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HYUNDAI HiMSEN

HD HYUNDAI HEAVY INDUSTRIES

HD HYUNDAI ENGINE & MACHINERY

PROGRAMME 2024

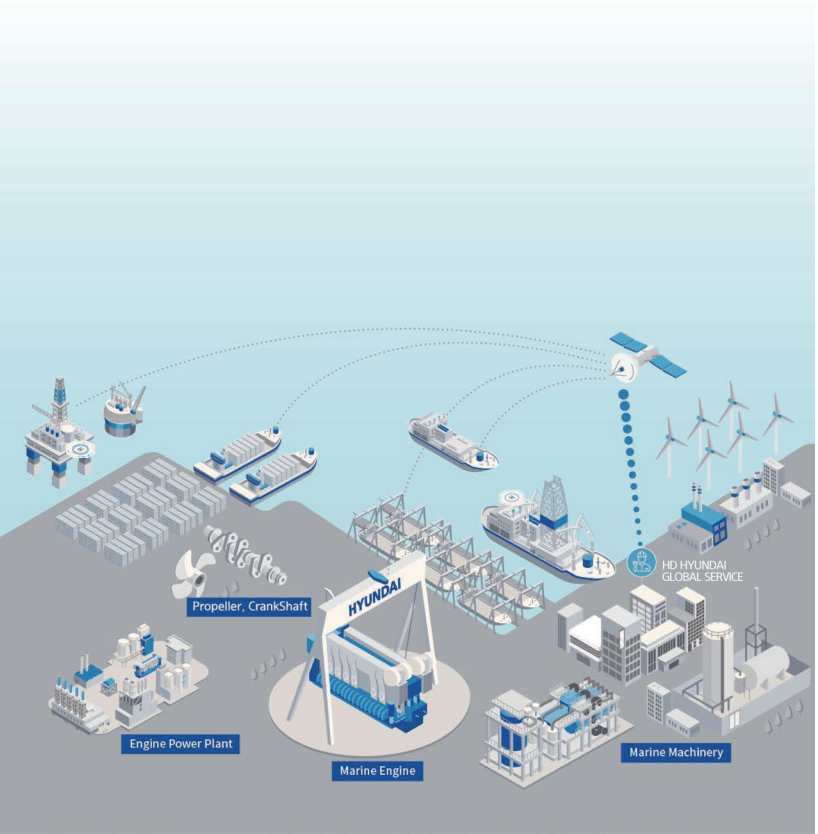
Hi-OPTIMIZED POWER SOLUTIONS

Hi-touch Marine & Stationary Engine

HD HYUNDAI HEAVY INDUSTRIES

HYUNDAI HiMSEN

MEMO


HD HYUNDAI
GLOBAL SERVICE
HYUNDAI
Propeller, CrankShaft
Engine Power Plant
Marine Engine
Marine Machinery

HD HYUNDAI HEAVY INDUSTRIES ENGINE & MACHINERY LANDSCAPE

HD Hyundai Heavy Industries(HHI) has been remarkably succeeded in shipbuilding since company's inception in 1972. As one of the leading engine builders in the world, Engine & Machinery has enjoyed its reputation since its beginning in 1978. HHI-EMD has taken up 35% of the world's market share in 2-stroke engines covering marine and stationary purposes. HHI-EMD has also developed its own engine brand HiMSEN, which is specially designed as a part of the ongoing efforts to provide the most practical and highest quality engines to our customers.

Proven Technology

Approval from major Classification societies

Global NO.1

2-stroke & 4-stroke engine Manufacturer

Total Solution

Engine & Marine machinery Total Solution

Lifecycle Service

Global service support

ENGINE & MACHINERY

Marine Propulsion System

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HiMSEN propulsion system Sales	1000, Bangeojinsunhwan-doro, Dong-gu, Ulsan, Korea (Zip code : 44032)	Tel. : +82-52-202-7683 e-mail : K2Z0group@hd.com

Marine Engine & Eco-Machinery

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Power Plant

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Customer Service

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Hyundai Global Service Co. Ltd	Centum Science Park 6F 79, Centum jungang-ro, Haeundae-gu, Busan, Korea (Zip code : 48058)	Tel. : +82-52-204-7760/7887(for Warranty Service) Tel. : +82-52-204-7718/7742(for Parts Sales) e-mail : service@hd.com / sales@hd.com

Marine Engine & Machinery

HD Hyundai Heavy Industries

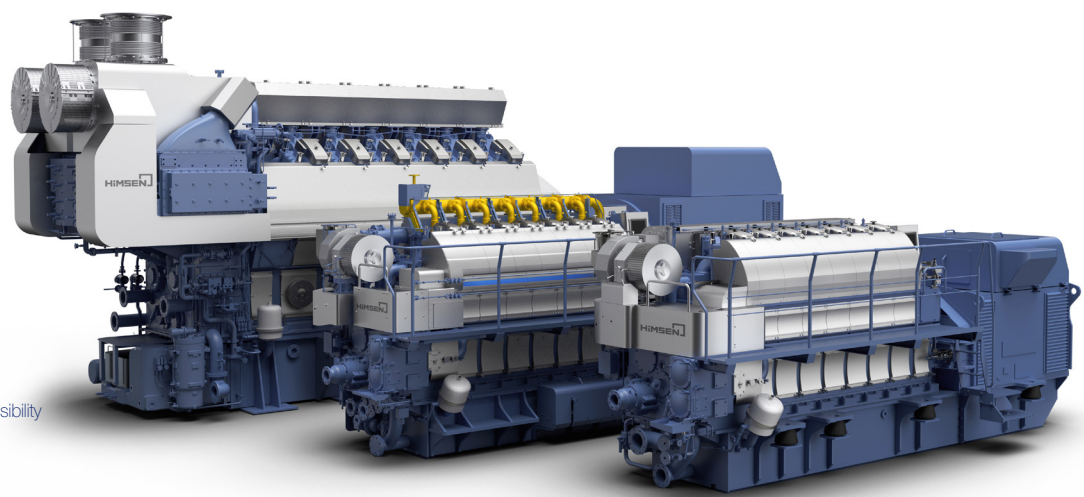
Design Philosophy
HD Hyundai's HiMSEN Family have simple and smart design suitable for marine & stationary applications with high reliability and performance.
The key features are:

Heavy Fuel Engine with same fuel of main engine (Uni-Fuel concept).
Hence, the viscosity of the diesel fuel and heavy fuel is acceptable up to 700 cSt at 50 °C.

Economical and Ecological Engine with low fuel consumption, NOx emission, and Smoke, etc., which is based on the below specific designs;
- Optimized high efficiency turbocharging with Miller Cycle
- High Fuel Injection Pressure
- Variable valve and injection timing

Reliable and Practical Engine with simple, smart and robust structure.
- Number of engine components are minimized with Pipe-Free design
- Most of the components are directly accessible for easier maintenance
- 'Individual Part' maintenance concept is provided
- Feed system is fully modularized with direct accessibility

The development of a pure LNG gas engine and dual fuel engine has been completed, organizing line up of cutting-edge engines that consider the environment.
The LNG DF engine is increasing its market share to 60% with its outstanding perfection.
In addition, by establishing a hybrid propulsion system, we are contributing to the environment as minimizing fuel consumption and emissions with high efficiency.



Earth-Friendly Engine

Main Features

Performance characteristics
- High output in the similar range engines
- Low fuel oil consumption
- Quick acceleration & load response

Maintenance
- Easier maintenance by modularized design
- Minimal number and kind of components

Earth-friendly engine
- Low NOx emissions
- Compliance with IMO NOx Tier II, Tier III
- Low vibration & noise

Jack-up Platform/Drilling Rig

FPSO

Drillship

Major Application

Marine
- Propulsion system
- Generating sets

Offshore
- Drill ship
- FPSO

Energy Solution
- Gas & Dual fuel power plant
- Diesel power plant
- Modular power plant & PPS
- EDG & BSDG
- EDG for Nuclear power plant
- CHP & Hybrid

Emergency GenSets for
Nuclear Power Plant

Power Plant

Car Ferry & Passenger Vessel

Container ship

HiMSEN ENGINE

Introduction

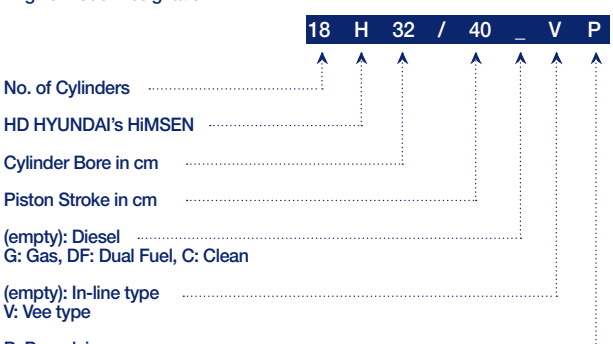
General

This programme provides necessary information and recommendations for the application of HD HYUNDAI's HiMSEN engines.

'HiMSEN'® is the registered brand name of HD HYUNDAI's own design engine and the abbreviation of 'Hi-touch Marine & Stationary ENgine'.

Please note that all data and information prepared in this programme are for guidance only and subject to change without notice. Therefore, please contact HD Hyundai Heavy Industries before actual applications of the data.
HD Hyundai Heavy Industries will always provide the data for the installation of specific project.

Engine Model Designation



Engine Operation

Reference Condition

General definition of engine rating is specified in accordance with ISO 3046/1:2002, ISO 15550:2002.
However the engine outputs are available within tropical conditions without derating.

Tropical Conditions

- Turbocharger inlet air pressure: 1 bar
- Intake air temperature: 318 K (45 °C)
- L.T cooling water temperature: 309 K (36 °C)

Specific Fuel Oil Consumption (SFOC) & Heat Rate

The stated consumption figures refer to the following ISO reference conditions:
- Turbocharger inlet air pressure: 1 bar
- Intake air temperature: 298 K (25 °C)
- L.T cooling water temperature: 298 K (25 °C)
- Lower calorific value of fuel 42,700 kJ/kg
- Without engine driven pumps
- Tolerance +5 %

Specific Lube Oil Consumption (SLOC)

The stated consumption is given with a tolerance of +25 % depending on the operating conditions.

HiMSEN ENGINE

Engine Operation

Engine Power

The engine brake power is stated in kW. For conversion between kW and metric horsepower, please note that 1 bhp = 75 kg·m/s = 0.7355 kW.
Ratings are given according to ISO 3046/1:2002, ISO 15550:2002.

