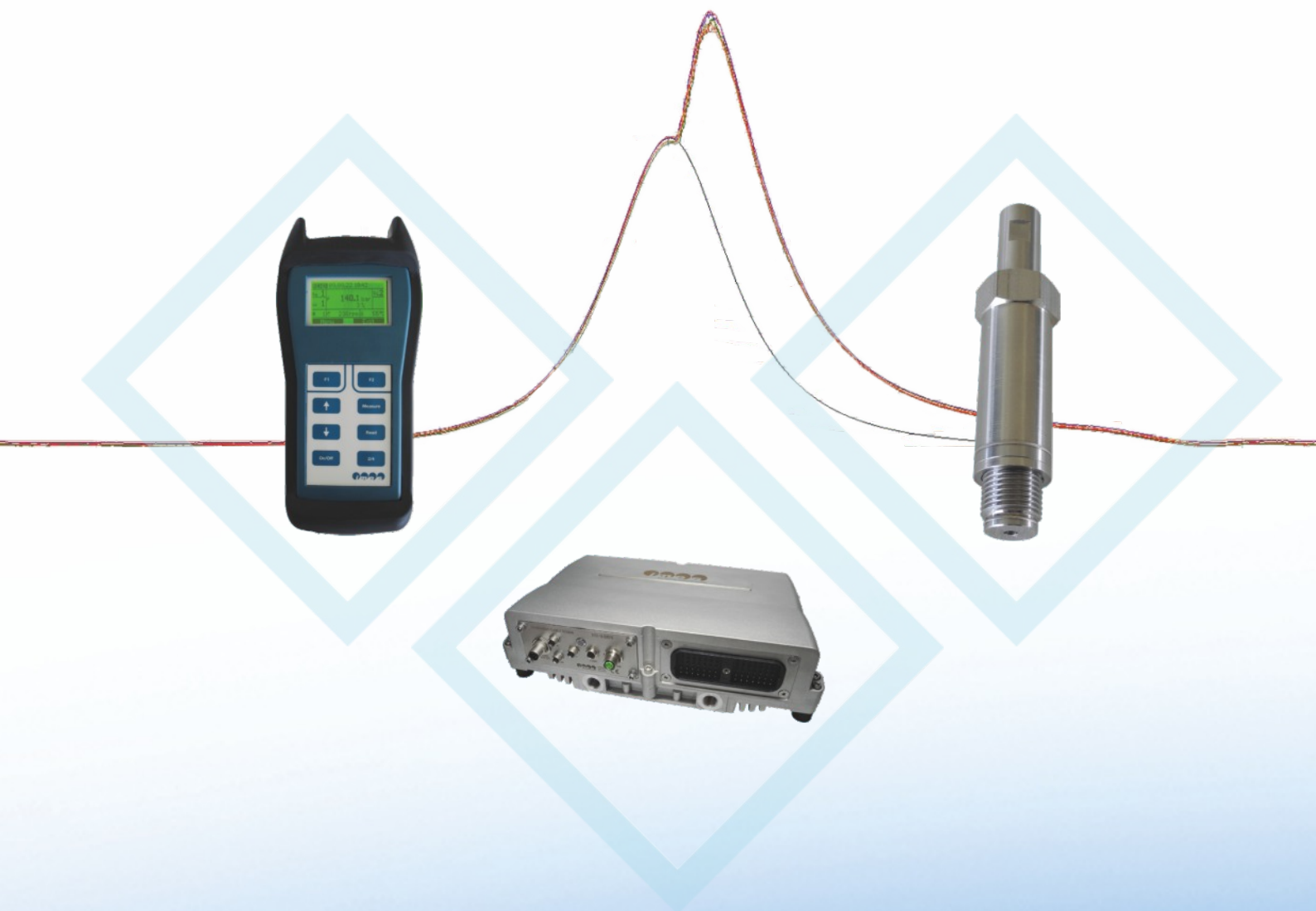




Intelligent Measuring Systems

for gas-, marine diesel- and
future fuels engines



our company
our products

www.imes.de



IMES is a privately owned company founded by Stefan Neumann in 1997.

For more than 25 years IMES is specialised in the field of combustion engine cylinder pressure and data acquisition systems. Our sensors, electronic pressure indicators and combustion control and monitoring systems are employed on a wide range of diesel-, gas-, dual-fuel- and future fuels engines, on ships and locomotives and in power and cogeneration plants and pipeline compressor stations all around the world.

Company structure

At our company in Kaubeuren, Germany, we have a close collaboration between all departments, especially between sales, development, and production. Our state-of-the-art ISO certificated production facilities equipped with the latest manufacturing technology and our highly qualified development department ensure that our products provide an outstanding quality and know-how.

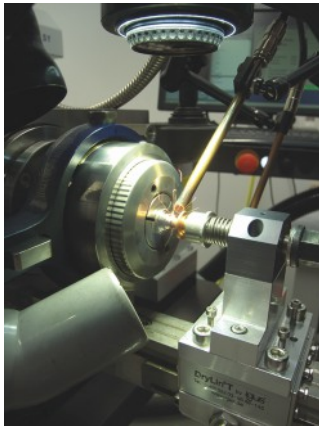
Permanent high quality

Quality management is a high priority at IMES. With strict quality management regulation in place, we strive to continually enhance the company's production, organizational and technical process. Therefore, we now combine all essential production processes in-house so that our products meet the highest standards and can convince with reliability, robustness, durability, and long-term accuracy.

