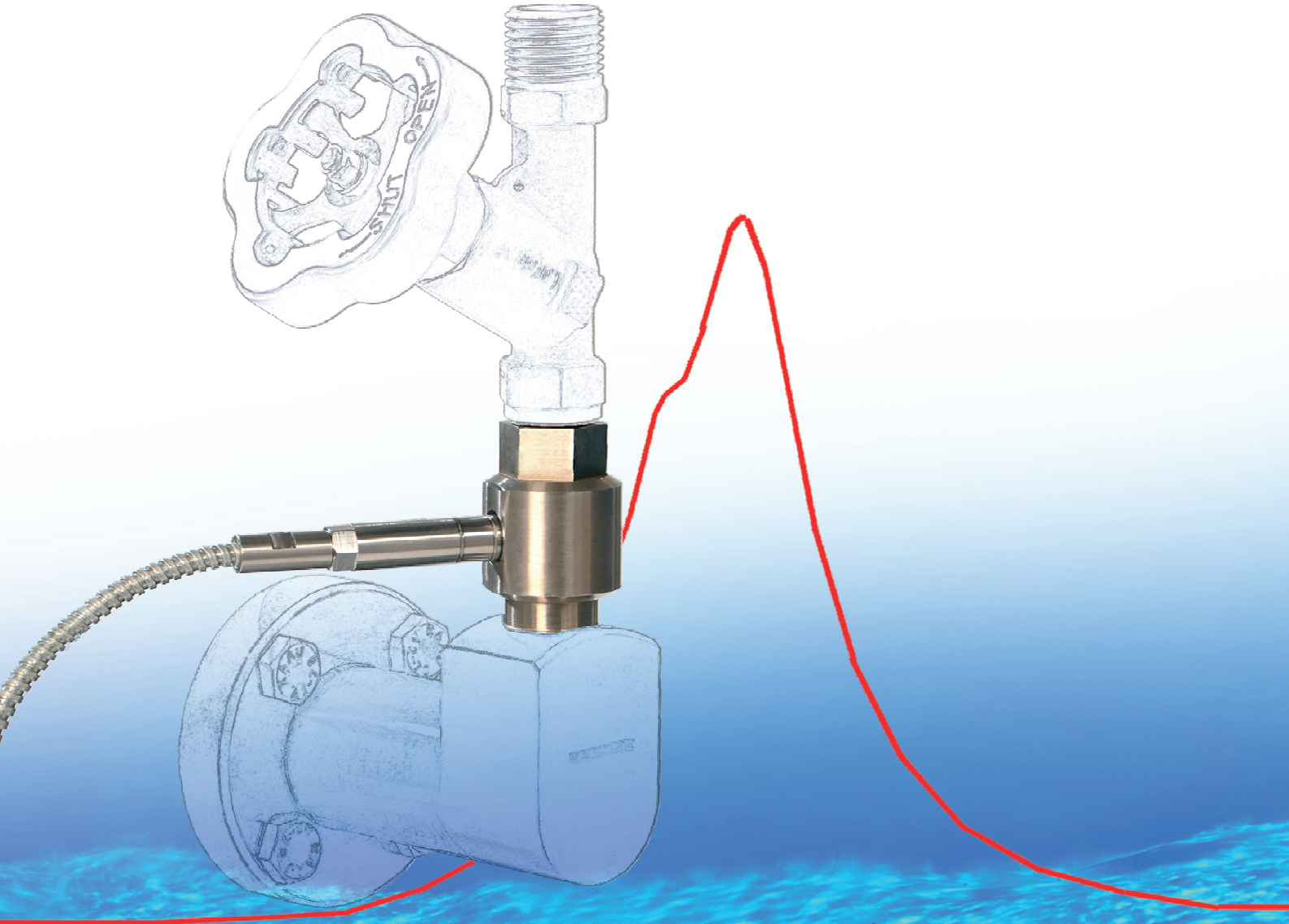
imes

the cylinder pressure people

CCM Marine

Optimise your engine performance



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CCM Marine - Combustion Monitoring Systems

CCM is an easy to use plug and play system, which enables in real time data acquisition of cylinder pressure on engines. Data can be recorded from up to 20 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.

CCM Marine is a modern system for advanced engine balancing on 2- and 4-stroke marine diesel engines. At the centre of the efforts is cylinder balancing – the equalisation of output across all cylinders. Well balanced engines minimise fuel consumption between 2% and 3%. The smoother engine running will decrease wear and tear in the engine.

As an additional benefit, emissions of the greenhouse gas carbon dioxide can be reduced by some 2% which is of high importance in times where environmental regulations are becoming increasingly stringent (e.g. IMO TIER III limitations in Emission Control Areas).

We offer fixed and portable CCM systems for diesel and gas engines.

Combustion control Module CCM

The main component of our CCM systems is the combustion control module. It is a smart combustion signal processing device for marine engines and stationary gas engines. Its function is to acquire and process in real time data from cylinder pressure sensors. Every combustion cycle will be evaluated on every cylinder for to calculate key parameters engine builders need to implement cylinder pressure based control on engines.
CCM is designed as a plug and play module, that means 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.

