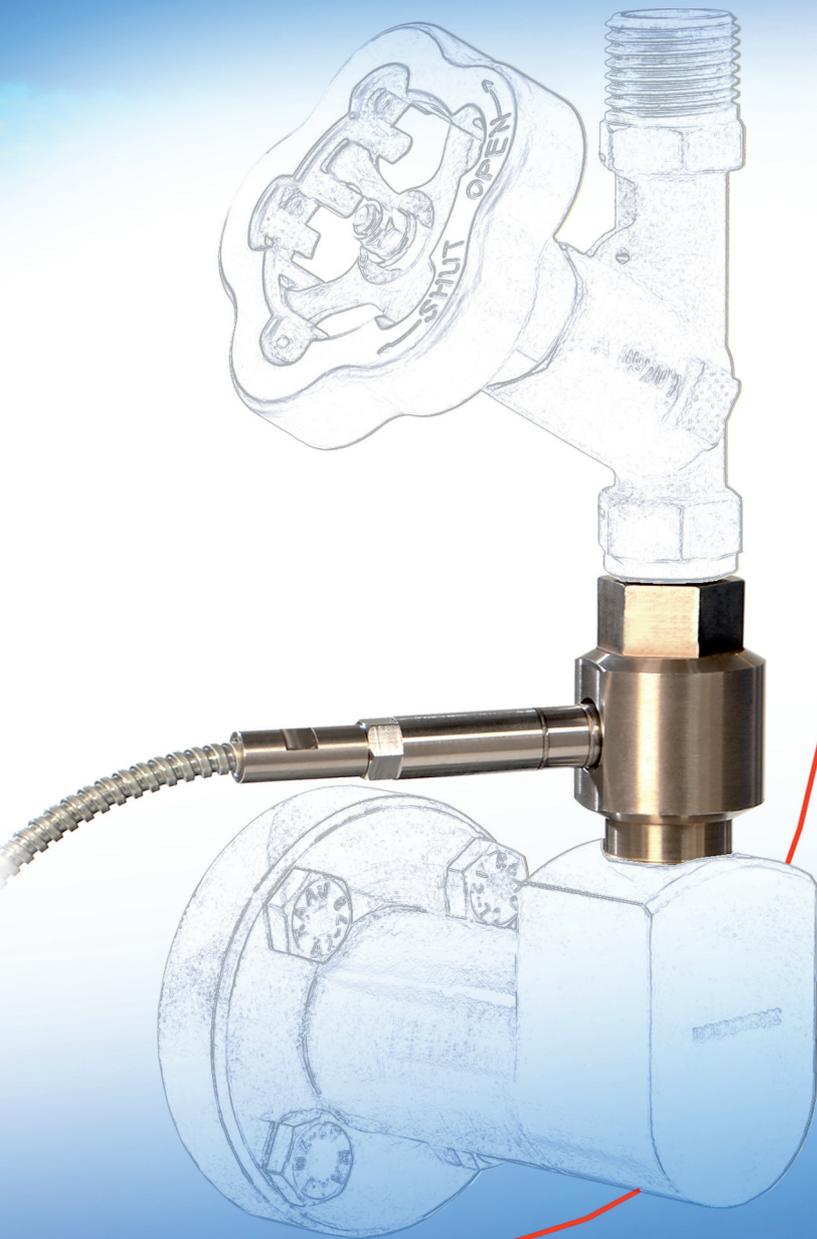




the cylinder pressure people

CCM Marine

Optimise your engine performance



www.imes.de

CCM Marine 2-stroke performance

CCM Marine 2-stroke performance has two hardware components, a multi channel data acquisition unit for 2 to 12 cylinders and the TCS-01CA sensors which have been designed for fixed and continuous operation on 2-stroke diesel engines. It is easy to use as an online solution for condition and performance monitoring. The combustion pressure is measured on each cylinder continuously and in all speed ranges.



