Performance and Efficiency Monitoring
Sea going vessels require large amounts of fuel to operate. Therefore diesel engine performance is paramount to a ship's 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.

### 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
Newly developed and part of CMTs modern range of Premet diesel performance analysers the PREMET® 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 PREMET® M helps balancing cylinder load, optimize 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.

Proper ignition timing reduces exhaust gas temperature and the rate of excess carbon build-up. Tuning the engine may reduce specific fuel oil consumption (SF0C). For each degree that the ignition is retarded SFOC increases by approximately 2%.

The PREMET® 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 PREMET® 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 PREMET® 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 with up to 20 cylinders per engine.

The angle precision of the PREMET® M is 0.17 deg. The max. cylinder pressure the sensor can be used with is 400 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

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Ignition pressure range</strong></td>
<td>0-350 bar</td>
</tr>
<tr>
<td><strong>Sensor</strong></td>
<td>Kistler 6013 CSF</td>
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<tr>
<td><strong>Speed range</strong></td>
<td>20-3000 rpm</td>
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<tr>
<td><strong>Max. number of engines</strong></td>
<td>18</td>
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<tr>
<td><strong>Max. number of cylinders over all engines</strong></td>
<td>125</td>
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<tr>
<td><strong>Max. temperature</strong></td>
<td>400 °C</td>
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<tr>
<td><strong>Compensation of torsional vibration</strong></td>
<td>P</td>
</tr>
<tr>
<td><strong>Compensation of pressure vibration</strong></td>
<td>P</td>
</tr>
<tr>
<td><strong>Display</strong></td>
<td>alphanumeric, size 75 x 25 mm, resolution 20 x 4 char</td>
</tr>
<tr>
<td><strong>Accuracy</strong></td>
<td>0.17% degree crank angle</td>
</tr>
</tbody>
</table>

### Ordering Information

- **PREMET® M Device**
  - KISTLER Piezo-SMART-Sensor
  - New Premium Analysis Software PREMET Viewer
- **PREMET® TDC pick up for 4-stroke engines**
- **PREMET® pair of Pick ups for 2-stroke engines**
- **PREMET® Fleet Management Software**
- **15m Premet pick up connection cable**
- **DPA evaluation service**
The PREMET® diesel indicators are known to be rugged and reliable. The newly developed PREMET® 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 PREMET® X is the perfect system to optimize your fuel injections to reduce fuel consumption but also to avoid repairs and damages as part of a condition monitoring regime. The PREMET® 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 300 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 PREMET® 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 two-stroke engines. Four-stroke engines can be measured with an extra TDC sensor with high accuracy. For even more accuracy a TDC sensor can be used with the PREMET® X.

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.

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:
- Revolutionary new sensor technology
- New analysis software

<table>
<thead>
<tr>
<th>Specification</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Ignition pressure range</td>
<td>0-350 bar</td>
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<tr>
<td>Sensor</td>
<td>Kistler 6019A 11S</td>
</tr>
<tr>
<td>Speed range</td>
<td>20-3000 rpm</td>
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<tr>
<td>Max. number of engines</td>
<td>Unlimited</td>
</tr>
<tr>
<td>Max. number of cylinders (per engine)</td>
<td>40</td>
</tr>
<tr>
<td>Max. temperature</td>
<td>400 °C</td>
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<tr>
<td>Compensation pressure</td>
<td></td>
</tr>
<tr>
<td>Compensation of torsional vibration</td>
<td>P</td>
</tr>
<tr>
<td>USB connection</td>
<td>P</td>
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<tr>
<td>WiFi connection</td>
<td>P</td>
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<tr>
<td>Display</td>
<td>color, size 160 x 90 mm, resolution 800 x 480</td>
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<tr>
<td>Accuracy</td>
<td>0.17% degree crank angle</td>
</tr>
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</table>

Ordering Information

DPA-CT-12020
PREMET® X Device
- 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-12024
PREMET® Fleet Management Software

DPA-CT-12025
PREMET® Fleet Management Cloud Subscription
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 100 MHz.

**Specifications**

<table>
<thead>
<tr>
<th>Specification</th>
<th>Details</th>
</tr>
</thead>
<tbody>
<tr>
<td>Frequency Range</td>
<td>200-700 kHz (Acoustic Emission)</td>
</tr>
<tr>
<td>Operating Temperature</td>
<td>130 °C</td>
</tr>
<tr>
<td>Power Supply</td>
<td>5.0 +/- 0.25 VDC</td>
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<tr>
<td>Output Signal</td>
<td>0.5-4.0 VDC</td>
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<tr>
<td>Attachment</td>
<td>Alnico Magnet, 5.2 kg pull force</td>
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<tr>
<td>Diameter</td>
<td>26 mm</td>
</tr>
<tr>
<td>Connector</td>
<td>Neutrik, NC4MP-BAG</td>
</tr>
</tbody>
</table>

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 PREMET® X, PREMET® Single Sensor and PREMET® 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

The Viewer helps to analyse the combustion process, store the measurements in data files, print diagrams or complete reports and sent data files by E-mail to the office.