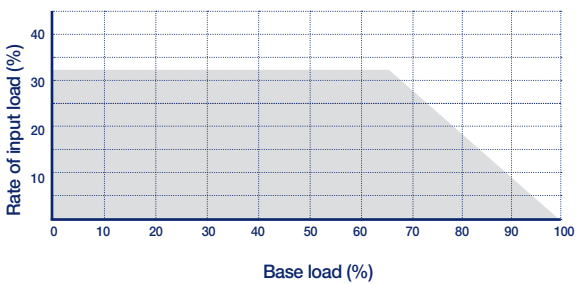
In case of HR (Higher Rating) version, overload is not permissible except for 10 % overload during official factory test.

Power Management of Gensets

When making power management system of multi-Gensets for marine application, a proper load balance is to be considered by shipyard.

In case of a failure of one engine, its output has to be made up for by the remaining engines or by reducing/switching off electric consumers.

In this case, an overload of remaining engine is not allowed, and the electric power scheme of the ship can be derived from the following load characteristics.



Continuous Load-Up

The quickest way to load-up from 0 % to 100 % load can be achieved by increasing the load continuously and gradually.

Step by Step Load-Up

Considering the time required for stabilizing the frequency deviation due to sudden load-up, it is recommended to load up from idle to full load by more than three steps according to IACS (especially for Gensets of 720rpm or 900rpm due to higher BMEP of over 24 bar).

HiMSEN Gensets except gas mode of DF and gas engine fulfill the requirements of classification societies concerning the frequency deviation and recovery time when loading up by 3 steps from 0 % to 100 %.

HiMSEN Gensets gas engine fulfill the requirements, considering the time and safety required for stabilizing the frequency due to sudden load up,
it is recommended to load up from idle to full load by more five steps.

HYUNDAI HiMSEN

Engine Operation

Information for Fuel oil control by EU Directive 2005-33-EC and California Code of Regulations

All HiMSEN engines are suitable and developed for continuous operation on HFO as well as MDO/MGO. There is no lower limit for the sulfur content of fuel oil. In connection with the low viscosity of MGO, (Marine Gas Oil, DMA as defined in ISO 8217) the viscosity at engine inlet should be kept within the value of 2 ~ 14 cSt in order to avoid possible wear or sticking of fuel injection pump due to low lubricity and in order to maintain the suitable hydrodynamic film between fuel injection pump plunger and barrel.

- Recommended stable viscosity at engine inlet: Min. 3 cSt
- Recommended minimum viscosity at engine inlet: 2 cSt

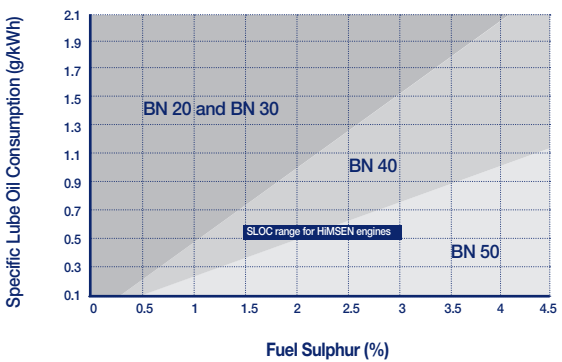
So, a proper cooling device (DO cooler or chiller etc.) is to be considered, if needed, to keep the above mentioned viscosity (2 ~ 14 cSt) at engine inlet.

When the MGO is to be used only for temporary engine operation (e.g. in port), higher BN lube oil used for residual fuel (HFO) should not present any problems in case of short periods of running.
When engine is not operated continuously with low sulfur fuel such as MGO, lube oil should be chosen according to the highest sulfur contents of the fuel with normal operation.

Guideline for Lube Oil

Base Number (BN) must be carefully selected depending on fuel grade and sulfur contents.
The followings are guidance values for initial filling.

Typical recommended BN depending on the fuel sulfur contents and SLOC (g/kWh)



Reference: CIMAC recommendation number 29/2008 'Guidelines for the lubrication of medium speed diesel engine'

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HiMSEN ENGINE

Engine Operation

IMO NOx EMISSION AND HiMSEN ENGINES

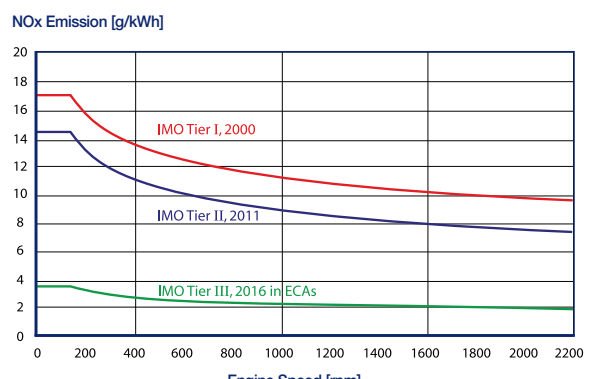
Annex VI of the MARPOL 73/78 convention entered into force 12 May 2005. All HiMSEN engines included in this booklet comply with the NOx Limits specified in the IMO regulation.

The exhaust emission regulations in Annex VI were referred to as IMO Tier I, MARPOL Annex VI regulations were amended at the MEPC (Marine Environment Protection Committee) in October 2008. These specify further NOx emission limits to be known as IMO Tier II and Tier III.

IMO Tier II regulations were entered into force on 1 January 2011 based on keel laying, according to a speed dependent function, with reduction of about 20 % in comparison with IMO Tier I (refer to chart).

Under IMO Tier III, the NOx emission limits for marine engines become effective on 1 January 2016 based on keel laying, according to a speed dependent function, with reduction of 80 % in comparison with IMO Tier I when the ship is operated in a designated Emission Control Areas (so called ECAs).

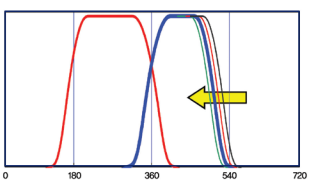
All types of HiMSEN engine are complied with the new upcoming NOx emission regulations, and do its best to satisfy further request if any from customers.



HD HYUNDAI ENVIRONMENTAL TECHNOLOGIES against IMO Tier II, Tier III

HD HYUNDAI is introducing technologies to meet IMO Tier II, Tier III regulation with internal engine measures only such as:

- Miller valve timing requiring increased charge air pressure by applying the high pressure ratio turbocharger
- Optimised combustion by applying the combustion control technologies with optimising the piston bowl shape and the fuel injection valve nozzle etc.

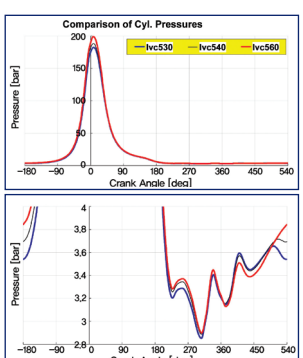


Various Intake Valve Closing Timing for 1-D Cycle Simulation

Miller valve timing

This technology is very useful to reduce the NOx emission by optimising the intake valve's closing timing especially, result in changing the effective compression and expansion ratio.

In order to apply this technology, the high pressure ratio turbocharger is required to increase the charge air pressure and new developed T/C with high pressure ratio is mounted on HiMSEN engine.



Combustion pressure depending on IVC timing from 1-D Cycle Simulation

HiMSEN ENGINE

Two Stage Turbo-Charger(TSTC)

TSTC with intercooler provides high charge air pressure and high turbocharging efficiency.
The availability on the high charge air pressure allows extreme Miller valve timing that increase engine thermal efficiency(SFOC) at same NOx emission level.

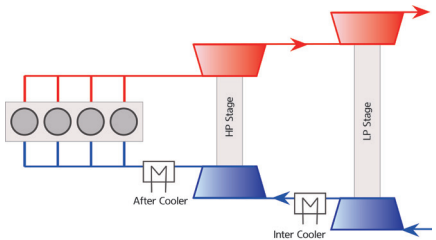
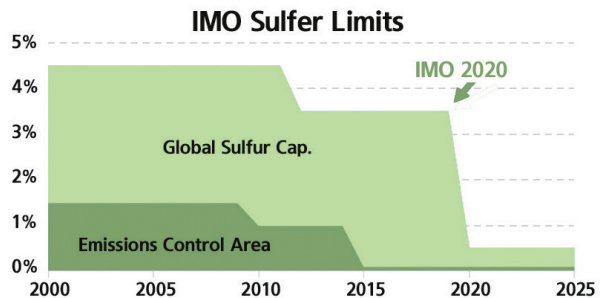


Figure 1 Schematic Diagram of Two Stage Turbocharger

IMO 2020 Ready

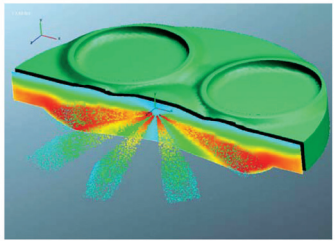
International Marine Organization (IMO) implements the worldwide sulphur regulations on January 1, 2020.



Engine Operation

Optimized combustion

The NOx emission can be reduced by the combustion control technologies with the optimum combination of the piston bowl shape and the fuel injection valve nozzle etc.
The piston bowl shape and the fuel injection valve nozzle's specification are optimized to meet the IMO Tier II, Tier III regulation, which are evaluated by 3-D combustion analysis and verified by the measurement at HiMSEN Techno Center.

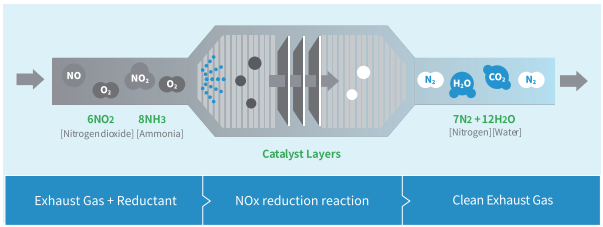


3-D Combustion Analysis

HD HYUNDAI ENVIRONMENTAL TECHNOLOGIES against IMO Tier III

As one of solutions, NoNOx™ SCR (Selective Catalytic Reduction) system

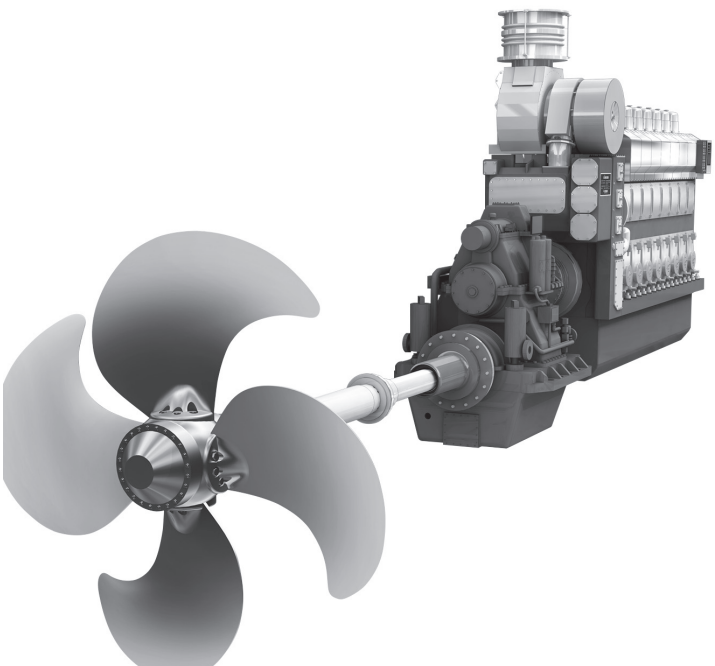
HD HYUNDAI can offer NoNOx™ SCR technology that can reduce NOx emissions by 95 %, designed for Tier III limits. HD HYUNDAI is optimizing the whole installation, performance and engine in order to achieve low cost of production and give benefits to the customers.



