BAB X
PENUTUP

XI.1 KESIMPULAN

Dengan perencanaan perancangan kamar mesin diatas didapat beberapa kesimpulan bahwa karakteristik ditekankan pada segi keselamatan penumpang dan perhitungan perencanaan menggunakan rumus yang sesuai dengan referensi tidak mengurangi tanggung jawab sesuai peraturan yang ada.

Sepesifikasi sebagai berikut :

1. MOTOR INDUK KAPAL:

- Merk : **WARTSILA**
- Type : **W 4L20**
- Jumlah silinder : 4
- Bore & Stroke : 200 x 280 (mm)
- Daya : 1080 HP (800 KW)
- Putaran Mesin : 1000 Rpm
- Berat mesin : 2365 Kg
- Konsumsi bahan bakar (Sfoc) : 197 g/kWh
- Dimensi : 2510 × 1483 × 1800 (mm)

Marine Gear specification

- Merk : **WUCHAI**
- Model : **ADVANCE 900 MG**
- Reduction Ratio : 1 : 2,04
- Berat Gear : 1600 Kg
-

2. BALING – BALING YANG DIPILIH

- Type baling – baling berada pada : B4 – 40
- Diameter baling – baling (D) : 1,35 M
- Pitch Ratio baling – baling (Ho/D) : 0,58
- Expanded blade ratio (Fa/F) : 0,40
- Effisiensi baling – baling (η_p) : 52,8 %
- Jumlah daun baling – baling (Z) : 4

3. SPESIFIKASI GENERATOR SET

- Merk : **YANMAR**
- Type : **6HAL2-DTN**
- Jumlah silinder : 4
- Bore & Stroke : 130 x 165 (mm)
- Daya : 225 KW
- Putaran Mesin : 1500 Rpm
- Dimensi : 1563 × 1163 × 1410 (mm)
- Jumlah : 2 set

4. Spesifikasi Air Starting Compressor

- Merk : Sauer compressor
- Tipe : WP 22 L
- Pressure : 40 bar maksimal
- Kapasitas : 16,6 m^3/jam
- Daya : 4,5 kW
-

5. Spesifikasi Fuel Oil Transfer Pump

Merk : Taiko
Type : HHC-7.5 MA
Head : 80 x 65 mm
Kapasitas : 7,5 m^3/h
Daya : 3,7 kW
RPM : 1200 min^{-1}
Jenis : Gear Pump

6. Spesifikasi Fuel Oil Sapplay Pump

Merk : Taiko
Type : HHC-6 MA
Head : 65 x 50 mm
Kapasitas : 6 m^3/h
Daya : 2,2 kW

RPM : 1200 min^{-1}

Jenis : Gear Pump

7. Spesifikasi Lubricuting Oil Pump

Merk : Taiko

Type : HHC- 1,5 MA

Head : 40 x 32 mm

Kapasitas : 1,5 m^3/h

Daya : 0,75 kW

RPM : 1800 min^{-1}

Jenis : Gear Pump

8. Spesifikasi Fresh Water Cooling Pump

Merk : Taiko

Type : TMC 50B

Head : 50 x 50 mm

Kapasitas : 10 – 25 m^3/h

Daya : 3,7 kW

RPM : 3600 min^{-1}

Jenis : Centrifugal Pump

9. Spesifikasi Sea Water Cooling Pump

Merk : Taiko

Type : EHC-51 J

Head : 50 x 50 mm

Kapasitas : 10 – 25 m^3/h

Daya : 3,7 kW

RPM : 1800 min^{-1}

Jenis : Centrifugal Pump

10. Spesifikasi Pompa Ballast

Merk	: TAIKO
Type	: EHS – 70C
Kapasitas	: 16 – 32,5m^3/jam
Daya	: 3,7 kW
RPM	: 1800 m^{-1}
Jenis	: Centrifugal Pump
Head	: 65 x 65 m (Suction x Discharge)

11. Spesifikasi Pompa Bilga

Merk	: TAIKO
Type	: EHS – 70C
Kapasitas	: 20 - 35m^3/jam
Daya	: 7,5 kW
RPM	: 1800 m^{-1}

12. Spesifikasi Pompa Fire

Merk	: TAIKO
Type	: EHS – 70C
Kapasitas	: 20 - 35m^3/jam
Daya	: 7,5 kW
RPM	: 1800 m^{-1}
Jenis	: Centrifugal Pump
Head	: 65 x 65 m (Suction x Discharge)

13. Spesifikasi Pompa Sanitary

Merk	: TAIKO
Type	: TMC – 32
Kapasitas	: 2 – 6,5 m^3/jam
Daya	: 2,2 kW
RPM	: 3600 min^{-1}
Jenis	: Centrifugal Pump

Head : 65 x 65 m (Suction x Discharge)

14. Spesifikasi Pompa Sanitary

Merk : TAIKO
Type : TMC – 32
Kapasitas : 2 – 6,5 m^3/jam
Daya : 2,2 kW
RPM : 3600 min^{-1}
Jenis : Centrifugal Pump
Head : 65 x 65 m (Suction x Discharge

15. Spesifikasi Pompa Seawage

Merk : TAIKO
Type : TMC – 32
Kapasitas : 2 – 6,5 m^3/jam
Daya : 2,2 kW
RPM : 3600 min^{-1}
Jenis : Centrifugal Pump
Head : 65 x 65 m (Suction x Discharge)

16. Spesifikasi *Steering Gear*

Merk : Kawasaki Motor Hydrolic
Type : Steering Gear RV* 1-004
Motor Output : 3,7 kw
Motor Speed : 1,750 rpm^{-1}

17. Spesifikasi Motor *Windlass*

Merk : Ingersoll Rand
Type : FH2B
Kapasitas : 1818 Kg
Daya Motor : 12,495 Kw

18. Spesifikasi Motor Capstan

Merk : Ingersoll Rand
Type : AM94A Air Powered
Kapasitas : FA2B 400 lb (1818 kg)
Daya Motor : 6,94 Kw

19. Spesifikasi Boad Winch

Merk : Ingersoll Rand
Type : 700 A40 – B40
Kapasitas : 200 – 2500 lb (91 – 11364 Kg)

20. *Spesifikasi Blower Fan*

- ***Exhaust Blower Fan***

  Merk = *DKE*
  Tipe = *KV-AC-DKE-400I*
  Kapasitas = 5650 – 11070 m^3/h
  Daya = 3,0 kW

- ***Supply Blower Fan***

  Merk = *DKE*
  Tipe = *KV-AC-DKE-355II*
  Kapasitas = 2980 – 7400 m^3/h
  Daya = 1,5 kW

21. Spesifikasi AC

RUANGAN	Q_{tot} [W]	Q_{tot} [Btu/h]	Merk	Tipe	Daya AC [W]
R.Klinik	1541,93	5051,437	DOMETIC	ECD06.5	1905
R.ABK1	3176,75	10629,674	Climarine	OF R407C	3000-12000
R.ABK2	4997,15	16841,137	Climarine	OF R407C	3000-12000
R.Chief Officer	1362,95	4440,732	DOMETIC	ECD05	1465

R.Chief Enginer	1362,95	4440,732	DOMETIC	ECD05	1465
R. Kemudi	9766,98	33116,472	Climarine	OF R407C	3000-12000
R. Nahkoda	1486,28	4861,51	DOMETIC	ECD06.5	1905
R. KKM	1468,28	4861,51	DOMETIC	ECD06.5	1905
R.Mess	2776,98	9265,602	Climarine	OF R407C	3000-12000
Engine Control Room	1809,79	5965,413	DOMETIC	ECD06.5	1905

22. Spesifikasi Compressor

Merk : Woden Case

Model : EL – 20 / 10 FZK

Speed : 750 rpm

Daya : 5.5 Kw

23. Spesifikasi *Lamps*

Marine Fluorescent Lamps	
Tipe	*Light flux [lm]*
FL-4W	90, 95, 100
FL-6W	155, 170, 180
FL-8W	260, 280, 290
FL-10W	410, 440, 460, 490, 530
FL-15W	710, 780, 820, 860, 920
FL-20W	1010, 1100, 1160, 1320, 1400
FL-30W	1480, 1620, 1700, 1790, 1900
FL-40W	2610, 2850, 3000, 3180, 3380

24. Spesifikasi *Life raft*

Merk : *Switlik CLR - 1*

Tipe : *Coastal Inflatable Liferaft*

Jumlah : 2 unit

Kapasitas : 1 unit maksimal 15 Orang.

25. Spesifikasi Life Jacket

Merk : *Viking – PFD L 1*

Ukuran : Panjang 28,56cm x lebar 55,93cm x Tebal 16,4cm

Sesuai dengan *Torremolinos International Convention For The Safety Of Fishing Vessels*, 1977, jumlah *life jacket* harus ditambah 5% dari jumlah awak kapal,

26. Spesifikasi Life Bouy

Merk : *Viking – RB 30s*

Tipe : *Line Throwing*

Ukuran : Diameter 30 cm x tebal 15 cm

Panjang Tali : 27,5 m

Jumlah : Dua unit

27. Instrumen Lainnya :

- 1 (satu) *Sextant*
- 1 (satu) *Prismatic Binoculars*
- 1 (satu) *Chronometer*
- 1 (satu) Radio *Clock* di ruang radio
- 1 (satu) *Stop Watch*
- 1 (satu) *Thermometer* air laut 5° C sampai 60° C
- 1 (satu) *Thermometer atmosphir* -20° C sampai 60° C
- 1 (satu) *Clinometer* tipe jam di ruang kemudi
- 1 (satu) *Clinometer* tipe pendulum 300 mm di ruang mesin
- 2 (dua) Mistar sejajar
- 2 (dua) Jangka semat
- 8 (delapan) pemberat peta

- 2 (dua) *Hand Lead*, 3,2 kg
- 1 (satu) *Deep sea lead*, 12,7 kg
- 1 (satu) *barometer*
- 1 (satu) set Radar
- 1 (satu) set *Echo sounder* dan 1 (satu) set *Anemometer.*

c. Bendera dan Buku Isyarat

- 1 (satu) *Intenational signal flag set*, 0,86 x 0,71 m
- 1 (satu) *Ships name flag set*, 0,86 x 0,71 m
- 1 (satu) *Blue peter*, 0,86 x 0,71 m
- 1 (satu) *Quarantine flag*, 0,86 x 0,71 m
- 1 (satu) *Pilot flag*, 0,86 x 0,71 m
- 1 (satu) *National flag*, 1,20 x 1,80 m dan 0,90 x 1,20 m
- 1 (satu) *Signal code book*
- 1 (satu) *Register book*
- 1 (satu) *Tide table, domestic issue and foreign issue each*
- 1 (satu) *Nautical almanac*
- 1 (satu) Daftar ilmu pelayaran
- 1 (satu) set peta laut.

Daftar Pustaka

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2. harvald poels, *Lecture On Ship Design and Theory*,
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5. Japan Marine Standards JIS F 8407 dan JIS C 7601.
6. M. Khetagurov, *Marine Auxiliary Machinery & Systems,*
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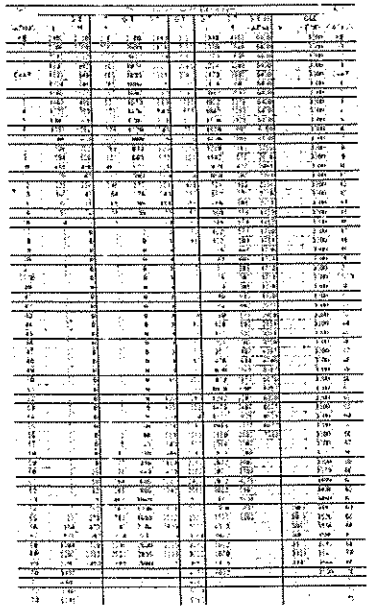
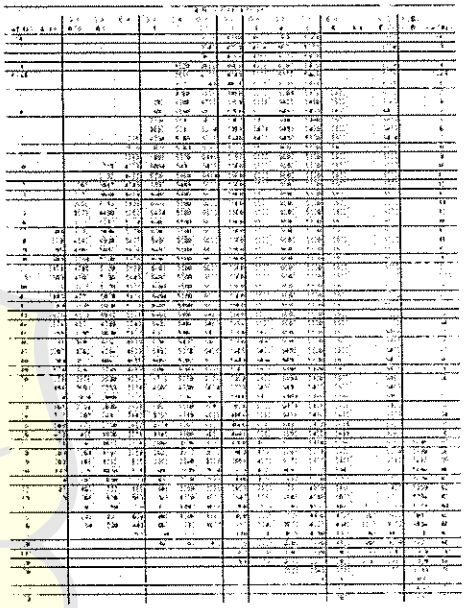
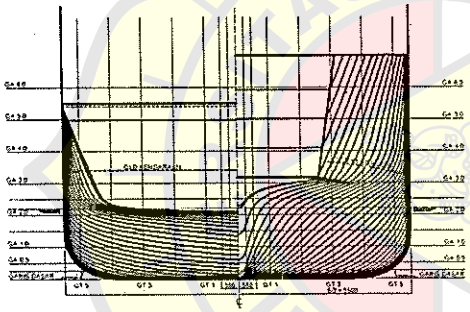
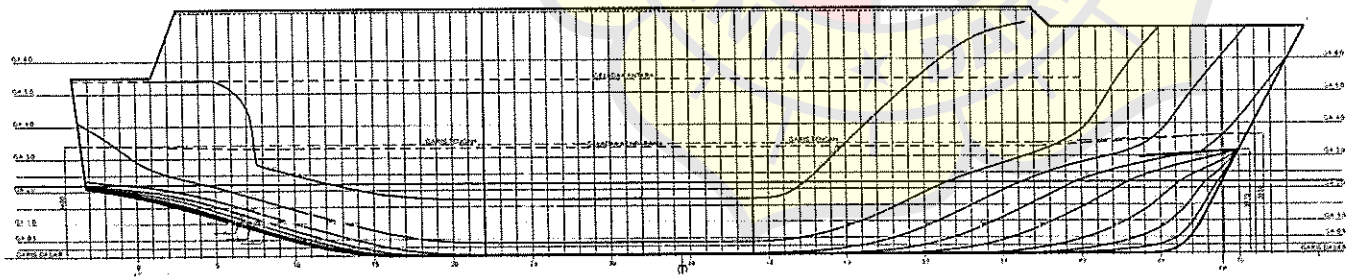
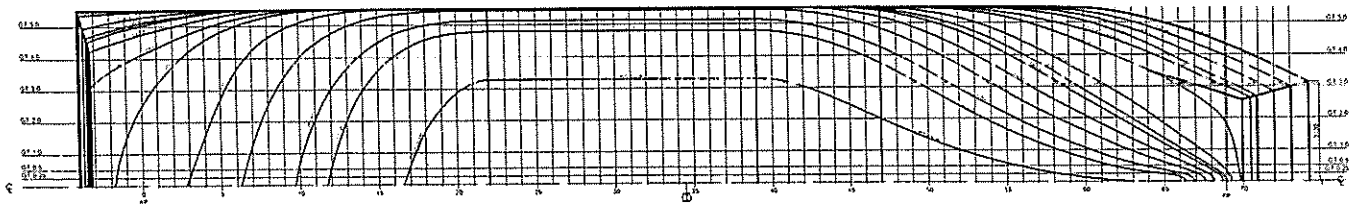
9. Sname, *ship design and construction*" oleh
10. Soekarsono NA,Teori Bangunan Kapal
11. Soekarsono N.A, Sistem dan Perlengkapan Kapal,











UKURAN UTAMA :

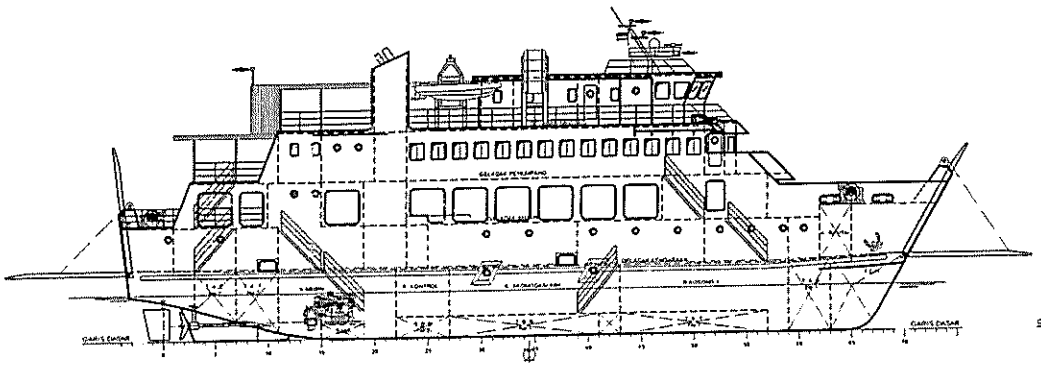
PANJANG SELURUHNYA	(Loa) =	39 38 m
PANJANG A G T	(Lpp) =	34 45 m
LEBAR	(B) =	11 00 m
TINGGI	(H) =	3 30 m
SARAT	(T) =	2 20 m
KECEPATAN DINAS	(v) =	12 00 Knot
DAYA MESIN INDUK		= 2 x 829 HP
		1900 rpm

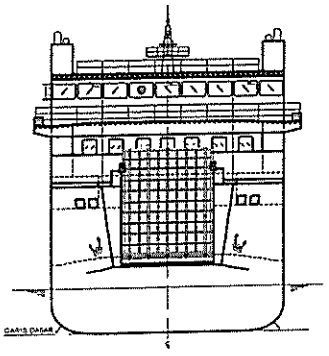
JURUSAN TEKNIK SISTEM PERKAPALAN
FAKULTAS TEKNOLOGI KELAUTAN
UNIVERSITAS DARMA PERSADA

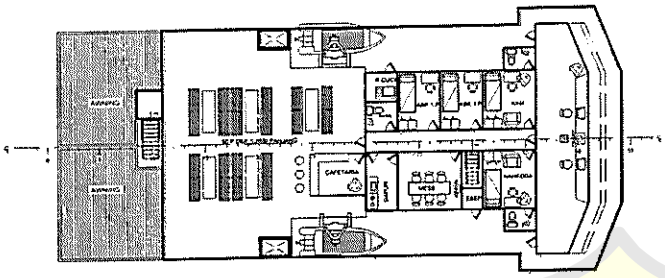
		TANGGAL	PARAF	KET
SKALA				
DIGAMBAR	AYIM AS'ARI			
N I M	08320011			
DIPERIKSA	Ir. TEGUH SASTRODIWONGSO M.SE			
DISETUJUI	Ir. TEGUH SASTRODIWONGSO M.SE			