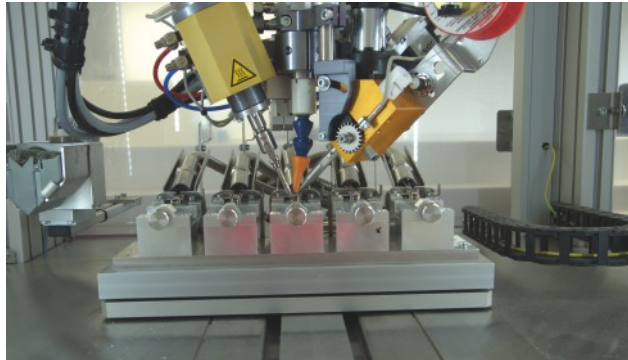
Prompt, flexible, reliable

All our products are manufactured in house under high quality standards. Due to our continuous increasing production depth and our own special setup and connection method and platform strategy we are able to manufacture all our sensors according to our customers' requirements with short delivery times.

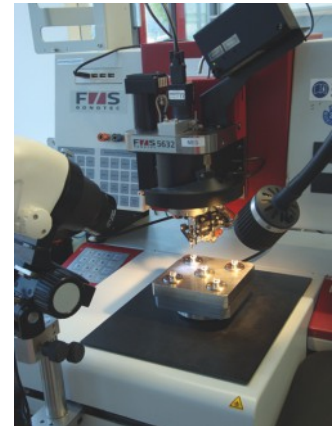
High precision production skills and quality assurance



laser welding



soldering



wire bonding



We are continuously expanding our machine park to increase our production depth and to improve our quality standard.

Over the past years we have expanded our machine park enormously. We automated many production processes e.g., laser welding, bonding, or soldering and we also enhance our quality assurance by investing in high precision equipment e.g., roughness measuring device or a high precision microscope for an optical inspection.

Quality awareness and quality inspection are of the utmost importance



Future-proof

Due to increasing environmental awareness, the marine, power generation, rail traction and gas compression sectors are all facing new challenges in the form of ever tighter national and international legislation, agreements and incentives affecting noxious emissions, greenhouse gas emissions and fuel economy. At the same time, demand from engine users for more power from the same or smaller displacement and lower life cycle costs continue uninterrupted.

Hydrogen, ammonia, or methanol will be an integral part of future engines. For these applications the sensors have to fulfil special material characteristics to withstand corrosion and embrittlement and as all our sensors they need to have a very good thermodynamic performance and they have to be extreme robust against high dp/dt.

Currently our sensors are installed on various hydrogen engines worldwide for long-time operation tests.

IMES Cylinder pressure sensors *ready for future fuels*

All our sensors offer

Output signal range	Frequency range	Accuracy error	max. temperature measuring cell	Thermal shock 1500 RPM pmi=10 bar
4...20 mA option 0,5...4,5 V	2 or 10 kHz (others on request)	≤ 1% Full scale	300°C (short time 1 min. 350°C)	< +/- 0,5 bar

Specification and technical data	HTT-06	CPS-03	SPS-01	PCS-01
				
	On-line combustion control on diesel- and gas engines for increasing engine performance and optimised engine control. Extreme robust against high dp/dt and against vibration. Protection class IP69.	On-line combustion control on diesel- and gas engines for increasing engine performance and optimised engine control. Extreme robust against high dp/dt and against vibration. Protection class IP69.	Small pressure sensor for continuous measurement of combustion on diesel- and gas engines.	Small pressure sensor for continuous measurement of combustion on diesel- and gas engines as well as for pre-chamber pressure.
Application	Closed loop control on diesel-, gas-, and dual fuel engines.	Closed loop control on diesel-, gas-, and dual fuel engines.	Closed loop control on diesel-, gas-, and dual fuel engines.	Closed loop control on diesel-, gas-, and dual fuel engines.
Measuring range	0...300 bar (others on request)	0...300 bar (others on request)	0...300 bar (others on request)	0...300 bar (others on request)
Over pressure static	1200 bar and 1600 bar	1200 bar and 1600 bar	1200 bar and 1600 bar	1200 bar and 1600 bar
Electrical connector	Plug DIN M12 / MIL-C-26482	Plug DIN M12 / MIL-C-26482	Plug DIN M12 / MIL-C-26482	Plug DIN M12
Thread	M14 x 1,25	M10 x 1	M8 x 0,75	M5 x 0,5
Certification	DNV, Bureau Veritas, ABS, Class NK, Lloyd's Register, Korean Register, RINA, SGS	DNV, Bureau Veritas, ABS, Class NK, Lloyd's Register, Korean Register, RINA, SGS		



All data sheets with more specific information may be found on our web site www.imes.de/support.html

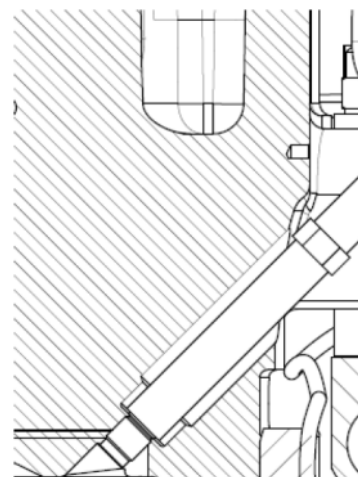
Mounting

The combustion pressure sensors should be installed close to the combustion chamber, the length of the pressure bore between sensor and combustion chamber depends on engine speed.

