BAB III

PENUTUP

Kesempurnaan dari suatu hasil penulisan adalah merupakan tujuan dari setiap penulis, namun hasil maksimal seorang penulis yang mungkin dianggapnya sempurna pasti mempunyai kekurangan dibeberapa bagian. Oleh karena itu penulis mohon maaf apabila masih banyak kekurangan dan kesalahan pada penulisan tugas mesin kapal ini.

3.1 Kesimpulan.

Dari hasil uraian diatas sebelumnya dimana mencangkup dari pada Pendahuluan, Perencanaan Perhitungan Motor Induk dan Motor Bantu. Maka penulis dapat menarik suatu kesimpulan yang berhubungan dengan perencanaan Lay Out Kamar Mesin Kapal Riset Oceanclogi 1270 GRT.

Adapun kesimpulan tersebut adalah sebagai berikut :

- Untuk menentukan besarnya daya motor induk kapal sebagai penggerak utama, maka faktor kecepatan, jarak pelayaran, serta dimensi dari kapal mempunyai pengaruh yang sangat besar.
- Didalam perencanaan kamar mesin, tidak terlepas dari adanya asumsi-asumsi yang diberikan untuk mempermudah dalam perhitungan dengan tidak mengabaikan tanggung jawab secara teknis, ekonomis dan peraturan-peraturan yang ada, sehingga hasil perhitungan dapat mendekati keadaan yang sebenarnya.
- Pemilihan mesin bantu tergantung dari jumlah daya yang harus di suplai pada kondisi operasi kapal yang berbeda-beda.
- Penempatan posisi mesin induk, mesin bantu serta peralatan-peralatan lainnya sangat berpengaruh pada stabilitas kapal.

3.2 Saran-saran.

Dengan melihat jenis kapal yang akan dirancang layout kamar mesin kapal ini, maka tata letak mesin induk, mesin bantu maupun peralatan-peralatan lain hendaknya diatur seefisien mungkin. Hal ini untuk mempermudah dalam perawatan dan perbaikan peralatan yang ada dikamar mesin itu sendiri.

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DAFTAR NOTASI

A	:	Luas bidang
a°	:	Jarak antara gading lintang normal
B	:	Labar kapal
b	:	Tinggi daun kemudi
BHP_s	:	*Break Horse Power*
Cr	:	Gaya daun kemudi
Cw	:	Faktor koreksi beban
d	:	Diameter
db	:	Diameter pipa *ballast*
Dcl	:	Diameter efektif panjang rantai
df	:	Diameter pipa *discharge* sistem pemadam kebakaran
dh	:	Diameter utama sistem bilga
Dt	:	Diameter poros kemudi
dw	:	diameter tali tambat
dz	:	Diameter cabang sistem bilga
EHPs	:	Tenaga efektif pada *service condition*
EHPtr	:	Tenaga efektif pada *trial condition*
Ga	:	Berat jangkar
g	:	Gravitasi
H	:	Tinggi kapal

h	:	Tinggi alas ganda
ha	:	*Head* statis total
He	:	*Head* kerugian sistim Ventilasi
hi	:	*Head* total sistem
hl	:	*Head* kerugian saluran, katup dll
HP	:	Daya kuda
la	:	Ratio antara putaran motor dengan putaran *cable lifter*
lcl	:	Panjang rantai untuk suatu putaran *cable lifter*
lw	:	Ratio antara putaran motor dengan putaran poros penggulung tali tambat
J	:	Kapasitas botol angin
K	:	Koefisien hambatan untuk katup dan fitting
L	:	Letak *misdship section*, panjang pipa
La	:	Panjang rantai yang menggantung
lb	:	Lebar ruangan
LCB	:	Letek titik tekan keatas terhadap *midship section*
Lpp	:	Panjang kapal antara dua garis tegak
Lwl	:	Panjang garis air
Mcl	:	Torsi pada *cable lifter*
Mm	:	Torsi pada motor
N	:	Putaran mesin, putaran baling-baling
Ncl	:	Putaran *cable lifter*
Nw	:	Putaran poros penggulung tali tambat

Pa	:	Tekanan kerja maksimum botol udara start
Pb	:	Tekanan kerja minimum botol udara start
Pc	:	Koefisien propulsi
Pe	:	Tekanan udara luar
Q	:	Kapasitas aliran fluida
Qc	:	Kapasitas fan
Qb	:	Berat peralatan
Qf	:	Berat alat penurun
rz	:	Koreksi kerugian pada sistim transmisi
ra	:	Koreksi karena perubahan B/T kapal terhadap B/T standart
Rbr	:	Beban putus tali tambat
Re	:	*Reynold Number*
Rpm	:	Putaran mesin
Rt	:	Total *specifik resistance*
S	:	Jarak pelayaran
SFOC	:	Pemakaian bahan bakar spesifik untuk mesin induk
SHP	:	Daya yang diberikan poros
T	:	Sarat kapal
t	:	Waktu
Tcl	:	Gaya tarik untuk menarik dua jangkar
Tmaks	:	Torsi maksimum daun kemudi
Tmin	:	Torsi minimum daun kemudi
Tw	:	Gaya tarik pada penggulung di *capstan*

V	:	Volume ruangan, kecepatan
Va	:	Kecepatan angkat rantai jangkar rata-rata
Vb	:	Volume tangki *ballast*
Vlo	:	Volume tangki minyak pelumas
Vs	:	Kecepatan dinas kapal
Vt	:	Volume tangki air tawar
Vw	:	Kecepatan tarik tali tambat
Wab	:	Berat air *ballast*
Wco	:	Berat minyak pelumas mesin induk
Wdo	:	Berat bahan bakar mesin bantu
Wfo	:	Berat bahan bakar mesin induk
Wlo	:	Luas permukaan basah kapal
Wt	:	Berat total keperluan air tawar
Z	:	Jumlah silinder
Δph	:	Kerugian *head* karena perbedaan tekanan
Δhv	:	Kerugian *head* karena perbedaan kecepatan antara saluran *inlet* dan **outlet**
λ	:	Koefisien gesek pada saluran
υ	:	Viskositas kinematis fluida
γ	:	Berat jenis fluida
α	:	Sudut putar kemudi
ξ	:	*Specific residuary resistance*
$\xi fr.s$	:	*Specific friction resistance*

ξts	:	Total *specific frictional resistance*
ηcl	:	Effisiensi peralatan mesin jangkar
ηh	:	Effisiensi pada *cable lifter*
ηm	:	Effisiensi mekanis
δ	:	*Koeffisien* blok
ϕ	:	*Koeffisien* prismatik memanjang
β	:	*Koeffisien midship*
Δ	:	Displasemen

Table 5 Form of Polynomial and Coefficients of Four-Bladed B-Screw Series

$C_{s,y,z}$		x	y	z	$D_{s,y,z}$		x	y	z
−.719075	×	−2	0	0	+.964375	×	−2	0	0
−.790016	×	−1	1	0	−.104103	×	−1	1	0
−.179541	×	0	0	1	+.512431	×	−2	2	0
−.625748	×	−1	1	1	+.109936	×	−1	3	0
−.311639	×	0	0	2	−.453419	×	−2	0	1
+.143160	×	0	2	3	+.216078	×	−1	1	1
+.531326	×	0	0	1	−.507337	×	−1	0	2
−.114389	×	0	1	1	+.377970	×	−1	1	2
+.625376	×	−1	0	1	−.549486	×	−1	3	3
+.125537	×	0	0	1	−.507319	×	−1	2	1
−.523821	×	−1	1	1	+.368649	×	−1	0	1
−.207108	×	0	0	2	−.106520	×	0	1	1
+.270781	×	0	1	2	+.465315	×	−1	3	1
+.134182	×	0	0	2	+.883010	×	−1	2	1
−.121086	×	0	1	2	+.112619	×	−1	0	2
−.189764	×	−1	3	2	+.104825	×	0	1	2
−.439535	×	−1	3	2	−.449154	×	−1	1	2
−.624937	×	−1	0	2	+.378780	×	−1	2	2
−.496939	×	−2	2	6	+.177304	×	−1	0	2
+.115986	×	−1	2	6	−.164687	×	−1	1	2
					−.344328	×	−1	2	2
					−.249132	×	−1	3	2
					−.233007	×	−1	1	2
					−.120209	×	−2	0	6
					−.118997	×	−2	3	6
					+.458094	×	−2	1	6

$$K_T = \Sigma C_{s,y,z}[A_E/A_0]^s[P/D]^y[J]^z$$

$$K_Q = \Sigma D_{s,y,z}[A_E/A_0]^s[P/D]^y[J]^z$$

Table 6 Form of Polynomial and Coefficients of Five-Bladed B-Screw Series

$C_{s,y,z}$		x	y	z	$D_{s,y,z}$		x	y	z
−.191226	×	−1	0	0	+.520666	×	−2	0	0
−.860251	×	−1	2	0	+.627259	×	−1	2	0
−.598290	×	−2	3	0	−.337780	×	−1	3	0
−.181301	×	0	0	1	−.518101	×	−1	0	0
−.457217	×	0	0	2	+.395494	×	−1	1	0
+.562903	×	−1	3	0	−.848886	×	−2	0	0
+.990584	×	−1	2	0	+.317571	×	−1	3	0
+.431314	×	0	0	1	+.130016	×	−1	0	1
+.189210	×	0	1	1	−.340161	×	−1	1	1
−.254103	×	0	1	1	+.624821	×	−1	0	1
+.413600	×	0	0	1	−.239057	×	0	1	1
−.126380	×	0	2	1	+.801838	×	−1	2	1
−.865914	×	−1	0	2	+.119589	×	−1	0	1
+.856485	×	−1	1	2	−.477460	×	−1	3	1
+.113060	×	0	0	2	+.133699	×	0	1	2
−.146526	×	0	0	2	−.382898	×	−1	2	2
−.792780	×	−2	0	6	+.270494	×	−1	1	2
+.669368	×	−2	1	6	−.381466	×	−2	1	6
					+.241740	×	−2	3	6

$$K_T = \Sigma C_{s,y,z}[A_E/A_0]^s[P/D]^y[J]^z$$

$$K_Q = \Sigma D_{s,y,z}[A_E/A_0]^s[P/D]^y[J]^z$$

For the different propeller groups the curves for optimum diameter (on base of $\sqrt{K_T/J^4}$) and optimum rpm (on base of $\sqrt{K_T/J^2}$) are given in Figs. 30, 31, and 32 and Figs. 33, 34, and 35 respectively.

