Marine Engine

IMO Tier II

Programme 3rd edition 2010

Engineering the Future – since 1758.

MAN Diesel & Turbo

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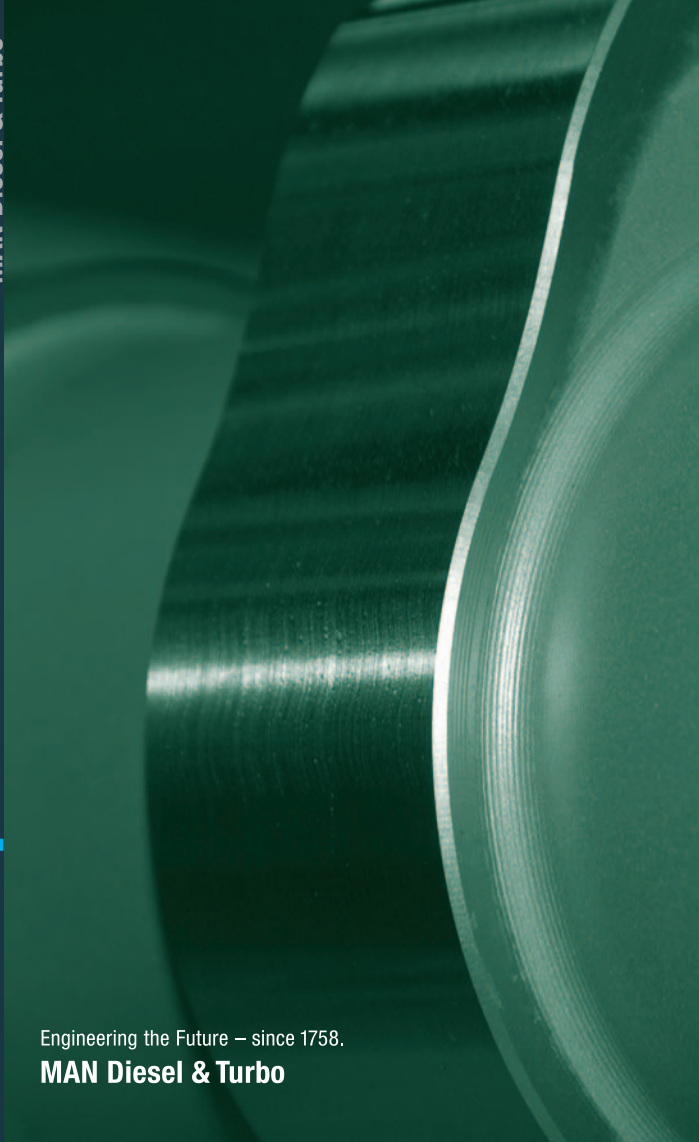

Engineering the Future – since 1758.

MAN Diesel & Turbo

MAN B&W Low Speed
Propulsion Engines

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MAN B&W Low Speed Propulsion Engines

MAN Diesel & Turbo Tier II Engine Programme
The International Maritime Organisation (IMO) has introduced tightened regulations on the emissions from main engines installed on ships with keel laying after 1 January 2011.

The latest engines in our Tier I programme are available as Tier II compliant engines with upgraded and optimised design and performance parameters. Also, a range of earlier engine models are available as Tier II optimised engines, as listed in the table on pages 46-48. Please note that some engines have a somewhat reduced layout area in the Tier II version. Information on dimensions and dry mass for these engines can be found in Project Guides.

Although this Tier II programme includes engines of the same type with different Mark numbers, it will always be an advantage to select the engine with the highest Mark number and then derate it to a lower Mark number that meets the power requirement.

The potential derating and part load SFOC figures for the Tier II engines have also been updated.

Generally, electronically controlled engines, ME types, will have an advantage in the Tier II environment.

ME Programme
The electronic control of the ME/ME-C/ME-B/-GI engines includes the combustion process, i.e. fuel injection timing, actuation of exhaust valves and starting valves, and cylinder lubrication. On the ME-B engines, the combustion process is electronically controlled while the actuation of exhaust valves and starting valves is mechanically controlled.

The benefits of the ME engines are:
- fuel optimised over a wide power range
- improved cylinder lube oil consumption
- improved low-load running
- adaptation to different fuel oil qualities
- better part load effiency.

As a standard integrated feature, the ME engines are specified with MAN B&W Alpha Cylinder Lubricators.

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Dual Fuel Engines
All ME/ME-C/ME-B engines are available for using natural gas as dual fuel engines with high pressure gas injection, designated ME-GI (Gas Injection). This engine programme includes the S70ME-C8-GI, S65ME-C8-GI, S60ME-C8-GI and S35ME-B9-GI. Power, speed and gross efficiency are the same as for the corresponding ME-C engines.

MC Programme
MAN B&W two-stroke MC/MC-C engines are characterised by having mechanically-driven camshaft-controlled timing of the fuel injection, the exhaust valves and the starting air valves. Only the fuel injection timing can be adjusted while the engine is running, if VIT fuel pumps are applied.

For MC/MC-C engines, the cylinder lubricators can be either of the electronic MAN B&W Alpha Cylinder Lubricators type or a mechanical type.

VIT Fuel Pumps for MC/MC-C IMO Tier II Engines, 50 Bore and Above
VIT (variable injection timing) fuel pumps, which are the standard on mechanically controlled MC/MC-C engine types, are able to control the engine p_{max} pressure (firing pressure) and, accordingly, ensure that the optimal combination of NO_x and SFOC can be obtained at all loads.

Engine Power
The engine brake power is stated in **kW**. For conversion between kW and metric horsepower, note that 1 bhp = 75 kpm/s = 0.7355 kW.

The power values stated in the tables are available up to tropical conditions at sea level, i.e.:

- blower inlet temperature 45 °C
- blower inlet pressure 1,000 mbar
- seawater temperature 32 °C

MAN B&W Low Speed Propulsion Engines

Specific Fuel Oil Consumption (SFOC)
The figures given in this folder represent the values obtained when the engine and turbocharger are matched with a view to obtaining the lowest possible SFOC values while also fulfilling the IMO NO_x Tier II emission limitations.

Stricter emission limits can be met on request, using proven technologies.

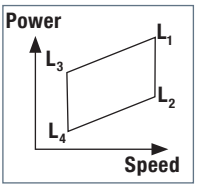
The SFOC figures are given in **g/kWh** with a tolerance of 5% and are based on the use of fuel with a lower calorific value of 42,700 kJ/kg (~10,200 kcal/kg) at ISO conditions:

- ambient air pressure 1,000 mbar
- ambient air temperature 25 °C
- cooling water temperature 25 °C

Most commercially available HFO with a viscosity below 700 cSt at 50 °C can be used.

Layout Diagram
The layout diagram applicable for the engines is defined by the power and speed combinations L_1 - L_2 - L_3 and L_4, with L_1 indicating the Nominal Maximum Continuous Rating.

Any combination of speed and power within the layout diagram may be used for selecting the Specified MCR point.



Fuel Consumption and Optimisation Possibilities
The current economic scenario has placed more emphasis on operational flexibility in terms of demand for improved part-load and low-load SFOC. As described below, different optimisation possibilities for the MAN B&W type engines have been developed.

NO_x regulations place a limit on the SFOC on two-stroke engines. In general, NO_x emissions will increase if SFOC is decreased and vice versa. In the standard configuration, the engines are optimised close to the IMO NO_x limit and, therefore, NO_x emissions may not be further increased.

The IMO NO_x limit is given as a weighted average of the NO_x emission at 25, 50, 75 and 100% load. This relationship can be utilised to tilt the SFOC profile over the load range. This means that SFOC can be reduced at part load and/or low load at the expense of a higher SFOC in the high-load range without exceeding the IMO NO_x limit.

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The tables below summarise the possibilities available with the MAN B&W type engines. All SFOC figures are relative to the SFOC at 100% load for a standard L_1 engine.

- ECT: Engine Control Tuning
- VT: Variable Turbine Area
- EGB: Exhaust Gas Bypass

SFOC optimised load range	Tuning methods	SFOC Change [g/kWh]				
		35%	50%	65%	80%	100%
High load (85–100%)	Standard L_1 engine	3.5	–1	–3.5	–3.5	0
Part load (50-85%)	ECT	2.5	–2	–4.5	–4.5	3
	VT	0.5	–4	–6.5	–4.5	0.5
	EGB	0.5	–4	–6.5	–4.5	1.5
Low load (25-70%)	ECT	1	–3.5	–6	–3.5	1.5
	VT	–1.5	–6	–8.5	–3.5	0.5
	EGB	–1.5	–6	–8.5	–3.5	1.5

Table 1: Optimisation possibilities – ME/ME-C engines, SMCR = L_1

SFOC optimised load range	Tuning methods	SFOC Change [g/kWh]				
		35%	50%	65%	80%	100%
High load (85-100%)	Standard L_1 engine	4	0	–2.5	–3	0
Part load (50-85%)	VT	2	–2	–4.5	–4	2
	EGB	2	–2	–4.5	–4	3
Low load (25-70%)	VT	1	–3	–5.5	–3	1
	EGB	1	–3	–5.5	–3	2

Table 2: Optimisation possibilities – MC/MC-C/ME-B engines, SMCR = L_1

For a specific L_1 engine, the SFOC profile can be found directly from the above tables. For example, an S70ME-C8.2 running at 65% load with an L_1 SFOC of 169 g/kWh and optimised for part load with VT tuning has a consumption of 169 –6.5 g/kWh = 162.5 g/kWh.

The above tuning methods are also available for derated engines with different SMCR. The standard SFOC profile vs. load is different for a derated engine, but the above difference between each tuning method and the standard engine will be the same.

Only high-load optimisation is possible for engines with conventional efficiency turbochargers.

The methods and options mentioned will be explained in the following.

MAN B&W Low Speed Propulsion Engines

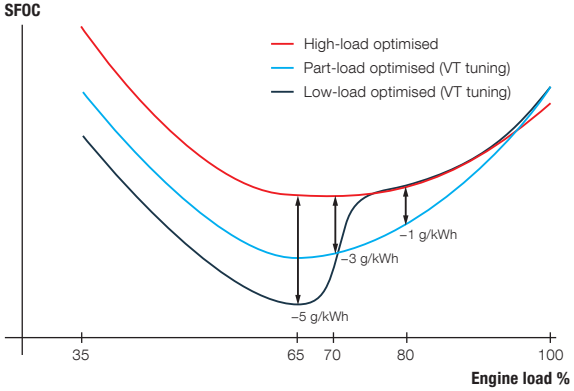


Fig. 1: ME/ME-C engines

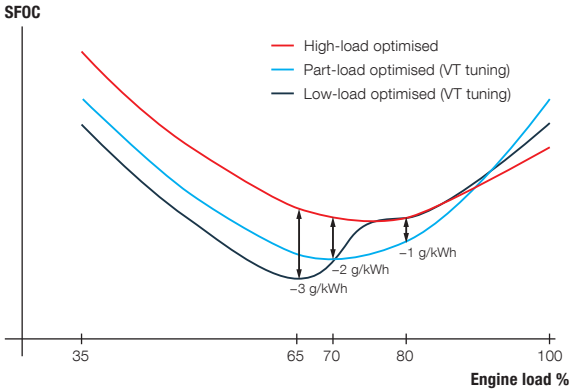


Fig. 2: MC/MC-C/ME-B engines

MAN B&W Low Speed Propulsion Engines

Engine Control Tuning – Only Available for ME/ME-C Type Engines
This method can be implemented without change of engine components, and it can be implemented as an engine running mode. Only engine control parameters are changed.

The method utilises the possibility for variable exhaust valve timing and injection timing and profiling.

Two different optimisation possibilities are available. With part-load optimisation, SFOC is decreased at all loads below 85%. With low-load optimisation, SFOC is further decreased at loads below 70%, however, at the expense of higher SFOC in the high-load range. Which option is optimal on a specific engine depends on the operating pattern.

Random shifting between the modes is not allowed by the authorities.
A mode shift in case of a change in trade pattern is permitted if reported and approved by the flag state representative, usually a classification society. Hence, on a longer term basis, the owner can select one or the other of the modes for the engine, provided the authorities are informed.

Variable Turbine Area – VT Technology (or similar)
This method requires special turbocharger parts allowing the turbocharger(s) on the engine to vary the area of the nozzle ring. The nozzle ring area is minimum at the lower engine load range. When the engine load is increased above approx. 80%, the area gradually starts to increase and reaches its maximum at 100% engine load. With this technology, SFOC is decreased at low load at the expense of higher SFOC at high load.

The VT technology is available for both the ME and MC type engines. The SFOC potential is better on the ME type engine, where VT is combined with variable exhaust valve timing.

For both the ME and MC type engines, two optimisation possibilities are available. With part-load optimisation, SFOC is decreased at all loads below 85%. With low-load optimisation, SFOC is further decreased at loads below 70%, at the expense of higher SFOC in the high-load range. Which option is optimal on a specific engine depends on the operating pattern.

MAN B&W Low Speed Propulsion Engines

Exhaust Gas Bypass (EGB)
This method requires installation of EGB. The turbocharger(s) on the engine are matched at 100% load with fully open EGB. At approximately 85% load, the EGB starts to close and is fully closed below 70% load. With this technology SFOC is decreased at low load, at the expense of higher SFOC at high load.

The EGB technology is available for both ME and MC type engines. The SFOC potential is better on the ME type engine, where EGB is combined with variable exhaust valve timing.

For both ME and MC type engines, two optimisation possibilities are available. With part-load optimisation, SFOC is decreased at all loads below 85%. With low-load optimisation, SFOC is further decreased at loads below 70%, at the expense of higher SFOC in the high-load range. Which option is optimal depends on the operating pattern.

Turbocharger (TC) cut-out
Besides the above-mentioned part-load and low-load methods (ECT, VT and EGB), turbocharger cut-out can be applied on MAN B&W engines. This method is mainly used on larger bore engines with two to four turbochargers. Many of the new container vessels in service with our K98 engines have TC cut-out installed.

At low load one (or two) TC is cut out, resulting in decreased SFOC. The majority of the cut-out systems use manually installed blinding plates, which assumes that owners expect operating at reduced speed for extended periods. As an option, semi-automatic cut-out valves can be installed reducing time for cut in or out to approx. 30 min. at dead slow or with stopped engine.

SFOC benefits are up to 7 g/kWh with TC cut-out at low load. The disadvantage is that engine load is limited when operating with TC cut-out.

MAN B&W Low Speed Propulsion Engines

Turbocharging System
Two-stroke low speed engines can be delivered with MAN, ABB or MHI turbochargers as standard.

The stated SFOC figures given in this folder for two-stroke engines are based on turbocharging with the best possible turbocharging efficiency generally available, i.e. 67% for all engines with 50 bore and above and 64% for engine bores smaller than 50 cm. Both efficiency figures refer to 100% specified MCR, at lower load the turbocharger efficiency will be even higher.

For more information see: www.mandieselturbo.com → 'Products' → 'Marine Engines & Systems' → 'Low Speed' → 'Turbocharger Selection'.

Waste Heat Recovery
Waste heat can be economically recovered from all MAN B&W two-stroke engines from 50 bore and up, by installing equipment for Waste Heat Recovery (WHR) and matching the engine for WHR.

A standard WHR-matched MAN B&W two-stroke engine will have a higher exhaust gas temperature compared with an engine without WHR, and can produce an extra electric power output corresponding to approx. 10% of the engine shaft power. Total system efficiency will therefore be better than that of the engine itself.

Dimensions
The minimum lengths L_{min} are stated from the aft end of the crankshaft to the fore end of the engine footprint.

H_1: normal lifting procedure
H_2: reduced height lifting procedure
H_3: with electric double jib crane
H_4: with manual double jib crane.

Dry masses
The masses are stated for engines with MAN turbocharger(s), and a standard turning wheel and can vary up to 10% depending on the design and options chosen, such as moment compensators, tuning wheel, etc.

MAN B&W Low Speed Propulsion Engines

Lubricating Oil Consumption

The system oil consumption varies for the different engine sizes and operational pattern. Typical consumptions are in the range from negligible to 0.1 g/kwh.

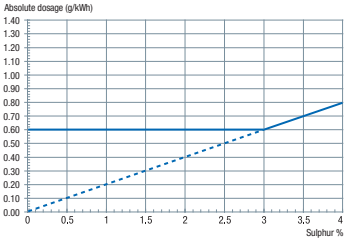
Specific Cylinder Oil Consumption

Alpha ACC (Adaptive Cylinder-oil Control) is the lubrication mode for MAN B&W two-stroke engines, i.e. lube oil dosing proportional to the engine load and proportional to the sulphur content in the fuel oil being burnt. The specific minimum dosage at lower-sulphur fuels is set at 0.6 g/kWh.

After a running-in period of 2,500 hours, the feed rate sulphur proportional factor is 0.20 g/kWh x S% for all engines with 60 bore and above and 0.26 g/kWh x S% for engine bores of 50 cm and below.

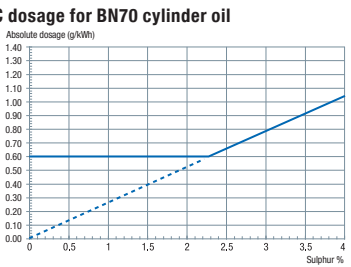
Engines with 60 bore and above - ACC dosage for BN70 cylinder oil

Based on calculations of the average worldwide sulphur content used on MAN B&W two-stroke engines, the average cylinder oil consumption will be less than 0.65 g/kWh.



Engines with 50 bore and below - ACC dosage for BN70 cylinder oil

Based on calculations of the average worldwide sulphur content used on MAN B&W two-stroke engines, the average cylinder oil consumption will be less than 0.7 g/kWh.



Further information on cylinder oil as a function of fuel oil sulphur content and alkalinity of lubricating oil is available from MAN Diesel & Turbo.

MAN B&W Low Speed Propulsion Engines

Extent of Delivery

The final and binding design of MAN B&W two-stroke engines is to be supplied by our licensee, the engine maker, who should be contacted in order to determine the execution for the actual project.

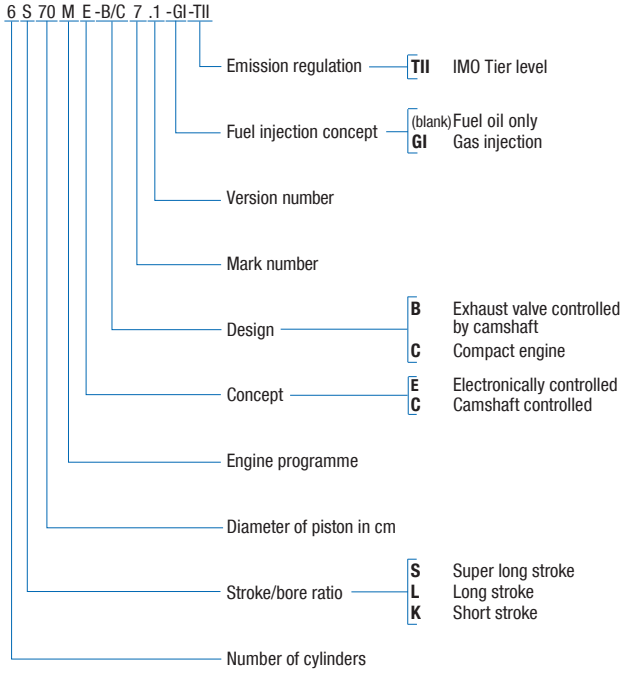
In order to facilitate negotiations between the yard, the engine maker and the customer, a set of 'Extent of Delivery' forms is available in which the basic and optional executions are specified.

CEAS - Engine Room Dimensioning

The CEAS program calculates basic data essential for the design and dimensioning of a ship's engine room. CEAS is available at www.mandieselturbo.com → 'Products' → 'Marine Engines & Systems' → 'Low Speed' → 'CEAS Engine Room Dimensions'.

