



the cylinder pressure people

## Electronic instruments

for diesel engine analysis



# Instruments for periodic combustion monitoring

## Three different devices - one design

IMES electronic instruments for periodic combustion monitoring on 2- and 4-stroke diesel engines are battery powered, compact and lightweight handheld devices. They are very robust, easy to use and convince with their high accuracy and their sophisticated visualisation and data processing software.

We offer three indicator types:

- EPM-Peak  
Electronic Peak Pressure Indicator
- EPM-XP  
Electronic Indicator
- EPM-XP<sup>plus</sup>  
Electronic Engine Analyser

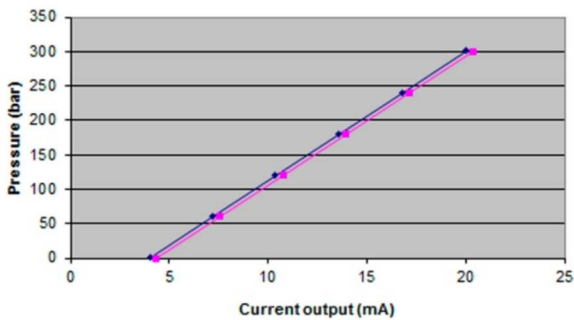


## Designed for robustness, high accuracy and long life



HTT cylinder pressure sensor including adaptor

The EPM electronic devices are characterised by their high accuracy, reliability and ease of use. One main reason for the performance of the EPM devices is the proven accuracy, reliability, longevity and cost effectiveness of IMES advanced type HTT pressure sensor. More than 60,000 HTT sensors have been delivered for a range of closed loop control application.



— IMES HTT-04 sensor 2008 — IMES HTT-04 sensor 2012

Long-term stability of IMES HTT-04. Evaluation after more than 10,000 operating hours.

The robustness and performance of the HTT cylinder pressure sensors has been proven in many application. As a result, standard effective life is more than 16,000 operating hours on both diesel- and gas engines.

The pressure diagram shows the evaluation of a HTT-04 sensor in comparison to a water cooled piezoelectric reference sensor. There is nearly no deviation after more than 10,000 operating hours.



The EPM electronic devices are easy to connect to a hand-operated pneumatic testing pump and manometer set.

With our hand-operated pump and manometer device, IMES provides customer with a quick and straightforward way of investigating apparently anomalous readings as well as achieving compliance with the ISO-9001 requirement for end-user testing of measuring equipment. Due to this no workshop calibration is needed.



## EPM-XP Electronic pressure indicator

The user friendly EPM-XP is a powerful electronic indication device. It serves to analyse 2- and 4-stroke large diesel engines.



Application on MAN&BW 2-stroke engine

The electronic indicator can record cylinder pressure values on a maximum of 20 cylinders on two-stroke engines operating at speed of 40 to 300 rpm and on four-stroke medium- and high-speed diesels with rated speeds from 200 to 1500 rpm. It gives immediate read-outs for peak pressure (Pmax and Pcomp) from a number of cycles per cylinder.

After acquisition, recorded data can be downloaded immediately to a PC or notebook via USB connection.

Recorded data can be simply processed by IMES visualisation software. Transmitting the data by Internet makes them available for expert analysis and condition monitoring at a remote location. An optional software upgrade allows power calculation to assist cylinder balancing.



The EPM-XP instrument case includes EPM-XP unit including protection cover, HTT cylinder pressure sensor, 2 x 9V E-Block NiMh re-chargeable batteries, visualisation software, USB connecting cable and Thompson adaptor including mounting tool.

Optional available is the IMES dongle for further evaluation, e.g., IPOWER- and IMEP calculation, including p/v diagram, Pcomp diagram, IMEP diagram and IMEP balance diagram including trending.

EPM-XP instrument case incl. all components

# with advanced visualisation and data processing software

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.

The standard software allows to calculate compression pressure on 2- and 4-stroke engines automatically without TDC sensor.

