

## 5 Installation Aspects

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## 5 Installation Aspects

The figures shown in this chapter are intended as an aid at the project stage. The data is subject to change without notice, and binding data is to be given by the engine builder in the "Installation Documentation" mentioned in Chapter 10.

### Space Requirements for the Engine

The space requirements stated in Fig. 5.01 are valid for engines rated at nominal MCR (L<sub>1</sub>).

Additional space needed for engines equipped with PTO is stated in Chapter 4.

If, during the project stage, the outer dimensions of the turbocharger seem to cause problems, it is possible, for the same number of cylinders, to use turbochargers with smaller dimensions by increasing the indicated number of turbochargers by one.

### Overhaul of Engine

The distances stated from the centre of the crankshaft to the crane hook are for vertical or tilted lift, see note F in Fig. 5.01.

A lower overhaul height is, however, available by using the MAN B&W double-jib crane, built by Danish Crane Building ApS, shown in Figs. 5.02 and 5.03.

Please note that the distance given by using a double-jib crane is from the centre of the crankshaft to the lower edge of the deck beam, see note E in Fig. 5.01.

2 x 0.5 ton double jib crane can be used for this engine as this crane has been individually designed for the engine.

The capacity of a normal engine room crane has to be minimum 0.63 tons.

The area covered by the engine room crane shall be wide enough to reach any heavy spare part required in the engine room, and the crane hook shall be able to reach the lowermost floor level in the engine

room. A special crane beam for dismantling the turbocharger shall be fitted. The lifting capacity of the crane beam for dismantling the turbocharger is stated in fig. 6.10.07

The overhaul tools for the engine are designed to be used with a crane hook according to DIN 15400, June 1990, material class M and load capacity 1Am and dimensions of the single hook type according to DIN 15401, part 1.

### Engine Outline

The total length of the engine at the crankshaft level may vary depending on the equipment to be fitted on the fore end of the engine, such as adjustable counterweights, tuning wheel, moment compensators PTO, which are shown as alternatives in Figs. 5.04 and 5.05.

Transparent outline drawings in scale 1:50 and 1:100 are included in section 11.

### Engine Masses and Centre of Gravity

The partial and total engine masses appear from Chapter 9, "Dispatch Pattern", to which the masses of water and oil in the engine, Fig. 5.07, are to be added. The centre of gravity is shown in Fig. 5.06, including the water and oil in the engine, but without moment compensators or PTO.

### Gallery Outline

Figs. 5.08 and 5.09 show the gallery outline for engines with high efficiency turbochargers and rated at nominal MCR (L<sub>1</sub>).

## Engine Pipe Connections

The position of the external pipe connections on the engine are stated in Figs. 5.10 and 5.11, and the corresponding lists of counterflanges for pipes and turbocharger in Figs. 5.12 and 5.13, respectively.

The flange connection on the turbocharger gas outlet is rectangular, but a transition piece to a circular form can be supplied as an option: 4 60 601.

## Engine Seating and Arrangement of Holding Down Bolts

The dimensions of the seating stated in Figs. 5.14 and 5.15 are for guidance only.

The engine is basically mounted on epoxy chocks 4 82 102 in which case the underside of the bed-plate's lower flanges has no taper.

The epoxy types approved by MAN B&W Diesel A/S are:

“Chockfast Orange PR 610 TCF”  
from ITW Philadelphia Resins Corporation, USA,  
and  
“Epocast 36”  
from H.A. Springer – Kiel, Germany

The engine may alternatively, be mounted on cast iron chocks (solid chocks 4 82 101), in which case the underside of the bedplate's lower flanges is with taper 1:100.

## Top Bracing

The so-called guide force moments are caused by the transverse reaction forces acting on the crossheads due to the connecting rod/crankshaft mechanism. When the piston of a cylinder is not exactly in its top or bottom position, the gas force from the combustion, transferred through the connecting rod will have a component acting on the crosshead and the crankshaft perpendicularly to the axis of the cylinder. Its resultant is acting on the guide shoe (or piston skirt in the case of a trunk engine), and together they form a guide force moment.

The moments may excite engine vibrations moving the engine top athwartships and causing a rocking (excited by H-moment) or twisting (excited by X-moment) movement of the engine.

For engines with fewer than seven cylinders, this guide force moment tends to rock the engine in transverse direction, and for engines with seven cylinders or more, it tends to twist the engine. Both forms are shown in the chapter dealing with vibrations. The guide force moments are harmless to the engine, however, they may cause annoying vibrations in the superstructure and/or engine room, if proper countermeasures are not taken.

Because of the moments it is recommended that the ship is prepared to have top bracings installed at the brackets marked with with 'X', just in case a trial trip indicates the need for bracings.

The top bracing is designed as a stiff connection which allows adjustment in accordance with the loading conditions of the ship.

**Without top bracing**, the natural frequency of the vibrating system comprising engine, ship's bottom, and ship's side, is often so low that resonance with the excitation source (the guide force moment) can occur close to the normal speed range, resulting in the risk of vibration.

**With top bracing**, such a resonance will occur above the normal speed range, as the top bracing increases the natural frequency of the above-mentioned vibrating system.

The top bracing is normally placed on the exhaust side of the engine (4 83 110), but it can alternatively be placed on the camshaft side, option: 4 83 111, see Figs. 5.16 and 5.17.

The top bracing is to be made by the shipyard in accordance with MAN B&W instructions.

**Mechanical top bracing**

The mechanical top bracing, option: 4 83 112 shown in Fig. 5.18 comprises stiff connections (links) with friction plates.

The forces and deflections for calculating the transverse top bracing's connection to the hull structure are:

Force per top bracing . . . . .  $\pm 32$  kN  
Minimum horizontal rigidity at the  
link's points of attachment to the hull . . . 85 MN/m  
Tightening torque at hull side. . . . . 50 Nm

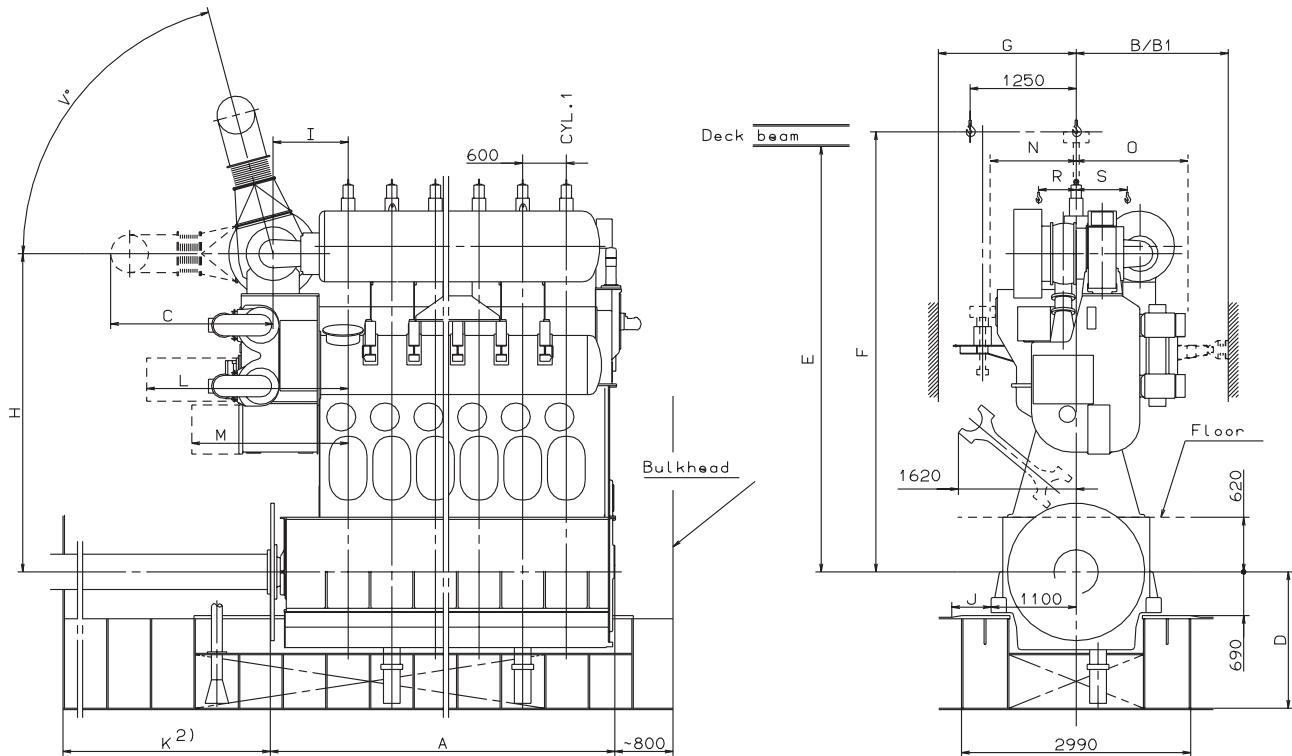
**Earthing Device**

In some cases, it has been found that the difference in the electrical potential between the hull and the propeller shaft (due to the propeller being immersed in seawater) has caused spark erosion on the main bearings and journals of the engine.

A potential difference of less than 80 mV is harmless to the main bearings so, in order to reduce the potential between the crankshaft and the engine structure (hull), and thus prevent spark erosion, we recommend the installation of a highly efficient earthing device.

The sketch Fig. 5.19 shows the layout of such an earthing device, i.e. a brush arrangement which is able to keep the potential difference below 50 mV.

We also recommend the installation of a shaft-hull mV-meter so that the potential, and thus the correct functioning of the device, can be checked.



1) Space for aux. Blowers with direct drive and frequency converter: 2200 mm

2) K must be equal to or larger than the propeller shaft, if the propeller shaft is to be drawn into the engine room

Normal/minimum centreline distance for twin engine installation: 3250/2900 mm (2900 mm for common gallery for starboard and port design engines)

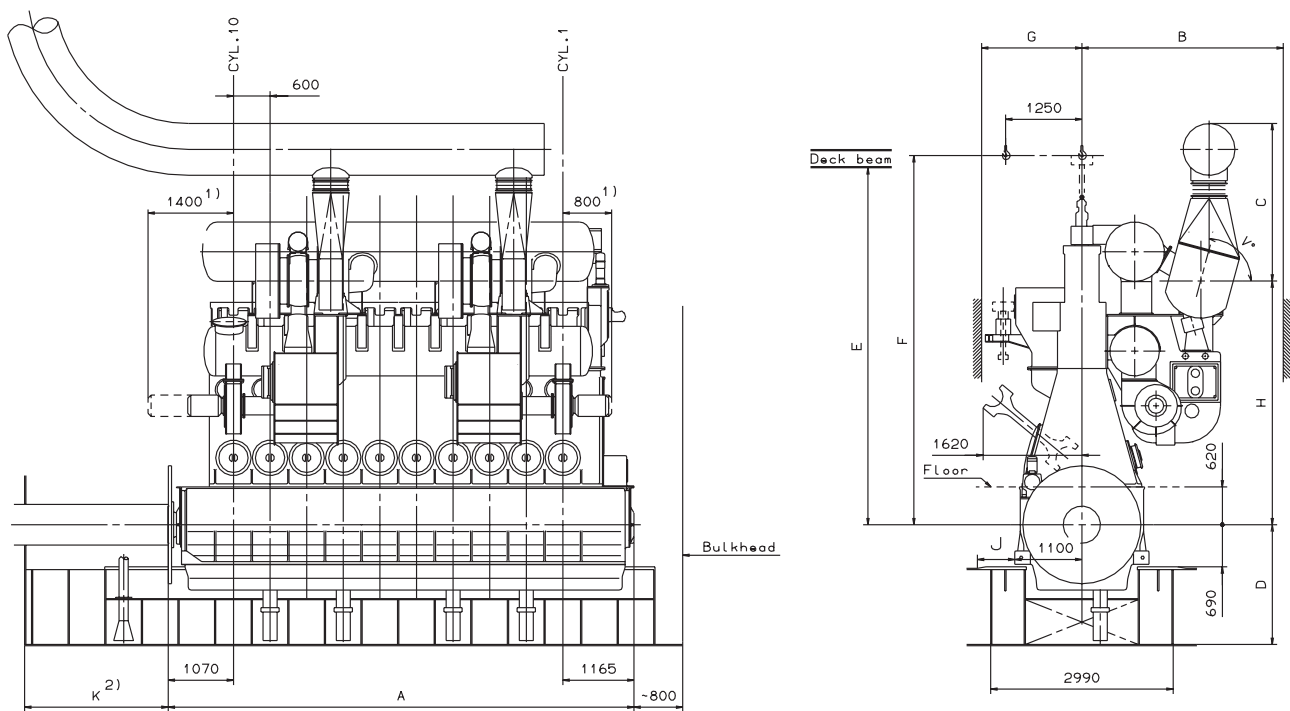
The dimensions are given in mm and are for guidance only. If the dimensions cannot be fulfilled, please contact MAN B&W Diesel A/S or our local representative

