BAB X

PENUTUP

10.1 Kesimpulan

Dari hasil perancangan mesin kapal ikan tuna longline 625 GT didapatkan hasil sebagai berikut :

- Panjang Seluruhnya Loa : 49 m
- Pajang Antara Garis Air Lwl : 45,50 m
- Panjang Garis Tegak Lpp : 44,50 m
- Lebar Kapal B : 8,5 m
- Tinggi Kapal H : 4,15 m
- Sarat Air Kapal T : 3,15 m
- Kecepatan Dinas : 11,5 Knot
- Jarak pelayaran : 3600 mil laut

Motor penggerak utama dipilih mesin diesel empat langkah sebagai berikut :

- Merk : Wartsila
- Tipe : Wartsila 4L20
- Daya : 1080 HP / 810 kW
- Putara Mesin : 1000 RPM

Motor bantu

- Merk : Yanmar
- Tipe : 6 HCHL-HTNA
- Daya mesin : 107 kWE / 145 HP
- Daya generator : 96 kWe / 120 kVA
- RPM : 1800 rpm

1. Dalam perencanaan kapal ikan tuna longline ini perlu diperhatikan antara lamanya masa penagkapan ikan, kapasitas palka ikan dengan kebutuhan bahan bakar dan akomodasi lainnnya karena akan berdampak pada daya muat kapal.
2. Peletakan kamar mesin sedikit mengalami perubahan mengingat kebutuhan peralatan pendukung dari kapal yang begitu banyak berbanding dengan ruang

mesin dari kapal yang begitu kecil seingga terjadi sedikit perubahan pada ukuran ruang mesin yang disesuaikan.

10.2 Saran

Setelah mengerjakan tugas perancangan mesin kapal ini banyak pengalaman dan pelajaran yang didapat dan dapat dijadikan pelajaran agar nantinya dapat melakukan perancangan lebih efektif yakni :

1. Agar mahasiswa dibekali dengan pengetahuan umum tentang perancangan selama masa kuliah agar nantinya bisa menjadi pondasi ketika sudah memulai tugas perancangan.
2. Perlunya disesuaiakan antara mata kuliah dengan perancangan dan yang nanti akan digunakan di dunia kerja kelak karena selama ini yang didapatkan selama perkuliahan hanya bagian kecilnya saja belum menyeluruh secara garis besarnya, sehingga ini menyulitkan dalam perancangan.
3. Selama perancangan ini pengalaman selama praktik kerja lapangan sangat membantu dalam mengerjakan perancangan, sehingga nantinya bisa diberikan arahan kepada mahasiswa yang melaksanakan kerja praktik agar dapat mengambil ilmu yang berguna untuk perancangan kelak.
4. Mohon agar disediakan panduan dan regulasi yang jelas untuk tugas perancangan apa yang harus dan tidak dikerjakan, hal ini untuk mempermudah dalam perancangan dan agar serupa dan tidak terjadi ketidak sesuaian satu dengan yang lainnya.

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1. Main Data and Outputs

The Wärtsilä 20 is a 4-stroke, non-reversible, turbocharged and intercooled diesel engine with direct injection of fuel.

Cylinder bore	200 mm
Stroke	280 mm
Piston displacement	8.8 l/cyl
Number of valves	2 inlet valves and 2 exhaust valves
Cylinder configuration	4, 6, 8, 9, in-line
Direction of rotation	Clockwise, counterclockwise on request
Speed	900, 1000 rpm
Mean piston speed	8.4, 9.3 m/s

1.1 Maximum continuous output

Table 1.1 Rating table for Wärtsilä 20

Cylinder configuration	Main engines		Generating sets			
	1000 rpm		900 rpm / 60 Hz		1000 rpm / 50 Hz	
	kW	bhp	Engine [kW]	Generator [kVA]	Engine [kW]	Generator [kVA]
W 4L20	800	1080	740	880	800	950
W 6L20	1200	1630	1110	1320	1200	1420
W 8L20	1600	2170	1480	1760	1600	1900
W 9L20	1800	2440	1665	1980	1800	2140

The mean effective pressure p_e can be calculated as follows:

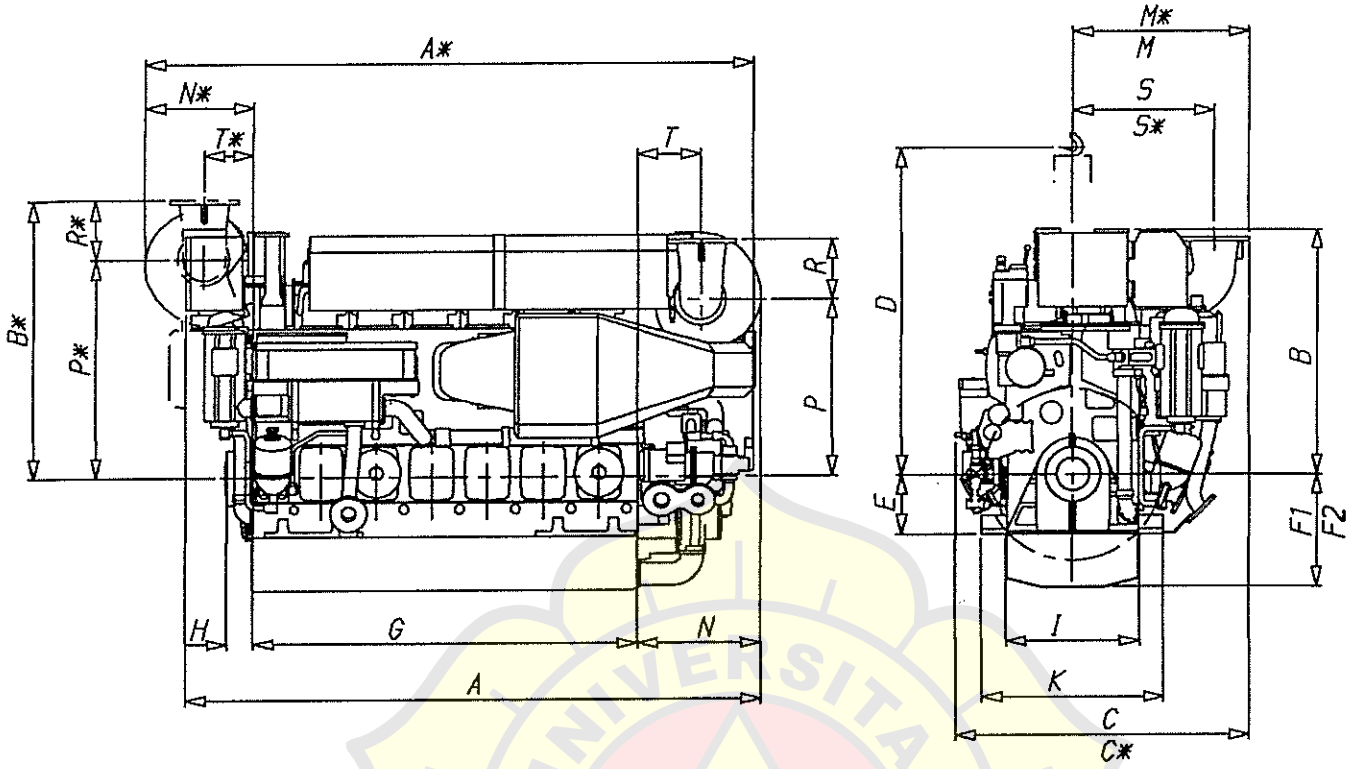
$$P_e = \frac{P \times c \times 1.2 \times 10^9}{D^2 \times L \times n \times \pi}$$

where:

P_e = Mean effective pressure [bar]
P = Output per cylinder [kW]
n = Engine speed [r/min]
D = Cylinder diameter [mm]
L = Length of piston stroke [mm]
c = Operating cycle (4)

1.4 Dimensions and weights

Figure 1.1 Main engines (3V92E0068c)



Engine	A*	A	B*	B	C*	C	D	E	F1	F2	G	H	I	K
W 4L20		2510		1348		1483	1800	325	725	725	1480	155	718	980
W 6L20	3292	3108	1528	1348	1580	1579	1800	325	624	824	2080	155	718	980
W 8L20	4011	3783	1614	1465	1756	1713	1800	325	624	824	2680	155	718	980
W 9L20	4299	4076	1614	1449	1756	1713	1800	325	624	824	2980	155	718	980

F1 for dry sump and F2 for deep wet sump

Engine	M*	M	N*	N	P*	P	R*	R	S*	S	T*	T	Weight
N 4L20		854		665		920		248		694		349	7.2
N 6L20	951	950	589	663	1200	971	328	328	762	763	266	343	9.3
N 8L20	1127	1084	708	738	1224	1000	390	390	907	863	329	339	11.0
N 9L20	1127	1084	696	731	1224	1000	390	390	907	863	329	339	11.6

Turbocharger at flywheel end
Dimensions in mm. Weight in tons.

3. Technical Data

3.1 Wärtsilä 4L20

Wärtsilä 4L20		ME IMO Tier 2	AE/DE IMO Tier 2	AE/DE IMO Tier 2	ME IMO Tier 2	AE/DE IMO Tier 2	AE/DE IMO Tier 2
Cylinder output	**kW**	**200**	**165**	**200**	**200**	**165**	**200**
Engine speed	**RPM**	**1000**	**900**	**1000**	**1000**	**900**	**1000**
Engine output	kW	800	740	800	800	740	800
Mean effective pressure	MPa	2.73	2.8	2.73	2.73	2.8	2.73
Combustion air system (Note 1)							
Flow at 100% load	kg/s	1.55	1.37	1.49	1.5	1.38	1.5
Temperature at turbocharger intake, max.	°C	45	45	45	45	45	45
Temperature after air cooler (TE601)	°C	50...70	50...70	50...70	50...70	50...70	50...70
Exhaust gas system (Note 2)							
Flow at 100% load	kg/s	1.55	1.42	1.55	1.55	1.42	1.55
Flow at 85% load	kg/s	1.39	1.31	1.43	1.39	1.31	1.43
Flow at 75% load	kg/s	1.2	1.16	1.28	1.2	1.16	1.28
Flow at 50% load	kg/s	0.8	0.81	0.9	0.8	0.81	0.9
Temperature after turbocharger, 100% load (TE517)	°C	370	370	370	370	370	370
Temperature after turbocharger, 85% load (TE517)	°C	340	335	335	340	335	335
Temperature after turbocharger, 75% load (TE517)	°C	350	335	335	350	335	335
Temperature after turbocharger, 50% load (TE517)	°C	385	355	355	385	355	355
Backpressure, max.	kPa	4.0	4.0	4.0	5.0	5.0	5.0
Calculated pipe diameter for 35 m/s	mm	320	306	320	320	306	320
Heat balance (Note 3)							
Jacket water, HT-circuit	kW	175	166	175	175	166	175
Charge air, LT-circuit	kW	275	251	275	275	251	275
Lubricating oil, LT-circuit	kW	130	122	130	130	122	130
Radiation	kW	33	32	33	33	32	33
Fuel system (Note 4)							
Pressure before injection pumps (PT101)	kPa	700±50	700±50	700±50	700±50	700±50	700±50
Engine driven pump capacity (MDF only)	m³/h	0.87	0.78	0.87	0.87	0.78	0.87
Fuel flow to engine (without engine driven pump), approx.	m³/h	0.69	0.64	0.7	0.69	0.64	0.7
HFO viscosity before engine	cSt	16... 24	16... 24	16... 24	16... 24	16... 24	16... 24
Max. HFO temperature before engine (TE101)	°C	140	140	140	140	140	140
MDF viscosity, min.	cSt	1.8	1.8	1.8	1.8	1.8	1.8
Max. MDF temperature before engine (TE101)	°C	45	45	45	45	45	45
Fuel consumption at 100% load	g/kWh	197	198	198	197	198	198
Fuel consumption at 85% load	g/kWh	194	195	196	194	195	196
Fuel consumption at 75% load	g/kWh	194	196	197	194	196	197
Fuel consumption at 50% load	g/kWh	196	203	204	196	203	204
Clean leak fuel quantity, MDF at 100% load	kg/h	3.3	3.1	3.3	3.3	3.1	3.3
Clean leak fuel quantity, HFO at 100% load	kg/h	0.7	0.6	0.7	0.7	0.6	0.7
Lubricating oil system							
Pressure before bearings, nom. (PT201)	kPa	450	450	450	450	450	450
Suction ability main pump, including pipe loss, max.	kPa	20	20	20	20	20	20
Priming pressure, nom. (PT201)	kPa	80	80	80	80	80	80
Suction ability priming pump, including pipe loss, max.	kPa	20	20	20	20	20	20
Temperature before bearings, nom. (TE201)	°C	66	66	66	66	66	66
Temperature after engine, approx.	°C	78	78	78	78	78	78
Pump capacity (main), engine driven	m³/h	34	24	27	34	24	27
Pump capacity (main), stand-by	m³/h	21	21	21	21	21	21
Priming pump capacity, 50Hz/60Hz	m³/h	8.6 / 10.5	8.6 / 10.5	8.6 / 10.5	8.6 / 10.5	8.6 / 10.5	8.6 / 10.5
Oil volume, wet sump, nom.	m³	0.27	0.27	0.27	0.27	0.27	0.27
Oil volume in separate system oil tank	m³	1.1	1.0	1.1	1.1	1.0	1.1
Filter fineness, nom.	microns	25	25	25	25	25	25
Oil consumption at 100% load, max.	g/kWh	0.5	0.5	0.5	0.5	0.5	0.5
Crankcase ventilation backpressure, max.	kPa	0.3	0.3	0.3	0.3	0.3	0.3
Oil volume in speed governor	liters	1.4...2.2	1.4...2.2	1.4...2.2	1.4...2.2	1.4...2.2	1.4...2.2
Cooling water system							
High temperature cooling water system							

Wärtsilä 4L20		ME IMO Tier 2	AE/DE IMO Tier 2	AE/DE IMO Tier 2	ME IMO Tier 2	AE/DE IMO Tier 2	AE/DE IMO Tier 2
Cylinder output	kW	200	185	200	200	185	200
Engine speed	RPM	1000	900	1000	1000	900	1000
Pressure at engine, after pump, nom. (PT401)	kPa	200 + static	200 + static	200 + static	200 + static	200 + static	200 + static
Pressure at engine, after pump, max. (PT401)	kPa	350	500	500	350	500	500
Temperature before cylinder, approx. (TE401)	°C	83	83	83	83	83	83
Temperature after engine, nom.	°C	91	91	91	91	91	91
Capacity of engine driven pump, nom.	m³/h	20	20	20	20	20	20
Pressure drop over engine, total	kPa	90	90	90	90	90	90
Pressure drop in external system, max.	kPa	120	120	120	120	120	120
Water volume in engine	m³	0.09	0.09	0.09	0.09	0.09	0.09
Pressure from expansion tank	kPa	70...150	70...150	70...150	70...150	70...150	70...150
Low temperature cooling water system							
Pressure at engine, after pump, nom. (PT451)	kPa	200 + static	200 + static	200 + static	200 + static	200 + static	200 + static
Pressure at engine, after pump, max. (PT451)	kPa	350	500	500	350	500	500
Temperature before engine, min...max	°C	25...38	25...38	25...38	25...38	25...38	25...38
Capacity of engine driven pump, nom.	m³/h	24	23	24	24	23	24
Pressure drop over charge air cooler	kPa	30	30	30	30	30	30
Pressure drop over oil cooler	kPa	30	30	30	30	30	30
Pressure drop in external system, max.	kPa	120	120	120	120	120	120
Pressure from expansion tank	kPa	70...150	70...150	70...150	70...150	70...150	70...150
Starting air system							
Pressure, nom.	kPa	3000	3000	3000	3000	3000	3000
Pressure, max.	kPa	3000	3000	3000	3000	3000	3000
Low pressure limit in air vessels	kPa	1800	1800	1800	1800	1800	1800
Starting air consumption, start (successful)	Nm³	1.2	1.2	1.2	1.2	1.2	1.2

Notes:

Note 1 At ISO 3046-1 conditions (ambient air temperature 25°C, LT-water 25°C) and 100% load. Tolerance 5%.

Note 2 *At ISO 3046-1 conditions (ambient air temperature 25°C, LT-water 25°C) and 100% load. Flow tolerance 5% and temperature tolerance 15°C.*

Note 3 At ISO 3046-1 conditions (ambient air temperature 25°C, LT-water 25°C) and 100% load. Tolerance for cooling water heat 10%, tolerance for radiation heat 30%. Fouling factors and a margin to be taken into account when dimensioning heat exchangers.

Note 4 According to ISO 3046/1, lower calorific value 42 700 kJ/kg, with engine driven pumps (two cooling water + one lubricating oil). Tolerance 5%. Load according to propeller law for mechanical propulsion engines (ME).

ME = Engine driving propeller, variable speed

AE = Auxiliary engine driving generator

DE = Diesel-Electric engine driving generator

Subject to revision without notice.

Contoh Formulir untuk Menghitung Daya Efektif

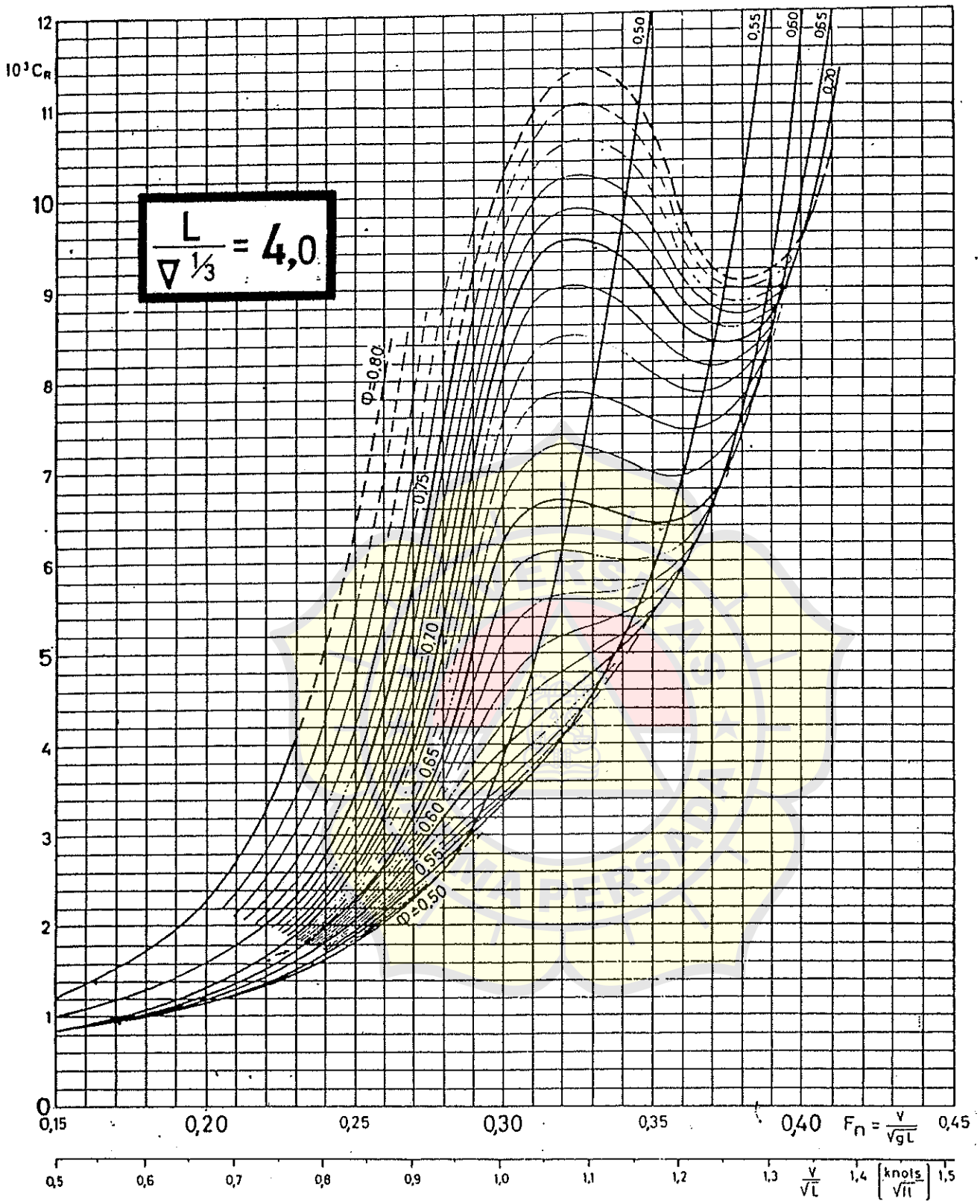
Ukuran			Koefisien, dsb.	
Panjang antara garis tengah	L_{pp}	____ m	Rasio lebar-sarat	B/T ____
Panjang garis air	L	____ m	Koefisien blok	δ ____
$\sqrt{gL}$ ____ m/detik			Koefisien penampang tengah	β ____
Lebar	B	____ m	Koefisien prismatik	
Sarat	T	____ m	Longitudinal	φ ____
Displasemen	Δ	____ t (1000 kg)	Rasio panjng-displasemen	$L/\nabla^{1/3}$ ____
Volume	∇	____ m^3	L/ν ____ detik/m	
$\nabla^{1/3}$ ____ m			Posisi longitudinal titik benam	
Permukaan basah	S	____ m^2	____ persen L di belakang ⊗ ($L_{pp}/2$)	
$\frac{1}{2}\rho S$ ____ N detik^2/m^2			$\Delta LCB = LCB_{sebenarnya} - LCB_{standar}$ = ____ persen	
Permukaan bawah (termasuk anggota badan)	S_1	____ m^2	Bentuk penampang : Belakang : Depan :	
S_1/S			Garis perancangan :	
			Bentuk haluan :	

Kolom	1	2	3	4	5	6	7	8	9	10	11	12	13	14
						10^3C_R			Korelasi 10^3C_R untuk					
	$F_n = \frac{V}{\sqrt{gL}}$	Kecepatan V				$L/\nabla^{1/3}$			B/T	LCB	Garis penampang	Haluan	Anggota badan	
Sumber (Rumus)						Diagram Gb. 5.5.5. – 5.5.13			(5.5.17)	Gb. 5.5.15 – 5.5.16	(5.5.20)	(5.5.21)	(5.5.22)	
Satuan	—	m/det	knot	$\frac{m^2}{det^2}$	N (atau kN)	–	–	–	–	–	–	–	–	–

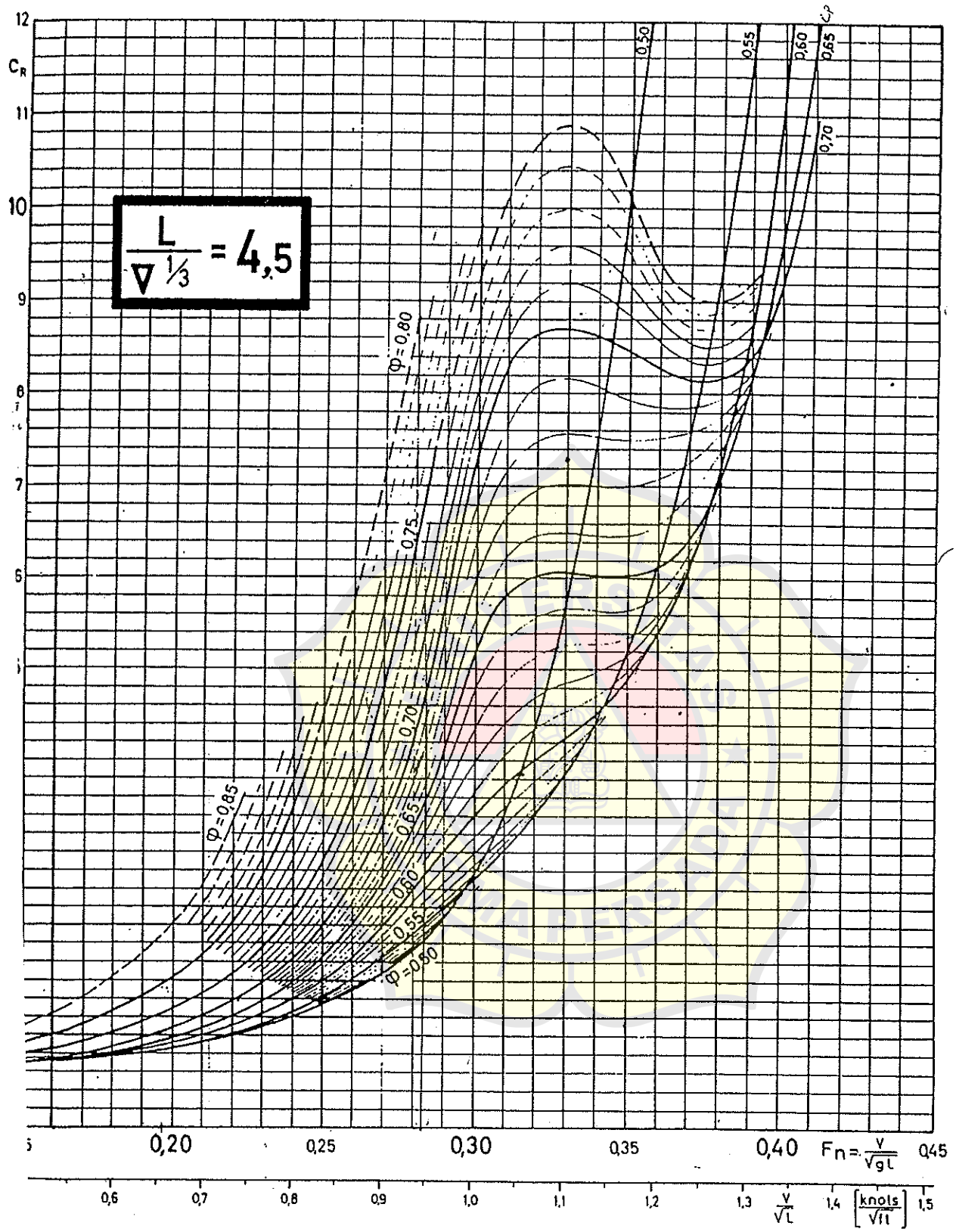
Perhatian! Angka di dalam kurung menunjukkan rumus dalam buku ini.
Kolom 20 – 22 dipakai untuk menghitung tahanan untuk udara, kemudi, dan sebagainya.
Untuk perkiraan awal, perhitungan di dalam kolom 9 – 14 dan 20 – 22 dapat dihilangkan sebagian atau seluruhnya.

2	15	16	17	18	19	20	21	22	23	24	25	26
V	Resultan 10^3C_R	$10^{-6}R_n$	10^3C_F ITTC 57	$10^3C_{F'}$	10^3C_A				10^3C_T	R_T	P_E	
	8+9+10 +11+12 +13+14	$10^{-6}\frac{VL}{\nu}$	Gb 5.5.14 atau (5.5.14)	$\frac{S_1}{S}$ [17]	(5.5.24)				15+18+19 20+21+22	10^{-3}[5] × [23]	[2] × [24]	$\frac{[25]}{k_{hp}}$
/s	–	–	–	–	–	–	–	–	–	N (atau kN)	W (atau kW)	hp (metrik)

$$k_{hp} = \begin{cases} 735{,}5 \\ 0{,}7355 \end{cases} \text{ untuk gaya yang diukur dalam } \begin{cases} \text{N} \\ \text{kN} \end{cases}$$



Gambar 5.5.5. Koefisien tahanan sisa terhadap rasio kecepatan – panjang untuk harga koefisien prismatik longitudinal yang berbeda-beda. $L/\nabla^{1/3} = 4{,}0$.



Gambar 5.5.6. Koefisien tahanan sisa terhadap rasio kecepatan–panjang untuk harga koefisien prismatik longitudinal yang berbeda-beda. $L/\nabla^{1/3} = 4{,}5$.

6. Diagram utama digambarkan untuk menyatakan kurva rata-rata C_R untuk rasio lebar – sarat B/T = 2,5. Diagram tersebut ditunjukkan di Gb. 5.5.5 – 5.5.13.

Dalam diagram tersebut kurva yang digambar dengan garis terputus-putus menunjukkan bahwa kurva ersebut didasarkan pada hasil percobaan yang sedikit umlahnya atau diperoleh secara ekstrapolasi. Karena tu keraguan hasil di daerah kurva itu cukup besar. lelain itu, perlu diperhatikan pula bahwa di dan di ekat daerah kurva yang mempunyai punuk (tonjolan) ang menyolok, terutama jika kemiringannya menjadi egatif, tingkat ketidak pastiannya juga tinggi. erubahan yang kecil saja dari bentuk badan kapal di alam daerah tersebut dapat mempunyai pengaruh yang erarti pada harga C_R.

Perlu pula disebutkan di sini bahwa kurva tahanan rsebut berlaku untuk kapal yang mempunyai bentuk andar, yaitu letak titik benamnya standar, harga B/T 'a standar, bentuk penampangnya normal, buritan- 'a merupakan buritan sendok (cruiser stern) yang oderat, dan linggi haluannya merupakan linggi haluan ndong (raked stem).

Tahanan R dan daya efektif P_E untuk kapal baru pat dihitung dengan memakai

$$R = C_T(\tfrac{1}{2}\rho V^2 S) \quad \text{(N)} \qquad (5.5.11)$$

$$P_E = RV \quad \text{(kW)} \qquad (5.5.12)$$

lam hal ini koefisien tahanan totalnya adalah

$$C_T = C_R + C_F + C_A \qquad (5.5.13)$$

C_R = koefisien tahanan sisa. Untuk bentuk kapal 'ang "standar" dapat diambil dari diagram (Gb. 5.5.5 – 5.5.13)

C_F = koefisien tahanan gesek dan dapat dihitung lengan memakai

$$C_F = \frac{0{,}075}{(\log_{10} R_n - 2)^2} \qquad (5.5.14)$$

tau dapat diambil dari Gb. 5.5.14. Dalam gambar ni kontur C_F diberikan untuk berbagai harga V ang berbeda. Koordinat L horizontalnya adalah anjang kapal. Diagram tersebut berlaku untuk ν = ,188 × 10^{-6} m.s^{-1}, ρ = 1,025 t/m^3, dan t = 5°C. Untuk kondisi yang lain, yaitu massa nis dan suhu yang lain, sebelum memakai diagram rsebut panjang kapal harus diubah dulu sebagai erikut :

$$L_1 = \frac{1{,}188}{10^6 \nu} L \qquad (5.5.15)$$

C_A = koefisien tahanan tambahan, yaitu koefisien kekasaran permukaan dan pengaruh skala pada hasil percobaan model. Dalam hal ini maka C_A akan tergantung pada cara penentuan C_R dan C_F.

Untuk kapal penarik, R harus diganti dengan $R + F$. Dalam hal ini F adalah gaya tarik tali penarik (tow rope pull).

Karena kapal pada umumnya berbeda dengan standar dengan tingkat perbedaan tertentu, lebih besar atau lebih kecil, maka harus dilakukan koreksi sebagai berikut.

B/T

Karena diagram tersebut dibuat berdasarkan rasio lebar – sarat

$$B/T = 2{,}5 \qquad (5.5.16)$$

maka harga C_R untuk kapal yang mempunyai rasio lebar – sarat lebih besar atau lebih kecil daripada harga tersebut harus dikoreksi.

Berdasarkan hasil pemeriksaan materi pengujian yang ada saat ini maka disarankan untuk memakai rumus koreksi berikut ini :

$$10^3 C_R = 10^3 C_{R(B/T=2{,}5)} + 0{,}16(B/T - 2{,}5) \qquad (5.5.17)$$

Koreksi ini dapat mempunyai harga yang negatif atau positif.

LCB

Semua kurva C_R tersebut dimaksudkan untuk kapal yang letak titik benam longitudinalnya dekat dengan letak yang dewasa ini dipandang sebagai letak yang terbaik yang memungkinkan. Letak LCB yang optimum merupakan kuantitas yang masih agak meragukan, dan semua kepustakaan yang ada menunjukkan pendapat yang berbeda-beda sehingga memberikan gambaran yang agak membingungkan. Namun demikian, ketergantungan tahanan kapal pada LCB nampak jelas pada kecepatan yang tinggi. Sebagai upaya untuk mengatasi kerancuan tersebut maka semua informasi yang ada dikumpulkan dan diringkas pada Gb. 5.5.15. Namun ini harus dipandang sebagai LCB standar untuk metode itu saja.

ANGGOTA BADAN KAPAL

Daun kemudi	Tidak ada koreksi bentuk standar sudah mencakup daun kemudi.	
unas bilga unas sayap)	Tidak ada koreksi	
os aling-baling	Untuk kapal penuh C_R dinaikkan sebesar 3 – 5%	(5.5.22)
raket dan oros baling-aling	Untuk kapal ramping C_R dinaikkan sebesar 5 – 8%	

AHANAN TAMBAHAN

emberian koreksi pada C_{FS} untuk kapal merupakan ra yang umum dilakukan dalam praktek dan sudah rtahun-tahun lamanya diterapkan untuk memper-tungkan pengaruh kekasaran permukaan kapal engingat bahwa permukaan kapal tidak akan pernah nulus permukaan model, sekalipun kapal itu benar-nar baru dan catnyapun masih segar. Koefisien nambahan tahanan untuk korelasi model – kapal umnya ditentukan sebesar $C_A = 0{,}0004$. Namun nikian, pengalaman lebih lanjut menunjukkan bahwa a demikian itu tidak selalu benar. Karena itu, isulkan koreksi untuk pengaruh kekasaran dan garuh sebagai berikut untuk kondisi pelayaran cobaan :

tuk kapal dengan $L \leqq$	100 m,	$10^3 C_A = 0{,}4$
	= 150 m	= 0,2
	= 200 m	= 0
	= 250 m	= −0,2
	≧ 300 m	= −0,3

(5.5.23)

erapa pihak berpendapat bahwa koreksi yang erikan di Bab 5, 5.2.4 lebih sesuai, yaitu,

Displasemen		
1.000 t	$C_A = 0{,}6 \times 10^{-3}$	
10.000 t	$= 0{,}4 \times 10^{-3}$	(5.5.24)
100.000 t	$= 0$	
1.000.000 t	$= -0{,}6 \times 10^{-3}$	

u disebutkan di sini bahwa koreksi untuk koefisien nan gesek ini masih agak meragukan.

ANGGOTA BADAN KAPAL

Koreksi C_F untuk anggota badan kapal hanya dilakukan dengan jalan menaikkan C_F sebanding dengan luas permukaan basah anggota badan begitu saja. Jadi,

$$C_{F'} = C_F \frac{S_1}{S} \qquad (5.5.25)$$

S adalah luas permukaan basah badan kapal dan S_1 adalah permukaan basah badan dan anggota badan kapal.