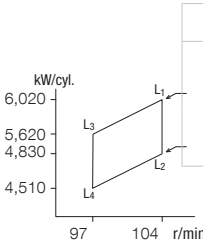
MAN B&W Low Speed Propulsion Engines

Engine Type Designation



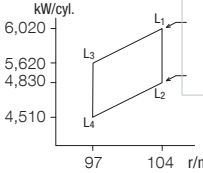
MAN B&W K98

	Cyl.	L_1 kW
ME-C7 Stroke: 2,400 mm	6	36,120
	7	42,140
	8	48,160
	9	54,180
	10	60,200
	11	66,220
	12	72,240
	14	84,280



MEP bar	SFOC g/kWh
	MCR
19.2	174
15.4	168

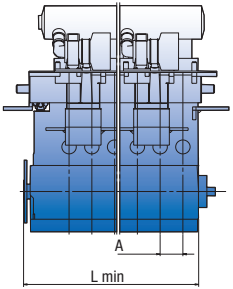
	Cyl.	L_1 kW
MC-C7 Stroke: 2,400 mm	6	36,120
	7	42,140
	8	48,160
	9	54,180
	10	60,200
	11	66,220
	12	72,240
	14	84,280

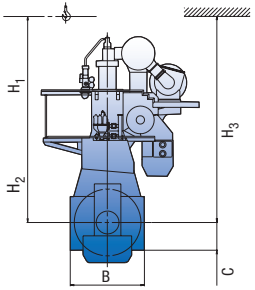


MEP bar	SFOC g/kWh
	MCR
19.2	177
15.4	171

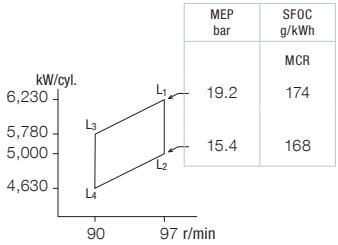
Please note:

- *In CEAS the above engines will have the designation K98ME-C7.1 and K98MC-C7.1*
- *The above Mark 7 engines can be delivered in Mark 6 rating with 1.5 g/kWh lower SFOC*
- *For part load and low load fuel consumptions please see pages 9-13.*

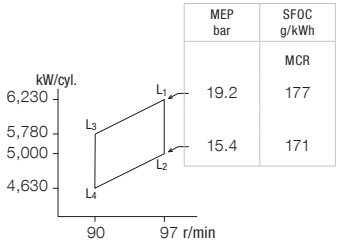




	Cyl.	L_1 kW
ME7	6	37,380
	7	43,610
	8	49,840
	9	56,070
Stroke:	10	62,300
2,660 mm	11	68,530
	12	74,760
	14	87,220



	Cyl.	L_1 kW
MC7	6	37,380
	7	43,610
	8	49,840
	9	56,070
Stroke:	10	62,300
2,660 mm	11	68,530
	12	74,760
	14	87,220



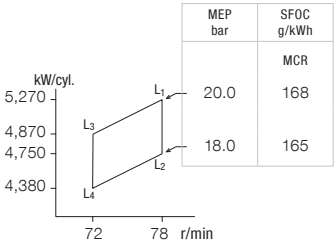
Please note:

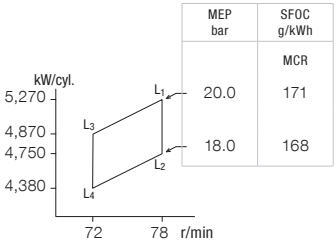
- *In CEAS the above engines will have the designation K98ME7.1 and K98MC7.1*
- *For part load and low load fuel consumptions please see pages 9-13.*

L_{min}:		6 cyl.	7 cyl.	8 cyl.	9 cyl.	10 cyl.	11 cyl.	12 cyl.	14 cyl.
Mark 7	mm	12,865	14,615	16,410	19,135	20,885	22,635	24,385	27,885
Dry mass:									
ME7	t	1,067	1,220	1,437	1,581	1,755	1,895	2,058	2,328
MC7	t	1,156	1,315	1,536	1,697	1,882	2,034	2,190	2,446
ME-C7	t	1,046	1,211	1,393	1,532	1,680	1,912	1,975	2,246
MC-C7	t	1,111	1,277	1,472	1,618	1,774	1,947	2,089	2,405

Dimensions:		A	B	C	H_1	H_2	H_3
ME7	mm	1,750	4,640	1,700	13,375	13,075	-
MC7	mm	1,750	4,640	1,700	13,400	13,125	13,100
ME-C7	mm	1,750	4,370	1,700	12,900	12,575	-
MC-C7	mm	1,750	4,370	1,700	12,825	-	12,650

MAN B&W S90

	Cyl.	L_1 kW	
ME-C8 Stroke: 3,188 mm	6 7 8 9	**31,620** **36,890** **42,160** **47,430**	

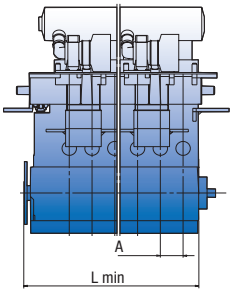
MC-C8 Stroke: 3,188 mm	6 7 8 9	**31,620** **36,890** **42,160** **47,430**	

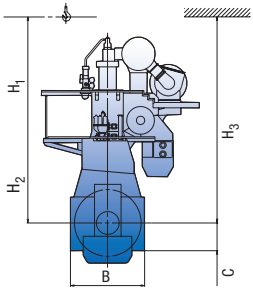
Please note:

- *In CEAS the above engines will have designation S90ME-C8.2 and S90MC-C8.2*
- *The above Mark 8 engines can be delivered in Mark 7 rating with 1.5 g/kWh lower SFOC.*
- *For part load and low load fuel consumptions please see pages 9-13.*

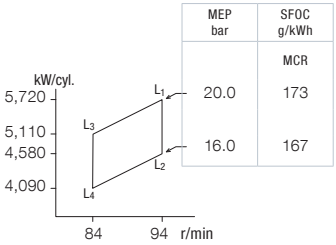
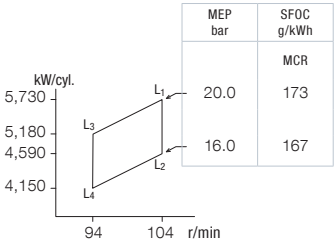
L_{min}:		6 cyl.	7 cyl.	8 cyl.	9 cyl.
Mark 8	mm	12,802	14,404	16,006	17,608
Dry mass:					
ME-C8	t	1,010	1,136	1,290	1,450
MC-C8	t	1,094	1,229	1,394	1,543

Dimensions:		A	B	C	H_1	H_2	H_3
ME-C8	mm	1,602	5,000	1,800	14,500	13,650	14,100
MC-C8	mm	1,602	5,000	1,800	14,500	13,525	14,275





MAN B&W K90

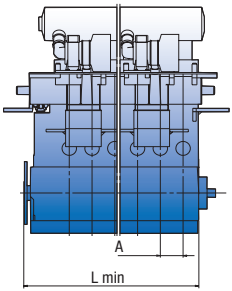
	Cyl.	L_1 kW	
ME9 Stroke: 2,870 mm	6 7 8 9 10 11 12	**34,320** **40,040** **45,760** **51,480** **57,200** **62,920** **68,640**	
ME-C9 Stroke: 2,600 mm	6 7 8 9 10 11 12	**34,380** **40,110** **45,840** **51,570** **57,300** **63,030** **68,760**	

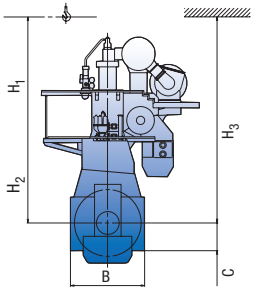
Please note:

- *In CEAS the above engines will have the designation K90ME9.2 and K90ME-C9.2*
- *K90MC9 and K90MC-C9 are available on request*
- *For part load and low load fuel consumptions please see pages 9-13.*

L_{min}:		6 cyl.	7 cyl.	8 cyl.	9 cyl.	10 cyl.	11 cyl.	12 cyl.
Mark 9	mm	11,210	12,690	14,170	17,360	19,056	20,536	22,124
Dry mass:								
ME9	t	945	1,070	1,200	1,400	1,560	1,685	1,820
ME-C9	t	905	1,025	1,150	1,340	1,490	1,615	1,740

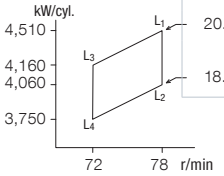
Dimensions:		A	B	C	H_1	H_2	H_3
ME9	mm	*	4,936	1,750	Data is available on request		
ME-C9	mm	*	4,760	1,700	Data is available on request		
** Cyl. distance*		*6-8 cyl.*	*9 cyl.*	*10 cyl.*	*11 cyl.*	*12 cyl.*	
	mm	*1,480*	*1-6:1,480*	*1-5:1,480*	*1-6:1,480*	*1-6:1,480*	
	mm	-	*7-9:1,588*	*6-10:1,588*	*7-11:1,588*	*7-12:1,588*	





MAN B&W S80

	Cyl.	L_1 kW
ME-C9	6	**27,060**
	7	**31,570**
Stroke: 3,450 mm	8	**36,080**
	9	**40,590**



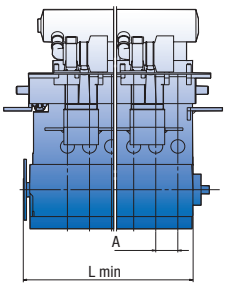
MEP bar	SFOC g/kWh
	MCR
20.0	168
18.0	165

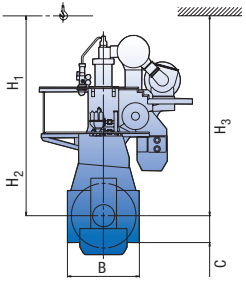
Please note:

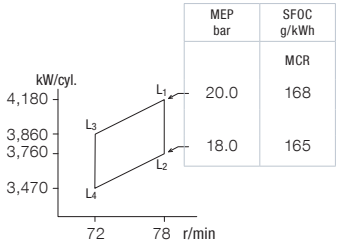
- *In CEAS the above engine will have the designation S80ME-C9.2*
- *For part load and low load fuel consumptions please see pages 9-13.*

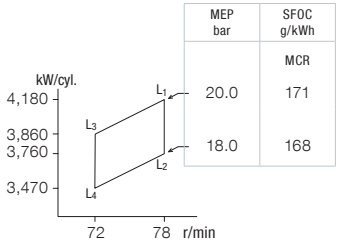
L_{min}:		6 cyl.	7 cyl.	8 cyl.	9 cyl.
Mark 9	mm	10,100	11,434	12,768	14,102
Mark 8	mm	11,431	12,855	14,279	-
Dry mass:					
ME-C9	t	800	910	1,020	1,130
ME-C8	t	820	922	1,023	-
MC-C8	t	866	967	1,092	-

Dimensions:		A	B	C	H_1	H_2	H_3
ME-C9	mm	1,334	5,280	1,900	15,050	13,925	13,500
ME/MC-C8	mm	1,424	5,000	1,736	14,325	13,175	12,950



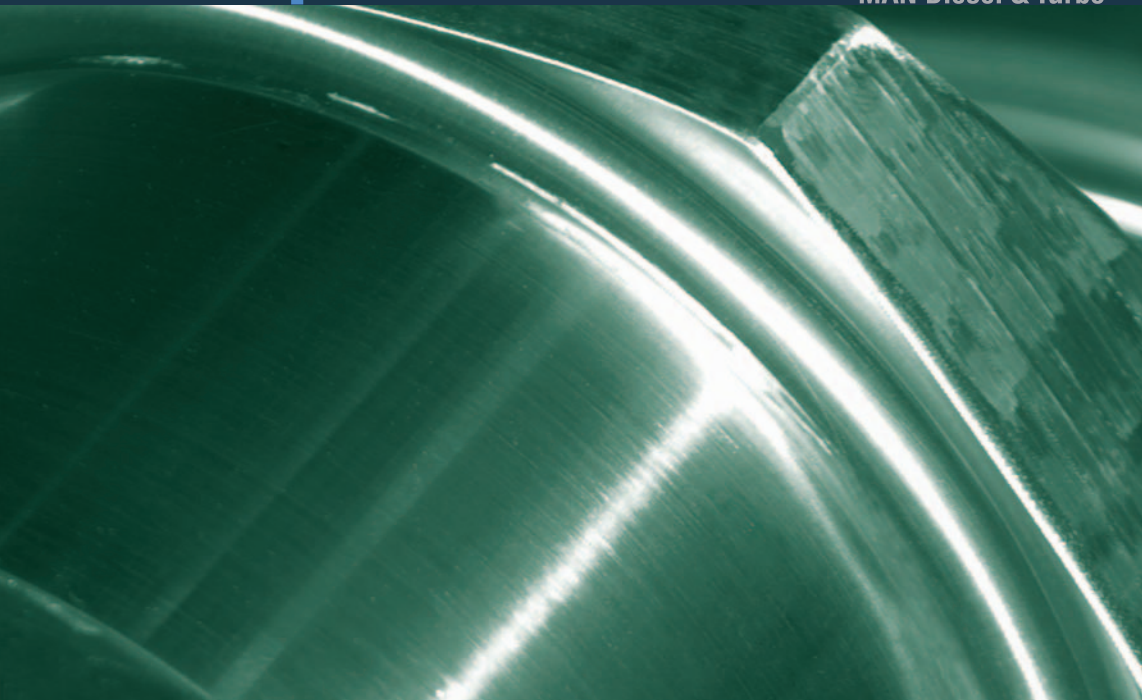


	Cyl.	L_1 kW	
ME-C8 Stroke: 3,200 mm	6 7 8	**25,080** **29,260** **33,440**	

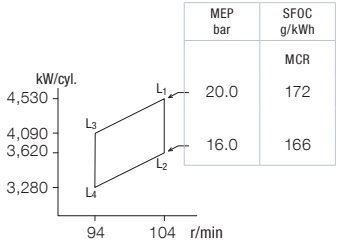
	Cyl.	L_1 kW	
MC-C8 Stroke: 3,200 mm	6 7 8	**25,080** **29,260** **33,440**	

Please note:

- *In CEAS the above engines will have the designation S80ME-C8.2 and S80MC-C8.2*
- *S80MC-C9 is available on request.*
- *The above Mark 8 engines can be delivered in Mark 7 rating with 1.5 g/kWh lower SFOC.*
- *For part load and low load fuel consumptions please see pages 9-13.*



	Cyl.	L_1 kW
ME-C9	6	**27,180**
	7	**31,710**
	8	**36,240**
Stroke:	9	**40,770**
2,600 mm	10	**45,300**
	11	**49,830**
	12	**54,360**

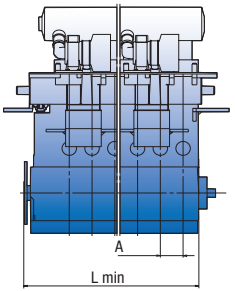


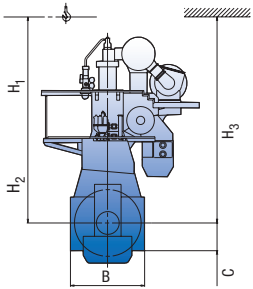
Please note:

- *In CEAS the above engine will have the designation K80ME-C9.2*
- *K80MC-C9 is available on request*
- *For part load and low load fuel consumptions please see pages 9-13.*

L_{min}:		6 cyl.	7 cyl.	8 cyl.	9 cyl.	10 cyl.	11 cyl.	12 cyl.
Mark 9	mm	10,100	11,434	12,768	14,102	16,676	18,010	19,344
Dry mass:								
ME-C9	t	705	790	890	985	1,130	1,220	1,315

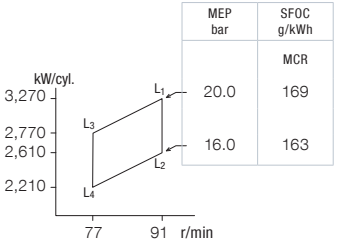
Dimensions:		A	B	C	H_1	H_2	H_3
ME-C9	mm	1,334	4,480	1,650	12,400	11,825	11,675



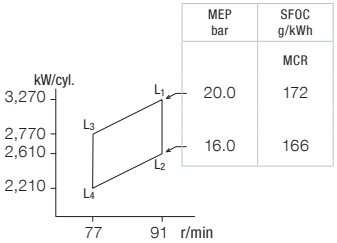


MAN B&W S70

	Cyl.	L_1 kW
ME-C8 **ME-C8-GI** Stroke: 2,800 mm	5 6 7 8	**16,350** **19,620** **22,890** **26,160**



	Cyl.	L_1 kW
MC-C8 Stroke: 2,800 mm	5 6 7 8	**16,350** **19,620** **22,890** **26,160**

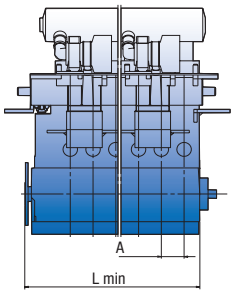


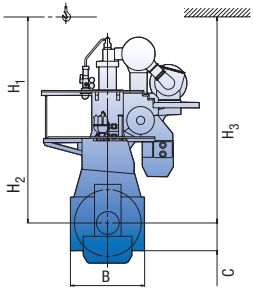
Please note:

- *In CEAS the above engines will have the designation S70ME-C8.2, S70ME-C8.2-GI and S70MC-C8.1*
- *The above Mark 8 engines can be delivered in Mark 7 rating with 1.5 g/kWh lower SFOC.*
- *4-cylinder engines are available on request*
- *For part load and low load fuel consumptions please see pages 9-13.*

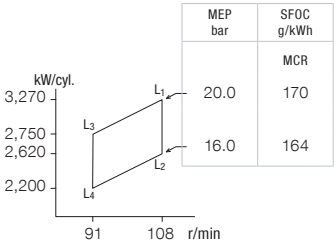
L_{min}:		5 cyl.	6 cyl.	7 cyl.	8 cyl.
Mark 8	mm	8,308	9,498	10,688	11,878
Dry mass:					
ME-C8/-GI	t	451	534	605	681
MC-C8	t	495	569	624	704

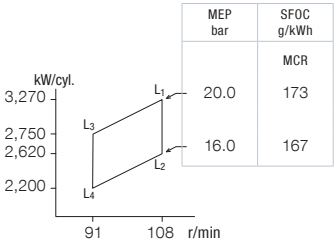
Dimensions:		A	B	C	H_1	H_2	H_3
ME-C8/-GI	mm	1,190	4,390	1,520	12,550	11,675	11,475
MC-C8	mm	1,190	4,390	1,520	12,475	11,675	11,425





MAN B&W L70

	Cyl.	L_1 kW	
ME-C8 Stroke: 2,360 mm	5 6 7 8	**16,350** **19,620** **22,890** **26,160**	

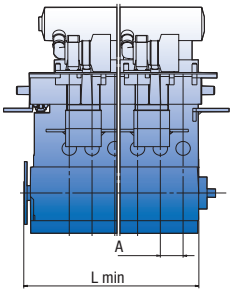
MC-C8 Stroke: 2,360 mm	5 6 7 8	**16,350** **19,620** **22,890** **26,160**	

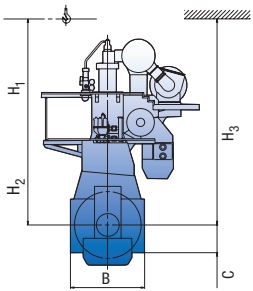
Please note:

- *In CEAS the above engines will have the designation L70ME-C8.2 and L70MC-C8.2*
- *The above Mark 8 engines can be delivered in Mark 7 rating with 1.5 g/kWh lower SFOC.*
- *4-cylinder engines are available on request*
- *For part load and low load fuel consumptions please see pages 9-13.*

L_{min}:		5 cyl.	6 cyl.	7 cyl.	8 cyl.
Mark 8	mm	7,639	8,829	10,019	11,209
Dry mass:					
ME-C8	t	437	506	569	642
MC-C8	t	465	501	586	683

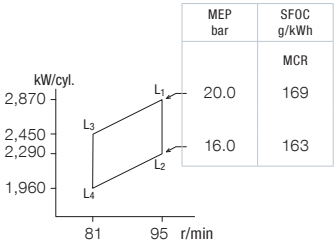
Dimensions:		A	B	C	H_1	H_2	H_3
ME-C8	mm	1,190	3,980	1,262	11,250	10,550	10,575
MC-C8	mm	1,190	3,980	1,262	11,250	10,475	10,475





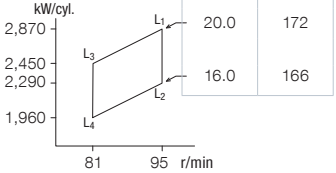
MAN B&W S65

	Cyl.	L_1 kW
ME-C8 **ME-C8-GI** Stroke: 2,730 mm	5 6 7 8	**14,350** **17,220** **20,090** **22,960**



MEP bar	SFOC g/kWh
	MCR
20.0	169
16.0	163

	Cyl.	L_1 kW
MC-C8 Stroke: 2,730 mm	5 6 7 8	**14,350** **17,220** **20,090** **22,960**