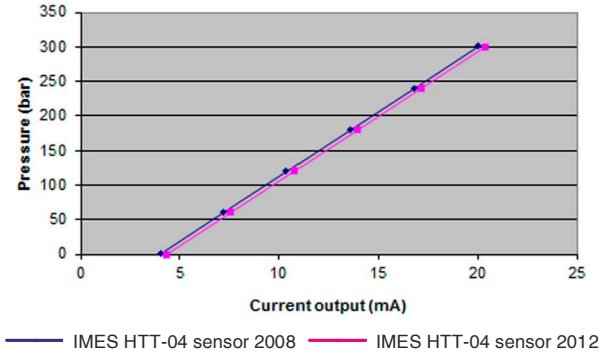
CCM combustion control module- the heart of our CCM systems

for continuous and periodic operation

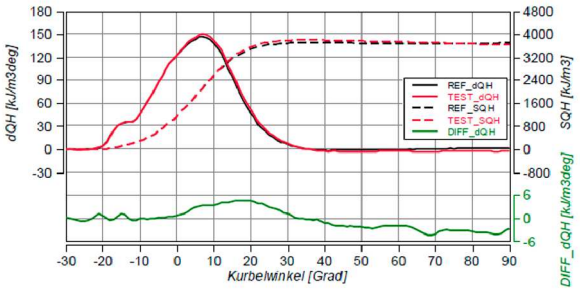
High precision cylinder pressure sensors

Our various types of cylinder pressure sensors are suitable for installation on 2- and 4-stroke engines and mesh with our CCM systems. Depending on engine type we offer sensors with various thread (M8 x 0,75, M10 x 1, M14 x 1,25), various sleeve and cable length and different measuring cells.

They all 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.



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



Thermodynamic comparison of IMES sensor CPS-01 to watercooled piezo electric sensor.

Marine Type Approvals

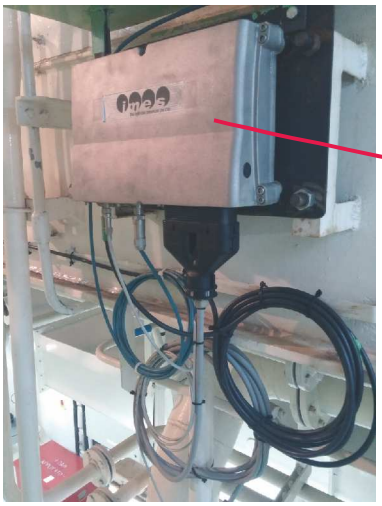
Large engine manufacturers are required to fulfil numerous international safety standards. Marine Type Approval is therefore a mandatory requirement for voyage and safety critical devices installed on any ship.
Our sensor types have received Marine Type Approval from all significant international classification societies, such as Bureau Veritas, DNV GL, ABS, Lloyd's Register, Class NK or China Classification Society.
For our combustion control module CCM, Marine Type Approval from Bureau Veritas and Class Nk are in preparation. Other approvals will follow shortly.

CCM Marine Performance

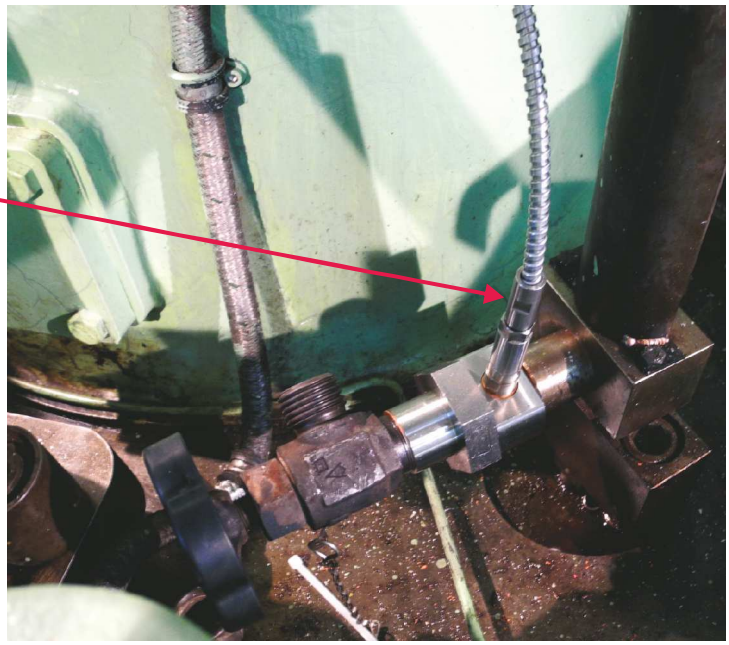
CCM Marine Performance designed for fixed and continuous operation is a system which includes a high speed data acquisition unit (CCM) for up to 12 cylinders, permanently installed cylinder pressure sensors and an advanced visualisation- and performance software .

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. It is also possible to transmit the data via satellite to the server of the engine operator. This allows engine control from land and the active regulation of emission as well as cost optimisation.