HYUNDAI HiMSEN

HiMSEN...

The best solution for all types of marine vessels and offshore applications with proven reliability, low emission, low operation cost, multi-fuel capability. Our extensive R&D facilities enable HD Hyundai Heavy Industries to provide the customers with high quality and excellent services in all phases of designing, production, assembly and commissioning of HiMSEN propulsion packaged system.



Marine Propulsion System

Long Term Commitment...

To provide the market with reliable, cost effective and earth-friendly solution

Optimized Matching of HiMSEN Propulsion Package

- HiMSEN Diesel or Dual fuel engines
- C.P/F.P Propeller with shafting, Azimuth thruster
- Pitch and speed control
- Load control
- Gear box
- Shaft generator
- Auxiliary machinery

Application

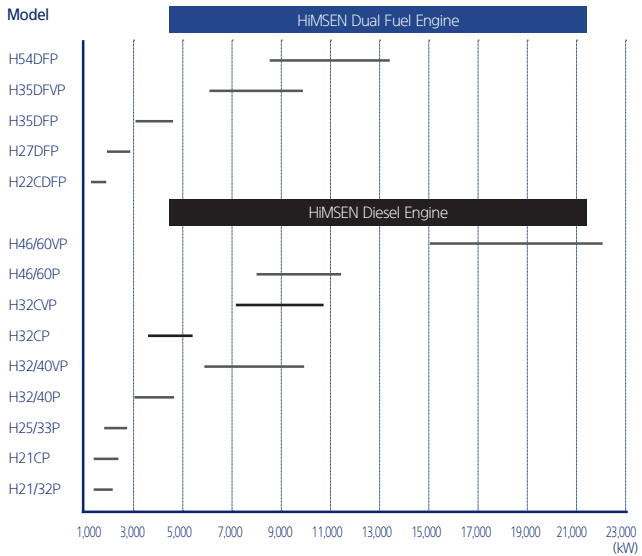
- Controllable pitch propulsion
- Fixed pitch propulsion
- Azimuth thruster propulsion
- Pump drive

Excellent Performance of HiMSEN Propulsion Engine

- Improved transient operation with pulse charging turbocharger
- Invisible smoke
- Lower thermal load engine
- Low fuel consumption
- Low NOx emission

HYUNDAI HiMSEN

Power range for HiMSEN Propulsion engines



Power Range

H22CDFP	1,100~1,980kW
H27DFP	1,860~2,790kW
H35DFP	3,000~4,500kW
H35DFVP	6,000~10,000kW
H54DFP	8,820~13,230kW

H21/32P	1,200~1,800kW
H21CP	1,200~2,160kW
H25/33P	1,740~2,610kW
H32/40P	3,000~4,500kW
H32/40VP	6,000~10,000kW
H32CP	3,600~5,400kW
H32CVP	7,200~10,800kW
H46/60P	7,500~11,250kW
H46/60VP	15,000~22,500kW

HiMSEN Dual Fuel Engines for Propulsion

Model			H22CDFP	H27DFP	H35DFP	H35DFVP	H54DFP
Bore		mm	220	270	350	350	540
Stroke		mm	330	330	400	400	600
Speed		r/min.	1,000	1,000	750	750	600
Cylinder output		kW/cyl.	220	310	500	500	1,470
Rated output #)		cyl.			kW		
		5	1,100				
		6	1,320	1,860	3,000		8,820
		7	1,540	2,170	3,500		10,290
		8	1,760	2,480	4,000		11,760
		9	1,980	2,790	4,500		13,230
		12				6,000	
		14				7,000	
		16				8,000	
		18				9,000	
		20				10,000	
SFOC *) on Diesel mode	at 100% MCR	g/kWh	193.0	186.0	185.0	185.0	175
	at 85% MCR		193.2	186.2	183.2	183.2	174.2
Heat rate *) on Gas mode	at 100% MCR	kJ/kWh	8,172	7,729	7,270	7,270	7,109

*) Note :
1) Reference condition based on ISO 3046/1
2) Main fuel oil based on marine diesel oil, LCV(Lower Calorific Value) 42,700kJ/kg
3) Fuel gas based on natural gas, Lower Heating Value 36MJ/Nm^3, Methane number Min. 80
4) Tolerance +5% and without engine driven pumps
5) NOx Emission limitation : IMO Tier II on Diesel mode, IMO Tier III on Gas mode

#) Based on the CPP Constant speed operation
(For FPP : Please contact HHI-EMD)

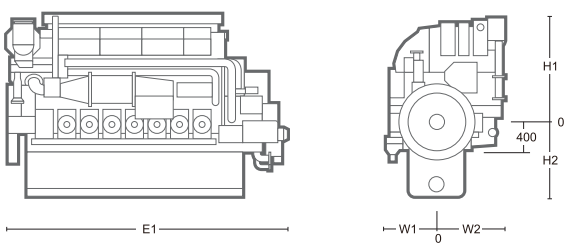
HYUNDAI HiMSEN

Marine Propulsion System

Tier II, Tier III

H22CDFP I Bore: 220 mm, Stroke: 330 mm

Controllable Pitch Propeller
Permit high skew angles to minimize noise and vibration.



Dimensions

1000 rpm	cyl.	Rated Output at Engine (kW)	Engine dimension (mm) & dry weight (ton)					
			E1	H1	H2	W1	W2	Dry Weight
	5	1,100	3,719	1,822	1,145	737	1,015	16.0
	6	1,320	4,069	1,822	1,145	737	1,060	18.0
	7	1,540	4,419	1,822	1,145	737	1,060	20.0
	8	1,760	4,769	1,822	1,145	737	1,150	22.0
	9	1,980	5,119	1,822	1,145	737	1,150	24.0

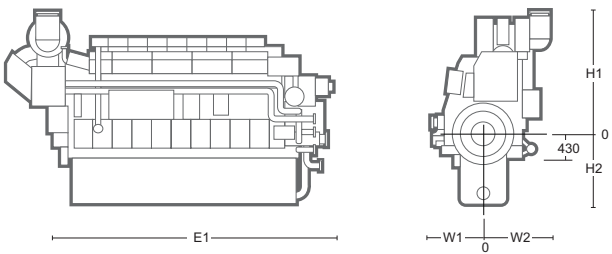
E1 : Dimension between eng. flywheel to eng. free end.
In case of dry sump, the weight and height will be reduced.

Marine Propulsion System

Tier II, Tier III

H27DFP I Bore: 270 mm, Stroke: 330 mm

Controllable Pitch Propeller
Permit high skew angles to minimize noise and vibration.



Dimensions

1000 rpm	cyl.	Rated Output at Engine (kW)	Engine dimension (mm) & dry weight (ton)					
			E1	H1	H2	W1	W2	Dry Weight
	6	1,860	4,200	2,199	1,360	1,030	1,214	26.5
	7	2,170	4,580	2,199	1,360	1,030	1,214	28.1
	8	2,480	4,960	2,199	1,360	1,030	1,214	30.1
	9	2,790	5,340	2,329	1,360	1,030	1,214	32.0

E1 : Dimension between eng. flywheel to eng. free end.
In case of dry sump, the weight and height will be reduced.

HiMSEN Diesel Engines for Propulsion

Tier II, Tier III (with SCR)

Model			H21/32P	H21CP	H25/33P	H32/40P	H32CP	H46/60P
Bore		mm	210	210	250	320	320	460
Stroke		mm	320	330	330	400	450	600
Speed		r/min.	900	900	900	750	750	600
Cylinder output		kW/cyl.	200	240	290	500	600	1,250
Rated output #)		cyl.	kW					
		5		1,200				
		6	1,200	1,440	1,740 / 1,800	3,000	3,600	7,500
		7	1,400	1,680	2,030	3,500	4,200	8,750
		8	1,600	1,920	2,320	4,000	4,800	10,000
		9	1,800	2,160	2,610	4,500	5,400	11,250
SFOC *)	at 100% MCR	g/kWh	183.0	184.0	181.0	184.0	180.0	177.0
	at 85% MCR		183.0	181.0	181.0	181.0	176.2	175.0

Model			H32/40VP	H32CVP	H46/60VP
Bore		mm	320	320	460
Stroke		mm	400	450	600
Speed		r/min.	750	750	600
Cylinder output		kW/cyl.	500	600	1,250
Rated output #)		cyl.	kW		
		12	6,000	7,200	15,000
		14	7,000	8,400	
		16	8,000	9,600	20,000
		18	9,000	10,800	22,500
		20	10,000		
SFOC *)	at 100% MCR	g/kWh	184.0	180 (100%)	177.0
	at 85% MCR		181.0	176.2(85%)	175.0

*) Note :
1) Reference condition based on ISO 3046/1
2) Fuel oil based on LCV(Lower Calorific Value) 42,700kJ/kg
3) Tolerance +5% and without engine driven pumps
4) NOx Emission limitation : IMO Tier II

#) Based on the CPP Constant speed operation (For FPP : Please contact HHI-EMD)
H32CVP 2-Stage Turbocharger : Please contact HHI-EMD

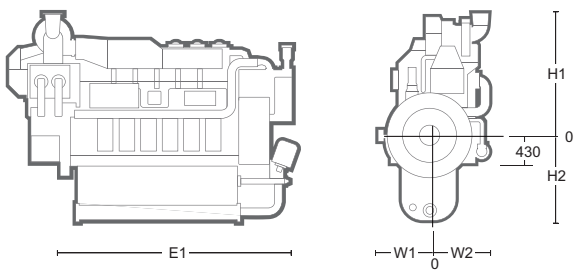
Marine Propulsion System

Tier II, Tier III (with SCR)

H21/32P I Bore: 210 mm, Stroke: 320 mm

Controllable Pitch Propeller
Permit high skew angles to minimize noise and vibration.

Fixed Pitch Propeller
Guarantee optimum thrust, minimal noise and vibration level.



