MAHA AIP GmbH & CO. KG (Automotive Industry Products) amends the parent company MAHA (workshop equipment) with tailor-made testing systems for vehicle manufacturers and their sub-suppliers – worldwide.

Special testing systems for cars, trucks, motorcycles, ATVs, tractors, forklifts, special vehicles, etc. for research- and design centers, quality assurance, e.g. for:

- Chassis Dynamometers for Emission-, NVH-, EMC-, Mileage-Accumulation Tests, etc.
- Chassis Dynamometers for the use in wind tunnels, climatic-, altitude chambers
- Flat Road Dynamometers
- Windtunnel Balance Systems
- Test Stand Automation
- Emission Test Systems
- Drive-robots / Throttle Actuators.

The comprehensive AIP system solutions are of modular design and easily adaptable to various vehicle types and customer requirements (budget, time frame, laws and regulations, etc.).

All of us at MAHA are committed to a high level of customer satisfaction and hope you will give us an opportunity to serve you.

MAHA AIP Highlights

1994
Formation of the AIP (Automotive Industry Projects) profit center to amend the standard MAHA workshop equipment product line with tailor-made vehicle testing solutions for the automotive industry.
Quality certification as per ISO 9001.

1998
Development of the first MAHA-AIP 48” Emission Chassis Dyno 4WD as per EPA standard, using MIM-design and AC-motor technology. Because of AIP’s innovations in the accuracy of the MAHA electrical 4WD synchronization module / dyno controller, AIP became the state-of-the-art in their field. As a result MAHA-AIP became the market leader in manufacturing 48” chassis dynos within few years. Currently worldwide nearly all ‘premium class’ vehicle manufacturers and the automotive industry suppliers rely on the strength of MAHA-AIP, for instance:

– high flexibility to fulfill special customer demands
– excellent product quality and reliability
– low maintenance design
– in-house production (hard-/software), vertically integrated

2000
Cooperative sales contract between MAHA-AIP and HORIBA for MAHA Emission Chassis Dynos
MAHA opens Beijing office

2004
EPA (Environmental Protection Agency) selects MAHA-AIP to supply a 4WD 48 MDD test dyno as the reference test stand for i.e. 4WD vehicle emission tests.

2005
The former MAHA-AIP profit center changed into an independent legal entity, the MAHA AIP GmbH & Co. KG. Nevertheless the close cooperation with the parent company MAHA workshop equipment (www.maha.de, more than 1,000 employees) offers a lot of benefits, especially in terms of in-house manufacturing capacity and global service.

2006
CARB (Californian Air Research Board) selects MAHA-AIP to supply 4WD 48 MDD test stands as the reference test stand for 4WD emission tests.
Certification as per ISO 14001:2004.

2007
Since 1999 more than 320 Emission Chassis Dynos 48” have been successfully installed – globally.
MAHA opens Shanghai/Pudong office

Extensive product development activities high growth in other vehicle test dyno applications, e.g. NVH,-, EMC,- or vehicle endurance test (mileage accumulation tests).

2008
New product range – emission measuring systems
MAHA designs and manufactures Solid Particle Counter, CVS, Particle Mass Controller and various other systems.

2009
Cooperative contract between MAHA-AIP and Prime ONE Contracting to provide ‘turn-key’ solutions and service of MAHA-AIP equipment in mainland USA, Canada, Mexico, and Brazil.

2010
Contract with EPA for the supply of four (4) additional MAHA 48” Emission Chassis Dynos through PrimeOne.

2012
Extension of product portfolio MAHA Emission Measurement Systems (N2O measurement, particle counter, etc.)
Emission Chassis Dynos for rear-, front- and/or 4WD vehicles (LDV, MDV, HDV).

Rolling road, conform e.g. with US Specification EPA RFP C1000081 T1 and also the valid Japanese and European guidelines and standards.

User Examples:
Vehicle manufacturers (e.g. R&D Centers), Automotive supply industry (2WD and 4WD applications) e.g.