CCM Marine performance installed on container ship Hedda Schulte



Installation of two-stroke combustion sensor TCS-01CA including adaptor on a Wärtsilä 6 RTFlex84 engine

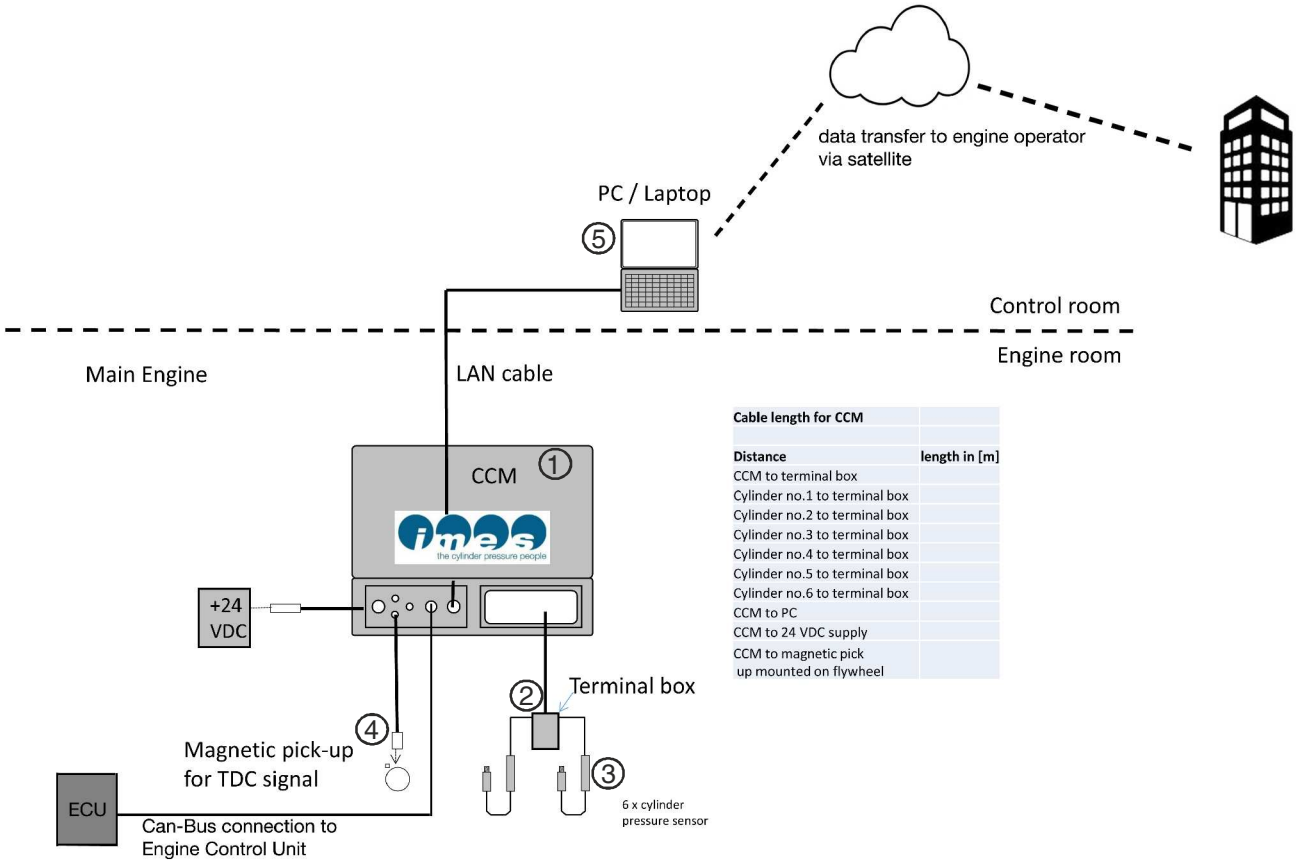
Technical data:

CCM Combustion Control Module	
Multichannel data acquisition unit	Max. 12 analog inputs Resolution: 0.1° CA Interface: Can-Bus, Ethernet Power supply: 24 VDC

Cylinder pressure sensors	
Measuring range pressure	0...300 bar
Over pressure	400 bar, 1200 bar, 1500 bar
Thermal shock 1500 RPM pmi=9bar	<+/- 0.5 bar
Accuracy	≤ 1% Full scale

for fixed and continuous operation

CCM Marine Performance 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.



Cable length for CCM	
Distance	**length in [m]**
CCM to terminal box	
Cylinder no.1 to terminal box	
Cylinder no.2 to terminal box	
Cylinder no.3 to terminal box	
Cylinder no.4 to terminal box	
Cylinder no.5 to terminal box	
Cylinder no.6 to terminal box	
CCM to PC	
CCM to 24 VDC supply	
CCM to magnetic pick up mounted on flywheel	

System overview - example for connection to 6 cylinders

Main components:

① Combustion Control Module CCM - high speed data acquisition unit

② Terminal box with10 or 12 connectors for IMES pressure sensors

③ IMES high precision cylinder pressure sensors - various types for 2- and 4-stroke engines available

④ Magnetic pick-up for TDC signal

⑤ PC / Laptop with installed data acquisition- and visualisation software and performance evaluation software

CCM Marine portable

CCM Marine Portable for periodic operation is a multi cylinder combustion monitoring system for 2- and 4-stroke marine diesel engines. It 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.

The easy installation of CCM Marine Portable enables a quick data acquisition. The recorded data can be transferred via Ethernet to a PC where the data acquisition and visualisation software can be used to diagnose malfunctions or to assist in the setting and optimising of engine operating parameters. At the centre of efforts is cylinder balancing - the equalisation of output across all cylinders of an engine.

HTT-04 sensors mounted on special Thompson adaptors for continuous combustion monitoring on a MAN L48/60B 4-stroke diesel engine. The adaptors have cooling fins to keep the operation temperature for continuous operation of the HTT-04 sensors below 300°C.