Generally, there are two possibilities for the installation position of cylinder pressure sensors:

Head mounted or set-back mounted. We recommend the head mounted installation.

Head mounted installation near to the combustion chamber



Precise and durable

Our sensors convince with their long-term accuracy with minimal signal drift over long periods. Designed for a minimum of 16,000 operating hours they enable the acquisition of highly accurate, processable data during periodic checks and during continuous monitoring of combustion pressure.

TCS-01	HTT-05
	
Two-stroke combustion sensor for continuous measurement of combustion pressure. Perfectly suitable for cylinder balancing and performance evaluation.	Compression pressure sensor for real time pressure inputs from the compressor cylinders, e.g. indicated HP, rod load, volumetric efficiencies. Received approval for hazardous area Class I, Division 1, Group A-D and Class I, Division 2, Group A-D.
Permanent installation on two-stroke diesel engines.	Pressure measurements on compressors.
0...250 bar	0...300, 600, 1000, 1500, 3000, 5000 psi
400 bar	3000, 4000, 10000 psi
MIL-C-26482	MIL-C-26482
M10 x 1	1/2" NPT others on request
DNV, Bureau Veritas, Class NK, Lloyd's Register, Korean Register, RINA	SGS

Marine Type Approvals

Large engine manufacturers are required to fulfil numerous international safety standards. Marine Type Approval is therefore a mandatory requirement for voyage and safety critical devices installed on any ship.

Our sensor types have received Marine Type Approval from all significant international classification societies, such as Bureau Veritas, DNV, ABS, Lloyd's Register, Class NK, RINA or Korean Register.

SGS Certification

Even for the installation on compressors special safety standards are required. Our compression pressure sensor HTT-05 is SGS certified for use in hazardous area Class I, Division 1, Group A-D and Class I, Division 2, Group A-D

Protection cover

For all our cylinder pressure sensors we offer protection covers for the signal conditioning unit (SCU). They are temperature and oil resistant.

The protection cover reduces the vibration level of SCU on engines and it enables an easy mounting on the engines.



Two-stroke combustion sensor TCS-01CA-PMI



The two-stroke combustion sensor TCS-01CA-PMI for continuous measurement of cylinder pressure on two-stroke diesel engines (24 h per day / 365 days per year) is designed for application on PMI-auto-tuning-systems.

The robust sensor offers an outstanding longevity and constant sensitivity. Cylinder pressure measurements can be made with high precision because of its very good thermodynamic characteristics. So, it is perfectly suitable for cylinder balancing and performance evaluation.

Mounting

For application on two-stroke engines the sensor should be installed in a special adaptor between cylinder cover and indicator cock.

The indicator valve should be opened regularly to blow out the combustion residuals.

The Harting connector is pin compatible to PMI-auto-tuning-systems.



TCS-01CA-PMI for an optimized engine operation

Accuracy check for all IMES sensor types

Sensor-Test-Kit for sensor offset and -span evaluation

The main components of the easy to mount test-kit are the hydraulic pressure pump including manometer, the sensor check-box and the visualisation software.



Sensor Check Report	
Company, ship name or power plant: IMES, Cogeneration plant	
Engine: MAN	
Engine number: 123456789	
Operator: Stefan Neumann	
Date: 08.11.2018	
Sensor Type: CPS-01CA	
Serial Number: 5952-17-1273-0	
Evaluation (Temperature: 23°C)	
Offset	Current: 4.1508mA
	Pressure: 2.8bar
	Deviation: 3.77% (referenced to 4.0000mA)
	Result: within specification
Span	Current (measured): 8.0091mA
	Pressure (entered): 150.0bar
	Current (norm. to 300.0bar): 16.0182mA
	Pressure (normalized): 300.3bar
	Deviation: 0.11% (referenced to 16.0000mA)
	Result: within specification
Total result: approved	
Read out Sensor Operation Data	
Operation time (powered): 1h	
Operation time (engine running): 1h	
Maximum pressure: 183.4bar	
Maximum temperature: 82.6°C	
Pressure Pump	
Model: Sika Ref-E2	H/W Serial number: 366935883436
Serial number: 1225TG0	Calibration date: 17.09.2018
Calibration date: 16.10.2018	
Signature:	

All data will be displayed in a sensor evaluation report and the measured data of sensor offset and -span will be compared with sensor specification.

In conjunction with the hydraulic pressure pump the check-box is suitable for **sensor offset and -span evaluation**.

The software is reading out stored **maximum pressure, maximum temperature and engine operating hours**.

Check-box for sensor data evaluation

Control of sensor accuracy by reading out sensor operation data. The sensor SCU is connected to the check-box by serial interface and via USB to a PC.