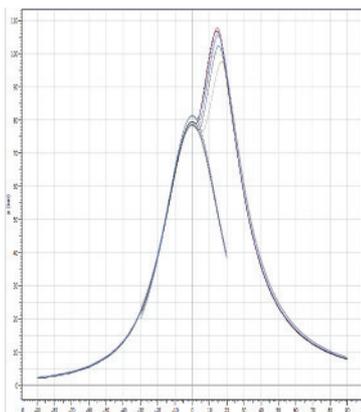
High precision cylinder pressure measurements

The robust type TCS-01CA sensor for continuous measurement of cylinder pressure on 2-stroke diesel engines offers outstanding longevity and constant sensitivity. Cylinder pressure measurements can be made with high precision because of its very good thermodynamic characteristics.



Combustion Control Module CCM

CCM is a smart combustion signal processing device for marine engines and stationary gas engines. The CCM function is to acquire and process in real time data from cylinder pressure sensors.



Advanced performance evaluation software

The CCM 2-stroke performance software allows an easy collection, management and comparison of engine performance data. It compares actual ISO corrected measurement with the reference data at any load point. Performance graphs and reports give a quick status of an engine and suggest actions to take for optimising engine condition. This enables extensive savings by reducing fuel and oil consumption as well as engine repairs caused by inadequately adjusted engines.