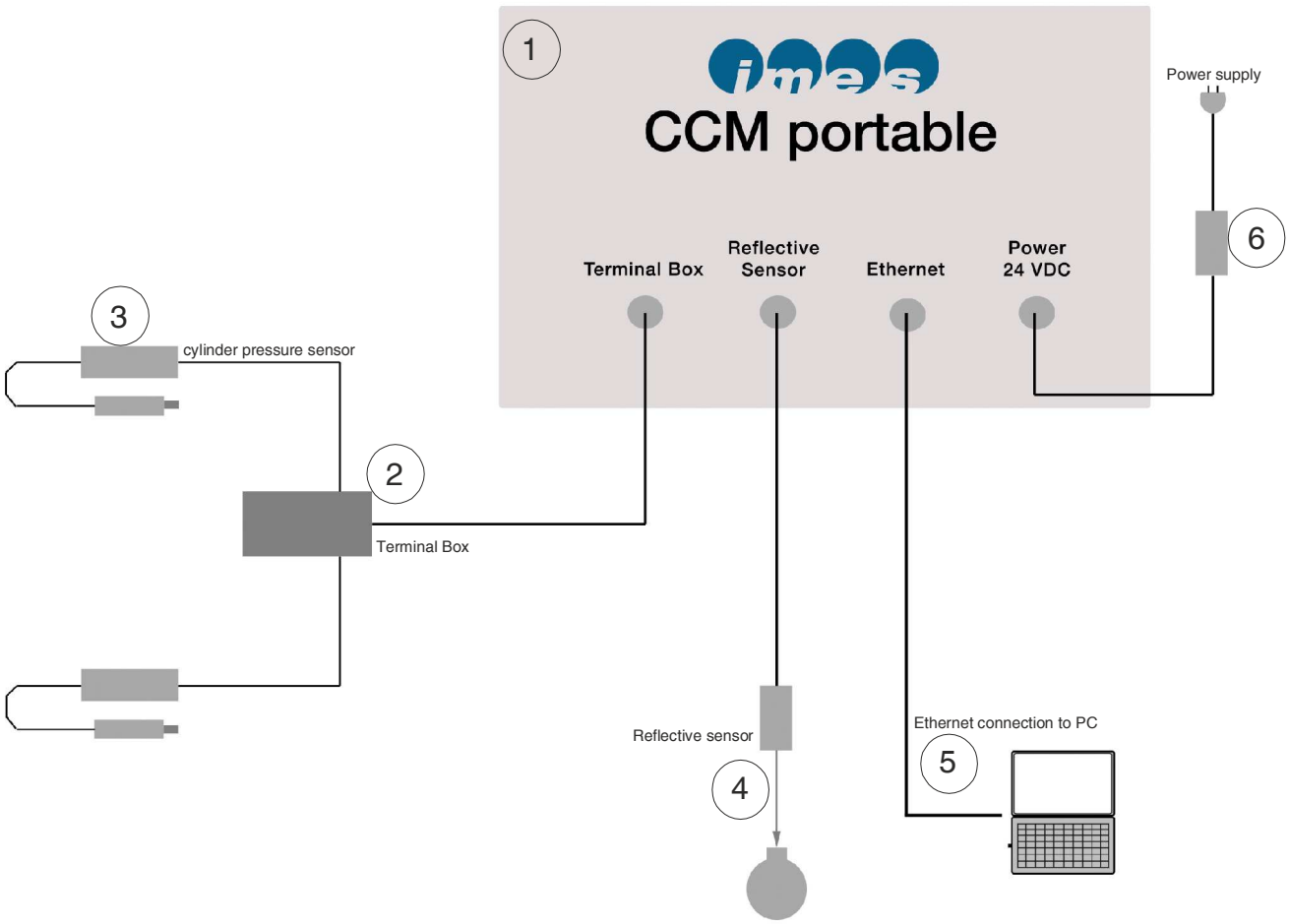
Technical data:

CCM Combustion control unit
Max. 12 analog inputs (option: extension to 24 analog inputs)
Sampling resolution: 0,1°CA
Interface: Fast Ethernet LAN 100 Mbits/s
Wide range power supply 90...264VAC
Optical Pickup for TDC position

Cylinder pressure sensors	
Measuring range pressure	0...300 bar
Over pressure	400 bar, 1200 bar, 1500 bar
Thermal shock 1500 RPM pmi=9bar	<+/- 0.5 bar
Accuracy	≤ 1% Full scale

for advanced engine balancing

The easy installation of CCM Marine portable enables periodic simultaneous balancing of all of an engine's cylinders in the field.



System overview - example for connection for up to 12 cylinders

Main components and technical data:

① CCM Marine portable box

② Terminal box with 10 or 12 connectors for IMES pressure sensors, option: extension to 24 analog inputs

③ IMES cylinder pressure sensor: various types for 2- and 4-stroke engines available

④ Reflective sensor: Pick-up sensor providing a position signal from crankshaft or camshaft

⑤ PC / Laptop with installed CCM Visualisation software connected via 100Mbit/s industrial Ethernet calbe