- Emission tests
  - WLTP
  - FTP 75 / SFTP (US06
  - EPA
  - ECE + EUDC
  - Japan 10 ... 15 mode
- Temperature tests (climate chambers)
- Fuel consumption
- Pre-conditioning
- Quality checks (COP)
- Mileage accumulation
- Electric Vehicle Tests

CDM 48“- Emission Chassis Dyno 2WD/4WD - LDD / MDD

- 48“ (1,219 mm) Roller set with AC motor for LDVs and MDVs (MIM -> motor-in-the-middle principle)
- Precise, reproducible mass simulation
- Accuracy exceeds EPA requirements
- Extremely compact design
  - Slim pit dimensions
- Excellent 4WD synchronization
  - high dynamic regulation
  - Roller set front- to rear-axle
  - max. speed diff. = 0.01 mph (0.02 km/h)
  - max. angle deviation = 0.2°
- Low wear and low maintenance construction for multiple shift-operation
- Intelligent bearing concept
  - no test stand ‘warm-up’ required
- Modular test stand concept for various applications and budgets

- Fast data availability
  - Simple, comfortable test stand setup and operation
- Interface to common emission measurement systems
DynoServer

Test Stand Software Module incl. basic controller modes, (constant v, constant F, road load simulation) incl. AK communication interface (RS232, AK LAN), incl. diagnostic tests / integrated oscilloscope.
Different optional software packages available.

ECDM – Convincing Concepts for Accurate, Reproducible Measurements

ECDM-References Since 1999:
More Than 425 Systems of 48” Emission Chassis Dynos installed – worldwide!

Audi Ingois1dt, Neckarsulm
ARCo Taiwan
Akrapovic Slovenia
Autovaz Russia
Bentley England
BMW Aushheim, Muc (FIZ/EVZ)

BOSCH Abstatt, Feuerbach, Germany
Scheible1dingen, Germany
Australia, China, France,

Korea,

California Air Research Board USA
CATAEC China
CAERI China
Changan V1steon China
Chongqing Lifan China
PSA (Citr./Peug.) France
Daimler AG

Delphi France, Korea, China
Dekr1 Laustirizing, Germany
DLR Stuttgart, Germany
Denso Dongfeng Nissan China
China
EETI China
EPA USA
FAW China
Ford Mexico, Germany
Fraunhofer Institut Germany
Fujian Daimler China

Greatwall China
Gillet China
Head Acoustics China
Hitachi China
Honda China
HORIBA China
INA China
Inst. Nacional del Aagua Argentina
ITRI Taiwan
Johnson Mathew Taiwan
JRC China
ISP Salzbergen Germany
Kefico Korea
KIER Korea
Kongdom Vehicle Korea
Magns Steyr Austria
MBU1i Germany
Mtxa China
MBtech USA

Ministry of Transport China
Mitsubishi Electric USA
Mitsubishi Motors China
NlER China
NISSAN China
Porsche China
Qing1ng Motors China
RAC China
Renault China

Sabs China
SAIC China
Scania China
Shell China
SIEMENS VDO China
Subaru China
Suzuki China
TAC China
Tochnogema China
Toyota China

Tech. High School ULM Germany
Tianjin Tianjian China
TUEV Nord Germany
TUEV Sied Germany
University of Bucareste Romania
University of Karlsruhe Germany

USA (MI, TX, CA), China

* State: July, 2012
Heavy Duty Dynos

CDM 72” Chassis Dynamometer
2WD/4WD HDD - Heavy Duty

- 72” (1,828 mm) Roller set with AC motor for measurement of heavy trucks, buses, ...
  (MIM, ‘inline principle’ or multi-motor principle)
- Precise, reproducible mass simulation
- Accuracy exceeds EPA requirements
- Extremely compact design
- Slim pit dimensions
- Excellent 4WD synchronization – high dynamic regulation
- Interface to common emission measurement systems

Example:
Axle load: max. 20.000 kg (twin-axle)
Inertia simulation range: min. 3.500 kg ... max. 40.000 kg
(GWS = gross vehicle weight)

Pull Down Device (option):
Hydraulic axle load simulation device

Chassis Dynamometer for Off-Road Vehicles

Depending on the customer requirement and budget, MAHA can offer various solutions for in-house testing of special purpose vehicles (e.g., combine harvester, construction machines, aircraft tractors, etc.) in the area of R&D or quality assurance.