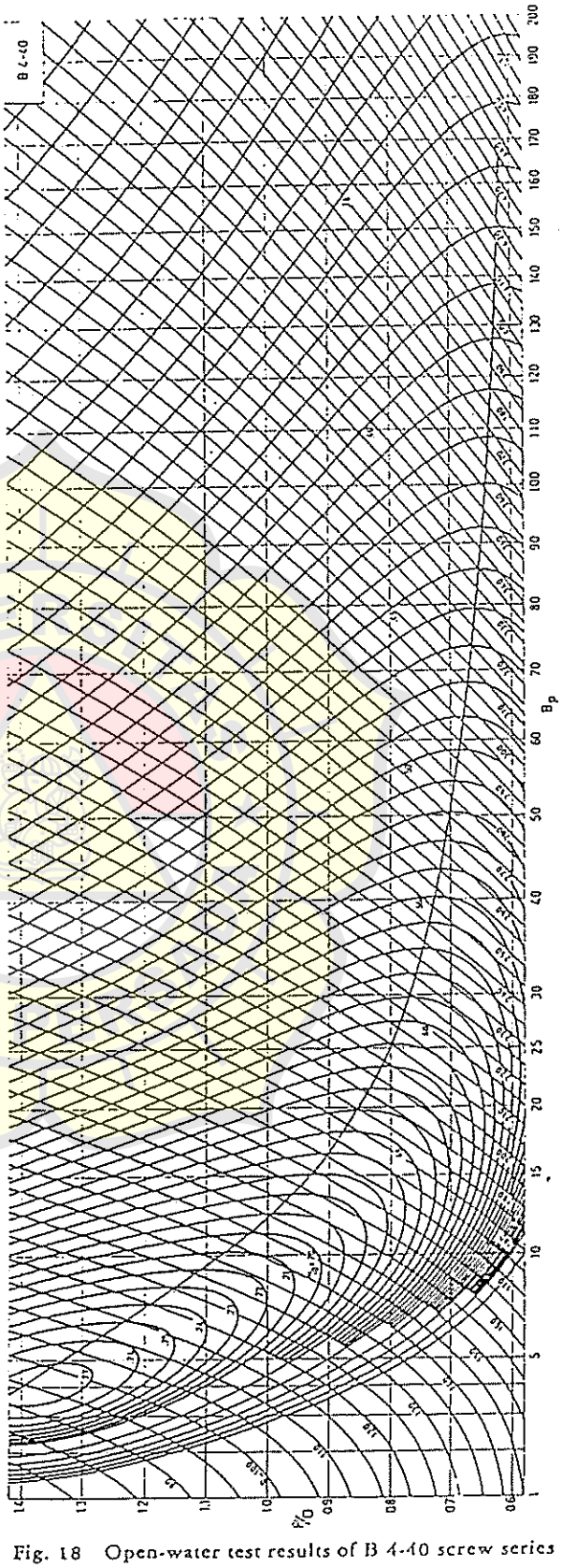


Fig. 18 Open-water test results of B 4-40 screw series

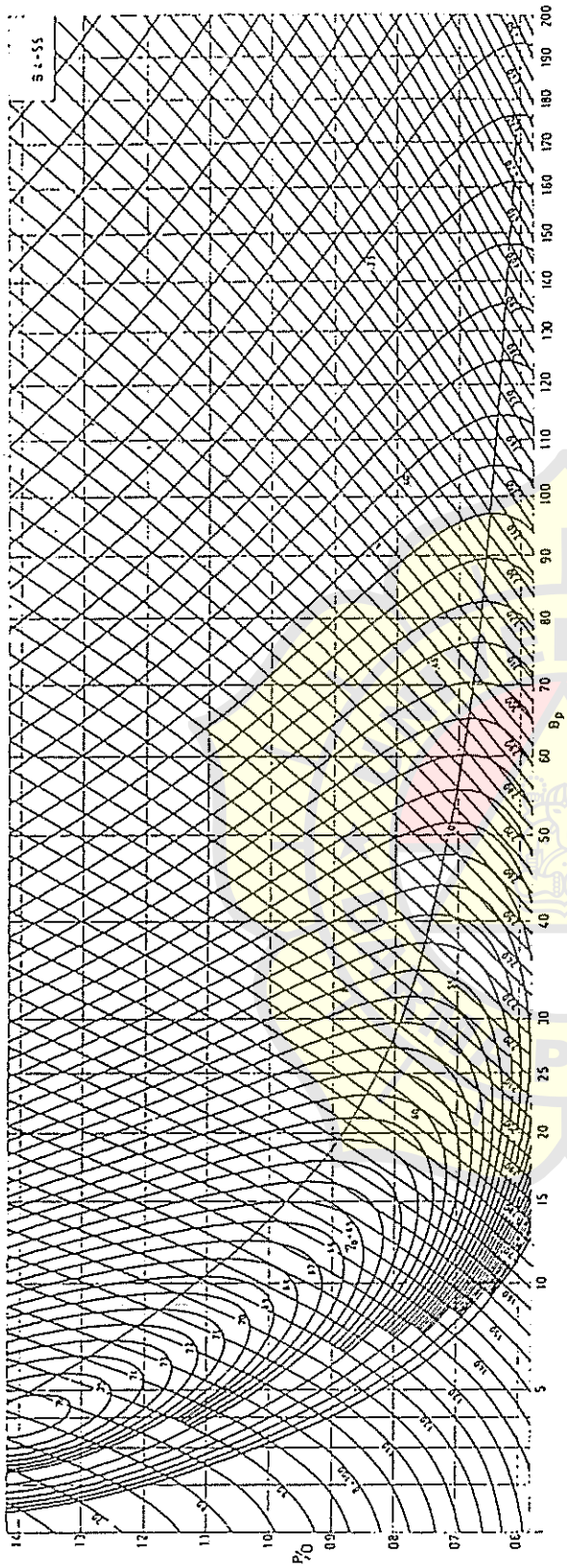


Fig. 19 Open-water test results of B 4-55 screw series

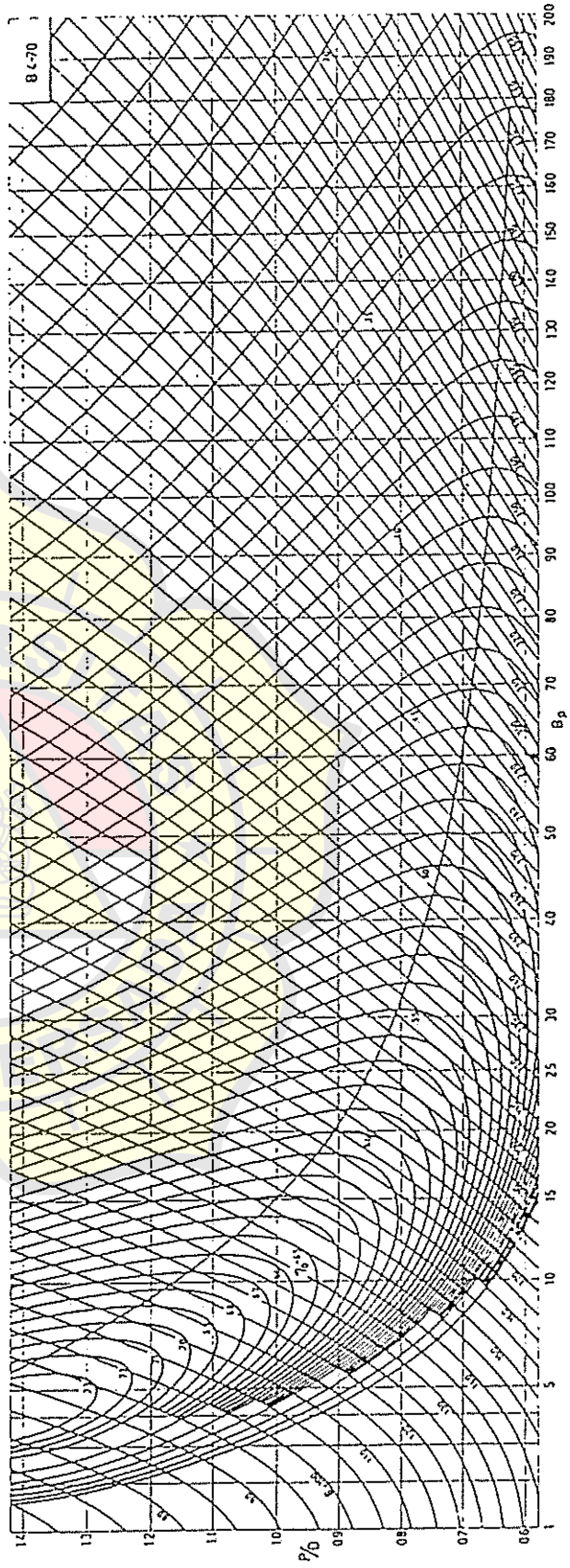


Fig. 20 Open-water test results of B 4-70 screw series

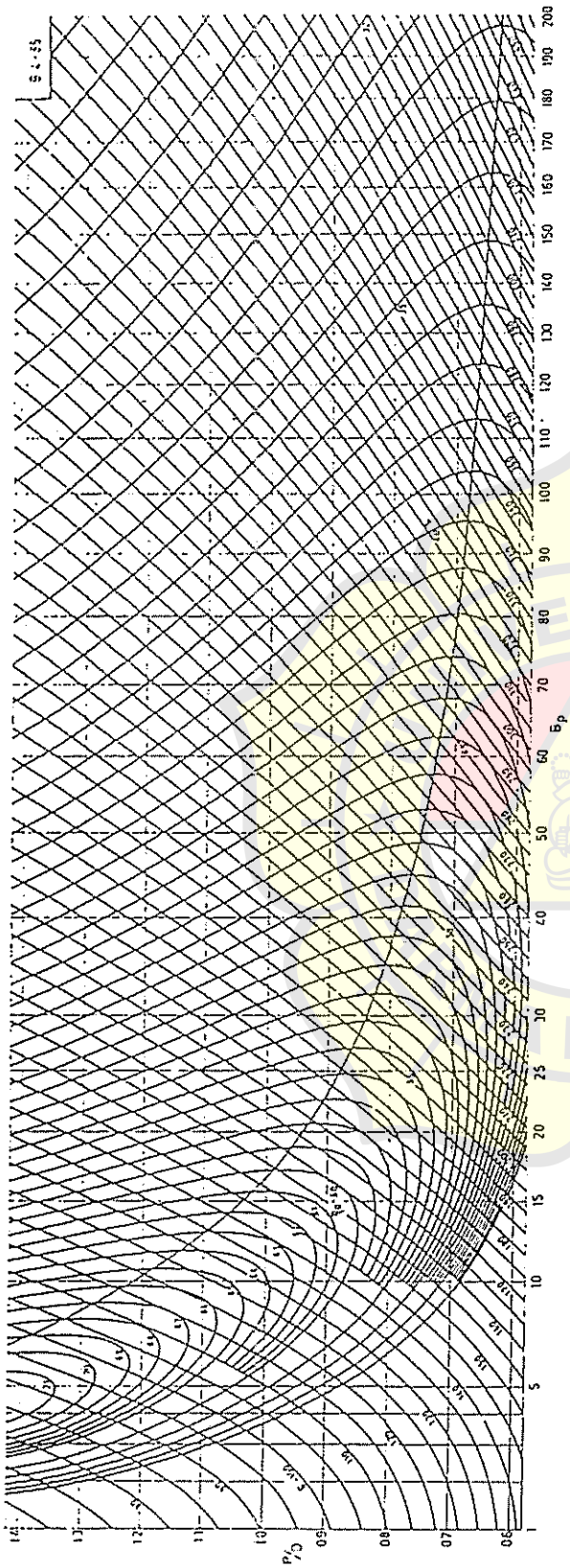


Fig. 21 Open-water test results of B 4-85 screw series

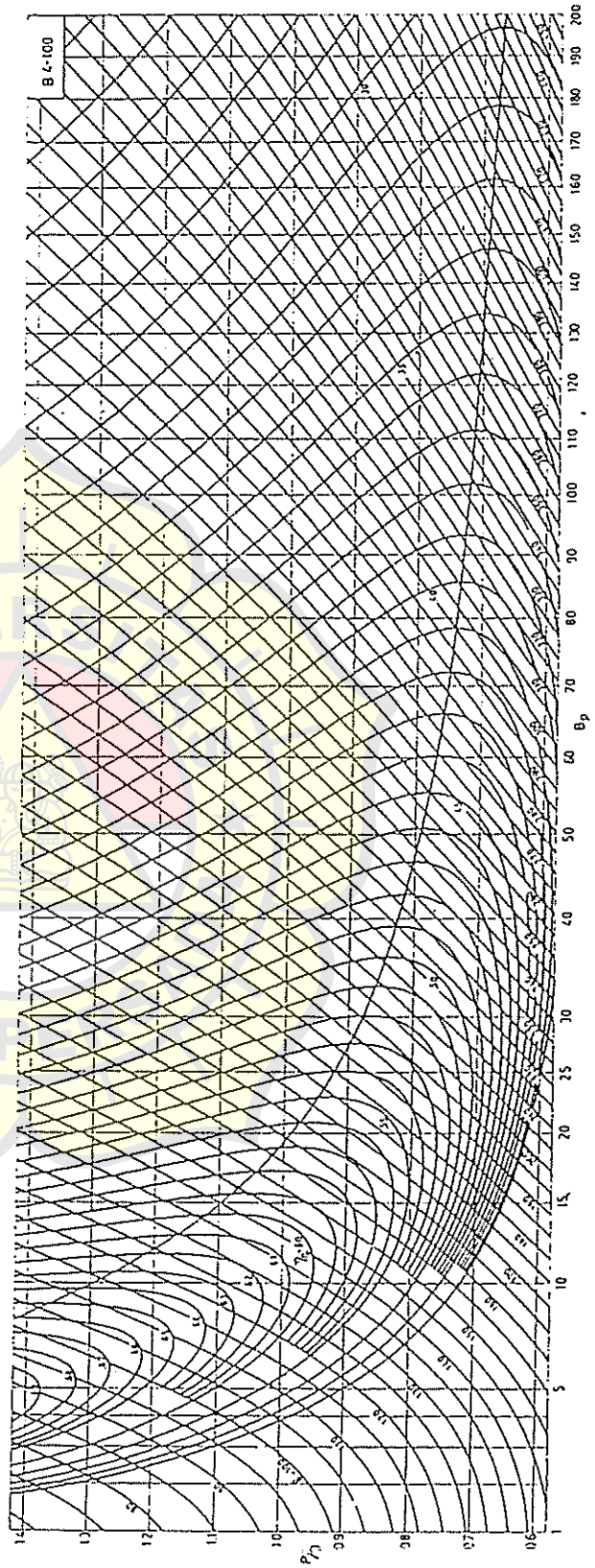


Fig. 22 Open-water test results of B 4-100 screw series

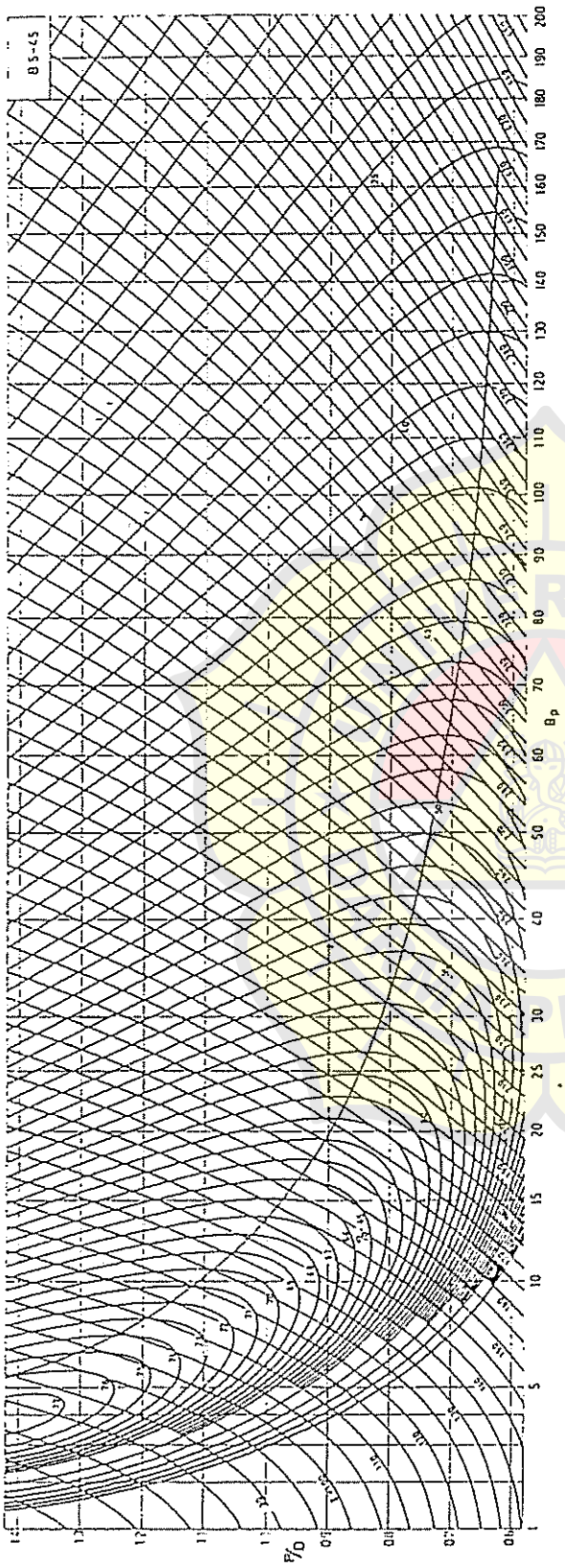


Fig. 23 Open-water test results of B 5-45 screw series

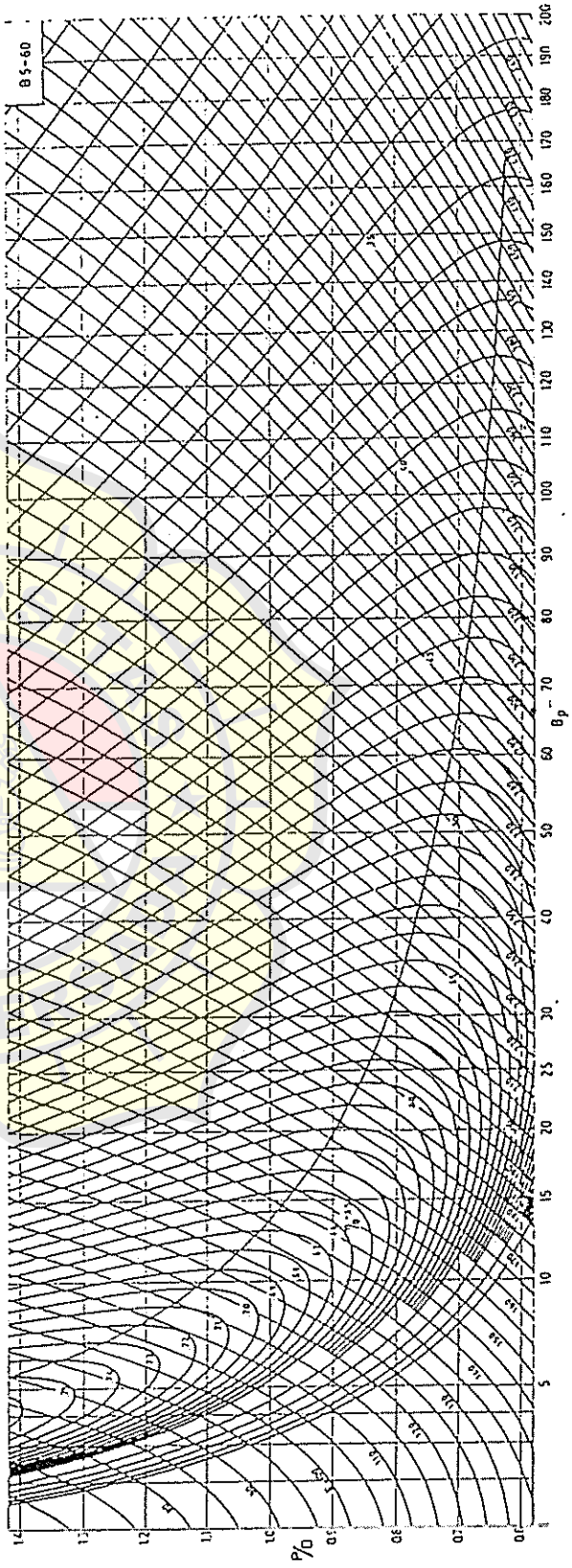


Fig. 24 Open-water test results of B 5-60 screw series

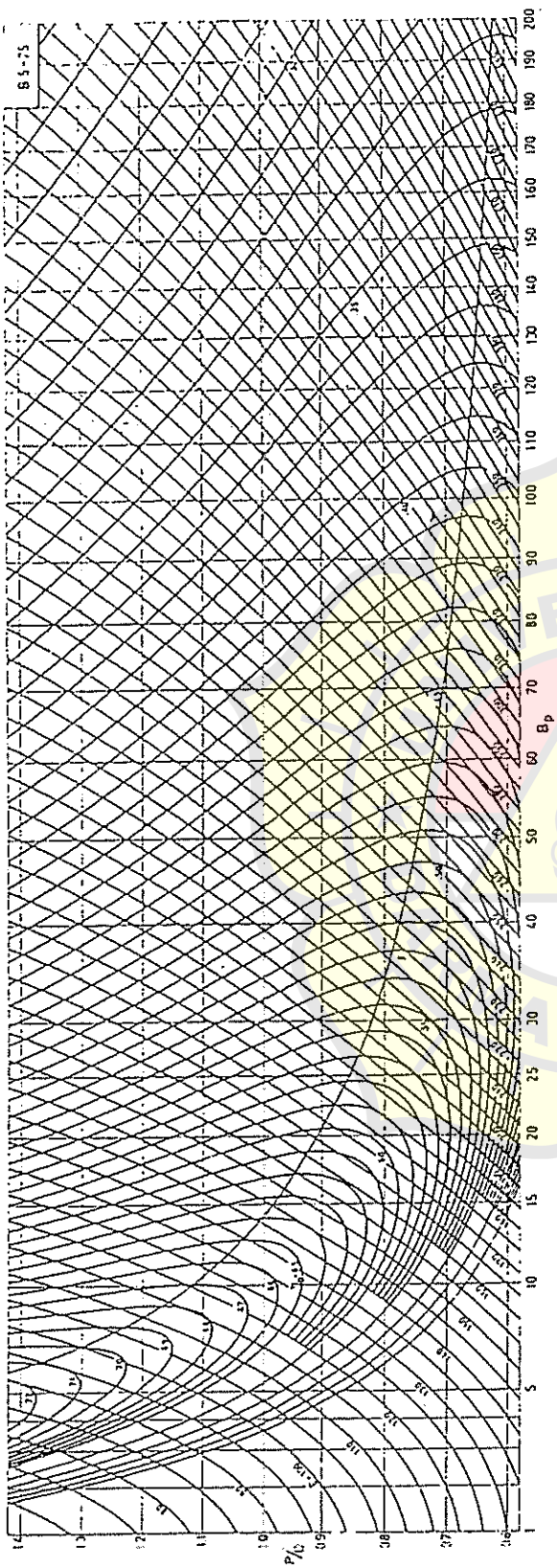


Fig. 25 Open-water test results of B 5-75 screw series

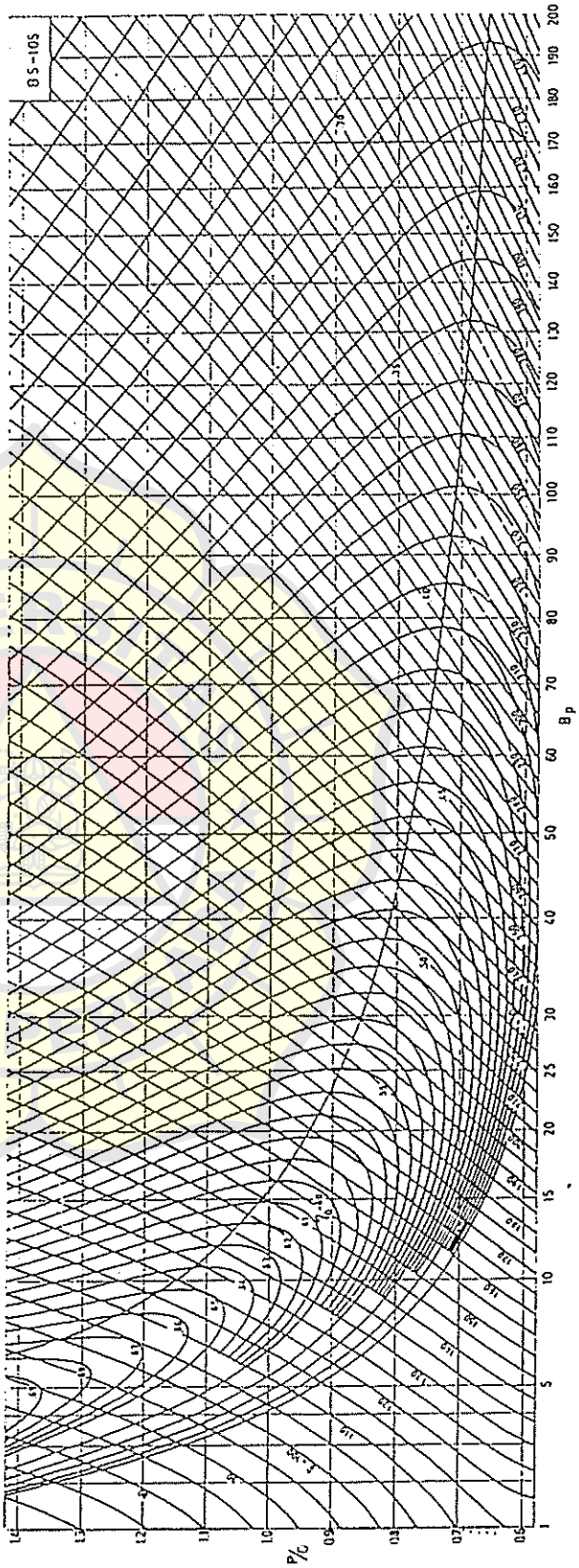
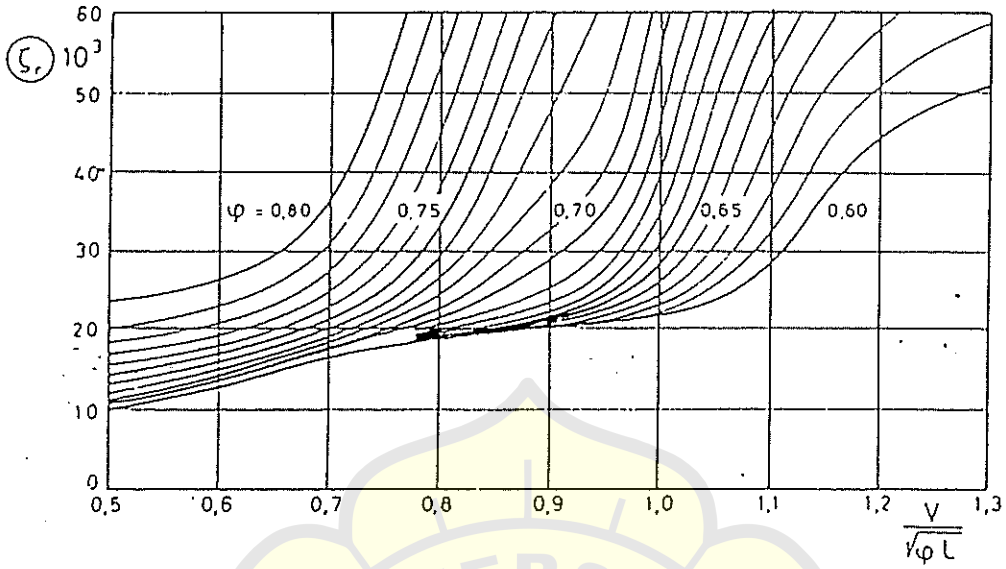


Fig. 26 Open-water test results of B 5-105 screw series



Gambar 5.5.2. Diagram NSMB untuk tahanan sisa untuk model dalam kelompok *C* (*B*/*T* = 2,40).