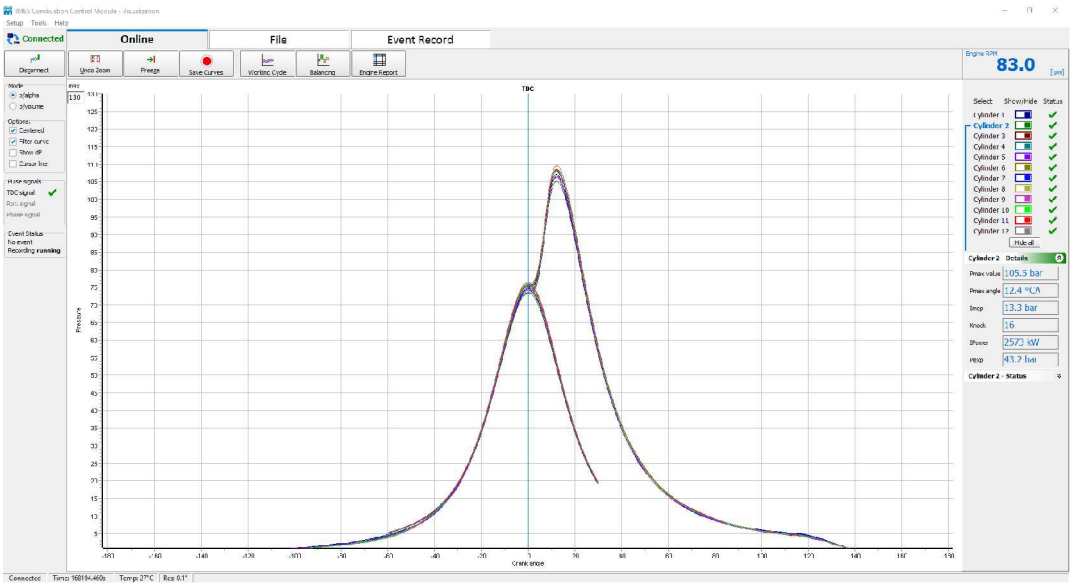
⑥ Wide range power supply : 90...264 VAC

Advanced visualisation software

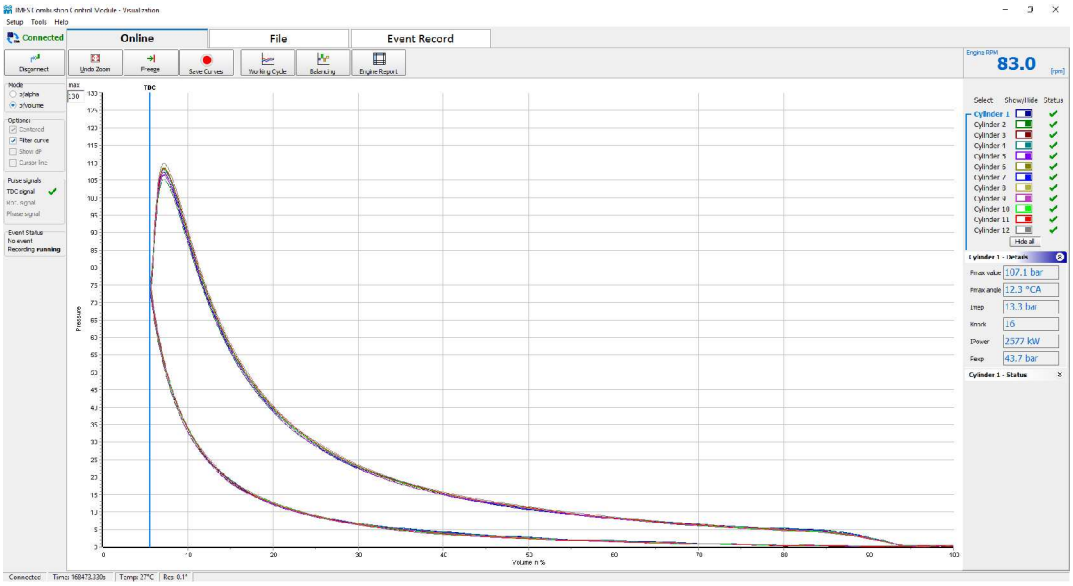
The CCM Marine PC software is a modernised version for online combustion monitoring on marine diesel engines. The recorded data can be used to diagnose malfunctions or to assist in the setting and optimising of engine operating parameters.
It offers the possibility of selecting advanced monitoring functions in the following diagrams and reports: ***Pressure curve diagram, Pmax and Pcomp diagram, Pmax balance, Pressure volume diagram, Engine report***

Event Record

CCM Marine offers an event storing, this means that a large memory buffer records combustion data and pressure curves from the latest 40 cycles on 4-stroke engines or rather the latest 80 cycles on 2-stroke engines. This function allows to analyse the data before, during and after a failure. This enables the engine operator to determine the cause of failure and to find possibilities how to prevent it in the future.



