BAB IX

PENUTUP

9.1. Kesimpulan

1. Dari hasil perhitungan yang telah dilakukan untuk kapal rancangan dengan ukuran utama sebagai berikut :

- Tipe : OIL TANKER 5500 DWT
- Dimensi :

Loa	: 105	Meters
Lpp	: 96	Meters
Lwl	: 98	Meters
Breadth (B)	: 21,3	Meters
Depth (H)	: 8,5	Meters
Draught (T)	: 6,3	Meters
Vs	: 13	Knots
DWT	: 5500	DWT
Cb	: 0,712	
Cm	: 0,98	
Cp	: 0,722	
Cw	: 0,80	
Disp Δ	: 9.401,45	Ton
Disp ∇	: 9.172,15	m^3

- Rute Pelayaran : Jakarta - Belawan (1800 mil)

Motor penggerak utama dipilih mesin diesel empat langkah dengan spesifikasi sebagai berikut :

- Merk : MAN B&W
- Type : S26MC
- Jumlah Silinder : 8L
- Daya : 3200 kW /(4.350 HP)

- Putaran mesin : 250 rpm
- Konsumsi BBM (SFOC) : 179 g/kw.h
- Dimensi : 6,5 m x 2,5 m x 3,5 m

Marine Gear Spesification

- Merk : Nico
- Model : MGN – 12042z
- Reduction Ratio : 1 : 1,27

Dan 2 unit mesin generator dengan merk:

- Spesifikasi Generating set

- Merk/Tipe = Yanmar 6 HAL2-WDT- 1.800 U/Min – HCM 434F2
- Daya Generator = 380 kW / 271 HP
- Jumlah = 2 unit

Mesin – mesin pendukung kerja mesin induk antara lain :

- Kompressor udara

- Merk : Sperre XA250
- Preassure : 30 Bar
- Daya : 46 Kw

- Spesifikasi Fuel Oil Transfer Pump

- Merk : Taiko
- Jenis : Gear Pump
- Kapasitas : 5 m^3/jam
- Putaran : 1200 rpm
- Daya : 1,5 kW
- Bore : 80 x 65 mm (suction x discharge)

- Spesifikasi Fresh Water Cooling Pump
  - Merk : TAIKO, Type TMC – 65C
  - Jenis : Centrifugal Pump
  - Putaran : 1800 min^{-1}
  - Daya : 5,5 kW

- Spesifikasi Bilge Pump
  - Merk : TAIKO, EHS-130 D
  - Jenis : Centrifugal Pump
  - Kapasitas : 34-78 m^3/jam
  - Putaran : 1800 min^{-1}
  - Daya : 15 kW

- Spesifikasi Ballast Pump
  - Merk : TAIKO, ESC-125 D
  - Jenis : Centrifugal Pump
  - Kapasitas : 36 – 124 (m^3/jam)
  - Putaran : 3600 min^{-1}
  - Daya : 18,5 kW

- Spesifikasi F.W. Sanitary Pump
  - Merk : TAIKO, Type TMC-32
  - Jenis : Centrifugal Pump
  - Putaran : 1800 min^{-1}
  - Daya : 1,5 kW

- Spesifikasi S.W. Sanitary Pump
  - Merk : TAIKO, Type TMC-32
  - Jenis : Centrifugal Pump
  - Head : 2 - 6,5 (m^3/jam)
  - Putaran : 1800 min^{-1}

- Daya : 1,5 kW

- Spesifikasi Fire Pump
- Merk : Carver
- Jenis : M series
- Head : 475 ft = 144,8 m
- Putaran : 3500 rpm
- Daya : 60 HP = 44,74 kW

- Mesin Kemudi

  Merek : Hatlapa Marine Equipment

  Type : Neptune

  Daya motor : 2 x 11,5 kW

2. Dalam perencanaan kamar mesin tidak lepas dari asumsi-asumsi yang diberikan untuk mempermudah perhitungan dengan tidak mengabaikan tanggung jawab secara teknis, ekonomis, serta peraturan-peraturan yang ada sehingga hasil perhitungan dapat mendekati keadaan sebenarnya.
3. Tata letak mesin induk, mesin bantu serta permesinan lainya diatur seefisien mungkin. Hal ini untuk mempermudah dalam hal perawatan dan perbaikan peralatan yang ada dikamar mesin.

9.2. Saran

Setelah melakukan perhitungan-perhitungan diatas dan dari pengalaman selama menyusun tugas perancangan mesin kapal, maka penulis dapat menyarankan sebagi berikut :

1. Bimbingan serta arahan dosen dalam tugas perancangan mesin kapal sangat membantu untuk menyelesaikan tugas ini, selain itu diharapkan kampus menambahkan referensi-referensi yang berkaitan dengan mata kuliah

perancangan mesin kapal guna memudahkan mahasiswa untuk menyelesaikan tugas.

2. Hubungan kerja sama kampus dengan dunia kerja yang berkaitan dengan jurusan Teknik Sistem Perkapalan, sangat diharapkan guna menambah wawasan tentang mata kuliah perancangan mesin kapal dapat mudah dipahami dan diselesaikan dengan baik.

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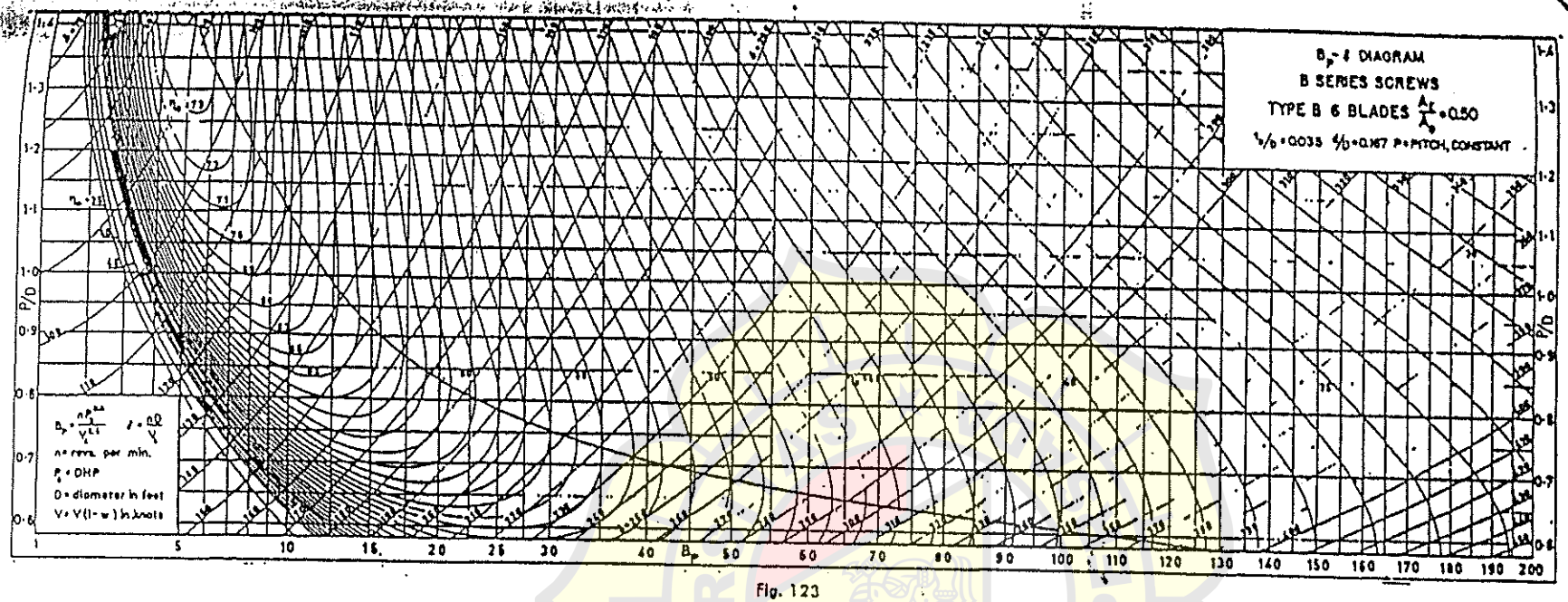


