

# V28/33D

Four-Stroke diesel engine



MAN Diesel



907



# MAN Diesel

## The responsible way in leading technology

MAN Diesel is the world's leading designer and manufacturer of low and medium speed engines – engines from MAN Diesel cover an estimated 50% of the power needed for all world trade. We develop two-stroke and four-stroke engines, auxiliary engines, turbochargers and propulsion packages that are manufactured both within the MAN Diesel Group and at our licensees.

More than ever before, MAN Diesel's development focus is the environmental performance of our engines. Using our unrivalled grasp of large engine technology, we aim to make our engines progressively cleaner, more powerful and more efficient.

Our absolute commitment to reducing emissions while increasing fuel efficiency and power density starts with our active partnership in the emissions law making process and ends with the delivery of engines that achieve an ideal synthesis of prime mover characteristics.

# Efficient, Clean and Compact

The MAN Diesel synthesis of world class engineering and state of the art technology brings high efficient, reliable, economic and environmentally friendly solutions to propulsion and power generation requirements, for both marine and industrial customers.

For over a century MAN Diesel has been constantly developing and improving its products to meet these demands. Satisfying requirements that are often seen as mutually exclusive, has been addressed in the design of the MAN Diesel V28/33D diesel engine. The V28/33D engine range is the culmination of world class engineering and state of the art technology brought together to design the most powerful and fuel efficient 1000 rpm diesel engine in the world. The V28/33D range of engines comprises of 12, 16 and 20 cylinder configurations covering power needs up to 10,000 kW per unit.

## Features and benefits

Utilising extensive field experience obtained with the V28/33D range and employing state of the art development processes the V28/33D incorporates a number of unique features, which results in quantifiable benefits to operators.

- Advanced electronic fuel injection improves SFOC, reduces NO<sub>x</sub> and smoke, and performance and transient response
- 52 degree vee angle allows centrally mounted inter-cooler assembly minimising height and width and facilitating installation
- Aligned cooling concept of cylinder liners eliminates water passages in the crankcase therefore facilitating easier maintenance and minimising installed weight

- Reduced component count and integrated ducts and passages improves reliability, ease of installation and maintenance
- Engine mounted lubricating oil cooler, filters and thermostatic eases installation, reduces overall weight, and eases cooling water system maintenance
- Differentiated cylinder head design minimises pressure drops and improves SFOC
- High efficiency turbo chargers with optional STC sequential turbocharging. The STC system allows high torque at low rpm with reduced SFOC, low noise and reduced smoke.

## Quantitative customer benefits

- Low operating cost – best in class SFOC below 188 g/kWh (85% power) Distillate acc. to ISO8217 DMA
- Low maintenance costs and high engine availability down-time – main overhaul at 32,000 hours
- Environmentally compliant – NO<sub>x</sub> emissions fulfilling IMO II and EPA TIER 2 regulations
- High power-to-weight ratio and compact size



### **Naval Vessels**

The V28/33D is perfectly designed for the propulsion of all military adapted vessels. Characterised by a perfect ratio between power and compactness, high performance, low weight, quietness and high reliability for maximised availability the engine has proved a recipe for low lifecycle costs.

### **Fast Ferries**

Based on 1.000 rpm and up to 10.000 kW the 28/33D is developed for high speed, fast acceleration, continuously high power and long TBOs. Due to the sophisticated Sacos<sub>one</sub> computer system maintenance costs are kept to a minimum.

### **Offshore**

With the new 28/33D engine series, MAN Diesel has set worldwide standards for the offshore market. Developed to meet the harshest of conditions that can be imposed, the 28/33D is ideally suited for long-term duties under extreme conditions thanks to its robust design and construction.

### **Engine features:**

- Low operating costs
- High power-to-weight ratio
- Low maintenance costs and minimal engine downtime
- Low smoke
- Improved SFOC
- Environmentally compliant
- High reliability and availability

# Engine Specifications

## High efficiency and low cost of ownership

### Operational flexibility

The engine is offered in basic packages to suit the particular operational requirements of marine propulsion, marine electrical power generation, base load and stand-by power generation, and mechanical drives. Sequential turbo charging (STC) is optionally applied for applications requiring an extended torque envelope at low engine speeds as well as long idling period.