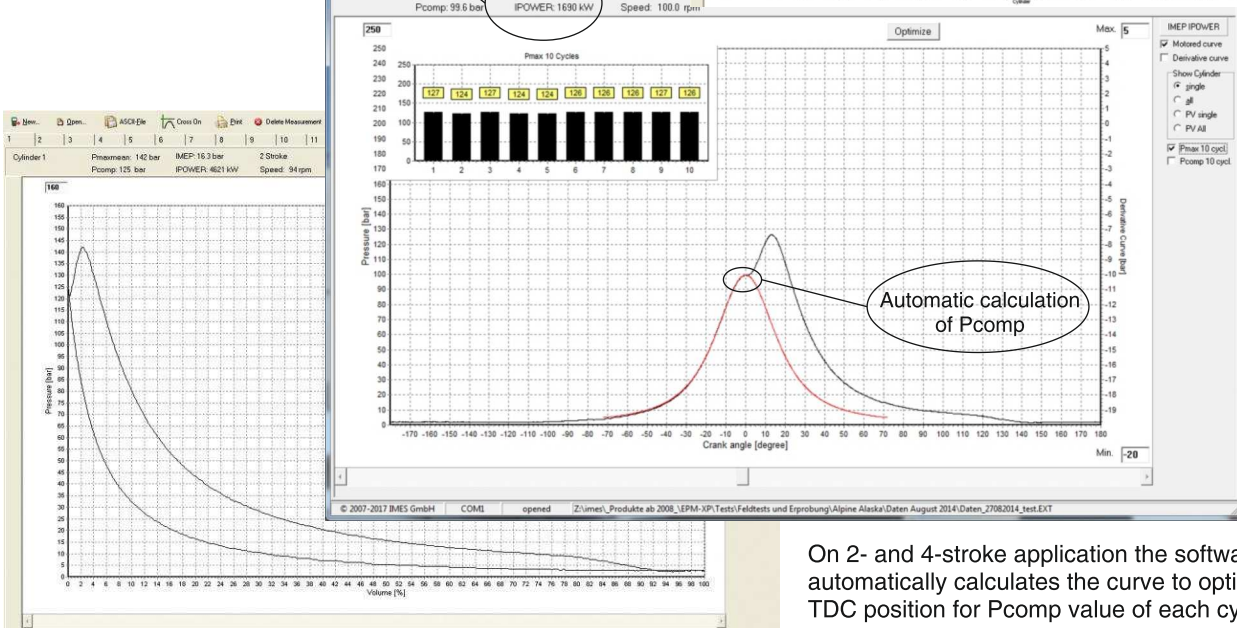
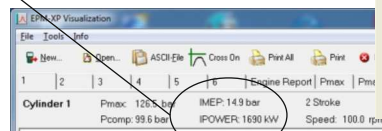
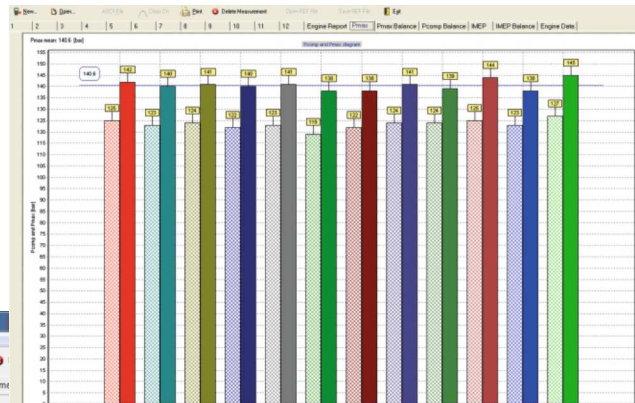
With the EPM-XP hardware dongle further evaluation can be activated. This enables to calculate IPOWER and IMEP by using a mathematical algorithm.



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

Special software algorithm enable the automatic evaluation of compression pressure and indicated power with high accuracy. Both values will be displayed in different diagrams of the EPM-XP visualisation software.

