FUEL CONSUMPTION MEASUREMENT

AVL KMA MOBILE
FUEL MEASUREMENT SYSTEM

The AVL KMA Mobile is a high precision measurement system for in vehicle fuel consumption measurements on the road and on chassis dynamometers

Main Item Description

The AVL KMA Mobile is a mobile fuel consumption measurement system that sets new standards for fuel consumption measurement in vehicles on the basics of its reliability, flexibility and precision. The universal fuel measurement system AVL KMA Mobile is used at chassis dynamometer test beds too. The AVL KMA Mobile enables a continuous measurement of instantaneous flow rates from 0.16 l/h to 300 l/h, thereby covering the range from passenger cars up to large Diesel applications.

The used flow meter is based on the world-wide proven PLU measuring principle of the servo-controlled displacement meter ($\Delta p = 0$) characterized by extremely short measuring times, in particular in case of low fuel consumption levels. Short measurement times require a high data quality which is achieved by low measurement uncertainty and high reproducibility over the whole measurement range.

Additionally following benefits related to the used PLU measuring principle can be mentioned: There is no energy taken from the fuel flow, there is no internal leakage flow and all PLU flow meters show wide measuring ranges with low measurement uncertainty and high reproducibility. Thanks to the large measurement ranges, it is possible to cover the fuel consumption over the whole engine map from the idle mode to the full load.

With the measuring instruments integrated in the system, volumetric and gravimetric (with option Density Meter) fuel consumption is measured precisely. For a determination of the gravimetric fuel consumption the density value can be read into the software. The calculation of the gravimetric fuel consumption includes a temperature correction. With the option high precision density meter the density is measured, and therefore the gravimetric fuel consumption can be determined with high accuracy.

Applications

- Standard fuel consumption measurement @ constant speeds 60/90/120 km/h
- Measurement of customer relevant fuel consumption
    - Real world fuel consumption under real life conditions
- Comparison of fuel consumption measurement
    - Chassis dyno versus street
    - Engine test bed versus street
- Evaluation of competitive vehicles
- Climatic tests with fuel consumption measurement
    - Heat test e. g. in Death Valley
    - Cold test e. g. in Kiruna
- Fuel consumption measurements with complaint cars

Benefits

- **Measurement range:**
  All applications from passenger cars to heavy commercial vehicles can be covered by the large measuring range of the AVL KMA Mobile. The AVL KMA Mobile is available with three different PLU sensors and thus allows for measuring flows between 0.16 l/h and 300 l/h.

- **Short Measurement Time:**
  Short measurement times require a high data quality which is achieved by low measurement uncertainty and high reproducibility over the whole measurement range.

- **Dynamics:**
  Instantaneous fuel consumption measurement at in vehicle applications needs a high dynamic of the measurement device. The AVL KMA Mobile is characterized by a dynamic response time of less than 125 ms and supports a data acquisition rate of up to 3 Hz.

- **Comparability of Data:**
  Consistent measurement results throughout the engine development process are achieved because the same PLU sensors are used in the AVL KMA Mobile as in the AVL FuelExact and the AVL KMA 4000 (the AVL FuelExact and the AVL KMA 4000 are fuel consumption measurement devices for engine test beds applications).

- **No Influences on the Engine Fuel System:**
  The feed pressure required by the fuel injection system is adjustable between -0.3 bar and 5 bar so that there will be no influence on the engine fuel system by the AVL KMA Mobile.

- **High Flexibility in the Application:**

Due to the flexible pump concept the pump configuration can be easily changed to meet the engine requirements e.g. the required circulation fuel volume in the engine feed line.

- **Easy handling and fast installation**:
  The modular system design ensures the easy handling of the measurement device. Due to the modular design, the measurement system can be adapted ideally to the different requirements of engines with or without return flow to the tank. The use of self-sealing quick release couplings results in short setup times. The setup time is below 30 min in case of engines without fuel return flow and in case of engines with fuel return flow it is below 60 min.

- **Long-term stability of the calibration** (calibrations intervals up to 3 years):
  The PLU sensors are working nearly without wear; therefore the calibration has a long-term stability.

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Technical Insight

Due to the modular design, the AVL KMA Mobile consists of two separate modules – the measuring module and the conditioning module. The measuring module contains the sensors, the electronic circuit for the signal and data processing. The conditioning module includes all hydraulic components such as fuel pumps, fuel pressure regulator, heat exchanger and venting valves.

Systems without return flow to the tank (only measuring module)

In cases of systems without return flow to the tank only the measuring module will be used. There is no conditioning module necessary. The measuring module should be installed as close as possible to the engine. Pressures up to 10 bar are possible.