- ‘Single roll design’ or ‘twin roll design’
- ‘Multi motor design’ or ‘inline design’

Example: HDD Restraint system
CDM-MC
Chassis Dynamometer for Motorcycles, Scooters, ATV’s

- Electrical mass-simulation
  200 ... 1.700 lbs (91 ... 771 kg)
- Single roller 20” (508 mm),
  21” (533 mm) dia. or larger
- Compact AC-Motor e.g. 134 HP
  (100 kW)
  – extended power upon request
- Max. test speed 155 mph (250 km/h)
  (extended speed upon request).

Test Stand Accessories

- Air speed simulation fans
  (radial / axial)
- Cooling fans for tires, vehicle components, catalysts etc.
- Drivers aid systems
- 2WD/4WD vehicle restraint systems
- Tailor-made pit decking

MAHA Workshop Equipment:
Various vehicle lifts, testing systems, gasoline- and diesel engine emission tester, tire diagnosis, etc.

More information under www.maha.de

MAHA Test Cell
For our internal development work regarding new technologies in test stand hard- and software, MAHA-AIP established in the new company building two test cells with permanent installed 4WD chassis dynos. The test chassis dynos are also in use for employee- and customer training.
C**DM 75L Chassis Dynamometer (4-Motor)**

for use in wind tunnels and climatic chambers to measure e.g. vehicle aerodynamic

Different designs for 2WD and 4WD applications available.

- Multi-motor principle, each roll has an individual motor
- Inline-principle
- Motor-in-the-middle design (MIM)

Special thermal isolated test stand design, water-cooled drives

- Roller dia. 75" (1,905 mm)
- AC-motor per roll e.g. 300 kW
- Test speed e.g. 300 km/h
- Temperature range e.g.: -40°C ... +60°C

FRD Flat Road Dynamometer for LDVs / MDVs

Specially designed for research and development tasks in wind tunnel, etc.

- Single belt flat road dynos for motorcycles

- Wind tunnel balance with integrated Flat Road Dynamometer FRDM 20L
- Two- or four-belt flat road dynos for 2WD and 4WD vehicles.

Service Aisle with integrated lifting platform to access the underbody of the test vehicle

The service platform is used as service pit cover when lifted up in test cell floor position

Special water management design for rain/snowfall simulation in wind-tunnels.
FRDM 12L
Pulsed Flat Road Dynamometer

Pulsed flat road dynamometer for development and research in the field of vibration measurement during road drive simulation for overall vehicle comfort.

Application – Research in Acoustics and Vibration Control

The pulsed flat road dynamometer provides highly dynamic excitation of the individual wheels in the vertical and horizontal direction during a road drive simulation.

A robot driver operates the vehicle during an automatic test. The excitation of the vehicle wheels in the vertical direction provides realistic simulation of various road surfaces (i.e. pot holes, gaps, cobblestone streets, bridge joints, etc.). This system allows for either full vehicle or individual vehicle components to be tested.

Test Bench Design (example):
An WDU (Wheel Drive Unit) is a pulsed wheel drive unit which is essentially flat with the following components:

- Flat road dynamometer unit
- Vertical hydraulic cylinder
- Drive unit for flat road dynamometer unit
- Test bed frame, adjustable wheelbase, ...
- Test Measurement
- Media Supply (hydraulics, compressed air, energy)

Test Bench Key Data (Example):

<table>
<thead>
<tr>
<th>WDU – Wheel Drive Unit:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Max. Axle Load: 2,000 kg</td>
</tr>
<tr>
<td>Max. Test Speed: 0 ... 200 km/h</td>
</tr>
<tr>
<td>Adjustable Wheelbase:</td>
</tr>
<tr>
<td>min. 2,400 ... max. 3,950 mm</td>
</tr>
<tr>
<td>Static Tension (Each Axle / Nominal): min. 6 kN</td>
</tr>
<tr>
<td>Acceleration: max. ± 0.2 g</td>
</tr>
</tbody>
</table>

