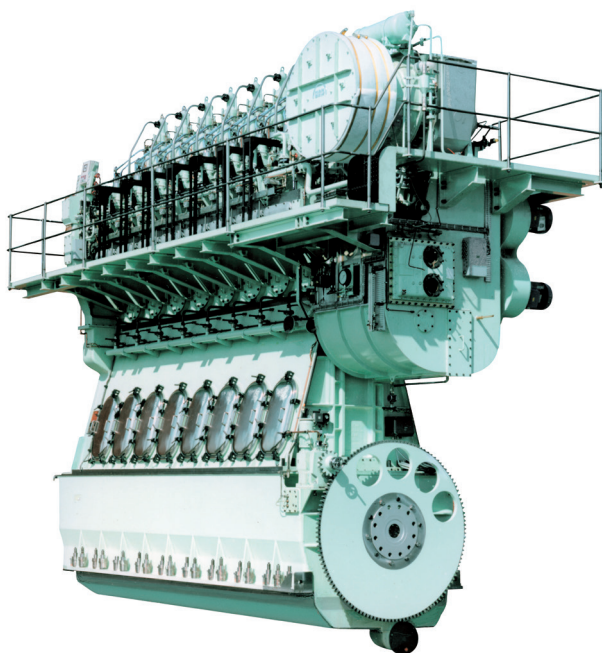




CMT

monitoring innovation



Performance and Efficiency Monitoring

Overview

Sea going vessels require large amounts of fuel to operate. Therefore diesel engine performance is paramount to a ships owner's bottom line. Most marine diesel engines operate on lower-quality fuels that can cause ignition delays and incomplete combustion.

CMTs Diesel Performance Analysers can provide early detection of worn or damaged engine components such as piston ring leakage, burnt piston crown, exhaust valve leakage and much more. It also ensures that the engine is well balanced and the injection timing is correct. An optional feature is an acoustic emission sensor that measures fuel injection without penetrating the fuel system. This option delivers enhanced engine performance by utilizing some of the latest technological innovations designed specifically for marine engines.

CMT provides five different systems:

- **Peak Pressure Indicator:** Easy, simple and efficient tool to measure peak pressure.
- **PREMET M:** Modern economic and easy to use device with all features needed.
- **PREMET X:** Ultra accurate device with a large color display and advanced connectivity.
- **PREMET Online Single Sensor:** Similar to the PREMET X functionality but permanently wired up always ready to take a measurement.
- **PREMET Online 24/7:** Measures continuously the performance of the main engine so will not miss any problem.

CMTs Training:

We at CM Technologies GmbH understand that the challenge of protecting the vessel against costly downtime and operating it cost effectively is putting high demands on the education of the employees seeing to the operation and maintenance.

Therefore we are offering training to make sure that your employees are properly trained in the use of a tool you have invested in.

Your benefits:

- Reduced fuel consumption
- Well balanced engine
- Correct ignition timing
- Overload protection
- Improved maintenance efficiency
- Reduced spare parts purchases
- Reduced emissions

Mechanical Peak Pressure Indicator

The CMT Peak Pressure Indicator is an easy, fast and cost effective way to maintain your diesel engines.

It measures the maximal firing pressure and the compression pressure of two and four stroke combustion engines. It helps balancing and optimizing your engine and with that you will be able to make the most out of your engine and fuel.

By cutting the fuel for one cylinder for a short time you can easily detect any possible blow by to avoid unwanted loss of energy.

Optimizing your engine cannot be easier



with the help of the CMT Peak Pressure Indicator.

We have designed the new CMT Peak Pressure Indicator with the engineer on site in mind. It has been designed for easy operation and to protect its user in case of excessive cylinder pressure.

A safety glass gauge and protection by a blow out back wall are just two examples for our features to avoid accidents during the usage.

Every single device will be tested and calibrated according to our ISO 9001 quality standards and will be supplied with a calibration certificate proving the accuracy of the device.

Your benefits:

- Prevents unbalanced peak pressure
- Detect blowbys
- Helps to avoid uncontrolled vibration
- Prevents loss of efficiency
- High accuracy at all speeds and pressure ranges
- Extremely robust
- Steel-gauge in safety construction

Ordering Information

Peak Pressure Indicator Types:

DPA-CT-00140

Peak Pressure Indicator 140

Range: 0-140 bar

DPA-CT-00180

Peak Pressure Indicator 180

Range: 0-180 bar

DPA-CT-00220

Peak Pressure Indicator 220

Range: 0-220 bar

DPA-CT-00250

Peak Pressure Indicator 250

Range: 0-250 bar

DPA-CT-02000

Peak Pressure Indicator 2000

Double Scale

Range: 0-150 bar

0-2000 Psi

DPA-CT-03000

Peak Pressure Indicator 3000

Double Scale

Range: 0-225 bar

0-3000 Psi

DPA-CT-12116

Spare part set for Peak Pressure Indicator

PREMET® M

Newly developed and part of CMT's modern range of PREMETS the PREMETS M is the way to go if you are looking for an economic approach to monitor your engines without sacrificing quality and accuracy. Brand new technologies give the user an unparalleled accuracy and will ensure you are getting results you can act on. Designed by marine engineers to be used from marine engineers the PREMETS M helps balancing cylinder load, optimise injection timing and detect worn or damaged engine components and thus reducing the engine's operating cost.

Balancing the cylinder load helps extend engine life, increases efficiency, and reduces emissions to assist with environmental compliance.



PREMET® M with Sensor

Proper ignition timing reduces exhaust gas temperature and the rate of excess carbon build-up. Tuning the engine may reduce specific fuel oil consumption (SFOC). For each degree that the ignition is retarded SFOC increases by approximately 2%. The PREMETS M may protect against costly downtime by implementing predictive maintenance. Major defects can be easily detected. Engine maintenance can be planned, thus saving in parts and labor by changing engine parts based on need, not on timed intervals.

The PREMETS M has a rugged housing and uses a Kistler PiezoSMART pressure sensor of latest design which is being connected to the indicator valve of the cylinder for a measurement. 4-stroke engines can be measured without pick up with high accuracy but to achieve an even higher accuracy a pick up can be used. For the measurement of 2-stroke engines a pair of pick up is available as optional extra. The integrated compensation of torsional vibrations enables an unparalleled accuracy when measuring on 2-stroke engines.

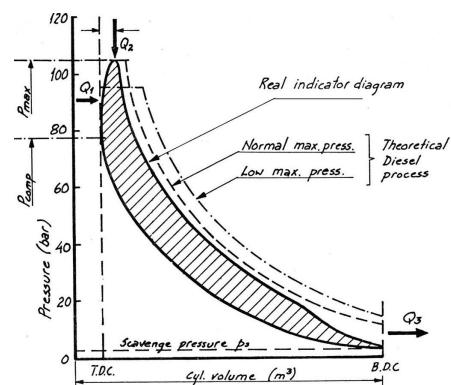
The PREMETS M is compact, easy to use and very intuitive. Data is being exported via USB and can be analyzed further with the software supplied together with the device. For personnel managing multiple vessels CMT offers a Fleet Management Software.

The non-volatile memory stores up to 18 engine records or up to 125 cylinders.

The angle precision of the PREMETS M is 0.17 deg. The max. cylinder pressure the sensor can be used with is 350 bar.

CM Technologies GmbH offers a measurement evaluation service to help you getting the most out of your CMT instrument.

Also individual training courses can be arranged either at CMT, at your office or even on board.



Your Benefits

- Shock prove protector available
- Newly designed using up to date technology
- New analysis software
- Fleet Management software available
- Rugged design for onboard use
- High accuracy
- DNV GL Eco Insight ready
- Economic initial costs
- Exchange Sensor without new calibration of the device



Specification

Ignition pressure range	0-350 bar
Sensor	Kistler 6019A 115
Speed range	20-3000 rpm
Max. number of engines	18
Max. number of cylinders over all engines	125
Max. temperature	400 °C
Compensation of torsional vibration	✓
Compensation of pressure vibration	✓
Display	alphanumeric, size 75 x 25 mm, resolution 20 x 4 char
Accuracy	0.17% degree crank angle

Ordering Information

DPA-CT-12021

PREMET® M

- KISTLER Piezo-SMART-Sensor
- New Premium Analysis Software (PREMET Viewer)

DPA-CT-12022

PREMET® TDC pick up for 4-stroke engines

DPA-CT-12023

PREMET® pair of Pick ups for 2-stroke engines

DPA-CT-12027

15m Premet pick up connection cable

PREMET® X



PREMET® X with Sensor

The PREMETS® diesel indicators are known to be rugged and reliable. The newly developed PREMETS® X now adds a brand new software, new sensor technology and connectivity to obtain, show, analyse and export the important pressure data of your diesel engine during operations. This device gives you the opportunity to fine tune your engine to a higher efficiency resulting in lower costs.

Compatible with low-, medium- and high-speed engines the PREMETS® X is the perfect system to optimise your fuel injections to reduce fuel consumption but also to avoid repairs and damages as part of a condition monitoring regime. The PREMETS® X, Made in Germany, is using high-quality materials and is equipped with the newest PiezoSMART sensor from Kistler Switzerland. Latest designed engines run with peak pressures up to 350 bar and high exhaust gas temperatures. The new sensor technology ensures high performance and accurate results for the complete range. The storage of calibration data inside the sensor makes it possible to easily exchange sensors without calibration of the device.