The software facilitates the evaluation of the engine condition. A variety of diagrams, bar plots and tables present the measurements incl. manually entered data in an user-friendly way.

The software makes it easier to compare current with reference data and thus detect worn parts or incorrect adjustment.

It helps to reduce the engine’s operating costs. Cylinder-to-cylinder load balancing and correct fuel injection settings will optimise engine performance and minimize specific fuel oil consumption.
The PREMET® Online - Single Sensor has been developed to be used for one up to four engines, monitoring the cylinder pressure and fuel injection system.

Operating costs, especially labour and maintenance costs, can be minimized, engine downtimes get shortened. The intention is to optimise engine operations while saving time and investigations.

**Coloradoan connectors**
- No wiring
- Easy installation
- No grounding problems

**Powered by the PC**
- Isolated pressure measurement channel
- Eliminates 220/110 voltage problems
- Small metal junction boxes
- Easy trouble shooting
- Repairs by component exchange

**Handheld repeater unit**
- One-man operation
- Tune engine while measuring

**Your benefits:**
- Uses existing PC to measure engine performance
- USB CJB with lifetime guarantee
- Fast measurement (8 cylinders in 5 minutes)
- Real-time cylinder and fuel pressure measurements
- Small data files (31 KB for 7 cylinder engine)

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**Ordering Information**

Customized system
- Please contact our office to discuss details -
The PREMET® 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

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Specification</th>
</tr>
</thead>
<tbody>
<tr>
<td>Measuring Range</td>
<td>A24 (0...200 bar), A14 (0...103 bar), A34 (0...300 bar)</td>
</tr>
<tr>
<td>Sensitivity</td>
<td>A24 (50 µA/bar), A14 (100 µA/bar), A34 (33.3 µA/bar)</td>
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<tr>
<td>Overload</td>
<td>300 bar</td>
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<tr>
<td>Connector (IP67)</td>
<td>M12x1</td>
</tr>
<tr>
<td>Linearity at 23°C</td>
<td>&lt; ± 0.75 %FSO</td>
</tr>
<tr>
<td>Mounting Torque</td>
<td>15 N•m</td>
</tr>
<tr>
<td>Zero Point (no pressure)</td>
<td>10 mA</td>
</tr>
<tr>
<td>Signal Stroke FSO</td>
<td>10 mA</td>
</tr>
<tr>
<td>Operating temp. range, Sensor front</td>
<td>-50...350 °C</td>
</tr>
<tr>
<td>Operating temp. at cable connect.</td>
<td>-20...200 °C</td>
</tr>
<tr>
<td>Operating temp. Charge amplifier</td>
<td>-10...85°C</td>
</tr>
<tr>
<td>Supply Voltage</td>
<td>16...30 V DC</td>
</tr>
<tr>
<td>Weight</td>
<td>150 g</td>
</tr>
</tbody>
</table>

### Ordering Information

Customized system
- Please contact our office to discuss details

**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
Efficiency and Performance Monitoring

Recording the fuel performance is important to run a sea-going vessel efficiently. With the rising prices of fuel and the ecological awareness it gets more important to monitor the fuel consumption.

Especially large ships require large amounts of fuel and it is necessary to monitor the fuel consumption to guarantee an efficient performance as well as to obey the new EU guide lines for CO₂ reporting.

CMT offers an easy way to monitor the performance based on the actual use of fuel on given distances. The system can not only monitor the engine performance, but also the whole ships efficiency which includes propeller and hull.

Fuel Performance and CO₂ Reporting

One of the large and still growing emission sources is the greenhouse gas, produced by international shipping. Due to that matter the EU wants to reduce the CO₂ emissions from maritime transport of EU flag states. The level of 2005 should be lowered at least by 40% until 2050.

As a first step, large ships using EU ports will be required to report their verified annual emissions and other relevant information from January 2018.

CMT offers a new online monitoring system for fuel performance and CO₂ reporting. The system FPS 2.0 requires minimum maintenance and has the following concept:

- Simple standard PLC system with class type approval certificate
- Web based open configuration
- 2nd screen in ECR to display main values with status
- Data history on board & data export on shore

- Standard data interface (open structure) 4 – 20 mA, 0 – 10 V, pulse, NMEA, Modbus Slave
- Engine performance or report of all available data

The System has a web based visualization which enables access to measured data over every computer. Therefore your performance can be managed everywhere, no matter if it is the office, the bridge or the ECR.

For the CO₂ reporting it is furthermore required to determine the actual density of the bunkered fuel and the fuel in the individual tanks. The following methods are allowed:

- On-board measurement
- Fuel supplier
- Laboratory test

While the fuel supplier can only specify the density of the fuel delivered the fuel in tanks can only be measured onboard or in a lab.