TAHANAN UDARA DAN TAHANAN KEMUDI

Tahanan udara dapat ditentukan dengan memakai data mengenai struktur yang berada di atas air dan data udara. Namun demikian, besarnya tahanan udara umumnya tidak terlalu penting, dan upaya yang harus dilakukan untuk mendapatkan hasil perhitungan yang tepat mungkin tidak memadai dengan pentingnya pengaruh udara tersebut. Karena itu, jika data mengenai angin dalam perancangan kapal tidak diketahui maka disarankan untuk mengoreksi $10^3 C_R$ sebagai berikut :

$$10^3 C_{AA} = 0{,}07 \qquad (5.5.26)$$

Koreksi untuk tahanan kemudi mungkin sekitar

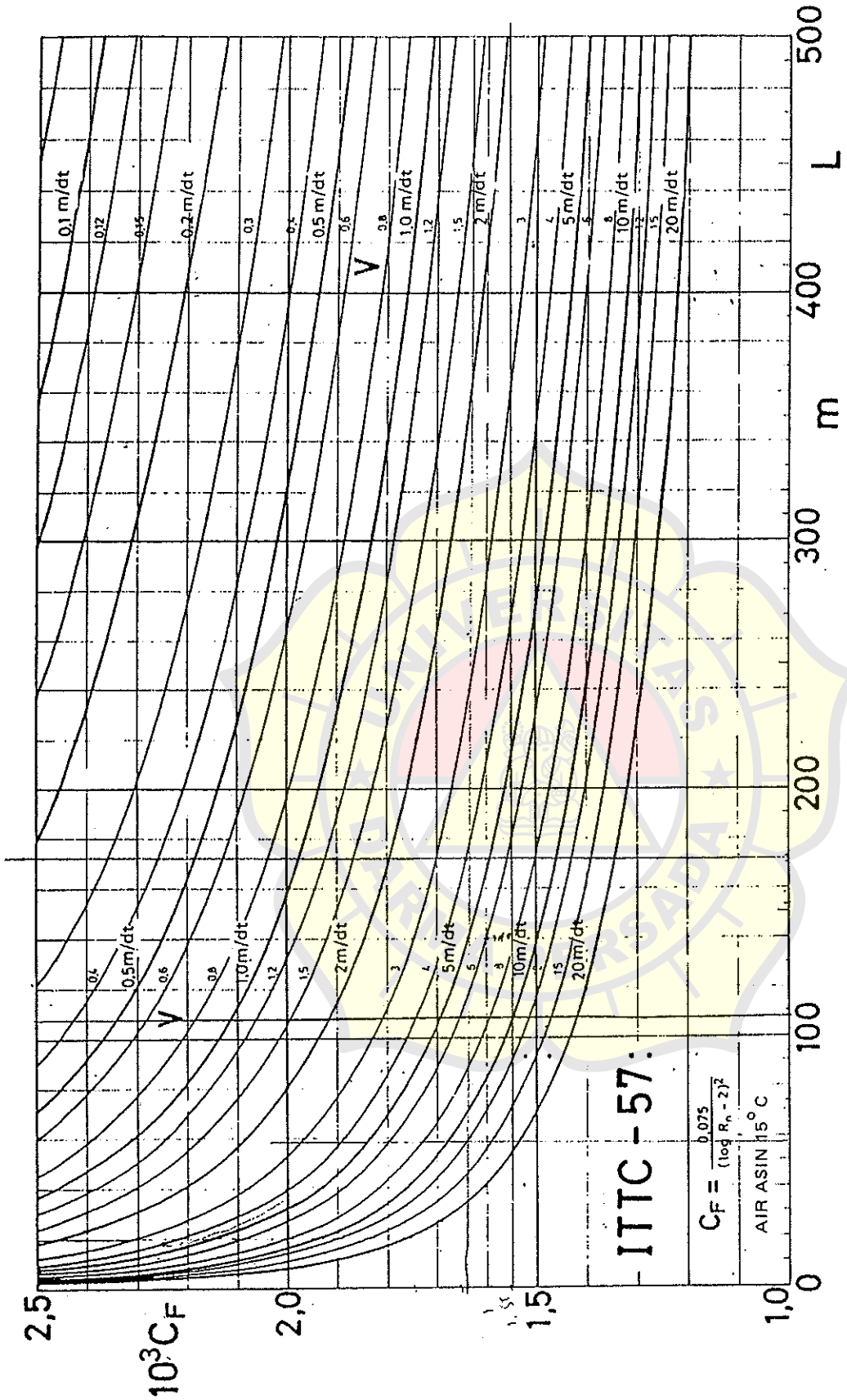
$$10^3 C_{AS} = 0{,}04 \qquad (5.5.27)$$

tetapi tentu saja untuk kapal yang stabil dalam kondisi yang wajar koreksi tersebut dapat diabaikan.

Terlihat bahwa kedua koreksi tersebut kecil dan dalam perancangan awal koreksi ini umumnya sudah tercakup dalam tahanan tambahan.

KONDISI PELAYARAN DINAS

Tahanan dan daya efektif yang dihitung dengan memakai diagram yang diberikan di sini berlaku untuk kapal dalam kondisi pelayaran percobaan, yaitu, untuk kondisi ideal dari segi angin, gelombang, kedalaman air, dan kemulusan badan kapal. Untuk kondisi rata-rata pelayaran dinas harus diberikan kelonggaran tambahan pada tahanan dan daya efektif yang disebabkan oleh angin, laut, erosi, dan fouling pada badan kapal.



Gambar 5.5.14. Koefisien tahanan gesek C_F (menurut ITTC 1957) sebagai fungsi panjang kapal L dan kecepatan V.

6.5.5. Prakiraan Fraksi Deduksi Gaya Dorong

Rumus atau diagram untuk menentukan fraksi deduksi gaya dorong untuk model harus terdiri dari parameter yang telah dibahas di 6.5.4 berikut ini :

1. Koefisien blok δ
2. Rasio lebar-panjang B/L
3. Rasio diameter baling-baling dengan panjang kapal, D/L.
4. Koefisien bentuk penampang.

Umumnya keterangan mengenai t terkait dengan keterangan mengenai w. Karena itu kurva untuk menentukan fraksi deduksi gaya dorong digambarkan di Gb. 6.4.26 sebagai kurva untuk fraksi arus ikut. Kurva tersebut berlaku untuk buritan konvensional (lihat Gb. 6.5.5). Untuk buritan baling-baling bebas harga t akan berkurang sebesar

$$\Delta t = -0{,}5t \qquad (6.5.16)$$

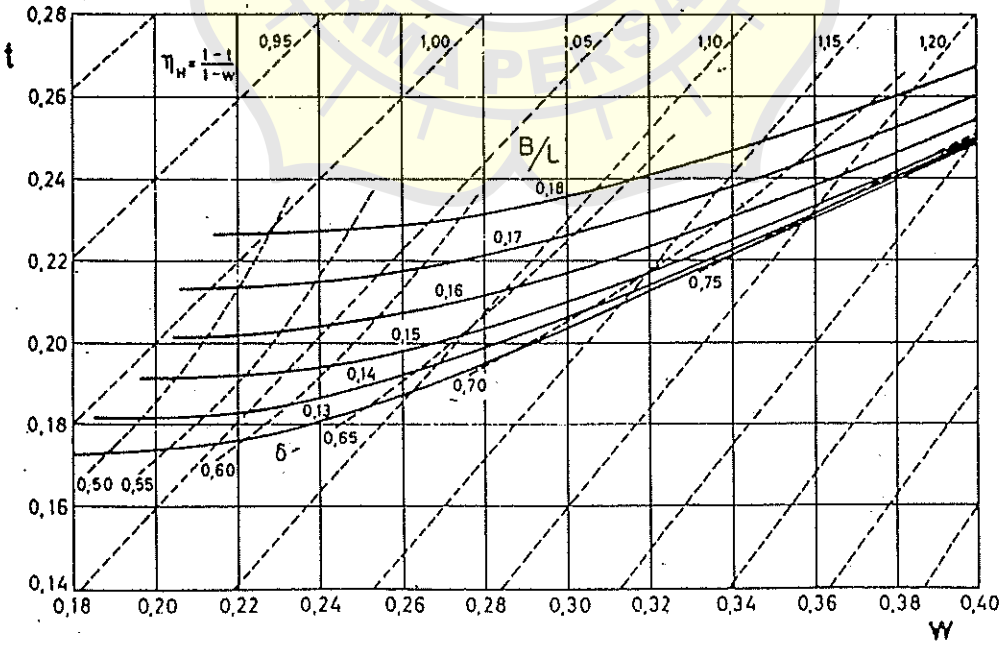
Buritan gembung memberikan pengertian bahwa t harus dikurangi sebesar

$$\Delta t = -0{,}25t \qquad (6.5.17)$$

Untuk kapal "standar" dengan bentuk penampang normal dan buritan konvensional, $D/L = 0{,}04$, serta $B/T = 2{,}5$, hubungan sederhana antara deduksi gaya dorong dengan arus ikut mudah dicari, dan hubungan ini ditunjukkan di Gb. 6.5.6. Dalam gambar ini koefisien arus ikut dipakai sebagai koordinat horizontal sedangkan ordinatnya adalah koefisien deduksi gaya dorong. Tiga perangkat kurva ditunjukkan dalam diagram tersebut. Perangkat yang pertama menunjukkan hubungan antara t dan w untuk harga koefisien blok yang tetap. Perangkat yang kedua menunjukkan hubungan yang sama tetapi untuk rasio lebar – panjang yang tetap, dan yang ketiga menunjukkan hubungan antara t dan w untuk efesiensi badan kapal yang tetap; $\eta_H = (1 - t)/(1 - w)$.

Sekalipun khusus hanya memandang kapal dengan bentuk yang normal dan mempunyai $D/L = 0{,}04$ akan terlihat bahwa antara t dan w tidak mempunyai hubungan yang proporsional. Lagi pula, t dan w bervariasi dengan cara sendiri-sendiri terhadap bentuk penampang kapal, garis tengah baling-baling, dan kecepatan. Karena itu Gb. 6.5.6 hanya dapat dipakai sebagai perkiraan yang sangat kasar untuk mendapatkan harga fraksi deduksi gaya dorong, fraksi arus ikut, dan efesiensi badan kapal dalam salah satu tahap perhitungan yang paling awal untuk menentukan daya yang diperlukan untuk propulsi kapal baru berbaling-baling tunggal.

Untuk memperkirakan fraksi deduksi gaya dorong kapal berbaling-baling ganda hanya pedoman dasarnya saja yang dapat diberikan. Yang jelas fraksi deduksi gaya dorong akan tergantung pada koefisien blok kapal.



Gambar 6.5.6. Hubungan antara fraksi deduksi gaya dorong, fraksi arus ikut, dan efesiensi badan kapal untuk kapal berbaling-baling tunggal dengan bentuk normal dan $D/L = 0{,}04$.

dan harga pitch rationya kalau type yang dipilih adalah type B 4-55 dan diameter baling2 tidak boleh melebihi 5,60 meter.

Penyelesaian :

Dengan ketentuan2 diatas maka diambil beberapa harga D dibawah 5,60 meter, disini disekitar 4,40 meter sampai 5,60 meter. Dengan menggunakan diagram Kt-Kq-J dari type B 4-55 dapatlah dicari harga2 H/D dan η_p sebagai berikut;

N = 126 rpm

P = 7200 - (3% x 7200) = 7200 - 216 = 6984 HP

$$Q = \frac{P \times 75 \times 60}{2\pi N} = \frac{6984 \times 4500}{6,28 \times 126} = 39718 \text{ kgm}$$

Dimisalkan w = 0,24 maka Va = (1 - w) Vs = 12,61 knots = 6,49 m/sc

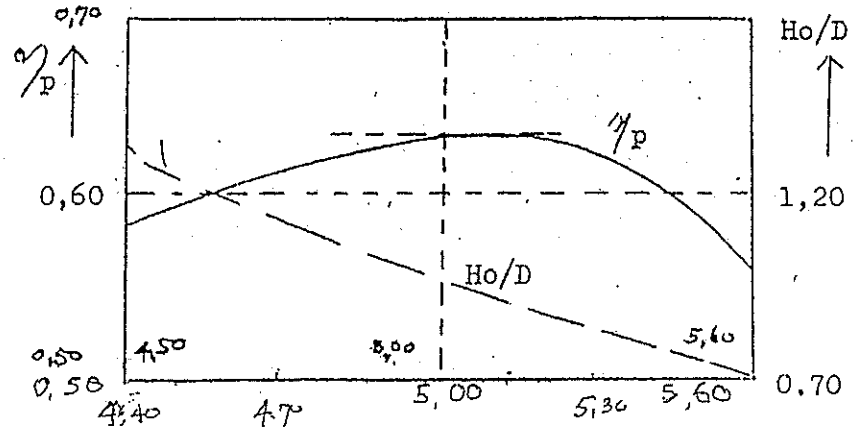
Dengan harga2 Kq dan J yang dihitung pada masing2 harga D maka dengan memakai diagram Kt-Kq-J dari B 4-55 dapatlah diketemukan harga2 seperti tabel berikut ;

D (m)	$Kq = \frac{Q}{\rho n^2 D^5}$	$J = \frac{Va}{n D}$	Ho/D	η_p
4,40	0,05354	0,702	1,229	0,596
4,70	0,03849	0,659	1,056	0,618
5,00	0,02825	0,618	0,921	0,627
5,30	0,02111	0,583	0,804	0,617
5,60	0,01603	0,552	0,712	0,551

rlu diketahui, bahwa Ho adalah pitch pada ujung daun baling2 (blade tip) ri baling2 type B-series berdaun 4 dimana pitchnya mengecil 20% pada hub, dangkan harga H adalah pitch rata2. Karena contoh soal dimuka baling2 yang pilih adalah type B 4-55, maka pada tabel dimuka harga2 Ho/D yang dicari ri diagramnya.

ri angka2 Ho/D dan η_p untuk masing2 harga diameter yang dimisalkan seper- pada tabel tersebut, maka dapatlah dibuat suatu grafik Ho/D dan η_p ver- s D untuk dapat menemukan berapa besarnya D dimana effisiensinya maximum. :i grafik untuk contoh soal ini, diketemukan besarnya D optimum adalah),00 meter dan Ho/D = 0,921 ; η_p = 0,627 .

gan memakai petunjuk dari tabel baling2 type B 4-55 yang ada, dapatlah bar perencanaan baling2 yang dicari (dengan diameter dan pitch ratio g telah diketemukan tadi) dibuat.



bentuk penampang badan kapal maupun harga perbandingan D/L. Menurut hasil yang didapat, ternyata harga-harga w yang dihitung dengan rumus Taylor perbedaannya tidak seberapa terhadap harga w dari diagram Harvald terutama untuk kapal-kapal samodera.

Dengan begitu untuk keperluan praktis dalam perencanaan dapatlah dipergunakan rumus Taylor untuk menghitung besarnya harga w.

Harga thrust deduction factor t tidak dapat dibuat diagram seperti halnya harga w. Hal ini disebabkan harga t sangat terpengaruh sekali besarnya terhadap :

- Ukuran-ukuran stern frame.
- Bentuk kelangsingan (fineness) dari garis air (waterlines) badan kapal.
- Harga perbandingan tebal dan panjang serta bentuk dari daun kemudi, dll.

Untuk keperluan praktis dapatlah dipakai rumus Taylor seperti dimuka yaitu;

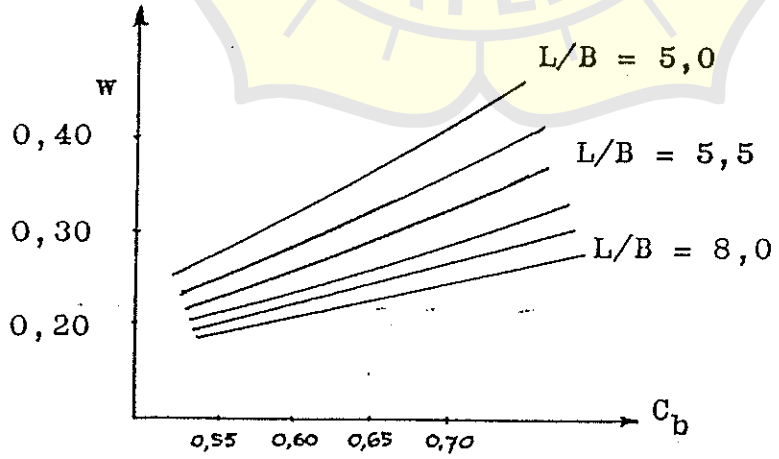
$t = 0,6\ w$ untuk kapal2 single screw.

$t \approx w$ untuk kapal-kapal twin screw.

Setelah didapatkannya harga w maka kalau kecepatan kapal diketahui Vs dapatlah harga kecepatan air yang melewati piringan baling-baling (intake velocity = advance speed) dihitung yaitu :

$$Va = Vs\ (1 - w)$$

Sketsa diagram Harvald untuk mencari w :



Untuk kapal2 perang destroyer, cruiser dsb. biasanya untuk kerugian gesekan pada shaftingnya diperkirakan hanya perlu koreksi - 1%.

Perlu diingat bahwa perhitungan P pada Bp-δ adalah memakai H.P. Inggris yaitu = 76 kg.m/detik, sehingga kapal data P yang diberikan adalah dalam metric maka perlu adanya koreksi penyesuaian.

3. Koreksi air tawar menjadi air laut :

Bp - δ maupun diagram Bu - δ semuanya adalah hasil percobaan yang dilaksanakan ditangki percobaan memakai air tawar. Bilamana baling2 yang direncanakan adalah untuk kapal laut, maka perlu diadakan koreksi pada harga P untuk penyesuaian air tawar terhadap air laut tersebut.

Besarnya koreksi adalah :

$$P \times \frac{1,000}{1,025}$$

4. Koreksi harga δ :

Baik Bp - δ maupun diagram Bu - δ adalah dihasilkan dari open water tests dimana model baling2 bekerja pada kondisi terbuka atau open condition.

Karena baling2 yang direncanakan adalah nantinya bekerja pada behind condition, maka perlu adanya koreksi sebagai berikut :

Kapal ber-baling2 tunggal :

Untuk C_b besar : - 4% s/d - 5%
Untuk C_b kecil : - 2%

Kapal ber-baling2 ganda: - 2% s/d - 4%

Adapun prosedur perencanaannya adalah sbb. :

a). Hitung harga load factor Bp :

$$Bp = \frac{N\ P^{\frac{1}{2}}}{Va^{2\frac{1}{2}}}$$

Adakan koreksi2 seperti telah diterangkan di muka.

b). Dengan memakai Bp - δ diagram pada harga Bp yg telah didapat dari perhitungan diatas, maka da patlah diketahui besarnya harga optimum advance coefficient δ yaitu dimana mempunyai harga ηp maximum (digaris putus2 pada Bp - δ diagram). Hitung beberapa harga untuk beberapa harga Fa/F.

Contoh Soal 2 :

Perencanaan baling2 dengan memakai Bp - δ diagram, Diminta untuk merencanakan sebuah baling2 dengan bahan manganese bronze untuk sebuah kapal barang ber-baling2 tunggal dengan lokasi kamar mesin dibelakang.

Data yang ada adalah sebagai berikut :

Ukuran pokok kapal : L (pp) = 138,99 m
B (mld) = 19,43 m
d (mld) = 8,44 m

Volume of displacement Δ = 14973 m

Block coefficient C_b = 0,657

Prismatic coefficient C_p = 0,670

Mesin induk kapal : pada trial condition ;

MCR (maximum continuous rating) = 10000 HP/118 rpm

NCR (normal continuos rating) = 9000 HP/115 rpm

Selain itu pula, bahwa dengan memakai perhitungan cara Taylor telah diestimasi besarnya tahanan kapal. Dan dengan estimasi P.C. = 0,75 dan dengan allowance 10% terhadap trial condition pada NCR maka akan dicapai kecepatan kapal (trial) sebesar

Vs = 17,93 knots.

Type baling2 dipilih : type B berdaun 4 dari Troost series.

Penyelesaian : Dipilih baling2 type B 4-40 dengan B4-55 dan dicari Fa/F terbaik.

1) Hitung harga w menurut rumus Taylor untuk kemudian mencari harga Va :

$w = 0,5\ C_b - 0,05 = 0,278$

$Va = (1 - w)\ Vs = (1 - 0,278)\ 17,93 =$ knots.

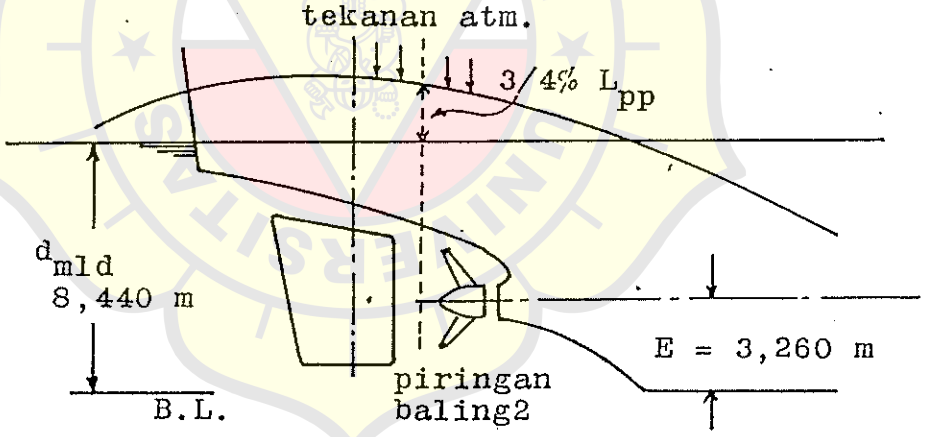
2) Rpm baling2 = 115 rpm.

Koreksi rpm = 3%

N = 115 x 0,97 = 111,5 rpm.

3) Tenaga ditempat dimana baling2 melekat :

P = (9000 - 3%) x 75/76 x 1,000/1,025 = 8405 HP
(Inggris, karena seperti diketahui: Bp - δ dia-


tekanan atm.
3/4% L_{pp}
d_{mld}
8,440 m
B.L.
piringan
baling2
E = 3,260 m

$Fp/Fa = 1,067 - 0,229\ H/D$

Untuk soal ini;

B4-40 : $F = 26,284\ m^2$; $Fa = 10,514\ m^2$

dengan rumus diatas akan didapatkan

$Fp = 9,126\ m^2$

B4-55 : $F = 24,175\ m^2$; $Fa = 13,296\ m^2$

dan akan didapatkan harga

$Fp = 11,328\ m^2$.

Dalam peta kavitasi pada yang perlu diketahui lebih dahulu adalah harga2 angka kavitasi pada 0,8 R dan ;

$$\sigma_c = \frac{T/Fp}{\frac{1}{2}\rho V^2}$$

dimana harga V didapat dari:

$$V^2 = Va^2 + (\pi n.0,8\ D)^2$$

Angka kavitasi pada 0,8 R dapat dihitung sbb.:

Sarat air kapal	: d_{mld}	=	8,440 m
Tinggi sumbu poros baling2 thd. garis dasar kapal	: E	=	3,620 m (-)
	$d_{mld} - E$	=	4,820 m
Tinggi ombak/gelombang = 3/4 % L_{pp}		=	1,040 m (+)
Water head diatas garis/ sumbu poros baling2		=	5,860 m
Tekanan hydrostatis pada garis/sumbu poros baling2 diair laut = 5,860 m x 1,025 kg/m³		=	6.007 kg/m²

Diketahui:

(tekanan atmosfeer)-(vapour press= e)= 10.100 kg/m² (+)

(Tekanan statis digaris sumbu poros baling2) - (e)

$p_o - e$ = 16.107 kg/m²

Angka kavitasi yang ditinjau adalah pada 0,8 R (yaitu disesuaikan dengan permintaan peta kavitasi yang dipakai) :

Section 11

Watertight Bulkheads

A. General

1. Watertight subdivision

1.1 All ships are to have a collision bulkhead, a stern tube bulkhead and one watertight bulkhead at each end of the engine room. In ships with machinery aft, the stern tube bulkhead may substitute the aft engine room bulkhead.

1.2 For ships without longitudinal bulkheads in the cargo hold area the number of watertight transverse bulkheads should, in general, not be less than given in Table 11.1.

Table 11.1 Number of watertight transverse bulkheads

L [m]	Arrangement of machinery space	
	aft	elsewhere
L ≤ 65	3	4
65 < L ≤ 85	4	4
85 < L ≤ 105	4	5
105 < L ≤ 125	5	6
125 < L ≤ 145	6	7
145 < L ≤ 165	7	8
165 < L ≤ 185	8	9
L > 185	to be special considered	

1.3 One or more of the watertight bulkheads required by 1.2, may be dispensed with where the transverse strength of the ship is adequate. The number of watertight bulkheads will be entered into the Register Book.

1.4 Number and location of transverse bulkheads fitted in addition to those specified in 1.1 are to be so selected as to ensure sufficient transverse strength of the hull.

1.5 For ships which require proof of survival capability in damaged conditions, the watertight sub-division will be determined by damage stability calculations. For oil tankers see Section 24, A.2., for passenger vessels see Section 29-I, C., for special purpose ships see Section 29-II, C., for cargo ships of more than 100 m in length see Section 36 and for supply vessels see Section 34, A.2. For liquefied gas tankers see Rules for Ships Carrying Liquefied Gases in Bulk, Volume IX, Section 2, for chemical tankers see Rules for Ships Carrying Dangerous Chemicals in Bulk, Volume X, Section 2.

2. Arrangement of watertight bulkheads

2.1 Collision bulkhead

2.1.1 Cargo ships with $L_c \leq 200$ m shall have the collision bulkhead situated not less than 0,05 L_c from the forward perpendicular. Cargo ships with $L_c > 200$ m shall have the collision bulkhead fitted at least 10 m from the forward perpendicular.

2.1.2 All cargo ships shall have the collision bulkhead located not more than 0,08 L_c from the forward perpendicular. Upon application greater distances may be approved in special cases.

2.1.3 In the case of ships having any part of the underwater body extending forward of the forward perpendicular, e.g. a bulbous bow, the required distances specified in 2.1.1 and 2.1.2 are to be measured from a reference point located at a distance x forward of the forward perpendicular which shall be the lesser of:

$$x = \frac{a}{2}$$

$$= 0{,}015\ L_c$$

$$= 3{,}0\ \text{m}.$$

For passenger ships see Section 29-I, C.3.

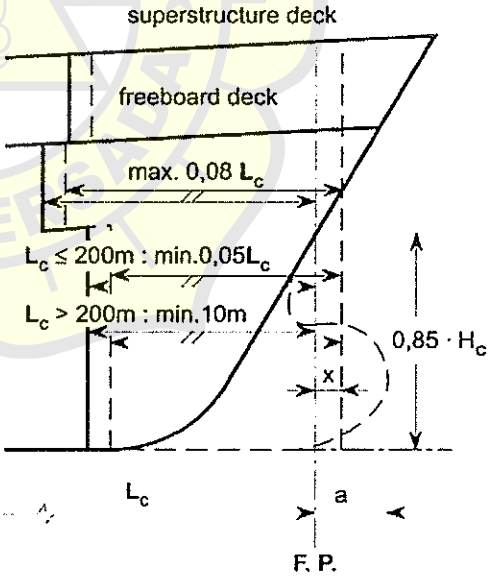


Fig. 11.1 Location of collision bulkhead

2.1.4 The collision bulkhead shall extend watertight up to the freeboard deck. Steps or recesses may be permitted provided 2.1.1, 2.1.2 and 2.1.3 are observed.

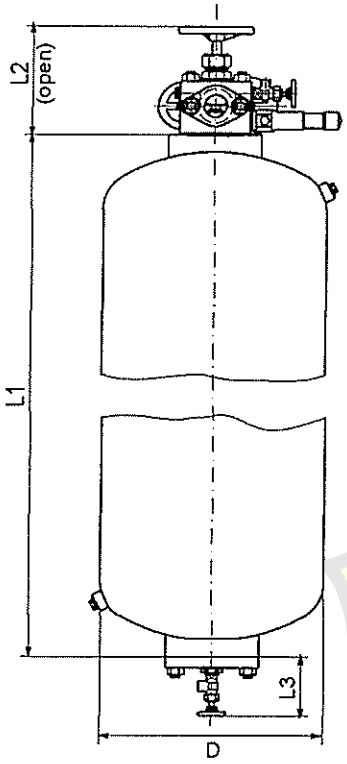
2.1.5 In ships having continuous or long superstructures, the collision bulkhead shall extend to the first deck above

The number and the capacity of the air vessels for propulsion engines depend on the requirements of the classification societies and the type of installation.

It is recommended to use a minimum air pressure of 1.8 MPa, when calculating the required volume of the vessels.

The starting air vessels are to be equipped with at least a manual valve for condensate drain. If the air vessels are mounted horizontally, there must be an inclination of 3...5° towards the drain valve to ensure efficient draining.

Figure 8.3 Starting air vessel



Size [Litres]	Dimensions [mm]				Weight [kg]
	L1	L2 1)	L3 1)	D	
125	1807	243	110	324	170
180	1217	243	110	480	200
250	1767	243	110	480	274
500	3204	243	133	480	450

1) Dimensions are approximate.

The starting air consumption stated in technical data is for a successful start. During start the main starting valve is kept open until the engine starts, or until the max. time for the starting attempt has elapsed. A failed start can consume two times the air volume stated in technical data. If the ship has a class notation for unattended machinery spaces, then the starts are to be demonstrated.

The required total starting air vessel volume can be calculated using the formula:

$$V_R = \frac{p_E \times V_E \times n}{p_{Rmax} - p_{Rmin}}$$

where:

V_R = total starting air vessel volume [m³]

p_E = normal barometric pressure (NTP condition) = 0.1 MPa

V_E = air consumption per start [Nm³] See *Technical data*

n = required number of starts according to the classification society

p_{Rmax} = *maximum starting air pressure* = 3 MPa

p_{Rmin} = minimum starting air pressure = 1.8 MPa

NOTE! The total vessel volume shall be divided into at least two equally sized starting air vessels.

Wärtsilä 4L20		ME IMO Tier 2	AE/DE IMO Tier 2	AE/DE IMO Tier 2	ME IMO Tier 2	AE/DE IMO Tier 2	AE/DE IMO Tier 2
Cylinder output	**kW**	**200**	**185**	**200**	**200**	**185**	**200**
Engine speed	**RPM**	**1000**	**900**	**1000**	**1000**	**900**	**1000**
Pressure at engine, after pump, nom. (PT401)	kPa	200 + static	200 + static	200 + static	200 + static	200 + static	200 + static
Pressure at engine, after pump, max. (PT401)	kPa	350	500	500	350	500	500
Temperature before cylinder, approx. (TE401)	°C	83	83	83	83	83	83
Temperature after engine, nom.	°C	91	91	91	91	91	91
Capacity of engine driven pump, nom.	m³/h	20	20	20	20	20	20
Pressure drop over engine, total	kPa	90	90	90	90	90	90
Pressure drop in external system, max.	kPa	120	120	120	120	120	120
Water volume in engine	m³	0.09	0.09	0.09	0.09	0.09	0.09
Pressure from expansion tank	kPa	70...150	70...150	70...150	70...150	70...150	70...150
Low temperature cooling water system							
Pressure at engine, after pump, nom. (PT451)	kPa	200 + static	200 + static	200 + static	200 + static	200 + static	200 + static
Pressure at engine, after pump, max. (PT451)	kPa	350	500	500	350	500	500
Temperature before engine, min....max	°C	25...38	25...38	25...38	25...38	25...38	25...38
Capacity of engine driven pump, nom.	m³/h	24	23	24	24	23	24
Pressure drop over charge air cooler	kPa	30	30	30	30	30	30
Pressure drop over oil cooler	kPa	30	30	30	30	30	30
Pressure drop in external system, max.	kPa	120	120	120	120	120	120
Pressure from expansion tank	kPa	70...150	70...150	70...150	70...150	70...150	70...150
Starting air system							
Pressure, nom.	kPa	3000	3000	3000	3000	3000	3000
Pressure, max.	kPa	3000	3000	3000	3000	3000	3000
Low pressure limit in air vessels	kPa	1800	1800	1800	1800	1800	1800
Starting air consumption, start (successful)	Nm³	1.2	1.2	1.2	1.2	1.2	1.2

Notes:

Note 1 At ISO 3046-1 conditions (ambient air temperature 25°C, LT-water 25°C) and 100% load. Tolerance 5%.

Note 2 At ISO 3046-1 conditions (ambient air temperature 25°C, LT-water 25°C) and 100% load. Flow tolerance 5% and temperature tolerance 15°C.

Note 3 At ISO 3046-1 conditions (ambient air temperature 25°C, LT-water 25°C) and 100% load. Tolerance for cooling water heat 10%, tolerance for radiation heat 30%. Fouling factors and a margin to be taken into account when dimensioning heat exchangers.

Note 4 According to ISO 3046/1, lower calorific value 42 700 kJ/kg, with engine driven pumps (two cooling water + one lubricating oil). Tolerance 5%. Load according to propeller law for mechanical propulsion engines (ME).

ME = Engine driving propeller, variable speed

AE = Auxiliary engine driving generator

DE = Diesel-Electric engine driving generator

Subject to revision without notice.

starting air compressors. At least one of the air compressors must be driven independently of the main engine and must supply at least 50 % of the total capacity required.

2.2 The total capacity of the starting air compressors is to be such that the starting air receivers designed in accordance with 2.4 or 2.5, as applicable, can be charged from atmospheric pressure to their final pressure within one hour.

Normally, compressors of equal capacity are to be installed.

This does not apply to an emergency air compressor which may be provided to meet the requirement stated in H.1.

2.3 If the main engine is started with compressed air, the available starting air is to be divided between at least two starting air receivers of approximately equal size which can bc used independently of each other.

2.4 The total capacity of air receivers is to be sufficient to provide, without their being replenished, not less than 12 consecutive starts alternating between Ahead and Astern of each main engine of the reversible type, and not less than six starts of each main non-reversible type engine connected to a controllable pitch propeller or other device enabling the start without opposite torque. The number of starts refers to an engine in cold and ready-to-start condition.

2.5 With multi-engine installations the number of start-up operations per engine may, with the Society's agreement, be reduced according to the concept of the propulsion plant.

2.6 If starting air systems for auxiliaries or for supplying pneumatically operated regulating and manoeuvering equipment or tyfon units are to be fed from the main starting air receivers, due attention is to be paid to the air comsumption of this equipment when calculating the capacity of the main starting air receivers.

2.7 Other consumers with a high air consumption apart from those mentioned in 2.6 may not be connected to the main starting air system. Separate air supplies are to be provided for these units. Deviations to this require the agreement of the Society.

2.8 For the approximate calculation of the starting air storage capacity, use may be made of the formulae given in Part C of the appendix to this section.

3. Electrical starting equipment

3.1 Where main engines are started electrically, two mutually independent starter batteries are to be installed. The batteries are to be so arranged that they cannot be connected in parallel with each other. Each battery must enable the main engine to be started from cold.

The total capacity of the starter batteries must be sufficient for the execution within 30 minutes, without recharging the batteries, of the same number of start-up operations as is prescribed in 2.4. or 2.5, as appropriate, for starting with compressed air.

3.2 If two or more auxiliary engines are started electrically, at least two mutually independent batteries are to be provided. Where starter batteries for the main engine are fitted, the use of these batteries is acceptable.

The capacity of the batteries must be sufficient for at least three start-up operations per engine.

If only one of the auxiliary engines is started electrically, one battery is sufficient.

3.3 The starter batteries may only be used for starting (and preheating where applicable) and for monitoring equipment belonging to the engine.

3.4 Steps are to be taken to ensure that the batteries are kept charged and the charge level is monitored.

4. Start-up of emergency generating sets

4.1 Emergency generating sets are to be so designed that they can be started up readily even at a temperature of 0 °C.

If the set can be started only at higher temperatures, or where there is a possibility that lower ambient temperatures may occur, heating equipment is to be fitted to ensure ready reliable starting.

The operational readiness of the set must be guaranteed under all weather and seaway conditions. Fire flaps required in air inlet and outlet openings must only be closed in case of fire and are to be kept open at all other times. Warning signs to this effect are to be applied. If the flaps close, an alarm must bc activated. No alarm is required in the case of automatic fire flap actuation dependent on the operation of the set. Air inlet and outlet openings must not be fitted with weatherproof covers.

4.2 Each emergency generating set required to be capable of automatic starting is to be equipped with an automatic starting system approved by the Society, the capacity of which is sufficient for at least three successive starts (see Volume IV, Rules for Electrical Installation, Section 3, C).

In addition, a second energy source is to be installed which will allow three further starts to be effected within 30 minutes. This requirement may be dispensed with if the set can also be started by hand.

Pressure : 2.45—2.94MPa
Capacity : 4.3—54.0m³/hr
Cooling : Air
Power : 1.5—15.0kW
Type : Vertical type or V-type, 2-stage
Model Range : LHC-22 — VLH-53

Features

1. Lightweight and compact in shape
2. Simple structure
3. Ease of maintenance

Lightweight and Simple Structure

Only by pursuing the simplest design and structure can we create economical compressors, and so with this principle in mind, we have developed an engine activator for small crafts, and emergency compressors for large ships. These compressors achieve ease of maintenance, and are highly regarded for their outstanding service durability.

Specifications chart *click to view large image.