Available KMA Mobile Measurement Modules:

Description	Specification	Part number
AVL KMA MOBILE TYPE 075 (MEASUREM.MOD.)	Measuring Module for max.75 l/h fuel flow rate	TNMES075.01
AVL KMA MOBILE TYPE 150 (MEASUREM. MOD.)	Measuring Module for max.150 l/h fuel flow rate	TNMES150.01
AVL KMA MOBILE TYPE 300 (MEASUREM. MOD.)	Measuring Module for max.300 l/h fuel flow rate	TNMES300.01

Technical Data

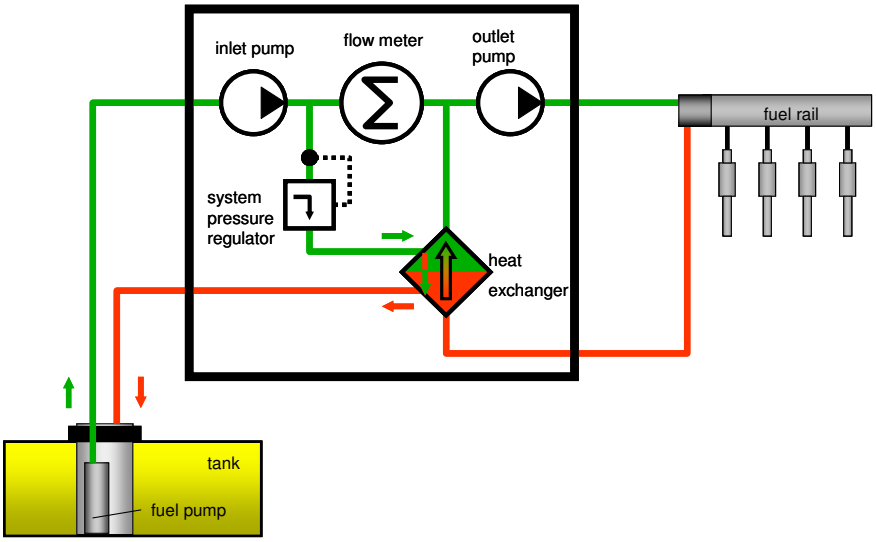
Measurement range (with different sensors):	Type 75: 0.16 … 75 l/h 0.12 ... 56 kg/h* Type 150: 0.35 … 150 l/h 0.26 ... 110 kg/h* Type 300: 0.80 … 300 l/h 0.6 ... 225 kg/h*
Density meter (option):	500 ... 2000 kg/m³
Density measurement uncertainty:	1 kg/m³
Measurement uncertainty (flow sensor calibration factors):	±0.1% (of reading)
Measurement resolution	Type -075: 3.400 Pulse/cm³ Type -150: 1.700 Pulse/cm³ Type -300: 840 Pulse/cm³
Dynamic response time:	< 125 ms Acc. to ISO 16183 (T10 ... T90)
Ambient temperature:	-10 °C ... +50 °C (non-condensing)
Media temperature:	-10 °C ... +60 °C (+80 °C in case of minimum 1/3 tankful)

Media (Measuring Module):	Commercially available Gasoline and Diesel fuels and compatible test fluids; alcoholic additives up to 100%, (device must be flushed after use with Biodiesel)
Signal Output:	RS 232 with AK-protocol Analog 0…10V (option) Frequency (up to 80 kHz) TTL, Open collector, RS 422
Operating voltage:	12 VDC, option: 24 VDC
Dimensions (measuring module):	470 x 170 x 550 mm (W x H x D)
Weight (measuring module):	15 kg

(*at a density of 0.75 g/cm³)

Systems with return line to the tank (with conditioning module)

The fuel consumption measurement of fuel systems with return line to the tank requires the use of the measuring- and the conditioning module.



The inlet pump delivers fuel from the vehicle tank through the fuel inlet to the system pressure regulator. To avoid degassing a fixed pressure is set at this system pressure regulator and any excessive fuel flows back to the tank through the heat exchanger and the fuel return line (inlet circuit).

The outlet pump delivers the fuel via the outlet to the engine. The fuel returns via the fuel return line back to the heat exchanger. The fuel feed pressure required by the fuel injection system can be adjusted by the optional external outlet pressure regulator, the optional vacuum pressure regulator or the pressure regulator on the engine.

The return fuel from the engine is cooled down by the heat exchanger and the use of the cold fuel from the inlet circuit. The temperature in the feed line to the engine corresponds to the temperature of the fuel in the tank.

The same amount of fuel which is consumed by the engine is feed in through the flow meter.