Fig. 123

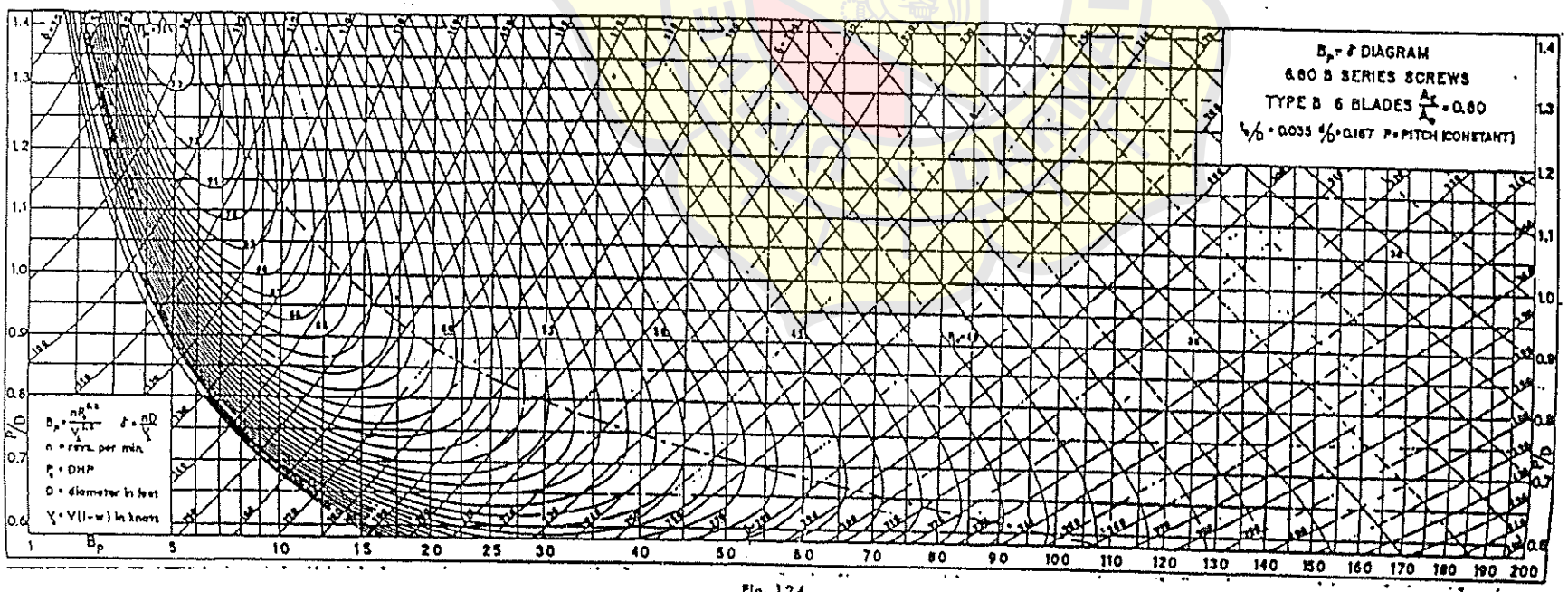


Fig. 124

MAN B&W S26MC6

Project Guide

Camshaft Controlled Two-stroke Engines

This Project Guide is intended to provide the information necessary for the layout of a marine propulsion plant.

The information is to be considered as **preliminary**. It is intended for the project stage only and subject to modification in the interest of technical progress. The Project Guide provides the general technical data available at the date of issue.

It should be noted that all figures, values, measurements or information about performance stated in this project guide are **for guidance only** and should not be used for detailed design purposes or as a substitute for specific drawings and instructions prepared for such purposes.

Data updates
Data not finally calculated at the time of issue is marked 'Available on request'. Such data may be made available at a later date, however, for a specific project the data can be requested. Pages and table entries marked 'Not applicable' represent an option, function or selection which is not valid.

The latest, most current version of the individual Project Guide sections are available on the Internet at: www.mandiesel.com under 'Marine' → 'Low Speed'.

Extent of Delivery
The final and binding design and outlines are to be supplied by our licensee, the engine maker, see Chapter 20 of this Project Guide.

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

Electronic versions
This Project Guide book and the 'Extent of Delivery' forms are available on a DVD and can also be found on the Internet at: www.mandiesel.com under 'Marine' → 'Low Speed', where they can be downloaded.

6th Edition

January 2009

Fuel considerations

When the engine is stopped, the circulating pump will continue to circulate heated heavy fuel through the fuel oil system on the engine, thereby keeping the fuel pumps heated and the fuel valves deaerated. This automatic circulation of preheated fuel during engine standstill is the background for our recommendation:

Constant operation on heavy fuel

In addition, if this recommendation was not followed, there would be a latent risk of diesel oil and heavy fuels of marginal quality forming incompatible blends during fuel change over or when operating in areas with restrictions on sulpher content in fuel oil due to exhaust gas emission control.

In special circumstances a change-over to diesel oil may become necessary – and this can be performed at any time, even when the engine is not running. Such a change-over may become necessary if, for instance, the vessel is expected to be inactive for a prolonged period with cold engine e.g. due to:

- docking
- stop for more than five days
- major repairs of the fuel system, etc.

Heating of drain pipe

Owing to the relatively high viscosity of the heavy fuel oil, it is recommended that the drain pipe and the tank are heated to min. 50 °C.

The size of the sludge tank is determined on the basis of the draining intervals, the classification society rules, and on whether it may be vented directly to the engine room.

This drained clean oil will, of course, influence the measured SFOC, but the oil is thus not wasted, and the quantity is well within the measuring accuracy of the flowmeters normally used.

For external pipe connections, we prescribe the following maximum flow velocities:

Marine diesel oil ..... 1.0 m/s
Heavy fuel oil ..... 0.6 m/s

The fuel viscosity is influenced by factors such as emulsification of water into the fuel for reducing the NO_x emission. This is further described in section 7.06.

An emulsification arrangement for the main engine is described in our publication:

Exhaust Gas Emission Control Today and Tomorrow

Further information about fuel oil specifications is available in our publication:

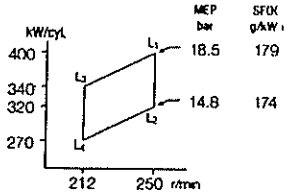
Operation on Heavy Residual Fuels

The publications are available at:
www.mandiesel.com under
'Quicklinks' → 'Technical Papers'.

S26

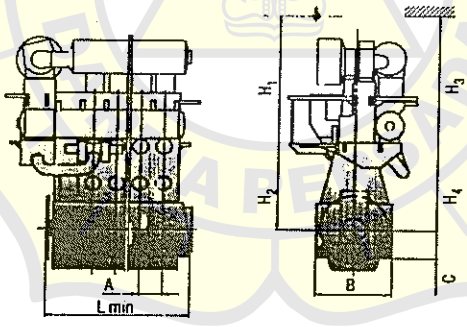
MAN B&W

	Cyl.	L_1 kW
MC6	5	2,000
	6	2,400
	7	2,800
	8	3,200
Stroke: 980 mm	9	3,600
	10	4,000
	11	4,400
	12	4,800



L_{min}		5 cyl.	6 cyl.	7 cyl.	8 cyl.	9 cyl.	10 cyl.	11 cyl.	12 cyl.
Mark 6	mm	3,637	4,127	4,617	5,107	5,597	6,577	7,067	7,557
Dry mass:									
MC6	t	37	43	48	53	58	68	74	79

Dimensions:		A*	B	C	H_1	H_2	H_3	H_4
MC6	mm	490	1,880	420	4,850	4,750	4,600	4,525



TABLF 9.4.1 Properties of Commonly Used Refrigerants 40°F Evaporating and 100°F Condensin

		Chemical Formula	Molecular Mass	Ozone Depletion Potential (ODP)	Global Warming Potential (HGWP)	Evaporating Pressure, psia	Condensing Pressure, psia	Compression Ratio	Refrigeration Effect, Btu/lb
Hydrofluorocarbons HFCs									
R-32	Difluoromethane	CH_2F_2	52.02	0.0	0.14	135.6	340.2	2.51	
R-125	Pentafluoroethane	CHF_2CF_3	120.03	0.0	0.84	111.9	276.2	2.47	37.1
R-134a	Tetrafluoroethane	CF_3CH_2F	102.03	0.0	0.26	49.7	138.8	2.79	65.2
R-143a	Trifluoroethane	CH_3CF_3	84.0	0.0					
R-152a	Difluoroethane	CH_3CHF_2	66.05	0.0		44.8	124.3	2.77	
R-245ca	Pentafluoropropane	$CF_3CF_2CH_3$	134.1	0.0					
HFC's azeotropics									
R-507	R-125/R-143 (45/55)			0.0	0.98				
HFC's near azeotropic									
R-404A	R-125/R-143a (44/52/4)			0.0	0.94				
R-407A	R-32/R-125/R-134a (20/40/40)			0.0	0.49				
R-407C	R-32/R-125/R-134a (23/25/52)			0.0	0.70				
Hydrochlorofluorocarbons HCFCs and their azeotropics									
R-22	Chlorodifluoromethane	$CHClF_2$	86.48	0.05	0.40	82.09	201.5	2.46	69.0
R-123	Dichlorotrifluoroethane	$CHCl_2CF_3$	152.93	0.02	0.02	5.8	20.8	3.59	62.9
R-124	Chlorotetrafluoroethane	$CHFClCF_3$	136.47	0.02		27.9	80.92	2.90	5.21
HCFC's near azeotropics									
R-402A	R-22/R-125/R-290 (38/60/2)			0.02	0.63				
HCFC's azeotropics									
R-401A	R-22/R-124/R-152a (53/34/13)			0.37	0.22				
R-401B	R-22/R-124/R-152a (61/28/11)			0.04	0.24				

SECTION 14
PRODUCT LOAD

The product load is composed of any heat gain occurring due to the product in the refrigerated space. The load may arise from a product placed in the refrigerator at a temperature higher than the storage temperature, from a chilling or freezing process, or from the heat of respiration of perishable products. The total product load is the sum of the various types of product load which may apply to the particular application.

TABLES OF SPECIFIC PRODUCT DATA

The following tables list data on specific products that is essential in calculating the refrigeration product load. Table 10 covers food products, Table 11 solids, and Table 12 liquids.

HEAT OF RESPIRATION

Fruits and vegetables, even though they have been removed from the vine or tree on which they grew, are still living organisms. Their life processes continue for some time after being harvested, and as a result they give off heat. Certain other food products also undergo continuing chemical reactions which produce heat. Meats and fish have no further life processes and do not generate any heat.

The amount of heat given off is dependent on the specific product and its storage temperature. Table 10 lists various food products with pertinent storage data. Note that the heat of respiration varies with the storage temperature.