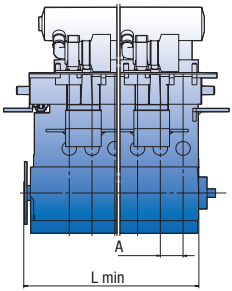
MEP bar	SFOC g/kWh
	MCR
20.0	172
16.0	166

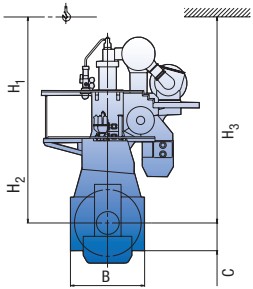
Please note:

- *In CEAS the above engines will have the designation S65ME-C8.2, S65ME-C8.2-GI and S65MC-C8.2*
- *4-cylinder engines are available on request*
- *For part load and low load fuel consumptions please see pages 9-13.*

L_{min}:		5 cyl.	6 cyl.	7 cyl.	8 cyl.
Mark 8	mm	7,068	8,152	9,236	10,320
Dry mass:					
ME-C8/-GI	t	382	451	512	575
MC-C8	t	401	474	538	604

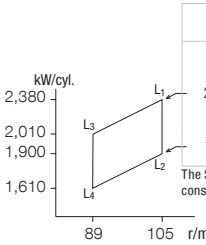
Dimensions:		A	B	C	H_1	H_2	H_3
ME-C8/-GI	mm	1,084	4,124	1,410	11,950	11,225	11,025
MC-C8	mm	Data is available on request					





MAN B&W S60

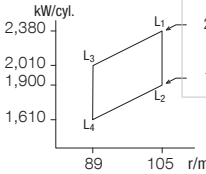
	Cyl.	L_1 kW
ME-B8 Stroke: 2,400 mm	5 6 7 8	**11,900** **14,280** **16,660** **19,040**



MEP bar	SFOC g/kWh
	MCR
20.0	168
16.0	162

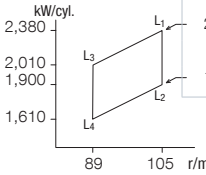
The SFOC excludes 1 g/kWh for the consumption of the electric HPS

ME-C8 **ME-C8-GI** Stroke: 2,400 mm	5 6 7 8	**11,900** **14,280** **16,660** **19,040**



MEP bar	SFOC g/kWh
	MCR
20.0	169
16.0	163

MC-C8 Stroke: 2,400 mm	5 6 7 8	**11,900** **14,280** **16,660** **19,040**



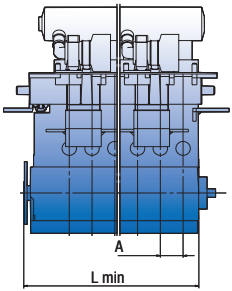
MEP bar	SFOC g/kWh
	MCR
20.0	172
16.0	166

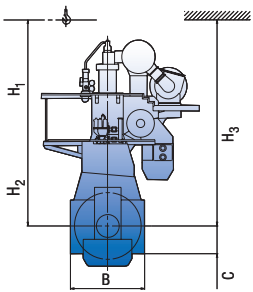
Please note:

- *In CEAS the above engines will have the designation S60ME-B8.2, S60ME-C8.2, S60ME-C8.2-GI and S60MC-C8.2*
- *The above Mark 8 engines can be delivered in Mark 7 rating with 1.5 g/kWh lower SFOC.*
- *4-cylinder engines are available on request*
- *For part load and low load fuel consumptions please see pages 9-13.*

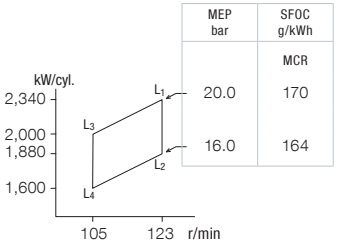
L_{min}:		5 cyl.	6 cyl.	7 cyl.	8 cyl.
Mark 8	mm	7,122	8,142	9,162	10,182
Dry mass:					
ME-B8	t	*Not yet available*			
ME-C8/-GI	t	321	366	414	463
MC-C8	t	324	368	410	467

Dimensions:½		A	B	C	H_1	H_2	H_3
ME-B8	mm	1,020	3,770	1,300	10,750	10,000	9,725
ME-C8/-GI	mm	1,020	3,770	1,300	10,750	10,000	9,725
MC-C8	mm	1,020	3,770	1,300	10,700	10,050	9,800

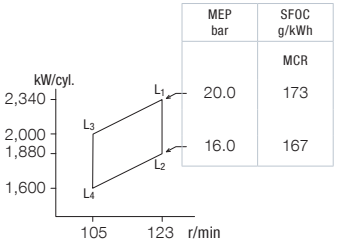




MAN B&W L60

	Cyl.	L_1 kW	
ME-C8 Stroke: 2,022 mm	5 6 7 8 9	**11,700** **14,040** **16,380** **18,720** **21,060**	

MEP bar	SFOC g/kWh
	MCR
20.0	170
16.0	164

MC-C8 Stroke: 2,022 mm	5 6 7 8 9	**11,700** **14,040** **16,380** **18,720** **21,060**	

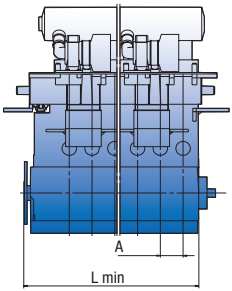
MEP bar	SFOC g/kWh
	MCR
20.0	173
16.0	167

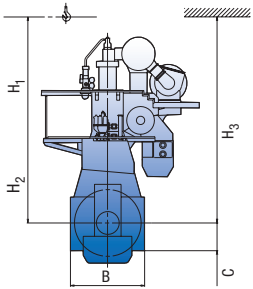
Please note:

- *In CEAS the above engines will have the designation L60ME-C8.2 and L60MC-C8.2*
- *The above Mark 8 engines can be delivered in Mark 7 rating with 1.5 g/kWh lower SFOC.*
- *4-cylinder engines are available on request*
- *For part load and low load fuel consumptions please see pages 9-13.*

L_{min}:		5 cyl.	6 cyl.	7 cyl.	8 cyl.	9 cyl.
Mark 8	mm	7,122	8,142	9,162	10,182	11,202
Dry mass:						
ME-C8	t	286	326	354	426	479
MC-C8	t	304	347	397	453	510

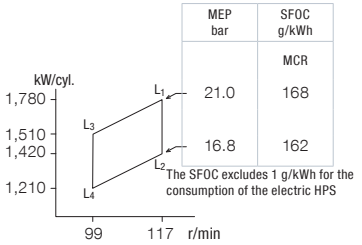
Dimensions:		A	B	C	H_1	H_2	H_3
ME-C8	mm	1,020	3,490	1,134	9,675	9,125	8,925
MC-C8	mm	1,020	3,228	1,134	9,675	9,125	8,925





MAN B&W S50

	Cyl.	L_1 kW
ME-B9 Stroke: 2,214 mm	5	**8,900**
	6	**10,680**
	7	**12,460**
	8	**14,240**
	9	**16,020**

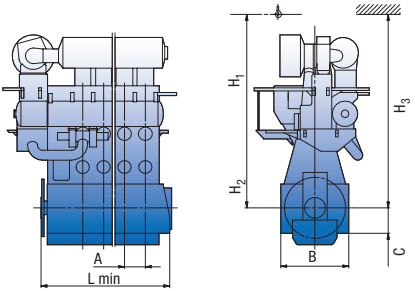


Please note:

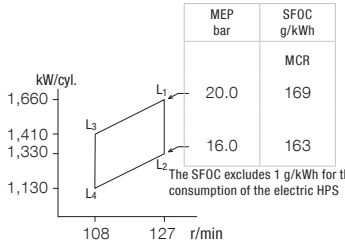
- *In CEAS the above engines will have the designation S50ME-B9.2*
- *4-cylinder engines are available on request*
- *For part load and low load fuel consumptions please see pages 9-13.*

L_{min}:		5 cyl.	6 cyl.	7 cyl.	8 cyl.	9 cyl.
Mark 9	mm	6,325	7,200	8,075	8,950	9,825
Mark 8	mm	5,924	6,774	7,624	8,474	9,324
Mark 8	mm	5,924	6,774	7,624	8,474	9,324
Dry mass:						
ME-B9	t	194	225	257	289	321
ME-B8	t	189	215	241	276	314
ME-C8	t	180	211	241	271	293
MC-C8	t	186	212	238	273	311

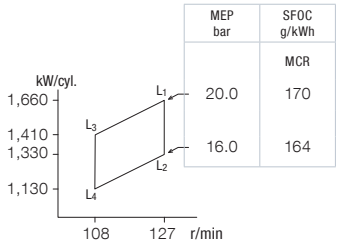
Dimensions:		A	B	C	H_1	H_2	H_3
ME-B9	mm	875	3,290	1,185	9,775	9,125	8,900
ME-B8	mm	850	3,150	1,088	9,000	8,475	8,250
ME-C8/MCC-8	mm	850	3,150	1,085	9,000	8,475	8,250



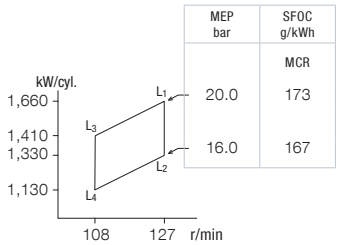
	Cyl.	L_1 kW
ME-B8 Stroke: 2,000 mm	5 6 7 8 9	**8,300** **9,960** **11,620** **13,280** **14,940**



	Cyl.	L_1 kW
ME-C8 Stroke: 2,000 mm	5 6 7 8 9	**8,300** **9,960** **11,620** **13,280** **14,940**



	Cyl.	L_1 kW
MC-C8 Stroke: 2,000 mm	5 6 7 8 9	**8,300** **9,960** **11,620** **13,280** **14,940**

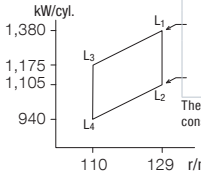


Please note:

- *In CEAS the above engines will have the designation S50ME-B8.2, S50ME-C8.2, and S50MC-C8.2*
- *The above Mark 8 engines can be delivered in Mark 7 rating with 1.5 g/kWh lower SFOC.*
- *4-cylinder engines are available on request*
- *For part load and low load fuel consumptions please see pages 9-13.*

MAN B&W S46

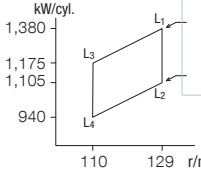
	Cyl.	L_1 kW
ME-B8 Stroke: 1,932 mm	5 6 7 8	**6,900** **8,280** **9,660** **11,040**



MEP bar	SFOC g/kWh
	MCR
20.0	170
16.0	164

The SFOC excludes 1 g/kWh for the consumption of the electric HPS

	Cyl.	L_1 kW
MC-C8 Stroke: 1,932 mm	5 6 7 8	**6,900** **8,280** **9,660** **11,040**



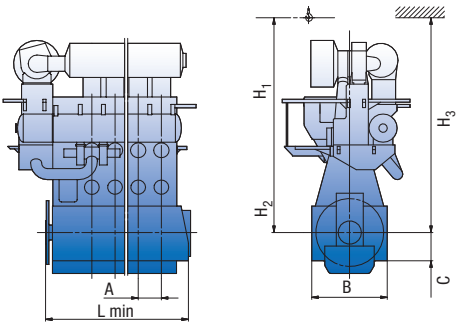
MEP bar	SFOC g/kWh
	MCR
20.0	174
16.0	168

Please note:

- *In CEAS the above engines will have the designation S46ME-B8.2 and S46MC-C8.2*
- *The above Mark 8 engines can be delivered in Mark 7 rating with 1.5 g/kWh lower SFOC.*
- *4-cylinder engines are available on request*
- *For part load and low load fuel consumptions please see pages 9-13.*

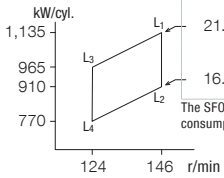
L_{min}:		5 cyl.	6 cyl.	7 cyl.	8 cyl.
Mark 8	mm	5,528	6,310	7,092	7,874
Dry mass:					
ME-B8	t	159	177	199	219
MC-C8	t	157	175	197	217

Dimensions:		A	B	C	H_1	H_2	H_3
ME-B/MC-C8	mm	782	2,924	986	9,000	8,175	7,900



MAN B&W S40

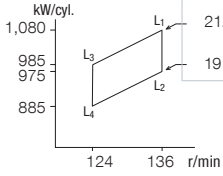
	Cyl.	L_1 kW
ME-B9 Stroke: 1,770 mm	5 6 7 8	**5,675** **6,810** **7,945** **9,080**



MEP bar	SFOC g/kWh
	MCR
21.0	174
16.8	170

The SFOC excludes 1 g/kWh for the consumption of the electric HPS

	Cyl.	L_1 kW
MC-C9 Stroke: 1,770 mm	5 6 7 8	**5,400** **6,480** **7,560** **8,640**



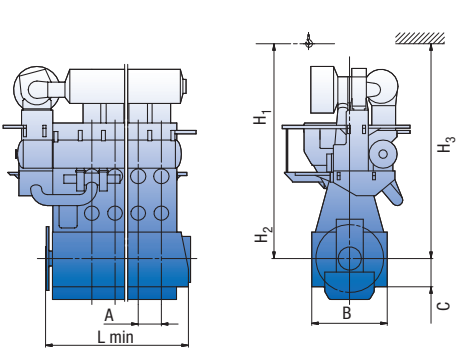
MEP bar	SFOC g/kWh
	MCR
21.4	177
19.3	173

Please note:

- *In CEAS the above engines will have the designation S40ME-B9.2 and S40MC-C9.2*
- *4-cylinder engines are available on request*
- *For part load and low load fuel consumptions please see pages 9-13.*

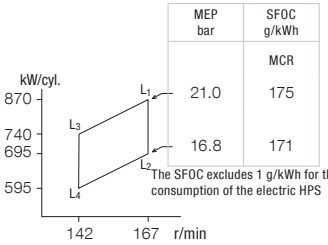
L_{min}:		5 cyl.	6 cyl.	7 cyl.	8 cyl.
Mark 9	mm	5,000	5,700	6,400	7,100
Dry mass:					
ME-B/MC-C9	t	112	131	148	163

Dimensions:		A	B	C	H_1	H_2	H_3
ME-B/MC-C9	mm	700	2,590	950	7,800	7,475	7,200

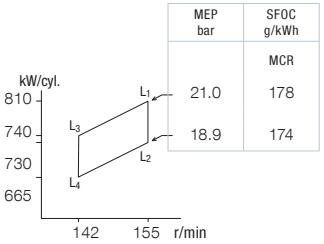


MAN B&W S35

	Cyl.	L_1 kW
ME-B9 **ME-B9-GI** Stroke: 1,550 mm	5 6 7 8	**4,350** **5,220** **6,090** **6,960**



	Cyl.	L_1 kW
MC-C9 Stroke: 1,550 mm	5 6 7 8	**4,050** **4,860** **5,670** **6,480**

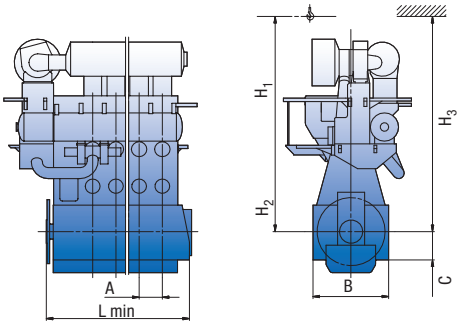


Please note:

- *In CEAS the above engines will have the designation S35ME-B9.2 and S35MC-C9.2*
- *4-cylinder engines are available on request*
- *For part load and low load fuel consumptions please see pages 9-13.*

L_{min}:		5 cyl.	6 cyl.	7 cyl.	8 cyl.
Mark 9	mm	4,378	4,990	5,602	6,214
Dry mass:					
ME-B/ ME-B9-GI/ MC-C9	t	81	90	99	111

Dimensions:		A	B	C	H_1	H_2	H_3
ME-B/ ME-B9-GI/ MC-C9	mm	612	2,265	830	6,875	6,700	6,325



Other MAN B&W Tier II engines

K98ME/MC6	6-12 and 14 cyl.		L_1	L_2	L_3	L_4
Bore: 980 mm	Power/cyl.	kW	5,720	4,590	5,110	4,100
Stroke: 2,660 mm	RPM	rpm	94	94	84	84
K98ME6	SFOC	g/kWh	174	168	174	168
K98MC6	SFOC	g/kWh	177	171	177	171

K98ME-C/MC-C6	6-12 and 14 cyl.		L_1	L_2	L_3	L_4
Bore: 980 mm	Power/cyl.	kW	5,710	4,580	5,160	4,140
Stroke: 2,400 mm	RPM	rpm	104	104	94	94
K98ME-C6	SFOC	g/kWh	174	168	174	168
K98MC-C6	SFOC	g/kWh	177	171	177	171

S90ME-C/MC-C7	6-9 cyl.		L_1	L_2	L_3	L_4
Bore: 900 mm	Power/cyl.	kW	4,890	3,920	3,930	3,140
Stroke: 3,188 mm	RPM	rpm	76	76	61	61
S90ME-C7	SFOC	g/kWh	170	164	170	164
S90MC-C7	SFOC	g/kWh	173	167	173	167

K90ME-C/MC-C6	6-12 cyl.		L_1	L_2	L_3	L_4
Bore: 900 mm	Power/cyl.	kW	4,570	3,650	3,910	3,130
Stroke: 2,300 mm	RPM	rpm	104	104	89	89
K90ME-C6	SFOC	g/kWh	174	168	168	168
K90MC-C6	SFOC	g/kWh	177	171	177	171

S80ME-C/MC-C7	6-8 cyl.		L_1	L_2	L_3	L_4
Bore: 800 mm	Power/cyl.	kW	3,880	3,100	2,910	2,320
Stroke: 3,200 mm	RPM	rpm	76	76	57	57
S80ME-C7	SFOC	g/kWh	170	164	170	164
S80MC-C7	SFOC	g/kWh	173	167	173	167

S80MC6	5-8 cyl.		L_1	L_2	L_3	L_4
Bore: 800 mm	Power/cyl.	kW	3,640	2,910	2,720	2,180
Stroke: 3,056 mm	RPM	rpm	79	79	59	59
S80MC6	SFOC	g/kWh	174	168	174	168

K80ME-C/MC-C6	6-12 cyl.		L_1	L_2	L_3	L_4
Bore: 800 mm	Power/cyl.	kW	3,610	2,890	3,090	2,470
Stroke: 2,300 mm	RPM	rpm	104	104	89	89
K80ME-C6	SFOC	g/kWh	174	168	174	168
K80MC-C6	SFOC	g/kWh	177	171	177	171

Please note:

- *In CEAS the above engines will have the designation xxxxx7.1 and xxxx6.1*

Other MAN B&W Tier II engines

S70ME-C/MC-C7	5-8 cyl.		L_1	L_2	L_3	L_4
Bore: 700 mm	Power/cyl.	kW	3,110	2,480	2,320	1,860
Stroke: 2,800 mm	RPM	rpm	91	91	68	68
S70ME-C7	SFOC	g/kWh	171	165	171	165
S70MC-C7	SFOC	g/kWh	174	168	174	168

S70MC6	5-8 cyl.		L_1	L_2	L_3	L_4
Bore: 700 mm	Power/cyl.	kW	2,810	2,250	2,100	1,680
Stroke: 2,674 mm	RPM	rpm	91	91	68	68
S70MC6	SFOC	g/kWh	175	169	175	169

L70ME-C/MC-C7	5-8 cyl.		L_1	L_2	L_3	L_4
Bore: 700 mm	Power/cyl.	kW	3,110	2,480	2,620	2,090
Stroke: 2,360 mm	RPM	rpm	108	108	91	91
L70ME-C7	SFOC	g/kWh	172	166	172	166
L70MC-C7	SFOC	g/kWh	175	169	175	169

S60ME-C/MC-C7	5-8 cyl.		L_1	L_2	L_3	L_4
Bore: 600 mm	Power/cyl.	kW	2,260	1,810	1,700	1,360
Stroke: 2,400 mm	RPM	rpm	105	105	79	79
S60ME-C7	SFOC	g/kWh	171	165	171	165
S60MC-C7	SFOC	g/kWh	174	168	174	168

S60MC6	5-8 cyl.		L_1	L_2	L_3	L_4
Bore: 600 mm	Power/cyl.	kW	2,040	1,630	1,540	1,230
Stroke: 2,292 mm	RPM	rpm	105	105	79	79
S60MC6	SFOC	g/kWh	175	169	175	169