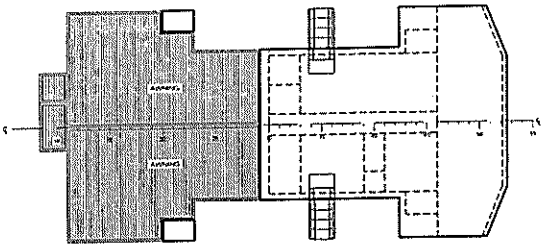
PERENCANAAN

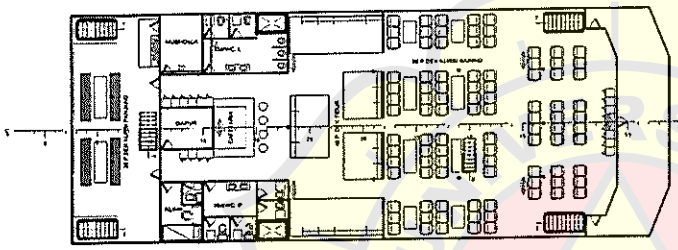
FERRY RO-RO 300 GT

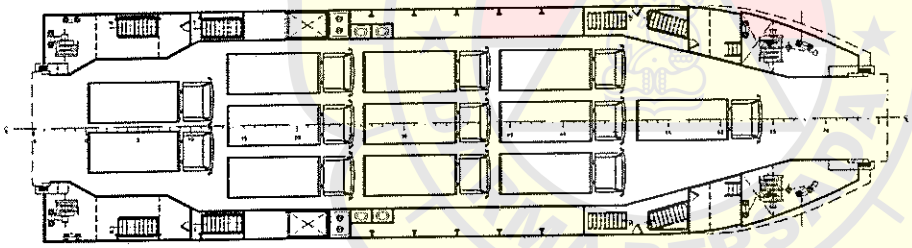


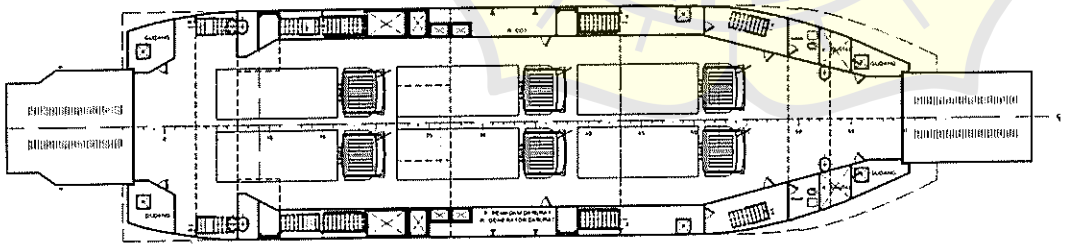


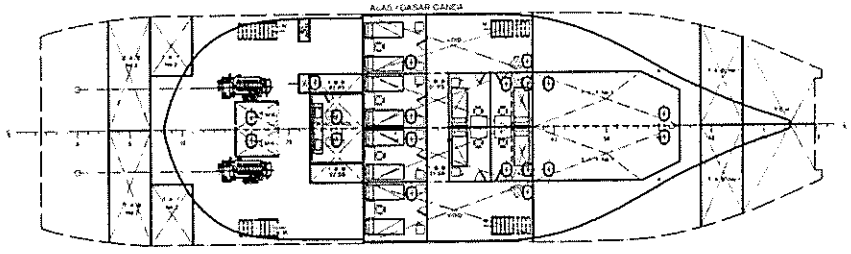












UKURAN UTAMA

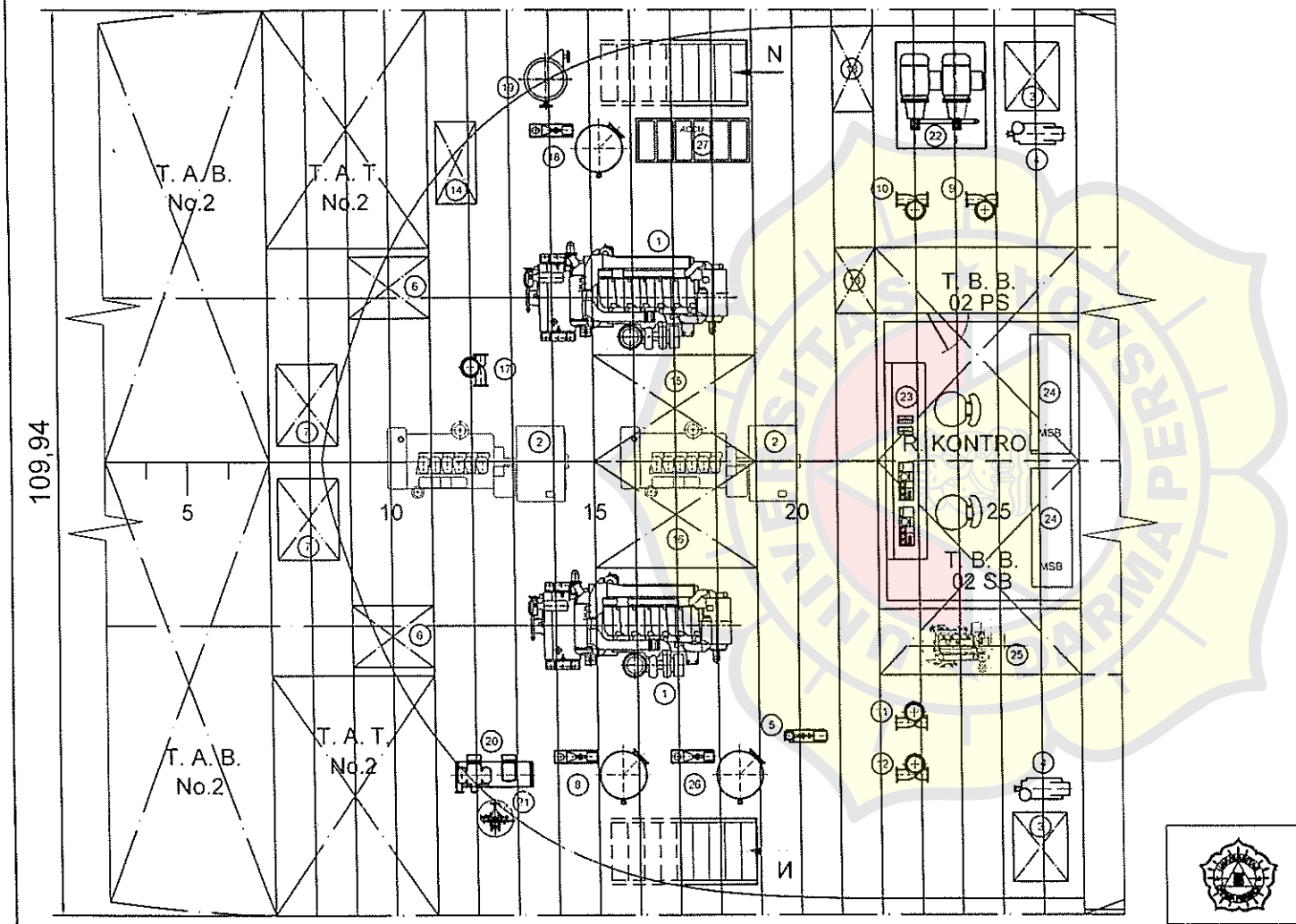
PANJANG SELURUHNYA	(Loa)	=	39.38 m
PANJANG A G T	(Lpp)	=	34.45 m
LEBAR	(B)	=	11.00 m
TINGGI	(H)	=	3.30 m
SARAT	(T)	=	2.20 m
KECEPATAN DINAS	(v)	=	12.00 Knot
DAYA MESIN INDUK		=	2 x 1050HP
			1000 rpm
ABK		=	16 ORANG
PENUMPANG DEK		=	206 ORANG
KENDARAAN		=	6 TRUK BESAR
		=	12 TRUK SEDANG

KLAS KI + A 100 (P) KAPAL PENYEBERANGAN
+ SM

JURUSAN TEKNIK SISTEM PERKAPALAN FAKULTAS TEKNOLOGI KELAUTAN UNIVERSITAS DARMA PERSADA				
SKALA		ANGKAT	BARAT	KET
DIGAMBAR	AYAM ASARY			
NRM	0832001*			
DIPERIKSA	Ir. TEGUH SASTRODIHARDJO M.Sc			
DISETUJUI	Ir. TEGUH SASTRODIHARDJO M.Sc			
NAMA	FERRY RO-RO 300 GT			
RUTE	KOLONEDALE - BATURUSE			
GAMBAR	GENERAL ARRANGEMENT			

5. LAY OUT ENGINE ROOM

ALAS / DASAR GANDA



No	KETERANGAN	JML
27	BATERAI	1 set
26	HIDROFOR SPRINKLE & POMPA	1
25	GENERATOR PELABUHAN + TANKI HARIAN	1
24	PAPAN HUBUNG UTAMA (MSB)	1 set
23	PANEL KONTROL MESIN	1 set
22	HYDRAULIC POWER PACK WINDLASS + 2 MOTOR	1 set
21	BOTOL ANGIN	1
20	KOMPRESOR UDARA	1
19	PEMISAH AIR - MINYAK	1
18	HIDROFOR AIR TAWAR & POMPA	1
17	POMPA AIR TAWAR	1
16	TANGKI BILGA DASAR GANDA	1
15	TANGKI MINYAK KOTOR DASAR GANDA	1
14	TANGKI MINYAK LUMAS	1
13	KERANGAN LAUT (SEA CHEST)	3
12	POMPA PEMADAM DRENCHER	1
11	POMPA BALAS	1
10	POMPA DINAS UMUM & PEMADAM KEBAKARAN	1
9	POMPA BILGA	1
8	HIDROFOR AIR LAUT & POMPA	1
7	TANGKI BAHAN BAKAR MOTOR BANTU	2
6	TANGKI BAHAN BAKAR MOTOR INDUK	2
5	POMPA TRANSFER BAHAN BAKAR	1
4	POMPA SEWAGE	2
3	TANGKI SEWAGE	2
2	MOTOR BANTU	2
1	MOTOR INDUK	2

UKURAN UTAMA :

PANJANG SELURUHNYA	(Loa) =	39.38 m
PANJANG A G.T	(Lpp) =	34.45 m
LEBAR	(B) =	11.00 m
TINGGI	(H) =	3.30 m
SARAT	(T) =	2.20 m
KECEPATAN DINAS	(v) =	12.00 Knot

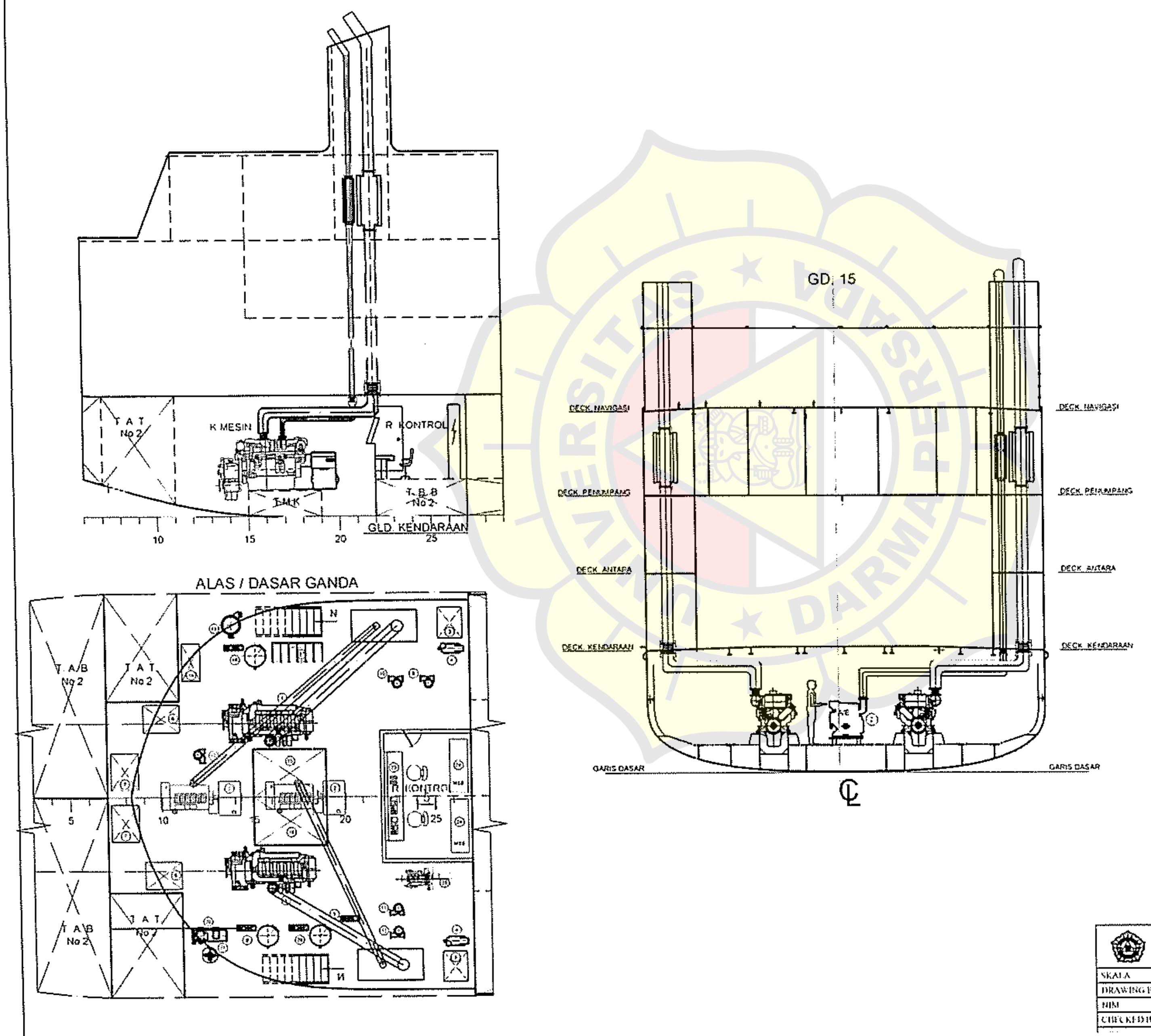
KLAS : KI + A 100 I (P) KAPAL PENYEBERANGAN + SM

UNIVERSITAS DARMA PERSADA
FAKULTAS TEKNOLOGI KELAUTAN

SCALE	: ---	PARAF	TANGGAL
DRAWING BY	: AYIM AS'ARI		
NIM	: 2008320011		
CHECKED BY	: Ir.TEGUH SASTRODIWONGSO, M.SE		
APPROVED BY	: Ir.TEGUH SASTRODIWONGSO, M.SE		

LAY OUT ENGINE ROOM

4 DIMENSI LAY OUT ENGINE ROOM

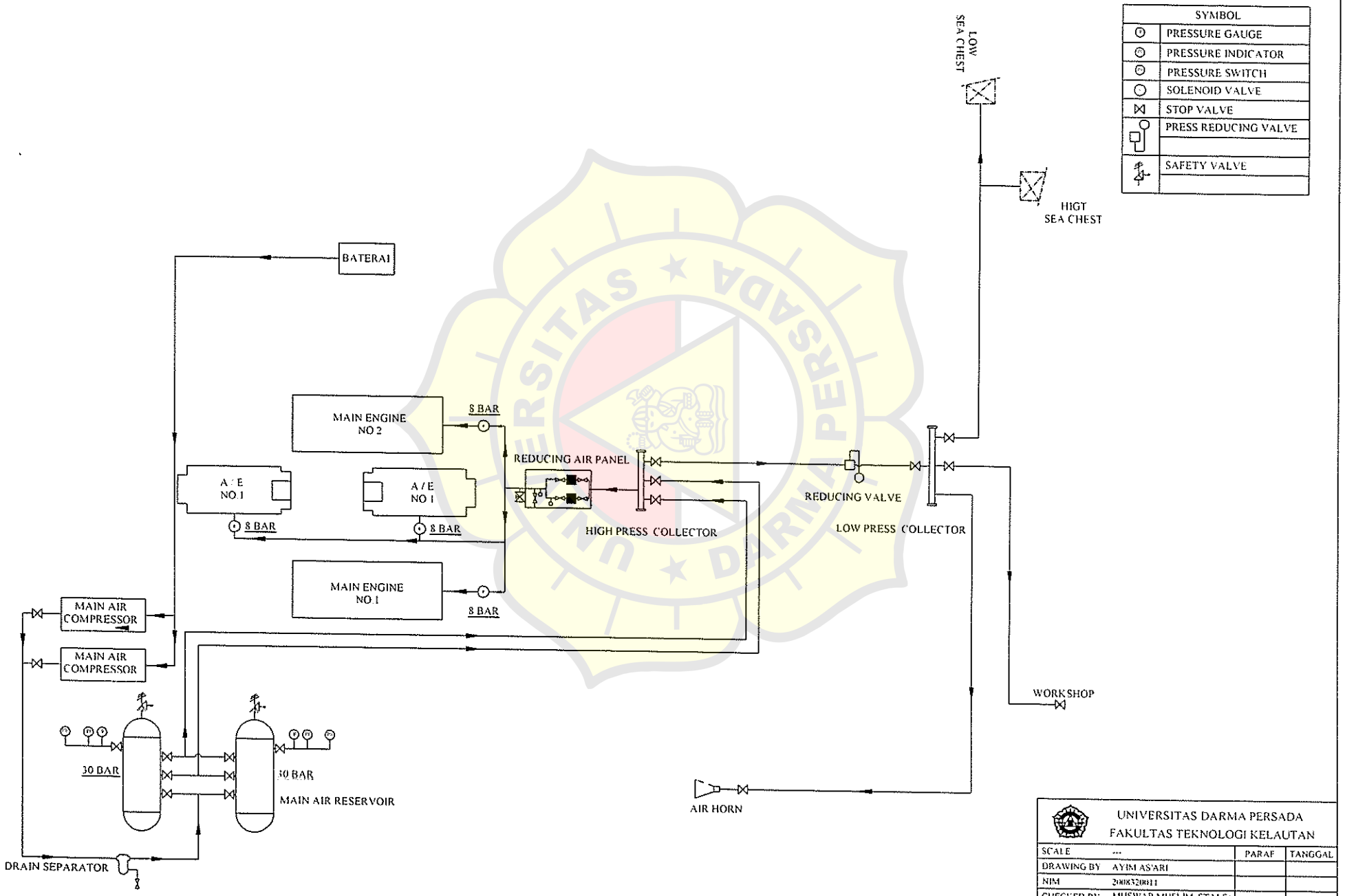


NO	KETERANGAN	JML
27	BATERAI	[illegible]
26	HIDROFOR SPRINKLE & POMPA	1
25	GENERATOR PELABUHAN + [illegible]	1
24	PAPAN HUBUNG UTAMA MESIN	[illegible]
23	PANEL KONTROL MESIN	[illegible]
22	HYDRAULIC POWER PACK WINDLASS + 2 MOTOR	[illegible]
21	BOTOL ANGIN	[illegible]
20	KOMPRESOR UDARA	1
19	PEMISAH AIR MINYAK	1
18	HIDROFOR AIR TAWAR & POMPA	1
17	POMPA AIR TAWAR	[illegible]
16	TANGKI BILGA DASAR GANDA	1
15	TANGKI MINYAK KOTOR DASAR GANDA	1
14	TANGKI MINYAK LUMAS	[illegible]
13	KOTAK LAUT / SEA CHEST	[illegible]
12	POMPA PEMISAH [illegible]	[illegible]
11	POMPA BALAS	[illegible]
10	POMPA DINAS UMUM & PEMADAM KEBAKARAN	[illegible]
9	POMPA BILGA	[illegible]
8	HIDROFOR AIR LAUT & POMPA	[illegible]
7	TANGKI BAHAN BAKAR MOTOR BANTU	2
6	TANGKI BAHAN BAKAR MOTOR INDUK	2
5	POMPA TRANSFER BAHAN BAKAR	1
4	POMPA SEWAGE	2
3	TANGKI SEWAGE	2
2	MOTOR BANTU	2
1	MOTOR INDUK	1

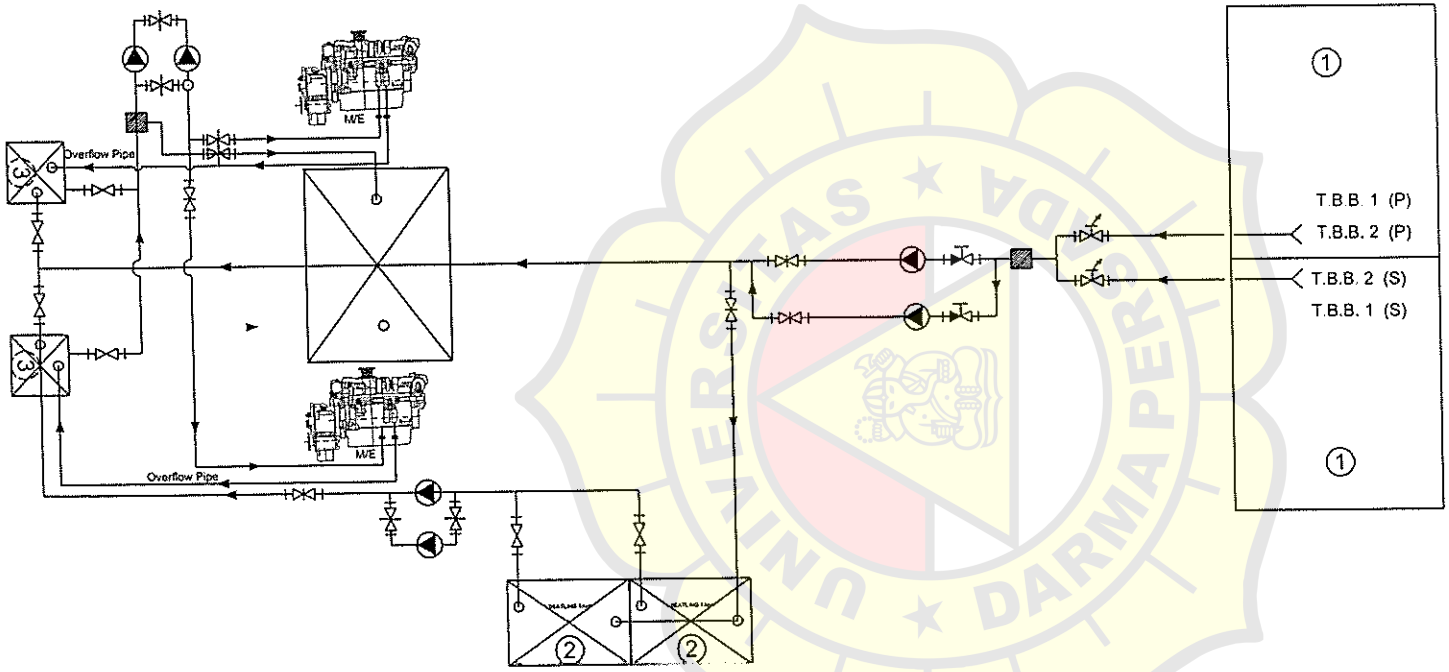
UKURAN UTAMA

PANJANG SELURUHNYA (LOA) = 39.38 m
PANJANG A.O.T (LBP) = 34.45 m
LEBAR (B) = [illegible]
TINGGI (H) = 3.30 m
SARAT (T) = 2.70 m
KECEPATAN DINAS (Vs) = 12.00 knot
KLAS [illegible] (KAPAL PENYEBERANGAN) [illegible]

UNIVERSITAS DARMA PERSADA FAKULTAS TEKNOLOGI KELAUTAN			
SKALA	[illegible]	PARAF	TANGGAL
DRAWING BY	AYIM ASARI		
NIM	2008320011		
CHECKED BY	[illegible]		


SYMBOL
PRESSURE GAUGE
PRESSURE INDICATOR
PRESSURE SWITCH
SOLENOID VALVE
STOP VALVE
PRESS REDUCING VALVE
SAFETY VALVE
LOW SEA CHEST
HIGT SEA CHEST
BATERAI
MAIN ENGINE NO 2
8 BAR
REDUCING AIR PANEL
A / E NO 1
A / E NO 1
8 BAR
8 BAR
HIGH PRESS COLLECTOR
REDUCING VALVE
LOW PRESS COLLECTOR
MAIN ENGINE NO 1
8 BAR
MAIN AIR COMPRESSOR
MAIN AIR COMPRESSOR
WORK SHOP
30 BAR
30 BAR
MAIN AIR RESERVOIR
AIR HORN
DRAIN SEPARATOR
UNIVERSITAS DARMA PERSADA
FAKULTAS TEKNOLOGI KELAUTAN
SCALE ...
PARAF
TANGGAL
DRAWING BY AYIM AS'ARI
NIM 2008320011
CHECKED BY MUSWAR MUSLIM, ST.M.Sc

6. FUEL OIL PIPING SYSTEM



No.	SIMBOL	NAMA	JML	SPEC
1		GATE VALVE	8	-
2		BATTERFLY VALVE	6	-
3		STRAINER	2	-
4		SDNR VALVE	2	-
5		CONTROL VALVE	4	-
6		FLOW METER	1	-
7	3	TANGKI SERVICE/ DAY TANK	2	-
8	2	SETLING TANK	2	-
9	1	F.O TANK	2	-
10		L.O PUMP	2	2,2 KW
10		L.O PUMP	1	3,7 KW

UKURAN UTAMA		
PANJANG SELURUH	(Loa) =	39.38 m
PANJANG A.G.T.	(Lpp) =	34.45 m
LEBAR	(B) =	11.00 m
TINGGI	(H) =	3.30 m
SARAT	(T) =	2.20 m