(continued on p. 14-7)

Table 10
FOOD PRODUCTS DATA

Product	Average Freezing Point F	Percent Water	SP ht, Btu/(lb) (F deg)		Latent Heat of Fusion Btu/lb	Heat of Respiration Btu per (24 hr) (ton) at Temp. Indicated	
			Above Freezing	Below Freezing		°F	BTU
VEGETABLES							
Artichokes	29.1	83.7	0.87	0.45	120	40	10,140
Asparagus	29.8	93	0.94	0.48	134	40	11,700-23,100
Beans, string	29.7	88.9	0.91	0.47	128	40	9700-11400
Beans, lima	30.1	66.5	0.73	0.40	94	40	4300-6100
Beans, dried		12.5	0.30	0.24	18		
Beets	31.1	87.6	0.90	0.46	126	32	2700
						40	4100
Broccoli	29.2	89.9	0.92	0.47	130	40	11,000-17,000
Brussels sprouts	31	84.9	0.88	0.46	122	40	6600-11,000
Cabbage	31.2	92.4	0.94	0.47	132	40	1700
Carrots	29.6	88.2	0.90	0.46	126	32	2100
						40	3500
Cauliflower	30.1	91.7	0.93	0.47	132	40	4500
Celery	29.7	93.7	0.95	0.48	135	32	1600
						40	2400
Corn (green)	28.9	75.5	0.79	0.42	106	32	7200-11,300
						40	10,600-13,200
Corn (dried)		10.5	0.28	0.23	15		
Cucumbers	30.5	96.1	0.97	0.49	137		
Eggplant	30.4	92.7	0.94	0.48	132		
Endive (escarole)	30.9	93.3	0.94	0.48	132		
Horseradish	26.4	73.4	0.78	0.42	104		
Kale	30.7	86.6	0.89	0.46	124		
Kohlrabi	30	90	0.92	0.47	128		
Lettuce	31.2	94.8	0.96	0.48	136	32	2300
						40	2700
Mushrooms	30.2	91.1	0.93	0.47	130	32	6100
						50	22,000
Olives	28.5	75.2	0.80	0.42	108		
Onions	30.1	87.5	0.90	0.46	124	32	700-1100
						40	1800

Table 10 (cont.)

FOOD PRODUCTS DATA

Product	Average Freezing Point F	Percent Water	SP ht, Btu/(lb) (F deg)		Latent Heat of Fusion Btu/lb	Heat of Respiration Btu per (24 hr) (ton) at Temp. Indicated	
			Above Freezing	Below Freezing		°F	BTU
Parsnips	28.9	78.6	0.84	0.46	112		
Peas (green)	30	74.3	0.79	0.42	106	40	13,200-16,000
Peas (dried)		9.5	0.28	0.22	14		
Peppers (sweet)	30.1	92.4	0.94	0.47	132	40	4700
Potatoes (white)	28.9	77.8	0.82	0.43	111	40	1300-1800
Potatoes (sweet)	28.5	68.5	0.75	0.40	97	40	1710
Pumpkin	30.1	90.5	0.92	0.47	130		
Radishes	30.1	93.6	0.95	0.48	134		
Rhubarb	28.4	94.9	0.96	0.48	134		
Sauerkraut	26	89	0.92	0.47	129		
Spinach	30.3	92.7	0.94	0.48	132	40	8000
Squash	30.1	90.5	0.92	0.47	130		
Tomatoes (green)	30.4	94.7	0.95	0.48	134	50	6230
Tomatoes (ripening)	30.4	94.1	0.95	0.48	134	40	1260
Turnips	30.5	90.9	0.93	0.47	130	32	1900
						40	2200
Vegetables (mixed)	30	90	0.90	0.45	130		
MEATS AND FISH							
Bacon		20	0.50	0.30	29		
Beef (dried)		5-15	0.22-0.34	0.19-0.26	7-22		
Beef (fresh-lean)	29	68	0.77	0.40	100		
Beef (fresh-fat)	28		0.60	0.35	79		
Brined meats			0.75				
Cod fish (fresh)	28		0.90	0.49	119		
Cut meats	29	65	0.72	0.40	95		
Fish (frozen)	28	70	0.76	0.41	101		
Fish (iced)		70	0.76	0.41	101		
Fish (dried)			0.56	0.34	65		
Hams and loins	27	60	0.68	0.38	86.5		
Lamb	29	58	0.67	0.30	83.5		
Livers	29	65.5	0.72	0.40	93.3		
Oyster (shell)	27	80.4	0.83	0.44	116		
Oysters (tub)	27	87	0.90	0.46	125		
Pork (fresh)	28	60	0.68	0.38	86.5		
Pork (smoked)		57	0.60	0.32			
Poultry (fresh)	27	74	0.79	0.37	106		
Poultry (frozen)	27	74	0.79	0.37	106		
Sausage (casings)			0.60				
Sausage (drying)	26	65.5	0.89	0.56	93		
Sausage (franks)	29	60	0.86	0.56	86		
Sausage (fresh)	26	55	0.89	0.56	93		
Sausage (smoked)	25	50	0.86	0.56	86		
Scallops	28	83.3	0.89	0.48	116		
Shrimp	28	70.8	0.83	0.45	119		
Veal	29	63	0.71	0.39	91		
MISCELLANEOUS							
Beer	28	92	1.0				
Bread		32-37	0.70	0.34	46-53		
Bread (dough)		58	0.75				
Butter	30-0	15	0.64	0.34	15		
Candy			0.93				
Caviar (tub)	20	55					
Cheese (American)	17	60	0.64	0.36	79	40	3820
Cheese (Camembert)	18	60	0.70	0.40	86	40	4680
						40	4920
Cheese (Limburger)	19	55	0.70	0.40	86	40	4920
Cheese (Roquefort)	3	55	0.65	0.32	79	45	4000
Cheese (Swiss)	15	55	0.64	0.36	79	40	4660
Chocolate (coating)	95-85	55	0.30	0.55	40		
Cream (40%)	28	73	0.85	0.40	90		
Eggs (cracked)	27		0.76	0.40	100		
Eggs (frozen)	27			0.41	100		
Flour		13.5	0.38	0.28			
Flowers (cut)	32					480/sq. ft. Floor Area	
Furs—Woolens				0.40			

STANDART UKURAN SEKOCI OLEH BOT (BOARD OF TRADE) ENGLAND

Tabel II

L. B. H (m)	L. B. H. (ft3)	Kapasitas (ft3)	Jumlah orang	berat sekoci (kg)	Berat Orang (kg)	berat perlengkapan (kg)	Total berat (kg)
9,4 x 2,74 x 1 x 1,114	30 x 9 x 3,75	607	60	2205	4500	356	7061
8,84 x 2,74 x 1,10	29 x 8,75 x 3,60	545	54	1975	4050	356	6382
8,53 x 2,59 x 1,07	28 x 8,50 x 3,50	500	50	1824	3750	330	5894
8,23 x 2,51 x 1,04	27 x 8,25 x 3,40	454	45	1646	3376	330	5351
7,92 x 2,44 x 0,99	26 x 8,00 x 3,25	405	40	473	3000	305	4778
7,62 x 2,36 x 0,96	25 x 7,75 x 3,15	366	36	1326	2700	305	4331
7,31 x 22,8 x 0,91	24 x 7,50 x 3,00	324	32	1180	2400	254	3843
7,01 x 2,29 x 0,88	23 x 7,50 x 2,90	300	30	1087	2250	254	3591
6,71 x 2,21 x 0,84	22 x 7,25 x 2,75	236	26	955	1950	229	3134
6,40 x 2,13 x 0,82	21 x 7,00 x 2,70	238	23	864	1725	229	2818
6,10 x 2,06 x 0,79	20 x 6,75 x 2,60	210	21	762	1575	203	2540
5,79 x 1,98 x 0,75	19 x 6,50 x 2,50	182	18	650	1350	178	2178
5,48 x 1,90 x 0,73	18 x 6,25 x 2,40	162	16	590	1200	152	1942
5,18 x 1,83 x 0,715	17 x 6,00 x 2,30	143	14	508	1050	152	1710
4,88 x 1,75 x 0,70	16 x 5,75 x 2,30	127	12	475	900	127	1484

IN-LINE TYPE

CONTINUOUS DUTY MARINE GEAR RATINGS

Model	SAE Hsg.	Standard Gear Ratios	Input Rating						Max. Input Speed
			300 min⁻¹		400 min⁻¹		500 min⁻¹		
			kW	HP	kW	HP	kW	HP	min⁻¹
MGN 3642Z	—	1.34, 1.60, 1.83	1125	1508	1500	2011	1875	2513	500
		1.91	1116	1496	1488	1995	1860	2493	
		2.00	1107	1484	1476	1979	1845	2473	
		2.10	1098	1472	1464	1962	1830	2453	
		2.20	1089	1460	1452	1946	1815	2433	
		2.31	1077	1444	1436	1925	1795	2406	
MGN 4042Z	—	1.49, 1.91, 2.39	1218	1633	1624	2177	2030	2721	500
		2.50	1179	1580	1572	2107	1965	2634	
			200 min⁻¹		300 min⁻¹		400 min⁻¹		
MGN 5642Z	—	1.38, 1.80, 2.20	1130	1515	1695	2272	2260	3030	400
		2.29	1080	1448	1620	2172	2160	2895	
		2.39	1032	1383	1548	2075	2064	2767	
		2.50	980	1314	1470	1971	1960	2627	
MGN 8042Z	—	1.19, 1.64, 2.12	1700	2279	2550	3418	3400	4558	400
		2.22	1680	2252	2520	3378	3360	4504	
		2.32	1600	2145	2400	3217	3200	4290	
MGN 10042Z	—	1.19, 1.59, 2.01	2100	2815	3150	4223	4200	5630	400
		2.09	2000	2681	3000	4022	4000	5362	
		2.18	1920	2574	2880	3861	3840	5148	
		2.27	1860	2493	2790	3740	3720	4987	
		2.36	1780	2386	2670	3579	3560	4772	
		2.46	1700	2279	2550	3418	3400	4558	
MGN 12042Z	—	1.27, 1.93, 2.66	2440	3271	2660	3566	4880	6542	400
		2.76	2400	3217	3600	4826	4800	6434	
		2.86	2320	3110	3480	4665	4640	6220	

nico

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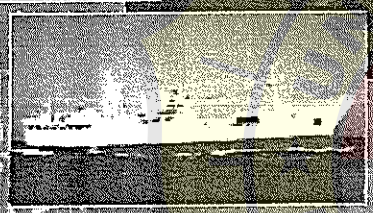


MARINE GEAR CAPACITY TABLES

tachi Nico Transmission Co., Ltd.