L60ME-C/MC-C7	5-9 cyl.		L_1	L_2	L_3	L_4
Bore: 600 mm	Power/cyl.	kW	2,230	1,780	1,900	1,520
Stroke: 2,022 mm	RPM	rpm	123	123	105	105
L60ME-C7	SFOC	g/kWh	172	166	172	166
L60MC-C7	SFOC	g/kWh	175	169	175	169

S50ME-C/MC-C7	5-9 cyl.		L_1	L_2	L_3	L_4
Bore: 500 mm	Power/cyl.	kW	1,580	1,260	1,180	950
Stroke: 2,000 mm	RPM	rpm	127	127	95	95
S50ME-C7	SFOC	g/kWh	172	166	172	166
S50MC-C7	SFOC	g/kWh	175	169	175	169

Please note:

- *In CEAS the above engines will have the designation xxxxx7.1 and xxxx6.1*

Other MAN B&W Tier II engines

S50MC6	5-8 cyl.		L_1	L_2	L_3	L_4
Bore: 500 mm	Power/cyl.	kW	1,430	1,140	1,070	860
Stroke: 1,910 mm	RPM	rpm	127	127	95	95
S50MC6	SFOC	g/kWh	176	170	176	170

S46MC-C7	5-8 cyl.		L_1	L_2	L_3	L_4
Bore: 460 mm	Power/cyl.	kW	1,310	1,050	1,100	880
Stroke: 1,932 mm	RPM	rpm	129	129	108	108
S46MC-C7	SFOC	g/kWh	177	173	177	173

S42MC7	5-12 cyl.		L_1	L_2	L_3	L_4
Bore: 420 mm	Power/cyl.	kW	1,080	865	915	730
Stroke: 1,764 mm	RPM	rpm	136	136	115	115
S42MC7	SFOC	g/kWh	179	175	179	175

S35MC7	5-12 cyl.		L_1	L_2	L_3	L_4
Bore: 350 mm	Power/cyl.	kW	740	595	630	505
Stroke: 1,400 mm	RPM	rpm	173	173	147	147
S35MC7	SFOC	g/kWh	179	175	179	175

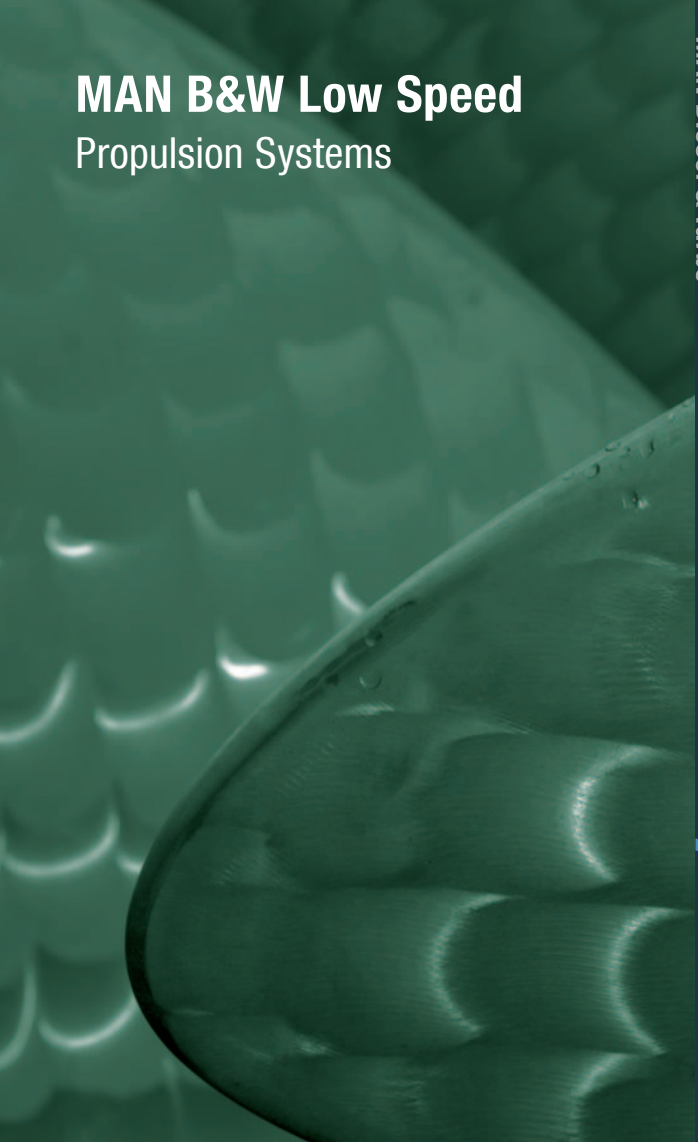
L35MC6	5-12 cyl.		L_1	L_2	L_3	L_4
Bore: 350 mm	Power/cyl.	kW	650	520	550	440
Stroke: 1,050 mm	RPM	rpm	210	210	178	178
L35MC6	SFOC	g/kWh	179	175	179	175

S26MC6	5-12 cyl.		L_1	L_2	L_3	L_4
Bore: 260 mm	Power/cyl.	kW	400	320	340	270
Stroke: 980 mm	RPM	rpm	250	250	212	212
S26MC6	SFOC	g/kWh	181	177	181	177

Please note:

- *In CEAS the above engines will have the designation xxxxx7.1 and xxxx6.1*

MAN B&W Low Speed
Propulsion Systems



MAN B&W Low Speed Propulsion Systems

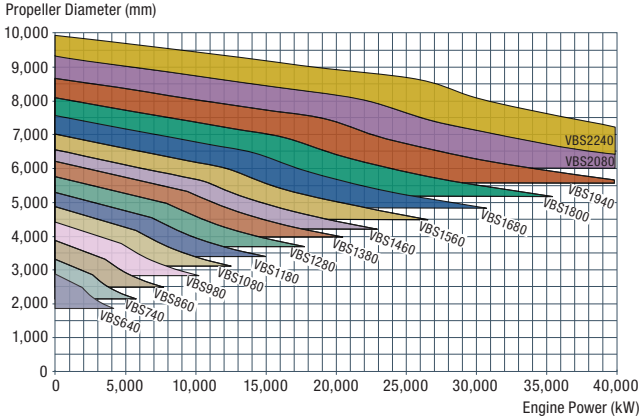
Alpha Controllable Pitch Propeller

The standard propeller programme type **VBS** features propeller blade pitch setting by a hydraulic servo piston integrated in the propeller hub.

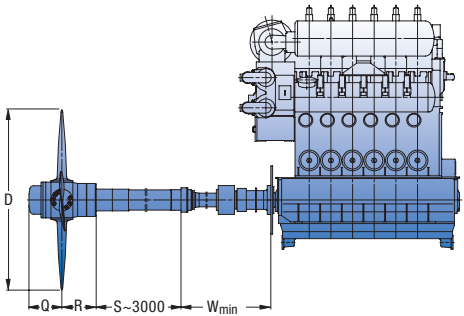
The figures stated after VBS indicate the propeller hub diameter.

Standard blade/hub materials are Ni-Al-bronze.
Stainless steel is available as an option.

The propellers are based on 'no ice' but are available up to the highest ice classes.



MAN B&W Standard Package Examples



Cyl.	kW	Prop. speed r/min	D mm	Hub VBS mm	Q mm	R mm	W_{min} mm	Prop. mass t*
S60MC-C/ME-C8/-GI								
5	11,900	105	6,350	1,680	1,278	1,289	3,000	53.4
6	14,280	105	6,600	1,800	1,367	1,362	3,000	59.7
7	16,660	105	6,850	1,800	1,367	1,367	3,000	63.2
8	19,040	105	7,050	1,940	1,458	1,450	3,000	72.0
L60MC-C/ME-C8**								
5	11,700	123	5,800	1,560	1,175	1,248	2,925	43.8
6	14,040	123	6,000	1,680	1,278	1,284	2,925	49.4
7	16,380	123	6,150	1,680	1,278	1,284	2,925	52.7
8	18,720	123	6,300	1,800	1,367	1,367	2,925	60.3

* *The masses are stated for 3,000 mm stern tube and 6,000 mm propeller shaft*

** *Data for 9 cylinders is available on request.*

MAN B&W Standard Package Examples

Cyl.	kW	Prop. speed r/min	D mm	Hub VBS mm	Q mm	R mm	W_{min} mm	Prop. mass t*
S50ME-B8**								
5	8,300	127	5,300	1,380	1,030	1,082	2,690	31.7
6	9,960	127	5,500	1,460	1,100	1,145	2,690	35.4
7	11,620	127	5,700	1,560	1,175	1,233	2,690	39.9
8	13,280	127	5,850	1,560	1,175	1,248	2,690	42.0
S50ME-B9								
5	8,900	117	5,650	1,460	1,100	1,141	2,700	35.7
6	10,680	117	5,850	1,560	1,175	1,202	2,700	41.3
7	12,460	117	6,050	1,560	1,175	1,202	2,700	44.5
8	14,240	117	6,200	1,680	1,278	1,279	2,700	50.5
9	16,020	117	6,350	1,800	1,367	1,332	2,900	58.0
S50MC-C/ME-C8**								
5	8,300	127	5,300	1,380	1,030	1,082	2,690	31.7
6	9,960	127	5,500	1,460	1,100	1,145	2,690	35.4
7	11,620	127	5,700	1,560	1,175	1,233	2,690	39.9
8	13,280	127	5,850	1,560	1,175	1,248	2,690	42.0
S46MC-C/ME-B8								
5	6,900	129	5,100	1,280	957	1,035	2,650	27.4
6	8,220	129	5,300	1,380	1,030	1,082	2,650	29.9
7	9,660	129	5,500	1,460	1,100	1,145	2,650	34.0
8	11,040	129	5,650	1,560	1,175	1,233	2,650	38.9
S42MC7								
5	5,400	136	4,600	1,180	855	996	2,265	20.1
6	6,480	136	4,850	1,280	957	1,075	2,511	24.4
7	7,560	136	5,050	1,280	957	1,075	2,511	27.5
8	8,640	136	5,200	1,380	1,030	1,131	2,676	30.5
9	9,720	136	5,350	1,380	1,030	1,131	2,676	32.7
10	10,800	136	5,500	1,460	1,100	1,170	2,676	36.0
11	11,880	136	5,650	1,460	1,100	1,185	2,595	38.4
12	12,960	136	5,750	1,560	1,175	1,257	2,595	42.4

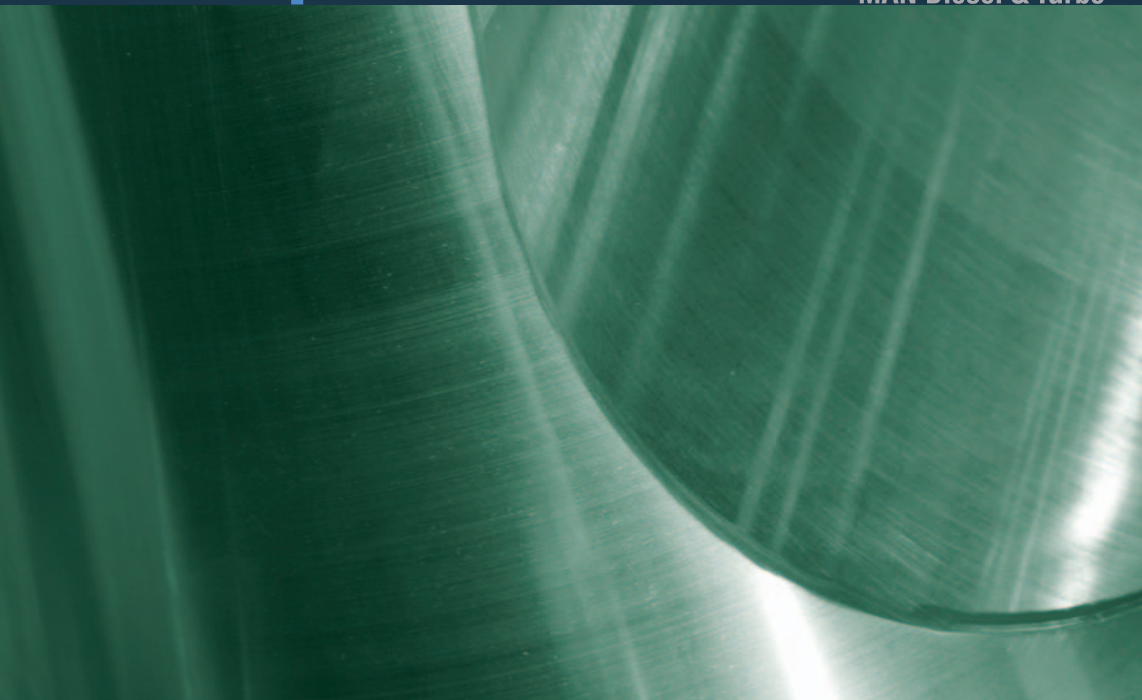
* *The masses are stated for 3,000 mm stern tube and 6,000 mm propeller shaft*

** *Data for 9 cylinders is available on request.*

MAN B&W Standard Package Examples

Cyl.	kW	Prop. speed r/min	D mm	Hub VBS mm	Q mm	R mm	W_{min} mm	Prop. mass t*
S40ME-B9								
5	5,675	146	4,500	1,180	885	972	2,500	22.1
6	6,810	146	4,700	1,280	957	1,025	2,500	24.6
7	7,945	146	4,850	1,280	957	1,025	2,500	26.0
8	9,080	146	5,000	1,380	1,030	1,081	2,500	29.8
S35ME-B9								
5	4,350	167	4,000	1,080	821	920	2,500	16.3
6	5,220	167	4,150	1,080	821	920	2,500	16.9
7	6,090	167	4,300	1,180	885	946	2,500	19.4
8	6,960	167	4,400	1,180	885	946	2,500	20.4
S35MC7								
5	3,700	173	3,750	980	746	807	2,040	12.5
6	4,440	173	3,950	980	746	807	2,170	14.0
7	5,180	173	4,100	1,080	821	945	2,170	16.6
8	5,920	173	4,250	1,080	821	945	2,265	18.5
9	6,660	173	4,350	1,180	885	996	2,265	20.4
10	7,400	173	4,450	1,180	885	996	2,265	21.1
11	8,140	173	4,550	1,280	957	1,075	2,511	24.8
12	8,880	173	4,650	1,280	957	1,075	2,676	27.4
L35MC6								
5	3,250	210	3,300	860	655	735	2,000	9.5
6	3,900	210	3,450	980	746	785	2,000	10.3
7	4,550	210	3,600	980	746	785	2,040	11.8
8	5,200	210	3,700	980	746	805	2,040	12.3
9	5,850	210	3,800	1,080	825	880	2,140	13.9
10	6,500	210	3,900	1,080	825	880	2,140	14.7
11	7,150	210	4,000	1,180	900	940	2,140	16.5
12	7,800	210	4,100	1,180	900	940	2,140	17.2
S26MC6								
5	2,000	250	2,750	740	569	655	1,940	6.4
6	2,400	250	2,850	740	569	655	1,940	7.2
7	2,800	250	2,950	860	655	735	1,970	8.5
8	3,200	250	3,050	860	655	735	1,970	9.3

* *The masses are stated for 3,000 mm stern tube and 6,000 mm propeller shaft.*



MAN Medium Speed
Propulsion Engines

MAN Medium Speed Propulsion Engines

IMO Tier II Compliant Engine Programme

While power density and fuel economy have always been in the focus of diesel engine developers, MAN Diesel & Turbo is going one step further and has committed itself to further reduce the environmental impact of its diesel engines.

With the current engine programme, MAN Diesel & Turbo is already offering a complete portfolio of IMO Tier II compliant diesel engines for the entire power range.

By applying engine internal and well proven measures which lead to a cleaner and more efficient combustion MAN Diesel & Turbo is able to decrease noxious emissions without exhaust gas after treatment. Taking every single engine into account, an assortment of the following measures has been applied in order to reach the IMO Tier II emission level.

- Common Rail injection
- Miller valve timing
- Variable Valve timing
- Optimised charge air pressure by high performance turbo charger
- Optimised charge air cooler
- Increased compression ratio and retarded injection.

Further Emission Reduction

In addition to the overall low emission level, MAN Diesel & Turbo is offering a wide range of complementary emission reduction technologies such as Fuel Water Emulsification (FWE), Humid Air Motor (HAM), Selective Catalytic Reduction (SCR) or Exhaust Gas Scrubbing. Please contact MAN Diesel & Turbo for further information.

The Common Rail (CR) Engine Programme

The well established MAN Diesel & Turbo common rail injection system permits independent and separate control of injection pressure and timing. The result is improved combustion and lower emissions with the same or even better fuel economy. This gives strong advantages, especially in the low-load range where it becomes possible to get the exhaust gas opacity down far below the visible limit.

Engines equipped with CR-systems operate on distillates according to ISO 8217 DMA, DMB and DMC and residual fuels up to 700 csT (acc ISO-F-RMK 700).

MAN Medium Speed Propulsion Engines

Dual Fuel (DF) Engines

Dual fuel engines from MAN Diesel & Turbo efficiently run on liquid fuels or natural gas with emissions far below the IMO limit. The possibility to switch over seamlessly from gas to diesel operation and vice versa provides full flexibility in multiple applications. All dual fuel engines can run on natural gas with a methane number higher than 80 without adjustments. For lower methane numbers, MAN Diesel & Turbo is in a position to deliver well adapted solutions. The optimised combustion chamber gives very low fuel consumption in both operational modes.

Diesel Oil (D) Engines

The V28/33 D engine operates on distillates according to ISO 8217 DMA or equivalent fuel types. The engine features very favourable ratios of power-to-weight and power-to-installation space. Together with its low fuel consumption, its low emissions and its reduced life cycle costs, this engine represents the ideal solution for propulsion in high speed ferries, naval and offshore patrol vessels as well as land based and offshore power generation.

Sequential Turbo Charging (STC)

The MAN Diesel & Turbo sequential turbocharging system operates with high efficiency turbochargers. Depending on the amount of charge air required, a second turbo charger can be switched on or off. In this way the engine is operated at its optimum operating point over the whole applicable load range. The result is an extended envelope at low engine speeds, which gives a power reserve for ship acceleration, ship turning, sprints or towing. Furthermore, a low thermal signature, decreased smoke emission, low vibrations and reduced fuel consumption in part load operation characterise the STC-system and make it the ideal solution for propulsion in naval and offshore patrol vessels.

Engine Programme with Conventional Injection System

These well established engine types are used in various applications all around the world. Based on long-term experience, the engines have been subject to constant development improving their power, emissions, fuel oil consumption and reliability, making them the prime mover of choice in the maritime sector.

MAN Medium Speed Propulsion Engines

Engine Power

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

The power figures in the tables remain valid up to tropical conditions at sea level, i.e.

- compressor inlet temperature 45 °C
- compressor inlet pressure 1,000 mbar
- seawater temperature 32 °C.

Ratings are given according to ISO 3046-1:2002.
According ISO 15550:2002,the power figures in the tables remain valid within a range of +/- 3% up to tropical conditions at sea level, i.e.

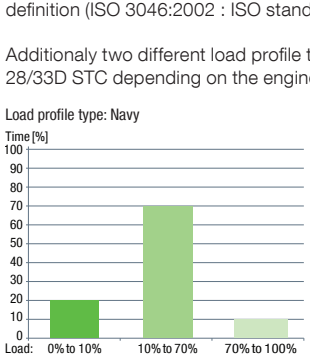
- compressor inlet temperature 45 °C
- compressor inlet pressure 1,000 mbar
- seawater temperature 32 °C.

For all medium speed propulsion engines except 28/33D and 28/33D STC the power is defined according ICN[1] definition (ISO 3046-1:2002 : ISO standard power).

The engine rated power for V28/33D and V28/33D STC refers to ICFN[1] power definition (ISO 3046:2002 : ISO standard fuel stop power)

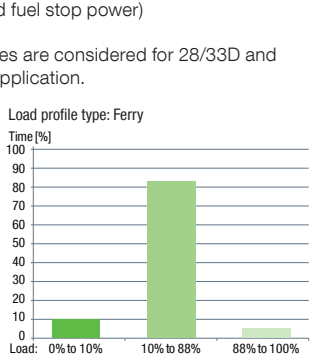
Additionaly two different load profile types are considered for 28/33D and 28/33D STC depending on the engine application.

Load profile type: Navy



Typical use : Fast yachts
Corvettes
Frigates
OPV

Load profile type: Ferry



Typical use : Ferries
Catamaran
Commercial vessel

[1] *IC[F]N according ISO 3046-1:2002 :*
I = ISO Power - C= Continuous Power Output - [F = Fuel Stop Power] - N = Net

MAN Medium Speed Propulsion Engines

Specific Fuel Oil Consumption (SFOC) & Heat Rate

The stated consumption figures refer to the following ISO reference conditions:

- ambient air pressure 1,000 mbar
- ambient air temperature 25 °C (77 °F)
- cooling water temperature upstream of charge air cooler 25 °C (77 °F).