Maka tahanan dalam koncisi pelayaran percobaan adalah

$$R = \left(C_{FS} + \zeta_r \frac{A_x}{S} + \Sigma C_n\right)(\tfrac{1}{2}\rho V^2 S) \quad (5.5.3)$$

ΣC_n adalah jumlah dari faktor kelonggaran.

Untuk kondisi pelayarar dinas harus diberikan kelonggaran tambahan yang tergantung pada daerah pelayaran. Harga faktor kelonggaran tersebut dapat diberikan dalam persentase tahanan total dari kondisi pelayaran percobaan.Untuk jalur utama, persentase kelonggaran tambahan (p) untuk kondisi pelayaran dinas dapat diberikan sebagai berikut :

Jalur pelayaran Atlantik Utara, ke Timur	25 – 30%
Jalur pelayaran Atlantik Utara, ke Barat	30 – 40%
Jalur pelayaran Pasifik	25 – 40%
Jalur pelayaran Australia	22 – 28%
Jalur Asia Timur	25 – 30%

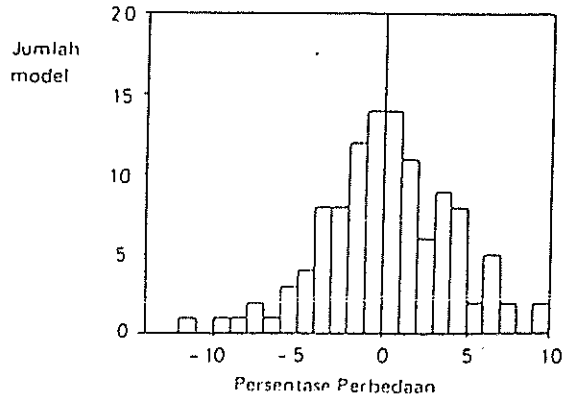
Akhirnya, tahanan total untuk kapal dalam kondisi pelayaran dinas dapat dinyatakan sebagai

$$R = \left(C_{FS} + \zeta_r \frac{A_x}{S} + \Sigma C_n\right)(1 + p)(\tfrac{1}{2}\rho V^2 S) \quad (5.5.4)$$

Dalam 5.5.2 disebutkan bahwa untuk ke 115 model berbaling-baling tunggal taci tahanan kapal pada kecepatan dinas yang diperoleh dari uji model tersebut dibandingkan dengan tahanan kapal yang dihitung berdasarkan diagram Gertler. Diagram Lap juga diuji seperti itu, dan distribusi persentase perbedaannya diberikan dalam Gb. 5.5.3. Seperti yang diharapkan, barangkali metode Lap ini agak lebih baik daripada metode Gertler karena materi pengujian NSMB dipakai dalam pengembangan metode tersebut.

5.5.4. Diagram Guldhammer dan Harvald

Dalam publikasi *Ship Resistance* (Guldhammer dan Harvald, 1965, 1974) disajikan koordinasi dari hasil yang dikumpulkan dari berbagai pengujian di tangki percobaan. Penganalisaan materi dasar yang dikumpulkan tersebut dilakukan dengan cara sebagai berikut :



Gambar 5.5.3. Distribusi frekuensi kesalahan dalam metode perkiraan tahanan menurut NSMB.

1. Semua data diacukan pada daerah (lingkup) model, dan tahanan model (R_{Tm}) ditentukan sebagai fungsi kecepatan.
2. Koefisien tahanan total spesifik model (C_{Tm}) ditentukan :

$$C_{Tm} = \frac{R_{Tm}}{\frac{1}{2}\rho V_m^2 S_m} \qquad (5.5.5)$$

ρ adalah massa jenis, V_m kecepatan model, S_m permukaan basah model (= panjang garis sisi rata-rata × panjang garis air).

3. Koefisien tahanan sisa spesifik ditentukan dari

$$C_R = C_{Tm} - C_{Fm} \qquad (5.5.6)$$

C_{Fm} adalah koefisien tahanan gesek spesifik. "Garis korelasi model – kapal ITTC 1957" dipakai untuk menentukan koefisien tahanan gesek.

$$C_F = \frac{0{,}075}{(\log_{10} R_n - 2)^2} \qquad (5.5.7)$$

R_n adalah angka Reynolds (VL/ν, ν adalah koefisien viskositas kinematik dan L panjang garis air). Dalam Gb. 5.5.4 diberikan kontur C_F untuk berbagai harga V dan F_n. Koordinat horizontal menunjukkan panjang model L. Diagram tersebut untuk $\nu = 1{,}139 \times 10^{-6}$ m s^{-1}, $\rho = 1000$ t/m^3, dan $T = 15°$C. Karena itu untuk memakai diagram tersebut dengan kondisi yang lain, yaitu massa jenis dan suhu yang lain, panjang kapal harus diubah dulu sebelum memakai diagram tersebut sebagai berikut

$$L_1 = \frac{1{,}139}{10^6 \nu} L \qquad (5.5.8)$$

4. C_R dinyatakan sebagai fungsi angka Froude

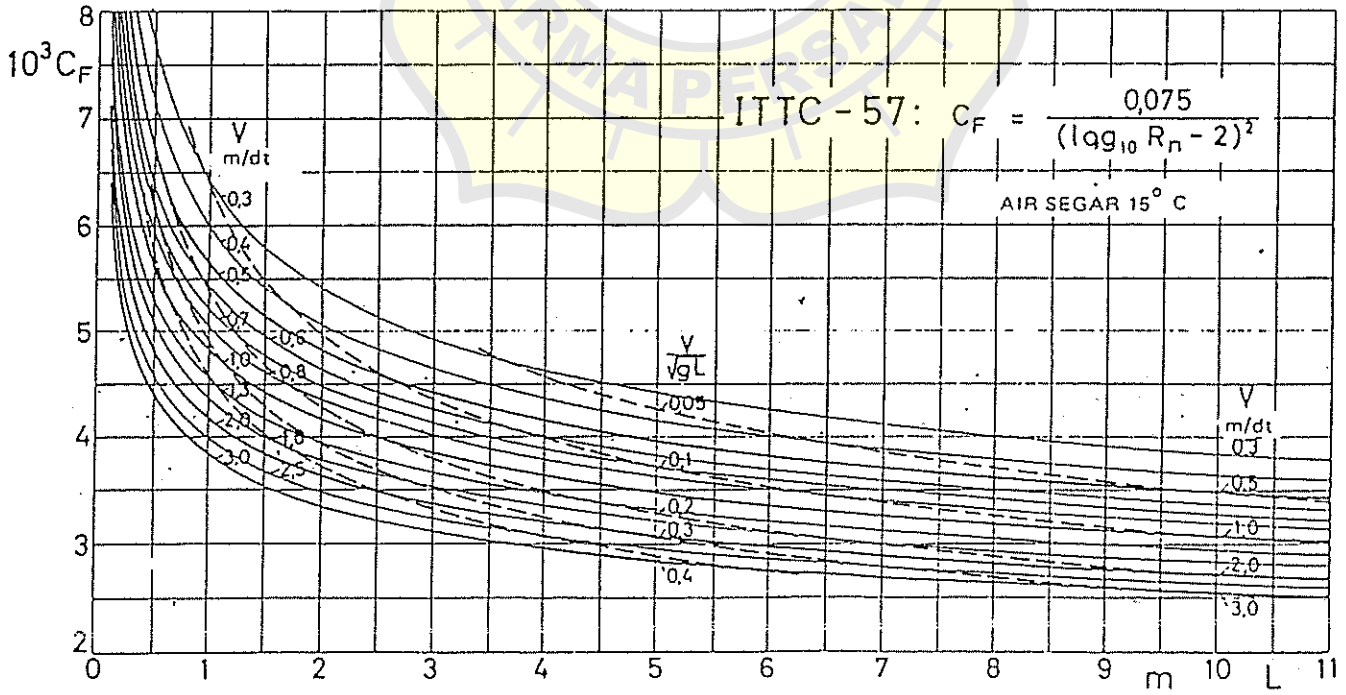
$$F_n = \frac{V}{\sqrt{gL}} \qquad (5.5.9)$$

(rasio kecepatan – panjang $V/\sqrt{L}$, dalam hal ini V diukur dalam knot dan L dalam kaki, didapat dari subskala dalam diagram C_R).

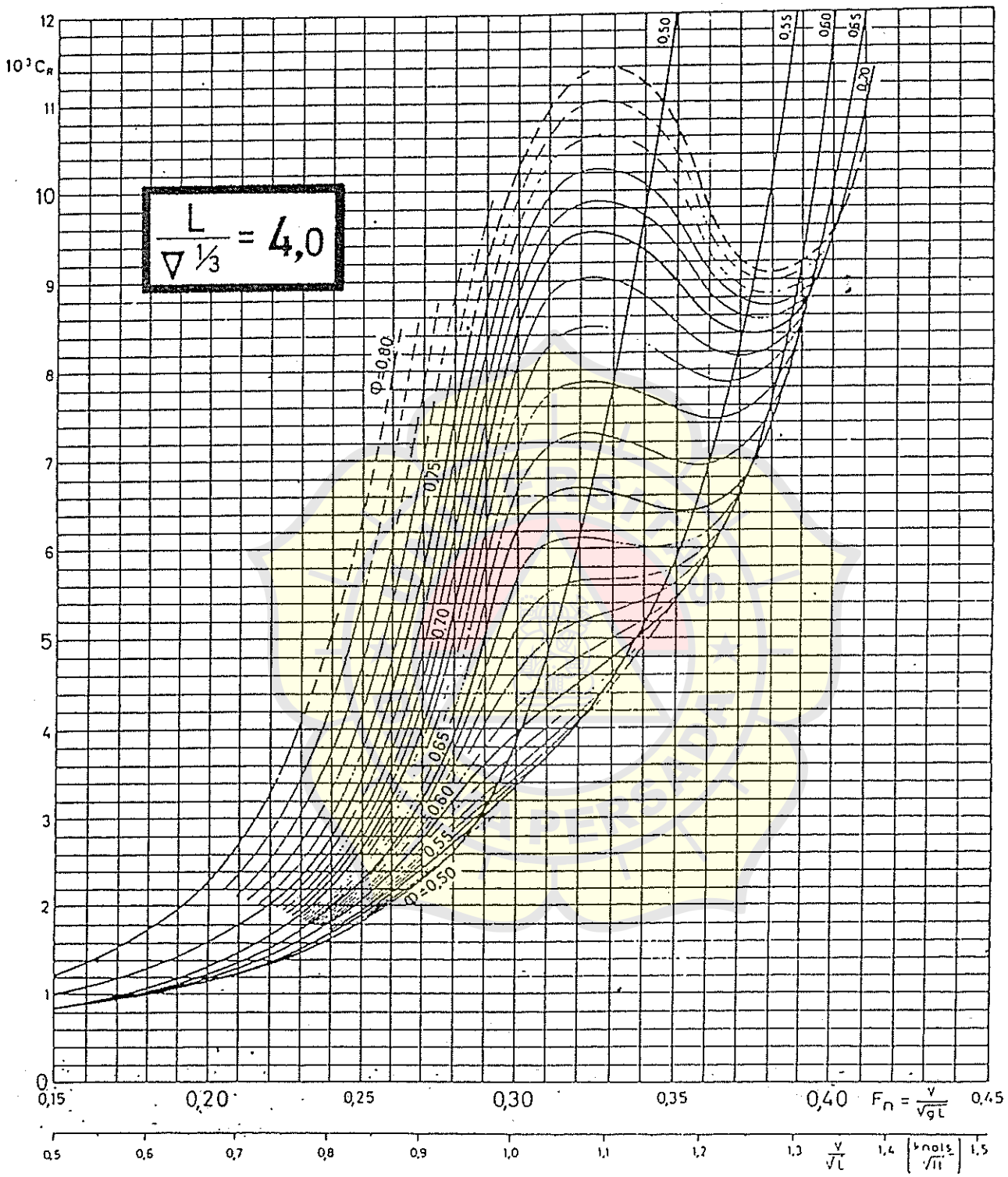
5. Hasilnya dikelompokkan menurut rasio panjang – displasemen $L/\nabla^{1/3}$ dan koefisien prismatik φ model. V adalah volume displasemen dan

$$\varphi = \frac{\nabla}{LBT\beta} \qquad (5.5.10)$$

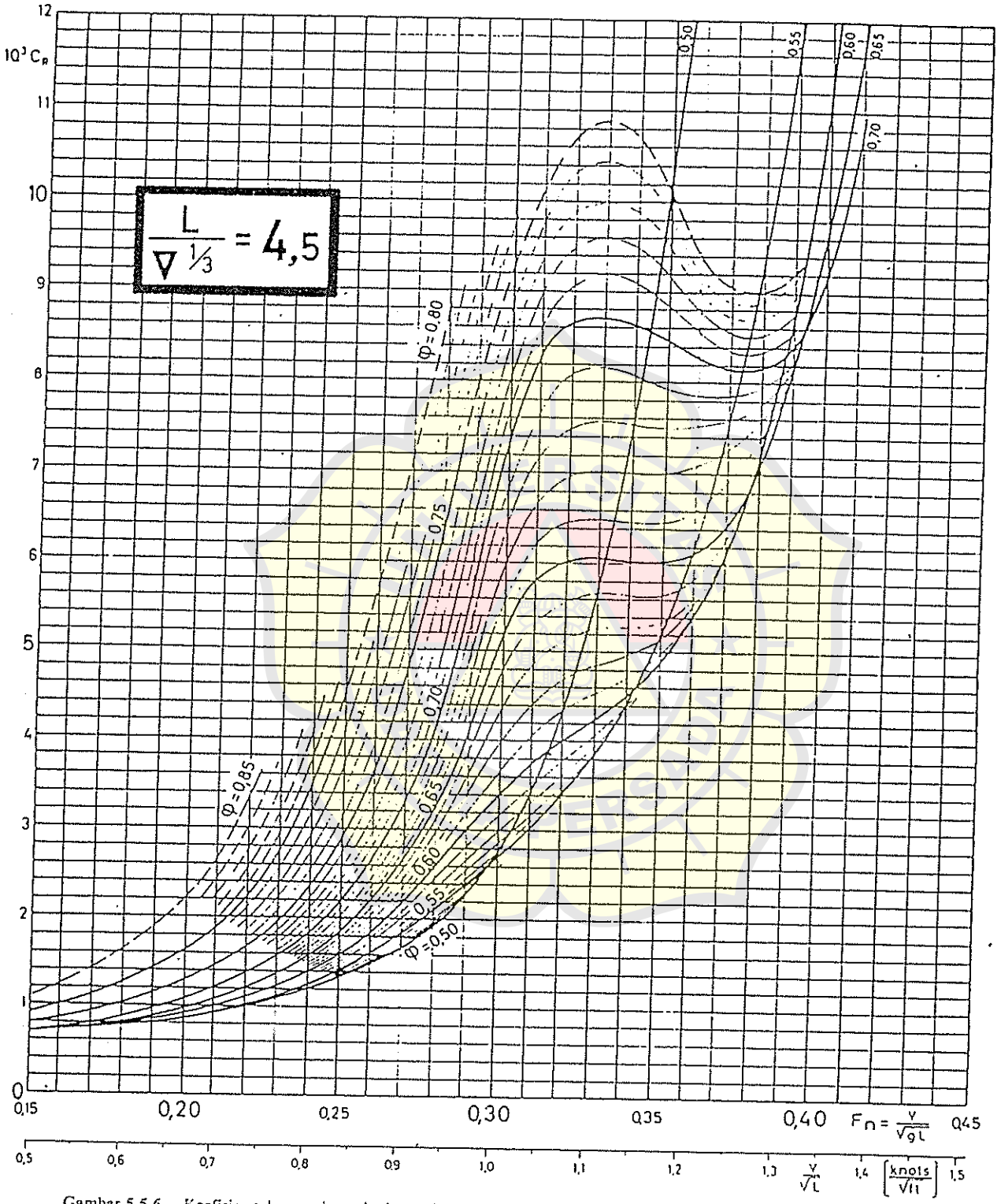
B adalah lebar, T sarat, dan β koefisien penampang melintang tengah kapal.