● For Water-Cooled Engine Activation

Model No.	Speed (r.p.m)	Pressure MPa (kgf/cm²)	Capacity m³/hr	Motor (kW)	Drive	
					50Hz	60Hz
LHC-22	1500	2.94 (30)	4.3	1.5	D	V
	1800		5.0	2.2	V	D
LHC-33	1200		14.5	3.7	V	D
	1500		18.5	5.5	D	V
	1800		22.0	5.5	V	D
VLH-43	1200		30.0	7.5	V	D
	1500		36.0	11.0	D	V
	1800		44.0	11.0	V	D
VLH-53	1200		54.0	15.0	V	D
	1500		—	—	D	V
	1800		—	—	V	D

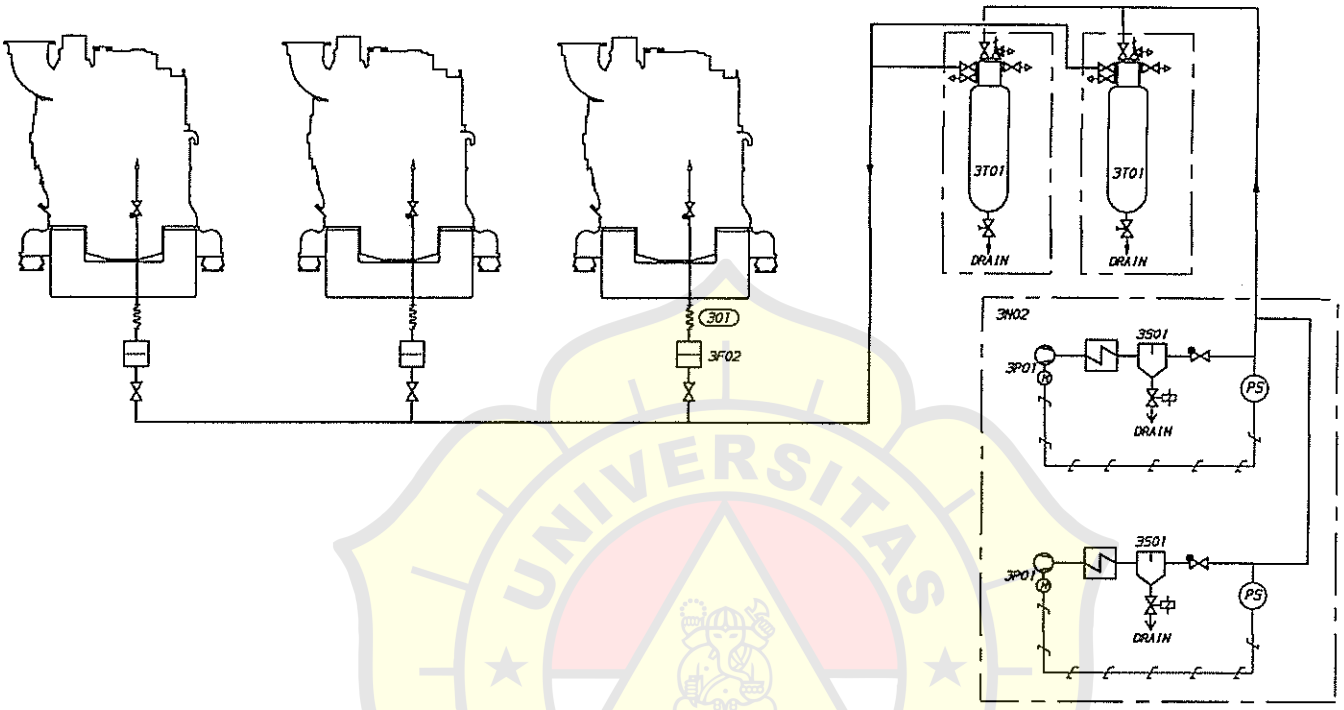
V : V Belt Drive D : Direct Couple

8.2 External compressed air system

The design of the starting air system is partly determined by classification regulations. Most classification societies require that the total capacity is divided into two equally sized starting air receivers and starting air compressors. The requirements concerning multiple engine installations can be subject to special consideration by the classification society.

The starting air pipes should always be slightly inclined and equipped with manual or automatic draining at the lowest points.

Figure 8.2 External starting air system (DAAE007204d)



System components		Pipe connections	
3F02	Air filter (Starting air inlet)	301	Starting air inlet
3N02	Starting air compressor unit		
3P01	Compressor (Starting air compressor unit)		
3S01	Separator (Starting air compressor unit)		
3T01	Starting air vessel		

8.2.1 Starting air compressor unit (3N02)

At least two starting air compressors must be installed. It is recommended that the compressors are capable of filling the starting air vessel from minimum (1.8 MPa) to maximum pressure in 15...30 minutes. For exact determination of the minimum capacity, the rules of the classification societies must be followed.

8.2.2 Oil and water separator (3S01)

An oil and water separator should always be installed in the pipe between the compressor and the air vessel. Depending on the operation conditions of the installation, an oil and water separator may be needed in the pipe between the air vessel and the engine.

8.2.3 Starting air vessel (3T01)

The starting air vessels should be dimensioned for a nominal pressure of 3 MPa.

5. Piping Design, Treatment and Installation

This chapter provides general guidelines for the design, construction and installation of piping systems, however, not excluding other solutions of at least equal standard.

Fuel, lubricating oil, fresh water and compressed air piping is usually made in seamless carbon steel (DIN 2448) and seamless precision tubes in carbon or stainless steel (DIN 2391), exhaust gas piping in welded pipes of corten or carbon steel (DIN 2458). Pipes on the freshwater side of the cooling water system must not be galvanized. Sea-water piping should be made in hot dip galvanised steel, aluminium brass, cunifer or with rubber lined pipes.

Attention must be paid to fire risk aspects. Fuel supply and return lines shall be designed so that they can be fitted without tension. Flexible hoses must have an approval from the classification society. If flexible hoses are used in the compressed air system, a purge valve shall be fitted in front of the hose(s).

The following aspects shall be taken into consideration:

- Pockets shall be avoided. When not possible, drain plugs and air vents shall be installed
- Leak fuel drain pipes shall have continuous slope
- Vent pipes shall be continuously rising
- Flanged connections shall be used, cutting ring joints for precision tubes

Maintenance access and dismounting space of valves, coolers and other devices shall be taken into consideration. Flange connections and other joints shall be located so that dismounting of the equipment can be made with reasonable effort.

.1 Pipe dimensions

When selecting the pipe dimensions, take into account:

- The pipe material and its resistance to corrosion/erosion.
- Allowed pressure loss in the circuit vs delivery head of the pump.
- Required net positive suction head (NPSH) for pumps (suction lines).
- In small pipe sizes the max acceptable velocity is usually somewhat lower than in large pipes of equal length.
- The flow velocity should not be below 1 m/s in sea water piping due to increased risk of fouling and pitting.
- In open circuits the velocity in the suction pipe is typically about 2/3 of the velocity in the delivery pipe.

Recommended maximum fluid velocities on the delivery side of pumps are given as guidance in table *5.1*.

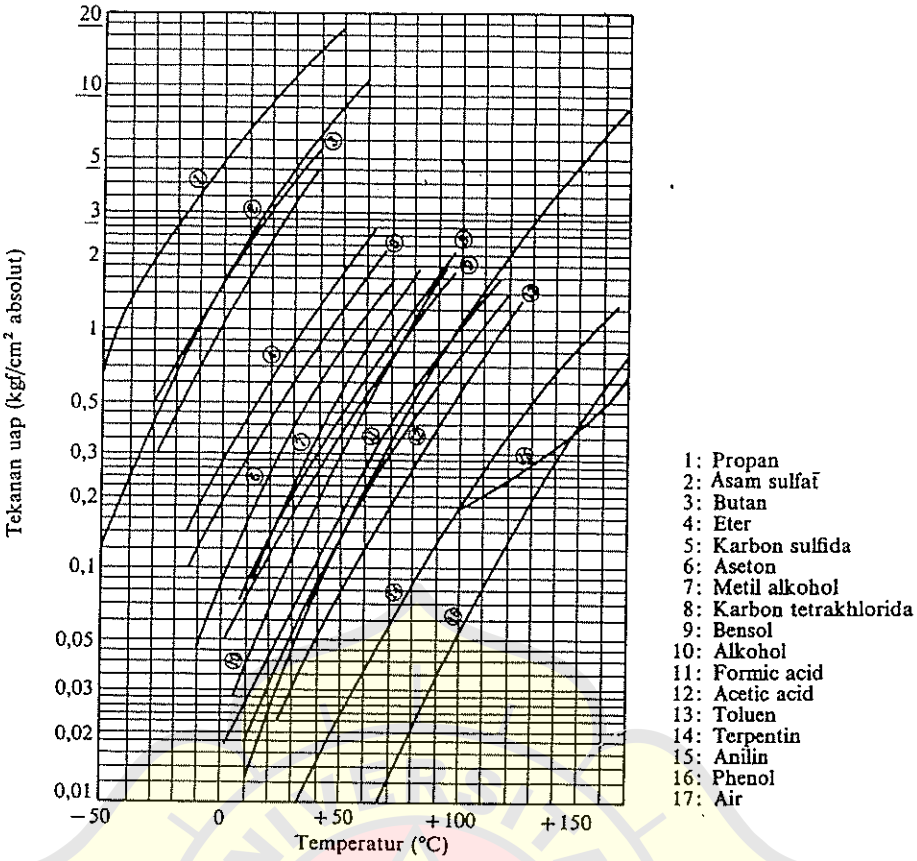
Table 5.1 Recommended maximum velocities on pump delivery side for guidance

Piping	Pipe material	Max velocity [m/s]
Fuel piping (MDF and HFO)	Black steel	1.0
Lubricating oil piping	Black steel	1.5
Fresh water piping	Black steel	2.5
Sea water piping	Galvanized steel	2.5
	Aluminium brass	2.5
	10/90 copper-nickel-iron	3.0
	70/30 copper-nickel	4.5
	Rubber lined pipes	4.5

NOTE! The diameter of gas fuel piping depends only on the allowed pressure loss in the piping, which has to be calculated project specifically.

Table 5.1 *Loss for fittings in equivalent lengths of straight pipe (m)*

Bore of pipe mm	*Vel. head for ordinary pipe*	*Vel. head for bell-mouthed entry*	*Bend*	*Foot valve*	*Non-return valve*	*Delivery valve full open*	*Strainer*	*Tess and elbows*
25	1.37	0.82	0.76	0.24	0.305	0.24	0.091	0.83
38	2.2	1.31	1.13	0.36	0.49	0.36	0.152	1.31
50	3.0	1.8	1.52	0.52	0.7	0.52	0.214	1.8
65	3.8	2.31	1.95	0.64	0.85	0.64	0.275	2.31
75	4.75	2.86	2.44	0.79	1.06	0.79	0.305	2.87
100	6.4	3.96	3.3	1.10	1.43	1.10	0.427	3.96
125	8.5	5.2	4.27	1.43	1.86	1.43	0.58	5.2
150	10.7	6.4	5.27	1.76	2.31	1.76	0.70	6.4



(b) Tekanan uap berbagai zat cair
(*Catatan*: 1 kgf/cm² = 0,1 M Pa)

Gb. 2.1 Sifat-sifat fisik berbagai zat cair.

2.4 Head

2.4.1 Head Total Pompa

Head total pompa yang harus disediakan untuk mengalirkan jumlah air seperti direncanakan, dapat ditentukan dari kondisi instalasi yang akan dilayani oleh pompa. Seperti diperlihatkan dalam Gb. 2.2, head total pompa dapat ditulis sebagai berikut:

$$H = h_a + \Delta h_p + h_l + \frac{v_d^2}{2g} \tag{2.6}$$

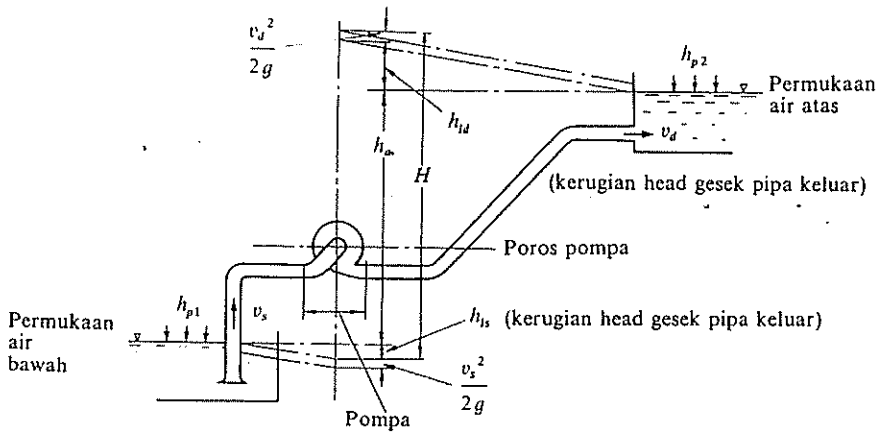
di mana H: Head total pompa (m)

h_a: Head statis total (m)
Head ini adalah perbedaan tinggi antara muka air di sisi keluar dan di sisi isap; tanda positip (+) dipakai apabila muka air di sisi ke luar lebih tinggi dari pada sisi isap.

Δh_p: Perbedaan head tekanan yang bekerja pada kedua permukaan air (m),

$$\Delta h_p = h_{p_2} - h_{p_1},$$

h_l: Berbagai kerugian head di pipa, katup, belokan, sambungan, dll (m),



Gb. 2.2 Head pompa (1).

$$h_l = h_{ld} + h_{ls}$$

$v^2/2g$: Head kecepatan keluar (m)

g: Percepatan gravitasi ($= 9{,}8\ \text{m/s}^2$)

Dalam hal pompa menerima energi dari aliran yang masuk ke sisi isapnya, seperti pada pompa penguat (pompa booster), maka head total pompa dapat dihitung dengan rumus berikut:

$$H = h_a + \Delta h_p + h_l + \frac{1}{2g}(v_d^2 - v_s^2) \tag{2.7}$$

di mana h_a: Perbedaan tinggi antara titik sebarang Ⓐ di pipa keluar, dan sembarang titik Ⓑ di pipa isap (m) (Lihat Gb. 2.3).

Δh_p: Perbedaan tekanan statis antara titik Ⓐ dan titik Ⓑ (m)

h_l: Berbagai kerugian head di pipa, katup, belokan dll, antara titik Ⓐ dan titik Ⓑ (m)

v_d: Kecepatan aliran rata-rata di titik Ⓐ (m/s)

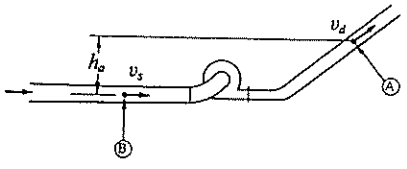
v_s: Kecepatan aliran rata-rata di titik Ⓑ (m/s)

Untuk pompa tegak yang tidak mempunyai pipa isap, $h_l = h_{ld}$.

Apabila permukaan air berubah-ubah dengan perbedaan besar, head statis total harus ditentukan dengan mempertimbangkan karakteristik pompa, besarnya selisih perubahan permukaan air, dan dasar yang dipakai untuk menentukan jumlah air yang harus dipompa.

Adapun hubungan antara tekanan dan head tekanan dapat diperoleh dari rumus berikut:

$$h_p = 10 \times \frac{p}{\gamma} \tag{2.8}$$



Gb. 2.3 Head pompa (2).

di mana Re: Bilangan Reynolds (tak berdimensi)
v: Kecepatan rata-rata aliran di dalam pipa (m/s)
D: Diameter dalam pipa (m)
ν: Viskositas kinematik zat cair (m^2/s)
Pada $Re < 2300$, aliran bersifat laminer.
Pada $Re > 4000$, aliran bersifat turbulen.
Pada $Re = 2300 - 4000$ terdapat daerah transisi, di mana aliran dapat bersifat laminer atau turbulen tergantung pada kondisi pipa dan aliran.

(I) Aliran laminer

Dalam hal aliran laminer, koefisien kerugian gesek untuk pipa (λ) dalam pers. (2.12) dapat dinyatakan dengan

$$\lambda = \frac{64}{Re} \tag{2.14}$$

(II) Aliran turbulen

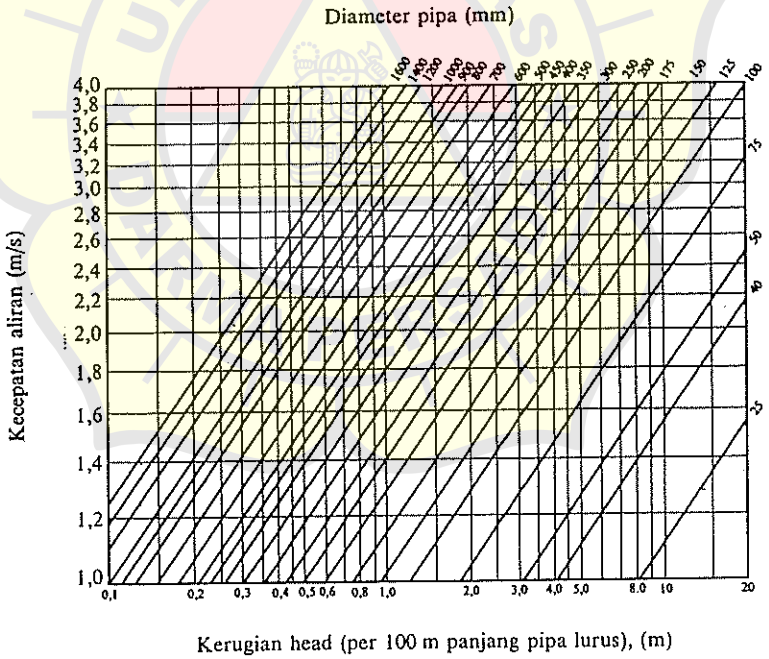
Untuk menghitung kerugian gesek dalam pipa pada aliran turbulen terdapat berbagai rumus empiris. Di bawah ini akan diberikan cara perhitungan dengan rumus Darcy dan Hazen-Williams.

I) Formula Darcy

Dengan cara Darcy, koefisien kerugian gesek λ dari Pers. (2.12) dihitung menurut rumus

$$\lambda = 0{,}020 + \frac{0{,}0005}{D} \tag{2.15}$$

di mana D adalah diameter dalam pipa (m). Rumus ini berlaku untuk pipa baru dari besi cor. Jika pipa telah dipakai selama bertahun-tahun, harga λ akan menjadi 1,5



Kerugian head (per 100 m panjang pipa lurus), (m)

Gb. 2.4 Kerugian gesek pada pipa lurus (rumus Darcy).

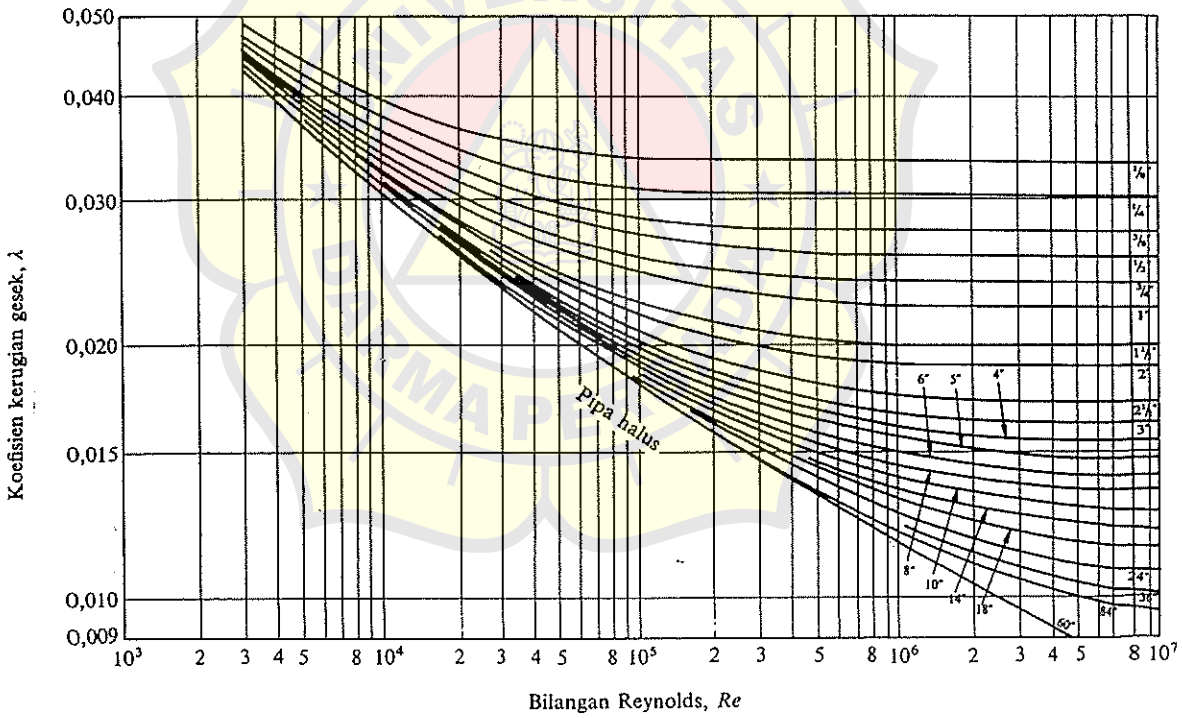
Tabel 2.21 Panjang pipa lurus ekivalen, L_f.

Nama peralatan pipa	Panjang pipa lurus ekivalen L_f	Nama peralatan pipa	Panjang pipa lurus ekivalen L_f
Belokan 45° (1"–3")	15–20 d	Meteran air: Jenis cakram	135–400 D
Belokan 90° (jari-jari lengkung standar)	32 D	jenis turbin	200–300 D
		Katup sorong: terbuka penuh	0–7 D
		" 3/4	10–40 D
Belokan (R/D = 3)	24 D	" 1/2	100–200 D
90° (R/D = 4)	10 D	" 1/4	800 D
Belokan 180°	75 D	Katup bola	
		1" – 2½"	45 D
Sambungan silang	50 D	3" – 6"	60 D
Sambungan -T	40–80 D	7" – 10"	75 D
Meteran air jenis torak	600DD		

pipa lurus. Harga-harga L_f untuk berbagai peralatan pipa yang umum, diberikan dalam Tabel 2.21.

(5) Head kerugian gesek untuk zat cair istimewa

Untuk menghitung kerugian head pada pipa yang mengalirkan zat cair bukan air, dapat dilakukan sebagai berikut. Mula-mula harus dihitung bilangan Reynolds Re dari aliran. Kemudian kerugian head ditentukan dengan cara seperti pada air di mana koefisien kerugian gesek diambil untuk bilangan Reynolds yang bersangkutan.



Gb. 2.17 Bilangan Reynolds dan koefisien gesek.
(angka-angka menunjukkan diameter dalam pipa).

歯　　形：世界にさきがけて考案された、一点連続接触歯車"欠円ギヤー"が標準です。

Tooth Profile : To be the first in the world to design a one-point-contact-gear called "Segmental Gear" as our standard model.

歯　　形：取扱い油温は、最高80℃です。

Temperature : Maximum handling oil temperature is 80℃.

軸　　受：内装軸受式で揚液による自己潤滑方式のため、潤滑性を有する液に適します。

Bearing : Internal bearing is self-lubricated by pumping liquid which is suitable to serve lubricant fluids.

軸　　封：グランドパッキン式が標準です。ご要望に応じて、メカニカルシール式又はオイルシール式を製作します。

Shaft Seal : The conventional gland packing is our standard; however, the mechanical seal type is also available.

フランジ：吸込み、吐出し共JIS10Kです。

Flange : Both suction and discharge are JIS10K.

軸　　心：ポンプと電動機との軸継手の芯の振れの許容範囲は、回転速度2000～500min^{-1}において、軸継手側面で0.1mm以下、軸継手端面で0.1mm以下です。

Centering : If connecting the pump with the motor, the standard allowable alignment value at the rate of 2000 to 500min^{-1}at the shaft coupling side surface should be under 0.1mm and at the shaft coupling end surface should be under 0.1mm.

水圧試験：計画仕様圧力の2倍が標準です。最高1.20MPaです。

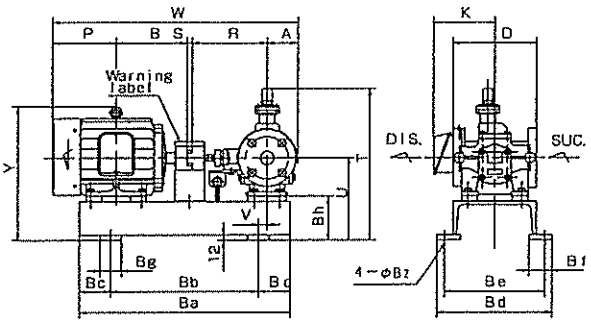
Hydraulic Test: Twice the value of the designed specification pressure with a maximum value of 1.20MPa.

吐出し量：吐出し量は、吐出圧力0.60MPa、粘度25.8mm^2/sにおける量です。許容吸込圧力範囲は、ポンプ入口において、−0.05～0.20MPaです。

Capacity : The following capacity shows at viscosity of 25.8mm^2/s with discharge pressure of 0.60MPa. The allowable suction pressure range is −0.05 to 0.20MPa at the pump suction.

形　番 Model No.	口径 Bore (mm) 吸込み×吐出し Suc.×Dis.	吐出し量 Capacity (m^3/h)			
		60Hz		50Hz	
		1200min^{-1}	1800min^{-1}	1000min^{-1}	1500min^{-1}
NHG-0.3	32×25	0.3	0.45	0.25	0.37
NHG-0.5		0.5	0.75	0.41	0.62
NHG-1		1	1.5	0.8	1.2
NHG-1.5	40×32	1.5	2.2	1.2	1.8
NHG-2		2	3	1.6	2.5
NHG-2.5	50×40	2.5	3.7	2	3
NHG-3		3	4.5	2.5	3.7
NHG-4	65×50	4	6	3.3	5
NHG-5		5	7.5	4	6
NHG-6		6	9	5	7.5
NHG-7.5	80×65	7.5	11	6	9
NHG-10		10	15	8	12
NHG-12		12	18	10	15
NHG-15		15	22	12	18
NHG-20	100×80	20	30	16	25
NHG-25		25	—	20	30
NHG-30	125×100	30	—	25	—

A



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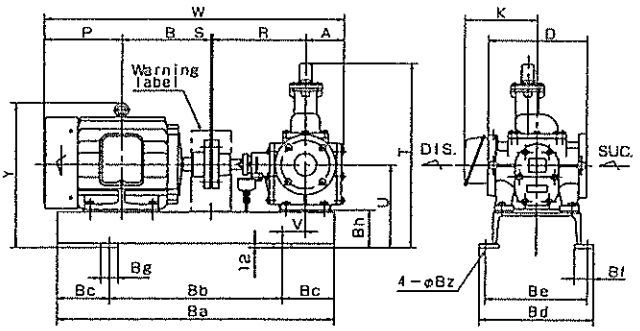

形番 Model No.	図 fig.	電動機 Motor (kW) 6P	4P	寸法 Dimension (mm) A	B	D	K	P	R	S	T	U	V	W	Y	Ba	Bb	Bc	Bd	Be	Bf	Bg	Bh	Bz	質量 Weight (kg) ポンプ Pump	台板 Base	電動機 Motor	軸継手 Coupling
NHG- 0.3	A	0.4	0.75	80	140	180	145	122	150	13	340	185	15	505	270	500	350	75	275	240	55	50	105	15	8	14	11	AL090
0.5		0.75	1.5		168.5		160	143						555	285												19	CL095
NHG- 1		0.4	0.75	85	140	200	145	122	175	13	365	195	20	535	280	500	350	75	275	240	55	50	105	15	12	15	11	AL090
1.5		0.75	1.5		168.5		160	143						585	295										14		19	CL095
2		1.5	2.2		193		165	168.5		18				640	335	600	400	100								17	31	CL100
NHG- 2.5		0.75	1.5	90	168.5	200	160	143	180	13	385	210	20	595	310	600	400	100	275	240	55	50	110	15	16	18	19	CL095
3		1.5	2.2		193		165	168.5		18				650	350												31	CL100
NHG- 4	B	1.5	2.2	95	193	240	165	168.5	220	3	435	210	35	680	350	600	400	100	275	240	55	50	98	15	22	18	31	A-125
		2.2	3.7		200		175	176						694	370											17	41	
NHG- 5		1.5	2.2	95	193	240	165	168.5	220	3	440	210	35	680	350	600	400	100	275	240	55	50	98	15	27	18	31	A-125
6		2.2	3.7		200		175	176						694	370											17	41	
		3.7	5.5		239		190	207.5			470	240		765	415	700	450	125	325	290			128			28	58	A-140
NHG- 7.5		2.2	3.7	105	200	250	175	176	250	3	515	240	45	734	400	700	450	125	325	290	55	50	108	15	37	28	41	A-125
10		3.7	5.5		239		190	207.5						805	415												58	A-140
		5.5	7.5		258			226.5						843		800	500	150								32	70	
NHG- 12		3.7	5.5	110	239	280	190	207.5	270	3	545	240	45	830	415	700	450	125	325	290	55	50	108	15	47	30	58	A-140
15		5.5	7.5		258			226.5					65	868		800	500	150								31	70	
		7.5	11		323		265	252			575	270	45	958	485	900	550	175	390	350	65	60	138	19		41	105	A-160
NHG- 20		5.5	7.5	130	258	320	190	226.5	320	3	630	270	45	938	445	900	550	175	390	350	65	60	110	19	71	40	70	A-160
25		7.5	11		323		265	252					75	1028	485	1000	600	200								42	105	
		11	15		345			274						1072													130	
NHG- 30		11	—	145	345	320	265	274	320	3	630	270	75	1087	485	1000	600	200	390	350	65	60	110	19	75	42	130	A-160
		15	—		351.5		290	294.5			660	300	90	1114	550				470	430			140			64	175	A-180

※電動機メーカー及び形番によりW、P、Y、K寸法及び質量が異なります。
Depend on motor manufacturer and model, measurement of W,P,Y, K and weight maybe changed.

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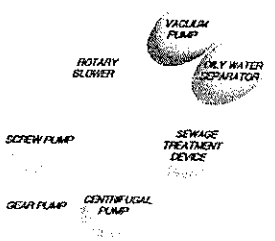

温　　度：世界にさきがけて考案された、一点連続接触歯車"欠円ギヤー"が標準です。

Tooth Profile : To be the first in the world to design a one-point-contact-gear called "Segmental Gear" as our standard model.

歯　　形：取扱い油温は、最高80℃です。

Temperature : Maximum handling oil temperature is 80℃.

軸　　受：内装軸受式で揚液による自己潤滑方式のため、潤滑性を有する液に適します。

Bearing : Internal bearing is self-lubricated by pumping liquid which is suitable to serve lubricant fluids.

軸　　封：グランドパッキン式が標準です。ご要望に応じて、メカニカルシール式又はオイルシール式を製作します。

Shaft Seal : The conventional gland packing is our standard; however, the mechanical seal type is also available.

フランジ：吸込み、吐出し共JIS10Kです。

Flange : Both suction and discharge are JIS10K.

軸　　心：ポンプと電動機との軸継手の芯の振れの許容範囲は、回転速度2000～500min^{-1}において、軸継手側面で0.1mm以下、軸継手端面で0.1mm以下です。

Centering : If connecting the pump with the motor, the standard allowable alignment value at the rate of 2000 to 500min^{-1}at the shaft coupling side surface should be under 0.1mm and at the shaft coupling end surface should be under 0.1mm.

水圧試験：計画仕様圧力の2倍が標準です。最高1.20MPaです。

Hydraulic Test: Twice the value of the designed specification pressure with a maximum value of 1.20MPa.

吐出し量：吐出し量は、吐出圧力0.60MPa、粘度25.8mm^2/sにおける量です。許容吸込圧力範囲は、ポンプ入口において、−0.05～0.20MPaです。

Capacity : The following capacity shows at viscosity of 25.8mm^2/s with discharge pressure of 0.60MPa.
The allowable suction pressure range is −0.05 to 0.20MPa at the pump suction.

形　番 Model No.	口径 Bore (mm)	吐出し量 Capacity (m^3/h)			
	吸込み×吐出し Suc.×Dis.	60Hz		50Hz	
		1200min^{-1}	1800min^{-1}	1000min^{-1}	1500min^{-1}
NHG-0.3	32×25	0.3	0.45	0.25	0.37
NHG-0.5		0.5	0.75	0.41	0.62
NHG-1		1	1.5	0.8	1.2
NHG-1.5	40×32	1.5	2.2	1.2	1.8
NHG-2		2	3	1.6	2.5
NHG-2.5	50×40	2.5	3.7	2	3
NHG-3		3	4.5	2.5	3.7
NHG-4	65×50	4	6	3.3	5
NHG-5		5	7.5	4	6
NHG-6		6	9	5	7.5
NHG-7.5	80×65	7.5	11	6	9
NHG-10		10	15	8	12
NHG-12		12	18	10	15
NHG-15		15	22	12	18
NHG-20	100×80	20	30	16	25
NHG-25		25	—	20	30
NHG-30	125×100	30	—	25	—

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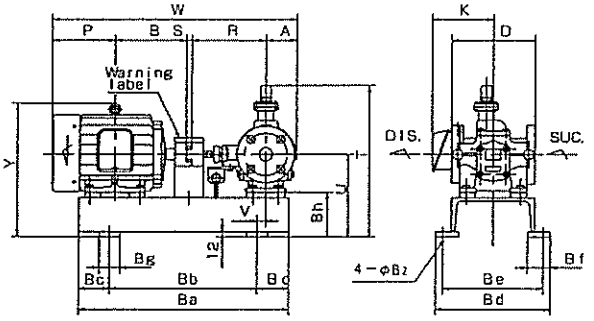

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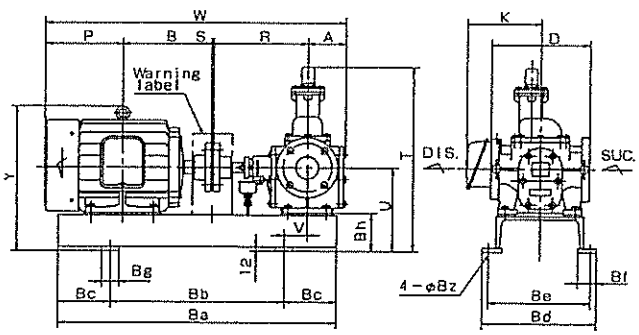

形番 Model No.	図 fig.	電動機 Motor (kW) 6P	4P	寸法 Dimension (mm) A	B	D	K	P	R	S	T	U	V	W	Y	Ba	Bb	Bc	Bd	Be	Bf	Bg	Bh	Bz	質量 Weight (kg) ポンプ Pump	台板 Base	電動機 Motor	軸継手 Coupling
NHG-0.3	A	0.4	0.75	80	140	180	145	122	150	13	340	185	15	505	270	500	350	75	275	240	55	50	105	15	8	14	11	AL090
0.5		0.75	1.5		168.5		160	143						555	285												19	CL095
NHG-1		0.4	0.75	85	140	200	145	122	175	13	365	195	20	535	280	500	350	75	275	240	55	50	105	15	12	15	11	AL090
1.5		0.75	1.5		168.5		160	143						585	295										14		19	CL095
2		1.5	2.2		193		165	168.5		18				640	335	600	400	100								17	31	CL100
NHG-2.5		0.75	1.5	90	168.5	200	160	143	180	13	385	210	20	595	310	600	400	100	275	240	55	50	110	15	16	18	19	CL095
3		1.5	2.2		193		165	168.5		18				650	350												31	CL100
NHG-4	B	1.5	2.2	95	193	240	165	168.5	220	3	435	210	35	680	350	600	400	100	275	240	55	50	98	15	22	18	31	A-125
		2.2	3.7		200		175	176						694	370											17	41	
NHG-5		1.5	2.2	95	193	240	165	168.5	220	3	440	210	35	680	350	600	400	100	275	240	55	50	98	15	27	18	31	A-125
6		2.2	3.7		200		175	176						694	370											17	41	
		3.7	5.5		239		190	207.5			470	240		765	415	700	450	125	325	290			128			28	58	A-140
NHG-7.5		2.2	3.7	105	200	250	175	176	250	3	515	240	45	734	400	700	450	125	325	290	55	50	108	15	37	28	41	A-125
10		3.7	5.5		239		190	207.5						805	415												58	A-140
		5.5	7.5		258			226.5						843		800	500	150								32	70	
NHG-12		3.7	5.5	110	239	280	190	207.5	270	3	545	240	45	830	415	700	450	125	325	290	55	50	108	15	47	30	58	A-140
15		5.5	7.5		258			226.5					65	868		800	500	150								31	70	
		7.5	11		323		265	252			575	270	45	958	485	900	550	175	390	350	65	60	138	19		41	105	A-160
NHG-20		5.5	7.5	130	258	320	190	226.5	320	3	630	270	45	938	445	900	550	175	390	350	65	60	110	19	71	40	70	A-160
25		7.5	11		323		265	252					75	1028	485	1000	600	200								42	105	
		11	15		345			274						1072													130	
NHG-30		11	—	145	345	320	265	274	320	3	630	270	75	1087	485	1000	600	200	390	350	65	60	110	19	75	42	130	A-160
		15	—		351.5		290	294.5			660	300	90	1114	550				470	430			140			64	175	A-180

※電動機メーカー及び形番によりW,P,Y,K寸法及び質量が異なります。
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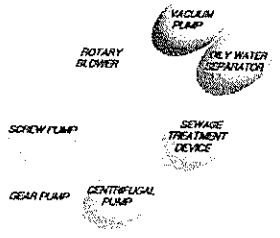

歯　　形：世界にさきがけて考案された、一点連続接触歯車"欠円ギヤー"が標準です。

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軸　　封：グランドパッキン式が標準です。ご要望に応じて、メカニカルシール式又はオイルシール式を製作します。

フランジ：吸込み、吐出し共JIS10Kです。

軸　　心：ポンプと電動機との軸継手の芯の振れの許容範囲は、回転速度2000～500min⁻¹において、軸継手側面で0.1mm以下、軸継手端面で0.1mm以下です。

水圧試験：計画仕様圧力の2倍が標準です。最高1.20MPaです。

吐出し量：吐出し量は、吐出圧力0.60MPa、粘度25.8mm²/sにおける量です。許容吸込圧力範囲は、ポンプ入口において、−0.05～0.20MPaです。

Temperature : Maximum handling oil temperature is 80℃.