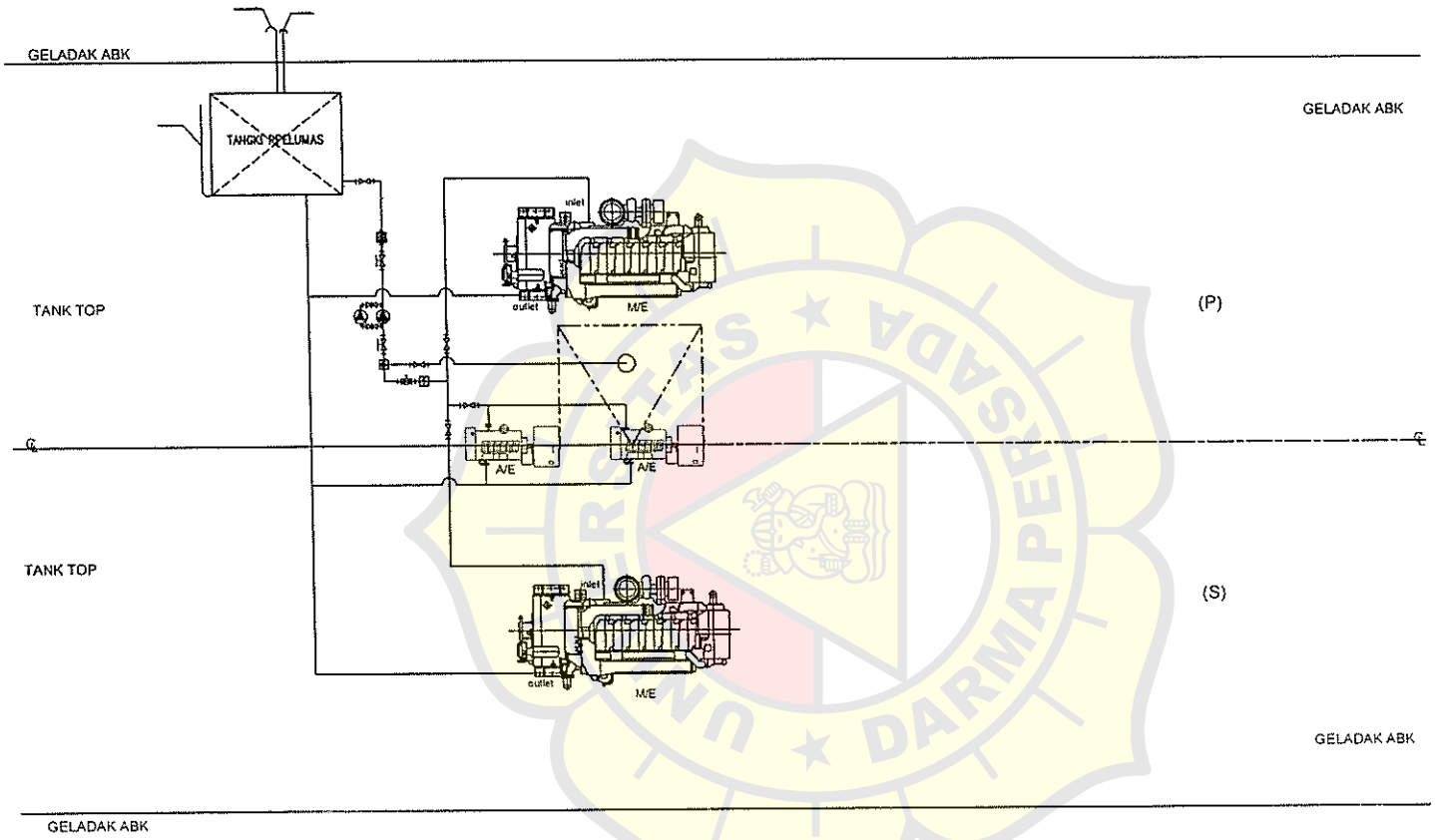
JURUSAN TEKNIK SISTEM PERKAPALAN
FAKULTAS TEKNOLOGI KELAUTAN
UNIVERSITAS DARMA PERSADA

SKALA		TANGGAL	PARAF	KET
DIGAMBAR	AYIM AS'ARI			
N.I.M	08320011			
DIPERIKSA	MUSWAR MUSLIM, ST., M.Sc			
DISETUJUI	MUSWAR MUSLIM, ST., M.Sc			

PERENCANAAN
FERRY 300 GT

GAMBAR
FUEL OIL PIPING SYSTEM

7. LUBRICATING OIL PIPING SYSTEM



No.	SIMBOL	NAMA	JML	SPEC
1		BATTERFLY VALVE	5	-
2		GATE VALVE	2	-
3		STRAINER	1	-
4		KATUP SELENOID	1	-
5		SDNR VALVE	2	-
6		HEATER	1	-
7		SEPARATOR	1	-
8		L.O PUMP	1	0,75 KW

UKURAN UTAMA			
PANJANG SELURUH	(Loa) =	39.38	m
PANJANG A.G.T.	(Lpp) =	34.45	m
LEBAR	(B) =	11.00	m
TINGGI	(H) =	3.30	m
SARAT	(T) =	2.20	m

JURUSAN TEKNIK SISTEM PERKAPALAN
FAKULTAS TEKNOLOGI KELAUTAN
UNIVERSITAS DARMA PERSADA

SKALA		TANGGAL	PARAF	KET.
DIGAMBAR	AYIM ASARI			
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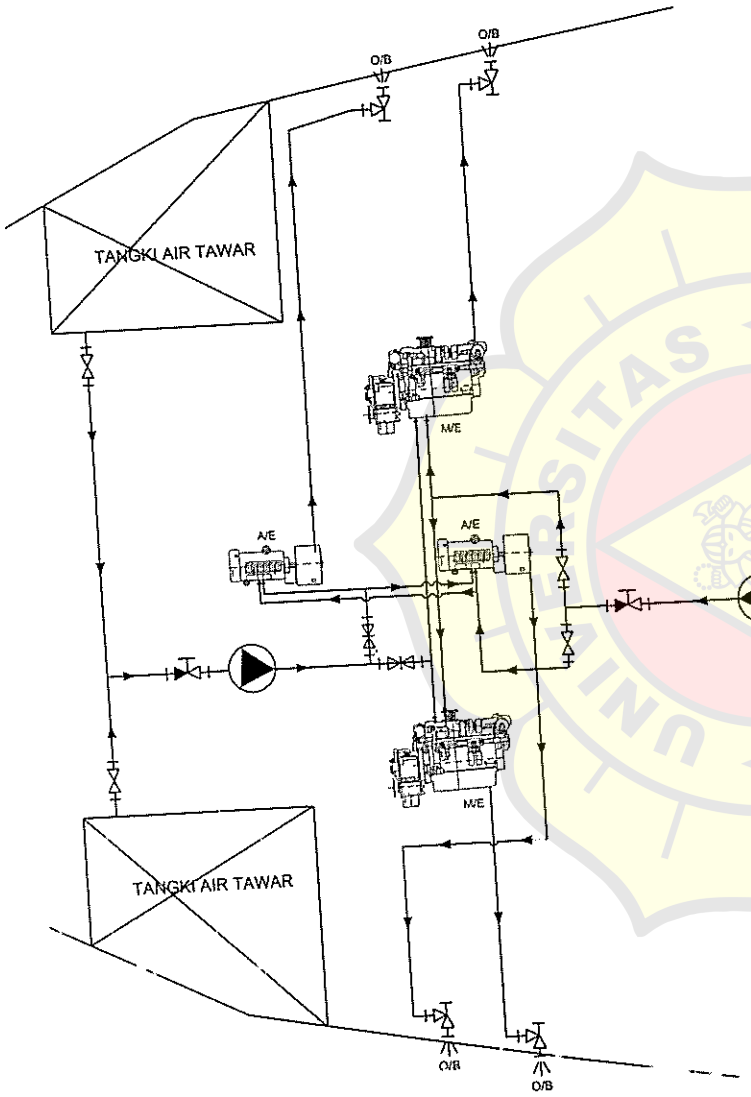
DIPERIKSA	MUSWAR MUSLIM, ST . M.Sc			
DISETUJUI	MUSWAR MUSLIM, ST . M.Sc			

PERENCANAAN

FERRY 300 GT

GAMBAR

8. FW & SW COOLING PIPING SYSTEM



No	SIMBOL	NAMA	JML	SPEC
1		KATUP GERBANG / GATE VALVE	5	-
2		SCREW DOWN NON RETURN VALVE (SDNRV)	2	-
3		STRAINER	1	-
4		POMPA	2	3,7 KW
5		KATUP SUDUT/KINGSTONE VALVE	4	-
6		BATTERFLY VALVE	4	-

No.	JML	KETERANGAN
②	1	POMPA PENDINGIN MESIN (AIR LAUT)
①	1	POMPA PENDINGIN MESIN (AIR TAWAR)

UKURAN UTAMA		
PANJANG SELURUH	(Loa) =	39.38 m
PANJANG A.G.T.	(Lpp) =	34.45 m
LEBAR	(B) =	11.00 m
TINGGI	(H) =	3.30 m
SARAT	(T) =	2.20 m

KETERANGAN :

SISTEM PIPA PENDINGIN (AIR TAWAR)

SISTEM PIPA PENDINGIN (AIR LAUT)

SISTEM PIPA AIR PANAS (KE OVER BOARD)

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		TANGGAL	PARAF	KET.
SKALA				
DIGAMBAR	AYM ASARI			
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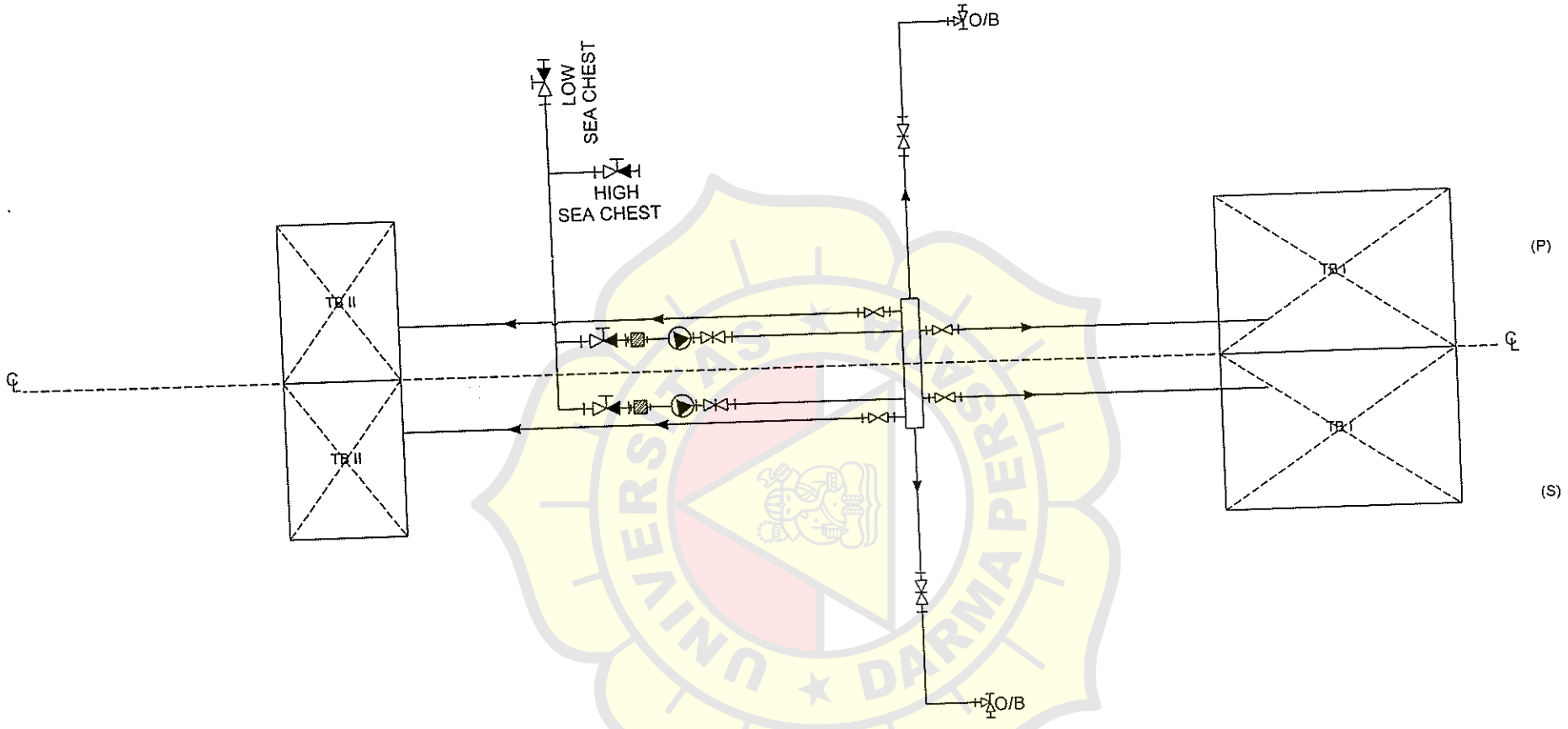
DISETUJUI	MUSWAR MUSLIM, ST , M.Sc			

PERENCANAAN: FERRY 300 GT

GAMBAR: FW & SW COOLING PIPING SYSTEM

9. BALLAST PIPING SYSTEM



No.	SIMBOL	NAMA	JML	SPEC
1		BATTERFLY VALVE	4	-
2		KATUP GERBANG / GATE VALVE	4	-
3		SCREW DOWN NON RETURN VALVE (SDNRV)	4	-
4		STRAINER	2	-
5		POMPA	2	?
6		KATUP SUDUT/KINGSTONE VALVE	2	-

UKURAN UTAMA		
PANJANG SELURUH	(Loa) =	39.38 m
PANJANG A.G.T.	(Lpp) =	34.45 m
LEBAR	(B) =	11.00 m
TINGGI	(H) =	3.30 m
SARAT	(T) =	2.20 m

JURUSAN TEKNIK SISTEM PERKAPALAN
FAKULTAS TEKNOLOGI KELAUTAN
UNIVERSITAS DARMA PERSADA

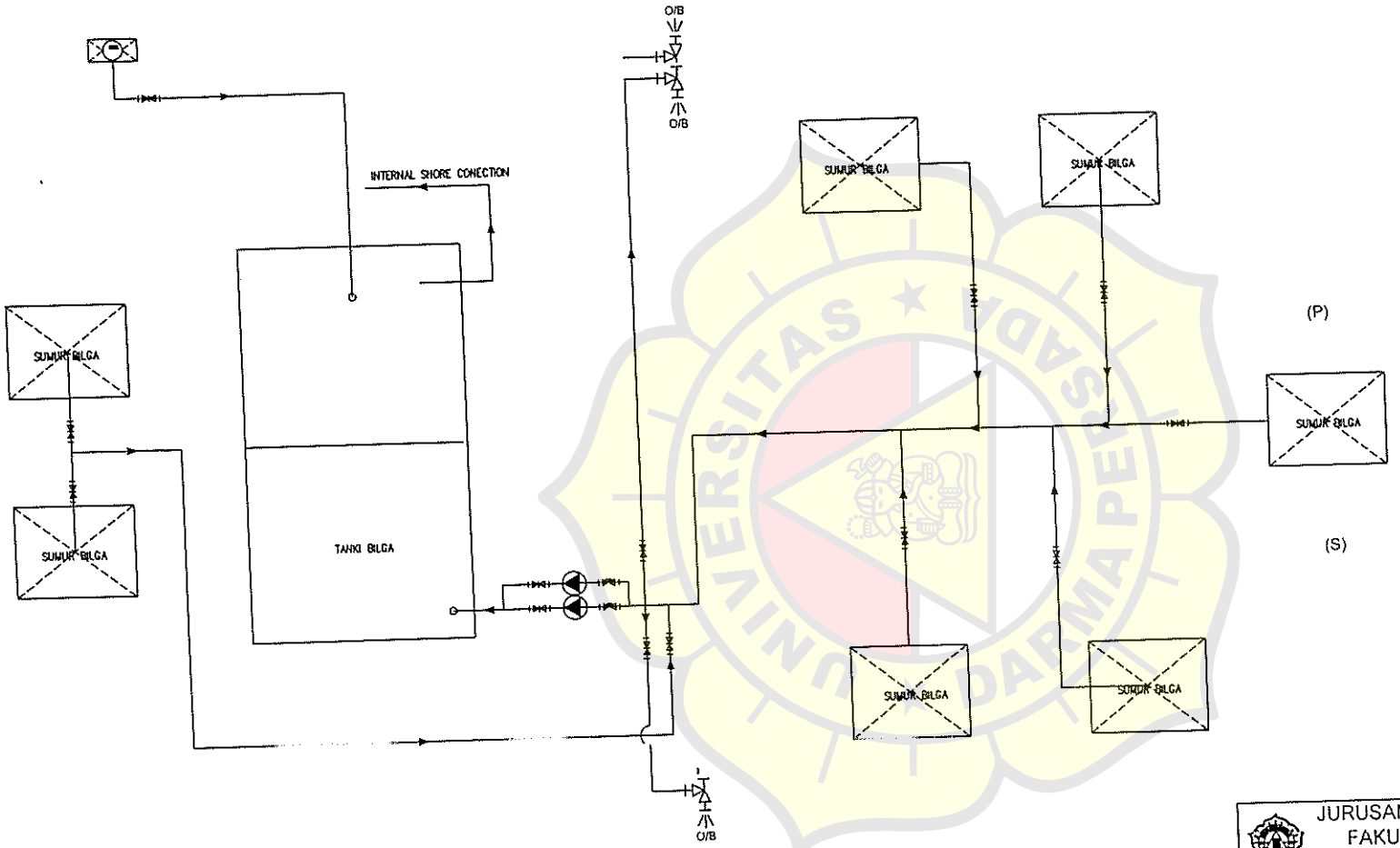
		TANGGAL	PARAF	Ket.
SKALA				
DIGAMBAR	AYIM AS'ARI			
N.I.M	08320011			
DIPERIKSA	MUSWAR MUSLIM. ST . M Sc			
DISETUJUI	MUSWAR MUSLIM. ST . M Sc			

PERENCANAAN

FERRY 300 GT

GAMBAR

10. BILGA PIPING SISTEM



No.	GIMBOL	NAMA	JML	SPEC
1		SDNR VALVE	2	-
2		GATE VALVE	13	-
3		KATUP SUDUT/KINGSTONE VALVE	2	-
		POMPA	2	5,5 KW

UKURAN UTAMA		
PANJANG SELURUH	(Loa) =	39,38 m
PANJANG A.G.T.	(Lpp) =	34,45 m
LEBAR	(B) =	11,00 m
TINGGI	(H) =	3,30 m
SARAT	(T) =	2,20 m

JURUSAN TEKNIK SISTEM PERKAPALAN
FAKULTAS TEKNOLOGI KELAUTAN
UNIVERSITAS DARMA PERSADA

		TANGGAL	PARAF	KET.
SKALA				
DIGAMBAR	Ayim As'ari			
N.I.M	08320011			
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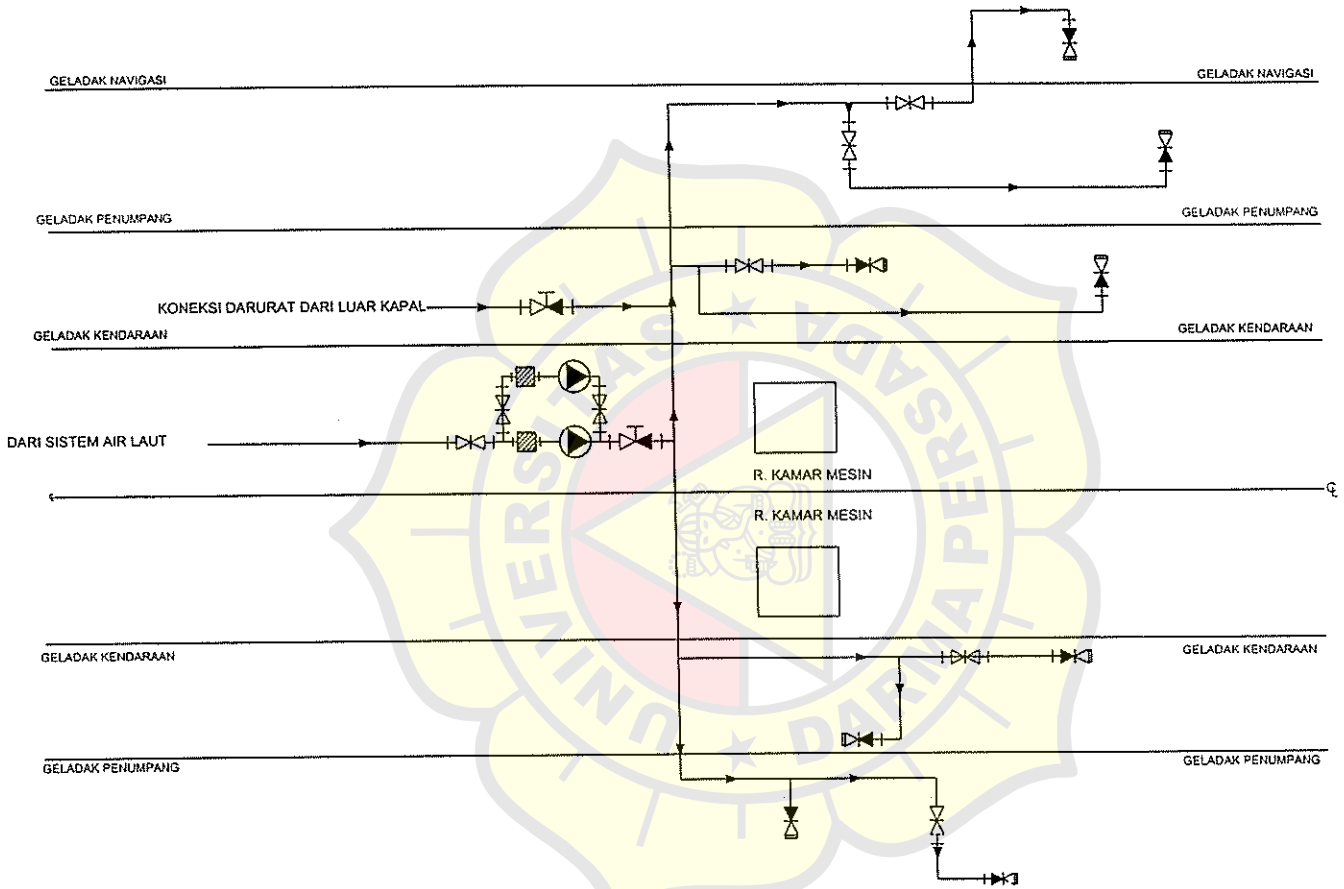
DISETUJUI	MUSWAR MUSLIM, ST . M.Sc			
PERENCANAAN	FERRY 300 GT			
GAMBAR	BILGA PIPING SISTEM			

11. FIRE FIGHTING PIPING SYSTEM



No.	SIMBOL	NAMA	JML	SPEC
1		KATUP GERBANG / GATE VALVE	8	-
2		SCREW DOWN NON RETURN VALVE (SDNRV)	2	-
3		STRAINER	2	-
4		POMPA	2	?
5		KATUP SUDUT/KINGSTONE VALVE	8	-

UKURAN UTAMA

PANJANG SELURUH	(Loa) =	39.38 m
PANJANG A.G.T.	(Lpp) =	34.45 m
LEBAR	(B) =	11.00 m
TINGGI	(H) =	3.30 m
SARAT	(T) =	2.20 m