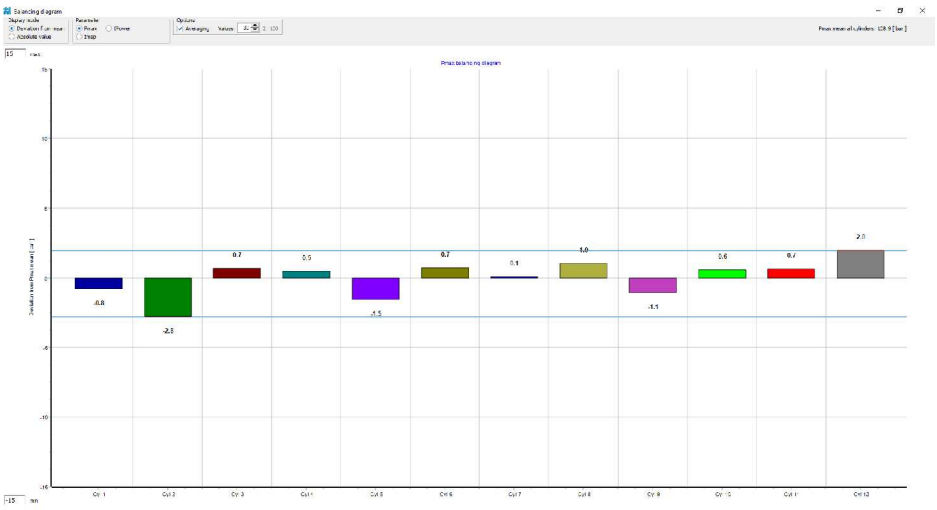
Pressure curve diagram



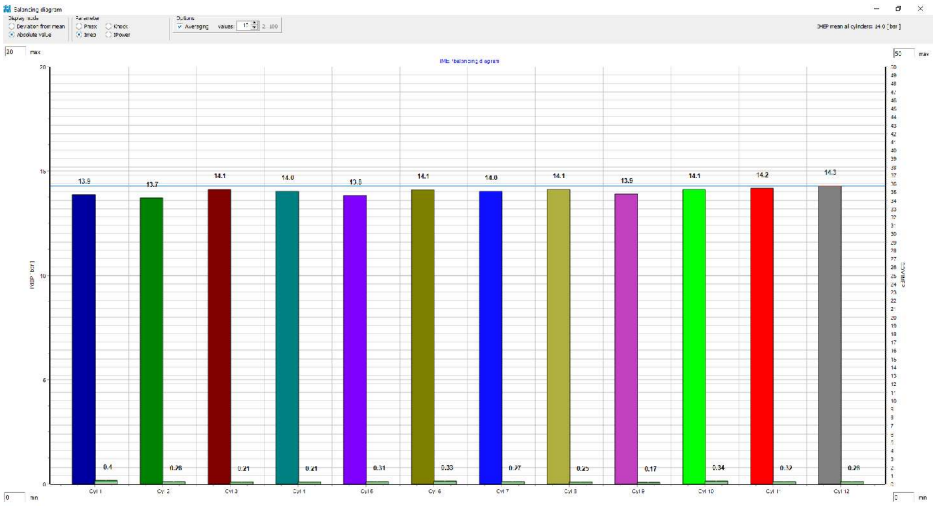
Pressure volume diagram

for an optimal engine adjustment

The visualisation data delivered can be used for much more than combustion monitoring, the main focus is periodic simultaneous balancing of all of an engine's cylinders. 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.



Pmax balancing diagram



IMEP with balancing diagram with COV

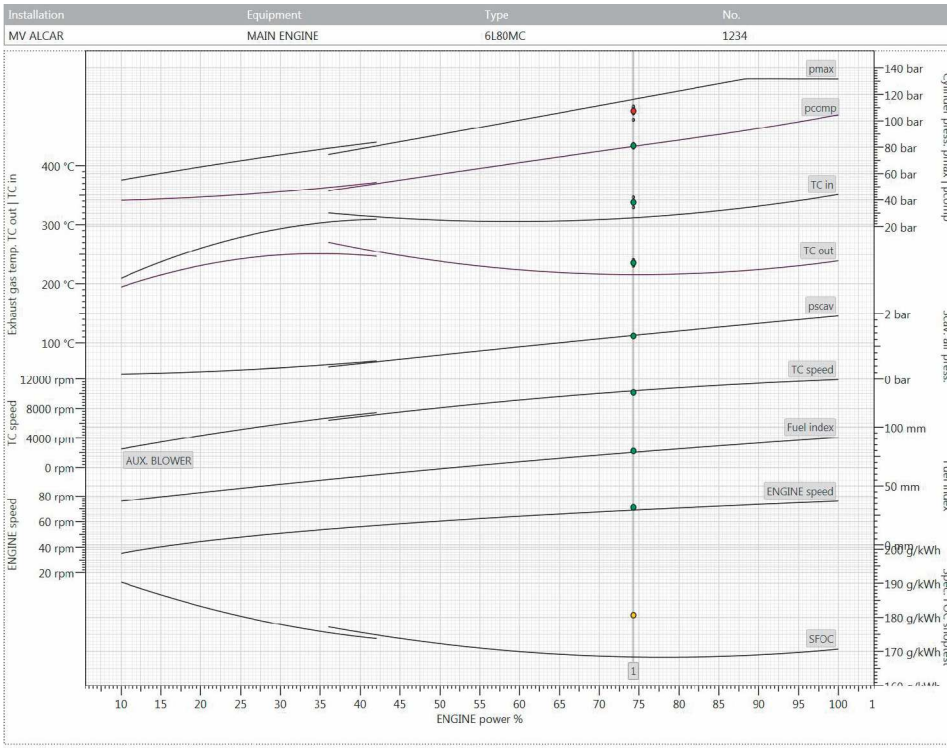
Main benefit

The stored data enable to adjust engine optimally. An engine report shows the measurement results of each cylinder and the complete engine as an average.
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.