IMES Sensor Data	
Offline	Online
Refresh	
Sensor Information	
Sensor type	HTT-04
Serial number	6234-19-1324-0
Operational Data	
Sensor operating hours	80h
Sensor operating hours with engine running	7h
Pressure maximum	223.5bar
Temperature maximum	242.5°C
Sensor Offset	
Current @ 0bar	4.2063mA
value within specification	
Device connected (S/N: 365335793436)	

Read out from sensor electronic

- sensor operating hours
- maximum pressure
- maximum temperature
- sensor offset @ 0 bar
- actual Pmax and Tmax reading during operation

CCM - Combustion Control Module

CCM is an easy to use plug and play system, which enables real time data acquisition of cylinder pressure on gas –, marine diesel- and future fuels engines. Data can be recorded from up to 24 cylinders for closed loop control applications and to diagnose malfunctions or to assist in the setting and optimising of engine parameters e.g. balancing cylinders.

Every combustion cycle will be evaluated on every cylinder for to calculate key parameters engine builder need to implement cylinder pressure based control on engines. Its quick data acquisition and recent evaluation software enables extensive analysis about engine performance.



CCM communicates via CAN bus with the engine control system, and it can be integrated to the engine management system. A further important function is that all data can be transmitted via internet to the server of the engine operator. This enables to control the engine from land.

Main functions:

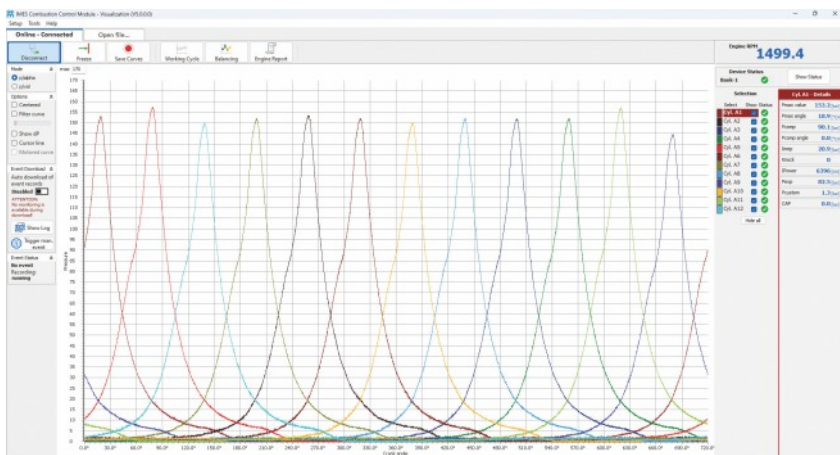
- Knock detection
- Misfire detection
- Calculation of thermodynamic parameters
- Peak pressure
- IMEP, IPOWER

Benefit

- Optimum cylinder balancing
- Optimization of fuel consumption
- Decrease of wear and tear
- Reduction of greenhouse gas carbon dioxide

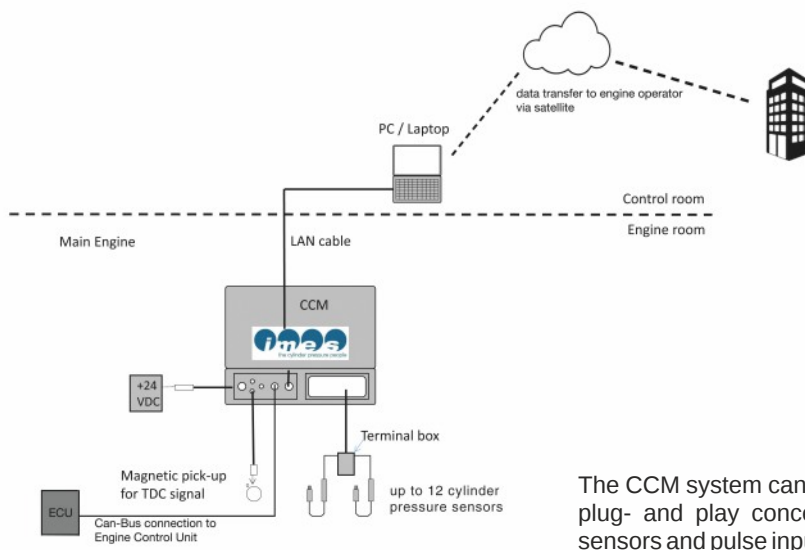
Event record

CCM offers an event storing, this means, that a large memory buffer records combustion data and pressure curves from the latest 40 combustion cycles on 4-stroke engines or rather the latest 80 cycles on 2-stroke engines. In case of deviation from engine performance parameters set by the engine operator or engine builder CCM automatically records the failure cycle plus the latest 39 (or rather 79) cycles before. This means all combustion data are stored in CCM hardware and the CCM visualisation software is able to compare and analyse the cause of the event afterwards.



Besides the user has the possibility to save the latest 40 (80) cycles manually under different load or different environmental conditions, e.g. during shop test, sea trial or voyage. He can use the recorded data for later comparison or analysis of engine performance und various conditions. The CCM event record enables to analyse the data before, during and after failure. So, it is possible to determine the cause of failure and to find solutions how to prevent in the future.