The new software allows to do an in depth analysis of your engine ensuring you will be in control of the condition of the engine without being an expert user. If your job includes responsibility for multiple vessels the Fleet Management Software will make your life much easier and for worldwide access CMT is offering a Cloud solution as well. The integrated WiFi connection increases the ease of data transfer considerably.

A WiFi network with an internet connection, which can easily be established with a standard mobile phone in the next port will allow an automated upload of the data into the cloud.

The large internal memory of the PREMETS® X allows to save as many engine set ups as you like up to 40 cylinders per engine. The integrated compensation of torsional vibrations enables ultra accurate measurements for 2-stroke engines. 4-stroke engines can be measured with an extra TDC sensor with high accuracy.



Using an acoustic emission sensor the fuel injection can be monitored with no need to tamper with the high pressure fuel lines during installation. Ignition delay and other critical timings during combustion will become visible.

Your benefits:

- Revolutionary new sensor technology
- New analysis software
- WiFi connection for easy data transfer
- Rugged design for onboard use
- Highest available accuracy
- DNV GL Eco Insight ready
- Cloud based Fleet Management



CM Technologies GmbH offers a measurement evaluation service to help you getting the most out of your CMT instrument. Also individual training courses can be arranged either at CMT, at your office or even on board.

Ordering Information

DPA-CT-12020

PREMET® X

- KISTLER Piezo-SMART-Sensor
- New Premium Analysis Software (PREMET Viewer)

DPA-CT-12022

PREMET® TDC Pick up for 4-stroke engines

DPA-CT-12023

PREMET® pair of pick ups for 2-stroke engines

DPA-CT-12027

15m Premet pick up connection cable

Specification

Ignition pressure range	0-350 bar
Sensor	Kistler 6019A 11S
Speed range	20-3000 rpm
Max. number of engines	Unlimited
Max. number of cylinders (per engine)	40
Max. temperature	400 °C
Compensation pressure	✓
Compensation of torosional vibration	✓
USB connection	✓
WiFi connection	✓
Display	color, size 160 x 90 mm, resolution 800 x 480
Accuracy	0.17% degree crank angle

Acoustic Emission (AE) waves are commonly defined as transient elastic waves within a material caused by the release of localized stress energy. Hence, an event source is the phenomenon which releases elastic energy into the material, which then propagates as an elastic wave.

AE events that are commonly studied among material failure processes include the extension of a fatigue crack, or fibre breakage in a composite material.

AE is also related to an irreversible release of energy that can be generated from sources not involving material failure including friction, cavitation and impact. Acoustic emissions can be detected in frequency up to 1 MHz.

Specifications	
Frequency Range:	300-400 kHz (Acoustic Emission)
Operating Temperature:	130°C
Power Supply:	5.0 +/- 0.25 VDC
Output Signal:	0.5-4.0 VDC
Attachment:	Alnico Magnet, 5.2 kg pull force
Diameter:	26 mm
Connector:	Fischer 3 Pol

The Acoustic Emission Sensors is a piezoelectric sensor with built-in amplifier and signal conditioning. It is optimised to detects waves in the range of 300 to 700 KHz , which are caused by the injection of the fuel through the nozzle, exhaust gas flow through the valve, impact of the injector needle, closing and opening of the fuel pump spill.

The AE sensor is used to measure the angle at which these events occur and to detect deviations in injection timing, late burning of fuel in the cylinder, leaking injectors.

The optional Acoustic Emission (AE) Sensor can be used for the PREMETS® X, PREMETS® Single Sensor and PREMETS® 24/7. It is not suitable for the use with the ECON Diesel Indicator.