Dimensions

900 rpm	cyl.	Rated Output at Engine (kW)	Engine dimension (mm) & dry weight (ton)					
			E1	H1	H2	W1	W2	Dry Weight
	6	1,200	3,535	1,885	1,300	812	939	18.0
	7	1,400	3,865	1,885	1,300	812	939	20.0
	8	1,600	4,195	2,059	1,355	812	1,005	21.0
	9	1,800	4,525	2,059	1,355	812	1,005	23.0

E1 : Dimension between eng. flywheel to eng. free end.
In case of dry sump, the weight and height will be reduced.

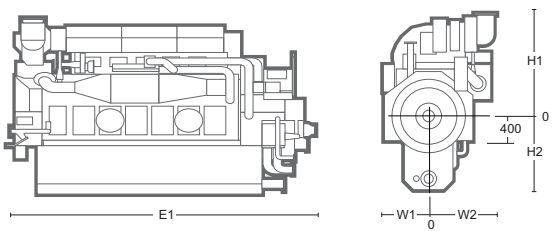
Marine Propulsion System

Tier II, Tier III (with SCR)

H21CP I Bore: 210 mm, Stroke: 330 mm

Controllable Pitch Propeller
Permit high skew angles to minimize noise and vibration.

Fixed Pitch Propeller
Guarantee optimum thrust, minimal noise and vibration level.



Dimensions

900 rpm	cyl.	Rated Output at Engine (kW)	Engine dimension (mm) & dry weight (ton)					
			E1	H1	H2	W1	W2	Dry Weight
	5	1,200	3,688	1,620	1,175	798	1,065	15.0
	6	1,440	4,038	1,620	1,175	798	1,065	17.0
	7	1,680	4,388	1,620	1,175	798	1,065	19.0
	8	1,920	4,738	1,620	1,175	798	1,065	20.0
	9	2,160	5,088	1,620	1,175	798	1,065	22.0

E1 : Dimension between eng. flywheel to eng. free end.
In case of dry sump, the weight and height will be reduced.

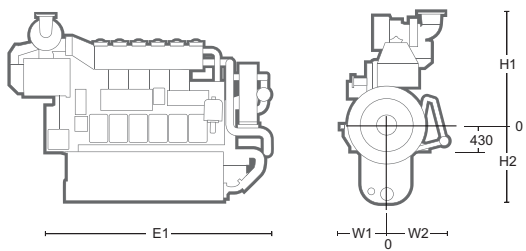
Marine Propulsion System

Tier II, Tier III (with SCR)

H25/33P I Bore: 250 mm, Stroke: 330 mm

Controllable Pitch Propeller
Permit high skew angles to minimize noise and vibration.

Fixed Pitch Propeller
Guarantee optimum thrust, minimal noise and vibration level.



Dimensions

900 rpm	cyl.	Rated Output at Engine (kW)	Engine dimension (mm) & dry weight (ton)					
			E1	H1	H2	W1	W2	Dry Weight
	6	1,740 1,800	4,238	2,209	1,360	812	998	23.0
	7	2,030	4,618	2,209	1,360	812	998	25.0
	8	2,320	4,998	2,331	1,360	812	1,068	26.9
	9	2,610	5,378	2,331	1,360	812	1,068	29.3

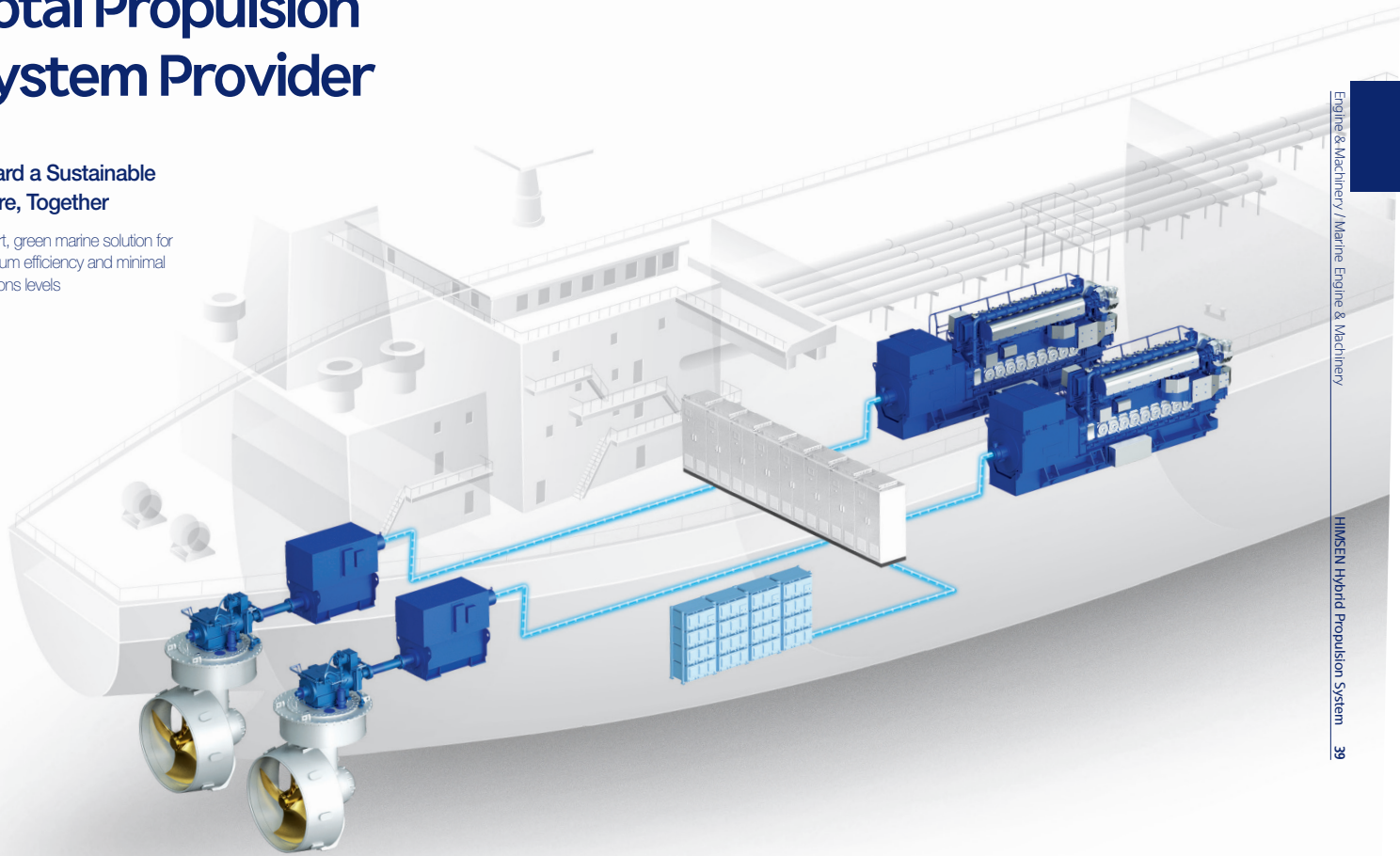
E1 : Dimension between eng. flywheel to eng. free end.
In case of dry sump, the weight and height will be reduced.

HYUNDAI HiMSEN

Total Propulsion System Provider

Toward a Sustainable Future, Together

A smart, green marine solution for maximum efficiency and minimal emissions levels

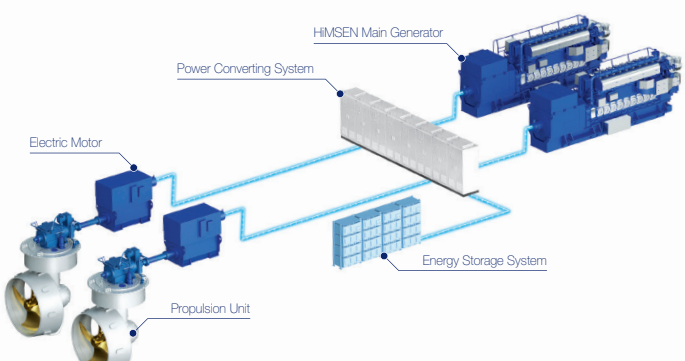


HYUNDAI HiMSEN

Speeding Toward a Greener Future

Taking the fullest possible advantage of all the data accumulated during its decades-long experience and expertise in state-of-the-art diesel and gas engine technologies, as well as its enviable record of close cooperation with recognized industry experts in electric power components, HD Hyundai Heavy Industries has launched a program called the HiMSEN Hybrid Propulsion System. Its goals include minimizing fuel oil consumption and GHG emissions by means of variable speed operations, the strategic sizing of operating components, and optimized operational modes.

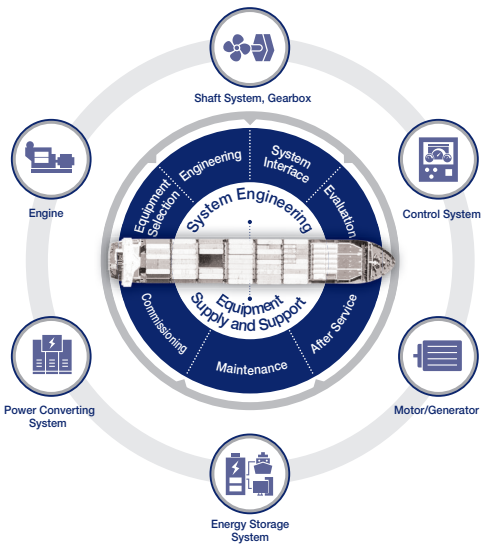
- Up to Zero Emissions
- High Performance, Enhanced Efficiency
- Reduced Ownership Costs
- Flexible Integration of Equipment



State-of-the-art Engine Technology
- HiMSEN diesel and dual-fuel engine
- Dedicated data for applications in electric and mechanical propulsion ships

Readiness for Electrification
- Affiliates to supply electrical components available 24/7
- Copious amounts of ship-based data available

Fully Packaged Solution for Complete System Integration



Single Contact Point
Our project handling system allows customers to contact a single provider for assistance with class approvals, equipment deliveries and installation, integration, commissioning, and any other forms of support.

Low Cost and Flexibility
Minimizing and simplifying the overall system and the interfaces between equipment. The entire system can be custom-designed, ranging from the main power source to the propulsion unit.

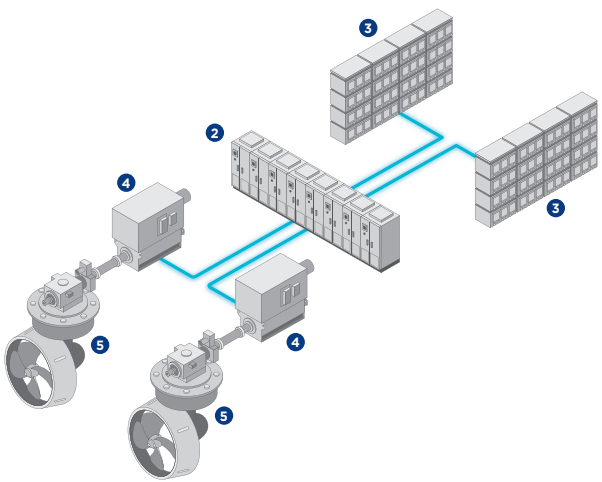
High Efficiency
Efficient performances are guaranteed thanks to our industry-leading engineering and evaluation systems.