Calculation of IMEP and IPOWER on 2- and 4-stroke engines

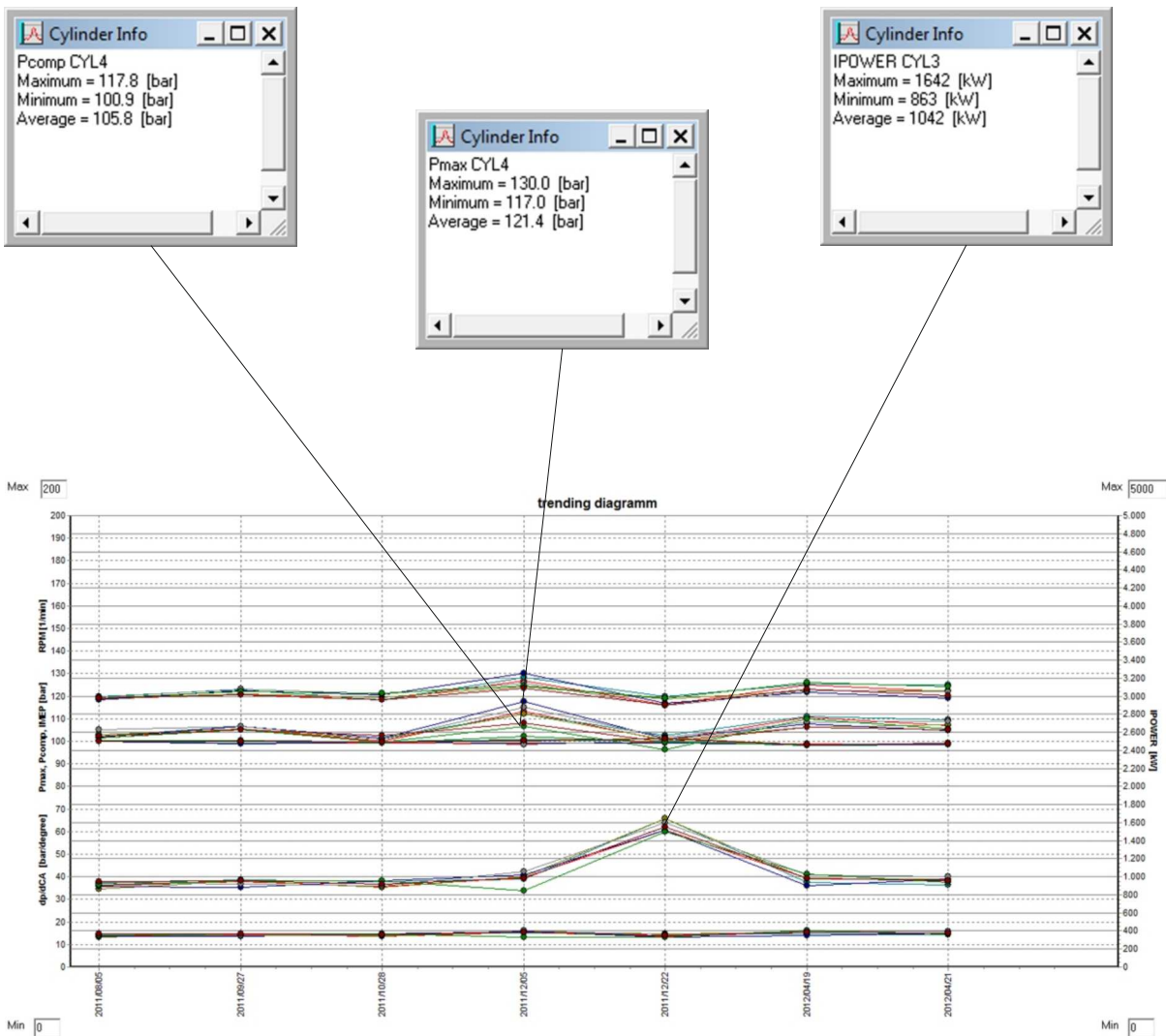


Automatic calculation of Pcomp

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

# Trending function to compare measurement data

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 indicate clearly the trends of the engine parameters, which will help to predict emerging failures.



## Advantages of EPM-XP

- High accuracy
- Battery charging from PC via USB port
- Excellent price performance ratio
- Automatic Pcomp calculation
- IPOWER and IMEP Calculation
- Trending function
- Calculation of specific F.O. consumption (g/kWh)



# New Generation Engine Analyser - EPM-XP<sup>plus</sup>

The engine analyser EPM-XP<sup>plus</sup> is a further development of the well-proven electronic indicator EPM-XP.

The main functions such as TDC correction, automatic Pcomp calculation, IPOWER and IMEP calculation as well as trending function are still available.

However, EPM-XP<sup>plus</sup> offers new functions that enable a specific combustion analysis for an increased engine diagnostic.