Fixed and continuous operation



The CCM system can be directly installed at the engine. A sophisticated plug- and play concept enables an easy fitting of cylinder pressure sensors and pulse inputs to the CCM housing.

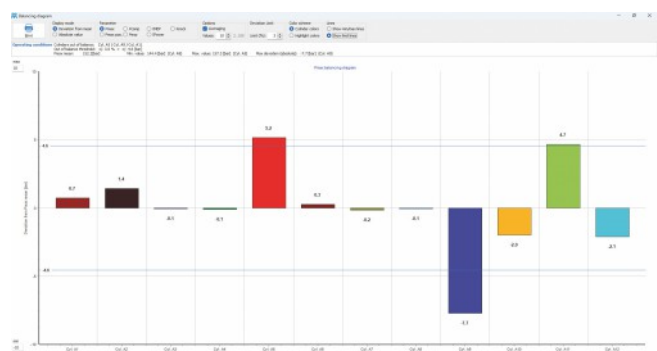
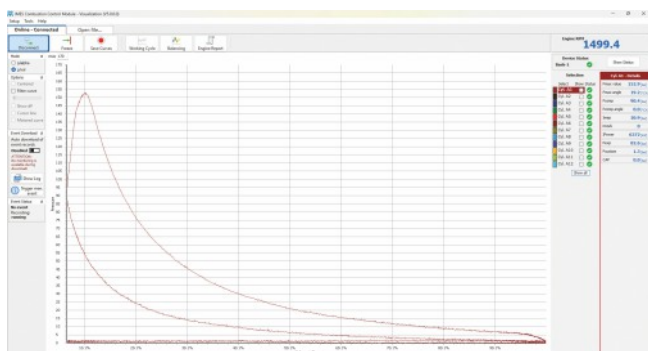
Advanced visualisation software

The combustion pressure is measured on each cylinder continuously and in all speed ranges. It is easy to use as an online solution for condition and performance monitoring. The data can be transmitted for evaluation directly via LAN/Ethernet to a PC where the CCM software is installed. The software allows an easy collection, management and comparison of engine performance data. This enables a quick overview about engine condition for an optimal engine performance. Furthermore, the data can be transmitted from CCM by CAN-Bus to an automation system which acts to stabilise engine operation.

The CCM PC software is a modernised version for online combustion monitoring. The recorded data can be used to diagnose malfunctions or to assist in the setting and optimising of engine operation parameters.

The software offers the possibility of selecting advanced monitoring functions in the following diagrams and reports:

Pressure/CA curve diagram, Pmax and Pcomp diagram, Pmax balance, Pressure volume diagram, working cycle diagram, IMEP balance and event recording, Engine report



The measured data can be also transmitted to the **IMES Performance Evaluation Software (IPE)** that offers advanced analysing functions.

IPE - IMES Performance Evaluation Software

The IMES performance evaluation software (IPE) is designed to facilitate the collection, evaluation, management and comparison of engine performance data for marine diesel engines. It loads recorded cylinder pressure data from CCM or EPM-XP^{plus} directly. Additional required information and parameters have to be entered so the programme can do ISO corrections and compare against new-engine performance benchmarks. Performance graphs and reports give a quick status of an engine and suggest actions to take for optimising engine conditions.

The user only has to fill in the required information in addition to the usual cylinder pressure measurement. For a quick overview regarding the engine condition a traffic light system is implemented.

Cylinder pressure													
	ISO CORRECTED			MEASURED BY EPM-XP/CCM									
	REF	ISO	AVG	Cyl 1	Cyl 2	Cyl 3	Cyl 4	Cyl 5	Cyl 6	Cyl 7	Cyl 8	Cyl 9	Cyl 10
Maximum pressure	bar	70.10	70.92	69.88	71.71	69.01	69.17	71.30	71.78	73.58	70.63	73.51	68.51
Maximum pressure deviation	bar				1.82	-0.88	-0.72	1.42	1.88	3.69	0.75	3.63	-1.38
Compression pressure	bar	58.14	58.43	57.41	57.19	57.65	57.23	57.26	57.12	57.47	58.15	58.35	56.59
Compression pressure deviation	bar				-0.22	0.24	-0.18	-0.15	-0.29	0.06	0.74	0.94	-0.82
Mean indicated pressure	bar	7.90			7.22	7.65	7.19	7.22	7.23	7.13	7.21	7.45	7.89
Mean indicated pressure deviation	bar				0.43	-0.03	-0.00	0.01	-0.09	-0.01	0.22	0.67	0.25
Power indicated	kW				17445.35	1541.05	1448.31	1453.96	1455.21	1436.48	1449.46	1497.30	1584.82
Load balance deviation	%				6.00	-0.38	0.01	0.10	-1.18	-0.30	2.99	9.91	2.77
Mean effective pressure (MEP)	bar	6.93			6.34								
Pmax - Pcomp	bar	11.97	12.49	12.47	14.51	11.36	11.94	14.04	14.66	16.11	12.48	15.16	11.92
Pcomp / Pacav	-	35.75	37.14	36.51	36.37	36.05	36.39	36.41	36.32	36.54	36.97	37.10	35.98

Parameter	Indication	Possible Problems
Maximum pressure Cyl. 12	Very Low	Fuel injection too late / injection valves or fuel pump utilized / injection pumps or cams are set incorrectly / Leakage because of damaged piston rings or exhaust gas valve (slowly)
Maximum pressure Cyl. 11	Low	Fuel injection too late / injection valves or fuel pump utilized / injection pumps or cams are set incorrectly / Leakage because of damaged piston rings or exhaust gas valve (slowly)

For the purpose of comparison the measurements are ISO corrected and displayed as reference to the shop test.