The figures are given with a tolerance of +5% and without engine driven pumps. Attached pumps and engines running in suction dredger operation will require additional fuel.

The SFOC figures for engines in diesel operation are based on a lower calorific value of the fuel of 42,700 kJ/kg.

Specific Lube Oil Consumption (SLOC)

The specific lube oil consumption is specified at MCR (Maximum Continuous Rating) with a tolerance of 20%.

Blocking of Output

Blocking of output is made for engines driving a propeller at 100% of the rated output. For engines powering an alternator, blocking of output is made at 110%. However, more than 100% load may only be run for a short period of time for recovery and prevention of a frequency drop.

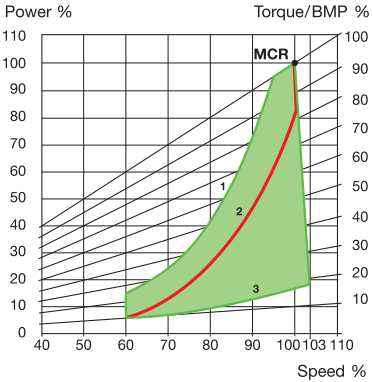
Masses and Dimensions

For main marine engines, the masses stated refer to engines without a turning wheel.

For auxiliary engines (GenSets), the masses correspond to the unit (including alternator). The weight of the GenSets might vary depending on the alternator make. All given masses are without lube oil and cooling water. Dimensions and weights are given for guidance only and are subject to change without notice. The length of the GenSet unit depends on the alternator make. The centreline distance for twin engine installation is stated at each engine type.

MAN Medium Speed Propulsion Engines

Marine Propulsion Engine with Controllable Pitch Propeller



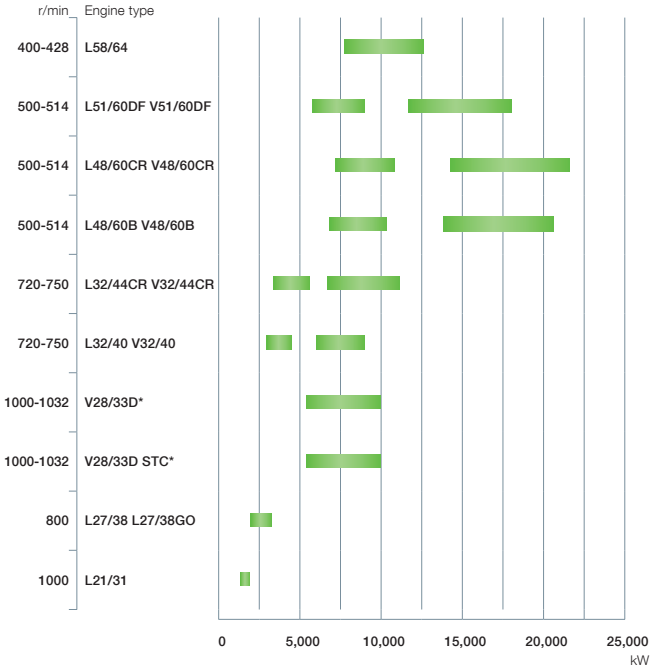
1. Load limit curve
2. Recommended combinatory curve
3. Zero thrust curve

Operating range

MCR Maximum continuous rating.

The combinator curve has to have a sufficient distance to the load limit curve. For overload protection, a load control is to be provided. Power requirements from additional devices (e.g. PTO or shaft power devices) as well as transmission losses (e.g. by gearboxes) are to be considered.

MAN Medium Speed Propulsion Engines



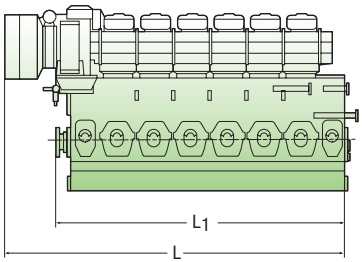
** The engine complies with EPA Tier 2.*

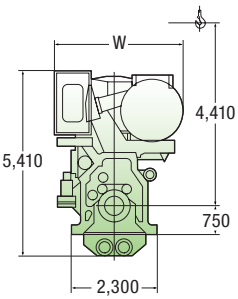
Bore: 580 mm, Stroke: 640 mm			
Speed	r/min	428	400
mep	bar	23.2	23.2
		kW	kW
6L58/64		8,400	7,860
7L58/64		9,800	9,170
8L58/64		11,200	10,480
9L58/64		12,600	11,790

Specific Fuel Oil Consumption (SFOC) to ISO conditions		
MCR	100%	85%
L58/64	176 g/kWh	176 g/kWh
Specific lube oil consumption 0.8 g/kWh		

Dimensions					
Cyl. No.		6	7	8	9
L	mm	9,190	10,600	11,600	12,600
L_1	mm	7,810	8,810	9,810	10,810
W	mm	3,550	3,550	3,550	3,550
Dry mass	t	149	170	189	208

Minimum centreline distance for twin engine installation: 3,800 mm
Speed 400 r/min for generator drive only.





MAN V51/60DF

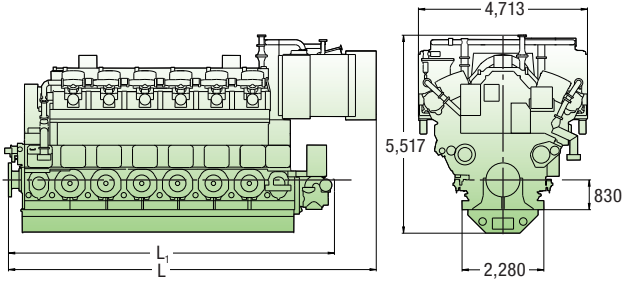
Bore: 510 mm, Stroke: 600 mm			
Speed	r/min	514	500
mep	bar	19.05	19.05
		kW	kW
12V51/60DF		12,000	11,700
14V51/60DF		14,000	13,650
16V51/60DF		16,000	15,600
18V51/60DF		18,000	17,550

Specific Fuel Oil Consumption (SFOC) and Heat Rate to ISO conditions		
MCR	100%	85%
Specific fuel oil consumption (HFO)*	184 g/kWh	183 g/kWh
Heat Rate**	7,260 kJ/kWh	7,400 kJ/kWh
Specific lube oil consumption 0.5 g/kWh		

** Diesel or HFO fuel operation. ** Gas operation (including pilot fuel)*

Dimensions					
Cyl. No.		12	14	16	18
L	mm	10,254	11,254	12,254	13,644
L_1	mm	9,088	10,088	11,088	12,088
Dry mass	t	187	213	240	265

Minimum centreline distance for twin engine installation: 4,800 mm
LHV_{min} = 28,000 kJ/m^3 (STP).



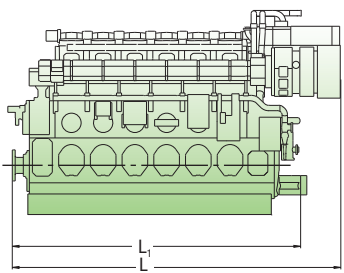
Bore: 510 mm, Stroke: 600 mm			
Speed	r/min	514	500
mep	bar	19.05	19.05
		kW	kW
6L51/60DF		6,000	5,850
7L51/60DF		7,000	6,825
8L51/60DF		8,000	7,800
9L51/60DF		9,000	8,775

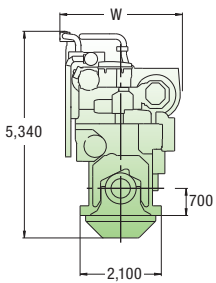
Specific Fuel Oil Consumption (SFOC) and Heat Rate to ISO conditions		
MCR	100%	85%
Specific fuel oil consumption (HFO)*	184 g/kWh	183 g/kWh
Heat Rate**	7,260 kJ/kWh	7,400 kJ/kWh
Specific lube oil consumption 0.5 g/kWh		

** Diesel or HFO fuel operation. ** Gas operation (including pilot fuel)*

Dimensions					
Cyl. No.		6	7	8	9
L	mm	8,494	9,314	10,134	11,160
L_1	mm	7,455	8,275	9,095	9,915
W	mm	3,165	3,165	3,165	3,283
Dry mass	t	106	119	135	148

Minimum centreline distance for twin engine installation: 3,200 mm
LHV_{min} = 28,000 kJ/m³ (STP).





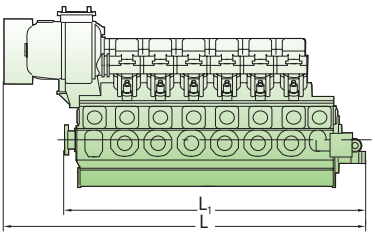
MAN V48/60CR

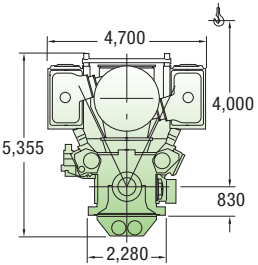
Bore: 480 mm, Stroke: 600 mm			
Speed	r/min	514	500
mep	bar	25.8	26.5
		kW	kW
12V48/60CR		14,400	14,400
14V48/60CR		16,800	16,800
16V48/60CR		19,200	19,200
18V48/60CR		21,600	21,600

Specific Fuel Oil Consumption (SFOC) to ISO conditions		
MCR	100%	85%
V48/60CR	178 g/kWh	174 g/kWh
Specific lube oil consumption 0.6 g/kWh		

Dimensions					
Cyl. No.		12	14	16	18
L	mm	10,760	11,760	13,100	14,100
L_1	mm	9,088	10,088	11,088	12,088
Dry mass	t	189	213	240	265

Minimum centreline distance for twin engine installation: 4,800 mm.



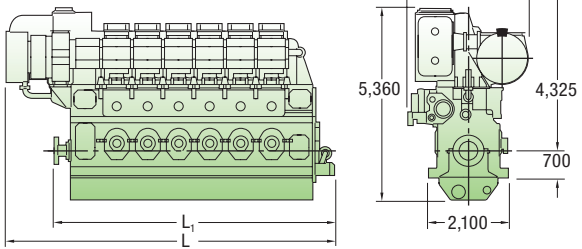


Bore: 480 mm, Stroke: 600 mm			
Speed	r/min	514	500
mep	bar	25.8	26.5
		kW	kW
6L48/60CR		7,200	7,200
7L48/60CR		8,400	8,400
8L48/60CR		9,600	9,600
9L48/60CR		10,800	10,800

Specific Fuel Oil Consumption (SFOC) to ISO conditions		
MCR	100%	85%
L48/60CR	180 g/kWh	176 g/kWh
Specific lube oil consumption 0.6 g/kWh		

Dimensions					
Cyl. No.		6	7	8	9
L	mm	8,615	9,435	10,460	11,425
L_1	mm	7,455	8,275	9,095	9,915
W	mm	3,195	3,195	3,325	3,325
Dry mass	t	106	119	135	148

Minimum centreline distance for twin engine installation: 3,200 mm.



MAN V48/60B

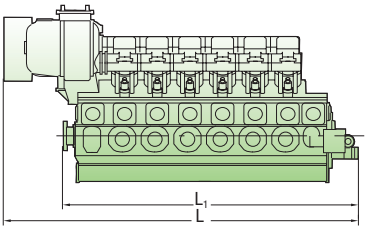
Bore: 480 mm, Stroke: 600 mm			
Speed	r/min	514	500
mep	bar	25.8	26.5
		kW	kW
12V48/60B		13,800	13,800
14V48/60B		16,100	16,100
16V48/60B		18,400	18,400
18V48/60B		20,700	20,700

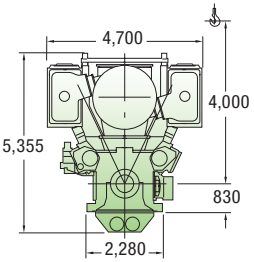
Specific Fuel Oil Consumption (SFOC) to ISO conditions		
MCR	100%	85%
V48/60B	-[1])	-[1])
Specific lube oil consumption 0.8 g/kWh		

Dimensions					
Cyl. No.		12	14	16	18
L	mm	10,760	11,760	13,100	14,100
L_1	mm	8,915	9,915	10,915	11,915
Dry mass	t	186	209	240	259

Minimum centreline distance for twin engine installation: 4,800 mm

[1]) *Please contact MAN Diesel & Turbo for further information.*



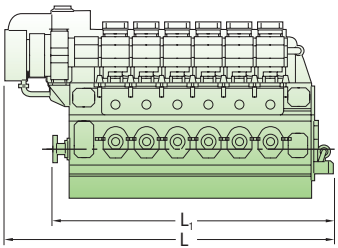


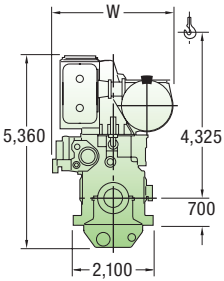
Bore: 480 mm, Stroke: 600 mm			
Speed	r/min	514	500
mep	bar	25.8	26.5
		kW	kW
6L48/60B		6,900	6,900
7L48/60B		8,050	8,050
8L48/60B		9,200	9,200
9L48/60B		10,350	10,350

Specific Fuel Oil Consumption (SFOC) to ISO conditions		
MCR	100%	85%
L48/60B	-[1]	-[1]
Specific lube oil consumption 0.8 g/kWh		

Dimensions					
Cyl. No.		6	7	8	9
L	mm	8,615	9,435	10,460	11,425
L_1	mm	7,290	8,110	8,930	9,895
W	mm	3,195	3,195	3,325	3,325
Dry mass	t	104	118	134	146

Minimum centreline distance for twin engine installation: 3,200 mm
[1]) *Please contact MAN Diesel & Turbo for further information.*





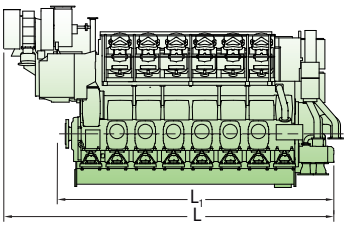
MAN V32/44CR

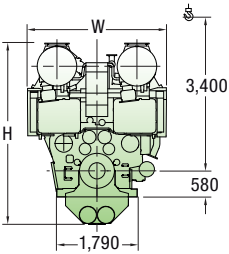
Bore: 320 mm, Stroke : 440 mm			
Speed	r/min	750	720
mep	bar	25.3	26.4
		kW	kW
12V32/44CR		6,720	6,720
14V32/44CR		7,840	7,840
16V32/44CR		8,960	8,960
18V32/44CR		10,080	10,080
20V32/44CR		11,200	11,200

Specific Fuel Oil Consumption (SFOC) to ISO conditions		
MCR	100%	85%
V32/44CR	179 g/kWh	177 g/kWh
Specific lube oil consumption 0.5 g/kWh		

Dimensions						
Cyl. No.		12	14	16	18	20
L	mm	7,195	7,970	8,600	9,230	9,860
L_1	mm	5,795	6,425	7,055	7,685	8,315
W	mm	3,100	3,100	3,100	3,100	3,100
H	mm	4,039	4,262	4,262	4,262	4,262
Dry mass*	t	70	79	87	96	104

Minimum centreline distance for twin engine installation: 4,000 mm
Speed 720 r/min for generator drive only
** Including built-on lube oil automatic filter, fuel oil filter and electronic equipment.*



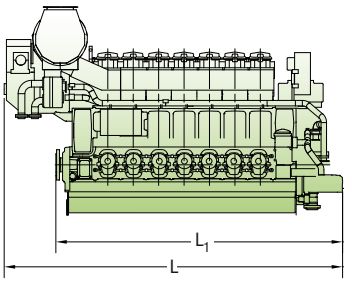


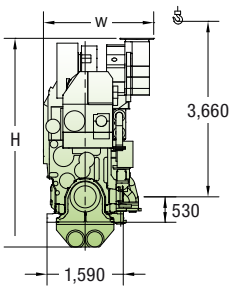
Bore: 320 mm, Stroke : 440 mm			
Speed	r/min	750	720
mep	bar	25.3	26.4
		kW	kW
6L32/44CR		3,360	3,360
7L32/44CR		3,920	3,920
8L32/44CR		4,480	4,480
9L32/44CR		5,040	5,040
10L32/44CR		5,600	5,600

Specific Fuel Oil Consumption (SFOC) to ISO conditions		
MCR	100%	85%
L32/44CR	179 g/kWh	177 g/kWh
Specific lube oil consumption 0.5 g/kWh		

Dimensions						
Cyl. No.		6	7	8	9	10
L	mm	6,312	6,924	7,454	7,984	8,603
L_1	mm	5,265	5,877	6,407	6,937	7,556
W	mm	2,174	2,359	2,359	2,359	2,359
H	mm	4,163	4,369	4,369	4,369	4,369
Dry mass*	t	39.5	44.5	49.5	53.5	58.0

Minimum centreline distance for twin engine installation: 2,500 mm
Speed 720 r/min for generator drive only
** Including built-on lube oil automatic filter, fuel oil filter and electronic equipment.*





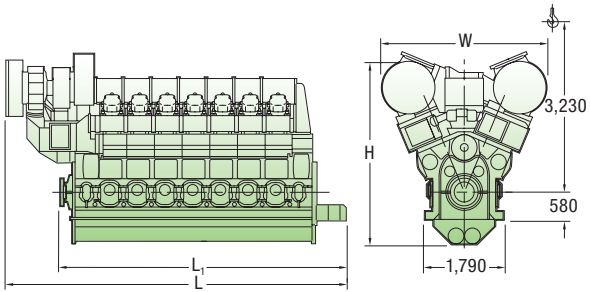
MAN V32/40

Bore: 320 mm, Stroke : 400 mm			
Speed	r/min	750	720
mep	bar	24.9	25.9
		kW	kW
12V32/40		6,000	6,000
14V32/40		7,000	7,000
16V32/40		8,000	8,000
18V32/40		9,000	9,000

Specific Fuel Oil Consumption (SFOC) to ISO conditions		
MCR	100%	85%
V32/40	183 g/kWh	182 g/kWh
V32/40 FPP	185 g/kWh	185 g/kWh
Specific lube oil consumption 0.5 g/kWh		

Dimensions					
Cyl. No.		12	14	16	18
L	mm	6,915	7,545	8,365	8,995
L_1	mm	5,890	6,520	7,150	7,780
W	mm	3,140	3,140	3,730	3,730
H	mm	4,100	4,100	4,420	4,420
Dry mass	t	61	68	77	85

Minimum centreline distance for twin engine installation: 4,000 mm
Speed 720 r/min for generator drive only
Fixed Pitch Propeller: 450 kW/cyl.

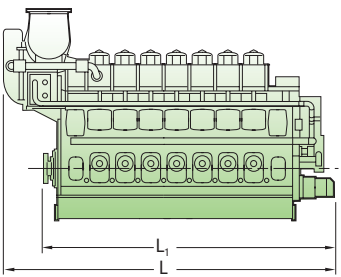


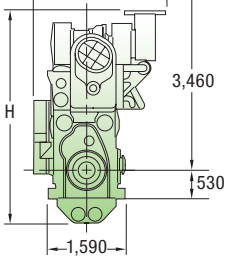
Bore: 320 mm, Stroke: 400 mm			
Speed	r/min	750	720
mep	bar	24.9	25.9
		kW	kW
6L32/40		3,000	3,000
7L32/40		3,500	3,500
8L32/40		4,000	4,000
9L32/40		4,500	4,500

Specific Fuel Oil Consumption (SFOC) to ISO conditions		
MCR	100%	85%
L32/40	183 g/kWh	182 g/kWh
L32/40 FPP	185 g/kWh	185 g/kWh
Specific lube oil consumption 0.5 g/kWh		

Dimensions					
Cyl. No.		6	7	8	9
L	mm	5,940	6,470	7,000	7,530
L_1	mm	5,140	5,670	6,195	6,725
W	mm	2,630	2,630	2,715	2,715
H	mm	4,010	4,010	4,490	4,490
Dry mass	t	38	42	47	51

Minimum centreline distance for twin engine installation: 2,500 mm
Minimum centreline distance for twin engine with TC on counter coupling side: 3,000 mm
Speed 720 r/min for generator drive only
Fixed Pitch Propeller: 450 kW/cyl.