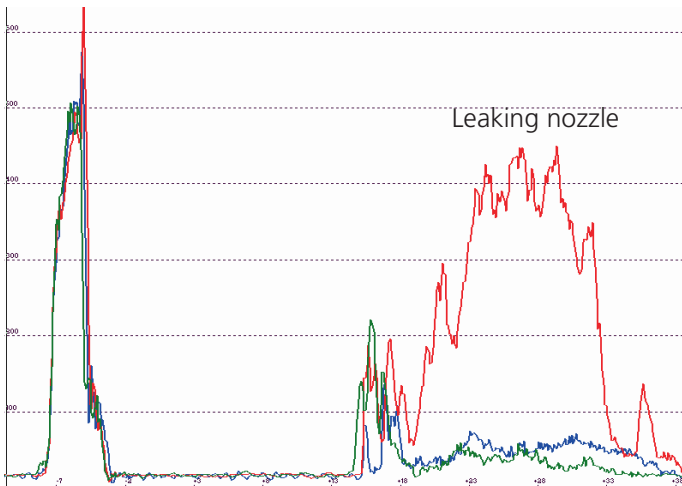
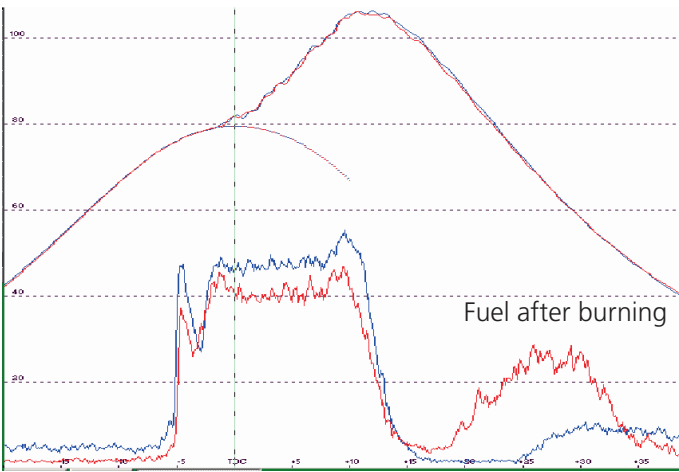
Your benefits:

- No penetration of the fuel system
- Eliminates possible fuel leakage
- Applicable for 2-stroke and 4-stroke engines

Ordering Information

DPA-CT-12026

Acoustic Emission Sensor



PREMET® Viewer

The PREMETS® Viewer helps to analyse the combustion process more efficiently. With an import of measurement data from a PREMETS® X or M you can create TDC graphs, Combustion and Decomposition Curves and p-V Diagrams to help with the condition monitoring of your engines.

The software is included in the delivery of a PREMETS from the newest generation. It facilitates the evaluation of the engine condition. A variety of diagrams, bar plots and tables present the measurements incl. manually entered data in a user friendly way.

Data from older generations of PREMETSs, DieselsCOPE and Diesel Indicator, DPA devices by DREW Chemicals and all BAEWERT and HLV devices by Kistler or MAN can be evaluated too. Therefore, the transition from an older diesel performance analyser is much easier and you can see trends immediately with the data of your previous devices.

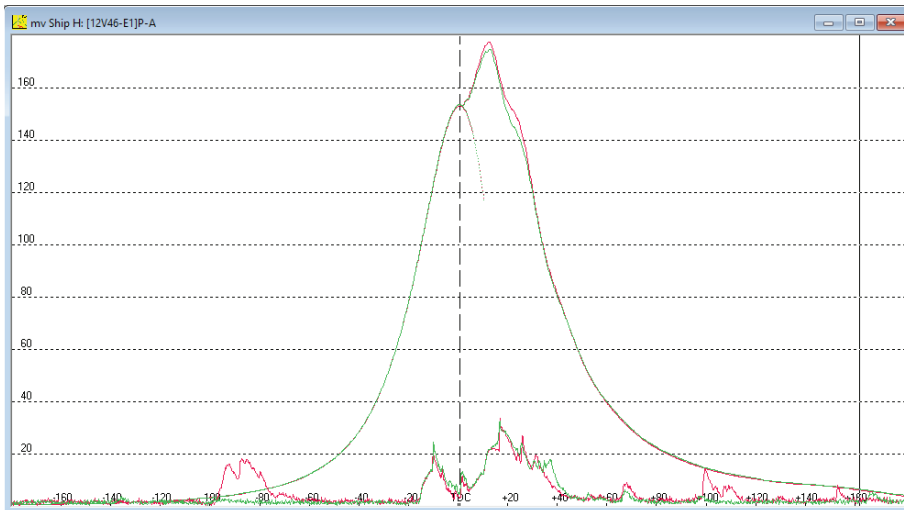
The correct adjustment of the engine helps to reduce the engine's operating costs. Cylinder-to-cylinder load balancing and the correct fuel injection settings will optimise the engine performance and minimize the specific fuel oil consumption. Another main feature of the software is the trend analysis. These trends can help to detect worn parts or incorrect adjustment and plan you repairs as well as avoid unexpected failure.

Engine setup

The most used functions of the PREMETS Viewer for evaluation are:

- The Pressure-Volume (p-V) diagram can indicate leakage or the incorrect setting of the TDC.
- The TDC Correction is used to maximise the power generated by the engine with lower loss.
- The Combustion Pressure Decomposition Curve is especially for modern engines with a very late ignition point.