PLEASURE CRAFT MARINE GEAR RATINGS

Model	SAE Hsg.	Standard Gear Ratios	Input Rating 2800 min⁻¹ kW	2800 min⁻¹ HP	3000 min⁻¹ kW	3000 min⁻¹ HP	3300 min⁻¹ kW	3300 min⁻¹ HP	Max. Input Speed min⁻¹
MGN 10	5	1.34, 2.04, 2.57, 2.95	44	59	47	63	52	70	3500
			2300 min⁻¹		2800 min⁻¹		3000 min⁻¹		
MGN 30	2, 3	1.93, 2.43, 3.16, 3.65	88	118	107	143	114	153	3500
MGN 35	2, 3	1.93, 2.54, 3.05, 3.47	135	181	164	220	176	236	3300
MGN 40E	2, 3	1.57, 1.94, 2.33	209	280	254	340	272	365	3300
		2.91	202	271	246	330	263	353	
		3.45	177	237	215	288	231	310	
MGN 46E	1, 2, 3	1.53, 1.97, 2.58	251	337	305	409	327	439	3300
		3.05	238	319	290	389	310	416	
		3.53	205	275	250	335	267	358	
MGN 46BL	1, 2, 3	3.90	244	327	296	397	318	426	3300
		4.42	233	312	283	380	304	408	
MGN 47BL	1, 2, 3	5.00	248	333	302	405	323	433	3300
		5.55	239	320	292	392	313	420	
		6.00	234	314	284	381	305	409	
			2100min⁻¹		2300 min⁻¹		2500 min⁻¹		
MGN 56BL	0, 1, 2	4.04, 4.48	341	457	374	502	406	544	2800
MGN 57BL	0, 1	5.08	336	451	368	493	400	536	2800
		5.50	333	447	365	489	397	532	
		5.91	309	414	338	453	368	493	
MGN 76E	0, 1	1.53, 1.97, 2.44, 2.93	481	645	527	707	573	768	2600
		3.54	440	590	481	645	523	701	
MGN 76L	0, 1	2.53, 3.03, 3.48	479	642	524	703	570	764	2600
		4.00	462	620	506	679	541	725	
		4.50	410	550	449	602	488	654	
MGN 80B	0, 1	1.68, 2.03, 2.55, 2.96, 3.31, 3.48	631	846	690	925	750	1005	2600
MGN 80E	0, 1	1.55, 1.77	686	920	751	1007	817	1094	2600
		1.97	686	920	697	934	758	1016	
		2.59	657	881	645	864	701	939	
		3.04	616	826	609	816	688	922	
		3.41	591	793	583	781	634	850	
			1900 min⁻¹		2100 min⁻¹		2300 min⁻¹		
MGN 86E	0, 1	2.06, 2.44, 2.93	699	937	772	1035	846	1134	2350
		3.40	678	909	749	1004	821	1101	
MGN 86EL	0, 1	3.48, 3.93	702	941	776	1041	849	1139	2350
		4.48, 5.03	678	909	749	1004	821	1101	