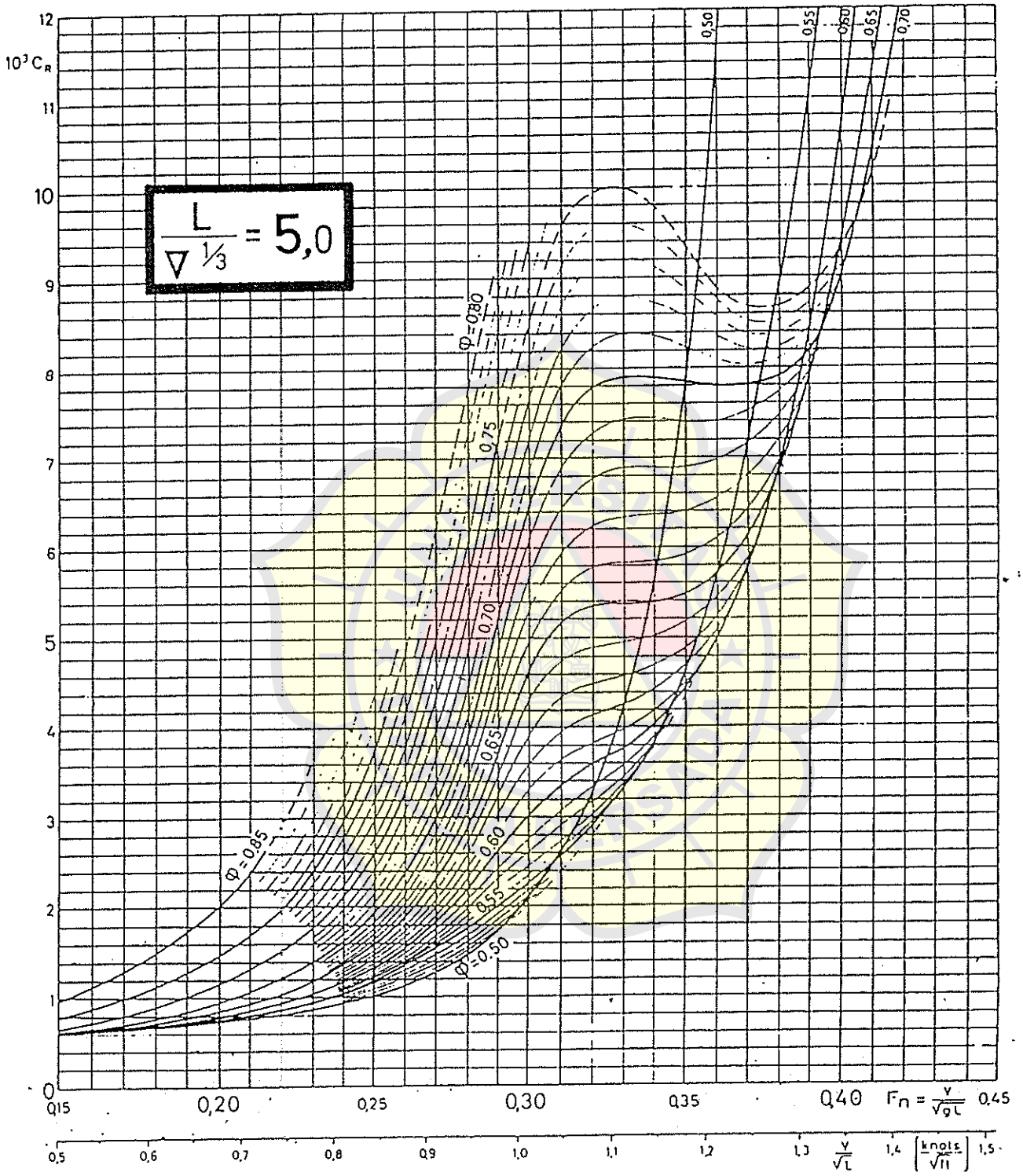
Gambar 5.5.4. Koefisien tahanan gesek C_F (menurut ITTC 1957) sebagai fungsi dari panjang model kapal L dan kecepatan V.



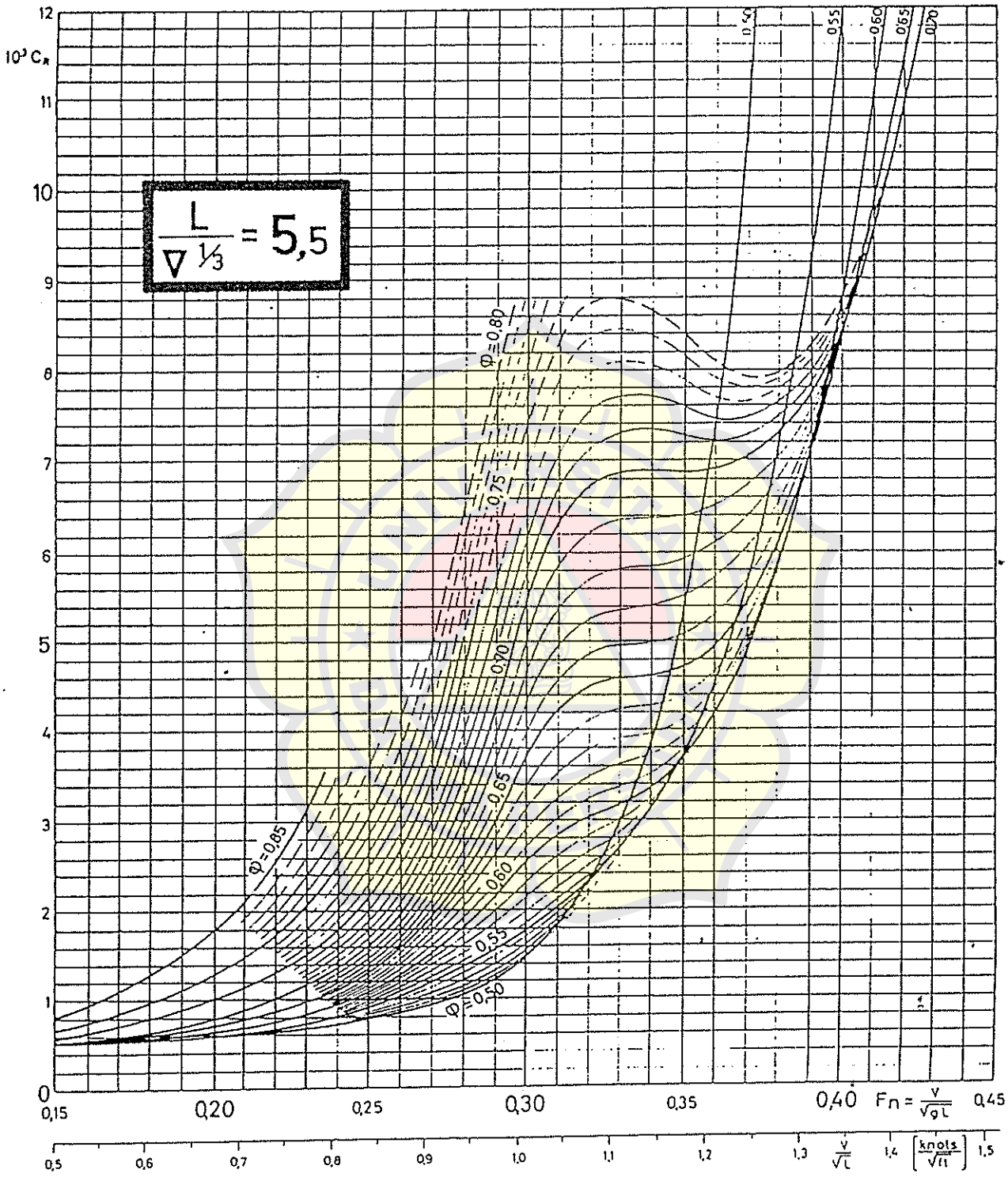
Gambar 5.5.5. Koefisien tahanan sisa terhadap rasio kecepatan – panjang untuk harga koefisien prismatik longitudinal yang berbeda-beda. $L/\nabla^{1/3} = 4{,}0$.



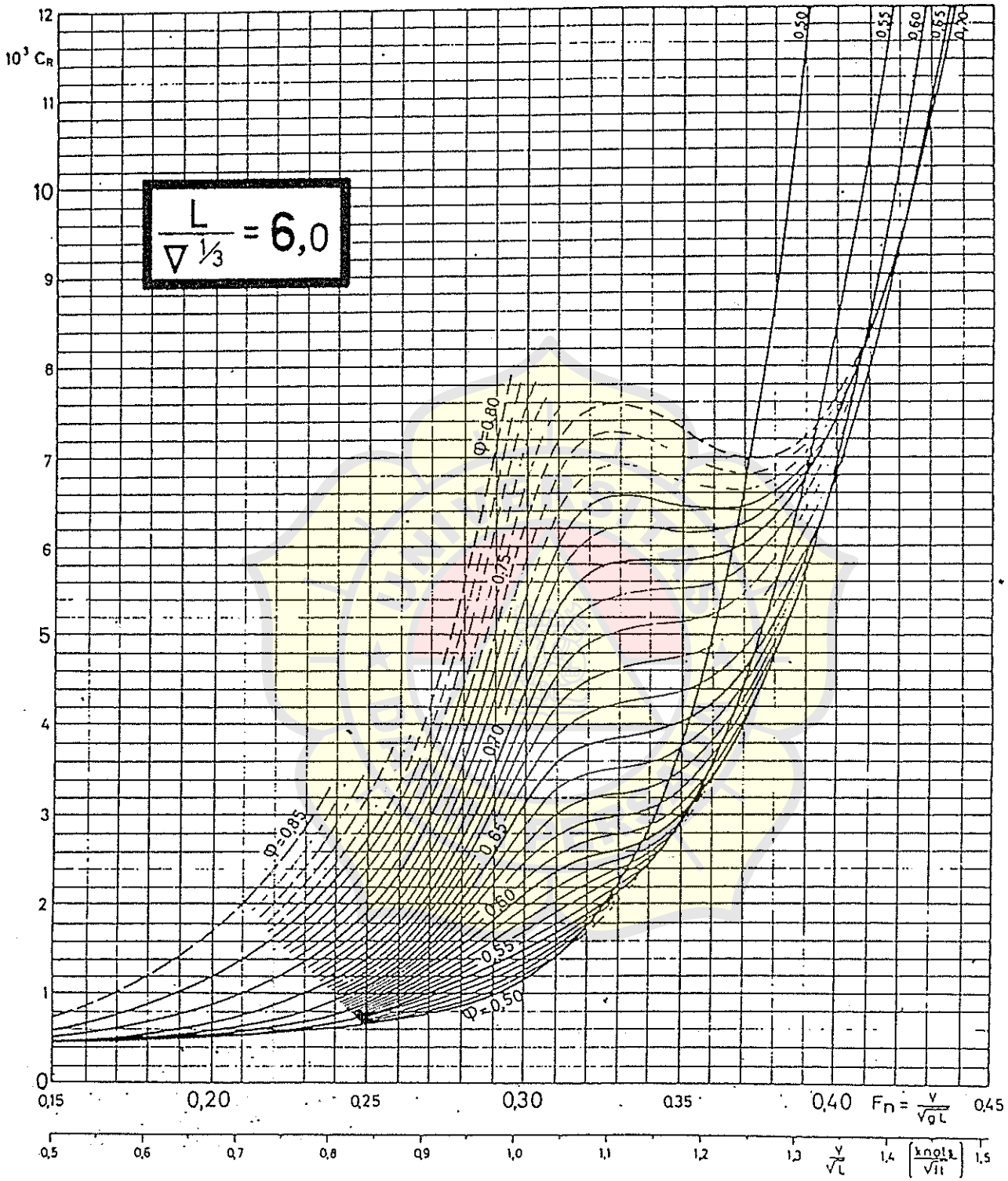
Gambar 5.5.6. Koefisien tahanan sisa terhadap rasio kecepatan-panjang untuk harga koefisien prismatik longitudinal yang berbeda-beda. $L/\nabla^{1/3} = 4{,}5$.



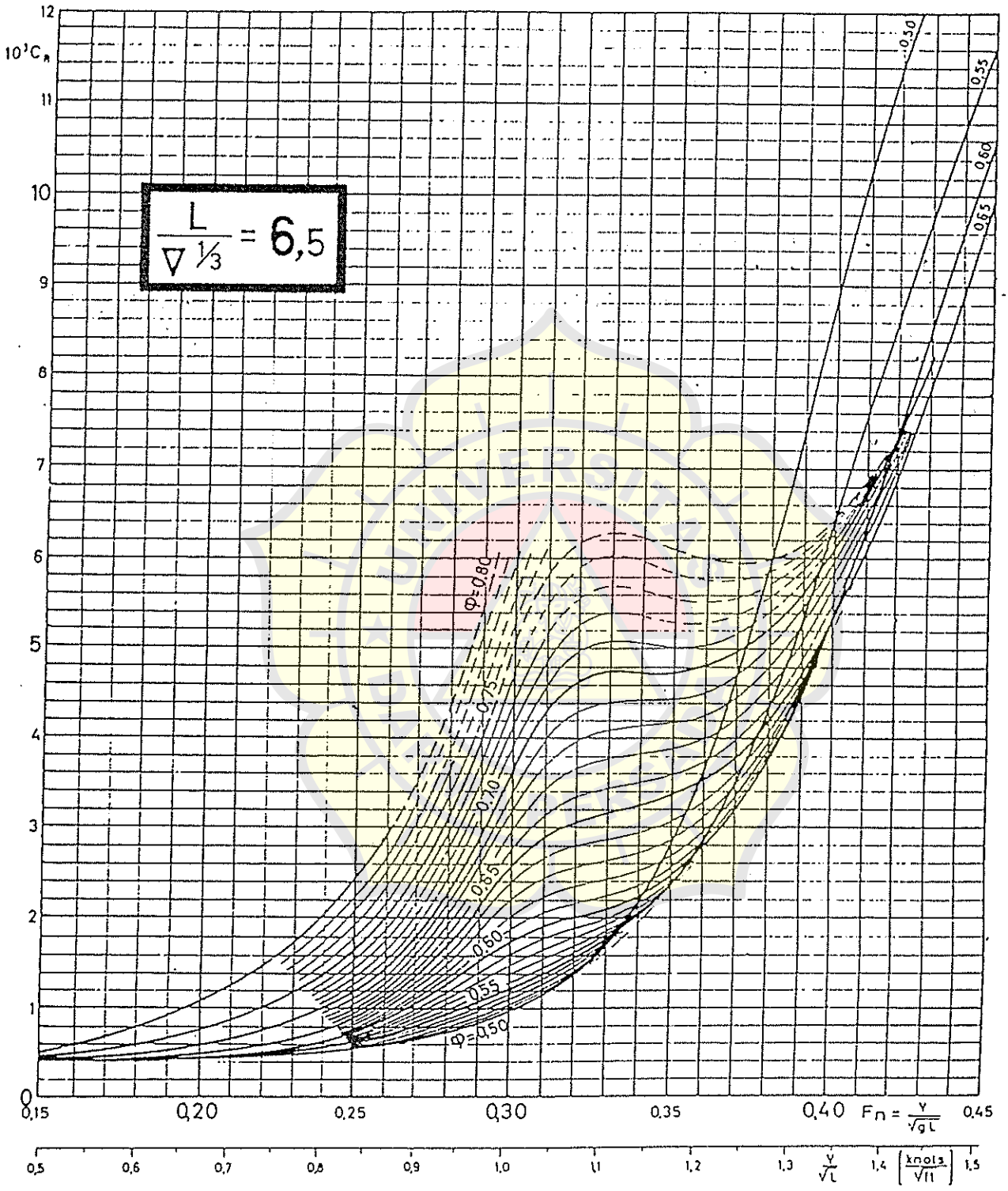
Gambar 5.5.7. Koefisien tahanan sisa terhadap rasio kecepatan-panjang untuk harga koefisien prismatik longitudinal yang berbeda-beda. $L/\nabla^{1/3} = 5{,}0$.



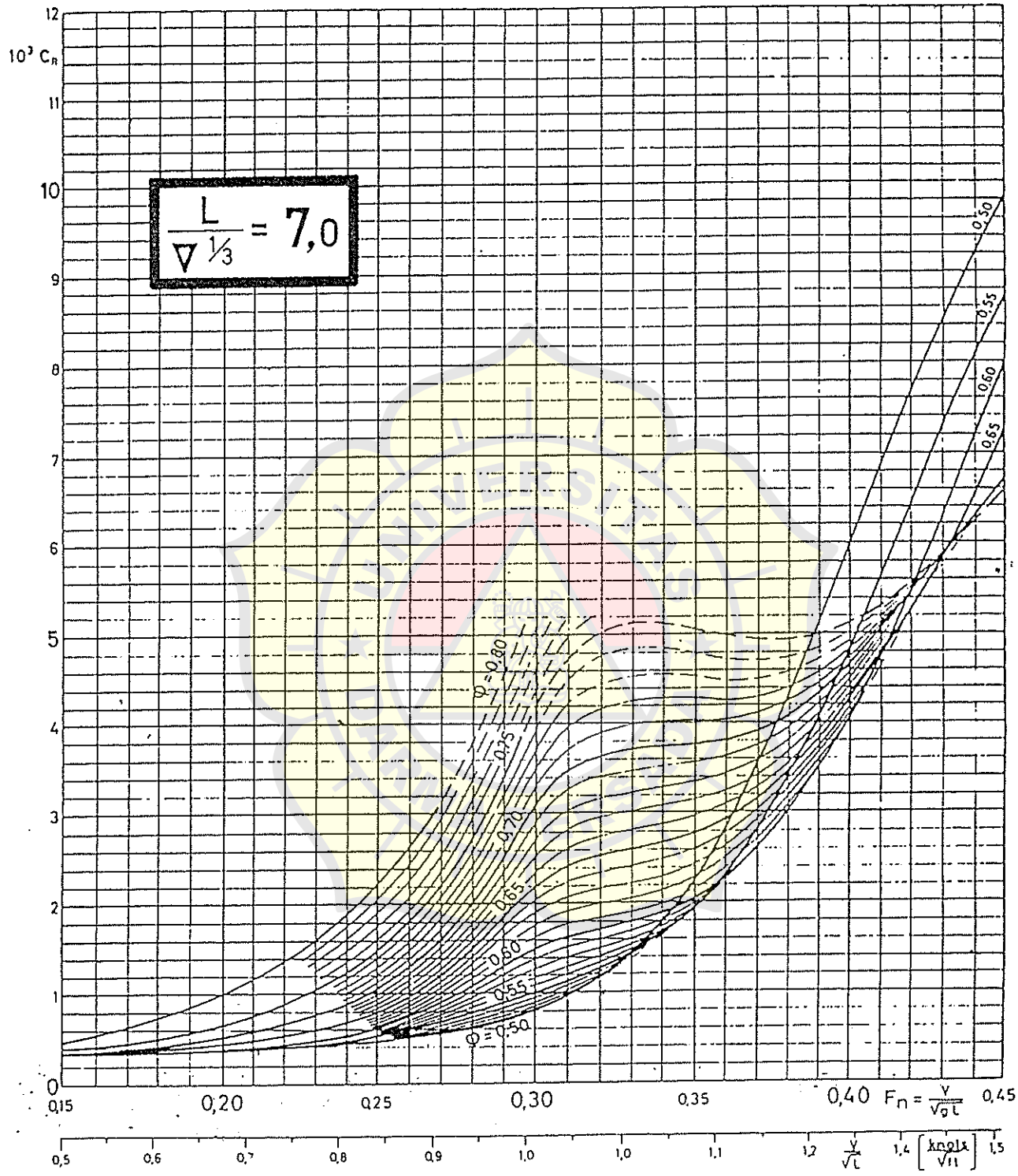
Gambar 5.5.8. Koefisien tahanan sisa terhadap rasio kecepatan–panjang untuk harga koefisien prismatik longitudinal yang berbeda-beda. $L/\nabla^{1/3} = 5{,}5$.