Fig.5.01a: Space requirement for the engine, turbocharger located on aft end (4 59 121)

178 41 14-8.0

Cyl. No.	4	5	6	7	8	9		
A	min.	3609	4209	4809	5409	6009	6609	Fore end: A min. shows basic engine A max. shows engine with built on tuning wheel
	max.	3858	4458	5058	5658	6258	6858	For PTO: See corresponding "Space requirement"
B	2100 <sup>1)</sup>						MAN B&W and ABB turbochargers	Without top bracing
B1	2110 <sup>1)</sup>							With top bracing
C	2382	2500	2637	2835	3012	3150	MAN B&W turbocharger	Dimensions according to "Turbocharger choice" at nominal MCR
	2173	2371	2612	2750	2927	3065	ABB turbocharger	
D	1853	1903	1953	1978	2003	2038	The dimension is includes a cofferdam and must fulfil minimum height to tanktop according to classification rules	
E	5925						El. crane	The distance from crankshaft centreline to lower edge of deck beam, when using MAN B&W Double jib crane. See "MAN B&W Double jib crane"
	5850						Manual crane	
F	6425						Vertical lift of piston, piston rod passes between cylinder cover studs	
	6050						Tilted lift of piston, piston rod passes between cylinder cover studs	
G	1900						See "Top bracing arrangement", if top bracing fitted on camshaft side	
H		4375	4375	4475	4475	4475	MAN B&W turbocharger	Dimensions according to "Turbocharger choice" at nominal MCR
	4505	4505	4350	4350	4350	4350	ABB turbocharger	
I		1032	1032	1118	1118	1128	MAN B&W turbocharger	Dimensions according to "Turbocharger choice" at nominal MCR
	1004	1037	1205	1205	1205	1205	ABB turbocharger	
J	515						Space for tightening control of holding down bolts	
L	2790	2790	2790	3260	3260	3260	Necessary space for overhaul of air cooler	
M	2230	2230	2230	2920	2920	2920	Necessary space for overhaul of water mist cather	
N	1184						The dimensions cover required space and hook travelling width for turbocharger NA40/S	
O	1537							
R	518							
S	702							
V	0°,15°, 30°, 45°, 60°, 75°, 90°						Max. 60° when MAN B&W Double jib crane is used	
							Max. 15° when engine room has min. headroom above turbocharger	

Fig.5.01b: Space requirement for the engine, turbocharger located on aft end (4 59 121)



1) Space for auxiliary blowers

2) K must be equal to or larger than the propeller shaft, if the propeller shaft is to be drawn into the engine room

Normal/minimum centreline distance for twin engine installation: 3250/2900 mm (2900 mm for common gallery for starboard and port design engines)

The dimensions are given in mm and are for guidance only. If the dimensions cannot be fulfilled, please contact MAN B&W Diesel A/S or our local representative

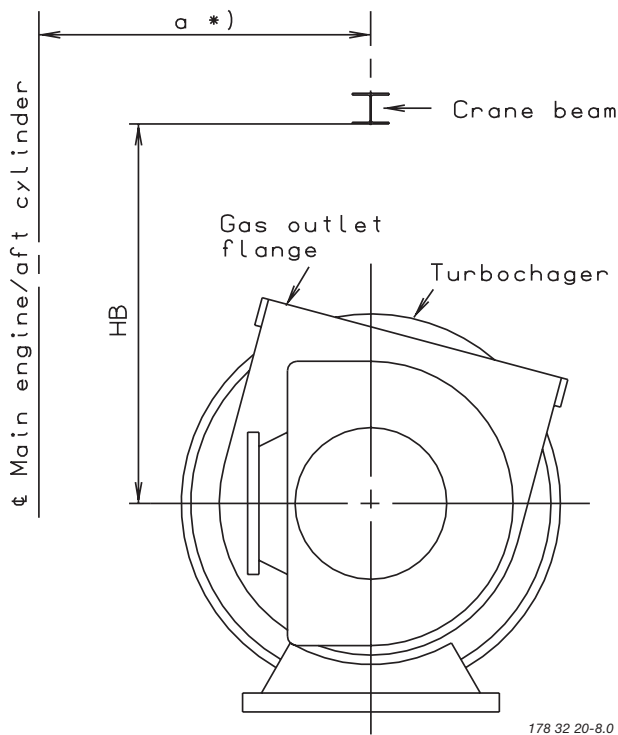
Fig.5.01c: Space requirement for the engine, turbocharger located on exhaust side (4 59 126)

178 43 37-7.0

Cyl. No.	10		
A	7635	Fore end: A min. Dimension A includes fore end with extra bearing for PTO For PTO: See corresponding "Space requirement"	
B	3300	MAN B&W turbochargers 2 x NA 34/S	Without top bracing
C	2581	MAN B&W turbocharger 2 x NA 34/S	
D	2063/2408	The dimension are for vertical/horizontal lub. oil outlet and exclusive cofferdam and must fulfil minimum height to tanktop according to classification rules	
E	5925	El. crane	The distance from crankshaft centreline to lower edge of deck beam, when using MAN B&W double jib crane. See "MAN B&W Double jib crane"
	5850	Manual crane	
F	6425	Vertical lift of piston, piston rod passes between cylinder cover studs	
	6050	Tilted lift of piston, piston rod passes between cylinder cover studs	
G	1900	See "Top bracing arrangement", if top bracing fitted on camshaft side	
H	3897	MAN B&W turbocharger 2 x NA 34/S	
J	515	Space for tightening control of holding down bolts	
V	0°, 15°, 30°, 45°, 60°, 75°, 90°	Max. 45° when engine room has min. headroom above turbocharger	

Fig.5.01d: Space requirement for the engine, turbocharger located on exhaust side (4 59 126)





For the overhaul of a turbocharger, a crane beam with trolleys is required at each end of the turbocharger.

Two trolleys are to be available at the compressor end and one trolley is needed at the gas inlet end.

The crane beam can be omitted if the main engine room crane also covers the turbocharger area.

The crane beam is used for lifting the following components:

- Exhaust gas inlet casing
- Turbocharger silencer
- Compressor casing
- Turbine rotor with bearings

The sketch shows a turbocharger and a crane beam that can lift the components mentioned.

The crane beam(s) is/are to be located in relation to the turbocharger(s) so that the components around the gas outlet casing can be removed in connection with overhaul of the turbocharger(s).

#### MAN B&W turbocharger related figures:

		Type				
	Units	NA34	NA40	NA48	NA57	NA70
W	kg	1000	1000	1000	2000	3000
HB	mm	1200	1300	1700	1800	2300

#### ABB turbocharger related figures:

		Type		
	Units	VTR454	VTR564	VTR714
W	kg	1000	2000	3000
HB	mm	1400	1700	2200

		Type			
	Units	TPL61	TPL65	TPL69	TPL73
W	kg	1000	1000	1000	1000
HB	mm	500	600	700	800

#### MHI turbocharger related figures:

		Type			
	Units	MET42SD MET42SE	MET53SD MET53SE	MET66SD MET66SE	MET83SD MET83SE
W	kg	1000	1500	2500	5000
HB	mm	1100	1200	1800	2200

The table indicates the position of the crane beam(s) in the vertical level related to the centre of the turbocharger(s).

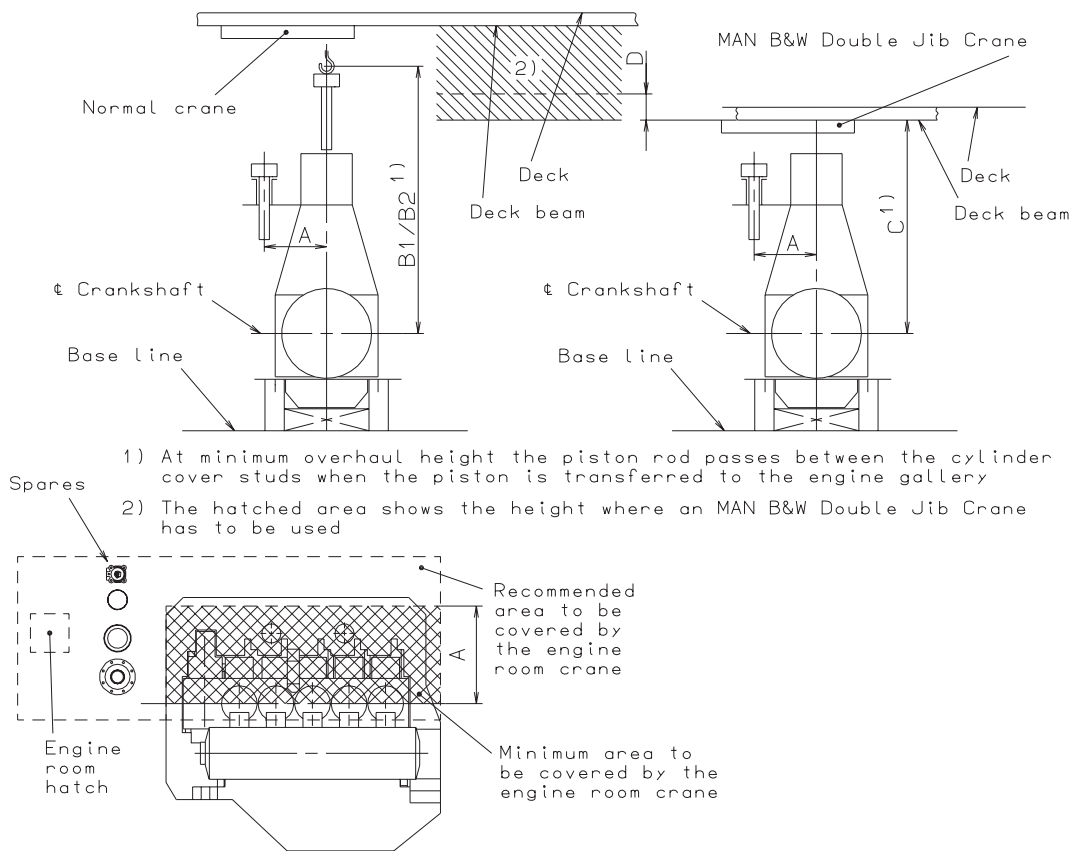
The crane beam location in horizontal direction:

- \*) Engines with the turbocharger(s) located on the exhaust side.  
The letter 'a' indicates the distance between vertical centrelines of the engine and the turbocharger(s).
- \*) Engines with the turbocharger located on the aft end of engine.  
The letter 'a' indicates the distance between vertical centrelines of the aft cylinder and the turbocharger.  
The figures 'a' are stated on the 'Engine Outline' drawing.

The crane beam can be bolted to brackets that are fastened to the ship structure or to columns that are located on the top platform of the engine.

The lifting capacity of the crane beam is indicated in the table for the various turbocharger makes. The crane beam shall be dimensioned for lifting the weight 'W' with a deflection of some 5 mm only.