Theoretical savings		
Influence	SFOC saving potential	Daily fuel saving potential
Water temp COOLER in	0,3 g/kWh	110,2 kg/d
Exh gas pressure TC out	0,0 g/kWh	8,8 kg/d
Maximum pressure ENGINE		
Pressure engine room		
Pressure drop across COOLER		
Suction pressure	0,1 g/kWh	35,9 kg/d

Consumption of fuel and cylinder lubrication oil are displayed depending on engine power, time and distance. Regarding the consumed fuel the SO_x and the CO₂ emissions are calculated.

Measured Consumption		
Indication	Fuel Oil	Lub Oil
Specific consumption reference	185,3 g/kWh	0,6 g/kWh
Specific consumption ISO / measured	188,5 g/kWh	1,4 g/kWh
Difference (Theoretical cost saving per day)	3,3 g/kWh (538 USD/d)	0,8 g/kWh (1824 USD/d)
SO _x emission per day	3231,6 kg	
CO ₂ emission per day	174,3 t	
Consumption per hour (per day)	3300,0 kg/h (79,2 t/d)	34,8 kg/h (532,2 kg/d)
Consumption nautical	194,1 kg/nm	

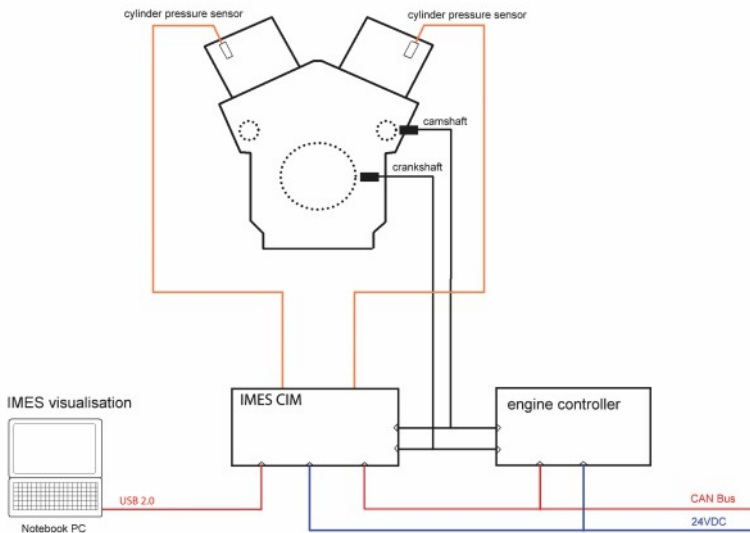
For some parameters the theoretical fuel saving and the related exhaust emissions are calculated. It is based on the deviation between the measured parameter and the reference value from the shop test.

Main benefits

- ISO correction of particular parameters for comparison with the reference data
- Improvement of the engine' efficiency
- Identification of possible malfunctions
- Calculation of fuel savings
- Calculation of exhaust gas emissions

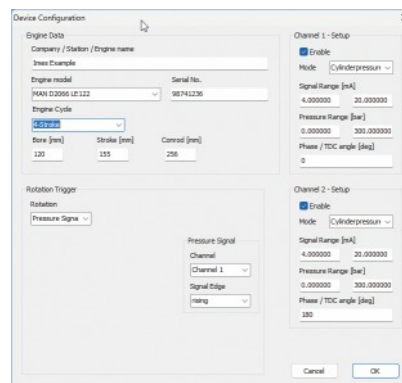
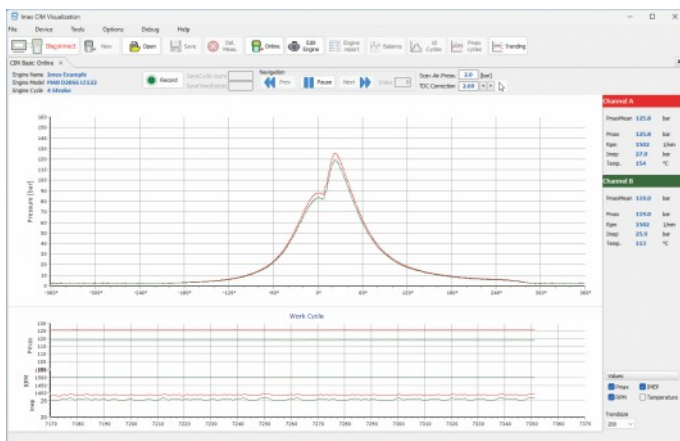
CIM - Combustion Inspection Module

CIM is an easy to use inspection module, which enables real time data acquisition of cylinder pressure on gas-, marine diesel and future fuels engines. The data can be recorded and monitored from up to 2 cylinders.