### Power afloat

The compact design, high-power-to-weight ratio and low operating costs make the V28/33D the ideal choice for marine applications where reliability, space and weight considerations are of paramount importance. Typical marine installations include propulsion engines and diesel electric drives for fast ferries, yachts, naval and conventional vessels.

### Mechanical drives

An extensive power range and a high degree of rating tolerance for a wide variety of ambient conditions enable the V28/33D to be offered in standardised form to power ships, generators, pumps or compressors which meet the application needs of operators throughout the world.

### Fuel system

An electronically-controlled unit pump injection system is used with the high pressure fuel pump mounted in the cam follower housing, which forms the body of the pump. Modular low pressure fuel supply and return rails connect each pump to the next while the short high pressure pipes to the injectors are double walled for safety. The electronic control unit for the fuel pumps is mounted locally on the engine.

### Ease of maintenance

Special attention has been paid to reducing the component count and minimising maintenance work, in combination with extended service intervals and ease of access with the engine in situ. This reduces downtime and keeps maintenance, time and cost to a minimum.

### Ease of installation

The use of integrated fluid passages and pipes results in a clean and compact design lines, reducing installation space requirements and requiring fewer connections. In addition, the inclusion of lubricating oil coolers, filters and all thermostatic valves on the engine eliminates the need for separately connected ancillary equipment.

### High power-to-weight ratio

The V28/33D has a relatively low weight compared to other engines in its class. The advantages of engine durability, efficiency, low noise and low maintenance costs allow it to be applied to an extended range of applications.

### Starting system

The air starter motor incorporates a control valve, pressure regulator and strainer, and engages with a ring-gear on the flywheel. A barring motor can be supplied as a service tool or fitted as standard where it is fully protected against the inadvertent starting of the engine.



### **Crankshaft**

The optimised crankshaft is designed according to proven MAN Diesel standards. The result of this optimisation is more straightforward fabrication and an improved design.

### **Crankcase**

The crankcase is machined from spheroidal graphite cast iron and features underslung main bearings which are retained by two vertical studs and two cross bolts per side for enhanced overall stiffness. The main bearing caps are secured by hydraulically tensioned studs to ensure maximum integrity of the crankcase structure. A 52 degree vee angle minimises torsional effects and allows location of the intercooler within the engine vee, reducing overhang loadings and minimising engine height and width. Inspection covers on both sides of the engine provide easy access to internal components. Selected covers carry the crankcase explosion relief valves. Engine mounting on anti vibration mountings is made by separate bolt-on feet.

### **Bearings**

Generously dimensioned, the main bearings are precision made, easily replaceable, thin wall, steel-backed aluminium tin shells.

### **Camshaft**

The camshafts are of modular design, comprising of one cam element per cylinder. They are hollow and also act as an oil supply channel. Optimised cam profiles for electronically controlled injection minimise vibrations, thus improving reliability and increasing component life.

### **Camshaft drive**

The timing gear train is located at the free end of the engine. The crankshaft gear drives a compound idler gear for each shaft, which, in turn drive the two camshafts.

### **Exhaust system**

The compact, modular exhaust system comprises of single cylinder units bolted to the cylinder head and connected to adjacent units via expansion bellows. The whole exhaust system is enclosed in insulation with each section made up of two cylinder units for ease of maintenance.

### **Sequential turbo charging (STC)**

The new MAN Diesel Sequential Turbo Charging System operates with high efficiency turbochargers. The benefit of this system is the option to switch a second turbocharger on or off. This enables a low thermal signature, decreased smoke emission, low vibrations and reduced partload fuel consumption.

### **New turbocharger – TCA 33**

Twin, high efficiency axial turbochargers have been specially developed for the 28/33D. These tuned axial turbocharger indicates low weight and compact design, provided for easier maintenance and have extended service life time. High efficiency at full and part loads results in substantial air surplus and thorough combustion without residues and low thermal stress of the combustion chamber components. Good part load operation due to very high turbocharger efficiency.