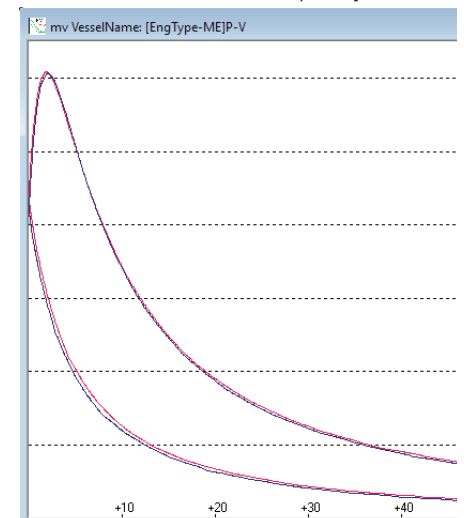
All the insights gained can be incorporated into prepared reports for better compilation and distribution so that action can be taken quickly.



Combustion process

Your benefits:

- Easy comparison with previous or sea trial data.
- Upload of Records into the optional PREMETS Cloud Solution.
- Allows to read in records from other devices like:
 - PREMETS all devices from 2nd and 1st generation
 - Diesel SCOPE and Diesel Indicator previously sold by CMT
 - All DPA devices sold by DREW Chemicals
 - All BAEWERT and HLV devices sold by Kistler or MAN
- Showing the first and second derivative to conclude correct TDC (Top Dead Centre) setting.
- Combustion Decomposition Curve.
- Logarithmic view of p-V Diagram (pressure-volume) to find TDC problems as well as thermal or pressure leakages during combustion process.
- High resolution data processing with the option of filtering to smooth the graph with adjustable low pass filter.
- Can be upgraded to Fleet Management Software including fleet comparison and trending capability.
- Simple adjustable and flexible report creation with all necessary parameters.
- Free of charge with every purchase of a PREMETS X or M.



p-v Diagram

Ordering Information

DPA-CT-12039

PREMETS® Viewer

- Included with every purchase of a PREMETS

DPA-CT-12024

PREMETS® Fleet Management Software

PREMET® Cloud

While every PREMETS® device comes including the PREMETS® Viewer, there is an even more beneficial solution. The PREMETS® Cloud allows an analysis from a single ship to complete fleets. Everything is stored in the cloud and can be accessed from all over the world. And the best thing? Its free to use, just register.

Management of the engines on board is nowadays crucial to reduce costs, adhere to modern maintenance requirements and to guarantee 24/7 reliable operation.



Availability - everywhere, anytime, instant and for everybody on your team

An **annual cloud subscription for the ship** is all you need to purchase, but all user accounts are free. The PREMETS® Cloud offers the **most modern DPA** with the **most complete number of parameters**.

For a retrospectively trend analysis, you can also **upload data from other devices** for example, older PREMETSs, HLV, DieselSCOPE or Diesel Indicators etc.

Comparison between sister engines within the fleet can help a lot and is easily done within the PREMETS® Cloud.



Cloud based - neat and uncomplicated

Your benefits:

- Free to use for all co-workers
- Easy account managing
- Only the ship needs an annual upload license
- Optional analysis service by marine engineers
- Worldwide access with all current browsers
- Most extensive Diesel Performance Analysis on the go
- Only software to show:
 - Maximum combustion pressure
 - Combustion pressure decomposition curve
 - Calculated point of ignition
 - Injection timing parameter

Alerts

Compression pressure alert on cylinder 1.

The compression pressure is -5.0 bars away from average. Should be less than 2.0 bars.

Maximum combustion pressure alert on cylinder 1.

The maximum pressure is 10.7 bars away from the average. Should be less than 3.0 bars.

Mean indicated pressure alert on cylinder 1.

The mean indicated pressure is 3.1 bars away from average. Should be less than 0.5 bars.

Maximum combustion pressure alert on cylinder 3.

The maximum pressure is -4.3 bars away from the average. Should be less than 3.0 bars.