Due to its 2-channel layout, it is an easy system for quick inspection and diagnosis of single cylinder or comparison measurement to a reference cylinder.

To display the measurements CIM can communicate via USB connection to a PC where the IMES visualisation software is installed. Via CAN bus CIM can communicate with the engine control system for an integration to the engine management system.



Main benefits

- Light weight
- Easy handling
- High resolution and accuracy
- USB- power supply
- Ideal for quick diagnosis
- Compatible to all IMES cylinder pressure sensors
- Excellent price performance ratio

CIM - Technical data

2 Channel data acquisition unit

Max. 2 analogue inputs

Resolution: 0.1 °CA @ 2100 rpm

Interface: USB 2.0
CAN-bus

Power supply: USB 2.0 or +24 VDC

EPM Peak - EPM-XP - EPM-XP^{plus} - EPM-XP^{plus-vibro}

EPM Next Generation - 4 different EPM types - only one device

All EPM devices are battery powered, compact and lightweight handheld devices for 2 -and 4-stroke diesel engines. They convince with their ease of use, robustness, and high accuracy. The next generation units are equipped with the very robust cylinder pressure sensor HTT-06 that offers a very good thermodynamic performance. All EPM types have a battery capacity of more than 20 working hours.

EPM Next Generation offers one common hardware for all EPM types, this enables a simple upgrade from peak pressure indicator EPM-Peak up to engine analyser EPM-XP^{plus-vibro}. The user can purchase a licence file for an upgrade to a higher version and it is not necessary to send the device back to IMES.



The measurements the user can perform are depending on the EPM type he is using. The digital peak pressure indicator EPM-Peak is designed to measure the maximum value of cylinder pressure while the engine analyser EPM-XP^{plus-vibro} enables advanced combustion pressure measurements including vibro-acoustic diagnostic on 2- and 4-stroke diesel engines.

Visualisation software features	EPM-Peak	EPM-XP	EPM-XP ^{plus}	EPM-XP ^{plus-vibro}
Pmax balancing	on demand	✓	✓	✓
Pcomp balancing	-	✓	✓	✓
IMEP / Ipower balancing	-	-	✓	✓
P/alpha diagram	-	✓	✓	✓
Engine report	-	✓	✓	✓
P/vol and P/vol/log	-	-	✓	✓
Open-and save ref	-	-	✓	✓
Trending function	-	-	✓	✓
Online - offline function	-	-	✓	✓
Data transfer to IPE software	-	-	✓	✓
Vibration monitoring	-	-	-	✓

Additional features

- simple online upgrade from EMP Peak up to EPM-XP^{plus-vibro} via web
- one EPM visualisation software for all device types
- online software- and firmware updates
- easy menu handling and a large and comprehensive display

for 2- and 4-stroke diesel engines

The collected data of all EPM types can be displayed and evaluated from the EPM visualisation software. Via USB port the device will be connected to a PC and the visualisation software identifies the EPM type and activates the corresponding software functions. Depending on the instrument peak pressure, pressure- and combustion behaviour, performance data as well as valve timing will be evaluated and analysed.

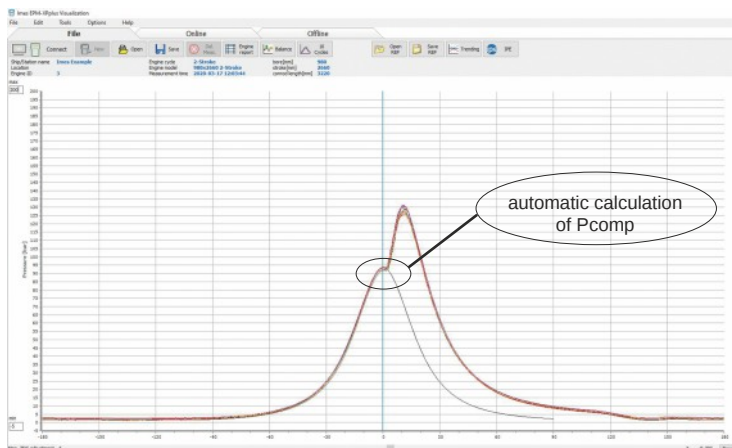
If the PC is connected to the Internet it will be automatically checked if there are any hardware or visualisation software updates. The user can install the updates and they are free of charge.



EPM connected via USB cable to notebook for quick data download and for battery charging

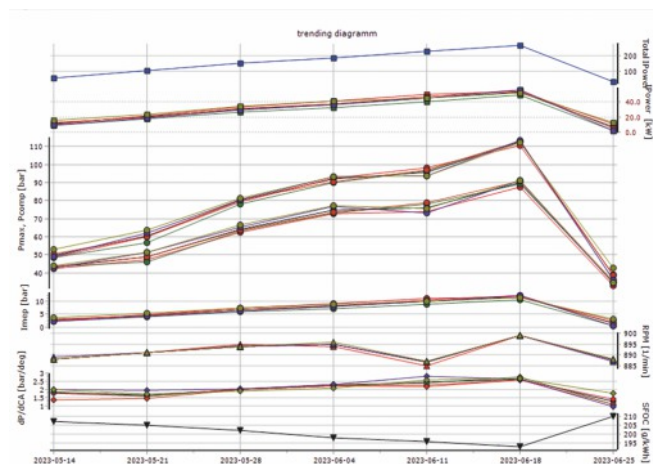
Advanced visualisation software

The visualisation software displays cylinder pressure sequences and the stored measurement data can be used for offline analysis to identify abnormal combustion behaviour.