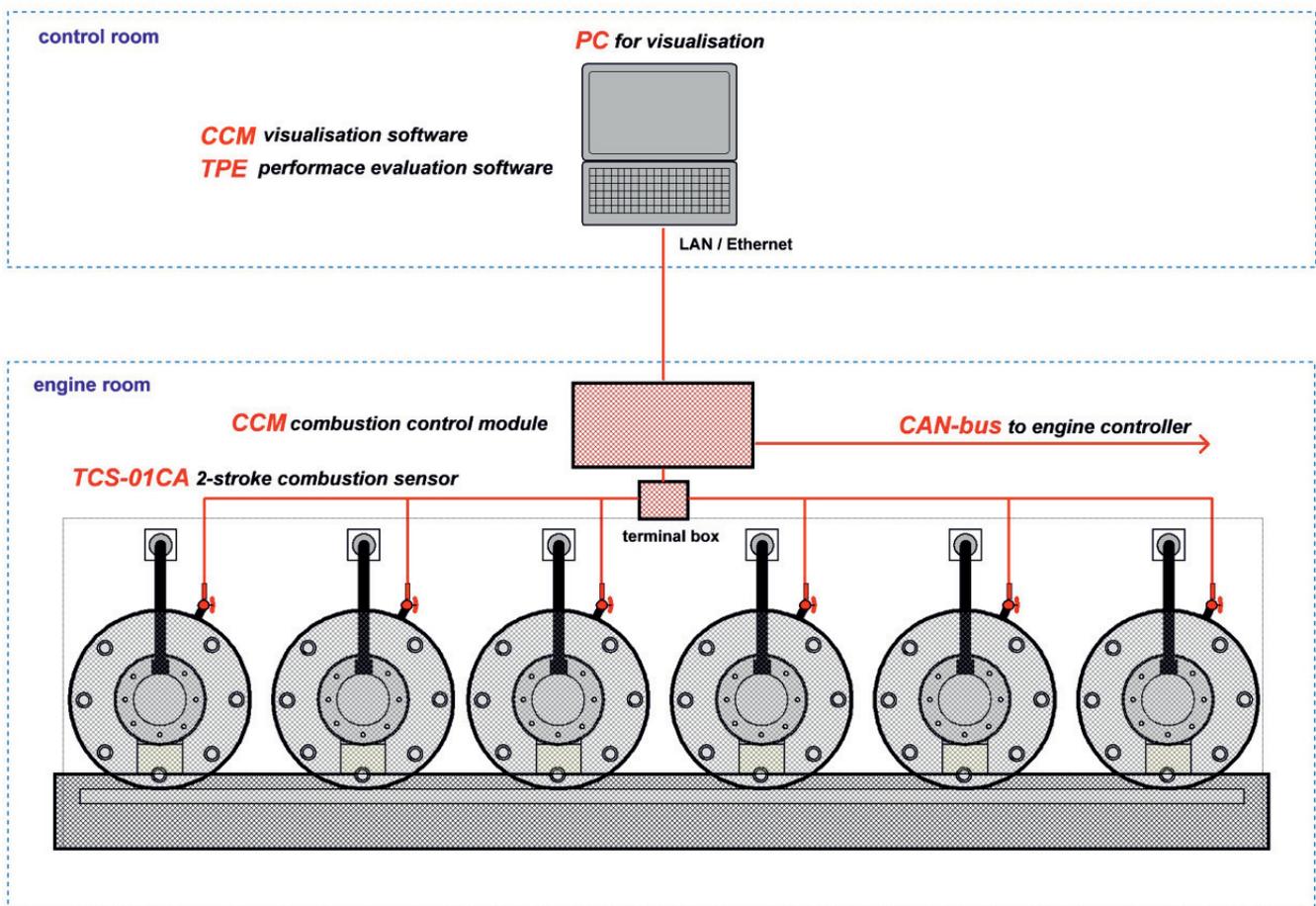
for fixed and continuous operation

CCM Marine 2-stroke performance is a system which includes permanent installed cylinder pressure sensors, a high speed data acquisition unit and an advanced visualisation- and performance evaluation software.

It is easy to install and the transmitted data can be evaluated directly via LAN / Ethernet to PC. This enables a quick overview about engine condition for an optimal engine adjustment.

Main components:

- two-stroke combustion sensor TCS-01CA
- combustion control module CCM
- data acquisition- and visualisation software
- performance evaluation software TPE

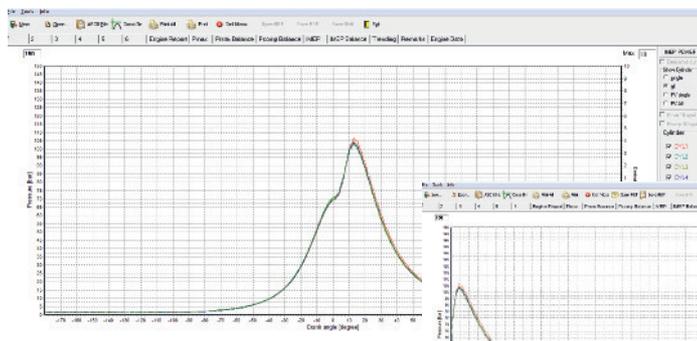


system overview

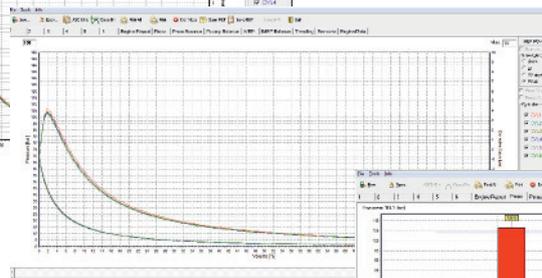
Advanced Visualisation Software and

The IMES data acquisition software is an advanced software that provides detailed and accurate information in a clear way. It is designed for use on 2-stroke engines with 4 to 12 cylinders and offers the possibility of selecting advanced monitoring functions in the following diagrams and reports:

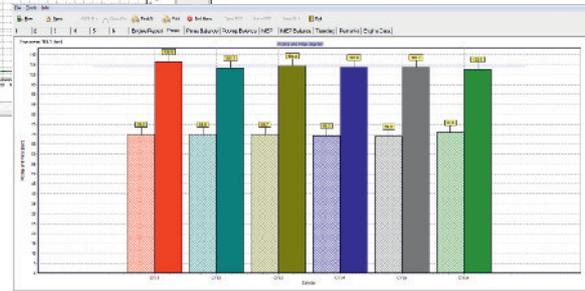
- Pressure curve diagram
- Pmax and Pcomp diagram
- Pressure-volume diagram
- Pmax balance
- Maximum pressure online
- Engine report



Pressure curve diagram



Pressure-volume diagram



Pmax and Pcomp diagram

The engine report shows the measurement results of each cylinder and the complete engine as an average value.

The stored data enable to adjust engine optimally. The cylinder conditions can be optimised and the engine can be easily balanced and tuned in order to improve the running performance. The result is minimising fuel consumption and environmental impact and a more durable engine.