Bearing : Internal bearing is self-lubricated by pumping liquid which is suitable to serve lubricant fluids.

Shaft Seal : The conventional gland packing is our standard; however, the mechanical seal type is also available.

Flange : Both suction and discharge are JIS10K.

Centering : If connecting the pump with the motor, the standard allowable alignment value at the rate of 2000 to 500min⁻¹at the shaft coupling side surface should be under 0.1mm and at the shaft coupling end surface should be under 0.1mm.

Hydraulic Test: Twice the value of the designed specification pressure with a maximum value of 1.20MPa.

Capacity : The following capacity shows at viscosity of 25.8mm²/s with discharge pressure of 0.60MPa.
The allowable suction pressure range is −0.05 to 0.20MPa at the pump suction.

形　番 Model No.	口径 Bore (mm) 吸込み×吐出し Suc.×Dis.	吐出し量 Capacity (m³/h)			
		60Hz		50Hz	
		1200min⁻¹	1800min⁻¹	1000min⁻¹	1500min⁻¹
NHG-0.3	32×25	0.3	0.45	0.25	0.37
NHG-0.5		0.5	0.75	0.41	0.62
NHG-1		1	1.5	0.8	1.2
NHG-1.5	40×32	1.5	2.2	1.2	1.8
NHG-2		2	3	1.6	2.5
NHG-2.5	50×40	2.5	3.7	2	3
NHG-3		3	4.5	2.5	3.7
NHG-4	65×50	4	6	3.3	5
NHG-5		5	7.5	4	6
NHG-6		6	9	5	7.5
NHG-7.5	80×65	7.5	11	6	9
NHG-10		10	15	8	12
NHG-12		12	18	10	15
NHG-15		15	22	12	18
NHG-20	100×80	20	30	16	25
NHG-25		25	—	20	30
NHG-30	125×100	30	—	25	—

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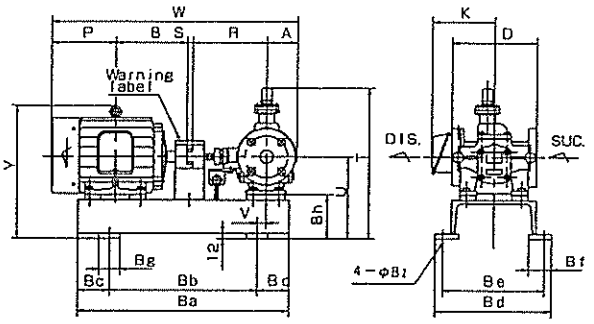

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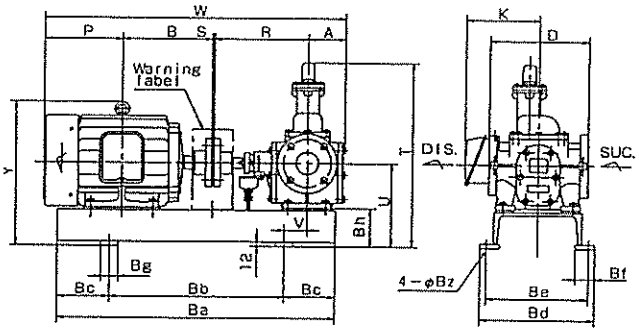

形番 Model No.	図 fig.	電動機 Motor (kW) 6P	4P	寸法 Dimension (mm) A	B	D	K	P	R	S	T	U	V	W	Y	Ba	Bb	Bc	Bd	Be	Bf	Bg	Bh	Bz	質量 Weight (kg) ポンプ Pump	台板 Base	電動機 Motor	軸継手 Coupling
NHG-0.3	A	0.4	0.75	80	140	180	145	122	150	13	340	185	15	505	270	500	350	75	275	240	55	50	105	15	8	14	11	AL090
0.5		0.75	1.5		168.5		160	143						555	285												19	CL095
NHG-1		0.4	0.75	85	140	200	145	122	175	13	365	195	20	535	280	500	350	75	275	240	55	50	105	15	12	15	11	AL090
1.5		0.75	1.5		168.5		160	143						585	295										14		19	CL095
2		1.5	2.2		193		165	168.5		18				640	335	600	400	100								17	31	CL100
NHG-2.5		0.75	1.5	90	168.5	200	160	143	180	13	385	210	20	595	310	600	400	100	275	240	55	50	110	15	16	18	19	CL095
3		1.5	2.2		193		165	168.5		18				650	350												31	CL100
NHG-4	B	1.5	2.2	95	193	240	165	168.5	220	3	435	210	35	680	350	600	400	100	275	240	55	50	98	15	22	18	31	A-125
		2.2	3.7		200		175	176						694	370											17	41	
NHG-5		1.5	2.2	95	193	240	165	168.5	220	3	440	210	35	680	350	600	400	100	275	240	55	50	98	15	27	18	31	A-125
6		2.2	3.7		200		175	176						694	370											17	41	
		3.7	5.5		239		190	207.5			470	240		765	415	700	450	125	325	290			128			28	58	A-140
NHG-7.5		2.2	3.7	105	200	250	175	176	250	3	515	240	45	734	400	700	450	125	325	290	55	50	108	15	37	28	41	A-125
10		3.7	5.5		239		190	207.5						805	415												58	A-140
		5.5	7.5		258			226.5						843		800	500	150								32	70	
NHG-12		3.7	5.5	110	239	280	190	207.5	270	3	545	240	45	830	415	700	450	125	325	290	55	50	108	15	47	30	58	A-140
15		5.5	7.5		258			226.5					65	868		800	500	150								31	70	
		7.5	11		323		265	252			575	270	45	958	485	900	550	175	390	350	65	60	138	19		41	105	A-160
NHG-20		5.5	7.5	130	258	320	190	226.5	320	3	630	270	45	938	445	900	550	175	390	350	65	60	110	19	71	40	70	A-160
25		7.5	11		323		265	252					75	1028	485	1000	600	200								42	105	
		11	15		345			274						1072													130	
NHG-30		11	—	145	345	320	265	274	320	3	630	270	75	1087	485	1000	600	200	390	350	65	60	110	19	75	42	130	A-160
		15	—		351.5		290	294.5			660	300	90	1114	550				470	430			140			64	175	A-180

※電動機メーカー及び形番によりW.P.Y.K寸法及び質量が異なります。
Depend on motor manufacturer and model, measurement of W.P.Y. K and weight maybe changed.

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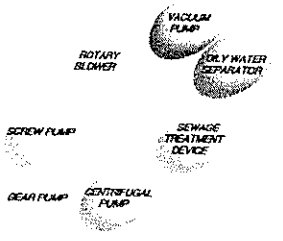

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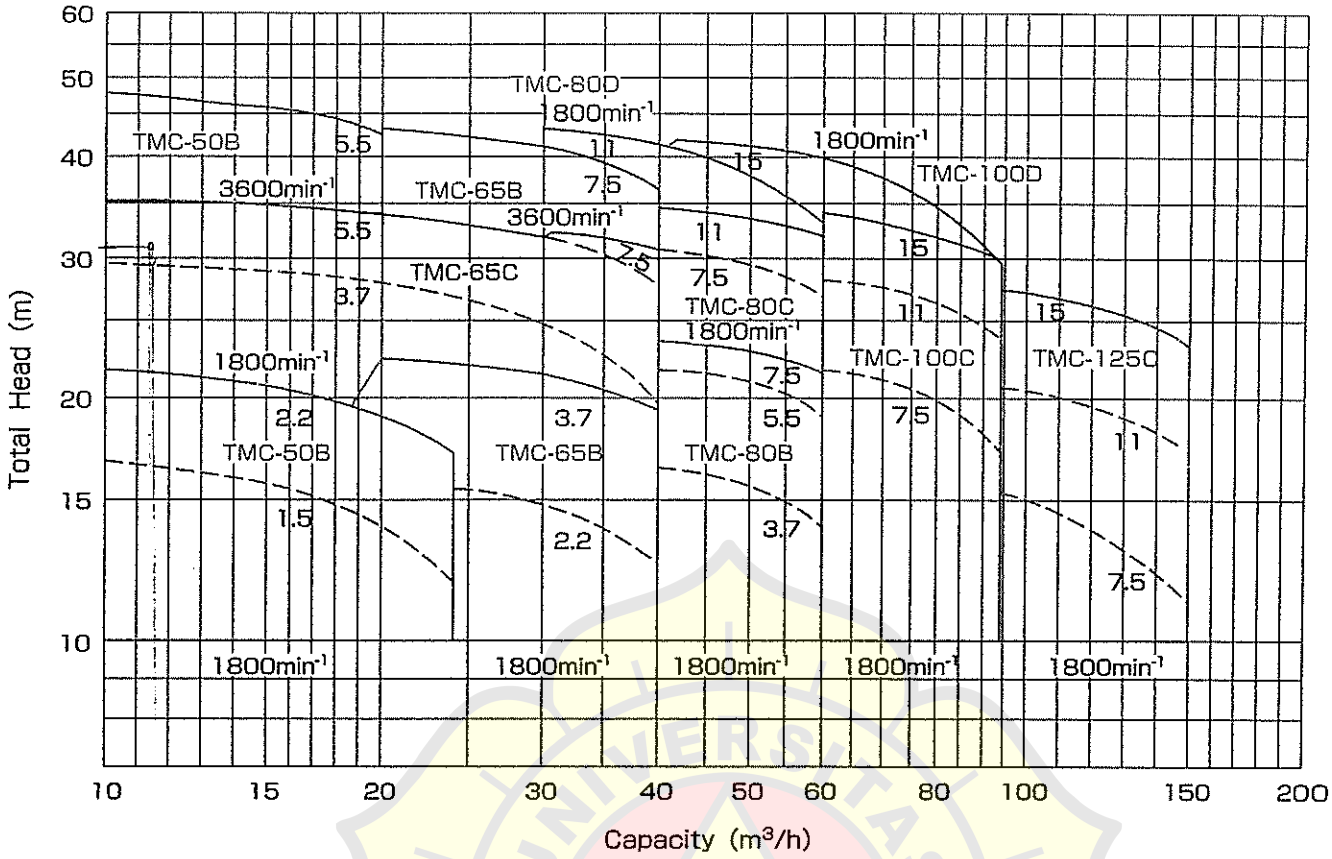
2009/01 MUTSUMI



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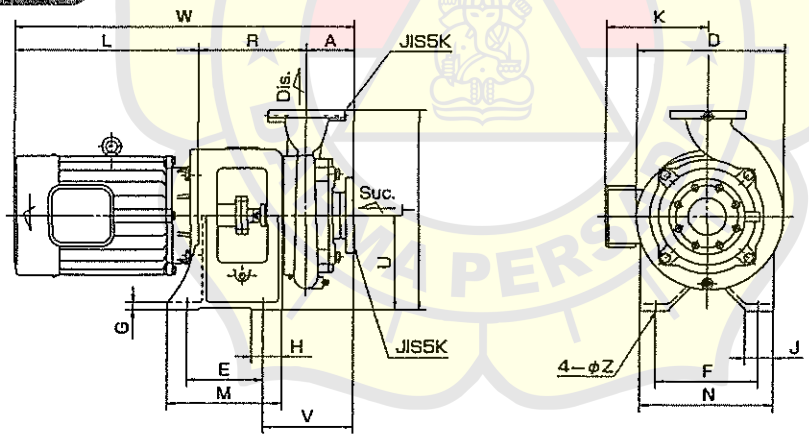
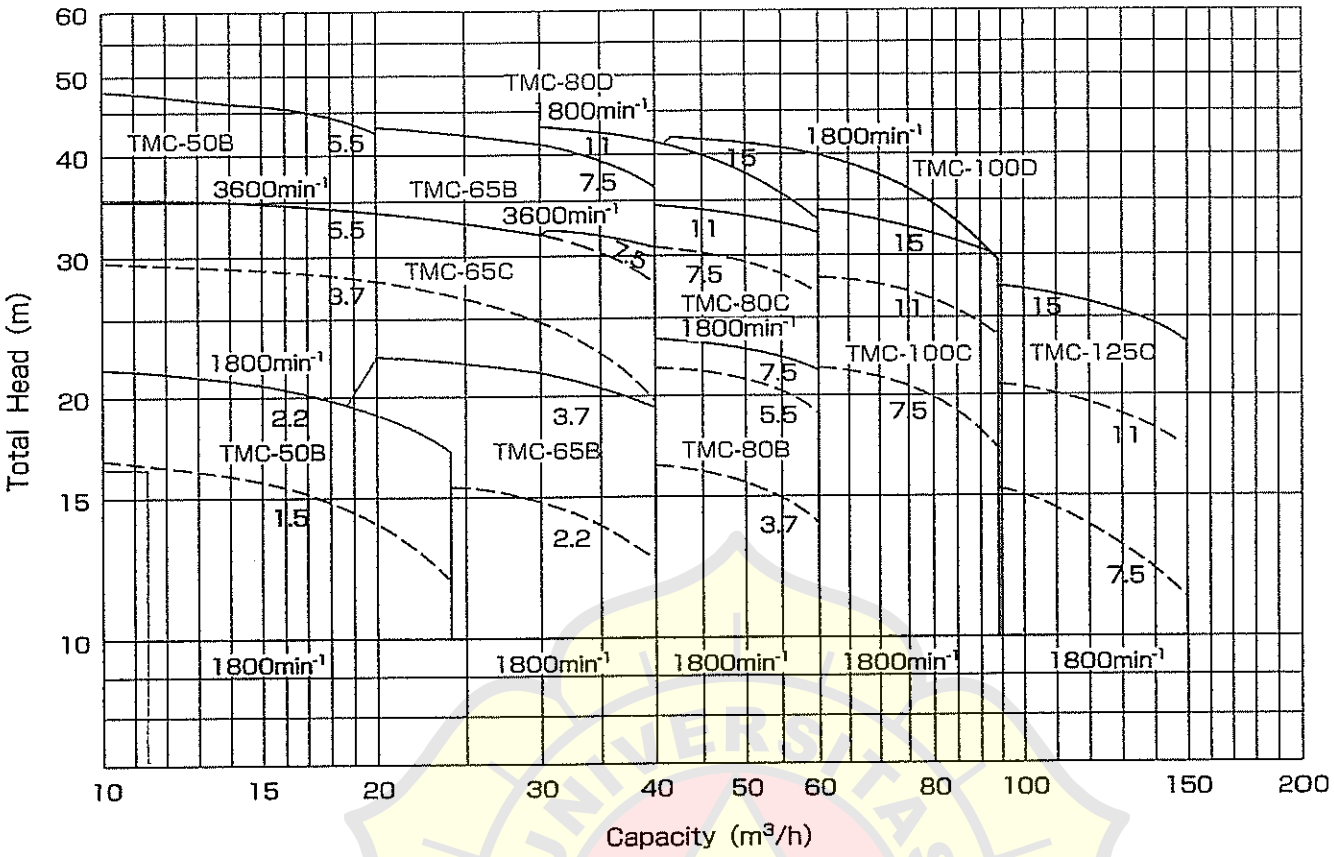


Model No.	Motor		Bore		Dimension (mm)																
	kW	min⁻¹	Suc.	Dis.	A	D	E	F	G	H	J	K	L	M	N	R	T	U	V	W	Z
TMC-50B	1.5	1800	50	50	100	265	150	220	15	80	65	195	300	250	280	215	370	190	205	615	15
	2.2						180		18			205	330	280		225				655	
	5.5	3600					200	270				265	400	300	330	245	390	210		745	
TMC-65B	2.2	1800	65	65	100	285	180	220	18	80	65	205	330	280	280	227	390	190	207	657	15
	3.7											215	355							682	
	7.5	3600					200	270				265	400	300	330	247	410	210		747	
TMC-65C	3.7	1800	65	65	100	335	180	220	18	80	65	215	355	280	280	227	415	190	207	682	15
	5.5						200	270				265	400	300	330	247	435	210		747	
	7.5																				
TMC-80B	3.7	1800	80	80	100	325	180	220	18	80	65	215	355	280	280	232	415	190	212	687	15
	5.5						200	270				265	400	300	330	252	435	210		752	
	7.5																				
TMC-80C	7.5	1800	80	80	100	365	200	270	18	80	75	265	400	300	350	252	500	250	212	752	19
	11								20			285	485			282				867	
TMC-80D	11	1800	80	80	125	405	200	270	20	80	75	285	485	300	350	290	530	250	245	900	19
TMC-100C	7.5	1800	100	100	125	385	200	270	18	80	75	265	400	300	350	253	530	250	238	778	19
	11								20			285	485			283				893	
	15												525							933	
TMC-100D	15	1800	100	100	125	405	200	270	20	80	75	285	525	300	350	290	565	250	245	940	19
TMC-125C	7.5	1800	125	125	140	420	200	270	18	80	75	265	400	300	350	265	530	250	265	805	19
	11								20			285	485			295				920	
	15												525							960	



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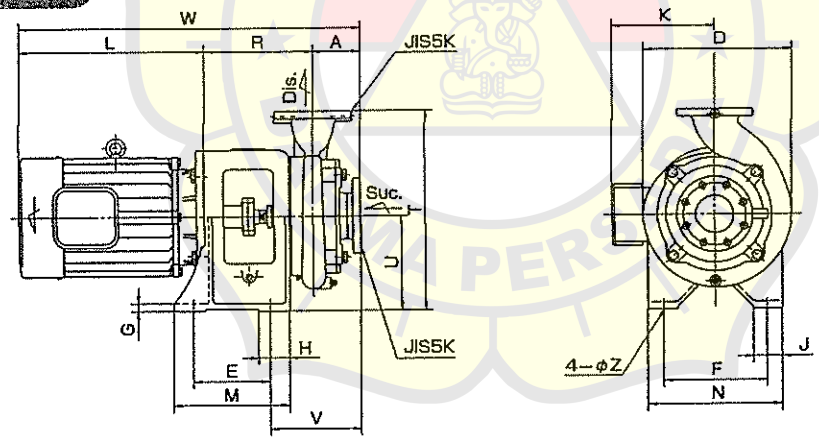

Model No.	Motor kW	Motor min⁻¹	Bore Suc.	Bore Dis.	Dimension (mm) A	D	E	F	G	H	J	K	L	M	N	R	T	U	V	W	Z
TMC-50B	1.5	1800	50	50	100	265	150	220	15	80	65	195	300	250	280	215	370	190	205	615	15
	2.2						180		18			205	330	280		225				655	
	5.5	3600					200	270				265	400	300	330	245	390	210		745	
TMC-65B	2.2	1800	65	65	100	285	180	220	18	80	65	205	330	280	280	227	390	190	207	657	15
	3.7											215	355							682	
	7.5	3600					200	270				265	400	300	330	247	410	210		747	
TMC-65C	3.7	1800	65	65	100	335	180	220	18	80	65	215	355	280	280	227	415	190	207	682	15
	5.5						200	270				265	400	300	330	247	435	210		747	
	7.5																				
TMC-80B	3.7	1800	80	80	100	325	180	220	18	80	65	215	355	280	280	232	415	190	212	687	15
	5.5						200	270				265	400	300	330	252	435	210		752	
	7.5																				
TMC-80C	7.5	1800	80	80	100	365	200	270	18	80	75	265	400	300	350	252	500	250	212	752	19
	11								20			285	485			282				867	
TMC-80D	11	1800	80	80	125	405	200	270	20	80	75	285	485	300	350	290	530	250	245	900	19
TMC-100C	7.5	1800	100	100	125	385	200	270	18	80	75	265	400	300	350	253	530	250	238	778	19
	11								20			285	485			283				893	
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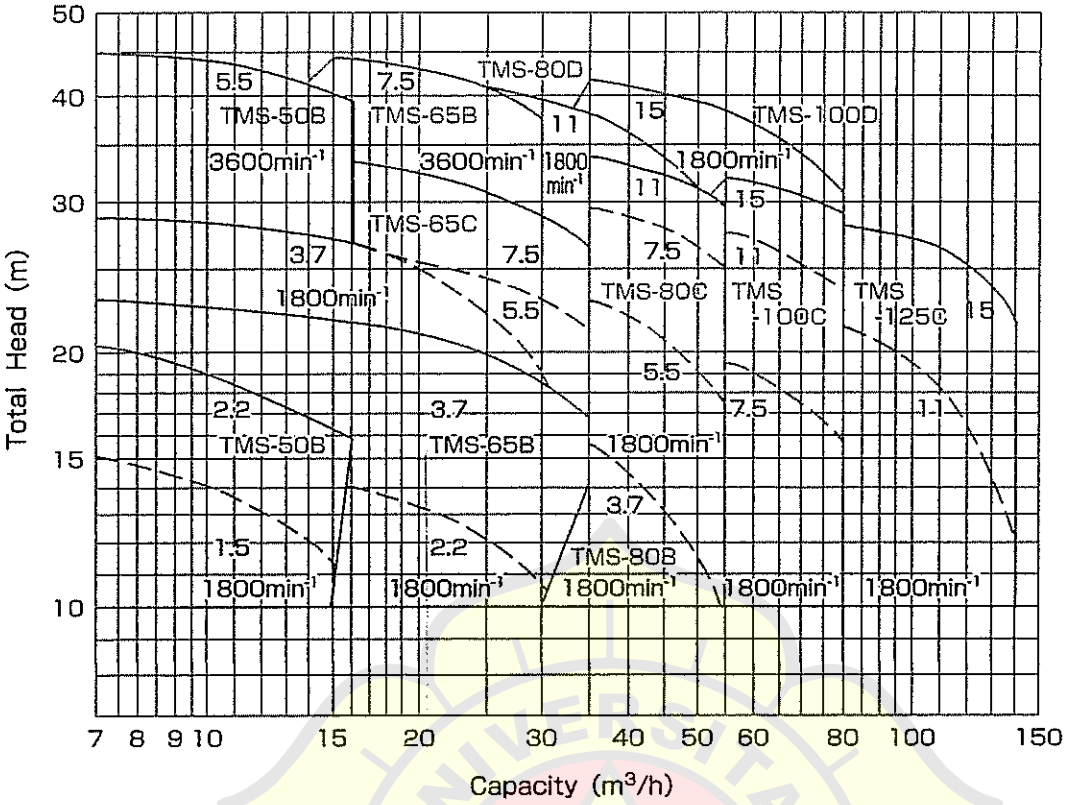
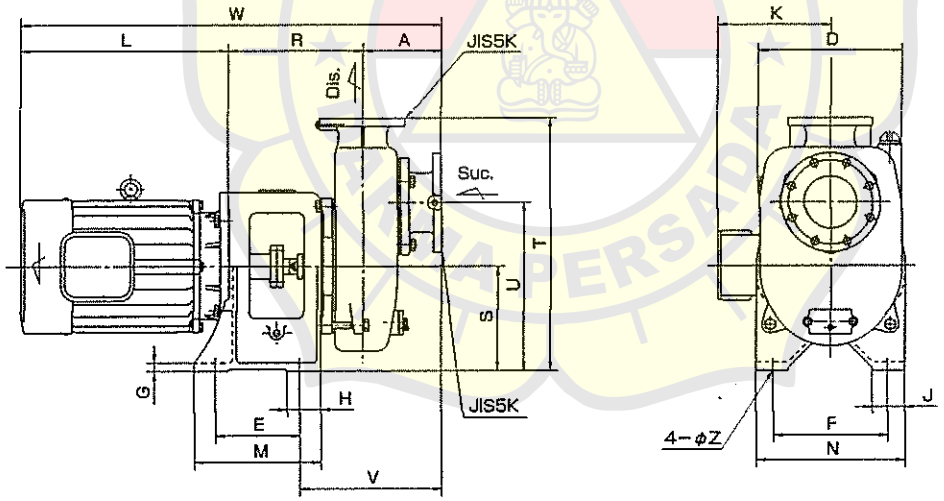
TMC-100D	15	1800	100	100	125	405	200	270	20	80	75	285	525	300	350	290	565	250	245	940	19
TMC-125C	7.5	1800	125	125	140	420	200	270	18	80	75	265	400	300	350	265	530	250	265	805	19
	11								20			285	485			295				920	
	15												525							960	



Dimension



Model No.	Motor kW	Motor min⁻¹	Bore Suc.	Bore Dis.	A	D	E	F	G	H	J	K	L	M	N	R	S	T	U	V	W	Z
TMS-50B	1.5	1800	50	50	150	270	150	220	15	80	65	195	300	250	280	240	190	455	315	280	690	15
	2.2						180		18			205	330	280		250					730	
	5.5	3600					200	270				265	400	300	330	270	210	475	335		820	
TMS-65B	2.2	1800	65	65	150	275	180	220	18	80	65	205	330	280	280	260	190	455	315	290	740	15
	3.7											215	355								765	
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TMS-65C	3.7	1800	65	65	150	325	180	220	18	80	65	215	355	280	280	260	190	480	330	290	765	15
	5.5						200	270				265	400	300	330	280	210	500	350		830	
	7.5																					
TMS-80B	3.7	1800	80	80	165	305	180	220	18	80	65	215	355	280	280	270	190	480	315	315	790	15
TMS-80C	5.5	1800	80	80	165	340	200	270	18	80	75	265	400	300	350	290	250	600	400	315	855	19
	7.5																					
	11								20			285	485			320					970	
TMS-80D	11	1800	80	80	165	480	200	270	20	80	75	285	485	300	350	335	250	625	425	330	985	19
TMS-100C	7.5	1800	100	100	185	340	200	270	18	80	75	265	400	300	350	290	250	600	400	335	875	19
	11								20			285	485			320					990	
	15												525								1030	
TMS-100D	15	1800	100	100	165	480	200	270	20	80	75	285	525	300	350	335	250	625	425	330	1025	19
TMS-125C	11	1800	125	125	210	365	200	270	20	80	75	285	485	300	350	335	250	625	425	375	1030	19
	15												525								1070	

1. Bilge lines

1.1 Layout of bilge lines

1.1.1 Bilge lines and bilge suction are to be so arranged that the bilges can be completely pumped even under disadvantageous trim conditions.

1.1.2 Bilge suction are normally to be located on both sides of the ship. For compartments located fore and aft in the ship, one bilge suction may be considered sufficient provided that it is capable of completely draining the relevant compartment.

1.1.3 Spaces located forward of the collision bulkhead and aft of the stern tube bulkhead and not connected to the general bilge system are to be drained by other suitable means of adequate capacity.

1.1.4 The required pipe thicknesses of bilge lines are to be in accordance with Table 11.4.

1.2 Pipes laid through tanks

1.2.1 Bilge pipes may not be led through tanks for lubricating oil, thermal oil, drinking water or feedwater.

1.2.2 Where bilge pipes are led through fuel tanks located above the double bottom and terminate in spaces which are not accessible during the voyage, an additional non-return valve is to be fitted in the bilge pipe where the pipe from the suction enters the fuel tank.

1.3 Bilge suction and strums

1.3.1 Bilge suction are to be so arranged as not to impede the cleaning of bilges and bilge wells. They are to be fitted with easily detachable, corrosion resistant strums.

1.3.2 Emergency bilge suction are to be arranged in such a manner that they are accessible, with free flow and at a suitable distance from the tank top or the ship's bottom.

1.3.3 For the size and design of bilge wells see Rules for Hull Construction, Volume II, Section 8. B.6.2.

1.4 Bilge valves

1.4.1 Valves in connecting pipes between the bilge and the seawater and ballast water system, as well as between the bilge connections of different compartments, are to be so arranged that even in the event of faulty operation or intermediate positions of the valves, penetration of seawater through the bilge system will be safely prevented.

1.4.2 Bilge discharge pipes are to be fitted with shut off valves at the ship's side.

1.4.3 Bilge valves are to be arranged so as to be always accessible irrespective of the ballast and loading condition of the ship.

1.5 Reverse-flow protection

1.5.1 A screw-down non-return valve is recognized as reverse-flow protection.

1.5.2 A combination of a non-return valve without shut off mechanism and a shut off valve may be recognized as equivalent with the Society's approval.

1.6 Pipe layout

1.6.1 To prevent the penetration of ballast and seawater into the ship through the bilge system, two means of reverse-flow protection are to be fitted in the bilge connections, one of which is to be a screwdown non-return valve.

One of such means of protection is to be fitted in each suction line.

1.6.2 For bilge connections outside machinery spaces, a combination of a non-return valve without shut off and a remote-controlled shut off valve may be recognized as equivalent.

1.6.3 The direct bilge suction and the emergency injection need only have one means of reverse-flow protection as specified in 1.5.1.

1.6.4 Where a direct seawater connection is arranged for attached bilge pumps to protect them against running dry, the bilge suction are also to be fitted with two reserve flow protecting devices.

1.6.5 The discharge lines of oily water separators are to be fitted with a reserve flow protecting valve at the ship's side.

2. Calculation of pipe diameters

2.1 The calculated values according to formulae (4) to (6) are to be rounded up to the next higher nominal diameter.

2.2 Dry cargo and passenger ships

a) main bilge pipes

$$d_H = 1{,}68 \cdot \sqrt{(B + H) \cdot L} + 25 \quad [mm] \qquad (4)$$

b) branch bilge pipes

$$d_z = 2{,}15 \cdot \sqrt{(B + H) \cdot l} + 25 \quad [mm] \qquad (5)$$

where

d_H [mm] calculated inside diameter of main bilge pipe

d_z [mm] calculated inside diameter of branch bilge pipe

L [m] length of ship between perpendiculars

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b) branch bilge pipes

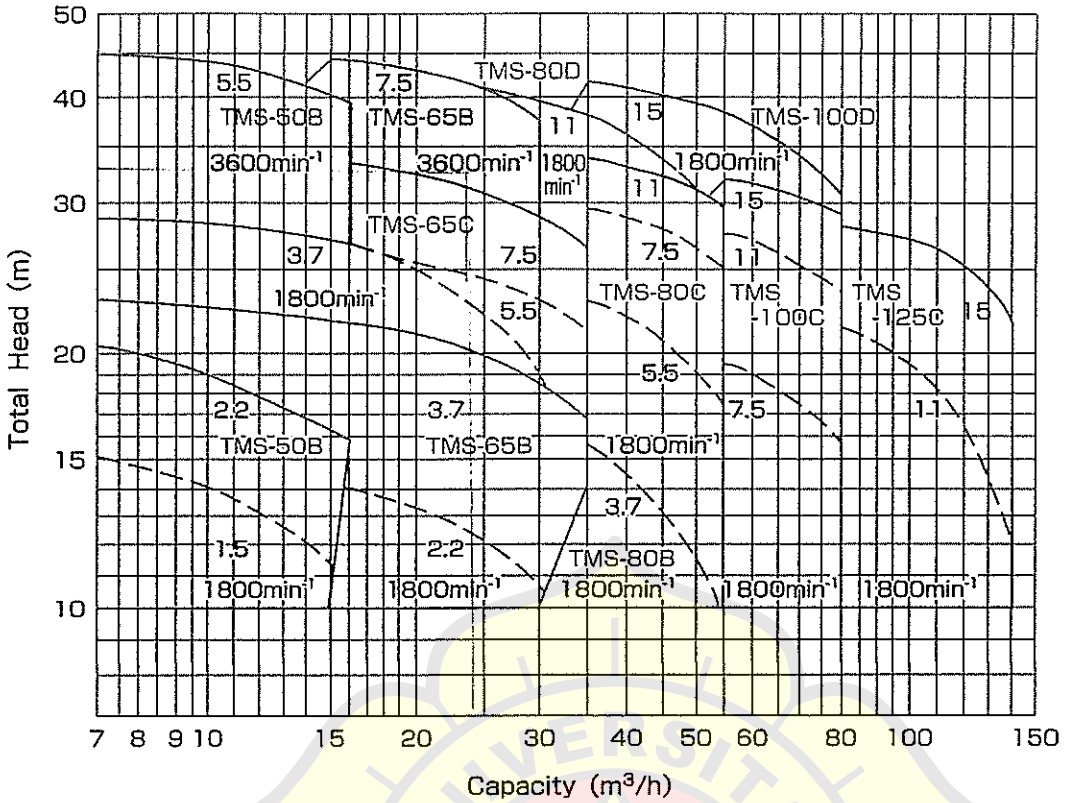
$$d_z = 2{,}15 \cdot \sqrt{(B + H) \cdot l} + 25 \quad [mm] \quad (5)$$

where

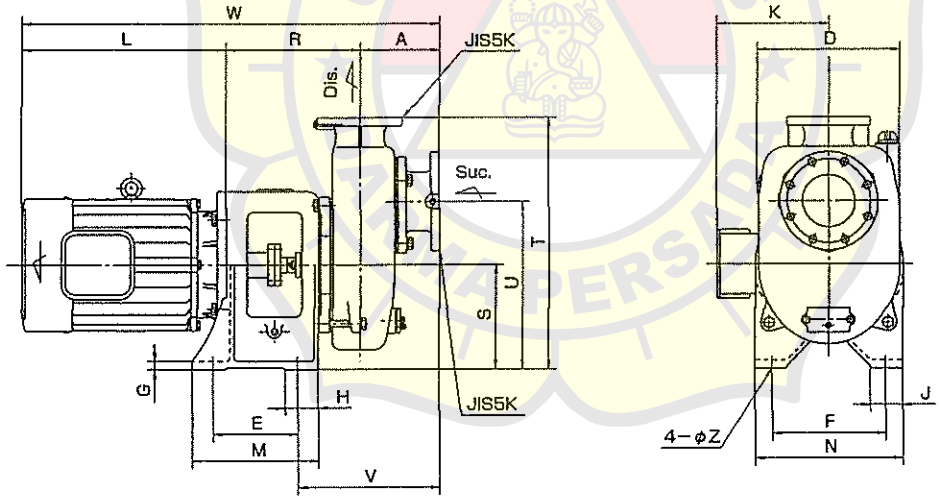
d_H [mm] calculated inside diameter of main bilge pipe

d_z [mm] calculated inside diameter of branch bilge pipe

L [m] length of ship between perpendiculars



Dimension



Model No.	Motor kW	Motor min⁻¹	Bore Suc.	Bore Dis.	Dimension (mm) A	D	E	F	G	H	J	K	L	M	N	R	S	T	U	V	W	Z
TMS-50B	1.5	1800	50	50	150	270	150	220	15	80	65	195	300	250	280	240	190	455	315	280	690	15
	2.2						180		18			205	330	280		250					730	
	5.5	3600					200	270				265	400	300	330	270	210	475	335		820	
TMS-65B	2.2	1800	65	65	150	275	180	220	18	80	65	205	330	280	280	260	190	455	315	290	740	15
	3.7											215	355								765	
	7.5	3600					200	270				265	400	300	330	280	210	475	335		830	
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	5.5						200	270				265	400	300	330	280	210	500	350		830	
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	7.5																					
	11								20			285	485			320					970	
TMS-80D	11	1800	80	80	165	480	200	270	20	80	75	285	485	300	350	335	250	625	425	330	985	19
TMS-100C	7.5	1800	100	100	185	340	200	270	18	80	75	265	400	300	350	290	250	600	400	335	875	19
	11								20			285	485			320					990	
	15												525								1030	
TMS-100D	15	1800	100	100	165	480	200	270	20	80	75	285	525	300	350	335	250	625	425	330	1025	19
TMS-125C	11	1800	125	125	210	365	200	270	20	80	75	285	485	300	350	335	250	625	425	375	1030	19
	15												525								1070	

[illegible] one of the fire pumps.