- less fuel consumption up to 3 %
- reduction of maintenance and service costs
- less costs for engine repair
- improved emissions, reduction of CO_2 and No_x
- engine control by the engine operator from land

IPE Performance Evaluation Software

The measured data can be transmitted to the IMES Performance Evaluation software (IPE). In addition to IMES data acquisition software it offers advanced functions to facilitate the collection, evaluation, management and comparison of engine performance data for marine diesel engines.The software evaluates the current engine performance automatically by comparing the actual ISO corrected measurement with the reference data at any load point. Due to this the user receives a quick and reliable overview on many operational aspects.



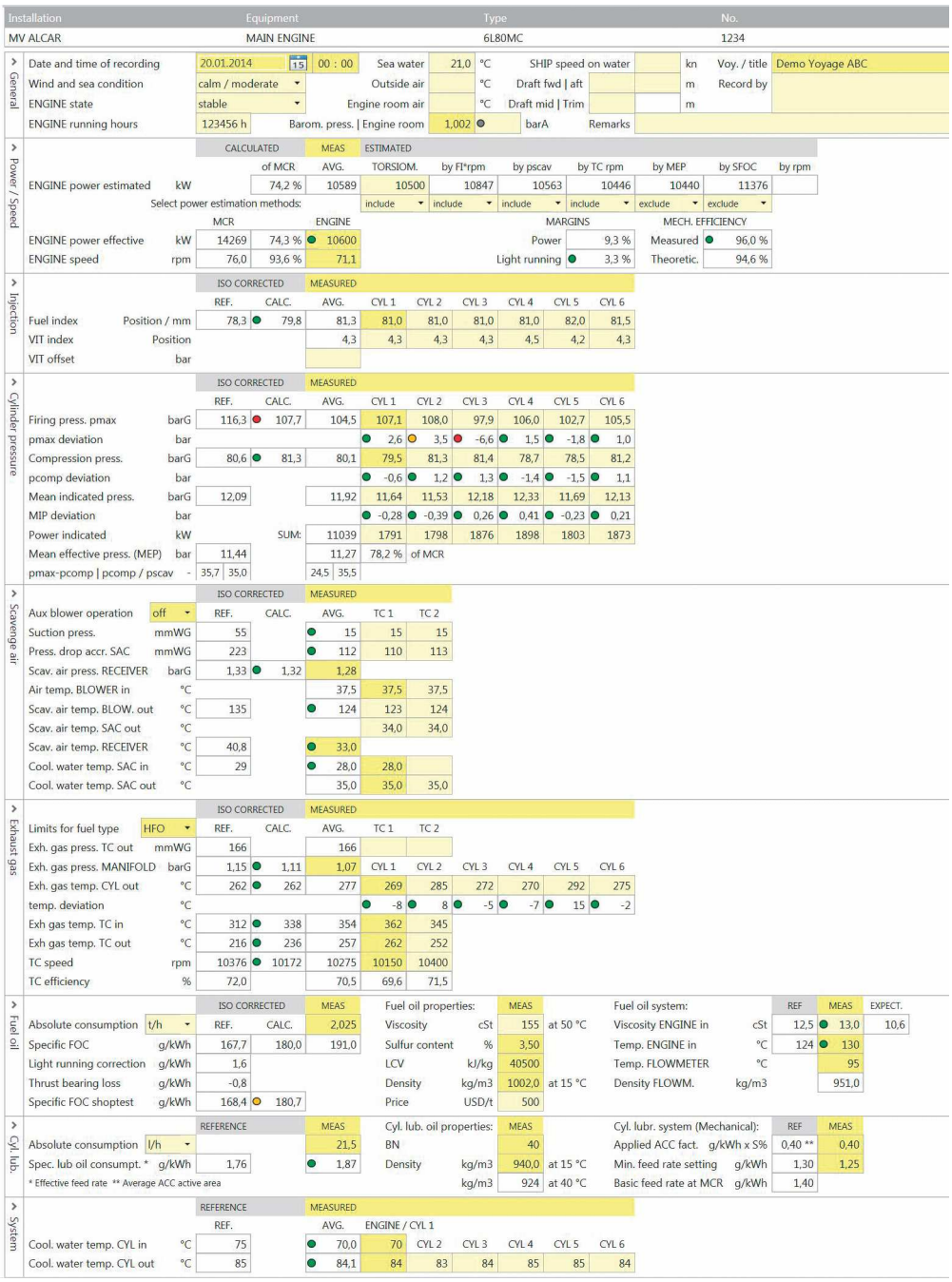
Performance graph showing deviation of engine performance compared to engine characteristic curve

Main features

- ISO correction
- automatic evaluation of current engine performance data
- easy collection, management and comparison of engine performance data
- performance graphs and reports show deviation and suggest actions to take
- clearly illustrated commercial calculations that allow to save money by reducing fuel and oil consumption
- automatic data transfer from CCM to IPE
- pressure curve analysis software module full integrated

for a comprehensive analysis of engine performance data

The chief engineer only needs to fill in the requested information so the programme can do ISO correction 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 condition. This enables extensive savings by reducing fuel and oil consumption as well as engine repairs caused by inadequately adjusted engines.