	Pmax	Pmax pos.	Pcomp	dP/dCA	RPM	iPOWER	IMEP	EXH. GAS TEMP.
	[bar]	[deg]	[bar]	[bar/degree]	[1/min]	[kW]	[bar]	[°C]
Total iPOWER = 3344 [kW]								
Cyl. 1	109.2	13.2	73.7	5.1	113.0	636	13.8	350
Cyl. 2	108.5	13.0	73.5	4.8	112.0	654	14.3	351
Cyl. 3	104.9	12.8	74.6	4.2	112.0	646	14.2	358
Cyl. 4	108.4	13.1	74.1	4.5	112.1	685	15.0	355
Cyl. 5	107.8	12.4	73.0	4.7	112.9	672	14.6	360
Cyl. 6	104.7	12.5	73.9	4.1	112.0	651	14.3	353
Mean	107.2	12.8	73.8	4.6	112.3	657	14.4	354

Engine report

TPE Performance Evaluation Software

The measured data can be transmitted to the IMES TPE performance evaluation software. This software evaluates the current engine performance automatically by comparing the actual ISO corrected measurement with the reference data at any load point.

Most important potential savings:

- fuel
- wear and tear of engine and components
- lube oil
- simplified troubleshooting and maintenance

	ISO CORRECTED		MEASURED						
	REF.	CALC.	AVG.	CYL 1	CYL 2	CYL 3	CYL 4	CYL 5	CYL 6
Firing pressure barG	116,0	108,0	104,5	107,1	108,0	97,9	106,0	102,7	105,5
pmax deviation bar				2,6	3,5	-6,6	1,5	-1,8	1,0
Compression pressure barG	80,7	81,6	80,1	79,5	81,3	81,4	78,7	78,5	81,2
pcomp deviation bar				-0,6	1,2	1,3	-1,4	-1,5	1,1
Mean indicated pressure barG	12,11		11,92	11,64	11,53	12,18	12,33	11,69	12,13
MIP deviation bar				-0,28	-0,39	0,26	0,41	-0,23	0,21
Mean effective press. (MEP) bar	11,47		11,27						
Power indicated kW			SUM: 11039	1791	1798	1876	1898	1803	1873
pmax-pcomp pcomp / pscav	35,3 34,8		24,5 35,5						

Performance graphs and reports give a quick status of an engine.

Other indications		
Exh. gas temp. TC in 1	High	
Firing press. (pmax) CYL 1	Very low	See Firing pressure AVG
Firing press. (pmax) CYL 2	Low	See Firing pressure AVG
Firing press. (pmax) CYL 3	Very low	See Firing pressure AVG
Firing press. (pmax) CYL 4	Very low	See Firing pressure AVG
Firing press. (pmax) CYL 5	Very low	See Firing pressure AVG
Firing press. (pmax) CYL 6	Very low	See Firing pressure AVG
p_max deviation CYL 2	High	
p_max deviation CYL 3	Very low	Injection- or fuel pump valves worn. / Injection pumps and cams adjustment wrong.

Finally the evaluation gives an overview of the thermodynamic health of an engine. It calculates the optimisation potential and suggests actions to take to eliminate deviation.

Optimization potential		
Influenced by	Potential saving / reduction	
	Fuel	Thermal load
Injection timing	2,4 g/kWh	3 °C
Suction pressure		
Pressure drop across SAC		
Water temp. SAC in (for setpoint 29°C)		
Scav. air temp. SAC out		
Press. drop across ENGINE		
Exh. gas press. TC out		
Turbocharger efficiency	1,0 g/kWh	10 °C
Light running (sea margin)		
Fuel oil viscosity ENGINE in		
TOTAL	3,4 g/kWh	0,14 g/kWh
TOTAL (% of current)	1,8 %	
TOTAL (absolute / 1000 run. hrs.)	36 t	1,452 t

Consumption		
Indication	Measured / calculated values	
	Fuel oil	Cylinder lub oil
Specific consumption reference	167,4 g/kWh	1,73 g/kWh
Specific consumption ISO / current	179,4 g/kWh	1,87 g/kWh
Measured values (uncorrected):		
Consumption per hour day	2025 kg/h	48,6 t/d
Consumption nautical		19,9 kg/h

CCM Marine 4-stroke portable

CCM Marine 4-stroke portable is a multi cylinder combustion monitoring system for marine diesel engines. Recorded data can be used to diagnose malfunctions or to assist in the setting and optimising of engine operating parameters e.g. balancing cylinder.