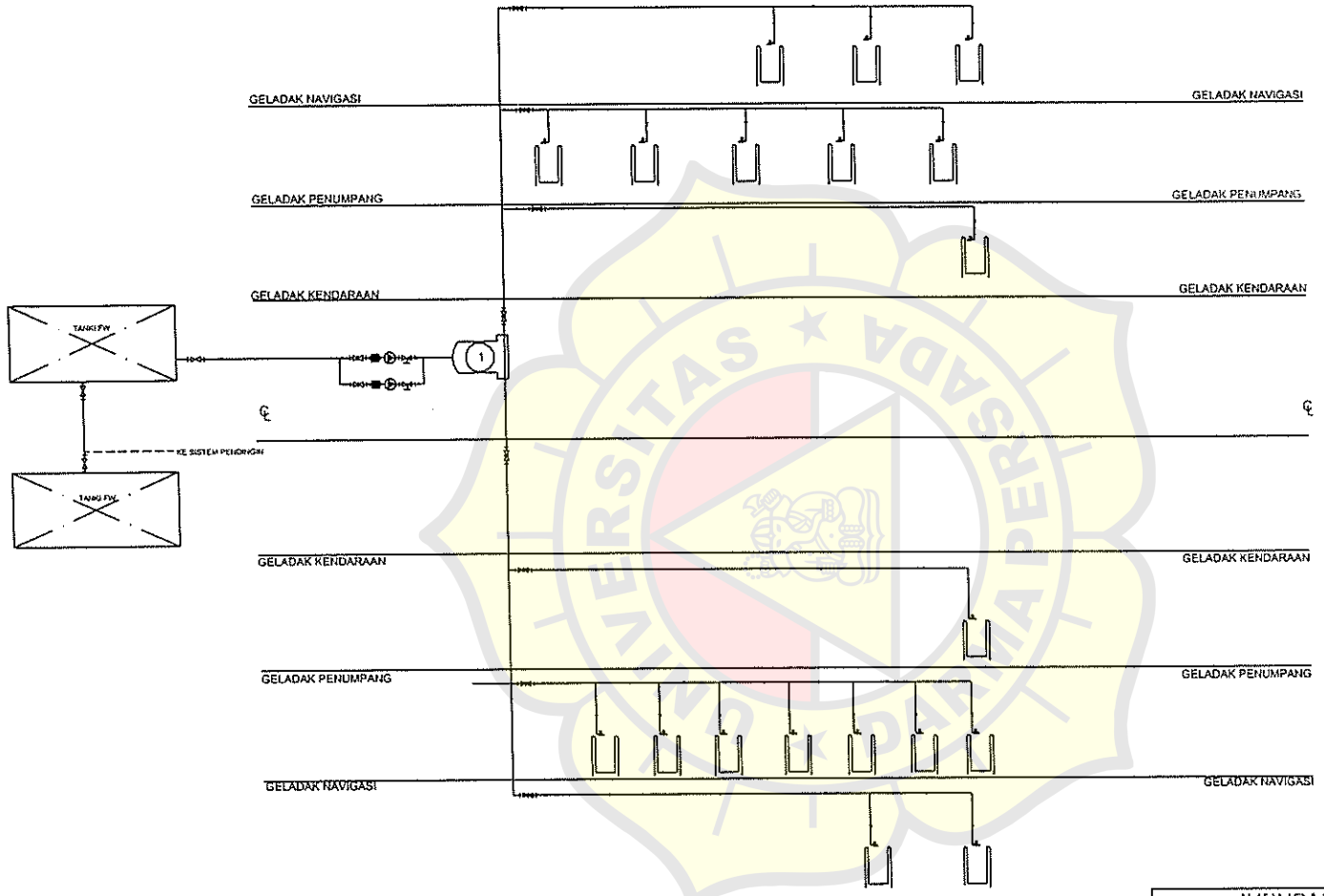
JURUSAN TEKNIK SISTEM PERKAPALAN
FAKULTAS TEKNOLOGI KELAUTAN
UNIVERSITAS DARMA PERSADA

		TANGGAL	PARAF	KET.
SKALA				
DIGAMBAR	AYIM ASARI			
N.I.M	08320011			
DIPERIKSA	MUSWAR MUSLIM, ST., M.Sc			
DISETUJUI	MUSWAR MUSLIM, ST., M.Sc			

PERENCANAAN
FERRY 300 GT

GAMBAR

12. SANITARY FRESH WATER PIPING SYSTEM



No.	SIMBOL	NAMA	JML	SPEC
1		BATTERFLY VALVE	2	-
2		KATUP GERBANG / GATE VALVE	10	-
3		SCREW DOWN NON RETURN VALVE (SDNRV)	2	-
4		STRAINER	2	-
5		POMPA	2	5,5 KW
6	1	TANGKI HYDROPHORE	1	10 m³/h

UKURAN UTAMA

PANJANG SELURUH	(Loa) =	39,38 m
PANJANG A.G.T.	(Lpp) =	34,45 m
LEBAR	(B) =	11,00 m
TINGGI	(H) =	3,30 m
SARAT	(T) =	2,20 m

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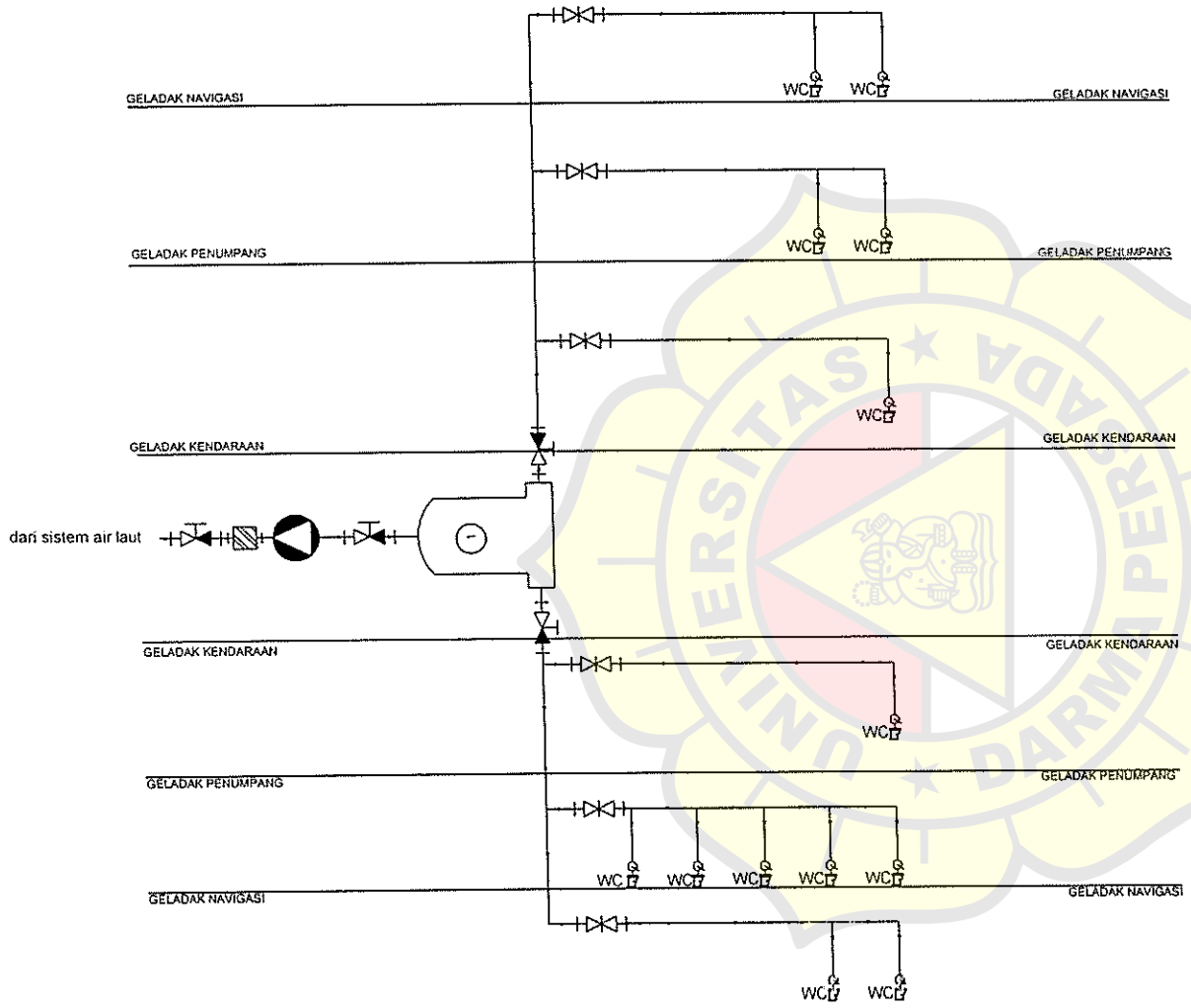
SKALA		TANGGAL	PARAF	KET.
DIGAMBAR	AYIM AS'ARI			
N.I.M	08320011			
DIPERIKSA	MUSWAR MUSLIM, ST , M Sc			
DISETUJUI	MUSWAR MUSLIM, ST , M.Sc			

PERENCANAAN

FERRY 300 GT

GAMBAR :



(P)

(S)

No	SIMBOL	NAMA	JML	SPEC
1		KATUP GERBANG / GATE VALVE	6	-
2		SCREW DOWN NON RETURN VALVE (SDNRV)	4	-
3		STRAINER	1	-
4		POMPA	1	5,5 KW
5	1	TANGKI HYDROPHORE	1	10 m³/h

UKURAN UTAMA			
PANJANG SELURUH	(Loa) =	39.38	m
PANJANG A.G.T.	(Lpp) =	34.45	m
LEBAR	(B) =	11.00	m
TINGGI	(H) =	3.30	m
SARAT	(T) =	2.20	m

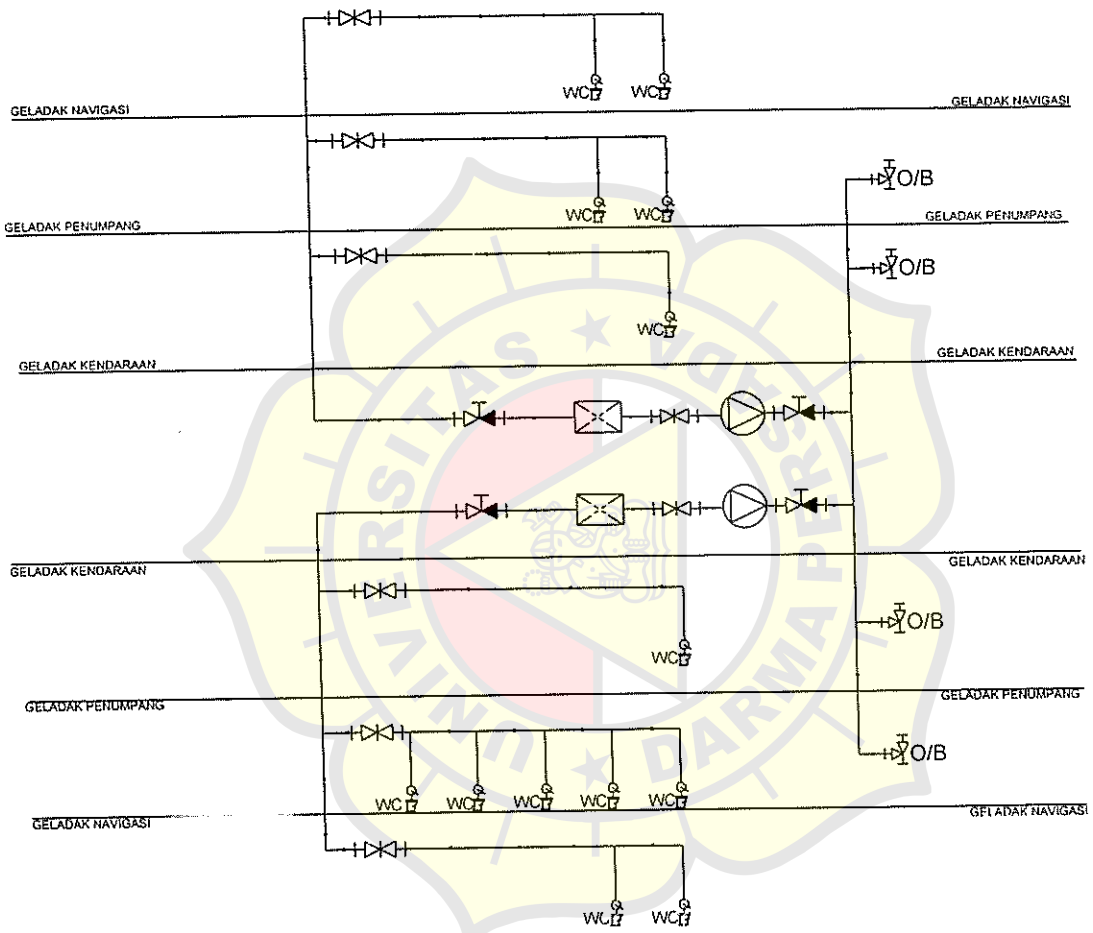
JURUSAN TEKNIK SISTEM PERKAPALAN
FAKULTAS TEKNOLOGI KELAUTAN
UNIVERSITAS DARMA PERSADA

SKALA		TANGGAL	PARAF	KET.
DIGAMBAR	AYIM AS'ARI			
N.I.M	08320011			
DIPERIKSA	MUSWAR MUSLIM, ST., M.Sc			
DISETUJUI	MUSWAR MUSLIM, ST., M.Sc			

PERENCANAAN :
FERRY 300 GT

GAMBAR :
SANITARY SEA WATER PIPING SYSTEM

14. SEWAGE PIPING SYSTEM



No.	SIMBOL	NAMA	JML	SPEC
1		KATUP GERBANG / GATE VALVE	8	-
2		SCREW DOWN NON RETURN VALVE (SDNRV)	4	-
3		POMPA	2	5,5 KW
4		KATUP SUDUT/KINGSTONE VALVE	4	-

UKURAN UTAMA

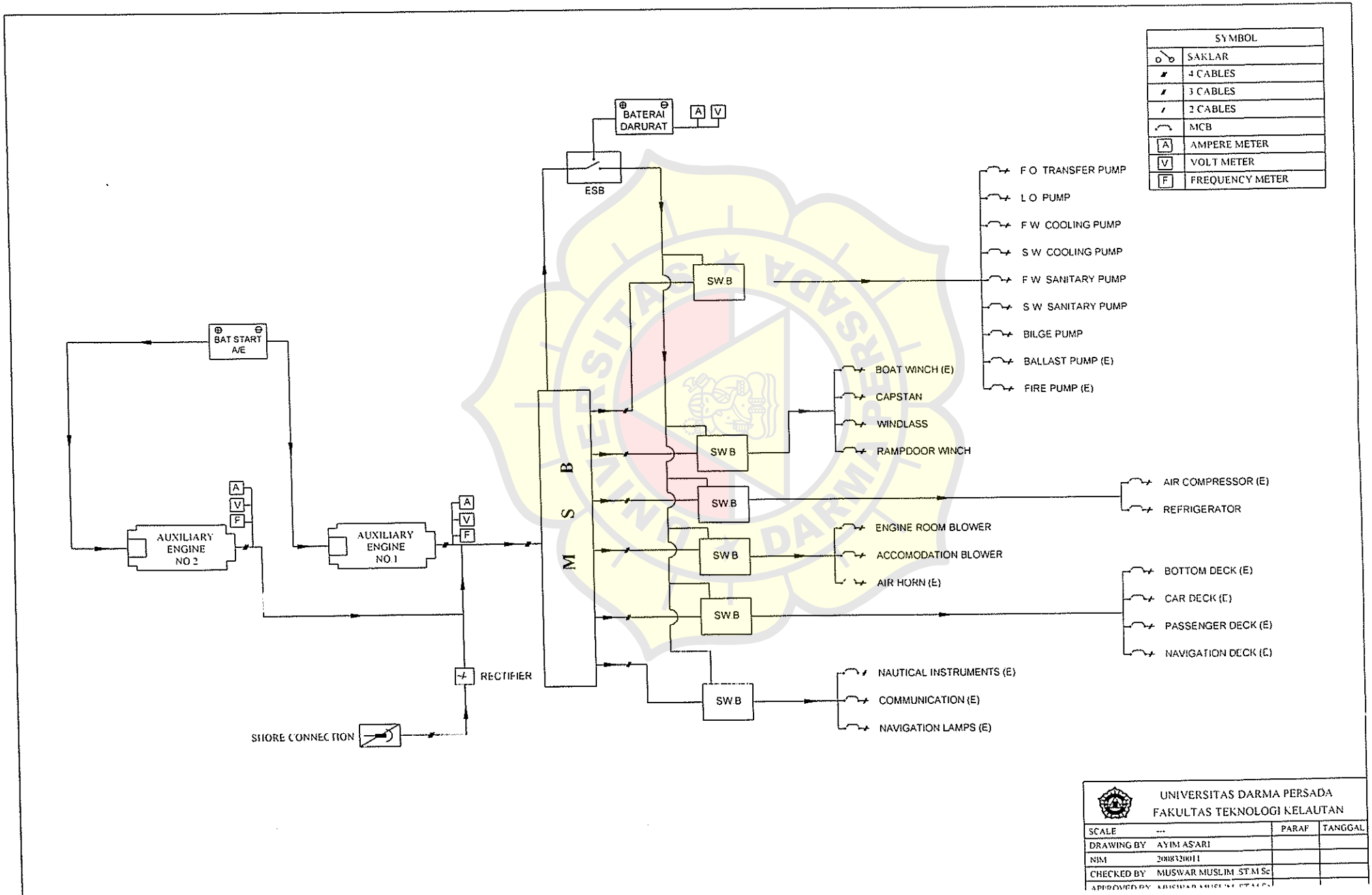
PANJANG SELURUH	(Loa) =	39.38	m
PANJANG A.G.T.	(Lpp) =	34.45	m
LEBAR	(B) =	12.00	m
TINGGI	(H) =	3.30	m
SARAT	(T) =	2.20	m

JURUSAN TEKNIK SISTEM PERKAPALAN
FAKULTAS TEKNOLOGI KELAUTAN
UNIVERSITAS DARMA PERSADA

		TANGGAL	PARAF	KET.
SKALA				
DIGAMBAR	AYIM AS'ARI			
N.I.M	08320011			
DIPERIKSA	MUSWAR MUSLIM, ST , M.Sc			
DISETUJUI	MUSWAR MUSLIM, ST , M.Sc			

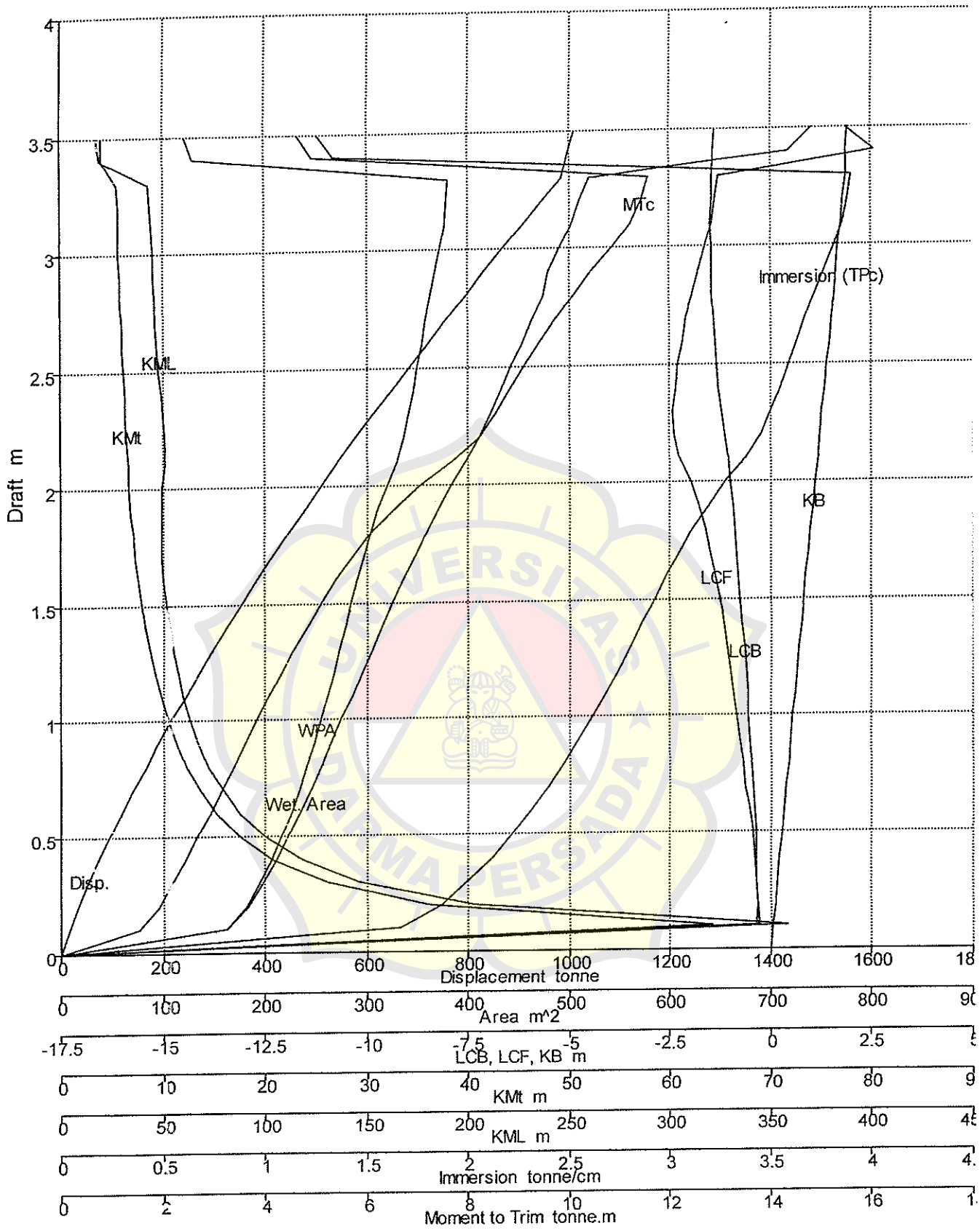
PERENCANAAN :
FERRY 300 GT
GAMBAR

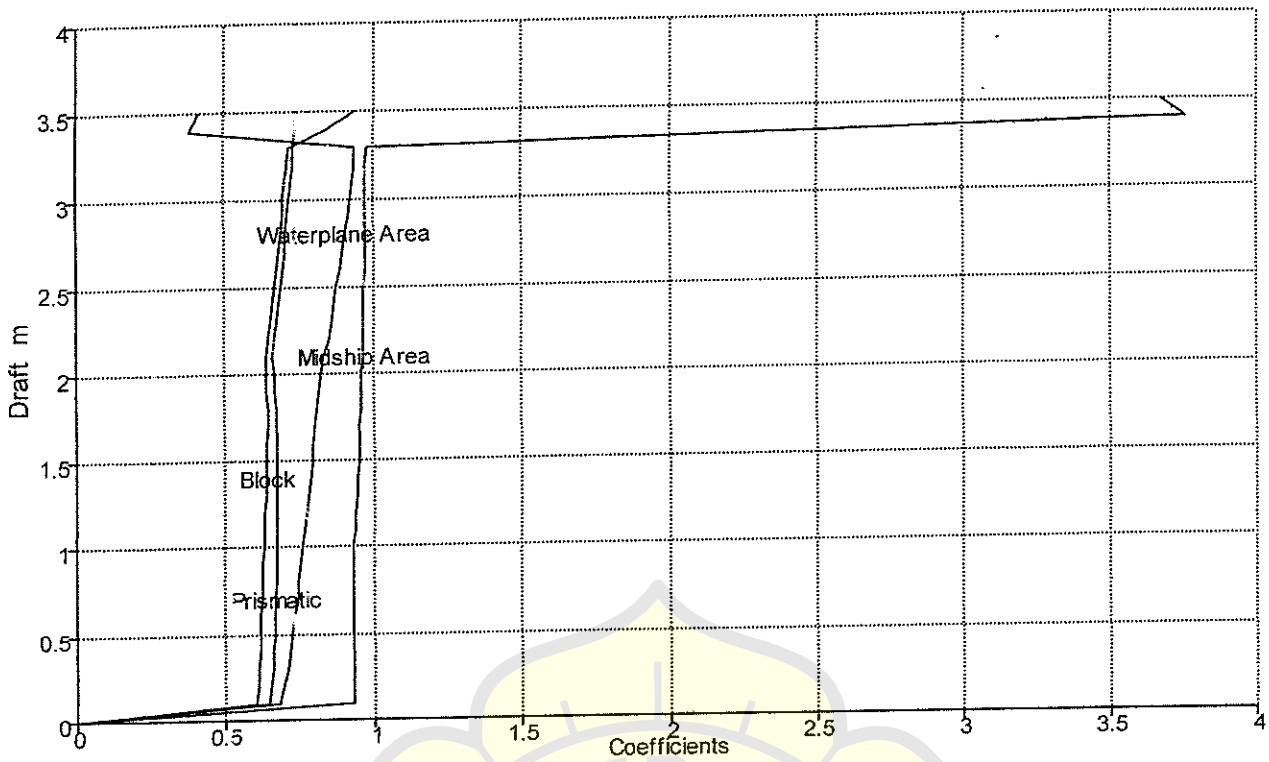
5. ELECTRICAL WIRING DIAGRAM



UNIVERSITAS DARMA PERSADA
FAKULTAS TEKNOLOGI KELAUTAN

		PARAF	TANGGAL
SCALE	---		
DRAWING BY	AYIM AS'ARI		
NIM	20083200111		
CHECKED BY	MUSWAR MUSLIM .ST.M.Sc		
APPROVED BY	MUSWAR MUSLIM .ST.M.Sc		