Hydraulic Pulser:

- Frequency Range (Operation): 0.4 ... 50 Hz in both the x- and z-axis
- Acceleration in the z-axis (Vibration mode): min. ± 10 g
- Range in the z-axis (Vibration mode): max. ± 25 mm

Further information on request.
Automatic Drive Robots

JAMES

Automatic Drive Robot

for the accurate, reproducible simulation of road drives in combination with chassis dynos or flat track dynos

Application Examples:

Highly reproducible drive cycles:

- **Emission Tests**
  - Consumption optimized (energy optimized)
  - Emission optimized

- **Mileage Accumulation Tests**
  Nonstop driving (24h, 7days a week)

- **Reproducible Road Drive Simulation in NVH-, Altitude- or Climatic Chambers**
  Driving at contrarious or dangerous environmental conditions

- **Compact, Modular Design**
  - Rugged design, low wear and service reduced
  - Threaded spindle free driven linear-actuators (pending patent) for a high dynamic control of the pedals and the gear shift assembly

- **Weight Saving Construction**
  Total weight of drive mechanic (without control box) approx. 20 kg

- **Easy, Quick Installation**
  (< 8 min.)
  - Positioning onto the driver seat, no need of modification at or in the test vehicle necessary
  - Installation / operation by one person

- **Simple, Menue Driven Education (‘Teach-in’), within Only A Few Minutes**
  (Example: < 2 min. at a 5-gear-shift assembly)
CDM 48L/M and CDM 62.6 L/M
Mileage Accumulation
Chassis Dynos 2WD/4WD

The MAHA-AIP Mileage Accumulation Dynos are designed for continuous long-term vehicle endurance tests.

The combination with a robot driver, automatic refuelling system, test stand automation and air speed simulation fan allows a nearly fully automated operation over long periods.

- Roller dia. e.g. 48" (1,219 mm) or 62,6" (1,590 mm)
- AC-motor e.g. 563 HP (420 kW)
- Test speed e.g. 205 mph (330 km/h)
- Low wear and low maintenance construction for multiple shift-operation
- Noise absorbing safety barriers and roller coating (optional)
- Compatible with various brands of robot driver systems, air speed simulation fans.

Example: Motorcycle adaption kit for the measurement of motorcycle durability tests

- Reduced mechanical base inertia
- Noise absorbing safety barriers and roller coating (optional)
- Touchless vehicle positioning sensors, integrated in the test stand safety loop

Various types of vehicle restraint systems for 2WD and 4WD vehicles
CDM 37.5L / EMC
Chassis Dynamometer

2WD or 4WD roller test stands for light and medium duty vehicles, motorcycles, ATVs for the indoor measurement of electromagnetic compliance of the test vehicle driving on a rolling road.

Reproducible measurement of internal and external EMC effects created through the vehicle to the environment or vice versa.

Roll diameter 37.5” (953 mm):

- Special MAHA-AIP motor design to avoid emission of electromagnetic disturbance
- Multi-motor-design (individual drive motors for ea. roll) rolls can be controlled individually, e.g. for ABS tests, traction control tests or other vehicle tests
- E.g. 121 HP (90 kW) per motor (other power packages available)
- Test speed up to 124 mph (200 km/h) – other configurations upon request

Option: P-JAMES EMC Drive Robot pneumatic brake, clutch actuator as well as steering wheel actuator designed for EMC test

Option: turn table, integrated in the test stand decking, to align the test vehicle into different angle positions toward the EM-antenna while driving the vehicle on the rolling road.

Different diameters available.

The MAHA-Chassis Dynamometer design has no “detectable RF-radiation” in the frequency range between 30 kHz and 3 GHz!
Test Stands for NVH measurement

CDM 75L NVH
Chassis Dynamometer

For use in anechoic chambers to measure vehicle noise, vibration and harshness levels, e.g. exterior noise and the interior investigation of noise emission inside the vehicle.

