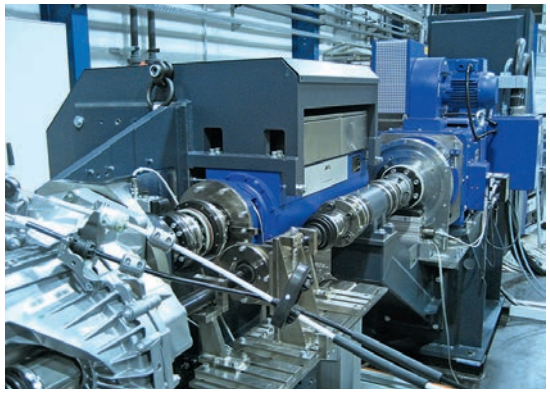
REQUIREMENTS

The mass inertia of the dynamometer has to be equal to the inertia of the combustion engine. Torque pulses of a combustion engine must be simulated. The center height must be very low. If the dyno is mounted to the bell housing of a front wheel drive vehicle, enough space must be provided to mount the axle shafts.

CHARACTERISTICS

- Very low inertia
- Low center height
- High overload capability

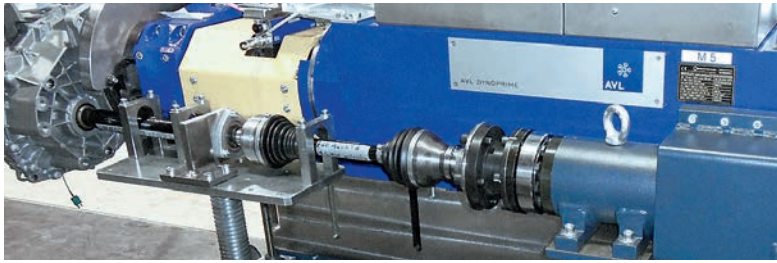
With its interfaces and dynamics, the AVL drive converter of the AVL DynoPrime corresponds to the converters of AVL DynoTrain and AVL DynoWheel dynamometers. The real vehicle behavior can be simulated in a system with one AVL DynoPrime and two or four AVL DynoWheels. The dynamometers are water jacket-cooled and supplemented by a closed air-cooling loop for the rotor. This makes noise measurements on a gearbox test stand more efficient.



AVL DynoPrime is a highly dynamic PMM drive system for the simulation of the rotational behavior of the crankshaft of combustion engines. The system is characterized by high nominal torques and a high overload capacity with the smallest moment of inertia.

APPLICATION

- Development and optimization of the driveline before the vehicle engine is available
- R&D for gearboxes, drivelines and vehicle parts that are influenced by the characteristics of the combustion engine
- Wear tests under dynamic conditions
- Noise measuring



BENEFITS AT A GLANCE

- Inertia similar to a combustion engine
- High nominal torque (larger than ICE), plus additional overload torque capability for simulation of speed oscillations
- High flexibility in the parameterization of various characteristics of engines
- Cost savings due to simpler setup of transmission and driveline testbeds
- Simple retrofitting into existing test cells is ensured by using the throttle as a demand value. Existing drive cycles can be used without modification