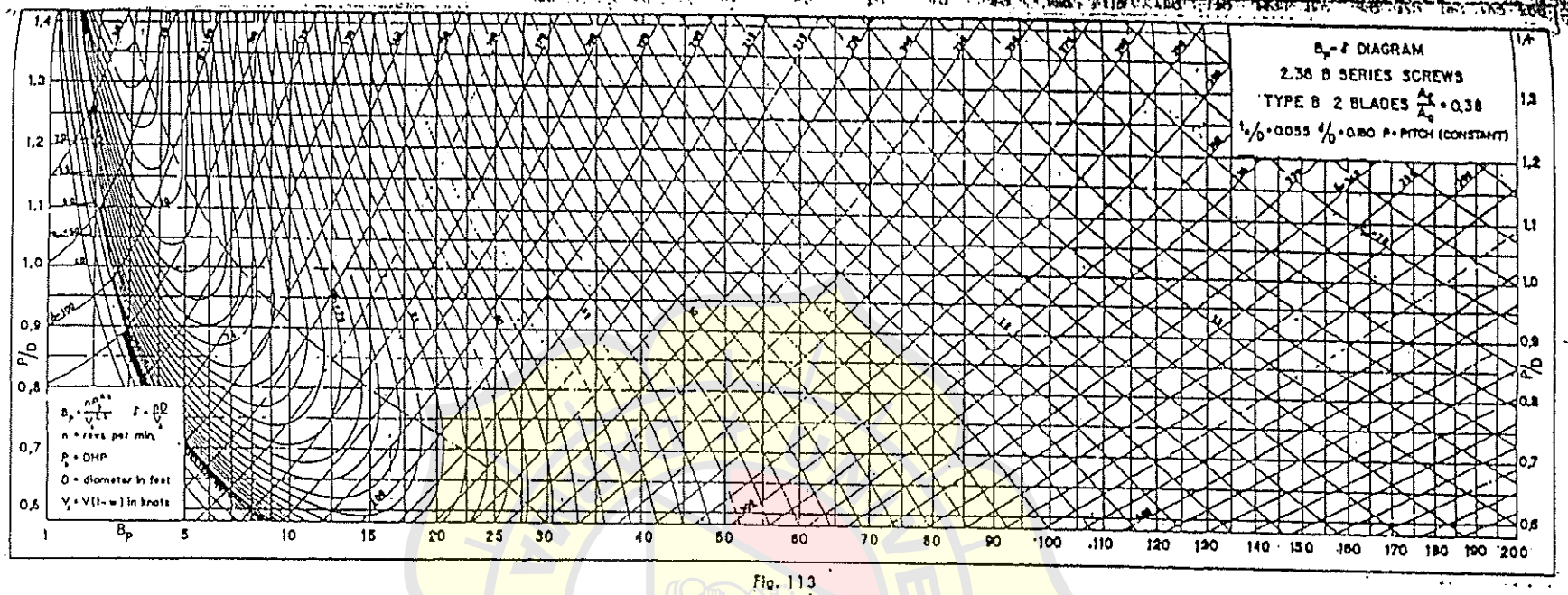


Fig. 113

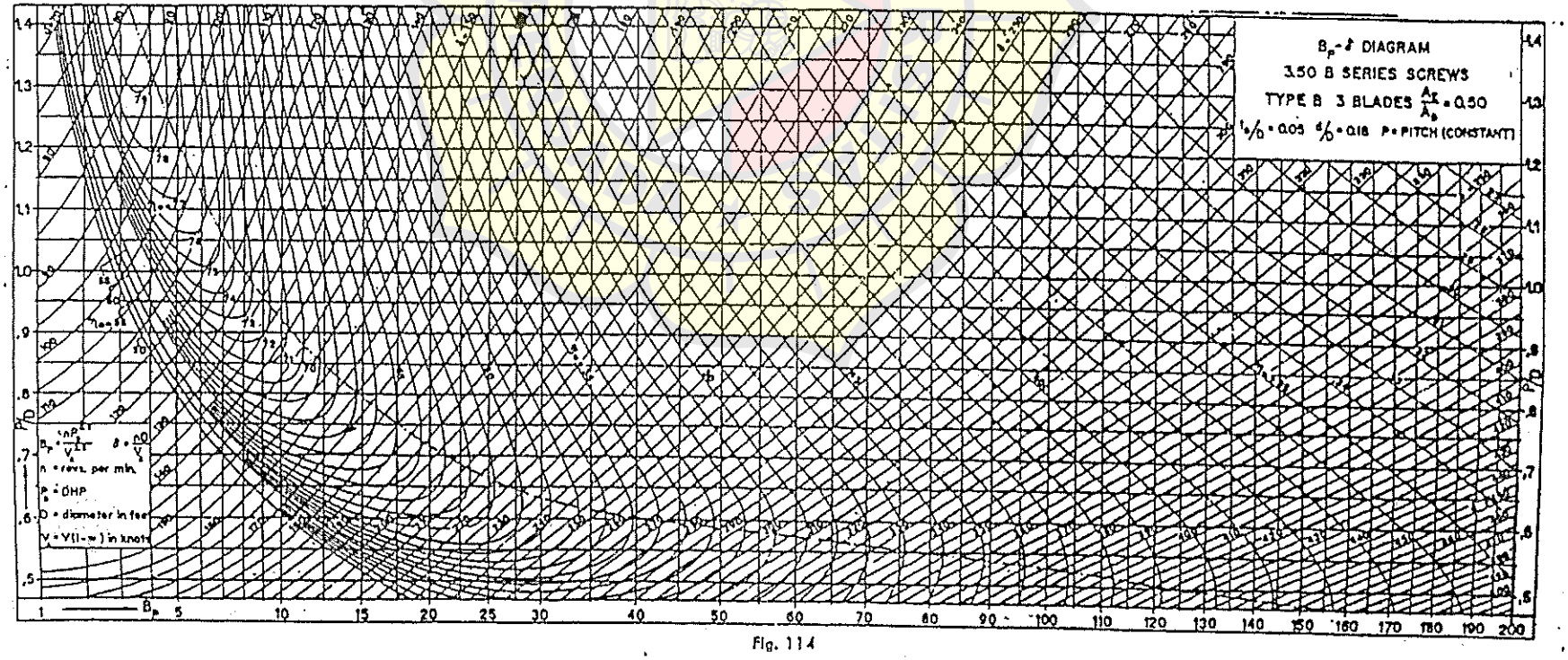


Fig. 114

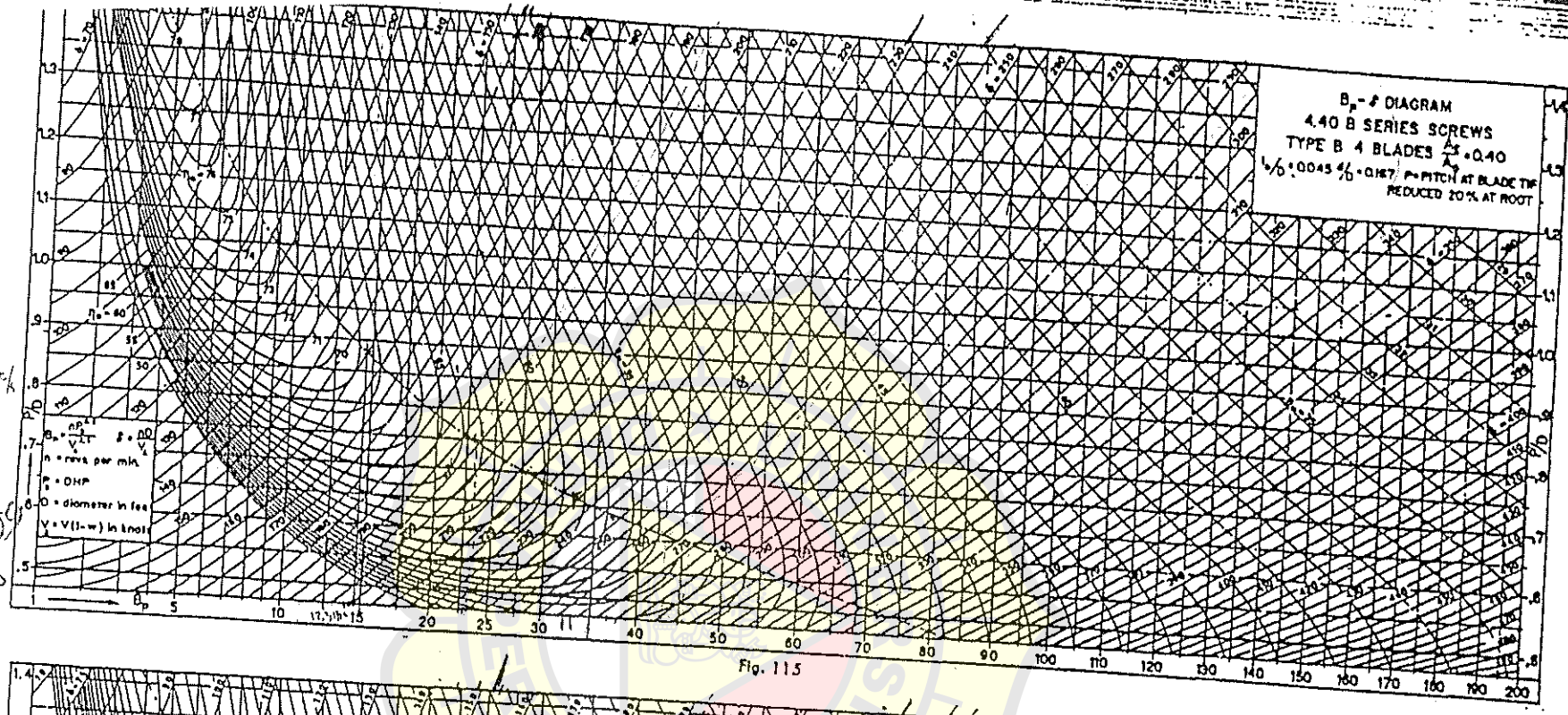

B_p–δ DIAGRAM
4.40 B SERIES SCREWS
TYPE B 4 BLADES $\frac{A_E}{A_O}$ = 0.40
t/D = 0.0045 r/D = 0.167 P=PITCH AT BLADE TIP
REDUCED 20% AT ROOT
$B_p = \frac{nP_D^{0.5}}{V_A^{2.5}}$ $\delta = \frac{nD}{V_A}$
n = revs per min
P_D = DHP
D = diameter in feet
V_A = V(1-w) in knots
B_p

Fig. 115

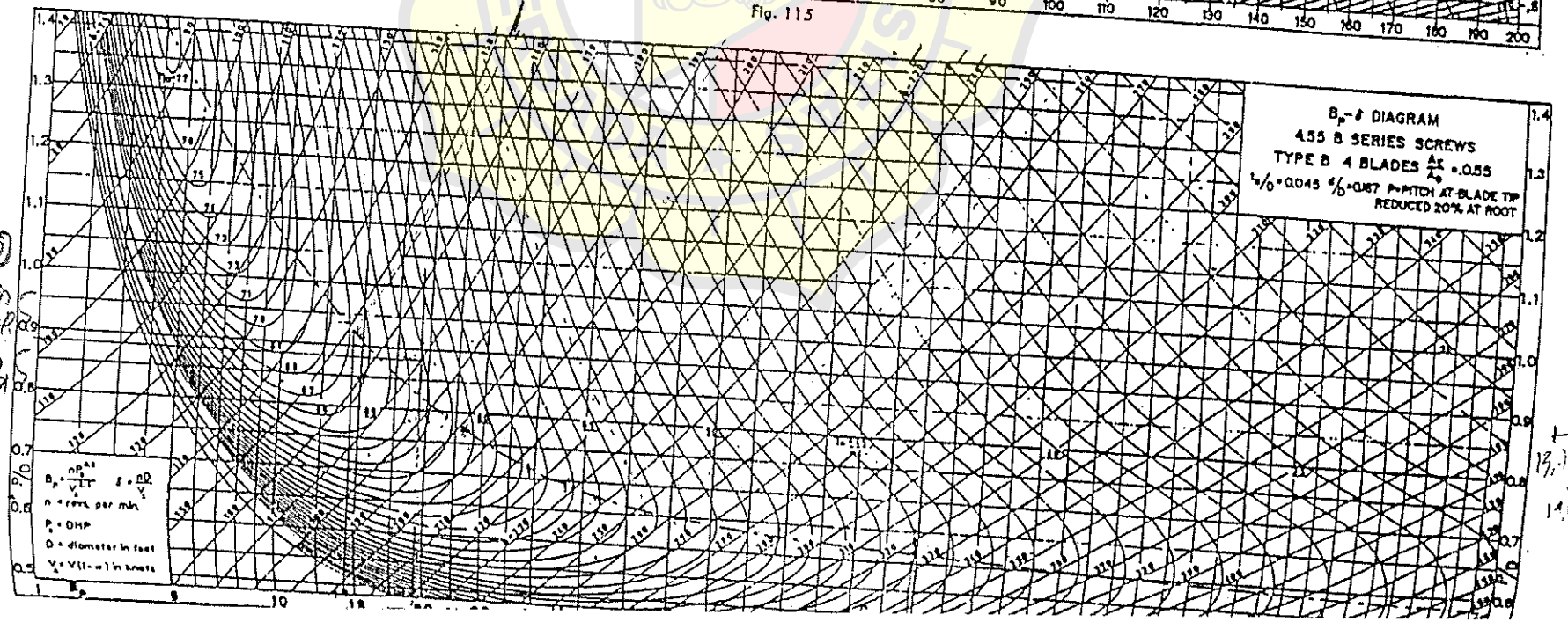

B_p–δ DIAGRAM
4.55 B SERIES SCREWS
TYPE B 4 BLADES $\frac{A_E}{A_O}$ = 0.55
t/D = 0.045 r/D = 0.167 P=PITCH AT BLADE TIP
REDUCED 20% AT ROOT
$B_p = \frac{nP_D^{0.5}}{V_A^{2.5}}$ $\delta = \frac{nD}{V_A}$
n = revs per min
P_D = DHP
D = diameter in feet
V_A = V(1-w) in knots
B_p