Draft m
4
3.5
3
2.5
2
1.5
1
0.5
0
MTc
Immersion (TPc)
KML
KMt
KB
LCF
LCB
WPA
Wet. Area
Disp.
0 200 400 600 800 1000 1200 1400 1600 18
Displacement tonne
0 100 200 300 400 500 600 700 800 9
Area m^2
-17.5 -15 -12.5 -10 -7.5 -5 -2.5 0 2.5
LCB, LCF, KB m
0 10 20 30 40 50 60 70 80 9
KMt m
0 50 100 150 200 250 300 350 400 4
KML m
0 0.5 1 1.5 2 2.5 3 3.5 4 4.
Immersion tonne/cm
0 2 4 6 8 10 12 14 16 1
Moment to Trim tonne.m


Draft m
Coefficients
Waterplane Area
Midship Area
Block
Prismatic
0
0.5
1
1.5
2
2.5
3
3.5
4

Hydrostatics - Model Penumpang RORO 300 GT

Damage Case - Intact

Fixed Trim = 0 m (+ve by stern)
Relative Density (specific gravity) = 1.025; (Density = 1.0252 tonne/m^3)

Draft Amidsh. m	0.000	0.100	0.200	0.300
Displacement tonne	0.0000	14.77	32.53	51.94
Heel to Starboard degrees	0.0	0.0	0.0	0.0
Draft at FP m	0.000	0.100	0.200	0.300
Draft at AP m	0.000	0.100	0.200	0.300
Draft at LCF m	0.000	0.100	0.200	0.300
Trim (+ve by stern) m	0.000	0.000	0.000	0.000
WL Length m	23.318	26.021	26.936	27.596
WL Beam m	0.000	9.194	9.684	9.984
Wetted Area m^2	0.000	162.912	183.655	198.121
Waterpl. Area m^2	0.000	162.445	182.242	195.271
Prismatic Coeff.	0.000	0.649	0.654	0.659
Block Coeff.	0.000	0.602	0.608	0.613
Midship Area Coeff.	0.000	0.928	0.929	0.929
Waterpl. Area Coeff.	0.000	0.679	0.699	0.709
LCB from Amidsh. (+ve fwd) m	-17.351	-0.359	-0.338	-0.341
LCF from Amidsh. (+ve fwd) m	-17.351	-0.283	-0.329	-0.341
KB m	0.000	0.053	0.106	0.160
KG m	2.200	2.200	2.200	2.200
BMt m	0.000	64.123	36.307	26.050
BML m	0.000	358.436	203.816	146.404
GMt m	-2.200	61.976	34.213	24.011
GML m	-2.200	356.289	201.722	144.364
KMt m	0.000	64.176	36.413	26.211
KML m	0.000	358.489	203.922	146.564
Immersion (TPc) tonne/cm	0.000	1.665	1.868	2.002
MTc tonne.m	0.000	1.528	1.905	2.177
RM at 1deg = GMt.Disp.sin(1) tonne.m	0.000	15.979	19.424	21.765
Max deck inclination deg	0.0	0.0	0.0	0.0
Trim angle (+ve by stern) deg	0.0	0.0	0.0	0.0

Draft Amidsh. m	0.400	0.500	0.600	0.700
Displacement tonne	72.59	94.34	117.0	140.5
Heel to Starboard degrees	0.0	0.0	0.0	0.0
Draft at FP m	0.400	0.500	0.600	0.700
Draft at AP m	0.400	0.500	0.600	0.700
Draft at LCF m	0.400	0.500	0.600	0.700
Trim (+ve by stern) m	0.000	0.000	0.000	0.000
WL Length m	28.121	28.592	29.040	29.452
WL Beam m	10.214	10.400	10.555	10.683
Wetted Area m^2	211.425	222.864	234.365	245.009

Midship Area Coeff.	0.953	0.955	0.958	0.960
Waterpl. Area Coeff.	0.799	0.804	0.810	0.817
LCB from Amidsh. (+ve fwd) m	-0.794	-0.840	-0.889	-0.942
LCF from Amidsh. (+ve fwd) m	-1.367	-1.485	-1.613	-1.778
KB m	0.878	0.934	0.990	1.047
KG m	2.200	2.200	2.200	2.200
BMt m	6.706	6.375	6.084	5.832
BML m	49.756	48.835	48.345	48.306
GMt m	5.384	5.108	4.874	4.679
GML m	48.433	47.569	47.136	47.153
KMt m	7.584	7.308	7.074	6.879
KML m	50.633	49.769	49.336	49.353
Immersion (TPc) tonne/cm	2.983	3.046	3.114	3.189
MTc tonne.m	5.400	5.720	6.089	6.523
RM at 1deg = GMt.Disp.sin(1) tonne.m	36.086	36.929	37.858	38.911
Max deck inclination deg	0.0	0.0	0.0	0.0
Trim angle (+ve by stern) deg	0.0	0.0	0.0	0.0

Draft Amidsh. m	2.000	2.100	2.200	2.300
Displacement tonne	508.9	542.1	576.3	611.1
Heel to Starboard degrees	0.0	0.0	0.0	0.0
Draft at FP m	2.000	2.100	2.200	2.300
Draft at AP m	2.000	2.100	2.200	2.300
Draft at LCF m	2.000	2.100	2.200	2.300
Trim (+ve by stern) m	0.000	0.000	0.000	0.000
WL Length m	35.245	35.992	36.064	36.133
WL Beam m	11.000	11.000	11.000	11.000
Wetted Area m^2	383.758	398.627	411.629	422.411
Waterpl. Area m^2	319.538	329.414	336.863	341.775
Prismatic Coeff.	0.665	0.660	0.667	0.674
Block Coeff.	0.640	0.636	0.644	0.652
Midship Area Coeff.	0.962	0.964	0.966	0.967
Waterpl. Area Coeff.	0.824	0.832	0.849	0.860
LCB from Amidsh. (+ve fwd) m	-1.002	-1.071	-1.147	-1.220
LCF from Amidsh. (+ve fwd) m	-1.990	-2.262	-2.404	-2.413
KB m	1.105	1.163	1.221	1.280
KG m	2.200	2.200	2.200	2.200
BMt m	5.617	5.443	5.289	5.111
BML m	48.846	50.057	50.062	49.034
GMt m	4.522	4.406	4.310	4.190
GML m	47.751	49.020	49.083	48.114
KMt m	6.722	6.606	6.510	6.390
KML m	49.951	51.220	51.283	50.314
Immersion (TPc) tonne/cm	3.276	3.377	3.454	3.504
MTc tonne.m	7.053	7.714	8.211	8.536
RM at 1deg = GMt.Disp.sin(1) tonne.m	40.156	41.683	43.352	44.694
Max deck inclination deg	0.0	0.0	0.0	0.0

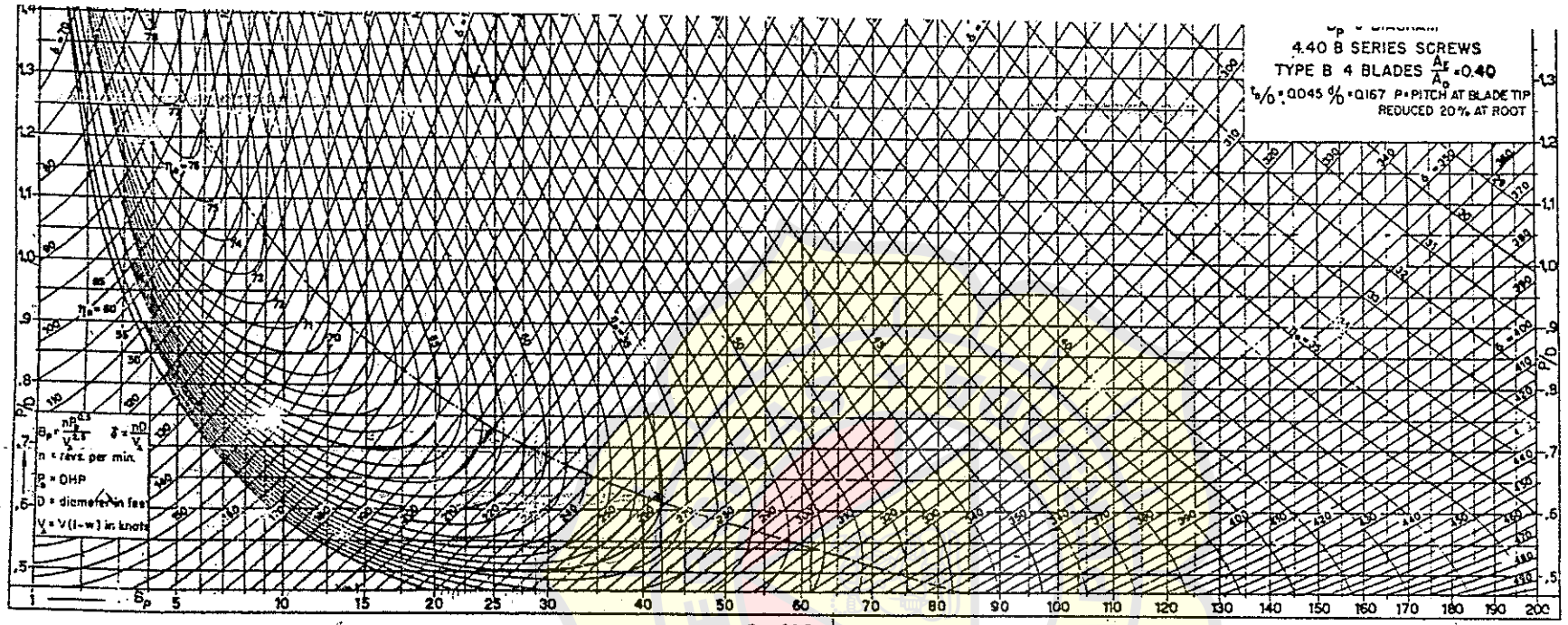
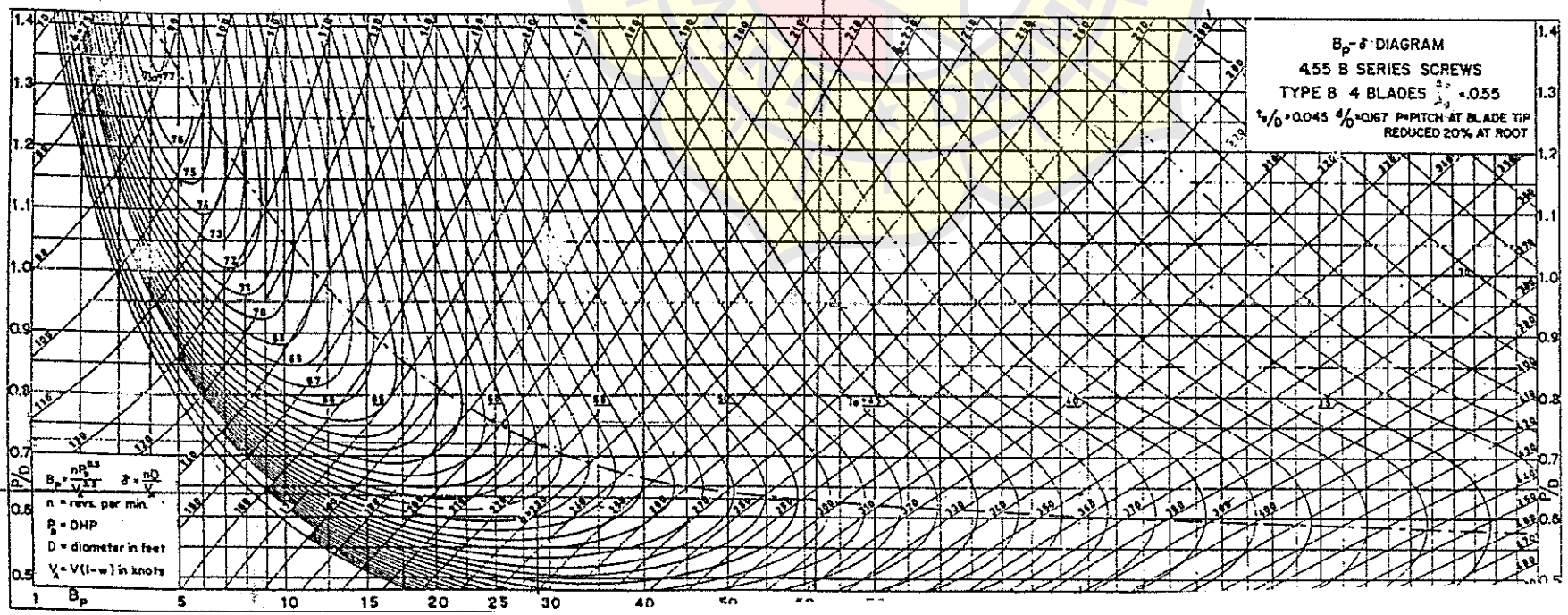

B_p-δ DIAGRAM
4.40 B SERIES SCREWS
TYPE B 4 BLADES $\frac{A_E}{A_O}$ =0.40
$t_{0.7}/D$ =0.045 $\phi_{0.7}$ =0.167 P=PITCH AT BLADE TIP
REDUCED 20% AT ROOT
$B_p = \frac{nP_D^{0.5}}{V_A^{2.5}}$ $\delta = \frac{nD}{V_A}$
n = revs. per min.
P_D = DHP
D = diameter in feet
V_A = V(1-w) in knots
P/D
B_p

Fig. 115


B_p-δ DIAGRAM
4.55 B SERIES SCREWS
TYPE B 4 BLADES $\frac{A_E}{A_O}$ =0.55
$t_{0.7}/D$ =0.045 $\phi_{0.7}$ =0.167 P=PITCH AT BLADE TIP
REDUCED 20% AT ROOT
$B_p = \frac{nP_D^{0.5}}{V_A^{2.5}}$ $\delta = \frac{nD}{V_A}$
n = revs. per min.
P_D = DHP
D = diameter in feet
V_A = V(1-w) in knots
P/D
B_p