1.3.10 For emergency fire pumps, see 1.4.

1.3.11 Ballast, bilge and other pumps provided for pumping seawater and having a sufficient capacity may be used as fire pumps provided that at least one pump is immediately available for fire fighting purposes.

1.3.12 Centrifugal pumps are to be connected to the fire mains by means of screw-down non-return valves or a combination of a shut-off and a non-return device.

1.3.13 On passenger ships of ≥ 1000 GRT, the water fire extinguishing equipment in interior locations is to be installed in such a way that at least one jet of water with the prescribed nozzle discharge pressure is immediately available. The uninterrupted supply of water is to be ensured by the automatic starting of one of the specified fire pumps.

1.3.14 On ships with the Class Notation "OT", at least one fire pump is to be provided with remote starting arrangements from the bridge and from the central fire control station, if there is

The associated shut-off valves from the sea water inlet to the fire main must be capable of being controlled from the above named positions. Alternatively locally-operated valves may be used; these are to be permanently kept open and provided [illegible] appropriate sign, e.g.:

"Valve always to be kept open !"

1.4 Emergency fire pumps

1.4.1 On ships of ≥ 2000 GRT, the emergency fire pumps must be capable of delivering at least 40 % of the total capacity specified for the main fire pumps. On ships of < 2000 GRT, the capacity of the pumps shall not be less than 25 m^3/h. Only self-priming pumps may be installed.

1.4.2 The emergency fire pump must be capable of supplying water to all parts of the ship from two hydrants simultaneously at the pressure stated in Table 12.3; see also 2.2.1.

1.4.3 All the power and water supply equipment required for the operation of the emergency fire pump must be independent of the space where the main fire pumps are installed.

1.4.4 The supply of fuel intended for the operation of the emergency fire pump must be sufficient for at least 18 h at nominal load.

The fuel tank intended for the emergency fire pump power supply must contain sufficient fuel to ensure the operation of the pump for at least the first 6 h without refilling. This period may be reduced to 3 h for cargo ships off less than 5000 GRT.

Table 12.2 Number and minimum capacity of fire pumps

Passenger ships				Cargo ships	
≥ 4000 GRT		< 4000 GRT [1]		≥ 500 GRT	< 500 GRT
Number of power-driven fire pumps					
3		2		2	1
Min Q (m^3/h) of one fire pump [2]					
[3] $5,1 \cdot 10^{-3} \cdot d^2_H$	$3,8 \cdot 10^{-3} \cdot d^2_H$	[3] $7,65 \cdot 10^{-3} \cdot d^2_H$	$5,75 \cdot 10^{-3} \cdot d^2_H$	$3,8 \cdot 10^{-3} \cdot d^2_H$	

[1]) On passenger ships of less than 250 GRT one fire pump is sufficient

[2]) d_H (mm) = theoritical diameter of the bilge main (see Section 11,N. formula 4.)

[3]) Applicable to passenger ships with a criterion numeral of 30 or over in accordance with SOLAS 1974 (including amendments as per A.1.1) Chapter II-1, Part B, Regulation 6.

equipment in accordance with Table 12.1. The design of this equipment is described in the following paragraphs.

Cargo spaces for the carriage of dangerous goods are also required to comply with Part Q.

Unless otherwise specified, this equipment is normally to be sited outside the spaces and areas to be protected and, in the event of a fire, must be capable of being actuated from points which are always accessible.

1.3 Approval of fire extinguishing appliances and equipment

Fire fighting appliances such as hoses, nozzles, fire extinguishers, fireman's outfits and fire extinguishing media must be approved for use aboard seagoing ships by the competent national authorities.

1.4 Protection of the cargo area of tankers

1.4.1 The cargo area and the cargo pump rooms of tankers are to be equipped with a fixed fire extinguishing system in accordance with Table 12.1

1.4.2 Tankers equipped with crude oil washing and tankers of 20000 dwt and above carrying flammable liquids with a flash point of 60° C, or less are to be additionally equipped with a fixed inert gas system (see Section 15.D).

1.5 Open top container cargo spaces

Fire extinguishing arrangements for open top container cargo spaces have to be agreed upon with BKI[1]).

E. General Water Fire Extinguishing Equipment

1. Fire pumps

1.1 Number of pumps

1.1.1 Passenger ships of 4000 GRT and over are to be equipped with at least three, passenger ships of 250 to 4000 GRT with at least two, and passenger ships of less than 250 GRT with at least one fire pump.

In passenger ships of 1000 GRT and over, fire pumps, their sea connections and power sources are to be distributed throughout the ship in such a way that an outbreak of fire in one compartment cannot put them out of action simultaneously. Where, on passenger ships of less than 1000 GRT, the main fire pumps are located in one compartment, an additional emergency fire pump is to be provided outside this compartment.

1.2 Minimum capacity and pressure head

1.2.1 The minimum capacity and the number of fire pumps shall be as specified in Table 12.2.

1.2.2 Where fire pumps with different capacities are installed, no pump shall supply less than 80 % of the total required capacity divided by the specified number of fire pumps.

1.2.3 Each fire pump must be capable of supplying sufficient water for at least two of the nozzles used on board the ship.

On ships for the carriage of dangerous goods the requirements of Part Q. shall also be complied

The capacity of a fire pump must not be less than 25 m^3/h

On cargo ships of less than 100 GRT the fire pump must be capable of supplying water for at least one effective jet of water via a 9 mm nozzle.

1.2.4 The total required capacity of the fire pumps – excluding emergency fire pumps – need not exceed 180 m^3/h on cargo ships.

1.2.5 For emergency fire pumps, see 1.4.

1.2.6 The pressure head of every fire pump must be so chosen that the requirement of 2.3.4 in this Section is met. On cargo ships and passenger ships of less than 1000 GRT, instead of the pressure given in Table 12.3 every nozzle must under the conditions of 2.3.4 be capable of delivering a water jet of at least 12 m length horizontally.

1.3 Drive and arrangement of pumps

1.3.1 Each fire pump must have a power source independent of the ship's propulsion machinery.

1.3.2 Cargo ships of 500 GRT and over are to be equipped with at least two, and cargo ships of less than 500 GRT with at least one fire pump

1.3.3 On cargo ships of 500 GRT and over a fixed emergency fire pump is to be provided if an outbreak of fire in one compartment can put all the fire pumps out of action.

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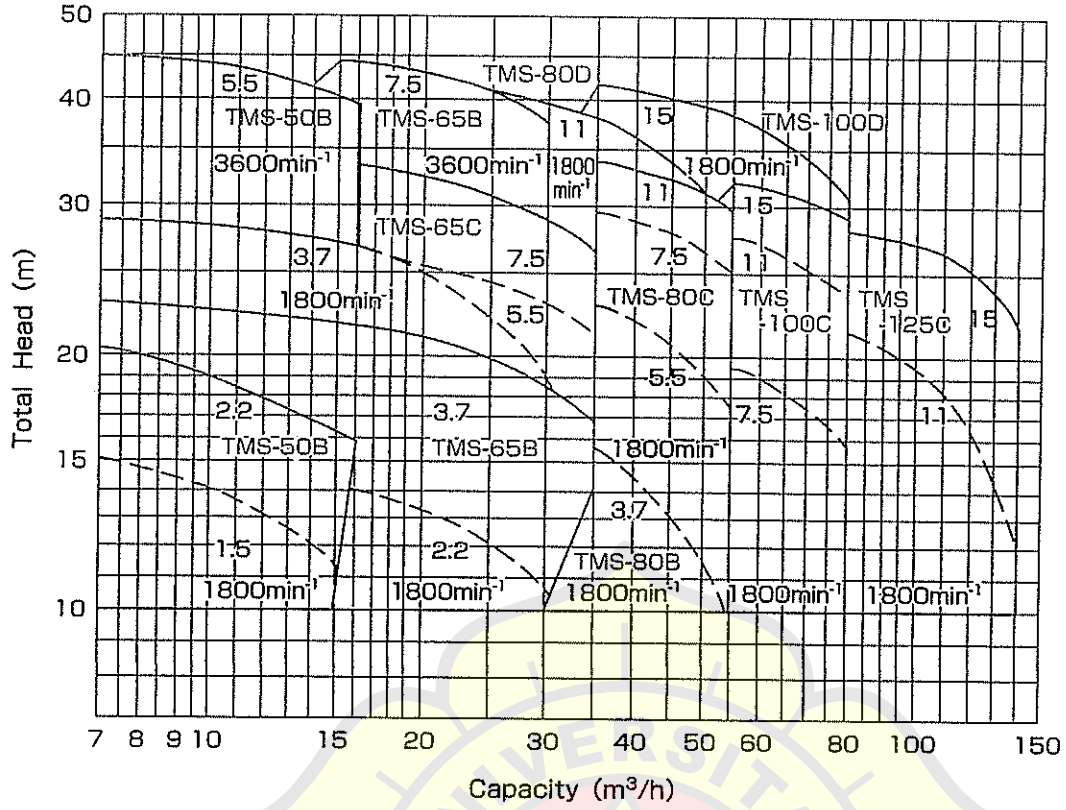
1) See IMO-MSC/Circ. 608/Rev.1 "Interim Guidelines for Open Top Containerships"



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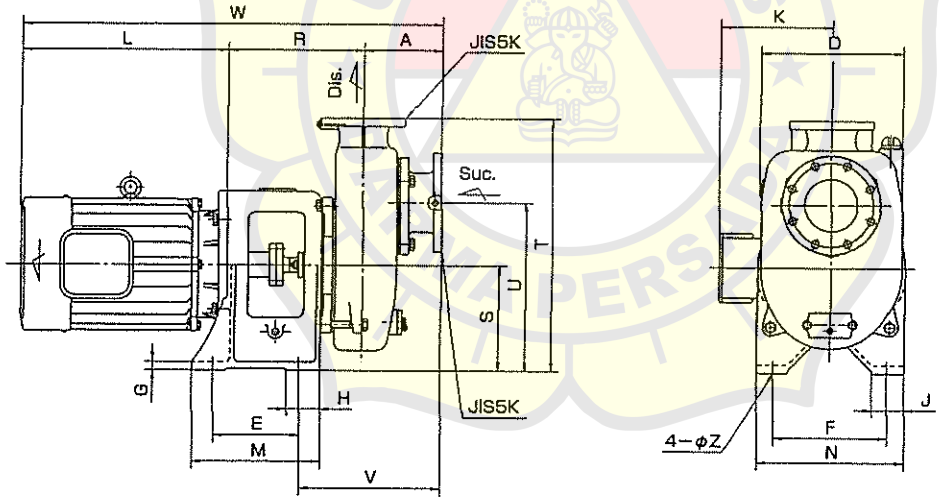
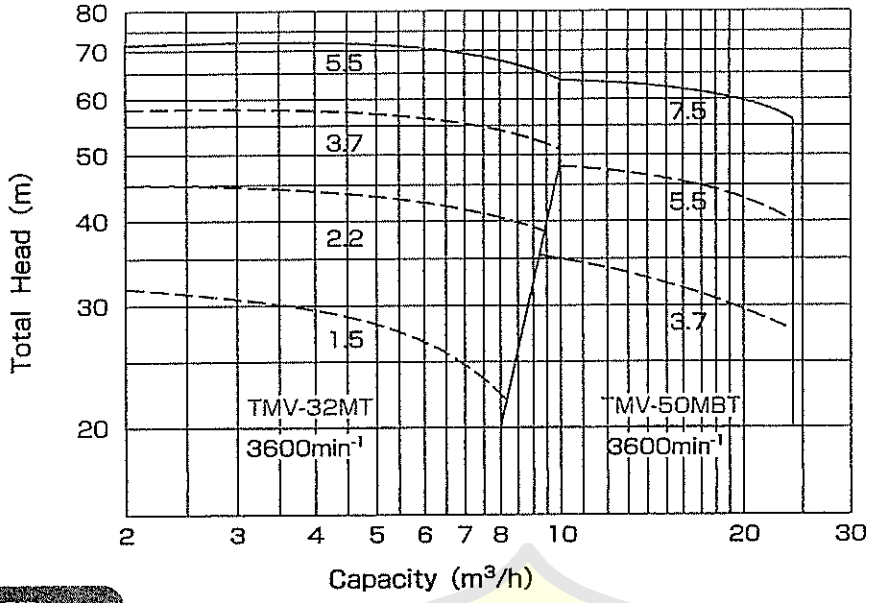
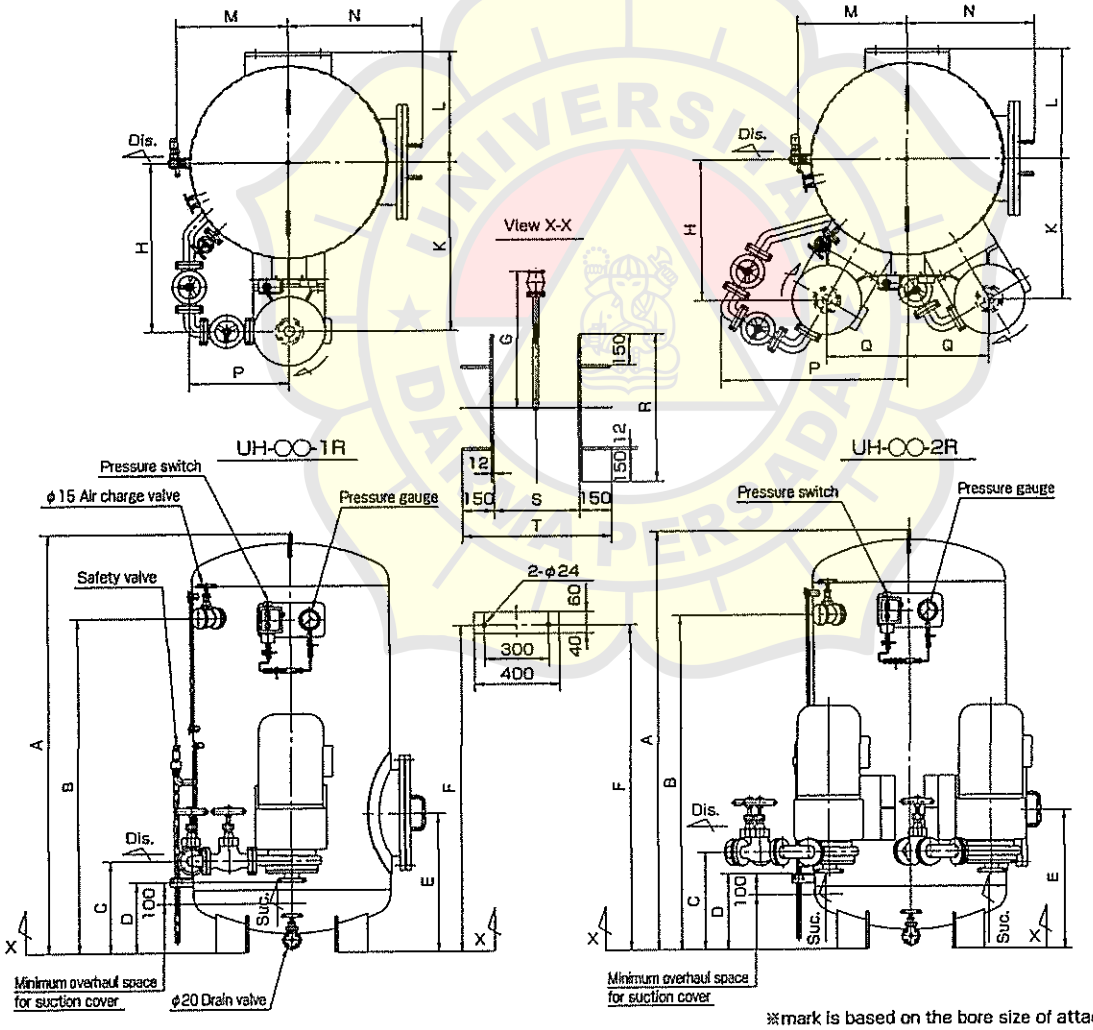


Model No.	Motor		Bore		Dimension (mm)																		
	kW	min⁻¹	Suc.	Dis.	A	D	E	F	G	H	J	K	L	M	N	R	S	T	U	V	W	Z
TMS-50B	1.5	1800	50	50	150	270	150	220	15	80	65	195	300	250	280	240	190	455	315	280	690	15
	2.2						180		18			205	330	280		250					730	
	5.5	3600					200	270				265	400	300	330	270	210	475	335		820	
TMS-65B	2.2	1800	65	65	150	275	180	220	18	80	65	205	330	280	280	260	190	455	315	290	740	15
	3.7											215	355								765	
	7.5	3600					200	270				265	400	300	330	280	210	475	335		830	
TMS-65C	3.7	1800	65	65	150	325	180	220	18	80	65	215	355	280	280	260	190	480	330	290	765	15
	5.5						200	270				265	400	300	330	280	210	500	350		830	
	7.5																					
TMS-80B	3.7	1800	80	80	165	305	180	220	18	80	65	215	355	280	280	270	190	480	315	315	790	15
TMS-80C	5.5	1800	80	80	165	340	200	270	18	80	75	265	400	300	350	290	250	600	400	315	855	19
	7.5																					
	11								20			285	485			320					970	
TMS-80D	11	1800	80	80	165	480	200	270	20	80	75	285	485	300	350	335	250	625	425	330	985	19
TMS-100C	7.5	1800	100	100	195	340	200	270	18	80	75	265	400	300	350	290	250	600	400	335	875	19
	11								20			285	485			320					990	
	15												525								1030	
TMS-100D	15	1800	100	100	165	480	200	270	20	80	75	285	525	300	350	335	250	625	425	330	1025	19
TMS-125C	11	1800	125	125	210	365	200	270	20	80	75	285	485	300	350	335	250	625	425	375	1030	19
	15												525								1070	

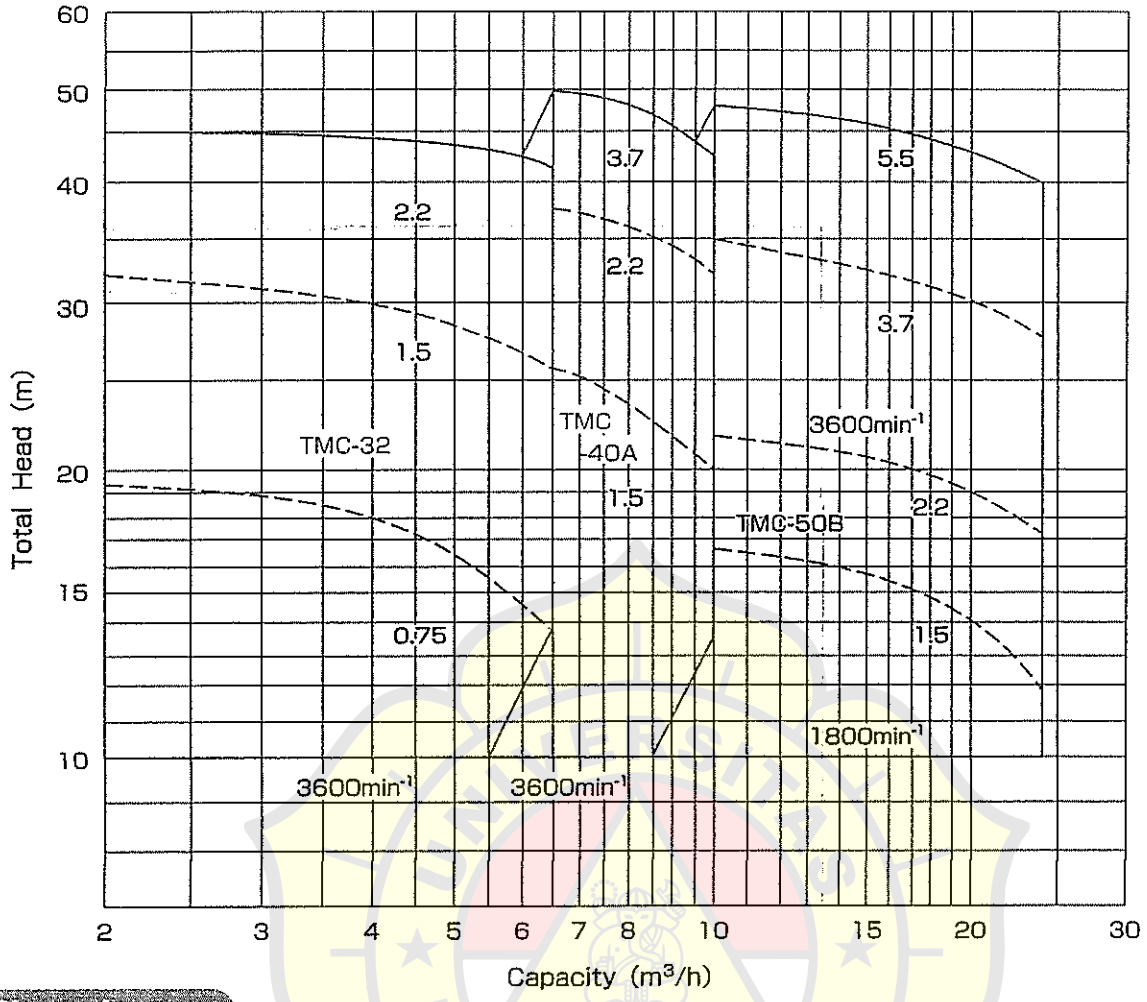


Dimension



※mark is based on the bore size of attached pump.

Model No.	Bore		Tank Volume (L)	Dimension (mm)																
	Suc.	Dis.		A	B	C	D	E	F	G	H	K	L	M	N	P	Q	R	S	T
UH-0.5-1R	※	50	500	1198	805	450	350	600	795	625	680	680	495	520	595	260	–	700	400	700
UH-0.5-2R	※	50	500	1198	880	450	350	600	795	625	589	589	495	520	595	560	340	700	400	700
UH-1.0-1R	※	50	1000	1967	1570	450	350	650	1620	650	720	720	520	520	620	240	–	700	400	700
UH-1.0-2R	※	50	1000	1967	1570	450	350	650	1620	650	624	624	520	520	620	580	360	700	400	700
UH-1.5-1R	※	50	1500	1956	1530	450	350	700	1520	750	820	820	620	650	715	240	–	800	500	800
UH-1.5-2R	※	50	1500	1956	1530	450	350	700	1520	750	710	710	620	650	715	630	410	800	500	800
UH-2.0-1R	※	50	2000	2170	1700	450	350	750	1690	800	960	960	670	700	785	280	–	900	600	900
UH-2.0-2R	※	50	2000	2170	1700	450	350	750	1690	800	830	830	670	700	785	734	480	900	600	900



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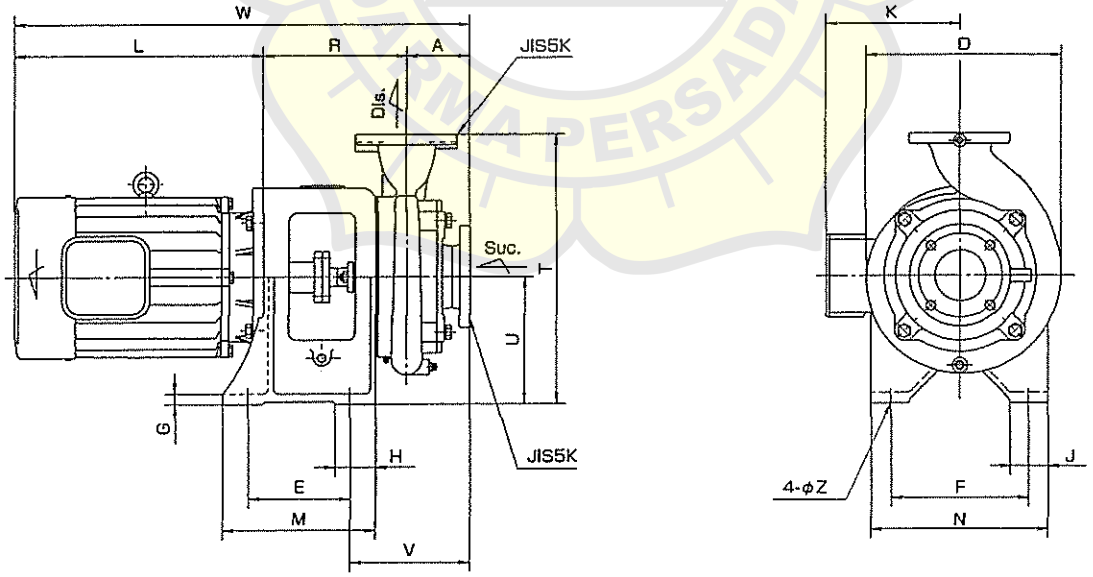
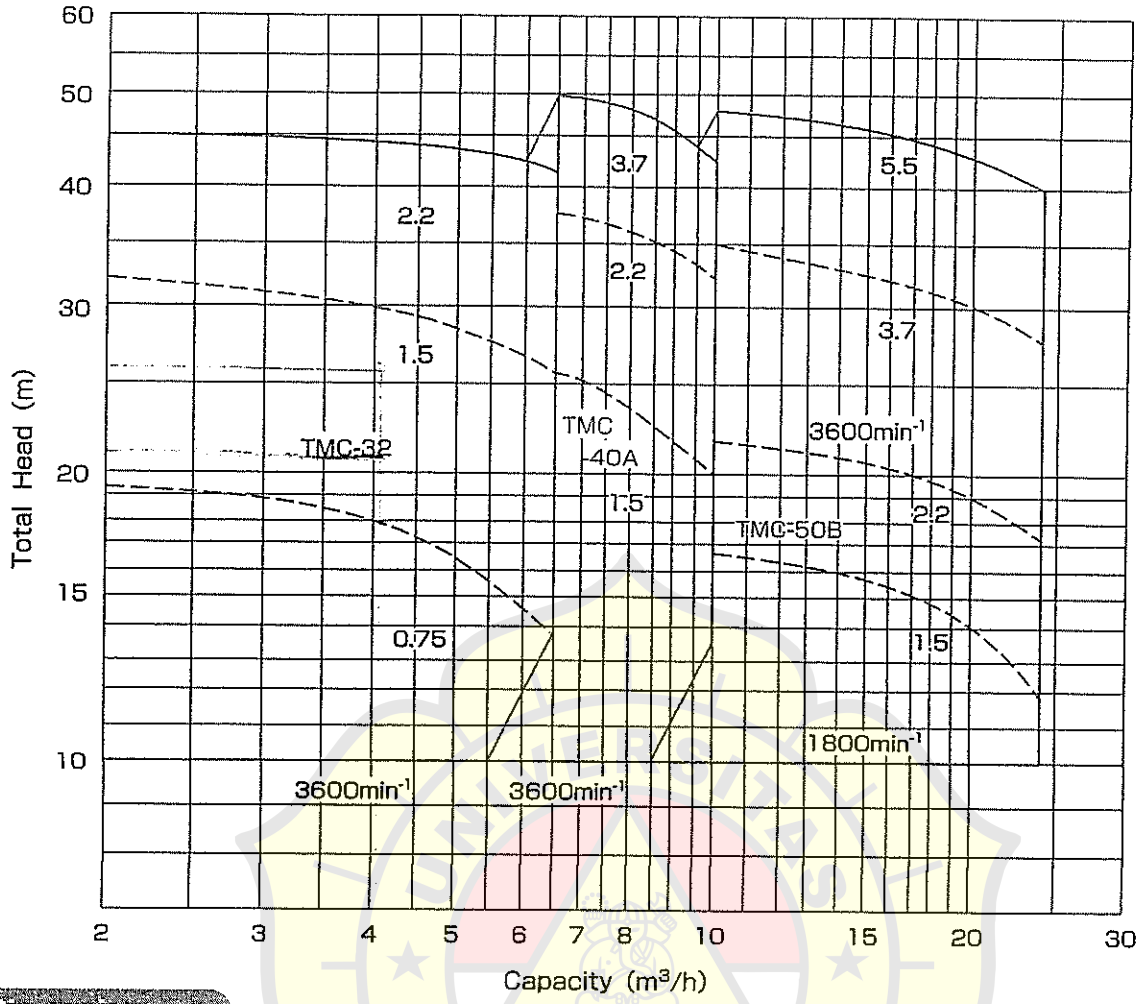


Model No.	Motor		Bore		Dimension (mm)																
	kW	min⁻¹	Suc.	Dis.	A	D	E	F	G	H	J	K	L	M	N	R	T	U	V	W	Z
TMC-32	0.75	3600	32	32	82	270	120	160	15	50	65	173	260	180	220	160	280	140	156	502	12
	1.5						140	190				188	302	200	250	170	300	160		554	
	2.2																				
TMC-40A	1.5	3600	40	40	80	205	140	190	15	50	65	188	302	200	250	175	320	160	160	557	12
	2.2											212	368			185				633	
	3.7																				
TMC-50B	1.5	1800	50	50	100	265	150	220	15	80	65	188	302	250	280	215	370	190	205	627	15
	2.2						180		18			197	328	280		225				653	
	3.7	3600										212	368							693	
	5.5						200	270				245	375	300	330	245	390	210		720	



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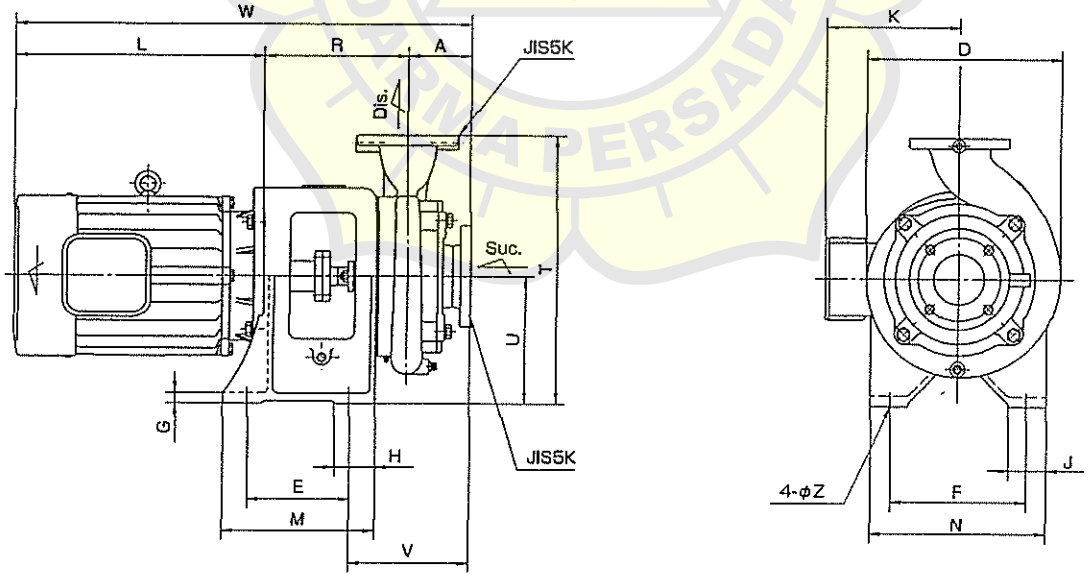
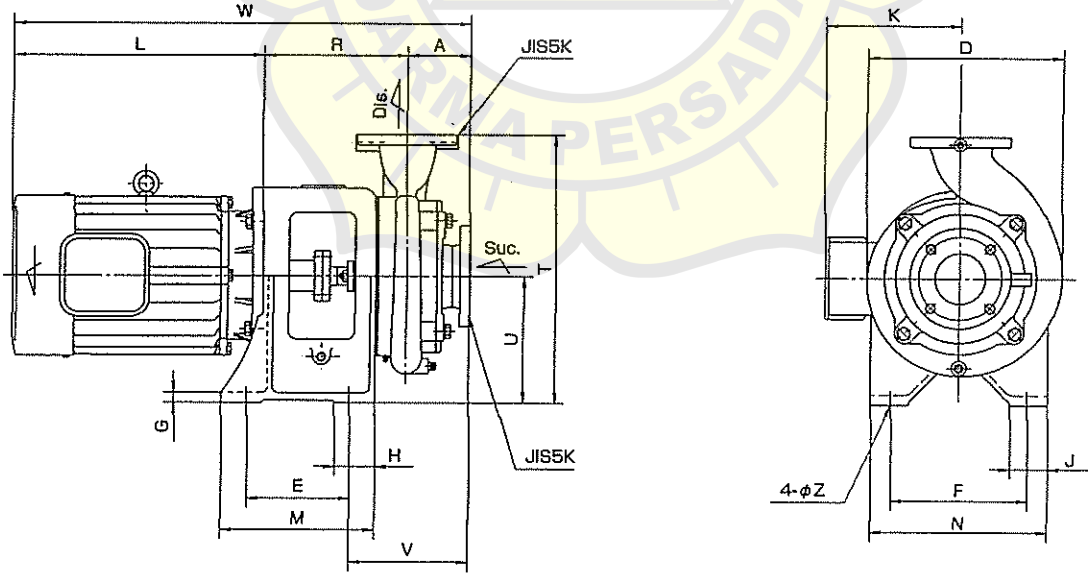


Model No.	Motor kW	Motor min⁻¹	Bore Suc.	Bore Dis.	A	D	E	F	G	H	J	K	L	M	N	R	T	U	V	W	Z
TMC-32	0.75	3600	32	32	82	270	120	160	15	50	65	173	260	180	220	160	280	140	156	502	12
	1.5						140	190				188	302	200	250	170	300	160		554	
	2.2																				
TMC-40A	1.5	3600	40	40	80	205	140	190	15	50	65	188	302	200	250	175	320	160	160	557	12
	2.2																				
	3.7											212	368			185				633	
TMC-50B	1.5	1800	50	50	100	265	150	220	15	80	65	188	302	250	280	215	370	190	205	627	15
	2.2						180		18			197	328	280		225				653	
	3.7	3600										212	368							693	
	5.5						200	270				245	375	300	330	245	390	210		720	

Dimension



Model No.	Motor kW	Motor min⁻¹	Bore Suc.	Bore Dis.	Dimension (mm) A	D	E	F	G	H	J	K	L	M	N	R	T	U	V	W	Z
TMC-32	0.75	3600	32	32	82	270	120	160	15	50	65	173	260	180	220	160	280	140	156	502	12
	1.5						140	190				188	302	200	250	170	300	160		554	
	(2.2)																				
TMC-40A	1.5	3600	40	40	80	205	140	190	15	50	65	188	302	200	250	175	320	160	160	557	12
	2.2																				
	3.7											212	368			185				633	
TMC-50B	1.5	1800	50	50	100	265	150	220	15	80	65	188	302	250	280	215	370	190	205	627	15
	2.2						180		18			197	328	280		225				653	
	3.7	3600										212	368							693	
	5.5						200	270				245	375	300	330	245	390	210		720	

LAMPIRAN BAB VI

Section 14

Rudder and Manoeuvring Arrangement

A. General

1. Manoeuvring arrangement

1.1 Each ship is to be provided with a manoeuvring arrangement which will guarantee sufficient manoeuvring capability.

1.2 The manoeuvring arrangement includes all parts from the rudder and steering gear to the steering position necessary for steering the ship.

1.3 Rudder stock, rudder coupling, rudder bearings and the rudder body are dealt with in this Section. The steering gear is to comply with Rules for Machinery Installations, Volume III, Section 14.

1.4 The steering gear compartment shall be readily accessible and, as far as practicable, separated from the machinery space. (See also Chapter II-I, Reg. 29.13 of **SOLAS 74**.)

Note

Concerning the use of non-magnetic material in the wheel house in way of a magnetic compass, the requirements of the National Administration concerned are to be observed.

1.5 For ice-strengthening see Section 15.

2. Structural details

2.1 Effective means are to be provided for sup porting the weight of the rudder body without excessive bearing pressure, e.g. by a rudder carrier attached to the upper part of the rudder stock. The hull structure in way of the rudder carrier is to be suitably strengthened.

2.2 Suitable arrangements are to be provided to prevent the rudder from lifting.

2.3 The rudder stock is to be carried through the hull either enclosed in a watertight trunk, or glands are to be fitted above the deepest load waterline, to prevent water from entering the steering gear compartment and the lubricant from being washed away from the rudder carrier. If the top of the rudder trunk is below the deepest waterline two separate stuffing boxes are to be provided.

Note

The following measures are recommended for preventive measures to avoid or minimize rudder cavitation:

Profile selection:

– *Use the appropriate profile shape and thickness.*

– *Use profiles with a sufficiently small absolute value of pressure coefficient for moderate angles of attack (below 5°). The pressure distribution around the profile should be possibly smooth. The maximum thickness of such profiles is usually located at more than 35 % behind the leading edge.*

– *Use a large profile nose radius for rudders operating in propeller slips.*

– *Computational Fluid Dynamic (CFD) analysis for rudder considering the propeller and ship wake can be used.*

Rudder sole cavitation:

Round out the leading edge curve at rudder sole.