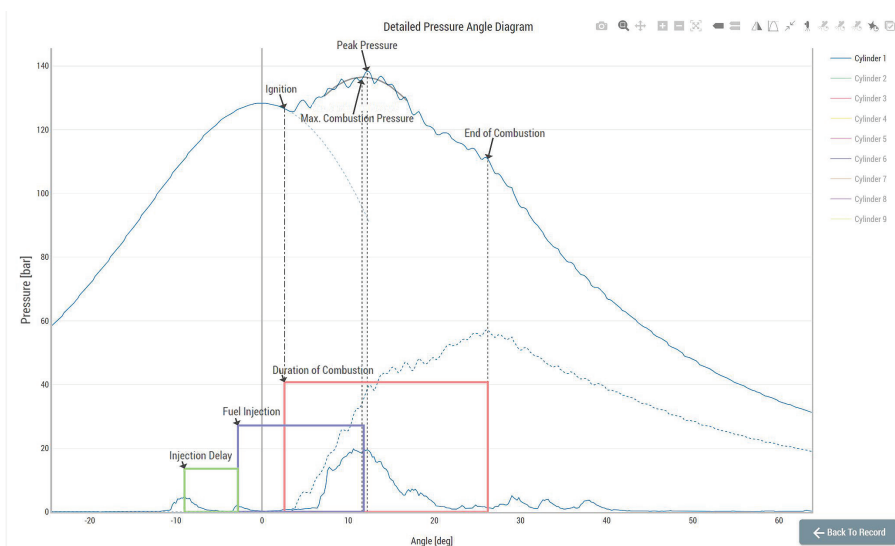
Compression pressure alert on cylinder 4.

The compression pressure is 2.4 bars away from average. Should be less than 2.0 bars.

Compression pressure alert on cylinder 5.

The Compression pressure is 2.5 bars away from average. Should be less than 2.0 bars.

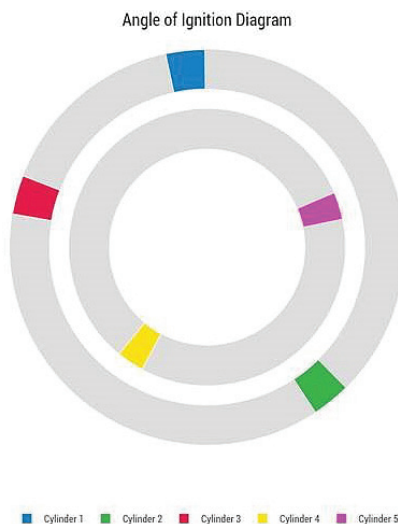
Clear - Alert system for quick actions



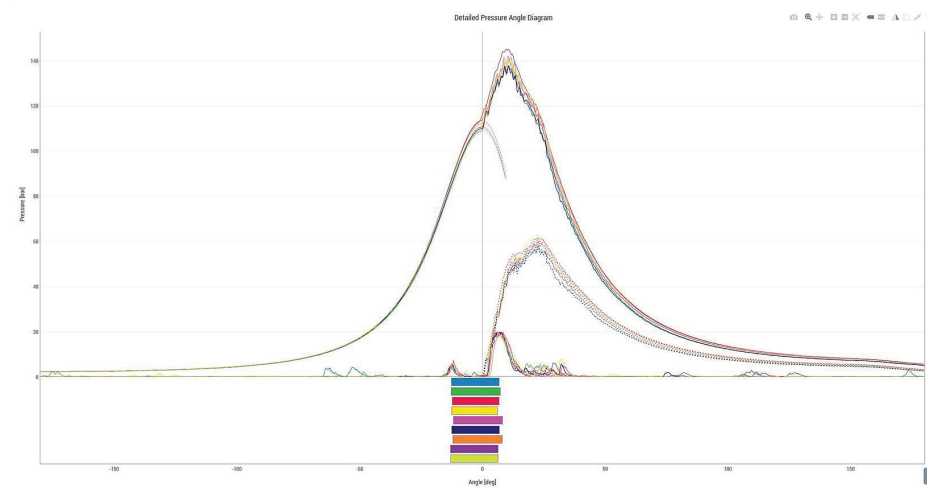
Extensive - complete analysis with no compromises

Complete list of parameters analysed in the PREMETS® Cloud*:

- Revolutions per Minute (RPM)
- Mean Indicated Pressure (MIP)
- Indicated Power (PI)
- Pressure at Fuel Ignition
- Angle at Fuel Ignition
- Compression Pressure
- Max. Combustion Pressure
- Angle at Max. Combustion Pressure
- Max. absolute Peak Pressure
- Angle at max. absolute Peak Pressure
- Angle where combustion ends
- Expansion Pressure
- $\text{Lambda} = p(\text{mxc}) / p(\text{cmp})$
- Combustion Pressure Rise
- Exhaust Gas Temperature
- Fuel Pump Index
- Ignition Delay = $a(\text{ign}) - a(\text{opn})$
- Injection Delay = $a(\text{opn}) - a(\text{pmp})$
- Angle where pump spill closes
- Angle where nozzle opens
- Angle where injection starts
- Fuel Injection Duration (length)



Visual - eye catching arrangement



Analysis Summary

Fuel pump timing to be checked

Analyst Comments

Compression pressure variation is acceptable.