# Engine Specifications

## High power-to-weight ratio

### Cylinder liners

Individual cylinder liners incorporate deep flanges and are strategically cooled by a separate water jacket enabling a dry crankcase to be utilised further reducing overall weight. Running surfaces are plateau honed and finished to improve oil retention throughout their life. Utilization of anti bore polishing rings eliminates the build up of carbon on the piston crowns and minimises oil consumption.

### Piston

The light weight pistons are a bolted two piece steel design. A three ring pack comprises two chrome-ceramic compression rings and an oil control ring. The case-hardened piston pin is fully floating and is retained by a circlip at each end.

### Cylinder heads

Individual cylinder heads have a wide combustion face incorporating coolant drillings. A four-valve arrangement is employed with two inlet and two exhaust valves around the central, vertical injector. Twin inlet ports are connected directly to the air manifold. The there single, tandem exhaust port outlet is lokated in the top face for ease of maintenance.

### Lubricating oil system

The engine lubricating oil system is completely integrated onto the engine. The lubricating oil pump is mounted directly on the free end of the crankcase and is driven from the camshaft gear drive. The plate-type oil cooler is mounted horizontally on top of the filter housing at the flywheel end of the engine. The duplex filter incorporates an integral oil thermostat. A deep oil sump has been designed to allow engine operation with extreme pitch and roll angles.

### Auxiliary drives

The water pumps (HT, LT and Sea water) lubricating oil and fuel oil pumps are all driven from the free end of the engine by gears housed in the pump drive casing.

### SaCoS<sub>one</sub> control system

The system undergoes testing at the factory together with the engine, ensuring minimum tuning and functional testing during ship commissioning.

### Governor

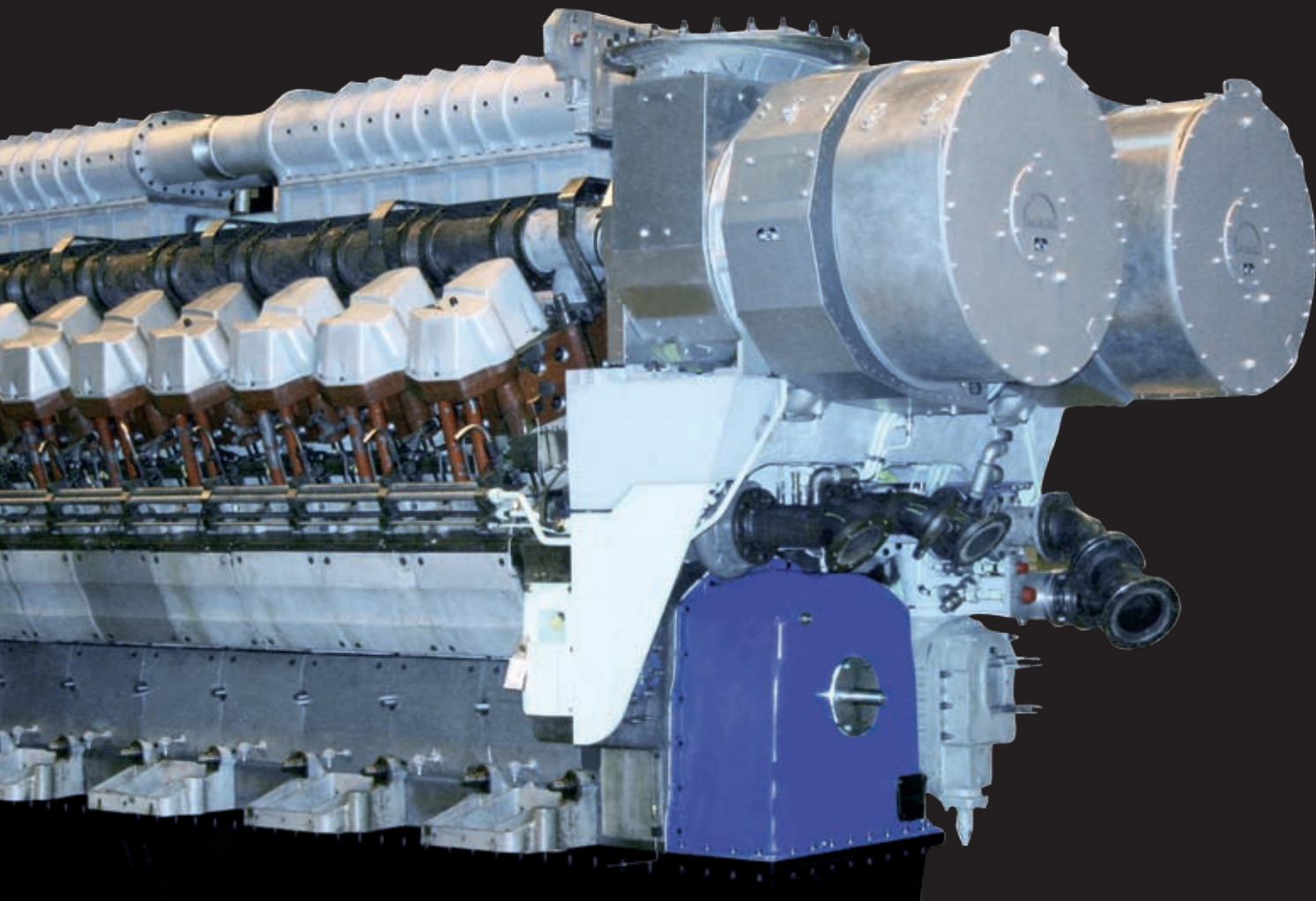
The engine employs a digital engine management system which controls the operation of the engine and communicates via a CAN bus link to a set of intelligent cylinder control modules that regulate the injector pumps and actuate the fuel injector solenoids. The system manages injection, timing and pressure based on a performance map.