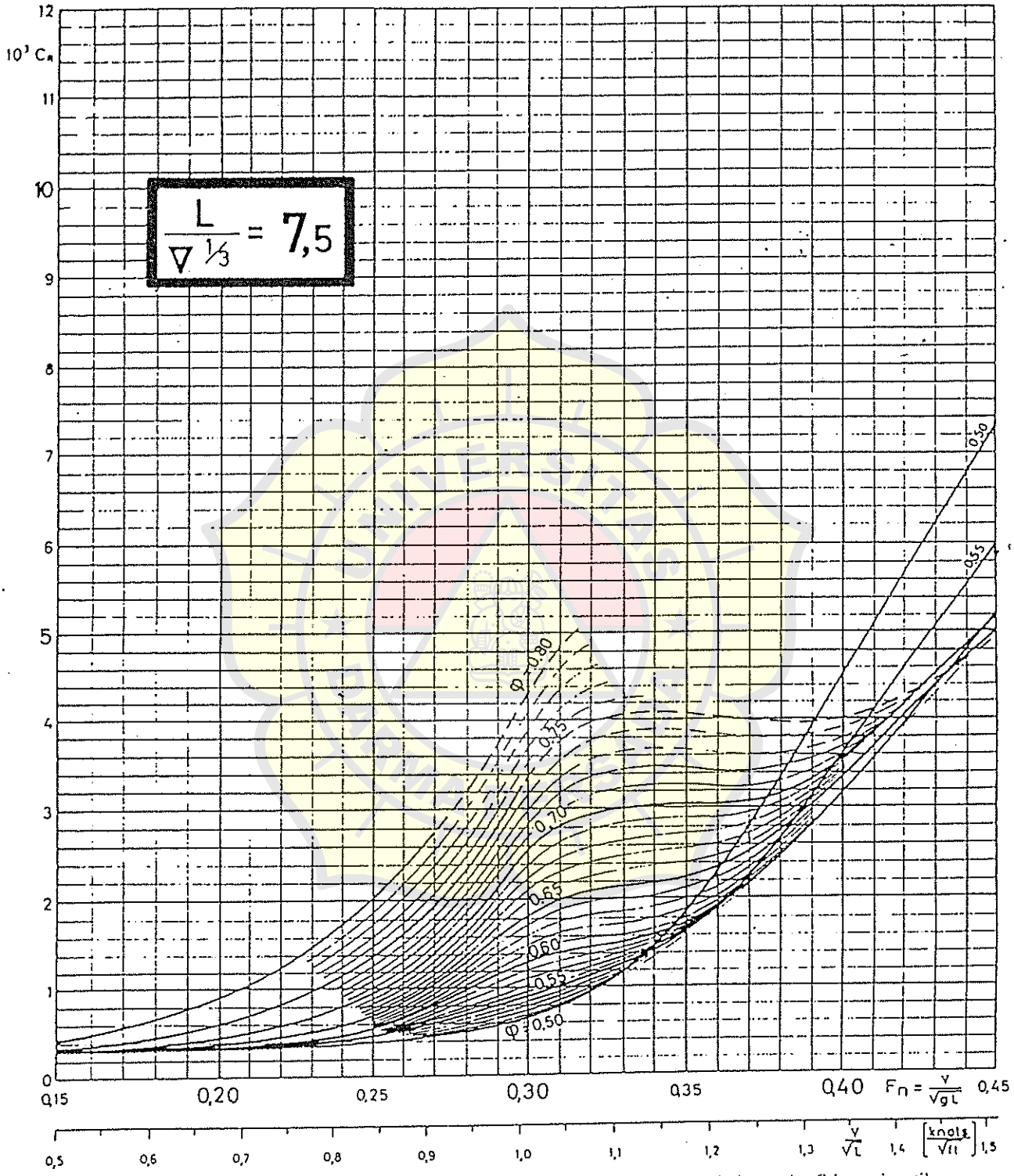
Gambar 5.5.9. Koefisien tahanan sisa terhadap rasio kecepatan-panjang untuk harga koefisien prismatik longitudinal yang berbeda-beda. $L/\nabla^{1/3} = 6{,}0$.



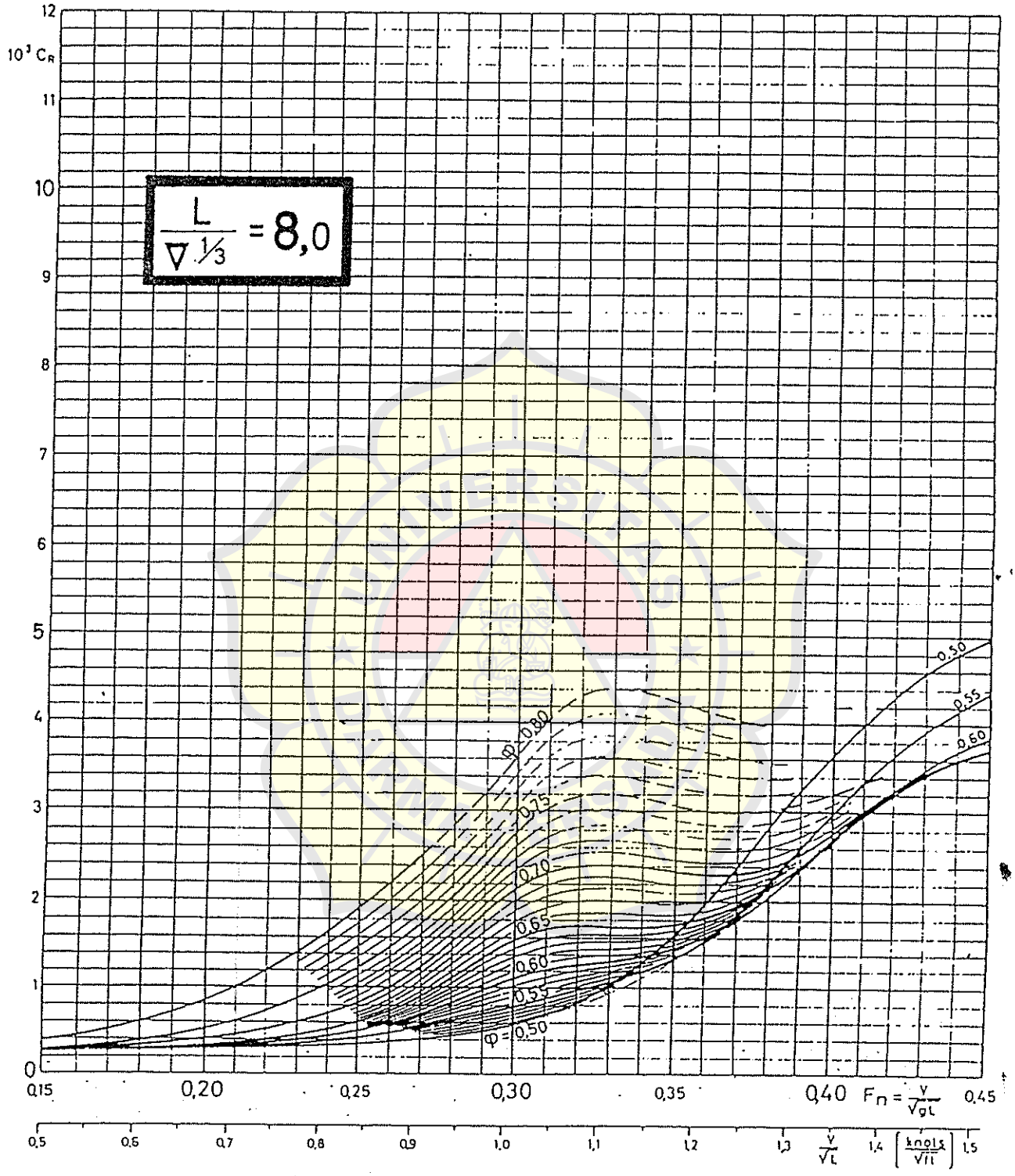
Gambar 5.5.10. Koefisien tahanan sisa terhadap rasio kecepatan-panjang untuk harga koefisien prismatik longitudinal yang berbeda-beda. $L/\nabla^{1/3} = 6.5$.



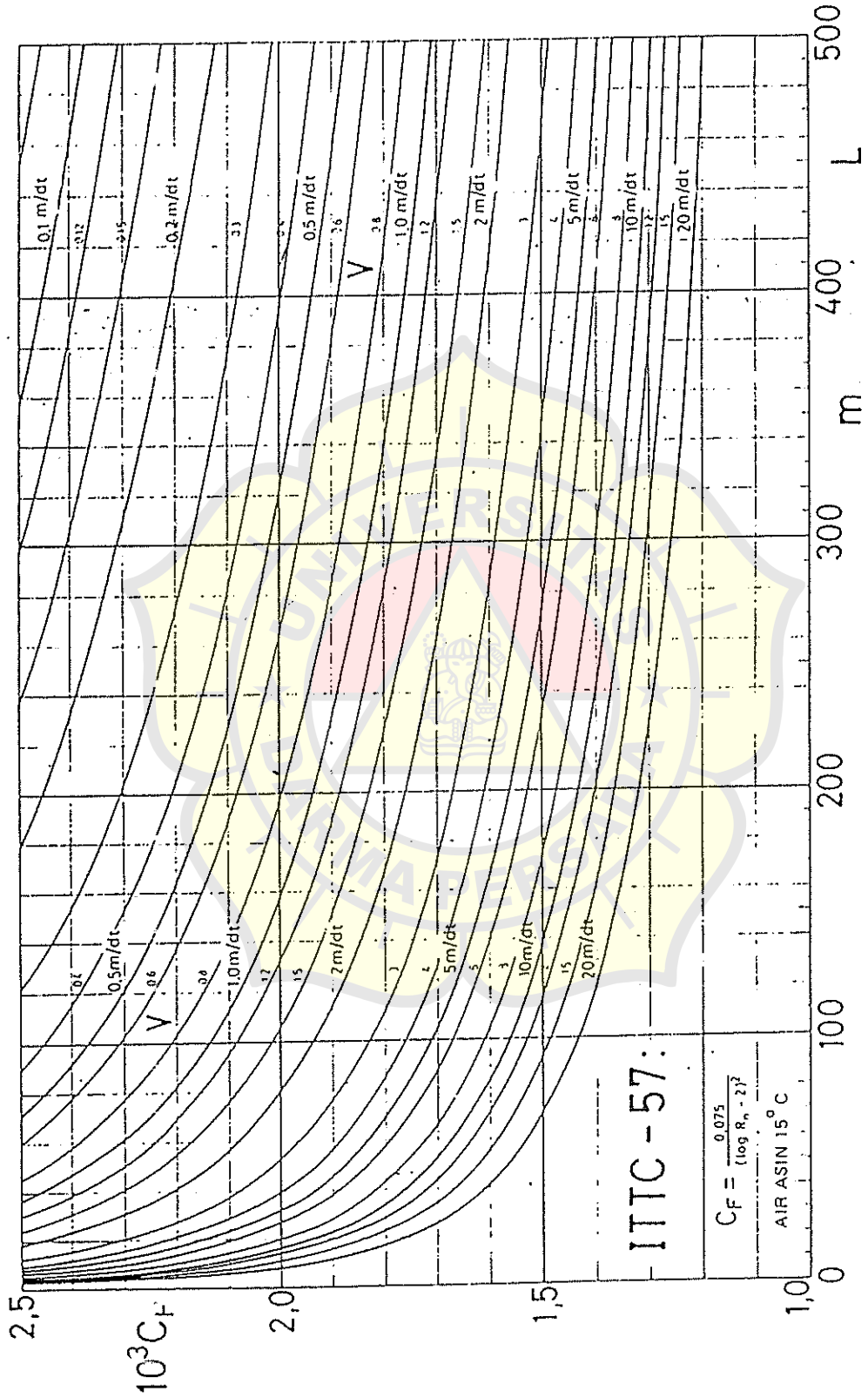
Gambar 5.5.11. Koefisien tahanan sisa terhadap rasio kecepatan-panjang untuk harga koefisien prismatik longitudinal yang berbeda-beda. $L/\nabla^{1/3} = 7{,}0$.



Gambar 5.5.12. Koefisien tahanan sisa terhadap rasio kecepatan-panjang untuk harga koefisien prismatik longitudinal yang berbeda-beda. $L/\nabla^{1/3} = 7.5$.

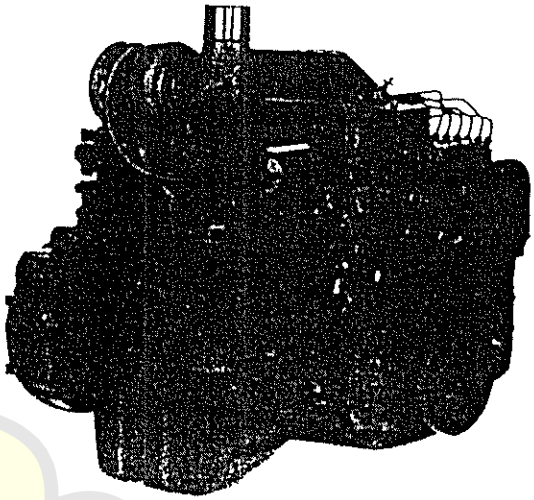


Gambar 5.5.13. Koefisien tahanan sisa terhadap rasio kecepatan-panjang untuk harga koefisien prismatik longitudinal yang berbeda-beda. $L/\nabla^{1/3} = 8{,}0$.



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

6CTA8.3-G
GENERATOR DRIVE



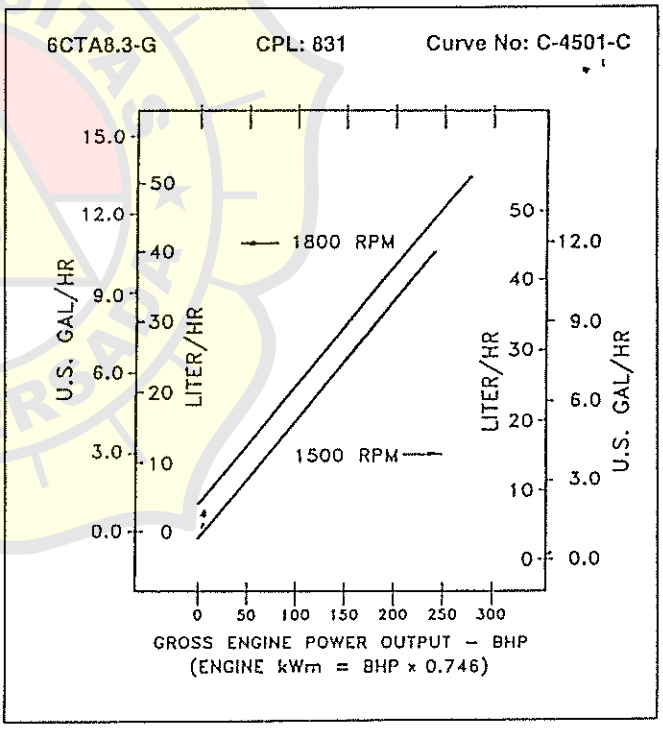
SPECIFICATIONS

Four Stroke Cycle, Turbocharged- Aftercooled, In-Line, 6 Cylinder Diesel Engine.

1800 RPM Engine Output		
Standby Power Rating	277 BHP	(207 kWm*)
Prime Power Rating	252 BHP	(188 kWm*)
1500 RPM Engine Output		
Standby Power Rating	241 BHP	(180 kWm*)
Prime Power Rating	219 BHP	(163 kWm*)

*Refers to gross power available from engine, not generator set.

Bore and Stroke	4.49x5.32 in.	(114x135 mm)
Displacement	504.5 cu.in.	(8.3 L)
Compression Ratio	16.5:1	(16.5:1)
Dry Weight with flywheel housing, flywheel and electrics	1395	(633 kg)



RATING GUIDELINES:

Standby Power Rating is applicable for supplying emergency power for the duration of the utility power outage. No overload capability is available for this rating. Under no condition is an engine allowed to operate in parallel with the public utility at the Standby Power rating.

Prime Power Rating is applicable for supplying electric power in lieu of commercially purchased power. Prime Power is the maximum power available at variable load for an unlimited number of hours. A 10% overload capability is available. See the engine performance data sheet for specific application power rating details.

Operation at Elevated Temperature and Altitude:

The engine may be operated at:

- 1800 RPM up to:
  4000 ft. (1220m) and 104° F (40° C) without power deration.
- 1500 RPM up to:
  5000 ft. (1525m) and 104° F (40° C) without power deration.

For sustained operation above these conditions derate by:
4% per 1,000 ft. (300 m), 1% per 10° F (2% per 11° C).

PERFORMANCE:

Standard Conditions:

Horsepower and fuel consumption curves are based on ISO-3046 conditions. Curves represent performance of the engine with fuel system, water pump, and lubricating oil pump; not included are battery charging alternator, fan, and optional equipment. Performance is certified to be within 5% of values shown on this specification sheet.

NOTES:

- For utility base load, interruptible rate, peak shaving, or high frequency outage applications contact your sales representative.
- In standby installations, it is recommended that exercising be done at a minimum of 30% rated load.

Cummins Diesel AS
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CUMMINS ENGINE COMPANY, INC Columbus, Indiana 47201 ENGINE PERFORMANCE CURVE	Basic Engine Model: 6CTA8.3-G		Curve Number: C-4501-D	G 48
	Dry Exh.Manifold CPL: 0831	Wet Exh.Manifold CPL: N.A.	Date: 1Jun92	

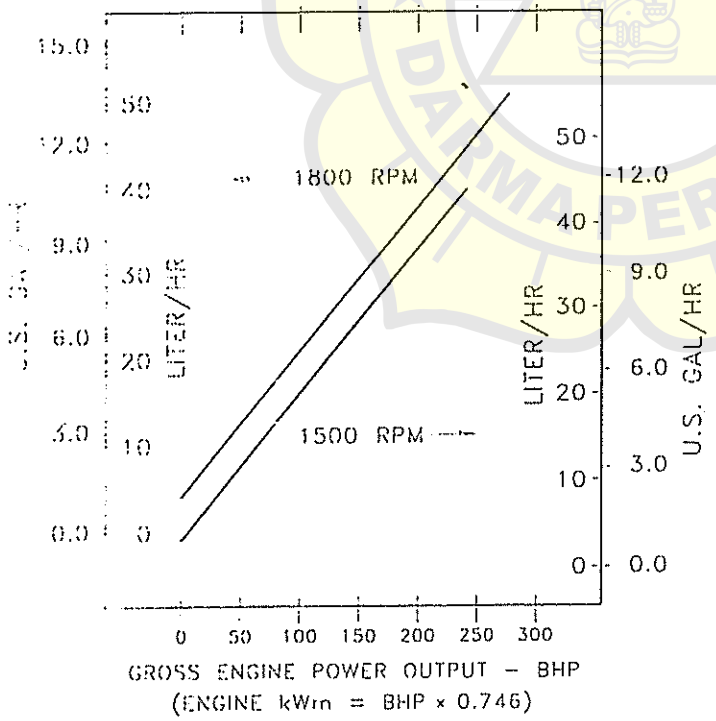
Displacement: 504.5 in.³ (8.3 liter) Aspiration: Turbocharged & Aftercooled Rating:
Bore: 4.49 in. (114 mm) Stroke: 5.32 in. (135 mm) No. of Cylinders: 6 277 HP (207 kWm) @ 1800 RPM

Power output curves are based on the engine operating with fuel system, water pump and lubricating oil pump; not included are battery charging alternator, fan, optional equipment and driven components.