Installation	Equipment	Type	No.
MV ALCAR	MAIN ENGINE	6L80MC	1234

General

Date and time of recording	20.01.2014 15	00 : 00	Sea water	21,0 °C	SHIP speed on water		kn	Voy. / title	Demo Voyage ABC
Wind and sea condition	calm / moderate		Outside air	°C	Draft fwd | aft		m	Record by	
ENGINE state	stable		Engine room air	°C	Draft mid | Trim		m		
ENGINE running hours	123456 h		Barom. press. | Engine room	1,002 barA	Remarks			

Power / Speed

		CALCULATED		MEAS	ESTIMATED					
		of MCR	AVG.	TORSIOM.	by FI*rpm	by pscav	by TC rpm	by MEP	by SFOC	by rpm
ENGINE power estimated	kW	74,2 %	10589	10500	10847	10563	10446	10440	11376	
Select power estimation methods:				include	include	include	include	exclude	exclude	

		MCR		ENGINE	MARGINS		MECH. EFFICIENCY	
ENGINE power effective	kW	14269	74,3 %	10600	Power	9,3 %	Measured	96,0 %
ENGINE speed	rpm	76,0	93,6 %	71,1	Light running	3,3 %	Theoretic.	94,6 %

Injection

		ISO CORRECTED		MEASURED						
		REF.	CALC.	AVG.	CYL 1	CYL 2	CYL 3	CYL 4	CYL 5	CYL 6
Fuel index	Position / mm	78,3	79,8	81,3	81,0	81,0	81,0	81,0	82,0	81,5
VIT index	Position			4,3	4,3	4,3	4,3	4,5	4,2	4,3
VIT offset	bar									

Cylinder pressure

		ISO CORRECTED		MEASURED						
		REF.	CALC.	AVG.	CYL 1	CYL 2	CYL 3	CYL 4	CYL 5	CYL 6
Firing press. pmax	barG	116,3	107,7	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 press.	barG	80,6	81,3	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 press.	barG	12,09		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
Power indicated	kW		SUM:	11039	1791	1798	1876	1898	1803	1873
Mean effective press. (MEP)	bar	11,44		11,27	78,2 %	of MCR				
pmax-pcomp | pcomp / pscav	-	35,7 | 35,0		24,5 | 35,5					

Scavenge air

			ISO CORRECTED		MEASURED		
			REF.	CALC.	AVG.	TC 1	TC 2
Aux blower operation		off					
Suction press.	mmWG		55		15	15	15
Press. drop accr. SAC	mmWG		223		112	110	113
Scav. air press. RECEIVER	barG		1,33	1,32	1,28		
Air temp. BLOWER in	°C				37,5	37,5	37,5
Scav. air temp. BLOW. out	°C		135		124	123	124
Scav. air temp. SAC out	°C					34,0	34,0
Scav. air temp. RECEIVER	°C		40,8		33,0		
Cool. water temp. SAC in	°C		29		28,0	28,0	
Cool. water temp. SAC out	°C				35,0	35,0	35,0

Exhaust gas

			ISO CORRECTED		MEASURED						
			REF.	CALC.	AVG.	TC 1	TC 2				
Limits for fuel type		HFO									
Exh. gas press. TC out	mmWG		166		166						
Exh. gas press. MANIFOLD	barG		1,15	1,11	1,07	CYL 1	CYL 2	CYL 3	CYL 4	CYL 5	CYL 6
Exh. gas temp. CYL out	°C		262	262	277	269	285	272	270	292	275
temp. deviation	°C					-8	8	-5	-7	15	-2
Exh gas temp. TC in	°C		312	338	354	362	345				
Exh gas temp. TC out	°C		216	236	257	262	252				
TC speed	rpm		10376	10172	10275	10150	10400				
TC efficiency	%		72,0		70,5	69,6	71,5				

Fuel oil

			ISO CORRECTED		MEAS	Fuel oil properties:		MEAS		Fuel oil system:		REF	MEAS	EXPECT.
			REF.	CALC.										
Absolute consumption		t/h			2,025	Viscosity	cSt	155	at 50 °C	Viscosity ENGINE in	cSt	12,5	13,0	10,6
Specific FOC	g/kWh		167,7	180,0	191,0	Sulfur content	%	3,50		Temp. ENGINE in	°C	124	130	
Light running correction	g/kWh		1,6			LCV	kJ/kg	40500		Temp. FLOWMETER	°C		95	
Thrust bearing loss	g/kWh		-0,8			Density	kg/m3	1002,0	at 15 °C	Density FLOWM.	kg/m3		951,0	
Specific FOC shoptest	g/kWh		168,4	180,7		Price	USD/t	500						

Cyl. lub.

			REFERENCE	MEAS	Cyl. lub. oil properties:		MEAS		Cyl. lubr. system (Mechanical):		REF	MEAS
Absolute consumption		l/h		21,5	BN		40		Applied ACC fact.	g/kWh x S%	0,40 **	0,40
Spec. lub oil consumpt. *	g/kWh		1,76	1,87	Density	kg/m3	940,0	at 15 °C	Min. feed rate setting	g/kWh	1,30	1,25
* Effective feed rate ** Average ACC active area						kg/m3	924	at 40 °C	Basic feed rate at MCR	g/kWh	1,40	

System

		REFERENCE	MEASURED						
		REF.	AVG.	ENGINE / CYL 1					
Cool. water temp. CYL in	°C	75	70,0	70	CYL 2	CYL 3	CYL 4	CYL 5	CYL 6
Cool. water temp. CYL out	°C	85	84,1	84	83	84	85	85	84

Engine report showing calculated actual values compared to reference data

the cylinder pressure people

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Professional support worldwide due to our global sales organisation.

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imes GmbH
Email: sales@imes.de
Phone: +49 8341 9661730
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