Fig. 117

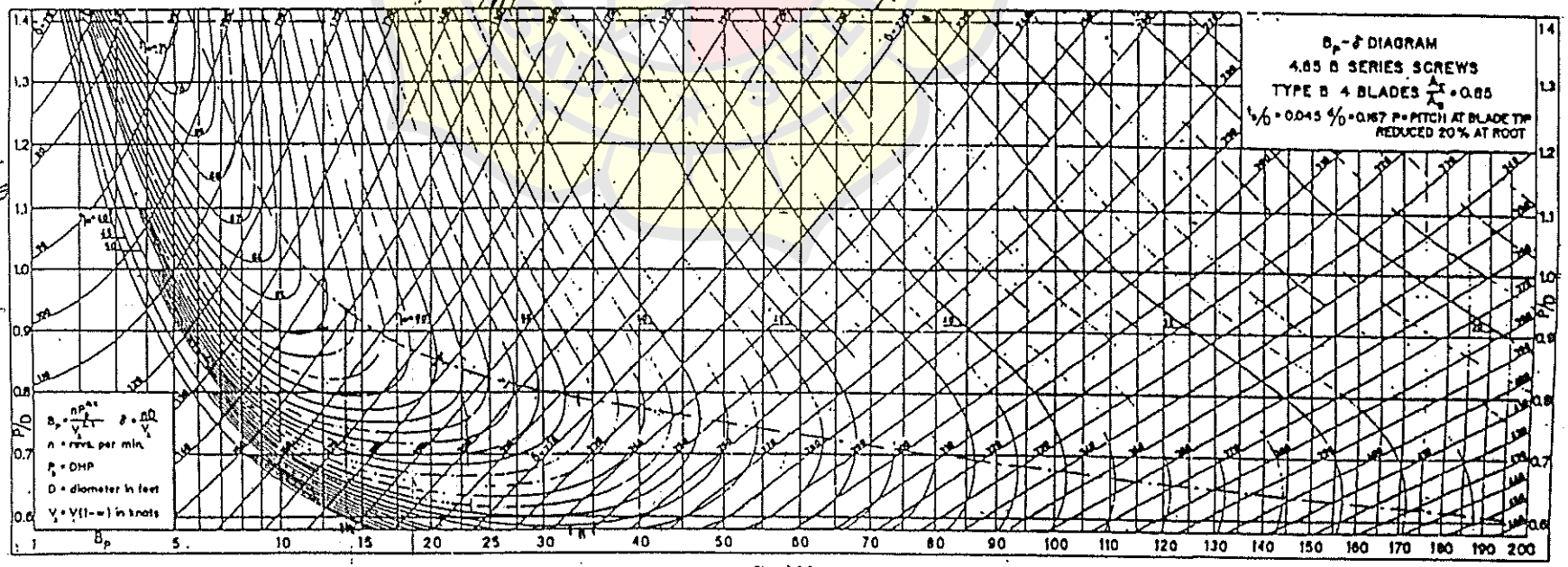


Fig. 118

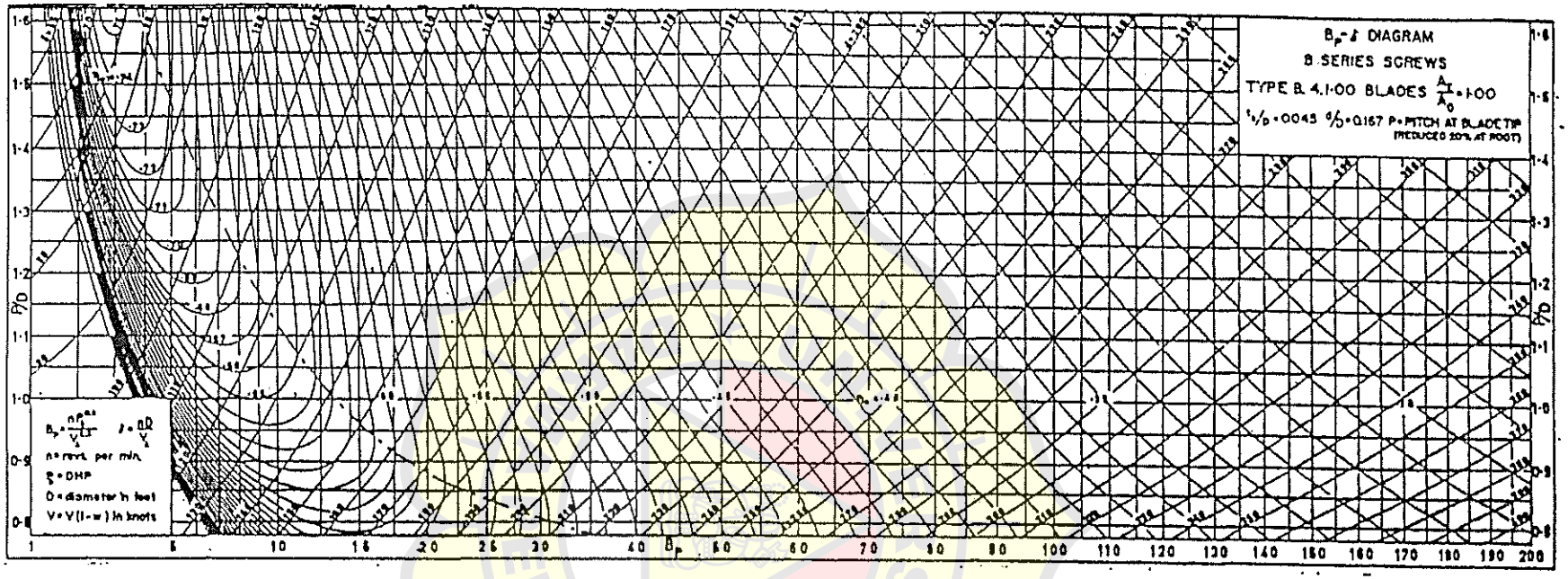
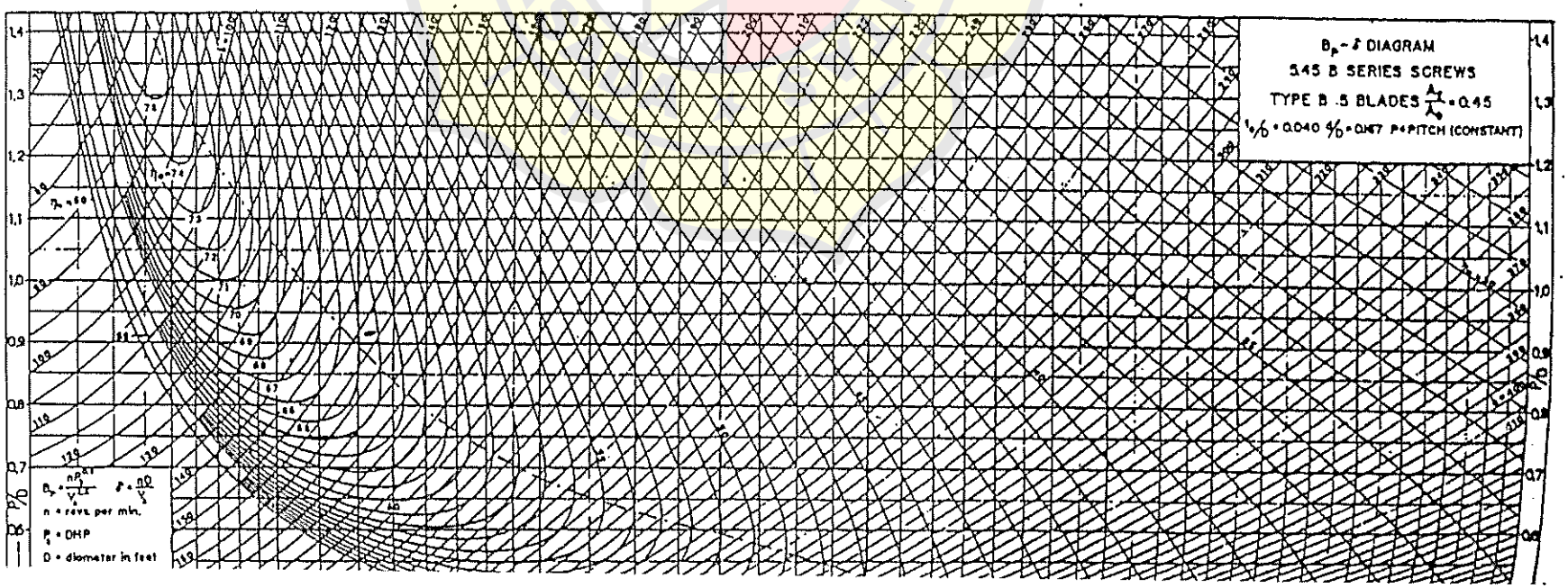
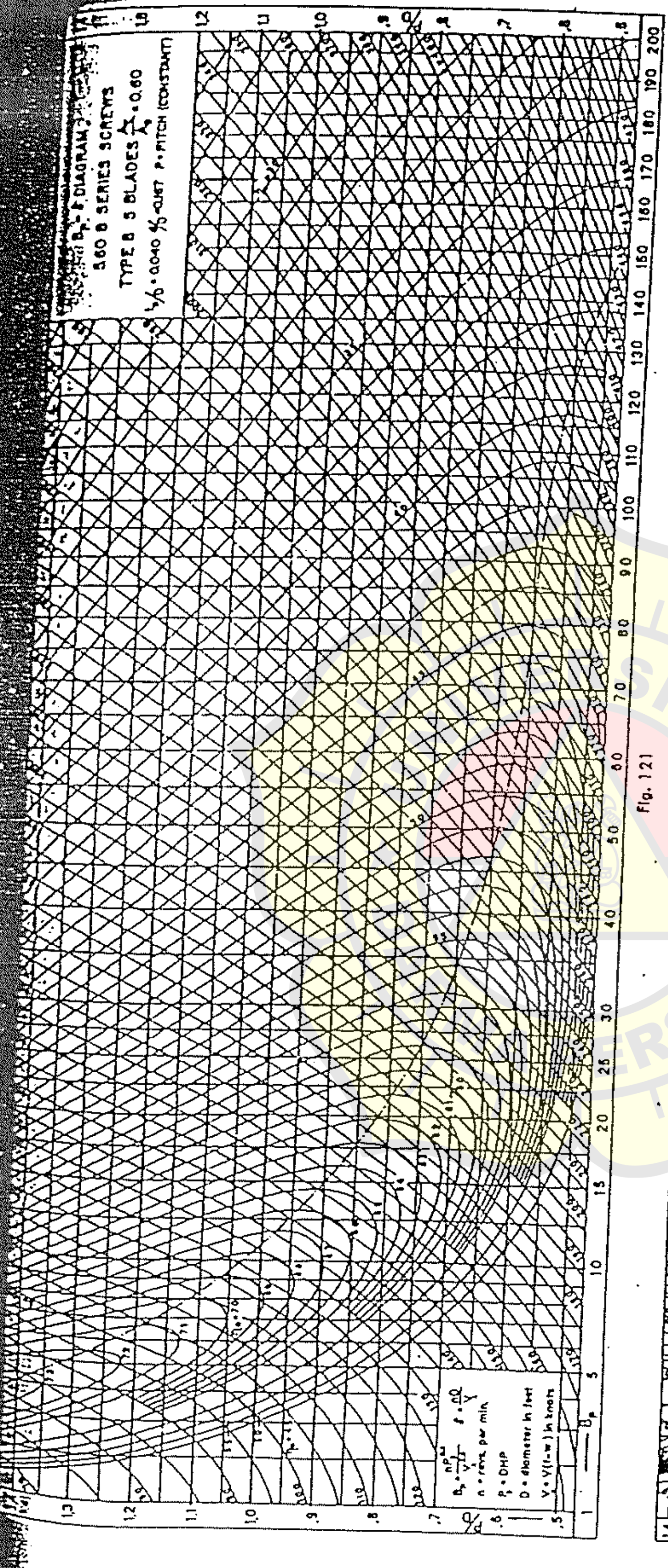
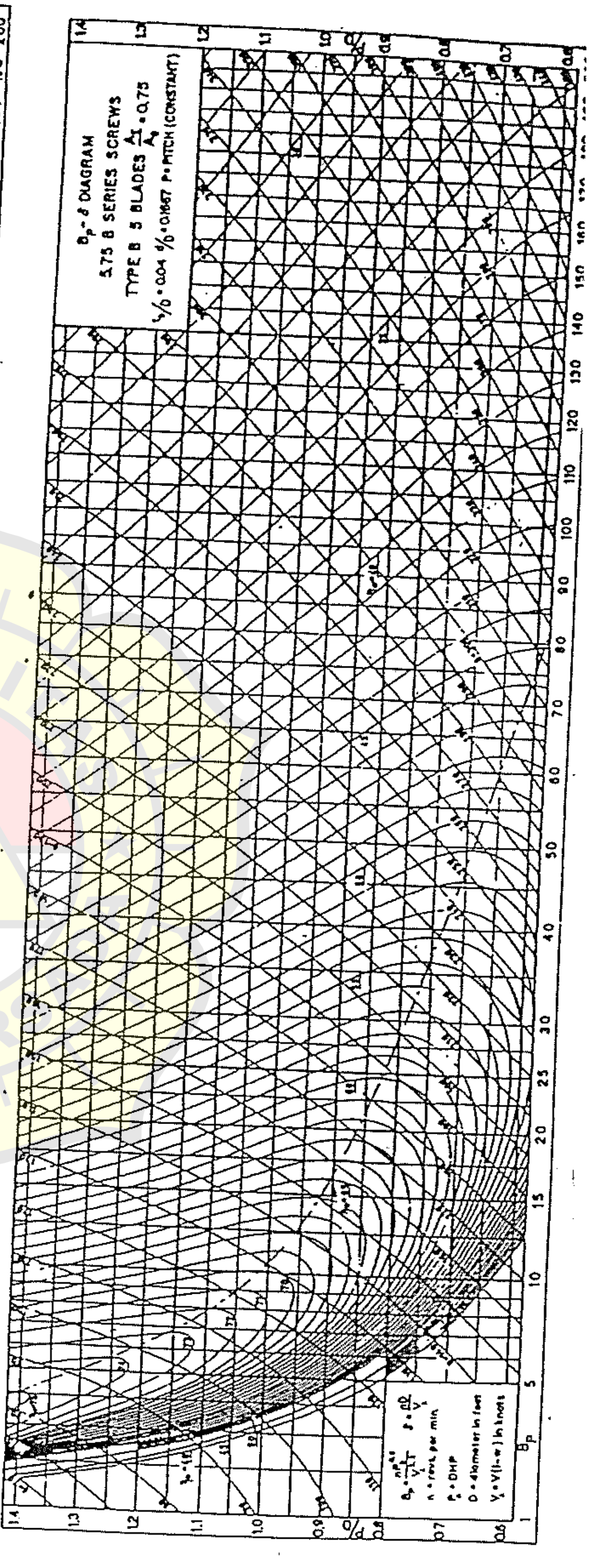