Fig. 5.01e: Crane beams for overhaul of turbocharger



Weight in kg inclusive lifting tools			Crane capacity in tons			Height in mm when using normal crane (vertical lift of piston/tilted lift of piston)	Building-in height in mm when using MAN B&W double-jib crane	
Cylinder cover complete with exhaust valve	Cylinder linier with cooling jacket	Piston with stuffing box	Normal crane	MAN B&W double-jib crane	A Minimum distance in mm	B1/B2 Minimum height from centre line crankshaft to crane hook	C Minimum height from centre line crankshaft to underside deck beam	D Additional height which makes overhaul of exhaust valve feasible without removal of any studs

The crane hook travelling area must cover at least the full lenght of the engine and a width in accordance with dimension A given on the drawing.

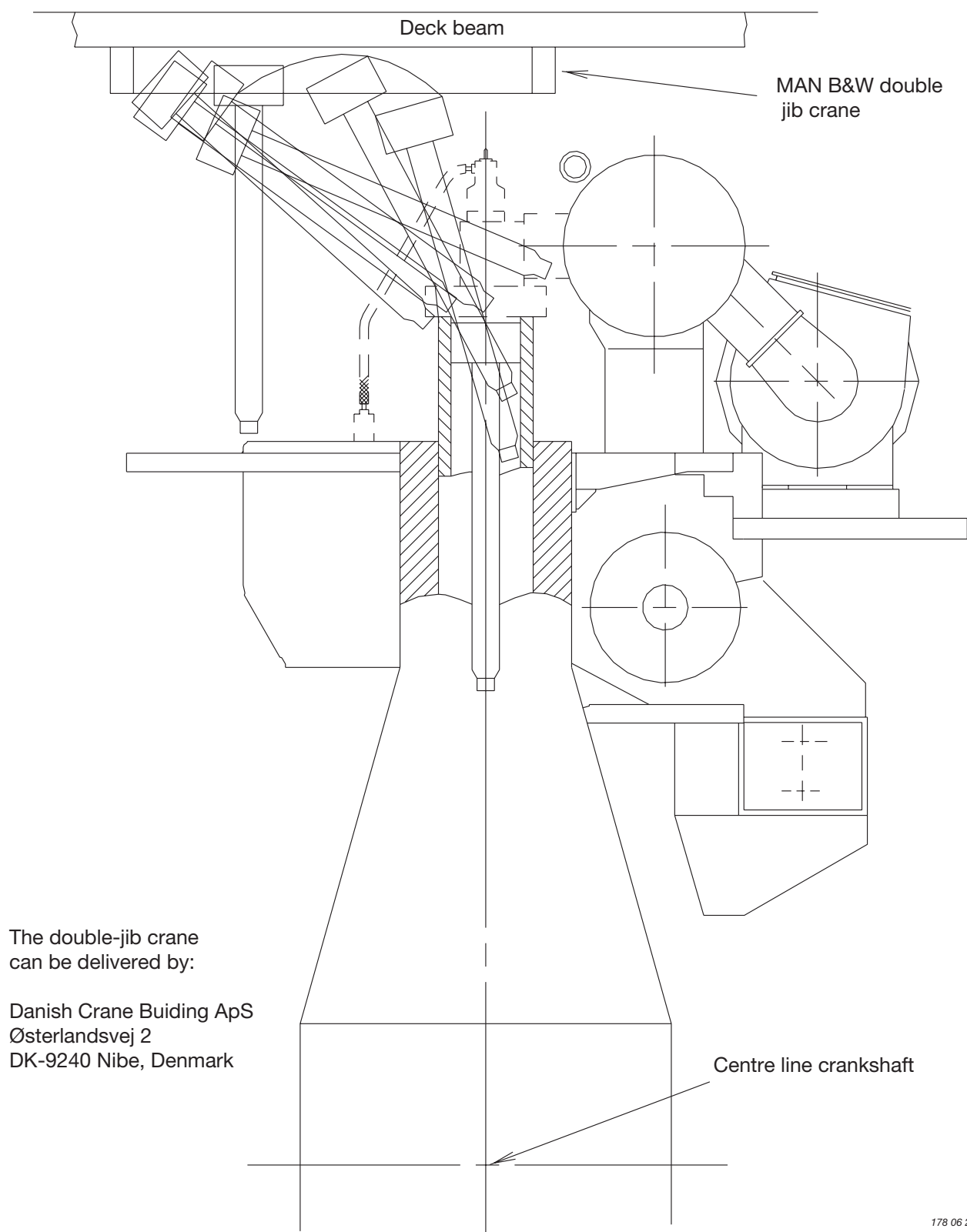
It is furthermore recommended that the engine room crane can be used for transport of heavy spare parts from the engine room hatch to the spare part stores and to the engine. See example on this drawing.

The crane hook should at least be able to reach down to a level corresponding to the centreline of the crankshaft.

For overhaul of the turbocharger(s) a trolley mounted chain hoists must be installed on a separate crane beam or, alternatively, in combination with the engine room crane structure, see Fig. 5.01b with information about the required lifting capacity for overhaul of turbocharger(s).

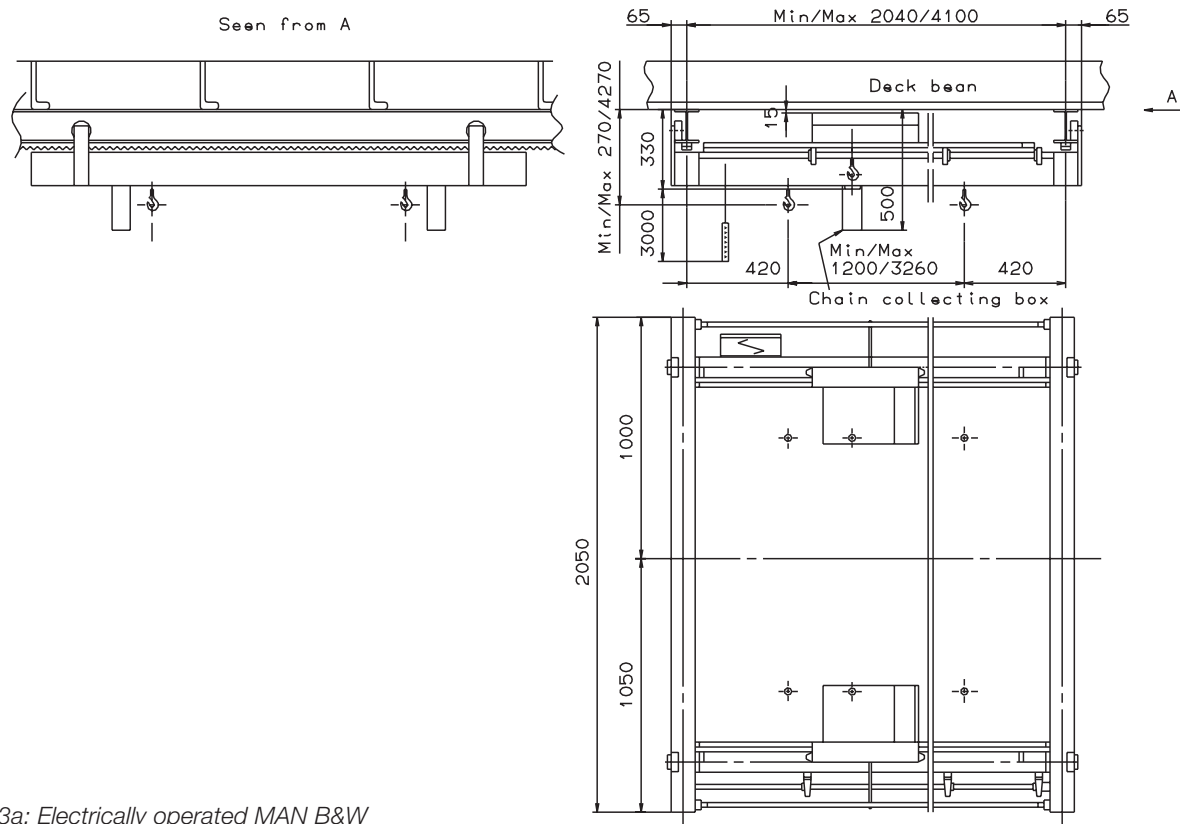
Fig. 5.01f: Engine room crane

178 41 08-9.0



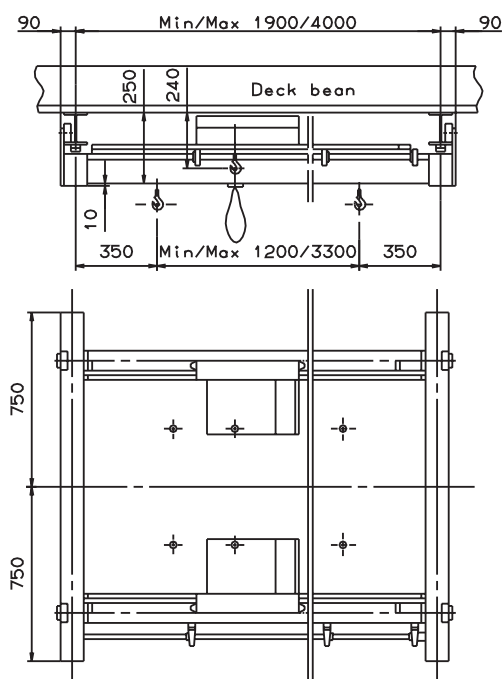
178 06 25-5.3

*Fig. 5.02: Overhaul with double-jib crane*



178 40 35-7.1

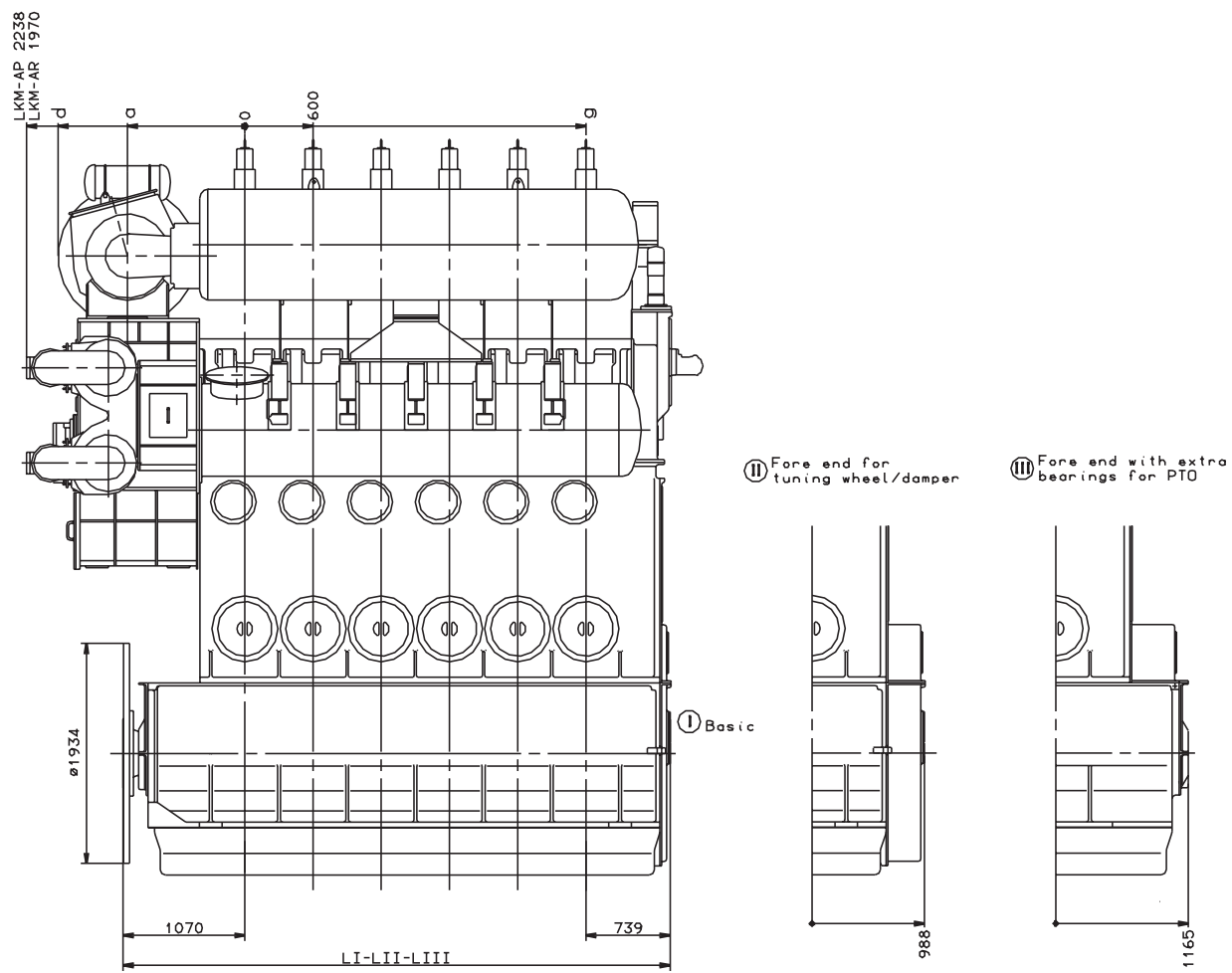
Fig. 5.03a: Electrically operated MAN B&W double-jib crane 2 x 0.5 t, option: 4 88 701