Low Risk with Product Care
We deliver only the most robust and proven technologies, as well as products from carefully selected business partners. Our global network ensures total readiness and supports in terms of both commissioning and maintenance.

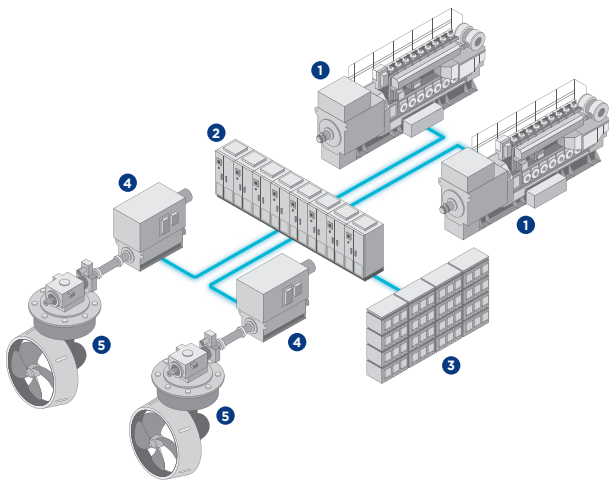
Higher Performance
Lower Emission

As the request of electric propulsion in marine business is growing in line with more strict regulation,
we are looking for better comprehensive electric propulsion system.

Pure Electric Propulsion System



Electric Propulsion System



What we do offer

❶ HiMSEN Generator Set	❷ Power Converting System	❸ Energy Storage System
High-efficiency dual-fuel/ diesel engine generator	Motor drive/grid protection/ power conversion	Spinning reserve/ peak shaving

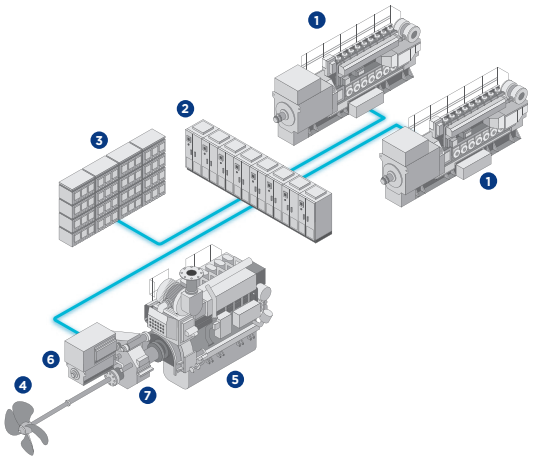
❹ Electric Motor	❺ Propulsion Unit
Optimized control with motor drive system	CPP / FPP azimuth thruster

HYUNDAI HiMSEN

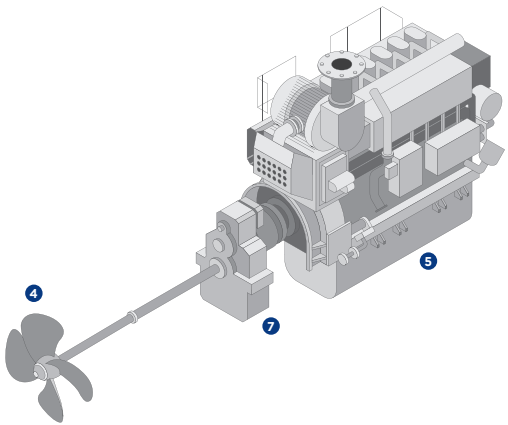
Smarter Combination
More Flexibility

We offer a comprehensive range of propulsion solutions, including hybrid and mechanical options, designed to revolutionize maritime transportation. Our hybrid propulsion systems blend electric and mechanical technologies, optimizing fuel efficiency, reducing emissions, and providing unparalleled operational versatility. For those seeking traditional yet reliable performance, our mechanical propulsion solutions incorporate advanced engineering to deliver powerful and efficient propulsion for vessels of all sizes.

Hybrid Propulsion System



Mechanical Propulsion System



What we do offer

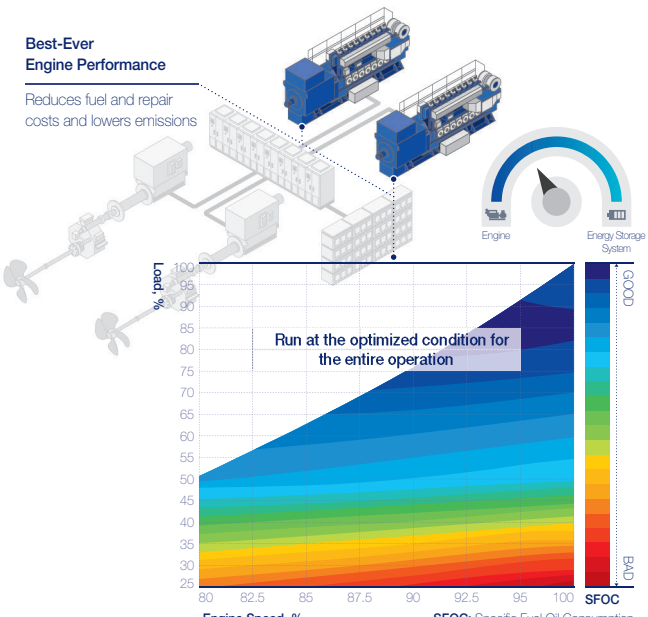
❶ HiMSEN Generator Set	❷ Power Converting System	❸ Energy Storage System
High-efficiency dual-fuel/ diesel engine generator	Motor drive/grid protection/ power conversion	Spinning reserve/ peak shaving

❹ Propulsion Unit	❺ Main Propulsion Engine	❻ Shaft Generator	❼ Gear Box
CPP / FPP azimuth thruster	High-efficiency dual-fuel/ diesel propulsion engine	Optimized control with motor drive system	Speed control / power transmission

HYUNDAI HiMSEN

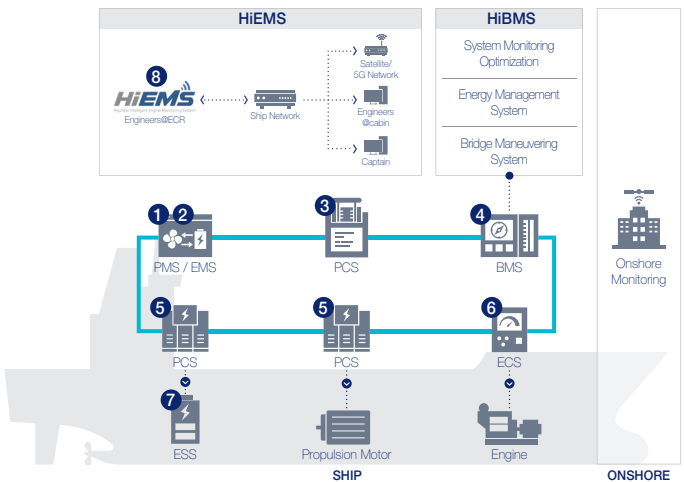
Making a Real Difference with Powerful and Variable Speed Engine Generator

Engine runs at higher efficiency in DC grid. Compared to a conventional AC system, the DC power system allows the DC-connected generators to operate at their optimal speeds at the required load level, bringing the customer significant financial and environmental values. For example, the level of engine fuel oil consumption can be adjusted by changing the speed of the engine at certain load points, allowing the HiMSEN engine to provide a wide range of variable and efficient speeds. This wide range of variable speeds is achieved by optimizing the engine-driven and standby pumps. As seen in the figure below, changing the speed of the engine at certain load points in combination with the power management system can achieve significant fuel oil consumption and emissions savings.



Maximizing Performance with Integrated Controls

From the engine control system to the energy management system, our extensive expertise and product knowledge guarantees that users will achieve excellent performances and functionality of their package equipment.
Our multiphysics-based simulations allow us to virtually assess and optimize the performance of all of our electric power and mechanical propulsion systems. This in turn allows our systems to boost overall productivity all the way from the initial development stages until the stage of final performance validations and controls calibrations.

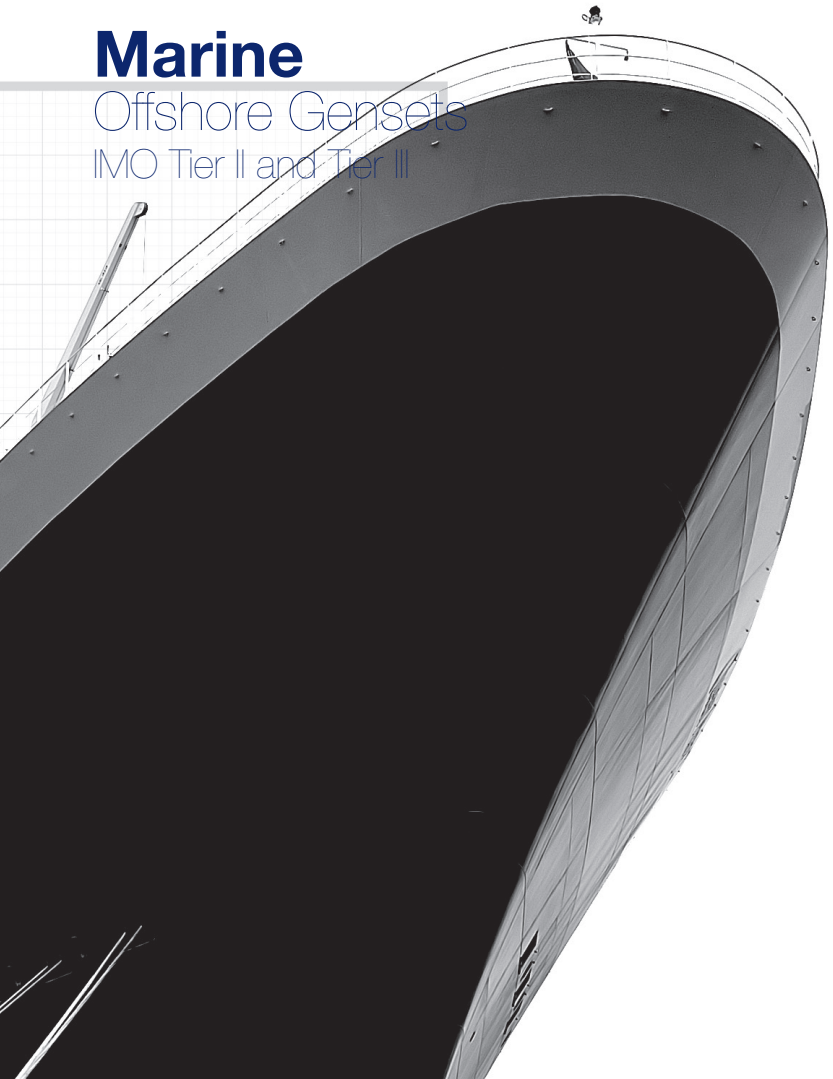


❶ PMS: Power Management System
❷ EMS: Energy Management System
❸ PCS: Propulsion Control System
❹ BMS: Bridge Maneuvering System
❺ PCS: Power Converting System
❻ ECS: Engine Control System
❼ ESS: Energy Storage System
❽ HiEMS: Hyundai intelligent Equipment Management Solution