MAN V28/33D

Bore: 280 mm, Stroke: 330 mm			
		Load profile 'Ferry'	Load profile 'Navy'
Speed	r/min	1000	1032
mep	bar	26.9	28.6
Rated power output - ICFN[1]		kW	kW
12V28/33D		5,460	6,000
16V28/33D		7,280	8,000
20V28/33D		9,100	10,000

Specific Fuel Oil Consumption (SFOC) to ISO conditions		
MCR 100%	191 g/kWh	194 g/kWh
MCR 85%	189 g/kWh	190 g/kWh
Specific lube oil consumption 0.4 g/kWh[2]		

Dimensions				
Cyl. No.		12	16	20
L	mm	5,713	6,633	7,543
Dry mass[3]	t	31.9	39.9	48.0

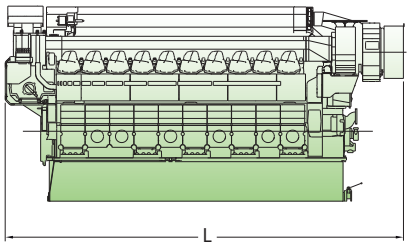
For multi engine arrangement only
Engine fuel: Distillate according to ISO 8217 DMA
Engine is EPA Tier 2 compliant

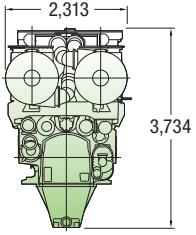
Weight and performance parameters refer to engine with flywheel, TC silencer, attached pumps, oil filters and lube oil cooler

[1] ICFN: I= Power to ISO 3046; C=Continuous power output; F= Fuel stop power; N= Net Power

[2] Tolerance: ±0.2 g/kWh

[3] Tolerance: 5%





Bore: 280 mm, Stroke: 330 mm			
		Load profile 'Ferry'	Load profile 'Navy'
Speed	r/min	1000	1032
mep	bar	26.9	28.6
Rated power output - ICFN[1]		kW	kW
12V28/33D STC		5,460	6,000
16V28/33D STC		7,280	8,000
20V28/33D STC		9,100	10,000

Specific Fuel Oil Consumption (SFOC) to ISO conditions		
MCR 100%	191 g/kWh	194 g/kWh
MCR 85%	189 g/kWh	190 g/kWh
Specific lube oil consumption 0.4 g/kWh[2]		

Dimensions				
Cyl. No.		12	16	20
L	mm	6,207	7,127	8,047
Dry mass[3]	t	33.6	41.6	49.5

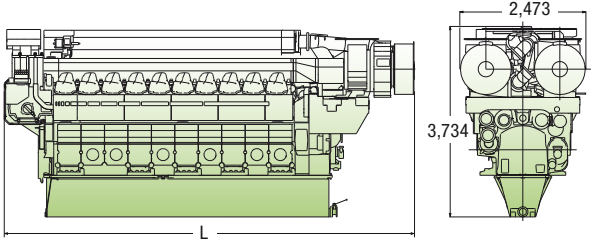
For multi engine arrangement only
Engine fuel: Distillate according to ISO 8217 DMA
Engine is EPA Tier 2 compliant

Weight and performance parameters refer to engine with flywheel, TC silencer, attached pumps, oil filters and lube oil cooler

[1] *ICFN: I= Power to ISO 3046; C=Continuous power output; F= Fuel stop power; N= Net Power*

[2] *Tolerance: ±0.2 g/kWh*

[3] *Tolerance: 5%*



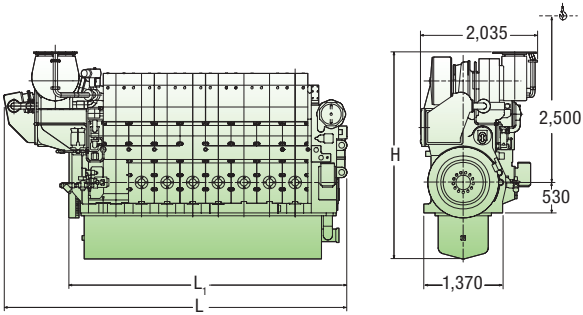
MAN L27/38

Bore: 270 mm, Stroke: 380 mm			
Speed	r/min	800	800 (MGO)
mep	bar	23.5	25.15
		kW	kW
6L27/38		2,040	2,190
7L27/38		2,380	2,555
8L27/38		2,720	2,920
9L27/38		3,060	3,285

Specific Fuel Oil Consumption (SFOC) to ISO conditions		
MCR	100%	85%
L27/38	188 g/kWh	185 g/kWh
L27/38GO	190 g/kWh	187 g/kWh
Specific lube oil consumption 0.8 g/kWh		

Dimensions					
Cyl. No.		6	7	8	9
L	mm	5,070	5,515	5,960	6,405
L_1	mm	3,962	4,407	4,852	5,263
H	mm	3,595	3,595	3,565	3,565
Dry mass	t	29.0	32.5	36.0	39.5

Minimum centreline distance for twin engine installation: 2,500 mm.

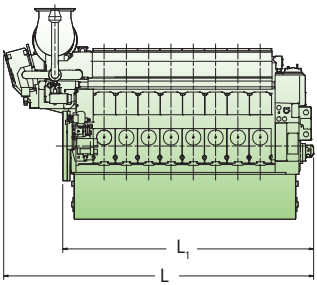


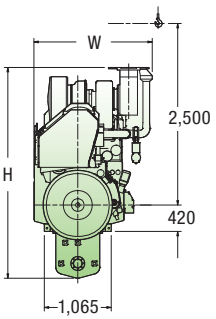
Bore: 210 mm, Stroke: 310 mm		
Speed	r/min	1000
mep	bar	24.1
		kW
6L21/31		1,290
7L21/31		1,505
8L21/31		1,720
9L21/31		1,935

Specific Fuel Oil Consumption (SFOC) to ISO conditions		
MCR	100%	85%
L21/31	195 g/kWh	189 g/kWh
Specific lube oil consumption 0.8 g/kWh		

Dimensions					
Cyl. No.		6	7	8	9
L	mm	4,225	4,580	4,935	5,290
L_1	mm	3,285	3,640	3,995	4,350
H	mm	3,115	3,115	3,267	3,267
W	mm	1,695	1,695	1,820	1,820
Dry mass	t	16.0	17.5	19.0	20.5

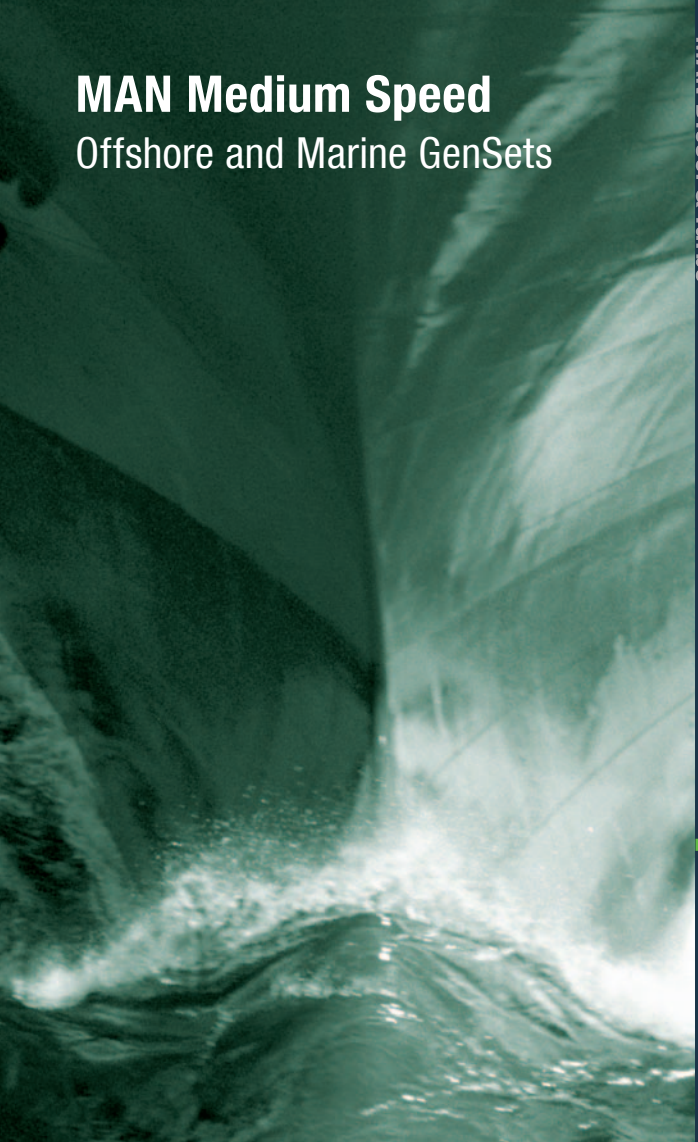
Minimum centreline distance for twin engine installation: 2,400 mm.



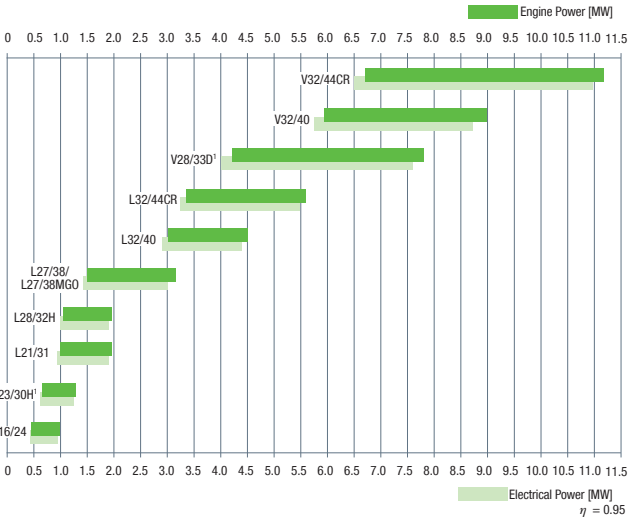


MAN Medium Speed

Offshore and Marine GenSets



MAN Medium Speed Offshore and Marine GenSet engines



[1] *The engine complies with EPA Tier 2.*

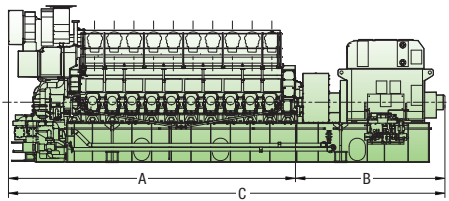
MAN V32/44CR

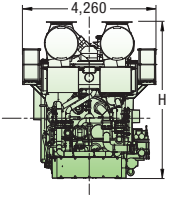
Diesel Electric Propulsion and Offshore version

Bore: 320 mm, Stroke: 440 mm					
Speed	r/min	750		720	
Frequency	Hz	50		60	
		Eng. kW	Gen. kW*	Eng. kW	Gen. kW*
12V32/44CR		6,720	6,518	6,720	6,518
14V32/44CR		7,840	7,605	7,840	7,605
16V32/44CR		8,960	8,691	8,960	8,691
18V32/44CR		10,080	9,778	10,080	9,778
20V32/44CR		11,200	10,864	11,200	10,864

Dimensions						
Cyl. No.		12	14	16	18	20
A	mm	5,382	6,012	6,642	7,272	7,902
B	mm	4,201	4,201	4,201	4,201	4,201
C	mm	11,338	11,968	12,598	13,228	13,858
H	mm	5,014	5,014	5,014	5,014	5,014
Dry mass	t	117	131	144	159	172

* *Based on nominal generator efficiencies of 97%.*





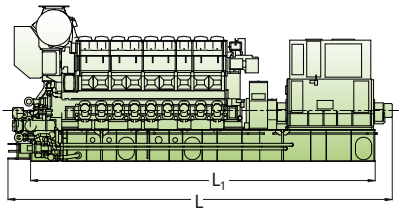
MAN L32/44CR

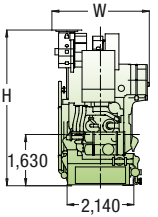
Diesel Electric Propulsion and Offshore version

Bore: 320 mm, Stroke: 440 mm					
Speed	r/min	750		720	
Frequency	Hz	50		60	
		Eng. kW	Gen. kW*	Eng. kW	Gen. kW*
6L32/44CR		3,360	3,242	3,360	3,242
7L32/44CR		3,920	3,783	3,920	3,783
8L32/44CR		4,480	4,323	4,480	4,323
9L32/44CR		5,040	4,864	5,040	4,864
10L32/44CR		5,600	5,404	5,600	5,404

Dimensions						
Cyl. No.		6	7	8	9	10
L	mm	10,738	11,268	11,798	12,328	12,858
L_1	mm	10,150	10,693	11,236	11,779	12,309
W	mm	2,490	2,490	2,573	2,573	2,573
H	mm	4,768	4,768	4,955	4,955	4,955
Dry mass	t	71	78	84	91	97

** Based on nominal generator efficiencies of 96.5%.*



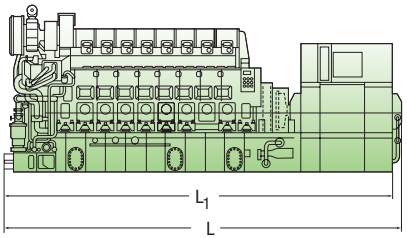


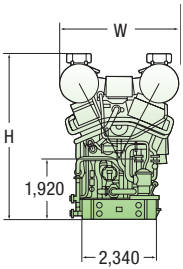
MAN V32/40

Bore: 320 mm, Stroke: 400 mm					
Speed	r/min	750		720	
Frequency	Hz	50		60	
		Eng. kW	Gen. kW*	Eng. kW	Gen. kW*
12V32/40		6,000	5,820	6,000	5,820
14V32/40		7,000	6,790	7,000	6,790
16V32/40		8,000	7,760	8,000	7,760
18V32/40		9,000	8,730	9,000	8,730

Dimensions					
Cyl. No.		12	14	16	18
L	mm	11,045	11,710	12,555	13,185
L_1	mm	10,450	11,115	11,950	12,580
W	mm	3,365	3,365	3,730	3,730
H	mm	4,850	4,850	5,245	5,245
Dry mass	t	101	113	126	138

* *Based on nominal generator efficiencies of 97%.*

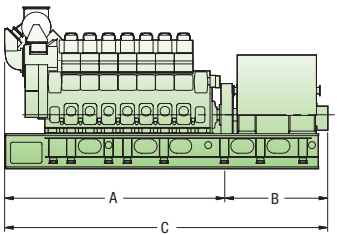


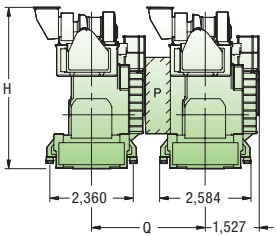


Bore: 320 mm, Stroke: 400 mm					
Speed	r/min	720		750	
Frequency	Hz	60		50	
		Eng. kW	Gen. kW*	Eng. kW	Gen. kW*
6L32/40		3,000	2,895	3,000	2,895
7L32/40		3,500	3,380	3,500	3,380
8L32/40		4,000	3,860	4,000	3,860
9L32/40		4,500	4,345	4,500	4,345

Dimensions					
Cyl. No.		6	7	8	9
	r/min	720/750	720/750	720/750	720/750
A	mm	6,340	6,870	7,400	7,930
B	mm	3,415	3,415	3,635	3,635
C	mm	9,755	10,285	11,035	11,565
H	mm	4,510	4,510	4,780	4,780
Dry Mass	t	75.0	79.0	87.0	91.0

** Based on nominal generator efficiencies of 96.5%.*





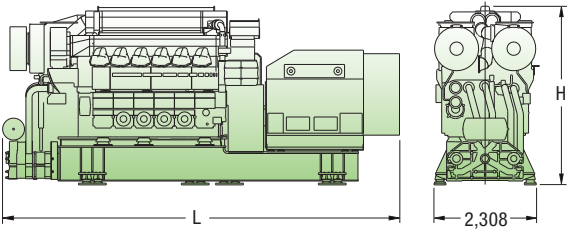
P Free passage between the engines, width 600 mm and height 2,000 mm
Q ~Min. distance between centre of engines: 2,835 mm (without gallery) ~3,220 mm (with gallery).

MAN V28/33D

Bore: 280 mm, Stroke: 330 mm					
Speed	r/min	1000		900	
Frequency	Hz	50		60	
		Eng. kW	Gen. kW*	Eng. kW	Gen. kW*
12V28/33D		4,680	4,540	4,200	4,074
16V28/33D		6,240	6,053	5,600	5,432
20V28/33D		7,800	7,566	7,000	6,790

Dimensions				
Cyl. No.		12	16	20
L_{min}	mm	9,000	10,320	11,640
H	mm	4,040	4,190	4,390
Dry mass[1]	t	64.0	75.0	94.0

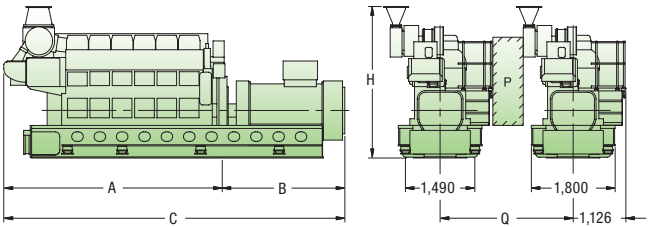
** Based on nominal generator efficiencies of 97%*
Engine fuel: Distillate according to ISO 8217 DMA
[1] Tolerance: 5%
Engine is EPA Tier 2 compliant.



Bore: 280 mm, Stroke: 320 mm					
Speed	r/min	720		750	
Frequency	Hz	60		50	
		Eng. kW	Gen. kW*	Eng. kW	Gen. kW*
5L28/32H		1,050	1,000	1,100	1,045
6L28/32H		1,260	1,200	1,320	1,255
7L28/32H		1,470	1,400	1,540	1,465
8L28/32H		1,680	1,600	1,760	1,670
9L28/32H		1,890	1,800	1,980	1,880

Dimensions						
Cyl. No.		5	6	7	8	9
	r/min	720/750	720/750	720/750	720/750	720/750
A	mm	4,279	4,759	5,499	5,979	6,199
B	mm	2,400	2,510	2,680	2,770	2,690
C	mm	6,679	7,269	8,179	8,749	8,889
H	mm	3,184	3,184	3,374	3,374	3,534
Dry Mass	t	32.6	36.3	39.4	40.7	47.1

* *Based on nominal generator efficiencies of 95%*



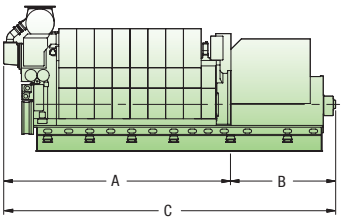
P Free passage between the engines, width 600 mm and height 2,000 mm
Q ~Min. distance between centre of engines: 2,655 mm (without gallery)
~2,850 mm (with gallery)

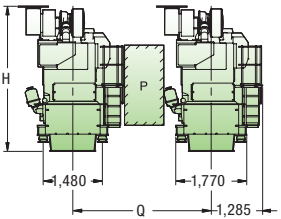
MAN L27/38

Bore: 270 mm, Stroke: 380 mm					
Speed	r/min	720/750		720/750 (MGO)	
Frequency	Hz	60/50		60/50	
		Eng. kW	Gen. kW*	Eng. kW	Gen. kW*
5L27/38		1,500/1,600	1,440/1,536	-	-
6L27/38		1,980	1,900	2,100	2,016
7L27/38		2,310	2,218	2,450	2,352
8L27/38		2,640	2,534	2,800	2,688
9L27/38		2,970	2,851	3,150	3,024

Dimensions						
Cyl. No.		5	6	7	8	9
	r/min	720/750	720/750	720/750	720/750	720/750
A	mm	4,346	4,791	5,236	5,681	6,126
B	mm	2,486	2,766	2,766	2,986	2,986
C	mm	6,832	7,557	8,002	8,667	9,112
H	mm	3,628	3,712	3,712	3,899	3,899
Dry Mass	t	42.3	45.8	52.1	58.3	63.9

** Based on nominal generator efficiencies of 96%.*



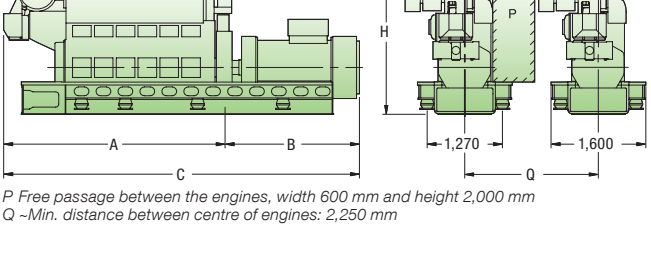


P Free passage between the engines, width 600 mm and height 2,000 mm
Q ~Min. distance between centre of engines: 2,900 mm (without gallery) ~3,100 mm (with gallery).