178 40 36-9.0

These cranes are adapted to the special tools for low overhaul

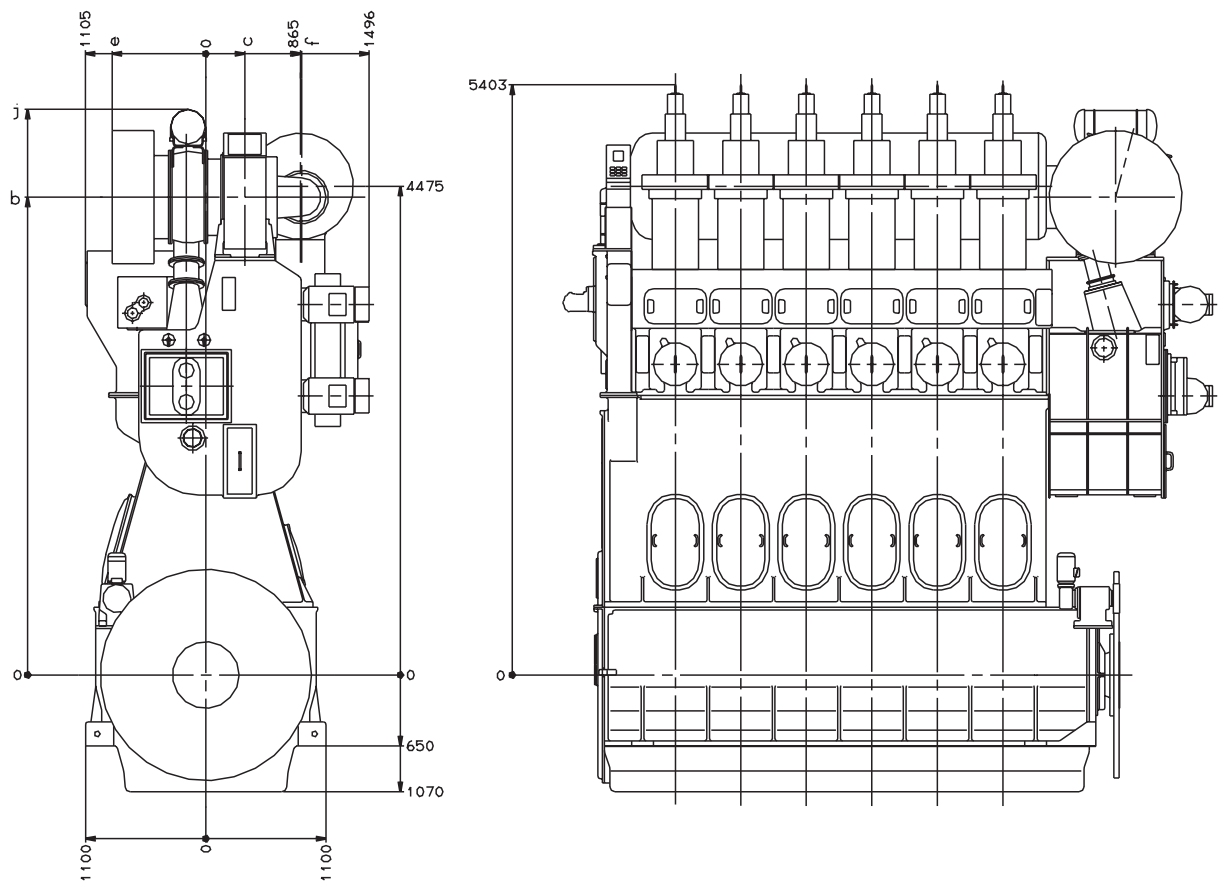
Fig. 5.03b: Manually operated MAN B&W double-jib crane 2 x 0.5 t, option: 4 88 702



Types of fore end	Typical for cylinder No.	Space demand valid for
I	7-8	Basic design
II	4-5-6	2nd order moment compensator
III	4-5-6	2nd order moment compensator and tuning wheel

Fig. 5.04a: Engine outline

178 41 56-7.0



	Turbocharger type	a	b	c	d	e	f	j
MAN B&W	NR29/S	1150	4475	1225	1565	380	650	-
	NA34/S	1032	4375	358	1642	859	878	5180
	NA40/S	1118	4475	432	1753	805	965	5365
ABB	VTR304	1004	4505	356	1464	514	865	
	VTR354	990	4405	301	1538	687	749	
	VTR454	1197	4475	390	1884	880	955	
MHI	MET33SD	990	4475	310	1460	750	670	
	MET42SD	1073	4405	417	1628	719	865	
	MET53SD	1150	4475	410	1840	1000	975	

Cyl. No.	g	LI	LII	LIII
4	1800	3609	3858	4035
5	2400	4209	4458	4635
6	3000	4809	5058	5235
7	3600	5409	5658	5835
8	4200	6009	6258	6435
9	4800	6609	6858	7035

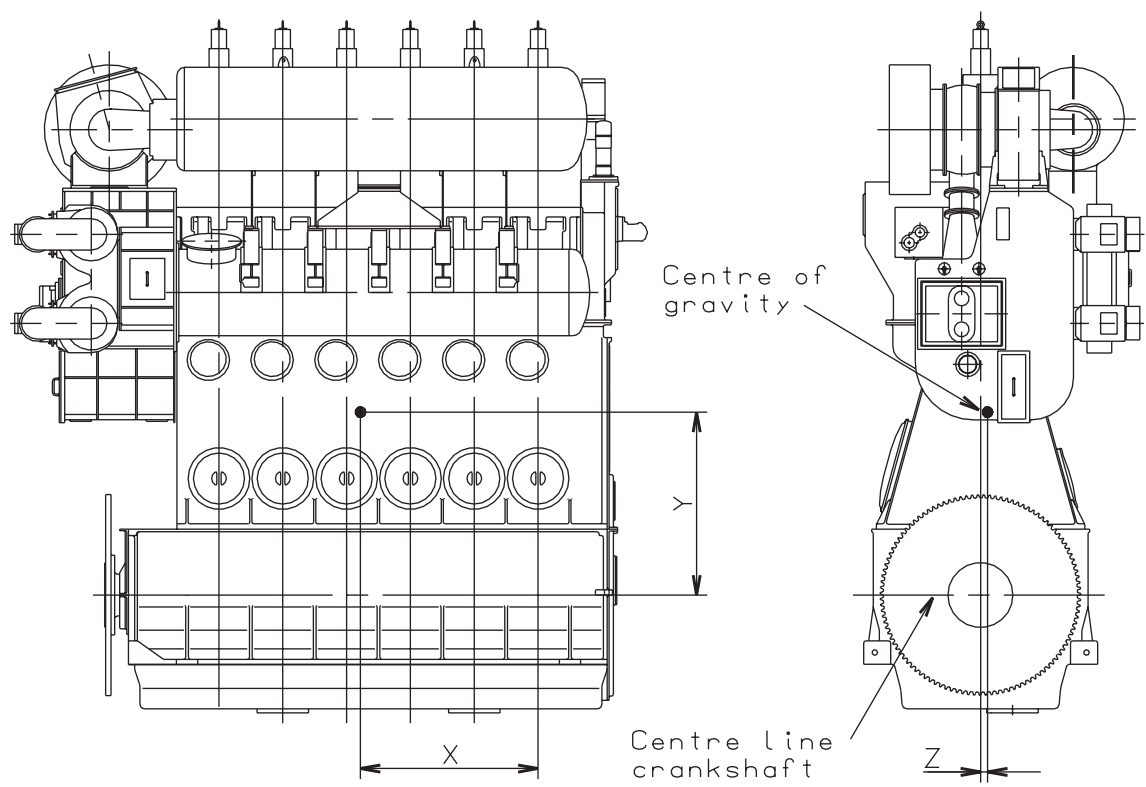
Please note:

The dimensions given are subject to revision without notice

For platforms dimensions see “Gallery outline”

178 41 56-7.0

Fig. 5.04b: Engine outline



No. of cylinders	4	5	6	7	8	9	10*	11*	12*
Distance X mm	1090	1400	1670	2020	2310	2640			
Distance Y mm	1675	1715	1720	1780	1780	1790			
Distance Z mm	65	65	65	67	67	67			

For engine dry masses, see dispatch pattern in section 9

\*The data for 10-12 cylinder engines with two turbochargers on exhaust side, are available on request

178 40 34-5.0

Fig. 5.05: Centre of gravity

No. of cylinders	Mass of water and oil in engine in service					
	Mass of water			Mass of oil in		
	Freshwater	Seawater	Total *	Engine system	Oil pan *	Total
	kg	kg	kg	kg	kg	kg
4	85	115	200	65	230	295
5	110	125	235	85	280	365
6	135	135	270	105	325	430
7	160	145	305	125	375	500
8	185	155	340	145	420	565
9	210	165	375	165	465	630
10	235	250	485	185	515	700
11	260	270	530	205	580	785
12	285	290	575	225	650	875

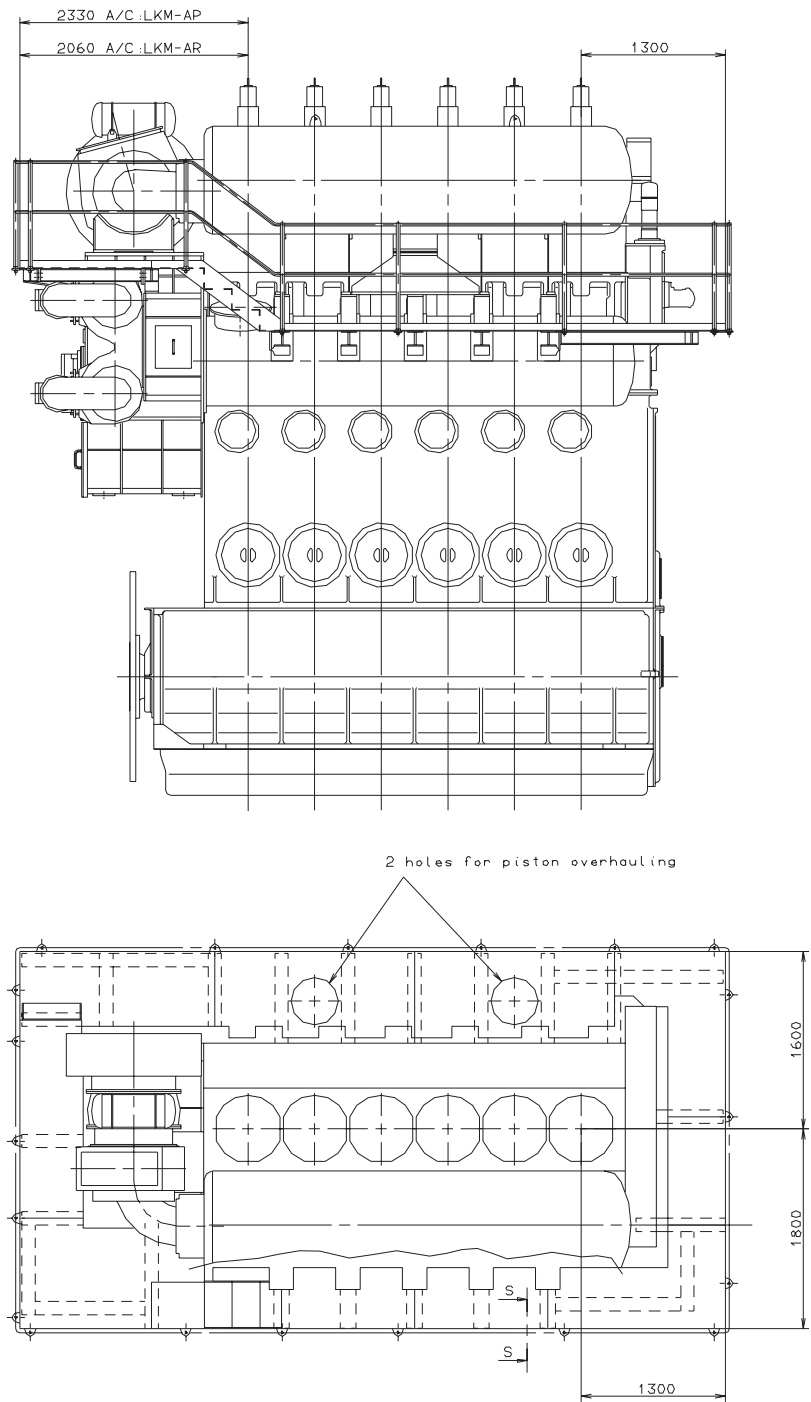
\* The stated values are valid for horizontally aligned engines with vertical oil outlets