Marine

Offshore Gensets

IMO Tier II and Tier III

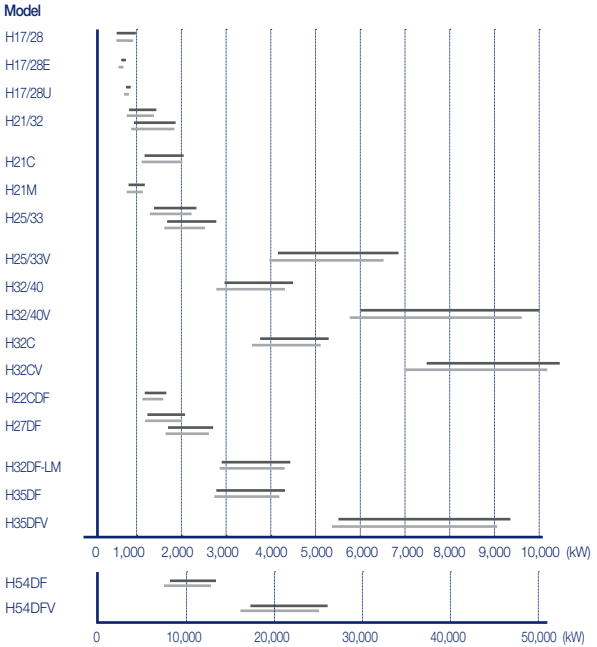


Power Range

H17/28	575~1,000 kW
H17/28E	660 kW
H17/28U	805 kW
H21/32	800~1,980 kW
H21C	1,200~2,160 kW
H21M	800~1,320 kW
H25/33	1,440~2,970 kW
H25/33V	4,080~6,800 kW
H32/40	3,000~4,500 kW
H32/40V	6,000~10,000 kW
H32C	3,600~5,400 kW
H32CV	7,200~10,800 kW

H22CDF	1,075~1980 kW
H27DF	1,368~2,790 kW
H32DF-LM	3,000~4,500 kW
H35DF	2,880~4,320 kW
H35DFV	5,760~9,600 kW
H54DF	8,820~13,230 kW
H54DFV	17,640~26,460 kW

Engine [kWm]
Generator [kWe]



HYUNDAI HiMSEN

Marine Offshore Gensets

H17/28 I Bore: 170 mm, Stroke: 280 mm

Tier II, Tier III (with SCR)

Main Data

Speed	900 rpm		1000 rpm	
Frequency	60 Hz		50 Hz	
	Eng.kW	Gen.kW	Eng.kW	Gen.kW
5H17/28	575	538	600	561
6H17/28	690	645	720	673
7H17/28	805	757	840	790
8H17/28	920	865	960	902

Based on alternator efficiency of 93.5 ~ 94 %.

Specific Fuel Oil Consumption

Load	900 rpm	1000 rpm
100%	188 g/kWh	188 g/kWh

Main Data (for Higher Power Rating)

Speed	900 rpm		1000 rpm	
Frequency	60 Hz		50 Hz	
	Eng.kW	Gen.kW	Eng.kW	Gen.kW
6H17/28	750	701	750	701
7H17/28	875	823	875	823
8H17/28	1,000	940	1,000	940

Based on alternator efficiency of 93.5 ~ 94 %.

Specific Fuel Oil Consumption (for Higher Power Rating)

Load	900 rpm	1000 rpm
100%	191 g/kWh	191 g/kWh

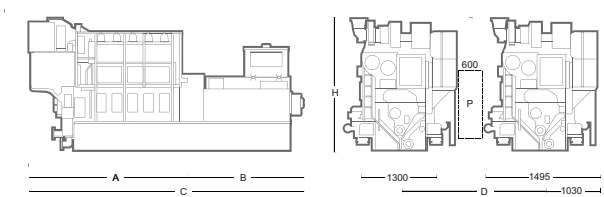
Specific Lubricating Oil Consumption

Lub. Oil: 0.6 g/kWh

Dimensions

Speed	cyl.	Dimension (mm)				Dry Mass (ton)	
		A	B 1)	C 1)	H	Engine 2)	GenSet 1),3)
900 rpm	5	2,791	2,200	4,991	2,314	7.7	13.6
	6	3,071	2,200	5,271	2,314	8.5	14.5
	7	3,351	2,200	5,551	2,314	9.4	15.6
	8	3,631	2,320	5,951	2,314	10.4	16.7

Speed	cyl.	Dimension (mm)				Dry Mass (ton)	
		A	B 1)	C 1)	H	Engine 2)	GenSet 1),3)
1000 rpm	5	2,791	2,200	4,991	2,314	7.7	13.6
	6	3,071	2,200	5,271	2,314	8.5	14.5
	7	3,351	2,200	5,551	2,314	9.4	15.6
	8	3,631	2,320	5,951	2,314	10.4	16.7



Remarks

1) Depending on alternator.
2) Without common base frame.
3) With common base frame & alternator (Maker: HD Hyundai Electric).

D: Min. distance between engines 2,552 mm (with gallery).
P: Free passage between the engines, width 600 mm and height 2,000 mm.
Note) All dimensions and weight are approximate value and subject to change without prior notice.

HYUNDAI HiMSEN

Marine Offshore Gensets

H17/28U(E) I Bore: 170 mm, Stroke: 280 mm

Tier II, Tier III (with SCR)

Main Data

Speed	900 rpm		1000 rpm	
Frequency	60 Hz		50 Hz	
	Eng.kW	Gen.kW	Eng.kW	Gen.kW
6H17/28E	660	618	660	618
6H17/28U	805	750	805	750

Based on alternator efficiency of 93.2 ~ 94 %.

Specific Fuel Oil Consumption

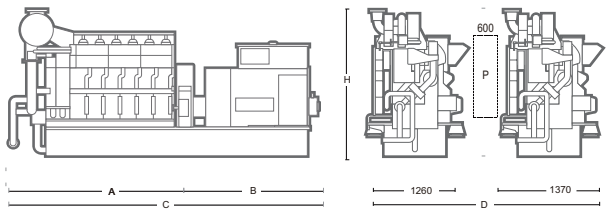
	Load	900 rpm	1000 rpm
6H17/28E	100%	189 g/kWh	190 g/kWh
6H17/28U	100%	191 g/kWh	191 g/kWh

Specific Lubricating Oil Consumption

Lub. Oil: 0.6 g/kWh

Dimensions

Speed	cyl.	Dimension (mm)				Dry Mass (ton)	
		A	B 1)	C 1)	H	Engine 2)	GenSet 1),3)
900 rpm	6H17/28E	2,920	1,939	4,859	2,323	6.9	13.0
	6H17/28U	2,920	2,069	4,983	2,393	7.1	13.8



Remarks

1) Depending on alternator.
2) Without common base frame.
3) With common base frame & alternator (Maker: HD Hyundai Electric).

D: Min distance between engines 2,445 mm (with gallery).
P: Free passage between the engines, width 600 mm and height 2,000 mm.
Note) All dimensions and weight are approximate value and subject to change without prior notice.

This type of engine is optimized as planning products.

1. Optimized capacity for front module (pump, cooler, filter, valve, etc) .
2. Only 6cyl. for pump cover.
3. Optimized design for crankshaft, engine module.
4. Reducing of weight, simplification, etc.

HYUNDAI HiMSEN

Marine Offshore Gensets

H21/32 I Bore: 210 mm, Stroke: 320 mm

Tier II, Tier III (with SCR)

Main Data

Speed	720 rpm		750 rpm		900 rpm		1000 rpm	
Frequency	60 Hz		50 Hz		60 Hz		50 Hz	
	Eng.kW	Gen.kW	Eng.kW	Gen.kW	Eng.kW	Gen.kW	Eng.kW	Gen.kW
5H21/32	800	752	800	752	960	910	-	-
6H21/32	960	902	960	902	1,200	1,140	1,200	1,140
7H21/32	1,120	1,064	1,120	1,064	1,400	1,330	1,400	1,330
8H21/32	1,280	1,216	1,280	1,216	1,600	1,520	1,600	1,520
9H21/32	1,440	1,368	1,440	1,368	1,800	1,710	1,800	1,710

Based on alternator efficiency of 94 ~ 95 %.

Specific Fuel Oil Consumption

Load	720 rpm	750 rpm	900 rpm	1000 rpm
100 %	182 g/kWh	182 g/kWh	183 g/kWh	185 g/kWh

Exceptionally, 5H21/32 × 720/750 rpm is 188 g/kWh, 5H21/32 × 900 rpm is 190 g/kWh

Main Data (for Higher Power Rating)

Speed	720 rpm		750 rpm		900 rpm		1000 rpm	
Frequency	60 Hz		50 Hz		60 Hz		50 Hz	
	Eng.kW	Gen.kW	Eng.kW	Gen.kW	Eng.kW	Gen.kW	Eng.kW	Gen.kW
6H21/32	1,050	987	1,050	987	1,320	1,254	1,320	1,254
7H21/32	1,225	1,164	1,225	1,164	1,540	1,463	1,540	1,463
8H21/32	1,400	1,330	1,400	1,330	1,760	1,672	1,760	1,672
9H21/32	1,575	1,496	1,575	1,496	1,980	1,881	1,980	1,881

Based on alternator efficiency of 94 ~ 95 %.

