LUBRISENSE
Oil Emission Measurement Technology

OIL CONSUMPTION?
EXCELLENT!

Lubrisense supports engine makers in their challenging tasks. We develop the best measuring instruments for the optimization of the lube oil consumption.

READ MORE
Spin-off from Institute of Measurement Technology at Hamburg University of Technology (TUHH)

Office in Hamburg close to the campus of TUHH

Close cooperation with research faculty TUHH, IAM

Member from FVV, Hamburg Economy Organization, Research Organization for combustion engines

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Peutestrasse 53A, 20539 Hamburg, Germany
Lubrisense at a second glance

Founder: Prof. Dr. Matz

Partners

Systems sold

Lubrisense 1200
Lubrisense 320
LUB360

Partners

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Why?

Customer requirements

Emission regulations

Catalyst poisoning

Real driving emissions

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Tasks of the past
- Bio fuels
- Fuel entrainment
- Pre-ignition
- Fuel-oil-interaction
- Emission legislation
- Real driving emissions
- Etc.

Tools for optimization of engine oil consumption

Limit of detection
- Better

Response time $T_{10-90}$
- 1 g/h oil emission @
  1000 kg/h exhaust gas flow

Drain and weight

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LUBRISENSE – LUB360
Oil Emission Measurement System

AxION iQT

PerkinElmer
For the Better
LUBRISENSE – LUB360

Oil Emission Measurement System

Q-TOF Mass Spectrometer
analyze gas composition

Inlet System
transport and condition gas

PiKal X Calibration System
generate artificial exhaust gas with known concentration

Engine under Test
in engine test cell or on chassis dynamometer

Engine Measurement

Data Acquisition

Control & Evaluation Software

Software
Mass Spectrum

Acquired Mass Range: 170 – 550 m/z

Time Trend Data

Engine Data and Calculated Results
LUB360 Typical Applications

Steady State Operation / Oil Emission Map

- Engine Speed [RPM]
- Torque [Nm]
- Oil Emission [g/h]
Oil Emission Maps

- Piston Ring Pack A
- Piston Ring Pack B
- High Viscosity Oil
- Low Viscosity Oil
Dynamic Effects in Oil Emission

Steady State / Dynamic Driving

Steady State Operation

Piston Ring Movement

Oscillating Oil Emission

Dynamic Driving

- Engine Speed [RPM]
- Torque [Nm]
Dynamic Effects in Oil Emission

Different Emission Mechanisms

- Engine Speed (RPM)
- Torque (Nm)

![Graph showing engine speed and torque over time with marked emission points.]

- Oil Emission [g/h]

![Graph showing oil emission over time with marked emission points.]

- Evaporation

- Droplets
Real Driving Emissions

Cooperation with IAV Chemnitz

loc = 3.6 g/h
LUBRISENSE Real-Time Measurements

Oil Emission (Exhaust Gas)

In-Cylinder (Gas Sample)

Intake Air / Breather Pipe

Oil Separator

Crank Case Ventilation

Cylinder-Liner (Liquid Sample)

Ring Grove (Liquid Sample)

Oil Sump (Liquid Sample)

Research Applications

Image: MTZ
2014 – Tools for the Development of the Mechanical Components of Turbochargers

MTZ worldwide, July 2014, Volume 75, Issue 7-8, pp 12-17
Authors B. Kehrwald, A. Jäger, M. Sailer, J. Hadler
Source: Springer Automotive Media Wiesbaden GmbH (2014)

Figure 5 – Oilemission of different Turbocharger-Setups
2015 – Methods for the development of a RDE-capable powertrain
MTZ worldwide, June 2015, Volume 76, Issue 7-8, pp 32-37
Prof. Dr.-Ing. Jens Hadler, Dipl.-Ing. Christian Lensch-Franzen, Dr.-Ing. Marcus Gohl, Dr.-Ing. Carsten Guhr

Figure 2 – Oil emission measurement and simulation of the functional group piston/piston ring/cylinder wall for optimisation
2015 – Emission Reduction A Solution of Lubricant Composition, Calibration and Mechanical Development

MTZ worldwide, August 2015, Volume 76, Issue 9, pp 30-33
Prof. Dr.-Ing. Jens Hadler, Dipl.-Ing. Christian Lensch-Franzen, Dr.-Ing. Marcus Gohl, Dipl.-Ing. Tobias Mink
The influence of piston drain holes on the oil emission off a turbo charged gasoline engine

Dipl.-Phys. I. Papadopoulos, MAHLE International GmbH, Stuttgart
Dr.-Ing. A. Frommer, MAHLE GmbH, Stuttgart
Dr.-Ing. R. Künzel, MAHLE International GmbH, Stuttgart

Bild 1: Schematic representation of the four investigated piston variants with a top and bottom horizontal cross-section in the 3rd nut (top) and a vertical cross-section (bottom).