Bore: 225 mm, Stroke: 300 mm							
Speed	r/min	720		750		900	
Frequency	Hz	60		50		60	
		Eng. kW	Gen. kW*	Eng. kW	Gen. kW*	Eng. kW	Gen. kW*
5L23/30H		650	620	675	640	-	-
6L23/30H		780	740	810	770	960	910
7L23/30H		910	865	945	900	1,120	1,065
8L23/30H		1,040	990	1,080	1,025	1,280	1,215

Dimensions								
Cyl. No.		5	6	6	7	7	8	8
	r/min	720/750	720/750	900	720/750	900	720/750	900
A	mm	3,369	3,738	3,738	4,109	4,109	4,475	4,475
B	mm	2,155	2,265	2,265	2,395	2,395	2,480	2,340
C	mm	5,524	6,004	6,004	6,504	6,504	6,959	6,815
H	mm	2,383	2,383	2,815	2,815	2,815	2,815	2,815
Dry Mass	t	18.0	19.7	21.0	21.4	22.8	23.5	24.5

** Based on nominal generator efficiencies of 95%*
Engine is EPA Tier 2 compliant.



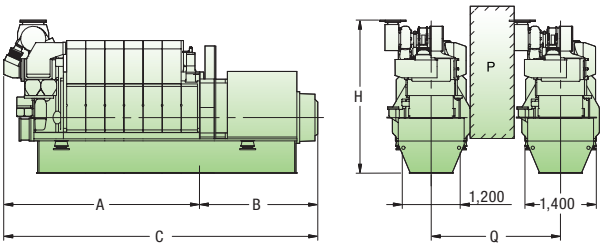
P Free passage between the engines, width 600 mm and height 2,000 mm
Q ~Min. distance between centre of engines: 2,250 mm

MAN L21/31

Bore: 210 mm, Stroke: 310 mm					
Speed	r/min	900		1,000	
Frequency	Hz	60		50	
		Eng. kW	Gen. kW*	Eng. kW	Gen. kW*
5L21/31		1,000	950	1,000	950
6L21/31		1,320	1,254	1,320	1,254
7L21/31		1,540	1,463	1,540	1,463
8L21/31		1,760	1,672	1,760	1,672
9L21/31		1,980	1,881	1,980	1,881

Dimensions						
Cyl. No.		5	6	7	8	9
	r/min	900/1000	900/1000	900/1000	900/1000	900/1000
A	mm	3,959	4,314	4,669	5,024	5,379
B	mm	1,870	2,000	1,970	2,250	2,400
C	mm	5,829	6,314	6,639	7,274	7,779
H	mm	3,183	3,183	3,183	3,289	3,289
Dry Mass	t	21.5	23.7	25.9	28.5	30.9

** Based on nominal generator efficiencies of 95%.*

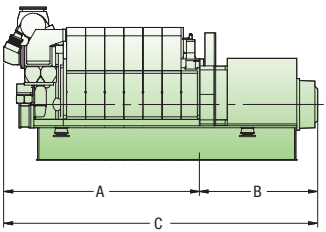


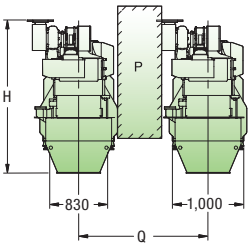
P Free passage between the engines, width 600 mm and height 2,000 mm
Q ~Min. distance between centre of engines: 2,400 mm (without gallery) ~2,600 mm (with gallery).

Bore: 160 mm, Stroke: 240 mm					
Speed	r/min	1,200		1,000	
Frequency	Hz	60		50	
		Eng. kW	Gen. kW*	Eng. kW	Gen. kW*
5L16/24		500	475	450	430
6L16/24		660	625	570	542
7L16/24		770	730	665	632
8L16/24		880	835	760	722
9L16/24		990	940	855	812

Dimensions						
Cyl. No.		5	6	7	8	9
	r/min	1200/1000	1200/1000	1200/1000	1200/1000	1200/1000
A	mm	2,751	3,026	3,501	3,776	4,051
B	mm	1,400	1,490	1,585	1,680	1,680
C	mm	4,151	4,516	5,086	5,456	5,731
H	mm	2,457	2,457	2,495/2,457	2,495	2,495
Dry Mass	t	9.5	10.5	11.4	12.4	13.1

** Based on nominal generator efficiencies of 95%.*

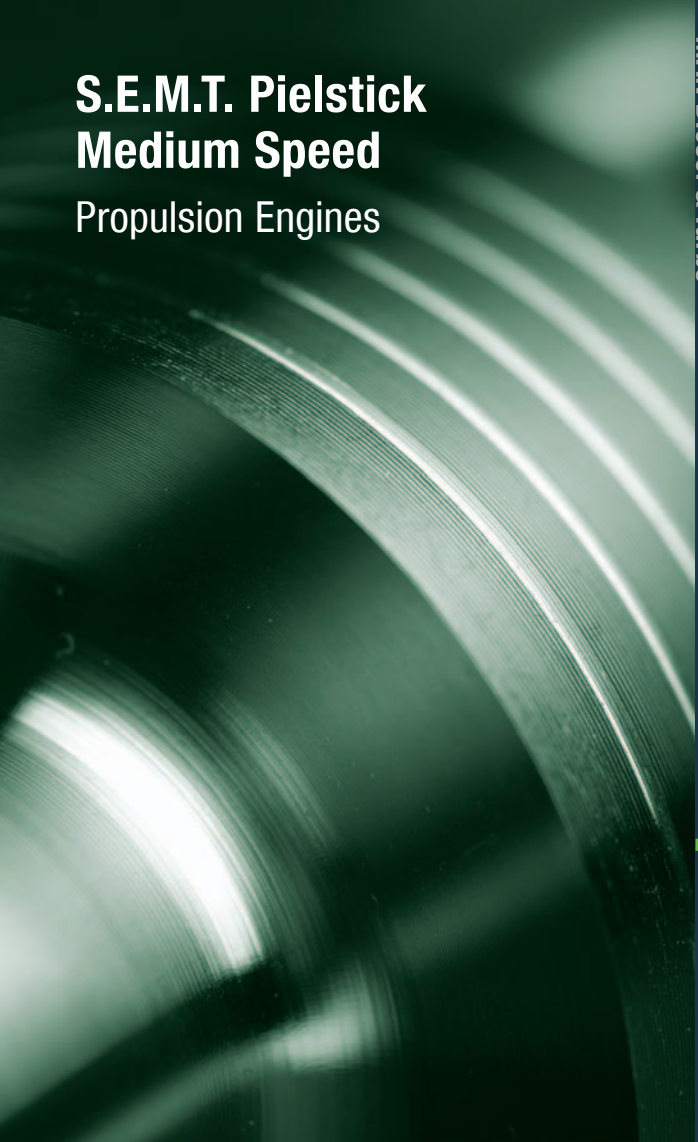




P Free passage between the engines, width 600 mm and height 2,000 mm
Q ~Min. distance between centre of engines: 1,800 mm.

S.E.M.T. Pielstick Medium Speed

Propulsion Engines



MAN Diesel & Turbo

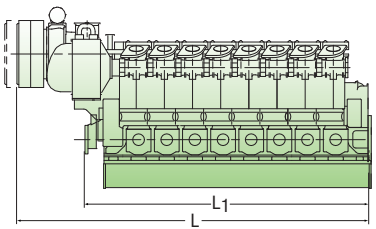
S.E.M.T. Pielstick PC2.6 B

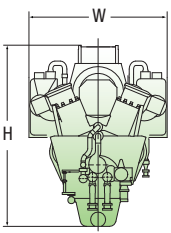
Bore: 400 mm, Stroke: 500 mm		
Speed	r/min	600
mep	bar	23.9
		kW
12PC2.6 B		9,000
14PC2.6 B		10,500
16PC2.6 B		12,000

Specific Fuel Oil Consumption (SFOC) to ISO conditions		
MCR	100%	85%
PC2.6 B	-[1)]	-[1)]

Dimensions				
Cyl. No.		12	14	16
L	mm	9,100	9,840	10,580
L_1	mm	5,960	6,700	7,440
W	mm	3,780	3,780	3,780
H	mm	4,800	4,800	4,800
Dry mass	t	94	104	114

[1)] *SFOC values are project specific. Please contact MAN Diesel & Turbo for further information.*





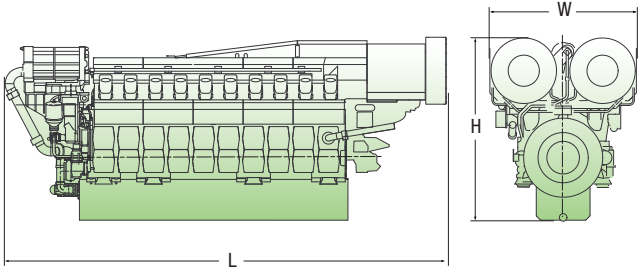
S.E.M.T. Pielstick PA6 B STC

Bore: 280 mm, Stroke: 330 mm		
Speed	r/min	1050
mep	bar	22.8
		kW*
12PA6 B STC		4,860
16PA6 B STC		6,480
20PA6 B STC		8,100

Specific Fuel Oil Consumption (SFOC) to ISO conditions		
MCR	100%	85%
PA6 B STC	-[1])	-[1])

Dimensions				
Cyl. No.		12	16	20
L	mm	5,830	6,780	7,960
W	mm	2,340	2,340	2,640
H	mm	3,124	3,124	3,166
Dry mass	t	31	37	43

Engine fuel: Distillate according to ISO 8217 DMA
Engine rating: engine rating according to ISO 3046 conditions
** 110% load for navy application for vessels with approval according to HSVR from DNV available 1 hour of 6 hours of engine operating time on special request.*
[1])SFOC values are project specific. Please contact MAN Diesel & Turbo for further information.
The engine is built by licensees.



S.E.M.T. Pielstick Medium Speed

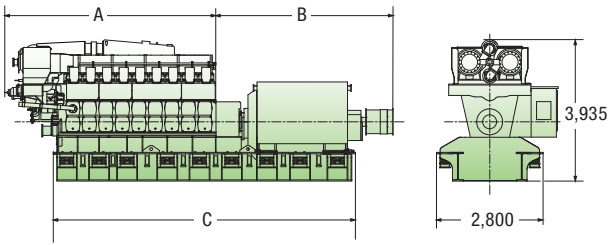
Marine GenSets

S.E.M.T. Pielstick PA6 B

Bore 280 mm, Stroke 330 mm					
Speed	r/min	1000		900	
Frequency	Hz	50		60	
		Eng. kW	Gen. kW*	Eng. kW	Gen. kW*
12PA6 B		4,440	4,307	4,200	4,074
16PA6 B		5,920	5,742	5,600	5,432
18PA6 B		6,660	6,460	6,300	6,111
20PA6 B		7,400	7,178	7,000	6,790

Dimensions					
Cyl. No.		12	16	18	20
A	mm	4,510	5,430	5,890	6,350
B	mm	4,600	4,800	4,933	5,000
C	mm	6,840	7,760	8,220	8,680
Dry mass	t	65	78	86	95

** Nominal generator efficiencies: 97%*
Engine fuel: Distillate according to ISO 8217 DMA
The engine is built by licensees.



MAN Medium Speed

Propulsion Systems

MAN Medium Speed Propulsion Systems

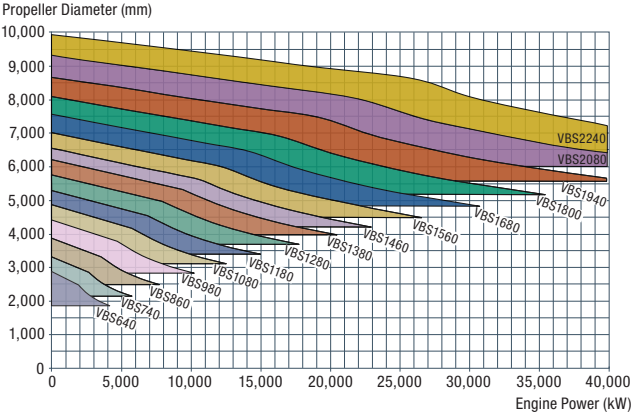
Alpha controllable Pitch Propeller

The standard propeller programme type **VBS** features propeller blade pitch setting by a hydraulic servo piston integrated in the propeller hub.

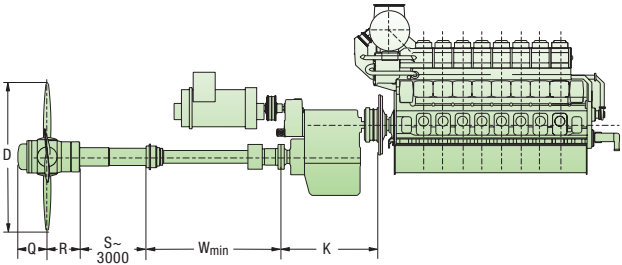
The figures stated after VBS indicate the propeller hub diameter.

Standard blade/hub materials are Ni-Al-bronze.
Stainless steel is available as an option.

The propellers are based on 'no ice' but are available up to the highest ice classes.



MAN Standard Package Examples



Cyl.	kW	Prop. speed r/min	D mm	Hub VBS mm	Q mm	R mm	Wmin mm	K mm	Gear mass t	Prop. mass t*
L58/64										
6	8,400	170	4,500	1,280	975	1,115	2,200	2,250	12.2	23.9
6	8,400	130	5,100	1,280	975	1,115	2,350	2,350	15.1	28.2
6	8,400	90	6,100	1,560	1,190	1,305	2,550	2,700	26.2	40.3
7	9,800	170	4,650	1,280	975	1,115	2,200	2,385	14.5	27.1
7	9,800	130	5,300	1,380	1,050	1,175	2,350	2,585	20.1	32.2
7	9,800	90	6,300	1,560	1,190	1,305	2,570	2,835	31.0	45.4
8	11,200	170	4,800	1,380	1,050	1,175	2,270	2,420	15.0	30.8
8	11,200	130	5,500	1,460	1,110	1,220	2,350	2,620	20.8	35.9
8	11,200	90	6,500	1,680	1,280	1,380	2,570	3,120	36.5	52.2
9	12,600	170	4,950	1,380	1,050	1,175	2,350	2,520	16.8	31.9
9	12,600	130	5,650	1,560	1,190	1,305	2,550	2,740	23.7	41.2
9	12,600	90	6,700	1,680	1,280	1,380	2,570	3,140	43.0	55.4

** S_{min} and propeller mass are based on 6,000 mm propeller shaft and 3,000 mm stern tube.*

MAN Standard Package Examples

Cyl.	kW	Prop. speed r/min	D mm	Hub VBS mm	Q mm	R mm	W_{min} mm	K mm	Gear mass t	Prop. mass t*
V48/60CR										
12	14,400	180	4,950	1,460	1,100	1,170	2,676	2,620	19.9	34.4
12	14,400	140	5,600	1,560	1,175	1,242	2,676	2,770	27.0	40.2
12	14,400	100	6,600	1,680	1,278	1,333	2,919	3,140	42.9	49.3
14	16,800	180	5,100	1,560	1,175	1,242	2,651	2,775	23.5	38.6
14	16,800	140	5,850	1,680	1,278	1,333	2,676	2,905	31.9	50.1
14	16,800	100	6,850	1,800	1,370	1,227	2,920	3,355	48.2	62.7
16	19,200	180	5,260	1,680	1,278	1,333	2,676	2,805	26.8	46.5
16	19,200	140	6,050	1,800	1,370	1,227	2,920	3,155	37.1	58.8
16	19,200	100	7,100	1,940	1,480	1,307	3,000	3,455	57.8	74.0
18	21,600	180	5,400	1,680	1,278	1,333	2,676	2,905	30.9	50.1
18	21,600	140	6,200	1,800	1,370	1,227	2,900	3,155	37.4	61.4
18	21,600	100	7,300	1,940	1,480	1,307	3,000	3,655	68.3	77.2
L48/60CR										
6	7,200	180	4,250	1,180	885	996	2,170	2,415	10.5	19.9
6	7,200	140	4,800	1,280	957	1,075	2,500	2,485	12.8	24.9
6	7,200	100	5,600	1,380	1,050	1,175	2,270	2,905	23.2	30.2
7	8,400	180	4,400	1,280	957	1,075	2,170	2,485	12.2	24.3
7	8,400	140	5,000	1,380	1,030	1,131	2,580	2,585	15.2	29.3
7	8,400	100	5,850	1,460	1,100	1,170	2,657	2,935	26.3	34.7
8	9,600	180	4,550	1,280	975	1,115	2,200	2,250	12.6	25.5
8	9,600	140	5,150	1,380	1,030	1,131	2,500	2,450	17.0	30.6
8	9,600	100	6,000	1,560	1,175	1,257	2,600	2,800	29.7	38.3
9	10,800	180	4,700	1,380	1,030	1,131	2,500	2,385	14.7	24.8
9	10,800	140	5,300	1,460	1,100	1,170	2,651	2,485	17.4	34.6
9	10,800	100	6,200	1,560	1,190	1,350	2,550	2,835	30.7	42.4

MAN Standard Package Examples

Cyl.	kW	Prop. speed r/min	D mm	Hub VBS mm
V32/44CR				
12	6,720	200	3,800	1,180
12	6,720	160	4,400	1,180
12	6,720	120	5,250	1,380
14	7,840	200	3,950	1,280
14	7,840	160	4,550	1,380
14	7,840	120	5,400	1,380
16	8,960	200	4,050	1,380
16	8,960	160	4,650	1,380
16	8,960	120	5,550	1,460
18	10,080	200	4,150	1,380
18	10,080	160	4,750	1,460
18	10,080	120	5,700	1,560
20	11,200	200	4,250	1,380
20	11,200	160	4,850	1,460
20	11,200	120	5,850	1,560
L32/44CR				
6	3,360	200	3,350	860
6	3,360	160	3,800	980
6	3,360	120	4,450	1,080
7	3,920	200	3,500	980
7	3,920	160	3,950	1,080
7	3,920	120	4,600	1,180
8	4,480	200	3,600	1,080
8	4,480	160	4,050	1,080
8	4,480	120	4,750	1,180
9	5,040	200	3,650	1,080
9	5,040	160	4,150	1,080
9	5,040	120	4,900	1,280
10	5,600	200	3,700	1,180
10	5,600	160	4,250	1,180
10	5,600	120	5,000	1,280

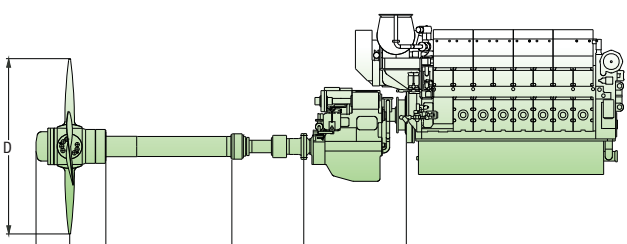
** S_{min} and propeller mass are based on 6,000 mm propeller shaft and 3,000 mm stern tube.*

MAN Standard Package Examples

Cyl.	kW	Prop. speed r/min	D mm	Hub VBS mm	Q mm	R mm	W_{min} mm	K mm	Gear mass t	Prop. mass t*
V32/40										
12	6,000	200	3,950	1,080	821	880	1,560	2,090	8.5	16.2
12	6,000	160	4,400	1,180	821	945	1,630	2,220	10.6	16.8
12	6,000	120	5,050	1,280	957	1,075	1,700	2,590	19.5	23.6
14	7,000	200	4,100	1,180	821	945	1,630	2,165	8.9	16.7
14	7,000	160	4,550	1,180	885	996	1,650	2,365	12.5	19.2
14	7,000	120	5,250	1,380	957	1,075	1,700	2,785	22.0	26.7
16	8,000	200	4,200	1,180	885	996	1,630	2,295	10.5	20.8
16	8,000	160	4,700	1,280	885	996	1,700	2,465	14.5	22.6
16	8,000	120	5,400	1,380	1,030	1,131	1,740	2,815	25.1	29.6
18	9,000	200	4,300	1,280	885	1,021	1,650	2,295	10.7	20.7
18	9,000	160	4,850	1,280	957	1,075	1,700	2,465	14.8	23.4
18	9,000	120	5,600	1,460	1,100	1,170	1,780	2,915	29.4	33.1
L32/40										
6	3,000	200	3,300	860	655	735	1,400	1,740	4.5	8.8
6	3,000	160	3,700	980	655	735	1,520	1,830	5.6	9.9
6	3,000	120	4,200	1,080	820	805	1,520	2,130	9.8	12.4
7	3,500	200	3,450	980	655	735	1,400	1,740	4.6	9.7
7	3,500	160	3,850	980	746	785	1,520	1,880	6.5	11.8
7	3,500	120	4,400	1,080	820	875	1,560	2,130	10.1	14.5
8	4,000	200	3,550	980	655	735	1,520	1,920	5.7	10.4
8	4,000	160	4,000	1,080	820	805	1,520	2,030	7.4	12.6
8	4,000	120	4,550	1,180	885	880	1,630	2,290	11.9	16.4
9	4,500	200	3,650	980	746	785	1,520	1,920	5.8	12.2
9	4,500	160	4,100	1,080	820	805	1,560	2,090	9.0	13.2
9	4,500	120	4,650	1,180	885	880	1,630	2,390	13.9	17.2