On 2- and 4-stroke application the software calculates the curve to optimise TDC position for Pcomp value of each cylinder

The IMES' visualisation and data processing software is used to process acquired values and to display the derived information. The resulting files can be transmitted by internet to the engine builder and shipowner for separate independent evaluation. Due to specifically developed mathematical algorithm the software allows automatic Pcomp and Ipower calculation without using a TDC sensor.



The advanced trending function is a useful tool to compare measurement data at the same engine output to find deviations in combustion process for preventive maintenance on engine. The analysis can be made by comparing the results to other measurements, mean values and configured limit lines (optimal range). Measurements made in long term clearly indicate the trends of the engine parameters, which will help to predict emerging failures.

The measured data can be also transmitted to the **IMES Performance Evaluation Software (IPE)** that offers advanced analysing functions.

Compri *New product*

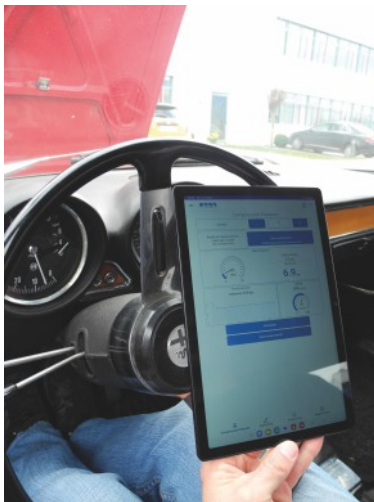


Compri is an electronic compression pressure meter and leakage test device. The unique device is designed for application on gas- and gasoline engines, bus, trucks, cars, classic cars and power plants.

The measurements can be easily performed by one person. The user only has to dismount the spark plugs and to install the pressure sensor on the cylinder. The sensor is directly connected to the Compri unit. Via Bluetooth the data will be transferred to the tablet, smartphone or PC.

Features

- One-man handling for all operations
- Standard M14 x 1,25 sensor incl. adaptor to M18 x 1,5
- Precise, safe and easy
- Bluetooth connection to PC, smartphone or tablet
- Visualisation app

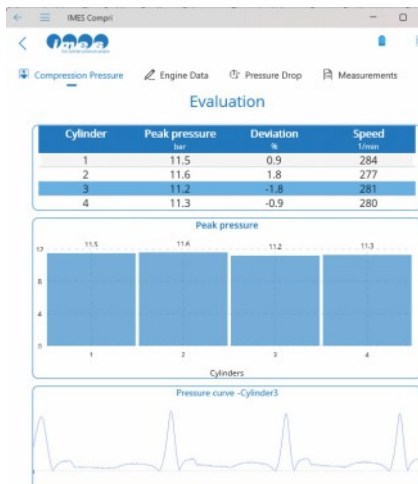
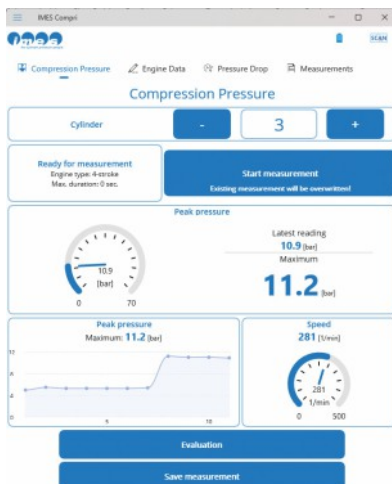


Benefits

- Avoiding expensive damage on engine
- Cost saving by early diagnosis of defective parts
- Avoiding wearing of engine parts
- Optimizing of engine performance
- Determining of correct engine part installation afterwards

Compri installed on an Alfa GT1300 engine.
The connection via Bluetooth enables the user an easy one-man handling.

App - Visualisation software



The user can download the visualisation software via the Compri App free of charge.

In the user-friendly operator interface he can fill in the engine data and start the measurements.

The visualisation software gives detailed information about e.g., compression pressure, peak pressure, rpm.



We are proud to offer a wide range of high quality measuring sensors and systems and a fast and reliable service to meet your needs.

From precise measurement systems to customized solutions, we support you in achieving your goals and optimizing your processes.

Our main products

- A wide range of cylinder pressure sensors for diesel-, gas-, dual-fuel-, and future fuel engines
- Various types of handheld electronic engine analyser
- Combustion monitoring systems

Our service

- Advice and training for optimal use of our products
- Customised solutions for your requirements
- Service and support for our products

Your benefit with IMES as your partner

- High quality products and services that meet the highest standards
- Expert support from our experienced team
- Tailored solutions that meet your specific requirements

Please contact us

www.imes.de; Email: info@imes.de; Phone: +49 8341 9661730



We deliver worldwide!

Professional support worldwide due to our global sales organisation.

www.imes.de/sales-team.html