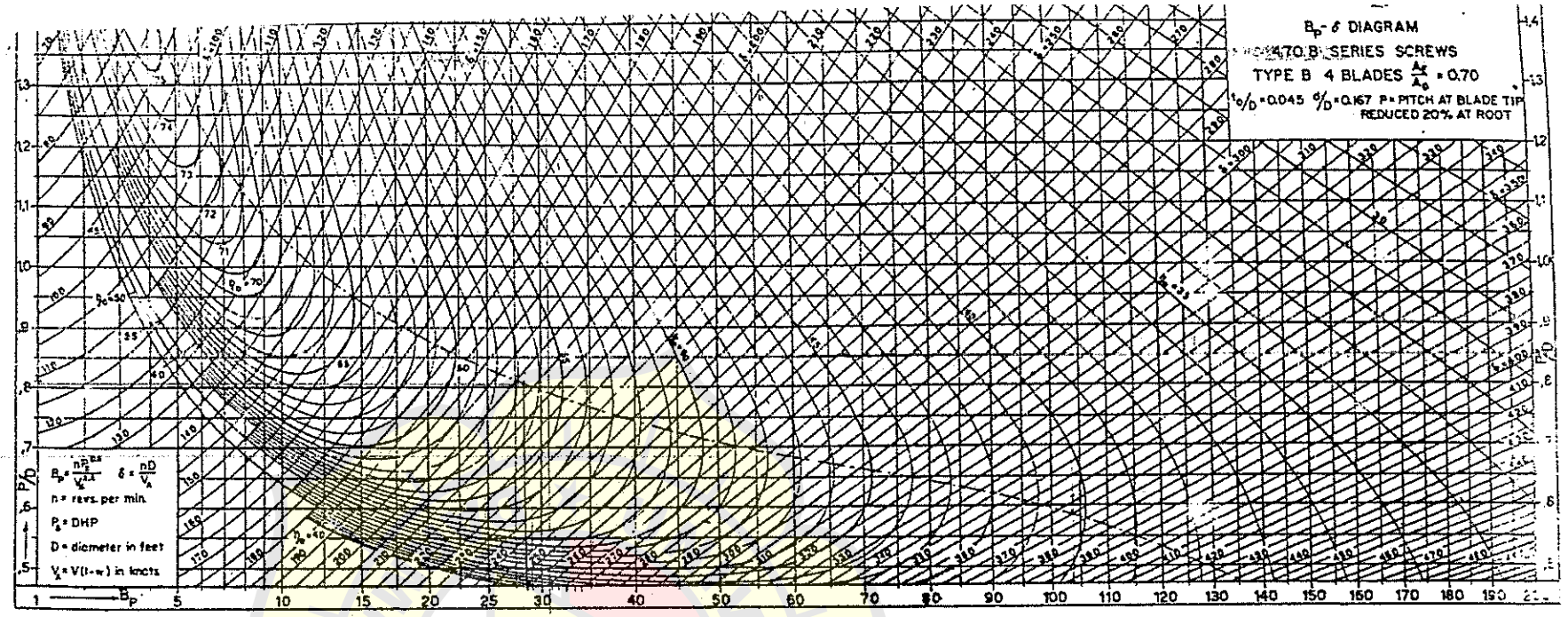


Fig. 117

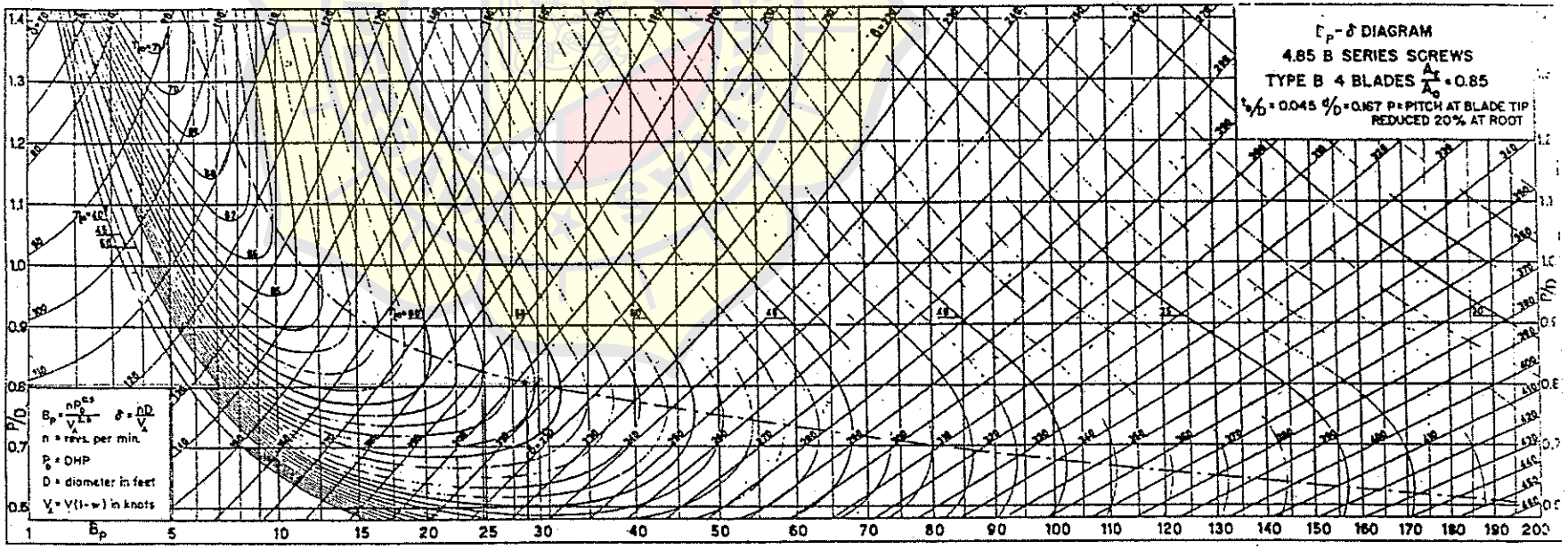


Fig. 118

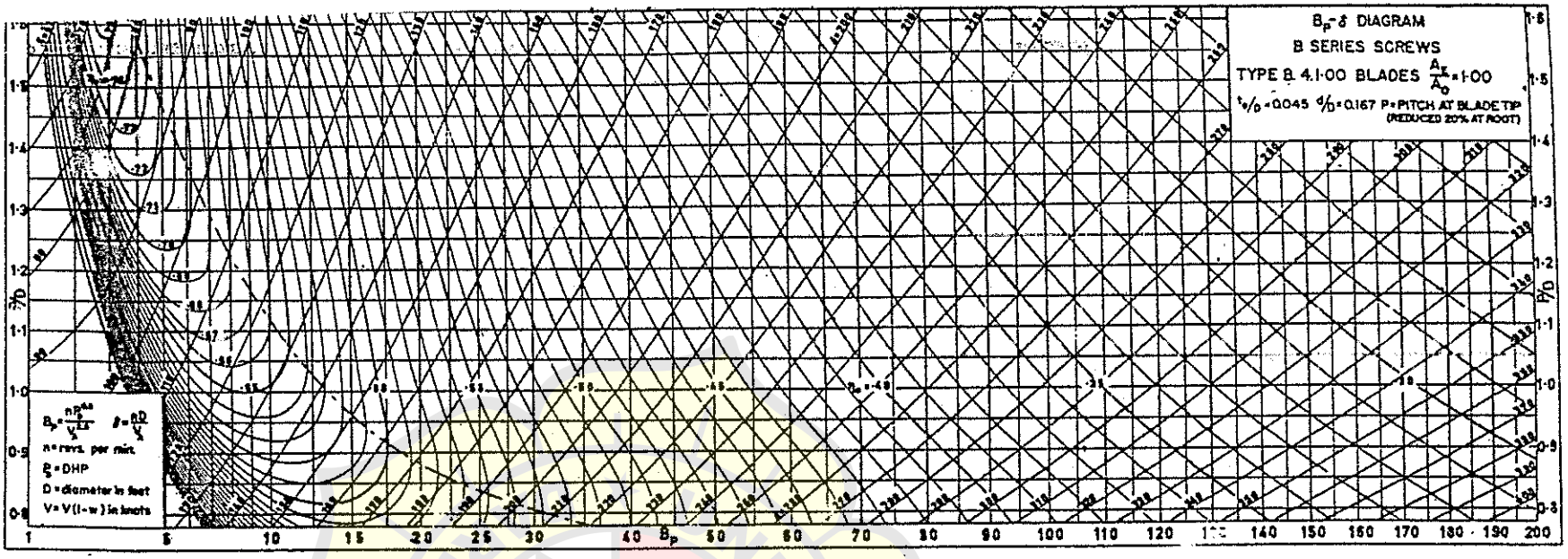


Fig. 119

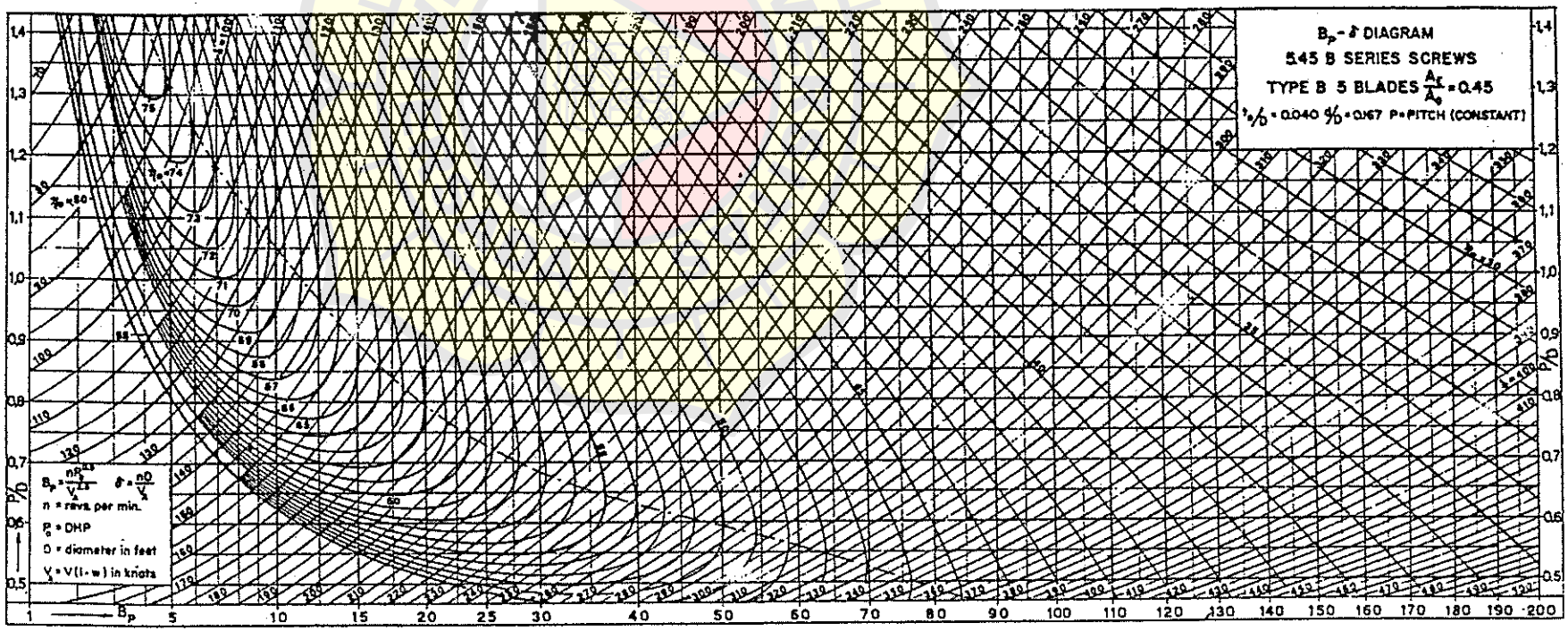


Fig. 120

Friction Losses in Pipe Fittings
Resistance Coefficient K (use in formula $hf = Kv^2/2g$)

Fitting		LD	Nominal Pipe Size											
			½	¾	1	1¼	1½	2	2½-3	4	6	8-10	12-16	18-24
			K Value											
Angle Valve		55	1.48	1.38	1.27	1.21	1.16	1.05	0.99	0.94	0.83	0.77	0.72	0.66
Angle Valve		150	4.05	3.75	3.45	3.30	3.15	2.85	2.70	2.55	2.25	2.10	1.95	1.80
Ball Valve		3	0.08	0.08	0.07	0.07	0.06	0.06	0.05	0.05	0.05	0.04	0.04	0.04
Butterfly Valve								0.86	0.81	0.77	0.68	0.63	0.35	0.30
Gate Valve		8	0.22	0.20	0.18	0.18	0.15	0.15	0.14	0.14	0.12	0.11	0.10	0.10
Globe Valve		340	9.2	8.5	7.8	7.5	7.1	6.5	6.1	5.8	5.1	4.8	4.4	4.1
Plug Valve Branch Flow		90	2.43	2.25	2.07	1.98	1.89	1.71	1.62	1.53	1.35	1.26	1.17	1.08
Plug Valve Straightaway		18	0.48	0.45	0.41	0.40	0.38	0.34	0.32	0.31	0.27	0.25	0.23	0.22
Plug Valve 3-Way Thru-Flow		30	0.81	0.75	0.69	0.66	0.63	0.57	0.54	0.51	0.45	0.42	0.39	0.36
Standard Elbow	90°	30	0.81	0.75	0.69	0.66	0.63	0.57	0.54	0.51	0.45	0.42	0.39	0.36
	45°	16	0.43	0.40	0.37	0.35	0.34	0.30	0.29	0.27	0.24	0.22	0.21	0.19
	long radius 90°	16	0.43	0.40	0.37	0.35	0.34	0.30	0.29	0.27	0.24	0.22	0.21	0.19
Close Return Bend		50	1.35	1.25	1.15	1.10	1.05	0.95	0.90	0.85	0.75	0.70	0.65	0.60
Standard Tee	Thru-Flow	20	0.54	0.50	0.46	0.44	0.42	0.38	0.36	0.34	0.30	0.28	0.26	0.24
	Thru-	60	1.62	1.50	1.38	1.32	1.26	1.14	1.08	1.02	0.90	0.84	0.78	0.72
90 Bends, Pipe Bends, Flanged Elbows, Butt-Welded Elbows	r/d=1	20	0.54	0.50	0.46	0.44	0.42	0.38	0.36	0.34	0.30	0.28	0.26	0.24
	r/d=2	12	0.32	0.30	0.28	0.26	0.25	0.23	0.22	0.20	0.18	0.17	0.16	0.14
	r/d=3	12	0.32	0.30	0.28	0.26	0.25	0.23	0.22	0.20	0.18	0.17	0.16	0.14
	r/d=4	14	0.38	0.35	0.32	0.31	0.29	0.27	0.25	0.24	0.21	0.20	0.18	0.17
	r/d=6	17	0.46	0.43	0.39	0.37	0.36	0.32	0.31	0.29	0.26	0.24	0.22	0.20
	r/d=8	24	0.65	0.60	0.55	0.53	0.50	0.46	0.43	0.41	0.36	0.34	0.31	0.29
	r/d=10	30	0.81	0.75	0.69	0.66	0.63	0.57	0.54	0.51	0.45	0.42	0.39	0.36
	r/d=12	34	0.92	0.85	0.78	0.75	0.71	0.65	0.61	0.58	0.51	0.48	0.44	0.41
	r/d=14	38	1.03	0.95	0.87	0.84	0.80	0.72	0.68	0.65	0.57	0.53	0.49	0.46
	r/d=16	42	1.13	1.05	0.97	0.92	0.88	0.80	0.76	0.71	0.63	0.59	0.55	0.50
	r/d=18	45	1.24	1.15	1.06	1.01	0.97	0.87	0.83	0.78	0.69	0.64	0.60	0.55

Mitre Bends	a=0°	2	0.05	0.05	0.05	0.04	0.04	0.04	0.04	0.03	0.03	0.03	0.03	0.02
	a=15°	4	0.11	0.10	0.09	0.09	0.08	0.08	0.07	0.07	0.06	0.06	0.05	0.05
	a=30°	8	0.22	0.20	0.18	0.18	0.17	0.15	0.14	0.14	0.12	0.11	0.10	0.10
	a=45°	15	0.41	0.38	0.35	0.33	0.32	0.29	0.27	0.26	0.23	0.21	0.20	0.18
	a=60°	25	0.68	0.63	0.58	0.55	0.53	0.48	0.45	0.43	0.38	0.35	0.33	0.30
	a=75°	40	1.09	1.00	0.92	0.88	0.84	0.76	0.72	0.68	0.60	0.56	0.52	0.48
	a=90°	60	1.62	1.50	1.38	1.32	1.26	1.14	1.08	1.02	0.90	0.84	0.78	0.72
Note: Fittings are standard with full openings.														

Fitting	L/D	Minimum Velocity for Full Disc Lift		Nominal Pipe Size											
				½	¾	1	1¼	1½	2	2½-3	4	6	8-10	12-16	18-24
		General ft/sec	Water ft/sec	K Value											
Swing Check Valve	100	$35\sqrt{\nabla}$	4.40	2.70	2.50	2.30	2.20	2.10	1.90	1.80	1.70	1.50	1.40	1.30	1.20
	50	$48\sqrt{\nabla}$	6.06	1.40	1.30	1.20	1.10	1.10	1.00	0.90	0.90	0.75	0.70	0.65	0.60
Lift Check Valve	600	$40\sqrt{\nabla}$	5.06	16.2	15.0	13.08	13.2	12.6	11.4	10.8	10.2	9.0	8.4	7.8	7.2
	55	$140\sqrt{\nabla}$	17.7	1.50	1.40	1.30	1.20	1.20	1.10	1.00	0.94	0.83	0.77	0.72	0.66
Tilting Disc Check Valve	5	$80\sqrt{\nabla}$	10.13						0.76	0.72	0.68	0.60	0.56	0.39	0.24
	15	$30\sqrt{\nabla}$	3.80						2.30	2.20	2.00	1.80	1.70	1.20	0.72
Foot Valve with Strainer Poppet Disc	420	$15\sqrt{\nabla}$	1.90	11.3	10.5	9.70	9.30	8.80	8.00	7.60	7.10	6.30	5.90	5.50	5.0
Foot Valve with Strainer Hinged Disc	75	$35\sqrt{\nabla}$	4.43	2.00	1.90	1.70	1.70	1.70	1.40	1.40	1.30	1.10	1.10	1.00	0.90

Fitting	Description	All Pipe Sizes
		K Value
Pipe Exit	Projecting Sharp-Edged Rounded	1.00

Friction Loss of Water in Pipe Fittings in Terms of Equivalent Length - Feet of Straight Pipe

Nominal pipe size	Actual inside diameter inches d	Friction factor f	Gate valve - full open	90° elbow	Long radius 90° or 45° std elbow	Std tee - thru flow	Std tee - branch flow	Close return bend	Swing check valve - full open	Angle valve - full open	Globe valve - full valve	Butter-fly valve	90°Welding elbow		Mitre bend	
													r/d =	r/d =	45°	90°
½	.622	.027	.41	1.55	.83	1.04	3.11	2.59	5.18	7.78	17.6					
¾	.824	.025	.55	2.06	1.10	1.37	4.12	3.43	6.86	10.3	23.3					
1	1.049	.023	.70	2.62	1.40	1.75	5.25	4.37	8.74	13.1	29.7					
1¼	1.380	.022	.92	3.45	1.84	2.30	6.90	5.75	11.5	17.3	39.1					
1½	1.610	.021	1.07	4.03	2.15	2.68	8.05	6.71	13.4	20.1	45.6					
2	2.067	.019	1.38	5.17	2.76	3.45	10.3	8.61	17.2	25.8	58.6	7.75	3.45	2.07	2.58	10.3
2½	2.469	.018	1.65	6.17	3.29	4.12	12.3	10.3	20.6	30.9	70.0	9.26	4.12	2.47	3.08	12.3
3	3.068	.018	2.04	7.67	4.09	5.11	15.3	12.8	25.5	38.4	86.9	11.5	5.11	3.07	3.84	15.3
4	4.026	.017	2.68	10.1	5.37	6.71	20.1	16.8	33.6	50.3	114	15.1	6.71	4.03	5.03	20.1
5	5.047	.016	3.36	12.6	6.73	8.41	25.2	21.0	42.1	63.1	143	18.9	8.41	5.05	6.31	25.2
6	6.065	.015	4.04	15.2	8.09	10.1	30.3	25.3	50.5	75.8	172	22.7	10.1	6.07	7.58	30.3
8	7.981	.014	5.32	20.0	10.6	13.3	39.9	33.3	33.3	99.8	226	29.9	13.3	7.98	9.98	39.9
10	10.02	.014	6.68	25.1	13.4	16.7	50.1	41.8	41.8	125	284	29.2	16.7	10.0	12.5	50.1
12	11.938	.013	7.96	29.8	15.9	19.9	59.7	49.7	49.7	149	338	34.8	19.9	11.9	14.9	59.7
14	13.124	.013	8.75	32.8	17.5	21.8	65.6	54.7	54.7	164	372	38.3	21.8	13.1	16.4	65.6
16	15.00	.013	10.0	37.5	20.0	25.0	75.0	62.5	62.5	188	425	31.3	25.0	15.0	18.8	75.0
18	16.876	.012	16.9	42.2	22.5	28.1	84.4	70.3	70.3	210	478	35.2	28.1	16.9	21.1	84.4
20	18.814	.012	12.5	47.0	25.1	31.4	94.1	78.4	78.4	235	533	39.2	31.4	18.8	23.5	94.1
24	22.628	0.12	15.1	56.6	30.2	37.7	113	94.3	94.3	283	641	47.1	37.7	22.6	28.3	113
30	28	.011	18.7	70	37.3	46.7	140	117					46.7	28	35	140
36	34	.011	22.7	85	45.3	56.7	170	142					56.7	34	43	170
42	40	.010	26.7	100	53.3	66.7	200	167					66.7	40	50	200
48	46	.010	30.7	115	61.3	76.7	230	192					76.7	46	58	230
L/D			8	30	16	20	60	50	½ to 6 = 100 24 to 48 =50	150	340		20	12	15	60

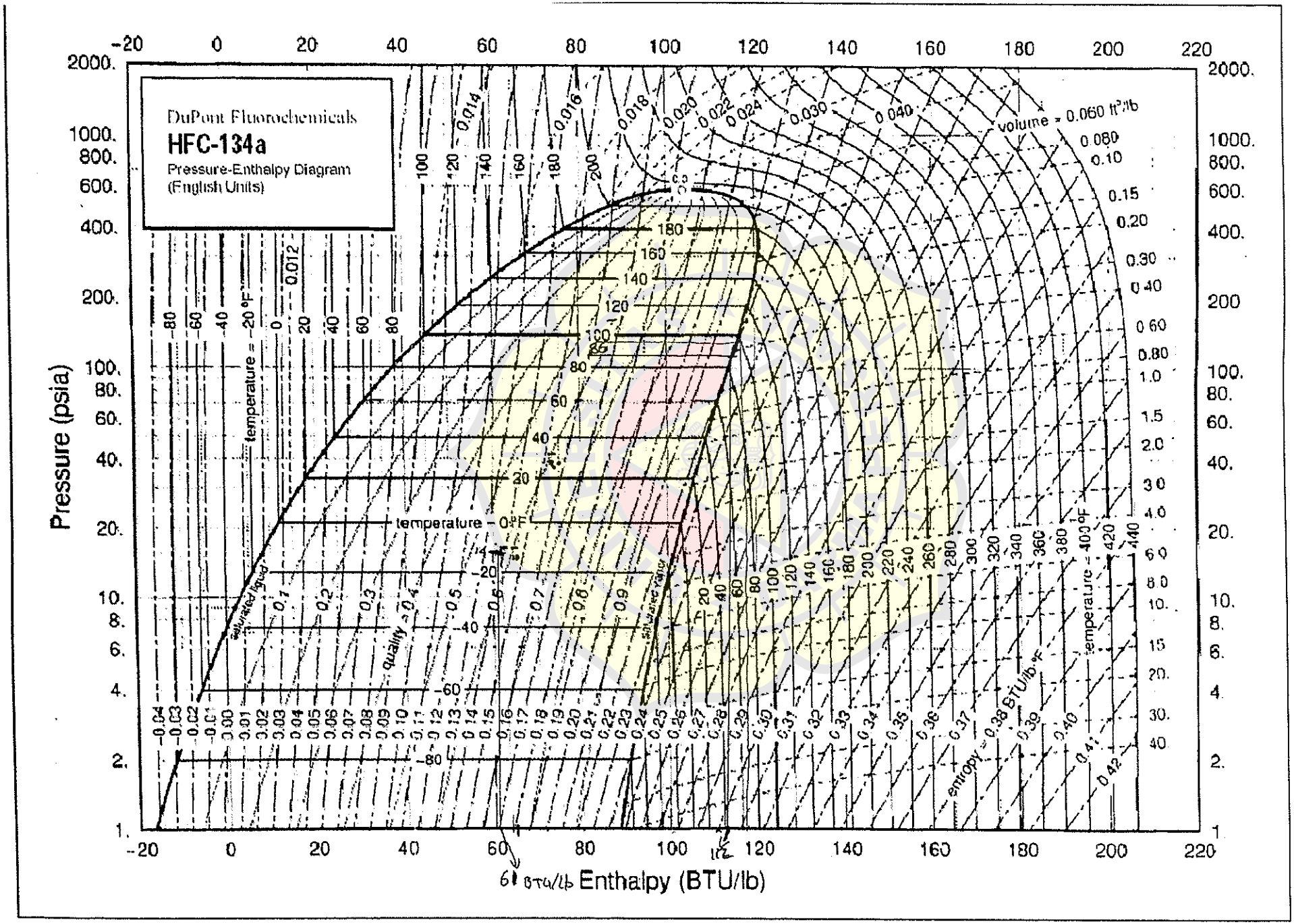
Pipe Entrance	Inward Projecting	0.78
Pipe Entrance Flush	Sharp-Edged	0.50
	r/d=0.02	0.28
	r/d=0.04	0.24
	r/d=0.06	0.15
	r/d=0.10	0.09
	r/d<0.14	0.04

The K values given below are for making estimates of friction loss in cases not covered in the previous tables.

Type of Fitting	K Value
Disk or Wobble Meter	3.4 - 10
Rotary Meter (Star or Cog-Wheel Piston)	10
Reciprocating Piston Meter	15
Turbine Wheel (Double-Flow) Meter	5 - 7.5
Bends w/Corrugated Inner Radius	1.3 - 1.6 times value for smooth bend

Example: Determine L (friction loss in pipe fittings in terms of equivalent length in feet of straight pipe).
Assume a 6" angle valve for Schedule 40 pipe size.
Select the appropriate K value for such and select D and f for Schedule 40 pipe from the table below where K is the pipe diameter in feet.

Pipe Size Inches Sch. 40	D feet	f	Pipe Size Inches Sch. 40	D feet	f	Pipe Size Inches Sch. 40	D feet	f	Pipe Size Inches Sch. 40	D feet	f
½	0.0518	0.027	2½	0.2058	0.018	10	0.8350	0.014	24	1.8857	0.012
¾	0.0687	0.025	3	0.2557	0.018	12	0.9948	0.013	30	2.3333	0.011
1	0.0874	0.023	4	0.3355	0.017	14	1.0937	0.013	36	2.8333	0.011
1¼	0.1150	0.022	5	0.4206	0.016	16	1.250	0.013	42	3.3333	0.010
1½	0.1342	0.021	6	0.5054	0.015	18	1.4063	0.012	48	3.8333	0.010
2	0.1723	0.019	8	0.6651	0.014	20	1.5678	0.012			



10 °C →
°F = ?

kcal/kg
kJ/kg

Table 4-1 Outdoor-air requirements for ventilation

Function	Estimated occupancy per 100 m^2 floor area	Outdoor-air requirements per person, L/s	
		Smoking	Nonsmoking
Offices	7	10	2.5
Meeting and waiting spaces	60	17.5	3.5
Lobbies	30	7.5	2.5

energy whenever the outdoor-air temperature is extremely high or low. The ASHRAE Standard[2] provides the following procedure for determining the allowable rate for recirculation

$$\dot{V} = \dot{V}_r + \dot{V}_m$$

where $\dot{V}$ = rate of supply air for ventilation purposes, L/s
$\dot{V}_r$ = recirculation air rate, L/s
$\dot{V}_m$ = minimum outdoor-air rate for specified occupancy, for example the nonsmoking value from Table 4-1, but never less than 2.5 L/s per person

also

$$\dot{V}_r = \frac{\dot{V}_o - \dot{V}_m}{E}$$

where $\dot{V}_o$ = outdoor-air rate from Table 4-1 for specified occupancy (smoking or nonsmoking, as appropriate), L/s
E = efficiency of contaminant removal by air-cleaning device. The efficiency must be determined relative to the contaminant to be removed. Table 4-2 provides values appropriate for removal of 1-μm particles

Example 4-1 Determine the ventilation rate, outdoor-air rate, and recirculated-air rate for an office-building meeting room if smoking is permitted. An air-cleaning device with $E = 60$ percent for removal of tobacco smoke is available.