Propeller hub cavitation:
Fit a nacelle (body of revolution) to the rudder at the level of the propeller hub. This nacelle functions as an extension of the propeller hub.

Cavitation at surface irregularities:

– *Grind and polish all welds.*

– *Avoid changes of profile shape. Often rudders are built with local thickenings (bubbles) and dents to ease fitting of the rudder shaft. Maximum changes in profile shape should be kept to less than two percent of profile thickness.*

Gap cavitation:

– *Round out all edges of the part around the gap.*

– *Gap size should be as small as possible.*

– *Place gaps outside of the propeller slipstream.*

3. Size of rudder area

In order to achieve sufficient manoeuvring capability the size of the movable rudder area A is recommended to be not less than obtained from the following formula:

$$A = c_1 \cdot c_2 \cdot c_3 \cdot c_4 \cdot \frac{1{,}75 \cdot L \cdot T}{100} \quad [m^2]$$

c_1 = factor for the ship type:
- = 1,0 in general
- = 0,9 for bulk carriers and tankers having a displacement of more than 50 000 ton
- = 1,7 for tugs and trawlers

c_2 = factor for the rudder type:
- = 1,0 in general
- = 0,9 for semi-spade rudders
- = 0,7 for high lift rudders

c_3 = factor for the rudder profile:
= 1,0 for NACA-profiles and plate rudder
= 0,8 for hollow profiles and mixed profiles

c_4 = factor for the rudder arrangement:
= 1,0 for rudders in the propeller jet
= 1,5 for rudders outside the propeller jet

For semi-spade rudder 50% of the projected area of the rudder horn may be included into the rudder area A.

Where more than one rudder is arranged the area of each rudder can be reduced by 20 %.

Estimating the rudder area A B.1. is to be observed.

. Materials

.1 For materials for rudder stock, pintles, coupling bolts etc. see Rules for Material Volume V. Special material requirements are to be observed for the ice notations **ES3** and **ES4** as well as for the arctic ice notations **ARC 1** to **ARC 4.**

.2 In general materials having a minimum nominal upper yield point R_{eH} of less than 200 N/mm^2 and a minimum tensile strength of less than 400 N/mm^2 or more than 900 N/mm^2 shall not be used for rudder stocks, pintles, keys and bolts. The requirements of this Section are based on a material's minimum nominal upper yield point R_{eH} of 235 N/mm^2. If material is used having a R_{eH} differing from 235 N/mm^2, the material factor k_r is to be determined as follows:

$$k_r = \left(\frac{235}{R_{eH}}\right)^{0,75} \quad \text{for } R_{eH} > 235 \text{ [N/mm}^2\text{]}$$

$$= \frac{235}{R_{eH}} \quad \text{for } R_{eH} \leq 235 \text{ [N/mm}^2\text{]}$$

= *minimum nominal upper yield point of material* used in [N/mm^2].

R_{eH} is not to be taken greater than 0,7. R_m or 450 N/mm^2, whichever is less. R_m = tensile strength of the material used.

Before significant reductions in rudder stock diameter due to the application of steels with R_{eH} exceeding N/mm^2 are granted, the Society may require the calculation of the elastic rudder stock deflections. Large deflections should be avoided in order to avoid excessive edge pressures in way of bearings.

The permissible stresses given in E.1. are applicable for normal strength hull structural steel. When higher tensile steels are used, higher values may be used which will be determined in each individual case.

Definitions

= rudder force in [N]

= rudder torque in [Nm]

A = total movable area of the rudder in [m^2], measured at the mid-plane of the rudder

For nozzle rudders, A is not to be taken less than 1,35 times the projected area of the nozzle.

A_t = A + area of a rudder horn, if any, in [m^2]

A_f = portion of rudder area located ahead of the rudder stock axis in [m^2]

b = mean height of rudder area in [m]

c = mean breadth of rudder area in [m] (see Fig. 14.1)

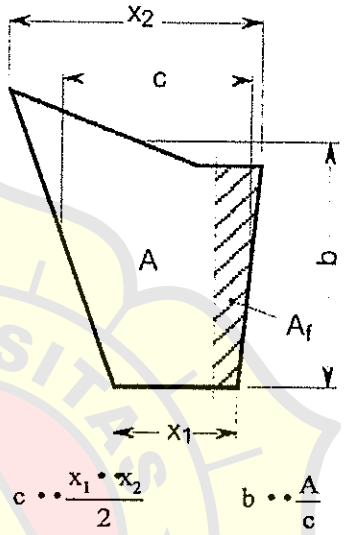


Fig. 14.1 Rudder area geometry

Λ = aspect ratio of rudder area A_t

$$= \frac{b^2}{A_t}$$

v_0 = ahead speed of ship in [kn] as defined in Section.1, H.5.; if this speed is less than 10 kn, v_0 is to be taken as

$$v_{min} = \frac{(v_0 + 20)}{3} \quad \text{[kn]}$$

v_a = *astern speed of ship in [kn]; if the astern speed* $v_a \leq 0,4 \cdot v_0$ or 6 kn, whichever is less, determination of rudder force and torque for astern condition is not required. For greater astern speeds special evaluation of rudder force and torque as a function of the rudder angle may be required. If no limitations for the rudder angle at astern condition is stipulated, the factor κ_2 is not to be taken less than given in Table 14.1 for astern condition.

k = material factor according to Section 2, B.2.

For ships strengthened for navigation in ice, Section 15, B.9 and D.3.7 have to be observed.

B. Rudder Force and Torque

1. Rudder force and torque for normal rudders

1.1 The rudder force is to be determined according to the following formula:

$$C_R = 132 \cdot A \cdot v^2 \cdot \kappa_1 \cdot \kappa_2 \cdot \kappa_3 \cdot \kappa_t \quad [N]$$

v = v_0 for ahead condition

= v_a for astern condition

κ_1 = coefficient, depending on the aspect ratio Λ

= $(\Lambda + 2)/3$, where Λ need not be taken greater than 2

κ_2 = coefficient, depending on the type of the rudder and the rudder profile according to Table 14.1.

Table 14.1 Coefficient κ_2

Profile/ type of rudder	κ_2	
	ahead	astern
NACA-00 series Göttingen profiles	1,1	0,8
flat side profiles	1,1	0,9
mixed profiles (e. g. HSVA)	1,21	0,9
hollow profiles	1,35	0,9
high lift rudders	1,7	to be specially considered; if not known: 1,7

κ_3 = coefficient, depending on the location of the rudder

= 0,8 for rudders outside the propeller jet

= 1,15 for rudders aft of the propeller nozzle

κ_3 = 1,0 elsewhere, including also rudders within the propeller jet

κ_t = coefficient depending on the thrust coefficient c_t

= 1,0 normally

In special cases for thrust coefficients $C_{Th} > 1,0$ determination of κ_t according to the following formula may be required:

$$\kappa_t = \frac{C_R\ (C_{Th})}{C_R\ (C_{Th} = 1,0)}$$

1.2 The rudder torque is to be determined by the following formula:

$$Q_R = C_R \cdot r \quad [Nm]$$

r = $c\ (\alpha - k_b)$ [m]

α = 0,33 for ahead condition

= 0,66 for astern condition (general)

= 0,75 for astern condition (hollow profiles)

For parts of a rudder behind a fixed structure such as a rudder horn:

α = 0,25 for ahead condition

= 0,55 for astern condition.

For high lift rudders α is to be specially considered. If not known, $\alpha = 0,4$ may be used for the ahead condition

k_b = balance factor as follows:

$$= \frac{A_f}{A}$$

= 0,08 for unbalanced rudders

r_{min} = $0,1 \cdot c$ [m] for ahead condition.

1.3 Effects of the provided type of rudder / profile on choice and operation of the steering gear are to be observed.

2. Rudder force and torque for rudder blades with cut-outs (semi-spade rudders)

2.1 The total rudder force C_R is to be calculated according to 1.1. The pressure distribution over the rudder area, upon which the determination of rudder torque and rudder blade strength is to be based, is to be derived as follows:

The rudder area may be divided into two rectangular or trapezoidal parts with areas A_1 and A_2 (see Fig. 14.2).

The resulting force of each part may be taken as:

$$C_{R1} = C_R \frac{A_1}{A} \quad [N]$$

$$C_{R2} = C_R \frac{A_2}{A} \quad [N]$$

2.2 The resulting torque of each part may be taken as:

$$Q_{R1} = C_{R1} \cdot r_1 \quad [Nm]$$

$$Q_{R2} = C_{R2} \cdot r_2 \quad [Nm]$$

r_1 = $c_1\ (\alpha - k_{b1})$ [m]

r_2 = $c_2\ (\alpha - k_{b2})$ [m]

$$k_{b1} = \frac{A_{1f}}{A_1}$$

$$k_{b2} = \frac{A_{2f}}{A_2}$$

A_{1f}, A_{2f} see Fig. 14.2

$$c_1 = \frac{A_1}{b_1}$$

$$c_2 = \frac{A_2}{b_2}$$

b_1, b_2 = mean heights of the partial rudder areas A_1 and A_2 (see Fig. 14.2).

c_3 = factor for the rudder profile:
= 1,0 for NACA-profiles and plate rudder
= 0,8 for hollow profiles and mixed profiles

c_4 = factor for the rudder arrangement:
= 1,0 for rudders in the propeller jet
= 1,5 for rudders outside the propeller jet

For semi-spade rudder 50% of the projected area of the rudder horn may be included into the rudder area A.

Where more than one rudder is arranged the area of each rudder can be reduced by 20 %.

Estimating the rudder area A B.1. is to be observed.

. Materials

.1 For materials for rudder stock, pintles, coupling bolts etc. see Rules for Material Volume V. Special material requirements are to be observed for the ice notations **ES3** and **ES4** as well as for the arctic ice notations **ARC 1** **ARC 4.**

2 In general materials having a minimum nominal upper yield point R_{eH} of less than 200 N/mm^2 and a minimum tensile strength of less than 400 N/mm^2 or more than 900 N/mm^2 shall not be used for rudder stocks, pintles, keys and bolts. The requirements of this Section are based on a material's minimum nominal upper yield point R_{eH} = 235 N/mm^2. If material is used having a R_{eH} differing from 235 N/mm^2, the material factor k_r is to be determined as follows:

$$k_r = \left(\frac{235}{R_{eH}}\right)^{0,75} \quad \text{for } R_{eH} > 235 \text{ [N/mm}^2\text{]}$$

$$= \frac{235}{R_{eH}} \quad \text{for } R_{eH} \leq 235 \text{ [N/mm}^2\text{]}$$

r = minimum nominal upper yield point of material used in [N/mm^2].

R_{eH} is not to be taken greater than 0,7. R_m or 450 N/mm^2, whichever is less. R_m = tensile strength of the material used.

Before significant reductions in rudder stock diameter due to the application of steels with R_{eH} exceeding N/mm^2 are granted, the Society may require the evaluation of the elastic rudder stock deflections. Large reductions should be avoided in order to avoid excessive surface pressures in way of bearings.

The permissible stresses given in E.1. are applicable for normal strength hull structural steel. When higher tensile steels are used, higher values may be used which will be fixed in each individual case.

Definitions

= rudder force in [N]

= rudder torque in [Nm]

A = total movable area of the rudder in [m^2], measured at the mid-plane of the rudder

For nozzle rudders, A is not to be taken less than 1,35 times the projected area of the nozzle.

A_t = A + area of a rudder horn, if any, in [m^2]

A_f = portion of rudder area located ahead of the rudder stock axis in [m^2]

b = mean height of rudder area in [m]

c = mean breadth of rudder area in [m] (see Fig. 14.1)

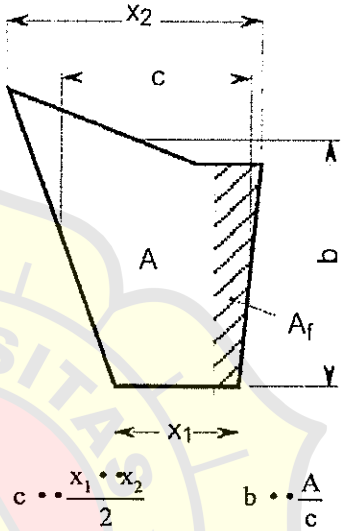


Fig. 14.1 Rudder area geometry

Λ = aspect ratio of rudder area A_t

$$= \frac{b^2}{A_t}$$

v_0 = ahead speed of ship in [kn] as defined in Section.1, H.5.; if this speed is less than 10 kn, v_0 is to be taken as

$$v_{min} = \frac{(v_0 + 20)}{3} \quad \text{[kn]}$$

v_a = astern speed of ship in [kn]; if the astern speed $v_a \leq 0,4 \cdot v_0$ or 6 kn, whichever is less, determination of rudder force and torque for astern condition is not required. For greater astern speeds special evaluation of rudder force and torque as a function of the rudder angle may be required. If no limitations for the rudder angle at astern condition is stipulated, the factor κ_2 is not to be taken less than given in Table 14.1 for astern condition.

k = material factor according to Section 2, B.2.

For ships strengthened for navigation in ice, Section 15, B.9 and D.3.7 have to be observed.

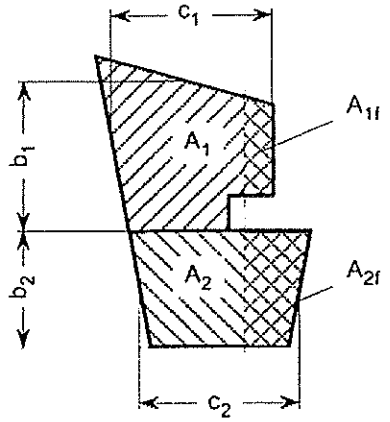


Fig. 14.2 Partial area A_1 and A_2

3 The total rudder torque is to be determined according the following formulae:

$$Q_R = Q_{R1} + Q_{R2} \quad [Nm] \text{ or}$$

$$Q_{Rmin} = C_R \cdot \tau_{1,2min} \quad [Nm].$$

$$_{2min} = \frac{0,1}{A} (c_1 \cdot A_1 + c_2 \cdot A_2) \quad [m]$$

for ahead condition

ıe greater value is to be taken.

Scantlings of the Rudder Stock

Rudder stock diameter

The diameter of the rudder stock for transmitting torsional moment is not to be less than:

$$D_t = 4,2 \sqrt[3]{Q_R \cdot k_r} \quad [mm]$$

see B. 1.2 and B. 2.2 - 2.3.

: related torsional stress is:

$$\tau_t = \frac{68}{k_r} \quad [N/mm^2]$$

ee A.4.2.

The steering gear is to be determined according to es for Machinery Installations, Volume III, Section 14 he rudder torque QR as required in B.1.2, B.2.2 or B.2.3 under consideration of the frictional losses at the rudder ·ings.

In case of mechanical steering gear the diameter ıe rudder stock in its upper part which is only intended ransmission of the torsional moment from the auxiliary ring gear may be 0,9 D_t. The length of the edge of the drangle for the auxiliary tiller must not be less than D_t and the height not less than 0,8 D_t.

The rudder stock is to be secured against axial ng. The degree of the permissible axial clearance depends on the construction of the steering engine and on the bearing.

2. Strengthening of rudder stock

2.1 If the rudder is so arranged that additional bending stresses occur in the rudder stock, the stock diameter has to be suitably increased. The increased diameter is, where applicable, decisive for the scantlings of the coupling.

For the increased rudder stock diameter the equivalent stress of bending and torsion is not to exceed the following value:

$$\sigma_v = \sqrt{\sigma_b^2 + 3\tau^2} \cdot \frac{118}{k_r} \quad [N/mm^2]$$

Bending stress:

$$\sigma_b = \frac{10,2 \cdot M_b}{D_1^3} \quad [N/mm^2]$$

M_b = bending moment at the neck bearing in [Nm]

Torsional stress:

$$\tau = \frac{5,1 \cdot Q_R}{D_1^3} \quad [N/mm^2]$$

D_1 = increased rudder stock diameter in [cm]

The increased rudder stock diameter may be determined by the following formula:

$$D_1 = 0,1.D_t \sqrt[6]{1 + \frac{4}{3}\left[\frac{M_b}{Q_R}\right]^2} \quad [mm]$$

Q_R see B.1.2 and B.2.2 - 2.3

D_t see 1.1.

Note

Where a double-piston steering gear is fitted, additional bending moments may be transmitted from the steering gear into the rudder stock. These additional bending moments are to be taken into account for determining the rudder stock diameter.

3. Analysis

3.1 General

The evaluation of bending moments, shear forces and support forces for the system rudder - rudder stock may be carried out for some basic rudder types as shown in Figs. 14.3 - 14.5 as outlined in 3.2. - 3.3.

3.2 Data for the analysis

$\cdot_{10} - \cdot_{50}$ = lengths of the individual girders of the system in [m]

$I_{10} - I_{50}$ = moments of inertia of these girders in [cm^4]

For rudders supported by a sole piece the length $\cdot_{20}$ is the distance between lower edge of rudder body and centre

c_3 = factor for the rudder profile:
= 1,0 for NACA-profiles and plate rudder
= 0,8 for hollow profiles and mixed profiles

c_4 = factor for the rudder arrangement:
= 1,0 for rudders in the propeller jet
= 1,5 for rudders outside the propeller jet

For semi-spade rudder 50% of the projected area of the rudder horn may be included into the rudder area A.

Where more than one rudder is arranged the area of each rudder can be reduced by 20 %.

Estimating the rudder area A B.1. is to be observed.

I. Materials

.1 For materials for rudder stock, pintles, coupling bolts etc. see Rules for Material Volume V. Special material requirements are to be observed for the ice notations **ES3** and **ES4** as well as for the arctic ice notations **ARC 1** **ARC 4.**

.2 In general materials having a minimum nominal upper yield point R_{eH} of less than 200 N/mm^2 and a minimum tensile strength of less than 400 N/mm^2 or more than 900 N/mm^2 shall not be used for rudder stocks, pintles, keys and bolts. The requirements of this Section are based on a material's minimum nominal upper yield point R_{eH} = 235 N/mm^2. If material is used having a R_{eH} differing from 235 N/mm^2, the material factor k_r is to be determined as follows:

$$k_r = \left(\frac{235}{R_{eH}}\right)^{0,75} \quad \text{for } R_{eH} > 235 \text{ [N/mm}^2\text{]}$$

$$= \frac{235}{R_{eH}} \quad \text{for } R_{eH} \leq 235 \text{ [N/mm}^2\text{]}$$

R_{eH} = *minimum nominal upper yield point of material* used in [N/mm^2].

R_{eH} is not to be taken greater than 0,7. R_m or 450 N/mm^2, whichever is less. R_m = tensile strength of the material used.

Before significant reductions in rudder stock diameter due to the application of steels with R_{eH} exceeding N/mm^2 are granted, the Society may require the evaluation of the elastic rudder stock deflections. Large cutouts should be avoided in order to avoid excessive edge pressures in way of bearings.

The permissible stresses given in E.1. are applicable for normal strength hull structural steel. When higher tensile steels are used, higher values may be used which will be specified in each individual case.

Definitions

= rudder force in [N]

= rudder torque in [Nm]

A = total movable area of the rudder in [m^2], measured at the mid-plane of the rudder

For nozzle rudders, A is not to be taken less than 1,35 times the projected area of the nozzle.

A_t = A + area of a rudder horn, if any, in [m^2]

A_f = portion of rudder area located ahead of the rudder stock axis in [m^2]

b = mean height of rudder area in [m]

c = mean breadth of rudder area in [m] (see Fig. 14.1)

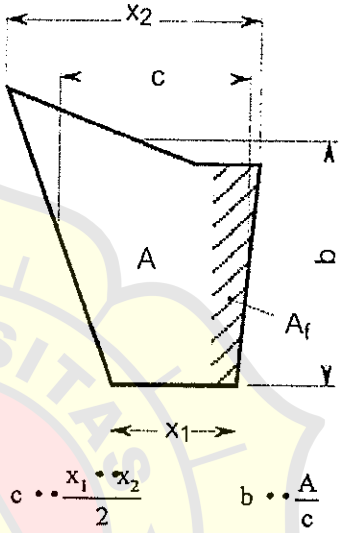


Fig. 14.1 Rudder area geometry

Λ = aspect ratio of rudder area A_t

$$= \frac{b^2}{A_t}$$

v_0 = ahead speed of ship in [kn] as defined in Section.1, H.5.; if this speed is less than 10 kn, v_0 is to be taken as

$$v_{min} = \frac{(v_0 + 20)}{3} \quad \text{[kn]}$$

v_a = *astern speed of ship in [kn]; if the astern speed* $v_a \leq 0,4 \cdot v_0$ or 6 kn, whichever is less, determination of rudder force and torque for astern condition is not required. For greater astern speeds special evaluation of rudder force and torque as a function of the rudder angle may be required. If no limitations for the rudder angle at astern condition is stipulated, the factor κ_2 is not to be taken less than given in Table 14.1 for astern condition.

k = material factor according to Section 2, B.2.

For ships strengthened for navigation in ice, Section 15, B.9 and D.3.7 have to be observed.

Section 18

Equipment

A. General

1. The equipment of anchors. chain cables, wires and ropes is to be determined from Table 18.2 in accordance with the equipment numeral Z.

Note

The anchoring equipment required by this Section is intended of temporary mooring of a vessel within a harbour or sheltered area when the vessel is awaiting berth, tide, etc.

The equipment is, therefore, not designed to hold a ship off fully exposed coasts in rough weather or to stop a ship which is moving or drifting. In this condition the loads on the anchoring equipment increase to such a degree that its components may be damaged or lost owing to the high energy forces generated, particularly in large ships.

The anchoring equipment required by this Section is designed to hold a ship in good holding ground in conditions such as to avoid dragging of the anchor. In poor holding ground the holding power of the anchors will be significantly reduced.

The equipment numeral formula for anchoring equipment required under this Section is based on an assumed current speed of 2,5 m/sec, wind speed of 25 m/sec and a scope of chain cable between 6 and 10, the scope being the ratio between length of chain paid out and water depth.

It is assumed that under normal circumstances a ship will use only one bow anchor and chain cable at a time.

Section 30, E. are to be observed.

5. When determining the equipment for tugs, Section 27, G. is to be observed.

When determining the equipment of barges and pontoons, Section 31, G. is to be observed.

6. Ships built under survey of BKI and which are to have the mark • •stated in their Certificate and in the Register Book must be equipped with anchors and chain cables complying with the Rules for Materials, Volume V, and having been tested on approved machines in the presence of Surveyor.

7. For ships having three or more propellers, a reduction of the weight of the bower anchors and the chain cables may be considered.

B. Equipment Numeral

The equipment numeral is to be calculated as follows:

$$Z = D^{2/3} \bullet\bullet 2\,h\,B \bullet\bullet \frac{A}{10}$$

D = moulded displacement in [ton] (in sea water having a density of 1,025 t/m^3) to the summer load waterline

h = effective height from the summer load water-line

FN-NS | Corner Light -IP20

Application
Passage way, corner

Protection degree IP20

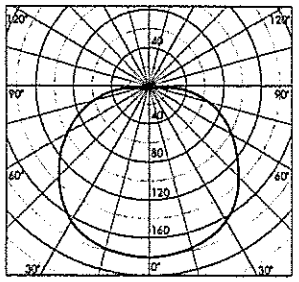
Materials
Body : Electro zinc coated steel sheet
Diffuser : Opal acryl

Finish
Body : White epoxy powder coat and stove enamelled(Munsell No. N-9.3)

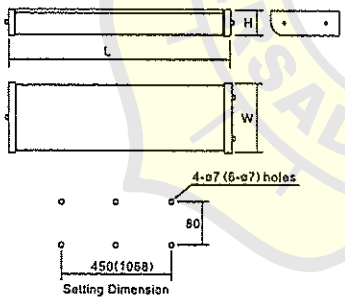
Equipment
Fluorescent lamp : 18/36W
Light sources : T26
Lamp base : G13
Cable inlet hole (diameter : 50mm)

Electrical
AC100~240V, 50/60Hz are available on request
Ballast : Glow, Rapid, Electronic

Light Distribution Curve (Cd / 1000lm)



Technical Drawing



Specification

Option • Emergency DC Lamp • Dimming • Battery back-up

Model No.	Capacity	L(mm)	W(mm)	H(mm)	Weight(Kg)	Remarks
FN120NS-GIS	18W X 2	660	167	65	3.75	
FN140NS-GIS	36W X 2	1278	167	65	5.23	

FB | Fluorescent Berth Light -IP20

Application
Accommodation area, indoor

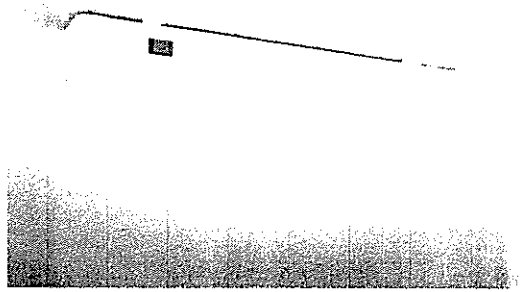
Protection degree IP20

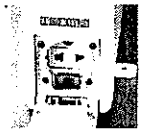
Materials
Body : Aluminium
End caps : ABS(Acrylonitrile Butadiene Styrene)
Diffuser : Opal polycarbonate

Finish
Body : White epoxy powder coat and stove enamelled(Munsell No. N-9.3)

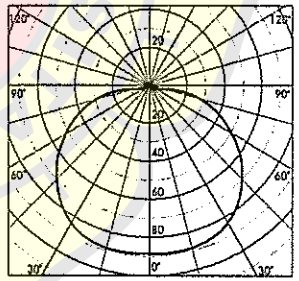
Equipment
Flourescent lamp : 8/10/15/20W
Lamp holder : G5(8W) & G13
Cable inlet hole (diameter : 30mm)
ON/OFF switch

Electrical
AC100~240V, 50/60Hz are available on request
Ballast : Glow

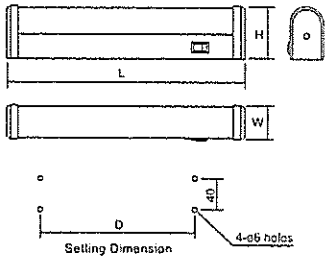




Light Distribution Curve (Cd / 1000lm)



Technical Drawing



Specification

Option • Switch(S), Receptacle(R), Switch&Receptacle(W)

Model No.	Capacity	L(mm)	W(mm)	H(mm)	D(mm)	Weight(Kg)	Remarks
FB108-GJAN	8W	384	70	113	335	1.3	
FB110-GJAN	10W	428	70	113	385	1.8	
FB115-GJAN	15W	529	70	113	486	1.8	
FB120-GJAN	20W	685	70	113	642	3.0	

Section 3

Power Supply Installations

A. Electrical Power Demand

1. A power balance of the electrical equipment has to be submitted to proof the sufficient ratings of units for the generating, storage and transformation of electrical energy.

1.1 The power demand has to be determined for the following operating conditions:

– navigation at sea,

– estuary trading and navigation close to port,

– emergency power supply.

1.2 Extreme environmental conditions, e.g. arctic or tropical conditions, appropriate to the ship's area of operation are also to be taken into account.

1.3 In compiling the power balance, all installed electrical consumers are to be tabulated together with an indication of their power inputs.

2. For the various operating conditions, attention is to be given to:

2.1 The full power input of all consumers continuously required for operation, except for those consumers which remain on standby and are used only when a similar consumer fails.

2.2 The power input of all temporarily used consumers multiplied by a diversity factor.

The consumers mentioned in 2.3 are excluded.

The diversity factor shall be applied only once during the calculation.

2.3 The full power input of consumers with a high power consumption relative to the primary plant, e.g. lateral thrusters (see also B.1.4).

2.4 Short-term peak loads caused, for example, by the automatic starting of large motors. Proof is required of reserve power.

B. Main Electrical Power Supply

1. Design

1.1 Every ship is to be provided with a main source of electrical power with sufficient capacity to meet the requirements of the plant mentioned in Section 1, A.3. This main source of electrical power shall consist of at least two mutually independent generating sets.

1.2 The capacity of the generating sets mentioned in 1.1 must be such that, if any one generating set should fail or be shut down, the remaining generating capacity is sufficient to supply all those items of equipment which are needed, when navigating at sea, to ensure:

– normal operational conditions of propulsion and safety of the ship,

– a minimum of comfortable conditions of habitability, and

– preservation of the cargo, as far as the equipment provided is part of the classification.

Minimum comforts for living on board include at least adequate services for lighting, cooking, heating, domestic refrigeration, mechanical ventilation, sanitary and drinking water.

1.3 For determination of generators capacity on ships with classified refrigeration equipment (class notation "**SMP**" or with other addenda to their character of classification (e.g "dredger") the power demand arising from the associated special operating conditions shall also be considered.

1.4 For determination of generators capacity on ships with classified refrigerated containers (class notation "**RCP**" the power demand according to BKI's Guidelines for the Carriage of Refrigerated Containers on Board Ships shall be considered.

1.5 If no operational data are available for containers, the following values are to be assumed when calculating the power demand:

Section 14

Additional Rules for Passenger Ships

A. General

1. Scope

These regulations apply additionally to electrical plants on passenger ships.

2. Reference to other BKI Rules

2.1 Rules for Hull, Volume II.

2.2 Rules for Machinery Installations, Volume III

2.3 Additional Requirements for Ships for the Carriage of Motor Vehicles, Section 16.

B. Installation of Electrical Equipment

1. Attention is drawn to special provisions for structural fire protection for control stations. Control stations are e.g:

- location of the emergency source of electrical power
- bridge and chart room,
- radio room
- main fire alarm and fire fighting station
- engine control room if is located outside the engine room
- rooms in which central stations for general emergency alarm and loudspeaker systems (PA-systems) for emergency announcements are located

2. Switch boards and distribution boards in the passenger area shall not be accessible to passengers.

C. Electrical Power Supply Systems

1. Emergency electrical power supply

1.1 An independent emergency source of electrical power shall be provided.

1.2 The emergency source of electrical power must be capable of simultaneously supplying at least the following equipment (if its operation depends on a source of electrical power) for the duration mentioned below, taking starting currents into account:

1.2.1 Emergency illumination for 36 hours

a) at all launching stations for survival appliances on deck and along the outside of the hull

b) in all passageways of the service area and accommodation area, on stairs and at exits and in personnel-lift cars

c) in the machinery rooms and main-generator stations, including their control positions,

d) at all control stations, engine control room, on the bridge, and each main switchboard and emergency switchboard

e) at all storage places for fireman's outfit,

f) in the steering gear compartment and the CO_2 room

g) at the fire pumps listed in 1.2.4, the sprinkler pump and the emergency bilge pump, and at the starting-positions for their motors.

1.2.2 For 36 hours

a) the navigation lights and any other signalling lights required in accordance with the "International Regulations for Preventing Collisions at Sea"

b) the **SOLAS** Chapter IV required "VHF radio installation" and, if necessary the "MF radio installation" and the "ship earth station" and the "MF/HF radio installation".

1.2.3 For 36 hours

a) all internal alarm systems and information equipment required in an emergency

b) all ship navigation devices, which are required in **SOLAS** Chapter V, Reg. 12

the fire detection and fire alarm system and the system for operating and monitoring the fire doors

d) devices for the intermittent operation of the daylight-signalling-lamp, the ship's siren, the manually operated fire alarm call points and all internal signals required in an emergency, such as General Emergency Alarm, CO_2 - alarm

if these facilities cannot be supplied in dependently from an emergency storage battery for the duration of 36 hours.

1.2.4 For 36 hours

a) the stipulated emergency fire pumps

b) the automatic sprinkler pump

c) the emergency bilge pump and all the devices necessary for the operation of electrically-powered remotely controlled drainage valves

d) the auxiliary equipment for the emergency diesel generator

1.2.5 During the period stipulated by Section 7, A.4., the steering gear if an emergency supply is obligatory, and the rudder angle indicator.

1.2.6 For 3 hours on Ro/Ro passenger ships the supplementary emergency illumination with own storage battery luminaries, see Section 16.

1.2.7 For one hour the electric operated Low Location Lighting (LLL system).

1.2.8 For half an hour

a) all watertight doors which in accordance with Rules for Machinery Installations, Volume III, must be power-operated, their controls and the stipulated indicating and warning devices in accordance with Section 7.D. (see also 1.4.2 b)

b) the emergency equipment which brings the passenger lift cars to the next exit point for reasons of escape. If there are several passenger lift cars, they may in an emergency be brought to the exit point successive.

1.3 For a ship which regularly makes voyages of limited duration, the national authorities may approve a shorter period than the 36 hours stipulated in paragraphs 1.2.1 to 1.2.4, but not less than 12 hours, if in their opinion this ensures an adequate level of safety.

1.4 The emergency source of electrical power for passenger ships may be either a generator set with a transitional source of emergency electrical power or a storage battery.

1.4.1 If the emergency source of electrical power is a generator set it must be powered by a suitable prime mover with its own independent fuel supply in accordance with Rules for Machinery Installations, Volume III, Section 10, and an independent cooling system. The set must start automatically if the main power supply fails. Supply to the consumers listed under 1.2 must be taken over automatically by the emergency set. The emergency electrical supply provisions must be such that its rated load capacity is assured as quickly as possible but not later than 45 seconds after failure of the main power supply.

1.4.2 The transitional emergency source of electrical power must be a storage battery which in the case of failure of the main and emergency power supplies immediately supplies the consumers listed below, until the emergency generator set described under 1.4.1 is operative and connected.

Its capacity shall be so rated that it is capable, without recharging to supply the consumers for the period as specified below. During this period its terminal voltage must remain within ± 12 % of the rated value.

The following consumers are to be taken into account, insofar as they depend on an electrical power source for their operation:

a) for half an hour the lighting stipulated under 1.2.1 and 1.2.2 a), lanterns and lights and all equipment stipulated under 1.2.3 a), 1.2.3 c) and 1.2.3 d) insofar as these are not supplied independently by their own emergency storage battery during the stipulated period

b) power for closing the watertight doors without a requirement for simultaneous closure of all doors and for their indicating devices and warning signals, as stipulated under 1.2.8 a).

1.4.3 If the emergency source of electrical power is a storage battery it must be capable in the event of failure of the main electrical power supply to take over automatically and immediately the supply to the consumers listed under 1.2 and of supplying them without a recharging for the stipulated period. During this period its terminal voltage must remain within ± 12 % of the rated value.

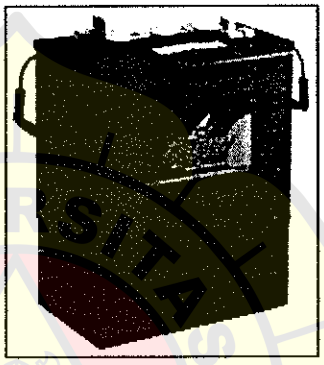
TECHNICAL DATA SHEET

Crown Battery Mfg. Co. • Fremont, Ohio USA
419-334-7181 • FAX 419-334-7124

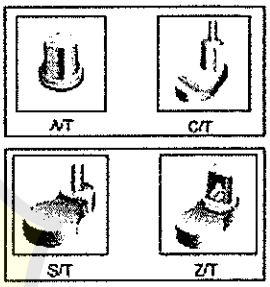
CR-395

Commercial Deep Cycle Battery

vn Battery Manufacturing Company offers a complete lineup gh-performing and low-maintenance commercial deep cycle ries produced in standard BCI industry profiles for voltage, rical capacity and physical dimension. Crown Battery's ative and proven deep cycle product design makes it the ry of choice for many tough commercial battery applications, ding commercial floor care and aerial access equipment, ric motorcars, personnel carriers, material handling ment and photovoltaic systems.