Specific Fuel Oil Consumption (for Higher Power Rating)

Load	720 rpm	750 rpm	900 rpm	1000 rpm
100 %	184 g/kWh	184 g/kWh	185 g/kWh	187 g/kWh

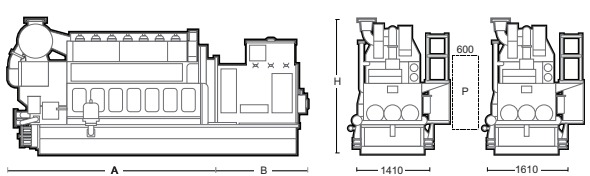
Specific Lub Oil Consumption (for Higher Power Rating)

Lub. Oil: 0.6 g/kWh

Dimensions

Speed	cyl.	Dimension (mm)				Dry Mass (ton)	
		A	B 1)	C 1)	H	Engine 2)	GenSet 1),3)
720 / 750 rpm	5	3,405	1,926	5,331	2,712	14.0	22.4
	6	3,781	2,093	5,874	2,712	15.6	23.5
	7	4,111	1,923	6,034	2,781	17.1	26.5
	8	4,453	2,175	6,628	2,781	18.5	29.1
	9	4,783	2,265	7,048	2,911	19.9	31.7

Speed	cyl.	Dimension (mm)				Dry Mass (ton)	
		A	B 1)	C 1)	H	Engine 2)	GenSet 1),3)
900 / 1000 rpm	5	3,411	2,097	5,508	2,712	13.4	22.9
	6	3,781	1,896	5,677	2,781	15.1	26.1
	7	4,235	1,900	6,135	2,781	16.7	28.6
	8	4,453	2,175	6,628	2,911	18.4	29.1
	9	4,783	2,265	7,048	2,911	19.8	31.7



Remarks

1) Depending on alternator.
2) Without common base frame.
3) With common base frame & alternator (Maker: HD Hyundai Electric).

D: Min. distance between engines 2,613 mm (with gallery).
P: Free passage between the engines, width 600 mm and height 2,000 mm.
Note) All dimensions and weight are approximate value and subject to change without prior notice.

HYUNDAI HiMSEN

Marine Offshore Gensets

H21C I Bore: 210 mm, Stroke: 330 mm

Tier II, Tier III (with SCR)

Main Data

Speed	900 rpm		1000 rpm	
Frequency	60 Hz		50 Hz	
	Eng.kW	Gen.kW	Eng.kW	Gen.kW
5H21C	1,200	1,140	1,200	1,140
6H21C	1,440	1,368	1,440	1,368
7H21C	1,680	1,596	1,680	1,596
8H21C	1,920	1,824	1,920	1,824
9H21C	2,160	2,052	2,160	2,052

Based on alternator efficiency of 94 ~ 95 %.

Specific Fuel Oil Consumption

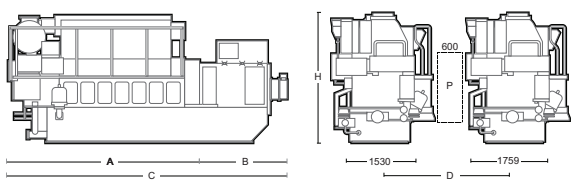
Load	900 rpm	1000 rpm
85 %	180 g/kWh	182 g/kWh

Specific Lubricating Oil Consumption

Lub. Oil: 0.5 g/kWh

Dimensions

Speed	cyl.	Dimension (mm)				Dry Mass (ton)	
		A	B 1)	C 1)	H	Engine 2)	GenSet 1),3)
900 / 1000 rpm	5	3,735	2,249	5,984	2,600	14.3	22.1
	6	4,085	2,249	6,334	2,600	16.0	24.9
	7	4,435	2,305	6,740	2,600	17.8	28.3
	8	4,785	2,305	7,090	2,653	19.4	30.2
	9	5,135	2,450	7,585	2,653	21.0	33.6



Remarks

1) Depending on alternator.
2) Without common base frame.
3) With common base frame & alternator (Maker: HD Hyundai Electric).

D: Min. distance between engines 2,990 mm (with gallery).
P: Free passage between the engines, width 600 mm and height 2,000 mm.
Note) All dimensions and weight are approximate value and subject to change without prior notice.

Marine Offshore Gensets

H21M I Bore: 210 mm, Stroke: 320 mm

Tier II, Tier III (with SCR)

Main Data

Speed	720 rpm		900 rpm	
Frequency	60 Hz		60 Hz	
	Eng.kW	Gen.kW	Eng.kW	Gen.kW
6H21M	800	752	1,050	987
	960	902	1,200	1,140
			1,320	1,254

Based on alternator efficiency of 94 ~ 95 %.

Specific Fuel Oil Consumption

		720 rpm		900rpm		
Load	Eng.kW	800	960	1,050	1,200	1,320
100%		184	183	185	83	187

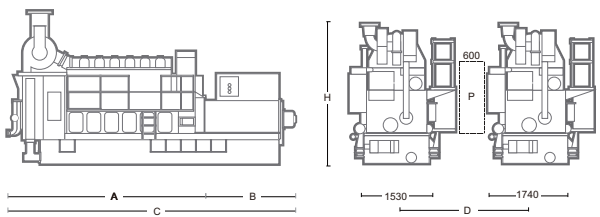
Specific Lubricating Oil Consumption

SLOC : 0.5g/kWh

- Tolerance : +25% depending on the operating conditions
- Only MCR should be used to evaluate the lubricating oil consumption

Dimensions

Speed	cyl.	Dimension (mm)					Dry Mass (ton)	
		A	B 1)	C 1)	D	H	Engine 2)	GenSet 1),3)
720 / 900 rpm	6	3,360	2,127	5,487	2,638	2,427	11.6	20



Remarks

1) Depending on a standard alternator.
2) Weight included a standard alternator.
3) Without common base frame.
4) With common base frame and alternator

D: Min. distance between engines.
P: Free passage between engines, width 600 mm and height 2,000 mm.
Note) All dimensions and weight are approximate value and subject to change without prior notice.

HYUNDAI HiMSEN

Marine Offshore Gensets

H25/33 I Bore: 250 mm, Stroke: 330 mm

Tier II, Tier III (with SCR)

Main Data

Speed	720 rpm		750 rpm		900 rpm		1000 rpm	
Frequency	60 Hz		50 Hz		60 Hz		50 Hz	
	Eng.kW	Gen.kW	Eng.kW	Gen.kW	Eng.kW	Gen.kW	Eng.kW	Gen.kW
6H25/33	1,440	1,368	1,500	1,425	1,800	1,710	1,800	1,710
7H25/33	1,680	1,596	1,750	1,663	2,100	1,995	2,100	1,995
8H25/33	1,920	1,824	2,000	1,900	2,400	2,280	2,400	2,280
9H25/33	2,160	2,052	2,250	2,138	2,700	2,565	2,700	2,565

Based on alternator efficiency of 95 %.

Specific Fuel Oil Consumption

Load	720 rpm	750 rpm	900 rpm	1000 rpm
100 %	180 g/kWh	180 g/kWh	181 g/kWh	181 g/kWh

Main Data (for Higher Power Rating)

Speed	720 rpm		750 rpm		900 rpm		1000 rpm	
Frequency	60 Hz		50 Hz		60 Hz		50 Hz	
	Eng.kW	Gen.kW	Eng.kW	Gen.kW	Eng.kW	Gen.kW	Eng.kW	Gen.kW
6H25/33	1,560	1,482	1,650	1,568	1,890	1,796	1,980	1,881
7H25/33	1,820	1,729	1,925	1,829	2,205	2,095	2,310	2,195
8H25/33	2,080	1,976	2,200	2,090	2,520	2,394	2,640	2,508
9H25/33	2,340	2,223	2,475	2,351	2,835	2,693	2,970	2,822

Based on alternator efficiency of 95 %.

Specific Fuel Oil Consumption (for Higher Power Rating)

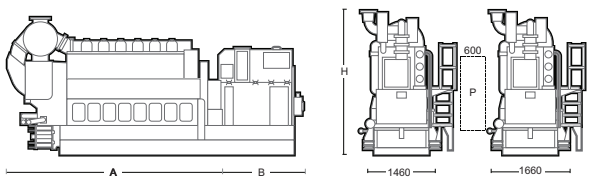
Load	720 rpm	750 rpm	900 rpm	1000 rpm
100 %	182 g/kWh	182 g/kWh	183 g/kWh	183 g/kWh

Specific Lubricating Oil Consumption
Lub. Oil: 0.6 g/kWh

Dimensions

Speed	cyl.	Dimension (mm)				Dry Mass (ton)	
		A	B 1)	C 1)	H	Engine 2)	GenSet 1),3)
720 / 750 rpm	6	4,414	2,262	6,676	2,961	20.2	29.8
	7	4,794	2,262	7,056	2,961	22.5	33.9
	8	5,311	2,340	7,651	3,241	24.1	39.5
	9	5,691	2,262	7,953	3,371	26.2	45.0

Speed	cyl.	Dimension (mm)				Dry Mass (ton)	
		A	B 1)	C 1)	H	Engine 2)	GenSet 1),3)
900 / 1000 rpm	6	4,414	2,262	6,676	2,961	20.2	29.8
	7	4,794	2,262	7,056	3,241	22.5	33.9
	8	5,311	2,340	7,651	3,371	24.1	39.5
	9	5,691	2,490	8,181	3,371	26.2	45.0



Remarks

1) Depending on alternator.
2) Without common base frame.
3) With common base frame & alternator (Maker: HD Hyundai Electric).

D: Min. distance between engines 2,844 mm (with gallery).
P: Free passage between the engines, width 600 mm and height 2,000 mm.
Note) All dimensions and weight are approximate value and subject to change without prior notice.

Marine Offshore Gensets

H25/33V I Bore: 250 mm, Stroke: 330 mm

Tier II, Tier III (with SCR)

Main Data

Speed	900 rpm		1000 rpm	
Frequency	60 Hz		50 Hz	
	Eng.kW	Gen.kW	Eng.kW	Gen.kW
12H25/33V	4,080	3,876	4,080	3,876
14H25/33V	4,760	4,522	4,760	4,522
16H25/33V	5,440	5,168	5,440	5,168
18H25/33V	6,120	5,814	6,120	5,814
20H25/33V	6,800	6,460	6,800	6,460

Based on alternator efficiency of 96 %.

Specific Fuel Oil Consumption

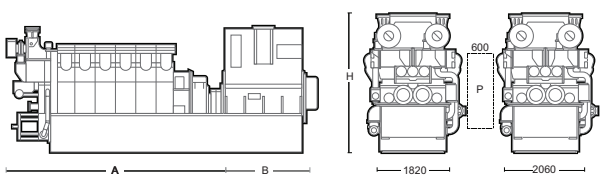
Load	900 rpm	1000 rpm
100 %	183 g/kWh	183 g/kWh

Specific Lubricating Oil Consumption

Lub. Oil: 0.6 g/kWh

Dimensions

Speed	cyl.	Dimension (mm)				Dry Mass (ton)	
		A	B 1)	C 1)	H	Engine 2)	GenSet 1),3)
900 / 1000 rpm	12	5,524	3,334	8,858	3,750	33.5	58.2
	14	5,944	3,504	9,448	3,750	36.5	63.4
	16	6,364	3,682	10,046	3,750	39.5	69.6
	18	6,784	3,772	10,556	3,750	42.5	77.5
	20	7,204	3,727	10,931	3,750	45.5	79.5



Remarks

1) Depending on alternator.
2) Without common base frame.
3) With common base frame & alternator (Maker: HD Hyundai Electric).