Table 4-2 ASHRAE dust spot efficiencies (1-μm particles)[3]

Filter type	Efficiency range, %	Application
Viscous impingement	5–25	Dust and lint removal
Dry media:		
Glass fiber, multi-ply cellulose, wool felt	25–40	Same as above and for some industrial applications
Mats of 3- to 10-μm fiber 6 to 20 mm thick	40–80	Building recirculated- and fresh-air systems
Mats of 0.5- to 4-μm fiber (usually glass)	80–98	Hospital surgeries, clean rooms, special applications
Electrostatic (depending on type)	20–90	Pollen and airborne particles

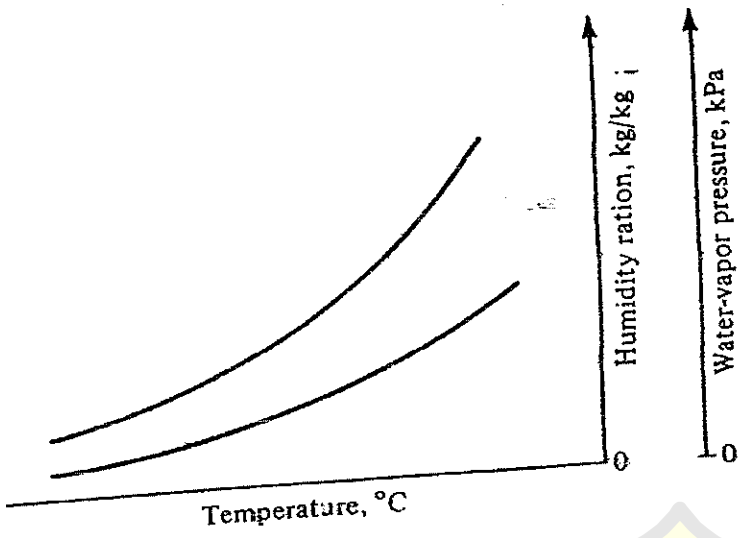


Figure 3-4 Humidity ratio W as another ordinate.

Substituting the numerical values of R_a and R_s into Eq. (3-1) gives

$$W = \frac{287}{461.5}\frac{p_s}{p_t - P_s} = 0.622\frac{p_s}{p_t - P_s} \tag{3-2}$$

The atmospheric pressure p_t has now appeared on the scene, and from this point on in the development of the psychrometric chart the chart will be unique to a given barometric pressure. Equation (3-2) shows the relationship between the humidity ratio and the water-vapor pressure, so that companion scales can be shown as ordinates of the psychrometric chart, as illustrated in Fig. 3-4. As Eq. (3-2) shows, the relation between W and p_s is not perfectly linear. In Fig. 3-1 and in most psychrometric charts the W scale is divided linearly, which makes the p_s scale slightly nonlinear.

Example 3-1 Compute the humidity ratio of air at 60 percent relative humidity when the temperature is 30°C. The barometric pressure is the standard value of 101.3 kPa.

Solution The water-vapor pressure of saturated air at 30°C is 4.241 kPa from Table A-1. Since the relative humidity is 60 percent, the water-vapor pressure of the air is 0.60 (4.241 kPa) = 2.545 kPa. From Eq. (3-2)

$$W = 0.622\frac{2.545}{101.3 - 2.545} = 0.0160 \text{ kg/kg}$$

This result checks the value read from Fig. 3-1.

3-6 Enthalpy The enthalpy of the mixture of dry air and water vapor is the sum of the enthalpy of the dry air and the enthalpy of the water vapor. Enthalpy values are always based on some datum plane, and the zero value of the dry air is chosen as air at 0°C. The zero value of the water vapor is saturated liquid water at 0°C, the same datum plane that is used for tables of steam. An equation for the enthalpy is

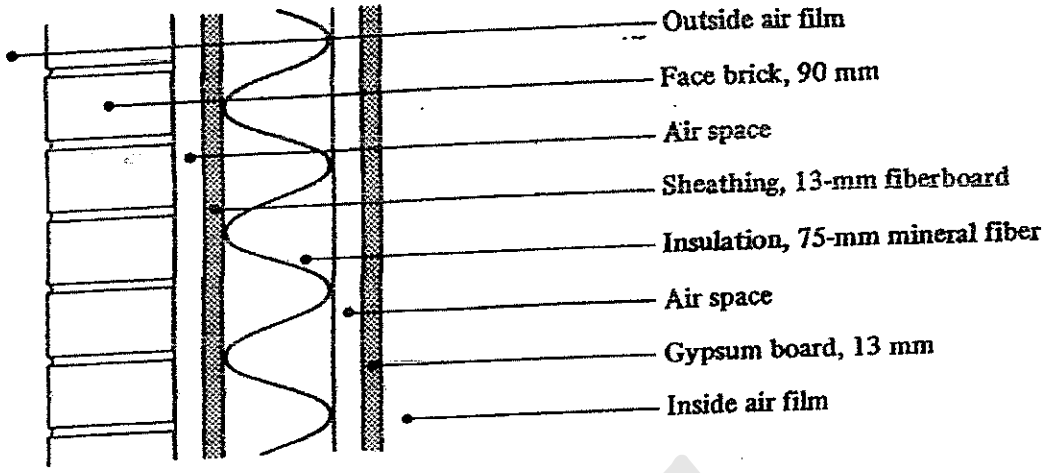


Figure 4-3 Wall section in Example 4-3.

If below-grade spaces are not conditioned, the heat loss through below-grade surfaces is often neglected. Heating loads are included in such cases based on an estimate of the temperature of these unconditioned spaces and transmission through the floor above them. If the below-grade spaces are to be conditioned, transmission heat losses are based on the wall and floor thermal resistance, the inside temperature to be maintained, and an estimate of the ground temperature adjacent to the surface.

For slab-on-grade construction the heat loss is more nearly proportional to the length of the perimeter of the slab (in meters) than its area. Thus

$$q_{\text{slab}} = F(\text{perimeter})\,(t_o - t_i) \qquad \text{where } F = \text{const}$$

Little information is available on which to base values of F for large slabs. Values for residential-scale slabs are given[4] as $F = 1.4$ W/m · K for an uninsulated edge and $F = 0.9$ W/m · K for a slab with 2.5 cm of insulation at the edge. These values must be viewed as approximate and are generally considered too high.

4-8 Infiltration and ventilation loads The entry of outside air into the space influences both the air temperature and the humidity level in the space. Usually a distinction is made between the two effects, referring to the temperature effect as *sensible load* and the humidity effect as *latent load*. This terminology applies to the other load components as well. For example, transmission and solar loads are sensible, as they affect only temperature, while internal loads arising from occupancy have both sensible and latent components. Heat loss or heat gain due to the entry of outside air is then expressed as

$$q_{is} = 1.23\dot{Q}(t_o - t_i) \qquad q_{il} = 3000\dot{Q}(W_o - W_i)$$

where $\dot{Q}$ = volumetric flow rate of outside air, L/s
W = humidity ratio, water to air, kg/kg

Infiltration, defined as the uncontrolled entry of unconditioned outside air directly into the building, results from natural forces, e.g., wind and buoyancy due to the temperature difference between inside and outside. For our purposes we define ventilation as air intentionally brought into the building by mechanical means. Of

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)

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**	**185**	**200**	**200**	**185**	**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	199	197	198	199
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. (TE2C1)	°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 ISC 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.

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.

5.1 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.

6LAAL

Engine output
243–669 kW (330–910 PS)

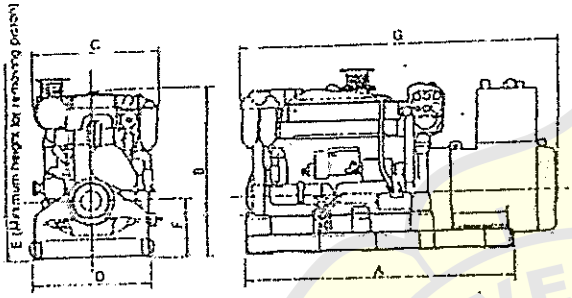
Specifications

Engine model		6LAAL-DTN	6LAAL-UTN			12LAAL-DTN		12LAAL-UTN	
No. of cylinders		6				V12			
Cylinder bore × stroke	mm	148×165				148×165			
Continuous rated output	kW (PS)	243 (330)	265 (360)	309 (420)	353 (480)	530 (720)	618 (840)	574 (780)	669 (910
Engine speed	rpm	1200	1200	1500	1800	1500	1800	1500	180
Generator capacity	kW	220	240	280	320	480	560	520	600
Starting system		Electric starting (Air-motor starting is available.)				Electric starting (Air-motor starting is available.)			
Dry weight	kg	1990	2050			3660		3680	

The engine dry weight may differ depending upon the specifications and attached acce

Dimensions (Units: mm)

Depending on the specifications or options that have been chosen, your model may differ slightly from the one in the photograph



Engine model	6LAAL-DTN	6LAAL-UTN		12LAAL-DTN	12LAAL
Engine speed (rpm)	1200	1200	1500 1800	1500 1800	150 180
A	2340	2530	2340	2900	290
B	1469	1469		1610	161
C	1061	1061		1452	145
D	1000	1000		1030	108
E	1414	1414		1315	131
F	489	489		640	64
G	2725	2785	2828	3544	354
Dry weight of generating equipment (kg)	3380	3710	3620	6400	640

Please confirm all specifications, etc. on the separate delivery specifications sheet

4HAL2/6HAL2

Engine output
72–305 kW (98–414 PS)

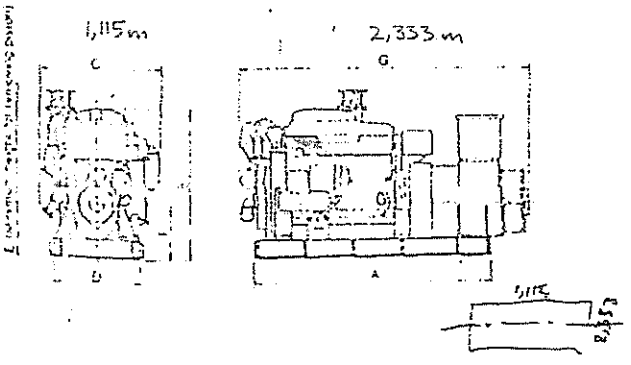
Specifications

Engine model		4HAL2-TN1			4HAL2-TN			6HAL2-N			6HAL2-TN			6HAL2-HTN			6HAL2-DT
No. of cylinders		4						6									
Cylinder bore × stroke	mm	130×165						130×165									
Continuous rated output	kW (PS)	72 (98)	89 (121)	116 (157)	90 (122)	115 (156)	135 (183)	90 (122)	115 (156)	135 (183)	120 (163)	150 (204)	180 (244)	160 (217)	220 (299)	265 (360)	200 (271)	255 (346)
Engine speed	rpm	1200	1500	1800	1200	1500	1800	1200	1500	1800	1200	1500	1800	1200	1500	1800	1200	1500
Generator capacity	kW	64	80	104	80	100	120	80	100	120	104	136	160	144	200	240	180	232
Starting system		Electric starting (Air-motor starting is available.)																
Dry weight	kg	1030			1030			1380			1395			1410			1420	

The engine dry weight may differ depending upon the specifications and attached acce

Dimensions (Units: mm)

Depending on the specifications or options that have been chosen, your model may differ slightly from the one in the photograph



Engine model	4HAL2-TN1		4HAL2-TN		6HAL2-N		6HAL2-TN		6HAL2-HTN		6HAL2
Engine speed (rpm)	1200	1500 1800	1200	1500 1800	1200	1500 1800	1200	1500 1800	1200	1500 1800	1200
A	1600		1600		1970		1970	2050	2150		21
B	1206		1206		1285		1351		1351		13
C	1013		1013		1115		1115		1115		11
D	800		800		800		800		800		8
E	1233		1233		1268		1268		1268		12
F	450		450		485		485		455		4
G	2021	2047	2021	2047	2339	2413	2484	2534	2625	2633	2682
Dry weight of generating equipment (kg)	1750	1820	1810	1870	2160	2190	2290	2340	2630	2650	2750

Please confirm all specifications, etc. on the separate delivery specifications sheet

Air Conditioning Kits

Technical Specifications for Dometic EnviroCool Air Conditioners

Model	ECM03.5	ECM05		ECM06.5	ECM09	ECM11		ECM15	
Capacity (BTU/hr)	3,500	5,000		6,500	9,000	11,000		15,000	
Power (Volt/Hz/Ph)	115/60/1	115/60/1	220/50/1	115/60/1	115/60/1	115/60/1	220/50/1	115/60/1	220/50/1
Full Load Amps - Cool	4.3	3.8	2.2	5.4	6.3	6.8	3.7	9.4	4.5
Locked Rotor Amperage	14.0	29.0	11.0	40.0	49.0	53.0	22.2	59.0	32.0
Refrigerant type	R-134A	R-417A		R-417A	R-417A	R-417A		R-417A	
Control type	Mechanical	Mechanical		Mechanical	Mechanical	Mechanical		Mechanical	
Dimensions (± 0.5" or 13mm)									
Height (in/mm)	9.50/241	11.75/298		11.75/298	13.50/343	13.50/343		13.50/343	
Width (in/mm)	9.75/248	9.50/241		9.50/241	9.75/248	9.75/248		11.00/279	
Depth (in/mm)	17.75/451	17.75/451		19.75/502	21.75/552	21.75/552		21.75/552	
Connections									
Sea Water (in/mm)	0.63/16	0.63/16		0.63/16	0.63/16	0.63/16		0.63/16	
Estimated Weight[1]									
Net weight (lbs/kg)	25.0/11.3	39.0/17.7		45.0/20.4	54.0/24.5	54.0/24.5		60.0/27.2	
Ship weight (lbs/kg)	32.0/14.5	50.0/22.7		TBD	TBD	TBD		72.0/32.7	

Notes:

(1) Weights listed are for ECM units only and do not include kit components.

)ual-Duct Kit

or applications requiring an additional air
ıtlet, Dometic's dual-duct kit is available for
5-15K BTU/hr EnviroCool models.

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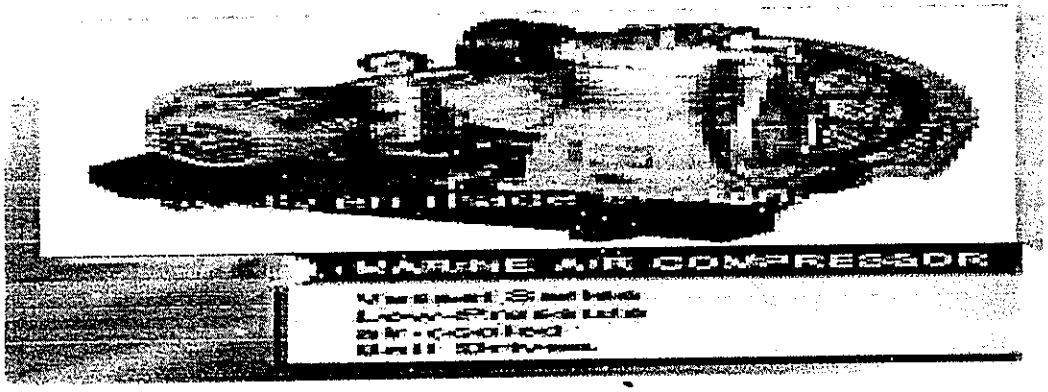


Packing : by Wooden Case

Model NO. : Low pressure, air-cooled

Standard : 1HP~5.5HP

Product Description

Main configuration:
Foundation base, main compressor, marin electric motor, pressure relay, cooler, secondary electromagnetism discharge valve, secondary oil-water separator, holding valve, secondary pressure gage, first and second class safety valve, electric cabinet.

Model	Power		Cool by	Speed	Air Delivery	Pressure		Weight	Overal Dimension	Remark
	HP	KW		rpm	Lt. /h	kgf/cm2	mpa	Kg	cm	
CZ-2.2/10F	1	0.75	air	750	2.2	10	1	42	520*320*350	
CZ-2.2/10FT	1	0.75	air	750	2.2	10	1	52	740*350*620	with tank
CZ-5/10FZK	2	1.5	air	750	5	10	1	90	71*36*46	
CZ-6/10FZK	2	1.5	air	750	6	10	1	90	71*36*46	
CZ-10/10FZK	3	2.2	air	750	10	10	1	120	79*41*53	
CZ-15/10FZK	4	3	air	800	15	10	1	125	79*41*53	
CZ-20/10FZK	5.5	4	air	750	20	10	1	190	85*47*63	

Electric Winches and Car Pullers
200 to 25000 lb (91 to 11364 kg) capacity

Ingersoll-Rand.

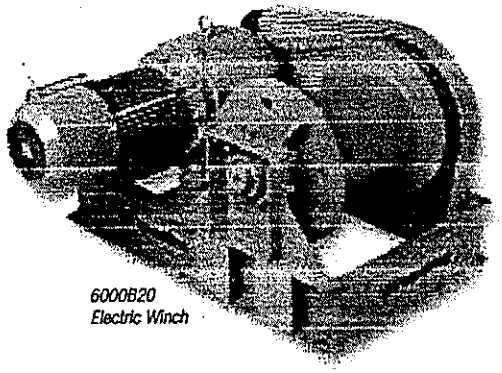
IR electric winches and car pullers offer maximum performance and reliability.

■ Standard features:

- Totally enclosed fan cooled (TEFC) motors are high torque design, Nema "B" class with an average of 280 percent starting torque. Rated for continuous duty.
- Winches utilize an automatic disc brake rated at 200% motor torque
- Structural steel frames allow flexibility in installation
- Car pullers have a lever operated, jaw clutch that allows for:
  - – disengagement of the drum for free spooling of wire rope
  - – bi-directional rail car pulling
- Car pullers have an adjustable drag brake to control drum spinning and cable over-run during free spooling operation

■ Options:

- Available in single or three phase motors (single phase through 3hp only)
- IEEE 45 marine grade motor (three phase only) and gear box available (specify by adding ***M*** to model; see ***How to Order*** information)
  - – Three phase marine grade winch motors have a corrosion-resistant coating on motor windings to prevent corrosion due to condensation
  - – Marine grade gear-boxes incorporate bronze filters and breather cover caps
- Longer or shorter drum sizes
- Drum divider flange and extra cable anchors
- Grooved drums



6000B20 Electric Winch

- Control packages consisting of:
  - – NEMA 4 magnetic reversing starters (single and three phase)
  - – NEMA 4 wall-mount pushbutton stations
  - – NEMA 3R or NEMA 4 hand-held pushbutton pendents
  - – NEMA 1 or NEMA 4 reversing drum switches (through 2hp only)
- Sandblast/carbozinc primer with a Marine 812 finish
- Heaters (in motor windings)
- Limit switch; 2 position; upper and lower; NEMA 4 class enclosure
- Adjustable torque limiting clutch
- Disengaging clutch
- Horizontal Load Reversing (HLR) designs for load movement in two directions. Includes grooved drum, two wire rope anchors and a drum length to spool all wire rope on the first layer
- Explosion-proof components
- Design and manufacturing expertise for special applications

Specifications

Model single/ three phase	Rated capacity at 2nd layer (1) lbs	kg	Appx line spd/min ft	m	hp	Starting line pull 1st layer lbs	kg	4th layer lbs	kg	Running line pull 1st layer lbs	kg	4th layer lbs	kg	Rec'd wire rope in.	mm	Drum capacity (2) 2nd layer ft	m	full drum ft	m	Shipping weight lbs	kg
200A40/B40	200	91	40	12.2	1/3	550	280	438	199	220	100	175	80	1/4	6	81	25	288	88	160	73
250A40/B40	250	114	20	6.1	1/4	688	313	538	245	275	125	215	98	1/4	6	81	25	288	88	160	73
500A20/B20	500	227	20	6.1	1/2	1375	625	1075	489	550	250	430	195	1/4	6	81	25	288	88	160	72
500A40/B40	500	227	40	12.2	3/4	1375	625	1075	489	550	250	430	195	1/4	6	81	25	288	88	160	72
700A40/B40	700	318	40	12.2	1	1938	881	1525	693	775	352	610	277	1/4	6	81	25	288	88	150	68
800A20/B20	800	364	20	6.1	2	2200	1000	1750	795	880	400	700	318	1/4	6	81	25	288	88	190	86
1300A20*/B20* (3)	1300	591	20	6.1	1	3240	1473	2550	1159	1410	641	1110	505	5/16	8	120	37	605	184	370	168
1400A40*/B40* (3)	1400	636	40	12.2	2	3540	1609	2780	1264	1540	700	1210	550	5/16	8	120	37	605	184	370	168
1600B90	1600	727	90	27.4	5	4400	2000	3350	1523	1760	800	1340	609	3/8	10	105	32	460	140	625	283
2000A20*/B20* (3)	2000	909	20	6.1	1 1/2	4950	2250	3750	1705	2150	977	1675	761	3/8	10	105	32	460	140	375	170
2000A40*/B40* (3)	2000	909	40	12.2	3	4970	2259	3770	1714	2160	982	1675	761	3/8	10	105	32	460	140	445	202
2000B60	2000	909	60	19.3	5	5400	2455	4175	1898	2160	982	1670	759	3/8	10	105	32	460	140	575	261
3000B40* (3)	3000	1364	40	12.2	5	7600	3455	5900	2682	3300	1500	2560	1164	7/16	12	119	36	422	129	575	261
3500B80	3500	1591	80	24.4	12	9450	4295	7450	3386	3780	1718	2980	1355	7/16	12	125	38	875	267	690	313
4000A20*/B20* (3)	4000	1818	20	6.1	3	9700	4409	7270	3305	4220	1918	3160	1436	1/2	13	107	33	309	94	525	239
4500B50* (3)	4500	2045	50	15.2	7 1/2	11200	5091	8450	3841	4840	2200	3680	1673	1/2	13	107	33	309	94	630	286
6000B20* (3)	6000	2727	20	6.1	5	15400	7000	11600	5273	6700	3045	5040	2291	5/8	16	146	45	422	129	930	422
6000B40* (3)	6000	2727	40	12.2	7 1/2	17200	7818	12950	5886	7480	3400	5630	2559	5/8	16	146	45	422	129	950	431
10000B20*	10000	4545	20	6.1	7 1/2	29670	13486	22200	10091	12900	5864	9650	4386	3/4	19	146	45	323	98	1525	692
10000B40* (3)	10000	4545	40	12.2	15	27150	12341	20350	9250	11800	5364	8850	4023	3/4	19	146	45	323	98	1740	789
15000B20* (3)	15000	6818	20	6.1	12	37500	17045	30000	13636	17200	7818	13000	5909	1	25	230	70	600	183	2750	1247
25000B25* (3)	25000	11363	25	7.6	20	62800	28545	48300	21955	27300	12409	21000	9545	1 1/4	32	240	73	860	262	3550	1614

*Chain drive from motor drum. Design factor 5:1 or more on chain at rated line pulls.