Available Terminals



ECIFICATIONS

ominal Voltage		6 Volts	
mp Hour Capacity		395 (C20)	320 (C5)
eserve Capacity Minutes		225 @ 75 Amperes	
ysical aracteristics	Length	12.19"	310 mm
	Width	7.19"	183 mm
	Height	16.50"	419 mm
	Wet Weight	121 Lbs	55.0 Kgs
rminal Options		A/T, C/T, S/T, Z/T	

ECTRICAL SPECIFICATIONS

ap Hour pacity	20 Hour Rate	19.75 A	395 Ah
	10 Hour Rate	33.20 A	332 Ah
	5 Hour Rate	57.00 A	285 Ah
	2 Hour Rate	108.0 A	216 Ah
ernal sistance	80 F	27 C	8.1 mOhm
pacity ected by mperature Ah Rate)	104 F	40 C	102%
	80 F	27 C	100%
	32 F	0 C	65%

Cover Style:	**Exposed Vent Opening**
Cover Vent Style:	**Quarter-Turn Bayonet Style**
Container and Cover Material:	**Black Polypropylene**
Case to Cover Seal Method:	**Heat Seal**
Inner-Cell Connector Type:	**Through Partition Weld**
Plate Lug to Collector Bar Fusion Method:	**Inverted Automatic Cast-On**
Number of Plates per Battery:	**51 Plates**
Positive Grid Material:	**Antimony Lead Alloy**
Positive Grid Design:	**Z³ Horizontal Pellet**
Positive Plate Dimension:	**5.750" x 11.500" x 0.140"** **146mm x 292mm x 3.6mm**
Negative Grid Material:	**Antimony Lead Alloy**
Negative Grid Design:	**Z³ Horizontal Pellet**
Negative Plate Dimension:	**5.750" x 11.500" x 0.105"** **146mm x 292mm x 2.7mm**
Separator Type:	**Microporous Polyethylene Envelope with Glass**

Visit our website at
www.crownbatterycom

Crown Battery Manufacturing's team of research and development engineers welcome the opportunity to discuss your technical requirements during the design and specification stage. To access this technical assistance, please contact Crown Battery Manufacturing's Customer Service Department at 800.487.2879 / sales@crownbattery.com / FAX 419.334.7124.

Recommended Charge Profile:

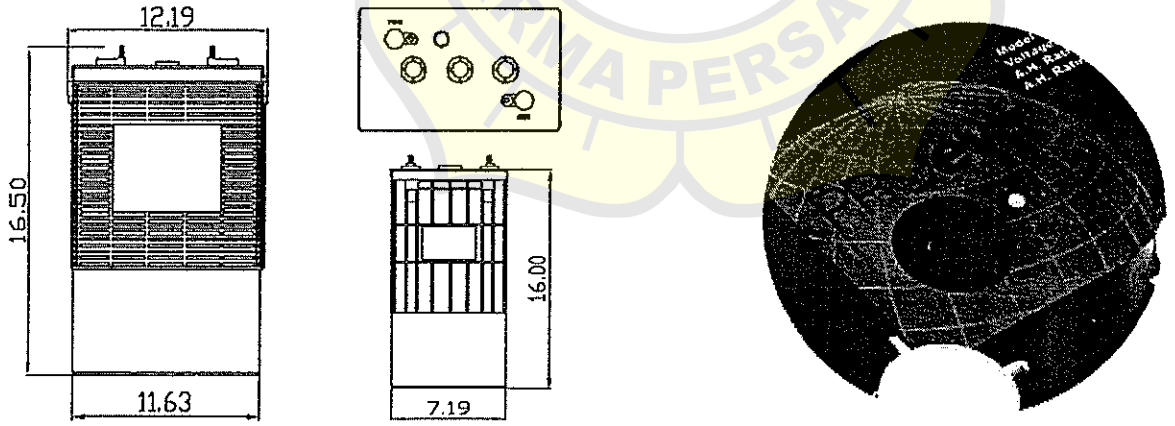
Following discharge, constant current charge the CR-395 battery at 40 to 50 amperes until the battery voltage measures 2.42 volts per cell (7.26 volts open circuit voltage).

The constant voltage charge phase begins after the gassing point (2.42) is achieved. During the constant voltage phase, the charger voltage limit is regulated to the gassing point of 2.42 volts per cell, while the input current is allowed to gradually fall off. When the input current drops to the finish rate setting of 15 amperes, the charging phase will change from constant voltage to a sustained 15 ampere constant current mode. The charging cycle will be terminated 3.5 to 5 hours from the gassing point, with factors such as ambient temperature, battery condition and depth of discharge affecting the charge completion time.

The CR-395 battery should receive a full recharge following the completion of each discharge, along with a weekly equalization service charge. During the equalization charge cycle the finish rate charge time is extended by 3 hours (6.5 to 8 hours from the gassing point).

The charge factor of the standard recharge should be equal to or greater than 1.07 (107%). The charge factor of the equalizing cycle should be equal to or greater than 1.15 (115%).

Please contact Crown Battery Manufacturing's engineering department with any questions regarding this charge profile specification.



The Power Behind Performance

nominal and should not be construed as maximum or values for specification or for final design. Data for this type may vary from that shown herein.

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6HAL2

Generator Capacity

80~280kWe

■ Main Data

Type ..... 4-stroke, Diesel
No. of Cylinders ..... In-line 6
Cylinder Bore ..... 130 mm
Piston Stroke ..... 165 mm
Engine Speed ..... 1200 / 1500 / 1800 min^{-1}
Mean Effective Pressure ..... 0.68 - 1.55 MPa
Piston Speed ..... 6.6 / 8.3 / 9.9 m/s

■ Rated Power

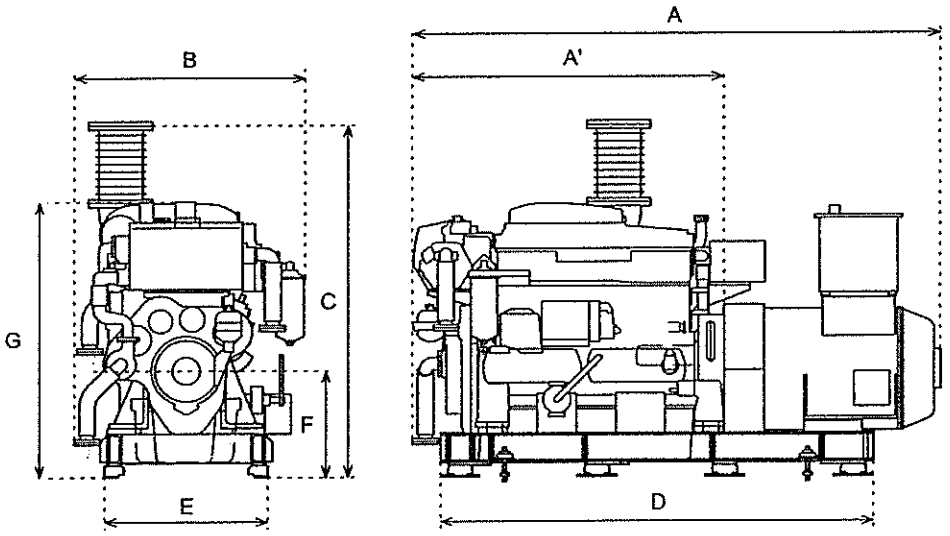
Engine Model	60Hz 1200min^{-1}		50Hz 1500min^{-1}	
	Eng [kW (PS)]	Gen [kWe]	Eng [kW (PS)]	Gen [kWe]
6HAL2-N	90 (122)	80	115 (156)	100
6HAL2-TN	120 (163)	104	-	-
6HAL2-WT	-	-	150 (204)	136
6HAL2-WHT	160 (217)	144	220 (299)	200
6HAL2-WDT	200 (271)	180	255 (346)	232

Engine Model	1800min^{-1}	
	Eng [kW (PS)]	Gen [kWe]
6HAL2-N	-	-
6HAL2-TN	-	-
6HAL2-WT	180 (244)	160
6HAL2-WHT	265 (360)	240
6HAL2-WDT	305 (414)	280

Above generator capacity will vary according to actual generator efficiency.

■ Dimensions [mm] / Weights [kg]

Engine Model	A	A'	B	C	D	E	F	G	Dry Weight Engine	Dry Weight Gen-Set
6HAL2-N (90~115kW)	2499	1589	1164	1654	2100	820	544	1327	1380	2360
6HAL2-TN (120kW)	2499	1589	1164	1774	2100	820	544	1327	1422	2410
6HAL2-WT (150~180kW)	2499	1589	1164	1774	2100	820	544	1327	1422	2410
6HAL2-WHT (160~265kW)	2574	1589	1164	1804	2200	820	544	1327	1437	2750
6HAL2-WDT (200~305kW)	2684	1589	1164	1804	2200	820	544	1327	1447	2850

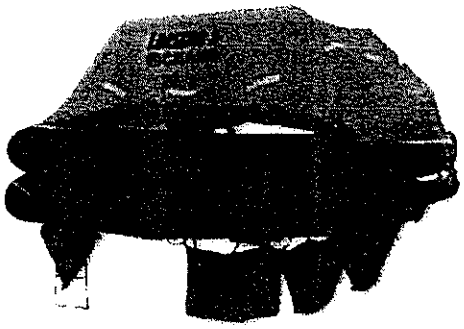


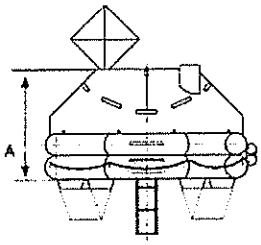
G : Minimum Height for Removing Piston

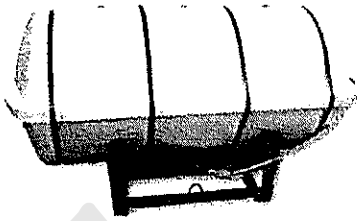
The engine dry weight and outline may differ depending upon the specifications and attached accessories.

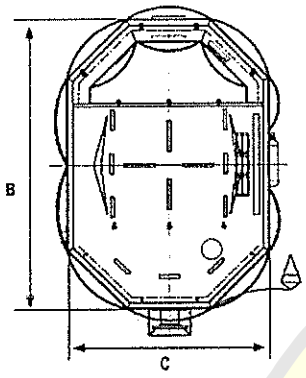
http://pdf.nauticexpo.com/pdf/lalizas-life-saving-equipment/marine-.

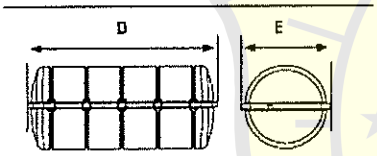
20, 25, 30 & 35 Person





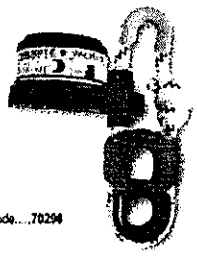






Code	Persons	Pack	Dimensions (mm) A	B	C	D	E
79873	20	A	1600	4304	2974	1335	696
79909		B				1285	670
79874	25	A	1650	4894	3154	1490	757
79910		B				1335	696
79875	30	A	1700	5384	3414	1700	765
79911		B				1490	757
79876	35	A	1750	5899	3568	1700	765
79912		B				1490	757

LALIZAS OCEANO



Code....70296

HAMMAR H20 Hydrostatic Release for Life Rafts (USCG&EC Approved SOLAS)

The Hammar H20 is a hydrostatic release unit designed to fit life rafts of all shapes and sizes (from 6 up to 150 persons). It is made of glass fibre reinforced nylon, which prevents it from corrosion. The Hammar H20 can be released at any angle and needs only the required water pressure to be activated (1,5 - 4,0m depth). It's safe, reliable and simple design has made it renowned and earned more worldwide approvals than any other unit.

- Simple to install and clearly marked with the expire date
- No spare parts or service required
- Must be replaced after two years

Lashing with Hook (Big)

Code....71892

12/25/2013 8:00 PM

GENERAL CHARACTERISTICS

Rules and Regulations	ITU-R M.1082-1, ITU-RIM.1173, ITU-R M.476-5, ITU-R M.490, ITU-R M.491-1, ITU-R M.492-6, ITU-R M.493-13, ITU-R M.541-9, ITU-R M.625-3, ITU-R M.821-1, IMO Res. A.694(17), IMO Res. A.806(19), IMO Res. MSC36 (63), IMO Res. MSC 68 (68), MSC/Circ. 862, IEC 61162-1 Ed. 4, IEC60945 Ed. 4, ETS 300 067 ed. 1, EN 300 338-1 V1.3.1, EN 300 338-2 V1.3.1, EN 301 033 V1.3.1, EN 300 379-1 V1.3.1		
Frequency Range TX:	1605.0kHz to 27500.0kHz		
Frequency Range RX:	100kHz to 29999.99kHz		
Number of Channels	256 user-specified channels plus ITU, SSB/TELEX channels		
Communication Mode	Simplex/Semi-duplex		Simplex/Semi-duplex/Duplex (option)
Class of Emission	J3E, H3E, A1A, J2B		

TRANSCEIVER

RF Output Power	150 W pep	250 W pep	500 W pep (HF) / 400 W pep (MF)
Antenna	10-18 m whip or wire		
Tuning Speed	within 15 sec		
Receiver Sensitivity	less than +7 dBµV (4.0-29.99999 MHz, J3E) / less than +13 dBµV (1.6-4 MHz, J3E)		

DSC

Receiving Frequency	General	All DSC frequencies in MF/HF
	Distress and safety	DSC distress/safety frequencies: 2187.5 kHz, 4207.5 kHz, 6312.0 kHz, 8414.5 kHz, 12577.0 kHz, 16804.5 kHz
Message Storage TX:	50 distress messages, plus 50 non-distress messages	
Message Storage RX:	50 messages, telephone no., frequencies, etc.	

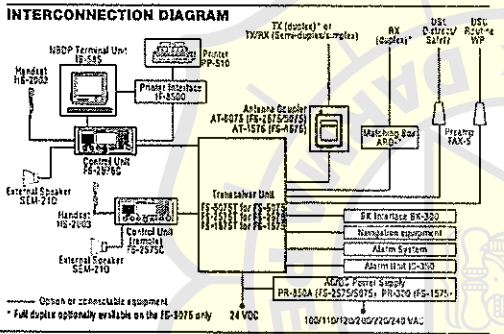
POWER SUPPLY	24 VDC, 100/110/120/200/220/240 VAC with optional AC/DC Power Supply PR-850A (FS-2575/5075) / PR-300 (FS-1575)		
	20 A (TX), 5.0 A (RX)	40 A (TX), 5.0 A (RX)	60 A (TX), 5.0 A (RX)

EQUIPMENT LIST

480 watt Tx 120 RX

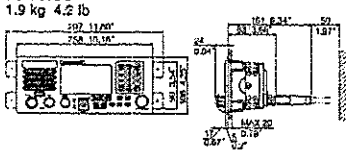
Standard	1 Transceiver Unit	FS-1575T (FS-1575), FS-2575T (FS-2575), FS-5075T (FS-5075)	1 Unit
	2 Control Unit	FS-2575C	1 Unit
	3 Handset	HS-2003	1 Unit
	4 Antenna Coupler	AT-5075 (FS-2575/5075) AT-1575 (FS-1575)	1 Unit
Option	1 Printer	PP-510	
	2 Printer Interface	IF-8500	
	3 External Speaker	SEM-21Q	
	4 Control Unit	FS-2575C	
	5 NBDP Terminal Unit	IB-585	
	6 BK Interface	BK-300	
	7 Whip Antenna		
	8 AC/DC Power Supply	PR-850A (FS-2575/5075) PR-300 (FS-1575)	
	9 Full Duplex Kit (for FS-5075)	DP05-125	
	10 Matching Box	ARD-1	
	11 Preamp	FAX-5	
	12 WR2 kit	DP05-123	

INTERCONNECTION DIAGRAM



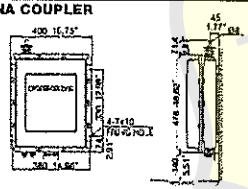
CONTROL UNIT

FS-2575C
1.9 kg 4.2 lb

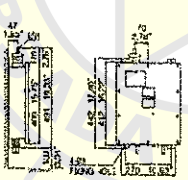


ANTENNA COUPLER

AT-5075
8.5 kg
18.7 lb

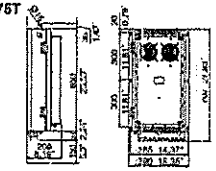


AT-1575
2.6 kg
5.7 lb

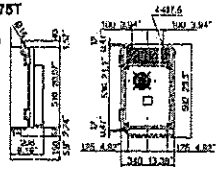


TRANSCEIVER UNIT

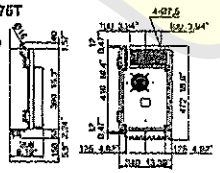
FS-5075T
27 kg
59.5 lb



FS-2575T
20kg
44.1 lb

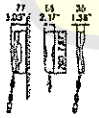


FS-1575T
16 kg
35.3 lb



HANDSET

HS-2003
0.5 kg
1.2 lb



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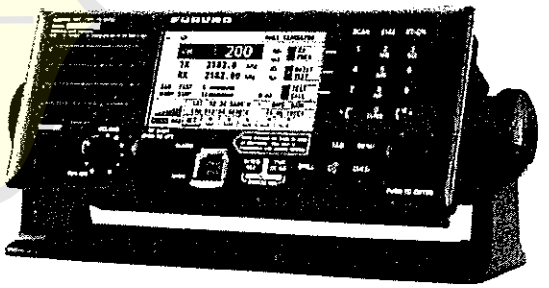
12023SK Printed in Japan
Catalogue No. S-025a

FURUNO

MF/HF

MF/HF Radiotelephone



Models: FS-1575 (150 W)
FS-2575 (250 W)
FS-5075 (500 W)

www.furuno.com

FEATURES

●Compact Design
The GM-20/21 measures only 228×321×377 mm, so it can be easily installed on fishing boats and other small commercial vessels.

●Low Power Consumption
Power consumption is only 50 VA (for master compass).

●Ease Of Operation

●Direct Reading And Synchro Output
Direct reading simplifies use considerably, and synchro output provides forlow-cost autopilot steering.

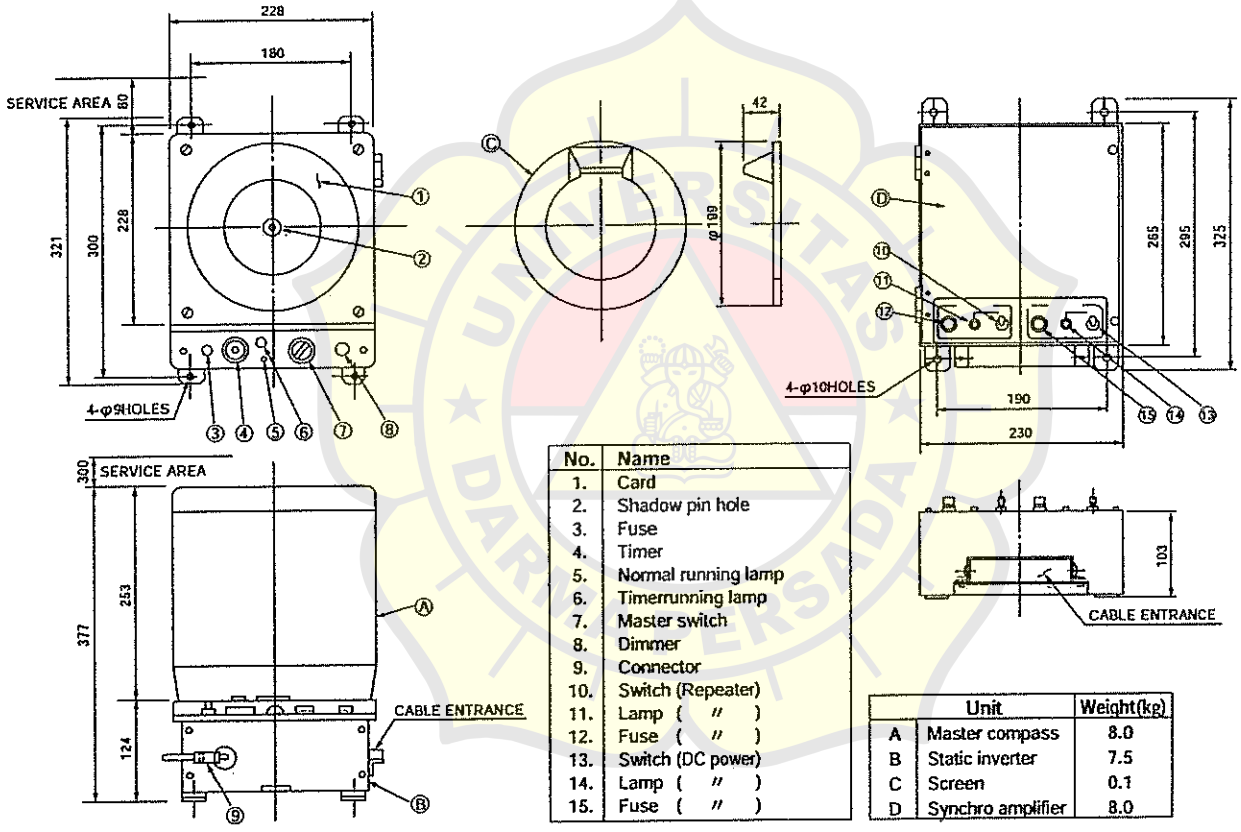
●Three Repeater Compass Circuits

●Automatic Preset Startup
A 24-hour timer permits automatic startup.

SPECIFICATIONS

Power Supply	AC 100/110, 1φ, 50/60 Hz, 60 VA (for repeater compass) DC 24 V, 2 A (with only master compass running)
Voltage Fluctuation	±20%
Ambient Temperature	+50 ℃ — −20 ℃
North-seeking Accuracy	Within ±2°
Follow-up Accuracy	Within ±0.1°
Setting Time	Less than 4 hours
Mechanical Freedom	±45°
Maximum Turning Follow Up Speed	Turning ratio of 10 sec/rev
Repeater	90× synchro motor (3 circuits)

Specifications are subject to change without notice.



No.	Name
1.	Card
2.	Shadow pin hole
3.	Fuse
4.	Timer
5.	Normal running lamp
6.	Timerrunning lamp
7.	Master switch
8.	Dimmer
9.	Connector
10.	Switch (Repeater)
11.	Lamp (〃)
12.	Fuse (〃)
13.	Switch (DC power)
14.	Lamp (〃)
15.	Fuse (〃)

	Unit	Weight(kg)
A	Master compass	8.0
B	Static inverter	7.5
C	Screen	0.1
D	Synchro amplifier	8.0

If the bottom power supply unit is separated, the device can be mounted on a wall(separate type).

Design and specifications are subject to change without prior notice, and without any obligation on the part of the manufactures.

⚠ CAUTION Before operating this equipment, you should first thoroughly read the operation manual.

TOKIMEC

TOKIMEC INC.

www.tokimec.co.jp/marine/

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Phone 81-3-3737-8631 Fax 81-3-3737-8666

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Los Angeles, California 90071 U.S.A.
Phone 1-213-689-4747 Fax 1-213-689-0303

Printed August 2002 in Japan. Cat.No.672-3-E-1-E

Simple Operation

- Keys and controls on the operation panel are minimized. Sensitivity, clutter rejection and STC are finely adjustable depending upon sea areas, seasons and fishing methods.
- Three types of fishing ground or fish species can be present and stored. Once they are present, any type of fishing ground or fish species is selectable and can be reset to another type by pushing the CUSTOM button.

Clear Detection at Surface and Bottom Ends

- The adoption of a narrow zero-line fuction and a new transducer makes the transducer line finer. The high-speed emission of 600(JFC-130)/300(JFC-130HP) pulses or more per minute enables small fish in the surface water to be clearly detected. The bottom enlargement display in 16 color gradations discriminates bottom fish from the sea bottom distinctly.

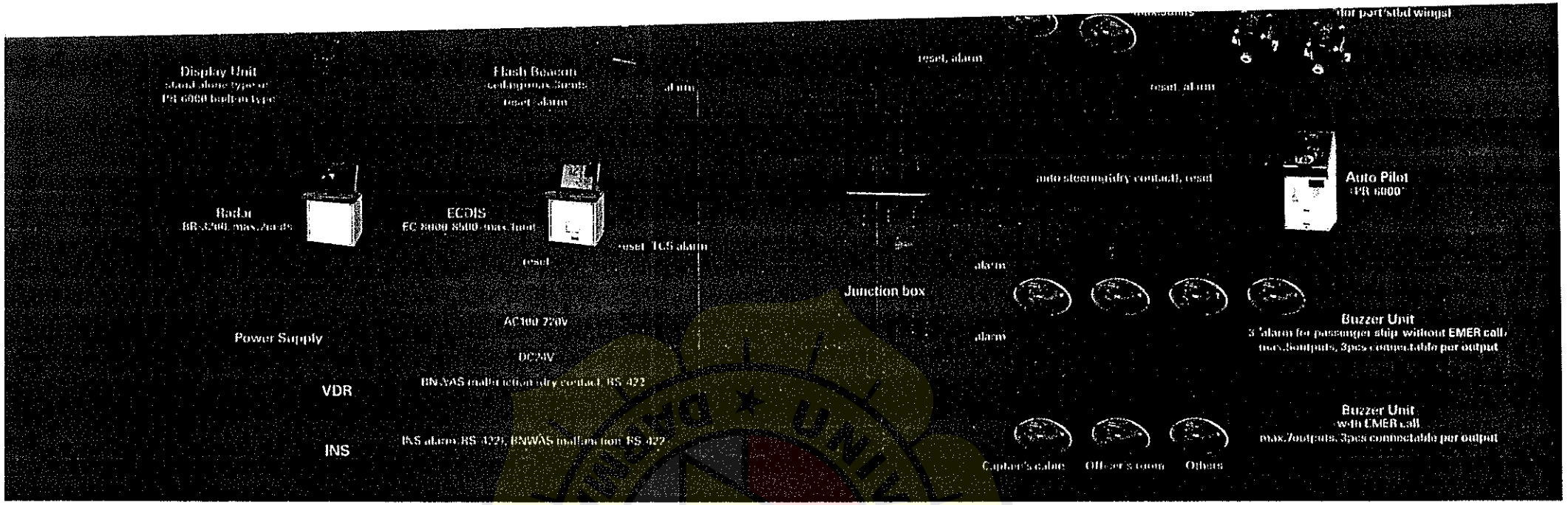
Various Functions

- Simultaneous display of two images
  When an image is switched to another, two images are immediately displayed for ease of comparsion.
- A-Scope Display
  A fish echo is displayed in a color tone with a width depending upon its signal intensity. The display mode is turned on or off by a one key-touch operation.
- Distinction (mix) mode
  The three-split display mode in which a distinction display is added to the dual-frequency split display is very useful in discriminating fish species.
- Water temperature and depth graphs
  Water temperature and depth graphs can be displayed in overlay with a fish echo image. Since these temperature and depth variations are stored, the graphs may be easily displayed by one key-touch operation. Normally, the fish echo image is displayed on a full screen.
- Bottom discrimination mode
  In the bottom lock enlargement mode, a long bottom tail shows a hard bottom (such as base rock) while a short bottom tail shows a soft bottom (mud and sand). Thus, the bottom topology can be discriminated depending upon the tail width.

Major Specification

Display	:10.4-inch high-luminance TFT color LCD
Power supply	:12/24/32 V DC (10.8-45 V DC)
Power consumption	:60 W or less (at 24 V)
Dimensions	:295(W) × 324(H) × 372(D)mm
Mass	:Approx. 16kg
Operating temperature	:−15℃ to +55℃
Brightness	:Adjustable by control(in common use with power switch)
Display modes	:Standard
	:Standard/Standard
	:Standard/A-scope
	:Standard/enlargement
	:Standard/Bottom enlargement
	:Standard/Bottom discrimination enlargement
	:Mixed mode

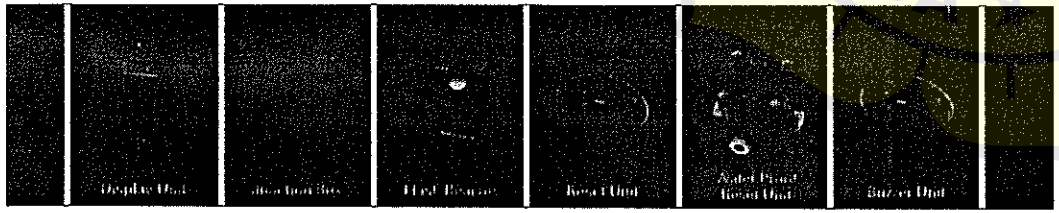
Frequencies	:One or two frequencies of 200/75/50/28 kHz
Output power	:1 kW or 3 kW(HP)
Depth range	:2,000m + shift 1,500m
Depth scale	:meter,feet,fathoms and optional
Scan speed	:9 steps and stop
Background color	:4 colors
Echo colors	:16 colors/8 colors
Interference rejection	:2 steps
Data indications	:Water depth,temperature and ship speed
Graphs	:Water temperature and depth
External input/output	:NMEA0183 input/output,JRC format
	:Water temperature and speed sensors



Bridge Navigation Watch Alarm System (BNWAS)

This system gives an alarm to prevent accidents at sea if it detects abnormalities in the watch officer's condition. If the system is not reset within the designated time period, the system will give visible and audible alarms in stages, as well as inform other officers.

In accordance with the SOLAS Chapter 5 regulation 19 revision, it is required that all new building vessels built on and after July 1, 2011 (passenger vessels and all other vessels of 150gt and over) have BNWAS installed. Also, existing vessels built before July 1, 2011, with relation to the vessel type and size, must also have BNWAS as per the SOLAS defined time periods.



■Function and features

- Conforms with IMO MSC.128 (75)
- Emergency Call transfer feature for selected rooms
- Self Diagnostic Check
- Timer reset option when connected with RADAR/ECDIS/AUTOPILOT
- Reset via motion sensor on the reset unit
- Option to build the display unit into the PR-6000 Autopilot for new building vessels

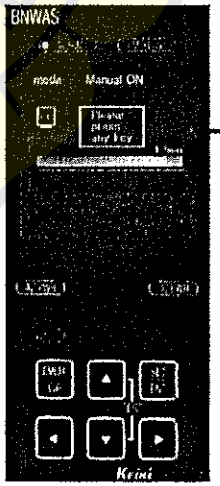
■Componenets

- Display Unit ····· ×1pc
- Junction Box ····· ×1pc
- Reset Unit ····· ×Max 3pcs
- Water Proof Reset Unit ···×Max 2pcs
- Flash Beacon ····· ×Max 3pcs
- Buzzer Unit ····· ×Max 36pcs

■Power

AC100~220V 1φ 50/60Hz(Max.120VA)
DC24V(Max.5A)

Display Unit



System condition with relation to watch observation

Each stage's display

Alarm pattern for each stage ✱ Green flash ✱ Orange flash ✱ Red flash ◀ξ Audible alarm

Display	VI	Alarm 1	Alarm 2	Alarm 3
Display Unit	✱	✱ ◀ξ	✱ ◀ξ	✱ ◀ξ
Reset Unit	✱	✱	✱	
Water Proof Reset Unit	✱	✱ ◀ξ	✱ ◀ξ	◀ξ
Flash Beacon	✱	✱	✱	✱
Buzzer Unit(Alarm2)			◀ξ	◀ξ
Buzzer Unit(Alarm3)				◀ξ

By performing the following, the system will reset and return to the Dormant Period

- Pushing a button on the Display Unit
- By movement near the motion sensor on the reset unit
- By pressing the button on the Water tight reset unit
- By performing an operation on the RADAR/ECDIS/or Autopilot (if connected to the BNWAS system)

型　式 Model

BR-3200-X 26 M

- 3200：有効直径320mm Effective dia. of 320mm
- X：Xバンド X-band / S：Sバンド S-band
- 空中線 Scanner
  - 6：6フィート 6ft
  - 7：7フィート 7ft
  - 9：9フィート 9ft
  - 12：12フィート 12ft
- 送信電力 Transceiver
  - 2：送受信機の尖頭送信出力 25kW 25kW Transceiver
  - 3：送受信機の尖頭送信出力 30kW 30kW Transceiver
- M：2ユニット 2unit / B：3ユニット 3unit

仕　様 Specification

機能 Function ＼ 型式 Model		Xバンド X-band				Sバンド S-band	
		BR-3200-X26M	BR-3200-X29M	BR-3200-X27B	BR-3200-X29B	BR-3200-S312M	BR-3200-S312B
		2ユニット 2 unit		3ユニット 3 unit		2ユニット 2 unit	3ユニット 3 unit
システム System	表示方式 Display type	23.1インチカラーLCD, ラスタースキャンPPI 23.1 Inch Color LCD, Raster Scan PPI					
	表示面 Display screen	有効直径 320mm以上 Effective diameter: more than 320mm					
	方位表示モード Orientation mode	ヘッドアップ(相対方位) / ノースアップ(真方位) / コースアップ(針路方位) Head up / North up / Course up					
	運動表示モード Motion mode	真運動-真航跡 / 相対運動ー相対航跡 / 相対運動ー真航跡 True motion - true trails / Relative motion - relative trails / Relative motion - true trails					
	距離範囲 Range scale	0.125~96nm*1 11レンジ 11 Ranges					
	距離分解能 Range discrimination	30 m					
	最小探知距離 Minimum range	40 m					
	海面反射・雨雲反射 抑制 Sea/Rain clutter suppression	自動／手動 Automatic / Manual					
	電源 Power supply	AC100-115V, 50/60Hz, 単相 1φ または AC220-240V, 50/60Hz, 単相 1φ					
	消費電力 Power consumption	350VA (標準) 350VA Standard				400VA (標準) 400VA Standard	
空中線 Scanner	アンテナ長 Antenna length	6ft	9ft	7ft	9ft	12ft	12ft
	回転数 Rotating speed	24min-1					
	ビーム幅 Beam width	水平：1.2° Horizontal	水平：0.8° Horizontal	水平：1.0° Horizontal	水平：0.8° Horizontal	水平：1.9° Horizontal	水平：1.9° Horizontal
		垂直：20° Vertical				垂直：25° Vertical	
送信機 Transmitter	送信周波数 Frequency	9410MHz±30MHz				3050MHz±20MHz	
	送信出力 Output peak	25kW				30kW	
	パルス幅 Pulse width	0.07, 0.2, 0.3, 0.4, 0.8, 1.0, 1.2μs					
	同調方式 Tuning method	自動同調／手動同調 Automatic / Manual					
目標追尾 Target tracking	追尾数 Tracking targets	100目標 100 targets					
	捕捉モード Acquisition mode	手動捕捉 およびゾーン設定(2本)による自動捕捉 Manual and Automatic with two acquisition zones					
	捕捉及び追尾領域 Acquisition and tracking area	0.1~32nm*1					
	試行操船 Trial maneuvering	自船の針路および速力変更による自船および他船のベクトル表示 When own ship's course and speed changes, own ship and other ship's vector are displayed					
AIS機能 AIS Function	活性化AIS表示数 Activated AIS targets	100目標 100 targets					
	休止化+活性化AIS表示数 Sleeping+activated AIS targets	300目標 300 targets					
	AISフィルタ Sleeping AIS filter	自船からの距離およびゾーン設定により休止化AIS表示をフィルタリング Display filtering by distance and zone settings from own ship					
	アソシエーション Target association	自船からの距離, 追尾物標とAIS物標の針路差/速力差によるアソシエーション判定 An automatic target association function is provided based on criteria. (Association criteria are Distance from own ship, TT*2/AIS target course difference, and TT/AIS target speed difference.)					
	試行操船 Trial maneuvering	自船の針路および速力変更による自船および他船のベクトル表示 When own ship's course and speed changes, own ship and other ship's vector are displayed					
インターフェース Interface <入力 Input>	ジャイロ信号 Gyro signal	IEC-61162-2(38400bps) HDG：THS>HDT Sentence (送信周期 50Hz) (Rate of sentence is 50Hz) シンクロ信号 Synchro signal (50-500Hz) 360X,180X,90X,36X AC50V~AC115V ステップ信号 Stepper signal 360X,180X,90X,36X DC24V~DC100V					
	ログ信号 Log signal	IEC-61162-1(4800bps) VBW Sentence, 接点入力 200パルス/nm*1 VBW sentence, Dry contact input 200p/nm*1					
	GPSデータ GPS data	IEC-61162-1(4800bps) LAT/LON ：GGA>RMC>RMA>GNS>GLL sentence COG/SOG ：RMC>RMA>VTG sentence WPT ：RMB>BWC sentence TIME ：ZDA sentence					
	AISデータ AIS data	IEC-61162-2(38400bps) VDO, VDM sentence					
<出力 Output>	ターゲットデータ(TT) Target data(TT)	IEC-61162-1/2(4800bps/38400bps) TTM, TTD, RSD/OSD sentence					
	レーダー映像(スレーブ指示器) Radar image(Slave display)	ビデオ, トリガ, 船首マーカ, アンテナパルス Video, Trigger, Heading marker, Antenna pulse					
	RGBデータ(VDR) RGB data(VDR)	アナログRGB Analog RGB					
	警報データ Alarm data	IEC-61162-1(4800bps) ALR sentence					
	ワッチマンアラームリセット Watch-man alarm reset	接点出力 Dry Contact output					
オプション Options		レーダー切替器：2台切替用(指示器に内蔵), 4台切替用(別置型) Interswitch unit(built-in Display Stand : 2 Display Units, Interswitch unit (Stand alone unit type) : 4 Display Units					
		空中線ヒータ：Xバンド用、Sバンド用 AC100V Scanner unit with Heater: X-band, S-Band AC100V					
		パワーコントロールユニット Power control unit　パワーコントロールユニット ー指示器間の最大ケーブル長 400m Max. length of the cable 400m (Power control unit - Display Unit)					
		VDR I/Fキット VDR I/F kit					
		18芯ケーブル：レーダー切替器用 5m/10m/15m/20m 18 core composite cable: 5m/10m/15m/20m (for external Interswitch unit)					
		フレキシブル導波管：Xバンド用 35m Flexible waveguide: 35m (for X-band)					
		同軸ケーブル：Sバンド用 35m Coaxial cable : 35m (for S-band)					
		14芯ケーブル：空中線ー指示器間 35m/50m/85m/100m/200m/300m 14 core composite cable : 35m/50m/85m/100m/200m/300m (Scanner-Display Unit)					
		4芯ケーブル：指示器ーECDIS間 5m/10m/15m/20m 4 core cable : 5m/10m/15m/20m (Display Unit-ECDIS)					