Gross Engine Power Output

Engine Speed RPM	Standby Power BHP	Standby Power kWm	Prime Power BHP	Prime Power kWm
1800	277	207	252	188
1500	241	180	219	163

Fuel Consumption



OUTPUT POWER %	BHP	kWm	FUEL CONSUMPTION U.S.Gal./HR	litre/h
		1800 RPM		
STANDBY POWER				
100	277	207	13.6	51
PRIME POWER				
100	252	188	12.2	46
75	189	141	9.0	34
50	126	94	6.2	23
25	63	47	3.6	14
0	0	0	1.1	4
		1500 RPM		
STANDBY POWER				
100	241	180	11.7	44
PRIME POWER				
100	219	163	10.6	40
75	164	122	7.8	30
50	110	82	5.3	20
25	55	41	2.9	11
0	0	0	0.8	3

Data shown above represent gross engine performance capabilities obtained and corrected in accordance with ISO-3046 conditions of 100 kPa (29.53. in. Hg.) barometric pressure [361 ft. (110 m) altitude], 77°F (25°C) air inlet temperature, and relative humidity of 30% with No. 2 diesel or a fuel corresponding to ASTM 2-D

See reverse side for application rating guidelines.

The fuel consumption data is based on No. 2 diesel fuel weight at 7.1 lbs./U.S. gal (0.85 kg/litre).

J. D. Kallenbach

TECHNICAL DATA DEPT. CERTIFIED WITHIN 5% CHIEF ENGINEER

UEL SYSTEM

Type Injection System	Bosch MW Direct Injectio	
Maximum Inlet Restriction at Lift Pump — in Hg (mm Hg)	4	(102)
Maximum Allowable Head on Injector Return Line (Consisting of Friction Head and Static Head)... — in Hg (mm Hg)	10	(254)
Maximum Fuel Flow to Injection Pump — US gph (liter / hr)	18	(68)

LECTRICAL SYSTEM

·king Motor (Heavy Duty, Positive Engagement) — volt	12	24
Battery Charging System, Negative Ground — ampere	63	40
Maximum Allowable Resistance of Cranking Circuit — ohm	0.00075	0.002
Minimum Recommended Battery Capacity		
· Cold Soak @ 10°F (-12°C) and above — 0°F CCA	950	950

OLD START CAPABILITY

Minimum Ambient Temperature for Aided (with Coolant Heater) Cold Start within 10 seconds — °F (°C)	50	(10)
Minimum Ambient Temperature for Unaided Cold Start — °F (°C)	10	(-12)

ERFORMANCE DATA

All data is based on:
- Engine operating with fuel system, water pump, lubricating oil pump, air cleaner and exhaust silencer; not included are battery charging alternator, fan, and optional driven components.
- Engine operating with fuel corresponding to grade No. 2-D per ASTM D975.
- ISO 3046, Part 1, Standard Reference Conditions of:

Barometric pressure : 100 kPa (29.53 in Hg) Air Temperature : 25°C (77°F)
Altitude : 110 m (361 ft) Relative Humidity : 30%

Steady-state Stability Band at any Constant Load — %	+/- 0.50	
Estimated Free Field Sound Pressure Level of a Typical Generator-set;		
Excludes Exhaust Noise; at Rated Load and 7.5 m (24.6 ft); 1800 rpm / 1500 rpm — dBA	N.A.	
Exhaust Noise at 1 m Horizontally from Centerline of Exhaust Pipe Outlet upwards at 45° — dBA	N.A.	

	STAND-BY 60 hz		STAND-BY 50 hz		PRIME POWER 60 hz		PRIME POWER 50 hz	
verned Engine Speed — rpm	1800		1500		1800		1500	
gine Idle Speed — rpm	700 - 900		700 - 900		700 - 900		700 - 900	
Engine Power Output — BHP (kW_m)	277	(207)	241	(180)	252	(188)	219	(163)
... Mean Effective Pressure — psi (kPa)	242	(1669)	252	(1737)	220	(1517)	229	(1579)
ton Speed — ft / min (m / s)	1596	(8.1)	1330	(6.8)	1596	(8.1)	1330	(6.8)
ction Horsepower — HP (kW_m)	30	(22)	23	(17)	30	(22)	23	(17)
gine Water Flow at Stated Friction Head External to Engine:								
· 1 psi Friction Head — US gpm (liter / s)	64	(4.0)	53	(3.3)	64	(4.0)	53	(3.3)
· Maximum Friction Head — US gpm (liter / s)	55	(3.5)	45	(2.8)	55	(3.5)	45	(2.8)
gine Data with Dry Type Exhaust Manifold								
ike Air Flow — cfm (liter / s)	495	(234)	375	(177)	460	(217)	345	(163)
aust Gas Temperature — °F (°C)	1130	(610)	1210	(654)	1095	(591)	1180	(638)
aust Gas Flow — cfm (liter / s)	1515	(715)	1205	(569)	1380	(651)	1090	(514)
liated Heat to Ambient — BTU / min (kW_m)	1765	(31)	1520	(27)	1585	(28)	1375	(24)
t Rejection to Coolant — BTU / min (kW_m)	6370	(112)	5545	(97)	5795	(102)	5035	(88)
t Rejection to Exhaust — BTU / min (kW_m)	9560	(168)	8040	(141)	8345	(147)	7250	(127)
gine Data with Water Cooled Exhaust Manifold								
ike Air Flow — cfm (liter / s)								
aust Gas Temperature — °F(°C)								
aust Gas Flow — cfm (liter / s)								
liated Heat to Ambient — BTU / min (kW_m)								
t Rejection to Coolant — BTU / min (kW_m)								
t Rejection to Exhaust — BTU / min (kW_m)								

Water cooled exhaust manifold is not available on this engine.

ENGINE MODEL : 6CTA8.3-G
DATA SHEET : DS-4501-C
DATE : March, 1993
CURVE NO. : C-4501-D

Cummins Engine Company, Inc.

Exhaust Emissions Data Sheet

Data Sheet: DS-450 I-C
Date: March, 1993

Engine

Model:	6CTA8.3-G	**Application:**	A.C. Generator Drive
Type:	4 cycle, In-Line, 6 Cylinder Diesel	**Config. Number:**	D413008GX02
Aspiration:	Turbocharged and Aftercooled	**Bore:**	4.49 in. (114 mm)
Compression Ratio:	16.5:1	**Stroke:**	5.32 in. (135 mm)
Emissions Control Device:	Turbo, Aftercooling	**Displacement:**	504.5 cu. in. (8.3 liters)

Performance Data	Standby	Prime
BHP @ 1800 RPM (60 Hz)	277	252
Fuel Consumption (gallons/hour)	13.6	12.2
Air to Fuel Ratio	21.5	22.9
Exhaust Gas Flow (CFM)	1515	1380
Exhaust Gas Temperature (°F)	1130	1095

Exhaust Emissions Data

(All values are grams/hp-hour)

Component		Standby	Prime
HC	(Total Unburned Hydrocarbons)	0.17	0.22
NOx	(Oxides of Nitrogen as NO_2)	6.35	6.60
CO	(Carbon Monoxide)	1.67	1.50
PM	(Particulate Matter)	0.25	0.25
SO_2	(Sulfur Dioxide)	0.61	0.61
CO_2	(Carbon Dioxide)	500	500
N_2	(Nitrogen)	2700	2800
O_2	(Oxygen)	310	330
H_2O	(Water Vapor)	180	180

Test Conditions

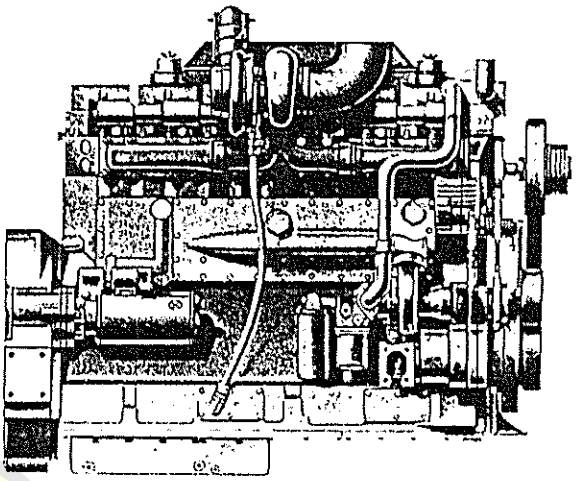
Data was recorded during steady-state rated engine speed (± 25 RPM) with full load (± 2%). Pressures, temperatures, and emission rates were stabilized.

Fuel Specification:	ASTM D975 No. 2-D diesel fuel with 0.2% sulfur content (by weight) and 42-50 cetane number.
Fuel Temperature:	99° F ± 9° (at fuel pump inlet)
Intake Air Temperature:	77° F ± 9°
Barometric Pressure:	29.6 in. Hg ± 1 in. Hg
Humidity:	NOx measurement corrected to 75 grains H_2O/lb. dry air

The HC, NOx, and CO emissions data tabulated here were taken from a single engine under the test conditions shown above. Data for the other components are estimates. This data is subject to instrumentation, measurement, and engine-to-engine variability. Engine operation with excessive air intake or exhaust restriction beyond published maximum limits, or with improper maintenance, may result in elevated emission levels.

Specifications May Change Without Notice

KTA19-G2
GENERATOR DRIVE



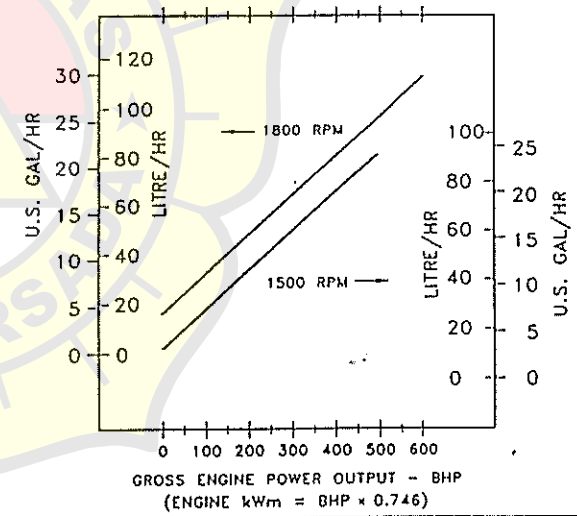
SPECIFICATIONS

Four Stroke Cycle, Turbocharged-Aftercooled, In-Line, 6 Cylinder Diesel Engine.

1800 RPM Engine Output		
Standby Power Rating	600 BHP	[448 kWm*]
Prime Power Rating	525 BHP	[392 kWm*]
Continuous Power Rating	450 BHP	[336 kWm*]
1500 RPM Engine Output		
Standby Power Rating	495 BHP	[369 kWm*]
Prime Power Rating	450 BHP	[336 kWm*]
Continuous Power Rating	440 BHP	[328 kWm*]
*Refers to gross power available from engine, not generator set.		
Bore and Stroke	6.25x6.25 in.	[159x159 mm]
Displacement	1150 cu.in.	[19 L]
**Lube System Oil Cap	12.1 U.S.gal.	[46 L]
Coolant Capacity	8 U.S. gal.	[30 L]
Net Weight with Std. Accessories, Dry	4,085 lb.	[1855 kg]
Approx. Overall Dimensions:		
Width	34.4 in.	[874 mm]
Length	65.6 in	[1666 mm]
Height	54.2 in.	[1377 mm]

** Optional by-pass filter is included in total.

KTA19-G2 CPL: 0520 (Dry) Curve: C-4084-D
Fuel Consumption



RATING GUIDELINES:

Standby Power Rating is applicable for supplying emergency electric power for the duration of the utility power outage. No overload capability is available for this rating. Under no condition is an engine allowed to operate in parallel with the public utility at the Standby Power rating.

Prime Power Rating is applicable for supplying electric power in lieu of commercially purchased power. Prime Power is the maximum power available at variable load for an unlimited number of hours. A 10% overload capability is available.

OPERATION at ELEVATED TEMPERATURE and ALTITUDE:

The engine may be operated at:

- 1800 RPM up to:
  5000 ft. (1525m) and 104 °F [40 °C] without power deration.
- 1500 RPM up to:
  4300 ft. (1525 and 104 °F [40 °C] without power deration.

For sustained operation above these conditions derate by:
4% per 1,000 ft. [300m] and 1% per 10 °F [2% per 11 °C].

PERFORMANCE:

Standard Conditions:

Data Shown Above Are Based On:

- Engine operating with fuel system, water pump, lubricating oil pump, cleaner and exhaust silencer; not included are battery charging alternator, and optional driven components.
- Engine operating with diesel fuel corresponding to grade No. 2D per AS D975.
- ISO-3046, Part 1, Standard Reference Conditions of: 29.53 in. Hg. [100 kI barometric pressure (361 ft. [110m] altitude), 77 °F [25 °C] air temperat and a relative humidity of 30%.

NOTES:

- For Continuous Power or Base Power, Interruptible Power (Utility Pov Curtailment) and Peak Shaving, contact the local Cummins representative
- Cummins Engine Company recommends that Cummins engines be opera at a minimum of load of 30% of their respective Standby Power rating.

Cummins Diesel AS
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CUMMINS ENGINE COMPANY, INC Columbus, Indiana 47201 ENGINE PERFORMANCE CURVE	Basic Engine Model: KTA19-G2		Curve Number: C-4084-D	
	Dry Exh.Manifold	Wet Exh.Manifold	Date:	
	CPL: 0520	CPL: 520	1Jun92	

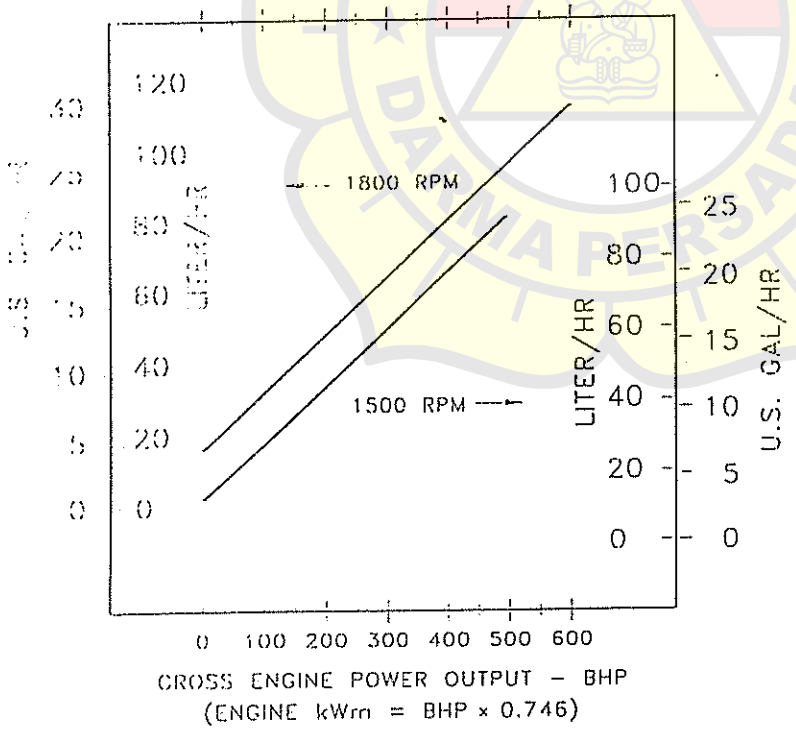
Displacement: 1150 in.^{3} (18.9 litre) Aspiration: Turbocharged & Aftercooled Rating:
Bore: 6.25 in. (159 mm) Stroke: 6.25 in. (159 mm) No. of Cylinders: 6 600 HP (448 kWm) @ 1800

Power output curves are based on the engine operating with fuel system, water pump and lubricating oil pump; not included ar battery charging alternator, fan, optional equipment and driven components.

Gross Engine Power Output

Engine Speed	Standby Power		Prime Power		Continuous Power	
RPM	BHP	kWm	BHP	kWm	BHP	kWm
1800	600	448	525	392	450	336
1500	495	369	450	336	440	328

Fuel Consumption



OUTPUT POWER			FUEL CONSUMPTION	
%	BHP	kWm	U.S.Gal./HR	litre/h
		1800 RPM		
STANDBY POWER				
100	600	448	29.8	113
PRIME POWER				
100	525	392	26.0	98
75	394	294	20.0	76
50	262	195	14.5	55
25	131	98	9.2	35
0	0	0	4.1	16
		1500 RPM		
STANDBY POWER				
100	495	369	24.0	91
PRIME POWER				
100	450	336	21.8	83
75	338	252	16.8	64
50	225	168	12.1	46
25	112	84	7.6	29
0	0	0	3.3	12

Data shown above represent gross engine performance capabilities obtained and corrected in accordance with ISO-3046 conditions of 100 kP (29.53. in. Hg.) barometric pressure [361 ft. (110 m) altitude], 77°F (25°C) air inlet temperature, and relative humidity of 30% with No. 2 diesel a fuel corresponding to ASTM D2.

See reverse side for application rating guidelines.

The fuel consumption data is based on No. 2 diesel fuel weight at 7.1 lbs./U.S. gal (0.85 kg/litre).

J. D. Kallenbach

TECHNICAL DATA DEPT. CERTIFIED WITHIN 5% CHIEF ENGINEER

Cummins Engine Company, Inc.

Engine Data Sheet

DATA SHEET : DS-4084-E
DATE : June, 1992
PERFORMANCE CURVE : C-4084-D

ENGINE MODEL : KTA19-G2 CONFIGURATION NUMBER : D193056DX02

INSTALLATION DIAGRAM
- Fan to Flywheel : 3003983
- Heat Exchanger Cooled : N.A.