The values for 11-12 cylinder engines are estimated

178 40 28-6.0

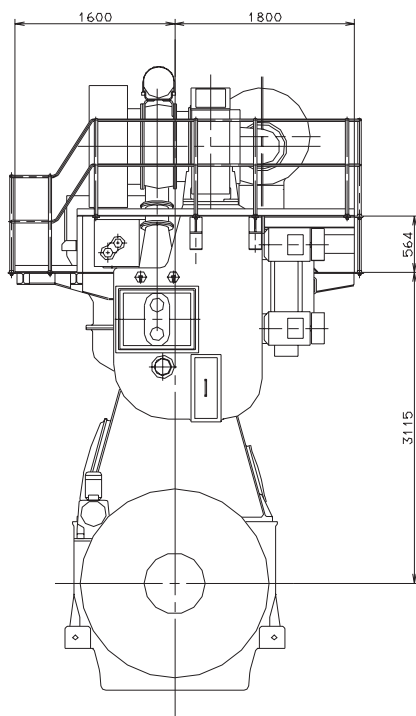
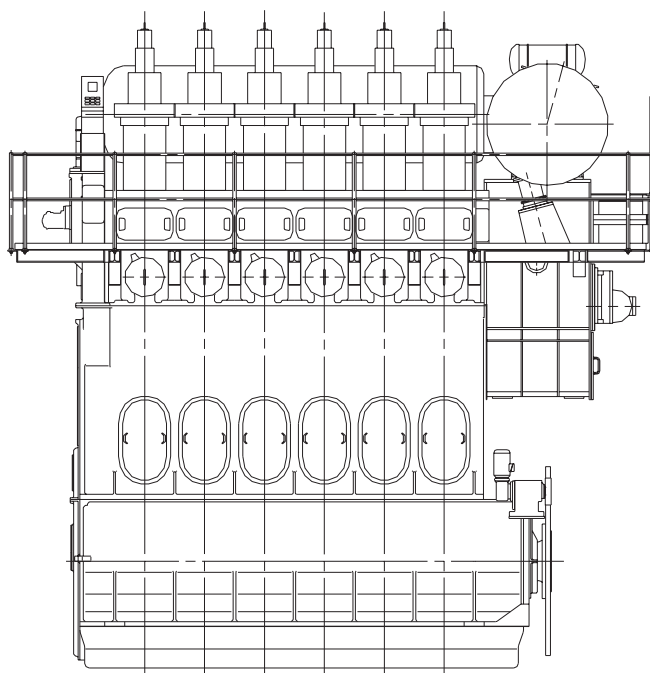
Fig. 5.06: Water and oil in engine





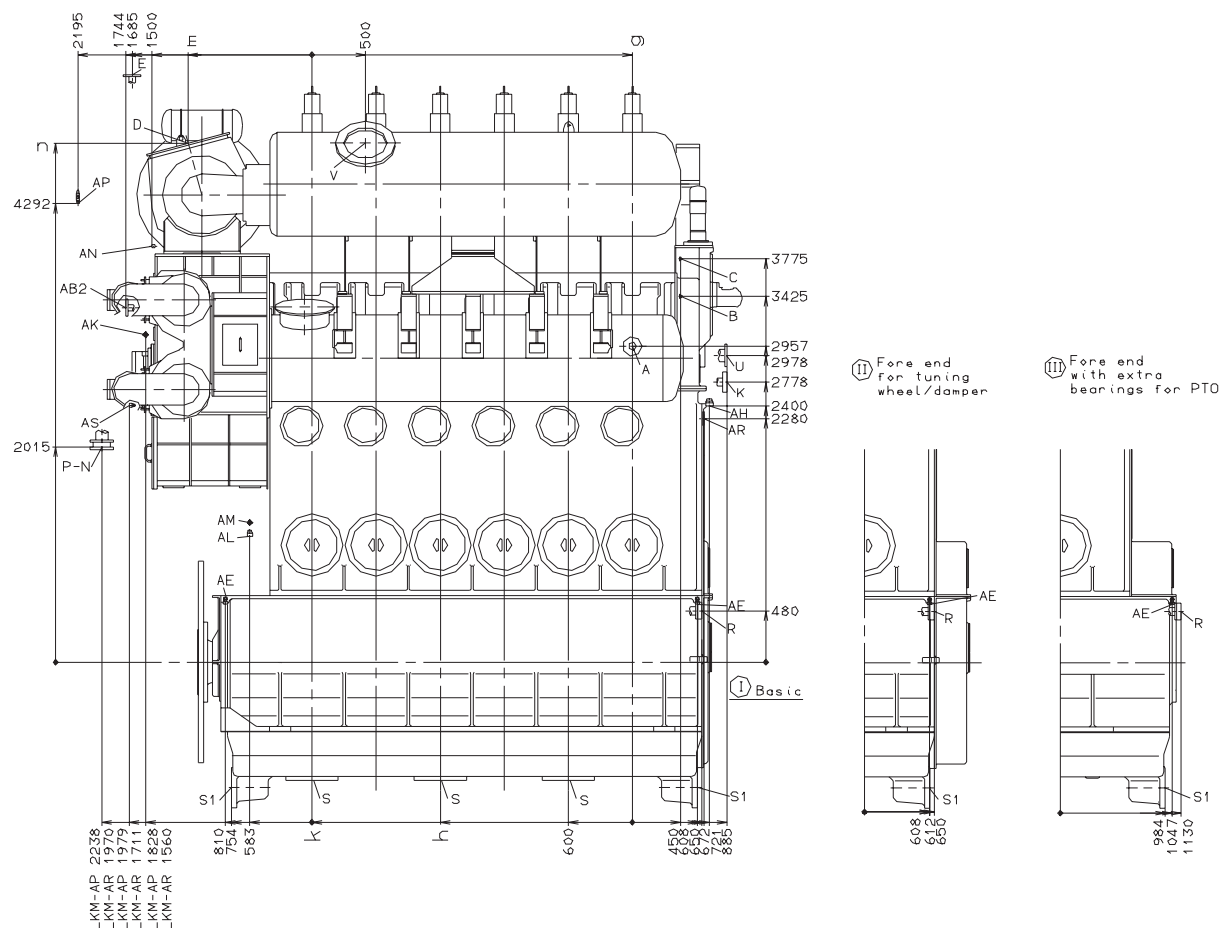
178 41 60-2.0

Fig. 5.07a: Gallery outline, with one turbocharger located on aft end



178 41 60-2.0

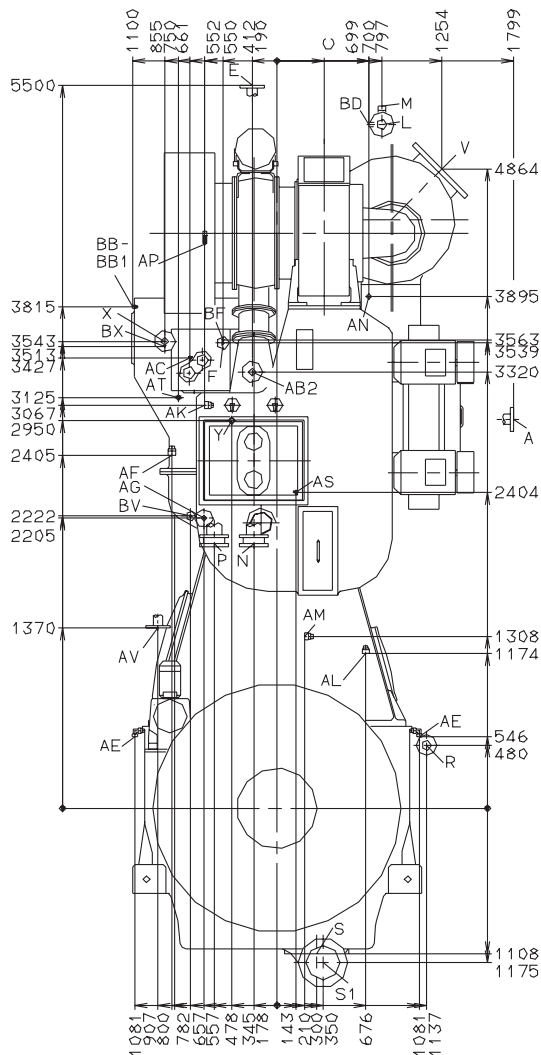
Fig. 5.07b: Gallery outline, with one turbocharger located on aft end



Turbocharger type		c	n	m
MAN B&W	NR29/S	1225	5006	1292
	NA34/S	358	4858	1161
	NA40/S	432	5045	1267
ABB	VTR304	356	4331	1042
	VTR354	301	4792	1094
	VTR454	390	4963	1336
MHI	MET33SD	310	4800	1020
	MET42SD	370	4800	1100
	MET53SD	410	5000	1200