B_p–δ DIAGRAM
B SERIES SCREWS
TYPE B 4.1·00 BLADES $\frac{A_E}{A_0}$ = 1·00
t/D = 0·045 r/D = 0·167 P = PITCH AT BLADE TIP
(REDUCED 20% AT ROOT)
$B_p = \frac{nP^{0.5}}{V_A^{2.5}}$ $\delta = \frac{nD}{V_A}$
n = revs. per min.
P = DHP
D = diameter in feet
V = V(1-w) in knots
P/D
B_p

Fig. 119


B_p–δ DIAGRAM
5·45 B SERIES SCREWS
TYPE B ·5 BLADES $\frac{A_E}{A_0}$ = 0·45
t/D = 0·040 r/D = 0·167 P = PITCH (CONSTANT)
$B_p = \frac{nP^{0.5}}{V_A^{2.5}}$ $\delta = \frac{nD}{V_A}$
n = revs. per min.
P = DHP
D = diameter in feet
P/D



Bp - δ DIAGRAM
5.60 B SERIES SCREWS
TYPE B 5 BLADES
P = PITCH (CONSTANT)
n = revs per min
D = diameter in feet
V = V(1-w) in knots
Bp



Bp - δ DIAGRAM
5.75 B SERIES SCREWS
TYPE B 5 BLADES
P = PITCH (CONSTANT)
n = revs per min
D = diameter in feet
V = V(1-w) in knots
Bp

Fig. 121

COOLMAR®

SPLIT TYPE MARINE AIR CONDITIONER

INSTALLATION, OPERATION AND MAINTENANCE MANUAL

Brand Name: COOLMAR

MODEL NO
MAS 008
MAS 010
MAS 012
MAS 015
MAS 018
MAS 020
MAS 022
MAS 024

CE

TÜV SUD

IKSUM101.R0.12.05

are made of chrome. The fan body can turn between 0 – 90 for the convenience during the air duct installation.

3. TECHNICAL SPECIFICATIONS TABLE

SPECIFICATIONS		Model / Unit	MAS 008	MAS 010	MAS 012	MAS 015	MAS 018	MAS 020	MAS 022	MAS 024
Cooling Capacity		Btu/h	7.500	9.500	12.200	15.000	18.200	20.000	22.100	24.600
Heating Capacity		Btu/h	7.600	9.700	12.600	15.800	18.700	20.300	22.600	25.000
Power Consumption		W	680	900	1.270	1.600	2.000	2.200	2.400	2.630
Currrent	Indoor Unit	A	0,3	0,4	0,5	0,6	0,6	0,7	0,7	0,7
	Outdoor Unit	A	3,0	3,7	5,3	6,6	8,7	10,1	10,5	11,3
Indoor Unit	Length	mm	290	290	320	450	450	450	450	450
	Width	mm	270	270	270	320	320	320	320	320
	Height	mm	320	320	320	350	350	350	350	350
	Net Weight	kg	12	12	14	18	19	19	20	22
	Air Flow	m^3/h	275	320	520	650	780	950	1.100	1.250
	Fan Motor Power	W	60	70	100	110	110	115	120	120
Outdoor Unit	Length	mm	330	330	330	330	330	330	330	330
	Width	mm	270	270	270	320	320	320	320	320
	Height	mm	320	320	340	370	370	370	400	400
	Net Weight	kg	17	18	19	25	27	27	29	32
Suction Pipe		Inch	3/8"	3/8"	3/8"	1/2"	1/2"	1/2"	1/2"	1/2"
Discharge Pipe		Inch	1/4"	1/4"	1/4"	3/8"	3/8"	3/8"	3/8"	3/8"
Condenser Pipe		Inch	3/4"	3/4"	3/4"	3/4"	3/4"	3/4"	3/4"	3/4"
Drain Pipe		Inch	5/8"	5/8"	5/8"	5/8"	5/8"	5/8"	5/8"	5/8"
Duct Diameter		mm	100	100	125	125	2x125	150	150	150
Proposed Fuse for the System		A	C 16	C 16	C 16	C 20	C 20	C 25	C 25	C 25
Max Pump Current That can be Connected to the Unit Electrical Box		A	4	4	4	4	4	4	4	4
Condenser water flow		l/m	9	11	13	13	16	19	19	20
Voltage		V	230							
Frequency		Hz	50							
IP Class			IP 22							
Feeding Cable Cross Section /Type			3 x 2,5 / Tin Coated							