CPL NUMBER
- Dry Type Exhaust Manifold : 0520
- Water Cooled Exhaust Manifold : 0520

GENERAL ENGINE DATA

Type	4 Cycle; Inline; 6 Cylinder Diesel
Aspiration	Turbocharged and Aftercooled
Bore x Stroke — in x in (mm x mm)	6.25 x 6.25 (159 x 159)
Displacement — in^3 (liter)	1150 (18.9)
Compression Ratio	14.5 : 1

	DRY TYPE EXHAUST MANIFOLD		WATER COOLED EXHAUST MANIFOLD	
Dry Weight				
Fan to Flywheel Engine — lb (kg)	4085	(1855)	4156	(1887)
Heat Exchanger Cooled Ergine — lb (kg)	4572	(2076)	4643	(2108)
Wet Weight				
Fan to Flywheel Engine — lb (kg)	4245	(1927)	4326	(1964)
Heat Exchanger Cooled Ergine — lb (kg)	4808	(2183)	4889	(2220)

Moment of Inertia of Rotating Components		
• with FW 4001 Flywheel — $lb_m \cdot ft^2$ ($kg \cdot m^2$)	170	(7.2)
• with FW 4006 Flywheel — $lb_m \cdot ft^2$ ($kg \cdot m^2$)	199	(8.4)
Center of Gravity from Rear Face of Flywheel Housing (FH 4018) — in (mm)	28.4	(721)
Center of Gravity above Crankshaft Centerline — in (mm)	9.0	(229)
Maximum Static Loading at Rear Main Bearing — lb (kg)	2000	(908)

ENGINE MOUNTING

Maximum Bending Moment at Rear Face of Block — lb • ft (N • m)	1000	(1356)

EXHAUST SYSTEM

Maximum Back Pressure — in Hg (mm Hg)	3	(76)

AIR INDUCTION SYSTEM

Maximum Intake Air Restriction		
• with Dirty Filter Element — in H_2O (mm H_2O)	25	(635)
• with Normal Duty Air Cleaner and Clean Filter Element — in H_2O (mm H_2O)	10	(254)
• with Heavy Duty Air Cleaner and Clean Filter Element — in H_2O (mm H_2O)	15	(381)

	DRY TYPE EXHAUST MANIFOLD		WATER COOLED EXHAUST MANIFOLD	
COOLING SYSTEM				
Coolant Capacity — Engine Only — US gal (liter)	8.0	(30)	9.25	(35)
— with HX 4073 Heat Exchanger — US gal (liter)	17.5	(66)	18.75	(71)

Maximum Coolant Friction Head External to Engine — 1800 rpm — psi (kPa)	10	(69)
— 1500 rpm — psi (kPa)	8	(55)
Maximum Static Head of Coolant Above Engine Crank Centerline — ft (m)	60	(18.3)
Standard Thermostat (modulating) Range — °F (°C)	180 - 200	(82 - 93)
Minimum Pressure Cap — psi (kPa)	10	(69)
Maximum Top Tank Temperature for Stand-by / Prime Power — °F (°C)	220 / 212	(104 / 100)
Minimum Raw Water Flow @ 90°F to HX 4073 Heat Exchanger — US gpm (liter / min)	54	(204)
Maximum Raw Water Inlet Pressure at HX 4073 Heat Exchanger — psi (kPa)	50	(345)

LUBRICATION SYSTEM

Oil Pressure @ Idle Speed — psi (kPa)	20	(138)
@ Governed Speed — psi (kPa)	50 - 70	(345 - 483)
Maximum Oil Temperature — °F (°C)	250	(121)
Oil Capacity with OP 4019 Oil Pan : High - Low — US gal (liter)	10 - 8.5	(38 - 32)
Total System Capacity (including By-pass Filter) — US gal (liter)	13.2	(50)
Angularity of OP 4019 Oil Pan — Front Down	30°	
— Front Up	30°	
— Side to Side	30°	

FUEL SYSTEM

Type Injection System		Direct Injection Cummins
Maximum Restriction at PT Fuel Injection Pump — with Clean Fuel Filter — in Hg (mm Hg)	4.0	(102)
— with Dirty Fuel Filter — in Hg (mm Hg)	8.0	(203)
Maximum Allowable Head on Injector Return Line (Consisting of Friction Head and Static Head)... — in Hg (mm Hg)	6.5	(165)
Maximum Fuel Flow to Injection Pump — US gph (liter / hr)	104	(394)

EL TRICAL SYSTEM

Cranking Motor (Heavy Duty, Positive Engagement) — volt	24	
Battery Charging System, Negative Ground — ampere	35	
Maximum Allowable Resistance of Cranking Circuit — ohm	0.002	
Minimum Recommended Battery Capacity		
• Cold Soak @ 50°F (10°C) and above — 0°F CCA	600	
• Cold Soak @ 32°F to 50°F (0°C to 10°C) — 0°F CCA	640	
• Cold Soak @ 0°F to 32°F (-18°C to 0°C) — 0°F CCA	900	

COLD START CAPABILITY

Minimum Ambient Temperature for Aided (with Coolant Heater) Cold Start within 10 seconds — °F (°C)	50	(10)
Minimum Ambient Temperature for Unaided Cold Start — °F (°C)	45	(7)

PERFORMANCE DATA

All data is based on:

- Engine operating with fuel system, water pump, lubricating oil pump, air cleaner and exhaust silencer; not included are battery charging alternator, fan, and optional driven components.
- Engine operating with fuel corresponding to grade No. 2-D per ASTM D975.
- ISO 3046, Part 1, Standard Reference Conditions of:

  Barometric pressure : 100 kPa (29.53 in Hg) Air Temperature : 25°C (77°F)
  Altitude : 110 m (361 ft) Relative Humidity : 30%

Steady-state Stability Band at any Constant Load — %	+/- 0.25	
Estimated Free Field Sound Pressure Level of a Typical Generator-set;		
Excludes Exhaust Noise; at Rated Load and 7.5 m (24.6 ft); 1800 rpm / 1500 rpm — dBA	N.A.	
Exhaust Noise at 1 m Horizontally from Centerline of Exhaust Pipe Outlet upwards at 45° — dBA	N.A.	

	STAND-BY				PRIME POWER			
	60 hz		*50 hz*		*60 hz*		*50 hz*	
Governed Engine Speed — rpm	1800		1500		1800		1500	
Engine Idle Speed — rpm	675 - 775		675 - 775		675 - 775		675 - 775	
Gross Engine Power Output — BHP (kW_m)	600	(448)	495	(369)	525	(392)	450	(336)
Brake Mean Effective Pressure — psi (kPa)	230	(1586)	227	(1565)	201	(1386)	207	(1427)
Piston Speed — ft / min (m / s)	1875	(9.5)	1562	(7.9)	1875	(9.5)	1562	(7.9)
Friction Horsepower — HP (kW_m)	85	(63)	60	(45)	85	(63)	60	(45)
Engine Water Flow at Stated Friction Head External to Engine:								
• 3 psi Friction Head — US gpm (liter / s)	196	(12.4)	162	(10.2)	196	(12.4)	162	(10.2)
• Maximum Friction Head — US gpm (liter / s)	175	(11.0)	145	(9.1)	175	(11.0)	145	(9.1)
Engine Data with Dry Type Exhaust Manifold								
Intake Air Flow — cfm (liter / s)	1320	(623)	945	(446)	1230	(581)	915	(432)
Exhaust Gas Temperature — °F (°C)	955	(513)	985	(529)	920	(493)	975	(524)
Exhaust Gas Flow — cfm (liter / s)	3600	(1699)	2630	(1241)	3270	(1543)	2530	(1194)
Radiated Heat to Ambient — BTU / min (kW_m)	3870	(68)	3120	(55)	3380	(59)	2830	(50)
Heat Rejection to Coolant — BTU / min (kW_m)	15600	(274)	12870	(226)	13650	(240)	11700	(206)
Heat Rejection to Exhaust — BTU / min (kW_m)	19595	(344)	14970	(263)	16995	(299)	13580	(239)
Engine Data with Water Cooled Exhaust Manifold								
Intake Air Flow — cfm (liter / s)	1195	(564)	860	(406)	1125	(531)	845	(399)
Exhaust Gas Temperature — °F(°C)	955	(513)	985	(529)	920	(493)	965	(518)
Exhaust Gas Flow — cfm (liter / s)	3260	(1539)	2395	(1130)	2990	(1411)	2320	(1095)
Radiated Heat to Ambient — BTU / min (kW_m)	3225	(57)	2600	(46)	2815	(49)	2360	(41)
Heat Rejection to Coolant — BTU / min (kW_m)	19800	(348)	16335	(287)	17325	(304)	14850	(261)
Heat Rejection to Exhaust — BTU / min (kW_m)	16040	(282)	12025	(211)	13885	(244)	10900	(192)

Cummins Engine Company, Inc.

Exhaust Emissions Data Sheet

Data Sheet: DS-4084-E
Date: Sept., 1992

Engine

Model:	KTA19-G2	Application:	A.C. Generator Drive
Type:	4 cycle, In-Line, 6 Cylinder Diesel	Config. Number:	D193056DX02
Aspiration:	Turbocharged and Aftercooled	Bore:	6.25 in. (159 mm)
Compression Ratio:	14.5:1	Stroke:	6.25 in. (159 mm)
Emissions Control Device:	Turbo, Aftercooling	Displacement:	1150 cu. in. (18.9 liters)

Performance Data	Standby	Prime
BHP @ 1800 RPM (60 Hz)	600	525
Fuel Consumption: (gallons/hour)	29.8	26.0
Air to Fuel Ratio	27.5	29.4
Exhaust Gas Flow (CFM)	3600	3270
Exhaust Gas Temperature (°F)	955	920

Exhaust Emissions Data

(All values are grams/hp-hour)

Component		Standby	Prime
HC	(Total Unburned Hydrocarbons)	2.40	1.48
NOx	(Oxides of Nitrogen as NO_2)	11.49	9.80
CO	(Carbon Monoxide)	0.41	0.38
PM	(Particulate Matter)	0.50	0.50
SO_2	(Sulfur Dioxide)	0.62	0.62
CO_2	(Carbon Dioxide)	510	510
N_2	(Nitrogen)	3400	3600
O_2	(Oxygen)	490	560
H_2O	(Water Vapor)	180	180

Test Conditions

Data was recorded during steady-state rated engine speed (± 25 RPM) with full load (± 2%). Pressures, temperatures, and emission rates were stabilized.

Fuel Specification:	ASTM D975 No. 2-D diesel fuel with 0.2% sulfur content (by weight) and 42-50 cetane number.
Fuel Temperature:	99° F ± 9° (at fuel pump inlet)
Intake Air Temperature:	77° F ± 9°
Barometric Pressure:	29.6 in. Hg ± 1 in. Hg
Humidity:	NOx measurement corrected to 75 grains H_2O/lb. dry air

The HC, NOx, and CO emissions data tabulated here were taken from a single engine under the test conditions shown above. Data for the other components are estimates. This data is subject to instrumentation, measurement, and engine-to-engine variability. Engine operation with excessive air intake or exhaust restriction beyond published maximum limits, or with improper maintenance, may result in elevated emission levels.

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Cummins Engine Company, Inc.

Exhaust Emissions Data Sheet

Data Sheet: DS-4084-E
Date: Sept., 1992

Engine

Model:	KTA19-G2
Type:	4 cycle, In-Line, 6 Cylinder Diesel
Aspiration:	Turbocharged and Aftercooled
Compression Ratio:	14.5:1
Emissions Control Device:	Turbo, Aftercooling

Application:	A.C. Generator Drive
Config. Number:	D193056DX02
Bore:	6.25 in. (159 mm)
Stroke:	6.25 in. (159 mm)
Displacement:	1150 cu. in. (18.9 liters)

Performance Data

	Standby	Prime
BHP @ 1500 RPM (50 Hz)	495	450
Fuel Consumption (gallons/hour)	24.0	21.8
Air to Fuel Ratio	24.5	26.0
Exhaust Gas Flow (CFM)	2630	2530
Exhaust Gas Temperature (° F)	985	975

Exhaust Emissions Data

(All values are grams/hp-hour)

Component		Standby	Prime
HC	(Total Unburned Hydrocarbons)	N/A	N/A
NOx	(Oxides of Nitrogen as NO_2)	N/A	N/A
CO	(Carbon Monoxide)	N/A	N/A
PM	(Particulate Matter)	0.50	0.50
SO_2	(Sulfur Dioxide)	0.61	0.61
CO_2	(Carbon Dioxide)	500	500
N_2	(Nitrogen)	2900	3100
O_2	(Oxygen)	370	430
H_2O	(Water Vapor)	180	180

Test Conditions

Data was recorded during steady-state rated engine speed (± 25 RPM) with full load (± 2%). Pressures, temperatures, and emission rates were stabilized.

Fuel Specification:	ASTM D975 No. 2-D diesel fuel with 0.2% sulfur content (by weight) and 42-50 cetane number.
Fuel Temperature:	99° F ± 9° (at fuel pump inlet)
Intake Air Temperature:	77° F ± 9°
Barometric Pressure:	29.6 in. Hg ± 1 in. Hg
Humidity:	NOx measurement corrected to 75 grains H_2O/lb. dry air

The HC, NOx, and CO emissions data tabulated here were taken from a single engine under the test conditions shown above. Data for the other components are estimates. This data is subject to instrumentation, measurement, and engine-to-engine variability. Engine operation with excessive air intake or exhaust restriction beyond published maximum limits, or with improper maintenance, may result in elevated emission levels.

Specifications May Change Without Notice

Cummins Diesel AS
Salg & Service

CUMMINS ENGINE COMPANY, INC Columbus, Indiana 47201 ENGINE PERFORMANCE CURVE	Basic Engine Model: KTA19-G3		Curve Number: C-4780-A	G 138
	Dry Exh.Manifold CPL: 1455	Wet Exh.Manifold CPL: N.A.	Date: 1Jun92	

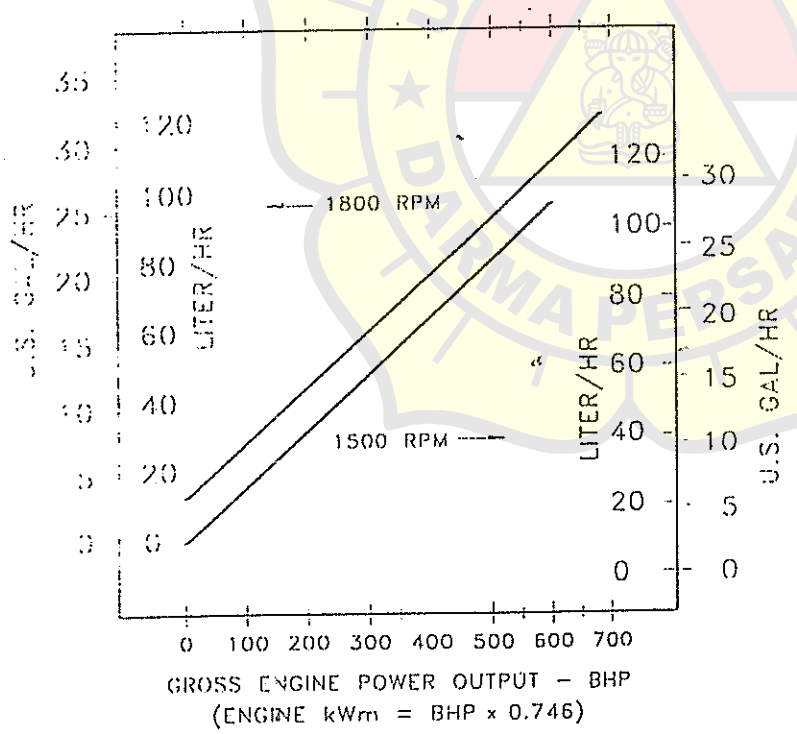
Displacement: 1150 in.^{3} (18.9 litre) Aspiration: Turbocharged & Aftercooled Rating:
Bore: 6.25 in. (159 mm) Stroke: 6.25 in. (159 mm) No. of Cylinders: 6 685 HP (511 kWm) @ 1800 RP

Power output curves are based on the engine operating with fuel system, water pump and lubricating oil pump; not included are battery charging alternator, fan, optional equipment and driven components.

Gross Engine Power Output

Engine Speed	Standby Power		Prime Power		Continuous Power	
RPM	BHP	kWm	BHP	kWm	BHP	kWm
1800	685	511	620	463	520	388
1500	600	448	540	403	475	354

Fuel Consumption



OUTPUT POWER			FUEL CONSUMPTION	
%	BHP	kWm	U.S.Gal./HR	litre/h
		1800 RPM		
STANDBY POWER				
100	685	511	32.2	122
PRIME POWER				
100	620	463	29.3	111
75	465	347	22.6	86
50	310	231	16.2	61
25	155	116	9.7	37
0	0	0	3.2	12
		1500 RPM		
STANDBY POWER				
100	600	448	28.2	107
PRIME POWER				
100	540	403	25.5	97
75	405	302	19.4	73
50	270	201	13.4	51
25	135	101	7.8	30
0	0	0	2.3	9

Data shown above represent gross engine performance capabilities obtained and corrected in accordance with ISO-3046 conditions of 100 kPa (29.53. in. Hg.) barometric pressure [361 ft. (110 m) altitude], 77°F (25°C) air inlet temperature, and relative humidity of 30% with No. 2 diesel or a fuel corresponding to ASTM D2.

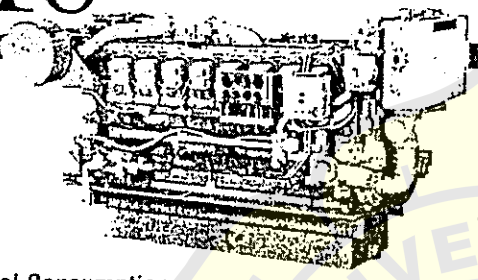
See reverse side for application rating guidelines.

The fuel consumption data is based on No. 2 diesel fuel weight at 7.1 lbs./U.S. gal (0.85 kg/litre).

J. D. Kallenbach

TECHNICAL DATA DEPT. CERTIFIED WITHIN 5% CHIEF ENGINEER

3516

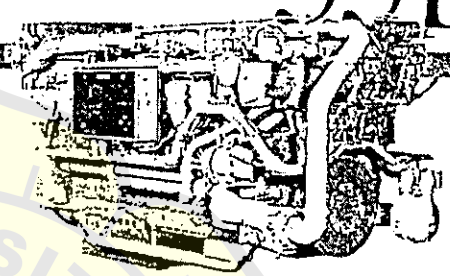


Ratings and Fuel Consumption

	bhp	bkW	mhp	Asp.	rpm	U.S. gph	L/h
A	1200	895	1217	TA	900	59.9	226
A	1410	1051	1430	TA	1200	69.5	263
A	1550	1156	1572	TA	1600	78.0	295
A1	1550	1156	1572	TA	1800	80.3	304
A	1600	1195	1622	TA	1200	80.7	305
B	1610	1200	1633	TA	1200	81.0	306
C	1665	1242	1688	TA	1200	83.6	316
B	1675	1250	1698	TA	1200	84.2	318
C	1700	1268	1724	TA	1800	88.0	333
A	1710	1276	1734	TA	1600	86.0	325
A	1710	1275	1734	TA	1800	86.6	327
C	1750	1305	1774	TA	1200	87.7	332
B	1920	1432	1947	TA	1800	96.6	365
C	2000	1491	2028	TA	1800	101.3	383
D	2200	1641	2231	TA	1800	113.9	431

Fuel use reflects SAE standards. Fuel use reflecting ISO standards is typically 2-3% less. Consult your Cat representative for details.