178 41 65-1.0

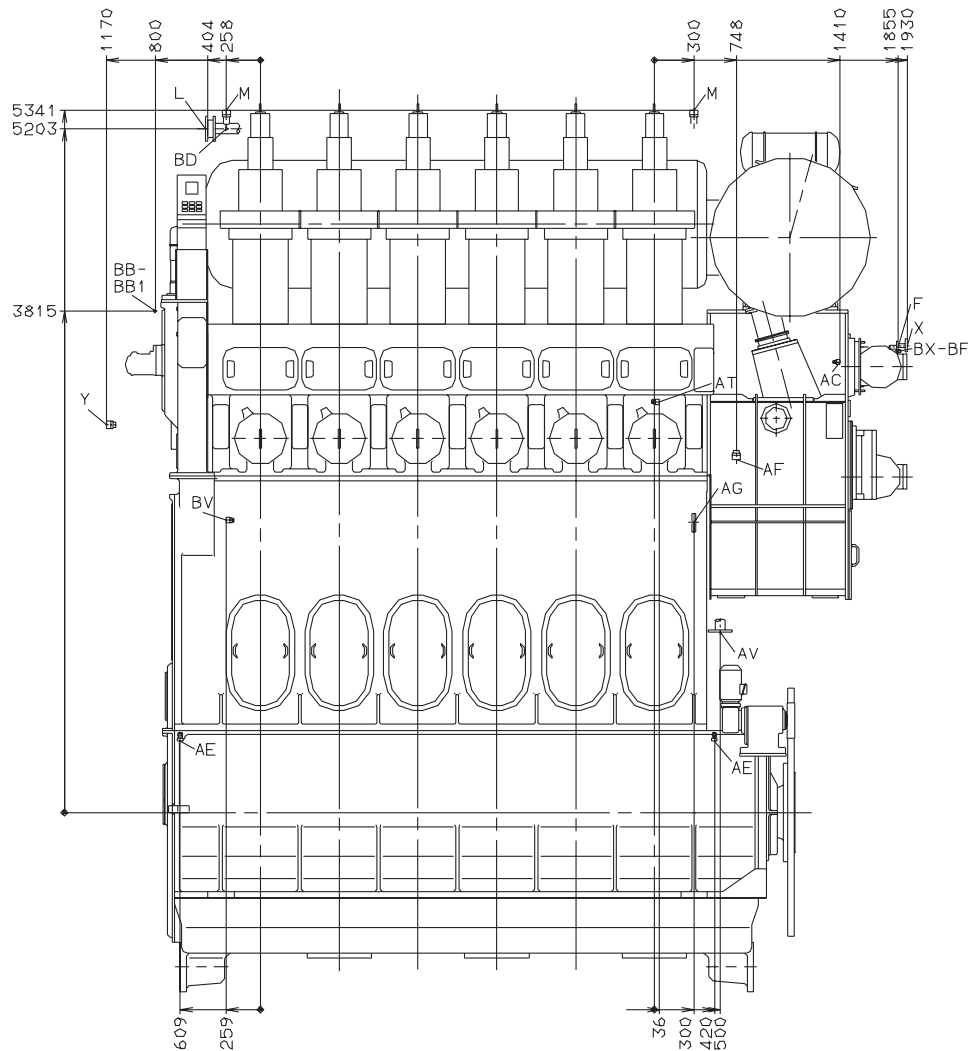
Fig. 5.08a: Engine pipe connections



Cyl . No.	g	h	k
4	1800	1800	-
5	2400	2400	-
6	3000	2400	-
7	3600	2400	3600
8	4200	2400	4200
9	4800	3600	4200

Fig. 5.08b: Engine pipe connections

178 41 65-1.0



The letters refer to "List of flanges"

Some of the pipes can be connected fore or aft as shown and the engine builder has to be informed which end to be used

For engine dimensions see "Engine outline" and "Gallery outline"

178 41 65-1.0

Fig. 5.08c: Engine pipe connections

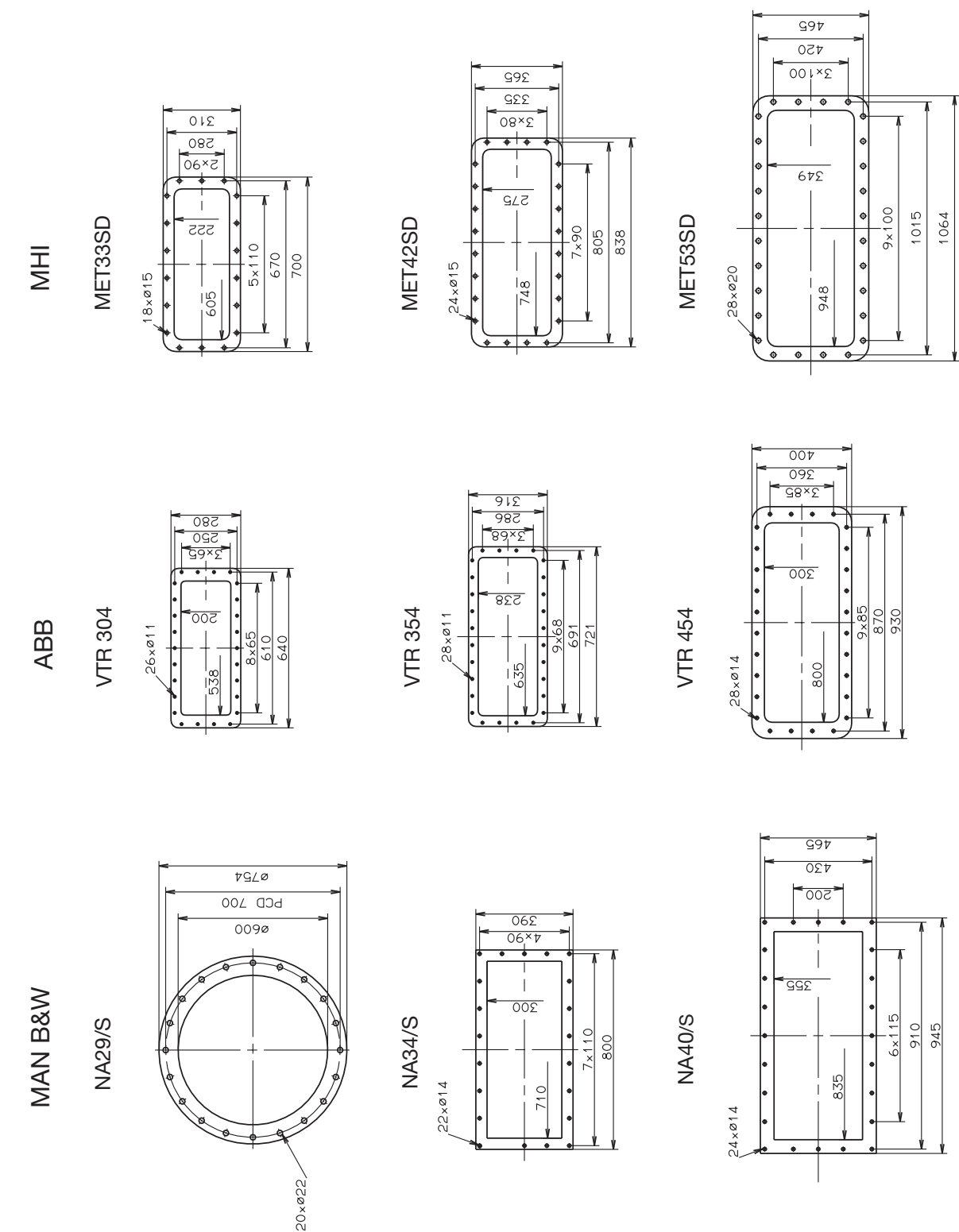
Reference	Cyl. No.	Flange			Bolts		DN*	Description
		Dia.	PCD	Thickn.	Dia.	No.		
A	4 - 9	185	145	22	M16	8	65	Starting air inlet (neck flange for welding supplied)
B	4 - 9	Coupling for 16 mm pipe						Control air inlet
C	4 - 9	Coupling for 16 mm pipe						Safety air inlet
D	4 - 9	See figures page 5.22						Exhaust outlet
E	4 - 9	Nominal dia. 50 mm pipe						Venting of lube oil discharge pipe MAN B&W NA T/C
F	4 - 9	115	85	14	M12	4	25	Fuel oil outlet
K	4 - 9	185	145	18	M16	4	65	Cooling water inlet
L	4 - 9	185	145	18	M16	4	65	Cooling water outlet
M	4 - 9	Coupling for 16 mm pipe						Cooling water deaeration
N	4 - 9	220	180	20	M16	8	100	Cooling water inlet from scavenge air cooler
P	4 - 9	220	180	20	M16	8	100	Cooling water outlet from scavenge air cooler
R	4 - 6	185	145	18	M16	4	65	Lubricating oil inlet (system oil)
	7 - 9	200	160	18	M16	8	80	
S	4 - 9	See special drawing						System oil outlet to bottom tank (vertical)
S1	4 - 9	375	335	24	M16	12	250	System oil outlet to bottom tank (horizontal)
U	4 - 9	220	180	20	M16	8	100	Lube oil inlet to piston cooling and camshaft
V	4 - 9	565	515	36	M24	16	400	Exh. gas bypass for emergency running (optional)
X	4 - 9	165	125	20	M16	4	50	Fuel oil inlet (neck flange for welding supplied)
Y	4 - 9	Coupling for 30 mm pipe						Lubricating oil inlet to exhaust valve actuator
AB1	-	165	125	18	M16	4	50	Lube oil outlet from MAN B&W T/C type: NR29/S
AB2	-	165	125	18	M16	4	50	Lube oil outlet from MAN B&W T/C type: NA34/S
AB3	-	165	125	18	M16	4	50	Lube oil outlet from MAN B&W T/C type: NA40/S
AC	4 - 9	Coupling for 16 mm pipe						Lubricating oil inlet to cylinder lubricators
AE	4 - 9	Coupling for 20 mm pipe						Fuel oil drain pipe from bedplate
AF	4 - 9	Coupling for 42 mm pipe						Fuel oil to drain outlet
AG	4 - 9	140	100	16	M16	4	32	Lube oil from stuff. box for piston rods to drain tank
AH	4 - 9	Coupling for 42 mm pipe						Cooling water drain
AK	4 - 9	Coupling for 25 mm pipe						Inlet cleaning air cooler
AL	4 - 9	Coupling for 25 mm pipe						Drain from cleaning AC/water mist catcher
AM	4 - 9	Coupling for 25 mm pipe						Outlet air cooler to chemical cleaning tank
AN	4 - 9	Coupling for 20 mm pipe						Water washing inlet turbocharger
AP	4 - 9	Coupling for 10 mm pipe						Air inlet for softblast cleaning of turbocharger
AR	4 - 9	130	100	16	M12	4	40	Oil vapour discharge
AS	4 - 9	Coupling for 16 mm pipe						Cooling water drain air cooler
AT	4 - 9	Coupling for 20 mm pipe						Fire extinguishing in scavenge air box
AV	4 - 9	185	145	18	M16	4	65	Drain from scavenge air chambers to closed drain tank
BB	4 - 9	Coupling for 10 mm pipe						Remote speed setting signal
BB1	4 - 9	Coupling for 10 mm pipe						Supply to remote speed setting
BD	4 - 9	Coupling for 10 mm pipe						Fresh water outlet for heating fuel oil drain pipe
BX	4 - 9	Coupling for 10 mm pipe						Steam inlet for heating fuel oil pipes
BF	4 - 9	Coupling for 10 mm pipe						Steam outlet for heating fuel oil pipes
BV	4 - 9	Coupling for 20 mm pipe						Steam inlet for cleaning drain scavenge air chambers

\* DN indicates the nominal diameter of the piping on the engine.

For external pipes the diameters should be calculated according to the fluids velocities (see list of capacities) or the recommended pipe sizes in diagrams should be used.