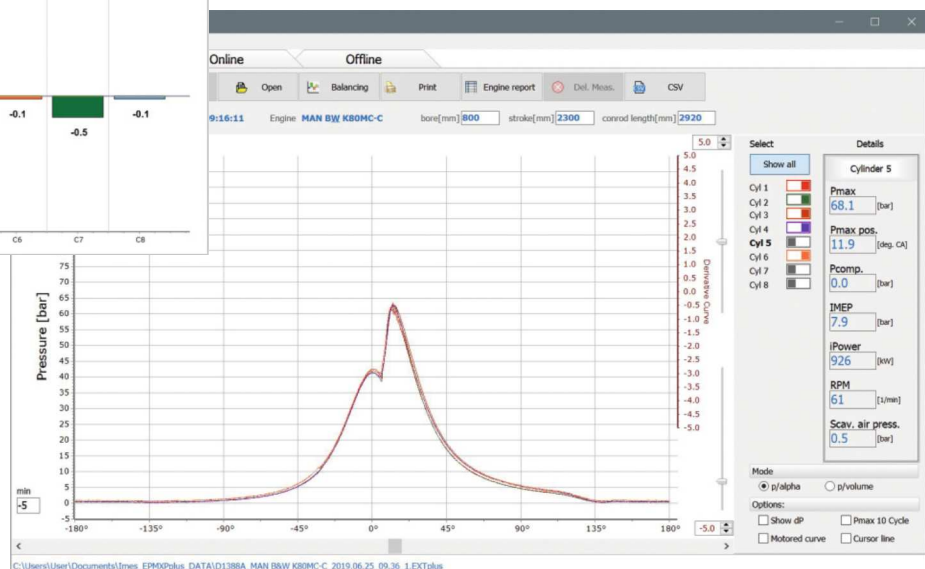
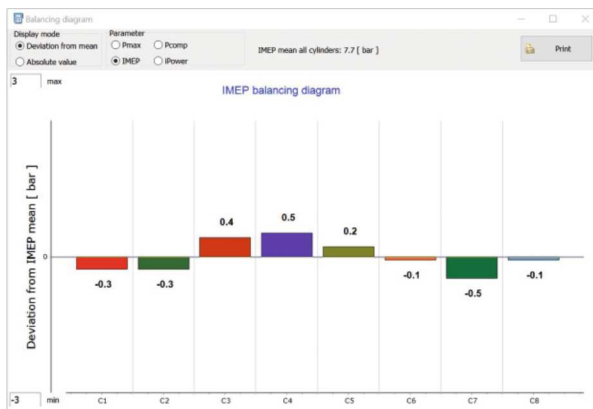
## Advanced features of EPM-XP<sup>plus</sup>

- Higher battery capacity - power more than 20 hours
- Continuous measurement to analyse actual engine condition by direct data transfer via USB/Ethernet to PC software
- Comprehensive analysing software for ships- and power plant application
- **Optional** direct data transfer to IPE (IMES Performance Evaluation software)
- **Optional** vibro sensor for definition of fuel injection timing and valves timing in preparation



The enhanced display gives detailed information about:

- date
- battery status
- pressure
- RPM
- time
- cylinder no.
- 2- or 4-stroke engine
- temperature of measuring element



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

The sophisticated visualisation and analysing software enables an extensive evaluation of engine performance data and important combustion parameters can be directly transferred to the IMES expert software (IPE).

# 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 EPM-XP<sup>plus</sup> 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 screenshot shows the IPE software interface with the following sections:

- General parameters:** Date / time of Reporting (2019-05-17 18:46), Date / time of measurement (2017-03-09 15:33), Running hours (34657 h), Sea water temperature (14 °C), Temperature in engine room (30 °C), Pressure in engine room (1024 mBar), Ambient Pressure (1021 mBar), Outside temperature (14 °C), Engine operation (steady), Voyage / Title (La Spezia to Valencia), Recorded by (Hans Baier), Remarks (Sea Trail).
- Nautical parameters:** Ship speed over ground (17 kn), Wind force (2 bit), Draft fwd (10 m), Towing resistance (1500 kN), Slip (apparent) (1.78 %), Ship speed through water (17 kn), Wind direction (geo.) (-), Draft aft (11 m), Propeller type (FP), Propeller efficiency (0.97), Sea scale direction (geo.) (352 °), Wind direction to vessel (-), Draft mid (10.5 m), Propeller diameter (7 m), Hull efficiency (0.89), Sea scale direction to vessel (8 °), Cargo total (5230 mt), Draft trim (1.00 m), Propeller blades (5), EEDI (155.53 gIt/ton), Sea scale height (2 m), Cargo type (Container), Thrust (1690 kN), Pitch (8 m).
- Power / Speed:** Engine power effective (44216.00 kW), Select power reference to use (by Indicator), Engine speed (84.00 rpm), Mechanical efficiency (87.75 %), Power Margin (15.63 %), Sea Margin (9.28 %), Load Balance (23.75 %).
- Injection:** ISO CORRECTED and MEASURED / READING tables for Governor / Fuel / Load ind. and VIT index (MAN only).
- Legend:** REF - Reference value based on shop test data, AVG - Arithmetic average value based on your input values, CALC - ISO corrected value based on AVG, MEAS - Measured value, - Enter or select data, - No input value (automatically calculated value), - Necessary value for further program analysis, - Valuation normal, - Valuation low / high, - Valuation very low / high.