CMT does provide a simple and cost effective method of measuring density on-board avoiding high laboratory costs. (See density section)

Ordering Information

FPS-CT-18002
Fuel Performance System FPS
FPS-CT-18003
FPS External Display
Size: 3,4 inch
FPS-CT-18004
Flow Meter for FPS
FPS-CT-18005
Power supply for FPS
Power: 24 V DC / 230 V AC
FPS-CT-18006
Analogue output modul
Output: 4 channels
Current: 4-20 mA
FPS-CT-18007
Interface modul
RS485, RS 422, RS 232 port
FPS-CT-18008
Digital input modul
Input: 8 channels
Power: 24 V DC 2,5 H
Shaft Power Meter

The CMT Shaft Power Meter is the cost effective solution when reliable shaft power measurement is required. It is a permanent monitoring system which continuously measures the shaft (effective) torque, power and RPM.

The Shaft Power Meter itself consists of two metal tapes with magnetic pattern, two sensors and a transmitter. A 4-20 mA signal, proportional to the shaft torque in % of the MCR value is averaged by a preset number of up to 255 consecutive revolutions.

The 4-20 mA torque output and the pulse RPM signal can be connected with any ship automation. Shaft power is calculated by torque and RPM. All data can be transferred to a PC via the USB connector.

The measured data is saved in a preset period.

The software displays trends of the saved data and the current and saved measurements on the main engine power / rpm diagram, as defined by the engine manufacturer.

The measured data can be exported in an Excel compatible CSV (Comma Separated Values) file for further calculations and analyses.

The system is easy to install and requires no electronic parts on the shaft. The system operates absolutely contact free.

The microprocessor based transmitter detects the shift of pulses of the second tape (the twist of the shaft), caused by the torque and calculates the actual torque reading.

Scope of delivery

- Plate for fixing the U profile
- U-profiled Bracket for Sensor holder (Depending on distance of ship frame to shaft surface)
- Sensor holder (U-profiled)
- 2 SPM Sensors
- Magnetic bands (length is depending on Shaft diameter)
- Rubber to cover the magnetic bands
- 2 converting boxes (130x110x80)
- Control cabinet (300x200x150)

Following prior questions need to be clarified prior final quoting:

- Shaft design / diameter / hollow shaft / (drawing to be provided)
- Material specification of the shaft
- Installation conditions (photos)
- Distance from ship frame installation point to shaft surface
- Free space for installation of sensor brackets contact less to shaft (min. 1,5 m)

Ordering Information

SPM-CT-18001
Shaft Power Meter System
Contact free method for permanent torque & power measurement
Shaft diameter: 200-1200 mm.
Speed: 0 - 800 rpm
Sensor: Contact-free

Electrical installation SPM

- Power supply at installation point converter box Shaft Power Meter 24 VDC
- Position control cabinet Shaft Power Meter (overview drawing requested)
- Power supply 110/240 VAC, 50-60 Hz, 2 A
- LAN connection
- Remote LCD display (separate power supply 24 VDC, 0,3A required)
- LCD display in control cabinet
- Length of cable converting box (analysis board) to control cabinet
- Length of cable control box to remote LCD display
Features

- PCL based system
- Contact Free Digital Sensors
- High Precision, time resolution of 100 nanoseconds
- RPM, Torque and Power signals stored on SD card
- Key component for fuel performance System
- No need to provide power to the components on the shaft
- No need to transfer any signals from rotating components
- Not Affected by Centrifugal Forces, temperature change, propeller thrust or shaft misalignment and stress
- No Mechanical Wear, No zero drifting over time;

Your benefits:

- Simple & Easy to Install, plug & play
- Cost effective
- No installation of electronic or electric components on shaft
- Easy to re-install after stern –tube inspections;
- Zero calibration procedure done by the push of a button
- Maintenance Free System
- Continuous Actual (effective) Power Output
- Real Time Measurements of any Diesel Engine
- Shaft Torque in % of the MCR value averaged by up to 255 consecutive revs.
- Gives feedback about engine balancing
- Expandable to fuel performance system

Transmitter Output Signals

<table>
<thead>
<tr>
<th>Output</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Output 1:</td>
<td>4 - 20 mA (Shaft rpm signal)</td>
</tr>
<tr>
<td>Output 2:</td>
<td>4 - 20 mA (Shaft power signal)</td>
</tr>
<tr>
<td>Output 3:</td>
<td>4 - 20 mA (torque signal)</td>
</tr>
<tr>
<td>Output 4:</td>
<td>4 - 20 mA (free configurable)</td>
</tr>
<tr>
<td>RPM at MCR:</td>
<td>0 - 800 RPM</td>
</tr>
<tr>
<td>Sensor Accuracy</td>
<td>+/- 0.1% torque</td>
</tr>
<tr>
<td>Operating temp.:</td>
<td>0...50°C</td>
</tr>
<tr>
<td>Power Supply:</td>
<td>24 V DC</td>
</tr>
</tbody>
</table>
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 engine's 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.

1994

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

1996

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

2007

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

2016

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

2018

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

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