178 41 69-9.0

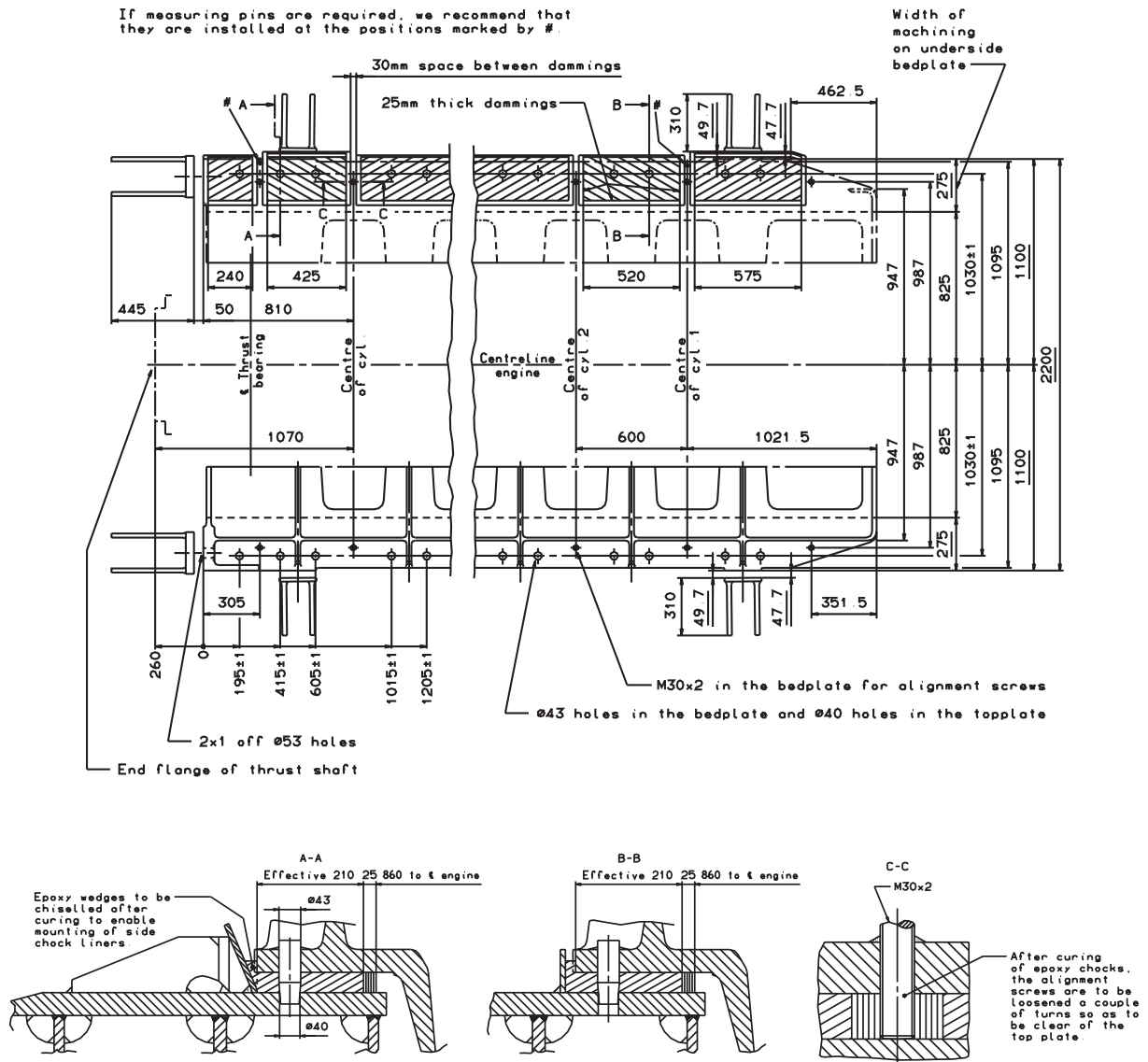
Fig. 5.09: List of counterflanges, option: 4 30 202



Thickness of flanges: 25 mm (for NA40/S, VTR454, VTR454E, MET42SD and MET33SD thickness = 20 mm)

178 41 73-4.0

Fig. 5.10: List of counterflanges, turbocharger exhaust outlet (yard's supply)



178 19 95-0.0

For details of chocks and bolts see special drawings

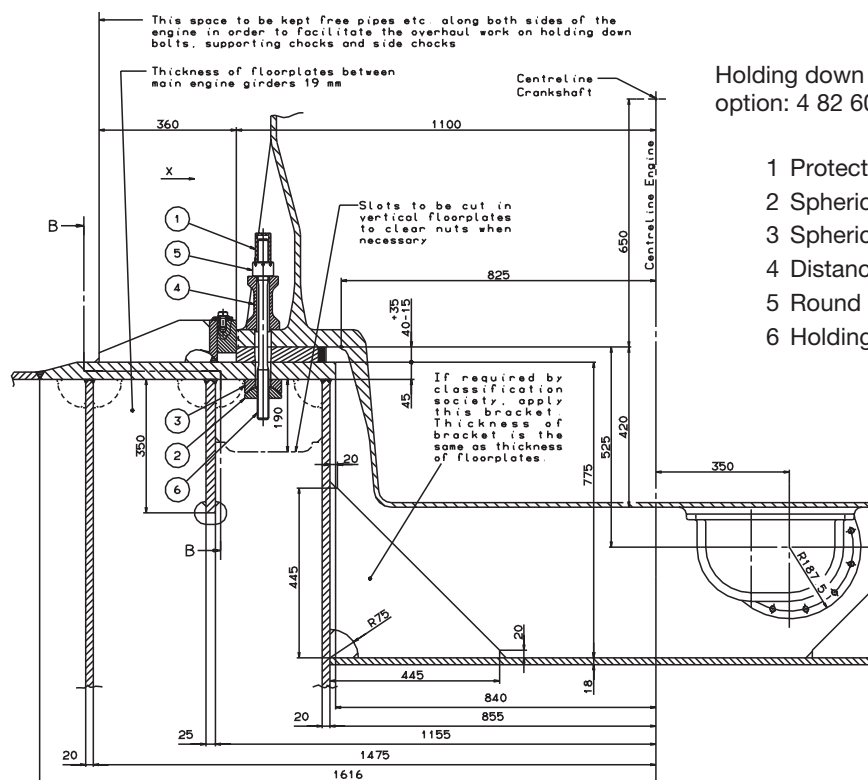
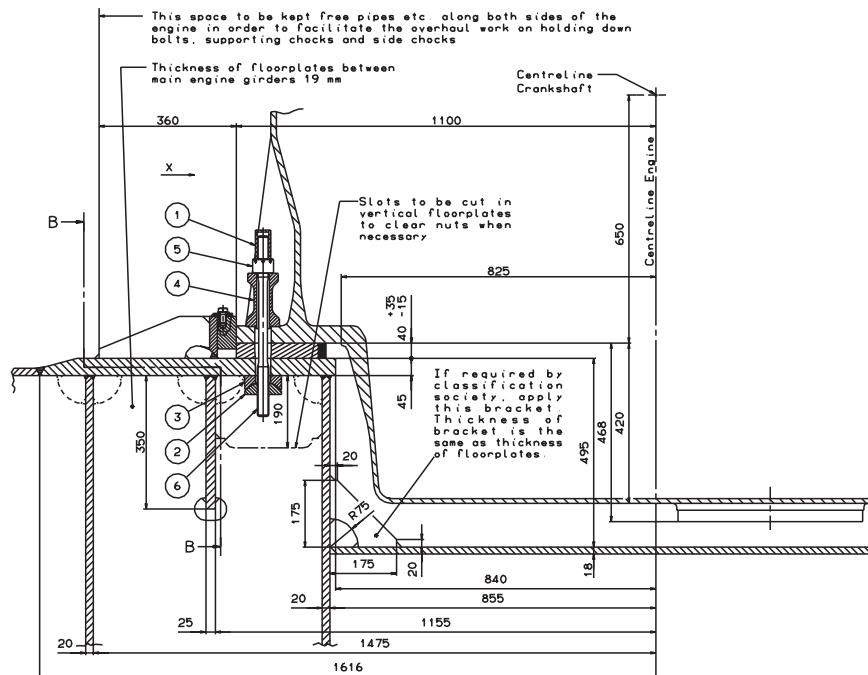
This drawing may, subject to the written consent of the actual engine builder concerned, be used as a basis for marking-off and drilling the holes for holding down bolts in the top plates, provided that:

- 1) The engine builder drills the holes for holding down bolts in the bedplate while observing the toleranced locations indicated on MAN B&W Diesel A/S drawings for machining the bedplate
- 2) The shipyard drills the holes for holding down bolts in the top plates while observing the toleranced locations given on the present drawing
- 3) The holding down bolts are made in accordance with MAN B&W Diesel A/S drawings of these bolts

Fig. 5.11: Arrangement of epoxy chocks and holding down bolts



## Section A-A

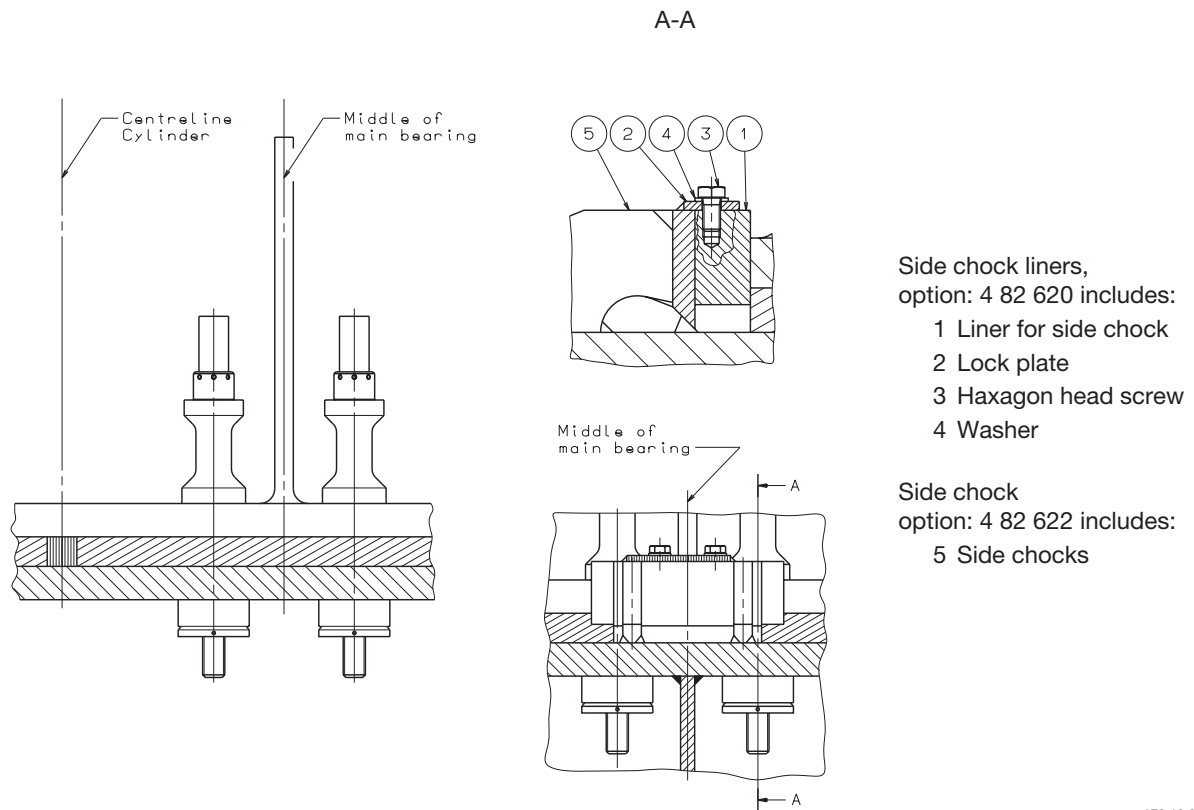


Holding down bolts,  
option: 4 82 602 include:

- 1 Protecting cap
- 2 Spherical nut
- 3 Spherical washer
- 4 Distance pipe
- 5 Round nut
- 6 Holding down bolt

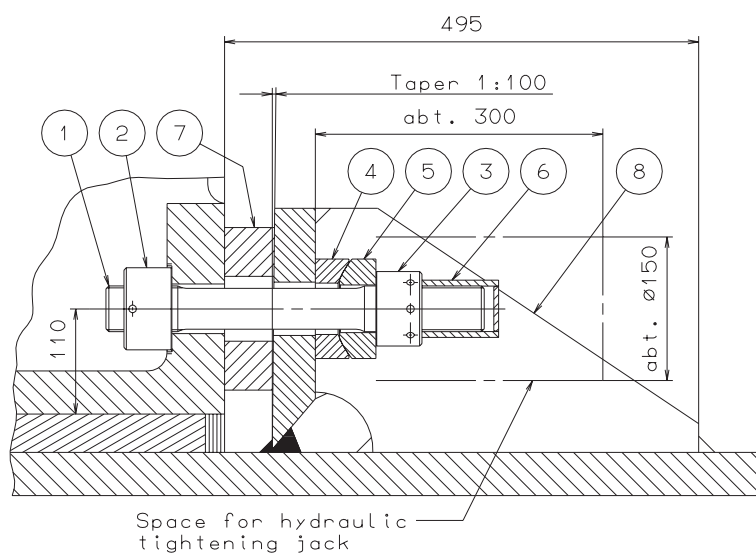
178 12 00-6.1

Fig. 5.12a: Profile of engine seating, vertical (4 40 101) or horizontal outlet (option: 4 40 102)



178 10 98-7.1

Fig. 5.12b: Profile of engine seating, side chocks, option: 4 82 620



End chock bolts,  
option: 4 82 610 includes:

- 1 Stud for end chock bolt
- 2 Round nut
- 3 Round nut
- 4 Spherical washer
- 5 Spherical washer
- 6 Protecting cap

End chock liners,  
option: 4 82 612 includes:

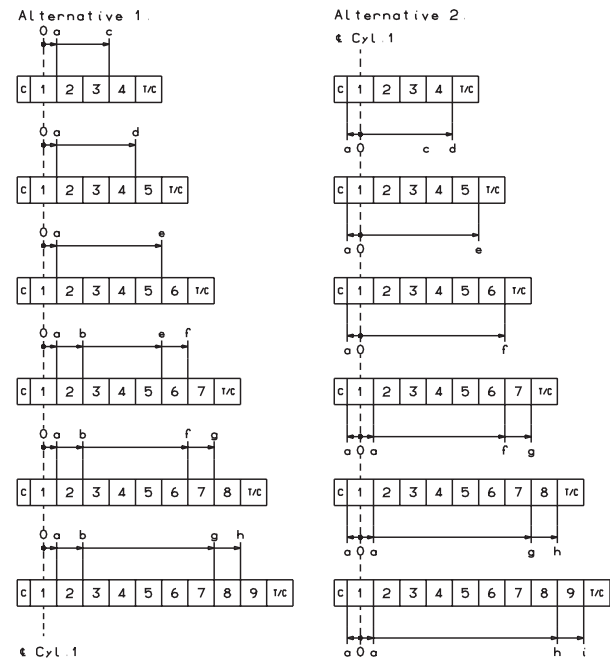
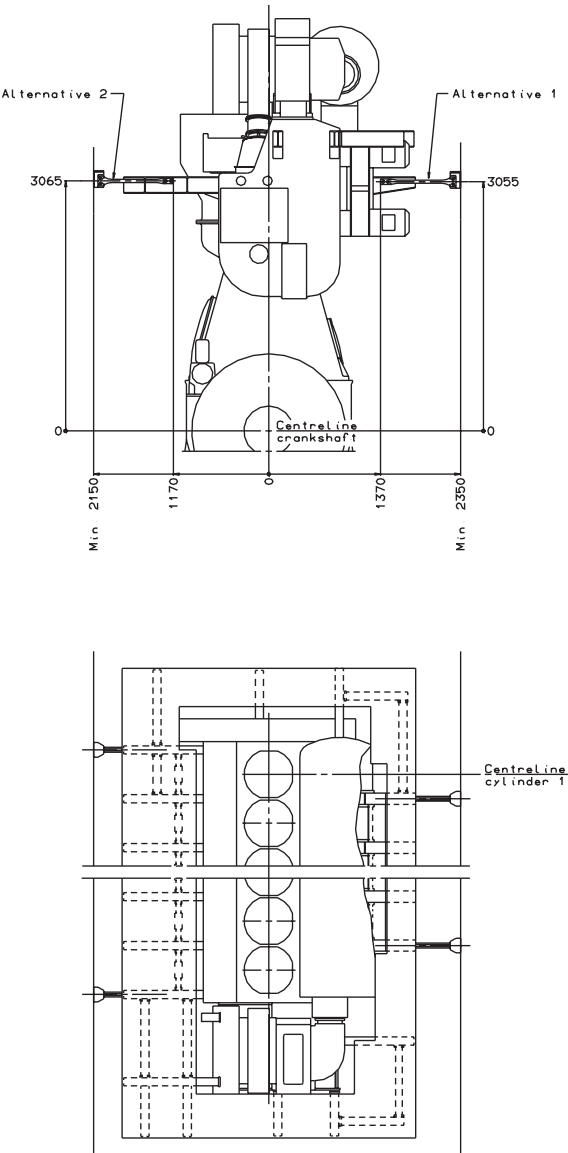
- 7 Liner for end chocks

End chock bolts,  
option: 4 82 614 includes:

- 8 End chock

178 10 99-9.1

Fig. 5.12c: Profile of engine seating, end chocks, option: 4 82 610



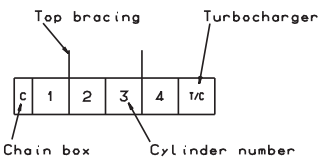
Top bracing should only be installed on one side, either the exhaust side (alternative 1), or the camshaft side (alternative 2).

T/C: Turbocharger C: Chain drive

The dimensions are valid for NA57/T only. Layout for other turbochargers are available on request.

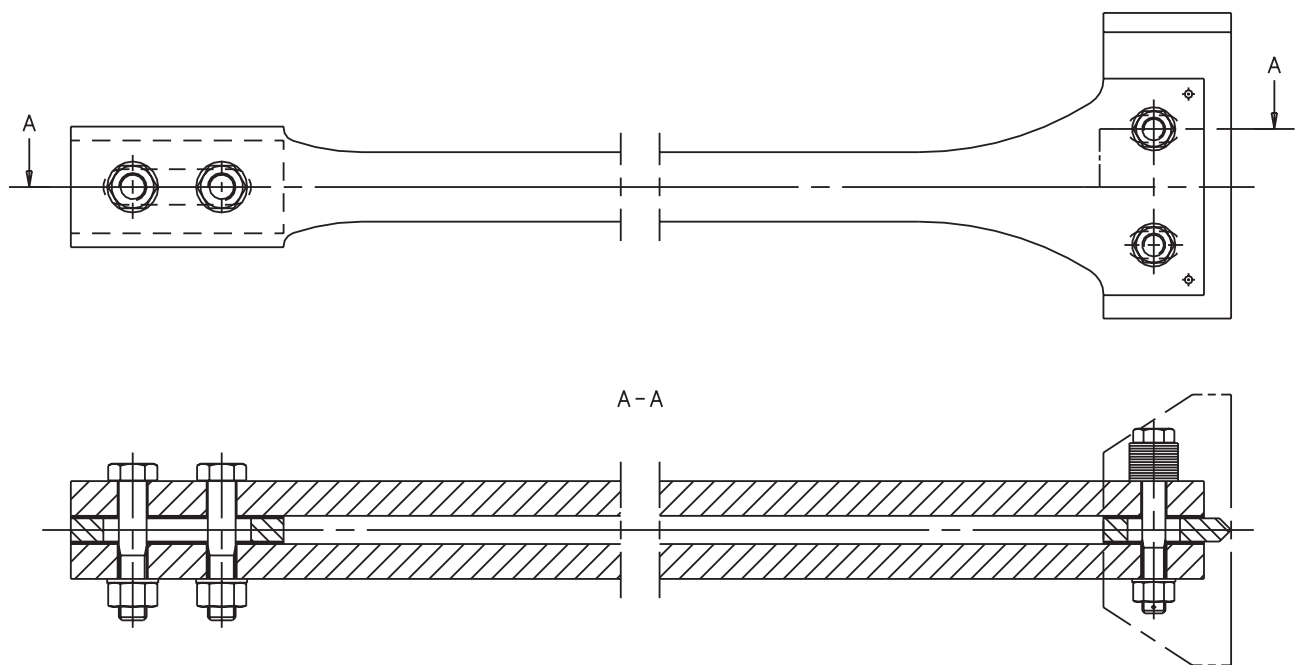
Horizontal distance between top bracing fix point and centre line of cylinder 1:

a = 300	e = 2700
b = 900	f = 3300
c = 1500	g = 4500
d = 2100	h = 5100



178 20 06-0.0

Fig. 5.13: Mechanical top bracing arrangement, if required



178 09 63-3.2

*Fig. 5.14: Mechanical top bracing outline, option: 4 83 112*

Cross section must not be smaller than  $45 \text{ mm}^2$  and the length of the cable must be as short as possible

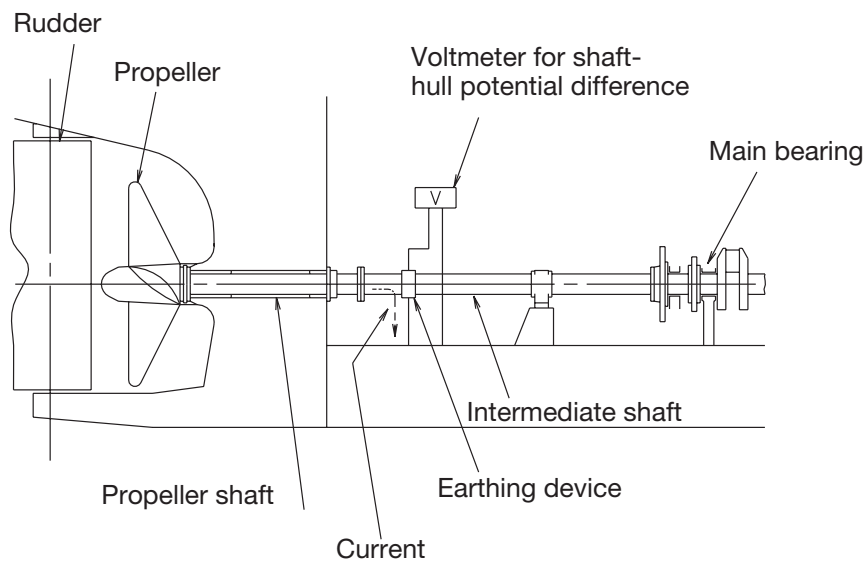
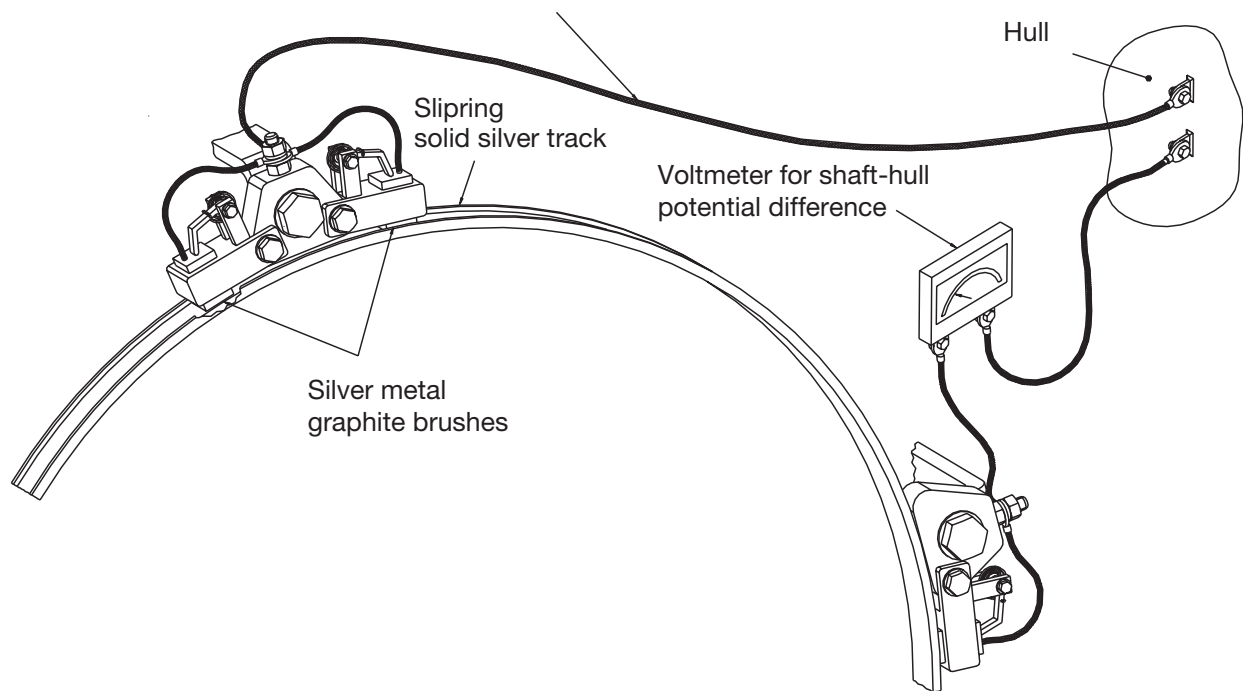


Fig. 5.15: Earthing device, (yard's supply)

178 32 07-8.1