Different designs for 2WD and 4WD applications available.

- Multi-motor principle, each roll has an individual motor
- Inline-principle
- Motor-in-the-middle design (MIM)

Special noise reduction test stand design incl. water-cooled drives, special roll coating (avoids e.g. bell-effect) enables accurate NVH measurement.

- Roller dia. 75" (1,905 mm)
- AC-motor e.g. 563 HP (420 kW)
- Test speed e.g. 155 mph (250 km/h)
- Noise level e.g. 40 dB(A) at 31 mph (50 km/h) without vehicle.

Multi-motor principle, each roll has an individual liquid cooled AC-motor (single wheel measurement possible).

Service aisle between the covered rolls allows the easy access underneath the test vehicle to install microphones or other sensors.
**CDM-FRP**
**Function-Performance Test Stands for LDVs / MDVs**

Specially designed for research- and development tasks in the automotive industry.

Front-, rear- and 4-wheel driven vehicles can be tested under load on the test stand with repeatable road load simulation, force, speed, etc.

**DynoServer** Test Stand Software
Optional software packages for different measuring application

Drivers Aid software module.

**Reliable test results under any condition**

Different test stand configurations available for special applications, e.g.:

- Wind tunnels
- Climatic chambers
- EMC chambers including turn table
- Moveable applications
- Altitude chambers.
Emission Measurement Systems

QCL
Quantum Cascade Laser

Measurement of the nitrous oxide levels in vehicle emissions is becoming increasingly important because N₂O with 298 CO₂ equivalent possesses a very high global warming potential. Accordingly, regulations for the car sector are expected in the near future.

Application:
- Certification of cars and combustion engines in accordance with future emissions legislation e.g.
  - EPA 40 CFR 1065
  - EPA 40 CFR 1066, WLTP GTR
  - Meets the requirements in terms of EURO VI completely
- Universal application in research, development and quality assurance

Advantages:
- Compact stand-alone analyzer module
- High Selectivity and Sensitivity
  - No cross sensitivity to CO, CO₂, H₂O, NOₓ, CₓHₓ
- Easy operation and calibration
- Short rise times T₉₀: < 2 sec.
- Low detection limit: < 10 ppb
- No LN₂ cooling required

Measuring Principle:

The QCL laser module is designed to emit laser light to measure N₂O in the MIR range. The advantage of using a Quantum Cascade Laser is the extremely narrow band width of the emitted laser light, where a very high selectivity to the desired measurement component can be achieved. When measured over a long path gas-flow cell the coupled laser light is partially absorbed. The absorption rate is a recipient which is determined by the analyzer software and is a measure of the sample gas concentration.

SPC 8000
Solid Particle Counter

For measurement of the number concentration of solid exhaust particles generated by combustion engines.

Application:
- Research and development, quality assurance, environmental protection
- Applicable at chassis dynamometers under simulation of road travels in connection with a CVS-system and/or a partial flow dilution

Advantages:
- Measuring system according to UN ECE R83
- Measurement from the raw exhaust in combination with engine test stands
- Absolute conform in accordance with PMP R83 (certified by AEA Energy & Environment)

- Compact and modular design
- Stand alone system and respectively to external automation systems connectable (AK-Interface)

Compact 19’ rack type housing

Measurement of the nitrous oxide levels in vehicle emissions is becoming increasingly important because N₂O with 298 CO₂ equivalent possesses a very high global warming potential. Accordingly, regulations for the car sector are expected in the near future.
MAHA is located since more than 40 years in the ‘heart of the beautiful Allgäu’ (‘foothills of the Bavarian Alps’), approx. 12 km north-east of the city D-87435 Kempten, near Munich.

Our research- and production head-quarter is situated on more than 30,000 m² production area (total 94,000 m²) with over 830 employees developing future-oriented vehicle testing systems for a safe and clean environment. Please contact us to arrange a visit to MAHA and learn about our products and services.

See you in Haldenwang!