Bild 11: Graphical representation of the dynamically emitted oil mass and the stationary Blow-by-Mass, averaged over all load switches with a positive change in the transient engine program.
2015 – Fuel in Oil

Investigation of the fuel lubrication oil interaction on oil dilution during particulate filter / NOx storage catalyst regeneration

\[ c_{\text{Ref}} = 15\% \]

\[ c_{\text{Ref}} = 9\% \]

\[ c_{\text{Ref}} = 3\% \]

Gradient: 0.0578 %/min

Referenz
Messung
Lineare Approximation
Exhaust Manifold

Inlet velocity
\[ v = 50 - 100 \text{ m/s} \]

Total transfer time
\[ t \sim 40 \text{ ms} \]
PiKal X – Lubrisense Calibration System
3rd Generation for LUB360
PiKal X – Functional Principal

identical to 1st and 2nd generation
PiKal X – Lubrisense Calibration System
3rd Generation for LUB360

New Features

- Smaller Footprint and ‘One-Side-Access’
  easier use | mountable onto LUB360 Trolley
- Push Buttons and Touch Panel Display
  versatile control directly at the unit
- New Piezo Valve Design
  easier to vent and clean
- Automated Piezo Valve Lift
  less user intervention | easier droplet weighing
- Digital Flow and Pressure Regulator
  easy to adjust | more stable operation
- Integrated in iQT Driver Software
  no extra software required | seamless workflow
- Controlling and Logging of all System Parameters
  widely automatable | easier troubleshooting
Smaller Footprint and ‘One-Side-Access’
easier use | mountable onto LUB360 Trolley

Controls and Evaporation Unit on the Front

320 cm

460 cm
Automated Piezo Valve Lift
less user intervention | easier droplet weighing

Piezo Valve moves up / down automatically

Special vial holder for droplet weighing
# LUB360 Specifications

**General**
- Dimensions: 690 x 550 x 2120 mm (without covers)
- Weight: 200 Kg (without covers)

**Installation**
- Trolley with 4 isolable wheels, stationary during system operation
- Ambient Temperature: °C / °F 15 / 59 - 35 / 95
- Relative Humidity: % 20 - 80

**Power Supply**
- Power Line A (Mass Spectrometer): 100-115 VAC, max. 20 A, typical 750 VA
- Power Line B (Control Unit): 100-115 VAC, max. 20 A, typical 150 VA

**Data Acquisition**
- Connection: optical data line, max. length 15m
- Molecular mass range: 10 - 1200
- Mass filter type: Coriolis ionisation
- Analog input: 10 - 101 (12k)
- Type K Thermocouple (4k)

**Sampling Line**
- Probe Tip Diameter: mm 6
- Probe Tip length into exhaust line: mm 140, 350
- Height of mass spectrometer from floor: mm 1005

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# PIKAL Specifications

**General**
- Dimensions: base unit (L x W x H): 490 x 225 x 445 mm
- Weight: 25 Kg

**Installation**
- Base unit for standalone use or installation on top of LUB360 trolley
- Ambient Temperature: °C / °F 10 - 69 / 50 - 150
- Relative Humidity: % 20 - 80

**Power Supply**
- Power Supply: 1 single phaset, independently fused AC power line
- Gas supply: 115 VAC, max. 10 A or 230 VAC, max. 6 A
- Cocks, dry air, nitrogen
- Min. 2 bar (44 psi), max. 7 bar (101 psi)

**Control**
- Data Connection: Calibration control, Data Acquisition
- Calibration Method: LUB 2.0
- Calibrated into LUB360 control software
- Calibration Fluid: Fluid evaporation in hot gas flow
- Fluid dosage: mm 2 - 50
- Fluid flow: ml/min 100 - 2000
- Expiration temperature: °C / °F Typical: 290 / 563, max. 400 / 842.
- Calibration Fluid: Typical: 1 - 10 % of target substance in cyclohexane
- Concentration range: ppm Typical: 1 - 1000

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LUB360 Features

- no tracer required
- high detection strength
- high speed measurement
- deep insight
- easy operation

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2015 – Emission Reduction: A Solution of Lubricant Composition, Calibration and Mechanical Development

MTZ worldwide, August 2015, Volume 76, Issue 9, pp 30-33
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Results
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<table>
<thead>
<tr>
<th>Variante 1 (V1)</th>
<th>Variante 2 (V2)</th>
<th>Variante 3 (V3)</th>
<th>Variante 4 (V4)</th>
</tr>
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<tbody>
<tr>
<td>- Keine ORB</td>
<td>- Keine ORB</td>
<td>- 4 ORB</td>
<td>- Keine ORB</td>
</tr>
<tr>
<td>- Kein Volumen</td>
<td>- Mit Volumen</td>
<td>- Mit Volumen</td>
<td>- 2 Scupper Slots</td>
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<tr>
<td>unter Ölabstreifring</td>
<td>unter Ölabstreifring</td>
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Bild 1: Schematische Darstellung der vier untersuchten Kolbenvarianten mit Abbildung eines horizontalen Schnitts in der 3. Nut (oben) und eines vertikalen Schnitts (unten)

Bild 11: Graphische Darstellung der dynamisch emittierten Ölmasse und der stationären Blow-by-Masse, gemittelt über alle Betriebspunkte mit positiver Laständerung des transienten Prüfauflaufprogramms

Results

Verbesserung der Wirkung der Öldrainage

- Gemittelte dynamisch emittierte Ölmasse
- Gemittelte stationäre Blow-by-Masse