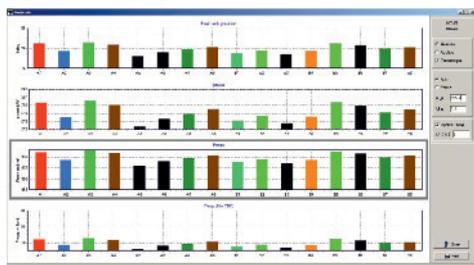
Cylinder pressure sensor HTT-04

The cylinder pressure sensor HTT-04 offers a digital electronic with event storing. It is designed for a minimum of 16,000 operating hours and enables the acquisition of highly accurate, processable data. Furthermore HTT-04 sensor received Marine Type Approval from all significant international classification societies.



CCM Marine portable box

CCM Marine is designed as a portable box a comprehensive, transportable system which can be rapidly installed on-site to enable acquisition of cylinder pressure data on engines in the field. Data can be recorded from up to 20 cylinders.

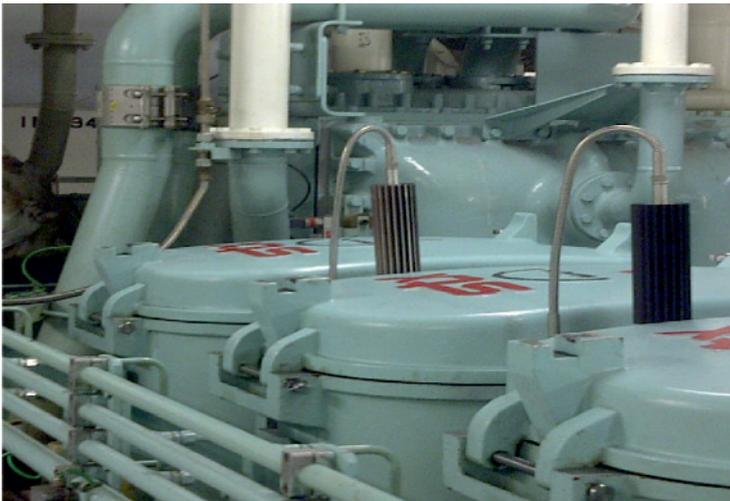


CCM Marine 4-stroke portable PC software

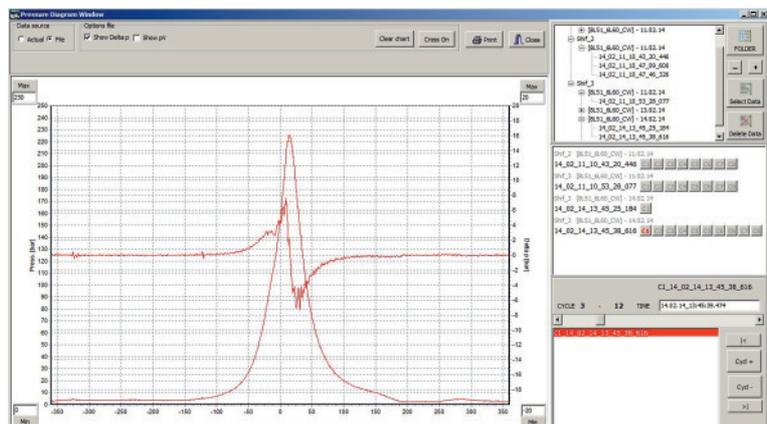
The CCM Marine PC software is a modernised version for online combustion monitoring on medium speed engines. Its visualisation software shows combustion pressure measurements for balancing cylinders.

Advanced engine balancing

The easy installation of CCM Marine 4-stroke portable enables a quick data acquisition. The visualisation data delivered can be used for much more than combustion monitoring. At the centre of the efforts is cylinder balancing – the equalisation of output across all cylinders of an engine.



HTT-04 sensors mounted on Thompson adaptors for continuous combustion monitoring on a 4-stroke diesel engine



The visualisation software allows analysis of the data from the measurements in detail.

Since unbalanced engines use more fuel than well balanced engines, the process has come into sharp focus at a time when shipowners are being squeezed by low freight rates and higher and higher fuel prices.

Well balanced engines minimise fuel consumption between 2% and 3%. As an additional benefit, emissions of the greenhouse gas carbon dioxide can be reduced by some 2%. The smoother engine running will decrease wear and tear in the engine. Optimised engines are complying with IMO TIER III limitations on NO_x and SO_x in Emission Control Areas from 2016 onwards.



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