3516B

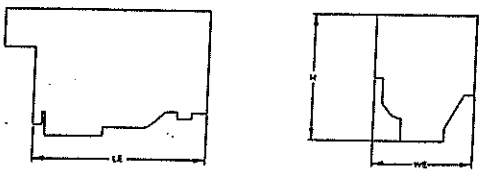


Ratings and Fuel Consumption

	bhp	bkW	mhp	Asp.	rpm	U.S. gph	L/h
A	2000	1491	2028	TA	1600	89.6	339
A	2000	1491	2028	TA	1800	92.2	349
B	2100	1566	2129	TA	1600	93.9	355
B	2100	1566	2129	TA	1800	96.5	365
C	2200	1641	2230	TA	1600	89.6	339
C	2200	1641	2230	TA	1800	100.9	382
BHP*	2400	1790	2434	TA	1785	115.0	436
C	2600	1939	2636	TA	1835	125.2	474
DHP*	2800	2088	2839	TA	1880	135.8	514
E	3000	2237	3042	TA	1925	148.6	562

Fuel use reflects SAE standards. Fuel use reflecting ISO standards is typically 2-3% less. Consult your Cat representative for details.
*Fuel consumption tolerance +5%. Reflects European standards.

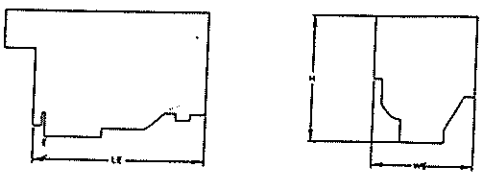
	LE in/mm	H in/mm	WE in/mm
min.	123.7/3141	80.8/2053	67.1/1703
max.	123.7/3141	80.8/2053	67.1/1703



16, 4-Stroke-Cycle Diesel

ore X Stroke	6.7 x 7.5 in	170 x 190 mm
isplacement	4210 cu in	69 liter
otation (from flywheel end)	Counterclockwise or clockwise	
gine dry weight (approx)	17,700 lb	8029 kg

	LE in/mm	H in/mm	WE in/mm
min.	123.4/3134	74.6/1896	67.1/1703
max.	123.7/3141	83.1/2110	73.4/1865



V16, 4-Stroke-Cycle Diesel

Bore X Stroke	6.7 x 7.5 in	170 x 190 mm
Displacement	4210 cu in	69 liter
Rotation (from flywheel end)	Counterclockwise or clockwise	
Engine dry weight (approx)	18,100-19750 lb	8210-8960 kg

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SEBU6911
April

152-2

Operation & Maintenance Manual

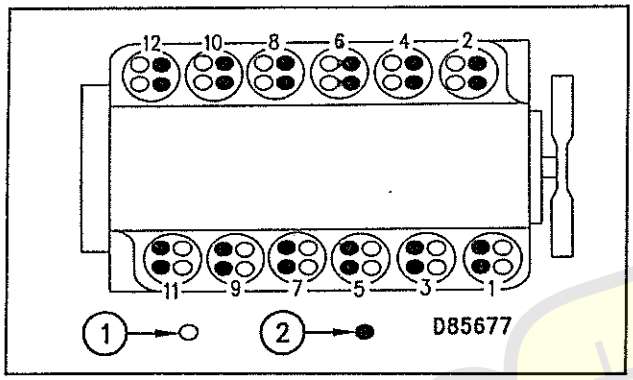
3500B Marine Propulsion Engines & 3500 Marine Propulsion Engines With EUI Option

2BM1-UP
7HM1-UP
7SM1-UP

4TN1-UP
8CN1-UP
8KN1-UP

3PS1-UP
3RS1-UP
3SS1-UP

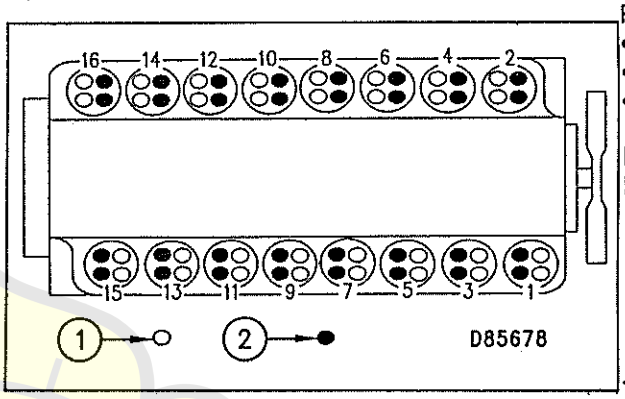
3512B Engines and 3512 Engines with EUI Option



3512 cylinder numbers, inlet valves (1) and exhaust valves (2).

3512 Engine Specifications	
Rated Speed (rpm)	1600 to 1925
Low Idle Speed (rpm)	650
Cylinders and Arrangement	60 degree Vee 12
Bore	170 mm (6.7 in)
Stroke	190 mm (7.5 in)
Type	4-stroke cycle Turbocharged Aftercooled
Compression Ratio	14:1 (3512B) 13.5:1 (3512 w/EUI)
Aspiration	Turbocharged (TA) with SCAC
Displacement/Cylinder Total	4.3 L (263 cu in) 51.8 L (3158 cu in)
Rotation (viewed from flywheel)	CCW Standard CW Optional
Injection Method	Electronic Unit Injectors
Fuel	See Fuel Specifications
Starting Method	Electric or Air Motors
Exhaust System Design Back Pressure	2.5 kPa (10 inches of H_2O)
Maximum Allowable Exhaust Back Pressure	5 kPa (20 inches of H_2O)
Maximum Allowable Inlet Air Restriction	6.2 kPa (25 inches of H_2O)
Air Cleaners	Single or Two Stage

3516B Engines and 3516 Engines with EUI Option



3516 cylinder numbers, inlet valves (1) and exhaust valves (2).

3516 Engine Specifications	
Rated Speed (rpm)	1600 to 1925
Low Idle Speed (rpm)	650
Number of Cylinders	60 degree Vee 16
Bore	170 mm (6.7 in)
Stroke	190 mm (7.5 in)
Type	4-stroke cycle Turbocharged Aftercooled
Compression Ratio	14:1 (3516B) 13.5:1 (3516 w/EUI)
Aspiration	Turbocharged (TA) with SCAC
Displacement/Cylinder Total	4.3 L (263 cu in) 69.1 L (4210 cu in)
Rotation (viewed from flywheel)	CCW Standard CW Optional
Injection Method	Electronic Unit Injectors
Fuel	See Fuel Specifications
Starting Method	Electric or Air Motors
Exhaust System Design Back Pressure	2.5 kPa (10 inches of H_2O)
Maximum Allowable Exhaust Back Pressure	5 kPa (20 inches of H_2O)
Maximum Allowable Inlet Air Restriction	6.2 kPa (25 inches of H_2O)
Air Cleaners	Single or Two Stage

E – (High Performance) – The "E" rating allows a load factor of up to 30 percent. The engine may be operated at rated rpm up to 8 percent of the time (½ hour out of every 6 hours). For use in planing hull vessels such as pleasure craft, harbor patrol, harbor master, and some fishing and pilot vessels. Typical operating hours for the "E" rating ranges from 250 to 1000 hours per year.

These rating definitions dictate the selection of a rating for an application based on a load profile determined by time at various throttle settings or engine speeds. In general, an application requiring less time at full throttle, or lower engine rpm at reduced throttle operation, can utilize a higher rating.

Marine Ratings For 3500B Engines And 3500 Engines With EUI

Rating Level[1]	Time At Full Throttle	Rated rpm At Full Throttle	Suggested Reduced rpm[2] (Cruising Speed)
A	80-100%	N/A	N/A
B	40 to 80%	1200 1800 2100 2400	1150 1700 1900 2000
C	20 to 80%	1330 1800 2100 2300 2400	1200 1600 1900 2100 2200
D	Up To 16%	2100 2300 2600	1800 2000 2200
E	Up To 8%	2100 2200 2300 2800	1800 1900 1900 2400

The chart assumes the use of a fixed pitch propeller. If operating with a controllable pitch propeller, contact your Caterpillar dealer for marine performance and reduced engine speed information.

[1] The Rating Level is defined as the percent of time that the engine is operated at full throttle with the balance of operation time below the rated rpm.

[2] Fuel consumption at the suggested reduced rpm is at or near the engine's optimum fuel efficiency.

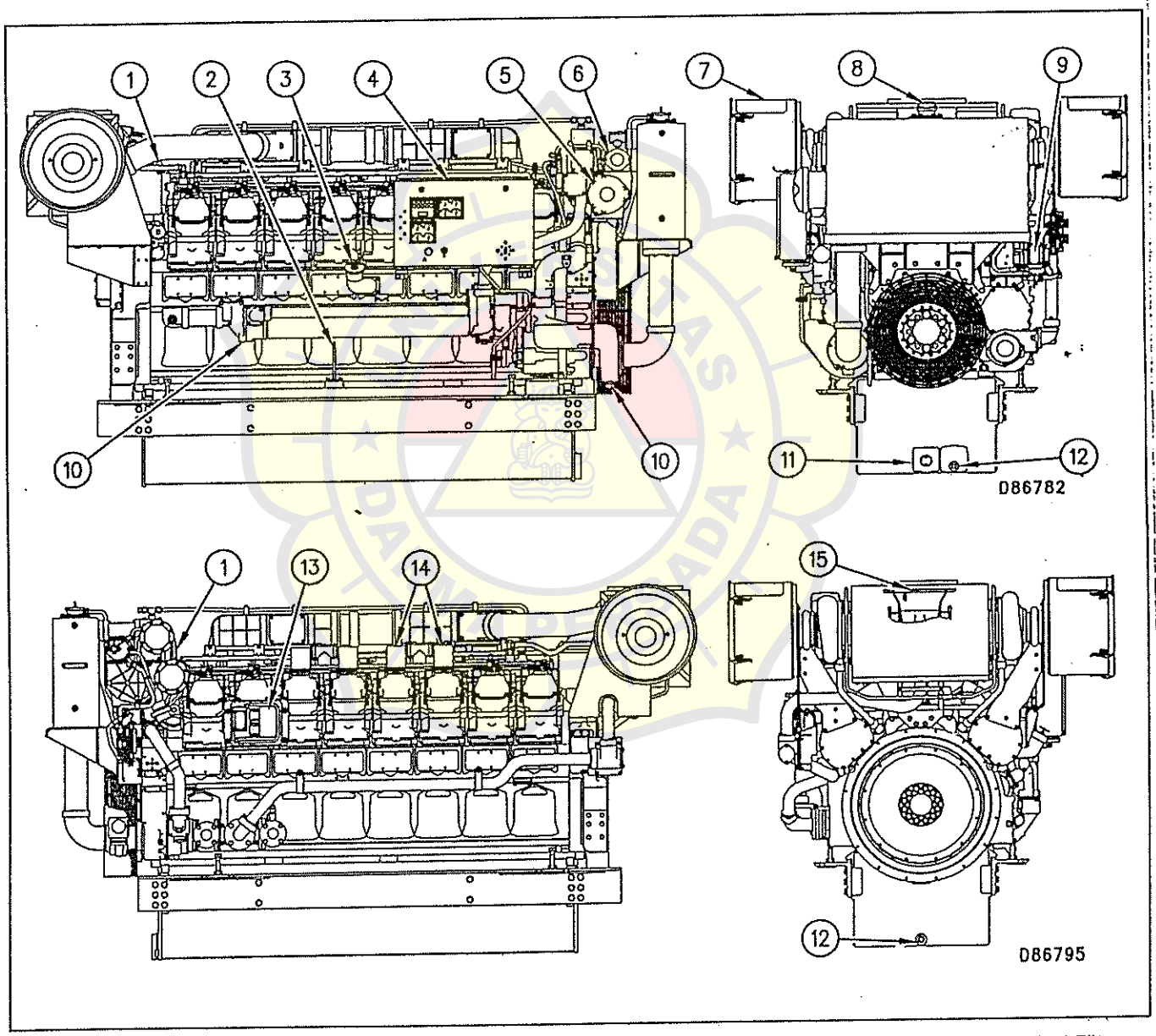
Marine Classification Society Certification Requirements

The major seafaring nations have established technical groups called marine classification societies. Caterpillar has established and maintained product standards and factory quality under the guidelines set forth by the eleven major marine classification societies listed below. For more information, refer to EDS 103.1 and 103.1.1 in the Caterpillar Technical Manual.

- ABS = American Bureau of Shipping (USA)
- BV = Bureau Veritas (France)
- CCG = Canadian Coast Guard (Canada, formerly CBSI)
- DnV = Det norske Veritas (Norway)
- GL = Germanischer Lloyd (Germany)
- KR = Korean Register of Shipping (Korea)
- LR = Lloyd's Register of Shipping (Great Britain)
- NK = Nippon Kaiji Kyokai (Japan)
- RINa = Registro Italiano Navale (Italy)
- RS = Register of Shipping (Russia)
- ZC = Zhong Chuan (China)

Model Views

The sample model views show various typical 3500 Marine Engine features. The illustrations are generic and do not reflect all available options. Because of individual applications, your engine may appear different from the illustrations.



Lifting Eye (1), Oil Level Gauge (Dipstick) (2), Oil Filler Cap (3), Electronic Instrument Panel (4), Oil Filter (5), Final Fuel Filter (6), Air Cleaner (7), Cooling System (Expansion Tank) Filler Cap (8), Primary Electronic Control Module (ECM), (9) Water Drain Plugs (10), Oil Screen (11), Oil Drain Plug (12), Backup ECM (13), Crankcase Breathers (14), Exhaust (15).

Engine Information

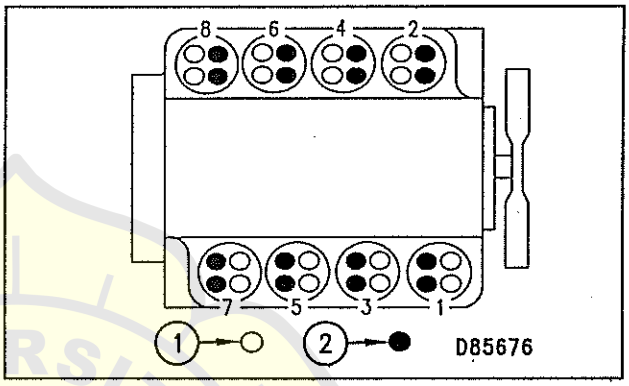
Engine Description

The 3500B Series engines and the 3500 Series engines with an EUI option are electronically controlled diesel engines. The engines have electronic unit injectors. The engines are equipped with either jacket water aftercooling (JWAC) or separate circuit aftercooling (SCAC). The engines are offered in 8, 12, and 16 cylinder versions.

Engine efficiency and engine performance depend on adherence to proper operation and maintenance recommendations. Follow the recommended Maintenance Schedule and use the recommended lubrication oils, fuels, and coolants.

Engine Specifications

3508B Engines and 3508 Engines with EUI Option



3508 cylinder numbers, inlet valves (1) and exhaust valves (2).

3508 Engine Specifications	
Rated Speed (rpm)	1600 to 1925
Low Idle Speed (rpm)	650
Cylinders and Arrangement	60 degree Vee 8
Bore	170 mm (6.7 in)
Stroke	190 mm (7.5 in)
Type	4-stroke cycle Turbocharged Aftercooled
Compression Ratio	14:1 (3508B) 13.5:1 (3508 w/EUI)
Aspiration	Turbocharged (TA) with SCAC
Displacement/Cylinder Total	4.3 L (263 cu in) 34.5 L (2105 cu in)
Rotation (viewed from flywheel)	CCW Standard CW Optional
Injection Method	Electronic Unit Injectors
Fuel	See Fuel Specifications
Starting Method	Electric or Air Motors
Exhaust System Design Back Pressure	2.5 kPa (10 inches of H_2O)
Maximum Allowable Exhaust Back Pressure	5 kPa (20 inches of H_2O)
Maximum Allowable Inlet Air Restriction	6.2 kPa (25 inches of H_2O)
Air Cleaners	Single or Two Stage

VOLDA
Tel.: +47 70 07 61 14 - Telefax: +47 70 07 99 03 - N-6100, Volda, Norway
Service (after office hour): +47 70 07 23 01

Data Sheet. (Cont'd).

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Dato

Sign.

Pressure switch set points:

~~Alarm high servo oil temperature:~~	60	°C
Alarm high temperature in sterntube:	60	°C
Alarm high temperature in thrust bearing:	67	°C
Automatic start stand by pump:	17	bar
Indication of clutch "Engaged - Disengaged":	10	bar
Indication of "Bridge" - "Engine Room" control:	-	bar
Alarm low servo pressure:	18	bar
Alarm control oil pressure:	-	bar
Interlock remote control, low servo oil pressure	-	bar
Alarm low clutch pressure:	17	bar
Alarm low clutch pressure PTO:	-	bar
Alarm low lubrication oil pressure:	1,5	bar
Alarm failure lubrication oil pressure:	-	bar
Auto stop stand by pump:	-	bar
Request stop main engine by extra low lub. oil pressure	1,0	bar
Emergency stop main engine	-	bar
Alarm low air pressure:	-	bar
Signal overload air pressure:	-	bar
Indication shaft brake ON-OFF.	-	bar
Soft clutch engagement	5	bar

Alarm low level in gravity tank. Oil level abt. 10 cm above bottom. Interlock remote control.

Pull up for propeller hub.
CP 42/3 - 47/3 - 52/3 distance a = -- mm

Tension of bolts:
Blade bolts: Use bolt holes in crank disc marked .....
Blade bolts: Prestressing angle.....°, cord..... mm, at ø..... mm Nm
Guide bolts: Prestressing angle.....°, cord..... mm, at ø..... mm
Flange bolts: Prestressing angle ..... °, cord 19 mm, at ø..... mm Nm
Servocyl. bolts: Prestressing angle.....°, cord..... mm, at ø..... mm
Servocyl. bolts: Tigthening torque 65 kpm.

Tightening torque for screws qual 12,9

M10 = 7,6	kpm
M12= 13,3	kpm
M16= 33,0	kpm
M20= 64,3	kpm
M24=111.0	kpm

Tightening torque for stainless screws qual 7,8 and 8,9

M10= 3,6	kpm
M12= 6,2	kpm
M16=15,5	kpm
M20=30,0	kpm
M24=52,0	kpm

For some screwconnectings tightening torque is written on actual drawing. Use this instead of standard torque.

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EGSET TRYKK AS, 6100 VOLDA