** S_{min} and propeller mass are based on 6,000 mm propeller shaft and 3,000 mm stern tube.*

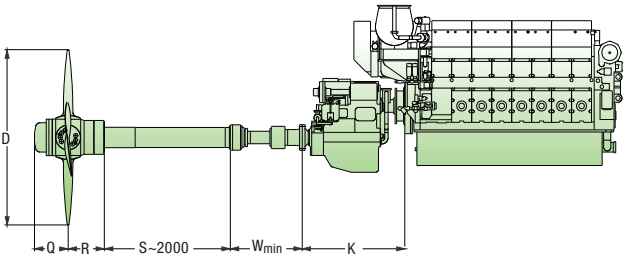
MAN Standard Package Examples



Cyl.	kW	Prop. speed r/min	D mm	Hub VBS mm	Q mm	R mm	W_{min} mm	K mm	Gear mass t	Prop. mass t*
L27/38										
6	2,040	256	2,650	740	569	655	1,300	2,279	8.5	4.7
6	2,040	208	2,950	740	569	655	1,300	2,279	8.5	5.3
6	2,040	177	3,200	860	653	743	1,400	2,279	8.5	5.7
6	2,040	145	3,500	860	653	743	1,400	2,279	8.5	7.0
6	2,040	133	3,650	860	653	743	1,400	3,071	14.0	7.3
7	2,380	256	2,800	740	569	655	1,300	2,279	8.5	5.3
7	2,380	208	3,100	860	653	743	1,400	2,279	8.5	6.4
7	2,380	177	3,350	860	653	743	1,400	2,279	8.5	6.6
7	2,380	145	3,650	860	653	743	1,450	2,279	8.5	7.7
7	2,380	133	3,800	980	746	806	1,500	3,071	14.0	9.4
8	2,720	256	2,900	860	653	743	1,400	2,279	8.5	6.4
8	2,720	208	3,200	860	653	743	1,400	2,279	8.5	6.8
8	2,720	177	3,450	860	653	743	1,450	2,279	8.5	7.6
8	2,720	161	3,600	860	653	743	1,450	2,279	8.5	7.8
8	2,720	133	3,950	980	746	806	1,500	3,071	14.0	9.6
9	3,060	256	2,950	860	653	743	1,400	2,279	8.5	6.7
9	3,060	208	3,300	860	653	743	1,400	2,279	8.5	7.1
9	3,060	177	3,550	860	653	743	1,400	2,279	8.5	8.1
9	3,060	161	3,700	980	746	806	1,500	2,279	8.5	9.4
9	3,060	133	4,050	980	746	806	1,550	3,071	14.0	10.0

** S_{min} and propeller mass are based on 4,000 mm propeller shaft and 2,000 mm stern tube for 21/31, 27/38 and 6,000 mm propeller shaft and 3,000 mm stem tube for the other types.*

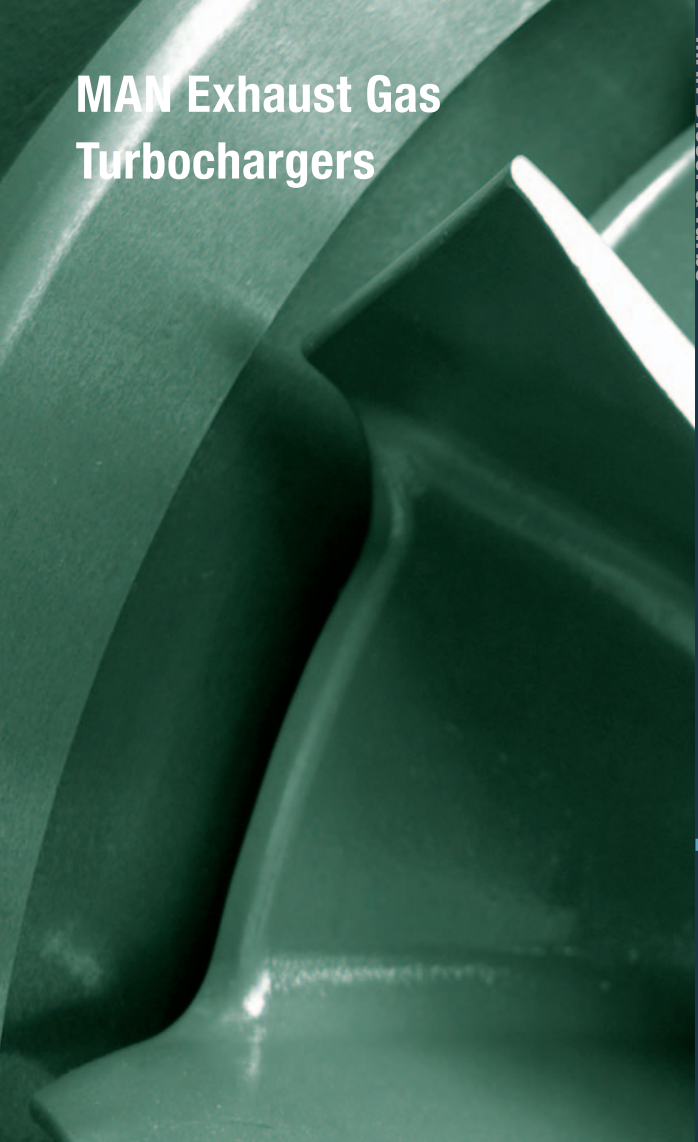
MAN Standard Package Examples



Cyl.	kW	Prop. speed r/min	D mm	Hub VBS mm	Q mm	R mm	W_{min} mm	K mm	Gear mass t	Prop. mass t*
L21/31										
6	1,290	270	2,350	640	550	596	1,200	2,241	4.9	3.2
6	1,290	218	2,600	640	550	596	1,200	2,241	4.9	3.6
6	1,290	190	2,800	740	569	655	1,300	2,241	6.4	4.5
6	1,290	167	3,000	740	569	655	1,300	2,241	6.4	5.7
7	1,505	270	2,500	640	550	596	1,200	2,241	4.9	3.6
7	1,505	218	2,750	740	569	655	1,300	2,241	4.9	4.4
7	1,505	190	2,950	740	569	655	1,300	2,241	6.4	4.9
7	1,505	167	3,150	860	653	743	1,400	2,241	6.4	6.2
8	1,720	278	2,550	640	550	596	1,200	2,241	6.1	3.7
8	1,720	218	2,850	740	569	655	1,300	2,241	6.1	4.6
8	1,720	190	3,050	740	569	655	1,300	2,241	6.4	6.1
8	1,720	167	3,250	860	653	743	1,400	2,241	6.4	6.5
9	1,935	278	2,600	740	569	655	1,300	2,241	6.1	4.5
9	1,935	218	2,900	740	569	655	1,300	2,241	6.1	5.0
9	1,935	194	3,100	860	653	743	1,400	2,241	8.5	6.4
9	1,935	182	3,200	860	653	743	1,400	2,241	8.5	7.0

** S_{min} and propeller mass are based on 4,000 mm propeller shaft and 2,000 mm stern tube for 21/31, 27/38 and 6,000 mm propeller shaft and 3,000 mm stem tube for the other types.*

MAN Exhaust Gas Turbochargers



MAN Exhaust Gas Turbochargers

TCR and NR types with radial flow turbine and TCA types with axial flow turbine

- Straightforward design, uncooled gas casings, inboard bearing arrangement, plain bearings
- Lube oil supply from the engine
- High availability, reliability, durability
- High efficiency
- Easy maintenance and servicing
- Long lifetimes of components
- Long intervals between overhauls

Applications for Marine and Stationary

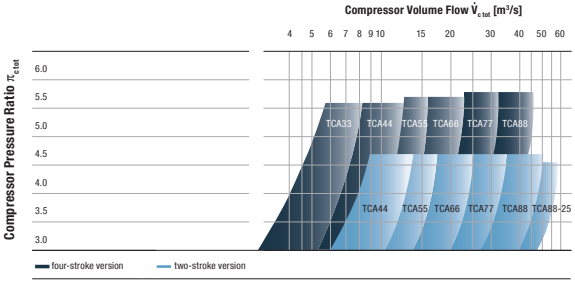
- Propulsion units
- Generating sets
- Diesel and dual fuel engines
- Gas engines
- HFO engines

Special Equipment

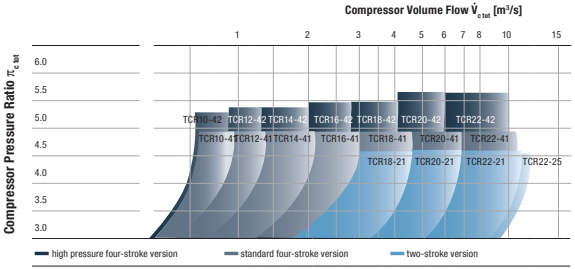
- Tailormade solutions
- Power Turbines (PTG)
- Turbo Compound Systems (TCS - PTG) with Power Turbine Generator
- Variable Turbine Area (VTA)

MAN Exhaust Gas Turbochargers

MAN Turbocharger types TCA



MAN Turbocharger types TCR



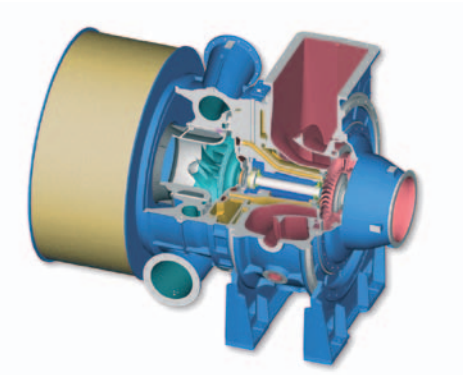
MAN TCA Series

Main features	
Turbine type	Axial flow turbine
Max. permiss. temp.	500 °C 2-stroke / 650 °C 4-stroke
Pressure ratio	up to 5.5
Suitable for HFO, MDO, Gas	

Turbocharger programme

Turbocharger type	Max. supercharged engine output kW		Max. permissible Speed rpm	Mass kg
	2-stroke b_e^* = 9 kg/kWh	4-stroke b_e^* = 6.5 kg/kWh		
TCA33	-	5,400	27,800	1,140
TCA44	6,150	7,900	22,700	1,970
TCA55	8,000	10,400	20,100	3,290
TCA66	11,600	14,800	16,900	5,510
TCA77	16,600	20,900	14,200	9,250
TCA88	27,200	29,800	12,000	15,790

** Specific air consumption*

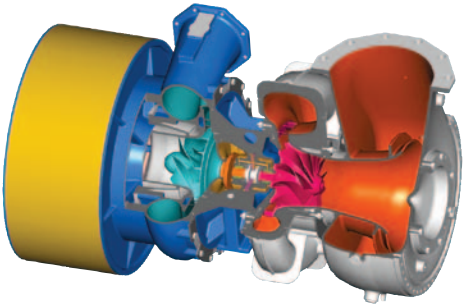


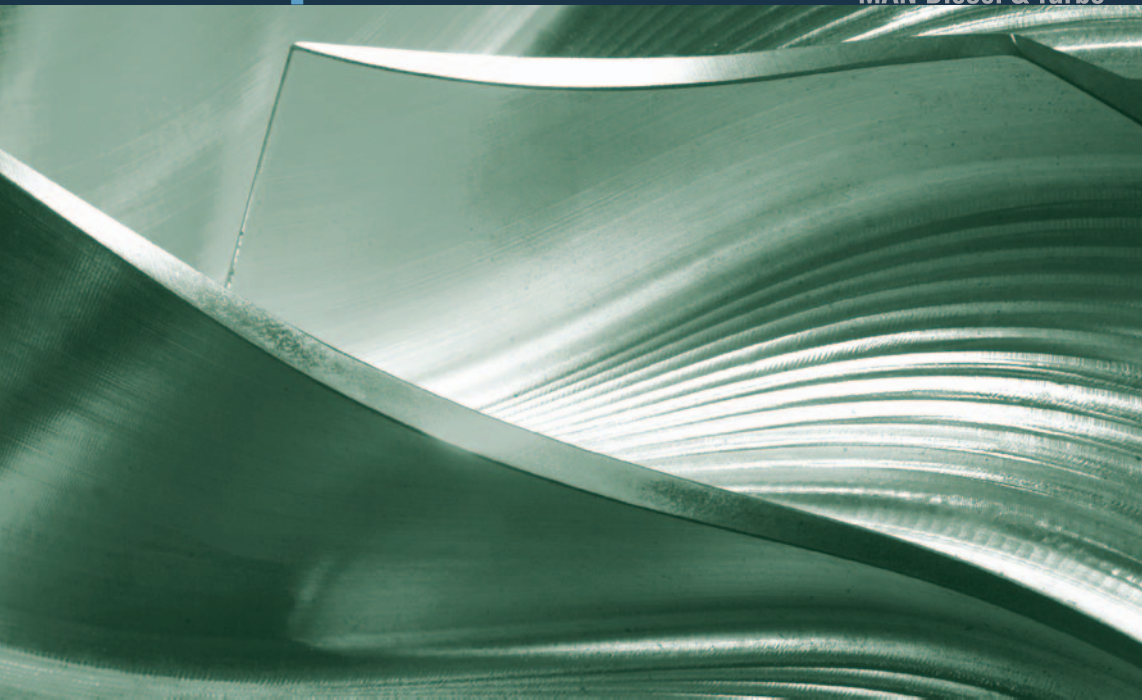
Main features	
Turbine type	Radial flow turbine
Max. permiss. temp.	700 °C
Pressure ratio	up to 5.4
Suitable for HFO, MDO, Gas	

Turbocharger programme

Turbocharger type	Max. supercharged engine output kW		Max. permissible Speed rpm	Mass kg
	2-stroke le* = 8 kg/kWh	4-stroke le* = 7 kg/kWh		
TCR10	-	600	84,100	40
TCR12	-	800	70,850	100
TCR14	-	1,200	58,700	135
TCR16	-	1,800	48,800	205
TCR18	2,400	2,700	40,250	350
TCR20	3,500	3,900	33,450	600
TCR22	6,400	6,900	25,600	1,400

** Specific air consumption*

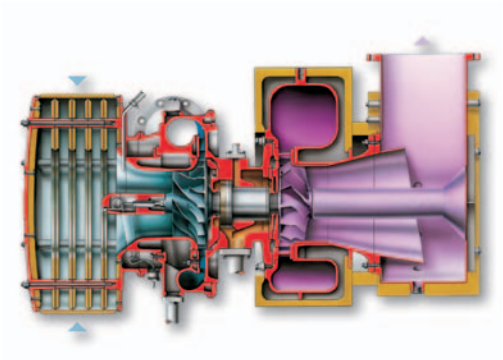




Main features	
Turbine type	Radial flow turbine
Max. permiss. temp.	650 °C (opt. 720 °C)
Pressure ratio	up to 4.5
Suitable for HFO, MDO, Gas	

Turbocharger programme			
Turbocharger type	Max. supercharged engine output kW	Max. permissible speed rpm	Mass kg
NR12/S	670	75,000	155
NR14/S	950	64,000	190
NR17/S	1,350	52,600	260
NR20/S	1,870	44,700	350
NR24/S	2,690	37,300	505
NR29/S	3,820	31,300	780
NR34/S	5,400	26,300	1,450

Specific air consumption Ie = 7 kg/kWh



MAN (TCS-) PTG Power Turbines

Exhaust Gas Turbine
- Newly developed high efficiency turbine
- New turbine nozzle ring with extended life time
- Bearing arrangement with long life time
- Axial: Based on most modern TCA series
- Radial: Based on most modern TCR series

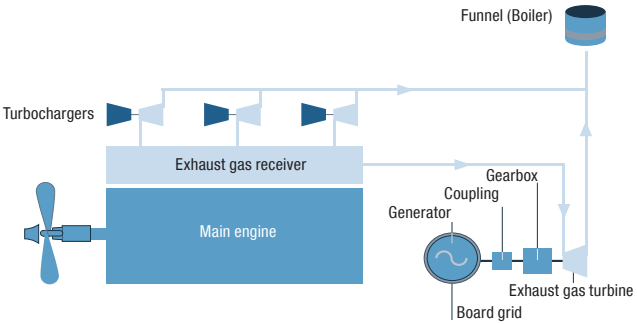
Gearbox
- High efficiency high speed gearbox reducing turbine speed to generator speed

Couplings
- Gearbox to generator: High flexible coupling

Generator
- Synchronous generator suited to marine applications
- Asynchronous generator suited to stationary applications

Exhaust Gas System
- Control valves for power turbine operating range
- Fast acting emergency valves for emergency shutdown
- Control and saftey equipment

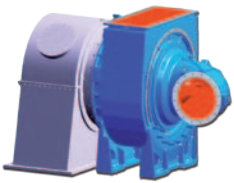
Optional: Variable Turbine Area (VTA) for Exhaust Gas Turbine
- Increasing efficiency and flexibility of operation



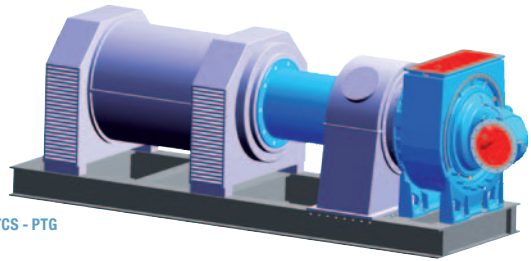
MAN (TCS-) PTG Power Turbines

Main Features Power Turbines	
Turbine type	Radial or Axial
Max. permiss. temp.	550 °C
Output shaft speed	1,800 rpm (1,500 rpm)
Suitable for HFO, MDO, Gas	

Radial flow turbine	Max. output kW $\prod_T = 3.3$	Max. flow rate kg/s Temperature before turbine 450 °C	Speed PT 1/min
(TCS-) PTG18	850	6.2	34,000
(TCS-) PTG20	1,250	8.9	28,500
(TCS-) PTG22	2,200	15.2	21,500
Axial flow turbine			
(TCS-) PTG55	3,300	21.2	17,000
(TCS-) PTG66	4,700	30.0	14,500



PTG



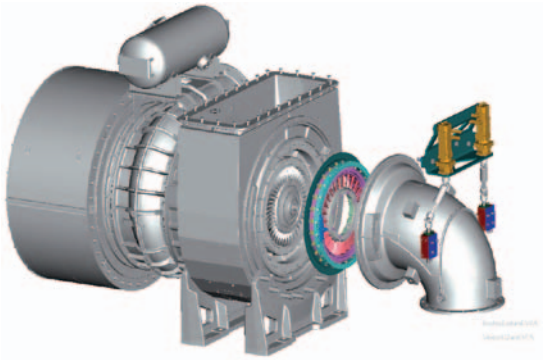
TCS - PTG

MAN Variable Turbine Area (VTA)

Variable Turbine Area (VTA)
The VTA system consists of a nozzle ring equipped with adjustable vanes which optionally replace the fixed-vane nozzle rings in MAN Diesel & Turbo's standard TCA and TCR turbochargers.

By altering the pitch of the adjustable vanes, the pressure of the exhaust gases on the turbine is regulated and thus the volume of charge air can be precisely matched to the quantity of injected fuel at all points in an engine's load and speed range. The result is reduced specific fuel consumption, reduced emissions HC and CO_2 and improved engine response.

Benefits of VTA
- Up to 5g/kWh lower fuel consumption
- Lower soot and smoke emission
- Lower CO_2 emissions
- Lower particle emissions
- Suitable for TCA and TCR turbochargers
- Retrofit packages
- Short payback time
- VTA cuts fuel consumption and reduces emissions



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F: MAN Diesel & Turbo Four-stroke licence
FS: MAN Diesel & Turbo Four-stroke SEMT Pielstick licence
P: MAN Diesel & Turbo Propeller licence
TC: MAN Diesel & Turbo Turbocharger licence

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