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.

	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	Cyl 11	Cyl 12
Maximum pressure	70.10	70.92	69.88	71.71	69.01	69.17	71.30	71.78	73.58	70.63	73.51	68.51	71.39	63.12	64.91
Maximum pressure deviation				1.82	-0.88	-0.72	1.42	1.89	3.69	0.75	3.63	-1.38	1.51	-6.76	-4.98
Compression pressure	58.14	58.43	57.41	57.19	57.65	57.23	57.26	57.12	57.47	58.15	58.35	56.59	57.61	56.65	57.66
Compression pressure deviation				-0.22	0.24	-0.18	-0.15	-0.29	0.06	0.74	0.94	-0.82	0.20	-0.76	0.25
Mean indicated pressure	7.90		7.22	7.65	7.19	7.22	7.23	7.13	7.21	7.45	7.89	7.42	7.75	6.14	6.39
Mean indicated pressure deviation				0.43	-0.03	-0.00	0.01	-0.09	-0.01	0.22	0.67	0.20	0.52	-1.08	-0.83
Power indicated			17445.35	1541.05	1448.31	1453.96	1455.21	1436.48	1449.46	1497.30	1584.82	1494.02	1560.34	1239.47	1284.95
Load balance deviation				6.00	-0.38	0.01	0.10	-1.19	-0.30	2.99	9.01	2.77	7.33	-14.74	-11.61
Mean effective pressure (MEP)	6.93		6.34												
Pmax - Pcomp	11.97	12.49	12.47	14.51	11.36	11.94	14.04	14.66	16.11	12.48	15.16	11.92	13.79	6.47	7.25
Pcomp / Pscav	35.75	37.14	36.51	36.37	36.65	36.39	36.41	36.32	36.54	36.97	37.10	35.99	36.63	36.03	36.66

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



# Analyse, optimise and operate efficiently

IPE offers an automatic evaluation of current engine performance. Performance graphs and reports show deviation and suggest actions to take for optimising engine adjustment.

▼ Main Parameters		
Parameter	Indication	Possible Problems
Fuel index ENGINE	Okay	
Maximum pressure ENGINE	Okay	
Compression pressure ENGINE	Okay	
Charge air pressure	Okay	
Exh gas temp TC in	Okay	
Exh gas temp TC out	Okay	
TC speed	Okay	
SFOC	Okay	

Based on the traffic light system the valuation of the most essential operational parameters are displayed. Depending of the indication possible problems / reasons / malfunctions are given.

▼ Additional Parameters		
Parameter	Indication	Possible Problems
Maximum pressure CYL 12	Low	Fuel injection too late / Injection valves or fuel pump attrited / Injection pumps or cams are set incorrectly / Leakage because of damaged piston rings or exhaust gas valve (blow by)
Maximum pressure CYL 11	Very Low	Fuel injection too late / Injection valves or fuel pump attrited / Injection pumps or cams are set incorrectly / Leakage because of damaged piston rings or exhaust gas valve (blow by)

▼ 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)
SOx emission per day	3231,6 kg	
CO2 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	

Consumption of fuel and cylinder lubrication oil are displayed depending on engine power, time and distance. Regarding the consumed fuel the SOx and the CO<sub>2</sub> emissions are calculated.