The circulation fuel volume in the engine feed line can be increased up to 600 l/h with additional outlet pumps. The circulation quantity over the inlet circuit can be increased by additional inlet pumps. This increased inlet circulation quantity results in an increased cooling capacity of the heat

Available KMA Mobile Conditioning Modules:

Description	Specification	Part number
AVL KMA MOBILE COND 2 PUMP (MOD.GASOL.)	Gasoline Conditioning Module with 2 pumps for max. 200 l/h inlet and/or outlet circulation	TNCOND11G.01
AVL KMA MOBILE COND 4 PUMP (MOD. GASOL.)	Gasoline Conditioning Module with 4 pumps for max. 400 l/h inlet and/or outlet circulation	TNCOND22G.01
AVL KMA MOBILE COND 2 PUMP (MOD. DIESEL)	Diesel Conditioning Module with 2 pumps for max. 200 l/h inlet and/or outlet circulation	TNCOND11D.01
AVL KMA MOBILE COND 4 PUMP (MOD. DIESEL)	Diesel Conditioning Module with 4 pumps for max. 400 l/h inlet and/or outlet circulation	TNCOND22D.01
AVL KMA MOBILE COND TRUCK (MOD. DIESEL)	Diesel Conditioning Module with 3 pumps for max. 600 l/h inlet circulation	TNCOND3024.01

Technical Data

Ambient temperature:	-10 °C up to +50 °C (not condensing)
Fuel feed temperature:	equal to tank temperature
Inlet pressure:	Suction height max. 0.5 m in wetted condition
Return pressure:	-0.1 bar … 1.2 bar
Feed pressure range:	0.3 ... 5 bar adjustable (< 0,1 bar, slightly negative, see option vacuum pressure regulator)
Circulation quantity:	approx. 180 / 200 l/h per pump max. 500 / 600 l/h
Measuring media (conditioning module):	Gasoline version: Commercially available Gasoline fuels with alcoholic additives (Methanol, Ethanol) up to 20% Version Diesel: Commercially available Gasoline fuels (device must be flushed after use with Biodiesel)
Operating voltage:	12 VDC, option: 24 VDC
Dimensions (conditioning module):	470 x 200 x 550 mm (W x H x D)
Weight (conditioning module):	20 kg

Options/Extensions
Available options for AVL KMA Mobile Fuel Measurement Systems:

Description	Specification	Part number
DENSITY METER AVL KMA MOBILE	Density meter for direct mass flow measurement integrated in the Measuring Module	TNMOBDENS.01
ANALOGUE OUTPUT FOR FUEL CONSUMPTION	Linearized analog output signal 0-10V for 0-max. flow	TNANALOG.01
OUTLET PRESSURE REGULATOR AVL KMA MOBILE	Externally mounted pressure regulator (~0.3…5 bar) for outlet pressure regulation (adjustment to required engine inlet pressure)	TNMOBOUTP.01
EXT VAC PRESS REG. KMA 4000/KMA MOBILE	Externally mounted vacuum pressure regulator (~ -0.3…1 bar) for outlet pressure	TNEXTVACUM.02

	adjustment to extremely low engine inlet pressure requirements	
AVL KMA MOB. COLLECTION TUB F. FUEL	Drip pan for catching spilled fuel	TNMOBTUB.01
AVL KMA MOBILE VOLTAGE CONVERTER 24 V	DC/DC voltage converter 24V to 12V	TN24V.01
TRANSPORTATIONBOX AVL KMA MOBILE	Robust Aluminum box for storage and transport	TNMOBBOX.01
AVL KMA MOBILE ADDIT. CONNECTION KIT	Additional connection kit including 8 m hose, 4 quick couplings (2 x male, 2 x female) and connection material	TNCONEKIT.01
ADD ON PUMP KIT-GASOLINE	Pump extension kit for adding two pumps (200 l/h each) to a Gasoline Conditioning Module with 2 pumps	TNADPUMPGM.01
CONVERTING KIT- DIESEL	Pump conversion kit with two Diesel pumps (200 l/h each) for converting a Gasoline Conditioning Module to Diesel	TNMOBCONVD.01
ADD ON PUMP KIT-DIESEL	Pump extension kit for adding two pumps (200 l/h each) to a Diesel Conditioning Module with 2 pumps	TNADPUMPDM.01
CONVERTING KIT GASOLINE	Pump conversion kit with Gasoline two pumps (200 l/h each) for converting a Diesel Conditioning Module to Diesel	TNMOBCONVG.01

Available AVL system commissioning and training:

Description	**Specification**	**Part number**
STARTUP&TRAINING KMA MOBILE MEAS. MODULE	Commissioning and training for KMA Mobile Measuring Module in-vehicle application	TT04KMAM01.01
STARTUP&TRAINING KMA MOBILE COND. MODULE	Commissioning and training for KMA Mobile Conditioning Module in-vehicle application (required for engines with return flow to tank)	TT04KMAM02.01
TRAINING KMA MOBILE MOVE SYSTEM INTEGR.	M.O.V.E system integration of KMA Mobile	TT04KMAM03.01