### Charge air cooler

With the utilization of a two stage high efficient air cooler, the air temperature at cylinder inlet can be kept as low as required which has a positive influence on NO<sub>x</sub> emission and specific fuel consumption. The assembly is mounted directly on top of the air manifold to provide firm support. Particular attention has been paid to minimising overhangs on external brackets to reduce the impact of shock loadings in fast vessel and naval applications.

### Air manifold

The air manifold consist of a casting mounted inside the crankcase vee and incorporate passages for the lubricating oil and water systems.



## Rating notes

### Marine Propulsion

Ratings are for vessels of all types, and are in accordance with ISO 3046/1 as service standard power under IACS marine service conditions.

### IMO Marpol Annex VI

All marine engines can be supplied in compliance with Marpol Annex VI emission requirements.

### Mechanical Drive

These engines are rated to deliver power in accordance with ISO 3046-1 (BS 5514 Part 1).

Refer to MAN Diesel SE for derate outside these limits.

## Engine data for 28/33

### General

Engine cycle: four-stroke

Turbocharging system: MPC – TCA33

Number of cylinders: 12, 16, 20

Bore: 280 mm

Stroke: 330 mm

Swept volume per cyl: 20,32l

Mean Piston Speed: 11.0 m/s at 1,000 rpm

Rotation: Standard anti-clockwise, optional clockwise looking on the drive end

Aspiration: Turbocharged and intercooled

Fuel Spec: MARINE ~ BSMA 100 (ISO8217),

Class MGO/DMA or equivalent

INDUSTRIAL ~ BS2869

Nato fuel F75/F76 and MDO

Class A1 or A2, ASTM D975 no 2D.

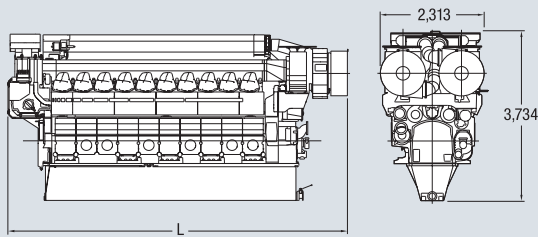
### Cylinder output (MCR)

455 kW/cyl. + 10%

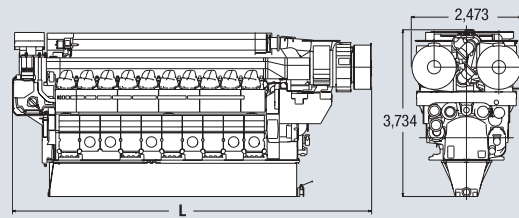
# Dimensions and Weights

## Engine specifications

V28/33D



V28/33D



### V-engine V28/33D

	Cyl. No.	Power kW	Speed rpm	L mm	Dry mass t**
12V28/33D	12	5,460	1,000	5,713	31.9
		6,000	1,032*		
16V28/33D	16	7,280	1,000	6,633	39.9
		8,000	1,032*		
20V28/33D	20	9,100	1,000	7,543	48.0
		10,000	1,032*		

For multi engine arrangement only.

