Vehicle Dynamics Measurement



A&D Testing Services

Synchronized vehicle dynamics data under real-world conditions

Using A&D's Vehicle Measurement System (VMS), A&D provides synchronized vehicle behavior data gathered under designated driving conditions. The VMS is a high-accuracy system consisting of three sensor modules that collect data simultaneously:

Wheel Force Sensor (WFS)

Measures all forces and moments on the wheel (Fx, Fy, Fz, Mx, My, Mz), as well as angular velocity of the wheel

Wheel Position Sensor (WPS)

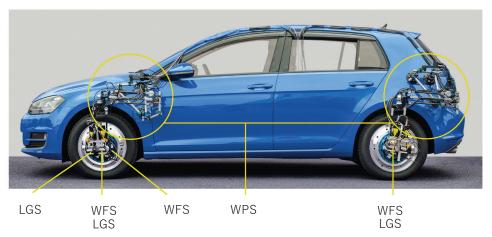
Collects data on the motion of the wheel relative to the chassis in five degrees of freedom

Laser Ground Sensor (LGS)

Provides dynamic side-slip and camber angles; also measures longitudinal and lateral wheel speeds and the effective tire radius

By attaching external sensors, such as an Inertial Measurement Unit (IMU) or steering angle sensor, other characteristics, such as the change in the center of gravity or steering ratio of the vehicle can be identified.

Using this integrated vehicle behavior data, it is possible to calculate the road gradient or snow-covered road surface μ . Other useful applications include developing Pacejka tire models and identifying suspension parameters.



The Vehicle Measurement (VMS) consists of a Wheel Force Sensor (WFS), Wheel Position Sensor (WPS) and a Laser Ground Sensor (LGS).

Included:

- Testing using either standard or customerrequested test procedures
- Creation of customerrequested test procedures
- Data collection for tire characteristics analysis or tire model creation

Measurements:

- WFS Forces (Fx,Fy,Fz) Moments (Mx,My,Mz,), angular position and velocity of wheel
- WPS Px,Py,Pz camber angle and tow angle in relation to the vehicle body
- LGS

 Wheel speed (Vx,Vy),
 - Slip angle (θs),
 - Wheel camber angle (θc) with respect to the ground
 - Wheel pitch angle (θp) used for data correction
 - Effective tire radius (distance from the center of the tire to the ground).
- Time series data of the above

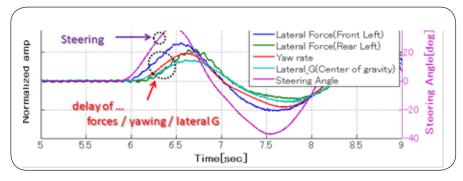
Example ISO-compliant measurement test services

Provide ISO-compliant stationary and transient test data by measuring vehicle behavior

- Stationary circle turning test (ISO4138)
- Steering transient response test (ISO7401, Sine wave steering/step steering test)
- Steering closed loop test (ISO3888-1, double lane-change test)

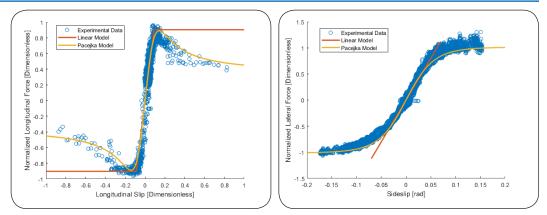
Data can be used with simulation software, such as CarSim® and CarMaker®, for vehicle behavior analysis.

Transient response example of wheel forces and vehicle behavior against steering input



Vertical axis: Normalized amplitude (wheel force/vehicle yaw rate/vehicle side G) Horizontal axis: Time

Pacejka Tire Modeling



Normalized Longitudinal Force (Fx/Fz)/Normalized Lateral Force (Fy/Fz) Vertical axis: Longitudinal Slip/Side-slip Angle Horizontal axis:

Americas

Europe

A&D Technology, Inc. Ann Arbor, MI USA Ph: +1 (734)973 1111 www.AandDTech.com

A&D Europe, GmbH

Griesheim, Germany PH: +49 (0)6155-605 250 www.AandDEurope.com

A&D Europe - UK Branch Abingdon, Oxon, UK PH: +44 (0)1235-550 420 www.AandDEurope.com

Asia

A&D Technology Trading Co. A&D Company, Ltd-Shanghai, China PH: +86 (0)21-3393 2340 www.AandDTech.com

Tokyo, Japan PH: +81 (0)3-5391 2753 www.AandD.co.jp

Australia

A&D Australasia Pty Ltd. Kensington, VIC, Australia PH: +61 (0)3-9372 1522 www.andaustralasia.com.au



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