(1) Capacities rated at specified voltage with single line on second layer on drum, providing 5:1 design factor. Starting line pulls for reference only.

(2) Drum capacities shown represent tightly spooled wire rope. Recommended drum working capacity is 80% of value shown.

(3) Also available as car puller models. Add *CP* to model number when ordering. Example: *CP1300B20*

"Third Generation" Air Winch Series
FA2B 4000 lb (1818 kg) capacity

Ingersoll-Rand.

How do you improve on a great idea? With four significant changes over the FA2A, the FA2B takes a good idea and makes it even better.

■ Four changes for improved performance and reliability

- ***NEW MP150*** piston motor maintains the progressive scotch yoke and adds more horsepower (16 hp). Oil free design with fewer parts and reduced vibration means easier and less frequent service. Two other piston motor options are available.
- New self-cleaning K5C2 control valve improves flow and performance. It has a primary bushing for reduced maintenance cost, more stainless steel and polymer corrosion resistant parts for smoother, more responsive control and is totally interchangeable with previous designs. 100% natural gas/sour gas compatible.
- Modified gearbox design improves efficiency and durability.
- Redesigned disc brake lowers required release pressure to 25 psig for smoother performance and no drag when air supplies are borderline.

■ What else is new....

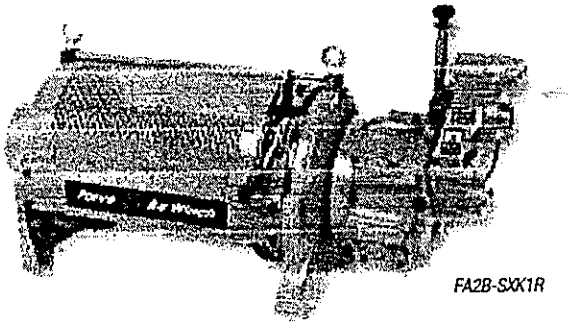
- Lifting lugs
- One size fastener on the entire motor.
- Slide lift column on throttle prevents accidental movement.

■ Options:

- Band brakes – manual and automatic
- Drum guards
- Remote full flow and pilot controls
- Free spool clutches
- CE packages
- Grooved drums
- Divider flanges

-E = Compliance with the European Machinery Directive. Includes as standard on utility rated winches:

1. Main air supply shutoff
2. Overload device
3. Drum guard
4. Muffler
5. CE documentation



FA2B-SXK1R

- Tensioning manifolds
- Natural gas compatible; Option ***R***
- HU40A (11 hp) or AMP94A (9.4 hp) motor/valve combinations
- Construction cages and open frame configurations
- Material Traceability and Type Approval Certification
- Low temperature versions
- FE2B electric and FH2B hydraulic units

■ Why the FA2B is such good value...

- Corrosion resistant marine grade coating system: Sandblast to white metal finish and carbozinc primer with a Marine 812 finish.
- Meets ANSI / ASME B30.16, B30.7 and has been design reviewed and approved by Det Norske Veritas. Meets European CE standards.
- Internal disc brake is oil cooled. They run and last longer. Band brakes use the latest Scanpac brake material.
- Wedge type, self tightening rope anchor provides 80% of rope breaking strength
- It is designed and built to survive some of the harshest conditions on the planet — the offshore drilling environment.

Specifications: performance is based on 90 psi (6.3 bar) air inlet pressure with motor running

Model number	Lift rating (1) per ANSI / ASME B30.16 at 5:1 first		mid		top		Pull rating (1) ANSI / ASME B30.7 at 3.5:1 first		mid		top		Stall lbs	Stall kg	Average air cons	Recom. Ingersoll Comp.	Mtr hp	Pipe size NPT in.	Rec'd rope size in. (1)
FA2B Air Powered																			
Capacity lbs (kg)	5000	(2268)	4000	(1818)	3200	(1451)	5000	(2313)	4000	(1818)	3200	(1451)	6800	3084	350	P185-P375	16	1 ¼	½
Speed fpm (mpm)	79	(24)	96	(29)	122	(37)	79	(24)	96	(29)	122	(37)							
HU40A Air Powered																			
Capacity lbs (kg)	5000	(2273)	4000	(1818)	3260	(1482)	7140	(3245)	5700	(2585)	4600	(2091)	11600	5273	270	P185-P375	11	1	½
Speed fpm (mpm)	54	(16.4)	70	(21.3)	86	(26.2)	40	(12)	49	(14.9)	60	(18.3)							
AM94A Air Powered																			
Capacity lbs (kg)	5000	(2273)	4000	(1818)	3260	(1482)	5000	(2273)	4000	(1818)	3260	(1482)	5500	2500	320	P185-P250	9.4	1	½
Speed fpm (mpm)	36	(10.0)	46	(14.0)	56	(17.1)	15	(4.6)	19	(5.8)	24	(7.3)							
FH2B Hydraulic Powered (2)																			
Capacity lbs (kg)	5000	(2273)	4000	(1818)	3260	(1482)	7140	(3245)	5700	(2585)	4600	(2091)	9560	4345	gpm (3)	psig (4)	17	(7)	½
Speed fpm (mpm)	93	(26.3)	112	(34.1)	138	(42.1)	93	(28.3)	112	(34.1)	138	(42.1)							
FE2B Electric Powered																			
Capacity lbs (kg)	5000	(2273)	4000	(1818)	3260	(1482)	5000	(2273)	4000	(1818)	3260	(1482)	11000	5000	amps (5)	amps (6)	15	NA	½
Speed fpm (mpm)	77	(23.5)	100	(30.5)	123	(37.5)	77	(23.5)	100	(30.5)	123	(37.5)							

(1) IR rates to both ANSI / ASME B30.16 (overhead hoists) and ANSI / ASME B30.7 (base mounted drum hoists). Always refer to these (or applicable) standards for details. We recommend ½ inch (13 mm) dia. 6 x 19 Extra Improved Plow Steel IWRC wire rope.

(2) Hydraulic winch performance is directly proportional to pressure and flow. An increase/decrease in pressure (psig) and flow (gpm) results in an increase/decrease in capacity and speed. FH2B performance has been set within ANSI / ASME B30.16/B30.7 design criteria. This rating may be different from other hydraulic winch manufacturers. Please contact technical sales with application/performance requirements.

(3) Flow (25 gpm).

(4) Pressure (psig), 1850 lifting, 2350 pulling.

(5) Full load current, 19 amps @ 460V.

(6) Max current draw (locked rotor), 110 amps @ 460V.

(7) SAE-12 JIC

業株式会社は、1924年に電動油圧舵取機の製作に取り組んで以来、世界各国の船主、造船
ご愛顧、ご信頼を得て、1万7,000台を超える各種船舶に納入を重ねてきました。従来型舵取
性、耐久性では世界最高水準にありますが、新シリーズの舵取機は、さらに造船所における
さを図り、信頼性、耐久性のさらなる向上と小型化をコンセプトに開発しました。

eighty years has passed since Kawasaki Heavy Industries, Ltd., began to
re electro-hydraulic steering gears in 1924. During this period our products have
h reputation among shipbuilders not only in Japan but also in many countries of the
we have supplied more than 17,000 units of steering gears. Reliability and durability
ventional series are of the world first class level. Furthermore, the new series are
to achieve more excellent reliability and durability, and more downsizing in addition
nstallation at the shipyard.

特長 Features

付

ットのレイアウト変更、安全弁の構造変更な
、据付台の縮減、配管取付作業の不要化、安全
時間の短縮を実現しています。

・高耐久性

圧：49MPa）と、長寿命の油圧ポンプ採用
い耐久性を持たせています。

パクト

の見直し、ポンプユニットの配置変更、電
変更などによって、据付スペースを小さくし

1 Simple installation
Modification of pump unit arrangement, safety valve construction, etc. contribute to smaller foundation, deleting the piping work, and saving the required time to confirm the safety valve operation.

2 High reliability and durability
High durability is achieved to apply higher pressure type (max. pressure: 49 MPa) and longer life type hydraulic pump.

3 Light and compact constitution
Higher pressure design, material improvement, modification of pump unit arrangement and electric motor type, etc. contribute to smaller installation space.

型式表示 Ordering Code

RV21-027-H

2シリンダ形
pe 1 Ram 2 Cylinders type

ユニット数
ハンドポンプ設置)

ped power pump units
hand pump)

常用動力ポンプユニット数
1：1台
2：2台（ーH型にのみ適用可能）
Number of power pump units for normal use
1：1 set
2：2 sets (available for ーH type only)

操舵トルク（35度時）
Approx. rated torque (at 35°)
003-30 kN・m (3.1 t・m) 010-105 kN・m (10.7 t・m)
004-46 kN・m (4.7 t・m) 013-130 kN・m (13.3 t・m)
005-57 kN・m (5.8 t・m) 017-170 kN・m (17.3 t・m)
007-75 kN・m (7.7 t・m) 022-220 kN・m (22.4 t・m)
009-90 kN・m (9.2 t・m) 027-270 kN・m (27.6 t・m)

無し：標準
ーH：電油弁作動不良検出装置
blank: standard
ーH: with hyd. lock detector

トを装備した舵取機は、規則要求によりハイドロ
ます。当社では次のいずれかで対応しています。

According to the Rule requirements, two (2) power pumps equipped type steering gear to be provided with any countermeasure of the followings to avoid the hydraulic locking.
1. Starter for electric motor to be provided simultaneously operate two(2) power pump units, or.
2. Steering gear to be provided with the alarm to be given in case of a failure

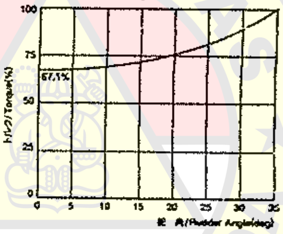
要目表 Particulars

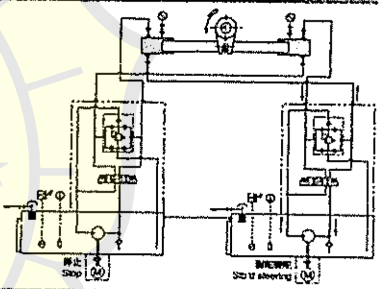
型式 Type		RV11 and RV21 Type										RV22 Type				
		RV*1-003	RV*1-004	RV*1-005	RV*1-007	RV*1-009	RV*1-010	RV*1-013	RV*1-017	RV*1-022	RV*1-027	RV22-010	RV22-013	RV22-017	RV22-022	RV22-027
Torque at max. working pressure	kN-m	30	46	57	75	90	105	130	170	220	270	105	130	170	220	270
	t-m	3.1	4.7	5.8	7.7	9.2	10.7	13.3	17.3	22.4	27.6	10.7	13.3	17.3	22.4	27.6
Rudder turning angle	deg.	70										70				
Rudder turning speed	deg/s	70/15	65/28									65/28				
Normal radius of tiller arm	mm	210	260			295		375				295		375		
Ram diameter	mm	100	125			140		180				140		180		
Max. working pressure	MPa	14.0	22.0	14.0	18.0	22.0	18.0	22.0	14.0	18.0	22.0	18.0	22.0	14.0	18.0	22.0
Safety valve set pressure	MPa	17.5	27.5	17.5	22.5	27.5	22.5	27.5	17.5	22.5	27.5	22.5	27.5	17.5	22.5	27.5
Motor 出力/Output	kW	2.2	3.7	2.2	2.2	3.7	3.7	3.7	5.5	5.5	7.5	2.2	2.2	2.2	3.7	3.7
Motor /Speed	min⁻¹	1,760										1,780				

Note) The mark "*" indicates "1" or "2".

油圧回路 Hydraulic Circuit

■ トルク曲線／Torque Curve





油圧ポンプ・電動機 Hydraulic Pumps & Electric Motor

■ 油圧ポンプ／Hydraulic Pumps

型式/Type			LVP017
構造 Structure			斜軸形ピストンポンプ Bent axis type axial piston pump
圧力 Pressure	定格/rated	MPa	34.3
	最高/max.	MPa	49.0
Rated speed		min⁻¹	1,800
質量 Mass		kg	12

■ 電動機／Electric Motor

項目/Item	仕様/Specifications
Power supply	AC440V-60Hz-3 φ
Structure	全閉外扇横フランジ形 Totally enclosed, fan-cooled, horizontal, flange mounted type
Shaft end type	キー付き With key
No. of pole	4
Speed min⁻¹	1,800 (同期／Synchronous)
Direction of rotation	左回転（軸端より見て） Counter clockwise (viewed from shaft end)
ベアリング番号 Bearing type	72 or 73 (片側／One side)
定格 Rated	100%連続／Cont. 230%.30s
始動トルク Starting torque	≧230%

Force 5™ Air Winch Series
4400 to 22000 lb (2000 to 10000 kg) capacity

Ingersoll-Rand.

Specifications: performance is based on 90 psi (6.3 bar) air inlet pressure with motor running

Model no.	Utility rating 5:1 design factor top layer line pull lbs	kg	top layer line speed fpm	m/min	Drum length A in.	mm	hp	Avg. air consumption at rated load @ 90 psi (6.3 bar) scfm	m³/min	Maximum stall pull 1st layer lbs	kg	Pipe inlet size in.	mm	Hose size in	mm	Ship weight lbs	kg
FA2-24	4400	2000	47	14	24	610	9.4	335	9.5	9000	4091	1¼	32	1¼	32	825	374
FA2.5-24	5000	2273	132	40	24	610	25	700	19.9	10000	4545	1¼	32	1½	38	1061	481
FA5-24	11000	5000	54	16	24	610	25	700	19.9	24000	10909	1¼	32	1½	38	1872	849
FA5T-24	8400	3818	70	21	24	610	25	700	19.9	24000	10909	1¼	32	1½	38	2153	977
FA7-24	15400	7000	40	12	24	610	25	750	21.3	36000	16364	1¼	32	1½	38	2205	1000
FA7T-24	12600	5727	48	15	24	610	25	750	21.3	36000	16364	1¼	32	1½	38	2335	1059
FA7TGL-42	3400	1545	152	46	42	1067	25	750	21.3	10000	4545	1¼	32	1½	38	2981	1352
FA7TPL-42	10200	4636	60	18	42	1067	25	750	21.3	36000	16364	1¼	32	1½	38	2850	1293
FA10-24	22000	10000	23	7	24	610	31	800	22.7	38000	17273	1¼	32	1½	38	3200	1451

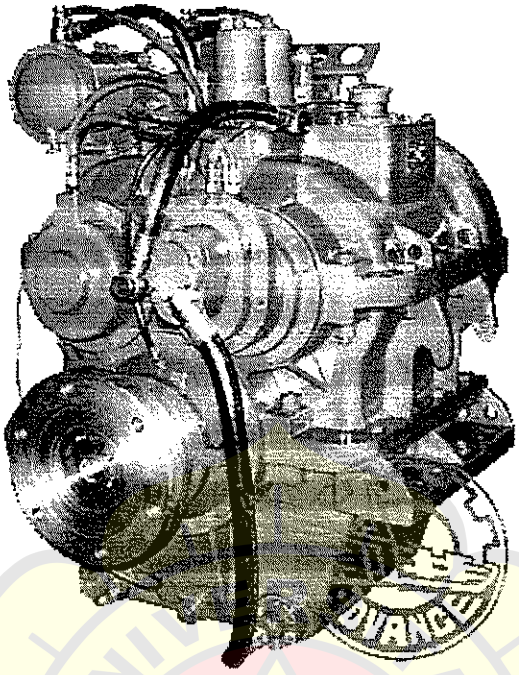
Note: Adding "-E" to model states compliance with European Machinery Directive. See the Air Winch Selection Guide for explanation of compliance.

Drum wire rope storage capacities (1)

Model	Capacity lbs	kg	Recommended wire rope size in.	mm	Drum length in.	mm	Rope diameter ½" (13 mm) ft	m	⅝" (16 mm) ft	m	¾" (19 mm) ft	m	⅞" (22 mm) ft	m	1" (25 mm) ft	m	1⅛" (29 mm) ft	m
FA2	4400	2000	½	13 mm	8	203	389	118	266	81								
					12	305	594	181	410	125								
					16	406	801	244	554	169								
					24	610	1214	370	843	257								
FA2.5	5000	2273	⅝	16 mm	8	203			266	81								
					12	305			410	125								
					16	406			554	169								
					24	610			843	259								
FA5	11000	5000	¾	19 mm	16	406			1181	360	746	227	544	166				
					24	610			1795	547	1138	347	832	254				
					30	762			2256	688	1431	433	1047	319				
FA5T	8400	3818	¾	19 mm	16	406					1682	512	1204	367				
					24	610					2564	761	1841	561				
					30	762					3225	983	2318	706				
					36	915					3887	1185	2796	852				
FA7	15400	7000	⅞	22 mm	24	610					1640	500	1059	323	786	240		
					30	762					2063	629	1334	406	991	302		
					36	915					2486	758	1608	493	1196	365		
FA7T	12600	5727	⅞	22 mm	24	610					2669	813	1917	584	1538	469		
					30	762					3358	1023	2414	736	1940	591		
					36	915					4047	1233	2912	887	2311	713		
					42	1067					4736	1443	3409	1039	2742	836		
FA10	22000	10000	1 ⅛	29 mm	24	610					2488	758	1962	598	1332	405	1028	313
					30	762					3130	954	2471	753	1679	511	1295	395
					36	915					3773	1150	2980	908	2027	617	1564	477
					40	1016					4201	1280	3319	1011	2258	688	1744	531
					50	1270					5271	1606	4168	1270	2837	865	2192	668

1) Capacities meet ANSI-ASME B30.7 which requires ½" (13 mm) minimum clear flange above last layer. Capacities represent tightly wound wire rope. Recommended working capacity is 80% of values shown.

WUCHAI ADVANCE 900 MG



commodity description:

900 MARINE GEARBOX MAX.1440HP at 1600RPM

Engine Speed:1000~1800RPM

Ratio	1.46	2.04	2.47	3.00	3.60	4.08	4.63	4.95
Rate(hp/rpm)	0.90	0.90	0.90	0.90	0.75	0.66	0.58	0.55

L*W*H : 1115*850*1310mm Net Weight : 1600Kg

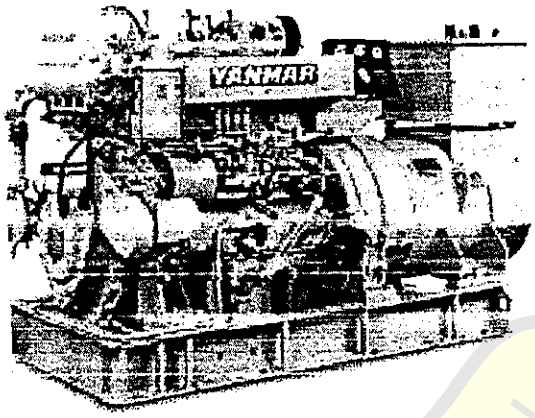
Options/Comments : Electrical remote control ;Flexible connection

Centre distance : Input and output coaxality

Engine : 12V190DC;M200...

4HAL2 series

RINE
ARY
NGINE 98~183hp/1200~1800rpm
80~150kVA(64~120kW)



linder, direct injection.
approved by BV, GL.

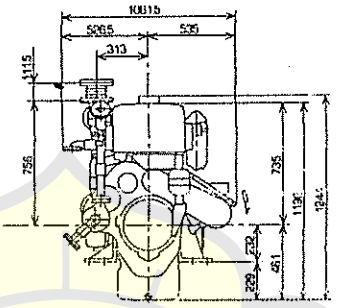
lications

		4HAL2-TN1			4HAL2-TN		
of cylinders		In-line 4					
stroke	mm	130 × 165					
nent	lit.	8.76					
s rated eed	rpm	1200	1500	1800	1200	1500	1800
s rated output	hp	98	121	157	122	156	183
capacity	kVA(kW)	80 (64)	100 (80)	130 (104)	100 (80)	125 (100)	150 (120)
	Hz	50	60	50	60	50	60
system		Direct injection					
		Exhaust Turbocharger					
(Engine only)	kg	1030					
(Gne. set)	kg	1785	1855	1855	1845	1855	1855

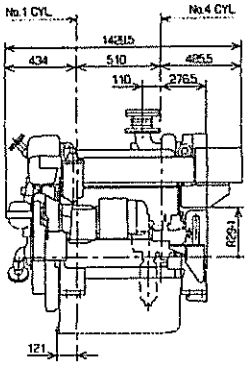
Dimensions Unit:mm

Engine only

Front view



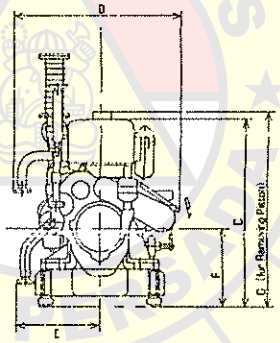
Left side view



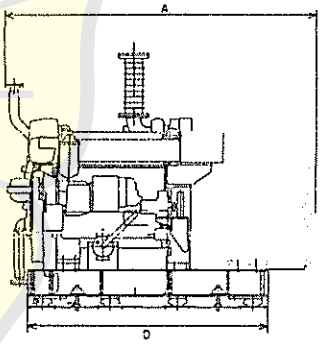
Generator set dimensions for your reference Unit:mm

Generator set dimensions shown below depend on generator model

Front view



Left side view



Model	A	B	C	D	E	F	G
4HAL2-TN1	2070.5	1116.5	1264	1600	559	529	1312
4HAL2-TN	2070.5	1116.5	1264	1600	559	529	1312

Generator

pries

ital panel (attached to engine)
stem : Sea water pump / Centrifugal type fresh water pump / Heat exchanger
er reservoir / Thermostat for fresh water / Emergency use sea water inlet
n system : Lubrication oil pump / Lubrication oil cooler
n oil filter (Single type) / Manual priming pump
n : Paper filter type fuel strainer / Drain separator to be mounted on vessel
ing system : Exhaust gas outlet expansion joint from engine
quipment : Starter motor (DC24V) 5.5kW / Alternator (DC24V600W)
vitch / 2 pole wiring
ter : Exhaust gas at outlet of each cylinder / Cooling water outlet
oil at cooler inlet

- Cooling system : Kingston cock
- Lubrication system : Inlet and outlet joint for semi dry sump
- Fuel system : Primary fuel strainer to be mounted on vessel
- Generator (and common bed) : Taiyo or Stamford
- Thermometer : Exhaust gas at inlet of turbocharger / Lubrication oil at cooler outlet
- Electrical governor for parallel operation
- Exhaust piping : Expansion joint for piping / Silencer
- Compressed air starting device
- Remote control device : Trip panel / Stop solenoid / LO pressure switch / FW temperature switch / Speed relay / Junction box & wiring