D: Min. distance between engines 3,840 mm (with gallery).
P: Free passage between the engines, width 600 mm and height 2,000 mm.
Note) All dimensions and weight are approximate value and subject to change without prior notice.

Marine Offshore Gensets

Dual Fuel Engine
Tier II, Tier III

H22CDF I Bore: 220mm, Stroke: 330mm

Main Data

Speed	900 rpm		1,000 rpm	
Frequency	60 Hz		50 Hz	
	Eng.kW	Gen.kW	Eng.kW	Gen.kW
5H22CDF	1,075	1,011	1,100	1,034
6H22CDF	1,290	1,220	1,320	1,248
7H22CDF	1,505	1,423	1,540	1,463
8H22CDF	1,720	1,634	1,760	1,672
9H22CDF	1,935	1,839	1,980	1,881

Based on alternator efficiency of 94~95 %.

Heat Rate & SFOC (100% Load)

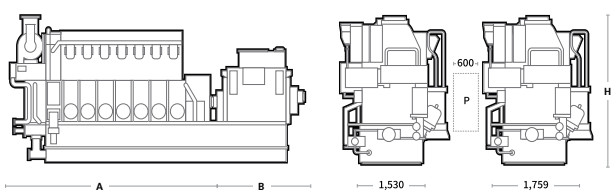
Load	900 rpm	1,000 rpm
Heat Rate@Gas mode	8,120 kJ/kWh	8,172kJ/kWh
SFOC@Diesel mode	191.5 g/kWh	193.0 g/kWh

Specific Lubricating Oil Consumption

Lub. Oil: 0.6 g/kWh

Dimensions

Speed	cyl.	Dimension (mm)				Dry Mass (ton)	
		A	B 1)	C 1)	H	Engine 2)	GenSet 1),3)
900 / 1,000 rpm	5	3,735	2,249	5,984	3,056	16.5	25.4
	6	4,085	2,249	6,334	3,056	18.2	27.6
	7	4,435	2,305	6,740	3,056	19.9	29.3
	8	4,785	2,305	7,090	3,056	21.6	31.2
	9	5,135	2,450	7,585	3,056	23.3	34.6



Remarks

1) Depending on alternator.
2) Without common base frame.
3) With common base frame & alternator (Maker: HD Hyundai Electric).

D: Min. distance between engines 2,990 mm (with gallery).
P: Free passage between the engines, width 600 mm and height 2,000 mm.
Note) All dimensions and weight are approximate value and subject to change without prior notice.

HYUNDAI HiMSEN

Marine Offshore Gensets

Dual Fuel Engine
Tier II, Tier III

H27DF I Bore: 270 mm, Stroke: 330 mm

Main Data

Speed	720 rpm		750 rpm		900 rpm		1000 rpm	
Frequency	60 Hz		50 Hz		60 Hz		50 Hz	
	Eng.kW	Gen.kW	Eng.kW	Gen.kW	Eng.kW	Gen.kW	Eng.kW	Gen.kW
6H27DF	1,368	1,300	1,422	1,351	1,710	1,625	1,860	1,767
7H27DF	1,596	1,516	1,659	1,576	1,995	1,895	2,170	2,062
8H27DF	1,824	1,733	1,896	1,801	2,280	2,166	2,480	2,356
9H27DF	2,052	1,949	2,133	2,026	2,565	2,437	2,790	2,651

Based on alternator efficiency of 95 %.

Heat Rate & SFOC (100% Load)

Load	720 rpm	750 rpm	900 rpm	1000 rpm
Heat rate @ Gas mode		7,900 kJ/kWh		
SFOC @ Diesel mode		190 g/kWh		

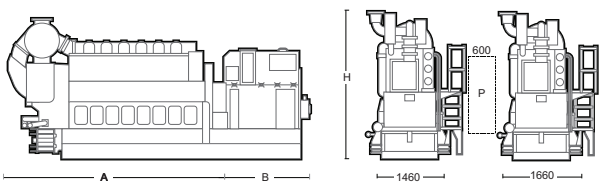
Specific Lubricating Oil Consumption

Gas mode : 0.25 g/kWh
Diesel mode : 0.4 g/kWh

Dimensions

Speed	cyl.	Dimension (mm)				Dry Mass (ton)	
		A	B 1)	C 1)	H	Engine 2)	GenSet 1),3)
720 / 750 rpm	6	4,414	2,262	6,676	2,835	21.2	30.8
	7	4,794	2,262	7,056	2,835	23.5	34.9
	8	5,311	2,340	7,573	3,241	25.1	40.5
	9	5,691	2,262	7,953	3,371	27.2	46.0

Speed	cyl.	Dimension (mm)				Dry Mass (ton)	
		A	B 1)	C 1)	H	Engine 2)	GenSet 1),3)
900 / 1000 rpm	6	4,414	2,262	6,676	2,835	21.2	30.8
	7	4,794	2,262	7,056	2,835	23.5	34.9
	8	5,311	2,340	7,651	3,371	25.1	40.5
	9	5,691	2,490	8,181	3,371	27.2	46.0



Remarks

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D: Min. distance between engines 2,844 mm (with gallery).
P: Free passage between the engines, width 600 mm and height 2,000 mm.
Note) All dimensions and weight are approximate value and subject to change without prior notice.

HYUNDAI HiMSEN

Marine 2-Stroke Engine

Products

HYUNDAI-MAN B&W / HYUNDAI-WÄRTSILÄ / Engine Components

Quality Management

Approval Status of Quality Management System

Product or Service Ranges		Certifying Agency
Design and Manufacture of Two & Four-Stroke Marine and Stationary Diesel & Gas Engine with Components (Turbochargers, Blocks,Crankshafts, Cylinder Liners, Propellers, Forged Steel and Shafting etc.), Marine and Industrial Equipment, BWTS, SCR, Hydraulic Machinery (Pumps, Valves, Compressors, Steam & Gas Turbines, etc.), Industrial Machinery (Conveyors, Presses etc.)		DNV·GL • ISO 9001:2008 KS Q ISO 9001:2009 • ISO 14001:2004 KS I ISO 14001:2009 • OHSAS 18001:2007
Nuclear Diesel Generator (Class 1E), Pump (Class 2, 3)		KEPIC-MNVEN
Forging Shop	Works Approval	ABS, BV, CCS, DNV·GL, KR, LR, NK, RINA
Casting Shop		ABS, BV, CCS, DNV·GL, KR, LR, RINA
Propeller		ABS, BV, CCS, DNV·GL, KR, LR, NK, RINA, RS
Crankshaft		ABS, BV, CCS, DNV·GL, KR, LR, NK, RINA
The Classification Approval of Quality Assurance System		DNV·GL-MSA, KR-QAS, LR-QAM

Global Network

HD Hyundai Marine Solution Co., Ltd.

Voyage with confidence, we handle the rest

HD Hyundai Marine Solution Co., LTD

HD Hyundai Marine Solutions (HD HMS) is an engineering service company established in 2016 to provide total solutions for the shipbuilding and marine industries. HD HMS is supporting clients manage their vessels in efficient ways throughout its' whole life span.

Furthermore, HD HMS strives to maximize customer satisfaction by not only providing timely on-request services and parts, but also providing customers long-term fleet management solutions. This includes scheduled deliveries of various parts supplies and services to preemptively minimize any customer inconvenience, and retrofit solutions to maintain vessel longevity and performance while complying with stricter environmental regulations.

As a sole solution provider for vessels built by the HD Group, HD HMS aims to improve customer experience while operating vessels all over the horizon.

HD Hyundai Marine Solution: Accessible to All Clients

HD Hyundai Marine Solution ensures its customers that it will provide comprehensive solutions to all vessel and equipment-related issues, regardless of time, location and situation.

Genuine Spare Parts Provision and Long Term Service Agreements (LTSA)

HD HMS's authorized sales agents are supplying clients with original and certified spare parts at competitive price, delivery time and quality. HD HMS also offers Long Term Service Agreements (LTSA) that provides spare parts & services under a predicted schedule set up by our experts which significantly decreases downtime. Our LTSA status can be monitored via the HD Voyage platform, informing clients of when and which parts & service is going to be supplied based on ship status.

Technical Support and Service

HD HMS provides technical support including supervision, reconditioning, conversion, retrofit, and technical consultancy. Extending from this, HD HMS provides a scheduled maintenance overhaul to prevent any potential problems that may arise. Through years of experience, HD HMS engineers have become masters of tending to not only conventional engines, but also to recent Dual Fuel engines such as ME-GI, ME-LGIP ME-LGIM ME-GIE, X-DF, and HiMSEN DF.

Retrofit Solutions for CII and IMO Regulation Compliance

HMS is a turnkey provider for re-engine solutions to meet CII, IMO standards and other GHG emission regulations. HD HGS's de-carbonization solution package is a convenient, time saving and cost efficient method to be in compliance with various environmental regulations.

Global Service Network

HD HMS is very proud of its well organized global service network which is systematically designed to efficiently meet client requirements. HD HMS's offices are located globally in Rotterdam, Hamburg, Athens, Dubai, Singapore, Houston and Taoyuan, enabling HD HMS to respond 24/7 on a global basis.

HYUNDAI HIMSEN

HD Hyundai Marine Solution

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Global Service Network

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Ocean Marine Services Co.,Ltd.
273, Jangsaengpogorae-ro, Nam-gu, Ulsan, Republic of Korea
Phone: +82 52 226 0700 **E-mail:** ocean@oceanma.com

List of Licensees

HiMSEN Engines (Licensee)
HYUNDAI-MAN B&W Engines (Sub-Licensee)
Hi-Well Cargo Pumping Systems (Licensee)

Saudi Arabia — **CountryCode: + 966**

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Phone: +966 13 512 2002
E-mail: info@makeen-ksa.com

Makeen : Joint Venture between Saudi Aramco, KSOE and Dussur

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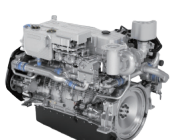

HYUNDAI HIMSEN

RELIABLE & POWERFUL SUPPORT AROUND THE WORLD

- Optimized Solutions for Every Customer's Needs
- Genuine Spare Parts from the Original Equipment Manufacturer
- Fast and Reliable Response through Our Global Service Network
- 24/7, Immediate Support

- Service Station
- Spare Parts Depot
- Spare Parts Dealer
- Authorized Repaired
- Licensee (Makeen)

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