Weight and performance parameters refer to engine with turning wheel, TC silenar, attached pumps, oil filters and lube oil cooler.

\* 110 % load for navy application and available vessels with approval according HSVR (High Speed Vessel Rules) from DNV 1h out of 6h of engine operating time on special request. Engine is EPA Tier 2 compliant.

\*\* Tolerance: 5 %

### V-engine V28/33D STC

	Cyl. No.	Power kW	Speed rpm	L mm	Dry mass t**
12V28/33D STC	12	5,460	1,000	6,207	33.6
		6,000	1,032*		
16V28/33D STC	16	7,280	1,000	7,127	41.6
		8,000	1,032*		
20V28/33D STC	20	9,100	1,000	8,047	49.5
		10,000	1,032*		

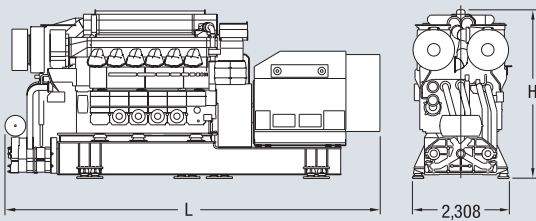
For multi engine arrangement only.

Weight and performance parameters refer to engine with turning wheel, TC silenar, attached pumps, oil filters and lube oil cooler.

\* 110 % load for navy application and available vessels with approval according HSVR (High Speed Vessel Rules) from DNV 1h out of 6h of engine operating time on special request. Engine is EPA Tier 2 compliant.

\*\* Tolerance: 5 %

## V28/33D GenSet



### V-engine V28/33D GenSet

	Cyl. No.	Power Gen. kW*	Speed rpm	L mm*	H mm	Dry mass t**
12V28/33D	12	5,296	1,000	9,000	4,040	66.0
		4,714	900			
16V28/33D	16	7,062	1,000	10,320	4,190	83.0
		6,286	900			
20V28/33D	20	8,827	1,000	11,640	4,390	101.0
		7,857	900			

\* Based on nominal generator efficiencies of 97 %. \*\* Tolerance: 5 %  
Engine is EPA Tier 2 compliant.

# World Class Service

## Marine propulsion and GenSets



### PrimeServ – peace of mind for life

With more than 150 PrimeServ service stations and service partners worldwide, plus our growing network of PrimeServ Academies, the MAN Diesel after-sales organisation is committed to maintaining the most efficient and accessible after-sales organisation in the business.

PrimeServ's aim is to provide:

- Prompt delivery of high demand OEM spare parts within 24 hours
- Fast, reliable and competent customer support.
- Individually tailored O&M contracts
- Ongoing training and qualification of service personnel.
- Global service, open 24 hours-a-day, 365 days-a-year
- Diagnosis and troubleshooting with our high performance Online Service.

### The PrimeServ Offering

Based on almost 110 years of service experience with marine Diesel engines, our sophisticated logistics system ensures that all frequently requested spare parts are available worldwide within 24 hours. In addition, MAN Diesel Online Service helps to optimise maintenance cycles by the use of remote engine monitoring, diagnostics and calibration. The resulting condition-based maintenance (CBM) promotes high availability, increases operational safety, shortens downtimes and enhances the performance of MAN Diesel marine engines.

The bottom line: leaner operating costs and better planning for you.

When service is required, the MAN Diesel PrimeServ network responds to organise assistance as fast as possible. This guarantees rapid completion of maintenance work and high availability of MAN Diesel engines, GenSets, turbochargers, gears, propellers and marine propulsion packages.

In short: MAN Diesel PrimeServ gives you the benefit of our specialist expertise in marine power so that you can concentrate on your own core business.



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