▼ 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

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's efficiency
- Identification of possible malfunctions
- Calculation of fuel savings
- Calculation of exhaust gas emissions

# Digital peak pressure indicator

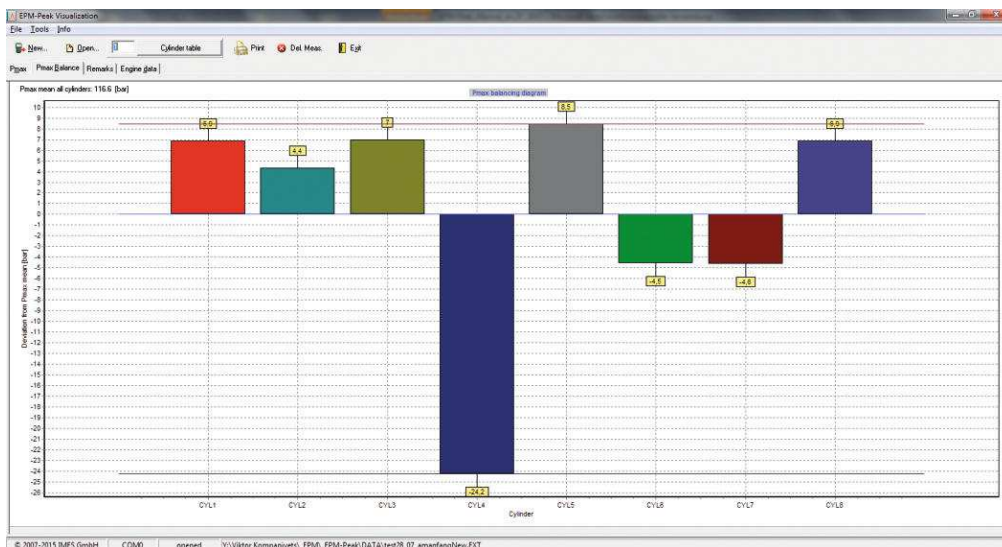


EPM-Peak is a digital peak pressure indicator. It is designed to measure the maximum value of cylinder pressure on 4-stroke diesel engines.

In comparison to conventional mechanical peak pressure meter the EPM-Peak offers an easy handling, the measurements have a higher accuracy, the data Pmax and speed will be displayed exactly on the LCD screen and up to 200 measurements can be stored.

The EMP-Peak collects 10 consecutive pressure measurements (cycles) and calculates peak pressure and engine speed. The measured data are displayed in numerical format on the LCD screen and stored in memory.

Optional the user can also obtain our visualisation software which displays Pmax and Pmax balance diagram on a PC.



The Pmax balance diagram shows deviation from Pmax mean of each cylinder compared to the calculated average peak pressure.

## Advantages

- lightweight, battery powered hand held device
- easy handling
- high accuracy
- battery charging from PC via USB port
- 200 measurements storing capacity
- including visualisation software

# Permanent high quality

## Overview technical data and features

	<b>EPM-Peak</b>	<b>EPM-XP</b>	<b>EPM-XP<sup>plus</sup></b>
<b>Measuring range</b>	0...300 bar	0...300 bar	0...300 bar
<b>Application range on 2-stroke engines</b>	-	40 - 300 RPM	40 - 900 RPM
<b>Application range on 4-stroke engines</b>	200 -1500 RPM	200 - 1500 RPM	200 - 1800 RPM
<b>Accuracy</b>	+ / - 1% full scale	+ / - 0,5% full scale	+ / - 0,5% full scale
<b>Sampling resolution</b>	1 °CA	0,5 °CA	0,1 °CA
<b>Max. temperature at measuring cell</b>	300 °C (short time 350°C)	300 °C (short time 350°C)	300 °C (short time 350°C)
<b>Operating time</b>	> 1h	> 1h	> 20h
<b>Online measurement</b>	-	-	via USB- / Ethernet cable
<b>Interface</b>	USB	USB	USB - HID
<b>Battery</b>	9V E-Block re-chargeable NiMh	9V E-Block re-chargeable NiMh	4 x NiMh AAA 930 mAh re-chargeable

## Functions of visualisation software

	<b>EPM-XP</b>	<b>EPM-XP<sup>plus</sup></b>
<b>cylinder pressure diagram incl. Pmax calculation,</b>	X	X
<b>Automatic TDC correction</b>	X	X
<b>Pcomp calculation</b>	X	X
<b>Pmax / Pcomp diagram</b>	X	X
<b>Ipower / IMEP calculation</b>	Option	X
<b>Ipower / IMEP diagram</b>	Option	X
<b>Trending</b>	Option	X
<b>Injection and valve timing, valves leakage</b>	-	Option
<b>Direct data transfer to IPE</b>	-	Option

**EPM Peak:** The visualisation software displays Pmax diagram and Pmax balance diagram.





We deliver worldwide!

Professional support worldwide due to our global sales organisation.

[www.imes.de/sales-team.html](http://www.imes.de/sales-team.html)