*1 nm = Nautical mile 画面表示上はNM (Nautical Mile) を使用
*2 TT = Tracked Target

型式検定番号および型式承認番号

総務省 無線機器型式検定

機器の名称	
マリンレーダーBR-3200-X26M	R08039
マリンレーダーBR-3200-X29M	R08013
マリンレーダーBR-3200-X27B	R09011
マリンレーダーBR-3200-X29B	R09012
マリンレーダーBR-3200-S312M	R08014
マリンレーダーBR-3200-S312B	R09015

国土交通省 型式承認

物件の名称	物件の型式	承認番号
航海用レーダー	マリンレーダーBR-3200-X26M	第4937号
航海用レーダー	マリンレーダーBR-3200-X29M	第4886号
航海用レーダー	マリンレーダーBR-3200-X27B	第4936号
航海用レーダー	マリンレーダーBR-3200-X29B	第4935号
航海用レーダー	マリンレーダーBR-3200-S312M	第4887号
航海用レーダー	マリンレーダーBR-3200-S312B	第4938号
自動衝突予防援助装置	AR-503	第4888号

del		JLN-650
ıeral		
	Measuring method	2-axis four beam pulse Doppler
	Frequency	125 kHz
	Screen	1024 by 768 pixels (XGA)
	Power supply	100V to 230V AC, 50Hz to 60Hz (single phase)
	Power consumption	< 270VA
ent measurement performance		
	Current speed range	0kn to 10kn
	Current measuring accuracy	maximum 2%rms or 0.2kn, whichever is greatest
	Current direction display	360° and numeric values with 32 bearing points
	Measurement layers	up to 100 layers (5 layers numerical)
	Minimum measurement depth of layer	8m (short pulse mode), 12m (normal pulse mode), 16m (long pulse mode)
	Maximum measurement depth of layer	160m (Tx power = standard), 200m (Tx power = high)
	Minimum measurement depth of bottom	26m (short pulse mode), 34m (normal pulse mode), 42m (long pulse mode)
	Setting depth range	5m to 500m
	Current reference	Doppler or GPS
	Measuring mode	relative or true
speed measurement performance		
	Fore/aft range	−10kn to 40kn
	Port/starboard range	−10kn to 10kn
	Ground speed depth	5m to 400m
	Measurement accuracy	± 1%rms or 0.1kn, whichever is greatest
	Water speed depth	more than 20m (ground and water speed simultaneous display)
	Distance run range	0nm to 99999.99nm
	Distance run accuracy	± 1%rms or 0.1kn
performance		
	Function	measuring current, ship speed, depth, fish finder, track plotting, graph display,profile display, self test, alam function (current speed, ship speed, trip, timer, water temperature)
	Display modes	current, ship, plot, graph, fish, profile
	Numeric display	current speed, current indication (absolute 5 layers, relative 4 layers), measurement depth, bottom tracking ship speed/course, water tracking ship speed/course, ship position, heading, trip, date, FA ship speed/PS ship speed, trip or time value, water depth, water temperature
	Graphic display	absolute/relative current vector, ship speed vector, water temperature graph, current/depth graph, ship speed graph, wind speed, wind direction graph, trip display, fish display, profile display
ıce		
	NMEA input (v1.5 to 3.01)	bearing (HDT, VHW, HDM, HDG, THS), lat/long (RMC, GGA, GLL, VTG), water temp (MTW), wind direction (MWD, MWV)
	External trigger input	transmission trigger
	NMEA output (v1.5 to 3.01)	ship speed current (VDVBW, VDVLW, VDVHW, VDDBT, VDDPT, VDCUR, PJRCL)
	Distance output	4x log pulse (200 pulse/nm)
	JRC output	JRC format (for current data output)
	Memory data output	USB port (up to 1000 memory points of current and track data can be saved)
ıment		
	Operating temperature	−15° to 55°C
	Relative humidity	0% to 93% non-condensing
als		
ıcer with stuffing tube (iron tank)		NKF-775
ıcer with stuffing tube		NKF-774
ıcer element (125 kHz)		CFT-068A
ı tube (for iron hull)		MPJD30076
ı tube (for FRP)		MPJD30078
r mount kit for NWZ-164		MPBX42944
ıde		MPOL30369

ırement depth is 80% or less of depth · Depths may vary according to sea (and sea bottom) conditions contents are subject to change without notice

• Specifications may be subject to change without notice.

For further information, contact:

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SPECIFICATIONS OF CH-250

1. Range scales and Pulselength

150 kHz

Range		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Unit	Meters	10	20	40	60	80	120	160	200	250	300	400	500	600	800	1000
	Feet	40	80	120	200	300	400	500	600	700	800	1000	1500	2000	2500	3500
	Fathoms	10	20	40	60	80	100	120	140	160	200	250	300	400	500	600
	P/B	10	20	40	60	80	100	120	140	160	200	250	300	400	500	700
Time to train full circle (s)		7	7	7	7	7	10	12/13	14/16	16/20	18/24	22/32	26/40	30/48	38/64	46/81

Max scale depends on the system frequency. 1600 m (60 kHz), 1200 m (88 kHz), 1000 m (150 kHz).
Training speed is subject to the system frequency and range scales. Two speeds on long range scales.

2. **Display Unit** 10.4" TFT color LCD (VGA: 640 x 480 pixels)
3. **Color** 8 or 16 colors
4. **Display Mode**
   (1) Full Circle scan (2) Zoom (x 1.5) (3) Vertical scan
   (4) Vertical Sounder (5) Full/Half Circle and Vertical scan
   (6) Full Circle and History (7) Full Circle and Strata
   (8) Full Circle and VideoPlotter
5. **Audio Monitor** 1000 Hz
6. **TX Output Power** 0.8-1.2 kW
7. **Beamwidth** (at -3 dB)
   60 kHz: 15° (H) x 12° (V)
   88 kHz: 11.5° (H) x 9.5° (V)
   150 kHz: 6.5° (H) x 6.5° (V)
8. **Transducer Control**
   Tilt 0° to -180° at 3° or 6° steps (in vertical scan)
   +5° to -90° at 1° steps (in full circle scan)
   Training Sector Manual or automatic training at 6° or 12° steps in search sector 6°-360°
   Target Lock By L/L or Echo position
   Interface NMEA 0183 Ver 1.5, 2.0 (IEC 61162-1)
   Input: DBS, DBT, DPT, GGA, GLL, HDG, HDM, MDA, MTW, RMA, RMC, VDR, VHW, VTG
   Output: SSTLL
9. **Language** English, Spanish, Danish, Portuguese, French, Norwegian, Italian, Swedish, Thai

Power Supply
Transceiver Unit 12-24/32 VDC, 55 W
Hull Unit 12/24-32 VDC, 55 W
(200 W while raising/lowering transducer)

ENVIRONMENT (Complies with IEC 60945)
Display Unit: -15°C to +55°C
Water proofing IEC IPX5, USCG CFR 46 (Display Unit)

EQUIPMENT LIST

Standard

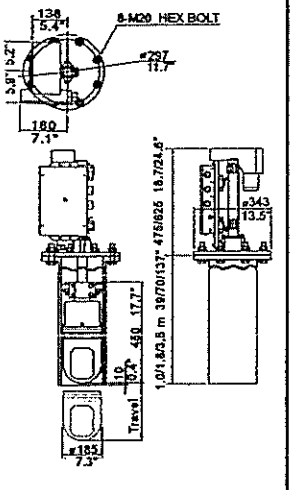
1.	Display Unit MU-100C	1 unit
2.	Control Unit CH-252	1 unit
3.	Hull Unit CH-254 (travel 400 mm) or CH-255 (travel 250 mm)	1 unit
4.	Transceiver Unit CH-253	
5.	Installation Materials and Spare Parts	1 set
6.	Interface Unit IF-8000 (BlackBox type only)	1 unit

Option

1. Remote Controller CH-256
2. Rectifier RU-1746B-2
3. External Speaker SC-05WR
4. 1 m tall steel tank (06-007-1570), 1.8 m tall steel tank (SHJ-0001), 3.5 m tall steel tank (06-007-1571), 1 m tall FRP tank (SHJ-0022), 1.8 m tall FRP tank (06-007-1573), 1 m tall aluminum tank (OP10-5),
5. NMEA Cable
   MJ-A6SPF0012-050 (5 m), MJ-A6SPF0011-050 (5 m),
   MJ-A6SPF0012-100 (10 m), MJ-A6SPF0011-100 (10 m),
6. Motion Sensor MS-100 or Clinometer BS-704
7. Interface Unit IF-8000

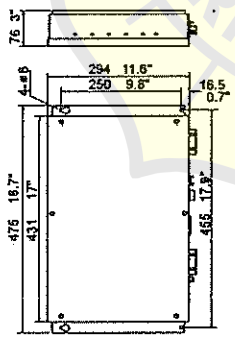
HULL UNIT

SH-254 (Travel: 400 mm)
3 kg, 94.8 lb
SH-255 (Travel: 250 mm)
2 kg, 92.6 lb



TRANSCEIVER UNIT

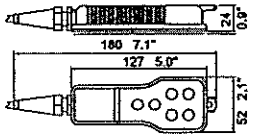
CH-253 3.2 kg, 7.1 lb



REMOTE CONTROLLER

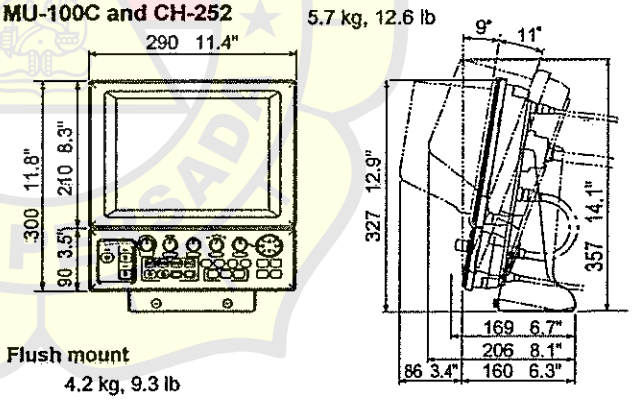
(OPTION) CH-256

0.3 kg
0.7 lb

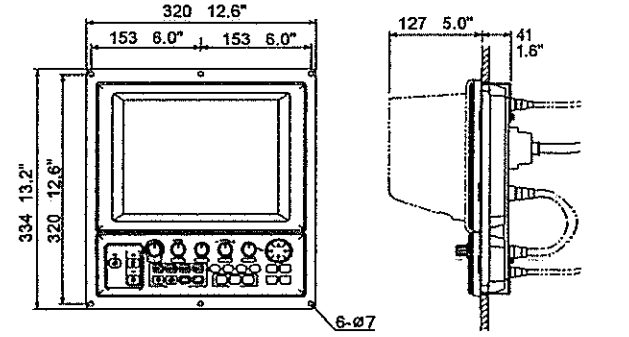


DISPLAY UNIT and CONTROL UNIT

MU-100C and CH-252 5.7 kg, 12.6 lb



Flush mount
4.2 kg, 9.3 lb



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FURUNO World Wide Warranty 2 years

GPS RECEIVER CHARACTERISTICS

1.	**Receiver Type**	Twelve discrete channels, C/A code, all-in-view, integral WAAS receiver processor
2.	**Receive Frequency**	L1 (1575.42 MHz)
3.	**Accuracy**	GPS: 10 m (95%) DGPS: 5 m (95%) WAAS: 3 m (95%)
4.	**Time to first fix**	12 seconds typical (Warm start)
5.	**Tracking Velocity**	999 kt
6.	**Geodetic System**	WGS-84, NAD-27, and others
7.	**DGPS Capability**	Optional internal DGPS beacon receiver kit

PLOTTER CHARACTERISTICS

1. **Display**
   GP-3500: 10.4" TFT Color LCD, 480(W) x 640(H) pixels
   GP-3500F: 10.4" TFT Color Transflective LCD, 480(W) x 640(H) pixels
2. **Map Scale** 0.125 to 1,024 nm
3. **Latitude Limits** Between 85°N and 85°S
4. **Plot Interval** 1 sec to 99 min 59 sec or 0.01 to 9.99 nm
5. **Display Modes** Course plot, Nav Data, Compass Display
6. **Presentation Modes** TM North-up, Course-up
7. **Memory Capacity** Up to 80,000 points for ship's track points and marks.
   3500 waypoints and 200 planned routes (Max. 35 waypoints/route)
8. **Voyage Planning** Waypoint navigation or route navigation
9. **Alarms** Arrival/anchor watch, XTE, proximity alert, ship speed, depth*, water temperature**, fish***
   *GP-3500F or Depth sensor required.
   **Temperature sensor required, ***GP-3500F only.
10. **Interface** (IEC-61162-1, NMEA 0183 ver. 1.5/2.0)
    Outputs: AAM, APB, BOD, BWC, DBT**, DPT**, GGA, GLL, MTW*, RMA, RMB, RMC, VTG, WPL, XTE, ZDA
    Inputs: DBT, DPT, HDG, HDM, HDT, GGA, GNS, GLL, MTW, RMA, RMC, TLL, TTM, VHW, VTG, ZDA
    *Depth sensor required **GP-3500F only
11. **Cartography**
    FURUNO MiniChart, NAVIONICS® Nav-Chart™ or C-MAP*NT* Chart
    note: Choose from two units that accept either C-MAP*NT* Charts or Navionics® Nav-Chart™/Furuno MiniCharts when ordering.

ECHO SOUNDER

1.	**Display Modes**	Normal (single- or dual-frequency), Bottom-lock, Bottom Zoom, Marker Zoom, A-scope
2.	**Frequency**	50 and 200 kHz
3.	**Output Power**	600 W/1 kW (specify when ordering)
4.	**Basic Ranges**	8 basic ranges customized to max 1200 m
5.	**Range Shift**	0 to 1200 m

ENVIRONMENTAL CONDITIONS (IEC 60945 testing)

1. **Temperature**
   Display Unit: -15°C to +55°C
   Antenna Unit: -25°C to +70°C
2. **Water resistance**
   Display Unit: IPX2 (IEC 60529), CFR46 (USCG)
   Antenna Unit: IPX6 (IEC 60529), CFR46 (USCG)

POWER SUPPLY

12 - 24 VDC, GP-3500: 25 W, GP-3500F: 30 W

EQUIPMENT LIST

Standard

1.	Display Unit GP-3500/3500F	1 unit
2.	Antenna Unit GP-017S	1 unit
3.	Antenna Cable 15 m	1 pc
4.	Installation Materials and Standard Spare Parts	1 set

Option

1. FURUNO MiniChart Card
2. Remote Controller
3. NMEA Cable 5/10 m MJ-A6SPF0012-050/100
4. Antenna Cable 30/50 m CP20-01700/01710
5. Antenna Mounting Base
   13-QA330 (Pipe mount), 13-QA310 (Offset bracket), 13-RC5180 (Handrail mount)
6. Rectifier PR-62 for 115/230 VAC mains
7. Temperature Sensor T-02MSB (GP-3500F)
8. Speed/Temperature Sensor ST-02MSB/ST-02PSB (GP-3500F)
9. Internal DGPS Beacon Receiver Kit GR7000A-3500-NN-019S
   (Including Internal Beacon Receiver Board and DGPS Antenna Unit GP-019S)

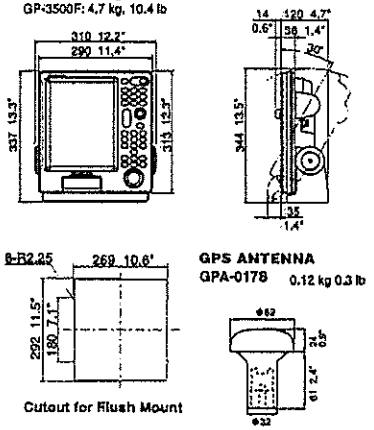
Transducers *(Specify when ordering GP-3500F)*

600 W
520-5PSD (Plastic thru-hull), 520-5MSD (Bronze thru-hull),
520-5PWD (Plastic transom), 525ST-MSD (Bronze thru-hull w/speed/temp sensor)
525ST-PWD (Plastic transom speed/temp sensor)

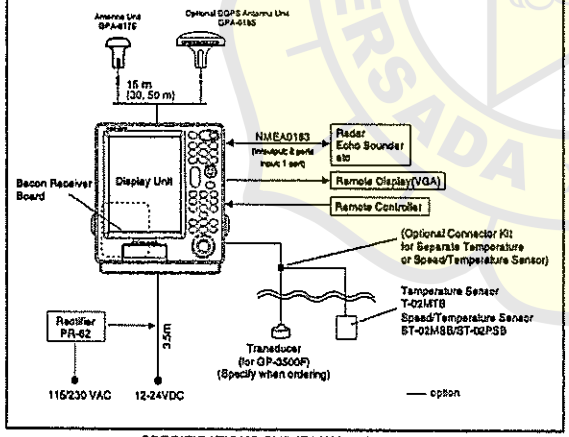
1 kW (Optional matching box MB-1000 required)
50B-6, 50B-6G, 200B-5, 200B-5S, 50/200-1T, 50/200-12M

DISPLAY UNIT

GP-3500: 4.5 kg, 9.9 lb
GP-3500F: 4.7 kg, 10.4 lb



INTERCONNECTION DIAGRAM



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GPS/DGPS/WAAS VIDEOPLOTTER

with Integral Echo Sounder

Models GP-3500/3500F

- Accuracy enhanced with built-in WAAS
- 10.4" high-definition TFT LCD for optimum viewing during daytime and nighttime
- Display of ship's tracks, waypoints and planned route on a precision electronic chart
- Dual Interchangeable Card Slot Works with C-MAP*NT* Charts or NAVIONICS® Nav-Charts™/FURUNO MiniCharts
- Display modes including:
  - Course Plot
  - Nav Data
  - Compass
- Low-profile, space-saving display unit with GPS/WAAS combo antenna
- Stores up to 80,000 ship's tracks and marks, 3,500 waypoints, 200 planned routes
- 50/200 kHz dual-frequency echo sounder, selection of 600 W or 1 kW (GP-3500F)
- Optional MiniMemory Card for storage of ship's tracks and marks
- Remote Controller available as option

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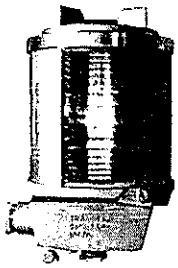
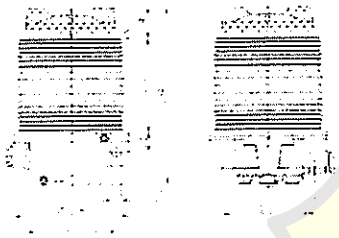
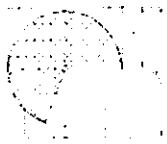
TEF 2870
NAVIGATION LIGHT FOR VESSELS 20 - 50M AND MORE THAN 50M IN LENGTH SAFE AREA







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(Fig. 1)

(Fig. 2)

(Fig. 3)

(Fig. 4)

Tranberg's navigation lights are all designed for rough environments. It is the policy of Tranberg to provide products and services that meet the highest standards of quality in the industry and the performance needs and expectations of our customers. Achievement of this objective requires that all products perform reliably and efficiently and in a manner that assures continuing market competitiveness.
The design of Tranberg navigation lights is based on many years of experience and extensive research in the field of professional Marine lighting. Carefully selected materials are used to ensure maximum performance, low maintenance and a long trouble free life. Proven through years of use in rough environments, navigation lights from Tranberg are the obvious choice by many vessel designers - ship owners and yards throughout the world.

APPLICATION

- Navigation lights for vessels 20 - 50 meters and more than 50 meters in length
- Signal lights

FEATURES AND BENEFITS

- Integrated terminalbox, no need for extra connection box(Fig. 1)
- Access to bulb from top - enabeling quick replacement of light source (Fig. 2)
- Supplied with isolators to be used between the lantern and hull/mast (such as aluminium) to prevent corrosion (Fig. 3)
- Durable bracket in stainless steel (SS316L) can be used when installing the lantern on 1" or 2" pipes (Fig. 4)
- 20 years warranty on lantern
- Extremely durable to mechanical deterioration
- Designed for use in arctic and tropical waters
- Small dimensions
- Resistant to vibrations
- Lens of through-coloured glass, - no de-colouration throughout the lifetime of the lantern
- The lens can easily be cleaned for paint, bird droppings, pollution and oil
- Optional feature: For Zone 2, Ex code: Ex nR II TS

TECHNICAL DATA

Material:	Cast brass, lens of through-coloured glass
Input voltage:	24V AC/DC On request all round lights can be supplied for 115/230V AC
Light source:	40 Watt for 24V DC/AC 65 Watt for 230V AC Light source according to DIN 49841
Minimum visibility:	6 n. m. with clear lens 3 n.m. with coloured lens
Ingress protection:	IP56
Standard cable entries:	M20

APPROVALS AND CERTIFICATES

Type approved and certified by Det Norske Veritas (DNV) to be in compliance with the requirements in the Council Directive 96/98/EC December 1996 on Maritime Equipment as amended by directive 2009/26/EC, issued as "Forskrift om skipsutstyr" by the Norwegian Maritime Directorate, Annex A.1, Item No. A.1/6.1 and Annex B, Module B in Directive, COLREG 72 as amended, Annex I/14, IMO Res. A694(17) and IMO Res. MSC.253(83). Certificates Nos.: MED-B and MED-D

Approved by Nemko to be used in Zone 2* Ex classification code: Ex nR II T5 Certificate No.: NEMKO Ex94Y019

* For 24V DC/AC only

TRANBERG

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Tranberg Systems | Hjulmagervej 15C | 7100 Vejle | Denmark | Tel.: (45) 75 85 83 80
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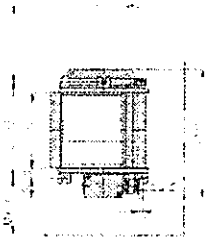
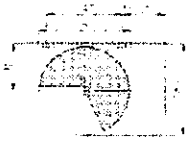
NAVIGATION LIGHT FOR VESSELS 20-50M AND MORE THAN 50M IN LENGTH SAFE AREA

Sector lantern





All round lantern

Tranberg's navigation lights are all designed for rough environments. It is the policy of Tranberg to provide products and services that meet the highest standards of quality in the industry and the performance needs and expectations of our customers. Achievement of this objective requires that all products perform reliable and efficiently and in a manner that assures continuing market competitiveness.
The design of Tranberg navigation lights is based on many years of experience and extensive research in the field of professional Marine lighting. Carefully selected materials are used to ensure maximum performance, low maintenance and a long trouble free life. Proven through years of use in rough environments, navigation lights from Tranberg are the obvious choice by many vessel designers - ship owners and yards throughout the world.

APPLICATION

- Navigation lights for all vessels 20-50 meters and over 50 meters in length

FEATURES AND BENEFITS

- Integrated terminal box - no need for extra connection box
- Hinged on top - enabling quick replacement of light source
- All round lanterns are delivered with mounting bracket for 2" pipe
- Designed for use in arctic and tropical waters
- Resistant to vibrations
- Lens of through-coloured glass, no de-colouration throughout the lifetime of the lantern.
- The lens can easily be cleaned for paint, bird droppings, pollution and oil
- Lamp to be in accordance with Norwegian Standard NS 2785 or equivalent
- Optional feature: For Zone 2 Ex code: Ex nR II T5

TECHNICAL DATA

Material:	Aluminium with clear or through-coloured lens
Input voltage:	24V, 120V, 230V
Light source:	55 Watt for vessels 20 - 50 meter 85 Watt for vessels more than 50 meter
Power comsumption:	55 - 85 Watt, dependant on light source
Ingress protection:	IP56

APPROVALS AND CERTIFICATES

Type approved and certified by Det Norske Veritas (DNV) to be in compliance with the requirements in the Council Directive 96/98/EC December 1996 on Maritime Equipment as amended by directive 2009/26/EC, issued as "Forskrift om skipsutstyr" by the Norwegian Maritime Directorate, Annex A.1, Item No. A.1/6.1 and Annex B, Module B in Directive, COLREG 72 as amended, Annex I/4, IMO Res. A694(17) and IMO Res. MSC.253(83).
Certificate Nos.: MED-B and MED-D

Approved by Nemko to be used in Zone 2 Ex classification code: Ex nR II T5 Certificate No.: NEMKO Ex99Y060

TRANBERG

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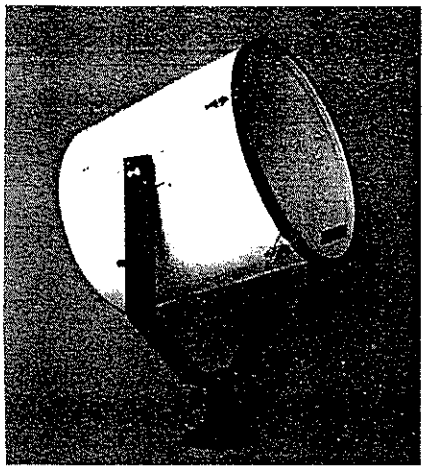
Tranberg Systems | Hjulmagervej 15C | 7100 Vejle | Denmark | Tel.: (45) 75 85 83 80
E-mail: mail@tranbergsystems.com | www.tranbergsystems.com



Francis

L560 Issue 4
Tungsten Halogen
Manual Operation

APPLICATION

The FRANCIS Lite range of searchlights incorporate the design features required to successfully operate searchlights in the most demanding product operating environments on land and sea.

The L560 has excellent illumination characteristics, powerful, focusable beam and is suitable for use on works boats, smaller cargo vessels and bridge wing projectors.

PART NUMBERS

Type	Part Number
560 Deck 3kw 110/240v	A2969
Cabin Control Assembly	C23348-01
Cabin Pedestal Control Assembly	C22786-01
Deck Pedestal	C22800-79

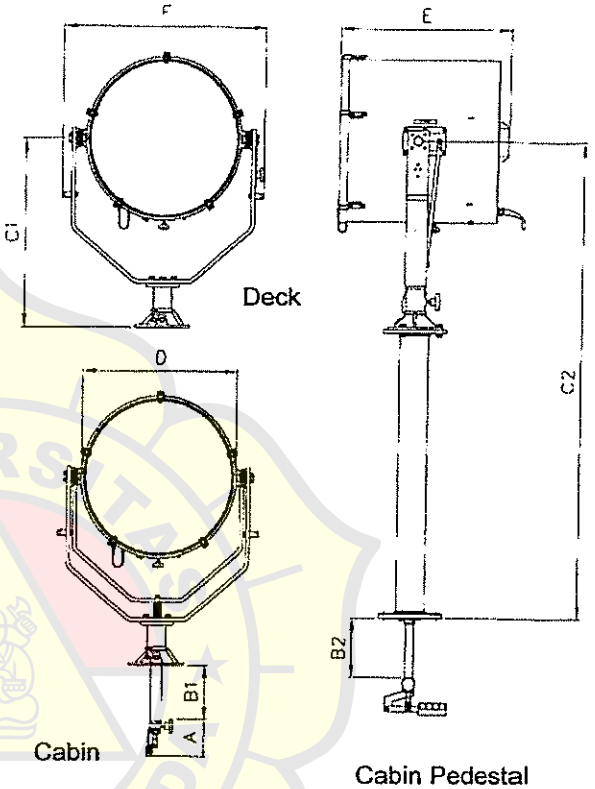
SPECIFICATION

Constructed from Marine grade materials & fixings.
Parabolic formed aluminium reflector.
Powder coated finish.
External lamp focus adjustment.
Toughened front glass.
Light shield to prevent unwanted glare & stray light.
Tungsten Halogen light source.
Sealing to IP66.
Special B1, B2 and C2 dimensions available on request.
Full 450° rotation.
Vertical movement +30° to - 25°

PERFORMANCE DATA

Volts	Lamp life	Range (m)	PBCP x1000	°Div	Watts	Lamp Cap	Lamp Part Number
24v	400 hrs	2450	4850	6.3	3000	G38	D9843
110/240v	400 hrs	2450	4850	6.3	3000	G38	D22559
24v	400 hrs	2030	3900	4.8	2000	G38	D1823
110/240v	400 hrs	2030	3900	4.8	2000	G38	D4604

Inclusive angle



All dimensions in Millimeters

Base fixings
Deck & Cabin - 3 holes Ø11 on a 174 PCD
Cabin Pedestal - 4 holes Ø12.5 on a 270 PCD
Central hole: Cabin Ø52, CP Ø95

Dimensions

A	B1	B2	C1	C2	D	E	F1
130	190	210	659	1663	560	616	731

Weights

L560Deck	23.5 Kgs
Cabin Control Assembly	10 Kgs
Cabin Pedestal Assembly	20 Kgs

For more information contact:

Francis Searchlights Limited
Orion Road, Bolton, BL2 2HJ, UK
Tel 44 (0) 1204 558960 Fax 44 (0) 1204 558969
Email sales@francis.co.uk Web site www.francis.co.uk

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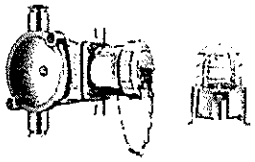
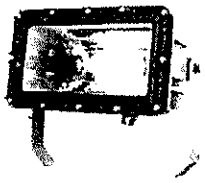


Home > Products > Equipment for hazardous areas >

HAMBURG LXN400 Ex HPS Floodlight 400W



Article number: 5304003
Catalog number: LXN400
Catalog page: 205
IP number: IP 67
Weight: 31,000 Kg

Ex-proof floodlight for High-Pressure-Sodium or Matal Halide lamp 400W with lampholder E40. Housing, glass-holding frame and bracket made of aluminium, special paint finish in grey colour. Glas holding frame with sealed borosilicate glass, with stainless steel screws (undetachable). Higned glass holding frame. Separate Ex-e terminal box with 1x M25 plastic cable gland and 1 x M25 plastic blind plug. Ballast unit and ignitor isolated from the lamp in a seperate compartment, thus ensuring that the heat of the lamp does not have any harmful effects. Ballast fittet with connection plug to allow easy removal for servicing purposes Rated voltage: 230V +/- 10%, 50Hz. Insulation class: I, Certificate: PTB04 ATEX 1046, -20°C to +55°C T3. Type of protection: EEx de IIB T3, Zone 1 and Zone 2

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Quantity

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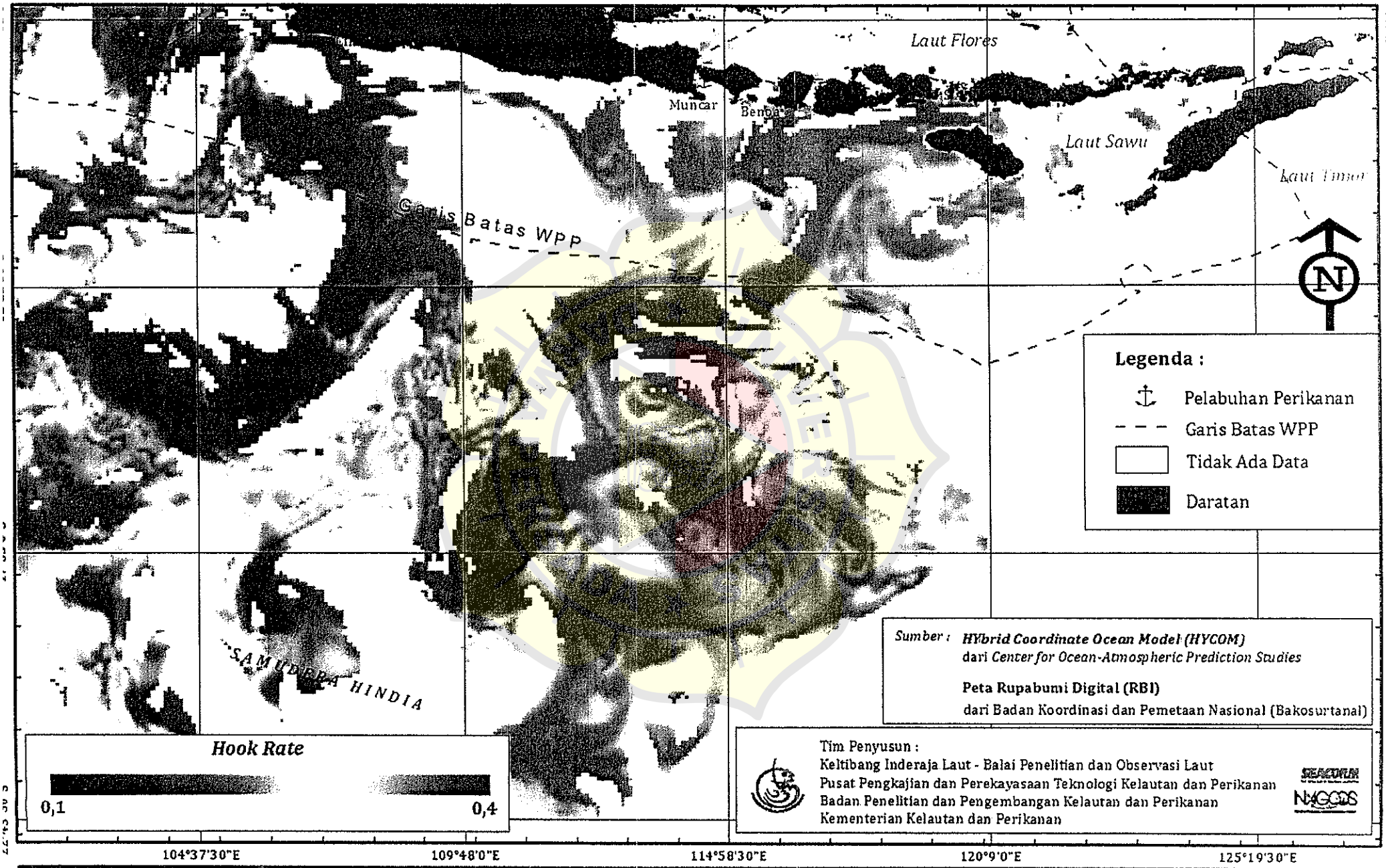
Spare parts

1 Mil Laut = 1.825 Meter



Sumber : ***HYbrid Coordinate Ocean Model (HYCOM)*** dari *Center for Ocean-Atmospheric Prediction Studies*

Peta Rupabumi Digital (RBI) dari Badan Koordinasi dan Pemetaan Nasional (Bakosurtanal)

Tim Penyusun :
Keltibang Inderaja Laut - Balai Penelitian dan Observasi Laut
Pusat Pengkajian dan Perekayasaan Teknologi Kelautan dan Perikanan
Badan Penelitian dan Pengembangan Kelautan dan Perikanan
Kementerian Kelautan dan Perikanan

DISCLAIMER : Peta lokasi penangkapan ikan tuna ini adalah hasil prediksi yang dibuat berdasarkan pada pendekatan statistik dengan menggunakan data dari hasil permodelan numerik.Untuk meningkatkan keakuratan dari hasil prediksi, EPOL sangat mengharapkan adanya data respon balik dari para pengguna. Data respon balik tersebut dapat dikirimkan ke alamat email ppdpi_brok@yahoo.com