Ignition timing needs improvement to bring the engine into balance.

Unit 8 does ignite very early. The pump spill closes about 0.5 deg early but ignition starts well over one deg early. This may be due to lower opening pressure of the fuel valve. This is also confirmed due to the latest closing time of fuel valve.

Unit 5 and 7 are about 0.5 deg to late which results in to high load on this two units. Especially on unit 5 this results in

Recommended Actions

Unit 8: Please check opening pressure of fuel valve (possible to low).

Fuel pump timing of unit number 5 and 7 should be brought forward by 0.5 deg.

Please take another measurement after above recommended actions.

Detailed - Complete reports with actions

The PREMETS® Cloud is the only available software on the market with:

- **Maximum combustion pressure**
Instead of maximum pressure at indicator valve the PREMETS® Cloud calculates the most probable value by FFT analysis for the highest accuracy.
- **Combustion pressure decomposition curve**
Identify combustion problems like insufficient injected fuel volume as well as the combustion length for each individual cylinder
- **Calculated point of ignition**
Easy improvement of the accuracy by adapting the coefficient of determination.
- Individual determination for **injection and combustion timing** on each cylinder like:
 - Angle **pump spill closes** including **ignition delay****
 - Angle **nozzle opening** including **injection delay****
 - **Point of ignition**
 - Point of **nozzle closing** including **length of injection****
 - **End of combustion** including **length of combustion**

* To take advantage of all parameters a PREMETS® from the third generation will be needed.

** (if optional AE sensor is used)

Ordering Information

DPA-CT-12025

PREMETS® Cloud Fleet Management Subscription

DPA-CT-12041

Evaluation Service per 3 records
(PREMETS® Cloud Subscription required)

DPA-CT-12040

Evaluation Service per vessel and year
(PREMETS® Cloud Subscription required)

PREMET® Online - 24/7

The PREMETS® Online 24/7 is the most advanced system for continuous diesel engine performance. It has been developed to be used for one Main Engine Only.

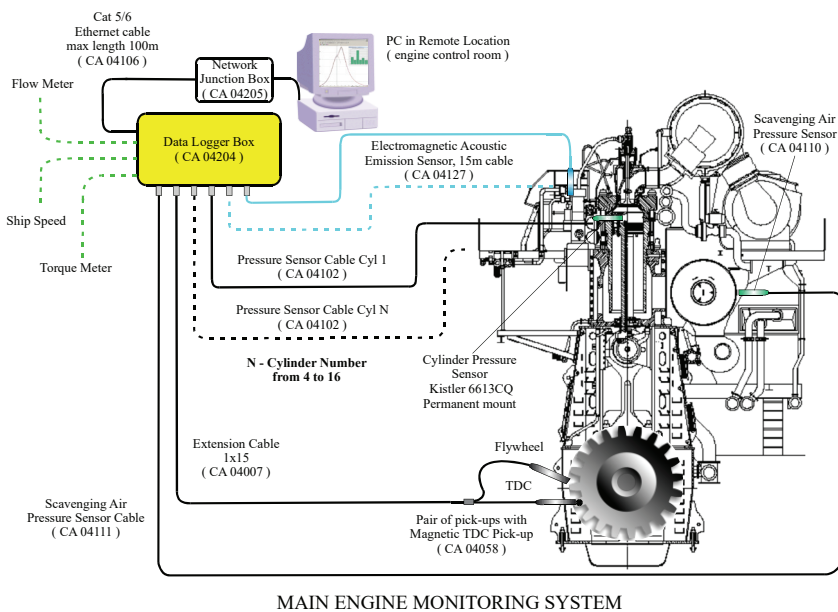
It can monitor up to 16 cylinders and log the data permanently. The Electronic Combustion Analyser is a comprehensive system for continuous engine performance measurement and monitoring which

will provide the key knowledge for obtaining optimum and reliable engine performance data. Using the combustion information you will have minimum engine wear, an optimum emission and fuel consumption.