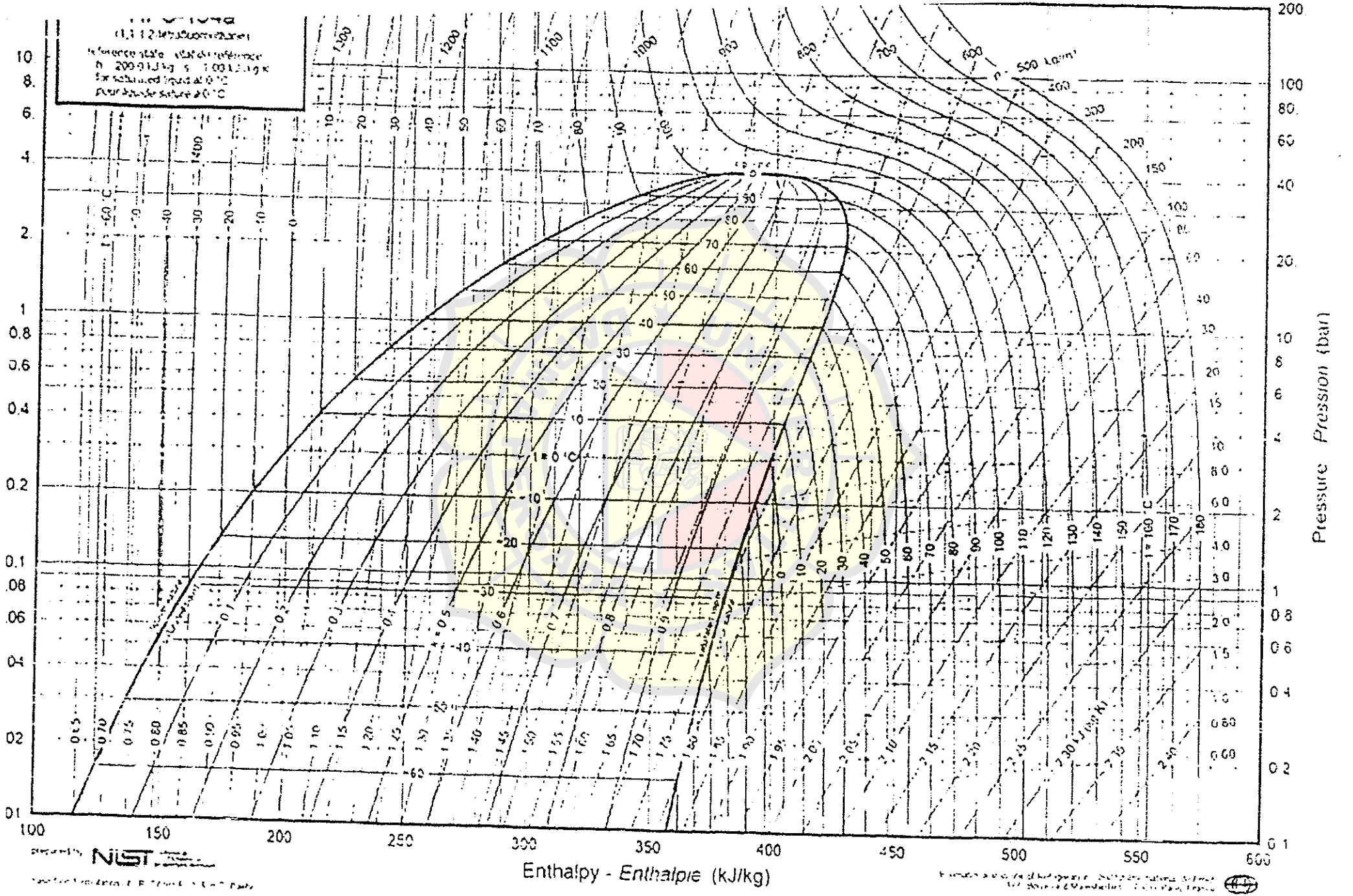

Enthalpy - Enthalpie (kJ/kg)
Pressure Pression (bar)
NIST

Table AE.1 Saturation Properties of Refrigerant R-134a: Temperature Increments

Temp., F	Press., P_{sat}, psia	Specific Volume, ft³/lbm: Sat. Liquid, v_f	Sat. Vapor, v_g	Internal Energy, Btu/lbm: Sat. Liquid, u_f	Sat. Vapor, u_g	Enthalpy, Btu/lbm: Sat. Liquid, h_f	Evap., h_{fg}	Sat. Vapor, h_g	Entropy, Btu/lbm·R: Sat. Liquid, s_f	Sat. Vapor, s_g
40	7.4272	0.011299	5.7830	63.718	152.95	63.733	97.167	160.90	0.19016	0.42169
30	9.8624	0.011429	4.4330	66.725	154.32	66.740	95.664	162.41	0.19723	0.41989
20	12.898	0.011565	3.4449	69.756	155.69	69.781	94.136	163.92	0.20421	0.41831
15	14.671	0.011635	3.0514	71.281	156.38	71.313	93.357	164.67	0.20766	0.41760
10	16.632	0.011706	2.7109	72.812	157.06	72.848	92.562	165.41	0.21109	0.41693
5	18.794	0.011779	2.4154	74.350	157.75	74.391	91.759	166.15	0.21449	0.41631
0	21.171	0.011853	2.1579	75.894	158.43	75.940	90.950	166.89	0.21786	0.41572
5	23.777	0.011929	1.9330	77.445	159.11	77.497	90.123	167.62	0.22122	0.41518
10	26.628	0.012007	1.7357	79.002	159.79	79.062	89.288	168.35	0.22456	0.41467
15	29.739	0.012086	1.5623	80.567	160.47	80.634	88.436	169.07	0.22787	0.41419
20	33.124	0.012168	1.4094	82.140	161.14	82.214	87.576	169.79	0.23117	0.41374
25	36.800	0.012251	1.2742	83.720	161.82	83.803	86.697	170.50	0.23445	0.41332
30	40.784	0.012337	1.1543	85.307	162.49	85.401	85.799	171.20	0.23771	0.41293
35	45.092	0.012425	1.0478	86.903	163.15	87.007	84.893	171.90	0.24095	0.41257
40	49.741	0.012515	0.95280	88.507	163.81	88.623	83.967	172.59	0.24418	0.41222
45	54.749	0.012608	0.86796	90.120	164.47	90.248	83.022	173.27	0.24739	0.41190
50	60.134	0.012703	0.79198	91.742	165.12	91.883	82.057	173.94	0.25059	0.41159
55	65.913	0.012802	0.72380	93.372	165.77	93.529	81.071	174.60	0.25378	0.41131
60	72.105	0.012903	0.66246	95.013	166.41	95.185	80.075	175.26	0.25695	0.41103
65	78.729	0.013008	0.60718	96.663	167.05	96.853	79.047	175.90	0.26011	0.41077
70	85.805	0.013116	0.55724	98.324	167.67	98.532	77.998	176.53	0.26327	0.41052
75	93.351	0.013229	0.51204	99.995	168.30	100.22	76.930	177.15	0.26641	0.41028
80	101.39	0.013345	0.47104	101.68	168.91	101.93	75.820	177.75	0.26955	0.41005
85	109.93	0.013465	0.43379	103.37	169.51	103.65	74.690	178.34	0.27268	0.40982
90	119.01	0.013590	0.39988	105.08	170.11	105.38	73.540	178.92	0.27580	0.40959
95	128.65	0.013720	0.36896	106.80	170.69	107.13	72.350	179.48	0.27892	0.40937
100	138.88	0.013856	0.34070	108.53	171.26	108.89	71.130	180.02	0.28204	0.40914
105	149.65	0.013998	0.31483	110.28	171.82	110.67	69.880	180.55	0.28515	0.40891
110	161.07	0.014146	0.29111	112.04	172.37	112.46	68.590	181.05	0.28827	0.40867
115	173.14	0.014301	0.26933	113.82	172.90	114.28	67.250	181.53	0.29139	0.40842
120	185.86	0.014464	0.24928	115.62	173.41	116.12	65.870	181.99	0.29451	0.40815
140	243.92	0.015214	0.18332	123.00	175.26	123.69	59.850	183.54	0.30708	0.40689
160	314.73	0.016191	0.13428	130.79	176.64	131.74	52.720	184.46	0.31995	0.40503
180	400.34	0.017588	0.096375	139.24	177.19	140.54	43.790	184.33	0.33350	0.40196
200	503.59	0.020096	0.064663	149.07	175.80	150.95	30.880	181.83	0.34896	0.39577
210	563.35	0.023150	0.047695	155.85	172.56	158.26	19.220	177.48	0.35960	0.38530

Tahap 4: Perhitungan faktor Penggunaan

Faktor penggunaan didefinisikan sebagai persen dari lumen lampu kosong yang mengeluarkan cahaya dan mencapai bidang kerja. Faktor ini bertanggungjawab langsung terhadap cahaya dari luminer dan cahaya yang dipantulkan permukaan ruangan. Pihak pabrik akan memasok setiap luminer dengan tabel CU nya sendiri yang berasal dari laporan pengujian fotometrik. Dengan menggunakann tabel yang tersedia dari pabrik, ditentukan faktor penggunaan untuk pemasangan berbagai cahaya jika pantulan dari dinding dan langit-langit diketahui, indeks ruangan telah ditentukan dan jenis luminer diketahui. Untuk peralatan tabung kembar, faktor pengunaannya adalah 0,66, sesuai untuk indeks ruangan 2,5.

Tahap 5: Perhitungan jumlah fitting yang diperlukan dengan penerapan rumus sebagai berikut:

$$N = \frac{E \times A}{F \times UF \times LLF}$$

Dimana:
N = Jumlah *fitting*
E = Tingkat *lux* yang diperlukan pada bidang kerja
A = Luas ruangan (L x W)
F = Flux total (Lumens) dari seluruh lampu dalam satu *fitting*
UF = Faktor penggunaan dari tabel untuk peralatan yang digunakan
LLF = Faktor kehilangan cahaya. Kehilangan ini disebabkan oleh penurunan keluaran lampu yang sudah lama dan penumpukan kotoran pada peralatan dan dinding bangunan.
LLF = Lumen lampu $_{MF}$ x Luminer $_{MF}$ x Permukaan ruangan $_{MF}$

Nilai LLF

Kantor ber AC	0,8
Industri bersih	0,7
Industri kotor	0,6

$$N = \frac{200 \times 100}{2 \times 3050 \times 0{,}66 \times 0{,}8}$$

= 6,2; Sehingga, lampu tabung kembar nomor 6 diperlukan. Jumlah total lampu 36-Watt adalah 12.

Tahap 6: Ruang luminer untuk mencapai keseragaman yang dikehendaki

Setiap luminer akan memiliki ruang yang direkomendasikan terhadap perbandingan tinggi. Pada metodologi perancangan sebelumnya, perbandingan keseragaman, yakni perbandingan terang minimum terhadap terang rata-rata dijaga pada 0,8 dan ruang yang cocok untuk perbandingan tinggi ditentukan untuk mencapai keseragaman. Dalam perancangan modern memadukan efisiensi energi dengan tugas pencahayaan, konsep yang muncul adalah memberi keseragaman 1/3 hingga 1/10 tergantung pada tugasnya. Nilai luminer diatas yang direkomedasikan adalah