Technical Data Sensor

Measuring Range:	A24 (0...200 bar), A14 (0...103 bar), A34 (0...300 bar)
Sensitivity:	A24 (50 μ A/bar), A14 (100 μ A/bar), A34 (33,3 μ A/bar)
Overload:	300 bar
Connector (IP67):	M12x1
Linearity at 23°C:	$< \pm 0,75$ %FSO
Mounting Torque:	15 N • m
Zero Point (no pressure):	10 mA
Signal Stroke FSO	10 mA
Operating temp. range, Sensor front:	-50...350 °C
Operating temp. at cable connect.:	-20...200 °C
Operating temp. Charge amplifier:	-10...85°C
Supply Voltage:	16...30 V DC
Weight:	150 g



MAIN ENGINE MONITORING SYSTEM



Your benefits:

- Longer lifetime of components
- Optimized maintenance planning
- Early fault detection
- Increased operational safety
- Lower fuel consumption
- Easy technical reporting

Your Features:

- Synchronous cylinder pressure measurement of up to 16 cylinders
- 3 x 4-20 mA Inputs
- 4 x Digital Outputs
- 2 x 62 Diagrams Buffer
- p(max) alarm record
- USB data transfer to PC

Ordering Information

Customized system
- Please contact our office to discuss details

Temperature and Pressure Calibrator

Pressure Pump



Calibration of measuring devices is very important to guarantee precise results even a long time after manufacturing. Most devices will suffer from degradation of accuracy over a longer period of time. CMT offers an inhouse calibration service or alternatively devices for the calibration of pressure and temperature measuring devices on board. They are available as standalone or in a combined kit.

The Temperature Calibrator is a true calibration with no simulation. It works with a dry heat block and no liquids are required for stable and accurate heat measurements. Therefore the stability of the Temperature Calibrator is as low as 0,1%. The range enables calibration of devices from 30°C - 650°C and is heated for measurements within 14 min.

Temperature Calibrator



Your benefits:

- Onboard recalibration of equipment
- More precision for measurements
- More efficiency with accordingly calibrated equipment.

Ordering Information

CBT-CT-00001

Temperature Calibrator TC65M

Range: 30 - 650 °C

CBT-CT-00002

Pressure Calibrator PM205

Range: (-)0,8 - 60 bar

CBT-CT-00003

Calibration Kit for TC/PM

CBT-CT-00005

Calibrators Temp./Pres. Combination

Combines all of the above incl. case

Diesel Performance Seminar

The challenge of upholding a maintenance regime on board ships is to protect the vessel against costly downtime and to operate it cost effectively. Engine maintenance can be planned, thus saving in parts and labour by changing engine parts based on need, not based on timing intervals.

Slow or late combustion is one of the most common problems in diesel engine operation. Balancing the cylinder load extends engine life, increases efficiency, and reduces emissions to assist with environmental compliance.



Training Topics :

- Introduction into Diesel Engine Performance Analysis
- Defining different pressures and angles, calculate indicated power
- Identification of problems by using the pressure / angle and pressure / volume diagram
- Cylinder load balance
- What influences the ignition time?
- Results of late ignition and how can it be identified?
- Slow or late combustion. Results and how can it be identified?
- Interpreting results and taking actions.
- Field experience

Target Group:

- Technical application engineers
- Technical crews from seagoing vessels
- Technical superintendents
- OEM and component producers

Improve the efficiency of your engine!

Specification:

- Participants: max. 12
- Location: Training Centre Elmshorn or on-site
- Duration: 1 day 9:00 – 17:00

Deliverables:

- Training held by industry professionals
- Modified training content on request
- Training documents (printed and on a USB Flash drive)
- Certificate of participation

The evolution of the PREMET® starting with the Steam Engine and James Watt

James Watt invents the **first steam indicator for measuring the varying pressure** within a steam engines cylinder.

1782

Hugo Maihak **improves Watt's engine indicator.**

1885

Foundation of the H. Maihak Aktiengesellschaft, which from then on produces the **Maihak indicators type 25 and 50.**

1910

The two engineers Lehmann and Michels of the H. Maihak Aktiengesellschaft found the Lehmann und Michels AG (LEMAG) who **further improve the indicator.**

1912

Relocation of the Lehmann and Michels AG from Hamburg to Meerane/Saxony due to the destruction of the companies building and foundation of the LEMAG Feinmesstechnik GmbH.

1942

Relocation back to Hamburg. **Ongoing production of the indicators type 25 and 50.**

1946

Foundation of the Metallwerker GmbH (later Baewert GmbH) by former employees at the old site in Meerane which from then on operates in competition for indicators.

The first electronic indicator with its own piezo-electric sensor is being sold under the brand name PREMET®.

1994

Development of an electronic indicator with piezo-electric sensor called HLV.

1996

Market introduction of the second generation with color display named PREMET® C.

2007

Take over of Baewert GmbH by the sensor manufacturer Kistler from Switzerland.

Insolvency of LEMAG. CMT takes over the PREMET® production and personnel.

2016

CMT takes over the HVL/PPG indicators of Kistler from Switzerland.

2018

Market introduction of the modern third generation of the PREMET® indicators as successors for the PREMET® C, HVL/PPG as well as the DieselSCOPE combining the advantages of their predecessors.



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